MSL-Equipment Documentation

Release 0.1.0

Measurement Standards Laboratory of New Zealand

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CONTENTS

The purpose of MSL-Equipment is to manage information about equipment that are required to perform a measurement and to connect to equipment that support computer control. Three items are used to achieve this purpose

1. *Configuration File*
2. *Equipment-Register Database*
3. *Connections Database*

The following example uses a configuration file that specifies an equipment-register database (which contains information about all of the equipment that is available), a connections database (which contains information on how to connect to equipment that support computer control), and specifies a digital multimeter to use for a measurement (which is defined as an <equipment> XML element).

Loading the configuration file using the *Config* class is the main entry point

```
>>> from msl.equipment import Config
>>> cfg = Config('config.xml')
```

and loading the *Databases* is done via the *database()* method

```
>>> db = cfg.database()
```

You can access XML elements, attributes and values in the configuration file

```
>>> cfg.find('max_voltage')
<Element 'max_voltage' at ...>
>>> cfg.attrib('max_voltage')
{'unit': 'V'}
>>> cfg.value('max_voltage')
3.3
```

and all of the *EquipmentRecord*'s that are contained within the *Equipment-Register Database*[1]

```
>>> for record in db.records():
...     print(record)
...
EquipmentRecord<Fluke|8506A|cecf2e0a>
EquipmentRecord<Oriel|66087|169b71e9>
EquipmentRecord<Kepco|JQE|baee83d4>
EquipmentRecord<Hewlett Packard|34401A|15ab8c6c>
EquipmentRecord<Arlunya|Milli Gauss|890a4c02>
EquipmentRecord<Toledo|1000|444213b7>
EquipmentRecord<Stanford Research Systems|SR850 DSP|cec817f5>
EquipmentRecord<HP|3478A|bd92c887>
```

To select the records that are from Hewlett Packard[1], specify the *manufacturer* as a search criteria (supports regex, so both *HP* and *Hewlett Packard* will match)

[1] Companies that sell equipment that is used for scientific research are identified in this guide in order to illustrate how to adequately use MSL-Equipment in your own application. Such identification is not intended to imply recommendation or endorsement by the Measurement Standards Laboratory of New Zealand, nor is it intended to imply that the companies identified are necessarily the best for the purpose.

```
>>> for record in db.records(manufacturer='H.*P'):
...     print(record)
...
EquipmentRecord<Hewlett Packard|34401A|15ab8c6c>
EquipmentRecord<HP|3478A|bd92c887>
```

Get the *ConnectionRecord*'s of the equipment that can be computer controlled

```
>>> for conn in db.connections():
...     print(conn)
...
ConnectionRecord<Fluke|8506A|cecf2e0a>
ConnectionRecord<Hewlett Packard|34401A|15ab8c6c>
ConnectionRecord<Stanford Research Systems|SR850 DSP|cec817f5>
ConnectionRecord<HP|3478A|bd92c887>
```

or filter by the equipment that use GPIB as the communication bus and that are from Hewlett Packard[1]

```
>>> for conn in db.connections(address='GPIB', manufacturer='H.*P'):
...     print(conn)
...
ConnectionRecord<HP|3478A|bd92c887>
```

Access the *EquipmentRecord* that has the specified alias `dmm` in the configuration file

```
>>> record = db.equipment['dmm']
>>> print(record)
EquipmentRecord<Hewlett Packard|34401A|15ab8c6c>
>>> record.is_calibration_due()
False
>>> print(record.connection)
ConnectionRecord<Hewlett Packard|34401A|15ab8c6c>
```

Establishing a connection to the equipment is achieved by calling the *connect()* method of an *EquipmentRecord*. This will return a specific *Connection* subclass that contains the necessary properties and methods for communicating with the equipment.

```
>>> dmm = record.connect()
>>> dmm.query('*IDN?')
'Hewlett Packard,34401A,15ab8c6c,A.02.14-02.40-02.14-00.49-03-01\n'
```

CHAPTER

ONE

CONTENTS

1.1 Configuration File

A configuration file is used by MSL-Equipment to:

1. Specify which *Databases* to use
2. Specify the equipment that is being used to perform a measurement
3. Specify additional parameters to use in your program

The configuration file uses the eXtensible Markup Language (XML) format to specify this information.

The following illustrates an example configuration file.

```
<?xml version="1.0" encoding="utf-8"?>
<msl>
  <!-- OPTIONAL: Use PyVISA-py as the PyVISA backend library.
   Other values are:
     @ivi (PyVISA >=1.11)
     @ni (PyVISA <1.11)
     @sim (PyVISA-sim) -->
  <pyvisa_library>@py</pyvisa_library>

  <!-- OPTIONAL: Whether to open all connections in demo mode. -->
  <demo_mode>true</demo_mode>

  <!-- OPTIONAL: Add paths to where external resource files are located. The
   paths get appended to Config.PATH and os.environ['PATH']. If the recursive=
↪"true"
   attribute is included then recursively adds all sub-directories starting␣
↪from
   the root directory (also includes the root directory). -->
  <path>I:\Photometry\SDKs</path>
  <path recursive="true">D:\code\resources\lib</path>

  <!-- OPTIONAL: The user can define their own elements. -->
  <max_temperature units="C">60</max_temperature>

  <!-- OPTIONAL: Specify the equipment that is being used to perform the␣
↪measurement
   and assign an "alias" that you want to use to associate for each␣
```

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```
↪equipment. You
    only need to specify enough XML attributes to uniquely identify the␣
↪equipment record
    in an Equipment-Registry database. For example, if there is only 1␣
↪equipment record
    in the Equipment-Registry databases (see the <registers> tag below) that␣
↪is from
    "Company XYZ" then specifying manufacturer="Company XYZ" is enough␣
↪information to
    uniquely identify the equipment record. If in the future another␣
↪equipment record
    is added to an Equipment-Registry database for "Company XYZ" then an␣
↪exception will
    be raised telling you to specify more information in the configuration␣
↪file to
    uniquely identify a single equipment record. -->
  <equipment alias="dmm" manufacturer="Keysight" model="34465A"/>
  <equipment alias="scope" manufacturer="Pico Technologies"/>
  <equipment alias="flipper" manufacturer="Thorlabs" model="MFF101/M" serial=
↪"123456"/>

  <!-- REQUIRED: Specify the Equipment-Register Databases to load equipment␣
↪records from. -->
  <registers>
    <!-- The "team" attribute is used to specify which research team the
     Equipment-Register database belongs to. -->
    <register team="P&amp;R">
      <path>Z:\Equipment\Equipment Register.xls</path>
      <!-- If there are multiple Sheets in the Excel database then you must␣
↪specify the
       name of the Sheet that contains the equipment records. This Excel␣
↪database
       also contains connection records (see the <connections> tag below)␣
↪and so
       the <sheet> tag must be specified. -->
      <sheet>Equipment</sheet>
    </register>
    <register team="Electrical">
      <path>H:\Quality\Registers\Equipment.xlsx</path>
      <!-- No need to specify the Sheet name if there is only 1 Sheet in the␣
↪Excel database. -->
    </register>
    <register team="Pressure">
      <!-- Using the XML or JSON format to store equipment records allows␣
↪for including
       MaintenanceRecords, CalibrationRecords, MeasurandRecords, ... -->
      <path>J:\Registers\Equipment.xml</path>
    </register>
    <!-- For a text-based database (e.g., CSV, TXT files) you can specify␣
```

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```
↪how the dates are
     formatted and the encoding that is used in the file (UTF-8 is assumed␣
↪if the encoding
     is not specified). A CSV database uses "," as the delimiter and a TXT␣
↪database uses
     "\t" as the delimiter. -->
    <register team="Time" date_format="%d.%m.%y" encoding="cp1252">
      <path>W:\Registers\Equip.csv</path>
    </register>
    <register team="Mass" date_format="%Y-%m-%d">
     <!-- You can also specify the database path to be a path that is␣
↪relative to the
      location of the configuration file. For example, this "equip-reg.txt"␣
↪file is
      located in the same directory as the configuration file. -->
     <path>equip-reg.txt</path>
    </register>
    <register team="Length" user_defined="apples, pears, oranges">
      <!-- An EquipmentRecord has standard properties (e.g, manufacturer,␣
↪model, ...) that
       are read from the database. You can also include additional fields␣
↪from the database
       that are not part of the standard properties. Include a "user_defined
↪" list
       (comma-separated) of additional properties to include. The field␣
↪names that
       contain the text "apples", "pears" and "oranges" are added to the
↪"user_defined"
       dictionary for all EquipmentRecord's in this register. -->
      <path>I:\LS-Equip-Reg\reg.csv</path>
    </register>
  </registers>

  <!-- OPTIONAL: Specify the Connection Databases to load connection records␣
↪from. -->
  <connections>
    <connection>
      <path>Z:\Equipment\Equipment Register.xls</path>
      <!-- Must also specify which Sheet in this Excel database contains the␣
↪connection records.
       This "Equipment Register.xls" file also contains an "Equipment" Sheet,
↪ see the
       <register team="P&amp;amp;R"> element above. -->
      <sheet>Connections</sheet>
    </connection>
    <!-- You can set the encoding that is used for a text-based database. -->
    <connection encoding="utf-16">
      <!-- Specify a relative path (relative to the location of the␣
↪configuration file). -->
```

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```
        <path>data/my_connections.txt</path>
      </connection>
    </connections>

</msl>
```

The *Config* class is used to load a configuration file and it is the main entry point, for example

```
>>> from msl.equipment import Config
>>> cfg = Config('config.xml')
```

1.2 Database Formats

Databases are used by MSL-Equipment to store *EquipmentRecord*'s in an *Equipment-Register Database* and *ConnectionRecord*'s in a *Connections Database*. The database file formats that are currently supported are **xml**, **json**, **txt** (`\t` delimited), **csv** (`,` delimited) and **xls[x]**.

The **txt**, **csv** and **xls[x]** formats are simple databases that are composed of *fields* (columns) and *records* (rows). The **xml** and **json** formats allow for storing more complex data structures, such as *MaintenanceRecord*'s *CalibrationRecord*'s and *MeasurandRecord*'s for each *EquipmentRecord*. For example **xml** and **json** formats, see equipment_register.xml and equipment_register.json respectively.

1.2.1 Equipment-Register Database

> **Attention:** The design of the Equipment-Register database is in active development and it will be unstable until an official release of MSL-Equipment is made.

The information about the equipment that is used to perform a measurement must be known and it must be kept up to date. Keeping a central and official (hence the word *Register*) database of the equipment that is available in the laboratory allows for easily managing this information and for helping to ensure that the equipment that is being used for a measurement meets the calibration requirements needed to obtain the desired measurement uncertainty.

MSL-Equipment does not require that a *single* database is used for all equipment records. However, it is vital that each equipment record can only be uniquely found in one *Equipment-Register Database*. The records in a database must never be copied from one database to another database *(keeping a backup copy of the database is encouraged)*. Rather, if you are borrowing equipment from another team you simply specify the path to that teams *Equipment-Register Database* as a `<register>` element in your *Configuration File*. The owner of the equipment is responsible for ensuring that the information about the equipment is kept up to date in their *Equipment-Register Database* and the user of the equipment defines an `<equipment>` element in the *Configuration File* to access this information. Therefore, an *Equipment-Register Database* is to be considered as a *global* database that can be accessed (with read permission only) by anyone.

Each record in an *Equipment-Register Database* is converted into an *EquipmentRecord*.

The following is an example of an *Equipment-Register Database* (additional *fields* can also be added to a database, see *Field Names*).

Manufacturer	Model Number	Serial Number	Description
Keysight	34465A	MY5450	6.5 digit digital multimeter
Hewlett Packard	HP8478B	BCD024	Dual element thermistor power sensors
Agilent	53230A	49e39f	Universal counter/timer

Tip: Not all records in the *Equipment-Register Database* need to have the ability to be interfaced with a computer. For example, cables, amplifiers, filters and adaptors can all be important equipment that may be used to perform a measurement and should be included in the *Equipment-Register Database* and specified as `<equipment>` elements in the *Configuration File*.

Field Names

Some of the supported *fields* for an *Equipment-Register Database* are:

- **Category** – The category (e.g., Laser, DMM) that the equipment belongs to.
- **Description** – A description of the equipment.
- **Location** – The location where the equipment can usually be found.
- **Manufacturer** – The name of the manufacturer of the equipment.
- **Model** – The model number of the equipment.
- **Serial** – The serial number, or engraved unique ID, of the equipment.

The text in the header of each *field* is not too particular for what it must be. The header text is parsed for one of the specific *field* names listed above and if the header contains one of these *field* names then that column is assigned to be that *field*.

For example, the following headers are valid (the blue text is what is important in the header)

- Headers can contain many words. For a *field* to be assigned to the `manufacturer` attribute the header can be written as:

This column is used to specify the Manufacturer *of the equipment*

- Text is case insensitive. For a *field* to be assigned to the `model` attribute the header can be written as any of the following:

MODEL *No.*	Model #	*The* model *number of the equipment*	MoDeL

  Although using the following header will not raise an exception, you should not use the following header because either the `manufacturer` or the `model` attribute will be assigned for this *field* depending on the order in which the *fields* appear in the database:

The model *number given by the* manufacturer

- Whitespace is replaced by an underscore. For a *field* to be assigned to the `is_operable` attribute the header can be written as:

Is Operable, *True or False*

- If the header does not contain any of the specific *field* names that are being searched for then the values in that column are silently ignored.

Equipment records should be defined in an *Equipment-Register Database* and accessed via the `database()` method; however, you can also define equipment records in a Python module, for example:

```
from msl.equipment import EquipmentRecord, ConnectionRecord, Backend

equipment = {
    'dmm':
        EquipmentRecord(
            manufacturer='HP',
            model='34401A',
            serial='123456789',
            connection=ConnectionRecord(
                backend=Backend.MSL,
                address='COM3',
                properties=dict(
                    baud_rate=19200,
                )
            )
        ),
    'scope':
        EquipmentRecord(
            manufacturer='Pico Technology',
            model='5244B',
            serial='XY135/001',
            description='Oscilloscope -- 2 Channel, 200 MHz, 1 GSPS, 512 Mpts,
↪ 5.8 ns',
            connection=ConnectionRecord(
                backend=Backend.MSL,
                address='SDK::ps5000a.dll',
                properties=dict(
                    resolution='16bit',
                )
            )
        ),
    '1ohm':
        EquipmentRecord(
            manufacturer='Tinsley',
            model='64750',
            serial='5672413',
            description='1.0 Ohm Resistor 3A',
        ),
}
```

1.2.2 Connections Database

A *Connections Database* is used to store the information that is required to establish communication with the equipment.

You specify the *Connections Database* that you what to use as a `<connection>` element in your *Configuration File*. Each record in an *Connections Database* is converted into a `ConnectionRecord`.

Field Names

The supported *fields* for a *Connections Database* are:

- **Address** – The address to use for the connection (see *Address Syntax*).
- **Backend** – The `Backend` to use to communicate with the equipment.
- **Manufacturer** – The name of the manufacturer of the equipment.
- **Model** – The model number of the equipment.
- **Properties** – Additional properties that may be required to establish a connection to the equipment as key-value pairs separated by a semi-colon. For example, for a `ConnectionSerial` connection the baud rate and parity might need to be defined – `baud_rate=11920; parity=even`. The value (as in a key-*value* pair) gets cast to the appropriate data type (e.g., `int`, `float`, `str`) so the baud rate value would be `11920` as an `int` and the parity value becomes `Parity.EVEN`.
- **Serial** – The serial number, or unique ID, of the equipment.

A record in a *Connections Database* gets matched with the appropriate record in an *Equipment-Register Database* by the unique combination of the `manufacturer + model + serial` values, which when combined act as the primary key in each database.

The following is an example of a *Connections Database*. The header of each *field* also follows the same *Field Names* format used in an *Equipment-Register Database* and so *MODEL#* would also be an acceptable header for *Model Number*.

Manufacturer	Model Number	Serial Number	Backend	Address	Properties
OMEGA	iTHX-W3	458615	MSL	TCP::192.168.1.100:	termination=”\r”; timeout=10
Hewlett Packard	3468A	BCD024	PyVISA	GPIB::7	
Agilent	53230A	49e39f	MSL	COM2	baud_rate=119200; parity=even

Unlike an *Equipment-Register Database* each person can maintain their own *Connections Database*. The reason being that since equipment can be shared between people some Connection *fields*, like the COM address, can vary depending on which computer the equipment is connected to and what other equipment is also connected to that computer. Therefore, everyone could have their own *Connections Database* and connection records can be copied from one *Connections Database* to another. If you are using someone else's equipment and if none of the Connection *fields* need to be changed to be able to communicate with the equipment then it is recommended to add their *Connections Database* as a `<connection>` element in your *Configuration File*.

Address Syntax

The following are examples of an **Address** syntax (see more examples from National Instruments).

Interfa	Syntax Example	Notes
PRO-LOGIX	Pro-logix::192.168.1.110::123	The GPIB-ETHERNET Controller: host=192.168.1.110, port=1234, primary-GPIB-address=6
PRO-LOGIX	Pro-logix::192.168.1.70::1234:	The GPIB-ETHERNET Controller: host=192.168.1.70, port=1234, primary-GPIB-address=6, secondary-GPIB-address=112
PRO-LOGIX	Pro-logix::192.168.1.70::1234:	The GPIB-ETHERNET Controller: host=192.168.1.70, port=1234, primary-GPIB-address=6, secondary-GPIB-address=112
PRO-LOGIX	Prologix::COM3::6	The GPIB-USB Controller: port=COM3, primary-GPIB-address=6
PRO-LOGIX	Pro-logix::/dev/ttyS0::4::96	The GPIB-USB Controller: port=/dev/ttyS0, primary-GPIB-address=4, secondary-GPIB-address=96
SDK	SDK::C:/Program Files/Manufacturer/bin/file	Specify the full path to the SDK
SDK	SDK::filename.dll	Specify only the filename if the path to where the SDK file is located has been added as a `<path>` element in the *Configuration File*
SERIAL	COM2	A serial port on Windows
SERIAL	ASRL/dev/ttyS1	A serial port on Linux
SERIAL	ASRL2::INSTR	Compatible with National Instruments syntax
SERIAL	ASRLCOM2	Compatible with PyVISA-py syntax
SOCKE	TCP::192.168.1.100::5000	Creates the connection as a `socket.SOCK_STREAM` to the IP address **192.168.1.100** at port **5000**
SOCKE	UDP::192.168.1.100::500(	Creates the connection as a `socket.SOCK_DGRAM`
SOCKE	TCPIP::192.168.1.100::50	Compatible with National Instruments syntax
SOCKE	SOCKET::192.168.1.100::	Generic socket type. You can specify the connection type in the **Properties** *field* (i.e., type=RAW)
TCPIP HiSLIP	TCPIP::dev.company.com:	A HiSLIP LAN instrument at the hostname **dev.company.com**.
TCPIP HiSLIP	TCPIP::10.12.114.50::hisl	A HiSLIP LAN instrument whose IP address is **10.12.114.50** with the server listening at port **5000**
TCPIP VXI-11	TCPIP::dev.company.com:	A VXI-11.3 LAN instrument at the hostname **dev.company.com**. This uses the default LAN Device Name **inst0**
TCPIP VXI-11	TCPIP::10.6.56.21::gpib0,	A VXI-11.2 GPIB device whose IP address is **10.6.56.21**
TCPIP VXI-11	TCPIP::192.168.1.100	A VXI-11.3 LAN instrument at IP address **192.168.1.100**. Note that default values for board **0** and LAN device name **inst0** will be used
ZMQ	ZMQ::192.168.20.90::555	Use the ZeroMQ messaging library to connect to a device at IP address **192.168.1.100** and port **5555**

1.3 Install MSL-Equipment

To install **MSL-Equipment** run

```
pip install https://github.com/MSLNZ/msl-equipment/archive/v0.1.0.zip#egg=msl-
↪equipment
```

Alternatively, using the MSL Package Manager run

```
msl install equipment
```

1.3.1 Dependencies

- Python 2.7, 3.5+
- msl-loadlib
- msl-io
- numpy
- pyserial
- python-dateutil
- pyzmq

1.3.2 Optional Dependencies

- PyVISA
- PyVISA-py
- NI-DAQmx

Some of the *MSL Resources* might not work in your application because the resource might depend on an external dependency (e.g., the SDK provided by a manufacturer) and this external dependency might not be available for your operating system.

1.4 Examples

Some example scripts that illustrate how to use MSL-Equipment to communicate with equipment can be found in the repository.

1.5 MSL Resources

MSL Resources are specific classes that are used to communicate with the equipment.

- Aim and Thurlby Thandar Instruments
  - *MXSeries* – MX100QP, MX100TP, MX180TP
- Avantes
  - *Avantes* – Wrapper around the AvaSpec SDK
- Bentham Instruments Ltd
  - *Bentham* – Wrapper around the Bentham SDK
- CMI (Czech Metrology Institute)
  - *SIA3* – Switched Integrator Amplifier
- DataRay
  - *DataRayOCX64* – Wrapper around the DATARAYOCX library
- Electron Dynamics Ltd
  - *TCSeries* – Temperature Controller (TC LV, TC M, TC Lite)
- Energetiq
  - *EQ99* – EQ-99 Manager
- MKS Instruments
  - *PR4000B* – Flow and Pressure controller
- NKT Photonics
  - *NKT* – Wrapper around the NKT Photonics SDK
- OMEGA
  - *iTHX* – iTHX-W3, iTHX-D3, iTHX-SD, iTHX-M, iTHX-W, iTHX-2
- OptoSigma
  - *SHOT702* – Two-axis Stage Controller
- Optronic Laboratories
  - *OL756* – UV-VIS spectroradiometer
  - *OLCurrentSource* – DC Current Source (16A, 65A, 83A)
- Pico Technology – Wrapper around the Pico Technology SDK
  - PicoScope
    - *PicoScope2000* - PicoScope 2000 Series
    - *PicoScope2000A* - PicoScope 2000 Series A
    - *PicoScope3000* - PicoScope 3000 Series
    - *PicoScope3000A* - PicoScope 3000 Series A
    - *PicoScope4000* - PicoScope 4000 Series

        * *PicoScope4000A* - PicoScope 4000 Series A
        * *PicoScope5000* - PicoScope 5000 Series
        * *PicoScope5000A* - PicoScope 5000 Series A
        * *PicoScope6000* - PicoScope 6000 Series
    - PT-104 Platinum Resistance Data Logger
        * *PT104* – PT-104
- Princeton Instruments
    - *PrincetonInstruments* – Wrapper around the ARC_Instrument.dll library
- Raicol Crystals
    - *RaicolTEC* – TEC (Peltier-based) oven
- Thorlabs
    - Wrapper around the Kinesis SDK.
        * *FilterFlipper* – MFF101, MFF102
        * *IntegratedStepperMotors* – LTS150, LTS300, MLJ050, MLJ150, K10CR1
        * *KCubeSolenoid* – KSC101
        * *KCubeStepperMotor* – KST101
        * *KCubeDCServo* – KDC101
        * *BenchtopStepperMotor* – BSC101, BSC102, BSC103, BSC201, BSC202, BSC203
    - *FilterWheelXX2C* – FW102C, FW212C

1.5.1 Creating a new MSL Resource

When adding a new MSL Resource class to the repository the following steps should be performed. Please follow the style guide.

Note: If you do not want to upload the new MSL Resource class to the repository then you only need to write the code found in Step 5 to use your class in your own programs.

---

1. Create a fork of the repository.
2. If you are adding a new MSL Resource for equipment from a manufacturer that does not already exist in the msl/equipment/resources directory then create a new Python package in msl/equipment/resources using the name of the *manufacturer* as the package name.
3. Create a new Python module, in the package from Step 2, using the *model number* of the equipment as the name of the module.
4. If a *msl.equipment.exceptions* class has not been created for this manufacture then create a new exception handler class using the name of the *manufacturer* in the class name.
5. Create a new connection class within the module that you created in Step 3. The class must be a subclass of one of the *Connection Classes*.

```python
# msl/equipment/resources/<manufacturer>/<model_number>.py
#
from msl.equipment.resources import register
from msl.equipment.exceptions import TheErrorClassFromStep4  # this is␣
↪optional
from msl.equipment.connection_xxx import ConnectionXxx  # replace xxx␣
↪with the Connection subclass

# Register your class so that MSL-Equipment knows that it exists
@register(manufacturer='a regex pattern', model='a regex pattern')  # can␣
↪include a `flags` kwarg
class ModelNumber(ConnectionXxx):  # change ModelNumber and ConnectionXxx

    def __init__(self, record):
        """Edit the docstring...

        Do not instantiate this class directly. Use the :meth:`~.
↪EquipmentRecord.connect`
        method to connect to the equipment.

        Parameters
        ----------
        record : :class:`~.EquipmentRecord`
            A record from an :ref:`equipment-database`.
        """
        super(ModelNumber, self).__init__(record)  # change ModelNumber

        # the following is optional, the default exception handler is␣
↪MSLConnectionError
        self.set_exception_class(TheErrorClassFromStep4)  # change␣
↪TheErrorClassFromStep4
```

6. Add at least one example for how to use the new MSL Resource in msl/examples/equipment. Follow the template of the other examples in this package for naming conventions and for showing how to use the new MSL Resource.

7. Create tests for the new MSL Resource. The tests cannot be dependent on whether the equipment is physically connected to the computer running the test (ideally the examples that you write in Step 6 will demonstrate that communicating with the equipment works). The very minimal test to create is to add a test case to the def test_find_resource_class() function for ensuring that your class is returned for various values of *manufacturer* and *model*. Run the tests using `python setup.py test` (ideally you would run the tests for all *currently-supported versions* of Python, see also condatests.py).

8. Add `.rst` documentation files for the new MSL Resource to the docs/_api folder. You can either run `python setup.py apidoc` to automatically generate the `.rst` documentation files or you can create the necessary `.rst` files manually. Running `python setup.py apidoc` will generate `.rst` files for *all* modules in **MSL-Equipment** in the `docs/_autosummary` folder. Only copy the `.rst` files that are associated with your new MSL Resource to the docs/_api folder. After copying the files you can delete the `docs/_autosummary` folder before running `python setup.py docs` to build the documentation, otherwise you will get numerous warnings. If you want to manually create the `.rst` files then look in the docs/_api folder for examples from other MSL Resources.

9. If you created a new package in Step 2 then you need to add the new package to the `toctree` of the `Subpackages` section in docs/_api/msl.equipment.resources.rst. Insert the name of the new MSL Resource package in the file alphabetically. If you forget to do this step then a warning will appear when building the documentation to help remind you to do it. If you did not create a new package in Step 2 then add the `.rst` file from Step 8 to the `Subpackages` section in the appropriate `msl.equipment.resources.*.rst` file.
10. Add the new MSL Resource class, alphabetically, to the list of MSL Resources in docs/resources.rst. Follow the template that is used for the other MSL Resources listed in this file.
11. Add yourself to `AUTHORS.rst` and add a note in `CHANGES.rst` that you created this new Resource. These files are located in the root directory of the **MSL-Equipment** package.
12. If running the tests pass and building the docs show no errors/warnings then create a pull request.

1.6 API Documentation

Although this package contains many classes and functions, the only object that you must initialize in your application is *Config* and perhaps *EquipmentRecord*'s (depending on the format that is chosen to store the *Databases*).

1.6.1 Connection Classes

Use the following functions to find equipment that are connected to a computer or that are on the network

list_resources()	A `dict` of all equipment that are available to connect to
print_resources()	Print a summary of all equipment that are available to connect to

The following *Connection* classes are available to communicate with the equipment *(although you should never need to instantiate these classes directly):*

ConnectionDemo	Simulate a connection to the equipment
ConnectionMessageBased	Equipment that use message-based communication
ConnectionPrologix	Equipment that is connected through a Prologix Controller
ConnectionSDK	Equipment that use the manufacturer's SDK for the connection
ConnectionSerial	Equipment that is connected through a Serial port
ConnectionSocket	Equipment that is connected through a Socket
ConnectionTCPIPVXI11	Equipment that use the VXI-11 protocol
ConnectionTCPIPHiSLIP	Equipment that use the HiSLIP protocol
ConnectionZeroMQ	Equipment that use the ZeroMQ protocol

and the *Connection* classes that are available from external Python libraries are:

ConnectionPyVISA	Uses PyVISA to establish a connection to the equipment
ConnectionNIDAQ	Uses NI-DAQ to establish a connection to the equipment

1.6.2 Package Structure

msl.equipment package

Manage and connect to equipment in the laboratory.

msl.equipment.**version_info = version_info(major=0, minor=1, micro=0, releaselevel='final')**

Contains the version information as a (major, minor, micro, releaselevel) tuple.

Type
namedtuple

msl.equipment.**list_resources**(*hosts=None*, *timeout=2*)

Returns a dictionary of all equipment that are available to connect to.

Parameters

- **hosts** (list of str, optional) – The IP address(es) on the computer to use to find network devices. If not specified, then find devices on all network interfaces.
- **timeout** (float, optional) – The maximum number of seconds to wait for a reply from a network device.

Returns
dict – The information about the devices that were found.

msl.equipment.**print_resources**(***kwargs*)

Print a summary of all equipment that are available to connect to.

Parameters
kwargs – All keyword arguments are passed to *list_resources()*.

msl.equipment.config module

Load an XML *Configuration File*.

class msl.equipment.config.**Config**(*path*)

Bases: object

Load an XML *Configuration File*.

This function is used to set the configuration constants to use for the Python runtime and it allows you to access *EquipmentRecord*'s from an *Equipment-Register Database* and *ConnectionRecord*'s from a *Connections Database*.

The following table summarizes the XML elements that are used by **MSL-Equipment** and can be defined in a *Configuration File*:

XML Tag	Example Values	Description
pyvisa_	@ivi, @py, @sim, /path/to/libvisa.so.'	The PyVISA library to use.
demo_n	true, false, True, False	Whether to open connections in demo mode.
path	/path/to/SDKs, D:/images	A path that contains external resources. Accepts a *recursive="true"* attribute. The path(s) are appended to `os.environ['PATH']` and to *PATH*

The user is also encouraged to define their own application-specific elements within the *Configuration File*.

Parameters
path (`str`) – The path to an XML *Configuration File*.

Raises
`OSError` – If *path* does not exist or if the *Configuration File* is invalid.

PyVISA_LIBRARY = '@ivi'

The PyVISA backend library to use.

Type
`str`

DEMO_MODE = False

Whether to open connections in demo mode.

If enabled then the equipment does not need to be physically connected to a computer and the connection is simulated.

Type
`bool`

PATH = []

Paths are also appended to `os.environ['PATH']`.

Type
`list` of `str`

property path

The path to the configuration file.

Type
`str`

property root

Returns the root element (the first node) of the XML tree.

Returns
`Element` – The root element.

database()

Returns
Database – A reference to the equipment and connection records in the database(s) that are specified in the configuration file.

value(*tag*, *default=None*)

Gets the value associated with the specified *tag* in the configuration file.

The first element with name *tag* (relative to the *root*) is used.

The value is converted to the appropriate data type if possible. Otherwise, the value will be returned as a str.

Parameters

- **tag** (str) – The name of an XML tag in the configuration file.
- **default** – The default value if *tag* cannot be found.

Returns
The value associated with *tag* or *default* if the tag cannot be found.

find(*tag*)

Find the first sub-element (from the *root*) matching *tag* in the configuration file.

Parameters
tag (str) – The name of an XML tag in the configuration file.

Returns
Element or None – The first sub-element or None if the tag cannot be found.

findall(*tag*)

Find all matching sub-elements (from the *root*) matching *tag* in the configuration file.

Parameters
tag (str) – The name of an XML tag in the configuration file.

Returns
list of Element – All matching elements in document order.

attrib(*tag*)

Get the attributes of an Element in the configuration file.

The first element with name *tag* (relative to the *root*) is used.

The values are converted to the appropriate data type if possible. Otherwise, the value will be kept as a str.

Parameters
tag (str) – The name of an XML element in the configuration file.

Returns
dict – The attributes of the Element. If an element with the name *tag* does not exist, then an empty dict is returned.

msl.equipment.connection module

Base class for establishing a connection to the equipment.

class msl.equipment.connection.**Connection**(*record*)

Bases: object

Base class for establishing a connection to the equipment.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

property equipment_record

The information about the equipment.

Type
EquipmentRecord

disconnect()

Disconnect from the equipment.

This method should be overridden in the subclass if the subclass must implement tasks that need to be performed in order to safely disconnect from the equipment.

For example:

- to clean up system resources from memory (e.g., if using a manufacturer's SDK)
- to configure the equipment to be in a state that is safe for people working in the lab when the equipment is not in use

---

Note: This method gets called automatically when the *Connection* object gets garbage collected, which happens when the reference count is 0.

---

raise_exception(*message*)

Raise an *MSLConnectionError* and log the error message.

Parameters
message (str or Exception) – The message to display in the exception class that was set by *set_exception_class()*. If an Exception object then its string representation is used as the message.

static convert_to_enum(*obj*, *enum*, *prefix=None*, *to_upper=False*, *strict=True*)

Convert *obj* to an Enum.

Parameters

- **obj** – Any object to be converted to the specified *enum*. Can be a value of member of the specified *enum*.
- **enum** – The Enum object that *obj* should be converted to.
- **prefix** (str, optional) – If *obj* is a str, then ensures that *prefix* is included at the beginning of *obj* before converting *obj* to the *enum*.

- **to_upper** (bool, optional) – If *obj* is a str, then whether to change *obj* to be upper case before converting *obj* to the *enum*.
- **strict** (bool, optional) – Whether errors should be raised. If False and *obj* cannot be converted to *enum* then *obj* is returned and the error is logged.

Returns
Enum – The *enum*.

Raises
ValueError – If *obj* is not in *enum* and *strict* is True.

static log_debug(*msg*, **args*, ***kwargs*)

Log a debug message.

All input parameters are passed to debug().

static log_info(*msg*, **args*, ***kwargs*)

Log an info message.

All input parameters are passed to info().

static log_warning(*msg*, **args*, ***kwargs*)

Log a warning message.

All input parameters are passed to warning().

static log_error(*msg*, **args*, ***kwargs*)

Log an error message.

All input parameters are passed to error().

static log_critical(*msg*, **args*, ***kwargs*)

Log a critical message.

All input parameters are passed to critical().

set_exception_class(*handler*)

Set the exception-handler class for this *Connection*.

Parameters
handler (*MSLConnectionError*) – A subclass of *MSLConnectionError*

Raises
TypeError – If the *handler* is not a subclass of *MSLConnectionError*

static parse_address(*address*)

Determine whether a subclass should be used to connect to the equipment.

Attention: The subclass should override this method.

Parameters
address (str) – The address of a *ConnectionRecord*.

Returns
dict or None – If the *address* is in a valid format for the subclass to be able to connect to the equipment then a dict is returned containing the information

necessary to connect to the equipment. Otherwise, if the *address* is not valid for the subclass to be able to connect to the equipment then `None` is returned.

msl.equipment.connection_demo module

Simulate a connection to the equipment.

class msl.equipment.connection_demo.**ConnectionDemo**(*record*, *cls*)

Bases: *Connection*

Simulate a connection to the equipment.

Establishing a connection in demo mode is useful when developing a program and the equipment is not physically connected to a computer.

A custom logging level is used for logging messages with a connection in demo mode. The `logging.DEMO` logging level is set to be between `logging.INFO` and `logging.WARNING`.

The returned data type is determined from the docstring of the called method. For example, if `:rtype: int` then an `int` is returned or if `:rtype: int, float` then an `int` and a `float` are returned. Although the expected data type is returned the value(s) of the returned object is randomly generated. The docstring must be in either the reStructuredText or NumPy format.

Do not instantiate this class directly. Use the *record.connect(demo=True)* method to connect to the equipment in demo mode or set *DEMO_MODE* to be `True` in the *Configuration File* to open all connections in demo mode.

Parameters

- **record** (*EquipmentRecord*) – A record from an *Equipment-Register Database*.
- **cls** (*Connection*) – A *Connection* subclass (that has **NOT** been instantiated).

disconnect()

Log a disconnection from the equipment.

msl.equipment.connection_message_based module

Base class for equipment that use message-based communication.

class msl.equipment.connection_message_based.**ConnectionMessageBased**(*record*)

Bases: *Connection*

Base class for equipment that use message-based communication.

The *backend* value must be equal to *MSL* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be `MSL`.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

CR = b'\r'

The carriage-return character (hex: 0x0D, decimal: 13).

Type
bytes

LF = b'\n'

The line-feed character (hex: 0x0A, decimal: 10).

Type
bytes

property encoding

The encoding that is used for *read()* and *write()* operations.

Type
str

property encoding_errors

The error handling scheme to use when encoding and decoding messages.

For example: *strict*, *ignore*, *replace*, *xmlcharrefreplace*, *backslashreplace*

Type
str

property read_termination

The termination character sequence that is used for the *read()* method.

Reading stops when the equipment stops sending data or the *read_termination* character sequence is detected. If you set the *read_termination* to be equal to a variable of type str it will automatically be encoded.

Type
bytes or None

property write_termination

The termination character sequence that is appended to *write()* messages.

If you set the *write_termination* to be equal to a variable of type str it will automatically be encoded.

Type
bytes or None

property max_read_size

The maximum number of bytes that can be *read()*.

Type
int

property timeout

The timeout, in seconds, for *read()* and *write()* operations.

A value 0 will set the timeout to be None (blocking mode).

Type
float or None

property rstrip

Whether to remove trailing whitespace from *read()* messages.

Type
bool

raise_timeout(*append_msg=''*)

Raise a *MSLTimeoutError*.

Parameters
append_msg (str, optional) – A message to append to the generic timeout message.

read(*size=None*, *fmt='ascii'*, *dtype=None*, *decode=True*)

Read a message from the equipment.

This method will block until one of the following conditions is fulfilled:

1. the *read_termination* byte(s) is(are) received – only if *read_termination* is not None.
2. *size* bytes have been received – only if *size* is not None.
3. a timeout occurs – only if *timeout* is not None. An *MSLTimeoutError* is raised.
4. *max_read_size* bytes have been received. An *MSLConnectionError* is raised.

Parameters

- **size** (int, optional) – The number of bytes to read. Ignored if it is None.
- **fmt** (str or None, optional) – The format that the message data is in. Ignored if *dtype* is not specified. See *from_bytes()* for more details.
- **dtype** – The data type of the elements in the message data. Can be any object that numpy.dtype supports. See *from_bytes()* for more details. For messages that are of scalar type (i.e., a single number) it is more efficient to not specify *dtype* but to pass the message to the int or float class to convert the message to the appropriate numeric type.
- **decode** (bool, optional) – Whether to decode the message (i.e., convert the message to a str) or keep the message as bytes. Ignored if *dtype* is specified.

Returns
str, bytes or ndarray – The message from the equipment. If *dtype* is specified, then the message is returned as an ndarray, if *decode* is True then the message is returned as a str, otherwise the message is returned as bytes.

See also:

rstrip

write(*message*, *data=None*, *fmt='ieee'*, *dtype='<f'*)

Write a message to the equipment.

Parameters

- **message** (str or bytes) – The message to write to the equipment.

- **data** (list, tuple or numpy.ndarray, optional) – The data to append to *message*. See *to_bytes()* for more details.
- **fmt** (str or None, optional) – The format to use to convert *data* to bytes. Ignored if *data* is None. See *to_bytes()* for more details.
- **dtype** – The data type to use to convert each element in *data* to bytes. Ignored if *data* is None. See *to_bytes()* for more details.

Returns

int – The number of bytes written.

query(*message*, *delay=0.0*, ***kwargs*)

Convenience method for performing a *write()* followed by a *read()*.

Parameters

- **message** (str or bytes) – The message to write to the equipment.
- **delay** (float, optional) – The time delay, in seconds, to wait between *write()* and *read()* operations.
- ****kwargs** – All additional keyword arguments are passed to *read()*

Returns

str, bytes or ndarray – The message from the equipment. If *dtype* is specified, then the message is returned as an ndarray, if *decode* is True then the message is returned as a str, otherwise the message is returned as bytes.

msl.equipment.connection_nidaq module

Uses NI-DAQ as the backend to communicate with the equipment.

class msl.equipment.connection_nidaq.**ConnectionNIDAQ**(*record*)

Bases: *Connection*

Uses NI-DAQ to establish a connection to the equipment.

See the nidaqmx examples for how to use NI-DAQ.

The returned object from the *connect()* method is equivalent to importing the NI-DAQ package.

For example:

```
nidaqmx = record.connect()
with nidaqmx.Task() as task:
    task.ai_channels.add_ai_voltage_chan('Dev1/ai0')
    voltage = task.read()
```

is equivalent to:

```
import nidaqmx
with nidaqmx.Task() as task:
    task.ai_channels.add_ai_voltage_chan('Dev1/ai0')
    voltage = task.read()
```

The *backend* value must be equal to *NIDAQ* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be NIDAQ.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

property constants

Returns the nidaqmx.constants module.

property CtrFreq

Returns the CtrFreq class.

property CtrTick

Returns the CtrTick class.

property CtrTime

Returns the CtrTime class.

property DaqError

Returns the DaqError class.

property DaqResourceWarning

Returns the DaqResourceWarning class.

property DaqWarning

Returns the DaqWarning class.

property errors

Returns the nidaqmx.errors module.

property Scale

Returns the Scale class.

property stream_readers

Returns the nidaqmx.stream_readers module.

property stream_writers

Returns the nidaqmx.stream_writers module.

property system

Returns the nidaqmx.system module.

property Task

Returns the Task class.

property types

Returns the nidaqmx.types module.

property utils

Returns the nidaqmx.utils module.

property version

The NI-DAQmx driver version number.

Type
str

msl.equipment.connection_prologix module

Uses Prologix hardware to establish a connection to the equipment.

class msl.equipment.connection_prologix.**ConnectionPrologix**(*record*)

Bases: *Connection*

Uses Prologix hardware to establish a connection to the equipment.

For the GPIB-ETHERNET Controller, the format of the *address* is `Prologix::HOST::1234::PAD[::SAD]`, where PAD (Primary Address) is a decimal value between 0 and 30 and SAD (Secondary Address) is a decimal value between 96 and 126. SAD is optional. For example, `Prologix::192.168.1.110::1234::6` or `Prologix::192.168.1.110::1234::6::96`.

For the GPIB-USB Controller, the format of the *address* is `Prologix::PORT::PAD[::SAD]`, where PAD (Primary Address) is a decimal value between 0 and 30 and SAD (Secondary Address) is a decimal value between 96 and 126. SAD is optional. For example, `Prologix::COM3::6` or `Prologix::/dev/ttyUSB0::6::112`.

The *properties* for a Prologix connection supports the following key-value pairs in the *Connections Database* and any of the key-value pairs supported by *ConnectionSerial* or *ConnectionSocket* (depending on whether a GPIB-USB or a GPIB-ETHERNET Controller is used):

```
'eoi': int, 0 or 1
'eos': int, 0, 1, 2 or 3
'eot_char': int, an ASCII value less than 256
'eot_enable': int, 0 or 1
'mode': int, 0 or 1 [default: 1]
'read_tmo_ms': int, a timeout value between 1 and 3000 milliseconds
```

The *backend* value must be equal to *MSL* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be `MSL`.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

controllers = {}

A `dict` of all Prologix Controllers that are being used to communicate with GPIB devices.

selected_addresses = {}

A `dict` of the currently-selected GPIB address for all Prologix Controllers.

property encoding

The encoding that is used for *read()* and *write()* operations.

Type
str

property encoding_errors

The error handling scheme to use when encoding and decoding messages.

For example: *strict*, *ignore*, *replace*, *xmlcharrefreplace*, *backslashreplace*

Type
str

property read_termination

The termination character sequence that is used for the *read()* method.

Reading stops when the equipment stops sending data or the *read_termination* character sequence is detected. If you set the *read_termination* to be equal to a variable of type str it will automatically be encoded.

Type
bytes or None

property write_termination

The termination character sequence that is appended to *write()* messages.

If you set the *write_termination* to be equal to a variable of type str it will automatically be encoded.

Type
bytes or None

property max_read_size

The maximum number of bytes that can be *read()*.

Type
int

property timeout

The timeout, in seconds, for *read()* and *write()* operations.

Type
float or None

property rstrip

Whether to remove trailing whitespace from *read()* messages.

Type
bool

property controller

ConnectionSerial or *ConnectionSocket*: The connection to the Prologix Controller for this equipment.

Depends on whether a GPIB-USB or a GPIB-ETHERNET Controller is being used to communicate with the equipment.

disconnect()

Calling this method does not close the underlying *ConnectionSerial* or *ConnectionSocket* connection to the Prologix Controller since the connection to the Prologix Controller may still be required to send messages to other devices via GPIB.

Calling this method sets the *controller* to be None.

group_execute_trigger(**addresses*)

Send the Group Execute Trigger command to equipment at the specified addresses.

Up to 15 addresses may be specified. If no address is specified then the Group Execute Trigger command is issued to the currently-addressed equipment.

Parameters

addresses – The primary (and optional secondary) GPIB addresses. If a secondary address is specified then it must follow its corresponding primary address. For example:

- group_execute_trigger(1, 11, 17) → primary, primary, primary
- group_execute_trigger(3, 96, 12, 21) → primary, secondary, primary, primary

Returns

int – The number of bytes written.

read(***kwargs*)

Read a message from the equipment.

Parameters

****kwargs** – All keyword arguments are passed to *read()*.

Returns

str, bytes or ndarray – The message from the equipment. If *dtype* is specified, then the message is returned as an ndarray, if *decode* is True then the message is returned as a str, otherwise the message is returned as bytes.

write(*message*, ***kwargs*)

Write a message to the equipment.

Parameters

- **message** (str or bytes) – The message to write to the equipment.
- ****kwargs** – All keyword arguments are passed to *write()*.

Returns

int – The number of bytes written.

query(*message*, ***kwargs*)

Convenience method for performing a *write()* followed by a *read()*.

Parameters

- **message** (str or bytes) – The message to write to the equipment.
- ****kwargs** – All keyword arguments are passed to *query()*.

Returns

str, bytes or ndarray – The message from the equipment. If *dtype* is specified, then the message is returned as an ndarray, if *decode* is True then the message is returned as a str, otherwise the message is returned as bytes.

property query_auto

Whether to send ++auto 1 before and ++auto 0 after a *query()* to the Prologix Controller.

Type
bool

version()

Get the version of the Prologix Controller.

Returns
str – The type of the Controller (GPIB-USB or GPIB-ETHERNET) and the version of the firmware.

static parse_address(*address*)

Parse the address to determine the connection class and the GPIB address.

Parameters
address (str) – The address of a *ConnectionRecord*.

Returns

dict or None – If *address* is valid for a Prologix connection then the key-value pairs are:

- **class, *ConnectionSocket* or *ConnectionSerial***
  The underlying connection class to use (not instantiated).
- **name, str**
  The name of the connection class.
- **pad, int**
  The primary GPIB address.
- **sad, int or None**
  The secondary GPIB address.

otherwise None is returned.

msl.equipment.connection_prologix.**find_prologix**(*hosts=None*, *timeout=1*)

Find all Prologix ENET-GPIB devices that are on the network.

To resolve the MAC address of a Prologix device, the arp program must be installed. On Linux, install net-tools. On Windows and macOS, arp should already be installed.

Parameters

- **hosts** (list of str, optional) – The IP address(es) on the computer to use to look for Prologix ENET-GPIB devices. If not specified, then use all network interfaces.
- **timeout** (float, optional) – The maximum number of seconds to wait for a reply.

Returns
dict – The information about the Prologix ENET-GPIB devices that were found.

msl.equipment.connection_pyvisa module

Uses PyVISA as the backend to communicate with the equipment.

class msl.equipment.connection_pyvisa.**ConnectionPyVISA**(*record*)

Bases: *Connection*

Uses PyVISA to establish a connection to the equipment.

The *backend* value must be equal to *PyVISA* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be `PyVISA`.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

property resource

The PyVISA resource that is used for the connection.

This is the `Resource` that would have been returned if you did the following in a script:

```
import pyvisa
rm = pyvisa.ResourceManager()
resource = rm.open_resource('ASRL3::INSTR')
```

Type
`Resource`

disconnect()

Calls `close()`.

static resource_manager(*visa_library=None*)

Return the PyVISA `ResourceManager`.

Parameters
visa_library (`VisaLibraryBase` or `str`, optional) – The library to use for PyVISA. For example:

- `@ivi` to use IVI
- `@ni` to use NI-VISA (only supported in PyVISA <1.11)
- `@py` to use PyVISA-py
- `@sim` to use PyVISA-sim

If `None` then *PyVISA_LIBRARY* will be used.

Returns
`ResourceManager` – The PyVISA Resource Manager.

Raises

- **ValueError** – If the PyVISA backend wrapper cannot be found.
- **OSError** – If an IVI library cannot be found.

static resource_class(*record*)

Get the PyVISA Resource class.

Parameters

record (*EquipmentRecord* or *ConnectionRecord*) – An equipment or connection record from a *Database*.

Returns

A `Resource` subclass – The PyVISA Resource class that can open the *record*.

msl.equipment.connection_sdk module

Base class for equipment that use the SDK provided by the manufacturer for the connection.

class msl.equipment.connection_sdk.**ConnectionSDK**(*record*, *libtype*, *path=None*)

Bases: *Connection*

Base class for equipment that use the SDK provided by the manufacturer for the connection.

The *backend* value must be equal to *MSL* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be `MSL`.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

- **record** (*EquipmentRecord*) – A record from an *Equipment-Register Database*.
- **libtype** (`str`) – The library type. See `LoadLibrary` for more information.
- **path** (`str`, optional) – The path to the SDK (if *record.connection.address* does not contain this information).

Raises

- **OSError** – If the shared library cannot be loaded.
- **TypeError** – If either *record* or *libtype* is invalid.

property assembly

The reference to the .NET assembly.

Type

`assembly`

property gateway

The reference to the JAVA gateway.

Type

`gateway`

property path

The path to the SDK file.

Type

`str`

property sdk

The reference to the SDK object.

Type
lib

log_errcheck(*result*, *func*, *arguments*)

Convenience method for logging an errcheck

static parse_address(*address*)

Get the file path from an address.

Parameters
address (str) – The address of a *ConnectionRecord*.

Returns
dict or None – The file path or None if *address* is not valid for an SDK.

msl.equipment.connection_serial module

Base class for equipment that is connected through a serial port.

class msl.equipment.connection_serial.**ConnectionSerial**(*record*)

Bases: *ConnectionMessageBased*

Base class for equipment that is connected through a serial port.

The *properties* for a serial connection supports the following key-value pairs in the *Connections Database* (see also serial.Serial for more details about each parameter):

```
'baud_rate': int, the baud rate [default: 9600]
'data_bits': int, the number of data bits, e.g. 5, 6, 7, 8 [default: 8]
'dsr_dtr': bool, enable hardware (DSR/DTR) flow control [default: False]
'encoding': str, the encoding to use [default: 'utf-8']
'encoding_errors': str, encoding error handling scheme, e.g. 'strict',
↪'ignore' [default: 'strict']
'inter_byte_timeout': float or None, the inter-character timeout␣
↪[default: None]
'max_read_size': int, the maximum number of bytes that can be read␣
↪[default: 1 MB]
'parity': str or None, parity checking, e.g. 'even', 'odd' [default: None]
'read_termination': str or None, read until this termination sequence is␣
↪found [default: '\n']
'rstrip': bool, whether to remove trailing whitespace from "read"␣
↪messages [default: False]
'rts_cts': bool, enable hardware (RTS/CTS) flow control [default: False]
'stop_bits': int or float, the number of stop bits, e.g. 1, 1.5, 2␣
↪[default: 1]
'termination': shortcut for setting both 'read_termination' and 'write_
↪termination' to this value
'timeout': float or None, the timeout (in seconds) for read and write␣
↪operations [default: None]
'write_termination': str or None, termination sequence appended to write␣
```

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```
↪messages [default: '\r\n']
'xon_xoff': bool, enable software flow control [default: False]
```

The *backend* value must be equal to *MSL* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be `MSL`.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

Raises
MSLConnectionError – If the serial port cannot be opened.

property serial

The reference to the serial object.

Type
`serial.Serial`

property baud_rate

The baud rate setting.

Type
`int`

property data_bits

The number of data bits.

Type
DataBits

property stop_bits

The stop bit setting.

Type
StopBits

property parity

The parity setting.

Type
Parity

disconnect()

Close the serial port.

static parse_address(*address*)

Get the serial port from an address.

Parameters
address (`str`) – The address of a *ConnectionRecord*

Returns
`dict` or `None` – The serial port in a format that is valid for PySerial (i.e., `ASRL3` becomes `COM3`) or `None` if the port cannot be determined from *address*.

msl.equipment.connection_socket module

Base classes for equipment that is connected through a socket.

class msl.equipment.connection_socket.**ConnectionSocket**(*record*)

Bases: *ConnectionMessageBased*

Base class for equipment that is connected through a socket.

The *properties* for a socket connection supports the following key-value pairs in the *Connections Database* (see also `socket` for more details):

```
'buffer_size': int, the maximum number of bytes to read at a time␣
↪[default: 4096]
'encoding': str, the encoding to use [default: 'utf-8']
'encoding_errors': str, encoding error handling scheme, e.g. 'strict',
↪'ignore' [default: 'strict']
'family': str, the address family, e.g., 'INET', 'INET6', 'IPX' [default:
↪'INET']
'max_read_size': int, the maximum number of bytes that can be read␣
↪[default: 1 MB]
'proto': int, the socket protocol number [default: 0]
'read_termination': str or None, read until this termination sequence is␣
↪found [default: '\n']
'rstrip': bool, whether to remove trailing whitespace from "read"␣
↪messages [default: False]
'socket_type': str, the socket type, e.g. 'STREAM', 'DGRAM' [default:
↪'STREAM']
'termination': shortcut for setting both 'read_termination' and 'write_
↪termination' to this value
'timeout': float or None, the timeout (in seconds) for read and write␣
↪operations [default: None]
'write_termination': str or None, termination sequence appended to write␣
↪messages [default: '\r\n']
```

The *backend* value must be equal to *MSL* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be `MSL`.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

Raises
MSLConnectionError – If the socket cannot be opened.

property byte_buffer

Returns the reference to the byte buffer.

Type
bytearray

property host

The host (IP address).

Type
str

property port

The port number.

Type
int

property socket

The reference to the socket.

Type
socket

static parse_address(*address*)

Get the host and port from an address.

Parameters
address (str) – The address of a *ConnectionRecord*.

Returns
dict or None – The value of the host and the port or None if *address* is not valid for a socket.

disconnect()

Close the socket.

reconnect(*max_attempts=1*)

Reconnect to the equipment.

Parameters
max_attempts (int, optional) – The maximum number of attempts to try to reconnect with the equipment. If < 1 or None then keep trying until a connection is successful. If the maximum number of attempts has been reached then an exception is raise.

msl.equipment.connection_tcpip_hislip module

Base class for equipment that use the HiSLIP communication protocol.

class msl.equipment.connection_tcpip_hislip.**ConnectionTCPIPHiSLIP**(*record*)

Bases: *ConnectionMessageBased*

Base class for equipment that use the HiSLIP communication protocol.

The *properties* for a HiSLIP connection supports the following key-value pairs in the *Connections Database*:

```
'buffer_size': int, the maximum number of bytes to read at a time␣
↪[default: 4096]
'encoding': str, the encoding to use [default: 'utf-8']
'encoding_errors': str, encoding error handling scheme, e.g. 'strict',
↪'ignore' [default: 'strict']
'lock_timeout': float or None, the timeout (in seconds) to wait for a␣
```

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```
↪lock [default: 0]
'max_read_size': int, the maximum number of bytes that can be read␣
↪[default: 1 MB]
'rstrip': bool, whether to remove trailing whitespace from "read"␣
↪messages [default: False]
'timeout': float or None, the timeout (in seconds) for read and write␣
↪operations [default: None]
```

The *backend* value must be equal to *MSL* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be `MSL`.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

property host
The host (IP address).

Type
`str`

property port
The port number.

Type
`int`

property asynchronous
The reference to the asynchronous client.

Type
AsyncClient

property synchronous
The reference to the synchronous client.

Type
SyncClient

static parse_address(*address*)
Parse the address for valid TCPIP HiSLIP fields.

Parameters
address (`str`) – The address of a *ConnectionRecord*.

Returns
`dict` or `None` – The board number, hostname, LAN device name, and HiSLIP port number of the device or `None` if *address* is not valid for a TCPIP HiSLIP connection.

property max_read_size
The maximum number of bytes that can be *read()*.

Type
`int`

property lock_timeout

The time, in seconds, to wait to acquire a lock.

Type
float

disconnect()

Close the connection to the HiSLIP server.

reconnect(*max_attempts=1*)

Reconnect to the equipment.

Parameters
max_attempts (int, optional) – The maximum number of attempts to try to reconnect with the equipment. If < 1 or None then keep trying until a connection is successful. If the maximum number of attempts has been reached then an exception is raise.

read_stb()

Read the status byte from the device.

Returns
int – The status byte.

trigger()

Send the trigger message (emulates a GPIB Group Execute Trigger event).

clear()

Send the *clear* command to the device.

lock(*lock_string=''*)

Acquire the device's lock.

Parameters
lock_string (str, optional) – An ASCII string that identifies this lock. If not specified, then an exclusive lock is requested, otherwise the string indicates an identification of a shared-lock request.

Returns
bool – Whether acquiring the lock was successful.

unlock()

Release the lock acquired by *lock()*.

Returns
bool – Whether releasing the lock was successful.

lock_status()

Request the lock status from the HiSLIP server.

Returns

- bool – Whether the HiSLIP server has an exclusive lock with a client.
- int – The number of HiSLIP clients that have a lock with the HiSLIP server.

remote_local_control(*request*)

Send a GPIB-like remote/local control request.

Parameters

request (int) – The request to perform.

- 0 – Disable remote, *VI_GPIB_REN_DEASSERT*
- 1 – Enable remote, *VI_GPIB_REN_ASSERT*
- 2 – Disable remote and go to local, *VI_GPIB_REN_DEASSERT_GTL*
- 3 – Enable Remote and go to remote, *VI_GPIB_REN_ASSERT_ADDRESS*
- 4 – Enable remote and lock out local, *VI_GPIB_REN_ASSERT_LLO*
- 5 – Enable remote, go to remote, and set local lockout, *VI_GPIB_REN_ASSERT_ADDRESS_LLO*
- 6 – go to local without changing REN or lockout state, *VI_GPIB_REN_ADDRESS_GTL*

msl.equipment.connection_tcpip_vxi11 module

Base class for equipment that use the VXI-11 communication protocol.

class msl.equipment.connection_tcpip_vxi11.**ConnectionTCPIPVXI11**(*record*)

Bases: *ConnectionMessageBased*

Base class for equipment that use the VXI-11 communication protocol.

The *properties* for a VXI-11 connection supports the following key-value pairs in the *Connections Database*:

```
'buffer_size': int, the maximum number of bytes to read at a time␣
↪[default: 4096]
'encoding': str, the encoding to use [default: 'utf-8']
'encoding_errors': str, encoding error handling scheme, e.g. 'strict',
↪'ignore' [default: 'strict']
'lock_timeout': float or None, the timeout (in seconds) to wait for a␣
↪lock [default: 0]
'max_read_size': int, the maximum number of bytes that can be read␣
↪[default: 1 MB]
'port': int, the port to use instead of calling the RPC Port Mapper␣
↪function [default: None]
'read_termination': str or None, read until this termination character is␣
↪found [default: None]
'rstrip': bool, whether to remove trailing whitespace from "read"␣
↪messages [default: False]
'termination': alias for 'read_termination'
'timeout': float or None, the timeout (in seconds) for read and write␣
↪operations [default: None]
```

The *backend* value must be equal to *MSL* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be MSL.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

property byte_buffer

Returns the reference to the byte buffer.

Type
bytearray

property host

The host (IP address).

Type
str

property port

The port number.

Type
int

property socket

The reference to the socket.

Type
socket

static parse_address(*address*)

Parse the address for valid TCPIP VXI-11 fields.

Parameters
address (str) – The address of a *ConnectionRecord*.

Returns
dict or None – The board number, hostname, and LAN device name of the device or None if *address* is not valid for a TCPIP VXI-11 connection.

disconnect()

Unlink and close the sockets.

reconnect(*max_attempts=1*)

Reconnect to the equipment.

Parameters
max_attempts (int, optional) – The maximum number of attempts to try to reconnect with the equipment. If < 1 or None then keep trying until a connection is successful. If the maximum number of attempts has been reached then an exception is raise.

property lock_timeout

The time, in seconds, to wait to acquire a lock.

Type
float

abort()

Stop an in-progress request.

read_stb()

Read the status byte from the device.

Returns

int – The status byte.

trigger()

Send a trigger to the device.

clear()

Send the *clear* command to the device.

remote()

Place the device in a remote state wherein all programmable local controls are disabled.

local()

Place the device in a local state wherein all programmable local controls are enabled.

lock()

Acquire the device's lock.

unlock()

Release the lock acquired by *lock()*

enable_sqr(*enable*, *handle*)

Enable or disable the sending of *device_intr_srq* RPCs by the network instrument server.

Parameters

- **enable** (bool) – Whether to enable or disable interrupts.
- **handle** (bytes) – Host specific data (maximum length is 40 characters).

docmd(*cmd*, *value*, *fmt*)

Allows for a variety of commands to be executed.

Parameters

- **cmd** (int) – An IEEE 488 command messages, (e.g., to send a group execute trigger, GET, command the value of *cmd* would be 0x08).
- **value** (bool, int or float) – The value to use with *cmd*.
- **fmt** (str) – How to format *value*. See Format Characters for more details. Do not include the byte-order character. Network (big-endian) order will always be used.

Returns

bytes – The results defined by *cmd*.

destroy_link()

Destroy the link with the device.

create_intr_chan(*host_addr*, *host_port*, *prog_num*, *prog_vers*, *prog_family*)

Inform the network instrument server to establish an interrupt channel.

Parameters

- **host_addr** (int) – Host servicing the interrupt.

- **host_port** (int) – Valid port number on the client.
- **prog_num** (int) – Program number.
- **prog_vers** (int) – Program version number.
- **prog_family** (int) – The underlying socket protocol family type (IPPROTO_TCP or IPPROTO_UDP).

destroy_intr_chan()

Inform the network instrument server to close its interrupt channel.

msl.equipment.connection_zeromq module

Base class for equipment that use the ZeroMQ communication protocol.

class msl.equipment.connection_zeromq.**ConnectionZeroMQ**(*record*)

Bases: *ConnectionMessageBased*

Base class for equipment that use the ZeroMQ communication protocol.

The *properties* for a ZeroMQ connection supports the following key-value pairs in the *Connections Database*:

```
'encoding': str, the encoding to use [default: 'utf-8']
'encoding_errors': str, encoding error handling scheme, e.g. 'strict',
↪'ignore' [default: 'strict']
'max_read_size': int, the maximum number of bytes that can be read␣
↪[default: 1 MB]
'protocol': str, the ZeroMQ protocol [default: 'tcp']
'rstrip': bool, whether to remove trailing whitespace from "read"␣
↪messages [default: False]
'socket_type': str, the ZeroMQ socket type [default: 'REQ']
'timeout': float or None, the timeout (in seconds) for read and write␣
↪operations [default: None]
```

The *backend* value must be equal to *MSL* to use this class for the communication system. This is achieved by setting the value in the **Backend** field for a connection record in the *Connections Database* to be MSL.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

Raises
MSLConnectionError – If the socket cannot be opened.

property context

Reference to the ZeroMQ context.

Type
Context

disconnect()

Close the connection.

property host

The host (IP address).

Type
str

property max_read_size

The maximum number of bytes that can be *read()*.

Type
int

static parse_address(*address*)

Parse the address for valid ZeroMQ fields.

Parameters
address (str) – The address of a *ConnectionRecord*.

Returns
dict or None – The host and port number of the device or None if *address* is not valid for a ZeroMQ connection.

property port

The port number.

Type
int

reconnect(*max_attempts=1*)

Reconnect to the equipment.

Parameters
max_attempts (int, optional) – The maximum number of attempts to try to reconnect with the equipment. If < 1 or None then keep trying until a connection is successful. If the maximum number of attempts has been reached then an exception is raise.

property socket

Reference to the ZeroMQ socket.

Type
Socket

msl.equipment.constants module

MSL-Equipment constants.

class msl.equipment.constants.**Backend**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The software backend to use for the communication system.

UNKNOWN = 0

MSL = 1

PyVISA = 2

NIDAQ = 3

class msl.equipment.constants.**Interface**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The interface to use for the communication system that transfers data between a computer and the equipment. Only used if *Backend.MSL* is chosen as the backend.

NONE = 0

SDK = 1

SERIAL = 2

SOCKET = 3

PROLOGIX = 4

TCPIP_VXI11 = 5

TCPIP_HISLIP = 6

ZMQ = 7

class msl.equipment.constants.**Parity**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: Enum

The parity type to use for Serial communication.

NONE = 'N'

ODD = 'O'

EVEN = 'E'

MARK = 'M'

SPACE = 'S'

class msl.equipment.constants.**StopBits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: Enum

The number of stop bits to use for Serial communication.

ONE = 1

ONE_POINT_FIVE = 1.5

TWO = 2

class msl.equipment.constants.**DataBits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The number of data bits to use for Serial communication.

FIVE = 5

SIX = 6

SEVEN = 7

EIGHT = 8

msl.equipment.database module

Load equipment and connection records from *Databases*.

class msl.equipment.database.**Database**(*path*)

Bases: object

Create *EquipmentRecord*'s and *ConnectionRecord*'s from *Databases* that are specified in a *Configuration File*.

This class should be accessed through the *database()* method after a *Config* object has been created.

Parameters
path (str) – The path to an XML *Configuration File*.

Raises

- **OSError** – If *path* does not exist or if the *Configuration File* is invalid.
- **AttributeError** – If an <equipment> XML tag is specified in the *Configuration File* and it does not uniquely identify an equipment record in an *Equipment-Register Database*.
- **ValueError** – If an *alias* has been specified multiple times for the same *EquipmentRecord* or if the name of the Sheet in an Excel spreadsheet is invalid.

property equipment

EquipmentRecord's that were listed as <equipment> XML tags in the *Configuration File*.

Type
dict

property path

The path to the *Configuration File*.

Type
str

connections(***kwargs*)

Search the *Connections Database* to find all `ConnectionRecord`'s that match the specified criteria.

Parameters

****kwargs** – The argument names can be any of the `ConnectionRecord` property names or a `flags` argument of type `int` for performing the search, see `re.search()`. For testing regex expressions online you can use this website.

If a *kwarg* is `properties` then the value must be a `dict`. See the examples below.

Examples

- *connections()* → a list of all ConnectionRecord's
- *connections(manufacturer='Keysight')* → a list of all ConnectionRecord's that have Keysight as the manufacturer
- *connections(manufacturer='Agilent|Keysight')* → a list of all ConnectionRecord's that are from Agilent or Keysight
- *connections(manufacturer='H.*P')* → a list of all ConnectionRecord's that have Hewlett Packard (or HP) as the manufacturer
- *connections(manufacturer='Agilent', model='^34')* → a list of all ConnectionRecord's that have Agilent as the manufacturer and a model number beginning with '34'
- *connections(interface=Interface.SERIAL)* → a list of all ConnectionRecord's that use SERIAL for the connection bus
- *connections(interface='SDK')* → a list of all ConnectionRecord's that use the manufacturers SDK to control the equipment
- *connections(backend=Backend.PyVISA)* → a list of all ConnectionRecord's that use PyVISA as the backend
- *connections(backend='MSL')* → a list of all ConnectionRecord's that use MSL as the backend
- *connections(properties={'baud_rate': 115200})* → a list of all ConnectionRecord's that specify a baud rate equal to 115200 in the Properties field

Returns

`list` of `ConnectionRecord` – The connection records that match the search criteria.

Raises

`NameError` – If the name of an input argument is not a `ConnectionRecord` property name or `flags`.

records(***kwargs*)

Search the *Equipment-Register Database* to find all `EquipmentRecord`'s that match the specified criteria.

Parameters

****kwargs** – The argument names can be any of the *EquipmentRecord* property names or a `flags` argument of type `int` for performing the search, see `re.search()`. For testing regex expressions online you can use this website.

If a *kwarg* is `connection` then the value will be used to test which *EquipmentRecord*'s have a *connection* value that is either `None` or *ConnectionRecord*. See the examples below.

Examples

- *records()* → a list of all EquipmentRecord's
- *records(manufacturer='Agilent')* → a list of all EquipmentRecord's that are from Agilent
- *records(manufacturer='Agilent|Keysight')* → a list of all EquipmentRecord's that are from Agilent or Keysight
- *records(manufacturer='Agilent', model='3458A')* → a list of all EquipmentRecords that are from Agilent and that have the model number 3458A
- *records(manufacturer='Agilent', model='3458A', serial='MY45046470')* → a list of only one EquipmentRecord (if the equipment record exists, otherwise an empty list)
- *records(manufacturer=r'H.*P')* → a list of all EquipmentRecord's that have Hewlett Packard (or HP) as the manufacturer
- *records(description='I-V Converter')* → a list of all EquipmentRecords that contain 'I-V Converter' in the description field
- *records(connection=True)* → a list of all EquipmentRecords that can be connected to

Returns

`list` of *EquipmentRecord* – The equipment records that match the search criteria.

Raises

NameError – If the name of an input argument is not an *EquipmentRecord* property name or `flags`.

msl.equipment.dns_service_discovery module

Implementation of the Multicast DNS and DNS-Based Service Discovery protocols.

References

- RFC-1035 – *Domain Names - Implementation and Specification*, **ISI**, November 1987.
- RFC-6762 – *Multicast DNS*, **Apple Inc.**, February 2013.
- RFC-6763 – *DNS-Based Service Discovery*, **Apple Inc.**, February 2013.

msl.equipment.dns_service_discovery.**find_lxi**(*hosts=None*, *timeout=1*)

Find all LXI devices that support the mDNS and DNS Service Discovery protocols.

Parameters

- **hosts** (list of str, optional) – The IP address(es) on the computer to use to broadcast the message. If not specified, then broadcast on all network interfaces.
- **timeout** (float, optional) – The maximum number of seconds to wait for a reply.

Returns

dict – The information about the HiSLIP, VXI-11 and SCPI-RAW devices that were found.

msl.equipment.exceptions module

Exceptions used by MSL-Equipment.

exception msl.equipment.exceptions.**MSLConnectionError**

Bases: OSError

Base class for all MSL *Connection* exceptions.

exception msl.equipment.exceptions.**MSLTimeoutError**

Bases: *MSLConnectionError*

A timeout exception for I/O operations.

exception msl.equipment.exceptions.**ResourceClassNotFound**(*record*)

Bases: *MSLConnectionError*

Exception if a resource class cannot be found to connect to the equipment.

exception msl.equipment.exceptions.**AimTTiError**

Bases: *MSLConnectionError*

Exception for equipment from Aim and Thurlby Thandar Instruments.

exception msl.equipment.exceptions.**AvantesError**

Bases: *MSLConnectionError*

Exception for equipment from Avantes.

exception msl.equipment.exceptions.**BenthamError**

Bases: *MSLConnectionError*

Exception for equipment from Bentham.

exception msl.equipment.exceptions.**CMIError**

Bases: *MSLConnectionError*

Exception for equipment from the Czech Metrology Institute.

exception msl.equipment.exceptions.**DataRayError**

Bases: *MSLConnectionError*

Exception for equipment from DataRay Inc.

exception msl.equipment.exceptions.**EnergetiqError**

Bases: *MSLConnectionError*

Exception for equipment from Energetiq.

exception msl.equipment.exceptions.**MKSInstrumentsError**

Bases: *MSLConnectionError*

Exception for equipment from MKS Instruments.

exception msl.equipment.exceptions.**NKTError**

Bases: *MSLConnectionError*

Exception for equipment from NKT Photonics.

exception msl.equipment.exceptions.**OmegaError**

Bases: *MSLConnectionError*

Exception for equipment from OMEGA.

exception msl.equipment.exceptions.**OptoSigmaError**

Bases: *MSLConnectionError*

Exception for equipment from OptoSigma.

exception msl.equipment.exceptions.**OptronicLaboratoriesError**

Bases: *MSLConnectionError*

Exception for equipment from Optronic Laboratories.

exception msl.equipment.exceptions.**PicoTechError**

Bases: *MSLConnectionError*

Exception for equipment from Pico Technology.

exception msl.equipment.exceptions.**PrincetonInstrumentsError**

Bases: *MSLConnectionError*

Exception for equipment from Princeton Instruments.

exception msl.equipment.exceptions.**RaicolCrystalsError**

Bases: *MSLConnectionError*

Exception for equipment from Raicol Crystals.

exception msl.equipment.exceptions.**ThorlabsError**

Bases: *MSLConnectionError*

Exception for equipment from Thorlabs.

msl.equipment.factory module

Establish a connection to the equipment.

msl.equipment.factory.**connect**(*record*, *demo=None*)

Factory function to establish a connection to the equipment.

Parameters

- **record** (*EquipmentRecord*) – A record from an *Equipment-Register Database*.
- **demo** (bool, optional) – Whether to simulate a connection to the equipment by opening a connection in demo mode. This allows you to test your code if the equipment is not physically connected to a computer.

  If None then the *demo* value is determined from the *DEMO_MODE* attribute.

Returns

A *Connection* subclass.

msl.equipment.factory.**find_interface**(*address*)

Find the interface enum.

Parameters

address (str) – The address of a *ConnectionRecord*.

Returns

constants.Interface – The interface to use for *address*.

msl.equipment.hislip module

Implementation of the HiSLIP protocol for a client.

This module implements the following IVI Protocol Specification:

IVI-6.1: High-Speed LAN Instrument Protocol (HiSLIP) v2.0 April 23, 2020

class msl.equipment.hislip.**MessageType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Message types.

Initialize = 0

InitializeResponse = 1

FatalError = 2

Error = 3

AsyncLock = 4

AsyncLockResponse = 5

Data = 6

```
DataEnd = 7

DeviceClearComplete = 8

DeviceClearAcknowledge = 9

AsyncRemoteLocalControl = 10

AsyncRemoteLocalResponse = 11

Trigger = 12

Interrupted = 13

AsyncInterrupted = 14

AsyncMaximumMessageSize = 15

AsyncMaximumMessageSizeResponse = 16

AsyncInitialize = 17

AsyncInitializeResponse = 18

AsyncDeviceClear = 19

AsyncServiceRequest = 20

AsyncStatusQuery = 21

AsyncStatusResponse = 22

AsyncDeviceClearAcknowledge = 23

AsyncLockInfo = 24

AsyncLockInfoResponse = 25

GetDescriptors = 26

GetDescriptorsResponse = 27

StartTLS = 28

AsyncStartTLS = 29

AsyncStartTLSResponse = 30

EndTLS = 31

AsyncEndTLS = 32

AsyncEndTLSResponse = 33

GetSaslMechanismList = 34

GetSaslMechanismListResponse = 35

AuthenticationStart = 36
```

AuthenticationExchange = 37

AuthenticationResult = 38

class msl.equipment.hislip.**ErrorType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Error types.

UNIDENTIFIED = 0

BAD_HEADER = 1

CHANNELS_INACTIVATED = 2

INVALID_INIT_SEQUENCE = 3

MAX_CLIENTS = 4

BAD_MESSAGE_TYPE = 1

BAD_CONTROL_CODE = 2

BAD_VENDOR = 3

MESSAGE_TOO_LARGE = 4

AUTHENTICATION_FAILED = 5

exception msl.equipment.hislip.**HiSLIPException**(*message_type*, *control_code*, *reason=None*)

Bases: Exception

Base class for HiSLIP exceptions.

Parameters

- **message_type** (*MessageType*) – The message type.
- **control_code** (int) – The control code from the server response.
- **reason** (str) – Additional information to display in exception string.

property message

The error message that can be written to the server.

Type
Message

exception msl.equipment.hislip.**FatalError**(*control_code*, *reason=None*)

Bases: *HiSLIPException*

Exception for a fatal error.

Parameters

- **control_code** (int) – The control code from the server response.
- **reason** (str) – Additional information to display in exception string.

exception msl.equipment.hislip.**Error**(*control_code*, *reason=None*)

Bases: *HiSLIPException*

Exception for a non-fatal error.

Parameters

- **control_code** (int) – The control code from the server response.
- **reason** (str) – Additional information to display in exception string.

class msl.equipment.hislip.**Message**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: object

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

header = <_struct.Struct object>

prologue = b'HS'

type = None

property length_payload

The length of the payload.

Type
int

pack()

Convert the message to bytes.

Returns
bytearray – The messaged packed as bytes.

static repack(*unpack_fmt*, *pack_fmt*, **args*)

Convert arguments from one byte format to another.

Parameters

- **unpack_fmt** (str) – The format to convert the arguments to.
- **pack_fmt** (str) – The format that the arguments are currently in.
- ***args** – The arguments to convert.

Returns
tuple – The converted arguments.

property size

int The total size of the message.

class msl.equipment.hislip.**FatalErrorMessage**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 2

class msl.equipment.hislip.**ErrorMessage**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 3

class msl.equipment.hislip.**Initialize**(*major*, *minor*, *client_id*, *sub_address*)

Bases: *Message*

Create an Initialize message.

Parameters

- **major** (int) – The major version number of the HiSLIP protocol that the client supports.
- **minor** (int) – The minor version number of the HiSLIP protocol that the client supports.
- **client_id** (bytes) – The vendor ID of the client. Must have a length of 2 characters.
- **sub_address** (bytes) – A particular device managed by this server. For VISA clients this field corresponds to the VISA LAN device name (default is *hislip0*). The maximum length is 256 characters.

type = 0

class msl.equipment.hislip.**InitializeResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

`type = 1`

`property encrypted`

Whether encryption is optional or mandatory.

Type
bool

`property initial_encryption`

Whether the client shall switch to encrypted mode.

Type
bool

`property overlapped`

Whether the server is in overlapped or synchronous mode.

Type
bool

`property protocol_version`

The (major, minor) version numbers of the HiSLIP protocol that the client and server are to use.

Type
tuple

`property session_id`

The session ID.

Type
int

`class msl.equipment.hislip.Data(control_code=0, parameter=0, payload=b'')`

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 6

class msl.equipment.hislip.**DataEnd**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 7

class msl.equipment.hislip.**AsyncLock**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 4

class msl.equipment.hislip.**AsyncLockResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 5

property error

Whether the request was an invalid attempt to release a lock that was not acquired or to request a lock already granted.

Type
bool

property failed

Whether a lock was requested but not granted (timeout expired).

Type
bool

property success

Whether requesting or releasing the lock was successful.

Type
bool

property shared_released

Whether releasing a shared lock was successful.

Type
bool

class msl.equipment.hislip.**AsyncLockInfo**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 24

class msl.equipment.hislip.**AsyncLockInfoResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 25

property exclusive

Whether the HiSLIP server has an exclusive lock with a client.

Type
bool

property num_locks

The number of HiSLIP clients that have a lock with the HiSLIP server.

Type
int

class msl.equipment.hislip.**AsyncRemoteLocalControl**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 10

class msl.equipment.hislip.**AsyncRemoteLocalResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 11

class msl.equipment.hislip.**AsyncDeviceClear**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 19

class msl.equipment.hislip.**AsyncDeviceClearAcknowledge**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 23

property feature_bitmap

The feature bitmap that the server prefers.

Type
int

class msl.equipment.hislip.**DeviceClearComplete**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 8

class msl.equipment.hislip.**DeviceClearAcknowledge**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 9

class msl.equipment.hislip.**Trigger**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 12

class msl.equipment.hislip.**AsyncMaximumMessageSize**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 15

class msl.equipment.hislip.**AsyncMaximumMessageSizeResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 16

property maximum_message_size

The maximum message size that the server's synchronous channel accepts.

Type
int

class msl.equipment.hislip.**GetDescriptors**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 26

class msl.equipment.hislip.**GetDescriptorsResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 27

class msl.equipment.hislip.**AsyncInitialize**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 17

class msl.equipment.hislip.**AsyncInitializeResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.

- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 18

SECURE_CONNECTION_SUPPORTED = 1

property secure_connection_supported

Whether secure connection capability is supported.

Type
bool

property server_vendor_id

The two-character vendor abbreviation of the server.

Type
bytes

class msl.equipment.hislip.**AsyncStatusQuery**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 21

class msl.equipment.hislip.**AsyncStatusResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 22

property status

The status value.

Type
int

class msl.equipment.hislip.**StartTLS**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 28

class msl.equipment.hislip.**AsyncStartTLS**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 29

class msl.equipment.hislip.**AsyncStartTLSResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 30

property busy

Whether the server is busy.

Type
bool

property success

Whether the request was successful.

Type
bool

property error

Whether there was an error processing the request.

Type
bool

class msl.equipment.hislip.**EndTLS**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 31

class msl.equipment.hislip.**AsyncEndTLS**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 32

class msl.equipment.hislip.**AsyncEndTLSResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 33

property busy

Whether the server is busy.

Type
bool

property success

Whether the request was successful.

Type
bool

property error

Whether there was an error processing the request.

Type
bool

class msl.equipment.hislip.**GetSaslMechanismList**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 34

class msl.equipment.hislip.**GetSaslMechanismListResponse**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 35

property data

List of SASL mechanisms.

Type
list

class msl.equipment.hislip.**AuthenticationStart**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 36

class msl.equipment.hislip.**AuthenticationExchange**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 37

class msl.equipment.hislip.**AuthenticationResult**(*control_code=0*, *parameter=0*, *payload=b''*)

Bases: *Message*

Create a new HiSLIP message.

Parameters

- **control_code** (int, optional) – This 8-bit field is a general parameter for the message. If the field is not defined for a message, 0 shall be sent.
- **parameter** (int, optional) – This 32-bit field has various uses in different messages. If this field is not defined for a message, 0 shall be sent.
- **payload** (bytes, optional) – The payload data.

type = 38

property data

Additional data returned by the server.

Type
bytes

property error

Whether there was an error processing the request.

Type
bool

property error_code

If authentication fails, the mechanism-dependent error code.

Type
int

property success

Whether the request was successful.

Type
bool

class msl.equipment.hislip.**HiSLIPClient**(*host*)

Bases: object

Base class for a HiSLIP client.

Parameters
host (str) – The hostname or IP address of the remote device.

close()

Close the TCP socket, if one is open.

connect(*port=4880*, *timeout=10*)

Connect to a specific port of the device.

Parameters

- **port** (int) – The port number to connect to.
- **timeout** (float or None, optional) – The maximum number of seconds to wait for the connection to be established.

get_descriptors()

Descriptors were added in HiSLIP version 2.0 to provide extra information about specific server capabilities.

Returns
GetDescriptorsResponse – The response.

property maximum_server_message_size

The maximum message size that the server accepts.

Type
int

read(*message*, *chunk_size=4096*)

Read a message from the server.

Parameters

- **message** (*Message*) – An instance of the type of message to read.

- **chunk_size** (int, optional) – The maximum number of bytes to receive at a time.

Returns
Message – The *message* that was passed in, but with its attributes updated with the information from the received data.

get_timeout()

Get the socket timeout value.

Returns
float or None – The timeout, in seconds, of the socket.

set_timeout(*timeout*)

Set the socket timeout value.

Parameters
timeout (float or None) – The timeout, in seconds, to use for the socket.

property socket

The reference to the socket.

Type
socket

write(*message*)

Write a message to the server.

Parameters
message (*Message*) – The message to write.

class msl.equipment.hislip.**SyncClient**(*host*)

Bases: *HiSLIPClient*

A synchronous connection to the HiSLIP server.

Parameters
host (str) – The hostname or IP address of the remote device.

device_clear_complete(*feature_bitmap*)

Send the device-clear complete message.

Also resets the message id.

Parameters
feature_bitmap (int) – The feature bitmap of the server (i.e., *AsyncDeviceClearAcknowledge.feature_bitmap*).

Returns
DeviceClearAcknowledge – The response.

initialize(*major=1*, *minor=0*, *client_id=b'XX'*, *sub_address=b''*)

Initialize the synchronous connection.

Parameters

- **major** (int, optional) – The major version number of the HiSLIP protocol that the client supports.

- **minor** (int, optional) – The minor version number of the HiSLIP protocol that the client supports.
- **client_id** (bytes, optional) – The vendor ID of the client. Must have a length of 2 characters.
- **sub_address** (bytes, optional) – A particular device managed by this server. For VISA clients this field corresponds to the VISA LAN device name (default is *hislip0*). The maximum length is 256 characters.

Returns
InitializeResponse – The response.

property message_id

The id of the most-recent message that has completed.

Type
int

property message_id_received

The id of most-recent message that has been received from the server.

Type
int

receive(*size=None*, *max_size=None*, *chunk_size=4096*)

Receive data.

Parameters

- **size** (int, optional) – The number of bytes to read. If not specified, then read until a Response Message Terminator (RMT) is detected.
- **max_size** (int, optional) – The maximum number of bytes that can be read. If not specified, then there is no limit.
- **chunk_size** (int, optional) – The maximum number of bytes to receive at a time.

Returns
bytearray – The received data.

property rmt

int The current state of the Response Message Terminator (RMT).

send(*data*)

Send data with the Response Message Terminator (RMT) character.

Parameters
data (bytes) – The data to send.

Returns
int – The number of bytes sent.

trigger()

Send the trigger message (emulates a GPIB Group Execute Trigger event).

start_tls()

Send the *StartTLS* message.

end_tls()

Send the *EndTLS* message.

get_sasl_mechanism_list()

Request the list of SASL mechanisms from the server.

Returns
GetSaslMechanismListResponse – The response.

authentication_start(*mechanism*)

Send a SASL authentication method to the server.

Parameters
mechanism (bytes) – The selected mechanism to use for authentication.

write_authentication_exchange(*data*)

Send exchange data during the authentication transaction.

Parameters
data (bytes) – The data to send.

read_authentication_exchange()

Receive exchange data during the authentication transaction.

Returns
AuthenticationExchange – The exchange.

authentication_result()

Receive an authentication result from the server.

Returns
AuthenticationResult – The result.

class msl.equipment.hislip.**AsyncClient**(*host*)

Bases: *HiSLIPClient*

An asynchronous connection to the HiSLIP server.

Parameters
host (str) – The hostname or IP address of the remote device.

async_initialize(*session_id*)

Initialize the asynchronous connection.

Parameters
session_id (int) – The session ID.

Returns
AsyncInitializeResponse – The response.

async_maximum_message_size(*size*)

Exchange the maximum message sizes that are accepted between the client and server.

Parameters
size (int) – The maximum message size that the client accepts.

Returns
AsyncMaximumMessageSizeResponse – The maximum message size that the server accepts.

async_lock_request(*timeout=None*, *lock_string=''*)

Request a lock.

Parameters

- **timeout** (float, optional) – The number of seconds to wait to acquire a lock. A timeout of 0 indicates that the HiSLIP server should only grant the lock if it is available immediately.
- **lock_string** (str, optional) – An ASCII string that identifies this lock. If not specified, then an exclusive lock is requested, otherwise the string indicates an identification of a shared-lock request. The maximum length is 256 characters.

Returns

AsyncLockResponse – The response.

async_lock_release(*message_id*)

Release a lock.

Parameters

message_id (int) – The most recent message id that was completed on the synchronous channel (i.e., *SyncClient.message_id*).

Returns

AsyncLockResponse – The response.

async_lock_info()

Request the lock status from the HiSLIP server.

Returns

AsyncLockInfoResponse – The response.

async_remote_local_control(*request*, *message_id*)

Send a GPIB-like remote/local control request.

Parameters

- **request** (int) – The request to perform.
  - 0 – Disable remote, *VI_GPIB_REN_DEASSERT*
  - 1 – Enable remote, *VI_GPIB_REN_ASSERT*
  - 2 – Disable remote and go to local, *VI_GPIB_REN_DEASSERT_GTL*
  - 3 – Enable Remote and go to remote, *VI_GPIB_REN_ASSERT_ADDRESS*
  - 4 – Enable remote and lock out local, *VI_GPIB_REN_ASSERT_LLO*
  - 5 – Enable remote, go to remote, and set local lockout, *VI_GPIB_REN_ASSERT_ADDRESS_LLO*
  - 6 – go to local without changing REN or lockout state, *VI_GPIB_REN_ADDRESS_GTL*
- **message_id** (int) – The most recent message id that was completed on the synchronous channel (i.e., *SyncClient.message_id*).

Returns
AsyncRemoteLocalResponse – The response.

async_device_clear()

Send the device clear request.

Returns
AsyncDeviceClearAcknowledge – The response.

async_status_query(*synchronous*)

Status query transaction.

The status query provides an 8-bit status response from the server that corresponds to the VISA *viReadSTB* operation.

Parameters
synchronous (*SyncClient*) – The synchronous client that corresponds with this asynchronous client.

Returns
AsyncStatusResponse – The response.

async_start_tls(*synchronous*)

Initiate the secure connection transaction.

Parameters
synchronous (*SyncClient*) – The synchronous client that corresponds with this asynchronous client.

Returns
AsyncStartTLSResponse – The response.

async_end_tls(*synchronous*)

Initiate the end of the secure connection transaction.

Parameters
synchronous (*SyncClient*) – The synchronous client that corresponds with this asynchronous client.

Returns
AsyncEndTLSResponse – The response.

msl.equipment.record_types module

Records from *Equipment-Register Database*'s or *Connections Database*'s.

class msl.equipment.record_types.**EquipmentRecord**(*alias=''*, *calibrations=None*, *category=''*, *connection=None*, *description=''*, *is_operable=False*, *maintenances=None*, *manufacturer=''*, *model=''*, *serial=''*, *team=''*, *unique_key=''*, ***user_defined*)

Bases: *Record*

Contains the information about an equipment record in an *Equipment-Register Database*.

Parameters

- **alias** (str) – An alias to use to reference this equipment by.
- **calibrations** (list of *CalibrationRecord*) – The calibration history of the equipment.
- **category** (str) – The category (e.g., Laser, DMM) that the equipment belongs to.
- **connection** (*ConnectionRecord*) – The information necessary to communicate with the equipment.
- **description** (str) – A description about the equipment.
- **is_operable** (bool) – Whether the equipment is able to be used.
- **maintenances** (list of *MaintenanceRecord*) – The maintenance history of the equipment.
- **manufacturer** (str) – The name of the manufacturer of the equipment.
- **model** (str) – The model number of the equipment.
- **serial** (str) – The serial number (or unique identifier) of the equipment.
- **team** (str) – The team (e.g., Light Standards) that the equipment belongs to.
- **unique_key** (str) – The key that uniquely identifies the equipment record in a database.
- ****user_defined** – All additional key-value pairs are added to the *user_defined* attribute.

alias

An alias to use to reference this equipment by.

The *alias* can be defined in 4 ways:

- by specifying it when the EquipmentRecord is created
- by setting the value after the EquipmentRecord has been created
- in the **<equipment>** XML tag in a *Configuration File*
- in the **Properties** field in a *Connections Database*

Type
str

calibrations

The calibration history of the equipment.

Type
tuple of *CalibrationRecord*

category

The category (e.g., Laser, DMM) that the equipment belongs to.

Type
str

description

A description about the equipment.

Type
str

is_operable

Whether the equipment is able to be used.

Type
bool

maintenances

The maintenance history of the equipment.

Type
tuple of *MaintenanceRecord*

manufacturer

The name of the manufacturer of the equipment.

Type
str

model

The model number of the equipment.

Type
str

serial

The serial number (or unique identifier) of the equipment.

Type
str

connection

The information necessary to communicate with the equipment.

Type
ConnectionRecord

team

The team (e.g., Light Standards) that the equipment belongs to.

Type
str

unique_key

The key that uniquely identifies the equipment record in a database.

Type
str

user_defined

User-defined, key-value pairs.

Type
RecordDict

connect(*demo=None*)

Establish a connection to the equipment.

Calls the *connect()* function.

Parameters

demo (bool, optional) – Whether to simulate a connection to the equipment by opening a connection in demo mode. This allows you to test your code if the equipment is not physically connected to a computer.

If None then the *demo* value is determined from the *DEMO_MODE* attribute.

Returns

A *Connection* subclass.

is_calibration_due(*months=0*)

Whether the equipment needs to be re-calibrated.

Parameters

months (int, optional) – The number of months to add to today's date to determine if the equipment needs to be re-calibrated within a certain amount of time. For example, if `months = 6` then that is a way of asking *"is a re-calibration due within the next 6 months?"*.

Returns

bool – True if the equipment needs to be re-calibrated, False if it does not need to be re-calibrated (or it has never been calibrated).

property latest_calibration

The latest calibration or None if the equipment has never been calibrated.

Type

CalibrationRecord

next_calibration_date()

The date that the next calibration is due.

Returns

datetime.date – The next calibration date (or None if the equipment has never been calibrated or if it is no longer in operation).

to_dict()

Convert this *EquipmentRecord* to a dict.

Returns

dict – The *EquipmentRecord* as a dict.

to_json()

Convert this *EquipmentRecord* to be JSON serializable.

Returns

dict – The *EquipmentRecord* as a JSON-serializable object.

to_xml()

Convert this *EquipmentRecord* to an XML Element.

Returns

Element – The *EquipmentRecord* as an XML element.

class msl.equipment.record_types.**CalibrationRecord**(*calibration_cycle=0*, *calibration_date=None*, *measurands=None*, *report_date=None*, *report_number=''*)

Bases: *Record*

Contains the information about a calibration record in an *Equipment-Register Database*.

Parameters

- **calibration_cycle** (int or float) – The number of years that can pass before the equipment must be re-calibrated.
- **calibration_date** (datetime.date, datetime.datetime or str) – The date that the calibration was performed. If a str then in the format 'YYYY-MM-DD'.
- **measurands** (list of *MeasurandRecord*) – The quantities that were measured.
- **report_date** (datetime.date, datetime.datetime or str) – The date that the report was issued. If a str then in the format 'YYYY-MM-DD'.
- **report_number** (str) – The report number.

to_dict()

dict: Convert the Record to a dict.

calibration_cycle

The number of years that can pass before the equipment must be re-calibrated.

Type
float

calibration_date

The date that the calibration was performed.

Type
datetime.date

measurands

The quantities that were measured.

Type
RecordDict

report_date

The date that the report was issued.

Type
datetime.date

report_number

The report number.

Type
str

to_json()

Convert this *CalibrationRecord* to be JSON serializable.

Returns

dict – The *CalibrationRecord* as a JSON-serializable object.

to_xml()

Convert this *CalibrationRecord* to an XML Element.

Returns

Element – The *CalibrationRecord* as a XML Element.

class msl.equipment.record_types.**MeasurandRecord**(*calibration=None*, *conditions=None*, *type=''*, *unit=''*)

Bases: *Record*

Contains the information about a measurement for a calibration.

Parameters

- **calibration** (dict) – The information about the calibration.
- **conditions** (dict) – The information about the conditions under which the measurement was performed.
- **type** (str) – The type of measurement (e.g., voltage, temperature, transmittance, ...).
- **unit** (str) – The unit that is associated with the measurement (e.g., V, deg C, %, ...).

to_dict()

dict: Convert the Record to a dict.

calibration

The information about calibration.

Type

RecordDict

conditions

The information about the measurement conditions.

Type

RecordDict

type

The type of measurement (e.g., voltage, temperature, transmittance, ...).

Type

str

unit

The unit that is associated with the measurement (e.g., V, deg C, %, ...).

Type

str

to_json()

Convert this *MeasurandRecord* to be JSON serializable.

Returns

dict – The *MeasurandRecord* as a JSON-serializable object.

to_xml()

Convert this *MeasurandRecord* to an XML Element.

Returns

Element – The *MeasurandRecord* as a XML Element.

class msl.equipment.record_types.**MaintenanceRecord**(*comment=''*, *date=None*)

Bases: *Record*

Contains the information about a maintenance record in an *Equipment-Register Database*.

Parameters

- **comment** (str) – A description of the maintenance that was performed.
- **date** (datetime.date, datetime.datetime or str) – An object that can be converted to a datetime.date object. If a str then in the format 'YYYY-MM-DD'.

comment

A description of the maintenance that was performed.

Type

str

date

The date that the maintenance was performed.

Type

datetime.date

to_json()

Convert this *MaintenanceRecord* to be JSON serializable.

Returns

dict – The *MaintenanceRecord* as a JSON-serializable object.

to_xml()

Convert this *MaintenanceRecord* to an XML Element.

Returns

Element – The *MaintenanceRecord* as a XML Element.

to_dict()

dict: Convert the Record to a dict.

class msl.equipment.record_types.**ConnectionRecord**(*address=''*, *backend=Backend.MSL*, *interface=None*, *manufacturer=''*, *model=''*, *serial=''*, ***properties*)

Bases: *Record*

Contains the information about a connection record in a *Connections Database*.

Parameters

- **address** (str) – The address to use for the connection (see *Address Syntax* for examples).
- **backend** (str, int, or *Backend*) – The backend to use to communicate with the equipment. The value must be able to be converted to a *Backend* enum.
- **interface** (str, int, or *Interface*) – The interface to use to communicate with the equipment. If None then determines the *interface* based on the value of *address*. If specified then the value must be able to be converted to a *Interface* enum.
- **manufacturer** (str) – The name of the manufacturer of the equipment.
- **model** (str) – The model number of the equipment.
- **serial** (str) – The serial number (or unique identifier) of the equipment.
- **properties** – Additional key-value pairs that are required to communicate with the equipment.

address

The address to use for the connection (see *Address Syntax* for examples).

Type
str

backend

The backend to use to communicate with the equipment.

Type
Backend

interface

The interface that is used for the communication system that transfers data between a computer and the equipment (only used if the *backend* is equal to *MSL*).

Type
Interface

manufacturer

The name of the manufacturer of the equipment.

Type
str

model

The model number of the equipment.

Type
str

properties

Additional key-value pairs that are required to communicate with the equipment.

For example, communicating via RS-232 may require:

```
{'baud_rate': 19200, 'parity': 'even'}
```

See the *Connections Database* for examples on how to set the *properties*.

Type
dict

serial

The serial number (or unique identifier) of the equipment.

Type
str

to_json()

Convert this *ConnectionRecord* to be JSON serializable.

Returns
dict – The *ConnectionRecord* as a JSON-serializable object.

to_xml()

Convert this *ConnectionRecord* to an XML Element.

Returns
Element – The *ConnectionRecord* as a XML Element.

to_dict()

dict: Convert the Record to a dict.

class msl.equipment.record_types.**RecordDict**(*dictionary*)

Bases: Mapping

A read-only dictionary that supports attribute access via a key lookup.

copy()

RecordDict: Return a copy of the *RecordDict*.

to_xml(*tag='RecordDict'*)

Convert the *RecordDict* to an XML Element

Parameters
tag (str) – The name of the Element.

Returns
Element – The *RecordDict* as an XML Element.

to_json()

dict: Convert the *RecordDict* to be JSON serializable.

class msl.equipment.record_types.**Record**

Bases: object

to_dict()

dict: Convert the Record to a dict.

to_json()

dict: Convert the Record to be JSON serializable.

This differs from *to_dict()* such that all values that are not JSON serializable, like datetime.date objects, are converted to a str.

to_xml()

Element: Convert the Record to an XML Element.

msl.equipment.resources package

MSL resources for connecting to equipment.

msl.equipment.resources.**register**(*manufacturer=None*, *model=None*, *flags=0*)

Use as a decorator to register a resource class.

Parameters

- **manufacturer** (str, optional) – The name of the manufacturer. Can be a regex pattern.
- **model** (str, optional) – The model number of the equipment. Can be a regex pattern.
- **flags** (int, optional) – The flags to use for the regex pattern.

msl.equipment.resources.**find_resource_class**(*record*)

Find the resource class for this *record*.

Parameters

record (*EquipmentRecord* or *ConnectionRecord*) – A record type. If the *properties* attribute contains a resource_class_name key with a value that is equal to the name of a resource class it forces this resource class to be returned, provided that a resource class with the requested name exists.

Returns

The *Connection* subclass or None if a resource class cannot be found.

Submodules

msl.equipment.resources.dmm module

Encapsulate some of the commands to communicate with a Digital Multimeter.

msl.equipment.resources.dmm.**dmm_factory**(*connection_record*, *connection_class*)

Returns a class that encapsulates some of the commands to communicate with a Digital Multimeter.

To add a DMM to the list of supported DMM's see the source code of this module to follow the template.

This function is not meant to be called directly. Use the *connect()* method to connect to the equipment.

Parameters

- **connection_record** (*ConnectionRecord*) – A connection record from a *Connections Database*.
- **connection_class** (*ConnectionMessageBased* or MessageBasedResource) – A connection subclass that communicates with the equipment through *read* and *write* commands.

Returns

Connection – The *connection_class* that was passed in with additional methods for communicating with the DMM, provided that the model number of the DMM is one of the DMM's that is supported. Otherwise returns the original, unmodified *connection_class* object.

msl.equipment.resources.utils module

Utility functions/classes to help create modules in the **msl.equipment.resources** package.

msl.equipment.resources.utils.**camelcase_to_underscore**(*text*)

Converts CamelCaseText to camel_case_text.

Parameters

text (str) – The camel-case text to be converted.

Returns

str – The *text* converted to lowercase and separated by underscores.

msl.equipment.resources.utils.**get_lines**(*path*, *remove_comments=True*)

Returns the lines in a C/C++ header file that are not empty.

Also strips the whitespace from each line and can optionally remove the comments.

Parameters

- **path** (str) – The path to a C/C++ header file.
- **remove_comments** (bool, optional) – Whether to remove the comments.

Returns

list of str – The list of lines in the header file.

class msl.equipment.resources.utils.**CHeader**(*path*, *remove_comments=True*)

Bases: object

Parses a C/C++ header file to determine the constants, enums, structs, callbacks and the function signatures.

Parameters

- **path** (str) – The path to the header file.
- **remove_comments** (bool, optional) – Whether to remove the comments.

constants(*ignore_ifdef=True*)

Finds the #define statements that are in the C/C++ header file.

Parameters

ignore_ifdef (bool, optional) – Whether to ignore the #define statements in between the #ifdef and #endif statements.

Returns

dict – A dictionary of all the #define constants (as strings).

enums()

Returns

dict – The enums that are defined in the C/C++ header file. The value for each dictionary key is a tuple of (the enum name, the enum data type, a dict of name-value pairs).

structs()

Returns

dict – The structs that are defined in the C/C++ header file.

callbacks()

Returns

dict – The callbacks that are defined in the C/C++ header file.

functions(*regex*)

Returns the function signatures.

Parameters

regex (str) – The regex must contain 2 groups, (return type)(function name), and it must match the function declaration up until, but excluding, the (which begins the argument declarations.

For example,

If the function declarations are similar to FILTERFLIPPERDLL_API unsigned int __cdecl FF_GetTransitTime(const char * serialNo); then the value of *regex* could be r'_API\s+([\w\s]+?)__cdecl\s+(\w+)'

If the function declarations are similar to PREF0 PREF1 PICO_STATUS PREF2 PREF3 (ps6000OpenUnit)(int16_t *handle, int8_t *serial); then the value of *regex* could be r'PREF0\s+PREF1\s+(\w+)\s+PREF2\s+PREF3\s+\((\w+)\)'

Returns

dict – The function signature. The key is the function name and the value is a list of [return type, [(argument data type, argument name), ...]].

get_lines()

Returns

list of str – The lines in the C/C++ header file.

get_struct_imports()

Returns

list of str – The list of structs that must be imported for the C/C++ functions.

Note: Must call *functions()* first.

---

static get_text_between_brackets(*lines*, *index*, *bracket1*, *bracket2*)

Get all the text (excluding comments) between two brackets.

Parameters

- **lines** (list of str) – A list of lines, see *get_lines()*.
- **index** (int) – The current index in *lines*.
- **bracket1** (str) – One of {, (, or [
- **bracket2** (str) – One of },) or]

Returns

- str – The text between *bracket1* and *bracket2*.
- int – The current index in *lines*.

Subpackages

msl.equipment.resources.aim_tti package

Resources for equipment from Aim and Thurlby Thandar Instruments.

Submodules

msl.equipment.resources.aim_tti.mx_series module

Establishes a connection to an MX100QP, MX100TP or MX180TP DC power supply from Aim and Thurlby Thandar Instruments

class msl.equipment.resources.aim_tti.mx_series.**MXSeries**(*record*)

Bases: object

Establishes a connection to an MX100QP, MX100TP or MX180TP DC power supply from Aim and Thurlby Thandar Instruments for different interfaces:

- *Interface.PROLOGIX*
- *Interface.SERIAL*
- *Interface.SOCKET*

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

clear()

Send the clear, *CLS, command.

decrement_current(*channel*)

Decrement the current limit by step size of the output channel.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

See also:

set_current_step_size()

decrement_voltage(*channel*, *verify=True*)

Decrement the voltage by step size of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **verify** (bool, optional) – Whether to verify that the output voltage has stabilized at the decremented voltage before returning to the calling program.

See also:

set_voltage_step_size()

event_status_register(*as_integer=True*)

Read and clear the standard event status register.

Parameters

as_integer (bool, optional) – Whether to return the value as an int.

Returns

int or str – The event status register value. The data type depends on the value of *as_integer*. If a str is returned then it will have a length of 8. For example,

- '10000000' or the integer value 128
- '00100000' or the integer value 32

get_current(*channel*)

Get the output current of the output channel.

Parameters

channel (int) – The output channel. The first output channel is 1 (not 0).

Returns

float – The output current, in Amps.

get_current_limit(*channel*)

Get the current limit of the output channel.

Parameters

channel (int) – The output channel. The first output channel is 1 (not 0).

Returns

float – The current limit, in Amps.

get_current_step_size(*channel*)

Get the current limit step size of the output channel.

Parameters

channel (int) – The output channel. The first output channel is 1 (not 0).

Returns

float – The current limit step size, in Amps.

get_over_current_protection(*channel*)

Get the over-current protection trip point of the output channel.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

Returns
float or None – If the trip point is enabled then returns the trip point value, in Amps. Returns None if the over-current protection is disabled.

`get_over_voltage_protection`(*channel*)

Get the over-voltage protection trip point of the output channel.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

Returns
float or None – If the trip point is enabled then returns the trip point value, in Volts. Returns None if the over-voltage protection is disabled.

`get_voltage`(*channel*)

Get the output voltage of the output channel.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

Returns
float – The output voltage, in Volts.

`get_voltage_range`(*channel*)

Get the output voltage range index of the output channel.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

Returns
int – The output voltage range index. See the manual for more details. For example, 2 = 35V/3A.

`get_voltage_setpoint`(*channel*)

Get the set-point voltage of the output channel.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

Returns
float – The set-point voltage, in Volts.

`get_voltage_step_size`(*channel*)

Get the voltage step size of the output channel.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

Returns
float – The voltage step size, in Volts.

`get_voltage_tracking_mode`()

Get the voltage tracking mode of the unit.

Returns
int – The voltage tracking mode. See the manual for more details.

increment_current(*channel*)

Increment the current limit by step size of the output channel.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

See also:

set_current_step_size()

increment_voltage(*channel*, *verify=True*)

Increment the voltage by step size of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **verify** (bool, optional) – Whether to verify that the output voltage has stabilized at the incremented voltage before returning to the calling program.

See also:

set_voltage_step_size()

is_output_on(*channel*)

Check if the output channel is on or off.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

Returns
bool – Whether the output channel is on (True) or off (False).

turn_on(*channel*)

Turn the output channel on.

Parameters
channel (int) – The output channel. The first output channel is 1 (not 0).

turn_on_multi(*options=None*)

Turn multiple output channels on (the Multi-On feature).

Parameters
options (dict, optional) – Set the Multi-On option for each output channel before setting Multi-On. If not specified then uses the pre-programmed options. If a particular output channel is not included in *options* then uses the pre-programmed option for that channel. The keys are the output channel number and the value can be False (set the channel to NEVER, see the manual for more details), True (set the channel to QUICK, see the manual for more details) or a delay in milliseconds (as an int).

Examples:

- {1: False} → channel 1 does not turn on
- {2: 100} → channel 2 has a 100-ms delay
- {1: 100, 3: True} → channel 1 has a 100-ms delay and channel 3 turns on immediately

- `{1: 100, 2: 200, 3: 300}` → channel 1 has a 100-ms delay, channel 2 has a 200-ms delay and channel 3 has a 300-ms delay

See also:

set_multi_on_delay(), *set_multi_on_action()*

turn_off(*channel*)

Turn the output channel off.

Parameters

channel (int) – The output channel. The first output channel is 1 (not 0).

turn_off_multi(*options=None*)

Turn multiple output channels off (the Multi-Off feature).

Parameters

options (dict, optional) – Set the Multi-Off option for each output channel before setting Multi-Off. If not specified then uses the pre-programmed options. If a particular output channel is not included in *options* then uses the pre-programmed option for that channel. The keys are the output channel number and the value can be False (set the channel to NEVER, see the manual for more details), True (set the channel to QUICK, see the manual for more details) or a delay in milliseconds (as an int).

Examples:

- `{1: False}` → channel 1 does not turn off
- `{2: 100}` → channel 2 has a 100-ms delay
- `{1: 100, 3: True}` → channel 1 has a 100-ms delay and channel 3 turns off immediately
- `{1: 100, 2: 200, 3: 300}` → channel 1 has a 100-ms delay, channel 2 has a 200-ms delay and channel 3 has a 300-ms delay

See also:

set_multi_off_delay(), *set_multi_off_action()*

recall(*channel*, *index*)

Recall the settings of the output channel from the store.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **index** (int) – The store index number, can be 0-49.

See also:

save()

recall_all(*index*)

Recall the settings for all output channels from the store.

Parameters

index (int) – The store index number, can be 0-49.

See also:

save_all()

reset()

Send the reset, *RST, command.

reset_trip()

Attempt to clear all trip conditions.

save(*channel*, *index*)

Save the present settings of the output channel to the store.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **index** (int) – The store index number, can be 0-49.

See also:

recall()

save_all(*index*)

Save the settings of all output channels to the store.

Parameters

index (int) – The store index number, can be 0-49.

See also:

recall_all()

set_current_limit(*channel*, *value*)

Set the current limit of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **value** (float) – The current limit, in Amps.

set_current_meter_averaging(*channel*, *value*)

Set the current meter measurement averaging of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **value** (str) – Can be ON, OFF, LOW, MED or HIGH.

set_current_step_size(*channel*, *size*)

Set the current limit step size of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **size** (float) – The current limit step size, in Amps.

set_multi_on_action(*channel*, *action*)

Set the Multi-On action of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **action** (str) – The Multi-On action, one of QUICK, NEVER or DELAY.

set_multi_on_delay(*channel*, *delay*)

Set the Multi-On delay, in milliseconds, of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **delay** (int) – The delay, in milliseconds.

set_multi_off_action(*channel*, *action*)

Set the Multi-Off action of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **action** (str) – The Multi-Off action, one of QUICK, NEVER or DELAY.

set_multi_off_delay(*channel*, *delay*)

Set the Multi-Off delay, in milliseconds, of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **delay** (int) – The delay, in milliseconds.

set_over_current_protection(*channel*, *enable*, *value=None*)

Set the over-current protection trip point of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **enable** (bool) – Whether to enable (True) or disable (False) the over-current protection trip point.
- **value** (float, optional) – If the trip point is enabled then you must specify a value, in Amps.

set_over_voltage_protection(*channel*, *enable*, *value=None*)

Set the over-voltage protection trip point of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **enable** (bool) – Whether to enable (True) or disable (False) the over-voltage protection trip point.
- **value** (float, optional) – If the trip point is enabled then you must specify a value, in Volts.

set_voltage(*channel*, *value*, *verify=True*)

Set the output voltage of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **value** (float) – The value, in Volts.
- **verify** (bool, optional) – Whether to verify that the output voltage has stabilized at *value* before returning to the calling program.

set_voltage_range(*channel*, *index*)

Set the output voltage range of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **index** (int) – The output voltage range index. See the manual for more details. For example, 2 = 35V/3A.

set_voltage_step_size(*channel*, *size*)

Set the voltage step size of the output channel.

Parameters

- **channel** (int) – The output channel. The first output channel is 1 (not 0).
- **size** (float) – The voltage step size, in Volts.

set_voltage_tracking_mode(*mode*)

Set the voltage tracking mode of the unit.

Parameters

mode (int) – The voltage tracking mode. See the manual for more details.

msl.equipment.resources.avantes package

Wrapper around the `avaspec.dll` SDK from Avantes.

Submodules

msl.equipment.resources.avantes.avaspec module

Wrapper around the `avaspec.dll` SDK from Avantes.

The wrapper was written using v9.7.0.0 of the SDK.

class msl.equipment.resources.avantes.avaspec.**DeviceStatus**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DeviceStatus enum.

UNKNOWN = 0

USB_AVAILABLE = 1

USB_IN_USE_BY_APPLICATION = 2

USB_IN_USE_BY_OTHER = 3

ETH_AVAILABLE = 4

ETH_IN_USE_BY_APPLICATION = 5

ETH_IN_USE_BY_OTHER = 6

ETH_ALREADY_IN_USE_USB = 7

class msl.equipment.resources.avantes.avaspec.**InterfaceType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

InterfaceType enum.

RS232 = 0

USB5216 = 1

USBMINI = 2

USB7010 = 3

ETH7010 = 4

class msl.equipment.resources.avantes.avaspec.**SensType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SensType enum.

SENS_HAMS8378_256 = 1

SENS_HAMS8378_1024 = 2

SENS_ILX554 = 3

SENS_HAMS9201 = 4

SENS_TCD1304 = 5

SENS_TSL1301 = 6

SENS_TSL1401 = 7

SENS_HAMS8378_512 = 8

SENS_HAMS9840 = 9

SENS_ILX511 = 10

SENS_HAMS10420_2048X64 = 11

SENS_HAMS11071_2048X64 = 12

SENS_HAMS7031_1024X122 = 13

SENS_HAMS7031_1024X58 = 14

SENS_HAMS11071_2048X16 = 15

SENS_HAMS11155_2048 = 16

SENS_SU256LSB = 17

SENS_SU512LDB = 18

SENS_HAMS11638 = 21

SENS_HAMS11639 = 22

SENS_HAMS12443 = 23

SENS_HAMG9208_512 = 24

SENS_HAMG13913 = 25

SENS_HAMS13496 = 26

class msl.equipment.resources.avantes.avaspec.**AvsIdentityType**

Bases: Structure

IdentityType Structure.

SerialNumber

Structure/Union member

Status

Structure/Union member

UserFriendlyName

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**BroadcastAnswerType**

Bases: Structure

BroadcastAnswerType Structure.

InterfaceType

Structure/Union member

LocalIp

Structure/Union member

RemoteHostIp

Structure/Union member

port
Structure/Union member

reserved
Structure/Union member

serial
Structure/Union member

status
Structure/Union member

class msl.equipment.resources.avantes.avaspec.**ControlSettingsType**
Bases: Structure

ControlSettingsType Structure.

m_LaserDelay
Structure/Union member

m_LaserWaveLength
Structure/Union member

m_LaserWidth
Structure/Union member

m_StoreToRam
Structure/Union member

m_StrobeControl
Structure/Union member

class msl.equipment.resources.avantes.avaspec.**DarkCorrectionType**
Bases: Structure

DarkCorrectionType Structure.

m_Enable
Structure/Union member

m_ForgetPercentage
Structure/Union member

class msl.equipment.resources.avantes.avaspec.**DetectorType**
Bases: Structure

DetectorType Structure.

m_DefectivePixels
Structure/Union member

m_ExtOffset
Structure/Union member

m_Gain
Structure/Union member

m_NLEnable

Structure/Union member

m_NrPixels

Structure/Union member

m_Offset

Structure/Union member

m_Reserved

Structure/Union member

m_SensorType

Structure/Union member

m_aFit

Structure/Union member

m_aHighNLCounts

Structure/Union member

m_aLowNLCounts

Structure/Union member

m_aNLCorrect

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**SmoothingType**

Bases: Structure

SmoothingType Structure.

m_SmoothModel

Structure/Union member

m_SmoothPix

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**SpectrumCalibrationType**

Bases: Structure

SpectrumCalibrationType Structure.

m_CalInttime

Structure/Union member

m_Smoothing

Structure/Union member

m_aCalibConvers

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**IrradianceType**

Bases: Structure

IrradianceType Structure.

m_CalibrationType

Structure/Union member

m_FiberDiameter

Structure/Union member

m_IntensityCalib

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**SpectrumCorrectionType**

Bases: Structure

SpectrumCorrectionType Structure.

m_aSpectrumCorrect

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**TriggerType**

Bases: Structure

TriggerType Structure.

m_Mode

Structure/Union member

m_Source

Structure/Union member

m_SourceType

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**MeasConfigType**

Bases: Structure

MeasConfigType Structure.

m_Control

Structure/Union member

m_CorDynDark

Structure/Union member

m_IntegrationDelay

Structure/Union member

m_IntegrationTime

Structure/Union member

m_NrAverages

Structure/Union member

m_SaturationDetection

Structure/Union member

m_Smoothing

Structure/Union member

m_StartPixel

Structure/Union member

m_StopPixel

Structure/Union member

m_Trigger

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**TimeStampType**

Bases: Structure

TimeStampType Structure.

m_Date

Structure/Union member

m_Time

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**StandAloneType**

Bases: Structure

StandAloneType Structure.

m_Enable

Structure/Union member

m_Meas

Structure/Union member

m_Nmsr

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**DynamicStorageType**

Bases: Structure

DynamicStorageType Structure.

m_Nmsr

Structure/Union member

m_Reserved

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**TempSensorType**

Bases: Structure

TempSensorType Structure.

m_aFit

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**TecControlType**

Bases: Structure

TecControlType Structure.

m_Enable

Structure/Union member

m_Setpoint

Structure/Union member

m_aFit

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**ProcessControlType**

Bases: Structure

ProcessControlType Structure.

m_AnalogHigh

Structure/Union member

m_AnalogLow

Structure/Union member

m_DigitalHigh

Structure/Union member

m_DigitalLow

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**EthernetSettingsType**

Bases: Structure

EthernetSettingsType Structure.

m_DhcpEnabled

Structure/Union member

m_Gateway

Structure/Union member

m_IpAddr

Structure/Union member

m_LinkStatus

Structure/Union member

m_NetMask

Structure/Union member

m_TcpPort

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**OemDataType**

Bases: Structure

OemDataType Structure.

m_data

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**HeartbeatRespType**

Bases: Structure

HeartbeatRespType Structure.

m_BitMatrix

Structure/Union member

m_Reserved

Structure/Union member

class msl.equipment.resources.avantes.avaspec.**DeviceConfigType**

Bases: Structure

DeviceConfigType Structure.

m_ConfigVersion

Structure/Union member

m_Detector

Structure/Union member

m_DynamicStorage

Structure/Union member

m_EthernetSettings

Structure/Union member

m_Irradiance

Structure/Union member

m_Len

Structure/Union member

m_OemData

Structure/Union member

m_ProcessControl

Structure/Union member

m_Reflectance

Structure/Union member

m_SpectrumCorrect

Structure/Union member

m_StandAlone

Structure/Union member

m_TecControl

Structure/Union member

m_aReserved

Structure/Union member

m_aTemperature

Structure/Union member

m_aUserFriendlyId

Structure/Union member

msl.equipment.resources.avantes.avaspec.**MeasureCallback**

Used as a decorator for a callback function when a scan is available.

class msl.equipment.resources.avantes.avaspec.**Avantes**(*record*)

Bases: *ConnectionSDK*

Wrapper around the `avaspec.dll` SDK from Avantes.

The *properties* for an Avantes connection supports the following key-value pairs in the *Connections Database*:

```
'port_id': int, One of -1 (Ethernet+USB), 0 (USB) or 256 (Ethernet)␣
↪[default: -1]
'activate': bool, Whether to automatically activate the connection␣
↪[default: True]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

WM_MEAS_READY = 32769

SETTINGS_RESERVED_LEN = 9720

INVALID_AVS_HANDLE_VALUE = 1000

USER_ID_LEN = 64

AVS_SERIAL_LEN = 10

MAX_TEMP_SENSORS = 3

ROOT_NAME_LEN = 6

VERSION_LEN = 16

AVASPEC_ERROR_MSG_LEN = 8

AVASPEC_MIN_MSG_LEN = 6

OEM_DATA_LEN = 4096

NR_WAVELEN_POL_COEF = 5

NR_NONLIN_POL_COEF = 8

MAX_VIDEO_CHANNELS = 2

NR_DEFECTIVE_PIXELS = 30

MAX_NR_PIXELS = 4096

NR_TEMP_POL_COEF = 5

```
NR_DAC_POL_COEF = 2

SAT_PEAK_INVERSION = 2

SW_TRIGGER_MODE = 0

HW_TRIGGER_MODE = 1

SS_TRIGGER_MODE = 2

EXTERNAL_TRIGGER = 0

SYNC_TRIGGER = 1

EDGE_TRIGGER_SOURCE = 0

LEVEL_TRIGGER_SOURCE = 1

ILX_FIRST_USED_DARK_PIXEL = 2

ILX_USED_DARK_PIXELS = 14

ILX_TOTAL_DARK_PIXELS = 18

TCD_FIRST_USED_DARK_PIXEL = 0

TCD_USED_DARK_PIXELS = 12

TCD_TOTAL_DARK_PIXELS = 13

HAMS9840_FIRST_USED_DARK_PIXEL = 0

HAMS9840_USED_DARK_PIXELS = 8

HAMS9840_TOTAL_DARK_PIXELS = 8

HAMS10420_FIRST_USED_DARK_PIXEL = 0

HAMS10420_USED_DARK_PIXELS = 4

HAMS10420_TOTAL_DARK_PIXELS = 4

HAMS11071_FIRST_USED_DARK_PIXEL = 0

HAMS11071_USED_DARK_PIXELS = 4

HAMS11071_TOTAL_DARK_PIXELS = 4

HAMS7031_FIRST_USED_DARK_PIXEL = 0

HAMS7031_USED_DARK_PIXELS = 4

HAMS7031_TOTAL_DARK_PIXELS = 4

HAMS11155_TOTAL_DARK_PIXELS = 20

MIN_ILX_INTTIME = 1.1

MILLI_TO_MICRO = 1000
```

NR_DIGITAL_OUTPUTS = 13

NR_DIGITAL_INPUTS = 13

NTC1_ID = 0

NTC2_ID = 1

TEC_ID = 2

NR_ANALOG_OUTPUTS = 2

ETH_CONN_STATUS_CONNECTING = 0

ETH_CONN_STATUS_CONNECTED = 1

ETH_CONN_STATUS_CONNECTED_NOMON = 2

ETH_CONN_STATUS_NOCONNECTION = 3

class DeviceStatus(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DeviceStatus enum.

UNKNOWN = 0

USB_AVAILABLE = 1

USB_IN_USE_BY_APPLICATION = 2

USB_IN_USE_BY_OTHER = 3

ETH_AVAILABLE = 4

ETH_IN_USE_BY_APPLICATION = 5

ETH_IN_USE_BY_OTHER = 6

ETH_ALREADY_IN_USE_USB = 7

class InterfaceType(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

InterfaceType enum.

RS232 = 0

USB5216 = 1

USBMINI = 2

USB7010 = 3

ETH7010 = 4

class SensType(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SensType enum.

SENS_HAMS8378_256 = 1

SENS_HAMS8378_1024 = 2

SENS_ILX554 = 3

SENS_HAMS9201 = 4

SENS_TCD1304 = 5

SENS_TSL1301 = 6

SENS_TSL1401 = 7

SENS_HAMS8378_512 = 8

SENS_HAMS9840 = 9

SENS_ILX511 = 10

SENS_HAMS10420_2048X64 = 11

SENS_HAMS11071_2048X64 = 12

SENS_HAMS7031_1024X122 = 13

SENS_HAMS7031_1024X58 = 14

SENS_HAMS11071_2048X16 = 15

SENS_HAMS11155_2048 = 16

SENS_SU256LSB = 17

SENS_SU512LDB = 18

SENS_HAMS11638 = 21

SENS_HAMS11639 = 22

SENS_HAMS12443 = 23

SENS_HAMG9208_512 = 24

SENS_HAMG13913 = 25

SENS_HAMS13496 = 26

class AvsIdentityType

Bases: Structure

IdentityType Structure.

SerialNumber

Structure/Union member

Status

Structure/Union member

UserFriendlyName

Structure/Union member

class BroadcastAnswerType

Bases: Structure

BroadcastAnswerType Structure.

InterfaceType

Structure/Union member

LocalIp

Structure/Union member

RemoteHostIp

Structure/Union member

port

Structure/Union member

reserved

Structure/Union member

serial

Structure/Union member

status

Structure/Union member

class ControlSettingsType

Bases: Structure

ControlSettingsType Structure.

m_LaserDelay

Structure/Union member

m_LaserWaveLength

Structure/Union member

m_LaserWidth

Structure/Union member

m_StoreToRam

Structure/Union member

m_StrobeControl

Structure/Union member

class DarkCorrectionType

Bases: Structure

DarkCorrectionType Structure.

m_Enable

Structure/Union member

m_ForgetPercentage

Structure/Union member

class DetectorType

Bases: Structure

DetectorType Structure.

m_DefectivePixels

Structure/Union member

m_ExtOffset

Structure/Union member

m_Gain

Structure/Union member

m_NLEnable

Structure/Union member

m_NrPixels

Structure/Union member

m_Offset

Structure/Union member

m_Reserved

Structure/Union member

m_SensorType

Structure/Union member

m_aFit

Structure/Union member

m_aHighNLCounts

Structure/Union member

m_aLowNLCounts

Structure/Union member

m_aNLCorrect

Structure/Union member

class SmoothingType

Bases: Structure

SmoothingType Structure.

m_SmoothModel

Structure/Union member

m_SmoothPix

Structure/Union member

class SpectrumCalibrationType

Bases: Structure

SpectrumCalibrationType Structure.

m_CalInttime

Structure/Union member

m_Smoothing

Structure/Union member

m_aCalibConvers

Structure/Union member

class IrradianceType

Bases: Structure

IrradianceType Structure.

m_CalibrationType

Structure/Union member

m_FiberDiameter

Structure/Union member

m_IntensityCalib

Structure/Union member

class SpectrumCorrectionType

Bases: Structure

SpectrumCorrectionType Structure.

m_aSpectrumCorrect

Structure/Union member

class TriggerType

Bases: Structure

TriggerType Structure.

m_Mode

Structure/Union member

m_Source

Structure/Union member

m_SourceType

Structure/Union member

class MeasConfigType

Bases: Structure

MeasConfigType Structure.

m_Control

Structure/Union member

m_CorDynDark

Structure/Union member

m_IntegrationDelay

Structure/Union member

m_IntegrationTime

Structure/Union member

m_NrAverages

Structure/Union member

m_SaturationDetection

Structure/Union member

m_Smoothing

Structure/Union member

m_StartPixel

Structure/Union member

m_StopPixel

Structure/Union member

m_Trigger

Structure/Union member

class TimeStampType

Bases: Structure

TimeStampType Structure.

m_Date

Structure/Union member

m_Time

Structure/Union member

class StandAloneType

Bases: Structure

StandAloneType Structure.

m_Enable

Structure/Union member

m_Meas

Structure/Union member

m_Nmsr

Structure/Union member

class DynamicStorageType

Bases: Structure

DynamicStorageType Structure.

m_Nmsr

Structure/Union member

m_Reserved

Structure/Union member

class TempSensorType

Bases: Structure

TempSensorType Structure.

m_aFit

Structure/Union member

class TecControlType

Bases: Structure

TecControlType Structure.

m_Enable

Structure/Union member

m_Setpoint

Structure/Union member

m_aFit

Structure/Union member

class ProcessControlType

Bases: Structure

ProcessControlType Structure.

m_AnalogHigh

Structure/Union member

m_AnalogLow

Structure/Union member

m_DigitalHigh

Structure/Union member

m_DigitalLow

Structure/Union member

class EthernetSettingsType

Bases: Structure

EthernetSettingsType Structure.

m_DhcpEnabled

Structure/Union member

m_Gateway

Structure/Union member

m_IpAddr

Structure/Union member

m_LinkStatus

Structure/Union member

m_NetMask

Structure/Union member

m_TcpPort

Structure/Union member

class OemDataType

Bases: `Structure`

OemDataType Structure.

m_data

Structure/Union member

class HeartbeatRespType

Bases: `Structure`

HeartbeatRespType Structure.

m_BitMatrix

Structure/Union member

m_Reserved

Structure/Union member

class DeviceConfigType

Bases: `Structure`

DeviceConfigType Structure.

m_ConfigVersion

Structure/Union member

m_Detector

Structure/Union member

m_DynamicStorage

Structure/Union member

m_EthernetSettings

Structure/Union member

m_Irradiance

Structure/Union member

m_Len
Structure/Union member

m_OemData
Structure/Union member

m_ProcessControl
Structure/Union member

m_Reflectance
Structure/Union member

m_SpectrumCorrect
Structure/Union member

m_StandAlone
Structure/Union member

m_TecControl
Structure/Union member

m_aReserved
Structure/Union member

m_aTemperature
Structure/Union member

m_aUserFriendlyId
Structure/Union member

activate()
Activates the spectrometer for communication.

Raises
AvantesError – If there was an error.

deactivate()
Closes communication with the spectrometer.

get_analog_in(*analog_id*)
Get the status of the specified analog input.

Parameters
analog_id (int) – The identifier of the analog input to get.

- AS5216:
  - 0 = thermistor on optical bench (NIR 2.0 / NIR2.2 / NIR 2.5 / TEC)
  - 1 = 1V2
  - 2 = 5VIO
  - 3 = 5VUSB
  - 4 = AI2 = pin 18 at 26-pins connector
  - 5 = AI1 = pin 9 at 26-pins connector
  - 6 = NTC1 onboard thermistor

- 7 = Not used

- Mini:
  - 0 = NTC1 onboard thermistor
  - 1 = Not used
  - 2 = Not used
  - 3 = Not used
  - 4 = AI2 = pin 13 on micro HDMI = pin 11 on HDMI Terminal
  - 5 = AI1 = pin 16 on micro HDMI = pin 17 on HDMI Terminal
  - 6 = Not used
  - 7 = Not used
- AS7010:
  - 0 = thermistor on optical bench (NIR 2.0 / NIR2.2 / NIR 2.5 / TEC)
  - 1 = Not used
  - 2 = Not used
  - 3 = Not used
  - 4 = AI2 = pin 18 at 26-pins connector
  - 5 = AI1 = pin 9 at 26-pins connector
  - 6 = digital temperature sensor, returns degrees Celsius, not Volts
  - 7 = Not used

Returns
`float` – The analog input value [Volts or degrees Celsius].

Raises
AvantesError – If there was an error.

`get_com_port_name()`
Get the IP address of the device.

Returns
`str` – The IP address of the device.

Raises
AvantesError – If there was an error.

`get_com_type()`
Get the communication protocol.

Returns

`str` – The communication type as defined below:

- RS232 = 0
- USB5216 = 1
- USBMINI = 2

- USB7010 = 3
- ETH7010 = 4
- UNKNOWN = -1

Raises
AvantesError – If there was an error.

get_dark_pixel_data()

Get the optically black pixel values of the last performed measurement.

You must call *get_data()* before you call this method.

Returns
numpy.ndarray – The dark pixels.

Raises
AvantesError – If there was an error.

get_dll_version()

Get the DLL version number.

Returns
str – The DLL version number

get_digital_in(*digital_id*)

Get the status of the specified digital input.

Parameters
digital_id (int) – The identifier of the digital input to get.

- AS5216:
  - 0 = DI1 = Pin 24 at 26-pins connector
  - 1 = DI2 = Pin 7 at 26-pins connector
  - 2 = DI3 = Pin 16 at 26-pins connector
- Mini:
  - 0 = DI1 = Pin 7 on Micro HDMI = Pin 5 on HDMI terminal
  - 1 = DI2 = Pin 5 on Micro HDMI = Pin 3 on HDMI Terminal
  - 2 = DI3 = Pin 3 on Micro HDMI = Pin 1 on HDMI Terminal
  - 3 = DI4 = Pin 1 on Micro HDMI = Pin 19 on HDMI Terminal
  - 4 = DI5 = Pin 4 on Micro HDMI = Pin 2 on HDMI Terminal
  - 5 = DI6 = Pin 2 on Micro HDMI = Pin 14 on HDMI Terminal
- AS7010:
  - 0 = DI1 = Pin 24 at 26-pins connector
  - 1 = DI2 = Pin 7 at 26-pins connector
  - 2 = DI3 = Pin 16 at 26-pins

Returns
int – The digital input value.

Raises
AvantesError – If there was an error.

`get_handle_from_serial`(*serial=None*)

Get the handle ID for the specified serial number.

Parameters
serial (str) – The serial number. Default is to get the status for this object.

Returns
int – The handle.

Raises
AvantesError – If there was an error.

`static find`(*path='avaspecx64.dll'*, *port_id=-1*, *nmax=16*)

Returns device information for each spectrometer that is connected.

Parameters

- **path** (str) – The path to the Avantes SDK.
- **port_id** (int) – ID of port to be used. One of:
  - -1: Use both Ethernet (AS7010) and USB ports
  - 0: Use USB port
  - 1..255: Not supported in v9.7 of the SDK
  - 256: Use Ethernet port (AS7010)
- **nmax** (int, optional) – The maximum number of devices that can be in the list.

Returns
list of *AvsIdentityType* – The information about the devices.

`get_status_by_serial`(*serial=None*)

Get the handle ID for the specified serial number.

Parameters
serial (str, optional) – The serial number. Default is to get the status for this object.

Returns
int – The status.

Raises
AvantesError – If there was an error.

`done`()

Closes communication and releases internal storage.

`disconnect`()

Closes communication with the spectrometer.

`get_ip_config`()

Retrieve IP settings from the spectrometer.

Use this function to read the Ethernet settings of the spectrometer, without having to read the complete device configuration structure.

Returns
EthernetSettingsType – The Ethernet settings of the spectrometer.

Raises
AvantesError – If there was an error.

get_lambda()

Returns the wavelength values corresponding to the pixels if available.

Returns
numpy.ndarray – The wavelength value of each pixel.

Raises
AvantesError – If there was an error.

get_num_devices()

Scans for attached devices and returns the number of devices detected.

Deprecated function, replaced by *update_usb_devices()*. The functionality is identical.

Returns
int – The number of devices found.

get_oem_parameter()

Returns the OEM data structure available on the spectrometer.

Returns
OemDataType – The OEM parameters.

Raises
AvantesError – If there was an error.

get_parameter()

Returns the device information of the spectrometer.

Returns
DeviceConfigType – The device parameters.

Raises
AvantesError – If there was an error.

get_saturated_pixels()

Returns, for each pixel, if a pixel was saturated (1) or not (0).

Returns
numpy.ndarray – The saturation state of each pixel.

Raises
AvantesError – If there was an error.

get_version_info()

Returns software version information.

Returns

- str – FPGA software version.
- str – Firmware version.

- str – DLL version.

Raises
AvantesError – If there was an error.

get_data()

Returns the pixel values of the last performed measurement.

Returns

- int – Tick count the last pixel of the spectrum was received by the microcontroller. Ticks are in 10 microsecond units since the spectrometer started.
- numpy.ndarray – The pixel values.

Raises
AvantesError – If there was an error.

get_num_pixels()

Returns the number of pixels of a spectrometer.

Raises
AvantesError – If there was an error.

heartbeat(*req_type*)

Monitor the (heartbeat) functions of the spectrometer.

This function applies only to the AS7010 platform. See the DLL manual for more details.

Parameters
req_type (int) – The heartbeat request values used to control heartbeat functions.

Returns
HeartbeatRespType – The heartbeat response structure received from the spectrometer.

Raises
AvantesError – If there was an error.

init(*port_id*)

Initializes the communication interface with the spectrometers and the internal data structures.

For Ethernet devices this function will create a list of available Ethernet spectrometers within all the network interfaces of the host.

Parameters
port_id (int) – ID of port to be used. One of:

- -1: Use both Ethernet (AS7010) and USB ports
- 0: Use USB port
- 1..255: Not supported in v9.7 of the SDK
- 256: Use Ethernet port (AS7010)

Returns
int – On success, the number of connected or found devices.

Raises

AvantesError – If no devices were found.

measure(*num_measurements*, *window_handle=None*)

Starts measurement on the spectrometer.

Parameters

- **num_measurements** (int) – Number of measurements to acquire. Use -1 to measure continuously until *stop_measure()* is called.
- **window_handle** (ctypes.c_void_p, optional) – Window handle to notify application measurement result data is available. The DLL sends a message to the window with command: *WM_MEAS_READY*, with *SUCCESS* (0), the number of scans that were saved in RAM (if *m_StoreToRAM* parameter > 0, see *ControlSettingsType*), or *INVALID_MEAS_DATA* as *WPARM* value and *a_hDevice* as *LPARM* value. Set this value to None if a callback is not needed.

Raises

AvantesError – If there was an error.

measure_callback(*num_measurements*, *callback=None*)

Starts measurement on the spectrometer.

Parameters

- **num_measurements** (int) – Number of measurements to acquire. Use -1 to measure continuously until *stop_measure()* is called.
- **callback** (*MeasureCallback*, optional) – A function to notify application measurement result data is available. The DLL will call the given function to notify a measurement is ready and pass two parameters. The first parameter is a reference to the DLL handle. The second parameter is a reference to an integer value: *SUCCESS* (0) if a new scan is available, or the number of scans that were saved in RAM (if *m_StoreToRAM* parameter > 0, see *ControlSettingsType*), or *INVALID_MEAS_DATA* (-8). Set this value to None if a callback is not needed.

Examples

```
from msl.equipment.resources.avantes import MeasureCallback

@MeasureCallback
def avantes_callback(handle, info):
    print('The DLL handle is:', handle.contents.value)
    if info.contents.value == 0:  # equals 0 if everything is okay
        print('  callback data:', ava.get_data())

# here "ava" is a reference to the AvaSpec class
ava.measure_callback(-1, avantes_callback)
```

Raises

AvantesError – If there was an error.

poll_scan()

Determines if new measurement results are available.

Returns
int – Whether there is a scan available: 0 (No) or 1 (Yes).

Raises
AvantesError – If there was an error.

prepare_measure(*config*)

Prepares measurement on the spectrometer using the specified measurement configuration.

Parameters
config (*MeasConfigType*) – The measurement configuration.

Raises
AvantesError – If there was an error.

register(*handle*)

Installs an application windows handle to which device attachment/removal messages have to be sent.

Parameters
handle (ctypes.c_void_p) – Application window handle.

Raises
AvantesError – If there was an error.

reset_device()

Performs a hard reset on the given spectrometer.

This function only works with the AS7010 platform.

During reset of the spectrometer, all spectrometer HW modules (microprocessor and USB controller) will be reset at once. The spectrometer will start its reset procedure right after sending the command response back to the host.

Raises
AvantesError – If there was an error.

set_analog_out(*port_id*, *value*)

Sets the analog output value for the specified analog identifier.

Parameters

- **port_id** (int) – Identifier for one of the two output signals:
  - AS5216:
    - 0 = AO1 = pin 17 at 26-pins connector
    - 1 = AO2 = pin 26 at 26-pins connector
  - Mini:
    - 0 = AO1 = Pin 12 on Micro HDMI = Pin 10 on HDMI terminal
    - 1 = AO2 = Pin 14 on Micro HDMI = Pin 12 on HDMI terminal
  - AS7010:
    - 0 = AO1 = pin 17 at 26-pins connector

* 1 = AO2 = pin 26 at 26-pins connector

- **value** (float) – DAC value to be set in Volts (internally an 8-bits DAC is used) with range 0 - 5.0V.

Raises

AvantesError – If there was an error.

set_digital_out(*port_id*, *value*)

Sets the digital output value for the specified digital identifier.

Parameters

- **port_id** (int) – Identifier for one of the 10 output signals:
  - AS5216:
    * 0 = DO1 = pin 11 at 26-pins connector
    * 1 = DO2 = pin 2 at 26-pins connector
    * 2 = DO3 = pin 20 at 26-pins connector
    * 3 = DO4 = pin 12 at 26-pins connector
    * 4 = DO5 = pin 3 at 26-pins connector
    * 5 = DO6 = pin 21 at 26-pins connector
    * 6 = DO7 = pin 13 at 26-pins connector
    * 7 = DO8 = pin 4 at 26-pins connector
    * 8 = DO9 = pin 22 at 26-pins connector
    * 9 = DO10 = pin 25 at 26-pins connector
  - Mini:
    * 0 = DO1 = Pin 7 on Micro HDMI = Pin 5 on HDMI terminal
    * 1 = DO2 = Pin 5 on Micro HDMI = Pin 3 on HDMI Terminal
    * 2 = DO3 = Pin 3 on Micro HDMI = Pin 1 on HDMI Terminal
    * 3 = DO4 = Pin 1 on Micro HDMI = Pin 19 on HDMI Terminal
    * 4 = DO5 = Pin 4 on Micro HDMI = Pin 2 on HDMI Terminal
    * 5 = DO6 = Pin 2 on Micro HDMI = Pin 14 on HDMI Terminal
    * 6 = Not used
    * 7 = Not used
    * 8 = Not used
    * 9 = Not used
  - AS7010:
    * 0 = DO1 =pin 11 at 26-pins connector
    * 1 = DO2 = pin 2 at 26-pins connector
    * 2 = DO3 = pin 20 at 26-pins connector

* 3 = DO4 = pin 12 at 26-pins connector
* 4 = DO5 = pin 3 at 26-pins connector
* 5 = DO6 = pin 21 at 26-pins connector
* 6 = DO7 = pin 13 at 26-pins connector
* 7 = DO8 = pin 4 at 26-pins connector
* 8 = DO9 = pin 22 at 26-pins connector
* 9 = DO10 = pin 25 at 26-pins connector

- **value** (int) – The value to be set (0 or 1).

Raises
AvantesError – If there was an error.

set_oem_parameter(*parameter*)

Sends the OEM data structure to the spectrometer.

Parameters
parameter (*OemDataType*) – The OEM data structure.

Raises
AvantesError – If there was an error.

set_parameter(*parameter*)

Overwrites the device configuration.

Please note that *OemDataType* is part of the DeviceConfigType in EEPROM (see section 3.5 of DLL manual). Precautions must be taken to prevent OEM data overwrites when using *set_parameter()* method together with *set_oem_parameter()*.

Parameters
parameter (*DeviceConfigType*) – The device parameters.

Raises
AvantesError – If there was an error.

set_prescan_mode(*boolean*)

If a prescan is set, the first measurement result will be skipped.

This function is only useful for the AvaSpec-3648 because this detector can be operated in prescan mode, or clear-buffer mode (see DLL manual).

Parameters
boolean (bool) – If True, the first measurement result will be skipped (prescan mode), else the detector will be cleared before each new scan (clear-buffer mode).

Raises
AvantesError – If there was an error.

set_pwm_out(*port_id*, *frequency*, *duty_cycle*)

Selects the PWM functionality for the specified digital output.

The PWM functionality is not supported on the Mini.

Parameters

- **port_id** (int) – Identifier for one of the 6 PWM output signals:
  - 0 = DO1 = pin 11 at 26-pins connector
  - 1 = DO2 = pin 2 at 26-pins connector
  - 2 = DO3 = pin 20 at 26-pins connector
  - 4 = DO5 = pin 3 at 26-pins connector
  - 5 = DO6 = pin 21 at 26-pins connector
  - 6 = DO7 = pin 13 at 26-pins connector
- **frequency** (int) – Desired PWM frequency (500 - 300000) [Hz]. For the AS5216, the frequency of outputs 0, 1 and 2 is the same (the last specified frequency is used) and also the frequency of outputs 4, 5 and 6 is the same. For the AS7010, you can define six different frequencies.
- **duty_cycle** (int) – Percentage high time in one cycle (0 - 100). For the AS5216, channels 0, 1 and 2 have a synchronized rising edge, the same holds for channels 4, 5 and 6. For the AS7010, rising edges are unsynchronized.

Raises
AvantesError – If there was an error.

set_sensitivity_mode(*value*)

Set the sensitivity mode.

This method is supported by the following detector types: HAMS9201, HAMG9208_512, SU256LSB and SU512LDB with the appropriate firmware version.

Parameters
value (int) – 0 for low noise, >0 for high sensitivity

Raises
AvantesError – If there was an error.

set_sync_mode(*enable*)

Disables/enables support for synchronous measurement.

Parameters
enable (bool) – False to disable sync mode, True to enable sync mode.

Raises
AvantesError – If there was an error.

stop_measure()

Stops the measurement.

Raises
AvantesError – If there was an error.

suppress_stray_light(*factor*)

Returns the stray light corrected pixel values of a dark corrected measurement.

Parameters
factor (float) – Multiplication factor for the stray light algorithm.

Returns

- numpy.ndarray – Scope minus dark.
- numpy.ndarray – Stray light suppressed.

Raises
AvantesError – If there was an error.

update_eth_devices(*nmax=16*)

Return the number of Ethernet devices that are connected to the computer.

Internally checks the list of connected Ethernet devices and returns the number of devices attached. If the *properties* attribute contains a key `'port_id'` with a value of `-1` then the returned value also includes the number of USB devices.

Parameters
nmax (int, optional) – The maximum number of devices that can be found.

Returns
list of *BroadcastAnswerType* – The information about the devices.

update_usb_devices()

Return the number of USB devices that are connected to the computer.

Internally checks the list of connected USB devices and returns the number of devices attached. If the *properties* attribute contains a key `'port_id'` with a value of `-1` then the returned value also includes the number of Ethernet devices.

Returns
int – The number of devices found.

use_high_res_adc(*enable*)

Enable the 16-bit AD converter.

When using the 16 bit ADC in full High Resolution mode (0..65535), please note that the irradiance intensity calibration, as well as the nonlinearity calibration are based on the 14bit ADC range. Therefore, if using the nonlinearity correction or irradiance calibration in your own software using the High Resolution mode, you need to apply the additional correction with ADCFactor (= 4.0), as explained in detail in section 4.6.1 and 4.6.3 of the manual.

Parameters
enable (bool) – If True use a 16-bit AD converter, otherwise use a 14-bit ADC.

Raises
AvantesError – If there was an error.

msl.equipment.resources.bentham package

Resources for equipment from Bentham.

Submodules

msl.equipment.resources.bentham.benhw32 module

A wrapper around the 32-bit Bentham `benhw32_cdecl` SDK.

class `msl.equipment.resources.bentham.benhw32.`**Bentham32**(*host*, *port*, *quiet*, ***kwargs*)

Bases: `Server32`

A wrapper around the 32-bit Bentham `benhw32_cdecl` SDK.

Do not instantiate this class directly.

The SDK is provided for 32-bit Windows only. This module is run on a 32-bit `Server` so that the the *Bentham* class can be run on a 64-bit Python interpreter in order to access the functions in the SDK from a 64-bit process.

auto_measure()

auto_range()

build_group()

build_system_model(*path*)

close()

close_shutter()

component_select_wl(*p_id*, *wavelength*)

get(*hw_id*, *token*, *index*)

get_c_group(*n*)

get_component_list()

get_group(*group*)

get_hardware_type(*hw_id*)

get_mono_items(*hw_id*)

get_no_of_dark_currents()

get_zero_calibration_info()

group_add(*p_id*, *group*)

group_remove(*p_id*, *group*)

initialise()

load_setup(*path*)

measurement()

multi_auto_range()

multi_get_no_of_dark_currents(*group*)

multi_get_zero_calibration_info(*group*)

multi_initialise()

multi_measurement()

multi_select_wavelength(*wavelength*)

multi_zero_calibration(*start_wavelength*, *stop_wavelength*)

park()

read(*p_message*, *buffer_size*, *p_id*)

report_error()

save_setup(*p_file_name*)

select_wavelength(*wavelength*)

send(*p_message*, *p_id*)

set(*hw_id*, *token*, *index*, *value*)

trace(*on*)

use_group(*group*)

get_version()

zero_calibration(*start_wavelength*, *stop_wavelength*)

camera_get_zero_calibration_info(*p_id*)

camera_measurement(*p_id*, *num*)

camera_zero_calibration(*p_id*, *start_wavelength*, *stop_wavelength*)

delete_group(*n*)

display_advanced_window(*p_id*, *hinstance*)

display_setup_window(*p_id*, *hinstance*)

get_log(*log*)

get_log_size()

get_max_bw(*group*, *start_wavelength*, *stop_wavelength*)

get_min_step(*group*, *start_wavelength*, *stop_wavelength*)

get_n_groups()

get_str(*hw_id*, *token*, *index*, *s*)

mapped_logging(*i*)

multi_auto_measure()

multi_park()

start_log(*c_list*)

stop_log(*c_list*)

msl.equipment.resources.bentham.benhw64 module

A wrapper around the *Bentham32* class.

class msl.equipment.resources.bentham.benhw64.**Bentham**(*record*)

Bases: *Connection*

A wrapper around the *Bentham32* class.

This class can be used with either a 32- or 64-bit Python interpreter to call the 32-bit functions in `benhw32_cdecl.dll`.

The *properties* for a Bentham connection supports the following key-value pairs in the *Connections Database*:

```
'cfg': str, the path to the System.cfg file [default: None]
'atr': str, the path to the System.atr file [default: None]
```

If the `cfg` and `atr` values are not defined in the *Connections Database* then you will have to call *build_system_model()*, *load_setup()* and *initialise()* (in that order) to configure the SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

auto_measure()

build_system_model(*path*)

Set the model configuration file.

Parameters
path (str) – The path to the `System.cfg` file.

disconnect()

Disconnect from the SDK and from the 32-bit server.

errcheck(*result*, **args*, ***kwargs*)

Checks whether a function call to the SDK was successful.

get(*hw_id*, *token*, *index*)

get_component_list()

get_hardware_type(*hw_id*)

get_mono_items(*hw_id*)

property wavelength

initialise()

Initialize the connection.

load_setup(*path*)

Load the setup file.

Parameters

path (str) – The path to the `System.atr` file.

park()

select_wavelength(*wavelength*)

set(*hw_id*, *token*, *index*, *value*)

version()

str: The version number of the SDK.

zero_calibration(*start_wavelength*, *stop_wavelength*)

msl.equipment.resources.bentham.errors module

Error code definition file for Bentham Instruments Spectroradiometer Control DLL

msl.equipment.resources.bentham.tokens module

Attribute token definition file for Bentham Instruments Spectroradiometer Control DLL.

msl.equipment.resources.cmi package

Resources for equipment from CMI.

Submodules

msl.equipment.resources.cmi.sia3 module

Establishes a connection to the Switched Integrator Amplifier (SIA3 board) that is designed by the Czech Metrology Institute.

class msl.equipment.resources.cmi.sia3.**IntegrationTime**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The amount of time to integrate the photo-diode signal.

TIME_50u = 5

TIME_100u = 6

TIME_1m = 7

TIME_10m = 8

TIME_20m = 9

TIME_100m = 10

TIME_200m = 11

TIME_500m = 12

TIME_1 = 13

TIME_2 = 14

class msl.equipment.resources.cmi.sia3.**SIA3**(*record*)

Bases: *ConnectionSerial*

Establishes a connection to the Switched Integrator Amplifier (SIA3 board) that is designed by the Czech Metrology Institute.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

GAIN

The gain (i.e., the integration time)

alias of *IntegrationTime*

set_integration_time(*time*)

Set the integration time (i.e., the gain).

Parameters
time (*IntegrationTime*) – The integration time as a *IntegrationTime* enum value or member name, e.g., `sia.set_integration_time('10m')`, `sia.set_integration_time(sia.GAIN.TIME_10m)` and `sia.set_integration_time(8)` are all equivalent statements.

set_ps(*ps*)

Set the timer pre-scale value.

The timer pre-scale value divides the microprocessor internal frequency by something similar to 2^PS. Therefore, to reach a 2-second integration time the *ps* value must be set to the maximum value of 7.

Parameters
ps (int) – The timer pre-scale value. Must be in the range [0, 7].

Raises
ValueError – If the value of *ps* is invalid.

msl.equipment.resources.dataray package

Resources for equipment from DataRay.

Submodules

msl.equipment.resources.dataray.datarayocx_32 module

Load the 32-bit DATARAYOCX library using MSL-LoadLib.

class msl.equipment.resources.dataray.datarayocx_32.**DataRayOCX32**(*host*, *port*, ***kwargs*)

Bases: Server32

Communicates with the 32-bit DATARAYOCX library.

Tested with the WinCamD-LCM-8.0D36 software version.

wait_to_configure()

Wait until the camera has been configured.

capture(*timeout*)

Capture an image.

start()

Start the camera.

stop()

Stop the camera.

shutdown_handler()

Stop the camera and close the application.

msl.equipment.resources.dataray.datarayocx_64 module

Establishes a connection to the DATARAYOCX library developed by DataRay Inc.

class msl.equipment.resources.dataray.datarayocx_64.**DataRayOCX64**(*record*)

Bases: *Connection*

A wrapper around the *DataRayOCX32* class.

This class can be used with either a 32- or 64-bit Python interpreter to call the 32-bit functions in the DATARAYOCX library. A GUI is created to configure and visualize the images taken by the camera.

Tested with the WinCamD-LCM-8.0D36 software version.

The *properties* for a DataRay connection supports the following key-value pairs in the *Connections Database*:

```
'area_filter': int, area filter: 1=1pixel, 2=3pixels, 3=5pixels,␣
↪4=7pixels, 5=9pixels [default: 1]
'camera_index': int, the camera to use (between 0 and 7; 0=first camera␣
↪found) [default: 0]
'centroid_method': int, the centroid method to use (0, 1 or 2) [default:␣
↪0]
'filter': float, percent full scale filter (0, 0.1, 0.2, 0.5, 1, 2, 5 or␣
↪10) [default: 0.2]
'major_minor_method': int, the major/minor method to use (0, 1 or 2)␣
↪[default: 0]
'ui_size': int, the size of the User Interface (value=height of a button␣
↪in pixels) [default: 25]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

wait_to_configure()

Wait until the camera has been configured.

This is a blocking call and waits until you close the popup Window.

capture(*timeout=10*, *restart=False*)

Capture an image.

Parameters

- **timeout** (float, optional) – The maximum number of seconds to wait to capture an image.
- **restart** (bool, optional) – Whether to keep the camera running after the image is captured.

Returns

dict – The information about the captured image. The key-value pairs are:

- adc_peak_%: float, the maximum ADC value (as a percentage)
- area_filter: int, area filtering applies a convolution to the pixels (1=1pixel, 2=3pixels, 3=5pixels, 4=7pixels, 5=9pixels)
- centroid: tuple, the (x, y) centroid value
- centroid_filter_size: int, centroid filter size (in pixels)
- centroid_type: int, the centroid type (0, 1 or 2)
- clip_level_centroid: float, the centroid clip level (between 0 and 1)
- clip_level_geo: float, the geometric clip level (between 0 and 1)
- crosshair: float, the angle between the horizontal x-axis and the solid crosshair line (in degrees)
- eff_2w: float, the effective beam size (in um)

- effective_centroid: tuple, the effective (x, y) centroid value
- effective_geo_centroid: tuple, the effective (x, y) geometric centroid value
- ellip: float, the ratio between the minor/major axis
- elp: float, the beam azimutal angle for ISO 11146 (in degrees)
- exposure_time: float, the exposure time (in ms)
- filter_full_scale: float, used in the triangular weighting smoothing function
- image: numpy.ndarray, the camera image
- image_zoom: float, the zoom factor of the image
- imager_gain: float, the gain used by the imager
- inc_p: float, Dxx power (in Watts)
- inc_power_area: float, Dxx beam area (in mm^2)
- inc_power_major: float, Dxx beam diameter along the major axis (in mm)
- inc_power_mean: float, Dxx mean beam diameter (in mm)
- inc_power_minor: float, Dxx beam diameter along the minor axis (in mm)
- is_fast_update: bool, whether the camera is in fast update or normal mode
- is_full_resolution: bool, whether the camera is set to full resolution
- maj_iso: float, the ISO 11146 beam size along the major axis (in um)
- major: float, the beam size along the major axis (in um)
- major_minor_method: int, the major/minor method used (0, 1 or 2)
- mean: float, the mean beam size (in um)
- mean_theta: float, Dxx mean angle (in mrad)
- min_iso: float, the ISO 11146 beam size along the minor axis (in um)
- minor: float, the beam size along the minor axis (in um)
- num_averages: int, the number of averages per capture
- num_captures: int, the number of images that have been captured
- orient: float, the angle between the horizontal x-axis and the major or minor axis closest to the horizontal x-axis (in degrees)
- peak: tuple, the peak location in (x, y), usually zero
- pixel_width_um: float, the width of a pixel (in um)
- pixel_height_um: float, the height of a pixel (in um)

- pk_to_avg: float, the peak to average value
- plateau_uniformity: float, the flatness of the plateau (between 0 and 1)
- profile_x: numpy.ndarray, the profile in the X direction
- profile_y: numpy.ndarray, the profile in the Y direction
- roi: tuple, the selected region of interest (x, y, width, height)
- xc: float, the centroid position along the x axis (in um)
- xg: float, the geometric centroid position along the x axis (in um)
- xp: float, the peak-intensity centroid position along the x axis (in um)
- xu: float, the user-selected centroid position along the x axis (in um)
- yc: float, the centroid position along the y axis (in um)
- yg: float, the geometric centroid position along the y axis (in um)
- yp: float, the peak-intensity centroid position along the y axis (in um)
- yu: float, the user-selected centroid position along the y axis (in um)

Raises

DataRayError – If not successful.

disconnect()

Disconnect from the camera.

start()

Start the camera.

stop()

Stop the camera.

msl.equipment.resources.electron_dynamics package

Resources for equipment from Electron Dynamics.

Submodules

msl.equipment.resources.electron_dynamics.tc_series module

Establishes a connection to a TC Series Temperature Controller from Electron Dynamics Ltd.

class msl.equipment.resources.electron_dynamics.tc_series.**TCSeries**(*record*)

Bases: *ConnectionSerial*

Establishes a connection to a TC Series Temperature Controller from Electron Dynamics Ltd.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

get_alarm()
Get the alarm parameters.

Returns
list – The alarm parameters. See *set_alarm()* for more details.

get_control()
Get the control parameters.

Returns
list – The control parameters. See *set_control()* for more details.

get_output()
Get the output parameters.

Returns
list – The output parameters. See *set_output()* for more details.

get_sensor()
Get the sensor parameters.

Returns
list – The sensor parameters. See *set_sensor()* for more details.

get_setpoint()
Get the setpoint parameters.

Returns
list – The setpoint parameters. See *set_setpoint()* for more details.

get_status()
Get the status.

Returns
list – The status parameters.

set_alarm(*alarm_type*, *minimum*, *maximum*, *ok_min*, *ok_max*, *limit_min*, *limit_max*)
Set the alarm parameters.

This corresponds to the c command in the Commands manual.

Parameters
- **alarm_type** (int) – The alarm type. One of:
  - 0: None
  - 1: Minimum
  - 2: Maximum
  - 3: Both
- **minimum** (float) – Sets the temperature below which the alarm is activated.

- **maximum** (float) – Sets the temperature above which the alarm is activated.
- **ok_min** (float) – Sets the lower temperature difference point from the setpoint for temperature OK.
- **ok_max** (float) – Sets the higher temperature difference point from the setpoint for temperature OK.
- **limit_min** (float) – Sets the temperature minimum, below which the drive output is disabled.
- **limit_max** (float) – Sets the temperature maximum, above which the drive output is disabled.

set_control(*control_type*, *p*, *i*, *d*, *d_filter*, *dead_band*, *power_up_state*)

Set the control type and the control parameters.

This corresponds to the a command in the Commands manual.

Parameters

- **control_type** (int) – The control type. One of:
  - 0: None
  - 1: On/Off - Output drive is only fully On (heating or cooling) or Off
  - 2: Proportional (P)
  - 3: Proportional and Integral (PI)
  - 4: Proportional, Integral and Derivative (PID)
- **p** (float) – The proportional (gain) value. With proportional action, the controller output is proportional to the temperature error from the setpoint. The proportional terms sets the gain for this where: `Output = (setpoint-actual temperature ) * proportional term`
- **i** (float) – The integral value. With integral action, the controller output is proportional to the amount of time the error is present. Integral action eliminates offset. The integral term is a time unit in seconds. NB for larger effects of integration reduce the integral time, also for operation without integral, integral time can be set to a large number e.g. 1e6.
- **d** (float) – The derivative value. With derivative action, the controller output is proportional to the rate of change of the measurement or error. The controller output is calculated by the rate of change of the measurement with time, in seconds. To increase the derivative action increase the derivative value. See also Derivative Filter (*d_filter*).
- **d_filter** (float) – The derivative filter is a low pass filter function on the derivative value. This allows the filtration of noise components which are a problem with a pure derivative function. The filter value should be set to be between 0 and 1.
- **dead_band** (float) – For use with On/Off control the dead band specifies the temperature range around the set point where the output is zero. For example:

- Temperature > setpoint + dead_band (Fully Cooling)
- Temperature < setpoint - dead_band (Fully Heating)
- Temperature < setpoint + dead_band AND > setpoint-dead_band (Output off)

- **power_up_state** (int) – This sets the temperature control state from power up. One of:
  - 0: Off
  - 1: On
  - 2: Same as the last setting prior to power off

set_output(*polarity*, *minimum*, *maximum*, *frequency*)

Set the output parameters.

This corresponds to the g command in the Commands manual.

Parameters

- **polarity** (int) – Sets the polarity of the output drive. One of:
  - 0: Negative
  - 1: Positive
- **minimum** (float) – Sets the minimum value limit of the output. Range -100 to +100.
- **maximum** (float) – Sets the maximum value limit of the output. Range -100 to +100.
- **frequency** (float) – Sets the pulse-width modulation repetition frequency of the output drive. Range 20 to 1000 Hz.

set_output_drive(*mode*, *value*)

Set the output drive state and value.

This corresponds to the m command in the Commands manual.

Parameters

- **mode** (int) – The drive mode. Either 0 (Off) or 1 (On).
- **value** (int) – Percent output.

set_sensor(*sensor*, *x2*, *x*, *c*, *unit*, *averaging*, *rl=22000*)

Set the sensor type and the sensor parameters.

This corresponds to the e command in the Commands manual.

Parameters

- **sensor** (int) – The sensor type. One of:
  - 0: Voltage
  - 1: PT100
  - 2: LM35
  - 3: LM50

  - 4: LM60
  - 5: LM61
  - 6: NTC Thermistor
  - 7: RES
  - 8: PT1000
  - 9: RTD
- **x2** (float) –
- **x** (float) –
- **c** (float) – The *x2*, *x* and *c* parameters are quadratic coefficients than can be used to convert the sensor voltage into a temperature, i.e., `temperature = (v * v * x2 ) + (v * x) + c`, where `v` is the measured sensor voltage.

  For `NTC` thermistors *x2* is the beta value as specified for the thermistor type, *x* is the resistance at 25 deg C, and, *c* is still the offset.
- **unit** (str) – The temperature units. One of:
  - `'C'`: Centigrade
  - `'F'`: Fahrenheit
  - `'K'`: Kelvin
  - `'V'`: Voltage
  - `'R'`: Resistance
- **averaging** (int) – Set the averaging to be 0 (Off) or 1 (On).
- **rl** (float, optional) – Used for `NTC` or `RES` sensors. This value corresponds to the RL drive resistance.

set_setpoint(*method*, *value*, *pot_range*, *pot_offset*)

Set the setpoint parameters.

This corresponds to the `i` command in the Commands manual.

Parameters

- **method** (int) – The temperature setpoint can be set via software or by altering the potentiometer on the temperature controller hardware. One of:
  - 0: Potentiometer
  - 1: Software
  - 2: Input
- **value** (float) – The setpoint value.
- **pot_range** (float) – The temperature range of the potentiometer.
- **pot_offset** (float) – The minimum temperature point of the potentiometer.

set_test(*mode*, *arg1*, *arg2*, *arg3*, *arg4*, *arg5*, *arg6*, *arg7*)

Set the test parameters.

This corresponds to the **k** command in the Commands manual.

Parameters

- **mode** (int) – The test mode. One of:
  - 0: Off
  - 1: Normal
  - 2: Temperature cycle
  - 3: Temperature ramp
  - 4: Auto tune
- **arg1** (float) – The maximum cycle value or the test time (in seconds).
- **arg2** (float) – The start temperature or setpoint value.
- **arg3** (float) – The end temperature or end peak test value.
- **arg4** (float) – The rate 1 or the calc PID value.
- **arg5** (float) – The rate 2 or the run PID value.
- **arg6** (float) – The time 1 or undo PID value.
- **arg7** (float) – The time 2 or auto cal value.

msl.equipment.resources.energetiq package

Resources for equipment from Energetiq.

Submodules

msl.equipment.resources.energetiq.eq99 module

Communicate with the EQ-99 Manager from Energetiq.

class msl.equipment.resources.energetiq.eq99.**EQ99**(*record*)

Bases: *ConnectionSerial*

Communicate with the EQ-99 Manager from Energetiq.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

identity()

Query the instrument identification.

Returns
str – Returns the identification string for the instrument in the following format: *Energetiq Model SN Ver Build*

reset()

Resets the instrument to factory defaults and the output is shut off.

The unit remains in remote mode.

get_beep()

Query whether beeps are enabled.

Returns
bool – Whether beeps are enabled.

set_beep(*beep=2*)

Set the beep value.

Parameters
beep (int or bool, optional) – Causes the instrument to beep, or enables or disabled the beep sound for error messages and other events that generate and audible response. Possible values are

- 0 or False – Disable the beep sound
- 1 or True – Enable the beep sound
- 2 – Generate one beep

get_brightness()

Query the display brightness.

Returns
int – Returns the value of the display brightness (between 0 and 100).

set_brightness(*brightness*)

Set the display brightness.

Parameters
brightness (int) – Sets the display brightness level from 0 to 100 percent. There are only 8 brightness levels (each separated by about 12.5 percent) and the brightness value is used to select an appropriate level.

delay(*milliseconds*)

Specify a delay to use in command processing.

Parameters
milliseconds (int) – Causes command processing to be delayed for the specified number of milliseconds. Valid range is from 1 to 30000 milliseconds.

condition_register()

Query LDLS condition register.

The condition register reflects the state of the instrument at the time the condition register is read.

The bitmask sequence is as follows:

Index	Value	Description
0	1	Interlock
1	2	Controller not detected
2	4	Controller fault
3	8	Lamp fault
4	16	Output on
5	32	Lamp on
6	64	Laser on
7	128	Laser stable
8	256	Shutter open

Returns

- `int` – The condition register value.
- `str` – The condition register as a bitmask string. For example, a value of `336` is expressed as `'000010101'` (meaning that the interlock is closed, there are no faults, the output is on, the lamp is off, the laser is on, the laser is not stable and the shutter is open).

`event_register()`

Query LDLS event register.

Returns the LDLS event register. The event register reflects the occurrence of any condition since the last time the event register was read. For example, if the output was turned on and then turned off, the Output on the bit in the condition register will be zero, but the same bit in the event register will be one.

The bitmask sequence is as follows:

Index	Value	Description
0	1	Interlock
1	2	Controller not detected
2	4	Controller fault
3	8	Lamp fault
4	16	Output on
5	32	Lamp on
6	64	Laser on
7	128	Laser stable
8	256	Shutter open

Returns

- `int` – The event register value.
- `str` – The event register as a bitmask string. For example, a value of `256` is expressed as `'000000001'` and `32` as `'000001000'`.

`get_exposure_time()`

Query the exposure time.

Returns
`int` – The exposure time, in milliseconds.

`set_exposure_time`(*milliseconds*)

Set the exposure time.

Exposure time is used when the shutter exposure mode is set to *Exposure mode* (see *set_exposure_mode()*). An exposure is triggered by a shutter button press or the shutter trigger input.

Parameters
milliseconds (`int`) – The exposure time, in milliseconds, from 100 to 30000 ms.

`get_exposure_mode`()

Query the exposure mode.

Returns
`int` – The exposure mode (0=Manual, 1=Exposure).

`set_exposure_mode`(*mode*)

Set the exposure mode.

Same as the Shutter setting in the menu.

Parameters
mode (`int` or `bool`) – The exposure mode (0=Manual, 1=Exposure).

`get_output`()

Query the output state.

Returns
`bool` – Whether the output is enabled.

`set_output`(*enable*)

Turn the output on or off.

Parameters
enable (`int` or `bool`) – Whether to enable the output.

`get_lamptime`()

Query the lamp runtime.

Returns
`float` – The number of hours accumulated while the lamp was on.

`set_lamptime`(*hours*)

Set the lamp runtime.

Resets the runtime to the new value. Useful for resetting the runtime to zero when the lamp has been serviced or replaced, or when moving the manager to a new LDLS system.

Parameters
hours (`float`) – The lamp runtime, in hours, between 0 and 9999.

`get_shutter_init`()

Query the power-up shutter state.

Returns

int – The power-up shutter state.

- 0 – Shutter is closed on power-up
- 1 – Shutter is open on power-up

set_shutter_init(*state*)

Set the power-up shutter state

Parameters

state (int or bool) – Sets the initial state of the shutter on power-up of the manager

- 0 or False – Shutter is closed on power-up
- 1 or True – Shutter is open on power-up

get_shutter_state()

Query the shutter state.

Returns

bool – The state of the shutter.

- False – Shutter is closed
- True – Shutter is open

set_shutter_state(*state*)

Open, close, or trigger the shutter.

A close command (state equals 0) will always close the shutter, regardless of exposure mode. An open command (state equals 1) will open the shutter if exposure mode is set to Manual, or trigger a shutter if exposure mode is set to Exposure.

Parameters

state (int or bool) – The state of the shutter.

- 0 or False – Close the shutter
- 1 or True – Open or trigger the shutter

get_trigger_mode()

Query the trigger mode.

Returns

int – The trigger mode. See *set_trigger_mode()* for more details.

set_trigger_mode(*mode*)

Set the trigger mode.

The trigger mode controls how the shutter trigger input controls the operation of the shutter. For more information on trigger modes, see *Shutter Operation* in the *Operating the Instrument* section of the manual for more details.

Parameters

mode (int) – The trigger mode.

- 0 – Positive edge trigger

- 1 – Negative edge trigger
- 2 – Positive level trigger
- 3 – Negative level trigger
- 4 – Off (trigger disabled)

get_message_buffer()

Query the internal message buffer.

Returns
str – The value of the internal message buffer.

set_message_buffer(*message*)

Set the message buffer.

Parameters
message (str) – Sets the internal message buffer, up to a maximum of 16 characters. If more than 16 characters are specified then the additional characters are silently ignored.

get_remote_mode_error()

Query whether errors are displayed while in remote mode.

Returns
bool – Whether errors are displayed while in remote mode.

set_remote_mode_error(*enable*)

Set whether to display errors while in remote mode.

This command controls if the instrument will display errors while in remote mode. If set to zero, then errors will not be displayed. If set to one, errors will be displayed. Errors will always accumulate in the error queue.

Parameters
enable (int or bool) – Whether to display errors while in remote mode.

- 0 or False – No not display errors in remote mode
- 1 or True – Display errors in remote mode

serial_number()

Query the serial number of the instrument.

Returns
str – The serial number of the instrument. This is the same information that is part of the *IDN? query.

get_termination()

Query response terminator.

Returns the current response terminator setting. See *set_termination()* for a complete definition of possible return values.

Returns
int – The response terminator.

set_termination(*value*)

Set the response terminator character(s).

This command controls the termination characters used for responses to queries.

Parameters

value (int) – The response terminator character(s)

- 0 or 1 – <CR><LF>
- 2 or 3 – <CR>
- 4 or 5 – <LF>
- 6 or 7 – no terminator

run_time()

Query run time.

Returns

str – Returns the elapsed time since the unit has been turned on. Format is in HH:MM:SS.ss, where HH is hours, MM is minutes, SS is seconds, and ss is hundredths of a second.

timer()

Query time since the last time this method was called.

Returns

str – Returns the elapsed time since the last time this method was called, or, if this is the first time calling this method then the time since unit has been turned on. Format is in HH:MM:SS.ss, where HH is hours, MM is minutes, SS is seconds, and ss is hundredths of a second.

version()

Query the firmware version.

Returns

str – Returns the firmware version. This is the same information that is part of the `*IDN?` query.

msl.equipment.resources.mks_instruments package

Resources for equipment from MKS Instruments.

Submodules

msl.equipment.resources.mks_instruments.pr4000b module

Flow and Pressure controller, PR4000B, from MKS Instruments.

class msl.equipment.resources.mks_instruments.pr4000b.**PR4000B**(*record*)

Bases: *ConnectionSerial*

Flow and Pressure controller, PR4000B, from MKS Instruments.

The default settings for the RS232 connection are:

- Baud rate = 9600
- Data bits = 7
- Stop bits = 1
- Parity = ODD
- Flow control = None

The baud rate and parity can be changed on the controller. The data bits, stop bits, and flow control cannot be changed. A null modem (cross over) cable is required when using a USB to RS232 converter. RS485 support is not implemented.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

```
ERROR_CODES = {'#E001': 'Communication Error', '#E002': 'ADC Overflow or
Underflow', '#E003': 'Range Error, Setpoint < 0 or out of range',
'#E010': 'Syntax Error', '#E020': 'Failed to execute command', '#W001':
'Offset > 250 mV'}

UNITS = {0: 'ubar', 1: 'mbar', 2: 'bar', 3: 'mTor', 4: 'Torr', 5:
'KTor', 6: 'Pa', 7: 'kPa', 8: 'mH2O', 9: 'cH2O', 10: 'PSI', 11:
'N/qm', 12: 'SCCM', 13: 'SLM', 14: 'SCM', 15: 'SCFH', 16: 'SCFM', 17:
'mA', 18: 'V', 19: '%', 20: 'C'}

SIGNAL_MODES = {0: 'METER', 1: 'OFF', 2: 'INDEP', 3: 'EXTRN', 4:
'SLAVE', 5: 'RTD'}

LIMIT_MODES = {0: 'SLEEP', 1: 'LIMIT', 2: 'BAND', 3: 'MLIMIT', 4:
'MBAND'}

TAGS = {0: 'SP', 1: 'VA', 2: 'CH', 3: 'FL', 4: 'PR', 5: 'EX'}
```

auto_zero(*channel*)

Auto zero a channel

Parameters
channel (*int*) – The channel, either 1 or 2.

Returns
int – The offset.

default(*mode*)

Reset to the default configuration.

Parameters
mode (*str*) – The mode to reset. One of `Pressure`, `Flow`, `P` or `F` (case insensitive).

displays_enable(*display*, *enable*)

Turn a display on or off.

Parameters

- **display** (int) – The display number [1, 4].
- **enable** (bool) – Whether to turn the display on, True, or off, False.

displays_setup(*display*, *line*, *tag*, *channel*)

Configure a display.

Parameters

- **display** (int) – The display number [1, 4].
- **line** (int) – The line number, 1 or 2.
- **tag** (int or str) – The tag to use (0=SP, 1=VA, 2=CH, 3=FL, 4=PR, 5=EX). For example, setting tag to 4 or 'PR' are equivalent.
- **channel** (int) – The channel, either 1 or 2.

display_4(*enable*)

Whether to enable or disable display 4.

Parameters

enable (bool) – Whether to enable or disable display 4.

external_input(*channel*)

Return the external input of a channel

Parameters

channel (int) – The channel, either 1 or 2.

Returns

float – The external input.

get_access_channel(*channel*)

Get the setpoint and the state of the valve of a particular channel.

Parameters

channel (int) – The channel, either 1 or 2.

Returns

- float – The setpoint value.
- bool – Whether the valve is on, True, or off, False.

get_actual_value(*channel*)

Get the actual value of a particular channel.

Parameters

channel (int) – The channel, either 1 or 2.

Returns

float – The value.

get_address()

Get the address.

Returns

int – The address.

get_dead_band(*channel*)

Get the dead band of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
float – The dead band.

get_dialog()

Get the current dialog index that is displayed.

Returns
int – The dialog index.

get_display_text()

Get the display text.

Returns
str – The display text.

get_external_input_range(*channel*)

Get the external input range of a channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
int – The external input range.

get_external_output_range(*channel*)

Get the external output range of a channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
int – The external output range.

get_formula_relay(*channel*)

Get the relay formula of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
str – The formula.

get_formula_temporary(*channel*)

Get the temporary formula of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
str – The formula.

get_gain(*channel*)

Get the gain of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
float – The gain.

get_input_range(*channel*)

Get the input range of a channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
int – The input range.

get_interface_mode()

Get the interface mode.

Returns
int – The interface mode.

get_limit_mode(*channel*)

Get the limit mode of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns

- int – The index of the limit mode.
- str – The name of the limit mode.

get_linearization_point(*channel*, *point*)

Get the point in the linearization table of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **point** (int) – The point in the table [0, 10].

Returns

- float – The x value.
- float – The y value.

get_linearization_size(*channel*)

Get the size of the linearization table of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
int – The size of the table.

get_lower_limit(*channel*)

Get the lower limit of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
float – The lower limit.

get_offset(*channel*)

Get the offset of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
int – The offset.

get_output_range(*channel*)

Get the output range of a channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
int – The output range.

get_range(*channel*)

Get the range and unit of a channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns

- float – The range.
- int – The unit index.
- str – The unit name.

get_relays(*channel*)

Get the relay state of a channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
bool – Whether the relay is enabled or disabled.

get_remote_mode()

Get the remote operation mode.

Returns
bool – Whether the remote operation mode is enabled, True, or disabled, False.

get_resolution()

Get whether 16-bit resolution is enabled.

Returns
bool – Whether 16-bit resolution is enabled, True, or disabled, False.

get_rtd_offset(*channel*)

Get the RTD offset of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
int – The offset.

get_scale(*channel*)
Get the scale of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
float – The scale.

get_setpoint(*channel*)
Get the setpoint of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
float – The setpoint.

get_signal_mode(*channel*)
Get the signal mode of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns

- int – The index number of the signal mode.
- str – The name of the signal mode.

get_upper_limit(*channel*)
Get the upper limit of a particular channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
float – The upper limit.

get_valves(*channel*)
Get the state of the valve of a channel.

Parameters
channel (int) – The channel, either 1 or 2.

Returns
bool – Whether the valve is enabled or disabled.

identity()
Returns the identity.

Returns
str – The identity (e.g., PR42vvrrssssss, where vv is the version, rr is the release and sssss is the serial number).

lock()

Lock setup.

request_key()

Requests most recent key that was pressed.

Returns

- int – The key that was most recently pressed.
- int – The number of key presses that occurred since the last time this method was called.

reset_status()

Send the reset/status command.

set_access_channel(*channel*, *setpoint*, *valve*)

Set the setpoint and the state of the valve for a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **setpoint** (float) – The setpoint value.
- **valve** (bool) – Whether to enable or disable the valve.

Returns

float – The actual setpoint value.

set_actual_value(*channel*, *setpoint*)

Set the actual value of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **setpoint** (float) – The setpoint.

Returns

float – The actual value.

set_address(*address*)

Set the address.

Parameters

address (int) – The address [0, 31].

set_dead_band(*channel*, *band*)

Set the dead band of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **band** (float) – The dead band [0.0% to 9.9% of full scale].

set_dialog(*index*)

Set the display dialog.

Parameters

index (int) – The dialog index (between 0 and 29 inclusive). See Appendix D of the manual for more information.

set_display_text(*text*, *clear=True*)

Set the display text.

To view the text on the display you must call *set_dialog()* with the index equal to 3.

Parameters

- **text** (str) – The text to display. Maximum 32 characters.
- **clear** (bool, optional) – Whether to clear the current display text before setting the new text.

set_external_input_range(*channel*, *range*)

Set the external input range of a channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **range** (int) – The external input range [1, 10] in Volts.

set_external_output_range(*channel*, *range*)

Set the external output range of a channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **range** (int) – The external output range [1, 10] in Volts.

set_formula_relay(*channel*, *formula*)

Set the relay formula of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **formula** (str) – The relay formula.

set_formula_temporary(*channel*, *formula*)

Set the temporary formula of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **formula** (str) – The temporary formula.

set_gain(*channel*, *gain*)

Set the gain of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **gain** (float) – The gain [0.001, 2.000].

set_input_range(*channel*, *range*)

Set the input range of a channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **range** (int) – The input range [1, 10] in Volts.

set_interface_mode(*mode*)

Set the interface mode.

Parameters

mode (int) – The interface mode.

set_limit_mode(*channel*, *mode*)

Set the limit mode of a channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **mode** (int or str) – The limit mode as either an index number [0, 4] or a name (e.g., SLEEP).

set_linearization_point(*channel*, *point*, *x*, *y*)

Set a point in the linearization table of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **point** (int) – The point in the table [0, 10].
- **x** (float) – The x value [-5% to 100% of full scale].
- **y** (float) – The y value [-5% to 100% of full scale].

set_linearization_size(*channel*, *size*)

Set the size of the linearization table of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **size** (int) – The size of the table.

set_lower_limit(*channel*, *limit*)

Set the lower limit of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **limit** (float) – The lower limit [-5% to 110% of full scale].

set_offset(*channel*, *offset*)

Set the offset of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.

- **offset** (int) – The offset [-250, 250].

set_output_range(*channel*, *range*)

Set the output range of a channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **range** (int) – The output range [1, 10] in Volts.

set_range(*channel*, *range*, *unit*)

Set the range and unit of a channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **range** (float) – The range value.
- **unit** (int or str) – The unit as either an index number [0, 20] or a name (e.g., kPa).

set_relays(*channel*, *enable*)

Set the relay state of a channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **enable** (bool) – Whether to enable or disable the relay.

set_remote_mode(*enable*)

Set the remote operation mode to be enable or disabled.

Parameters

enable (bool) – Whether to enable or disable remote operation.

set_resolution(*enable*)

Set the 16-bit resolution to be enable or disabled.

Parameters

enable (bool) – Whether to enable or disable 16-bit resolution.

set_rtd_offset(*channel*, *offset*)

Set the RTD offset of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **offset** (int) – The RTD offset [-250, 250].

set_scale(*channel*, *scale*)

Set the scale of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **scale** (float) – The scale.

set_setpoint(*channel*, *setpoint*)

Set the setpoint of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **setpoint** (float) – The setpoint.

set_signal_mode(*channel*, *mode*)

Set the range and unit of a channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **mode** (int or str) –

  The signal mode as either an index number (e.g., between 0 and 5 inclusive)
  or a name (e.g., INDEP).

set_tweak_control(*enable*)

Set tweak control.

Parameters

enable (bool) – Whether to switch tweak control on or off.

set_upper_limit(*channel*, *limit*)

Set the upper limit of a particular channel.

Parameters

- **channel** (int) – The channel, either 1 or 2.
- **limit** (float) – The upper limit [-5% to 110% of full scale].

set_valves(*channel*, *enable*)

Set the state of the valve of a channel.

Parameters

channel (int) – The channel, either 1 or 2.

status()

Request status bits.

Returns

- int – The status value.
- str – The binary representation of the value.

unlock()

Unlock setup.

msl.equipment.resources.nkt package

Resources for equipment from NKT Photonics.

Submodules

msl.equipment.resources.nkt.nktpdll module

Wrapper around the `NKTPDLL.dll` SDK from NKT Photonics.

The wrapper was written using v2.1.2.766 of the SDK.

`msl.equipment.resources.nkt.nktpdll.`**PortStatusCallback**
: Use as a decorator for a callback function when a port status changes.

`msl.equipment.resources.nkt.nktpdll.`**DeviceStatusCallback**
: Use as a decorator for a callback function when a device status changes.

`msl.equipment.resources.nkt.nktpdll.`**RegisterStatusCallback**
: Use as a decorator for a callback function when a register status changes.

class `msl.equipment.resources.nkt.nktpdll.`**DateTimeType**
: Bases: `Structure`

  The DateTimeType struct (24 hour format).

  Day
  : Structure/Union member

  Hour
  : Structure/Union member

  Min
  : Structure/Union member

  Month
  : Structure/Union member

  Sec
  : Structure/Union member

  Year
  : Structure/Union member

class `msl.equipment.resources.nkt.nktpdll.`**ParameterSetType**
: Bases: `Structure`

  The ParameterSet struct.

  This is how calculation on parameter sets is done internally by modules:

  DAC_value = (value * (X/Y)) + Offset

  where, value is either ParameterSetType::StartVal or ParameterSetType::FactoryVal

  value = (ADC_value * (X/Y)) + Offset

where, value often is available via another measurement register.

Denominator

Structure/Union member

ErrorHandler

Structure/Union member

FactoryVal

Structure/Union member

LLimit

Structure/Union member

Numerator

Structure/Union member

Offset

Structure/Union member

StartVal

Structure/Union member

ULimit

Structure/Union member

Unit

Structure/Union member

class msl.equipment.resources.nkt.nktpdll.**DeviceModeTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The DeviceModeTypes enum.

DevModeDisabled = 0

DevModeAnalyzeInit = 1

DevModeAnalyze = 2

DevModeNormal = 3

DevModeLogDownload = 4

DevModeError = 5

DevModeTimeout = 6

DevModeUpload = 7

class msl.equipment.resources.nkt.nktpdll.**DeviceStatusTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The DeviceStatusTypes enum.

DeviceModeChanged = 0

DeviceLiveChanged = 1

DeviceTypeChanged = 2

DevicePartNumberChanged = 3

DevicePCBVersionChanged = 4

DeviceStatusBitsChanged = 5

DeviceErrorCodeChanged = 6

DeviceBlVerChanged = 7

DeviceFwVerChanged = 8

DeviceModuleSerialChanged = 9

DevicePCBSerialChanged = 10

DeviceSysTypeChanged = 11

class msl.equipment.resources.nkt.nktpdll.**ParamSetUnitTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The ParamSetUnitTypes enum

UnitNone = 0

UnitmV = 1

UnitV = 2

UnituA = 3

UnitmA = 4

UnitA = 5

UnituW = 6

UnitcmW = 7

```
UnitdmW = 8

UnitmW = 9

UnitW = 10

UnitmC = 11

UnitcC = 12

UnitdC = 13

Unitpm = 14

Unitdnm = 15

Unitnm = 16

UnitPerCent = 17

UnitPerMille = 18

UnitcmA = 19

UnitdmA = 20

UnitRPM = 21

UnitdBm = 22

UnitcBm = 23

UnitmBm = 24

UnitdB = 25

UnitcB = 26

UnitmB = 27

Unitdpm = 28

UnitcV = 29

UnitdV = 30

Unitlm = 31

Unitdlm = 32

Unitclm = 33

Unitmlm = 34
```

class msl.equipment.resources.nkt.nktpdll.**RegisterPriorityTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The RegisterPriorityTypes enum.

RegPriority_Low = 0

RegPriority_High = 1

class msl.equipment.resources.nkt.nktpdll.**RegisterDataTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The RegisterDataTypes enum.

RegData_Unknown = 0

RegData_Mixed = 1

RegData_U8 = 2

RegData_S8 = 3

RegData_U16 = 4

RegData_S16 = 5

RegData_U32 = 6

RegData_S32 = 7

RegData_F32 = 8

RegData_U64 = 9

RegData_S64 = 10

RegData_F64 = 11

RegData_Ascii = 12

RegData_Paramset = 13

RegData_B8 = 14

RegData_H8 = 15

RegData_B16 = 16

RegData_H16 = 17

RegData_B32 = 18

RegData_H32 = 19

RegData_B64 = 20

RegData_H64 = 21

RegData_DateTime = 22

class msl.equipment.resources.nkt.nktpdll.**RegisterStatusTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The RegisterStatusTypes enum.

RegSuccess = 0

RegBusy = 1

RegNacked = 2

RegCRCErr = 3

RegTimeout = 4

RegComError = 5

class msl.equipment.resources.nkt.nktpdll.**PortStatusTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The PortStatusTypes enum

PortStatusUnknown = 0

PortOpening = 1

PortOpened = 2

PortOpenFail = 3

PortScanStarted = 4

PortScanProgress = 5

PortScanDeviceFound = 6

PortScanEnded = 7

PortClosing = 8

PortClosed = 9

PortReady = 10

class msl.equipment.resources.nkt.nktpdll.**NKT**(*record*)

Bases: *Connection*

Wrapper around the NKTPDLL.dll SDK from NKT Photonics.

The *properties* for a NKT connection supports the following key-value pairs in the *Connections Database*:

```
'sdk_path': str, The path to the SDK [default: 'NKTPDLL.dll']
'open_port': bool, Whether to automatically open the port [default: True]
'auto': bool, Whether to open the port with bus scanning [default: True]
'live': bool, Whether to open the port in live mode [default: True]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

RegisterStatusCallback

alias of CFunctionType

PortStatusCallback

alias of CFunctionType

DeviceStatusCallback

alias of CFunctionType

class DeviceModeTypes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The DeviceModeTypes enum.

DevModeDisabled = 0

DevModeAnalyzeInit = 1

DevModeAnalyze = 2

DevModeNormal = 3

DevModeLogDownload = 4

DevModeError = 5

DevModeTimeout = 6

DevModeUpload = 7

class DeviceStatusTypes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The DeviceStatusTypes enum.

DeviceModeChanged = 0

DeviceLiveChanged = 1

DeviceTypeChanged = 2

DevicePartNumberChanged = 3

DevicePCBVersionChanged = 4

DeviceStatusBitsChanged = 5

DeviceErrorCodeChanged = 6

DeviceBlVerChanged = 7

DeviceFwVerChanged = 8

DeviceModuleSerialChanged = 9

DevicePCBSerialChanged = 10

DeviceSysTypeChanged = 11

class ParamSetUnitTypes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The ParamSetUnitTypes enum

UnitNone = 0

UnitmV = 1

UnitV = 2

UnituA = 3

UnitmA = 4

UnitA = 5

UnituW = 6

UnitcmW = 7

UnitdmW = 8

UnitmW = 9

UnitW = 10

UnitmC = 11

UnitcC = 12

UnitdC = 13

Unitpm = 14

Unitdnm = 15

Unitnm = 16

UnitPerCent = 17

UnitPerMille = 18

UnitcmA = 19

UnitdmA = 20

UnitRPM = 21

UnitdBm = 22

UnitcBm = 23

UnitmBm = 24

UnitdB = 25

UnitcB = 26

UnitmB = 27

Unitdpm = 28

UnitcV = 29

UnitdV = 30

Unitlm = 31

Unitdlm = 32

Unitclm = 33

Unitmlm = 34

class RegisterPriorityTypes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The RegisterPriorityTypes enum.

RegPriority_Low = 0

RegPriority_High = 1

class RegisterDataTypes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The RegisterDataTypes enum.

RegData_Unknown = 0

RegData_Mixed = 1

RegData_U8 = 2

RegData_S8 = 3

RegData_U16 = 4

RegData_S16 = 5

RegData_U32 = 6

RegData_S32 = 7

RegData_F32 = 8

RegData_U64 = 9

RegData_S64 = 10

RegData_F64 = 11

RegData_Ascii = 12

RegData_Paramset = 13

RegData_B8 = 14

RegData_H8 = 15

RegData_B16 = 16

RegData_H16 = 17

RegData_B32 = 18

RegData_H32 = 19

RegData_B64 = 20

RegData_H64 = 21

RegData_DateTime = 22

class RegisterStatusTypes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The RegisterStatusTypes enum.

RegSuccess = 0

RegBusy = 1

RegNacked = 2

RegCRCErr = 3

RegTimeout = 4

RegComError = 5

class PortStatusTypes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The PortStatusTypes enum

PortStatusUnknown = 0

PortOpening = 1

PortOpened = 2

PortOpenFail = 3

PortScanStarted = 4

PortScanProgress = 5

PortScanDeviceFound = 6

PortScanEnded = 7

PortClosing = 8

PortClosed = 9

PortReady = 10

static close_ports(*names=None*)

Close the specified port name(s).

Parameters

names (str, list of str, optional) – If None then close all opened ports. If a str then the name of a port. Otherwise a list of names. Port names are case sensitive.

Raises

NKTError – If there was an error calling this method.

static load_sdk(*path=None*)

Load the SDK.

Parameters

path (str, optional) – The path to NKTPDLL.dll. If not specified then searches for the library.

static device_get_all_types(*opened_ports=None*, *size=255*)

Returns all device types (module types) from the internal device list.

Parameters

- **opened_ports** (str or list of str, optional) – A port or a list of opened ports. If not specified then the *get_open_ports()* method will be called and the types for each port will be returned.
- **size** (int, optional) – The maximum number of bytes that the device list can be.

Returns

dict – The port names are the keys and each value is dict with the module type as the keys and its corresponding device ID as the value.

Raises

NKTError – If there was an error calling this method.

device_create(*device_id*, *wait_ready*)

Creates a device in the internal device list.

If the *open_ports()* function has been called with *live* = 1 then the kernel immediately starts to monitor the device.

Parameters

- **device_id** (int) – The device id (module address).
- **wait_ready** (bool) – False - Don't wait for the device to be ready. True - Wait up to 2 seconds for the device to complete its analyze cycle. (All standard registers being successfully read)

Raises

NKTError – If there was an error calling this method.

device_exists(*device_id*)

Checks if a specific device already exists in the internal device list.

Parameters

device_id (int) – The device id (module address).

Returns

bool – Whether the device exists.

Raises

NKTError – If there was an error calling this method.

device_get_boot_loader_version(*device_id*)

Returns the boot-loader version (int) for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

device_id (int) – The device id (module address).

Returns

int – The boot-loader version.

Raises
NKTError – If there was an error calling this method.

device_get_boot_loader_version_str(*device_id*)

Returns the boot-loader version (string) for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
str – The boot-loader version.

Raises
NKTError – If there was an error calling this method.

device_get_error_code(*device_id*)

Returns the error code for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
int – The error code.

Raises
NKTError – If there was an error calling this method.

device_get_firmware_version(*device_id*)

Returns the firmware version (int) for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
int – The firmware version.

Raises
NKTError – If there was an error calling this method.

device_get_firmware_version_str(*device_id*)

Returns the firmware version (string) for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
str – The firmware version.

Raises
NKTError – If there was an error calling this method.

device_get_live(*device_id*)

Returns the internal device live status for a specific device id.

Requires the port being already opened with the *open_ports()* function and the device being already created, either automatically or with the *device_create()* function.

Parameters
device_id (int) – The device id (module address).

Returns
bool – Whether live mode is enabled.

Raises
NKTError – If there was an error calling this method.

device_get_mode(*device_id*)

Returns the internal device mode for a specific device id.

Requires the port being already opened with the *open_ports()* function and the device being already created, either automatically or with the *device_create()* function.

Parameters
device_id (int) – The device id (module address).

Returns
DeviceModeTypes – The device mode type.

Raises
NKTError – If there was an error calling this method.

device_get_module_serial_number_str(*device_id*)

Returns the module serial number (string) for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
str – The serial number.

Raises
NKTError – If there was an error calling this method.

device_get_part_number_str(*device_id*)

Returns the part number for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
str – The part number.

Raises
NKTError – If there was an error calling this method.

device_get_pcb_serial_number_str(*device_id*)

Returns the PCB serial number (string) for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
str – The part number.

Raises
NKTError – If there was an error calling this method.

device_get_pcb_version(*device_id*)

Returns the PCB version for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
int – The PCB version number.

Raises
NKTError – If there was an error calling this method.

device_get_status_bits(*device_id*)

Returns the status bits for a given device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
int – The status bits.

Raises
NKTError – If there was an error calling this method.

device_get_type(*device_id*)

Returns the module type for a specific device id.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters
device_id (int) – The device id (module address).

Returns
int – The module type.

Raises
NKTError – If there was an error calling this method.

`device_remove`(*device_id*)

Remove a specific device from the internal device list.

Parameters
device_id (int) – The device id (module address).

Raises
NKTError – If there was an error calling this method.

`device_remove_all`()

Remove all devices from the internal device list.

No confirmation is given, the list is simply cleared.

Raises
NKTError – If there was an error calling this method.

`device_set_live`(*device_id*, *live_mode*)

Sets the internal device live status for a specific device id (module address).

Parameters

- **device_id** (int) – The device id (module address).
- **live_mode** (bool) – Set to True to enable.

Raises
NKTError – If there was an error calling this method.

`disconnect`()

Disconnect from the port.

Raises
NKTError – If there was an error calling this method.

`static get_all_ports`(*size=255*)

Returns a list of all ports.

Parameters
size (int, optional) – The maximum size of the string buffer to fetch the results.

Returns
list of str – A list of port names.

`get_modules`(*size=255*)

Returns all device types (module types) from the device.

Parameters
size (int, optional) – The maximum number of bytes that the device list can be.

Returns
dict – The module type as the keys and its corresponding device ID as the value.

Raises
NKTError – If there was an error calling this method.

`static get_legacy_bus_scanning()`

Get the bus-scanning mode.

Returns
`bool` – `True` if in legacy mode otherwise in normal mode.

`static get_open_ports(size=255)`

Returns a list of already-opened ports.

Parameters
size (`int`, optional) – The maximum size of the string buffer to fetch the results.

Returns
`list` of `str` – A list of port names that are already open.

`get_port_error_msg()`

Retrieve error message for the port.

Returns
`str` – The error message. An empty string indicates no error.

Raises
NKTError – If there was an error calling this method.

`get_port_status()`

Get the status of the port.

Returns
PortStatusTypes – The port status.

Raises
NKTError – If there was an error calling this method.

`static open_ports(names=None, auto=True, live=True)`

Open the specified port(s).

Repeated calls to this function is allowed to reopen and/or rescan for devices.

Parameters

- **names** (`str`, `list` of `str`, optional) – If `None` then open all available ports. If a `str` then the name of a port. Otherwise a `list` of names. Port names are case sensitive. Example port names are `'AcoustikPort1'`, `'COM6'`.
- **auto** (`bool`, optional) – If `True` then automatically start bus scanning and add the found devices in the internal device list. If `False` then bus scanning and device creation is not automatically handled. The port is automatically closed if no devices are found.
- **live** (`bool`, optional) – If `True` then keep all the found or created devices in live mode, which means the Interbus kernel keeps monitoring all the found devices and their registers. Please note that this will keep the modules watchdog alive as long as the port is open. If `False` then disable continuous monitoring of the registers. No callback is possible

on register changes. Use the *register_read()*, *register_write()* and *register_write_read()* methods.

Raises
NKTError – If there was an error calling this method.

point_to_point_port_add(*host_address*, *host_port*, *client_address*, *client_port*, *protocol*, *ms_timeout=100*)

Creates or modifies a point to point port.

Parameters

- **host_address** (str) – The local ip address, e.g., '192.168.1.67'.
- **host_port** (int) – The local port number.
- **client_address** (str) – The remote ip address, e.g., '192.168.1.100'.
- **client_port** (int) – The remote port number.
- **protocol** (int) – Either 0 (TCP) or 1 (UDP).
- **ms_timeout** (int, optional) – Telegram timeout value in milliseconds.

Raises
NKTError – If there was an error calling this method.

point_to_point_port_del()

Delete the point-to-point port.

Raises
NKTError – If there was an error calling this method.

point_to_point_port_get()

Retrieve the information about the point-to-point port setting.

Returns
dict – The information about the point-to-point port setting.

Raises
NKTError – If there was an error calling this method.

register_read(*device_id*, *reg_id*, *index=-1*)

Reads a register value and returns the result.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
bytes – The register value.

Raises
NKTError – If there was an error calling this method.

register_create(*device_id*, *reg_id*, *priority*, *data_type*)

Creates a register in the internal register list.

If the *open_ports()* function has been called with the *live* = 1 then the kernel immediately starts to monitor the register.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **priority** (int) – The *RegisterPriorityTypes* (monitoring priority).
- **data_type** (int) – The *RegisterDataTypes*, not used internally but could be used in a common callback function to determine data type.

Raises
NKTError – If there was an error calling this method.

register_exists(*device_id*, *reg_id*)

Checks if a specific register already exists in the internal register list.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).

Returns
bool – Whether the register exists.

Raises
NKTError – If there was an error calling this method.

register_get_all(*device_id*)

Returns the register ids (register addresses) from the internal register list.

Parameters
device_id (int) – The device id (module address).

Returns
list of int – The register ids.

Raises
NKTError – If there was an error calling this method.

register_read_ascii(*device_id*, *reg_id*, *index=-1*)

Reads an ascii string from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).

- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
str – The ascii value.

Raises
NKTError – If there was an error calling this method.

register_read_f32(*device_id*, *reg_id*, *index=-1*)

Reads 32-bit float value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
float – The 32-bit float value.

Raises
NKTError – If there was an error calling this method.

register_read_f64(*device_id*, *reg_id*, *index=-1*)

Reads 64-bit double value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
float – The 64-bit double value.

Raises
NKTError – If there was an error calling this method.

register_read_s16(*device_id*, *reg_id*, *index=-1*)

Reads 16-bit signed short value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).

- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
int – The 16-bit signed short value.

Raises
NKTError – If there was an error calling this method.

register_read_s32(*device_id*, *reg_id*, *index=-1*)

Reads 32-bit signed long value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
int – The 32-bit signed long value.

Raises
NKTError – If there was an error calling this method.

register_read_s64(*device_id*, *reg_id*, *index=-1*)

Reads 64-bit signed long long value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
int – The 64-bit signed long long value.

Raises
NKTError – If there was an error calling this method.

register_read_s8(*device_id*, *reg_id*, *index=-1*)

Reads 8-bit signed char value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).

- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
int – The 8-bit signed char value.

Raises
NKTError – If there was an error calling this method.

register_read_u16(*device_id*, *reg_id*, *index=-1*)

Reads 16-bit unsigned short value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
int – The 16-bit unsigned short value.

Raises
NKTError – If there was an error calling this method.

register_read_u32(*device_id*, *reg_id*, *index=-1*)

Reads 32-bit unsigned long value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
int – The 32-bit unsigned long value.

Raises
NKTError – If there was an error calling this method.

register_read_u64(*device_id*, *reg_id*, *index=-1*)

Reads 64-bit unsigned long long value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).

- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
int – The 64-bit unsigned long long value.

Raises
NKTError – If there was an error calling this method.

register_read_u8(*device_id*, *reg_id*, *index=-1*)

Reads 8-bit unsigned char value from the register.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **index** (int, optional) – Value index. Typically -1, but could be used to extract data from a specific position in the register. Index is byte counted.

Returns
int – The 8-bit unsigned char value.

Raises
NKTError – If there was an error calling this method.

register_remove(*device_id*, *reg_id*)

Remove a specific register from the internal register list.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).

Raises
NKTError – If there was an error calling this method.

register_remove_all(*device_id*)

Remove all registers from the internal register list.

No confirmation given, the list is simply cleared.

Parameters
device_id (int) – The device id (module address).

Raises
NKTError – If there was an error calling this method.

register_write(*device_id*, *reg_id*, *data*, *index=-1*)

Writes a register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).

- **reg_id** (int) – The register id (register address).
- **data** (bytes) – The data to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_ascii(*device_id*, *reg_id*, *string*, *write_eol*, *index=-1*)

Writes a string to the register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **string** (str) – The string to write to the register.
- **write_eol** (bool) – Whether to append the End Of Line character (a null character) to the string.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a mixed-type register.

Raises

NKTError – If there was an error calling this method.

register_write_f32(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 32-bit float register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (float) – The 32-bit float to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_f64(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 64-bit double register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).

- **reg_id** (int) – The register id (register address).
- **value** (float) – The 64-bit double to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_read(*device_id*, *reg_id*, *data*, *index=-1*)

Writes then reads a register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **data** (bytes) – The data to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns

bytes – The data that was written to the register.

Raises

NKTError – If there was an error calling this method.

register_write_read_ascii(*device_id*, *reg_id*, *string*, *write_eol*, *index=-1*)

Writes then reads a string register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **string** (str) – The string to write to the register.
- **write_eol** (bool) – Whether to append the End Of Line character (a null character) to the string.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns

str – The string that was written to the register.

Raises

NKTError – If there was an error calling this method.

register_write_read_f32(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 32-bit float register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (float) – The 32-bit float value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns

float – The 32-bit float value that was written to the register.

Raises

NKTError – If there was an error calling this method.

register_write_read_f64(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 64-bit double register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (float) – The 64-bit double value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns

float – The 64-bit double value that was written to the register.

Raises

NKTError – If there was an error calling this method.

register_write_read_s16(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 16-bit signed short register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 16-bit signed short value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns
int – The 16-bit signed short value that was written to the register.

Raises
NKTError – If there was an error calling this method.

register_write_read_s32(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 32-bit signed long register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 32-bit signed long value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns
int – The 32-bit signed long value that was written to the register.

Raises
NKTError – If there was an error calling this method.

register_write_read_s64(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 64-bit signed long long register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 64-bit signed long long value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns
int – The 64-bit signed long long value that was written to the register.

Raises
NKTError – If there was an error calling this method.

register_write_read_s8(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 8-bit signed char register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).

- **value** (int) – The 8-bit signed char value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns
int – The 8-bit signed char value that was written to the register.

Raises
NKTError – If there was an error calling this method.

register_write_read_u16(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 16-bit unsigned short register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 16-bit unsigned short value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns
int – The 16-bit unsigned short value that was written to the register.

Raises
NKTError – If there was an error calling this method.

register_write_read_u32(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 32-bit unsigned long register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 32-bit unsigned long value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns
int – The 32-bit unsigned long value that was written to the register.

Raises
NKTError – If there was an error calling this method.

register_write_read_u64(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 64-bit unsigned long long register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 64-bit unsigned long long value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns

int – The 64-bit unsigned long long value that was written to the register.

Raises

NKTError – If there was an error calling this method.

register_write_read_u8(*device_id*, *reg_id*, *value*, *index=-1*)

Writes then reads a 8-bit unsigned char register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write followed by a dedicated read.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 8-bit unsigned char value to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Returns

int – The 8-bit unsigned char value that was written to the register.

Raises

NKTError – If there was an error calling this method.

register_write_s16(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 16-bit signed short register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 16-bit signed short to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_s32(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 32-bit signed long register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 32-bit signed long to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_s64(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 64-bit signed long long register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 64-bit signed long long to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_s8(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 8-bit signed char register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 8-bit signed char to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_u16(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 16-bit unsigned short register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 16-bit unsigned short to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_u32(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 32-bit unsigned long register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 32-bit unsigned long to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_u64(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 64-bit unsigned long long register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 64-bit unsigned long long to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

register_write_u8(*device_id*, *reg_id*, *value*, *index=-1*)

Writes a 8-bit unsigned char register value.

It is not necessary to open the port, create the device or register before using this function, since it will do a dedicated write.

Parameters

- **device_id** (int) – The device id (module address).
- **reg_id** (int) – The register id (register address).
- **value** (int) – The 8-bit unsigned char to write to the register.
- **index** (int, optional) – Value index. Typically -1, but could be used to write a value in a multi-value register.

Raises

NKTError – If there was an error calling this method.

static set_legacy_bus_scanning(*mode*)

Set the bus-scanning mode to normal or legacy.

Parameters

mode (bool) – If False then bus scanning is set to normal mode and allows for a rolling masterId. In this mode the masterId is changed for each message to allow for out-of-sync detection. If True then bus scanning is set to legacy mode and fixes the masterId at address 66(0x42). Some older modules do not accept masterIds other than 66(0x42).

static set_callback_device_status(*callback*)

Enables/Disables a callback for device status changes.

Parameters

callback (*DeviceStatusCallback*) – A *DeviceStatusCallback* object. Pass in None to disable callbacks.

Note: Due to a risk of circular runaway leading to stack overflow, it is not allowed to call functions in the DLL from within the callback function. If a call is made to a function in the DLL the function will raise an exception.

Examples

```
from ctypes import c_ubyte
from msl.equipment.resources import NKT

@NKT.DeviceStatusCallback
def device_callback(port, dev_id, status, length, address):
    # 'address' is an integer and represents the address of c_void_p␣
↪from the callback
    data = bytearray((c_ubyte * length).from_address(address)[:])
    print('The port is {!r}'.format(port))
    print('The device ID is {}'.format(dev_id))
```

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```
    print('The device status is {!r}'.format(NKT.
↪DeviceStatusTypes(status)))
    print('The device data is {!r}'.format(data))

NKT.set_callback_device_status(device_callback)
```

static set_callback_port_status(*callback*)

Enables/Disables a callback for port status changes.

Used by the *open_ports()* and *close_ports()* functions.

Parameters

callback (*PortStatusCallback*) – A *PortStatusCallback* object. Pass in None to disable callbacks.

Note: Due to a risk of circular runaway leading to stack overflow, it is not allowed to call functions in the DLL from within the callback function. If a call is made to a function in the DLL the function will raise an exception.

Examples

```
from msl.equipment.resources import NKT

@NKT.PortStatusCallback
def port_callback(port, status, cur_scan, max_scan, device):
    print('The port is {!r}'.format(port))
    print('The port status is {!r}'.format(NKT.
↪PortStatusTypes(status)))
    print('Current scanned address or device found address is {}'.
↪format(cur_scan))
    print('There are {} addresses to scan in total'.format(max_scan))
    print('Found device with type {}'.format(device))

NKT.set_callback_port_status(port_callback)
```

static set_callback_register_status(*callback*)

Enables/Disables a callback for register status changes.

Parameters

callback (*RegisterStatusCallback*) – A *RegisterStatusCallback* object. Pass in None to disable callbacks.

Note: Due to a risk of circular runaway leading to stack overflow, it is not allowed to call functions in the DLL from within the callback function. If a call is made to a function in the DLL the function will raise an exception.

Examples

```
from ctypes import c_ubyte
from msl.equipment.resources import NKT

@NKT.RegisterStatusCallback
def register_callback(port, dev_id, reg_id, reg_status, reg_type,␣
↪length, address):
    # 'address' is an integer and represents the address of c_void_p␣
↪from the callback
    data = bytearray((c_ubyte * length).from_address(address)[:])
    print('The port is {!r}'.format(port))
    print('The device ID is {}'.format(dev_id))
    print('The register ID is {}'.format(reg_id))
    print('The register status is {!r}'.format(NKT.
↪RegisterStatusTypes(reg_status)))
    print('The register type is {!r}'.format(NKT.
↪RegisterDataTypes(reg_type)))
    print('The register data is {!r}'.format(data))

NKT.set_callback_register_status(register_callback)
```

msl.equipment.resources.nkt.nktpdll.**unknown_error**(*result*)

msl.equipment.resources.omega package

Resources for equipment from OMEGA.

Submodules

msl.equipment.resources.omega.ithx module

OMEGA iTHX Series Temperature and Humidity Chart Recorder.

This class is compatible with the following model numbers:

- iTHX-W3
- iTHX-D3
- iTHX-SD
- iTHX-M
- iTHX-W
- iTHX-2

class msl.equipment.resources.omega.ithx.**iTHX**(*record*)

Bases: *ConnectionSocket*

OMEGA iTHX Series Temperature and Humidity Chart Recorder.

The *properties* for an iTHX connection supports the following key-value pairs in the *Connections Database*:

```
'nprobes': int, the number of probes the device has
'nbytes': int, the number of bytes to read from each probe
```

as well as those key-value pairs supported by the parent *ConnectionSocket* class.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

temperature(*probe=1*, *celsius=True*, *nbytes=None*)

Read the temperature.

Parameters

- **probe** (int, optional) – The probe number to read the temperature of (for iTHX's that contain multiple probes).
- **celsius** (class:*bool*, optional) – True to return the temperature in celsius, False for fahrenheit.
- **nbytes** (class:*int*, optional) – The number of bytes to read. If None then read until the termination character sequence.

Returns
float or tuple of float – The temperature.

humidity(*probe=1*, *nbytes=None*)

Read the percent humidity.

Parameters

- **probe** (int, optional) – The probe number to read the humidity of (for iTHX's that contain multiple probes).
- **nbytes** (class:*int*, optional) – The number of bytes to read. If None then read until the termination character sequence.

Returns
float or tuple of float – The percent humidity.

dewpoint(*probe=1*, *celsius=True*, *nbytes=None*)

Read the dew point.

Parameters

- **probe** (int, optional) – The probe number to read the dew point of (for iTHX's that contain multiple probes).
- **celsius** (bool, optional) – True to return the dew point in celsius, False for fahrenheit.
- **nbytes** (class:*int*, optional) – The number of bytes to read. If None then read until the termination character sequence.

Returns

`float` or `tuple` of `float` – The dew point.

temperature_humidity(*probe=1*, *celsius=True*, *nbytes=None*)

Read the temperature and the humidity.

Parameters

- **probe** (`int`, optional) – The probe number to read the temperature and humidity of (for iTHX's that contain multiple probes).
- **celsius** (`bool`, optional) – `True` to return the temperature in celsius, `False` for fahrenheit.
- **nbytes** (class:*int*, optional) – The number of bytes to read. If `None` then read until the termination character sequence. If specified, *nbytes* is the combined value to read both values.

Returns

- `float` – The temperature.
- `float` – The humidity.

temperature_humidity_dewpoint(*probe=1*, *celsius=True*, *nbytes=None*)

Read the temperature, the humidity and the dew point.

Parameters

- **probe** (`int`, optional) – The probe number to read the temperature, humidity and dew point (for iTHX's that contain multiple probes).
- **celsius** (`bool`, optional) – If `True` then return the temperature and dew point in celsius, `False` for fahrenheit.
- **nbytes** (`int`, optional) – The number of bytes to read. If `None` then read until the termination character sequence. If specified, *nbytes* is the combined value to read all three values.

Returns

- `float` – The temperature.
- `float` – The humidity.
- `float` – The dew point.

reset(*wait=True*, *password=None*, *port=2002*, *timeout=10*)

Power reset the iServer.

Some iServers accept the reset command to be sent via the TCP/UDP protocol and some require the reset command to be sent via the Telnet protocol.

Parameters

- **wait** (`bool`, optional) – Whether to wait for the connection to the iServer to be re-established before returning to the calling program. Rebooting an iServer takes about 10 to 15 seconds.
- **password** (`str`, optional) – The administrator's password of the iServer. If not specified then uses the default manufacturer's password. Only used if the iServer needs to be reset via the Telnet protocol.

- **port** (int, optional) – The port to use for the Telnet connection. Only used if the iServer needs to be reset via the Telnet protocol.
- **timeout** (float, optional) – The timeout value to use during the Telnet session. Only used if the iServer needs to be reset via the Telnet protocol.

start_logging(*path*, *wait=60*, *nprobes=None*, *nbytes=None*, *celsius=True*, *msg_format=None*, *db_timeout=10*, *validator=None*)

Start logging the temperature, humidity and dew point to the specified path.

The information is logged to an SQLite database. To stop logging press CTRL+C.

Parameters

- **path** (str) – The path to the SQLite database. If you only specify a directory then a database with the default filename, `model_serial.sqlite3`, is created/opened in this directory.
- **wait** (int, optional) – The number of seconds to wait between each log event.
- **nprobes** (int, optional) – The number of probes that the iServer has (1 or 2). If not specified then gets the value defined in *properties*. Default is 1.
- **nbytes** (int, optional) – The number of bytes to read from each probe (the probes are read sequentially). The value is passed to *temperature_humidity_dewpoint()*. If not specified then gets the value defined in *properties*. Default is None.
- **celsius** (bool, optional) – True to return the temperature and dew point in celsius, False for fahrenheit.
- **msg_format** (str, optional) – The format to use for the INFO logging messages each time data is read from an iServer. The format must use the `str.format()` syntax, `{}`. The positional arguments to `str.format()` are the values from the iServer, where the values are *(temperature, humidity, dewpoint)* for a 1-probe sensor and *(temperature1, humidity1, dewpoint1, temperature2, humidity2, dewpoint2)* for a 2-probe sensor. The keyword arguments to `str.format()` are the attributes of an *EquipmentRecord*.

  Examples:

  - T={0} H={1} D={2}
  - {connection[address]} T={0:.1f} H={1:.1f} D={2:.1f}
  - T1={0} T2={3} H1={1} H2={4} D1={2} D2={5}
  - {alias} {serial} -> T={0}C H={1}% D={2}C
- **db_timeout** (float, optional) – The number of seconds the connection to the database should wait for the lock to go away until raising an exception.
- **validator** – A callback that is used to validate the data. The callback must accept two arguments *(data, ithx)*, where *data* is a tuple of the temperature, humidity and dewpoint values for each probe and *ithx* is

the *iTHX* instance (i.e., *self*). The callback must return a value whose truthness decides whether to insert the data into the database. If the returned value evaluates to `True` then the data is inserted into the database.

static data(*path*, *start=None*, *end=None*, *as_datetime=True*, *select='*'*)

Fetch all the log records between two dates.

Parameters

- **path** (`str`) – The path to the SQLite database.
- **start** (`datetime` or `str`, optional) – Include all records that have a timestamp $\geq$ *start*. If a `str` then in the ISO 8601 `yyyy-mm-dd` or `yyyy-mm-ddTHH:MM:SS` format.
- **end** (`datetime` or `str`, optional) – Include all records that have a timestamp $\leq$ *end*. If a `str` then in the ISO 8601 `yyyy-mm-dd` or `yyyy-mm-ddTHH:MM:SS` format.
- **as_datetime** (`bool`, optional) – Whether to fetch the timestamps in the database as `datetime` objects. If `False` then the timestamps will be of type `str` and this function will return much faster if requesting data over a large date range.
- **select** (`str` or `list` of `str`, optional) – The field name(s) in the database table to use for the SELECT SQL command (e.g., `'datetime, temperature'` or `['datetime', 'humidity']`).

Returns

`list` of `tuple` – A list of `(pid, datetime, temperature, humidity, dewpoint, ...)` log records, depending on the value of *select*.

msl.equipment.resources.omega.ithx.**convert_datetime**(*value*)

Convert a date and time to a `datetime` object.

Parameters

value (`bytes`) – The datetime value from an SQLite database.

Returns

`datetime.datetime` – The *value* as a datetime object.

msl.equipment.resources.optosigma package

Resources for equipment from OptoSigma.

Submodules

msl.equipment.resources.optosigma.shot702 module

Two-axis stage controller (SHOT-702) from OptoSigma.

class msl.equipment.resources.optosigma.shot702.**SHOT702**(*record*)

Bases: *ConnectionSerial*

Two-axis stage controller (SHOT-702) from OptoSigma.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

get_input_status()

Get the I/O input connector status.

Returns
status (int) – Can either be 0 or 1 – see manual.

get_speed()

Get the speed that each stage moves to a position.

Returns

dict –

The speed of each stage. The returned value has the form:

```
{
  'stage1' : (minimum, maximum, acceleration),
  'stage2' : (minimum, maximum, acceleration),
}
```

get_speed_origin()

Get the speed that each stage moves to the origin.

Returns

dict –

The speed of each stage. The returned value has the form:

```
{
  'stage1' : (minimum, maximum, acceleration),
  'stage2' : (minimum, maximum, acceleration),
}
```

get_steps()

Get the number of steps for each stage.

Returns

- int – The number of steps for stage 1.
- int – The number of steps for stage 2.

get_travel_per_pulse()

Get the travels per pulse for each stage.

Returns

- float – The travel per pulse for stage 1.
- float – The travel per pulse for stage 2.

get_version()

Get the version number.

Returns
str – The version number.

home(*stage*)

Move the stage(s) to the home position.

Parameters
stage (int or str) – The stage(s) to home. Allowed values:

- 1 (home stage 1),
- 2 (home stage 2), or
- 'W' (home stages 1 and 2).

Raises
OptoSigmaError – If there was an error processing the command.

is_moving()

Whether a stage is busy moving.

Returns
bool – Whether a stage is busy moving.

move(*stage*, *direction*)

Start moving the stage(s), at the minimum speed, in the specified direction.

Parameters

- **stage** (int or str) – The stage(s) to move. Allowed values:
  - 1 (start moving stage 1),
  - 2 (start moving stage 2), or
  - 'W' (start moving stages 1 and 2).
- **direction** (str) – The direction that the stage(s) should move. Allowed values are:
  - '+' or '-' (move a single stage in the specified direction)
  - '++' (move stage 1 in the + direction, stage 2 in the + direction)
  - '+-' (move stage 1 in the + direction, stage 2 in the - direction)
  - '-+' (move stage 1 in the - direction, stage 2 in the + direction)
  - '--' (move stage 1 in the - direction, stage 2 in the - direction)

Raises
OptoSigmaError – If there was an error processing the command.

move_absolute(*stage*, **position*)

Move the stage(s) to the specified position.

Examples:

- move_absolute(1, 1000)

- move stage 1 to position 1000 in the + direction

- move_absolute(2, -5000)
  - move stage 2 to position 5000 in the - direction
- move_absolute('W', 1000, -5000)
  - move stage 1 to position 1000 in the + direction, and
  - move stage 2 to position 5000 in the - direction

Parameters

- **stage** (int or str) – The stage(s) to move. Allowed values: 1, 2, 'W'.
- **position** (int or tuple of int) – The position the stage(s) should move to.

Raises

OptoSigmaError – If there was an error processing the command.

move_relative(*stage*, **num_pulses*)

Move the stage(s) by a relative amount.

Examples:

- move_relative(1, 1000)
  - move stage 1 by 1000 pulses in the + direction
- move_relative(2, -5000)
  - move stage 2 by 5000 pulses in the - direction
- move_relative('W', 1000, -5000)
  - move stage 1 by 1000 pulses in the + direction, and
  - move stage 2 by 5000 pulses in the - direction

Parameters

- **stage** (int or str) – The stage(s) to move. Allowed values: 1, 2, 'W'.
- **num_pulses** (int or tuple of int) – The number of pulses the stage(s) should move.

Raises

OptoSigmaError – If there was an error processing the command.

set_mode(*stage*, *mode*)

Set whether the stage(s) can be moved by hand or by the motor.

Parameters

- **stage** (int or str) – The stage(s) to set the mode of. Allowed values:
  - 1 (set the mode for stage 1),
  - 2 (set the mode for stage 2), or
  - 'W' (set the mode for stages 1 and 2).

- **mode** (int) – Whether the stage(s) can be moved by hand (0) or motor (1).

Raises
OptoSigmaError – If there was an error processing the command.

set_origin(*stage*)

Set the origin of the stage(s) to its current position.

Parameters
stage (int or str) – The stage(s) to set the home of. Allowed values:

- 1 (set the home for stage 1),
- 2 (set the home for stage 2), or
- 'W' (set the home for stages 1 and 2).

Raises
OptoSigmaError – If there was an error processing the command.

set_output_status(*status*)

Set the I/O output status.

Parameters
status (int) – Can either be 0 or 1 – see manual.

Raises
OptoSigmaError – If there was an error processing the command.

set_speed(*stage*, *minimum*, *maximum*, *acceleration*)

Set the minimum, maximum and acceleration values when moving to a position.

Examples:

- set_speed(1, 100, 1000, 50)
  - set stage 1 to a minimum speed of 100 PPS, maximum speed of 1000 PPS and a 50 ms acceleration/deceleration time.
- set_speed(2, 1000, 5000, 200)
  - set stage 2 to a minimum speed of 1000 PPS, maximum speed of 5000 PPS and a 200 ms acceleration/deceleration time.
- set_speed('W', [100,1000], [1000,5000], [50,200])
  - set stage 1 to a minimum speed of 100 PPS, maximum speed of 1000 PPS and a 50 ms acceleration/deceleration time.
  - set stage 2 to a minimum speed of 1000 PPS, maximum speed of 5000 PPS and a 200 ms acceleration/deceleration time.

Parameters

- **stage** (int or str) – The stage(s) to set the setting for. Allowed values: 1, 2, 'W'.
- **minimum** (int or list of int) – The minimum speed (allowed range 1 - 500k).

- **maximum** (int or list of int) – The maximum speed (allowed range 1 - 500k).
- **acceleration** (int or list of int) – The acceleration and deceleration time in milliseconds (allowed range 1 - 1000).

Raises

OptoSigmaError – If there was an error processing the command.

set_speed_origin(*stage*, *minimum*, *maximum*, *acceleration*)

Set the minimum, maximum and acceleration values when moving to the origin.

Examples:

- set_speed_origin(1, 100, 1000, 50)
  - set origin speed for stage 1 to a minimum speed of 100 PPS, maximum speed of 1000 PPS and a 50 ms acceleration/deceleration time.
- set_speed_origin(2, 1000, 5000, 200)
  - set origin speed for stage 2 to a minimum speed of 1000 PPS, maximum speed of 5000 PPS and a 200 ms acceleration/deceleration time.
- set_speed_origin('W', [100,1000], [1000,5000], [50,200])
  - set origin speed for stage 1 to a minimum speed of 100 PPS, maximum speed of 1000 PPS and a 50 ms acceleration/deceleration time.
  - set origin speed for stage 2 to a minimum speed of 1000 PPS, maximum speed of 5000 PPS and a 200 ms acceleration/deceleration time.

Parameters

- **stage** (int or str) – The stage(s) to set the setting for. Allowed values: 1, 2, 'W'.
- **minimum** (int or list of int) – The minimum origin speed (allowed range 1 - 500k).
- **maximum** (int or list of int) – The maximum origin speed (allowed range 1 - 500k).
- **acceleration** (int or list of int) – The origin acceleration and deceleration time in milliseconds (allowed range 1 - 1000).

Raises

OptoSigmaError – If there was an error processing the command.

set_steps(*stage*, *num_steps*)

Set the number of steps that the stage motor will use.

See the manual for more details – the S command.

Parameters

- **stage** (int) – The stage to set the steps of (must be 1 or 2).
- **num_steps** (int) – The number of steps that the motor should use (must be one of 1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 80, 100, 125, 200, 250).

Raises
OptoSigmaError – If there was an error processing the command.

`status()`

Returns the current position and state of each stage.

Returns

- **pos1** (`int`) – The current position of stage 1.
- **pos2** (`int`) – The current position of stage 2.
- **state** (`str`) – The stopped state of the stage (one of `'L'`, `'M'`, `'W'`, `'K'`) – see the manual for more details.
- **is_moving** (`bool`) – Whether a stage is busy moving.

Raises
OptoSigmaError – If there was an error processing the command.

`stop()`

Immediately stop both stages from moving.

Raises
OptoSigmaError – If there was an error processing the command.

`stop_slowly`(*stage*)

Slowly bring the stage(s) to a stop.

Parameters
stage (`int` or `str`) – The stage(s) to slowly stop. Allowed values:

- `1` (slowly stop stage 1),
- `2` (slowly stop stage 2), or
- `'W'` (slowly stop stages 1 and 2).

Raises
OptoSigmaError – If there was an error processing the command.

`wait`(*callback=None*, *sleep=0.05*)

Wait for the stages to finish moving.

This is a blocking call because it uses `time.sleep()`.

Parameters

- **callback** (`callable()`, optional) – A callable function. The function will receive 4 arguments – the returned values from *status()*
- **sleep** (`float`, optional) – The number of seconds to wait between calls to *callback*.

msl.equipment.resources.optronic_laboratories package

Resources for equipment from Optronic Laboratories.

Submodules

msl.equipment.resources.optronic_laboratories.ol756ocx_32 module

Load the 32-bit `OL756SDKActiveXCtrl` library using MSL-LoadLib.

class msl.equipment.resources.optronic_laboratories.ol756ocx_32.**OL756**(*host*, *port*, ***kwargs*)

Bases: `Server32`

Communicates with the 32-bit `OL756SDKActiveXCtrl` library.

accumulate_signals(*meas_type*)

Function needs to be called after a measurement was performed.

This essentially accumulates the data together until the user is ready to average out the data. This function is used in combination with *reset_averaging()* and *do_averaging()*.

Parameters

meas_type (`int`) – The measurement type wanted.

- 0 - Irradiance
- 1 - Radiance
- 2 - Transmittance
- 3 - Irradiance Calibration
- 4 - Radiance Calibration
- 5 - Transmittance Calibration

connect_to_ol756(*mode*, *com_port=1*)

Desired mode to connect to OL756. If attempting to connect in RS232 or USB mode, and OL756 is not detected, then a dialog box will appear to prompt user to select either to retry, cancel or switch to DEMO.

Parameters

- **mode** (`int`) – Valid modes are:
  - -1: Disconnect. Call this before quitting the application.
  - 0: RS232
  - 1: USB
  - 2: DEMO mode
- **com_port** (`int`, optional) – If connecting through RS232 then *port* is the COM port number to use.

Returns

`int` – The mode that was actually used for the connection.

do_averaging(*meas_type*, *num_to_average*)

Function divides the accumulated signal by the number of scans performed. It then sets the array containing the data with the averaged data. This function is used in combination with *reset_averaging()* and *accumulate_signals()*.

Parameters

- **meas_type** (int) – The measurement type wanted.
  - 0 - Irradiance
  - 1 - Radiance
  - 2 - Transmittance
  - 3 - Irradiance Calibration
  - 4 - Radiance Calibration
  - 5 - Transmittance Calibration
- **num_to_average** (int) – The number of scans to average.

do_calculations(*meas_type*)

Function needs to be called after each measurement to update the calculations.

Parameters

meas_type (int) – The measurement type wanted.

- 0 - Irradiance
- 1 - Radiance
- 2 - Transmittance
- 3 - Irradiance Calibration
- 4 - Radiance Calibration
- 5 - Transmittance Calibration

enable_calibration_file(*meas_type*, *enable*)

Enables or disables the use of a calibration file.

Use this option to generate calibrated results. To open a standard file used to create a calibration, use *enable_standard_file()* instead.

The user should call *load_calibration_file()* first to load the calibration file before enabling it.

Parameters

- **meas_type** (int) – The measurement type wanted.
  - 0 - Irradiance
  - 1 - Radiance
  - 2 - Transmittance
- **enable** (bool) – Whether to enable or disable the use of a calibration file.

enable_dark_current(*enable*)

Turn the dark current on or off.

Enable this feature if you want the dark current automatically acquired and subtracted before each measurement. If you wish to take a dark current manually, see the *get_dark_current()* function.

The parameters for the dark current will need to be set using *set_dark_current_params()*.

Parameters
enable (bool) – Whether to turn the dark current on or off.

enable_pmt_protection_mode(*enable*)

Turn the PMT protection routines on or off.

Enable this feature if you want the PMT to be shielded while traveling through high intensity spikes. This feature will make the scan slower since the wavelength and filter drive will move asynchronously.

The PMT is still protected by the hardware. This function prevents exposure of the PMT while traveling.

Parameters
enable (bool) – Whether to turn the PMT protection routines on or off.

enable_standard_file(*meas_type*, *enable*)

Function enables standard files to be used.

To open a calibration file used to create a measurement, use *enable_calibration_file()* instead.

The user should call *load_standard_file()* first to load the standard file before enabling it.

Parameters

- **meas_type** (int) – The calibration measurement type wanted.
  - 3 - Irradiance Calibration
  - 4 - Radiance Calibration
  - 5 - Transmittance Calibration
- **enable** (bool) – Whether to turn the application of the standard file on or off.

export_config_file(*file_path*)

Exports the config file into a OL756 compatible configuration file.

Not all settings used will be applicable.

Parameters
file_path (str) – A valid path to save the file at.

export_registry()

Save data out to the Windows registry.

Make sure that a read was done at some point using *import_registry()*. Does not create a configuration file that can be loaded into another computer. For that particular function, call *export_config_file()*.

get_adaptive_int_time_index(*gain_index*)

Get the adaptive integration time index.

Parameters

gain_index (int) – The index of the gain to use to get the integration time.

- 0 - 1.0E-5
- 1 - 1.0E-6
- 2 - 1.0E-7
- 3 - 1.0E-8
- 4 - 1.0E-9
- 5 - 1.0E-10
- 6 - 1.0E-11

Returns

int – The adaptive integration time index.

get_cri(*meas_type*, *index*)

Get the color-rendering information.

The user should call *do_calculations()* at least once before calling this function.

Parameters

- **meas_type** (int) – The measurement type wanted.
  - 0 - Irradiance
  - 1 - Radiance
  - 2 - Transmittance
  - 3 - Irradiance Calibration
  - 4 - Radiance Calibration
  - 5 - Transmittance Calibration
- **index** (int) – The color-rendering index.
  - 0 - General CRI
  - 1 - Light Greyish Red (CRI#1)
  - 2 - Dark Greyish Yellow (CRI#2)
  - 3 - Strong Yellow Green (CRI#3)
  - 4 - Moderate Yellowish Green (CRI#4)
  - 5 - Light Bluish Green (CRI#5)
  - 6 - Light Blue (CRI#6)
  - 7 - Light Violet (CRI#7)

- 8 - Light Reddish Purple (CRI#8)
- 9 - Strong Red (CRI#9)
- 10 - Strong Yellow (CRI#10)
- 11 - Strong Green (CRI#11)
- 12 - Strong Blue (CRI#12)
- 13 - Light Yellowish Pink (CRI#13)
- 14 - Moderate Olive Green (CRI#14)

Returns
`float` – The color-rendering information.

get_cal_array()

This method allows user to get the spectral data of a calibration after it is made. The data allows the user to take the data and create their own data files.

Returns

- `int` – A pointer to an array of signals.
- `int` – The number of points acquired.

get_cal_file_enabled(*meas_type*)

Checks to see if the calibration file is enabled.

The user should call *load_calibration_file()* first to load the calibration file before enabling it.

Parameters
meas_type (`int`) – The measurement type wanted.

- 0 - Irradiance
- 1 - Radiance
- 2 - Transmittance

Returns
`bool` – Whether the calibration file is enabled.

get_calculated_data(*meas_type*, *index*)

Gets data calculated from the intensities.

The user should call *do_calculations()* at least once before calling this function.

Parameters

- **meas_type** (`int`) – The measurement type wanted.
  - 0 - Irradiance
  - 1 - Radiance
  - 2 - Transmittance
  - 3 - Irradiance Calibration
  - 4 - Radiance Calibration
  - 5 - Transmittance Calibration

- **index** (int) – The index to retrieve data of.
  - 0 - Color Temperature
  - 1 - Dominant Wavelength
  - 2 - LED Half Bandwidth
  - 3 - Left Half Bandwidth
  - 4 - Right Half Bandwidth
  - 5 - Peak Spectral Value
  - 6 - LEDPeakWavelength
  - 7 - Radiometric Value
  - 8 - Purity
  - 9 - Center Wavelength
  - 10 - Photometric Value

Returns
float – Pointer to a double to hold the data.

get_calibration_file(*meas_type*)

Get a calibration file that is loaded.

Parameters
meas_type (int) – The measurement type wanted.
- 0 - Irradiance
- 1 - Radiance
- 2 - Transmittance

Returns
str – String containing the name and path of the calibration file that is loaded for a particular measurement type.

get_chromaticity_data(*meas_type*, *index*)

Get the calculated chromaticity values requested.

Must have called *do_calculations()* at least once.

Parameters
- **meas_type** (int) – The measurement type wanted.
  - 0 - Irradiance
  - 1 - Radiance
  - 2 - Transmittance
  - 3 - Irradiance Calibration
  - 4 - Radiance Calibration
  - 5 - Transmittance Calibration

- **index** (int) – The chromaticity index value [0..70]. See the SDK manual for more details.

Returns
float – Pointer to a double to hold the data.

get_dark_current(*use_compensation*)

Takes a manual dark current.

User will have to subtract from data array by retrieving this array via a *get_cal_array()* or *get_signal_array()*. This is a special function and most users will want to use *enable_dark_current()* instead because it automatically does the subtraction.

Function if called externally by user program will not have result saved out to data file. If the *enable_dark_current()* was enabled, then this function need should not be called.

Parameters
use_compensation (int) – Adjusts dark current for more dynamic ranging using reverse current.

Returns
float – The dark current.

get_dark_current_enable()

Returns whether the dark-current mode is enabled.

Returns
bool – Whether the dark-current mode is enabled or disabled.

get_dark_current_mode()

Returns whether the dark current is taken at a wavelength or in shutter mode.

Returns

int – The dark-current mode

- 0 - Dark current in wavelength mode (taken at a particular wavelength designated by the user).
- 1 - Dark current in shutter mode

get_dark_current_wavelength()

Get the dark current wavelength.

Returns
float – Wavelength that the dark current will be taken at.

get_ending_wavelength()

Get the ending wavelength of the scan range.

Returns
float – The ending wavelength, in nanometers, of the scan range.

get_gain_index()

Get the index of the gain that will be applied when the parameters are to be sent down.

Applies to both quick scan and point to point scans.

Returns

int – The gain index.

- 0 - 1.0E-5
- 1 - 1.0E-6
- 2 - 1.0E-7
- 3 - 1.0E-8
- 4 - 1.0E-9
- 5 - 1.0E-10 (Point to Point mode only)
- 6 - 1.0E-11 (Point to Point mode only)
- 7 - Auto Gain Ranging (Point to Point mode only)

get_increment()

Get the wavelength increment that is used for a scan.

Returns

float – The wavelength increment, in nanometers.

get_increment_index()

Get the index of the wavelength increment that is used for a scan.

Applies to both quick scan and point to point scans.

Returns

int – Index of the wavelength increment of a scan.

- 0 - 0.025 nm
- 1 - 0.05 nm
- 2 - 0.1 nm
- 3 - 0.2 nm
- 4 - 0.5 nm
- 5 - 1.0 nm
- 6 - 2.0 nm
- 7 - 5.0 nm
- 8 - 10.0 nm

get_integration_time_index(*scan_mode*)

Get the index into the integration time array.

Applies to both quick scan and point to point scans. In quick scan, the speed will vary based on the scan range and increments.

Parameters

scan_mode (int) – The scan mode to use to get the index of.

Returns

int – Point to Point mode

- 0 - 1.000 sec
- 1 - 0.500 sec

- 2 - 0.200 sec
- 3 - 0.100 sec
- 4 - 0.050 sec
- 5 - 0.020 sec
- 6 - 0.010 sec
- 7 - 0.005 sec
- 8 - 0.002 sec
- 9 - 0.001 sec
- 10 - Adaptive (Point To Point mode only)

Quick Scan mode

- 0 - slowest
- 10 - fastest

get_ocx_version()

Get the version of the OL756 SDK ActiveX control.

Returns

str – The software version.

get_pmt_flux_overload()

Get the voltage of the photomultiplier tube flux overload.

Returns

float – Voltage that the PMT will determine to be at the overload point.

get_pmt_voltage()

Returns the voltage that will sent or has been sent down to the PMT.

Returns

float – Voltage value, in volts, of the photomultiplier tube.

get_quick_scan_rate()

Returns the rate at the quick scan index.

Returns

float – Rate of the quick scan at the current index in nm/s.

get_quick_scan_rate_index()

Returns the index of the quick scan rate.

Returns

int – Index of the quick scan rate.

get_scan_mode()

Get the mode the scan will be done in.

Returns

int – The scan mode

- 0 - Point to Point mode

- 1 - Quick Scan mode

get_settling_time()

Gte the settling time.

Settling time is time where the wavelength drive pauses once it reaches its target wavelength.

Returns
float – Settling time, in seconds, to be sent down or has already been sent to the system.

get_signal_array()

Get the spectral data of a measurement after it is made.

Returns
tuple – The spectral data.

get_standard_file(*meas_type*)

Retrieves the name of standard file.

Parameters
meas_type (int) – The measurement type wanted.

- 3 - Irradiance calibration
- 4 - Radiance calibration
- 5 - Transmittance calibration

Returns
str – String containing the name and path of the standard file that is loaded for a particular calibration type.

get_start_wavelength()

Get the starting wavelength of a scan.

Applies to both quick scan and point to point scans.

Returns
float – The wavelength, in nanometers, that the scan will start from.

get_std_file_enabled(*meas_type*)

Checks to see if the standard file is enabled.

The user should call *load_standard_file()* first to load the standard file before enabling it.

Parameters
meas_type (int) – The calibration type wanted.

- 0 - Irradiance
- 1 - Radiance
- 2 - Transmittance

Returns
bool – Whether a standard file is enabled.

import_config_file(*path*)

The file is a standard OL756 configuration file.

Not all settings used will be applicable. Measurement type is not used because in the SDK, the *take_point_to_point_measurement()* function has as an input the measurement type. The user should select the type and not have it based on the configuration file.

Parameters

path (str) – A valid path to load the file at.

import_registry()

Loads data from the registry.

Loads default if no registry exists. To import the configuration from another computer, use *import_config_file()* instead.

Not all settings used will be applicable. Measurement type is not used because in the SDK, the *take_point_to_point_measurement()* function has as an input the measurement type. The user should select the type and not have it based on the configuration file.

load_calibration_file(*path*, *meas_type*)

Load a calibration file.

Parameters

- **path** (str) – The path of a calibration file.
- **meas_type** (int) – The measurement type.
  - 0 - Irradiance
  - 1 - Radiance
  - 2 - Transmittance

load_standard_file(*path*, *meas_type*)

Load a standard file.

Parameters

- **path** (str) – The path of a standard file.
- **meas_type** (int) – The measurement type.
  - 3 - Irradiance Calibration
  - 4 - Radiance Calibration
  - 5 - Transmittance Calibration

manual_filter_drive_connect(*connect*)

Used to connect or disconnect the filter drive.

Disconnecting essentially acquires scans without the filter.

Parameters

connect (bool) – Connect or disconnect the filter drive. Reconnecting will home the wavelength and filter drive.

manual_get_gain()

The index of the gain that will be applied when the parameters are to be sent down.

Returns

int – The gain index.

- 0 - 1.0E-5
- 1 - 1.0E-6
- 2 - 1.0E-7
- 3 - 1.0E-8
- 4 - 1.0E-9
- 5 - 1.0E-10 (Point to Point mode only)
- 6 - 1.0E-11 (Point to Point mode only)
- 7 - Auto Gain Ranging (Point to Point mode only)

manual_get_integration_time()

Returns the integration time set in the system.

Only applies to the integration time used for Point to Point scans.

Returns

float – The integration time in seconds.

manual_get_pmt_overload()

Returns the PMT overload voltage set in the system.

Returns

float – Overload voltage, in volts, of the photomultiplier tube.

manual_get_pmt_voltage()

Returns the PMT high voltage set in the system.

Returns

float – Voltage, in volts, of the photomultiplier tube.

manual_get_settling_time()

Returns the settling time of the instrument.

Returns

float – Settling time of the system in seconds.

manual_get_signal()

Returns the signal at the current position of the wavelength drive.

Returns

float – The signal, in amperes.

manual_home_ol756()

Homes the wavelength and filter drive.

Will reconnect the filter drive if it was disconnected

manual_move_to_wavelength(*wavelength*)

Moves the wavelength drive to a particular location.

Parameters
wavelength (float) – The wavelength to move the wavelength drive to.

manual_set_gain(*gain_index*, *mode*)

Set the gain.

Parameters

- **gain_index** (int) – The gain index.
  - 0 - 1.0E-5
  - 1 - 1.0E-6
  - 2 - 1.0E-7
  - 3 - 1.0E-8
  - 4 - 1.0E-9
  - 5 - 1.0E-10 (Point to Point mode only)
  - 6 - 1.0E-11 (Point to Point mode only)
  - 7 - Auto Gain Ranging (Point to Point mode only)
- **mode** (int) – The scan mode
  - 0 - point to point
  - 1 - quick scan

manual_set_integration_time(*time*)

Sets the integration time set in the system.

Only applies to the integration time used for Point to Point scans.

Parameters
time (float) – The integration time in seconds.

manual_set_pmt_overload(*overload*)

Sets the PMT overload voltage set in the system.

Parameters
overload (float) – Overload voltage, in volts, of the photomultiplier tube in Volts.

manual_set_pmt_voltage(*voltage*)

Sets the PMT high voltage set in the system.

Parameters
voltage (float) – Voltage, in volts, of the photomultiplier tube.

manual_set_settling_time(*time*)

Sets the settling time of the instrument.

Parameters
time (float) – Settling time of the system.

move_to_wavelength(*wavelength*)

Moves the wavelength drive to a particular location.

Parameters

wavelength (float) – The wavelength, in nanometers, to move the wavelength drive to.

read_ol756_flash_settings()

Reads the saved settings from the flash memory.

Reads the settings such as the grating alignment factor, filter skew and wavelength skew. Loads these values into the ActiveX control memory.

reset_averaging(*meas_type*)

Resets the accumulated signal array for the specified measurement type.

This function is used in combination with *do_averaging()* and *accumulate_signals()*.

Parameters

meas_type (int) – The measurement type.

- 0 - Irradiance
- 1 - Radiance
- 2 - Transmittance
- 3 - Irradiance Calibration
- 4 - Radiance Calibration
- 5 - Transmittance Calibration

save_calibration_file(*meas_type*, *path*)

Create a OL756-compatible calibration file.

Parameters

- **meas_type** (int) – The measurement type.
  - 3 - Irradiance Calibration
  - 4 - Radiance Calibration
  - 5 - Transmittance Calibration
- **path** (str) – The path to save the calibration file to.

save_measurement_data(*meas_type*, *path*)

Save the measurement data to a OL756-compatible data file.

Parameters

- **meas_type** (int) – The measurement type.
  - 0 - Irradiance
  - 1 - Radiance
  - 2 - Transmittance
- **path** (str) – The path to save the data to.

send_down_parameters(*scan_mode*)

Sends down the parameters to the system.

This needs to be called whenever parameters dealing with the PMT or integration time and gain has changed. Needs to be called once before doing any measurements or other signal acquisition including dark current.

The following methods affect the parameters: *set_pmt_flux_overload_voltage()* *set_gain()* *set_integration_time()* *set_pmt_hi_voltage()* *set_settling_time()* *set_scan_range()* *set_adaptive_integration_time()*

Parameters

scan_mode (int) – The scan mode.

- 0 - Point to point
- 1 - Quick scan

set_adaptive_integration_time(*gain_index*, *speed_index*)

Sets the scan speed of the scan at a particular gain range.

Adaptive integration time is used solely for point to point scans in auto-gain ranging.

Parameters

- **gain_index** (int) – The index of the gain to use to set the integration time.
  - 0 - 1.0E-5
  - 1 - 1.0E-6
  - 2 - 1.0E-7
  - 3 - 1.0E-8
  - 4 - 1.0E-9
  - 5 - 1.0E-10
  - 6 - 1.0E-11
- **speed_index** (int) – The scan speed index [0..12] – 0=Slowest, 12=Fastest.

set_averaging_number_of_scan(*num_avg_scans*)

Set the number of scans to average.

Parameters

num_avg_scans (int) – The number of scans to average.

set_dark_current_params(*mode*, *wavelength*)

Sets the mode and the wavelength to use for a dark-current measurement.

Parameters

- **mode** (int) – The mode to use to acquire a dark-current measurement
  - 0 - wavelength
  - 1 - shutter

- **wavelength** (float) – The wavelength, in nanometers, to use for a dark-current measurement.

set_gain(*scan_mode*, *gain_index*)

Sets the index of the gain that will be applied when the parameters are to be sent down.

Applies to both quick scan and point to point scans.

Parameters

- **scan_mode** (int) – The scan mode
  - 0 - Point to Point
  - 1 - Quick Scan
- **gain_index** (int) – The gain index
  - 0 - 1.0E-5
  - 1 - 1.0E-6
  - 2 - 1.0E-7
  - 3 - 1.0E-8
  - 4 - 1.0E-9
  - 5 - 1.0E-10 (available only in Point to Point mode)
  - 6 - 1.0E-11 (available only in Point to Point mode)
  - 7 - Auto Gain Ranging (available only in Point to Point mode)

set_integration_time(*scan_mode*, *scan_speed*)

Sets the index of the scan speed used.

Applies to both quick scan and point to point scans. In quick scan, the speed will vary based on the scan range and increments.

Parameters

- **scan_mode** (int) – The scan mode
  - 0 - Point to Point
  - 1 - Quick Scan
- **scan_speed** (int) – Index to the integration time array

  Point to Point mode
  - 0 - 1.000 sec
  - 1 - 0.500 sec
  - 2 - 0.200 sec
  - 3 - 0.100 sec
  - 4 - 0.050 sec
  - 5 - 0.020 sec
  - 6 - 0.010 sec

- 7 - 0.005 sec
- 8 - 0.002 sec
- 9 - 0.001 sec
- 10 - Adaptive (Point To Point mode only)
- 11 - User defined (Point To Point mode only)

Quick Scan mode

- 0 - slowest
- 10 - fastest

set_pmt_flux_overload_voltage(*overload_voltage*)

Sets the value to use for the photomultiplier tube flux overload.

Parameters

overload_voltage (float) – Voltage that the PMT will determine to be at the overload point. Software only, because PMT has built-in protection also.

set_pmt_hi_voltage(*hi_voltage*)

Sets the value to be determined to be a flux overload by the software.

Parameters

hi_voltage (float) – Voltage, in volts, that the PMT will determine to be overload point.

set_reference_white_point(*white*, *user_def_x*, *user_def_y*)

Sets the value of the reference illuminant.

Parameters

- **white** (int) – The reference white point
  - 0 - Incandescent(A)
  - 1 - Direct Sunlight(B)
  - 2 - Indirect Sunlight(C)
  - 3 - Natural Daylight(D65)
  - 4 - Normalized Reference(E)
  - 5 - User Defined
- **user_def_x** (float) – User defined x on CIE chart.
- **user_def_y** (float) – User defined y on CIE chart.

set_scan_range(*start*, *end*, *inc_index*)

Sets the wavelength scan range.

Parameters

- **start** (float) – Starting wavelength, in nanometers.
- **end** (float) – Ending wavelength, in nanometers.
- **inc_index** (int) – Increment index, in nanometers.

set_settling_time(*time*)

Set the settling time.

Settling time is the time that the wavelength drive pauses once it reaches its target wavelength.

Parameters
time (float) – Settling Time in seconds to be sent down or has already been sent to the system.

set_tab_delimited_mode(*enable*)

Purpose of function is to set what mode to write the data files as.

Setting the tab delimited to true will write the data in a tab delimited format, else a false will write in a comma delimited format. Tab delimited files will not be compatible with some versions of the software. If you want data files to be compatible with v1.32 software and below, leave the mode to False.

Parameters
enable (bool) – Whether to use the new file format using TABs as a delimited or the old file format compatible with v1.32 and below.

set_user_defined_integration_time(*time*)

Sets the user defined integration time to be used only in point to point scans and only if the user sets the integration time mode.

Parameters
time (float) – Integration time in seconds.

stop_measurement()

Stops a measurement.

Applies only to Point to Point measurements. Quick scans are done so quickly that there is no need to stop a measurement once it starts.

take_point_to_point_calibration(*meas_type*)

Takes a calibration in point to point mode.

Need to have called *send_down_parameters()* at least once before calling any of the measurement functions or data acquisition functions.

Parameters
meas_type (int) – The measurement type.

- 3 - Irradiance Calibration
- 4 - Radiance Calibration
- 5 - Transmittance Calibration

take_point_to_point_measurement(*meas_type*)

Takes a measurement in point to point mode.

Need to have called *send_down_parameters()* at least once before calling any of the measurement functions or data acquisition functions.

Parameters
meas_type (int) – The measurement type.

- 0 - Irradiance

- 1 - Radiance
- 2 - Transmittance

take_quick_scan_calibration(*meas_type*)

Takes a calibration in quick scan mode.

Need to have called *send_down_parameters()* at least once before calling any of the measurement functions or data acquisition functions.

Parameters

meas_type (int) – The measurement type.

- 3 - Irradiance Calibration
- 4 - Radiance Calibration
- 5 - Transmittance Calibration

take_quick_scan_measurement(*meas_type*)

Takes a measurement in quick scan mode.

Need to have called *send_down_parameters()* at least once before calling any of the measurement functions or data acquisition functions.

Parameters

meas_type (int) – The measurement type.

- 0 - Irradiance
- 1 - Radiance
- 2 - Transmittance

msl.equipment.resources.optronic_laboratories.ol756ocx_64 module

Load the 32-bit OL756SDKActiveXCtrl library using MSL-LoadLib.

class msl.equipment.resources.optronic_laboratories.ol756ocx_64.**OL756**(*record=None*)

Bases: *Connection*

A wrapper around the OL756SDKActiveXCtrl library.

> **Attention:** See the *ol756ocx_32.OL756* class for all available methods.

This class can be used with either a 32- or 64-bit Python interpreter to call the 32-bit functions in the OL756SDKActiveXCtrl library.

The *properties* for an OL756 connection supports the following key-value pairs in the *Connections Database*:

```
'mode': int, connection mode (0=RS232, 1=USB) [default: 1]
'com_port': int, the COM port number (RS232 mode only) [default: 1]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

`disconnect()`
Disconnect from the OL756 spectroradiometer.

msl.equipment.resources.optronic_laboratories.ol_current_source module

Communicate with a DC current source from Optronic Laboratories.

`class msl.equipment.resources.optronic_laboratories.ol_current_source.OLCurrentSource(record)`
Bases: *ConnectionSerial*

Communicate with a DC current source from Optronic Laboratories.

Attention: The COM interface must be selected (using the buttons on the front panel) to be RS-232 after the Current Source is initially powered on. Even if this is the default power-on interface, it must be re-selected before communication will work. This is required for models with firmware revision 5.8, other firmware versions may be different.

The *properties* for the connection supports the following key-value pairs in the *Connections Database*:

```
'address': int, the internal address of the device [default: 1]
'delay': float, the number of seconds to wait between send/receive␣
↪commands [default: 0.05]
```

as well as those key-value pairs supported by the parent *ConnectionSerial* class.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

`get_current()`
Get the output current.

Returns
`float` – The value of the output current.

`get_setup(lamp, typ)`
Get the lamp setup.

Parameters

- **lamp** (`int`) – The lamp number, between 0 and 9.
- **typ** (`int`) – The type of data to read. Must be one of 40, 50, 60, 70, 80, 90, 95.
  - 40: Lamp Hours
  - 50: Recalibration interval (hours)

- 60: Target units (A, V or W)
- 70: Target value
- 80: Current limit
- 90: Lamp description text
- 95: Wattage (L or H)

Returns
`str` or `float` – The value of the data type that was requested.

`get_voltage()`
Get the output voltage.

Returns
`float` – The value of the output voltage.

`get_wattage()`
Get the output wattage.

Returns
`float` – The value of the output wattage.

`reset()`
Reset the communication buffers.

`select_lamp(number)`
Select a lamp.

Parameters
number (`int`) – The lamp number to select, between 0 and 9.

`set_current(amps)`
Set the target output current.

Parameters
amps (`float`) – The target current, in Amps. If the value is above the target current limit for the presently selected lamp setup or if the value is less than the minimum supported current, the target current will not change.

Returns
`float` – The present value of the output current.

`set_setup(lamp, typ, value)`
Set the lamp setup.

Parameters

- **lamp** (`int`) – The lamp number, between 0 and 9.
- **typ** (`int`) – The type of data to write. Must be one of 40, 50, 60, 70, 80, 90, 95.
  - 40: Lamp Hours
  - 50: Recalibration interval (hours)
  - 60: Target units (A, V or W)
  - 70: Target value

- 80: Current limit
- 90: Lamp description text
- 95: Wattage (L or H)

- **value** (str or float) – The value to write.

set_voltage(*volts*)

Set the target output voltage.

Parameters
volts (float) – The target voltage, in Volts. If the value is above the target voltage limit for the presently selected lamp setup or if the value is less than the minimum supported voltage, the target voltage will not change.

Returns
float – The present value of the output voltage.

set_wattage(*watts*)

Set the target output wattage.

Parameters
watts (float) – The target wattage, in Volts. If the value is above the target wattage limit for the presently selected lamp setup or if the value is less than the minimum supported wattage, the target wattage will not change.

Returns
float – The present value of the output wattage.

state()

Returns whether the output is on or off.

Returns
bool – True if the output is on, False if the output is off.

property system_status_byte

The system status byte that is returned in every reply.

It is constructed as follows:

- bit 7: Busy flag (the device is performing a function)
- bit 6: Reserved
- bit 5: Reserved
- bit 4: Lamp status (0=off, 1=on)
- bit 3: Reserved
- bit 2: Reserved
- bit 1: Seeking current (1=current is ramping)
- bit 0: Reserved

Type
int

target_info()

Get the target information of the currently-selected lamp.

Returns

dict – The lamp number, target value and target unit. The key-value pairs are:

```
{'lamp': int, 'value': float, 'unit': str}
```

turn_off()

Turn the output off.

turn_on()

Turn the output on.

zero_voltage_monitor()

Zero the voltage monitor.

msl.equipment.resources.picotech package

Resources for equipment from Pico Technology.

Subpackages

msl.equipment.resources.picotech.errors module

Exceptions and error codes defined in the Pico Technology SDK.

class msl.equipment.resources.picotech.errors.**PS2000Error**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OK = 0

MAX_UNITS_OPENED = 1

MEM_FAIL = 2

NOT_FOUND = 3

FW_FAIL = 4

NOT_RESPONDING = 5

CONFIG_FAIL = 6

OS_NOT_SUPPORTED = 7

PICOPP_TOO_OLD = 8

class msl.equipment.resources.picotech.errors.**PS3000Error**(*value*, *names=None*, *, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OK = 0

MAX_UNITS_OPENED = 1

MEM_FAIL = 2

NOT_FOUND = 3

FW_FAIL = 4

NOT_RESPONDING = 5

CONFIG_FAIL = 6

OS_NOT_SUPPORTED = 7

PICOPP_TOO_OLD = 8

msl.equipment.resources.picotech.picoscope package

Wrapper around the PicoScope SDK from Pico Technologies.

This package was initially created using Pico Technology SDK 64-bit v10.6.10.24

The latest SDK can be downloaded from here.

Submodules

msl.equipment.resources.picotech.picoscope.callbacks module

Callback functions in the Pico Technology SDK v10.6.10.24

msl.equipment.resources.picotech.picoscope.callbacks.**BlockReady**
All BlockReady callbacks have the same function signature, so create a generic BlockReady callback.

msl.equipment.resources.picotech.picoscope.callbacks.**ps2000aBlockReady**
ps2000aBlockReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps3000aBlockReady**
ps3000aBlockReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps4000BlockReady**
ps4000BlockReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps4000aBlockReady**
ps4000aBlockReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps5000BlockReady**
ps5000BlockReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps5000aBlockReady**
ps5000aBlockReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps6000BlockReady**
ps6000BlockReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps2000aStreamingReady**
ps2000aStreamingReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps3000aStreamingReady**
ps3000aStreamingReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps4000StreamingReady**
ps4000StreamingReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps4000aStreamingReady**
ps4000aStreamingReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps5000StreamingReady**
ps5000StreamingReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps5000aStreamingReady**
ps5000aStreamingReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps6000StreamingReady**
ps6000StreamingReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps2000aDataReady**
ps2000aDataReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps3000aDataReady**
ps3000aDataReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps4000DataReady**
ps4000DataReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps4000aDataReady**
ps4000aDataReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps5000DataReady**
ps5000DataReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps5000aDataReady**
ps5000aDataReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**ps6000DataReady**
ps6000DataReady callback

msl.equipment.resources.picotech.picoscope.callbacks.**PS3000_CALLBACK_FUNC**
PS3000_CALLBACK_FUNC callback

msl.equipment.resources.picotech.picoscope.callbacks.**GetOverviewBuffersMaxMin**
GetOverviewBuffersMaxMin callback

msl.equipment.resources.picotech.picoscope.channel module

Contains the information about a PicoScope channel.

class msl.equipment.resources.picotech.picoscope.channel.**PicoScopeChannel**(*channel*, *enabled*, *coupling*, *voltage_range*, *voltage_offset*, *bandwidth*, *max_adu_value*)

Bases: object

Contains the information about a PicoScope channel.

This class is used by *PicoScope* and is not meant to be called directly.

Parameters

- **channel** (enum.IntEnum) – The PSX000xChannel enum.
- **enabled** (bool) – Whether the channel is enabled.
- **coupling** (enum.IntEnum) – The PSX000xCoupling enum, e.g. AC or DC.
- **voltage_range** (float) – The voltage range, in Volts.
- **voltage_offset** (float) – The voltage offset, in Volts.
- **bandwidth** (enum.IntEnum or None) – The PSX000xBandwidthLimiter enum.
- **max_adu_value** (int) – The maximum analog-to-digital unit.

property channel

The PSX000xChannel enum.

Type
enum.IntEnum

property enabled

Whether the channel is enabled.

Type
bool

property coupling

The PSX000xCoupling enum, e.g. AC or DC.

Type
enum.IntEnum

property voltage_range

The voltage range, in Volts.

Type
float

property voltage_offset

The voltage offset, in Volts.

Type
float

property bandwidth

The PSX000xBandwidthLimiter enum.

Type
enum.IntEnum or None

property volts_per_adu

The conversion factor to convert ADU to volts

Type
float

property raw

The raw data, in ADU

Type
numpy.ndarray

property buffer

The raw data, in ADU

Type
numpy.ndarray

property volts

The data, in volts

Type
numpy.ndarray

property num_samples

The size of the data array.

Type
int

allocate(*num_captures*, *num_samples*)

Allocate memory to save the data.

Parameters

- **num_captures** (int) – The number of captures
- **num_samples** (int) – The number of samples

msl.equipment.resources.picotech.picoscope.enums module

Enums defined in the Pico Technology SDK v10.6.10.24

class msl.equipment.resources.picotech.picoscope.enums.**PicoScopeInfoApi**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Constants that can be passed to the *get_unit_info()* method.

DRIVER_VERSION = 0

USB_VERSION = 1

HARDWARE_VERSION = 2

VARIANT_INFO = 3

BATCH_AND_SERIAL = 4

CAL_DATE = 5

KERNEL_VERSION = 6

DIGITAL_HARDWARE_VERSION = 7

ANALOGUE_HARDWARE_VERSION = 8

FIRMWARE_VERSION_1 = 9

FIRMWARE_VERSION_2 = 10

class msl.equipment.resources.picotech.picoscope.enums.**PS2000Channel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

EXT = 4

MAX_CHANNELS = 4

NONE = 5

class msl.equipment.resources.picotech.picoscope.enums.**PS2000Range**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_MAX = 12

class msl.equipment.resources.picotech.picoscope.enums.**PS2000TimeUnits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS2000Info**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DRIVER_VERSION = 0

USB_VERSION = 1

HARDWARE_VERSION = 2

VARIANT_INFO = 3

BATCH_AND_SERIAL = 4

CAL_DATE = 5

ERROR_CODE = 6

KERNEL_DRIVER_VERSION = 7

class msl.equipment.resources.picotech.picoscope.enums.**PS2000TriggerDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

MAX = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS2000OpenProgress**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FAIL = -1

PENDING = 0

COMPLETE = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS2000EtsMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ButtonState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NO_PRESS = 0

SHORT_PRESS = 1

LONG_PRESS = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS2000SweepType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UP = 0

DOWN = 1

UPDOWN = 2

DOWNUP = 3

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS2000WaveType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINE = 0

SQUARE = 1

TRIANGLE = 2

RAMPUP = 3

RAMPDOWN = 4

DC_VOLTAGE = 5

GAUSSIAN = 6

SINC = 7

HALF_SINE = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

ADV_RISING = 2

ADV_FALLING = 3

RISING_OR_FALLING = 4

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

ADV_NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS2000TriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS2000PulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AChannelBufferIndex**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A_MAX = 0

A_MIN = 1

B_MAX = 2

B_MIN = 3

C_MAX = 4

C_MIN = 5

D_MAX = 6

D_MIN = 7

MAX = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AChannel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

EXT = 4

MAX_CHANNELS = 4

AUX = 5

MAX_TRIGGER_SOURCES = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ATriggerOperand**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

OR = 1

AND = 2

THEN = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS2000DigitalPort**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

PORT0 = 128

PORT1 = 129

PORT2 = 130

PORT3 = 131

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ADigitalChannel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

CHANNEL_0 = 0

CHANNEL_1 = 1

CHANNEL_2 = 2

CHANNEL_3 = 3

CHANNEL_4 = 4

CHANNEL_5 = 5

CHANNEL_6 = 6

CHANNEL_7 = 7

CHANNEL_8 = 8

CHANNEL_9 = 9

CHANNEL_10 = 10

CHANNEL_11 = 11

CHANNEL_12 = 12

CHANNEL_13 = 13

CHANNEL_14 = 14

CHANNEL_15 = 15

CHANNEL_16 = 16

CHANNEL_17 = 17

CHANNEL_18 = 18

CHANNEL_19 = 19

CHANNEL_20 = 20

CHANNEL_21 = 21

CHANNEL_22 = 22

CHANNEL_23 = 23

CHANNEL_24 = 24

CHANNEL_25 = 25

CHANNEL_26 = 26

CHANNEL_27 = 27

CHANNEL_28 = 28

CHANNEL_29 = 29

CHANNEL_30 = 30

CHANNEL_31 = 31

CHANNEL_MAX = 32

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ARange**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_MAX = 12

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ACoupling**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

AC = 0

DC = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AChannelInfo**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RANGES = 0

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AEtsMode**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ATimeUnits**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ASweepType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UP = 0

DOWN = 1

UPDOWN = 2

DOWNUP = 3

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AWaveType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINE = 0

SQUARE = 1

TRIANGLE = 2

RAMP_UP = 3

RAMP_DOWN = 4

SINC = 5

GAUSSIAN = 6

HALF_SINE = 7

DC_VOLTAGE = 8

MAX = 9

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AExtraOperations**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

WHITENOISE = 1

PRBS = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ASigGenTrigType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

GATE_HIGH = 2

GATE_LOW = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ASigGenTrigSource**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

SCOPE_TRIG = 1

AUX_IN = 2

EXT_IN = 3

SOFT_TRIG = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AIndexMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINGLE = 0

DUAL = 1

QUAD = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS2000A_ThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

RISING = 2

FALLING = 3

RISING_OR_FALLING = 4

ABOVE_LOWER = 5

BELOW_LOWER = 6

RISING_LOWER = 7

FALLING_LOWER = 8

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

POSITIVE_RUNT = 9

NEGATIVE_RUNT = 10

NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ADigitalDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

LOW = 1

HIGH = 2

RISING = 3

FALLING = 4

RISING_OR_FALLING = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ATriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS2000ARatioMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

AGGREGATE = 1

DECIMATE = 2

AVERAGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS2000APulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS2000AHoldOffType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

TIME = 0

MAX = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS3000Channel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

EXT = 4

MAX_CHANNELS = 4

NONE = 5

MAX_TRIGGER_SOURCES = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS3000Range**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_100V = 12

R_200V = 13

R_400V = 14

R_MAX = 15

class msl.equipment.resources.picotech.picoscope.enums.**PS3000WaveTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SQUARE = 0

TRIANGLE = 1

SINE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS3000TimeUnits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS3000Info**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DRIVER_VERSION = 0

USB_VERSION = 1

HARDWARE_VERSION = 2

VARIANT_INFO = 3

BATCH_AND_SERIAL = 4

CAL_DATE = 5

ERROR_CODE = 6

KERNEL_DRIVER_VERSION = 7

class msl.equipment.resources.picotech.picoscope.enums.**PS3000TriggerDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

MAX = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS3000OpenProgress**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FAIL = -1

PENDING = 0

COMPLETE = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS3000EtsMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

RISING = 2

FALLING = 3

RISING_OR_FALLING = 4

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS3000TriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS3000PulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ABandwidthLimiter**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

BW_FULL = 0

BW_20MHZ = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AChannelBufferIndex**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A_MAX = 0

A_MIN = 1

B_MAX = 2

B_MIN = 3

C_MAX = 4

C_MIN = 5

D_MAX = 6

D_MIN = 7

MAX = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AChannel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

EXT = 4

MAX_CHANNELS = 4

AUX = 5

MAX_TRIGGER_SOURCES = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ADigitalPort**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

PORT0 = 128

PORT1 = 129

PORT2 = 130

PORT3 = 131

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ADigitalChannel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

CHANNEL_0 = 0

CHANNEL_1 = 1

CHANNEL_2 = 2

CHANNEL_3 = 3

CHANNEL_4 = 4

```
CHANNEL_5 = 5

CHANNEL_6 = 6

CHANNEL_7 = 7

CHANNEL_8 = 8

CHANNEL_9 = 9

CHANNEL_10 = 10

CHANNEL_11 = 11

CHANNEL_12 = 12

CHANNEL_13 = 13

CHANNEL_14 = 14

CHANNEL_15 = 15

CHANNEL_16 = 16

CHANNEL_17 = 17

CHANNEL_18 = 18

CHANNEL_19 = 19

CHANNEL_20 = 20

CHANNEL_21 = 21

CHANNEL_22 = 22

CHANNEL_23 = 23

CHANNEL_24 = 24

CHANNEL_25 = 25

CHANNEL_26 = 26

CHANNEL_27 = 27

CHANNEL_28 = 28

CHANNEL_29 = 29

CHANNEL_30 = 30

CHANNEL_31 = 31

CHANNEL_MAX = 32
```

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ARange**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_MAX = 12

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ACoupling**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

AC = 0

DC = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AChannelInfo**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RANGES = 0

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AEtsMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ATimeUnits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ASweepType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UP = 0

DOWN = 1

UPDOWN = 2

DOWNUP = 3

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AWaveType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINE = 0

SQUARE = 1

TRIANGLE = 2

RAMP_UP = 3

RAMP_DOWN = 4

SINC = 5

GAUSSIAN = 6

HALF_SINE = 7

DC_VOLTAGE = 8

MAX = 9

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AExtraOperations**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

WHITENOISE = 1

PRBS = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ASigGenTrigType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

GATE_HIGH = 2

GATE_LOW = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ASigGenTrigSource**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

SCOPE_TRIG = 1

AUX_IN = 2

EXT_IN = 3

SOFT_TRIG = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AIndexMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINGLE = 0

DUAL = 1

QUAD = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS3000A_ThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

RISING = 2

FALLING = 3

RISING_OR_FALLING = 4

ABOVE_LOWER = 5

BELOW_LOWER = 6

RISING_LOWER = 7

FALLING_LOWER = 8

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

POSITIVE_RUNT = 9

NEGATIVE_RUNT = 10

NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ADigitalDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

LOW = 1

HIGH = 2

RISING = 3

FALLING = 4

RISING_OR_FALLING = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ATriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS3000ARatioMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

AGGREGATE = 1

DECIMATE = 2

AVERAGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS3000APulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS3000AHoldOffType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

TIME = 0

EVENT = 1

MAX = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ChannelBufferIndex**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A_MAX = 0

A_MIN = 1

B_MAX = 2

B_MIN = 3

C_MAX = 4

C_MIN = 5

D_MAX = 6

D_MIN = 7

MAX = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS4000Channel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

EXT = 4

MAX_CHANNELS = 4

AUX = 5

MAX_TRIGGER_SOURCES = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS4000Range**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_100V = 12

MAX_RANGES = 13

RESISTANCE_100R = 13

RESISTANCE_1K = 14

RESISTANCE_10K = 15

```
RESISTANCE_100K = 16

RESISTANCE_1M = 17

MAX_RESISTANCES = 18

ACCELEROMETER_10MV = 18

ACCELEROMETER_20MV = 19

ACCELEROMETER_50MV = 20

ACCELEROMETER_100MV = 21

ACCELEROMETER_200MV = 22

ACCELEROMETER_500MV = 23

ACCELEROMETER_1V = 24

ACCELEROMETER_2V = 25

ACCELEROMETER_5V = 26

ACCELEROMETER_10V = 27

ACCELEROMETER_20V = 28

ACCELEROMETER_50V = 29

ACCELEROMETER_100V = 30

MAX_ACCELEROMETER = 31

TEMPERATURE_UPTO_40 = 31

TEMPERATURE_UPTO_70 = 32

TEMPERATURE_UPTO_100 = 33

TEMPERATURE_UPTO_130 = 34

MAX_TEMPERATURES = 35

RESISTANCE_5K = 35

RESISTANCE_25K = 36

RESISTANCE_50K = 37

MAX_EXTRA_RESISTANCES = 38
```

class msl.equipment.resources.picotech.picoscope.enums.**PS4000Probe**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

CURRENT_CLAMP_10A = 1

CURRENT_CLAMP_1000A = 2

TEMPERATURE_SENSOR = 3

CURRENT_MEASURING_DEVICE = 4

PRESSURE_SENSOR_50BAR = 5

PRESSURE_SENSOR_5BAR = 6

OPTICAL_SWITCH = 7

UNKNOWN = 8

MAX_PROBES = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ChannelInfo**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RANGES = 0

RESISTANCES = 1

ACCELEROMETER = 2

PROBES = 3

TEMPERATURES = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000EtsMode**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000TimeUnits**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS4000SweepType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UP = 0

DOWN = 1

UPDOWN = 2

DOWNUP = 3

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000OperationTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

WHITENOISE = 1

PRBS = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS4000WaveType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINE = 0

SQUARE = 1

TRIANGLE = 2

RAMP_UP = 3

RAMP_DOWN = 4

SINC = 5

GAUSSIAN = 6

HALF_SINE = 7

DC_VOLTAGE = 8

WHITE_NOISE = 9

MAX = 10

class msl.equipment.resources.picotech.picoscope.enums.**PS4000SigGenTrigType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

GATE_HIGH = 2

GATE_LOW = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000SigGenTrigSource**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

SCOPE_TRIG = 1

AUX_IN = 2

EXT_IN = 3

SOFT_TRIG = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000IndexMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINGLE = 0

DUAL = 1

QUAD = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

RISING = 2

FALLING = 3

RISING_OR_FALLING = 4

ABOVE_LOWER = 5

BELOW_LOWER = 6

RISING_LOWER = 7

FALLING_LOWER = 8

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

POSITIVE_RUNT = 9

NEGATIVE_RUNT = 10

NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS4000TriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000RatioMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

AGGREGATE = 1

AVERAGE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS4000PulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000Ps4000HoldOffType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

TIME = 0

MAX = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000FrequencyCounterRange**(*value*, *names=No*, ***, *module=None*, *qualname=Non*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FC_2K = 0

FC_20K = 1

FC_20 = 2

FC_200 = 3

FC_MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AExtraOperations**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

WHITENOISE = 1

PRBS = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ABandwidthLimiter**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

BW_FULL = 0

BW_20KHZ = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ACoupling**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

AC = 0

DC = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AChannel**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

MAX_4_CHANNELS = 4

E = 4

F = 5

G = 6

H = 7

EXT = 8

MAX_CHANNELS = 8

AUX = 9

MAX_TRIGGER_SOURCES = 10

PULSE_WIDTH_SOURCE = 268435456

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AChannelBufferIndex**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A_MAX = 0

A_MIN = 1

B_MAX = 2

B_MIN = 3

C_MAX = 4

C_MIN = 5

D_MAX = 6

D_MIN = 7

E_MAX = 8

E_MIN = 9

F_MAX = 10

F_MIN = 11

G_MAX = 12

G_MIN = 13

H_MAX = 14

H_MIN = 15

MAX = 16

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ARange**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_100V = 12

R_200V = 13

R_MAX = 14

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AResistanceRange**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_315K = 512

R_1100K = 513

R_10M = 514

R_MAX = 3

R_ADCV = 268435456

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AEtsMode**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ATimeUnits**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ASweepType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UP = 0

DOWN = 1

UPDOWN = 2

DOWNUP = 3

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AWaveType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINE = 0

SQUARE = 1

TRIANGLE = 2

RAMP_UP = 3

RAMP_DOWN = 4

SINC = 5

GAUSSIAN = 6

HALF_SINE = 7

DC_VOLTAGE = 8

WHITE_NOISE = 9

MAX = 10

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AChannelLed**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

RED = 1

GREEN = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AMetaType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UNIT_INFO = 0

DEVICE_CAPABILITY = 1

DEVICE_SETTINGS = 2

SIGNAL_GENERATOR_SETTINGS = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AMetaOperation**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

READ = 0

WRITE = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AMetaFormat**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

COMMA_SEPERATED = 0

XML = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ASigGenTrigType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

GATE_HIGH = 2

GATE_LOW = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ASigGenTrigSource**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

SCOPE_TRIG = 1

AUX_IN = 2

EXT_IN = 3

SOFT_TRIG = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AIndexMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINGLE = 0

DUAL = 1

QUAD = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

RISING = 2

FALLING = 3

RISING_OR_FALLING = 4

ABOVE_LOWER = 5

BELOW_LOWER = 6

RISING_LOWER = 7

FALLING_LOWER = 8

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

POSITIVE_RUNT = 9

NEGATIVE_RUNT = 10

NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ATriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ASensorState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

CONNECT_STATE_FLOATING = 0

SENSOR_STATE_CONNECTED = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AFrequencyCounterRange**(*value*, *names=N*, ***, *module=None*, *qualname=No*, *type=Non*, *start=1*, *boundary=None*)

Bases: IntEnum

FC_2K = 0

FC_20K = 1

FC_20 = 2

FC_200 = 3

FC_MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AConditionsInfo**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

CLEAR = 1

ADD = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS4000ARatioMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

AGGREGATE = 1

DECIMATE = 2

AVERAGE = 4

DISTRIBUTION = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS4000APulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS4000AChannelInfo**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RANGES = 0

RESISTANCES = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS4000APicoStringValue**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

```
MEMORY = 0

MEMORY_NO_OF_SEGMENTS = 1

MEMORY_MAX_SAMPLES = 2

NO_OF_CHANNELS = 3

ARRAY_OF_CHANNELS = 4

CHANNEL = 5

CHANNEL_NAME = 6

CHANNEL_RANGE = 7

CHANNEL_COUPLING = 8

CHANNEL_ENABLED = 9

CHANNEL_ANALOGUE_OFFSET = 10

CHANNEL_BANDWIDTH = 11

TRIGGER = 12

TRIGGER_AUXIO_OUTPUT_ENABLED = 13

TRIGGER_AUTO_TRIGGER_MILLISECONDS = 14

TRIGGER_PROPERTIES = 15

NO_OF_TRIGGER_PROPERTIES = 16

TRIGGER_PROPERTIES_CHANNEL = 17

TRIGGER_PROPERTIES_THRESHOLD_UPPER = 18

TRIGGER_PROPERTIES_THRESHOLD_UPPER_HYSTERESIS = 19

TRIGGER_PROPERTIES_THRESHOLD_LOWER = 20

TRIGGER_PROPERTIES_THRESHOLD_LOWER_HYSTERESIS = 21

TRIGGER_PROPERTIES_THRESHOLD_MODE = 22

TRIGGER_ARRAY_OF_BLOCK_CONDITIONS = 23

TRIGGER_NO_OF_BLOCK_CONDITIONS = 24

TRIGGER_CONDITIONS = 25

TRIGGER_NO_OF_CONDITIONS = 26

TRIGGER_CONDITION_SOURCE = 27

TRIGGER_CONDITION_STATE = 28

TRIGGER_DIRECTION = 29
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TRIGGER_NO_OF_DIRECTIONS = 30

TRIGGER_DIRECTION_CHANNEL = 31

TRIGGER_DIRECTION_DIRECTION = 32

TRIGGER_DELAY = 33

TRIGGER_DELAY_MS = 34

FREQUENCY_COUNTER = 35

FREQUENCY_COUNTER_ENABLED = 36

FREQUENCY_COUNTER_CHANNEL = 37

FREQUENCY_COUNTER_RANGE = 38

FREQUENCY_COUNTER_TRESHOLDMAJOR = 39

FREQUENCY_COUNTER_TRESHOLDMINOR = 40

PULSE_WIDTH_PROPERTIES = 41

PULSE_WIDTH_PROPERTIES_DIRECTION = 42

PULSE_WIDTH_PROPERTIES_LOWER = 43

PULSE_WIDTH_PROPERTIES_UPPER = 44

PULSE_WIDTH_PROPERTIES_TYPE = 45

PULSE_WIDTH_ARRAY_OF_BLOCK_CONDITIONS = 46

PULSE_WIDTH_NO_OF_BLOCK_CONDITIONS = 47

PULSE_WIDTH_CONDITIONS = 48

PULSE_WIDTH_NO_OF_CONDITIONS = 49

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SAMPLE_PROPERTIES = 52

SAMPLE_PROPERTIES_PRE_TRIGGER_SAMPLES = 53

SAMPLE_PROPERTIES_POST_TRIGGER_SAMPLES = 54

SAMPLE_PROPERTIES_TIMEBASE = 55

SAMPLE_PROPERTIES_NO_OF_CAPTURES = 56

SAMPLE_PROPERTIES_RESOLUTION = 57

SAMPLE_PROPERTIES_OVERLAPPED = 58

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SAMPLE_PROPERTIES_OVERLAPPED_DOWN_SAMPLE_RATIO_MODE = 60

SAMPLE_PROPERTIES_OVERLAPPED_REQUERSTED_NO_OF_SAMPLES = 61

SAMPLE_PROPERTIES_OVERLAPPED_SEGMENT_INDEX_FROM = 62

SAMPLE_PROPERTIES_OVERLAPPED_SEGMENT_INDEX_TO = 63

SIGNAL_GENERATOR = 64

SIGNAL_GENERATOR_BUILT_IN = 65

SIGNAL_GENERATOR_BUILT_IN_WAVE_TYPE = 66

SIGNAL_GENERATOR_BUILT_IN_START_FREQUENCY = 67

SIGNAL_GENERATOR_BUILT_IN_STOP_FREQUENCY = 68

SIGNAL_GENERATOR_BUILT_IN_INCREMENT = 69

SIGNAL_GENERATOR_BUILT_IN_DWELL_TIME = 70

SIGNAL_GENERATOR_AWG = 71

SIGNAL_GENERATOR_AWG_START_DELTA_PHASE = 72

SIGNAL_GENERATOR_AWG_STOP_DELTA_PHASE = 73

SIGNAL_GENERATOR_AWG_DELTA_PHASE_INCREMENT = 74

SIGNAL_GENERATOR_AWG_DWELL_COUNT = 75

SIGNAL_GENERATOR_AWG_INDEX_MODE = 76

SIGNAL_GENERATOR_AWG_WAVEFORM_SIZE = 77

SIGNAL_GENERATOR_ARRAY_OF_AWG_WAVEFORM_VALUES = 78

SIGNAL_GENERATOR_OFFSET_VOLTAGE = 79

SIGNAL_GENERATOR_PK_TO_PK = 80

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SIGNAL_GENERATOR_SHOTS = 82

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SIGNAL_GENERATOR_SWEEP_TYPE = 84

SIGNAL_GENERATOR_TRIGGER_TYPE = 85

SIGNAL_GENERATOR_TRIGGER_SOURCE = 86

SIGNAL_GENERATOR_EXT_IN_THRESHOLD = 87

ETS = 88

ETS_STATE = 89
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ETS_CYCLE = 90

ETS_INTERLEAVE = 91

ETS_SAMPLE_TIME_PICOSECONDS = 92

class msl.equipment.resources.picotech.picoscope.enums.**PS5000Channel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

EXT = 4

MAX_CHANNELS = 4

AUX = 5

MAX_TRIGGER_SOURCES = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ChannelBufferIndex**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A_MAX = 0

A_MIN = 1

B_MAX = 2

B_MIN = 3

C_MAX = 4

C_MIN = 5

D_MAX = 6

D_MIN = 7

MAX = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS5000Range**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_MAX = 12

class msl.equipment.resources.picotech.picoscope.enums.**PS5000EtsMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS5000TimeUnits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS5000SweepType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UP = 0

DOWN = 1

UPDOWN = 2

DOWNUP = 3

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS5000WaveType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINE = 0

SQUARE = 1

TRIANGLE = 2

RAMP_UP = 3

RAMP_DOWN = 4

SINC = 5

GAUSSIAN = 6

HALF_SINE = 7

DC_VOLTAGE = 8

WHITE_NOISE = 9

MAX = 10

class msl.equipment.resources.picotech.picoscope.enums.**PS5000SigGenTrigType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

GATE_HIGH = 2

GATE_LOW = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS5000SigGenTrigSource**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

SCOPE_TRIG = 1

AUX_IN = 2

EXT_IN = 3

SOFT_TRIG = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS5000IndexMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINGLE = 0

DUAL = 1

QUAD = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

RISING = 2

FALLING = 3

RISING_OR_FALLING = 4

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS5000TriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS5000RatioMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

AGGREGATE = 1

DECIMATE = 2

AVERAGE = 4

DISTRIBUTION = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS5000PulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ChannelInfo**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RANGES = 0

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ADeviceResolution**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RES_8BIT = 0

RES_12BIT = 1

RES_14BIT = 2

RES_15BIT = 3

RES_16BIT = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AExtraOperations**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

WHITENOISE = 1

PRBS = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ABandwidthLimiter**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

BW_FULL = 0

BW_20MHZ = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ACoupling**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

AC = 0

DC = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AChannel**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

EXT = 4

MAX_CHANNELS = 4

AUX = 5

MAX_TRIGGER_SOURCES = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AChannelBufferIndex**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A_MAX = 0

A_MIN = 1

B_MAX = 2

B_MIN = 3

C_MAX = 4

C_MIN = 5

D_MAX = 6

D_MIN = 7

MAX = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ARange**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_MAX = 12

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AEtsMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ATimeUnits**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ASweepType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UP = 0

DOWN = 1

UPDOWN = 2

DOWNUP = 3

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AWaveType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINE = 0

SQUARE = 1

TRIANGLE = 2

RAMP_UP = 3

RAMP_DOWN = 4

SINC = 5

GAUSSIAN = 6

HALF_SINE = 7

DC_VOLTAGE = 8

WHITE_NOISE = 9

MAX = 10

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ASigGenTrigType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

GATE_HIGH = 2

GATE_LOW = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ASigGenTrigSource**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

SCOPE_TRIG = 1

AUX_IN = 2

EXT_IN = 3

SOFT_TRIG = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AIndexMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINGLE = 0

DUAL = 1

QUAD = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

RISING = 2

FALLING = 3

RISING_OR_FALLING = 4

ABOVE_LOWER = 5

BELOW_LOWER = 6

RISING_LOWER = 7

FALLING_LOWER = 8

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

POSITIVE_RUNT = 9

NEGATIVE_RUNT = 10

NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ATriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ATriggerWithinPreTrigger**(*value*, *names=*
***,
module=No
qualname=
type=N
start=1
boundary=No

Bases: IntEnum

DISABLE = 0

ARM = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS5000ARatioMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

AGGREGATE = 1

DECIMATE = 2

AVERAGE = 4

DISTRIBUTION = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS5000APulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS5000AChannelInfo**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RANGES = 0

class msl.equipment.resources.picotech.picoscope.enums.**PS6000ExternalFrequency**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

EF_OFF = 0

EF_5MHZ = 1

EF_10MHZ = 2

EF_20MHZ = 3

EF_25MHZ = 4

EF_MAX = 5

class msl.equipment.resources.picotech.picoscope.enums.**PS6000BandwidthLimiter**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

BW_FULL = 0

BW_20MHZ = 1

BW_25MHZ = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS6000Channel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A = 0

B = 1

C = 2

D = 3

EXT = 4

MAX_CHANNELS = 4

AUX = 5

MAX_TRIGGER_SOURCES = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS6000ChannelBufferIndex**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

A_MAX = 0

A_MIN = 1

B_MAX = 2

B_MIN = 3

C_MAX = 4

C_MIN = 5

D_MAX = 6

D_MIN = 7

MAX = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS6000Range**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

R_10MV = 0

R_20MV = 1

R_50MV = 2

R_100MV = 3

R_200MV = 4

R_500MV = 5

R_1V = 6

R_2V = 7

R_5V = 8

R_10V = 9

R_20V = 10

R_50V = 11

R_MAX = 12

class msl.equipment.resources.picotech.picoscope.enums.PS6000Coupling(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

AC = 0

DC_1M = 1

DC_50R = 2

class msl.equipment.resources.picotech.picoscope.enums.PS6000EtsMode(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

FAST = 1

SLOW = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS6000TimeUnits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FS = 0

PS = 1

NS = 2

US = 3

MS = 4

S = 5

MAX = 6

class msl.equipment.resources.picotech.picoscope.enums.**PS6000SweepType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

UP = 0

DOWN = 1

UPDOWN = 2

DOWNUP = 3

MAX = 4

class msl.equipment.resources.picotech.picoscope.enums.**PS6000WaveType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINE = 0

SQUARE = 1

TRIANGLE = 2

RAMP_UP = 3

RAMP_DOWN = 4

SINC = 5

GAUSSIAN = 6

HALF_SINE = 7

DC_VOLTAGE = 8

MAX = 9

class msl.equipment.resources.picotech.picoscope.enums.**PS6000ExtraOperations**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OFF = 0

WHITENOISE = 1

PRBS = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS6000SigGenTrigType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RISING = 0

FALLING = 1

GATE_HIGH = 2

GATE_LOW = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS6000SigGenTrigSource**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

SCOPE_TRIG = 1

AUX_IN = 2

EXT_IN = 3

SOFT_TRIG = 4

TRIGGER_RAW = 5

class msl.equipment.resources.picotech.picoscope.enums.**PS6000IndexMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SINGLE = 0

DUAL = 1

QUAD = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS6000ThresholdMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LEVEL = 0

WINDOW = 1

class msl.equipment.resources.picotech.picoscope.enums.**PS6000ThresholdDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ABOVE = 0

BELOW = 1

RISING = 2

FALLING = 3

RISING_OR_FALLING = 4

ABOVE_LOWER = 5

BELOW_LOWER = 6

RISING_LOWER = 7

FALLING_LOWER = 8

INSIDE = 0

OUTSIDE = 1

ENTER = 2

EXIT = 3

ENTER_OR_EXIT = 4

POSITIVE_RUNT = 9

NEGATIVE_RUNT = 10

NONE = 2

class msl.equipment.resources.picotech.picoscope.enums.**PS6000TriggerState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DONT_CARE = 0

TRUE = 1

FALSE = 2

MAX = 3

class msl.equipment.resources.picotech.picoscope.enums.**PS6000RatioMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

AGGREGATE = 1

AVERAGE = 2

DECIMATE = 4

DISTRIBUTION = 8

class msl.equipment.resources.picotech.picoscope.enums.**PS6000PulseWidthType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

LESS_THAN = 1

GREATER_THAN = 2

IN_RANGE = 3

OUT_OF_RANGE = 4

msl.equipment.resources.picotech.picoscope.functions module

Functions defined in the Pico Technology SDK v10.6.10.24

msl.equipment.resources.picotech.picoscope.helper module

The functions in this module are only helper functions that were initially used for wrapping the PicoScope SDK in Python. There are no user-facing functions here, only those used by a developer.

These functions are used to

Print the following to stdout

- the #define constants
- the function signatures for the PicoScope subclasses
- functions with similar function signatures

Create the following files

- picoscope_enums.py
- picoscope_structs.py

- picoscope_callbacks.py
- picoscope_function_pointers.py

msl.equipment.resources.picotech.picoscope.helper.**parse_pico_scope_api_header**(*path*)

Parse a PicoScope header file.

Parameters
path (str) – The path to a PicoScope header file.

Returns
dict – {'enums': {}, 'defines': {}, 'functions': {}, 'structs': {}, 'functypes': {}}

msl.equipment.resources.picotech.picoscope.helper.**print_define_statements**(*header_dict*)

Print the #define constants in the PicoScope header files to stdout

The output is copied and pasted to the appropriate PicoScope subclass.

For example, the stdout text below

ps5000aApi

is copied to

class PicoScope5000A(PicoScope):

msl.equipment.resources.picotech.picoscope.helper.**create_picoscope_enums_file**(*header_dict*, *picostatus_h_path*)

Creates the _picoscope_enums.py file

msl.equipment.resources.picotech.picoscope.helper.**create_picoscope_structs_file**(*header_dict*)

Creates the _picoscope_structs.py file

msl.equipment.resources.picotech.picoscope.helper.**check_enum_struct_names**()

Ensure that none of the items in ENUM_DATA_TYPE_NAMES are in STRUCT_DATA_TYPE_ALIASES

msl.equipment.resources.picotech.picoscope.helper.**create_callbacks_file**(*header_dict*)

Create the _picoscope_callbacks.py file

msl.equipment.resources.picotech.picoscope.helper.**ctypes_map**(*dtype*, *hkey*)

msl.equipment.resources.picotech.picoscope.helper.**create_picoscope_functions_file**(*header_dict*)

Create the _picoscope_functions.py file. The lists in this file are used for creating ctypes._FuncPtr objects

msl.equipment.resources.picotech.picoscope.helper.**print_class_def_signatures**(*header_dict*)

msl.equipment.resources.picotech.picoscope.helper.**print_common_functions**(*header_dict*, *ps_name*)

msl.equipment.resources.picotech.picoscope.picoscope module

Base class for a PicoScope from Pico Technology.

msl.equipment.resources.picotech.picoscope.picoscope.**enumerate_units**()

Find the PicoScopes that are connected to the computer.

This function counts the number of PicoScopes connected to the computer, and returns a list of serial numbers as a string.

Note: You cannot call this function after you have opened a connection to a PicoScope.

Returns

list of str – A list of serial numbers of the PicoScopes that were found.

class msl.equipment.resources.picotech.picoscope.picoscope.**PicoScope**(*record*, *func_ptrs*)

Bases: *ConnectionSDK*

Use the PicoScope SDK to communicate with the oscilloscope.

The *properties* for a PicoScope connection supports the following key-value pairs in the *Connections Database*:

```
'open': bool, Whether to open the connection synchronously [default: True]
'open_async': bool, Whether to open the connection asynchronously␣
↪[default: False]
'auto_select_power': bool, For devices that can be powered by an AC␣
↪adaptor or a USB cable [default: True]
'resolution': str, Only valid for ps5000a [default: '8bit']
```

The SDK version that was initially used to create this base class and the PicoScope subclasses was *Pico Technology SDK 64-bit v10.6.10.24*

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

- **record** (*EquipmentRecord*) – A record from an *Equipment-Register Database*.
- **func_ptrs** (*functions*) – The appropriate function-pointer list for the SDK.

property handle

Returns the handle to the SDK library.

Type

int

property channel

The information about each channel.

Type

dict of *PicoScopeChannel*

property dt

The time between voltage samples (i.e., delta t).

Type
float

property pre_trigger

The number of seconds that data was acquired for before the trigger event.

Type
float

close_unit()

Disconnect from the PicoScope.

disconnect()

Disconnect from the PicoScope.

get_unit_info(*info=None*, *include_name=True*)

Retrieves information about the PicoScope.

This function retrieves information about the specified oscilloscope. If the device fails to open, or no device is opened only the driver version is available.

Parameters

- **info** (*PicoScopeInfoApi*, *PS2000Info* or *PS3000Info*, optional) – An enum value, or if None then request all information from the PicoScope. The enum depends on the model number of the PicoScope that you are connected to.
- **include_name** (bool, optional) – If True then includes the enum member name as a prefix. For example, returns 'CAL_DATE: 09Aug16' if *include_name* is True else '09Aug16'.

Returns
str – The requested information from the PicoScope.

is_ready()

Has the PicoScope collecting the requested number of samples?

This function may be used instead of a callback function to receive data from *run_block()*. To use this method, pass None as the callback parameter in *run_block()*. You must then poll the driver to see if it has finished collecting the requested samples.

Returns
bool – Whether the PicoScope has collected the requested number of samples.

maximum_value()

int: This function returns the maximum ADC count.

minimum_value()

int: This function returns the minimum ADC count.

ping_unit()

Ping the PicoScope.

This function can be used to check that the already opened device is still connected to the USB port and communication is successful.

run_block(*pre_trigger=0.0*, *callback=None*, *segment_index=0*)

Start collecting data in block mode.

All input arguments are ignored for ps2000 and ps3000.

Parameters

- **pre_trigger** (float, optional) – The number of seconds before the trigger event to start acquiring data.
- **segment_index** (int, optional) – Specifies which memory segment to save the data to (see manual).
- **callback** (*BlockReady*, optional) – A BlockReady callback function.

run_streaming(*pre_trigger=0.0*, *auto_stop=True*, *factor=1*, *ratio_mode='NONE'*)

Start collecting data in streaming mode.

This function tells the oscilloscope to start collecting data in streaming mode. When data has been collected from the device it is down sampled if necessary and then delivered to the application. Call *get_streaming_latest_values()* to retrieve the data.

When a trigger is set, the total number of samples stored in the driver is the sum of *max_pre_trigger_samples* and *max_post_trigger_samples*. If *auto_stop* is false then this will become the maximum number of samples without down sampling.

The *ratio_mode* argument is ignored for ps4000 and ps5000.

Parameters

- **pre_trigger** (float, optional) – The number of seconds before the trigger event to start acquiring data.
- **auto_stop** (bool, optional) – A flag that specifies if the streaming should stop when all of samples have been captured.
- **factor** (int, optional) – The down-sampling factor that will be applied to the raw data.
- **ratio_mode** (enum.IntEnum, optional) – Which down-sampling mode to use.

set_channel(*channel*, *coupling='dc'*, *scale='10V'*, *offset=0.0*, *bandwidth='full'*, *enabled=True*)

Configure a channel.

This function specifies whether an input channel is to be enabled, its input coupling type, voltage range, analog offset and bandwidth limit. Some of the arguments within this function have model-specific values. Please consult the manual according to the model you have.

The *bandwidth* argument is only used for ps6000.

The *offset* and *bandwidth* arguments are ignored for ps2000, ps3000, ps4000 and ps5000.

Parameters

- **channel** (enum.IntEnum) – The channel to be configured

- **coupling** (enum.IntEnum, optional) – The impedance and coupling type.
- **scale** (enum.IntEnum, optional) – The input voltage range.
- **offset** (float, optional) – A voltage to add to the input channel before digitization. The allowable range of offsets depends on the input range selected for the channel, as obtained from *get_analogue_offset()*.
- **bandwidth** (enum.IntEnum, optional) – The bandwidth limiter to use.
- **enabled** (bool, optional) – Whether to enable the channel.

set_timebase(*dt*, *duration*, *segment_index=0*, *oversample=0*)

Set the timebase information.

The *segment_index* is ignored for ps2000 and ps3000.

The *oversample* argument is ignored by ps2000a, ps3000a, ps4000a and ps5000a.

Parameters

- **dt** (float) – The sampling interval, in seconds.
- **duration** (float) – The number of seconds to acquire data for.
- **segment_index** (int, optional) – Which memory segment to save the data to.
- **oversample** (int, optional) – The amount of over-sample required.

Returns

- float – The sampling interval, i.e. dt.
- int – The number of samples that will be acquired.

Raises

PicoTechError – If the timebase or duration is invalid.

set_trigger(*channel*, *threshold*, *delay=0.0*, *direction='rising'*, *timeout=0.1*, *enable=True*)

Set up the trigger.

Parameters

- **channel** (enum.IntEnum) – The trigger channel.
- **threshold** (float) – The threshold voltage to signal a trigger event.
- **delay** (float, optional) – The time, in seconds, between the trigger occurring and the first sample.
- **direction** (enum.IntEnum, optional) – The direction in which the signal must move to cause a trigger.
- **timeout** (float, optional) – The time, in seconds, to wait to automatically create a trigger event if no trigger event occurs. If *timeout* <= 0 then wait indefinitely for a trigger. Only accurate to the nearest millisecond.
- **enable** (bool, optional) – Set to False to disable the trigger for this channel. Not used for ps2000 or ps3000.

stop()

Stop the oscilloscope from sampling data.

If this function is called before a trigger event occurs, then the oscilloscope may not contain valid data.

wait_until_ready()

Blocking function to wait for the scope to finish acquiring data.

set_pulse_width_qualifier(*conditions*, *direction*, *lower*, *upper*, *pulse_width_type*)

This function sets up pulse width qualification, which can be used on its own for pulse width triggering or combined with other triggering to produce more complex triggers. The pulse width qualifier is set by defining a list of `PwqConditions` structures, which are found in the *structs* module.

msl.equipment.resources.picotech.picoscope.picoscope_2k3k module

Base class for the ps2000 and ps3000 PicoScopes.

class msl.equipment.resources.picotech.picoscope.picoscope_2k3k.**PicoScope2k3k**(*record*, *func_ptrs*)

Bases: *PicoScope*

Use the PicoScope SDK to communicate with ps2000 and ps3000 oscilloscopes.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

- **record** (*EquipmentRecord*) – A record from an *Equipment-Register Database*.
- **func_ptrs** (*functions*) – The appropriate function-pointer list for the SDK.

errcheck_zero(*result*, *func*, *args*)

If the SDK function returns 0 then raise an exception.

errcheck_one(*result*, *func*, *args*)

If the SDK function returns 1 then raise an exception.

errcheck_negative_one(*result*, *func*, *args*)

If the SDK function returns -1 then raise an exception.

flash_led()

Flashes the LED on the front of the oscilloscope three times and returns within one second.

get_streaming_last_values(*lp_get_overview_buffers_max_min*)

This function is used to collect the next block of values while fast streaming is running. You must call *run_streaming_ns()* beforehand to set up fast streaming.

get_streaming_values(*no_of_values*, *no_of_samples_per_aggregate*)

This function is used after the driver has finished collecting data in fast streaming mode. It allows you to retrieve data with different aggregation ratios, and thus zoom in to and out of any region of the data.

get_streaming_values_no_aggregation(*no_of_values*)

This function retrieves raw streaming data from the driver's data store after fast streaming has stopped.

get_timebase(*timebase*, *no_of_samples*, *oversample=0*)

This function discovers which timebases are available on the oscilloscope. You should set up the channels using *set_channel()* and, if required, ETS mode using *set_ets()* first. Then call this function with increasing values of timebase, starting from 0, until you find a timebase with a sampling interval and sample count close enough to your requirements.

get_times_and_values(*time_units*, *no_of_values*)

This function is used to get values and times in block mode after calling *run_block()*.

get_values(*num_values*)

This function is used to get values in compatible streaming mode after calling *run_streaming()*, or in block mode after calling *run_block()*.

open_unit()

This function opens a PicoScope 2000/3000 Series oscilloscope. The driver can support up to 64 oscilloscopes.

open_unit_async()

This function opens a PicoScope 2000/3000 Series oscilloscope without waiting for the operation to finish. You can find out when it has finished by periodically calling *open_unit_progress()*, which returns a value of 100 when the scope is open.

The driver can support up to 64 oscilloscopes.

open_unit_progress()

This function checks on the progress of *open_unit_async()*.

The function will return a value from 0 to 100, where 100 implies that the operation is complete.

overview_buffer_status()

This function indicates whether or not the overview buffers used by *run_streaming_ns()* have overrun. If an overrun occurs, you can choose to increase the overview_buffer_size argument that you pass in the next call to *run_streaming_ns()*.

run_streaming_ns(*sample_interval*, *time_units*, *max_samples*, *auto_stop*, *no_of_samples_per_aggregate*, *overview_buffer_size*)

This function tells the scope unit to start collecting data in fast streaming mode . The function returns immediately without waiting for data to be captured. After calling this function, you should next call *get_streaming_last_values()* to copy the data to your application's buffer.

set_adv_trigger_channel_directions(*channel_a*, *channel_b*, *channel_c*, *channel_d*, *ext*)

This function sets the direction of the trigger for each channel.

set_adv_trigger_delay(*delay*, *pre_trigger_delay*)

This function sets the pre-trigger and post-trigger delays. The default action, when both these delays are zero, is to start capturing data beginning with the trigger event and to stop a specified time later. The start of capture can be delayed by using a nonzero value of `delay`. Alternatively, the start of capture can be advanced to a time before the trigger event by using

a negative value of `pre_trigger_delay`. If both arguments are non-zero then their effects are added together.

set_ets(*mode*, *ets_cycles*, *ets_interleave*)

This function is used to enable or disable ETS (equivalent time sampling) and to set the ETS parameters.

set_trigger(*source*, *threshold*, *direction*, *delay*, *auto_trigger_ms*)

This function just calls *set_trigger2()*, since Python supports a floating-point value for defining the `delay` parameter.

set_trigger2(*source*, *threshold*, *direction*, *delay*, *auto_trigger_ms*)

This function is used to enable or disable triggering and its parameters. It has the same behaviour as *set_trigger()*, except that the delay parameter is a floating-point value.

For oscilloscopes that support advanced triggering, see *set_adv_trigger_channel_conditions()* and related functions.

set_adv_trigger_channel_properties(*channel_properties*, *auto_trigger_milliseconds*)

This function is used to enable or disable triggering and set its parameters.

set_adv_trigger_channel_conditions(*conditions*)

This function sets up trigger conditions on the scope's inputs. The trigger is set up by defining a list of `TriggerConditions` structures, which are found in the *structs* module. Each structure is the `AND` of the states of one scope input.

msl.equipment.resources.picotech.picoscope.picoscope_api module

Base class for the PicoScopes that have a header file which ends with *Api.h.

Namely, ps2000aApi, ps3000aApi, ps4000Api, ps4000aApi, ps5000Api, ps5000aApi and ps6000Api.

class msl.equipment.resources.picotech.picoscope.picoscope_api.**PicoScopeApi**(*record*, *func_ptrs*)

Bases: *PicoScope*

Base class for the PicoScopes that have a header file which ends with *Api.h.

Use the PicoScope SDK to communicate with the ps2000a, ps3000a, ps4000, ps4000a, ps5000, ps5000a and ps6000 oscilloscopes.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

- **record** (*EquipmentRecord*) – A record from an *Equipment-Register Database*.
- **func_ptrs** (*functions*) – The appropriate function-pointer list for the SDK.

errcheck_api(*result*, *func*, *args*)

The SDK function returns PICO_OK if the function call was successful.

change_power_source(*power_state*)

Change the power source.

This function selects the power supply mode. You must call this function if any of the following conditions arises:

- USB power is required
- the AC power adapter is connected or disconnected during use
- a USB 3.0 scope is plugged into a USB 2.0 port (indicated if any function returns the `PICO_USB3_0_DEVICE_NON_USB3_0_PORT` status code)

This function is only valid for ps3000a, ps4000a and ps5000a.

current_power_source()

This function returns the current power state of the device.

This function is only valid for ps3000a, ps4000a and ps5000a.

flash_led(*action*)

This function flashes the LED on the front of the scope without blocking the calling thread. Calls to *run_streaming()* and *run_block()* cancel any flashing started by this function. It is not possible to set the LED to be constantly illuminated, as this state is used to indicate that the scope has not been initialized.

get_analogue_offset(*voltage_range*, *coupling*)

This function is used to get the maximum and minimum allowable analog offset for a specific voltage range.

This function is invalid for ps4000 and ps5000.

get_channel_information(*channel*, *info='ranges'*)

This function queries which ranges are available on a scope device.

This function is invalid for ps5000 and ps6000.

Parameters

- **channel** (enum.IntEnum) – 0=ChannelA, 1=ChannelB, ...
- **info** (enum.IntEnum, optional) – A `ChannelInfo` enum value or enum member name.

get_max_down_sample_ratio(*num_unaggreated_samples*, *mode='None'*, *segment_index=0*)

Returns

int – This function returns the maximum down-sampling ratio that can be used for a given number of samples in a given down-sampling mode.

get_max_segments()

This function is valid for ps2000a, ps3000a, ps4000a and ps5000a.

Returns

int – This function returns the maximum number of segments allowed for the opened device. This number is the maximum value of `nsegments` that can be passed to *memory_segments()*.

get_no_of_captures()

This function finds out how many captures are available in rapid block mode after *run_block()* has been called when either the collection completed or the collection of waveforms was interrupted by calling *stop()*. The returned value (`nCaptures`) can then be used to iterate through the number of segments using *get_values()*, or in a single call to *get_values_bulk()* where it is used to calculate the `toSegmentIndex` parameter.

Not valid for ps5000.

get_num_of_processed_captures()

This function finds out how many captures in rapid block mode have been processed after *run_block()* has been called when either the collection completed or the collection of waveforms was interrupted by calling *stop()*. The returned value (`nCaptures`) can then be used to iterate through the number of segments using *get_values()*, or in a single call to *get_values_bulk()* where it is used to calculate the `toSegmentIndex` parameter.

Not valid for ps4000 and ps5000.

get_streaming_latest_values(*lp_ps*)

This function instructs the driver to return the next block of values to your *StreamingReady callback*. You must have previously called *run_streaming()* beforehand to set up streaming.

get_timebase(*timebase*, *num_samples=0*, *segment_index=0*, *oversample=0*)

Since Python supports the `float` data type, this function returns *get_timebase2()*. The timebase that is returned is in **seconds** (not ns).

This function calculates the sampling rate and maximum number of samples for a given timebase under the specified conditions. The result will depend on the number of channels enabled by the last call to *set_channel()*.

The *oversample* argument is only used by ps4000, ps5000 and ps6000.

get_timebase2(*timebase*, *num_samples=0*, *segment_index=0*, *oversample=0*)

This function is an upgraded version of *get_timebase()*, and returns the time interval as a `float` rather than an `int`. This allows it to return sub-nanosecond time intervals. See *get_timebase()* for a full description.

The timebase that is returned is in **seconds** (not ns).

The *oversample* argument is only used by ps4000, ps5000 and ps6000.

get_trigger_time_offset(*segment_index=0*)

This function gets the time, as two 4-byte values, at which the trigger occurred. Call it after block-mode data has been captured or when data has been retrieved from a previous block-mode capture. A 64-bit version of this function, *get_trigger_time_offset64()*, is also available.

get_trigger_time_offset64(*segment_index=0*)

This function gets the time, as a single 64-bit value, at which the trigger occurred. Call it after block-mode data has been captured or when data has been retrieved from a previous block-mode capture. A 32-bit version of this function, *get_trigger_time_offset()*, is also available.

get_values(*num_samples=None*, *start_index=0*, *factor=1*, *ratio_mode='None'*, *segment_index=0*)

This function returns block-mode data, with or without down sampling, starting at the specified sample number. It is used to get the stored data from the driver after data collection has stopped.

Parameters

- **num_samples** (int or None, optional) – The number of samples required. If None then automatically determine the number of samples to retrieve.
- **start_index** (int, optional) – A zero-based index that indicates the start point for data collection. It is measured in sample intervals from the start of the buffer.
- **factor** (int, optional) – The down-sampling factor that will be applied to the raw data.
- **ratio_mode** (enum.IntEnum, optional) – Which down-sampling mode to use. A RatioMode enum.
- **segment_index** (int, optional) – The zero-based number of the memory segment where the data is stored.

get_values_async(*lp_data_ready*, *num_samples=None*, *start_index=0*, *factor=1*, *ratio_mode='None'*, *segment_index=0*)

This function returns data either with or without down sampling, starting at the specified sample number. It is used to get the stored data from the scope after data collection has stopped. It returns the data using the lp_data_ready callback.

Parameters

- **lp_data_ready** (*callback*) – A *DataReady callback* function.
- **num_samples** (int, optional) – The number of samples required. If None then automatically determine the number of samples to retrieve.
- **start_index** (int, optional) – A zero-based index that indicates the start point for data collection. It is measured in sample intervals from the start of the buffer.
- **factor** (int, optional) – The downsampling factor that will be applied to the raw data.
- **ratio_mode** (enum.IntEnum, optional) – Which down-sampling mode to use. A RatioMode enum.
- **segment_index** (int, optional) – The zero-based number of the memory segment where the data is stored.

get_values_bulk(*from_segment_index=0*, *to_segment_index=None*, *factor=1*, *ratio_mode='None'*)

This function retrieves waveforms captured using rapid block mode. The waveforms must have been collected sequentially and in the same run.

The *down_sample_ratio* and *down_sample_ratio_mode* arguments are ignored for ps4000 and ps5000.

get_values_overlapped(*start_index*, *down_sample_ratio*, *down_sample_ratio_mode*, *segment_index*)

This function allows you to make a deferred data-collection request, which will later be executed, and the arguments validated, when you call *run_block()* in block mode. The advantage of this function is that the driver makes contact with the scope only once, when you call *run_block()*, compared with the two contacts that occur when you use the conventional *run_block()*, *get_values()* calling sequence. This slightly reduces the dead time between successive captures in block mode.

This function is invalid for ps4000 and ps5000.

get_values_overlapped_bulk(*start_index*, *down_sample_ratio*, *down_sample_ratio_mode*, *from_segment_index*, *to_segment_index*)

This function allows you to make a deferred data-collection request, which will later be executed, and the arguments validated, when you call *run_block()* in rapid block mode. The advantage of this method is that the driver makes contact with the scope only once, when you call *run_block()*, compared with the two contacts that occur when you use the conventional *run_block()*, *get_values_bulk()* calling sequence. This slightly reduces the dead time between successive captures in rapid block mode.

This function is invalid for ps4000 and ps5000.

get_values_trigger_time_offset_bulk(*from_segment_index*, *to_segment_index*)

This function retrieves the time offsets, as lower and upper 32-bit values, for waveforms obtained in rapid block mode. This function is provided for use in programming environments that do not support 64- bit integers. If your programming environment supports this data type, it is easier to use *get_values_trigger_time_offset_bulk64()*.

get_values_trigger_time_offset_bulk64(*from_segment_index=0*, *to_segment_index=None*)

This function retrieves the 64-bit time offsets for waveforms captured in rapid block mode.

A 32-bit version of this function, *get_values_trigger_time_offset_bulk()*, is available for use with programming languages that do not support 64-bit integers

hold_off(*holdoff*, *holdoff_type*)

This function is for backward compatibility only and is not currently used.

This function is only defined for ps2000a, ps3000a and ps4000.

is_led_flashing()

This function reports whether or not the LED is flashing.

This function is supported by ps4000, ps4000a and ps5000.

is_trigger_or_pulse_width_qualifier_enabled()

This function discovers whether a trigger, or pulse width triggering, is enabled.

memory_segments(*num_segments*)

This function sets the number of memory segments that the scope will use. When the scope is opened, the number of segments defaults to 1, meaning that each capture fills the scopes available memory. This function allows you to divide the memory into a number of segments so that the scope can store several waveforms sequentially.

no_of_streaming_values()

This function returns the number of samples available after data collection in streaming mode. Call it after calling *stop()*.

open_unit(*auto_select_power=True*, *resolution='8Bit'*)

Open the PicoScope for communication.

This function opens a PicoScope attached to the computer. The maximum number of units that can be opened depends on the operating system, the kernel driver and the computer.

Parameters

- **auto_select_power** (bool, optional) – PicoScopes that can be powered by either DC power or by USB power may raise PICO_POWER_SUPPLY_NOT_CONNECTED if the DC power supply is not connected. Passing in True will automatically switch to the USB power source.
- **resolution** (str, optional) – The ADC resolution: 8, 12, 14, 15 or 16Bit. Only used by the PS5000A Series and it is ignored for all other PicoScope Series.

open_unit_async(*auto_select_power=True*, *resolution='8Bit'*)

This function opens a scope without blocking the calling thread. You can find out when it has finished by periodically calling *open_unit_progress()* until that function returns a value of 100.

Parameters

- **auto_select_power** (bool, optional) – PicoScopes that can be powered by either DC power or by USB power may raise PICO_POWER_SUPPLY_NOT_CONNECTED if the DC power supply is not connected. Passing in True will automatically switch to the USB power source.
- **resolution** (str, optional) – The ADC resolution: 8, 12, 14, 15 or 16Bit. Only used by the PS5000A Series and it is ignored for all other PicoScope Series.

open_unit_progress()

This function checks on the progress of a request made to *open_unit_async()* to open a scope. The return value is from 0 to 100, where 100 implies that the operation is complete.

set_bandwidth_filter(*channel*, *bandwidth*)

This function is reserved for future use.

This function is only valid for ps3000a, ps4000a and ps5000a.

set_data_buffer(*channel*, *buffer=None*, *mode='None'*, *segment_index=0*)

Set the data buffer for the specified channel.

The *mode* argument is ignored for ps4000 and ps5000. The *segment_index* argument is ignored for ps4000, ps5000 and ps6000.

Parameters

- **channel** (enum.IntEnum) – An enum value or member name from Channel.

- **buffer** (numpy.ndarray, optional) – A int16, numpy array. If None then use a pre-allocated array.
- **mode** (enum.IntEnum, optional) – An enum value or member name from RatioMode.
- **segment_index** (int, optional) – The zero-based number of the memory segment where the data is stored.

set_data_buffer_bulk(*channel*, *buffer*, *waveform*, *mode='None'*)

This function allows you to associate a buffer with a specified waveform number and input channel in rapid block mode. The number of waveforms captured is determined by the nCaptures argument sent to *set_no_of_captures()*. There is only one buffer for each waveform because the only down-sampling mode that requires two buffers, aggregation mode, is not available in rapid block mode. Call one of the GetValues functions to retrieve the data after capturing.

This function is only valid for ps4000, ps5000 and ps6000.

The *down_sample_ratio_mode* argument is ignored for ps4000 and ps5000.

set_data_buffers(*channel*, *buffer_length*, *mode*, *segment_index*)

This function tells the driver where to store the data, either unprocessed or down sampled, that will be returned after the next call to one of the GetValues functions. The function allows you to specify only a single buffer, so for aggregation mode, which requires two buffers, you need to call *set_data_buffers()* instead.

You must allocate memory for the buffer before calling this function.

The *mode* argument is ignored for ps4000 and ps5000.

The *segment_index* argument is ignored for ps4000, ps5000 and ps6000.

set_digital_port(*port*, *enabled*, *logic_level*)

This function is used to enable the digital port and set the logic level (the voltage at which the state transitions from 0 to 1).

This function is only used by ps2000a and ps3000a.

set_ets(*mode*, *ets_cycles*, *ets_interleave*)

This function is used to enable or disable ETS (equivalent-time sampling) and to set the ETS parameters. See ETS overview for an explanation of ETS mode.

set_ets_time_buffer(*buffer*)

This function tells the driver where to find your applications ETS time buffers. These buffers contain the 64-bit timing information for each ETS sample after you run a block-mode ETS capture.

Parameters

buffer (ctypes.c_longlong) – An array of 64-bit words (ctypes.c_int64), each representing the time, in picoseconds, at which the sample was captured.

set_ets_time_buffers(*time_upper*, *time_lower*)

This function tells the driver where to find your applications ETS time buffers. These buffers contain the timing information for each ETS sample after you run a blockmode ETS capture. There are two buffers containing the upper and lower 32-bit parts of the timing information, to allow programming languages that do not support 64-bit data to retrieve the timings.

set_frequency_counter(*channel*, *enabled*, *range*, *threshold_major*, *threshold_minor*)

This function is only define in the header file and it is not in the manual. This function is only valid for ps4000 and ps4000a.

set_no_of_captures(*n_captures*)

This function sets the number of captures to be collected in one run of rapid block mode. If you do not call this function before a run, the driver will capture only one waveform. Once a value has been set, the value remains constant unless changed.

set_sig_gen_arbitrary(*waveform*, *repetition_rate=None*, *offset_voltage=0.0*, *pk_to_pk=None*, *start_delta_phase=None*, *stop_delta_phase=None*, *delta_phase_increment=0*, *dwell_count=None*, *sweep_type='up'*, *operation='off'*, *index_mode='single'*, *shots=None*, *sweeps=None*, *trigger_type='rising'*, *trigger_source='None'*, *ext_in_threshold=0*)

This function programs the signal generator to produce an arbitrary waveform.

Parameters

- **waveform** (numpy.ndarray) – The arbitrary waveform, in volts.
- **repetition_rate** (float, optional) – The requested repetition rate (frequency) of the entire arbitrary waveform. The actual repetition rate that is used may be different based on the specifications of the AWG. If specified then the *sig_gen_frequency_to_phase()* method is called to determine the value of *start_delta_phase*.
- **offset_voltage** (float, optional) – The voltage offset, in volts, to be applied to the waveform.
- **pk_to_pk** (float, optional) – The peak-to-peak voltage, in volts, of the waveform signal. If None then uses the maximum value of the waveform to determine the peak-to-peak voltage.
- **start_delta_phase** (int, optional) – The initial value added to the phase accumulator as the generator begins to step through the waveform buffer.
- **stop_delta_phase** (int, optional) – The final value added to the phase accumulator before the generator restarts or reverses the sweep. When frequency sweeping is not required, set equal to *start_delta_phase*.
- **delta_phase_increment** (int, optional) – The amount added to the delta phase value every time the *dwell_count* period expires. This determines the amount by which the generator sweeps the output frequency in each dwell period. When frequency sweeping is not required, set to zero.
- **dwell_count** (int, optional) – The time, in units of dacPeriod, between successive additions of *delta_phase_increment* to the delta phase accumulator. This determines the rate at which the generator sweeps the output frequency.
- **sweep_type** (enum.IntEnum, optional) – Whether the frequency will sweep from *start_frequency* to *stop_frequency*, or in the opposite direction, or repeatedly reverse direction. One of: UP, DOWN, UPDOWN, DOWNUP

- **operation** (enum.IntEnum, optional) – The type of waveform to be produced, specified by one of the following enumerated types (B models only): OFF, WHITENOISE, PRBS
- **index_mode** (enum.IntEnum, optional) – Specifies how the signal will be formed from the arbitrary waveform data. Possible values are SINGLE or DUAL.
- **shots** (int, optional) – If None then start and run continuously after trigger occurs.
- **sweeps** (int, optional) – If None then start a sweep and continue after trigger occurs.
- **trigger_type** (enum.IntEnum, optional) – The type of trigger that will be applied to the signal generator. One of: RISING, FALLING, GATE_HIGH, GATE_LOW.
- **trigger_source** (enum.IntEnum, optional) – The source that will trigger the signal generator. If None then run without waiting for trigger.
- **ext_in_threshold** (int, optional) – Used to set trigger level for external trigger.

Returns

numpy.ndarray – The arbitrary waveform, in ADU.

Raises

PicoTechError – If the value of an input parameter is invalid.

set_sig_gen_builtin(*offset_voltage*, *pk_to_pk*, *wave_type*, *start_frequency*, *stop_frequency*, *increment*, *dwell_time*, *sweep_type*, *operation*, *shots*, *sweeps*, *trigger_type*, *trigger_source*, *ext_in_threshold*)

This function sets up the signal generator to produce a signal from a list of built-in waveforms. If different start and stop frequencies are specified, the device will sweep either up, down or up and down. Call *set_sig_gen_builtin_v2()* instead, which uses double-precision arguments.

set_sig_gen_builtin_v2(*offset_voltage=0.0*, *pk_to_pk=1.0*, *wave_type='sine'*, *start_frequency=1.0*, *stop_frequency=None*, *increment=0.1*, *dwell_time=1.0*, *sweep_type='up'*, *operation='off'*, *shots=None*, *sweeps=None*, *trigger_type='rising'*, *trigger_source='None'*, *ext_in_threshold=0*)

This function is an upgraded version of *set_sig_gen_builtin()* with double-precision frequency arguments for more precise control at low frequencies.

This function is invalid for ps4000 and ps4000a.

Parameters

- **offset_voltage** (float, optional) – The voltage offset, in volts, to be applied to the waveform.
- **pk_to_pk** (float, optional) – The peak-to-peak voltage, in volts, of the waveform signal.
- **wave_type** (enum.IntEnum, optional) – The type of waveform to be generated. A WaveType enum.

- **start_frequency** (float, optional) – The frequency that the signal generator will initially produce.
- **stop_frequency** (float, optional) – The frequency at which the sweep reverses direction or returns to the initial frequency.
- **increment** (float, optional) – The amount of frequency increase or decrease in sweep mode.
- **dwell_time** (float, optional) – The time, in seconds, for which the sweep stays at each frequency.
- **sweep_type** (enum.IntEnum, optional) – Whether the frequency will sweep from *start_frequency* to *stop_frequency*, or in the opposite direction, or repeatedly reverse direction. One of: UP, DOWN, UPDOWN, DOWNUP
- **operation** (enum.IntEnum, optional) – The type of waveform to be produced, specified by one of the following enumerated types (B models only): OFF, WHITENOISE, PRBS
- **shots** (int, optional) – If None then start and run continuously after trigger occurs.
- **sweeps** (int, optional) – If None then start a sweep and continue after trigger occurs.
- **trigger_type** (enum.IntEnum, optional) – The type of trigger that will be applied to the signal generator. One of: RISING, FALLING, GATE_HIGH, GATE_LOW.
- **trigger_source** (enum.IntEnum, optional) – The source that will trigger the signal generator. If None then run without waiting for trigger.
- **ext_in_threshold** (int, optional) – Used to set trigger level for external trigger.

set_sig_gen_properties_arbitrary(*start_delta_phase*, *stop_delta_phase*, *delta_phase_increment*, *dwell_count*, *sweep_type*, *shots*, *sweeps*, *trigger_type*, *trigger_source*, *ext_in_threshold*, *offset_voltage=0*, *pk_to_pk=-1*)

This function reprograms the arbitrary waveform generator. All values can be reprogrammed while the signal generator is waiting for a trigger.

The *offset_voltage* and *pk_to_pk* arguments are only used for ps6000.

This function is invalid for ps4000 and ps5000.

set_sig_gen_properties_builtin(*start_frequency*, *stop_frequency*, *increment*, *dwell_time*, *sweep_type*, *shots*, *sweeps*, *trigger_type*, *trigger_source*, *ext_in_threshold*, *offset_voltage=0*, *pk_to_pk=-1*)

This function reprograms the signal generator. Values can be changed while the signal generator is waiting for a trigger.

The *offset_voltage* and *pk_to_pk* arguments are only used for ps6000.

This function is invalid for ps4000 and ps5000.

set_simple_trigger(*enable*, *source*, *threshold*, *direction*, *delay*, *auto_trigger_ms*)

This function simplifies arming the trigger. It supports only the LEVEL trigger types and does not allow more than one channel to have a trigger applied to it. Any previous pulse width qualifier is cancelled.

set_trigger_channel_directions(*a='rising'*, *b='rising'*, *c='rising'*, *d='rising'*, *ext='rising'*, *aux='rising'*)

This function sets the direction of the trigger for each channel.

ps4000a overrides this method because it has a different implementation.

set_trigger_delay(*delay*)

This function sets the post-trigger delay, which causes capture to start a defined time after the trigger event.

sig_gen_arbitrary_min_max_values()

This function returns the range of possible sample values and waveform buffer sizes that can be supplied to *set_sig_gen_arbitrary()* for setting up the arbitrary waveform generator (AWG).

sig_gen_frequency_to_phase(*repetition_rate*, *index_mode*, *buffer_length*)

This function converts a frequency to a phase count for use with the arbitrary waveform generator (AWG). The value returned depends on the length of the buffer, the index mode passed and the device model. The phase count can then be sent to the driver through *set_sig_gen_arbitrary()* or *set_sig_gen_properties_arbitrary()*.

Parameters

- **repetition_rate** (float) – The requested repetition rate (frequency) of the entire arbitrary waveform.
- **index_mode** (enum.IntEnum) – An IndexMode enum value or member name.
- **buffer_length** (int) – The size (number of samples) of the waveform.

Returns

int – The phase count.

Raises

PicoTechError – If the value of an input parameter is invalid.

sig_gen_software_control(*state*)

This function causes a trigger event, or starts and stops gating. It is used when the signal generator is set to SOFT_TRIG.

trigger_within_pre_trigger_samples(*state*)

This function is in the header file, but it is not in the manual.

This function is only valid for ps4000 and ps5000a.

set_trigger_channel_conditions(*conditions*, *info='clear'*)

This function sets up trigger conditions on the scope's inputs. The trigger is defined by one or more TriggerConditions structures, which are found in the *structs* module, that are then ORed together. Each structure is itself the AND of the states of one or more of the inputs. This AND-OR logic allows you to create any possible Boolean function of the scope's inputs.

The *info* parameter is only used for ps4000a and it is a PS4000AConditionsInfo enum.

set_trigger_channel_properties(*channel_properties*, *timeout=0.1*, *aux_output_enable=0*)

This function is used to enable or disable triggering and set its parameters.

Parameters

- **channel_properties** (list of TriggerChannelProperties *structs*) – A list of TriggerChannelProperties structures describing the requested properties.
- **timeout** (float, optional) – The time, in seconds, for which the scope device will wait before collecting data if no trigger event occurs. If this is set to zero, the scope device will wait indefinitely for a trigger.
- **aux_output_enable** (int, optional) – Zero configures the AUXIO connector as a trigger input. Any other value configures it as a trigger output. Only used by ps5000.

msl.equipment.resources.picotech.picoscope.ps2000 module

A wrapper around the PicoScope ps2000 SDK.

class msl.equipment.resources.picotech.picoscope.ps2000.**PicoScope2000**(*record*)

Bases: *PicoScope2k3k*

A wrapper around the PicoScope ps2000 SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

FIRST_USB = 1

LAST_USB = 127

MAX_UNITS = 127

MAX_TIMEBASE = 19

PS2105_MAX_TIMEBASE = 20

PS2104_MAX_TIMEBASE = 19

PS2200_MAX_TIMEBASE = 23

MAX_OVERSAMPLE = 256

PS2105_MAX_ETS_CYCLES = 250

PS2105_MAX_ETS_INTERLEAVE = 50

PS2104_MAX_ETS_CYCLES = 125

PS2104_MAX_ETS_INTERLEAVE = 25

PS2203_MAX_ETS_CYCLES = 250

PS2203_MAX_ETS_INTERLEAVE = 50

PS2204_MAX_ETS_CYCLES = 250

PS2204_MAX_ETS_INTERLEAVE = 40

PS2205_MAX_ETS_CYCLES = 250

PS2205_MAX_ETS_INTERLEAVE = 40

MIN_ETS_CYCLES_INTERLEAVE_RATIO = 1

MAX_ETS_CYCLES_INTERLEAVE_RATIO = 10

MIN_SIGGEN_FREQ = 0.0

MAX_SIGGEN_FREQ = 100000.0

MAX_VALUE = 32767

MIN_VALUE = -32767

LOST_DATA = -32768

last_button_press()

This function returns the last registered state of the pushbutton on the PicoScope 2104 or 2105 PC Oscilloscope and then resets the status to zero.

set_led(*state*)

This function turns the LED on the oscilloscope on and off, and controls its colour.

set_light(*state*)

This function controls the white light that illuminates the probe tip on a handheld oscilloscope.

set_sig_gen_arbitrary(*offset_voltage*, *pk_to_pk*, *start_delta_phase*, *stop_delta_phase*, *delta_phase_increment*, *dwell_count*, *arbitrary_waveform_size*, *sweep_type*, *sweeps*)

This function programs the signal generator to produce an arbitrary waveform.

set_sig_gen_built_in(*offset_voltage*, *pk_to_pk*, *wave_type*, *start_frequency*, *stop_frequency*, *increment*, *dwell_time*, *sweep_type*, *sweeps*)

This function sets up the signal generator to produce a signal from a list of built-in waveforms. If different start and stop frequencies are specified, the oscilloscope will sweep either up, down or up and down.

msl.equipment.resources.picotech.picoscope.ps2000a module

A wrapper around the PicoScope ps2000a SDK.

class msl.equipment.resources.picotech.picoscope.ps2000a.**PicoScope2000A**(*record*)

Bases: *PicoScopeApi*

A wrapper around the PicoScope ps2000a SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

PS2208_MAX_ETS_CYCLES = 500

PS2208_MAX_INTERLEAVE = 20

PS2207_MAX_ETS_CYCLES = 500

PS2207_MAX_INTERLEAVE = 20

PS2206_MAX_ETS_CYCLES = 250

PS2206_MAX_INTERLEAVE = 10

EXT_MAX_VALUE = 32767

EXT_MIN_VALUE = -32767

MAX_LOGIC_LEVEL = 32767

MIN_LOGIC_LEVEL = -32767

MIN_SIG_GEN_FREQ = 0.0

MAX_SIG_GEN_FREQ = 20000000.0

MAX_SIG_GEN_BUFFER_SIZE = 8192

MIN_SIG_GEN_BUFFER_SIZE = 1

MIN_DWELL_COUNT = 3

MAX_SWEEPS_SHOTS = 1073741823

MAX_ANALOGUE_OFFSET_50MV_200MV = 0.25

MIN_ANALOGUE_OFFSET_50MV_200MV = -0.25

MAX_ANALOGUE_OFFSET_500MV_2V = 2.5

MIN_ANALOGUE_OFFSET_500MV_2V = -2.5

MAX_ANALOGUE_OFFSET_5V_20V = 20.0

MIN_ANALOGUE_OFFSET_5V_20V = -20.0

SHOT_SWEEP_TRIGGER_CONTINUOUS_RUN = 4294967295

SINE_MAX_FREQUENCY = 1000000.0

SQUARE_MAX_FREQUENCY = 1000000.0

TRIANGLE_MAX_FREQUENCY = 1000000.0

SINC_MAX_FREQUENCY = 1000000.0

RAMP_MAX_FREQUENCY = 1000000.0

HALF_SINE_MAX_FREQUENCY = 1000000.0

GAUSSIAN_MAX_FREQUENCY = 1000000.0

PRBS_MAX_FREQUENCY = 1000000.0

PRBS_MIN_FREQUENCY = 0.03

MIN_FREQUENCY = 0.03

set_digital_analog_trigger_operand(*operand*)

This function is define in the header file, but it is not in the manual.

set_trigger_digital_port_properties(*directions*)

This function will set the individual Digital channels trigger directions. Each trigger direction consists of a channel name and a direction. If the channel is not included in the array of *PS2000ADigitalChannelDirections* the driver assumes the digital channel's trigger direction is PS2000A_DIGITAL_DONT_CARE.

msl.equipment.resources.picotech.picoscope.ps3000 module

A wrapper around the PicoScope ps3000 SDK.

class msl.equipment.resources.picotech.picoscope.ps3000.**PicoScope3000**(*record*)

Bases: *PicoScope2k3k*

A wrapper around the PicoScope ps3000 SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

FIRST_USB = 1

LAST_USB = 127

MAX_UNITS = 127

PS3206_MAX_TIMEBASE = 21

PS3205_MAX_TIMEBASE = 20

PS3204_MAX_TIMEBASE = 19

PS3224_MAX_TIMEBASE = 19

PS3223_MAX_TIMEBASE = 19

PS3424_MAX_TIMEBASE = 19

PS3423_MAX_TIMEBASE = 19

PS3225_MAX_TIMEBASE = 18

PS3226_MAX_TIMEBASE = 19

PS3425_MAX_TIMEBASE = 19

PS3426_MAX_TIMEBASE = 19

MAX_OVERSAMPLE = 256

MAX_VALUE = 32767

MIN_VALUE = -32767

LOST_DATA = -32768

MIN_SIGGEN_FREQ = 0.093

MAX_SIGGEN_FREQ = 1000000

PS3206_MAX_ETS_CYCLES = 500

PS3206_MAX_ETS_INTERLEAVE = 100

PS3205_MAX_ETS_CYCLES = 250

PS3205_MAX_ETS_INTERLEAVE = 50

PS3204_MAX_ETS_CYCLES = 125

PS3204_MAX_ETS_INTERLEAVE = 25

MAX_ETS_CYCLES_INTERLEAVE_RATIO = 10

MIN_ETS_CYCLES_INTERLEAVE_RATIO = 1

PS300_MAX_ETS_SAMPLES = 100000

MAX_PULSE_WIDTH_QUALIFIER_COUNT = 16777215

MAX_HOLDOFF_COUNT = 8388607

release_stream_buffer()

Not found in the manual, but it is in the header file.

save_streaming_data(*lp_callback_func*, *data_buffer_size*)

This function sends all available streaming data to the `lp_callback_func` callback function in your application. Your callback function decides what to do with the data.

set_siggen(*wave_type*, *start_frequency*, *stop_frequency*, *increment*, *dwell_time*, *repeat*, *dual_slope*)

This function is used to enable or disable the signal generator and sweep functions.

streaming_ns_get_interval_stateless(*n_channels*)

Not found in the manual, but it is in the header file.

msl.equipment.resources.picotech.picoscope.ps3000a module

A wrapper around the PicoScope ps3000a SDK.

class msl.equipment.resources.picotech.picoscope.ps3000a.**PicoScope3000A**(*record*)

Bases: *PicoScopeApi*

A wrapper around the PicoScope ps3000a SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

MAX_OVERSAMPLE = 256

PS3207A_MAX_ETS_CYCLES = 500

PS3207A_MAX_INTERLEAVE = 40

PS3206A_MAX_ETS_CYCLES = 500

PS3206A_MAX_INTERLEAVE = 40

PS3206MSO_MAX_INTERLEAVE = 80

PS3205A_MAX_ETS_CYCLES = 250

PS3205A_MAX_INTERLEAVE = 20

PS3205MSO_MAX_INTERLEAVE = 40

PS3204A_MAX_ETS_CYCLES = 125

PS3204A_MAX_INTERLEAVE = 10

PS3204MSO_MAX_INTERLEAVE = 20

EXT_MAX_VALUE = 32767

EXT_MIN_VALUE = -32767

MAX_LOGIC_LEVEL = 32767

MIN_LOGIC_LEVEL = -32767

MIN_SIG_GEN_FREQ = 0.0

MAX_SIG_GEN_FREQ = 20000000.0

PS3207B_MAX_SIG_GEN_BUFFER_SIZE = 32768

PS3206B_MAX_SIG_GEN_BUFFER_SIZE = 16384

MAX_SIG_GEN_BUFFER_SIZE = 8192

MIN_SIG_GEN_BUFFER_SIZE = 1

MIN_DWELL_COUNT = 3

MAX_SWEEPS_SHOTS = 1073741823

MAX_ANALOGUE_OFFSET_50MV_200MV = 0.25

MIN_ANALOGUE_OFFSET_50MV_200MV = -0.25

MAX_ANALOGUE_OFFSET_500MV_2V = 2.5

MIN_ANALOGUE_OFFSET_500MV_2V = -2.5

MAX_ANALOGUE_OFFSET_5V_20V = 20.0

MIN_ANALOGUE_OFFSET_5V_20V = -20.0

SHOT_SWEEP_TRIGGER_CONTINUOUS_RUN = 4294967295

SINE_MAX_FREQUENCY = 1000000.0

SQUARE_MAX_FREQUENCY = 1000000.0

TRIANGLE_MAX_FREQUENCY = 1000000.0

SINC_MAX_FREQUENCY = 1000000.0

RAMP_MAX_FREQUENCY = 1000000.0

HALF_SINE_MAX_FREQUENCY = 1000000.0

GAUSSIAN_MAX_FREQUENCY = 1000000.0

PRBS_MAX_FREQUENCY = 1000000.0

PRBS_MIN_FREQUENCY = 0.03

MIN_FREQUENCY = 0.03

get_max_ets_values()

This function returns the maximum number of cycles and maximum interleaving factor that can be used for the selected scope device in ETS mode. These values are the upper limits for the `etsCycles` and `etsInterleave` arguments supplied to *set_ets()*.

get_trigger_info_bulk(*from_segment_index*, *to_segment_index*)

This function returns trigger information in rapid block mode.

Returns

The *PS3000ATriggerInfo* structure.

set_pulse_width_digital_port_properties(*directions*)

This function will set the individual digital channels' pulse-width trigger directions. Each trigger direction consists of a channel name and a direction. If the channel is not included in the array of *PS3000ADigitalChannelDirections* the driver assumes the digital channel's pulse-width trigger direction is PS3000A_DIGITAL_DONT_CARE.

set_pulse_width_qualifier_v2(*conditions*, *direction*, *lower*, *upper*, *pulse_width_type*)

This function sets up pulse-width qualification, which can be used on its own for pulse width triggering or combined with level triggering or window triggering to produce more complex triggers. The pulse-width qualifier is set by defining one or more structures that are then ORed together. Each structure is itself the AND of the states of one or more of the inputs. This AND-OR logic allows you to create any possible Boolean function of the scope's inputs.

set_trigger_channel_conditions_v2(*conditions*)

This function sets up trigger conditions on the scope's inputs. The trigger is defined by one or more *PS3000ATriggerConditionsV2* structures that are then ORed together. Each structure is itself the AND of the states of one or more of the inputs. This AND-OR logic allows you to create any possible Boolean function of the scope's inputs.

If complex triggering is not required, use *set_simple_trigger()*.

set_trigger_digital_port_properties(*directions*)

This function will set the individual digital channels' trigger directions. Each trigger direction consists of a channel name and a direction. If the channel is not included in the array of *PS3000ADigitalChannelDirections* the driver assumes the digital channel's trigger direction is PS3000A_DIGITAL_DONT_CARE.

msl.equipment.resources.picotech.picoscope.ps4000 module

A wrapper around the PicoScope ps4000 SDK.

class msl.equipment.resources.picotech.picoscope.ps4000.**PicoScope4000**(*record*)

Bases: *PicoScopeApi*

A wrapper around the PicoScope ps4000 SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

MAX_OVERSAMPLE_12BIT = 16

MAX_OVERSAMPLE_8BIT = 256

PS4XXX_MAX_ETS_CYCLES = 400

PS4XXX_MAX_INTERLEAVE = 80

PS4262_MAX_VALUE = 32767

PS4262_MIN_VALUE = -32767

MAX_VALUE = 32764

MIN_VALUE = -32764

LOST_DATA = -32768

EXT_MAX_VALUE = 32767

EXT_MIN_VALUE = -32767

MAX_PULSE_WIDTH_QUALIFIER_COUNT = 16777215

MAX_DELAY_COUNT = 8388607

MIN_SIG_GEN_FREQ = 0.0

MAX_SIG_GEN_FREQ = 100000.0

MAX_SIG_GEN_FREQ_4262 = 20000.0

MIN_SIG_GEN_BUFFER_SIZE = 1

MAX_SIG_GEN_BUFFER_SIZE = 8192

MIN_DWELL_COUNT = 10

PS4262_MAX_WAVEFORM_BUFFER_SIZE = 4096

PS4262_MIN_DWELL_COUNT = 3

MAX_SWEEPS_SHOTS = 1073741823

get_probe()

This function is in the header file, but it is not in the manual.

get_trigger_channel_time_offset(*segment_index*, *channel*)

This function gets the time, as two 4-byte values, at which the trigger occurred, adjusted for the time skew of the specified channel relative to the trigger source. Call it after block-mode data has been captured or when data has been retrieved from a previous block-mode capture.

get_trigger_channel_time_offset64(*segment_index*, *channel*)

This function gets the time, as a single 8-byte value, at which the trigger occurred, adjusted for the time skew of the specified channel relative to the trigger source. Call it after block-mode data has been captured or when data has been retrieved from a previous block-mode capture.

get_values_trigger_channel_time_offset_bulk(*from_segment_index*, *to_segment_index*, *channel*)

This function retrieves the time offset, as lower and upper 32-bit values, for a group of waveforms obtained in rapid block mode, adjusted for the time skew relative to the trigger source. The array size for `timesUpper` and `timesLower` must be greater than or equal to the number of waveform time offsets requested. The segment indexes are inclusive.

get_values_trigger_channel_time_offset_bulk64(*from_segment_index*, *to_segment_index*, *channel*)

This function retrieves the time offset, as a 64-bit integer, for a group of waveforms captured in rapid block mode, adjusted for the time skew relative to the trigger source. The array size of `times` must be greater than or equal to the number of waveform time offsets requested. The segment indexes are inclusive.

open_unit_async_ex()

This function opens a scope device selected by serial number without blocking the calling thread. You can find out when it has finished by periodically calling *open_unit_progress()* until that function returns a non-zero value.

open_unit_ex()

This function opens a scope device. The maximum number of units that can be opened is determined by the operating system, the kernel driver and the PC's hardware.

run_streaming_ex(*sample_interval_time_units*, *max_pre_trigger_samples*, *max_post_pre_trigger_samples*, *auto_stop*, *down_sample_ratio*, *down_sample_ratio_mode*, *overview_buffer_size*)

This function tells the oscilloscope to start collecting data in streaming mode and with a specified data reduction mode. When data has been collected from the device it is aggregated and the values returned to the application. Call *get_streaming_latest_values()* to retrieve the data.

set_bw_filter(*channel*, *enable*)

This function enables or disables the bandwidth-limiting filter on the specified channel.

set_data_buffer_with_mode(*channel*, *buffer_length*, *mode*)

This function registers your data buffer, for non-aggregated data, with the PicoScope 4000 driver. You need to allocate the buffer before calling this function.

set_data_buffers_with_mode(*channel*, *buffer_length*, *mode*)

This function registers your data buffers, for receiving aggregated data, with the PicoScope 4000 driver. You need to allocate memory for the buffers before calling this function.

set_ext_trigger_range(*ext_range*)

This function sets the range of the external trigger.

set_probe(*probe*, *range_*)

This function is in the header file, but it is not in the manual.

msl.equipment.resources.picotech.picoscope.ps4000a module

A wrapper around the PicoScope ps4000a SDK.

class msl.equipment.resources.picotech.picoscope.ps4000a.**PicoScope4000A**(*record*)

Bases: *PicoScopeApi*

A wrapper around the PicoScope ps4000a SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

MAX_VALUE = 32767

MIN_VALUE = -32767

LOST_DATA = -32768

EXT_MAX_VALUE = 32767

EXT_MIN_VALUE = -32767

MAX_PULSE_WIDTH_QUALIFIER_COUNT = 16777215

MAX_DELAY_COUNT = 8388607

MAX_SIG_GEN_BUFFER_SIZE = 16384

MIN_SIG_GEN_BUFFER_SIZE = 10

MIN_DWELL_COUNT = 10

MAX_SWEEPS_SHOTS = 1073741823

AWG_DAC_FREQUENCY = 80000000.0

AWG_PHASE_ACCUMULATOR = 4294967296.0

MAX_ANALOGUE_OFFSET_50MV_200MV = 0.25

MIN_ANALOGUE_OFFSET_50MV_200MV = -0.25

MAX_ANALOGUE_OFFSET_500MV_2V = 2.5

MIN_ANALOGUE_OFFSET_500MV_2V = -2.5

MAX_ANALOGUE_OFFSET_5V_20V = 20.0

MIN_ANALOGUE_OFFSET_5V_20V = -20.0

SINE_MAX_FREQUENCY = 1000000.0

SQUARE_MAX_FREQUENCY = 1000000.0

TRIANGLE_MAX_FREQUENCY = 1000000.0

SINC_MAX_FREQUENCY = 1000000.0

RAMP_MAX_FREQUENCY = 1000000.0

HALF_SINE_MAX_FREQUENCY = 1000000.0

GAUSSIAN_MAX_FREQUENCY = 1000000.0

MIN_FREQUENCY = 0.03

apply_resistance_scaling(*channel*, *range_*, *buffer_length*)

This function is in the header file, but it is not in the manual.

connect_detect(*sensors*)

This function is in the header file, but it is not in the manual.

device_meta_data(*meta_type*, *operation*, *format_*)

This function is in the header file, but it is not in the manual.

get_common_mode_overflow()

This function is in the header file, but it is not in the manual.

get_string(*string_value*)

This function is in the header file, but it is not in the manual.

set_channel_led(*led_states*)

This function is in the header file, but it is not in the manual.

set_pulse_width_qualifier_conditions(*conditions*, *info*)

This function sets up the conditions for pulse width qualification, which can be used on its own for pulse width triggering or combined with window triggering to produce more complex triggers. Each call to this function creates a pulse width qualifier equal to the logical AND of the elements of the `conditions` array. Calling this function multiple times creates the logical OR of multiple AND operations. This AND-OR logic allows you to create any possible Boolean function of the scope's inputs.

Other settings of the pulse width qualifier are configured by calling *set_pulse_width_qualifier_properties()*.

set_pulse_width_qualifier_properties(*direction*, *lower*, *upper*, *pulse_width_type*)

This function configures the general properties of the pulse width qualifier.

set_trigger_channel_directions(*directions*)

This function sets the direction of the trigger for the specified channels.

msl.equipment.resources.picotech.picoscope.ps5000 module

A wrapper around the PicoScope ps5000 SDK.

class msl.equipment.resources.picotech.picoscope.ps5000.**PicoScope5000**(*record*)

Bases: *PicoScopeApi*

A wrapper around the PicoScope ps5000 SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

MAX_OVERSAMPLE_8BIT = 256

MAX_VALUE = 32512

MIN_VALUE = -32512

LOST_DATA = -32768

EXT_MAX_VALUE = 32767

EXT_MIN_VALUE = -32767

MAX_PULSE_WIDTH_QUALIFIER_COUNT = 16777215

MAX_DELAY_COUNT = 8388607

MAX_SIG_GEN_BUFFER_SIZE = 8192

MIN_SIG_GEN_BUFFER_SIZE = 10

MIN_DWELL_COUNT = 10

MAX_SWEEPS_SHOTS = 1073741823

SINE_MAX_FREQUENCY = 20000000.0

SQUARE_MAX_FREQUENCY = 20000000.0

TRIANGLE_MAX_FREQUENCY = 20000000.0

SINC_MAX_FREQUENCY = 20000000.0

RAMP_MAX_FREQUENCY = 20000000.0

HALF_SINE_MAX_FREQUENCY = 20000000.0

GAUSSIAN_MAX_FREQUENCY = 20000000.0

MIN_FREQUENCY = 0.03

msl.equipment.resources.picotech.picoscope.ps5000a module

A wrapper around the PicoScope ps5000a SDK.

class msl.equipment.resources.picotech.picoscope.ps5000a.**PicoScope5000A**(*record*)

Bases: *PicoScopeApi*

A wrapper around the PicoScope ps5000a SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

MAX_VALUE_8BIT = 32512

MIN_VALUE_8BIT = -32512

MAX_VALUE_16BIT = 32767

MIN_VALUE_16BIT = -32767

LOST_DATA = -32768

EXT_MAX_VALUE = 32767

EXT_MIN_VALUE = -32767

MAX_PULSE_WIDTH_QUALIFIER_COUNT = 16777215

MAX_DELAY_COUNT = 8388607

PS5X42A_MAX_SIG_GEN_BUFFER_SIZE = 16384

```
PS5X43A_MAX_SIG_GEN_BUFFER_SIZE = 32768

PS5X44A_MAX_SIG_GEN_BUFFER_SIZE = 49152

MIN_SIG_GEN_BUFFER_SIZE = 1

MIN_DWELL_COUNT = 3

MAX_SWEEPS_SHOTS = 1073741823

AWG_DAC_FREQUENCY = 200000000.0

AWG_PHASE_ACCUMULATOR = 4294967296.0

MAX_ANALOGUE_OFFSET_50MV_200MV = 0.25

MIN_ANALOGUE_OFFSET_50MV_200MV = -0.25

MAX_ANALOGUE_OFFSET_500MV_2V = 2.5

MIN_ANALOGUE_OFFSET_500MV_2V = -2.5

MAX_ANALOGUE_OFFSET_5V_20V = 20.0

MIN_ANALOGUE_OFFSET_5V_20V = -20.0

PS5244A_MAX_ETS_CYCLES = 500

PS5244A_MAX_ETS_INTERLEAVE = 40

PS5243A_MAX_ETS_CYCLES = 250

PS5243A_MAX_ETS_INTERLEAVE = 20

PS5242A_MAX_ETS_CYCLES = 125

PS5242A_MAX_ETS_INTERLEAVE = 10

SHOT_SWEEP_TRIGGER_CONTINUOUS_RUN = 4294967295

SINE_MAX_FREQUENCY = 20000000.0

SQUARE_MAX_FREQUENCY = 20000000.0

TRIANGLE_MAX_FREQUENCY = 20000000.0

SINC_MAX_FREQUENCY = 20000000.0

RAMP_MAX_FREQUENCY = 20000000.0

HALF_SINE_MAX_FREQUENCY = 20000000.0

GAUSSIAN_MAX_FREQUENCY = 20000000.0

MIN_FREQUENCY = 0.03

EXT_MAX_VOLTAGE = 5.0
```

get_device_resolution()

Returns
PS5000ADeviceResolution – This function retrieves the resolution the specified device will run in.

get_trigger_info_bulk(*from_segment_index*, *to_segment_index*)

This function is in the header file, but it is not in the manual.

Populates the *PS5000ATriggerInfo* structure.

set_device_resolution(*resolution*)

This function sets the new resolution. When using 12 bits or more the memory is halved. When using 15-bit resolution only 2 channels can be enabled to capture data, and when using 16-bit resolution only one channel is available. If resolution is changed, any data captured that has not been saved will be lost. If *set_channel()* is not called, *run_block()* and *run_streaming()* may fail.

msl.equipment.resources.picotech.picoscope.ps6000 module

A wrapper around the PicoScope ps6000 SDK.

class msl.equipment.resources.picotech.picoscope.ps6000.**PicoScope6000**(*record*)

Bases: *PicoScopeApi*

A wrapper around the PicoScope ps6000 SDK.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

MAX_OVERSAMPLE_8BIT = 256

MAX_VALUE = 32512

MIN_VALUE = -32512

MAX_PULSE_WIDTH_QUALIFIER_COUNT = 16777215

MAX_SIG_GEN_BUFFER_SIZE = 16384

PS640X_C_D_MAX_SIG_GEN_BUFFER_SIZE = 65536

MIN_SIG_GEN_BUFFER_SIZE = 1

MIN_DWELL_COUNT = 3

MAX_SWEEPS_SHOTS = 1073741823

MAX_WAVEFORMS_PER_SECOND = 1000000

MAX_ANALOGUE_OFFSET_50MV_200MV = 0.5

MIN_ANALOGUE_OFFSET_50MV_200MV = -0.5

MAX_ANALOGUE_OFFSET_500MV_2V = 2.5

MIN_ANALOGUE_OFFSET_500MV_2V = -2.5

MAX_ANALOGUE_OFFSET_5V_20V = 20.0

MIN_ANALOGUE_OFFSET_5V_20V = -20.0

MAX_ETS_CYCLES = 250

MAX_INTERLEAVE = 50

PRBS_MAX_FREQUENCY = 20000000.0

SINE_MAX_FREQUENCY = 20000000.0

SQUARE_MAX_FREQUENCY = 20000000.0

TRIANGLE_MAX_FREQUENCY = 20000000.0

SINC_MAX_FREQUENCY = 20000000.0

RAMP_MAX_FREQUENCY = 20000000.0

HALF_SINE_MAX_FREQUENCY = 20000000.0

GAUSSIAN_MAX_FREQUENCY = 20000000.0

MIN_FREQUENCY = 0.03

get_values_bulk_asyc(*start_index*, *down_sample_ratio*, *down_sample_ratio_mode*, *from_segment_index*, *to_segment_index*)

This function is in the header file, but it is not in the manual.

set_data_buffers_bulk(*channel*, *buffer_length*, *waveform*, *down_sample_ratio_mode*)

This function tells the driver where to find the buffers for aggregated data for each waveform in rapid block mode. The number of waveforms captured is determined by the `nCaptures` argument sent to *set_no_of_captures()*. Call one of the GetValues functions to retrieve the data after capture. If you do not need two buffers, because you are not using aggregate mode, then you can optionally use *set_data_buffer_bulk()* instead.

set_external_clock(*frequency*, *threshold*)

This function tells the scope whether or not to use an external clock signal fed into the AUX input. The external clock can be used to synchronise one or more PicoScope 6000 units to an external source.

When the external clock input is enabled, the oscilloscope relies on the clock signal for all of its timing. The driver checks that the clock is running before starting a capture, but if the clock signal stops after the initial check, the oscilloscope will not respond to any further commands until it is powered down and back up again.

Note: if the AUX input is set as an external clock input then it cannot also be used as an external trigger input.

set_waveform_limiter(*n_waveforms_per_second*)

This function is in the header file, but it is not in the manual.

msl.equipment.resources.picotech.picoscope.structs module

Structures defined in the Pico Technology SDK v10.6.10.24

class msl.equipment.resources.picotech.picoscope.structs.**PS2000TriggerChannelProperties**

Bases: Structure

channel

Structure/Union member

hysteresis

Structure/Union member

thresholdMajor

Structure/Union member

thresholdMinor

Structure/Union member

thresholdMode

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS2000TriggerConditions**

Bases: Structure

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS2000PwqConditions**

Bases: Structure

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS2000ATriggerConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

digital

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS2000APwqConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

digital

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS2000ADigitalChannelDirections**

Bases: Structure

channel

Structure/Union member

direction

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS2000ATriggerChannelProperties**

Bases: Structure

channel

Structure/Union member

thresholdLower

Structure/Union member

thresholdLowerHysteresis

Structure/Union member

thresholdMode

Structure/Union member

thresholdUpper

Structure/Union member

thresholdUpperHysteresis

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000TriggerChannelProperties**

Bases: Structure

channel

Structure/Union member

hysteresis

Structure/Union member

thresholdMajor

Structure/Union member

thresholdMinor

Structure/Union member

thresholdMode

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000TriggerConditions**

Bases: Structure

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000PwqConditions**

Bases: Structure

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000ATriggerConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000ATriggerConditionsV2**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

digital

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000APwqConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000APwqConditionsV2**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

digital

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000ADigitalChannelDirections**

Bases: Structure

channel

Structure/Union member

direction

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000ATriggerChannelProperties**

Bases: Structure

channel

Structure/Union member

thresholdLower

Structure/Union member

thresholdLowerHysteresis

Structure/Union member

thresholdMode

Structure/Union member

thresholdUpper

Structure/Union member

thresholdUpperHysteresis

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS3000ATriggerInfo**

Bases: Structure

reserved0

Structure/Union member

reserved1

Structure/Union member

segmentIndex

Structure/Union member

status

Structure/Union member

timeStampCounter

Structure/Union member

timeUnits

Structure/Union member

triggerTime

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS4000TriggerConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS4000PwqConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS4000TriggerChannelProperties**

Bases: Structure

channel

Structure/Union member

thresholdLower

Structure/Union member

thresholdLowerHysteresis

Structure/Union member

thresholdMode

Structure/Union member

thresholdUpper

Structure/Union member

thresholdUpperHysteresis

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS4000AChannelLedSetting**

Bases: Structure

channel

Structure/Union member

state

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS4000ADirection**

Bases: Structure

channel

Structure/Union member

direction

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS4000ACondition**

Bases: Structure

condition

Structure/Union member

source

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.
PS4000ATriggerChannelProperties

Bases: Structure

channel

Structure/Union member

thresholdLower

Structure/Union member

thresholdLowerHysteresis

Structure/Union member

thresholdMode

Structure/Union member

thresholdUpper

Structure/Union member

thresholdUpperHysteresis

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS4000AConnectDetect**

Bases: Structure

channel

Structure/Union member

state

Structure/Union member

class
msl.equipment.resources.picotech.picoscope.structs.**PS5000TriggerConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS5000PwqConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.
PS5000TriggerChannelProperties

Bases: Structure

channel

Structure/Union member

hysteresis

Structure/Union member

thresholdMajor

Structure/Union member

thresholdMinor

Structure/Union member

thresholdMode

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS5000ATriggerInfo**

Bases: Structure

reserved0

Structure/Union member

reserved1

Structure/Union member

segmentIndex

Structure/Union member

status

Structure/Union member

timeUnits

Structure/Union member

triggerIndex

Structure/Union member

triggerTime

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS5000ATriggerConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS5000APwqConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS5000ATriggerChannelProperties**

Bases: Structure

channel

Structure/Union member

thresholdLower

Structure/Union member

thresholdLowerHysteresis

Structure/Union member

thresholdMode

Structure/Union member

thresholdUpper

Structure/Union member

thresholdUpperHysteresis

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS6000TriggerConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

pulseWidthQualifier

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS6000PwqConditions**

Bases: Structure

aux

Structure/Union member

channelA

Structure/Union member

channelB

Structure/Union member

channelC

Structure/Union member

channelD

Structure/Union member

external

Structure/Union member

class msl.equipment.resources.picotech.picoscope.structs.**PS6000TriggerChannelProperties**

Bases: Structure

channel

Structure/Union member

hysteresisLower

Structure/Union member

hysteresisUpper

Structure/Union member

thresholdLower

Structure/Union member

thresholdMode

Structure/Union member

thresholdUpper

Structure/Union member

msl.equipment.resources.picotech.pt104 module

Pico Technology PT-104 Platinum Resistance Data Logger.

class msl.equipment.resources.picotech.pt104.**Pt104DataType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The allowed data types for a PT-104 Data Logger.

OFF = 0

PT100 = 1

PT1000 = 2

RESISTANCE_TO_375R = 3

RESISTANCE_TO_10K = 4

DIFFERENTIAL_TO_115MV = 5

DIFFERENTIAL_TO_2500MV = 6

SINGLE_ENDED_TO_115MV = 7

SINGLE_ENDED_TO_2500MV = 8

MAX_DATA_TYPES = 9

msl.equipment.resources.picotech.pt104.**enumerate_units**(*comm_type='all'*)

Find PT-104 Platinum Resistance Data Logger's.

This routine returns a list of all the attached PT-104 devices of the specified communication type.

Note: You cannot call this function after you have opened a connection to a Data Logger.

Parameters

comm_type (str, optional) – The communication type used by the PT-104. Can be any of the following values: `'usb'`, `'ethernet'`, `'enet'`, `'all'`

Returns

list of str – A list of serial numbers of the PT-104 Data Loggers that were found.

class msl.equipment.resources.picotech.pt104.**PT104**(*record*)

Bases: *ConnectionSDK*

Uses the PicoTech SDK to communicate with a PT-104 Platinum Resistance Data Logger.

The *properties* for a PT-104 connection supports the following key-value pairs in the *Connections Database*:

```
'ip_address': str, The IP address and port number of the PT-104 (e.g.,
↪'192.168.1.201:1234')
'open_via_ip': bool, Whether to connect to the PT-104 by Ethernet.␣
↪Default is to connect by USB.
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

MIN_WIRES = 2

MAX_WIRES = 4

DataType

alias of *Pt104DataType*

disconnect()

Disconnect from the PT-104 Data Logger.

get_ip_details()

Reads the IP details of the PT-104 Data Logger.

Returns

dict – The IP details.

get_unit_info(*info=None*, *include_name=True*)

Retrieves information about the PT-104 Data Logger.

If the device fails to open, or no device is opened only the driver version is available.

Parameters

- **info** (*PicoScopeInfoApi*, optional) – An enum value or member name. If None then request all information from the PT-104.
- **include_name** (bool, optional) – If True then includes the enum member name as a prefix. For example, returns 'CAL_DATE: 09Aug16' if *include_name* is True else '09Aug16'.

Returns

str – The requested information from the PT-104 Data Logger.

get_value(*channel*, *filtered=False*)

Get the most recent reading for the specified channel.

Once you open the driver and define some channels, the driver begins to take continuous readings from the PT-104 Data Logger.

The scaling of measurements is as follows:

Range	Scaling
Temperature	value * 1/1000 deg C
Voltage (0 to 2.5 V)	value * 10 nV
Voltage (0 to 115 mV)	value * 1 nV
Resistance	value * 1 mOhm

Parameters

- **channel** (int) – The number of the channel to read, from 1 to 4 in differential mode or 1 to 8 in single-ended mode.

- **filtered** (bool, optional) – If set to True, the driver returns a low-pass filtered value of the temperature. The time constant of the filter depends on the channel parameters as set by *set_channel()*, and on how many channels are active.

Returns

float – The latest reading for the specified channel.

open()

Open the connection to the PT-104 via USB.

open_via_ip(*address=None*)

Open the connection to the PT-104 via ETHERNET.

Parameters

address (str, optional) – The IP address and port number to use to connect to the PT-104. For example, '192.168.1.201:1234'. If None then uses the 'ip_address' value of the *properties*

set_channel(*channel*, *data_type*, *num_wires*)

Configure a single channel of the PT-104 Data Logger.

The fewer channels selected, the more frequently they will be updated. Measurement takes about 1 second per active channel.

If a call to the *set_channel()* method has a data type of single-ended, then the specified channel's 'sister' channel is also enabled. For example, enabling 3 also enables 7.

Parameters

- **channel** (int) – The channel you want to set the details for. It should be between 1 and 4 if using single-ended inputs in voltage mode.
- **data_type** (*DataType*) – The type of reading you require. Can be an enum value or member name.
- **num_wires** (int) – The number of wires the PT100 or PT1000 sensor has (2, 3 or 4)

set_ip_details(*enabled*, *ip_address=None*, *port=None*)

Writes the IP details to the device.

Parameters

- **enabled** (bool) – Whether to enable or disable Ethernet communication for this device.
- **ip_address** (str, optional) – The new IP address. If None then do not change the IP address.
- **port** (int, optional) – The new port number. If None then do not change the port number.

set_mains(*hertz*)

Inform the driver of the local mains (line) frequency.

This helps the driver to filter out electrical noise.

Parameters
hertz (int) – Either 50 or 60.

msl.equipment.resources.princeton_instruments package

Wrapper around the ARC_Instrument.dll SDK from Princeton Instruments.

Submodules

msl.equipment.resources.princeton_instruments.arc_instrument module

Wrapper around the ARC_Instrument.dll SDK from Princeton Instruments.

The wrapper was written using v2.0.3 of the SDK.

class msl.equipment.resources.princeton_instruments.arc_instrument.**PrincetonInstruments**(*reco*

Bases: *Connection*

Wrapper around the ARC_Instrument.dll SDK from Princeton Instruments.

The *properties* for a ARCInstrument connection supports the following key-value pairs in the *Connections Database*:

```
'sdk_path': str, The path to the SDK [default: 'ARC_Instrument_x64.dll']
'open': bool, Whether to automatically open the connection [default: True]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

disconnect()

Close all open connections.

static close_enum(*enum*)

Function to close an open enumeration.

Parameters
enum (int) – A handle defined in ARC_Open_xxxx by which the instrument is to be addressed.

det_read(*det_num*)

Readout a single detector.

Parameters
det_num (int) – The detector to be addressed.

Returns
float – Reading value for the selected detector.

det_readall()

Readout all detectors.

Returns
tuple of float – The reading of each detector.

det_start_nonblock_read(*det_num*)

Start to readout a single detector, but return immediately (non-blocking read).

Parameters
det_num (int) – The detector to be addressed.

det_nonblock_read_done(*det_num*)

Returns the detector value.

Parameters
det_num (int) – The detector to be addressed.

Returns
float – The value of the detector.

filter_home()

Homes the filter wheel.

mono_filter_home()

Homes the filter wheel.

mono_grating_calc_gadjust(*grating*, *wave*, *ref_wave*)

Calculate a new grating GAdjust.

Parameters

- **grating** (int) – The number of the grating that is to be addressed.
- **wave** (float) – The wavelength, in nm, on which a peak is currently falling.
- **ref_wave** (float) – The wavelength, in nm, on which the peak should fall.

Returns
int – The calculated grating GAdjust. Note - this value is specific to a specific instrument-grating combination and not transferable between instruments.

mono_grating_calc_offset(*grating*, *wave*, *ref_wave*)

Calculate a new grating offset.

Parameters

- **grating** (int) – The number of the grating that is to be addressed.
- **wave** (float) – The wavelength, in nm, on which a peak is currently falling.
- **ref_wave** (float) – The wavelength, in nm, on which the peak should fall.

Returns
int – The calculated grating offset. Note - this value is specific to a specific instrument-grating combination and not transferable between instruments.

mono_grating_install(*grating*, *density*, *blaze*, *nm_blaze*, *um_blaze*, *hol_blaze*, *mirror*, *reboot*)

Install a new grating.

Parameters

- **grating** (int) – The number of the grating that is to be addressed.
- **density** (int) – The groove density in grooves per mm of the grating.
- **blaze** (str) – The Blaze string.
- **nm_blaze** (bool) – Whether the grating has a nm blaze.
- **um_blaze** (bool) – Whether the grating has a um blaze.
- **hol_blaze** (bool) – Whether the grating has a holographic blaze.
- **mirror** (bool) – Whether the grating position is a mirror.
- **reboot** (bool) – Whether to reboot the monochromator after installing.

mono_grating_uninstall(*grating*, *reboot*)

Uninstall a grating.

Parameters

- **grating** (int) – The number of the grating that is to be uninstalled.
- **reboot** (bool) – Whether to reboot the monochromator after uninstalling.

mono_move_steps(*num_steps*)

Move the grating a set number of steps.

Parameters

num_steps (int) – Number of steps to move the wavelength drive.

mono_reset()

Reset the monochromator.

mono_restore_factory_settings()

Restore the instrument factory settings.

mono_scan_done()

Check if a scan has completed.

Returns

- bool – Whether the scan finished (the scan ended or the grating wavelength limit was reached).
- float – The current wavelength, in nm, of the grating.

mono_slit_home(*slit_num*)

Homes a motorized slit.

Parameters

slit_num (int) – The slit to be homed.

- 1 - Side entrance slit.

- 2 - Front entrance slit.
- 3 - Front exit slit.
- 4 - Side exit slit.
- 5 - Side entrance slit on a double slave unit.
- 6 - Front entrance slit on a double slave unit.
- 7 - Front exit slit on a double slave unit.
- 8 - Side exit slit on a double slave unit.

static mono_slit_name(*slit_num*)

Returns a text description of a slit position.

Parameters
slit_num (int) – The slit to be addressed.

Returns
str – The description of the slit port location.

mono_start_jog(*jog_max_rate*, *jog_forwards*)

Start jogging the wavelength of the monochromator.

Parameters

- **jog_max_rate** (bool) – Whether to jog at the max scan rate or at the current scan rate.
  - False - Current Scan Rate.
  - True - Max Scan Rate.
- **jog_forwards** (bool) – Whether to jog forward (increasing nm) or backwards (decreasing nm).
  - False - Jog Backwards (decreasing nm).
  - True - Jog Forwards (increasing nm).

mono_start_scan_to_nm(*wavelength_nm*)

Start a wavelength scan.

Parameters
wavelength_nm (float) – Wavelength in nm we are to scan to. Note - the value should not be lower than the current wavelength and should not exceed the current grating wavelength limit.

mono_stop_jog()

End a wavelength jog.

calc_mono_slit_bandpass(*slit_num*, *width*)

Calculates the band pass for the provided slit width.

Parameters

- **slit_num** (int) – The slit number.
  - 1 - Side entrance slit.
  - 2 - Front entrance slit.

- 3 - Front exit slit.
- 4 - Side exit slit.
- 5 - Side entrance slit on a double slave unit.
- 6 - Front entrance slit on a double slave unit.
- 7 - Front exit slit on a double slave unit.
- 8 - Side exit slit on a double slave unit.

- **width** (float) – The slit width that the band pass is being calculated for.

Returns
float – The calculated band pass for the slit, in nm.

ncl_filter_home()

Home the filter wheel.

open_filter(*enum_num*)

Function to open a Filter Wheel.

Parameters
enum_num (int) – Number in the enumeration list to open.

open_mono(*enum_num*)

Function to open a Monochromator.

Parameters
enum_num (int) – Number in the enumeration list to open.

open_mono_port(*port*)

Function to open a Monochromator on a specific COM Port.

Parameters
port (int or str) – The COM port (e.g., 5 or 'COM5').

open_mono_serial(*serial*)

Function to open a Monochromator with a specific serial number.

Parameters
serial (class:*int* or str) – The serial number of the Monochromator.

open_filter_port(*port*)

Function to open a Filter Wheel on a specific COM Port.

Parameters
port (int or str) – The COM port (e.g., 5 or 'COM5').

open_filter_serial(*serial*)

Function to open a Filter Wheel with a specific serial number.

Parameters
serial (class:*int* or str) – The serial number of the Filter Wheel.

open_readout(*port_num*)

Function to open a Readout System (NCL/NCL-Lite).

Parameters
port_num (int) – Number in the enumeration list to open.

Returns
- int – If a mono is attached to an NCL on port 1, then this is the enum by which to address the first mono.
- int – If a mono is attached to an NCL on port 2, then this is the enum by which to address the second mono.

open_readout_port(*port*)

Function to open a Readout System (NCL/NCL-Lite) on a specific COM Port.

Parameters
port (class:*int* or str) – The COM port (e.g., 5 or 'COM5').

Returns
- int – If a mono is attached to an NCL on port 1, then this is the enum by which to address the first mono.
- int – If a mono is attached to an NCL on port 2, then this is the enum by which to address the second mono.

static search_for_inst()

Function used to search for all attached Acton Research Instruments.

Returns
int – The number of Acton Research Instruments found and enumerated. Enumeration list starts with zero and ends with the "number found" minus one.

valid_det_num(*det_num*)

Check if the detector number is valid on the Readout System.

Parameters
det_num (int) – The detector number to check.

Returns
bool – Whether the detector number is valid on the Readout System.

static valid_enum(*enum*)

Check if an enumeration is valid and the instrument is open.

Parameters
enum (int) – The enumeration to check.

Returns
bool – Whether the enumeration is valid and the instrument is open.

static valid_mono_enum(*mono_enum*)

Check if a monochromator enumeration is valid and the instrument is open.

All functions call this function to verify that the requested action is valid.

Parameters
mono_enum (int) – The enumeration to check.

Returns
bool – Whether the enumeration is valid and the instrument is open.

static valid_readout_enum(*readout_enum*)

Check if a Readout System (NCL/NCL-Lite) enumeration is valid and the instrument is open.

Parameters
readout_enum (int) – The enumeration to check.

Returns
bool – Whether the enumeration is valid and the instrument is open.

static valid_filter_enum(*filter_enum*)

Check if a Filter Wheel enumeration is valid and the instrument is open.

Parameters
filter_enum (int) – The enumeration to check.

Returns
bool – Whether the enumeration is valid and the instrument is open.

static ver()

Get the DLL version number.

It is the only function that can be called at any time.

Returns

- int – The major version number.
- int – The minor version number.
- int – The build version number.

get_det_bipolar(*det_num*)

Return if a detector takes bipolar (+/-) readings.

Parameters
det_num (int) – The detector to be addressed.

Returns
bool – True if the detector is bipolar (+/-).

get_det_bipolar_str(*det_num*)

Return the description of the detector polarity.

Parameters
det_num (int) – The detector to be addressed.

Returns
str – A description of whether the detector is uni-polar or bipolar.

get_det_hv_volts(*det_num*)

Return the high voltage volts setting.

Parameters
det_num (int) – The detector to be addressed.

Returns
int – High voltage volts that the detector is set to.

get_det_hv_on(*det_num*)

Return if the high voltage for a detector is turned on.

Parameters
det_num (int) – The detector to be addressed.

Returns
bool – Whether the high voltage is turned on.

get_det_num_avg_read()

Return the number of readings that are averaged.

Returns
int – Number of readings averaged into a single reading.

get_det_range(*det_num*)

Return the detector range factor.

Parameters
det_num (int) – The detector to be addressed.

Returns

int – The detector gain range.

- Detector Range 0 - 1x
- Detector Range 1 - 2x
- Detector Range 2 - 4x
- Detector Range 3 - 50x
- Detector Range 4 - 200x

get_det_range_factor(*det_num*)

Return the detector range multiplier.

Parameters
det_num (int) – The detector to be addressed.

Returns
int – The detector range multiplier.

get_det_type(*det_num*)

Return the detector readout type (Current, Voltage, Photon Counting).

Parameters
det_num (int) – The detector to be addressed.

Returns

int –

The detector readout type.

- Detector Type 1 - Current
- Detector Type 2 - Voltage
- Detector Type 3 - Photon Counting

get_det_type_str(*det_num*)

Return a description of the detector readout type.

Parameters
det_num (int) – The detector to be addressed.

Returns
str – The detector readout type (Current, Voltage, Photon Counting).

get_filter_max_pos()

Returns the maximum filter position.

Returns
int – Returns the maximum position possible with the filter wheel.

get_filter_min_pos()

Returns the minimum filter position.

Returns
int – Returns the minimum position possible with the filter wheel.

get_filter_model()

Returns the model string from the instrument.

Returns
str – The model string of the instrument.

get_filter_position()

Returns the current filter position.

Returns
int – The current filter wheel position.

get_filter_present()

Returns if the instrument has a filter wheel.

Returns
int – Whether an integrated filter wheel is present on the filter wheel.

get_filter_serial()

Returns the serial number of the instrument.

Returns
str – The serial number of the instrument.

static get_filter_preopen_model(*filter_enum*)

Returns the model string of an instrument not yet opened.

Note, *search_for_inst()* needs to be called prior to this call. In the case of multiple Filter Wheel/Spectrographs attached, it allows the user to sort, which instruments are to be opened before opening them.

Parameters
filter_enum (int) – A filter enumeration value.

Returns
str – The model string of the unopened filter wheel.

static get_enum_preopen_model(*enum*)

Returns the model number of an instrument not yet opened.

Note, *search_for_inst()* needs to be called prior to this call.

Parameters
enum (int) – The enumeration for the unopened instrument.

Returns
str – A Princeton Instruments model number.

static get_enum_preopen_serial(*enum*)

Returns the serial number of an instrument not yet opened.

Note, *search_for_inst()* needs to be called prior to this call.

Parameters
enum (int) – The enumeration for the unopened instrument.

Returns
str – A Princeton Instruments serial number.

static get_enum_preopen_com(*enum*)

Returns the COM port number of an instrument not yet opened.

Note, *search_for_inst()* needs to be called prior to this call.

Parameters
enum (int) – The enumeration for the unopened instrument.

Returns
int – The COM port number.

get_mono_backlash_steps()

Returns the number of backlash steps used when reversing the wavelength drive.

Returns
int – The number of steps the instrument backlash corrects. Not valid on older instruments.

get_mono_detector_angle()

Returns the default detector angle of the instrument in radians.

Returns
float – The default detector angle of the instrument in radians.

get_mono_diverter_pos(*diverter_num*)

Returns the slit that the diverter mirror is pointing to.

Parameters
diverter_num (int) – The diverter to be queried.

- Mirror Position 1 - motorized entrance diverter mirror.
- Mirror Position 2 - motorized exit diverter mirror.
- Mirror Position 3 - motorized entrance diverter on a double slave unit.
- Mirror Position 4 - motorized exit diverter on a double slave unit.

Returns

int –

The slit port that the diverter mirror is currently pointing at.

- Slit Port 1 - Side entrance slit.
- Slit Port 2 - Front entrance slit.
- Slit Port 3 - Front exit slit.
- Slit Port 4 - Side exit slit.
- Slit Port 5 - Side entrance slit on a double slave unit.
- Slit Port 6 - Front entrance slit on a double slave unit.
- Slit Port 7 - Front exit slit on a double slave unit.
- Slit Port 8 - Side exit slit on a double slave unit.

get_mono_diverter_pos_str(*diverter_num*)

Returns a string describing the port the mirror is pointing to.

Parameters

diverter_num (int) – The diverter to be queried.

- Mirror Position 1 - motorized entrance diverter mirror.
- Mirror Position 2 - motorized exit diverter mirror.
- Mirror Position 3 - motorized entrance diverter on a double slave unit.
- Mirror Position 4 - motorized exit diverter on a double slave unit.

Returns

str – A string describing which port the diverter is pointing at.

get_mono_diverter_valid(*diverter_num*)

Returns if a motorized diverter position is valid for an instrument.

Parameters

diverter_num (int) – The diverter to be queried.

- Mirror Position 1 - motorized entrance diverter mirror.
- Mirror Position 2 - motorized exit diverter mirror.
- Mirror Position 3 - motorized entrance diverter on a double slave unit.
- Mirror Position 4 - motorized exit diverter on a double slave unit.

Returns

bool – Whether the diverter mirror is valid.

get_mono_double()

Returns if the instrument is a double monochromator.

Returns

bool – Whether the instrument is a double monochromator.

`get_mono_double_subtractive()`

Returns if a double monochromator is subtractive instead of additive.

Returns

`bool` – Whether the double monochromator is subtractive.

`get_mono_double_intermediate_slit()`

If a monochromator is a double, return the intermediate slit position.

Returns

slit_pos (`int`) – The intermediate slit of the double monochromator

- Slit Port 1 - Side entrance slit.
- Slit Port 2 - Front entrance slit.
- Slit Port 3 - Front exit slit.
- Slit Port 4 - Side exit slit.
- Slit Port 5 - Side entrance slit on a double slave unit.
- Slit Port 6 - Front entrance slit on a double slave unit.
- Slit Port 7 - Front exit slit on a double slave unit.
- Slit Port 8 - Side exit slit on a double slave unit.

`get_mono_exit_slit()`

Return the exit slit position for a monochromator.

Function works with single and double monochromators.

Returns

slit_pos (`int`) – The intermediate slit of the double monochromator

- Slit Port 1 - Side entrance slit.
- Slit Port 2 - Front entrance slit.
- Slit Port 3 - Front exit slit.
- Slit Port 4 - Side exit slit.
- Slit Port 5 - Side entrance slit on a double slave unit.
- Slit Port 6 - Front entrance slit on a double slave unit.
- Slit Port 7 - Front exit slit on a double slave unit.
- Slit Port 8 - Side exit slit on a double slave unit.

`get_mono_filter_max_pos()`

Returns the maximum filter position.

Returns

`int` – The maximum position possible with the filter wheel.

`get_mono_filter_min_pos()`

Returns the minimum filter position.

Returns
int – The minimum position possible with the filter wheel.

`get_mono_filter_position()`

Returns the current filter position.

Returns
int – The current filter wheel position.

`get_mono_filter_present()`

Returns if the instrument has an integrated filter wheel.

Note, is a new option and not available on most instruments. All filter functions call this function before proceeding.

Returns
bool – Wether an integrated filter wheel is present on the monochromator.

`get_mono_focal_length()`

Returns the default focal length of the instrument.

Returns
float – The focal length of the instrument in millimeters.

`get_mono_gear_steps()`

Returns the number of steps in a set of sine drive gears.

Returns

- int – The number of steps per rev on the minor gear of a sine wavelength drive.
- int – The number of steps per rev on the major gear of a sine wavelength drive.

`get_mono_grating()`

Returns the current grating.

Returns
int – The current grating. This assumes the correct turret has been inserted in the instrument.

`get_mono_grating_blaze(grating)`

Returns the blaze of a given grating.

Parameters
grating (int) – Which grating to request the information about. Validates the request by calling *get_mono_grating_installed()*.

Returns
str – The blaze of the grating.

`get_mono_grating_density(grating)`

Returns the groove density (grooves per millimeter) of a given grating.

Parameters
grating (int) – Which grating to request the information about. Validates the request by calling *get_mono_grating_installed()*.

Returns
int – The groove density of the grating in grooves per millimeter. For a mirror, this function will return 1200 grooves per MM.

`get_mono_grating_gadjust`(*grating*)

Returns the GAdjust of a grating.

Parameters
grating (int) – Which grating to request the information about.

Returns
int – The grating GAdjust. Note, this value is specific to a specific instrument grating combination and not transferable between instruments.

`get_mono_grating_installed`(*grating*)

Returns if a grating is installed.

Parameters
grating (int) – Which grating we are requesting the information about.

Returns
bool – Whether the grating requested is installed.

`get_mono_grating_max`()

Get the maximum grating position installed.

This is usually the number of gratings installed.

Returns
int – The number of gratings installed.

`get_mono_grating_offset`(*grating*)

Returns the offset of a grating.

Parameters
grating (int c_long) – The number of the grating that is to be addressed.

Returns
int – The grating offset. Note, this value is specific to a specific instrument grating combination and not transferable between instruments.

`get_mono_half_angle`()

Returns the default half angle of the instrument in radians.

:param float: The half angle of the instrument in radians.

`get_mono_init_grating`()

Returns the initial grating (on instrument reboot).

Returns
int – The power-up grating number.

`get_mono_init_scan_rate_nm`()

Returns the initial wavelength scan rate (on instrument reboot).

Returns
float – The power-up scan rate in nm / minute.

get_mono_init_wave_nm()

Returns the initial wavelength (on instrument reboot).

Returns
float – The power-up wavelength in nm.

get_mono_int_led_on()

Checks if the interrupter LED is on.

Returns
bool – Whether the interrupter LED is on.

get_mono_model()

Returns the model number of the instrument.

Returns
str – The model number of the instrument.

get_mono_motor_int()

Read the motor gear interrupter.

Returns
bool – Whether the motor gear was interrupted.

get_mono_precision()

Returns the nm-decimal precision of the wavelength drive.

Note, this is independent of the wavelength step resolution whose coarseness is defined by the grating being used.

Returns
int – The number of digits after the decimal point the instrument uses. Note, the true precision is limited by the density of the grating and can be much less than the instruments wavelength precision.

get_mono_scan_rate_nm_min()

Return the current wavelength scan rate.

Returns
float – Scan rate in nm per minute.

get_mono_serial()

Returns the serial number of the instrument.

Returns
str – The serial number of the instrument as a string.

get_mono_shutter_open()

Returns if the integrated shutter is open.

Returns
bool – Whether the shutter is open.

get_mono_shutter_valid()

Returns if the instrument has an integrated shutter.

Returns
bool – Whether a shutter is present.

get_mono_sine_drive()

Returns if the gearing system has sine instead of a linear drive system.

Returns

bool – Whether the gearing is sine based verses linear gearing.

get_mono_slit_type(*slit_pos*)

Returns the slit type for a given slit.

Parameters

slit_pos (int) – The slit to be addressed.

- Slit Port 1 - Side entrance slit.
- Slit Port 2 - Front entrance slit.
- Slit Port 3 - Front exit slit.
- Slit Port 4 - Side exit slit.
- Slit Port 5 - Side entrance slit on a double slave unit.
- Slit Port 6 - Front entrance slit on a double slave unit.
- Slit Port 7 - Front exit slit on a double slave unit.
- Slit Port 8 - Side exit slit on a double slave unit.

Returns

int – The type of slit attached.

- Slit Type 0 - No slit, older instruments that do will only return a slit type of zero.
- Slit Type 1 - Manual Slit.
- Slit Type 2 - Fixed Slit Width.
- Slit Type 3 - Focal Plane adapter.
- Slit Type 4 - Continuous Motor.
- Slit Type 5 - Fiber Optic.
- Slit Type 6 - Index able Slit.

get_mono_slit_type_str(*slit_pos*)

Returns a string descriptor of a given slit.

Parameters

slit_pos (int) – The slit to be addressed.

- Slit Port 1 - Side entrance slit.
- Slit Port 2 - Front entrance slit.
- Slit Port 3 - Front exit slit.
- Slit Port 4 - Side exit slit.
- Slit Port 5 - Side entrance slit on a double slave unit.
- Slit Port 6 - Front entrance slit on a double slave unit.

- Slit Port 7 - Front exit slit on a double slave unit.
- Slit Port 8 - Side exit slit on a double slave unit.

Returns
`str` – The description of the slit.

`get_mono_slit_width`(*slit_pos*)

Returns the slit width of a motorized slit.

Parameters
slit_pos (`int`) – The slit to be addressed.

- Slit Port 1 - Side entrance slit.
- Slit Port 2 - Front entrance slit.
- Slit Port 3 - Front exit slit.
- Slit Port 4 - Side exit slit.
- Slit Port 5 - Side entrance slit on a double slave unit.
- Slit Port 6 - Front entrance slit on a double slave unit.
- Slit Port 7 - Front exit slit on a double slave unit.
- Slit Port 8 - Side exit slit on a double slave unit.

Returns
`int` – The width of the slit, if the slit is motorized.

`get_mono_slit_width_max`(*slit_pos*)

Returns the maximum width of a motorized slit.

Parameters
slit_pos (`int`) – The slit to be addressed.

- Slit Port 1 - Side entrance slit.
- Slit Port 2 - Front entrance slit.
- Slit Port 3 - Front exit slit.
- Slit Port 4 - Side exit slit.
- Slit Port 5 - Side entrance slit on a double slave unit.
- Slit Port 6 - Front entrance slit on a double slave unit.
- Slit Port 7 - Front exit slit on a double slave unit.
- Slit Port 8 - Side exit slit on a double slave unit.

Returns
`int` – The maximum width of the slit, if the slit is motorized.

`get_mono_turret`()

Returns the current grating turret number.

Returns
`int` – The current turret number.

get_mono_turret_max()

Returns the number of turrets installed.

Returns

int – The number of turrets installed.

get_mono_turret_gratings()

Returns the number of gratings per turret.

Returns

int – The number of gratings that can be placed on a single turret. This number can be one, two or three depending on the monochromator model.

get_mono_wavelength_cutoff_nm()

Returns, in nm, the max wavelength achievable by the instrument using the current grating.

Returns

float – The maximum center wavelength in nanometers for the current grating. On SpectraPro's this value equals 1400 nm * grating density / 1200 g/mm. On AM/VM products, this value is limited by the sine bar and will vary.

get_mono_wavelength_min_nm()

Returns, in nm, the min wavelength achievable by the instrument using the current grating.

Returns

float – The minimum center wavelength in nanometers for the current grating. On SpectraPro's it is usually -10 nm, on linear AM/VM instruments this value will vary.

get_mono_wavelength_abs_cm()

Returns the current center wavelength of instrument in absolute wavenumber.

Returns

float – The current wavelength of the instrument in absolute wavenumber.

get_mono_wavelength_ang()

Returns the current center wavelength of instrument in Angstroms.

Returns

float – The current wavelength of the instrument in Angstroms.

get_mono_wavelength_ev()

Returns the current center wavelength of instrument in electron volts.

Returns

float – The current wavelength of the instrument in electron volts.

get_mono_wavelength_micron()

Returns the current center wavelength of instrument in microns.

Returns

float – The current wavelength of the instrument in microns.

get_mono_wavelength_nm()

Returns the current center wavelength of instrument in nm.

Returns
float – The current wavelength of the instrument in nanometers.

get_mono_wavelength_rel_cm(*center_nm*)

Returns the current center wavelength of instrument in relative wavenumber.

Parameters
center_nm (int) – The wavelength in nanometers that 0 relative wavenumber is centered around.

Returns
float – The current wavelength of the instrument in relative wavenumber.

get_mono_wheel_int()

Read the wheel gear interrupter.

Returns
bool – Whether the wheel gear was interrupted.

get_mono_nm_rev_ratio()

Returns the number of stepper steps per rev of the wavelength drive motor.

Returns
float – The ratio of nm per rev in a linear wavelength drive.

static get_mono_preopen_model(*mono_enum*)

Returns the model of an instrument not yet opened.

Note, *search_for_inst()* needs to be called prior to this call. In the case of multiple Monochromator/Spectrographs attached, it allows the user to sort, which instruments are to be opened before opening them.

Parameters
mono_enum (int) – A monochromator enumeration.

Returns
str – The model of the unopened monochromator.

get_ncl_filter_max_pos()

Returns the maximum filter position.

Returns
int – The maximum filter position.

get_ncl_filter_min_pos()

Returns the minimum filter position.

Returns
int – The minimum filter position.

get_ncl_filter_position()

Return the current filter position.

Returns
int – The current filter position.

get_ncl_filter_present()

Returns if the instrument has an integrated filter wheel setup.

Returns
bool – Whether a NCL filter wheel is setup and present.

get_ncl_mono_enum(*mono_num*)
Return the enumeration of the attached monochromator.

Parameters
mono_num (int) – The readout system monochromator port being addressed.

Returns
int – The enumeration of the monochromator. Check the value returned with *valid_mono_enum()*.

get_ncl_mono_setup(*mono_num*)
Return if the open NCL port has a Mmnochromator attached.

Parameters
mono_num (int) – The readout system monochromator port being addressed.

Returns
bool – Whether a monochromator is attached to the port and it is set up.

get_ncl_shutter_open(*shutter_num*)
Return if a NCL Readout shutter is open.

Parameters
shutter_num (int) – The shutter being addressed (1 or 2 on an NCL).

Returns
bool – Whether the shutter is in the open position.

get_ncl_shutter_valid(*shutter_num*)
Return if a NCL Readout shutter number is valid.

Parameters
shutter_num (int) – The shutter being addressed (1 or 2 on an NCL).

Returns
bool – Whether the shutter number is valid.

get_ncl_ttl_in(*ttl_line*)
Return if an input TTL line is being pulled on by an outside connection.

Parameters
ttl_line (int) – The TTL line number being addressed.

Returns
bool – Whether *ttl_line* is being pulled to TTL high.

get_ncl_ttl_out(*ttl_line*)
Return if an output TTL line is on.

Parameters
ttl_line (int) – The TTL line number being addressed.

Returns
bool – Whether the output *ttl_line* is set to TTL high.

get_ncl_ttl_valid(*ttl_line*)

Return if a TTL line is a valid line.

Parameters
ttl_line (int) – The TTL line number being addressed.

Returns
bool – Whether *ttl_line* is a valid line number.

get_num_det()

Return the number of single point detectors in the Readout System.

Returns
int – Number of single point detectors the readout system supports. (1 NCL-Lite, 2,3 NCL).

static get_num_found_inst_ports()

Returns the value last returned by *search_for_inst()*.

Can be called multiple times.

Returns
int – The number of instruments found.

get_readout_itime_ms()

Return the integration time used for taking a reading.

Returns
int – The integration time used for taking a reading, in milliseconds.

get_readout_model()

Returns the model string from the instrument.

:param str: The model string of the instrument.

get_readout_serial()

Returns the serial number from the instrument.

Returns
str – The serial number of the instrument as a string.

static get_readout_preopen_model(*enum*)

Returns the model string of an instrument not yet opened.

Note, “meth:.*search_for_inst* needs to be called prior to this call. In the case of multiple Readout Systems attached, it allows the user to sort, which instruments are to be opened before opening them.

Parameters
enum (int) – The instrument enumeration.

Returns
str – The model string of the unopened instrument.

set_det_bipolar(*det_num*)

Set the detector readout to bipolar (+/-).

Parameters
det_num (int) – The detector to be addressed.

set_det_current(*det_num*)

Set the detector readout type to Current.

Parameters
det_num (int) – The detector to be addressed.

set_det_hv_volts(*det_num*, *hv_volts*)

Set the voltage value of the high voltage.

Parameters

- **det_num** (int) – The detector to be addressed.
- **hv_volts** (int) – The voltage value.

set_det_hv_off(*det_num*)

Set the detector high voltage to off.

Parameters
det_num (int c_long) – The detector to be addressed.

Returns
bool – Whether the high voltage has been turned off.

set_det_hv_on(*det_num*)

Set the detector high voltage to on.

Parameters
det_num (int) – The detector to be addressed.

Returns
bool – Whether the high voltage has been turned on.

set_det_num_avg_read(*num_reads_avg*)

Set the number of readings to average.

Parameters
num_reads_avg (int) – The number reads that will be required to acquire a single read.

set_det_photon(*det_num*)

Set the detector readout type to Photon Counter.

Parameters
det_num (int) – The detector to be addressed.

set_det_range(*det_num*, *gain_range*)

Set the detector gain-range factor.

Parameters

- **det_num** (int) – The detector to be addressed.
- **gain_range** (int) – The detector gain range.
  - Detector Range 0 - 1x
  - Detector Range 1 - 2x
  - Detector Range 2 - 4x

- Detector Range 3 - 50x
- Detector Range 4 - 200x

set_det_type(*det_num*, *det_type*)

Set the detector readout type.

Parameters

- **det_num** (int) – The detector to be addressed.
- **det_type** (int) – The detector readout type.
  - Detector Type 1 - Current
  - Detector Type 2 - Voltage
  - Detector Type 3 - Photon Counting

set_det_unipolar(*det_num*)

Set the detector readout to unipolar (-).

Parameters

det_num (int) – The detector to be addressed.

set_det_voltage(*det_num*)

Set the detector readout type to voltage.

Parameters

det_num (int) – The detector to be addressed.

set_filter_position(*position*)

Sets the current filter position.

Parameters

position (int) – Position the filter is to be set to.

set_mono_diverter_pos(*diverter_num*, *diverter_pos*)

Sets the port that the unit is to point to.

Parameters

- **diverter_num** (int) – The diverter to be modified.
  - Mirror Position 1 - motorized entrance diverter mirror.
  - Mirror Position 2 - motorized exit diverter mirror.
  - Mirror Position 3 - motorized entrance diverter on a double slave unit.
  - Mirror Position 4 - motorized exit diverter on a double slave unit.
- **diverter_pos** (int) – The slit port that the diverter mirror is to be set to. Not all ports are valid for all diverters.
  - Slit Port 1 - Side entrance slit.
  - Slit Port 2 - Front entrance slit. Slit Port 3 - Front exit slit.
  - Slit Port 4 - Side exit slit.
  - Slit Port 5 - Side entrance slit on a double slave unit.
  - Slit Port 6 - Front entrance slit on a double slave unit.

- Slit Port 7 - Front exit slit on a double slave unit.
- Slit Port 8 - Side exit slit on a double slave unit.

set_mono_filter_position(*position*)

Sets the current filter position.

Parameters
position (int) – Position the filter is to be set to.

set_mono_grating(*grating*)

Sets the current grating.

Parameters
grating (int) – Set the current grating. This assumes the correct turret is inserted in the instrument and grating selected is a valid grating. This function will change to current turret in the firmware, but needs user interaction to install the correct turret.

set_mono_grating_gadjust(*grating*, *gadjust*)

Sets the grating GAdjust.

Parameters

- **grating** (int) – The number of the grating that is to be addressed.
- **gadjust** (int) – The grating GAdjust. Note, this value is specific to a specific instrument-grating combination and not transferable between instruments.

set_mono_grating_offset(*grating*, *offset*)

Sets the grating offset.

Parameters

- **grating** (int) – The number of the grating that is to be addressed.
- **offset** (int) – The grating offset. Note, this value is specific to a specific instrument-grating combination and not transferable between instruments.

set_mono_init_grating(*init_grating*)

Sets the initial grating (on instrument reboot).

Parameters
init_grating (int) – The power-up grating number.

set_mono_init_scan_rate_nm(*init_scan_rate*)

Sets the initial wavelength scan rate (on instrument reboot).

Parameters
init_scan_rate (float) – The power-up scan rate in nm / minute.

set_mono_init_wave_nm(*init_wave*)

Sets the initial wavelength (on instrument reboot).

Parameters
init_wave (float) – The power-up wavelength in nm.

set_mono_int_led(*led_state*)

Turns on and off the interrupter LED.

Parameters
led_state (bool) – Indicates whether the LED should be on or off.

set_mono_scan_rate_nm_min(*scan_rate*)

Set the wavelength scan rate.

Parameters
scan_rate (float) – The rate to scan the wavelength in nm/minute.

set_mono_shutter_closed()

Sets the integrated shutter position to closed.

Returns
bool – Whether the shutter has been closed.

set_mono_shutter_open()

Sets the integrated shutter position to open.

Returns
bool – Whether the shutter has been opened.

set_mono_slit_width(*slit_pos*, *slit_width*)

Sets the slit width of a motorized slit (Types 4, 6 and 9).

Parameters

- **slit_pos** (int) – The slit to be addressed.
  - Slit Port 1 - Side entrance slit.
  - Slit Port 2 - Front entrance slit.
  - Slit Port 3 - Front exit slit.
  - Slit Port 4 - Side exit slit.
  - Slit Port 5 - Side entrance slit on a double slave unit.
  - Slit Port 6 - Front entrance slit on a double slave unit.
  - Slit Port 7 - Front exit slit on a double slave unit.
  - Slit Port 8 - Side exit slit on a double slave unit.
- **slit_width** (int) – The width to which the slit is to be set to. Note valid ranges are 10 to 3000 microns in one-micron increments for normal continuous motor slits (type 4 and 9), 10 to 12000 microns in five-micron increments for large continuous motor slits (type 4) and 25, 50, 100, 250, 500, 1000 microns for indexable slits (Type 6).

set_mono_turret(*turret*)

Sets the current grating turret.

Parameters
turret (int) – Set the current turret. This will change the grating to Turret number minus one times gratings per turret plus the one plus the current grating number minus one mod gratings per turret. The user must insert the correct turret into the instrument when using this function.

set_mono_wavelength_abs_cm(*wavelength*)

Sets the center wavelength of the instrument in absolute wavenumbers.

Parameters

wavelength (float) – The wavelength in absolute wavenumber that the instrument is to be moved to.

set_mono_wavelength_ang(*wavelength*)

Sets the center wavelength of the instrument in angstroms.

Parameters

wavelength (float) – The wavelength in Angstroms that the instrument is to be moved to.

set_mono_wavelength_ev(*wavelength*)

Sets the center wavelength of the instrument in Electron Volts.

Parameters

wavelength (float) – The wavelength in Electron Volts that the instrument is to be moved to.

set_mono_wavelength_micron(*wavelength*)

Sets the center wavelength of the instrument in microns.

Parameters

wavelength (float) – The wavelength in microns that the instrument is to be moved to.

set_mono_wavelength_nm(*wavelength*)

Sets the center wavelength of the instrument in nm.

Parameters

wavelength (float) – The wavelength in nm that the instrument is to be moved to.

set_mono_wavelength_rel_cm(*center_nm*, *wavelength*)

Sets the center wavelength of the instrument in relative Wavenumbers.

Parameters

- **center_nm** (float) – The wavelength in nanometers that 0 relative Wavenumber is centered around.
- **wavelength** (float) – The wavelength in relative Wavenumber that the instrument is to be moved to.

set_ncl_filter_position(*position*)

Set the current filter position.

Parameters

position (int) – The current filter position.

set_ncl_filter_present(*min_filter*, *max_filter*)

Set the instrument filter wheel to active (NCL only).

Parameters

- **min_filter** (int) – Min Filter Position (on an NCL with the standard filter wheel 1).

- **max_filter** (int) – Max Filter Position (on an NCL with the standard filter wheel 6).

set_ncl_shutter_closed(*shutter_num*)

Set a NCL Readout shutter to a closed state.

Parameters
shutter_num (int) – The shutter being addressed (1 or 2 on an NCL).

set_ncl_shutter_open(*shutter_num*)

Set a NCL Readout shutter to a closed state.

Parameters
shutter_num (int) – The shutter being addressed (1 or 2 on an NCL).

set_ncl_ttl_out_off(*ttl_line*)

Turn a TTL line off.

Parameters
ttl_line (int) – The TTL line number being addressed.

set_ncl_ttl_out_on(*ttl_line*)

Turn a TTL line on.

Parameters
ttl_line (int) – The TTL line number being addressed.

set_readout_itime_ms(*itime_ms*)

Set the integration time used for taking a reading.

Parameters
itime_ms (int) – The integration time in milliseconds to be used when reading out a detector.

static init(*path='ARC_Instrument_x64.dll'*)

Initialize the SDK.

Parameters
path (str) – The path to the SDK.

static is_inited()

Check if the *init()* method was called.

Returns
bool – Whether the *init()* method was called.

static error_to_english(*error_code*)

Convert an error code into a message.

Parameters
error_code (int) – The error code.

Returns
str – The error message.

msl.equipment.resources.raicol package

Resources for equipment from Raicol Crystals.

Submodules

msl.equipment.resources.raicol.raicol_tec module

Control a TEC (Peltier-based) oven from Raicol Crystals.

class msl.equipment.resources.raicol.raicol_tec.**RaicolTEC**(*record*)

Bases: *ConnectionSerial*

Control a TEC (Peltier-based) oven from Raicol Crystals.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

get_setpoint()

Get the setpoint temperature.

Returns
float – The setpoint temperature, in Celsius.

off()

Turn the TEC off.

on()

Turn the TEC on.

set_setpoint(*temperature*)

Set the setpoint temperature.

Parameters
temperature (float) – The setpoint temperature, in Celsius. Must be in the range [20.1, 60.0].

temperature()

Returns the current temperature of the oven.

The temperature is measured by a PT1000-Platinum resistor temperature sensor that is located near the crystal in the metalic mount.

Returns
float – The temperature of the oven, in Celsius.

msl.equipment.resources.thorlabs package

Resources for equipment from Thorlabs.

Subpackages

msl.equipment.resources.thorlabs.kinesis package

Wrapper package around the Thorlabs.MotionControl.C_API.

The Kinesis software can be downloaded from the Thorlabs website

Submodules

msl.equipment.resources.thorlabs.kinesis.api_functions module

C Functions defined in Thorlabs Kinesis v1.14.10

msl.equipment.resources.thorlabs.kinesis.benchtop_stepper_motor module

This module provides all the functionality required to control a **Benchtop Stepper Motor** including:

- BSC101
- BSC102
- BSC103
- BSC201
- BSC202
- BSC203

class msl.equipment.resources.thorlabs.kinesis.benchtop_stepper_motor.**BenchtopStepperMotor**(

Bases: *MotionControl*

A wrapper around `Thorlabs.MotionControl.Benchtop.StepperMotor.dll`.

The *properties* for a BenchtopStepperMotor connection supports the following key-value pairs in the *Connections Database*:

```
'device_name': str, the device name found in ThorlabsDefaultSettings.xml␣
↪[default: None]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

can_home(*channel*)

Can the device perform a *home()*?

Parameters
channel (int) – The channel number (1 to n).

Returns
bool – True if the device can perform a home.

can_move_without_homing_first(*channel*)

Does the device need to be *home()*'d before a move can be performed?

Parameters
channel (int) – The channel number (1 to n).

Returns
bool – True if the device does not need to be *home()*'d before a move can be commanded.

check_connection()

Check connection.

Returns
bool – True if the USB is listed by the FTDI controller.

clear_message_queue(*channel*)

Clears the device message queue.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

close()

Disconnect and close the device.

Raises
ThorlabsError – If not successful.

disable_channel(*channel*)

Disable the channel so that the motor can be moved by hand.

When disabled, power is removed from the motor and it can be freely moved.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

enable_channel(*channel*)

Enable channel for computer control.

When enabled, power is applied to the motor so it is fixed in position.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

enable_last_msg_timer(*channel*, *enable*, *last_msg_timeout*)

Enables the last message monitoring timer.

This can be used to determine whether communications with the device is still good.

Parameters

- **channel** (int) – The channel number (1 to n).
- **enable** (bool) – True to enable monitoring otherwise False to disable.
- **last_msg_timeout** (int) – The last message error timeout in ms. Set to 0 to disable.

get_backlash(*channel*)

Get the backlash distance setting (used to control hysteresis).

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The backlash distance in DeviceUnits (see manual).

get_bow_index(*channel*)

Gets the stepper motor bow index.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The bow index.

get_calibration_file(*channel*)

Get the calibration file for this motor.

Parameters
channel (int) – The channel number (1 to n).

Returns
str – The filename of the calibration file.

Raises
ThorlabsError – If not successful.

get_device_unit_from_real_value(*channel*, *real_value*, *unit_type*)

Converts a real-world value to a device value.

Either *load_settings()*, *load_named_settings()* or *set_motor_params_ext()* must be called before calling this function, otherwise the returned value will always be 0.

Parameters

- **channel** (int) – The channel number (1 to n).

- **real_value** (float) – The real-world value.
- **unit_type** (*enums.UnitType*) – The unit of the real-world value.

Returns
int – The device value.

Raises
ThorlabsError – If not successful.

get_digital_outputs(*channel*)

Gets the digital output bits.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – Bit mask of states of the 4 digital output pins.

get_encoder_counter(*channel*)

Get the Encoder Counter.

For devices that have an encoder, the current encoder position can be read.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – Encoder count of encoder units.

get_firmware_version(*channel*)

Gets the version number of the device firmware.

Returns
str – The firmware version.

get_hardware_info(*channel*)

Gets the hardware information from the device.

Parameters
channel (int) – The channel number (1 to n).

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

get_hardware_info_block(*channel*)

Gets the hardware information in a block.

Parameters
channel (int) – The channel number (1 to n).

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

get_homing_params_block(*channel*)

Get the homing parameters.

Parameters
channel (int) – The channel number (1 to n).

Returns
structs.MOT_HomingParameters – The homing parameters.

Raises
ThorlabsError – If not successful.

get_homing_velocity(*channel*)

Gets the homing velocity.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The homing velocity in DeviceUnits (see manual).

get_input_voltage(*channel*)

Gets the analogue input voltage reading.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The input voltage 0-32768 corresponding to 0-5V.

get_jog_mode(*channel*)

Gets the jog mode.

Parameters
channel (int) – The channel number (1 to n).

Returns

- *enums.MOT_JogModes* – The jog mode.
- *enums.MOT_StopModes* – The stop mode.

Raises
ThorlabsError – If not successful.

get_jog_params_block(*channel*)

Get the jog parameters.

Parameters
channel (int) – The channel number (1 to n).

Returns
structs.MOT_JogParameters – The jog parameters.

Raises
ThorlabsError – If not successful.

get_jog_step_size(*channel*)

Gets the distance to move when jogging.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters
channel (`int`) – The channel number (1 to n).

Returns
`int` – The step size in `DeviceUnits` (see manual).

get_jog_vel_params(*channel*)

Gets the jog velocity parameters.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters
channel (`int`) – The channel number (1 to n).

Returns

- `int` – The maximum velocity in `DeviceUnits` (see manual).
- `int` – The acceleration in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

get_joystick_params(*channel*)

Gets the joystick parameters.

Parameters
channel (`int`) – The channel number (1 to n).

Returns
structs.MOT_JoystickParameters – The joystick parameters.

Raises
ThorlabsError – If not successful.

get_limit_switch_params(*channel*)

Gets the limit switch parameters.

Parameters
channel (`int`) – The channel number (1 to n).

Returns

- *enums.MOT_LimitSwitchModes* – The clockwise hardware limit mode.
- *enums.MOT_LimitSwitchModes* – The anticlockwise hardware limit mode.
- `int` – The position of the clockwise software limit in `DeviceUnits` (see manual).
- `int` – The position of the anticlockwise software limit in `DeviceUnits` (see manual).

- *enums.MOT_LimitSwitchSWModes* – The soft limit mode.

Raises
ThorlabsError – If not successful.

get_limit_switch_params_block(*channel*)

Get the limit switch parameters.

Parameters
channel (int) – The channel number (1 to n).

Returns
structs.MOT_LimitSwitchParameters – The limit switch parameters.

Raises
ThorlabsError – If not successful.

get_motor_params(*channel*)

Gets the motor stage parameters.

Deprecated: calls *get_motor_params_ext()*

get_motor_params_ext(*channel*)

Gets the motor stage parameters.

These parameters, when combined define the stage motion in terms of `RealWorldUnits` [millimeters or degrees]. The real-world unit is defined from `steps_per_rev * gear_box_ratio / pitch`.

Parameters
channel (int) – The channel number (1 to n).

Returns

- float – The steps per revolution.
- float – The gear box ratio.
- float – The pitch.

Raises
ThorlabsError – If not successful.

get_motor_travel_limits(*channel*)

Gets the motor stage min and max position.

These define the range of travel for the stage.

Parameters
channel (int) – The channel number (1 to n).

Returns

- float – The minimum position in `RealWorldUnits` [millimeters or degrees].
- float – The maximum position in `RealWorldUnits` [millimeters or degrees].

Raises
ThorlabsError – If not successful.

get_motor_travel_mode(*channel*)

Get the motor travel mode.

Parameters
channel (int) – The channel number (1 to n).

Returns
enums.MOT_TravelModes – The travel mode.

get_motor_velocity_limits(*channel*)

Gets the motor stage maximum velocity and acceleration.

Parameters
channel (int) – The channel number (1 to n).

Returns

- float – The maximum velocity in RealWorldUnits [millimeters or degrees].
- float – The maximum acceleration in RealWorldUnits [millimeters or degrees].

Raises
ThorlabsError – If not successful.

get_move_absolute_position(*channel*)

Gets the move absolute position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The move absolute position in DeviceUnits (see manual).

get_move_relative_distance(*channel*)

Gets the move relative distance.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The move relative position in DeviceUnits (see manual).

get_next_message(*channel*)

Get the next Message Queue item, if it is available. See *messages*.

Parameters
channel (int) – The channel number (1 to n).

Returns

- int – The message type.
- int – The message ID.

- int – The message data.

Raises
ThorlabsError – If not successful.

get_num_channels()

Gets the number of channels in the device.

Returns
int – The number of channels.

get_number_positions(*channel*)

Get the number of positions.

This function will get the maximum position reachable by the device. The motor may need to be set to its *home()* position before this parameter can be used.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The number of positions.

get_pid_loop_encoder_coeff(*channel*)

Gets the Encoder PID loop encoder coefficient.

Parameters
channel (int) – The channel number (1 to n).

Returns
float – The Encoder PID loop encoder coefficient.

get_pid_loop_encoder_params(*channel*)

Gets the Encoder PID loop parameters.

Parameters
channel (int) – The channel number (1 to n).

Returns
structs.MOT_PIDLoopEncoderParams – The parameters used to define the Encoder PID Loop.

Raises
ThorlabsError – If not successful.

get_position(*channel*)

Get the current position.

The current position is the last recorded position. The current position is updated either by the polling mechanism or by calling *request_position()*.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters
channel (int) – The channel number (1 to n).

Returns
index (int) – The current position in DeviceUnits (see manual).

get_position_counter(*channel*)

Get the position counter.

The position counter is identical to the position parameter. The position counter is set to zero when homing is complete. The position counter can also be set using *set_position_counter()* if homing is not to be performed.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters
channel (`int`) – The channel number (1 to n).

Returns
`int` – The position counter in `DeviceUnits` (see manual).

get_power_params(*channel*)

Gets the power parameters for the stepper motor.

Parameters
channel (`int`) – The channel number (1 to n).

Returns
structs.MOT_PowerParameters – The power parameters.

Raises
ThorlabsError – If not successful.

get_rack_digital_outputs()

Gets the rack digital output bits.

Returns
`int` – Bit mask of states of the 4 digital output pins.

get_rack_status_bits()

Gets the Rack status bits.

Returns
`int` – The status bits including 4 with one per electronic input pin.

get_real_value_from_device_unit(*channel*, *device_value*, *unit_type*)

Converts a device value to a real-world value.

Either *load_settings()*, *load_named_settings()* or *set_motor_params_ext()* must be called before calling this function, otherwise the returned value will always be 0.0.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **device_value** (`int`) – The device value.
- **unit_type** (*enums.UnitType*) – The unit of the device value.

Returns
`float` – The real-world value.

Raises
ThorlabsError – If not successful.

get_soft_limit_mode(*channel*)

Gets the software limits mode.

Parameters
channel (int) – The channel number (1 to n).

Returns
enums.MOT_LimitsSoftwareApproachPolicy – The software limits mode.

get_software_version()

Gets version number of the device software.

Returns
str – The device software version.

get_stage_axis_max_pos(*channel*)

Gets the Stepper Motor maximum stage position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The maximum position in DeviceUnits (see manual).

get_stage_axis_min_pos(*channel*)

Gets the Stepper Motor minimum stage position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The minimum position in DeviceUnits (see manual).

get_status_bits(*channel*)

Get the current status bits.

This returns the latest status bits received from the device. To get new status bits, use *request_status_bits()* or use the polling function, *start_polling()*.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The status bits from the device.

get_trigger_switches(*channel*)

Gets the trigger switch parameter.

Parameters
channel (int) – The channel number (1 to n).

Returns

int – Trigger mask where:

- Bit 0 - Input trigger enabled.
- Bit 1 - Output trigger enabled.
- Bit 2 - Output Passthrough mode enabled where Output Trigger mirrors Input Trigger.
- Bit 3 - Output trigger high when moving.
- Bit 4 - Performs relative move when input trigger goes high.
- Bit 5 - Performs absolute move when input trigger goes high.
- Bit 6 - Perfgorms home when input trigger goes high.
- Bit 7 - Output triggers when motor moved by software command.

get_vel_params(*channel*)

Gets the move velocity parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

channel (int) – The channel number (1 to n).

Returns

- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

get_vel_params_block(*channel*)

Get the move velocity parameters.

Parameters

channel (int) – The channel number (1 to n).

Returns

structs.MOT_VelocityParameters – The velocity parameters.

Raises

ThorlabsError – If not successful.

has_last_msg_timer_overrun(*channel*)

Queries if the time since the last message has exceeded the lastMsgTimeout set by *enable_last_msg_timer()*.

This can be used to determine whether communications with the device is still good.

Parameters

channel (int) – The channel number (1 to n).

Returns
bool – True if last message timer has elapsed, False if monitoring is not enabled or if time of last message received is less than lastMsgTimeout.

home(*channel*)

Home the device.

Homing the device will set the device to a known state and determine the home position.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

identify(*channel*)

Sends a command to the device to make it identify itself.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

is_calibration_active(*channel*)

Is a calibration file active for this motor?

Parameters
channel (int) – The channel number (1 to n).

Returns
bool – Whether a calibration file is active.

is_channel_valid(*channel*)

Verifies that the specified channel is valid.

Parameters
channel (int) – The requested channel number (1 to n).

Returns
bool – Whether the channel is valid.

load_settings(*channel*)

Update device with stored settings.

The settings are read from ThorlabsDefaultSettings.xml, which gets created when the Kinesis software is installed.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

load_named_settings(*channel*, *settings_name*)

Update device with named settings.

Parameters

- **channel** (int) – The channel number (1 to n).

- **settings_name** (str) – The name of the device to load the settings for. Examples for the value of *setting_name* can be found in *ThorlabsDefaultSettings.xml`*, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

max_channel_count()

Gets the number of channels available to this device.

This function returns the number of available bays, not the number of bays filled.

Returns
int – The number of channels available on this device.

message_queue_size(*channel*)

Gets the size of the message queue.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The number of messages in the queue.

move_absolute(*channel*)

Moves the device to the position defined in the *set_move_absolute_position()* command.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

move_at_velocity(*channel*, *direction*)

Start moving at the current velocity in the specified direction.

Parameters

- **channel** (int) – The channel number (1 to n).
- **direction** (*enums.MOT_TravelDirection*) – The required direction of travel as a *enums.MOT_TravelDirection* enum value or member name.

Raises
ThorlabsError – If not successful.

move_jog(*channel*, *jog_direction*)

Perform a jog.

Parameters

- **channel** (int) – The channel number (1 to n).
- **jog_direction** (*enums.MOT_TravelDirection*) – The jog direction as a *enums.MOT_TravelDirection* enum value or member name.

Raises
ThorlabsError – If not successful.

move_relative(*channel*, *displacement*)

Move the motor by a relative amount.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **displacement** (`int`) – Signed displacement in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

move_relative_distance(*channel*)

Moves the device by a relative distance defined by *set_move_relative_distance()*.

Parameters
channel (`int`) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

move_to_position(*channel*, *index*)

Move the device to the specified position (index).

The motor may need to be set to its *home()* position before a position can be set.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **index** (`int`) – The position in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

needs_homing(*channel*)

Does the device need to be *home()*'d before a move can be performed?

Deprecated: calls *can_move_without_homing_first()* instead.

Returns
`bool` – Whether the device needs to be homed.

open()

Open the device for communication.

Raises
ThorlabsError – If not successful.

persist_settings(*channel*)

Persist device settings to device.

Parameters
channel (int) – The channel number (1 to n).

polling_duration(*channel*)

Gets the polling loop duration.

Parameters
channel (int) – The channel number (1 to n).

Returns
int – The time between polls in milliseconds or 0 if polling is not active.

register_message_callback(*channel*, *callback*)

Registers a callback on the message queue.

Parameters

- **channel** (int) – The channel number (1 to n).
- **callback** (*MotionControlCallback*) – A function to be called whenever messages are received.

Raises
ThorlabsError – If not successful.

request_backlash(*channel*)

Requests the backlash.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_bow_index(*channel*)

Requests the stepper motor bow index.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_digital_outputs(*channel*)

Requests the digital output bits.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_encoder_counter(*channel*)

Requests the encoder counter.

For devices that have an encoder, the current encoder position can be read.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_homing_params(*channel*)

Requests the homing parameters.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_input_voltage(*channel*)

Requests the analogue input voltage reading.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_jog_params(*channel*)

Requests the jog parameters.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_joystick_params(*channel*)

Requests the joystick parameters.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_limit_switch_params(*channel*)

Requests the limit switch parameters.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_move_absolute_position(*channel*)

Requests the position of next absolute move.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_move_relative_distance(*channel*)

Requests the relative move distance.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_pid_loop_encoder_params(*channel*)

Requests the Encoder PID loop parameters.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_position(*channel*)

Requests the current position.

This needs to be called to get the device to send its current position. Note, this is called automatically if Polling is enabled for the device using *start_polling()*.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_power_params(*channel*)

Requests the power parameters.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_rack_digital_outputs()

Requests the rack digital output bits.

Raises
ThorlabsError – If not successful.

request_rack_status_bits()

Requests the Rack status bits be downloaded.

Raises
ThorlabsError – If not successful.

request_settings(*channel*)

Requests that all settings are downloaded from the device.

This function requests that the device upload all its settings to the DLL.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_status_bits(*channel*)

Request the status bits which identify the current motor state.

This needs to be called to get the device to send its current status bits. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_trigger_switches(*channel*)

Requests the trigger switch parameter.

> **Warning:** This function is currently not in the DLL, as of v1.14.8, but it is in the header file.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

request_vel_params(*channel*)

Requests the velocity parameters.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

reset_rotation_modes(*channel*)

Reset the rotation modes for a rotational device.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

resume_move_messages(*channel*)

Resume suspended move messages.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

set_backlash(*channel*, *distance*)

Sets the backlash distance (used to control hysteresis).

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **distance** (`int`) – The backlash distance in `DeviceUnits` (see manual).

Raises

ThorlabsError – If not successful.

set_bow_index(*channel*, *bow_index*)

Sets the stepper motor bow index.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **bow_index** (`int`) – The bow index.

Raises

ThorlabsError – If not successful.

set_calibration_file(*channel*, *path*, *enabled*)

Set the calibration file for this motor.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **path** (`str`) – The path to a calibration file to load.
- **enabled** (`bool`) – `True` to enable, `False` to disable.

Raises

`OSError` – If the *path* does not exist.

set_digital_outputs(*channel*, *outputs_bits*)

Sets the digital output bits.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **outputs_bits** (`int`) – Bit mask to set states of the 4 digital output pins.

Raises

ThorlabsError – If not successful.

set_direction(*channel*, *reverse*)

Sets the motor direction sense.

This function is used because some actuators use have directions of motion reversed. This parameter will tell the system to reverse the direction sense when moving, jogging etc.

Parameters

- **channel** (`int`) – The channel number (1 to n).

- **reverse** (bool) – If True then directions will be swapped on these moves.

Raises
ThorlabsError – If not successful.

set_encoder_counter(*channel*, *count*)

Set the Encoder Counter values.

Setting the encoder counter to zero, effectively defines a home position on the encoder strip. Setting this value does not move the device.

Parameters

- **channel** (int) – The channel number (1 to n).
- **count** (int) – The encoder count in encoder units.

Raises
ThorlabsError – If not successful.

set_homing_params_block(*channel*, *direction*, *limit*, *velocity*, *offset*)

Set the homing parameters.

Parameters

- **channel** (int) – The channel number (1 to n).
- **direction** (*enums.MOT_TravelDirection*) – The Homing direction sense as a *enums.MOT_TravelDirection* enum value or member name.
- **limit** (*enums.MOT_HomeLimitSwitchDirection*) – The limit switch direction as a *enums.MOT_HomeLimitSwitchDirection* enum value or member name.
- **velocity** (int) – The velocity in small indivisible units.
- **offset** (int) – Distance of home from limit in small indivisible units.

Raises
ThorlabsError – If not successful.

set_homing_velocity(*channel*, *velocity*)

Sets the homing velocity.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **channel** (int) – The channel number (1 to n).
- **velocity** (int) – The homing velocity in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_jog_mode(*channel*, *mode*, *stop_mode*)

Sets the jog mode.

Parameters

- **channel** (int) – The channel number (1 to n).
- **mode** (*enums.MOT_JogModes*) – The jog mode, as a *enums.MOT_JogModes* enum value or member name.
- **stop_mode** (*enums.MOT_StopModes*) – The stop mode, as a *enums.MOT_StopModes* enum value or member name.

Raises
ThorlabsError – If not successful.

set_jog_params_block(*channel*, *jog_params*)

Set the jog parameters.

Parameters

- **channel** (int) – The channel number (1 to n).
- **jog_params** (*structs.MOT_JogParameters*) – The jog parameters.

Raises
ThorlabsError – If not successful.

set_jog_step_size(*channel*, *step_size*)

Sets the distance to move on jogging.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **channel** (int) – The channel number (1 to n).
- **step_size** (int) – The step size in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_jog_vel_params(*channel*, *max_velocity*, *acceleration*)

Sets jog velocity parameters.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **channel** (int) – The channel number (1 to n).
- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_joystick_params(*channel*, *joystick_params*)

Sets the joystick parameters.

Parameters

- **channel** (int) – The channel number (1 to n).
- **joystick_params** (*structs.MOT_JoystickParameters*) – The joystick parameters.

Raises
ThorlabsError – If not successful.

set_limit_switch_params(*channel*, *cw_lim*, *ccw_lim*, *cw_pos*, *ccw_pos*, *soft_limit_mode*)

Sets the limit switch parameters.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **channel** (int) – The channel number (1 to n).
- **cw_lim** (*enums.MOT_LimitSwitchModes*) – The clockwise hardware limit mode as a *enums.MOT_LimitSwitchModes* enum value or member name.
- **ccw_lim** (*enums.MOT_LimitSwitchModes*) – The anticlockwise hardware limit mode as a *enums.MOT_LimitSwitchModes* enum value or member name.
- **cw_pos** (int) – The position of the clockwise software limit in `DeviceUnits` (see manual).
- **ccw_pos** (int) – The position of the anticlockwise software limit in `DeviceUnits` (see manual).
- **soft_limit_mode** (*enums.MOT_LimitSwitchSWModes*) – The soft limit mode as a *enums.MOT_LimitSwitchSWModes* enum value or member name.

Raises
ThorlabsError – If not successful.

set_limit_switch_params_block(*channel*, *params*)

Set the limit switch parameters.

Parameters

- **channel** (int) – The channel number (1 to n).
- **params** (*structs.MOT_LimitSwitchParameters*) – The new limit switch parameters.

Raises
ThorlabsError – If not successful.

set_limits_software_approach_policy(*channel*, *policy*)

Sets the software limits policy.

Parameters

- **channel** (int) – The channel number (1 to n).

- **policy** (*enums.MOT_LimitsSoftwareApproachPolicy*) – The soft limit mode as a *enums.MOT_LimitsSoftwareApproachPolicy* enum value or member name.

set_motor_params(*channel*, *steps_per_rev*, *gear_box_ratio*, *pitch*)

Sets the motor stage parameters.

Deprecated: calls *set_motor_params_ext()*

set_motor_params_ext(*channel*, *steps_per_rev*, *gear_box_ratio*, *pitch*)

Sets the motor stage parameters.

These parameters, when combined, define the stage motion in terms of `RealWorldUnits` [millimeters or degrees]. The real-world unit is defined from `steps_per_rev * gear_box_ratio / pitch`.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **steps_per_rev** (`float`) – The steps per revolution.
- **gear_box_ratio** (`float`) – The gear box ratio.
- **pitch** (`float`) – The pitch.

Raises

ThorlabsError – If not successful.

set_motor_travel_limits(*channel*, *min_position*, *max_position*)

Sets the motor stage min and max position.

These define the range of travel for the stage.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **min_position** (`float`) – The minimum position in `RealWorldUnits` [millimeters or degrees].
- **max_position** (`float`) – The maximum position in `RealWorldUnits` [millimeters or degrees].

Raises

ThorlabsError – If not successful.

set_motor_travel_mode(*channel*, *travel_mode*)

Set the motor travel mode.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **travel_mode** (*enums.MOT_TravelModes*) – The travel mode as a *enums.MOT_TravelModes* enum value or member name.

Raises
ThorlabsError – If not successful.

set_motor_velocity_limits(*channel*, *max_velocity*, *max_acceleration*)

Sets the motor stage maximum velocity and acceleration.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **max_velocity** (`float`) – The maximum velocity in `RealWorldUnits` [millimeters or degrees].
- **max_acceleration** (`float`) – The maximum acceleration in `RealWorldUnits` [millimeters or degrees].

Raises
ThorlabsError – If not successful.

set_move_absolute_position(*channel*, *position*)

Sets the move absolute position.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **position** (`int`) – The absolute position in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

set_move_relative_distance(*channel*, *distance*)

Sets the move relative distance.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **distance** (`int`) – The relative position in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

set_pid_loop_encoder_coeff(*channel*, *coeff*)

Sets the Encoder PID loop encoder coefficient.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **coeff** (`float`) – The Encoder PID loop encoder coefficient. Set to 0.0 to disable the encoder or if no encoder is present otherwise the positive encoder coefficient.

Raises
ThorlabsError – If not successful.

set_pid_loop_encoder_params(*channel*, *mode*, *prop_gain*, *int_gain*, *diff_gain*, *limit*, *tol*)

Sets the Encoder PID loop parameters.

Parameters

- **channel** (int) – The channel number (1 to n).
- **mode** (*enums.MOT_PID_LoopMode*) – The Encoder PID loop mode as a *enums.MOT_PID_LoopMode* enum value or member name.
- **prop_gain** (int) – The Encoder PID Loop proportional gain. Range 0 to 2^24.
- **int_gain** (int) – The Encoder PID Loop integral gain. Range 0 to 2^24.
- **diff_gain** (int) – The Encoder PID Loop differential gain. Range 0 to 2^24.
- **limit** (int) – The Encoder PID Loop output limit. Range 0 to 2^15.
- **tol** (int) – The Encoder PID Loop tolerance. Range 0 to 2^15.

Raises
ThorlabsError – If not successful.

set_position_counter(*channel*, *count*)

Set the position counter.

Setting the position counter will locate the current position. Setting the position counter will effectively define the home position of a motor.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **channel** (int) – The channel number (1 to n).
- **count** (int) – The position counter in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_power_params(*channel*, *rest*, *move*)

Sets the power parameters for the stepper motor.

Parameters

- **channel** (int) – The channel number (1 to n).
- **rest** (int) – Percentage of full power to give while not moving (0 - 100).
- **move** (int) – Percentage of full power to give while moving (0 - 100).

Raises
ThorlabsError – If not successful.

set_rack_digital_outputs(*outputs_bits*)

Sets the rack digital output bits.

Parameters

outputs_bits (int) – Bit mask to set states of the 4 digital output pins.

Raises

ThorlabsError – If not successful.

set_rotation_modes(*channel*, *mode*, *direction*)

Set the rotation modes for a rotational device.

Parameters

- **channel** (int) – The channel number (1 to n).
- **mode** (*enums.MOT_MovementModes*) – The travel mode as a *enums.MOT_MovementModes* enum value or member name.
- **direction** (*enums.MOT_MovementDirections*) – The travel mode as a *enums.MOT_MovementDirections* enum value or member name.

Raises

ThorlabsError – If not successful.

set_stage_axis_limits(*channel*, *min_position*, *max_position*)

Sets the stage axis position limits.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **channel** (int) – The channel number (1 to n).
- **min_position** (int) – The minimum position in DeviceUnits (see manual).
- **max_position** (int) – The maximum position in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_trigger_switches(*channel*, *indicator_bits*)

Sets the trigger switch bits.

Parameters

- **channel** (int) – The channel number (1 to n).
- **indicator_bits** (int) – Sets the 8 bits indicating action on trigger input and events to trigger electronic output.
  - Bit 0 - Input trigger enabled.
  - Bit 1 - Output trigger enabled.
  - Bit 2 - Output pass-through mode enabled where Output Trigger mirrors Input Trigger.
  - Bit 3 - Output trigger high when moving.

- Bit 4 - Performs relative move when input trigger goes high.
- Bit 5 - Performs absolute move when input trigger goes high.
- Bit 6 - Performs home when input trigger goes high.
- Bit 7 - Output triggers when motor moved by software command.

Raises
ThorlabsError – If not successful.

set_vel_params(*channel*, *max_velocity*, *acceleration*)

Sets the move velocity parameters.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **max_velocity** (`int`) – The maximum velocity in `DeviceUnits` (see manual).
- **acceleration** (`int`) – The acceleration in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

set_vel_params_block(*channel*, *min_velocity*, *max_velocity*, *acceleration*)

Set the move velocity parameters.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **min_velocity** (`int`) – The minimum velocity in `DeviceUnits` (see manual).
- **max_velocity** (`int`) – The maximum velocity in `DeviceUnits` (see manual)..
- **acceleration** (`int`) – The acceleration in `DeviceUnits` (see manual)..

Raises
ThorlabsError – If not successful.

start_polling(*channel*, *milliseconds*)

Starts the internal polling loop.

This function continuously requests position and status messages.

Parameters

- **channel** (`int`) – The channel number (1 to n).
- **milliseconds** (`int`) – The polling rate, in milliseconds.

Raises
ThorlabsError – If not successful.

stop_immediate(*channel*)

Stop the current move immediately (with the risk of losing track of the position).

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

stop_polling(*channel*)

Stops the internal polling loop.

Parameters
channel (int) – The channel number (1 to n).

stop_profiled(*channel*)

Stop the current move using the current velocity profile.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

suspend_move_messages(*channel*)

Suspend automatic messages at ends of moves.

Useful to speed up part of real-time system with lots of short moves.

Parameters
channel (int) – The channel number (1 to n).

Raises
ThorlabsError – If not successful.

time_since_last_msg_received(*channel*)

Gets the time, in milliseconds, since the last message was received.

This can be used to determine whether communications with the device is still good.

Parameters
channel (int) – The channel number (1 to n).

Returns

- int – The time, in milliseconds, since the last message was received.
- bool – True if monitoring is enabled otherwise False.

uses_pid_loop_encoding(*channel*)

Determines if we can uses PID loop encoding.

This is true if the stage supports PID Loop Encoding. Requires *get_pid_loop_encoder_coeff()* to have a positive non-zero coefficient, see also *set_pid_loop_encoder_coeff()*.

Parameters
channel (int) – The channel number (1 to n).

wait_for_message(*channel*)

Wait for next Message Queue item if it is available. See *messages*.

Parameters

channel (int) – The channel number (1 to n).

Returns

- int – The message type.
- int – The message ID.
- int – The message data.

Raises

ThorlabsError – If not successful.

msl.equipment.resources.thorlabs.kinesis.callbacks module

A callback to register for a *MotionControl* message queue.

```
from msl.equipment import Config
from msl.equipment.resources.thorlabs import MotionControlCallback

@MotionControlCallback
def msg_callback():
    print('MotionControlCallback: ', flipper.convert_message(*flipper.get_
↪next_message()))

# The "example2.xml" configuration file contains the following element:
# <equipment alias="filter_flipper" manufacturer="Thorlabs" model="MFF101/M"/>

db = Config('config.xml').database()

flipper = db.equipment['filter_flipper'].connect()
flipper.register_message_callback(msg_callback)

# ... do stuff with the `flipper` ...
```

msl.equipment.resources.thorlabs.kinesis.callbacks.**MotionControlCallback**

A callback to register for a *MotionControl* message queue.

msl.equipment.resources.thorlabs.kinesis.enums module

Enums defined in Thorlabs Kinesis v1.14.10

class msl.equipment.resources.thorlabs.kinesis.enums.**FT_Status**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FT_OK = 0

FT_InvalidHandle = 1

FT_DeviceNotFound = 2

FT_DeviceNotOpened = 3

FT_IOError = 4

FT_InsufficientResources = 5

FT_InvalidParameter = 6

FT_DeviceNotPresent = 7

FT_IncorrectDevice = 8

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_MotorTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_NotMotor = 0

MOT_DCMotor = 1

MOT_StepperMotor = 2

MOT_BrushlessMotor = 3

MOT_CustomMotor = 100

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_TravelModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_TravelModeUndefined = 0

MOT_Linear = 1

MOT_Rotational = 2

class msl.equipment.resources.thorlabs.kinesis.enums.MOT_TravelDirection(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_TravelDirectionDisabled = 0

MOT_Forwards = 1

MOT_Reverse = 2

class msl.equipment.resources.thorlabs.kinesis.enums.MOT_DirectionSense(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_Normal = 0

MOT_Backwards = 1

class msl.equipment.resources.thorlabs.kinesis.enums.MOT_HomeLimitSwitchDirection(*value*, *names=Non*
***,
module=None,
qualname=None
type=None,
start=1,
boundary=None)

Bases: IntEnum

MOT_LimitSwitchDirectionUndefined = 0

MOT_ReverseLimitSwitch = 1

MOT_ForwardLimitSwitch = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_JogModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_JogModeUndefined = 0

MOT_Continuous = 1

MOT_SingleStep = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_StopModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_StopModeUndefined = 0

MOT_Immediate = 1

MOT_Profiled = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_ButtonModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_ButtonModeUndefined = 0

MOT_JogMode = 1

MOT_Preset = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_VelocityProfileModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_Trapezoidal = 0

MOT_SCurve = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_LimitSwitchModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_LimitSwitchModeUndefined = 0

MOT_LimitSwitchIgnoreSwitch = 1

MOT_LimitSwitchMakeOnContact = 2

MOT_LimitSwitchBreakOnContact = 3

MOT_LimitSwitchMakeOnHome = 4

MOT_LimitSwitchBreakOnHome = 5

MOT_PMD_Reserved = 6

MOT_LimitSwitchIgnoreSwitchSwapped = 129

MOT_LimitSwitchMakeOnContactSwapped = 130

MOT_LimitSwitchBreakOnContactSwapped = 131

MOT_LimitSwitchMakeOnHomeSwapped = 132

MOT_LimitSwitchBreakOnHomeSwapped = 133

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_LimitSwitchSWModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_LimitSwitchSWModeUndefined = 0

MOT_LimitSwitchIgnored = 1

MOT_LimitSwitchStopImmediate = 2

MOT_LimitSwitchStopProfiled = 3

MOT_LimitSwitchIgnored_Rotational = 129

MOT_LimitSwitchStopImmediate_Rotational = 130

MOT_LimitSwitchStopProfiled_Rotational = 131

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_LimitsSoftwareApproachPolicy**(*value*, *names=*
***,
module=No
qualname=
type=N
start=1
boundary=No

Bases: IntEnum

DisallowIllegalMoves = 0

AllowPartialMoves = 1

AllowAllMoves = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_CurrentLoopPhases**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_PhaseA = 0

MOT_PhaseB = 1

MOT_PhaseAB = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_MovementModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LinearRange = 0

RotationalUnlimited = 1

RotationalWrapping = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_MovementDirections**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Quickest = 0

Forwards = 1

Reverse = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**MOT_PID_LoopMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

MOT_PIDLoopModeDisabled = 0

MOT_PIDOpenLoopMode = 1

MOT_PIDClosedLoopMode = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_SignalState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_BadSignal = 0

NT_GoodSignal = 1

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_Mode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_ModeUndefined = 0

NT_Piezo = 1

NT_Latch = 2

NT_Tracking = 3

NT_HorizontalTracking = 4

NT_VerticalTracking = 5

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_ControlMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_ControlModeUndefined = 0

NT_OpenLoop = 1

NT_ClosedLoop = 2

NT_OpenLoopSmoothed = 3

NT_ClosedLoopSmoothed = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_FeedbackSource**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_FeedbackSourceUndefined = 0

NT_TIA = 1

NT_BNC_1v = 2

NT_BNC_2v = 3

NT_BNC_5v = 4

NT_BNC_10v = 5

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_TIARange**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_TIARange1_3nA = 3

NT_TIARange2_10nA = 4

NT_TIARange3_30nA = 5

NT_TIARange4_100nA = 6

NT_TIARange5_300nA = 7

NT_TIARange6_1uA = 8

NT_TIARange7_3uA = 9

NT_TIARange8_10uA = 10

NT_TIARange9_30uA = 11

NT_TIARange10_100uA = 12

NT_TIARange11_300uA = 13

NT_TIARange12_1mA = 14

NT_TIARange13_3mA = 15

NT_TIARange14_10mA = 16

class msl.equipment.resources.thorlabs.kinesis.enums.NT_OddOrEven(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_OddAndEven = 1

NT_Odd = 2

NT_Even = 3

class msl.equipment.resources.thorlabs.kinesis.enums.NT_UnderOrOver(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_InRange = 1

NT_UnderRange = 2

NT_OverRange = 3

class msl.equipment.resources.thorlabs.kinesis.enums.NT_CircleDiameterMode(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_ParameterCircleMode = 1

NT_AbsPowerCircleMode = 2

NT_LUTCircleMode = 3

class msl.equipment.resources.thorlabs.kinesis.enums.NT_CircleAdjustment(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_LinearCircleAdjustment = 1

NT_LogCircleAdjustment = 2

NT_SquareCircleAdjustment = 3

NT_CubeCircleAdjustment = 4

class msl.equipment.resources.thorlabs.kinesis.enums.NT_TIARangeMode(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_TIARangeModeUndefined = 0

NT_AutoRangeAtSelected = 1

NT_ManualRangeAtSelected = 2

NT_ManualRangeAtParameter = 3

NT_AutoRangeAtParameter = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_LowPassFrequency**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_LowPassNone = 0

NT_LowPass_1Hz = 1

NT_LowPass_3Hz = 2

NT_LowPass_10Hz = 3

NT_LowPass_30Hz = 4

NT_LowPass_100Hz = 5

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_VoltageRange**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_VoltageRangeUndefined = 0

NT_VoltageRange_5v = 1

NT_VoltageRange_10v = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_OutputVoltageRoute**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_SMAOnly = 1

NT_HubOrSMA = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_PowerInputUnits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_Amps = 0

NT_Watts = 1

NT_Db = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_SMA_Units**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_Voltage = 0

NT_FullRange = 1

NT_UserDefined = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**BNT_CurrentLimit**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_CurrentLimit_100mA = 0

NT_CurrentLimit_250mA = 1

NT_CurrentLimit_500mA = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**BNT_OutputLowPassFilter**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_OutputFilter_10Hz = 0

NT_OutputFilter_100Hz = 1

NT_OutputFilter_5kHz = 2

NT_OutputFilter_None = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**BNT_FeedbackSignalSelection**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_FeedbackSignalDC = 0

NT_FeedbackSignalAC = 65535

class msl.equipment.resources.thorlabs.kinesis.enums.BNT_BNCTriggerModes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_BNCModeTrigger = 0

NT_BNCModeLVOut = 65535

class msl.equipment.resources.thorlabs.kinesis.enums.PZ_ControlModeTypes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

PZ_Undefined = 0

PZ_OpenLoop = 1

PZ_CloseLoop = 2

PZ_OpenLoopSmooth = 3

PZ_CloseLoopSmooth = 4

class msl.equipment.resources.thorlabs.kinesis.enums.PZ_InputSourceFlags(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

PZ_SoftwareOnly = 0

PZ_ExternalSignal = 1

PZ_Potentiometer = 2

PZ_All = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**PZ_OutputLUTModes**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

PZ_Continuous = 1

PZ_Fixed = 2

PZ_OutputTrigEnable = 4

PZ_InputTrigEnable = 8

PZ_OutputTrigSenseHigh = 16

PZ_InputTrigSenseHigh = 32

PZ_OutputGated = 64

PZ_OutputTrigRepeat = 128

class msl.equipment.resources.thorlabs.kinesis.enums.**PPC_DerivFilterState**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DerivFilterOn = 1

DerivFilterOff = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**PPC_NotchFilterState**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NotchFilterOn = 1

NotchFilterOff = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**PPC_NotchFilterChannel**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NotchFilter1 = 1

NotchFilter2 = 2

NotchFilterBoth = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**PPC_IOControlMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SWOnly = 0

ExtBNC = 1

Joystick = 2

JoystickBnc = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**PPC_IOOutputMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

HV = 1

PosRaw = 2

PosCorrected = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**PPC_IOOutputBandwidth**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

OP_Unfiltered = 1

OP_200Hz = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**PPC_IOFeedbackSourceDefinition**(*value*, *names=N*, ***, *module=None*, *qualname=No*, *type=Non*, *start=1*, *boundary=None*)

Bases: IntEnum

StrainGauge = 1

Capacitive = 2

Optical = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**PPC_DisplayIntensity**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Bright = 1

Dim = 2

Off = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**FF_Positions**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FF_PositionError = 0

Position1 = 1

Position2 = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**FF_IOModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FF_ToggleOnPositiveEdge = 1

FF_SetPositionOnPositiveEdge = 2

FF_OutputHighAtSetPosition = 4

FF_OutputHighWhemMoving = 8

class msl.equipment.resources.thorlabs.kinesis.enums.**FF_SignalModes**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FF_InputButton = 1

FF_InputLogic = 2

FF_InputSwap = 4

FF_OutputLevel = 16

FF_OutputPulse = 32

FF_OutputSwap = 64

class msl.equipment.resources.thorlabs.kinesis.enums.**KMOT_WheelDirectionSense**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KMOT_WM_Positive = 1

KMOT_WM_Negative = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KMOT_WheelMode**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KMOT_WM_Velocity = 1

KMOT_WM_Jog = 2

KMOT_WM_MoveAbsolute = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**KMOT_TriggerPortMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KMOT_TrigDisabled = 0

KMOT_TrigIn_GPI = 1

KMOT_TrigIn_RelativeMove = 2

KMOT_TrigIn_AbsoluteMove = 3

KMOT_TrigIn_Home = 4

KMOT_TrigOut_GPO = 10

KMOT_TrigOut_InMotion = 11

KMOT_TrigOut_AtMaxVelocity = 12

KMOT_TrigOut_AtPositionSteps = 13

KMOT_TrigOut_Synch = 14

class msl.equipment.resources.thorlabs.kinesis.enums.**KMOT_TriggerPortPolarity**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KMOT_TrigPolarityHigh = 1

KMOT_TrigPolarityLow = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_Channels**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Channel1 = 1

Channel2 = 2

Channel3 = 3

Channel4 = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_JogMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

JogContinuous = 1

JogStep = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_TravelDirection**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Forward = 1

Reverse = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_FBSignalMode**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

FB_LimitSwitch = 1

FB_Encoder = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_LimitSwitchModes**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Ignore = 1

SwitchMakes = 2

SwitchBreaks = 3

SwitchMakes_HomeOnly = 4

SwitchBreaks_HomeOnly = 5

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_DirectionSense**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Dir_Disabled = 0

Dir_Forward = 1

Dir_Reverse = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_TrigModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Trig_Disabled = 0

Trig_In_GPI = 1

Trig_InRelativeMove = 2

Trig_InAbsoluteMove = 3

Trig_InResetCount = 4

Trig_Out_GP0 = 10

Trig_Out_InMotion = 11

Trig_Out_AtMaxVelocity = 12

Trig_Out_PosStepFwd = 13

Trig_Out_PosStepRev = 14

Trig_Out_PosStepBoth = 15

Trig_Out_AtFwdLimit = 16

Trig_Out_AtRevLimit = 17

Trig_Out_AtEitherLimit = 18

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_TrigPolarities**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Trig_High = 1

Trig_Low = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KIM_JoysticModes**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

JS_Velocity = 1

JS_Jog = 2

JS_GotoPosition = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**ChannelEnableModes**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NONE = 0

Channel1Only = 1

Channel2Only = 2

Channel3Only = 3

Channel4Only = 4

Channels1and2 = 5

Channels3and4 = 6

class msl.equipment.resources.thorlabs.kinesis.enums.**LD_InputSourceFlags**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LD_SoftwareOnly = 1

LD_ExternalSignal = 2

LD_Potentiometer = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**LD_DisplayUnits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LD_ILim = 1

LD_ILD = 2

LD_IPD = 3

LD_PLD = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**LD_TIA_RANGES**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LD_TIA_10uA = 1

LD_TIA_100uA = 2

LD_TIA_1mA = 4

LD_TIA_10mA = 8

class msl.equipment.resources.thorlabs.kinesis.enums.**LD_POLARITY**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LD_CathodeGrounded = 1

LD_AnodeGrounded = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KLD_TriggerMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KLD_Disabled = 0

KLD_Input = 1

KLD_Output = 10

KLD_LaserOn = 11

KLD_InterlockEnabled = 12

KLD_SetPointChange = 13

KLD_HighStability = 14

KLD_LowStability = 15

class msl.equipment.resources.thorlabs.kinesis.enums.**KLD_TrigPolarity**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KLD_TrigPol_High = 1

KLD_TrigPol_Low = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**LS_InputSourceFlags**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LS_SoftwareOnly = 0

LS_ExternalSignal = 1

LS_Potentiometer = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**KLS_OpMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KLS_ConstantPower = 0

KLS_ConstantCurrent = 1

class msl.equipment.resources.thorlabs.kinesis.enums.**KLS_TriggerMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KLS_Disabled = 0

KLS_Input = 1

KLS_Output = 10

KLS_LaserOn = 11

KLS_InterlockEnabled = 12

KLS_SetPointChange = 13

KLS_HighStability = 14

KLS_LowStability = 15

class msl.equipment.resources.thorlabs.kinesis.enums.KLS_TrigPolarity(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KLS_TrigPol_High = 1

KLS_TrigPol_Low = 2

class msl.equipment.resources.thorlabs.kinesis.enums.KNA_FeedbackSource(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_FeedbackSourceUndefined = 0

NT_TIA = 1

NT_IO1_5v = 4

class msl.equipment.resources.thorlabs.kinesis.enums.KNA_TIARange(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_TIARange1_5nA = 3

KNA_TIARange2_16_6nA = 4

KNA_TIARange3_50nA = 5

KNA_TIARange4_166nA = 6

KNA_TIARange5_500nA = 7

KNA_TIARange6_1_66uA = 8

KNA_TIARange7_5uA = 9

KNA_TIARange8_16_6uA = 10

KNA_TIARange9_50uA = 11

KNA_TIARange10_166uA = 12

KNA_TIARange11_500uA = 13

KNA_TIARange12_1_66mA = 14

KNA_TIARange13_5mA = 15

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_LowVoltageRange**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_VoltageRange_10v = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_LowOutputVoltageRoute**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_IO1Only = 1

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_HighVoltageRange**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_Default_Range = 0

KNA_VoltageRange_CH1_75v = 0

KNA_VoltageRange_CH1_150v = 1

KNA_VoltageRange_CH2_75v = 0

KNA_VoltageRange_CH2_150v = 16

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_HighOutputVoltageRoute**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_Default_Route = 0

KNA_ExtIn_PIN = 0

KNA_ExtIn_IO1 = 1

KNA_ExtOut_Dis = 0

KNA_ExtOut_IO2 = 16

KNA_EnableInputBoost = 256

class msl.equipment.resources.thorlabs.kinesis.enums.**NT_IO1_Units**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

NT_Voltage = 0

NT_FullRange = 1

NT_UserDefined = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_WheelAdjustRate**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_WM_Low = 0

KNA_WM_Medium = 1

KNA_WM_High = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_TriggerPortMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_TrigDisabled = 0

KNA_TrigIn_GPI = 1

KNA_TrigIn_VoltageStepUp = 2

KNA_TrigIn_VoltageStepDown = 3

KNA_TrigOut_GPO = 10

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_TriggerPortPolarity**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_TrigPolarityHigh = 1

KNA_TrigPolarityLow = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_Channels**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KNA_ChannelUndefined = 0

KNA_Channel1 = 1

KNA_Channel2 = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KNA_FeedbackModeTypes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

PZ_ControlModeUndefined = 0

PZ_OpenLoop = 1

PZ_CloseLoop = 2

PZ_OpenLoopSmooth = 3

PZ_CloseLoopSmooth = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**KPZ_WheelDirectionSense**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KPZ_WM_Positive = 1

KPZ_WM_Negative = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KPZ_WheelMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KPZ_WM_MoveAtVoltage = 1

KPZ_WM_JogVoltage = 2

KPZ_WM_SetVoltage = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**KPZ_WheelChangeRate**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KPZ_WM_High = 1

KPZ_WM_Medium = 2

KPZ_WM_Low = 3

class msl.equipment.resources.thorlabs.kinesis.enums.KPZ_TriggerPortMode(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KPZ_TrigDisabled = 0

KPZ_TrigIn_GPI = 1

KPZ_TrigIn_VoltageStepUp = 2

KPZ_TrigIn_VoltageStepDown = 3

KPZ_TrigOut_GPO = 10

class msl.equipment.resources.thorlabs.kinesis.enums.KPZ_TriggerPortPolarity(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KPZ_TrigPolarityHigh = 1

KPZ_TrigPolarityLow = 2

class msl.equipment.resources.thorlabs.kinesis.enums.HubAnalogueModes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

AnalogueCh1 = 1

AnalogueCh2 = 2

ExtSignalSMA = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**QD_OperatingMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

QD_ModeUndefined = 0

QD_Monitor = 1

QD_OpenLoop = 2

QD_ClosedLoop = 3

QD_AutoOpenClosedLoop = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**QD_LowVoltageRoute**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

QD_RouteUndefined = 0

QD_SMAOnly = 1

QD_HubAndSMA = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**QD_OpenLoopHoldValues**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

QD_HoldOnZero = 1

QD_HoldOnLastValue = 2

class msl.equipment.resources.thorlabs.kinesis.enums.QD_FilterEnable(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

QD_Undefined = 0

QD_Enabled = 1

QD_Disabled = 2

class msl.equipment.resources.thorlabs.kinesis.enums.QD_KPA_TrigModes(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

QD_Trig_Disabled = 0

QD_TrigIn_GPI = 1

QD_TrigIn_LoopOpenClose = 2

KD_TrigOut_GPO = 10

KD_TrigOut_Sum = 11

KD_TrigOut_Diff = 12

KD_TrigOut_SumDiff = 13

class msl.equipment.resources.thorlabs.kinesis.enums.**QD_KPA_TrigPolarities**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

GD_Trig_High = 1

GD_Trig_Low = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**SC_OperatingModes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SC_Manual = 1

SC_Single = 2

SC_Auto = 3

SC_Triggered = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**SC_OperatingStates**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SC_Unknown = 0

SC_Active = 1

SC_Inactive = 2

class msl.equipment.resources.thorlabs.kinesis.enums.SC_SolenoidStates(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

SC_SolenoidOpen = 1

SC_SolenoidClosed = 2

class msl.equipment.resources.thorlabs.kinesis.enums.KSC_TriggerPortMode(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KSC_TrigDisabled = 0

KSC_TrigIn_GPI = 1

KSC_TrigOut_GPO = 10

class msl.equipment.resources.thorlabs.kinesis.enums.KSC_TriggerPortPolarity(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KSC_TrigPolarityHigh = 1

KSC_TrigPolarityLow = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**KST_Stages**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ZST6 = 32

ZST13 = 33

ZST25 = 34

ZST206 = 48

ZST213 = 49

ZST225 = 50

ZFS206 = 64

ZFS213 = 65

ZFS225 = 66

DRV013_25MM = 80

DRV014_50MM = 81

NR360 = 112

PLS_X25MM = 114

PLS_X25MM_HiRes = 115

FW103 = 117

class msl.equipment.resources.thorlabs.kinesis.enums.**TSG_Hub_Analogue_Modes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

TSG_HubChannel1 = 1

TSG_HubChannel2 = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**TSG_Display_Modes**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

TSG_Undefined = 0

TSG_Position = 1

TSG_Voltage = 2

TSG_Force = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**KSG_TriggerPortMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KSG_TrigDisabled = 0

KSG_TrigIn_GPI = 1

KSG_TrigOut_GPO = 10

KSG_TrigOut_LessThanLowerLimit = 11

KSG_TrigOut_MoreThanLowerLimit = 12

KSG_TrigOut_LessThanUpperLimit = 13

KSG_TrigOut_MoreThanUpperLimit = 14

KSG_TrigOut_BetweenLimits = 15

KSG_TrigOut_OutsideLimits = 16

class msl.equipment.resources.thorlabs.kinesis.enums.**KSG_TriggerPortPolarity**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

KSG_TrigPolarityHigh = 1

KSG_TrigPolarityLow = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**TIM_Channels**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Channel1 = 1

Channel2 = 2

Channel3 = 3

Channel4 = 4

class msl.equipment.resources.thorlabs.kinesis.enums.**TIM_JogMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

JogContinuous = 1

JogStep = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**TIM_ButtonsMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Jog = 1

Position = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**TIM_Direction**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Forward = 1

Reverse = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**LS_DisplayUnits**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

LS_mAmps = 1

LS_mWatts = 2

LS_mDb = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**TST_Stages**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

ZST6 = 32

ZST13 = 33

ZST25 = 34

ZST206 = 48

ZST213 = 49

ZST225 = 50

ZFS206 = 64

ZFS213 = 65

ZFS225 = 66

TBD1 = 96

TBD2 = 97

TBD3 = 98

TBD4 = 99

NR360 = 112

MVS025 = 113

PLS_X25MM = 114

PLS_X25MM_HiRes = 115

FW103 = 117

NEWZFS06 = 10006

NEWZFS13 = 10013

NEWZFS25 = 10025

NEWZST06 = 11006

NEWZST13 = 11013

NEWZST25 = 12025

class msl.equipment.resources.thorlabs.kinesis.enums.**TC_SensorTypes**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

TC_Transducer = 0

TC_TH20kOhm = 1

TC_TH200kOhm = 2

class msl.equipment.resources.thorlabs.kinesis.enums.**TC_DisplayModes**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

TC_ActualTemperature = 0

TC_TargetTemperature = 1

TC_TempDifference = 2

TC_Current = 3

class msl.equipment.resources.thorlabs.kinesis.enums.**UnitType**(*value*, *names=None*, **, module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

DISTANCE = 0

VELOCITY = 1

ACCELERATION = 2

msl.equipment.resources.thorlabs.kinesis.errors module

Device and Low Level Error Codes defined in Thorlabs Kinesis v1.14.10

msl.equipment.resources.thorlabs.kinesis.filter_flipper module

This module provides all the functionality required to control a Filter Flipper (MFF101, MFF102).

class msl.equipment.resources.thorlabs.kinesis.filter_flipper.**FilterFlipper**(*record*)

Bases: *MotionControl*

A wrapper around `Thorlabs.MotionControl.FilterFlipper.dll`.

The *properties* for a FilterFlipper connection supports the following key-value pairs in the *Connections Database*:

```
'device_name': str, the device name found in ThorlabsDefaultSettings.xml␣
↪[default: None]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

MIN_TRANSIT_TIME = 300

MAX_TRANSIT_TIME = 2800

MIN_PULSE_WIDTH = 10

MAX_PULSE_WIDTH = 200

open()

Open the device for communication.

Raises
ThorlabsError – If not successful.

close()

Disconnect and close the device.

check_connection()

Check connection.

Returns
`bool` – Whether the USB is listed by the FTDI controller.

identify()

Sends a command to the device to make it identify itself.

get_hardware_info()

Gets the hardware information from the device.

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

`get_firmware_version()`

Gets version number of the device firmware.

Returns
`str` – The firmware version.

`get_software_version()`

Gets version number of the device software.

Returns
`str` – The device software version.

`load_settings()`

Update device with stored settings.

The settings are read from `ThorlabsDefaultSettings.xml`, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

`load_named_settings(settings_name)`

Update device with named settings.

Parameters
settings_name (`str`) – The name of the device to load the settings for. Examples for the value of *setting_name* can be found in *ThorlabsDefaultSettings.xml* `, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

`persist_settings()`

Persist the devices current settings.

Raises
ThorlabsError – If not successful.

`get_number_positions()`

Get number of positions available from the device.

Returns
`int` – The number of positions.

`home()`

Home the device.

Homing the device will set the device to a known state and determine the home position.

Raises
ThorlabsError – If not successful.

`move_to_position(position)`

Move the device to the specified position (index).

Parameters
position (int) – The required position. Must be 1 or 2.

Raises
ThorlabsError – If not successful.

get_position()

Get the current position.

Returns
int – The position, 1 or 2 (can be 0 during a move).

get_io_settings()

Gets the I/O settings from filter flipper.

Returns
FF_IOSettings – The Filter Flipper I/O settings.

Raises
ThorlabsError – If not successful.

request_io_settings()

Requests the I/O settings from the filter flipper.

Raises
ThorlabsError – If not successful.

set_io_settings(*transit_time=500*, *oper1=FF_IOModes.FF_ToggleOnPositiveEdge*, *sig1=FF_SignalModes.FF_InputButton*, *pw1=200*, *oper2=FF_IOModes.FF_ToggleOnPositiveEdge*, *sig2=FF_SignalModes.FF_OutputLevel*, *pw2=200*)

Sets the settings on filter flipper.

Parameters

- **transit_time** (int, optional) – Time taken to get from one position to other in milliseconds.
- **oper1** (*FF_IOModes*, optional) – I/O 1 Operating Mode.
- **sig1** (*FF_SignalModes*, optional) – I/O 1 Signal Mode.
- **pw1** (int, optional) – Digital I/O 1 pulse width in milliseconds.
- **oper2** (*FF_IOModes*, optional) – I/O 2 Operating Mode.
- **sig2** (*FF_SignalModes*, optional) – I/O 2 Signal Mode.
- **pw2** (int, optional) – Digital I/O 2 pulse width in milliseconds.

Raises
ThorlabsError – If not successful.

get_transit_time()

Gets the transit time.

Returns
int – The transit time in milliseconds.

set_transit_time(*transit_time*)

Sets the transit time.

Parameters
transit_time (int) – The transit time in milliseconds.

Raises
ThorlabsError – If not successful.

request_status()

Request status bits.

This needs to be called to get the device to send it's current status.

This is called automatically if Polling is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

get_status_bits()

Get the current status bits.

This returns the latest status bits received from the device. To get new status bits, use *request_status()* or use the polling function, *start_polling()*

Returns
int – The status bits from the device.

start_polling(*milliseconds*)

Starts the internal polling loop.

This function continuously requests position and status messages.

Parameters
milliseconds (int) – The polling rate, in milliseconds.

Raises
ThorlabsError – If not successful.

polling_duration()

Gets the polling loop duration.

Returns
int – The time between polls in milliseconds or 0 if polling is not active.

stop_polling()

Stops the internal polling loop.

time_since_last_msg_received()

Gets the time, in milliseconds, since tha last message was received.

This can be used to determine whether communications with the device is still good.

Returns
int – The time, in milliseconds, since the last message was received.

enable_last_msg_timer(*enable*, *msg_timeout=0*)

Enables the last message monitoring timer.

This can be used to determine whether communications with the device is still good.

Parameters

- **enable** (bool) – True to enable monitoring otherwise False to disable.
- **msg_timeout** (int, optional) – The last message error timeout in ms. Set to 0 to disable.

has_last_msg_timer_overrun()

Queries if the time since the last message has exceeded the lastMsgTimeout set by *enable_last_msg_timer()*.

This can be used to determine whether communications with the device is still good.

Returns

bool – True if last message timer has elapsed or False if monitoring is not enabled or if time of last message received is less than msg_timeout.

request_settings()

Requests that all settings are downloaded from the device.

This function requests that the device upload all it's settings to the DLL.

Raises

ThorlabsError – If not successful.

clear_message_queue()

Clears the device message queue.

register_message_callback(*callback*)

Registers a callback on the message queue.

Parameters

callback (*MotionControlCallback*) – A function to be called whenever messages are received.

message_queue_size()

Gets the size of the message queue.

Returns

int – The number of messages in the queue.

get_next_message()

Get the next Message Queue item. See *messages*.

Returns

- int – The message type.
- int – The message ID.
- int – The message data.

Raises

ThorlabsError – If not successful.

wait_for_message()

Wait for next Message Queue item. See *messages*.

Returns

- int – The message type.
- int – The message ID.
- int – The message data.

Raises

ThorlabsError – If not successful.

msl.equipment.resources.thorlabs.kinesis.integrated_stepper_motors module

This module provides all the functionality required to control a number of **Integrated Stepper Motors** including:

- Long Travel Stages (LTS150 and LTS300)
- Lab Jack (MLJ050, MLJ150)
- Cage Rotator (K10CR1)

class msl.equipment.resources.thorlabs.kinesis.integrated_stepper_motors.**IntegratedStepperMo**

Bases: *MotionControl*

A wrapper around Thorlabs.MotionControl.IntegratedStepperMotors.dll.

The *properties* for an IntegratedStepperMotors connection supports the following key-value pairs in the *Connections Database*:

```
'device_name': str, the device name found in ThorlabsDefaultSettings.xml␣
↪[default: None]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

can_home()

Can the device perform a *home()*?

Returns

bool – Whether the device can be homed.

can_move_without_homing_first()

Does the device need to be *home()*'d before a move can be performed?

Returns

bool – Whether the device needs to be homed.

check_connection()

Check connection.

Returns

bool – Whether the USB is listed by the FTDI controller.

clear_message_queue()

Clears the device message queue.

close()

Disconnect and close the device.

disable_channel()

Disable the channel so that motor can be moved by hand.

When disabled, power is removed from the motor and it can be freely moved.

Raises

ThorlabsError – If not successful.

enable_channel()

Enable channel for computer control.

When enabled, power is applied to the motor so it is fixed in position.

Raises

ThorlabsError – If not successful.

enable_last_msg_timer(*enable*, *last_msg_timeout*)

Enables the last message monitoring timer.

This can be used to determine whether communications with the device is still good.

Parameters

- **enable** (bool) – True to enable monitoring otherwise False to disable.
- **last_msg_timeout** (int) – The last message error timeout in ms. Set to 0 to disable.

get_backlash()

Get the backlash distance setting (used to control hysteresis).

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

int – The backlash distance in DeviceUnits (see manual).

get_bow_index()

Gets the stepper motor bow index.

Returns

int – The bow index.

get_button_params()

Gets the LTS button parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- *enums.MOT_ButtonModes* – The button mode.
- int – The Preset position in DeviceUnits for the left button (when in preset mode).

- int – The Preset position in DeviceUnits for the right button (when in preset mode).
- int – The time that buttons need to be pressed in order to go home or to record a preset buttons defined position.

Raises
ThorlabsError – If not successful.

get_button_params_block()

Get the button parameters.

Returns
structs.MOT_ButtonParameters – The button parameters.

Raises
ThorlabsError – If not successful.

get_calibration_file()

Get the calibration file for this motor.

Returns
str – The filename of the calibration file.

Raises
ThorlabsError – If not successful.

get_device_unit_from_real_value(*real_value*, *unit_type*)

Converts a real-world value to a device value.

Either *load_settings()*, *load_named_settings()* or *set_motor_params_ext()* must be called before calling this function, otherwise the returned value will always be 0.

Parameters
- **real_value** (float) – The real-world value.
- **unit_type** (*enums.UnitType*) – The unit of the real-world value.

Returns
int – The device value.

Raises
ThorlabsError – If not successful.

get_firmware_version()

Gets version number of the device firmware.

Returns
str – The firmware version.

get_hardware_info()

Gets the hardware information from the device.

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

get_hardware_info_block()

Gets the hardware information in a block.

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

get_homing_params_block()

Get the homing parameters.

Returns
structs.MOT_HomingParameters – The homing parameters.

Raises
ThorlabsError – If not successful.

get_homing_velocity()

Gets the homing velocity.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The homing velocity in `DeviceUnits` (see manual).

get_jog_mode()

Gets the jog mode.

Returns

- *enums.MOT_JogModes* – The jog mode.
- *enums.MOT_StopModes* – The stop mode.

Raises
ThorlabsError – If not successful.

get_jog_params_block()

Get the jog parameters.

Returns
structs.MOT_JogParameters – The jog parameters.

Raises
ThorlabsError – If not successful.

get_jog_step_size()

Gets the distance to move when jogging.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The step size in `DeviceUnits` (see manual).

get_jog_vel_params()

Gets the jog velocity parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- int – The maximum velocity in DeviceUnits (see manual).
- int – The acceleration in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

get_led_switches()

Get the LED indicator bits on the device.

Returns

int – Sum of: 8 to indicate moving 2 to indicate end of track and 1 to flash on identify command.

get_limit_switch_params()

Gets the limit switch parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- *enums.MOT_LimitSwitchModes* – The clockwise hardware limit mode.
- *enums.MOT_LimitSwitchModes* – The anticlockwise hardware limit mode.
- int – The position of the clockwise software limit in DeviceUnits (see manual).
- int – The position of the anticlockwise software limit in DeviceUnits (see manual).
- *enums.MOT_LimitSwitchSWModes* – The soft limit mode.

Raises

ThorlabsError – If not successful.

get_limit_switch_params_block()

Get the limit switch parameters.

Returns

structs.MOT_LimitSwitchParameters – The limit switch parameters.

Raises

ThorlabsError – If not successful.

get_motor_params()

Gets the motor stage parameters.

Deprecated: calls *get_motor_params_ext()*

get_motor_params_ext()

Gets the motor stage parameters.

These parameters, when combined define the stage motion in terms of `RealWorldUnits` [millimeters or degrees]. The real-world unit is defined from `steps_per_rev * gear_box_ratio / pitch`.

Returns

- class`float` – The steps per revolution.
- `float` – The gear box ratio.
- `float` – The pitch.

Raises

ThorlabsError – If not successful.

get_motor_travel_limits()

Gets the motor stage min and max position.

Returns

- `float` – The minimum position in `RealWorldUnits` [millimeters or degrees].
- `float` – The maximum position in `RealWorldUnits` [millimeters or degrees].

Raises

ThorlabsError – If not successful.

get_motor_travel_mode()

Get the motor travel mode.

Returns

enums.MOT_TravelModes – The travel mode.

get_motor_velocity_limits()

Gets the motor stage maximum velocity and acceleration.

Returns

- `float` – The maximum velocity in `RealWorldUnits` [millimeters or degrees].
- `float` – The maximum acceleration in `RealWorldUnits` [millimeters or degrees].

Raises

ThorlabsError – If not successful.

get_move_absolute_position()

Gets the move absolute position.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns

`int` – The move absolute position in `DeviceUnits` (see manual).

get_move_relative_distance()

Gets the move relative distance.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The move relative position in DeviceUnits (see manual).

get_next_message()

Get the next Message Queue item. See *messages*.

Returns

- int – The message type.
- int – The message ID.
- int – The message data.

Raises
ThorlabsError – If not successful.

get_number_positions()

Get the number of positions.

This function will get the maximum position reachable by the device. The motor may need to be set to its *home()* position before this parameter can be used.

Returns
int – The number of positions.

get_position()

Get the current position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
index (int) – The position in DeviceUnits (see manual).

get_position_counter()

Get the position counter.

The position counter is identical to the position parameter. The position counter is set to zero when homing is complete.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The position counter in DeviceUnits (see manual).

get_potentiometer_params(*index*)

Gets the potentiometer parameters for the LTS.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters
index (int) – The potentiometer index to be read.

Returns

- int – The potentiometer threshold, range 0 to 127.
- int – The velocity in DeviceUnits for the current potentiometer threshold.

Raises

ThorlabsError – If not successful.

get_potentiometer_params_block()

Get the potentiometer parameters.

Returns

structs.MOT_PotentiometerSteps – The potentiometer parameters.

Raises

ThorlabsError – If not successful.

get_power_params()

Gets the power parameters for the stepper motor.

Returns

structs.MOT_PowerParameters – The power parameters.

Raises

ThorlabsError – If not successful.

get_real_value_from_device_unit(*device_value*, *unit_type*)

Converts a device value to a real-world value.

Either *load_settings()*, *load_named_settings()* or *set_motor_params_ext()* must be called before calling this function, otherwise the returned value will always be 0.

Parameters

- **device_value** (int) – The device value.
- **unit_type** (*enums.UnitType*) – The unit of the device value.

Returns

float – The real-world value.

Raises

ThorlabsError – If not successful.

get_soft_limit_mode()

Gets the software limits mode.

Returns

enums.MOT_LimitsSoftwareApproachPolicy – The software limits mode.

get_software_version()

Gets version number of the device software.

Returns

str – The device software version.

get_stage_axis_max_pos()

Gets the LTS Motor maximum stage position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The maximum position in DeviceUnits (see manual).

get_stage_axis_min_pos()

Gets the LTS Motor minimum stage position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The minimum position in DeviceUnits (see manual).

get_status_bits()

Get the current status bits.

This returns the latest status bits received from the device. To get new status bits, use *request_status_bits()* or use *request_status()* or use the polling function, *start_polling()*.

Returns
int – The status bits from the device.

get_trigger_switches()

Gets the trigger switch bits.

Returns
int – 8 bits indicating action on trigger input and events to trigger electronic output.

get_vel_params()

Gets the move velocity parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

get_vel_params_block()

Get the move velocity parameters.

Returns
structs.MOT_VelocityParameters – The velocity parameters.

Raises
ThorlabsError – If not successful.

has_last_msg_timer_overrun()

Queries if the time since the last message has exceeded the `lastMsgTimeout` set by *enable_last_msg_timer()*.

This can be used to determine whether communications with the device is still good.

Returns
`bool` – `True` if last message timer has elapsed, `False` if monitoring is not enabled or if time of last message received is less than `lastMsgTimeout`.

home()

Home the device.

Homing the device will set the device to a known state and determine the home position.

Raises
ThorlabsError – If not successful.

identify()

Sends a command to the device to make it identify itself.

Raises
ThorlabsError – If not successful.

is_calibration_active()

Is a calibration file active for this motor?

Returns
`bool` – Whether a calibration file is active.

load_settings()

Update device with stored settings.

The settings are read from `ThorlabsDefaultSettings.xml`, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

load_named_settings(*settings_name*)

Update device with named settings.

Parameters
settings_name (`str`) – The name of the device to load the settings for. Examples for the value of *setting_name* can be found in *ThorlabsDefaultSettings.xml* `, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

message_queue_size()

Gets the size of the message queue.

Returns
`int` – The number of messages in the queue.

move_absolute()

Moves the device to the position defined in *set_move_absolute_position()*.

Raises
ThorlabsError – If not successful.

move_at_velocity(*direction*)

Start moving at the current velocity in the specified direction.

Parameters
direction (*enums.MOT_TravelDirection*) – The required direction of travel as a *enums.MOT_TravelDirection* enum value or member name.

Raises
ThorlabsError – If not successful.

move_jog(*jog_direction*)

Perform a jog.

Parameters
jog_direction (*enums.MOT_TravelDirection*) – The jog direction as a *enums.MOT_TravelDirection* enum value or member name.

Raises
ThorlabsError – If not successful.

move_relative(*displacement*)

Move the motor by a relative amount.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
displacement (`int`) – Signed displacement in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

move_relative_distance()

Moves the device by a relative distance defined by *set_move_relative_distance()*.

Raises
ThorlabsError – If not successful.

move_to_position(*index*)

Move the device to the specified position (index).

The motor may need to be set to its *home()* position before a position can be set.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
index (`int`) – The position in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

needs_homing()

Does the device need to be *home()*'d before a move can be performed?

Deprecated: calls *can_move_without_homing_first()* instead.

Returns
bool – Whether the device needs to be homed.

open()

Open the device for communication.

Raises
ThorlabsError – If not successful.

persist_settings()

Persist the devices current settings.

Raises
ThorlabsError – If not successful.

polling_duration()

Gets the polling loop duration.

Returns
int – The time between polls in milliseconds or 0 if polling is not active.

register_message_callback(*callback*)

Registers a callback on the message queue.

Parameters
callback (*MotionControlCallback*) – A function to be called whenever messages are received.

request_backlash()

Requests the backlash.

Raises
ThorlabsError – If not successful.

request_bow_index()

Requests the stepper motor bow index.

Raises
ThorlabsError – If not successful.

request_button_params()

Requests the LTS button parameters.

Raises
ThorlabsError – If not successful.

request_homing_params()

Requests the homing parameters.

Raises
ThorlabsError – If not successful.

request_jog_params()

Requests the jog parameters.

Raises
ThorlabsError – If not successful.

request_limit_switch_params()

Requests the limit switch parameters.

Raises
ThorlabsError – If not successful.

request_move_absolute_position()

Requests the position of next absolute move.

Raises
ThorlabsError – If not successful.

request_move_relative_distance()

Requests the relative move distance.

Raises
ThorlabsError – If not successful.

request_position()

Requests the current position.

This needs to be called to get the device to send its current position. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

request_potentiometer_params()

Requests the potentiometer parameters.

Raises
ThorlabsError – If not successful.

request_power_params()

Requests the power parameters.

Raises
ThorlabsError – If not successful.

request_settings()

Requests that all settings are downloaded from the device.

This function requests that the device upload all its settings to the DLL.

Raises
ThorlabsError – If not successful.

request_status()

Request position and status bits.

This needs to be called to get the device to send it's current status. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

request_status_bits()

Request the status bits which identify the current motor state.

This needs to be called to get the device to send its current status bits. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

request_trigger_switches()

Requests the trigger switch bits.

Raises
ThorlabsError – If not successful.

request_vel_params()

Requests the velocity parameters.

Raises
ThorlabsError – If not successful.

reset_rotation_modes()

Reset the rotation modes for a rotational device.

Raises
ThorlabsError – If not successful.

reset_stage_to_defaults()

Reset the stage settings to defaults.

Raises
ThorlabsError – If not successful.

set_backlash(*distance*)

Sets the backlash distance (used to control hysteresis).

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
distance (`int`) – The backlash distance in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

set_bow_index(*bow_index*)

Sets the stepper motor bow index.

Parameters
bow_index (`int`) – The bow index.

Raises
ThorlabsError – If not successful.

set_button_params(*button_mode*, *left_button_position*, *right_button_position*)

Sets the LTS button parameters.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **button_mode** (*enums.MOT_ButtonModes*) – The button mode as a *enums.MOT_ButtonModes* enum value or member name.
- **left_button_position** (int) – The Preset position in DeviceUnits for the left button (when in preset mode).
- **right_button_position** (int) – The Preset position in DeviceUnits for the right button (when in preset mode).

Raises

ThorlabsError – If not successful.

set_button_params_block(*mode*, *left_button*, *right_button*, *timeout*)

Set the button parameters.

Parameters

- **mode** (*enums.MOT_ButtonModes*) – The mode of operation of the device buttons as a *enums.MOT_ButtonModes* enum value or member name.
- **left_button** (int) – Position in encoder counts to go to when left button is pressed.
- **right_button** (int) – Position in encoder counts to go to when right button is pressed.
- **timeout** (int) – The Time a button needs to be held down for to record the position as a preset.

Raises

ThorlabsError – If not successful.

set_calibration_file(*path*, *enabled*)

Set the calibration file for this motor.

Parameters

- **path** (str) – The path to a calibration file to load.
- **enabled** (bool) – True to enable, False to disable.

Raises

OSError – If the *path* does not exist.

set_direction(*reverse*)

Sets the motor direction sense.

This function is used because some actuators use have directions of motion reversed. This parameter will tell the system to reverse the direction sense when moving, jogging etc.

Parameters

reverse (bool) – If True then directions will be swapped on these moves.

Raises

ThorlabsError – If not successful.

set_homing_params_block(*direction*, *limit*, *velocity*, *offset*)

Set the homing parameters.

Parameters

- **direction** (*enums.MOT_TravelDirection*) – The Homing direction sense as a *enums.MOT_TravelDirection* enum value or member name.
- **limit** (*enums.MOT_HomeLimitSwitchDirection*) – The limit switch direction as a *enums.MOT_HomeLimitSwitchDirection* enum value or member name.
- **velocity** (int) – The velocity in small indivisible units.
- **offset** (int) – Distance of home from limit in small indivisible units.

Raises

ThorlabsError – If not successful.

set_homing_velocity(*velocity*)

Sets the homing velocity.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

velocity (int) – The homing velocity in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_jog_mode(*mode*, *stop_mode*)

Sets the jog mode.

Parameters

- **mode** (*enums.MOT_JogModes*) – The jog mode, as a *enums.MOT_JogModes* enum value or member name.
- **stop_mode** (*enums.MOT_StopModes*) – The stop mode, as a *enums.MOT_StopModes* enum value or member name.

Raises

ThorlabsError – If not successful.

set_jog_params_block(*jog_params*)

Set the jog parameters.

Parameters

jog_params (*structs.MOT_JogParameters*) – The jog parameters.

Raises

- *ThorlabsError* – If not successful.
- TypeError – If the data type of *jog_params* is not *structs.MOT_JogParameters*

set_jog_step_size(*step_size*)

Sets the distance to move on jogging.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

step_size (int) – The step size in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_jog_vel_params(*max_velocity*, *acceleration*)

Sets jog velocity parameters.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_led_switches(*led_switches*)

Set the LED indicator bits on the device.

Parameters

led_switches (int) – Sum of: 8 to indicate moving 2 to indicate end of track and 1 to flash on identify command.

Raises

ThorlabsError – If not successful.

set_limit_switch_params(*cw_lim*, *ccw_lim*, *cw_pos*, *ccw_pos*, *soft_limit_mode*)

Sets the limit switch parameters.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **cw_lim** (*enums.MOT_LimitSwitchModes*) – The clockwise hardware limit mode as a *enums.MOT_LimitSwitchModes* enum value or member name.
- **ccw_lim** (*enums.MOT_LimitSwitchModes*) – The anticlockwise hardware limit mode as a *enums.MOT_LimitSwitchModes* enum value or member name.
- **cw_pos** (int) – The position of the clockwise software limit in DeviceUnits (see manual).
- **ccw_pos** (int) – The position of the anticlockwise software limit in DeviceUnits (see manual).

- **soft_limit_mode** (*enums.MOT_LimitSwitchSWModes*) – The soft limit mode as a *enums.MOT_LimitSwitchSWModes* enum value or member name.

Raises

ThorlabsError – If not successful.

set_limit_switch_params_block(*params*)

Set the limit switch parameters.

Parameters

params (*structs.MOT_LimitSwitchParameters*) – The new limit switch parameters.

Raises

- *ThorlabsError* – If not successful.
- **TypeError** – If the data type of *joystick_params* is not *structs.MOT_JoystickParameters*

set_limits_software_approach_policy(*policy*)

Sets the software limits policy.

Parameters

policy (*enums.MOT_LimitsSoftwareApproachPolicy*) – The soft limit mode as a *enums.MOT_LimitsSoftwareApproachPolicy* enum value or member name.

set_motor_params(*steps_per_rev*, *gear_box_ratio*, *pitch*)

Sets the motor stage parameters.

Deprecated: calls *set_motor_params_ext()*

These parameters, when combined, define the stage motion in terms of `RealWorldUnits` [millimeters or degrees]. The real-world unit is defined from `steps_per_rev * gear_box_ratio / pitch`.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters

- **steps_per_rev** (`float`) – The steps per revolution.
- **gear_box_ratio** (`float`) – The gear box ratio.
- **pitch** (`float`) – The pitch.

Raises

ThorlabsError – If not successful.

set_motor_params_ext(*steps_per_rev*, *gear_box_ratio*, *pitch*)

Sets the motor stage parameters.

These parameters, when combined, define the stage motion in terms of `RealWorldUnits` [millimeters or degrees]. The real-world unit is defined from `steps_per_rev * gear_box_ratio / pitch`.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters

- **steps_per_rev** (float) – The steps per revolution.
- **gear_box_ratio** (float) – The gear box ratio.
- **pitch** (float) – The pitch.

Raises

ThorlabsError – If not successful.

set_motor_travel_limits(*min_position*, *max_position*)

Sets the motor stage min and max position.

These define the range of travel for the stage.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **min_position** (float) – The minimum position in RealWorldUnits [millimeters or degrees].
- **max_position** (float) – The maximum position in RealWorldUnits [millimeters or degrees].

Raises

ThorlabsError – If not successful.

set_motor_travel_mode(*travel_mode*)

Set the motor travel mode.

Parameters

travel_mode (*enums.MOT_TravelModes*) – The travel mode as a *enums.MOT_TravelModes* enum value or member name.

Raises

ThorlabsError – If not successful.

set_motor_velocity_limits(*max_velocity*, *max_acceleration*)

Sets the motor stage maximum velocity and acceleration.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **max_velocity** (float) – The maximum velocity in RealWorldUnits [millimeters or degrees].
- **max_acceleration** (float) – The maximum acceleration in RealWorldUnits [millimeters or degrees].

Raises

ThorlabsError – If not successful.

set_move_absolute_position(*position*)

Sets the move absolute position.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters
position (int) – The absolute position in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_move_relative_distance(*distance*)

Sets the move relative distance.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters
distance (int) – The relative position in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_position_counter(*count*)

Set the position counter.

Setting the position counter will locate the current position. Setting the position counter will effectively define the home position of a motor.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters
count (int) – The position counter in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_potentiometer_params(*index*, *threshold*, *velocity*)

Sets the potentiometer parameters for the LTS.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **index** (int) – The potentiometer index to be stored.
- **threshold** (int) – The potentiometer threshold, range 0 to 127.
- **velocity** (int) – The velocity in DeviceUnits for the current potentiometer threshold.

Raises
ThorlabsError – If not successful.

set_potentiometer_params_block(*params*)

Set the potentiometer parameters.

Parameters
params (*structs.MOT_PotentiometerSteps*) – The potentiometer parameters.

Raises
ThorlabsError – If not successful.

set_power_params(*rest*, *move*)

Sets the power parameters for the stepper motor.

Parameters

- **rest** (int) – Percentage of full power to give while not moving (0 - 100).
- **move** (int) – Percentage of full power to give while moving (0 - 100).

Raises

ThorlabsError – If not successful.

set_rotation_modes(*mode*, *direction*)

Set the rotation modes for a rotational device.

Parameters

- **mode** (*enums.MOT_MovementModes*) – The travel mode as a *enums.MOT_MovementModes* enum value or member name.
- **direction** (*enums.MOT_MovementDirections*) – The travel mode as a *enums.MOT_MovementDirections* enum value or member name.

Raises

ThorlabsError – If not successful.

set_stage_axis_limits(*min_position*, *max_position*)

Sets the stage axis position limits.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **min_position** (int) – The minimum position in DeviceUnits (see manual).
- **max_position** (int) – The maximum position in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_trigger_switches(*indicator_bits*)

Sets the trigger switch bits.

Parameters

indicator_bits (int) – Sets the 8 bits indicating action on trigger input and events to trigger electronic output.

Raises

ThorlabsError – If not successful.

set_vel_params(*max_velocity*, *acceleration*)

Sets the move velocity parameters.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_vel_params_block(*min_velocity*, *max_velocity*, *acceleration*)

Set the move velocity parameters.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **min_velocity** (int) – The minimum velocity in DeviceUnits (see manual)..
- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual)..
- **acceleration** (int) – The acceleration in DeviceUnits (see manual)..

Raises
ThorlabsError – If not successful.

start_polling(*milliseconds*)

Starts the internal polling loop.

This function continuously requests position and status messages.

Parameters
milliseconds (int) – The polling rate, in milliseconds.

Raises
ThorlabsError – If not successful.

stop_immediate()

Stop the current move immediately (with the risk of losing track of the position).

Raises
ThorlabsError – If not successful.

stop_polling()

Stops the internal polling loop.

stop_profiled()

Stop the current move using the current velocity profile.

Raises
ThorlabsError – If not successful.

time_since_last_msg_received()

Gets the time, in milliseconds, since the last message was received.

This can be used to determine whether communications with the device is still good.

Returns

- int – The time, in milliseconds, since the last message was received.
- bool – True if monitoring is enabled otherwise False.

wait_for_message()

Wait for next Message Queue item. See *messages*.

Returns

- int – The message type.
- int – The message ID.
- int – The message data.

Raises

ThorlabsError – If not successful.

msl.equipment.resources.thorlabs.kinesis.kcube_dc_servo module

This module provides all the functionality required to control a KCube DC Servo (KDC101).

class msl.equipment.resources.thorlabs.kinesis.kcube_dc_servo.**KCubeDCServo**(*record*)

Bases: *MotionControl*

A wrapper around Thorlabs.MotionControl.KCube.DCServo.dll.

The *properties* for a KCubeDCServo connection supports the following key-value pairs in the *Connections Database*:

```
'device_name': str, the device name found in ThorlabsDefaultSettings.xml␣
↪[default: None]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

can_device_lock_front_panel()

Determine if the device front panel can be locked.

Returns

bool – True if the front panel of the device can be locked, False if not.

can_home()

Can the device perform a *home()*?

Returns

bool – Whether the device can be homed.

can_move_without_homing_first()

Does the device need to be *home()*'d before a move can be performed?

Returns

bool – Whether the device needs to be homed.

check_connection()

Check connection.

Returns
bool – Whether the USB is listed by the FTDI controller.

clear_message_queue()

Clears the device message queue.

close()

Disconnect and close the device.

disable_channel()

Disable the channel so that motor can be moved by hand.

When disabled, power is removed from the motor and it can be freely moved.

Raises
ThorlabsError – If not successful.

enable_channel()

Enable channel for computer control.

When enabled, power is applied to the motor so it is fixed in position.

Raises
ThorlabsError – If not successful.

enable_last_msg_timer(*enable*, *last_msg_timeout*)

Enables the last message monitoring timer.

This can be used to determine whether communications with the device is still good.

Parameters

- **enable** (bool) – True to enable monitoring otherwise False to disable.
- **last_msg_timeout** (int) – The last message error timeout in ms. Set to 0 to disable.

get_backlash()

Get the backlash distance setting (used to control hysteresis).

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The backlash distance in DeviceUnits (see manual).

get_dcpid_params()

Get the DC PID parameters for DC motors used in an algorithm involving calculus.

Returns
structs.MOT_DC_PIDParameters – The DC PID parameters.

Raises
ThorlabsError – If not successful.

get_device_unit_from_real_value(*real_value*, *unit_type*)

Converts a real-world value to a device value.

Either *load_settings()*, *load_named_settings()* or *set_motor_params_ext()* must be called before calling this function, otherwise the returned value will always be 0.

Parameters

- **real_value** (float) – The real-world value.
- **unit_type** (*enums.UnitType*) – The unit of the real-world value.

Returns

int – The device value.

Raises

ThorlabsError – If not successful.

get_digital_outputs()

Gets the digital output bits.

Returns

bytes – Bit mask of states of the 4 digital output pins.

get_encoder_counter()

Get the encoder counter.

For devices that have an encoder, the current encoder position can be read.

Returns

int – The encoder count in encoder units.

get_front_panel_locked()

Query if the device front panel locked.

Returns

bool – True if the device front panel is locked, False if not.

get_hardware_info()

Gets the hardware information from the device.

Returns

structs.TLI_HardwareInformation – The hardware information.

Raises

ThorlabsError – If not successful.

get_hardware_info_block()

Gets the hardware information in a block.

Returns

structs.TLI_HardwareInformation – The hardware information.

Raises

ThorlabsError – If not successful.

get_homing_params_block()

Get the homing parameters.

Returns
structs.MOT_HomingParameters – The homing parameters.

Raises
ThorlabsError – If not successful.

get_homing_velocity()

Gets the homing velocity.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The homing velocity in `DeviceUnits` (see manual).

get_hub_bay()

Gets the hub bay number this device is fitted to.

Returns
`bytes` – The number, 0x00 if unknown or 0xff if not on a hub.

get_jog_mode()

Gets the jog mode.

Returns

- *enums.MOT_JogModes* – The jog mode.
- *enums.MOT_StopModes* – The stop mode.

Raises
ThorlabsError – If not successful.

get_jog_params_block()

Get the jog parameters.

Returns
structs.MOT_JogParameters – The jog parameters.

Raises
ThorlabsError – If not successful.

get_jog_step_size()

Gets the distance to move when jogging.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The step size in `DeviceUnits` (see manual).

get_jog_vel_params()

Gets the jog velocity parameters.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns

- `int` – The maximum velocity in `DeviceUnits` (see manual).

- int – The acceleration in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

get_led_switches()

Get the LED indicator bits on cube.

Returns
int – Sum of: 8 to indicate moving 2 to indicate end of track and 1 to flash on identify command.

get_limit_switch_params()

Gets the limit switch parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- *enums.MOT_LimitSwitchModes* – The clockwise hardware limit mode.
- *enums.MOT_LimitSwitchModes* – The anticlockwise hardware limit mode.
- int – The position of the clockwise software limit in DeviceUnits (see manual).
- int – The position of the anticlockwise software limit in DeviceUnits (see manual).
- *enums.MOT_LimitSwitchSWModes* – The soft limit mode.

Raises
ThorlabsError – If not successful.

get_limit_switch_params_block()

Get the limit switch parameters.

Returns
structs.MOT_LimitSwitchParameters – The limit switch parameters.

Raises
ThorlabsError – If not successful.

get_mmi_params()

Get the MMI Parameters for the KCube Display Interface.

Deprecated calls by *get_mmi_params_ext()*

get_mmi_params_block()

Gets the MMI parameters for the device.

Returns
structs.KMOT_MMIParams – The MMI parameters for the device.

get_mmi_params_ext()

Get the MMI Parameters for the KCube Display Interface.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- *enums.KMOT_WheelMode* – The device joystick mode.
- int – The joystick maximum velocity in DeviceUnits.
- int – The joystick acceleration in DeviceUnits.
- *enums.KMOT_WheelDirectionSense* – The joystick direction sense.
- int – The first preset position in DeviceUnits.
- int – The second preset position in DeviceUnits.
- int – The display intensity, range 0 to 100%.
- int – The display timeout, range 0 to 480 in minutes (0 is off, otherwise the inactivity period before dimming the display).
- int – The display dimmed intensity, range 0 to 10 (after the timeout period the device display will dim).

Raises

ThorlabsError – If not successful.

get_motor_params()

Gets the motor stage parameters.

Deprecated: calls *get_motor_params_ext()*

These parameters, when combined define the stage motion in terms of RealWorldUnits [millimeters or degrees]. The real-world unit is defined from steps_per_rev * gear_box_ratio / pitch.

Returns

- float – The steps per revolution.
- float – The gear box ratio.
- float – The pitch.

Raises

ThorlabsError – If not successful.

get_motor_params_ext()

Gets the motor stage parameters.

These parameters, when combined define the stage motion in terms of RealWorldUnits [millimeters or degrees]. The real-world unit is defined from steps_per_rev * gear_box_ratio / pitch.

Returns

- float – The steps per revolution.
- float – The gear box ratio.
- float – The pitch.

Raises
ThorlabsError – If not successful.

`get_motor_travel_limits()`
Gets the motor stage min and max position.

Returns
- `float` – The minimum position in `RealWorldUnits` [millimeters or degrees].
- `float` – The maximum position in `RealWorldUnits` [millimeters or degrees].

Raises
ThorlabsError – If not successful.

`get_motor_travel_mode()`
Get the motor travel mode.

Returns
enums.MOT_TravelModes – The travel mode.

`get_motor_velocity_limits()`
Gets the motor stage maximum velocity and acceleration.

Returns
- `float` – The maximum velocity in `RealWorldUnits` [millimeters or degrees].
- `float` – The maximum acceleration in `RealWorldUnits` [millimeters or degrees].

Raises
ThorlabsError – If not successful.

`get_move_absolute_position()`
Gets the move absolute position.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The move absolute position in `DeviceUnits` (see manual).

`get_move_relative_distance()`
Gets the move relative distance.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The move relative position in `DeviceUnits` (see manual).

`get_next_message()`
Get the next Message Queue item. See *messages*.

Returns
- `int` – The message type.

- int – The message ID.
- int – The message data.

Raises
ThorlabsError – If not successful.

get_number_positions()

Get the number of positions.

This function will get the maximum position reachable by the device. The motor may need to be set to its *home()* position before this parameter can be used.

Returns
int – The number of positions.

get_position()

Get the current position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
index (int) – The position in DeviceUnits (see manual).

get_position_counter()

Get the position counter.

The position counter is identical to the position parameter. The position counter is set to zero when homing is complete.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The position counter in DeviceUnits (see manual).

get_real_value_from_device_unit(*device_value*, *unit_type*)

Converts a device value to a real-world value.

Either *load_settings()*, *load_named_settings()* or *set_motor_params_ext()* must be called before calling this function, otherwise the returned value will always be 0.

Parameters

- **device_value** (int) – The device value.
- **unit_type** (*enums.UnitType*) – The unit of the device value.

Returns
float – The real-world value.

Raises
ThorlabsError – If not successful.

get_soft_limit_mode()

Gets the software limits mode.

Returns
enums.MOT_LimitsSoftwareApproachPolicy – The software limits mode.

get_software_version()

Gets version number of the device software.

Returns
str – The device software version.

get_stage_axis_max_pos()

Gets the Stepper Motor maximum stage position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The maximum position in DeviceUnits (see manual).

get_stage_axis_min_pos()

Gets the Stepper Motor minimum stage position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The minimum position in DeviceUnits (see manual).

get_status_bits()

Get the current status bits.

This returns the latest status bits received from the device. To get new status bits, use *request_status_bits()* or use the polling functions, *start_polling()*.

Returns
int – The status bits from the device.

get_trigger_config_params()

Get the Trigger Configuration Parameters.

Returns

- *enums.KMOT_TriggerPortMode* – The trigger 1 mode.
- *enums.KMOT_TriggerPortPolarity* – The trigger 1 polarity.
- *enums.KMOT_TriggerPortMode* – The trigger 2 mode.
- *enums.KMOT_TriggerPortPolarity* – The trigger 2 polarity.

Raises
ThorlabsError – If not successful.

get_trigger_config_params_block()

Gets the trigger configuration parameters block.

Returns
structs.KMOT_TriggerConfig – Options for controlling the trigger configuration.

Raises
ThorlabsError – If not successful.

get_trigger_params_params()

Get the Trigger Parameters parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- int – The trigger start position, forward, in DeviceUnits (see manual).
- int – The trigger interval, forward, in DeviceUnits (see manual).
- int – Number of trigger pulses, forward.
- int – The trigger start position, reverse, in DeviceUnits (see manual).
- int – The trigger interval, reverse, in DeviceUnits (see manual).
- int – Number of trigger pulses, reverse.
- int – Width of the trigger pulse in milliseconds, range 10 (10us) to 650000 (650ms).
- int – Number of cycles to perform triggering.

Raises

ThorlabsError – If not successful.

get_trigger_params_params_block()

Gets the trigger parameters block.

Returns

structs.KMOT_TriggerParams – Options for controlling the trigger.

Raises

ThorlabsError – If not successful.

get_vel_params()

Gets the move velocity parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

get_vel_params_block()

Get the move velocity parameters.

Returns

structs.MOT_VelocityParameters – The velocity parameters.

Raises

ThorlabsError – If not successful.

has_last_msg_timer_overrun()

Queries if the time since the last message has exceeded the `lastMsgTimeout` set by *enable_last_msg_timer()*.

This can be used to determine whether communications with the device is still good.

Returns
`bool` – `True` if last message timer has elapsed or `False` if monitoring is not enabled or if time of last message received is less than `lastMsgTimeout`.

home()

Home the device.

Homing the device will set the device to a known state and determine the home position.

Raises
ThorlabsError – If not successful.

identify()

Sends a command to the device to make it identify itself.

load_settings()

Update device with stored settings.

The settings are read from `ThorlabsDefaultSettings.xml`, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

load_named_settings(*settings_name*)

Update device with named settings.

Parameters
settings_name (`str`) – The name of the device to load the settings for. Examples for the value of *setting_name* can be found in *ThorlabsDefaultSettings.xml* `, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

message_queue_size()

Gets the size of the message queue.

Returns
`int` – The number of messages in the queue.

move_absolute()

Moves the device to the position defined in *set_move_absolute_position()*.

Raises
ThorlabsError – If not successful.

move_at_velocity(*direction*)

Start moving at the current velocity in the specified direction.

Parameters
direction (*enums.MOT_TravelDirection*) – The required direction of travel as a *enums.MOT_TravelDirection* enum value or member name.

Raises
ThorlabsError – If not successful.

move_jog(*jog_direction*)

Perform a jog.

Parameters
jog_direction (*enums.MOT_TravelDirection*) – The jog direction as a *enums.MOT_TravelDirection* enum value or member name.

Raises
ThorlabsError – If not successful.

move_relative(*displacement*)

Move the motor by a relative amount.

See *get_device_unit_from_real_value()get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
displacement (`int`) – Signed displacement in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

move_relative_distance()

Moves the device by a relative distance defined by *set_move_relative_distance()*.

Raises
ThorlabsError – If not successful.

move_to_position(*index*)

Move the device to the specified position (index).

The motor may need to be set to its *home()* position before a position can be set.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
index (`int`) – The position in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

needs_homing()

Does the device need to be *home()*'d before a move can be performed?

Deprecated: calls *can_move_without_homing_first()* instead.

Returns
`bool` – Whether the device needs to be homed.

open()

Open the device for communication.

Raises
ThorlabsError – If not successful.

persist_settings()

Persist the devices current settings.

Raises
ThorlabsError – If not successful.

polling_duration()

Gets the polling loop duration.

Returns
int – The time between polls in milliseconds or 0 if polling is not active.

register_message_callback(*callback*)

Registers a callback on the message queue.

Parameters
callback (*MotionControlCallback*) – A function to be called whenever messages are received.

request_backlash()

Requests the backlash.

Raises
ThorlabsError – If not successful.

request_dcpid_params()

Request the PID parameters for DC motors used in an algorithm involving calculus.

Raises
ThorlabsError – If not successful.

request_digital_outputs()

Requests the digital output bits.

Raises
ThorlabsError – If not successful.

request_encoder_counter()

Requests the encoder counter.

Raises
ThorlabsError – If not successful.

request_front_panel_locked()

Ask the device if its front panel is locked.

Raises
ThorlabsError – If not successful.

request_homing_params()

Requests the homing parameters.

Raises
ThorlabsError – If not successful.

request_jog_params()

Requests the jog parameters.

Raises
ThorlabsError – If not successful.

request_led_switches()

Requests the LED indicator bits on the cube.

Raises
ThorlabsError – If not successful.

request_limit_switch_params()

Requests the limit switch parameters.

Raises
ThorlabsError – If not successful.

request_mmi_params()

Requests the MMI Parameters for the KCube Display Interface.

Raises
ThorlabsError – If not successful.

request_move_absolute_position()

Requests the position of next absolute move.

Raises
ThorlabsError – If not successful.

request_move_relative_distance()

Requests the relative move distance.

Raises
ThorlabsError – If not successful.

request_pos_trigger_params()

Requests the position trigger parameters.

Raises
ThorlabsError – If not successful.

request_position()

Requests the current position.

This needs to be called to get the device to send it's current position. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

request_settings()

Requests that all settings are downloaded from the device.

This function requests that the device upload all it's settings to the DLL.

Raises
ThorlabsError – If not successful.

request_status_bits()

Request the status bits which identify the current motor state.

This needs to be called to get the device to send it's current status bits. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

request_trigger_config_params()

Requests the Trigger Configuration Parameters.

Raises
ThorlabsError – If not successful.

request_vel_params()

Requests the velocity parameters.

Raises
ThorlabsError – If not successful.

reset_rotation_modes()

Reset the rotation modes for a rotational device.

Raises
ThorlabsError – If not successful.

reset_stage_to_defaults()

Reset the stage settings to defaults.

Raises
ThorlabsError – If not successful.

resume_move_messages()

Resume suspended move messages.

Raises
ThorlabsError – If not successful.

set_backlash(*distance*)

Sets the backlash distance (used to control hysteresis).

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
distance (`int`) – The backlash distance in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

set_dcpid_params(*params*)

Set the PID parameters for DC motors used in an algorithm involving calculus.

Parameters
params (*structs.MOT_DC_PIDParameters*) – The DC PID parameters.

Raises

- *ThorlabsError* – If not successful.

- **TypeError** – If the data type of *params* is not *structs.MOT_DC_PIDParameters*

set_digital_outputs(*outputs_bits*)

Sets the digital output bits.

Parameters
outputs_bits (int) – Bit mask to set the states of the 4 digital output pins.

Raises
ThorlabsError – If not successful.

set_direction(*reverse*)

Sets the motor direction sense.

This function is used because some actuators have directions of motion reversed. This parameter will tell the system to reverse the direction sense when moving, jogging etc.

Parameters
reverse (bool) – If True then directions will be swapped on these moves.

Raises
ThorlabsError – If not successful.

set_encoder_counter(*count*)

Set the Encoder Counter values.

Setting the encoder counter to zero, effectively defines a home position on the encoder strip. Note, setting this value does not move the device.

Parameters
count (int) – The encoder count in encoder units.

Raises
ThorlabsError – If not successful.

set_front_panel_lock(*locked*)

Sets the device front panel lock state.

Parameters
locked (bool) – True to lock the device, False to unlock

Raises
ThorlabsError – If not successful.

set_homing_params_block(*direction*, *limit*, *velocity*, *offset*)

Set the homing parameters.

Parameters

- **direction** (*enums.MOT_TravelDirection*) – The Homing direction sense as a *enums.MOT_TravelDirection* enum value or member name.
- **limit** (*enums.MOT_HomeLimitSwitchDirection*) – The limit switch direction as a *enums.MOT_HomeLimitSwitchDirection* enum value or member name.
- **velocity** (int) – The velocity in small indivisible units.

- **offset** (int) – Distance of home from limit in small indivisible units.

Raises
ThorlabsError – If not successful.

set_homing_velocity(*velocity*)

Sets the homing velocity.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters
velocity (int) – The homing velocity in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_jog_mode(*mode*, *stop_mode*)

Sets the jog mode.

Parameters

- **mode** (*enums.MOT_JogModes*) – The jog mode, as a *enums.MOT_JogModes* enum value or member name.
- **stop_mode** (*enums.MOT_StopModes*) – The stop mode, as a *enums.MOT_StopModes* enum value or member name.

Raises
ThorlabsError – If not successful.

set_jog_params_block(*jog_params*)

Set the jog parameters.

Parameters
jog_params (*structs.MOT_JogParameters*) – The jog parameters.

Raises

- *ThorlabsError* – If not successful.
- **TypeError** – If the data type of *jog_params* is not *structs.MOT_JogParameters*

set_jog_step_size(*step_size*)

Sets the distance to move on jogging.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters
step_size (int) – The step size in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_jog_vel_params(*max_velocity*, *acceleration*)

Sets jog velocity parameters.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_led_switches(*led_switches*)

Set the LED indicator bits on the cube.

Parameters

led_switches (int) – Sum of: 8 to indicate moving 2 to indicate end of track and 1 to flash on identify command.

Raises

ThorlabsError – If not successful.

set_limit_switch_params(*cw_lim*, *ccw_lim*, *cw_pos*, *ccw_pos*, *soft_limit_mode*)

Sets the limit switch parameters.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **cw_lim** (*enums.MOT_LimitSwitchModes*) – The clockwise hardware limit mode as a *enums.MOT_LimitSwitchModes* enum value or member name.
- **ccw_lim** (*enums.MOT_LimitSwitchModes*) – The anticlockwise hardware limit mode as a *enums.MOT_LimitSwitchModes* enum value or member name.
- **cw_pos** (int) – The position of the clockwise software limit in DeviceUnits (see manual).
- **ccw_pos** (int) – The position of the anticlockwise software limit in DeviceUnits (see manual).
- **soft_limit_mode** (*enums.MOT_LimitSwitchSWModes*) – The soft limit mode as a *enums.MOT_LimitSwitchSWModes* enum value or member name.

Raises

ThorlabsError – If not successful.

set_limit_switch_params_block(*params*)

Set the limit switch parameters.

Parameters

params (*structs.MOT_LimitSwitchParameters*) – The limit switch parameters.

Raises

ThorlabsError – If not successful.

set_limits_software_approach_policy(*policy*)

Sets the software limits mode.

Parameters

policy (*enums.MOT_LimitsSoftwareApproachPolicy*) – The soft limit mode as a *enums.MOT_LimitsSoftwareApproachPolicy* enum value or member name.

set_mmi_params(*joystick_mode*, *joystick_max_velocity*, *joystick_acceleration*, *direction_sense*, *preset_position1*, *preset_position2*, *display_intensity*)

Set the MMI Parameters for the KCube Display Interface.

Deprecated calls *set_mmi_params_ext()* setting the *display_timeout* to 1 minute and the *display_dim_intensity* to 8.

Raises

ThorlabsError – If not successful.

set_mmi_params_block(*mmi_params*)

Sets the MMI parameters for the device.

Parameters

mmi_params (*structs.KMOT_MMIParams*) – Options for controlling the mmi.

Raises

ThorlabsError – If not successful.

set_mmi_params_ext(*joystick_mode*, *joystick_max_velocity*, *joystick_acceleration*, *direction_sense*, *preset_position1*, *preset_position2*, *display_intensity*, *display_timeout*, *display_dim_intensity*)

Set the MMI Parameters for the KCube Display Interface.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters

- **joystick_mode** (*enums.KMOT_WheelMode*) – The device joystick mode as a *enums.KMOT_WheelMode* enum value or member name.
- **joystick_max_velocity** (`int`) – The joystick maximum velocity in `DeviceUnits`.
- **joystick_acceleration** (`int`) – The joystick acceleration in `DeviceUnits`.
- **direction_sense** (*enums.KMOT_WheelDirectionSense*) – The joystick direction sense as a *enums.KMOT_WheelDirectionSense* enum value or member name.
- **preset_position1** (`int`) – The first preset position in `DeviceUnits`.
- **preset_position2** (`int`) – The second preset position in `DeviceUnits`.
- **display_intensity** (`int`) – The display intensity, range 0 to 100%.

- **display_timeout** (int) – The display timeout, range 0 to 480 in minutes (0 is off, otherwise the inactivity period before dimming the display).
- **display_dim_intensity** (int) – The display dimmed intensity, range 0 to 10 (after the timeout period the device display will dim).

Raises

ThorlabsError – If not successful.

set_motor_params(*steps_per_rev*, *gear_box_ratio*, *pitch*)

Sets the motor stage parameters.

Deprecated: calls *set_motor_params_ext()*

These parameters, when combined, define the stage motion in terms of RealWorldUnits [millimeters or degrees]. The real-world unit is defined from steps_per_rev * gear_box_ratio / pitch.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **steps_per_rev** (float) – The steps per revolution.
- **gear_box_ratio** (float) – The gear box ratio.
- **pitch** (float) – The pitch.

Raises

ThorlabsError – If not successful.

set_motor_params_ext(*steps_per_rev*, *gear_box_ratio*, *pitch*)

Sets the motor stage parameters.

These parameters, when combined, define the stage motion in terms of RealWorldUnits [millimeters or degrees]. The real-world unit is defined from steps_per_rev * gear_box_ratio / pitch.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **steps_per_rev** (float) – The steps per revolution.
- **gear_box_ratio** (float) – The gear box ratio.
- **pitch** (float) – The pitch.

Raises

ThorlabsError – If not successful.

set_motor_travel_limits(*min_position*, *max_position*)

Sets the motor stage min and max position.

These define the range of travel for the stage.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **min_position** (float) – The minimum position in RealWorldUnits [millimeters or degrees].
- **max_position** (float) – The maximum position in RealWorldUnits [millimeters or degrees].

Raises

ThorlabsError – If not successful.

set_motor_travel_mode(*travel_mode*)

Set the motor travel mode.

Parameters

travel_mode (*enums.MOT_TravelModes*) – The travel mode as a *enums.MOT_TravelModes* enum value or member name.

Raises

ThorlabsError – If not successful.

set_motor_velocity_limits(*max_velocity*, *max_acceleration*)

Sets the motor stage maximum velocity and acceleration.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **max_velocity** (float) – The maximum velocity in RealWorldUnits [millimeters or degrees].
- **max_acceleration** (float) – The maximum acceleration in RealWorldUnits [millimeters or degrees].

Raises

ThorlabsError – If not successful.

set_move_absolute_position(*position*)

Sets the move absolute position.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

position (int) – The absolute position in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_move_relative_distance(*distance*)

Sets the move relative distance.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

distance (int) – The relative position in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_position_counter(*count*)

Set the position counter.

Setting the position counter will locate the current position. Setting the position counter will effectively define the home position of a motor.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

count (`int`) – The position counter in `DeviceUnits` (see manual).

Raises

ThorlabsError – If not successful.

set_rotation_modes(*mode*, *direction*)

Set the rotation modes for a rotational device.

Parameters

- **mode** (*enums.MOT_MovementModes*) – The travel mode as a *enums.MOT_MovementModes* enum value or member name.
- **direction** (*enums.MOT_MovementDirections*) – The travel mode as a *enums.MOT_MovementDirections* enum value or member name.

Raises

ThorlabsError – If not successful.

set_stage_axis_limits(*min_position*, *max_position*)

Sets the stage axis position limits.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **min_position** (`int`) – The minimum position in `DeviceUnits` (see manual).
- **max_position** (`int`) – The maximum position in `DeviceUnits` (see manual).

Raises

ThorlabsError – If not successful.

set_trigger_config_params(*mode1*, *polarity1*, *mode2*, *polarity2*)

Set the trigger configuration parameters.

Parameters

- **mode1** (*enums.KMOT_TriggerPortMode*) – The trigger 1 mode as a *KMOT_TriggerPortMode* enum value or member name.
- **polarity1** (*enums.KMOT_TriggerPortPolarity*) – The trigger 1 polarity as a *KMOT_TriggerPortPolarity* enum value or member name.
- **mode2** (*enums.KMOT_TriggerPortMode*) – The trigger 2 mode as a *KMOT_TriggerPortMode* enum value or member name.

- **polarity2** (*enums.KMOT_TriggerPortPolarity*) – The trigger 2 polarity as a *KMOT_TriggerPortPolarity* enum value or member name.

Raises

ThorlabsError – If not successful.

set_trigger_config_params_block(*trigger_config_params*)

Sets the trigger configuration parameters block.

Parameters

trigger_config_params (*structs.KMOT_TriggerConfig*) – Options for controlling the trigger configuration.

Raises

- *ThorlabsError* – If not successful.
- **TypeError** – If *trigger_config_params* is not a *structs.KMOT_TriggerConfig*.

set_trigger_params_params(*trigger_start_position_fwd*, *trigger_interval_fwd*, *trigger_pulse_count_fwd*, *trigger_start_position_rev*, *trigger_interval_rev*, *trigger_pulse_count_rev*, *trigger_pulse_width*, *cycle_count*)

Set the Trigger Parameters parameters.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters

- **trigger_start_position_fwd** (`int`) – The trigger start position, forward, in `DeviceUnits` (see manual).
- **trigger_interval_fwd** (`int`) – The trigger interval, forward, in `DeviceUnits` (see manual).
- **trigger_pulse_count_fwd** (`int`) – Number of trigger pulses, forward.
- **trigger_start_position_rev** (`int`) – The trigger start position, reverse, in `DeviceUnits` (see manual).
- **trigger_interval_rev** (`int`) – The trigger interval, reverse, in `DeviceUnits` (see manual).
- **trigger_pulse_count_rev** (`int`) – Number of trigger pulses., reverse.
- **trigger_pulse_width** (`int`) – Width of the trigger pulse in milliseconds, range 10 (10us) to 650000 (650ms).
- **cycle_count** (`int`) – Number of cycles to perform triggering.

Raises

ThorlabsError – If not successful.

set_trigger_params_params_block(*trigger_params_params*)

Set the Trigger Parameters parameters.

Parameters
trigger_params_params (*structs.KMOT_TriggerParams*) – Options for controlling the trigger.

Raises
- *ThorlabsError* – If not successful.
- **TypeError** – If *trigger_params_params* is not a *structs.KMOT_TriggerParams*.

set_vel_params(*max_velocity*, *acceleration*)

Sets the move velocity parameters.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
- **max_velocity** (`int`) – The maximum velocity in `DeviceUnits` (see manual).
- **acceleration** (`int`) – The acceleration in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

set_vel_params_block(*min_velocity*, *max_velocity*, *acceleration*)

Set the move velocity parameters.

Parameters
- **min_velocity** (`int`) – The minimum velocity.
- **max_velocity** (`int`) – The maximum velocity.
- **acceleration** (`int`) – The acceleration.

Raises
ThorlabsError – If not successful.

start_polling(*milliseconds*)

Starts the internal polling loop.

This function continuously requests position and status messages.

Parameters
milliseconds (`int`) – The polling rate, in milliseconds.

Raises
ThorlabsError – If not successful.

stop_immediate()

Stop the current move immediately (with the risk of losing track of the position).

Raises
ThorlabsError – If not successful.

stop_polling()

Stops the internal polling loop.

stop_profiled()

Stop the current move using the current velocity profile.

Raises

ThorlabsError – If not successful.

suspend_move_messages()

Suspend automatic messages at ends of moves.

Useful to speed up part of real-time system with lots of short moves.

Raises

ThorlabsError – If not successful.

time_since_last_msg_received()

Gets the time, in milliseconds, since the last message was received.

This can be used to determine whether communications with the device is still good.

Returns

- `int` – The time, in milliseconds, since the last message was received.
- `bool` – `True` if monitoring is enabled otherwise `False`.

wait_for_message()

Wait for next Message Queue item. See *messages*.

Returns

- `int` – The message type.
- `int` – The message ID.
- `int` – The message data.

Raises

ThorlabsError – If not successful.

msl.equipment.resources.thorlabs.kinesis.kcube_solenoid module

This module provides all the functionality required to control a KCube Solenoid (KSC101).

class msl.equipment.resources.thorlabs.kinesis.kcube_solenoid.**KCubeSolenoid**(*record*)

Bases: *MotionControl*

A wrapper around `Thorlabs.MotionControl.KCube.Solenoid.dll`.

The *properties* for a KCubeSolenoid connection supports the following key-value pairs in the *Connections Database*:

```
'device_name': str, the device name found in ThorlabsDefaultSettings.xml␣
↪[default: None]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

check_connection()

Check connection.

Returns

bool – Whether the USB is listed by the FTDI controller.

clear_message_queue()

Clears the device message queue.

close()

Disconnect and close the device.

enable_last_msg_timer(*enable*, *msg_timeout=0*)

Enables the last message monitoring timer.

This can be used to determine whether communications with the device is still good.

Parameters

- **enable** (bool) – True to enable monitoring otherwise False to disable.
- **msg_timeout** (int) – The last message error timeout in ms. Set to 0 to disable.

get_cycle_params()

Gets the cycle parameters.

Returns

- int – The *On Time* parameter. Range 250 to 100,000,000 in steps of 1 milliseconds (0.250s to 10,000s).
- int – The *Off Time* parameter. Range 250 to 100,000,000 in steps of 1 milliseconds (0.250s to 10,000s).
- int – The *Number of Cycles* parameter. Range 0 to 1000,000 where 0 represents unlimited.

Raises

ThorlabsError – If not successful.

get_cycle_params_block()

Get the cycle parameters.

Returns

structs.SC_CycleParameters – The cycle parameters.

Raises

ThorlabsError – If not successful.

get_digital_outputs()

Gets the digital output bits.

Returns

int – Bit mask of states of the 4 digital output pins.

get_hardware_info()

Gets the hardware information from the device.

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

get_hardware_info_block()
Gets the hardware information in a block.

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

get_hub_bay()
Gets the hub bay number this device is fitted to.

Returns
int – Either the number, or 0x00 if unknown, or 0xff if not on a hub.

get_led_switches()
Get the LED indicator bits on cube.

Returns
int – Sum of: 8 to indicate moving 2 to indicate end of track and 1 to flash on identify command.

get_mmi_params()
Get the MMI Parameters for the KCube Display Interface.

Deprecated: calls *get_mmi_params_ext()*

Returns
- int – The display intensity, range 0 to 100%.
- int – The display timeout, range 0 to 480 in minutes (0 is off, otherwise the inactivity period before dimming the display).
- int – The display dimmed intensity, range 0 to 10 (after the timeout period the device display will dim).

Raises
ThorlabsError – If not successful.

get_mmi_params_block()
Gets the MMI parameters for the device.

> **Warning:** This function is currently not in the DLL, as of v1.11.2, but it is in the header file.

Returns
structs.KSC_MMIParams – Options for controlling the MMI.

Raises
ThorlabsError – If not successful.

get_mmi_params_ext()

Get the MMI Parameters for the KCube Display Interface.

Returns

- int – The display intensity, range 0 to 100%.
- int – The display timeout, range 0 to 480 in minutes (0 is off, otherwise the inactivity period before dimming the display).
- int – The display dimmed intensity, range 0 to 10 (after the timeout period the device display will dim).

Raises

ThorlabsError – If not successful.

get_next_message()

Get the next Message Queue item. See *messages*.

Returns

- int – The message type.
- int – The message ID.
- int – The message data.

Raises

ThorlabsError – If not successful.

get_operating_mode()

Gets the Operating Mode.

Returns

enums.SC_OperatingModes – The current operating mode.

get_operating_state()

Gets the current operating state.

Returns

enums.SC_OperatingStates – The current operating state.

get_software_version()

Gets version number of the device software.

Returns

str – The device software version.

get_solenoid_state()

Gets the current solenoid state.

Returns

enums.SC_SolenoidStates – The current solenoid state.

get_status_bits()

Get the current status bits.

This returns the latest status bits received from the device. To get new status bits, use *request_status()* or use the polling function, *start_polling()*

Returns
int – The status bits from the device.

`get_trigger_config_params()`

Get the Trigger Configuration Parameters.

Returns

- *enums.KSC_TriggerPortMode* – The trigger 1 mode.
- *enums.KSC_TriggerPortPolarity* – The trigger 1 polarity.
- *enums.KSC_TriggerPortMode* – The trigger 2 mode.
- *enums.KSC_TriggerPortPolarity* – The trigger 2 polarity.

Raises
ThorlabsError – If not successful.

`get_trigger_config_params_block()`

Gets the trigger configuration parameters block.

Returns
structs.KSC_TriggerConfig – Options for controlling the trigger configuration.

Raises
ThorlabsError – If not successful.

`has_last_msg_timer_overrun()`

Queries if the time since the last message has exceeded the `lastMsgTimeout` set by *enable_last_msg_timer()*.

This can be used to determine whether communications with the device is still good.

Returns
bool – `True` if last message timer has elapsed or `False` if monitoring is not enabled or if time of last message received is less than `lastMsgTimeout`.

`identify()`

Sends a command to the device to make it identify itself.

`load_settings()`

Update device with stored settings.

The settings are read from `ThorlabsDefaultSettings.xml`, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

`load_named_settings(settings_name)`

Update device with named settings.

Parameters
settings_name (str) – The name of the device to load the settings for. Examples for the value of *setting_name* can be found in *ThorlabsDefaultSettings.xml* `, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

message_queue_size()

Gets the size of the message queue.

Returns
int – The number of messages in the queue.

open()

Open the device for communication.

Raises
ThorlabsError – If not successful.

persist_settings()

Persist the devices current settings.

Raises
ThorlabsError – If not successful.

polling_duration()

Gets the polling loop duration.

Returns
int – The time between polls in milliseconds or 0 if polling is not active.

register_message_callback(*callback*)

Registers a callback on the message queue.

Parameters
callback (*MotionControlCallback*) – A function to be called whenever messages are received.

request_cycle_params()

Requests the cycle parameters.

Raises
ThorlabsError – If not successful.

request_digital_outputs()

Requests the digital output bits.

Raises
ThorlabsError – If not successful.

request_hub_bay()

Requests the hub bay number this device is fitted to.

Raises
ThorlabsError – If not successful.

request_led_switches()

Requests the LED indicator bits on the cube.

Raises
ThorlabsError – If not successful.

request_mmi_params()

Requests the MMI Parameters for the KCube Display Interface.

Raises
ThorlabsError – If not successful.

request_operating_mode()

Requests the operating mode.

Raises
ThorlabsError – If not successful.

request_operating_state()

Requests the operating state.

Raises
ThorlabsError – If not successful.

request_settings()

Requests that all settings are download from device.

This function requests that the device upload all it's settings to the DLL.

Raises
ThorlabsError – If not successful.

request_status()

Requests the status from the device.

This needs to be called to get the device to send it's current status bits. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

request_status_bits()

Request the status bits which identify the current motor state.

This needs to be called to get the device to send it's current status bits. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

request_trigger_config_params()

Requests the Trigger Configuration Parameters.

Raises
ThorlabsError – If not successful.

set_cycle_params(*on_time*, *off_time*, *num_cycles*)

Sets the cycle parameters.

Parameters

- **on_time** (`int`) – The On Time parameter. Range 250 to 100,000,000 in steps of 1 milliseconds (0.250s to 10,000s).
- **off_time** (`int`) – The Off Time parameter. Range 250 to 100,000,000 in steps of 1 milliseconds (0.250s to 10,000s).

- **num_cycles** (int) – The Number of Cycles parameter Range 0 to 1,000,000 where 0 represent unlimited.

Raises
ThorlabsError – If not successful.

set_cycle_params_block(*cycle_params*)

Sets the cycle parameters.

Parameters
cycle_params (*structs.SC_CycleParameters*) – The new cycle parameters.

Raises
ThorlabsError – If not successful.

set_digital_outputs(*outputs_bits*)

Sets the digital output bits.

Parameters
outputs_bits (int) – Bit mask to set the states of the 4 digital output pins.

Raises
ThorlabsError – If not successful.

set_led_switches(*led_switches*)

Set the LED indicator bits on the cube.

Parameters
led_switches (int) – Sum of: 8 to indicate moving 2 to indicate end of track and 1 to flash on identify command.

Raises
ThorlabsError – If not successful.

set_mmi_params(*display_intensity*)

Set the MMI Parameters for the KCube Display Interface.

Deprecated: superceded by *set_mmi_params_ext()*

Parameters
display_intensity (int) – The display intensity, range 0 to 100%.

Raises
ThorlabsError – If not successful.

set_mmi_params_block(*mmi_params*)

Sets the MMI parameters for the device.

> **Warning:** This function is currently not in the DLL, as of v1.11.2, but it is in the header file.

Parameters
mmi_params (*structs.KSC_MMIParams*) – Options for controlling the MMI.

Raises
ThorlabsError – If not successful.

set_mmi_params_ext(*intensity*, *timeout*, *dim_intensity*)

Set the MMI Parameters for the KCube Display Interface.

Parameters

- **intensity** (int) – The display intensity, range 0 to 100%.
- **timeout** (int) – The display timeout, range 0 to 480 in minutes (0 is off, otherwise the inactivity period before dimming the display).
- **dim_intensity** (int) – The display dimmed intensity, range 0 to 10 (after the timeout period the device display will dim).

Raises
ThorlabsError – If not successful.

set_operating_mode(*mode*)

Sets the operating mode.

Parameters
mode (*enums.SC_OperatingModes*) – The required operating mode as a *SC_OperatingModes* enum value or member name.

Raises
ThorlabsError – If not successful.

set_operating_state(*state*)

Sets the operating state.

Parameters
state (*enums.SC_OperatingStates*) – The required operating state as a *SC_OperatingStates* enum value or member name.

Raises
ThorlabsError – If not successful.

set_trigger_config_params(*mode1*, *polarity1*, *mode2*, *polarity2*)

Set the trigger configuration parameters.

Parameters

- **mode1** (*enums.KSC_TriggerPortMode*) – The trigger 1 mode as a *KSC_TriggerPortMode* enum value or member name.
- **polarity1** (*enums.KSC_TriggerPortPolarity*) – The trigger 1 polarity as a *KSC_TriggerPortPolarity* enum value or member name.
- **mode2** (*enums.KSC_TriggerPortMode*) – The trigger 2 mode as a *KSC_TriggerPortMode* enum value or member name.
- **polarity2** (*enums.KSC_TriggerPortPolarity*) – The trigger 2 polarity as a *KSC_TriggerPortPolarity* enum value or member name.

Raises
ThorlabsError – If not successful.

set_trigger_config_params_block(*trigger_config_params*)

Sets the trigger configuration parameters block.

Parameters
trigger_config_params (*structs.KSC_TriggerConfig*) – Options for controlling the trigger configuration.

Raises
ThorlabsError – If not successful.

start_polling(*milliseconds*)

Starts the internal polling loop.

This function continuously requests position and status messages.

Parameters
milliseconds (int) – The polling rate, in milliseconds.

Raises
ThorlabsError – If not successful.

stop_polling()

Stops the internal polling loop.

time_since_last_msg_received()

Gets the time, in milliseconds, since tha last message was received.

This can be used to determine whether communications with the device is still good.

Returns
int – The time, in milliseconds, since the last message was received.

wait_for_message()

Wait for next Message Queue item. See *messages*.

Returns

- int – The message type.
- int – The message ID.
- int – The message data.

Raises
ThorlabsError – If not successful.

msl.equipment.resources.thorlabs.kinesis.kcube_stepper_motor module

This module provides all the functionality required to control a KCube Stepper Motor (KST101).

class msl.equipment.resources.thorlabs.kinesis.kcube_stepper_motor.**KCubeStepperMotor**(*record*)

Bases: *MotionControl*

A wrapper around Thorlabs.MotionControl.KCube.StepperMotor.dll.

The *properties* for a KCubeStepperMotor connection supports the following key-value pairs in the *Connections Database*:

```
'device_name': str, the device name found in ThorlabsDefaultSettings.xml␣
↪[default: None]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters
record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

can_device_lock_front_panel()
Determine if the device front panel can be locked.

Returns
bool – True if the front panel of the device can be locked, False if not.

can_home()
Can the device perform a *home()*?

Returns
bool – Whether the device can be homed.

can_move_without_homing_first()
Does the device need to be *home()*'d before a move can be performed?

Returns
bool – Whether the device needs to be homed.

check_connection()
Check connection.

Returns
bool – Whether the USB is listed by the FTDI controller.

clear_message_queue()
Clears the device message queue.

close()
Disconnect and close the device.

disable_channel()
Disable the channel so that motor can be moved by hand.

When disabled, power is removed from the motor and it can be freely moved.

Raises
ThorlabsError – If not successful.

enable_channel()
Enable channel for computer control.

When enabled, power is applied to the motor so it is fixed in position.

Raises
ThorlabsError – If not successful.

enable_last_msg_timer(*enable*, *last_msg_timeout*)
Enables the last message monitoring timer.

This can be used to determine whether communications with the device is still good.

Parameters

- **enable** (bool) – True to enable monitoring otherwise False to disable.
- **last_msg_timeout** (int) – The last message error timeout in ms. Set to 0 to disable.

get_backlash()

Get the backlash distance setting (used to control hysteresis).

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The backlash distance in DeviceUnits (see manual).

get_bow_index()

Gets the stepper motor bow index.

Returns
int – The bow index.

get_calibration_file()

Get calibration file for this motor.

Returns
str – The filename of the calibration file.

Raises
ThorlabsError – If not successful.

get_device_unit_from_real_value(*real_value*, *unit_type*)

Converts a real-world value to a device value.

Either *load_settings()*, *load_named_settings()* or *set_motor_params_ext()* must be called before calling this function, otherwise the returned value will always be 0.

Parameters

- **real_value** (float) – The real-world value.
- **unit_type** (*enums.UnitType*) – The unit of the real-world value.

Returns
int – The device value.

Raises
ThorlabsError – If not successful.

get_digital_outputs()

Gets the digital output bits.

Returns
bytes – Bit mask of states of the 4 digital output pins.

get_encoder_counter()

Get the encoder counter.

For devices that have an encoder, the current encoder position can be read.

Returns
int – The encoder count in encoder units.

get_front_panel_locked()

Query if the device front panel locked.

Returns
bool – True if the device front panel is locked, False if not.

get_hardware_info()

Gets the hardware information from the device.

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

get_hardware_info_block()

Gets the hardware information in a block.

Returns
structs.TLI_HardwareInformation – The hardware information.

Raises
ThorlabsError – If not successful.

get_homing_params_block()

Get the homing parameters.

Returns
structs.MOT_HomingParameters – The homing parameters.

Raises
ThorlabsError – If not successful.

get_homing_velocity()

Gets the homing velocity.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The homing velocity in DeviceUnits (see manual).

get_hub_bay()

Gets the hub bay number this device is fitted to.

Returns
bytes – The number, 0x00 if unknown or 0xff if not on a hub.

get_jog_mode()

Gets the jog mode.

Returns

- *enums.MOT_JogModes* – The jog mode.
- *enums.MOT_StopModes* – The stop mode.

Raises
ThorlabsError – If not successful.

`get_jog_params_block()`

Get the jog parameters.

Returns
structs.MOT_JogParameters – The jog parameters.

Raises
ThorlabsError – If not successful.

`get_jog_step_size()`

Gets the distance to move when jogging.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The step size in `DeviceUnits` (see manual).

`get_jog_vel_params()`

Gets the jog velocity parameters.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns

- `int` – The maximum velocity in `DeviceUnits` (see manual).
- `int` – The acceleration in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

`get_limit_switch_params()`

Gets the limit switch parameters.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns

- *enums.MOT_LimitSwitchModes* – The clockwise hardware limit mode.
- *enums.MOT_LimitSwitchModes* – The anticlockwise hardware limit mode.
- `int` – The position of the clockwise software limit in `DeviceUnits` (see manual).
- `int` – The position of the anticlockwise software limit in `DeviceUnits` (see manual).
- *enums.MOT_LimitSwitchSWModes* – The soft limit mode.

Raises
ThorlabsError – If not successful.

get_limit_switch_params_block()

Get the limit switch parameters.

Returns

structs.MOT_LimitSwitchParameters – The limit switch parameters.

Raises

ThorlabsError – If not successful.

get_mmi_params()

Get the MMI Parameters for the KCube Display Interface.

Deprecated calls by *get_mmi_params_ext()*

get_mmi_params_block()

Gets the MMI parameters for the device.

Returns

structs.KMOT_MMIParams – The MMI parameters for the device.

get_mmi_params_ext()

Get the MMI Parameters for the KCube Display Interface.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns

- *enums.KMOT_WheelMode* – The device joystick mode.
- `int` – The joystick maximum velocity in `DeviceUnits`.
- `int` – The joystick acceleration in `DeviceUnits`.
- *enums.KMOT_WheelDirectionSense* – The joystick direction sense.
- `int` – The first preset position in `DeviceUnits`.
- `int` – The second preset position in `DeviceUnits`.
- `int` – The display intensity, range 0 to 100%.
- `int` – The display timeout, range 0 to 480 in minutes (0 is off, otherwise the inactivity period before dimming the display).
- `int` – The display dimmed intensity, range 0 to 10 (after the timeout period the device display will dim).

Raises

ThorlabsError – If not successful.

get_motor_params()

Gets the motor stage parameters.

Deprecated: calls *get_motor_params_ext()*

These parameters, when combined define the stage motion in terms of `RealWorldUnits` [millimeters or degrees]. The real-world unit is defined from `steps_per_rev * gear_box_ratio / pitch`.

Returns

- float – The steps per revolution.
- float – The gear box ratio.
- float – The pitch.

Raises
ThorlabsError – If not successful.

`get_motor_params_ext()`

Gets the motor stage parameters.

These parameters, when combined define the stage motion in terms of `RealWorldUnits` [millimeters or degrees]. The real-world unit is defined from `steps_per_rev * gear_box_ratio / pitch`.

Returns

- float – The steps per revolution.
- float – The gear box ratio.
- float – The pitch.

Raises
ThorlabsError – If not successful.

`get_motor_travel_limits()`

Gets the motor stage min and max position.

Returns

- float – The minimum position in `RealWorldUnits` [millimeters or degrees].
- float – The maximum position in `RealWorldUnits` [millimeters or degrees].

Raises
ThorlabsError – If not successful.

`get_motor_travel_mode()`

Get the motor travel mode.

Returns
enums.MOT_TravelModes – The travel mode.

`get_motor_velocity_limits()`

Gets the motor stage maximum velocity and acceleration.

Returns

- float – The maximum velocity in `RealWorldUnits` [millimeters or degrees].
- float – The maximum acceleration in `RealWorldUnits` [millimeters or degrees].

Raises
ThorlabsError – If not successful.

`get_move_absolute_position()`

Gets the move absolute position.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The move absolute position in `DeviceUnits` (see manual).

`get_move_relative_distance()`

Gets the move relative distance.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Returns
`int` – The move relative position in `DeviceUnits` (see manual).

`get_next_message()`

Get the next Message Queue item. See *messages*.

Returns

- `int` – The message type.
- `int` – The message ID.
- `int` – The message data.

Raises
ThorlabsError – If not successful.

`get_number_positions()`

Get the number of positions.

This function will get the maximum position reachable by the device. The motor may need to be set to its *home()* position before this parameter can be used.

Returns
`int` – The number of positions.

`get_pid_loop_encoder_coeff()`

Gets the encoder PID loop coefficient.

This is the encoder coefficient. Use 0.0 to disable the encoder or if no encoder is present otherwise a positive encoder coefficient.

Returns
`float` – The encoder PID loop coefficient.

`get_pid_loop_encoder_params()`

Gets the Encoder PID loop parameters.

Returns
structs.MOT_PIDLoopEncoderParams – The Encoder PID loop parameters.

Raises
ThorlabsError – If not successful.

get_position()

Get the current position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
index (int) – The position in DeviceUnits (see manual).

get_position_counter()

Get the position counter.

The position counter is identical to the position parameter. The position counter is set to zero when homing is complete.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The position counter in DeviceUnits (see manual).

get_power_params()

Gets the power parameters for the stepper motor.

Returns
structs.MOT_PowerParameters – The power parameters.

Raises
ThorlabsError – If not successful.

get_real_value_from_device_unit(*device_value*, *unit_type*)

Converts a device value to a real-world value.

Either *load_settings()*, *load_named_settings()* or *set_motor_params_ext()* must be called before calling this function, otherwise the returned value will always be 0.

Parameters

- **device_value** (int) – The device value.
- **unit_type** (*enums.UnitType*) – The unit of the device value.

Returns
float – The real-world value.

Raises
ThorlabsError – If not successful.

get_soft_limit_mode()

Gets the software limits mode.

Returns
enums.MOT_LimitsSoftwareApproachPolicy – The software limits mode.

get_software_version()

Gets version number of the device software.

Returns
str – The device software version.

get_stage_axis_max_pos()

Gets the Stepper Motor maximum stage position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The maximum position in DeviceUnits (see manual).

get_stage_axis_min_pos()

Gets the Stepper Motor minimum stage position.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns
int – The minimum position in DeviceUnits (see manual).

get_status_bits()

Get the current status bits.

This returns the latest status bits received from the device. To get new status bits, use *request_status_bits()* or use the polling functions, *start_polling()*.

Returns
int – The status bits from the device.

get_trigger_config_params()

Get the Trigger Configuration Parameters.

Returns

- *enums.KMOT_TriggerPortMode* – The trigger 1 mode.
- *enums.KMOT_TriggerPortPolarity* – The trigger 1 polarity.
- *enums.KMOT_TriggerPortMode* – The trigger 2 mode.
- *enums.KMOT_TriggerPortPolarity* – The trigger 2 polarity.

Raises
ThorlabsError – If not successful.

get_trigger_config_params_block()

Gets the trigger configuration parameters block.

Returns
structs.KMOT_TriggerConfig – Options for controlling the trigger configuration.

Raises
ThorlabsError – If not successful.

get_trigger_params_params()

Get the Trigger Parameters parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- int – The trigger start position, forward, in DeviceUnits (see manual).
- int – The trigger interval, forward, in DeviceUnits (see manual).
- int – Number of trigger pulses, forward.
- int – The trigger start position, reverse, in DeviceUnits (see manual).
- int – The trigger interval, reverse, in DeviceUnits (see manual).
- int – Number of trigger pulses., reverse.
- int – Width of the trigger pulse in milliseconds, range 10 (10us) to 650000 (650ms).
- int – Number of cycles to perform triggering.

Raises
ThorlabsError – If not successful.

get_trigger_params_params_block()

Gets the trigger parameters block.

Returns
structs.KMOT_TriggerParams – Options for controlling the trigger.

Raises
ThorlabsError – If not successful.

get_vel_params()

Gets the move velocity parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Returns

- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

get_vel_params_block()

Get the move velocity parameters.

Returns
structs.MOT_VelocityParameters – The velocity parameters.

Raises
ThorlabsError – If not successful.

has_last_msg_timer_overrun()

Queries if the time since the last message has exceeded the lastMsgTimeout set by *enable_last_msg_timer()*.

This can be used to determine whether communications with the device is still good.

Returns
bool – True if last message timer has elapsed or False if monitoring is not enabled or if time of last message received is less than lastMsgTimeout.

home()

Home the device.

Homing the device will set the device to a known state and determine the home position.

Raises
ThorlabsError – If not successful.

identify()

Sends a command to the device to make it identify itself.

is_calibration_active()

Is a calibration file active for this motor?

Returns
bool – Whether a calibration file is active.

load_settings()

Update device with stored settings.

The settings are read from ThorlabsDefaultSettings.xml, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

load_named_settings(*settings_name*)

Update device with named settings.

Parameters
settings_name (str) – The name of the device to load the settings for. Examples for the value of *setting_name* can be found in *ThorlabsDefaultSettings.xml* `, which gets created when the Kinesis software is installed.

Raises
ThorlabsError – If not successful.

message_queue_size()

Gets the size of the message queue.

Returns
int – The number of messages in the queue.

move_absolute()

Moves the device to the position defined in *set_move_absolute_position()*.

Raises
ThorlabsError – If not successful.

move_at_velocity(*direction*)

Start moving at the current velocity in the specified direction.

Parameters
direction (*enums.MOT_TravelDirection*) – The required direction of travel as a *enums.MOT_TravelDirection* enum value or member name.

Raises
ThorlabsError – If not successful.

move_jog(*jog_direction*)

Perform a jog.

Parameters
jog_direction (*enums.MOT_TravelDirection*) – The jog direction as a *enums.MOT_TravelDirection* enum value or member name.

Raises
ThorlabsError – If not successful.

move_relative(*displacement*)

Move the motor by a relative amount.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
displacement (`int`) – Signed displacement in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

move_relative_distance()

Moves the device by a relative distance defined by *set_move_relative_distance()*.

Raises
ThorlabsError – If not successful.

move_to_position(*index*)

Move the device to the specified position (index).

The motor may need to be set to its *home()* position before a position can be set.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
index (`int`) – The position in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

needs_homing()

Does the device need to be *home()*'d before a move can be performed?

Deprecated: calls *can_move_without_homing_first()* instead.

Returns
`bool` – Whether the device needs to be homed.

open()

Open the device for communication.

Raises
ThorlabsError – If not successful.

persist_settings()

Persist the devices current settings.

Raises
ThorlabsError – If not successful.

polling_duration()

Gets the polling loop duration.

Returns
int – The time between polls in milliseconds or 0 if polling is not active.

register_message_callback(*callback*)

Registers a callback on the message queue.

Parameters
callback (*MotionControlCallback*) – A function to be called whenever messages are received.

request_backlash()

Requests the backlash.

Raises
ThorlabsError – If not successful.

request_bow_index()

Requests the stepper motor bow index.

Raises
ThorlabsError – If not successful.

request_digital_outputs()

Requests the digital output bits.

Raises
ThorlabsError – If not successful.

request_encoder_counter()

Requests the encoder counter.

Raises
ThorlabsError – If not successful.

request_front_panel_locked()

Ask the device if its front panel is locked.

Raises
ThorlabsError – If not successful.

request_homing_params()

Requests the homing parameters.

Raises
ThorlabsError – If not successful.

request_jog_params()

Requests the jog parameters.

Raises
ThorlabsError – If not successful.

request_limit_switch_params()

Requests the limit switch parameters.

Raises
ThorlabsError – If not successful.

request_mmi_params()

Requests the MMI Parameters for the KCube Display Interface.

Raises
ThorlabsError – If not successful.

request_move_absolute_position()

Requests the position of next absolute move.

Raises
ThorlabsError – If not successful.

request_move_relative_distance()

Requests the relative move distance.

Raises
ThorlabsError – If not successful.

request_pid_loop_encoder_params()

Requests the Encoder PID loop parameters.

Raises
ThorlabsError – If not successful.

request_pos_trigger_params()

Requests the position trigger parameters.

Raises
ThorlabsError – If not successful.

request_position()

Requests the current position.

This needs to be called to get the device to send it's current position. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

request_power_params()

Requests the power parameters.

Raises
ThorlabsError – If not successful.

request_settings()

Requests that all settings are downloaded from the device.

This function requests that the device upload all it's settings to the DLL.

Raises
ThorlabsError – If not successful.

`request_status_bits()`

Request the status bits which identify the current motor state.

This needs to be called to get the device to send it's current status bits. Note, this is called automatically if `Polling` is enabled for the device using *start_polling()*.

Raises
ThorlabsError – If not successful.

`request_trigger_config_params()`

Requests the Trigger Configuration Parameters.

Raises
ThorlabsError – If not successful.

`request_vel_params()`

Requests the velocity parameters.

Raises
ThorlabsError – If not successful.

`reset_rotation_modes()`

Reset the rotation modes for a rotational device.

Raises
ThorlabsError – If not successful.

`resume_move_messages()`

Resume suspended move messages.

Raises
ThorlabsError – If not successful.

`set_backlash(distance)`

Sets the backlash distance (used to control hysteresis).

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
distance (`int`) – The backlash distance in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

`set_bow_index(bow_index)`

Sets the stepper motor bow index.

Parameters
bow_index (`int`) – The bow index.

Raises
ThorlabsError – If not successful.

`set_calibration_file(path, enabled)`

Set the calibration file for this motor.

Parameters

- **path** (str) – The path to a calibration file to load.
- **enabled** (bool) – True to enable, False to disable.

Raises

OSError – If the *path* does not exist.

set_digital_outputs(*outputs_bits*)

Sets the digital output bits.

Parameters

outputs_bits (int) – Bit mask to set the states of the 4 digital output pins.

Raises

ThorlabsError – If not successful.

set_direction(*reverse*)

Sets the motor direction sense.

This function is used because some actuators have directions of motion reversed. This parameter will tell the system to reverse the direction sense when moving, jogging etc.

Parameters

reverse (bool) – If True then directions will be swapped on these moves.

Raises

ThorlabsError – If not successful.

set_encoder_counter(*count*)

Set the Encoder Counter values.

Setting the encoder counter to zero, effectively defines a home position on the encoder strip. Note, setting this value does not move the device.

Parameters

count (int) – The encoder count in encoder units.

Raises

ThorlabsError – If not successful.

set_front_panel_lock(*locked*)

Sets the device front panel lock state.

Parameters

locked (bool) – True to lock the device, False to unlock

Raises

ThorlabsError – If not successful.

set_homing_params_block(*direction*, *limit*, *velocity*, *offset*)

Set the homing parameters.

Parameters

- **direction** (*enums.MOT_TravelDirection*) – The Homing direction sense as a *enums.MOT_TravelDirection* enum value or member name.

- **limit** (*enums.MOT_HomeLimitSwitchDirection*) – The limit switch direction as a *enums.MOT_HomeLimitSwitchDirection* enum value or member name.
- **velocity** (int) – The velocity in small indivisible units.
- **offset** (int) – Distance of home from limit in small indivisible units.

Raises

ThorlabsError – If not successful.

set_homing_velocity(*velocity*)

Sets the homing velocity.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

velocity (int) – The homing velocity in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_jog_mode(*mode*, *stop_mode*)

Sets the jog mode.

Parameters

- **mode** (*enums.MOT_JogModes*) – The jog mode, as a *enums.MOT_JogModes* enum value or member name.
- **stop_mode** (*enums.MOT_StopModes*) – The stop mode, as a *enums.MOT_StopModes* enum value or member name.

Raises

ThorlabsError – If not successful.

set_jog_params_block(*jog_params*)

Set the jog parameters.

Parameters

jog_params (*structs.MOT_JogParameters*) – The jog parameters.

Raises

- *ThorlabsError* – If not successful.
- **TypeError** – If the data type of *jog_params* is not *structs.MOT_JogParameters*

set_jog_step_size(*step_size*)

Sets the distance to move on jogging.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

step_size (int) – The step size in DeviceUnits (see manual).

Raises

ThorlabsError – If not successful.

set_jog_vel_params(*max_velocity*, *acceleration*)

Sets jog velocity parameters.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **max_velocity** (`int`) – The maximum velocity in `DeviceUnits` (see manual).
- **acceleration** (`int`) – The acceleration in `DeviceUnits` (see manual).

Raises

ThorlabsError – If not successful.

set_limit_switch_params(*cw_lim*, *ccw_lim*, *cw_pos*, *ccw_pos*, *soft_limit_mode*)

Sets the limit switch parameters.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **cw_lim** (*enums.MOT_LimitSwitchModes*) – The clockwise hardware limit mode as a *enums.MOT_LimitSwitchModes* enum value or member name.
- **ccw_lim** (*enums.MOT_LimitSwitchModes*) – The anticlockwise hardware limit mode as a *enums.MOT_LimitSwitchModes* enum value or member name.
- **cw_pos** (`int`) – The position of the clockwise software limit in `DeviceUnits` (see manual).
- **ccw_pos** (`int`) – The position of the anticlockwise software limit in `DeviceUnits` (see manual).
- **soft_limit_mode** (*enums.MOT_LimitSwitchSWModes*) – The soft limit mode as a *enums.MOT_LimitSwitchSWModes* enum value or member name.

Raises

ThorlabsError – If not successful.

set_limit_switch_params_block(*params*)

Set the limit switch parameters.

Parameters

params (*structs.MOT_LimitSwitchParameters*) – The limit switch parameters.

Raises

ThorlabsError – If not successful.

set_limits_software_approach_policy(*policy*)

Sets the software limits mode.

Parameters

policy (*enums.MOT_LimitsSoftwareApproachPolicy*) – The soft limit mode as a *enums.MOT_LimitsSoftwareApproachPolicy* enum value or member name.

set_mmi_params(*joystick_mode*, *joystick_max_velocity*, *joystick_acceleration*, *direction_sense*, *preset_position1*, *preset_position2*, *display_intensity*)

Set the MMI Parameters for the KCube Display Interface.

Deprecated calls *set_mmi_params_ext()* setting the *display_timeout* to 1 minute and the *display_dim_intensity* to 8.

Raises

ThorlabsError – If not successful.

set_mmi_params_block(*mmi_params*)

Sets the MMI parameters for the device.

Parameters

mmi_params (*structs.KMOT_MMIParams*) – Options for controlling the mmi.

Raises

ThorlabsError – If not successful.

set_mmi_params_ext(*joystick_mode*, *joystick_max_velocity*, *joystick_acceleration*, *direction_sense*, *preset_position1*, *preset_position2*, *display_intensity*, *display_timeout*, *display_dim_intensity*)

Set the MMI Parameters for the KCube Display Interface.

See *get_real_value_from_device_unit()* for converting from a `DeviceUnit` to a `RealValue`.

Parameters

- **joystick_mode** (*enums.KMOT_WheelMode*) – The device joystick mode as a *enums.KMOT_WheelMode* enum value or member name.
- **joystick_max_velocity** (`int`) – The joystick maximum velocity in `DeviceUnits`.
- **joystick_acceleration** (`int`) – The joystick acceleration in `DeviceUnits`.
- **direction_sense** (*enums.KMOT_WheelDirectionSense*) – The joystick direction sense as a *enums.KMOT_WheelDirectionSense* enum value or member name.
- **preset_position1** (`int`) – The first preset position in `DeviceUnits`.
- **preset_position2** (`int`) – The second preset position in `DeviceUnits`.
- **display_intensity** (`int`) – The display intensity, range 0 to 100%.
- **display_timeout** (`int`) – The display timeout, range 0 to 480 in minutes (0 is off, otherwise the inactivity period before dimming the display).

- **display_dim_intensity** (int) – The display dimmed intensity, range 0 to 10 (after the timeout period the device display will dim).

Raises

ThorlabsError – If not successful.

set_motor_params(*steps_per_rev*, *gear_box_ratio*, *pitch*)

Sets the motor stage parameters.

Deprecated: calls *set_motor_params_ext()*

These parameters, when combined, define the stage motion in terms of RealWorldUnits [millimeters or degrees]. The real-world unit is defined from steps_per_rev * gear_box_ratio / pitch.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **steps_per_rev** (float) – The steps per revolution.
- **gear_box_ratio** (float) – The gear box ratio.
- **pitch** (float) – The pitch.

Raises

ThorlabsError – If not successful.

set_motor_params_ext(*steps_per_rev*, *gear_box_ratio*, *pitch*)

Sets the motor stage parameters.

These parameters, when combined, define the stage motion in terms of RealWorldUnits [millimeters or degrees]. The real-world unit is defined from steps_per_rev * gear_box_ratio / pitch.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **steps_per_rev** (float) – The steps per revolution.
- **gear_box_ratio** (float) – The gear box ratio.
- **pitch** (float) – The pitch.

Raises

ThorlabsError – If not successful.

set_motor_travel_limits(*min_position*, *max_position*)

Sets the motor stage min and max position.

These define the range of travel for the stage.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **min_position** (float) – The minimum position in RealWorldUnits [millimeters or degrees].

- **max_position** (float) – The maximum position in RealWorldUnits [millimeters or degrees].

Raises
ThorlabsError – If not successful.

set_motor_travel_mode(*travel_mode*)

Set the motor travel mode.

Parameters
travel_mode (*enums.MOT_TravelModes*) – The travel mode as a *enums.MOT_TravelModes* enum value or member name.

Raises
ThorlabsError – If not successful.

set_motor_velocity_limits(*max_velocity*, *max_acceleration*)

Sets the motor stage maximum velocity and acceleration.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **max_velocity** (float) – The maximum velocity in RealWorldUnits [millimeters or degrees].
- **max_acceleration** (float) – The maximum acceleration in RealWorldUnits [millimeters or degrees].

Raises
ThorlabsError – If not successful.

set_move_absolute_position(*position*)

Sets the move absolute position.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters
position (int) – The absolute position in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_move_relative_distance(*distance*)

Sets the move relative distance.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters
distance (int) – The relative position in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_pid_loop_encoder_coeff(*coeff*)

Sets the encoder PID loop coefficient.

This is the encoder coefficient. Use 0.0 to disable the encoder or if no encoder is present otherwise a positive encoder coefficient.

Parameters
coeff (float) – The encoder PID loop coefficient.

Raises
ThorlabsError – If not successful.

set_pid_loop_encoder_params(*params*)

Sets the encoder PID loop parameters.

Parameters
params (*structs.MOT_PIDLoopEncoderParams*) – The encoder PID loop parameters.

Raises
- *ThorlabsError* – If not successful.
- **TypeError** – If *params* is not a *structs.MOT_PIDLoopEncoderParams*.

set_position_counter(*count*)

Set the position counter.

Setting the position counter will locate the current position. Setting the position counter will effectively define the home position of a motor.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters
count (int) – The position counter in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

set_power_params(*rest*, *move*)

Sets the power parameters for the stepper motor.

Parameters
- **rest** (int) – Percentage of full power to give while not moving (0 - 100).
- **move** (int) – Percentage of full power to give while moving (0 - 100).

Raises
ThorlabsError – If not successful.

set_rotation_modes(*mode*, *direction*)

Set the rotation modes for a rotational device.

Parameters
- **mode** (*enums.MOT_MovementModes*) – The travel mode as a *enums.MOT_MovementModes* enum value or member name.
- **direction** (*enums.MOT_MovementDirections*) – The travel mode as a *enums.MOT_MovementDirections* enum value or member name.

Raises
ThorlabsError – If not successful.

set_stage_axis_limits(*min_position*, *max_position*)

Sets the stage axis position limits.

See *get_device_unit_from_real_value()* for converting from a `RealValue` to a `DeviceUnit`.

Parameters

- **min_position** (`int`) – The minimum position in `DeviceUnits` (see manual).
- **max_position** (`int`) – The maximum position in `DeviceUnits` (see manual).

Raises
ThorlabsError – If not successful.

set_trigger_config_params(*mode1*, *polarity1*, *mode2*, *polarity2*)

Set the trigger configuration parameters.

Parameters

- **mode1** (*enums.KMOT_TriggerPortMode*) – The trigger 1 mode as a *KMOT_TriggerPortMode* enum value or member name.
- **polarity1** (*enums.KMOT_TriggerPortPolarity*) – The trigger 1 polarity as a *KMOT_TriggerPortPolarity* enum value or member name.
- **mode2** (*enums.KMOT_TriggerPortMode*) – The trigger 2 mode as a *KMOT_TriggerPortMode* enum value or member name.
- **polarity2** (*enums.KMOT_TriggerPortPolarity*) – The trigger 2 polarity as a *KMOT_TriggerPortPolarity* enum value or member name.

Raises
ThorlabsError – If not successful.

set_trigger_config_params_block(*trigger_config_params*)

Sets the trigger configuration parameters block.

Parameters
trigger_config_params (*structs.KMOT_TriggerConfig*) – Options for controlling the trigger configuration.

Raises

- *ThorlabsError* – If not successful.
- **TypeError** – If *trigger_config_params* is not a *structs.KMOT_TriggerConfig*.

set_trigger_params_params(*trigger_start_position_fwd*, *trigger_interval_fwd*, *trigger_pulse_count_fwd*, *trigger_start_position_rev*, *trigger_interval_rev*, *trigger_pulse_count_rev*, *trigger_pulse_width*, *cycle_count*)

Set the Trigger Parameters parameters.

See *get_real_value_from_device_unit()* for converting from a DeviceUnit to a RealValue.

Parameters

- **trigger_start_position_fwd** (int) – The trigger start position, forward, in DeviceUnits (see manual).
- **trigger_interval_fwd** (int) – The trigger interval, forward, in DeviceUnits (see manual).
- **trigger_pulse_count_fwd** (int) – Number of trigger pulses, forward.
- **trigger_start_position_rev** (int) – The trigger start position, reverse, in DeviceUnits (see manual).
- **trigger_interval_rev** (int) – The trigger interval, reverse, in DeviceUnits (see manual).
- **trigger_pulse_count_rev** (int) – Number of trigger pulses, reverse.
- **trigger_pulse_width** (int) – Width of the trigger pulse in milliseconds, range 10 (10us) to 650000 (650ms).
- **cycle_count** (int) – Number of cycles to perform triggering.

Raises

ThorlabsError – If not successful.

set_trigger_params_params_block(*trigger_params_params*)

Set the Trigger Parameters parameters.

Parameters

trigger_params_params (*structs.KMOT_TriggerParams*) – Options for controlling the trigger.

Raises

- *ThorlabsError* – If not successful.
- **TypeError** – If *trigger_params_params* is not a *structs.KMOT_TriggerParams*.

set_vel_params(*max_velocity*, *acceleration*)

Sets the move velocity parameters.

See *get_device_unit_from_real_value()* for converting from a RealValue to a DeviceUnit.

Parameters

- **max_velocity** (int) – The maximum velocity in DeviceUnits (see manual).
- **acceleration** (int) – The acceleration in DeviceUnits (see manual).

Raises
ThorlabsError – If not successful.

set_vel_params_block(*min_velocity*, *max_velocity*, *acceleration*)

Set the move velocity parameters.

Parameters

- **min_velocity** (int) – The minimum velocity.
- **max_velocity** (int) – The maximum velocity.
- **acceleration** (int) – The acceleration.

Raises
ThorlabsError – If not successful.

start_polling(*milliseconds*)

Starts the internal polling loop.

This function continuously requests position and status messages.

Parameters
milliseconds (int) – The polling rate, in milliseconds.

Raises
ThorlabsError – If not successful.

stop_immediate()

Stop the current move immediately (with the risk of losing track of the position).

Raises
ThorlabsError – If not successful.

stop_polling()

Stops the internal polling loop.

stop_profiled()

Stop the current move using the current velocity profile.

Raises
ThorlabsError – If not successful.

suspend_move_messages()

Suspend automatic messages at ends of moves.

Useful to speed up part of real-time system with lots of short moves.

Raises
ThorlabsError – If not successful.

time_since_last_msg_received()

Gets the time, in milliseconds, since the last message was received.

This can be used to determine whether communications with the device is still good.

Returns

- int – The time, in milliseconds, since the last message was received.
- bool – True if monitoring is enabled otherwise False.

uses_pid_loop_encoding()

Determines if we can uses PID loop encoding.

This is true if the stage supports PID Loop Encoding. Requires *get_pid_loop_encoder_coeff()* to have a positive non zero coefficient.

Returns

bool – Whether PID loop encoding is supported.

wait_for_message()

Wait for next Message Queue item. See *messages*.

Returns

- int – The message type.
- int – The message ID.
- int – The message data.

Raises

ThorlabsError – If not successful.

msl.equipment.resources.thorlabs.kinesis.messages module

Device Message Queue defined in Thorlabs Kinesis v1.14.18

The device message queue allows the internal events raised by the device to be monitored by the DLLs owner.

The device raises many different events, usually associated with a change of state.

These messages are temporarily stored in the DLL and can be accessed using the appropriate message functions.

The message consists of 3 components, a messageType, a messageID and messageData:

```
WORD messageType
WORD messageID
WORD messageData
```

msl.equipment.resources.thorlabs.kinesis.messages.**MessageTypes = {0: 'GenericDevice', 1: 'GenericPiezo', 2: 'GenericMotor', 3: 'GenericDCMotor', 4: 'GenericSimpleMotor', 5: 'RackDevice', 6: 'Laser', 7: 'TECCtlr', 8: 'Quad', 9: 'NanoTrak', 10: 'Specialized', 11: 'Solenoid'}**

MessageTypes

msl.equipment.resources.thorlabs.kinesis.messages.**GenericDevice = {0: 'settingsInitialized', 1: 'settingsUpdated', 2: 'settingsExtern', 3: 'error', 4: 'close', 5: 'settingsReset'}**

GenericDevice

msl.equipment.resources.thorlabs.kinesis.messages.**GenericMotor = {0: 'Homed', 1: 'Moved', 2: 'Stopped', 3: 'LimitUpdated'}**

GenericMotor

msl.equipment.resources.thorlabs.kinesis.messages.**GenericDCMotor = {0: 'error', 1: 'status'}**

GenericDCMotor

msl.equipment.resources.thorlabs.kinesis.messages.**GenericPiezo = {0: 'maxVoltageChanged', 1: 'controlModeChanged', 2: 'statusChanged', 3: 'maxTravelChanged', 4: 'TSG_Status', 5: 'TSG_DisplayModeChanged'}**

GenericPiezo

msl.equipment.resources.thorlabs.kinesis.messages.**RackDevice = {0: 'RackCountEstablished', 1: 'RackBayState'}**

RackDevice

msl.equipment.resources.thorlabs.kinesis.messages.**Quad = {0: 'statusChanged'}**

Quad

msl.equipment.resources.thorlabs.kinesis.messages.**TECCtlr = {0: 'statusChanged', 2: 'displaySettingsChanged', 3: 'feedbackParamsChanged'}**

TECCtlr

msl.equipment.resources.thorlabs.kinesis.messages.**Laser = {0: 'statusChanged', 1: 'controlSourceChanged', 2: 'displayModeChanged'}**

Laser

msl.equipment.resources.thorlabs.kinesis.messages.**Solenoid = {0: 'statusChanged'}**

Solenoid

msl.equipment.resources.thorlabs.kinesis.messages.**NanoTrak = {0: 'statusChanged'}**

NanoTrak

msl.equipment.resources.thorlabs.kinesis.messages.**Specialized = {}**

Specialized

msl.equipment.resources.thorlabs.kinesis.messages.**GenericSimpleMotor = {}**

GenericSimpleMotor

msl.equipment.resources.thorlabs.kinesis.messages.**MessageID = {'GenericDCMotor': {0: 'error', 1: 'status'}, 'GenericDevice': {0: 'settingsInitialized', 1: 'settingsUpdated', 2: 'settingsExtern', 3: 'error', 4: 'close', 5: 'settingsReset'}, 'GenericMotor': {0: 'Homed', 1: 'Moved', 2: 'Stopped', 3: 'LimitUpdated'}, 'GenericPiezo': {0: 'maxVoltageChanged', 1: 'controlModeChanged', 2: 'statusChanged', 3: 'maxTravelChanged', 4: 'TSG_Status', 5: 'TSG_DisplayModeChanged'}, 'GenericSimpleMotor': {}, 'Laser': {0: 'statusChanged', 1: 'controlSourceChanged', 2: 'displayModeChanged'}, 'NanoTrak': {0: 'statusChanged'}, 'Quad': {0: 'statusChanged'}, 'RackDevice': {0: 'RackCountEstablished', 1: 'RackBayState'}, 'Solenoid': {0: 'statusChanged'}, 'Specialized': {}, 'TECCtlr': {0: 'statusChanged', 2: 'displaySettingsChanged', 3: 'feedbackParamsChanged'}}**

MessageID

msl.equipment.resources.thorlabs.kinesis.motion_control module

Base `Thorlabs.MotionControl` class.

`msl.equipment.resources.thorlabs.kinesis.motion_control.`**device_manager**`()`

Returns a reference to the DeviceManager library.

The `Thorlabs.MotionControl.DeviceManager.dll` library must be available on `os.environ['PATH']`.

Returns

`ctypes.CDLL` – A reference to the library.

class `msl.equipment.resources.thorlabs.kinesis.motion_control.`**MotionControl**(*record*, *api_function*, *build_device_list=F*

Bases: *ConnectionSDK*

Base **Thorlabs.MotionControl** class.

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

- **record** (*EquipmentRecord*) – A record from an *Equipment-Register Database*.
- **api_function** (*api_functions*) – An API function list from *api_functions* that the subclass is a wrapper around.
- **build_device_list** (`bool`, optional) – Whether to call *build_device_list()* before opening the connection to the device.

Raises

ThorlabsError – If a connection to the device cannot be established.

Benchtop_Brushless_Motor = 73

Benchtop Brushless Motor device ID

Benchtop_NanoTrak = 22

Benchtop NanoTrak device ID

Benchtop_Piezo_1_Channel = 41

Benchtop Piezo 1-Channel device ID

Benchtop_Piezo_3_Channel = 71

Benchtop Piezo 3-Channel device ID

Benchtop_Stepper_Motor_1_Channel = 40

Benchtop Stepper Motor 1-Channel device ID

Benchtop_Stepper_Motor_3_Channel = 70

Benchtop Stepper Motor 3-Channel device ID

Filter_Flipper = 37

Filter Flipper device ID

Filter_Wheel = 47
Filter Wheel device ID

KCube_Brushless_Motor = 28
KCube Brushless Motor device ID

KCube_DC_Servo = 27
KCube DC Servo device ID

KCube_Inertial_Motor = 97
KCube Inertial Motor device ID

KCube_LaserSource = 56
KCube Laser Source device ID

KCube_NanoTrak = 57
KCube NanoTrak device ID

KCube_Piezo = 29
KCube Piezo device ID

KCube_Solenoid = 68
KCube Solenoid device ID

KCube_Stepper_Motor = 26
KCube Stepper Motor device ID

Long_Travel_Stage = 45
Long Travel Stage device ID

Cage_Rotator = 55
Cage Rotator device ID

LabJack_490 = 46
LabJack 490 device ID

LabJack_050 = 49
LabJack 050 device ID

Modular_NanoTrak = 52
Modular NanoTrak device ID

Modular_Piezo = 51
Modular Piezo device ID

Modular_Stepper_Motor = 50
Modular Stepper Motor device ID

TCube_Brushless_Motor = 67
TCube Brushless Motor device ID

TCube_DC_Servo = 83
TCube DC Servo device ID

TCube_Inertial_Motor = 65
TCube Inertial Motor device ID

TCube_LaserSource = 86

TCube Laser Source device ID

TCube_LaserDiode = 64

TCube Laser Diode device ID

TCube_NanoTrak = 82

TCube NanoTrak device ID

TCube_Quad = 89

TCube Quad device ID

TCube_Solenoid = 85

TCube Solenoid device ID

TCube_Stepper_Motor = 80

TCube Stepper_Motor device ID

TCube_Strain_Gauge = 84

TCube Strain Gauge device ID

TCube_TEC = 87

TCube TEC device ID

Vertical_Stage = 24

Vertical Stage device ID

SERIAL_NUMBER_BUFFER_SIZE = 500

errcheck_api(*result*, *func*, *args*)

The API function returns OK if the function call was successful.

errcheck_true(*result*, *func*, *args*)

The API function returns `True` if the function call was successful.

disconnect()

Disconnect and close the device.

property settings

The device settings specified in `ThorlabsDefaultSettings.xml`

If this is an empty `dict` then you can specify the `device_name` in the properties field in the *Connections Database* or you can run the Kinesis software and allow Kinesis to configure the actuator that is connected to the motor controller.

The possible values for `device_name` can be found in the `ThorlabsDefaultSettings.xml` file (located in the Kinesis installation folder, e.g., C:Program FilesThorlabsKinesis). as the `Name` value in one of the <`DeviceSettingsType`> tags.

Type
`dict`

static build_device_list()

Build the device list.

This function builds an internal collection of all devices found on a USB port that are not currently open.

Note: If a device is open, it will not appear in the list until the device has been closed.

Raises
ThorlabsError – If the device list cannot be built.

`static get_device_list_size()`

`int`: The number of devices in the device list.

`static get_device_list(*device_ids)`

Get the contents of the device list which match the supplied device IDs.

Parameters
device_ids (`int`) – A sequence of device ID's.

Returns
`list` of `str` – A list of device serial numbers for the specified device ID(s).

Raises
ThorlabsError – If there was an error getting the device list.

`static get_device_info(serial_number)`

Get the device information from a USB port.

The device info is read from the USB port not from the device itself.

Parameters
serial_number (`str`) – The serial number of the device.

Returns
structs.TLI_DeviceInfo – A DeviceInfo structure.

Raises
ThorlabsError – If there was an error getting the device information.

`static to_version(dword)`

Convert the firmware or software number to a string.

The number is made up of 4-byte parts.

See the *get_firmware_version()* or the *get_software_version()* method of the appropriate Thorlabs MotionControl subclass.

Parameters
dword (`int`) – The firmware or software number.

Returns
`str` – The string representation of the version number.

`static convert_message(msg_type, msg_id, msg_data)`

Converts the message into a `dict`.

See the *get_next_message()* or the *wait_for_message()* method of the appropriate Thorlabs MotionControl subclass.

Parameters

- **msg_type** (int) – The message type defines the device type which raised the message.
- **msg_id** (int) – The message ID for the *msg_type*.
- **msg_data** (int) – The message data.

Returns

dict – The message represented as

{ 'type': *MessageTypes*, 'id': *MessageID*, 'data': int }

msl.equipment.resources.thorlabs.kinesis.structs module

Structs defined in Thorlabs Kinesis v1.14.10

class msl.equipment.resources.thorlabs.kinesis.structs.**TLI_DeviceInfo**

Bases: Structure

PID

Structure/Union member

description

Structure/Union member

isCustomType

Structure/Union member

isKnownType

Structure/Union member

isLaser

Structure/Union member

isPiezoDevice

Structure/Union member

isRack

Structure/Union member

maxChannels

Structure/Union member

motorType

Structure/Union member

serialNo

Structure/Union member

typeID

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**TLI_HardwareInformation**

Bases: Structure

deviceDependantData

Structure/Union member

firmwareVersion

Structure/Union member

hardwareVersion

Structure/Union member

modelNumber

Structure/Union member

modificationState

Structure/Union member

notes

Structure/Union member

numChannels

Structure/Union member

serialNumber

Structure/Union member

type

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_VelocityParameters**

Bases: Structure

acceleration

Structure/Union member

maxVelocity

Structure/Union member

minVelocity

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_JogParameters**

Bases: Structure

mode

Structure/Union member

stepSize

Structure/Union member

stopMode

Structure/Union member

velParams

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_HomingParameters**

Bases: Structure

direction

Structure/Union member

limitSwitch

Structure/Union member

offsetDistance

Structure/Union member

velocity

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_VelocityProfileParameters**

Bases: Structure

jerk

Structure/Union member

lastNotUsed

Structure/Union member

mode

Structure/Union member

notUsed

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_StageAxisParameters**

Bases: Structure

axisID

Structure/Union member

countsPerUnit

Structure/Union member

maxAcceleration

Structure/Union member

maxDecceleration

Structure/Union member

maxPosition

Structure/Union member

maxVelocity

Structure/Union member

minPosition

Structure/Union member

partNumber

Structure/Union member

reserved1

Structure/Union member

reserved2

Structure/Union member

reserved3

Structure/Union member

reserved4

Structure/Union member

reserved5

Structure/Union member

reserved6

Structure/Union member

reserved7

Structure/Union member

reserved8

Structure/Union member

serialNumber

Structure/Union member

stageID

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_JoystickParameters**

Bases: Structure

directionSense

Structure/Union member

highGearAcceleration

Structure/Union member

highGearMaxVelocity

Structure/Union member

lowGearAcceleration

Structure/Union member

lowGearMaxVelocity

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.
MOT_BrushlessPositionLoopParameters

Bases: Structure

accelerationFeedForward

Structure/Union member

derivativeRecalculationTime

Structure/Union member

differentialGain

Structure/Union member

factorForOutput

Structure/Union member

integralGain

Structure/Union member

integralLimit

Structure/Union member

lastNotUsed

Structure/Union member

notUsed

Structure/Union member

positionErrorLimit

Structure/Union member

proportionalGain

Structure/Union member

velocityFeedForward

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.
MOT_BrushlessTrackSettleParameters

Bases: Structure

lastNotUsed

Structure/Union member

maxTrackingError

Structure/Union member

notUsed

Structure/Union member

settledError

Structure/Union member

time

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.
MOT_BrushlessCurrentLoopParameters

Bases: Structure

deadErrorBand

Structure/Union member

feedForward

Structure/Union member

integralGain

Structure/Union member

integralLimit

Structure/Union member

lastNotUsed

Structure/Union member

notUsed

Structure/Union member

phase

Structure/Union member

proportionalGain

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_BrushlessElectricOutputParameters**

Bases: Structure

continuousCurrentLimit

Structure/Union member

excessEnergyLimit

Structure/Union member

lastNotUsed

Structure/Union member

motorSignalBias

Structure/Union member

motorSignalLimit

Structure/Union member

notUsed

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_LimitSwitchParameters**

Bases: Structure

anticlockwiseHardwareLimit

Structure/Union member

anticlockwisePosition

Structure/Union member

clockwiseHardwareLimit

Structure/Union member

clockwisePosition

Structure/Union member

softLimitMode

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_PowerParameters**

Bases: Structure

movePercentage

Structure/Union member

restPercentage

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_DC_PIDParameters**

Bases: Structure

differentialGain

Structure/Union member

integralGain

Structure/Union member

integralLimit

Structure/Union member

parameterFilter

Structure/Union member

proportionalGain

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**BNT_IO_Settings**

Bases: Structure

BNCtriggerOrLowVoltageOut

Structure/Union member

amplifierCurrentLimit

Structure/Union member

amplifierLowPassFilter

Structure/Union member

channel

Structure/Union member

feedbackSignal

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**NT_HVComponent**

Bases: Structure

horizontalComponent

Structure/Union member

verticalComponent

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**NT_CircleParameters**

Bases: Structure

algorithmAdjustment

Structure/Union member

diameter

Structure/Union member

maxDiameter

Structure/Union member

minDiameter

Structure/Union member

mode

Structure/Union member

samplesPerRevolution

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**NT_CircleDiameterLUT**

Bases: Structure

LUTdiameter

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**NT_TIARangeParameters**

Bases: Structure

changeToOddOrEven

Structure/Union member

downLimit

Structure/Union member

mode

Structure/Union member

newRange

Structure/Union member

settleSamples

Structure/Union member

upLimit

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**NT_LowPassFilterParameters**

Bases: Structure

param1

Structure/Union member

param2

Structure/Union member

param3

Structure/Union member

param4

Structure/Union member

param5

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**NT_TIAReading**

Bases: Structure

absoluteReading

Structure/Union member

relativeReading

Structure/Union member

selectedRange

Structure/Union member

underOrOverRead

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**NT_IOSettings**

Bases: Structure

lowVoltageOutRange

Structure/Union member

lowVoltageOutputRoute

Structure/Union member

notYetInUse

Structure/Union member

unused

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**NT_GainParameters**

Bases: Structure

controlMode

Structure/Union member

gain

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.PZ_FeedbackLoopConstants

Bases: Structure

integralTerm

Structure/Union member

proportionalTerm

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.PZ_LUTWaveParameters

Bases: Structure

LUTValueDelay

Structure/Union member

cycleLength

Structure/Union member

mode

Structure/Union member

numCycles

Structure/Union member

numOutTriggerRepeat

Structure/Union member

outTriggerDuration

Structure/Union member

outTriggerStart

Structure/Union member

postCycleDelay

Structure/Union member

preCycleDelay

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.PPC_PIDConsts

Bases: Structure

PIDConstsD

Structure/Union member

PIDConstsDFc

Structure/Union member

PIDConstsI

Structure/Union member

PIDConstsP

Structure/Union member

PIDDerivFilterOn

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**PPC_NotchParams**

Bases: Structure

filter1Fc

Structure/Union member

filter1Q

Structure/Union member

filter2Fc

Structure/Union member

filter2Q

Structure/Union member

filterNo

Structure/Union member

notchFilter1On

Structure/Union member

notchFilter2On

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**PPC_IOSettings**

Bases: Structure

FPBrightness

Structure/Union member

controlSrc

Structure/Union member

feedbackSrc

Structure/Union member

monitorOPBandwidth

Structure/Union member

monitorOPSig

Structure/Union member

reserved1

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_PIDLoopEncoderParams**

Bases: Structure

PIDOutputLimit

Structure/Union member

PIDTolerance

Structure/Union member

differentialGain

Structure/Union member

integralGain

Structure/Union member

loopMode

Structure/Union member

proportionalGain

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**FF_IOSettings**

Bases: Structure

ADCspeedValue

Structure/Union member

digIO1OperMode

Structure/Union member

digIO1PulseWidth

Structure/Union member

digIO1SignalMode

Structure/Union member

digIO2OperMode

Structure/Union member

digIO2PulseWidth

Structure/Union member

digIO2SignalMode

Structure/Union member

reserved1

Structure/Union member

reserved2

Structure/Union member

transitTime

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_ButtonParameters**

Bases: Structure

buttonMode

Structure/Union member

leftButtonPosition

Structure/Union member

rightButtonPosition

Structure/Union member

timeout

Structure/Union member

unused

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_PotentiometerStep**

Bases: Structure

thresholdDeflection

Structure/Union member

velocity

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**MOT_PotentiometerSteps**

Bases: Structure

potentiometerStepParameters

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KMOT_MMIParams**

Bases: Structure

DisplayDimIntensity

Structure/Union member

DisplayIntensity

Structure/Union member

DisplayTimeout

Structure/Union member

PresetPos1

Structure/Union member

PresetPos2

Structure/Union member

WheelAcceleration

Structure/Union member

WheelDirectionSense

Structure/Union member

WheelMaxVelocity

Structure/Union member

WheelMode

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.KMOT_TriggerConfig

Bases: Structure

Trigger1Mode

Structure/Union member

Trigger1Polarity

Structure/Union member

Trigger2Mode

Structure/Union member

Trigger2Polarity

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.KMOT_TriggerParams

Bases: Structure

CycleCount

Structure/Union member

TriggerIntervalFwd

Structure/Union member

TriggerIntervalRev

Structure/Union member

TriggerPulseCountFwd

Structure/Union member

TriggerPulseCountRev

Structure/Union member

TriggerPulseWidth

Structure/Union member

TriggerStartPositionFwd

Structure/Union member

TriggerStartPositionRev

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.KIM_DriveOPParameters

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.KIM_JogParameters

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.KIM_LimitSwitchParameters

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KIM_HomeParameters**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KIM_MMIParameters**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KIM_MMIChannelParameters**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KIM_TrigIOConfig**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KIM_TrigParamsParameters**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KIM_FeedbackSigParams**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KIM_Status**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KLD_MMIParams**

Bases: Structure

displayIntensity

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KLD_TrigIOParams**

Bases: Structure

mode1

Structure/Union member

mode2

Structure/Union member

polarity1

Structure/Union member

polarity2

Structure/Union member

reserved1

Structure/Union member

reserved2

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KLS_MMIParams**

Bases: Structure

displayIntensity

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.KLS_TrigIOParams

Bases: Structure

mode1

Structure/Union member

mode2

Structure/Union member

polarity1

Structure/Union member

polarity2

Structure/Union member

reserved1

Structure/Union member

reserved2

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.KNA_TIARangeParameters

Bases: Structure

changeToOddOrEven

Structure/Union member

downLimit

Structure/Union member

mode

Structure/Union member

newRange

Structure/Union member

settleSamples

Structure/Union member

upLimit

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.KNA_TIAReading

Bases: Structure

absoluteReading

Structure/Union member

relativeReading

Structure/Union member

selectedRange

Structure/Union member

underOrOverRead

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KNA_IOSettings**

Bases: Structure

highVoltageOutRange

Structure/Union member

highVoltageOutputRoute

Structure/Union member

lowVoltageOutRange

Structure/Union member

lowVoltageOutputRoute

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KNA_MMIParams**

Bases: Structure

DisplayIntensity

Structure/Union member

WheelAdjustRate

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KNA_TriggerConfig**

Bases: Structure

Trigger1Mode

Structure/Union member

Trigger1Polarity

Structure/Union member

Trigger2Mode

Structure/Union member

Trigger2Polarity

Structure/Union member

reserved

Structure/Union member

unused1

Structure/Union member

unused2

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KNA_FeedbackLoopConstants**

Bases: Structure

integralTerm

Structure/Union member

proportionalTerm

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**TPZ_IOSettings**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**KPZ_MMIParams**

Bases: Structure

DisplayDimIntensity

Structure/Union member

DisplayIntensity

Structure/Union member

DisplayTimeout

Structure/Union member

JoystickDirectionSense

Structure/Union member

JoystickMode

Structure/Union member

PresetPos1

Structure/Union member

PresetPos2

Structure/Union member

VoltageAdjustRate

Structure/Union member

VoltageStep

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KPZ_TriggerConfig**

Bases: Structure

Trigger1Mode

Structure/Union member

Trigger1Polarity

Structure/Union member

Trigger2Mode

Structure/Union member

Trigger2Polarity

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_LoopParameters**

Bases: Structure

differentialGain

Structure/Union member

integralGain

Structure/Union member

lowPassFilterCutOffFreq

Structure/Union member

lowPassFilterEnabled

Structure/Union member

notchFilterCenterFrequency

Structure/Union member

notchFilterEnabled

Structure/Union member

notchFilterQ

Structure/Union member

proportionalGain

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_PIDParameters**

Bases: Structure

differentialGain

Structure/Union member

integralGain

Structure/Union member

proportionalGain

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_LowPassFilterParameters**

Bases: Structure

lowPassFilterCutOffFreq

Structure/Union member

lowPassFilterEnabled

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_NotchFilterParameters**

Bases: Structure

notchFilterCenterFrequency

Structure/Union member

notchFilterEnabled

Structure/Union member

notchFilterQ

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_PositionDemandParameters**

Bases: Structure

lowVoltageOutputRoute

Structure/Union member

maxXdemand

Structure/Union member

maxYdemand

Structure/Union member

minXdemand

Structure/Union member

minYdemand

Structure/Union member

openLoopOption

Structure/Union member

xFeedbackSignedGain

Structure/Union member

yFeedbackSignedGain

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_Position**

Bases: Structure

x

Structure/Union member

y

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_Readings**

Bases: Structure

demandedPos

Structure/Union member

posDifference

Structure/Union member

sum

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_KPA_TrigIOConfig**

Bases: Structure

trig1DiffThreshold

Structure/Union member

trig1Mode

Structure/Union member

trig1Polarity

Structure/Union member

trig1SumMax

Structure/Union member

trig1SumMin

Structure/Union member

trig2DiffThreshold

Structure/Union member

trig2Mode

Structure/Union member

trig2Polarity

Structure/Union member

trig2SumMax

Structure/Union member

trig2SumMin

Structure/Union member

wReserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**QD_KPA_DigitalIO**

Bases: Structure

wDigOPs

Structure/Union member

wReserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**SC_CycleParameters**

Bases: Structure

closedTime

Structure/Union member

numCycles

Structure/Union member

openTime

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KSC_MMIParams**

Bases: Structure

DisplayDimIntensity

Structure/Union member

DisplayIntensity

Structure/Union member

DisplayTimeout

Structure/Union member

reserved

Structure/Union member

unused

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KSC_TriggerConfig**

Bases: Structure

Trigger1Mode

Structure/Union member

Trigger1Polarity

Structure/Union member

Trigger2Mode

Structure/Union member

Trigger2Polarity

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**TSG_IOSettings**

Bases: Structure

displayMode

Structure/Union member

forceCalibration

Structure/Union member

futureUse

Structure/Union member

hubAnalogOutput

Structure/Union member

notYetInUse

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KSG_MMIParams**

Bases: Structure

DisplayDimIntensity

Structure/Union member

DisplayIntensity

Structure/Union member

DisplayTimeout

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**KSG_TriggerConfig**

Bases: Structure

LowerLimit

Structure/Union member

SmoothingSamples

Structure/Union member

Trigger1Mode

Structure/Union member

Trigger1Polarity

Structure/Union member

Trigger2Mode

Structure/Union member

Trigger2Polarity

Structure/Union member

UpperLimit

Structure/Union member

reserved

Structure/Union member

class msl.equipment.resources.thorlabs.kinesis.structs.**TIM_DriveOPParameters**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**TIM_JogParameters**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**TIM_ButtonParameters**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**TIM_Status**

Bases: Structure

class msl.equipment.resources.thorlabs.kinesis.structs.**TC_LoopParameters**

Bases: Structure

differentialGain

Structure/Union member

integralGain

Structure/Union member

proportionalGain

Structure/Union member

Submodules

msl.equipment.resources.thorlabs.fwxx2c module

Wrapper around Thorlabs FilterWheel102.dll, v4.0.0.

Thorlabs FW102C Series and FW212C Series Motorized Filter Wheels.

class msl.equipment.resources.thorlabs.fwxx2c.**FilterCount**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

The number of filter positions that the filter wheel has.

SIX = 6

TWELVE = 12

class msl.equipment.resources.thorlabs.fwxx2c.**SensorMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Sensor modes of the filter wheel.

ON = 0

OFF = 1

class msl.equipment.resources.thorlabs.fwxx2c.**SpeedMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Speed modes of the filter wheel.

SLOW = 0

FAST = 1

class msl.equipment.resources.thorlabs.fwxx2c.**TriggerMode**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

Trigger modes of the filter wheel.

INPUT = 0

Respond to an active-low pulse by advancing the position by 1

OUTPUT = 1

Generate an active-high pulse when the position changes

class msl.equipment.resources.thorlabs.fwxx2c.**FilterWheelXX2C**(*record*)

Bases: *ConnectionSDK*

Wrapper around Thorlabs `FilterWheel102.dll`, v4.0.0.

Connects to the Thorlabs FW102C Series and FW212C Series Motorized Filter Wheels.

A 64-bit version of the library can be download from here and it is located in **AppNotes_FW102C/LabVIEW/Thorlabs_FW102C/Library/FilterWheel102_win64.dll**.

The *properties* for a FilterWheelXX2C connection supports the following key-value pairs in the *Connections Database*:

```
'port': str, the serial port number, e.g., 'COM3'
'baud_rate': int, the baud rate for the serial connection [default:␣
↪115200]
'timeout': int, the timeout in seconds [default: 10]
```

Do not instantiate this class directly. Use the *connect()* method to connect to the equipment.

Parameters

record (*EquipmentRecord*) – A record from an *Equipment-Register Database*.

Raises

ThorlabsError – If a connection to the filter wheel cannot be established.

close()

Close the opened COM port.

disconnect()

Close the opened COM port.

errcheck_code(*result*, *func*, *arguments*)

The SDK function returns OK if the function call was successful.

errcheck_negative(*result*, *func*, *arguments*)

The SDK function returns a positive number if the call was successful.

errcheck_non_zero(*result*, *func*, *arguments*)

The SDK function returns 0 if the call was successful.

get_acceleration()

Returns
int – The current acceleration value of the filter wheel.

get_id()

Returns
str – The id of the filter wheel.

get_max_velocity()

Returns
int – The current maximum velocity value of the filter wheel.

get_min_velocity()

Returns
int – The current minimum velocity value of the filter wheel.

get_ports()

List all the COM ports on the computer.

Returns
dict – A dictionary where the keys are the port numbers, e.g. COM1, COM3, and the values are a description about each device connected to the port.

get_position()

Returns
int – The current position of the filter wheel.

get_position_count()

Returns
FilterCount – The number of filter positions that the filter wheel has.

get_sensor_mode()

Returns
SensorMode – The current sensor mode of the filter wheel.

get_speed_mode()

Returns
SpeedMode – The current speed mode of the filter wheel.

get_time_to_current_pos()

Returns
int – The time from last position to current position.

get_trigger_mode()

Returns
TriggerMode – The current trigger mode of the filter wheel.

is_open(*port*)

Check if the COM port is open.

Parameters
port (str) – The port to be checked, e.g. COM3.

Returns
bool – True if the port is opened; False if the port is closed.

open(*port*, *baud_rate*, *timeout*)

Open a COM port for communication.

Parameters

- **port** (str) – The port to be opened, use the *get_ports()* function to get a list of available ports.
- **baud_rate** (int) – The number of bits per second to use for the communication protocol.
- **timeout** (int) – Set the timeout value, in seconds.

save()

Save the current settings as the default settings on power up.

set_acceleration(*acceleration*)

Set the filter wheel's acceleration.

Parameters
acceleration (int) – The filter wheel's acceleration value.

set_max_velocity(*maximum*)

Set the filter wheel's maximum velocity.

Parameters
maximum (int) – The filter wheel's maximum velocity value.

set_min_velocity(*minimum*)

Set the filter wheel's minimum velocity.

Parameters
minimum (int) – The filter wheel's minimum velocity value.

set_position(*position*)

Set the filter wheel's position.

Parameters
position (int) – The position number to set the filter wheel to.

Raises
ValueError – If the value of *position* is invalid.

set_position_count(*count*)

Set the filter wheel's position count.

This is the number of filter positions that the filter wheel has.

Parameters
count (*FilterCount*) – The number of filters in the filter wheel as a *FilterCount* enum value or member name.

Raises
ValueError – If the value of *count* is invalid.

set_sensor_mode(*mode*)

Set the filter wheel's sensor mode.

Parameters
mode (*SensorMode*) – The filter wheel's sensor mode as a *SensorMode* enum value or member name.

Raises
ValueError – If the value of *mode* is invalid.

set_speed_mode(*mode*)

Set the filter wheel's speed mode.

Parameters
mode (*SpeedMode*) – The speed mode of the filter wheel as a *SpeedMode* enum value or member name.

Raises
ValueError – If the value of *mode* is invalid.

set_trigger_mode(*mode*)

Set the filter wheel's trigger mode.

Parameters
mode (*TriggerMode*) – The filter wheel's trigger mode as a *TriggerMode* enum value or member name.

Raises
ValueError – If the value of *mode* is invalid.

msl.equipment.utils module

Common functions.

msl.equipment.utils.**convert_to_enum**(*obj*, *enum*, *prefix=None*, *to_upper=False*, *strict=True*)

Convert *obj* to an Enum member.

Parameters

- **obj** (object) – Any object to be converted to the specified *enum*. Can be a value of member of the specified *enum*.
- **enum** (Type[Enum]) – The Enum object that *obj* should be converted to.

- **prefix** (str, optional) – If *obj* is a str, then ensures that *prefix* is included at the beginning of *obj* before converting *obj* to the *enum*.
- **to_upper** (bool, optional) – If *obj* is a str, then whether to change *obj* to be upper case before converting *obj* to the *enum*.
- **strict** (bool, optional) – Whether errors should be raised. If False and *obj* cannot be converted to *enum* then *obj* is returned and the error is logged.

Returns
Enum – The *enum* member.

Raises
ValueError – If *obj* is not in *enum* and *strict* is True.

msl.equipment.utils.**convert_to_primitive**(*text*)

Convert text into a primitive value.

Parameters
text (str or bytes) – The text to convert.

Returns

- The *text* as a None, bool, int,
- float or complex object. Returns the
- original *text* if it cannot be converted to any of these types.
- *The text 0 and 1 get converted to an integer not a boolean.*

msl.equipment.utils.**convert_to_date**(*obj*, *fmt='%Y-%m-%d'*, *strict=True*)

Convert an object to a datetime.date object.

Parameters

- **obj** (datetime.date, datetime.datetime or str) – Any object that can be converted to a datetime.date object.
- **fmt** (str) – If *obj* is a str then the format to use to convert *obj* to a datetime.date.
- **strict** (bool, optional) – Whether errors should be raised. If False and *obj* cannot be converted to datetime.date then datetime.date(datetime.MINYEAR, 1, 1) is returned and the error is logged.

Returns
datetime.date – A datetime.date object.

msl.equipment.utils.**convert_to_xml_string**(*element*, *indent=' '*, *encoding='utf-8'*, *fix_newlines=True*)

Convert an XML Element in to a string with proper indentation.

Parameters

- **element** (Element) – The element to convert.
- **indent** (str, optional) – The value to use for the indentation.
- **encoding** (str, optional) – The encoding to use.

- **fix_newlines** (bool, optional) – Whether to remove newlines inside text nodes.

Returns

str – The *element* as a pretty string. The returned value can be directly written to a file (i.e., it includes the XML declaration).

Examples

If the Element contains unicode characters then you should use the codecs module to create the file if you are using Python 2.7:

```
import codecs
with codecs.open('my_file.xml', mode='w', encoding='utf-8') as fp:
    fp.write(convert_to_xml_string(element))
```

otherwise you can use the builtin open() function:

```
with open('my_file.xml', mode='w', encoding='utf-8') as fp:
    fp.write(convert_to_xml_string(element))
```

msl.equipment.utils.**xml_element**(*tag*, *text=None*, *tail=None*, ***attributes*)

Create a new XML element.

Parameters

- **tag** (str) – The element's name.
- **text** (str, optional) – The text before the first sub-element. Can either be a string or None.
- **tail** (str, optional) – The text after this element's end tag, but before the next sibling element's start tag.
- **attributes** – All additional key-value pairs are included as XML attributes for the element. The value must be of type str.

Returns

Element – The new XML element.

msl.equipment.utils.**xml_comment**(*text*)

Create a new XML comment element.

Parameters

text (str) – The comment.

Returns

Comment() – A special element that is an XML comment.

msl.equipment.utils.**to_bytes**(*iterable*, *fmt='ieee'*, *dtype='<f'*)

Convert an iterable of numbers into bytes.

Parameters

- **iterable** – An object to convert to bytes. Must be a 1-dimensional sequence of elements (not a multidimensional array).

- **fmt** (str or None, optional) – The format to use to convert *iterable*. Possible values are:
  - '' (empty string or None) – convert *iterable* to bytes without a header.

    None: <byte><byte><byte>...

  - 'ascii' – comma-separated ASCII characters, see the *<PROGRAM DATA SEPARATOR>* standard that is defined in Section 7.4.2.2, IEEE 488.2-1992.

    ascii: <string>,<string>,<string>,...

  - 'ieee' – arbitrary block data for *SCPI* messages, see the *<DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>* standard that is defined in Section 8.7.9, IEEE 488.2-1992.

    ieee: #<length of num bytes value><num bytes><byte><byte><byte>...

  - 'hp' – the HP-IB data transfer standard, i.e., the *FORM#* command option. See the programming guide for an HP 8530A for more details.

    hp: #A<num bytes as uint16><byte><byte><byte>...

- **dtype** – The data type to use to convert each element in *iterable* to. If *fmt* is 'ascii' then *dtype* must be of type str and it is used as the *format_spec* argument in format() to first convert each element in *iterable* to a string, and then it is encoded (e.g., '.2e' converts each element to scientific notation with two digits after the decimal point). If *dtype* includes a byte-order character, it is ignored. For all other values of *fmt*, the *dtype* can be any object that numpy.dtype supports (e.g., 'H', 'uint16' and numpy.ushort are equivalent values to convert each element to an *unsigned short*). If a byte-order character is specified then it is used, otherwise the native byte order of the CPU architecture is used. See Format Strings for more details.

Returns

bytes – The *iterable* converted to bytes.

msl.equipment.utils.**from_bytes**(*buffer*, *fmt='ieee'*, *dtype='<f'*)

Convert bytes into an array.

Parameters

- **buffer** (bytes, bytearray or str) – A byte buffer. Can be an already-decoded buffer of type str, but only if *fmt* equals 'ascii'.
- **fmt** (str or None, optional) – The format that *buffer* is in. See *to_bytes()* for more details.
- **dtype** – The data type of each element in *buffer*. Can be any object that numpy.dtype supports. See *to_bytes()* for more details.

Returns

numpy.ndarray – The array.

msl.equipment.utils.**ipv4_addresses**()

Get the IPv4 addresses of the computer.

Returns

set of str – All IPv4 addresses on all network interfaces.

msl.equipment.utils.**parse_lxi_webserver**(*host*, *port=80*, *timeout=1*)

Get the information about an LXI device from the device's webserver.

Parameters

- **host** (str) – The IP address or hostname of the LXI device.
- **port** (int, optional) – The port number of the device's webservice.
- **timeout** (float, optional) – The maximum number of seconds to wait for a reply.

Returns

dict – The information about the LXI device.

msl.equipment.vxi11 module

Implementation of the VXI-11 protocol.

VXI-11 is a client-service model to send messages through a network. The messages are formatted using the Remote Procedure Call protocol [RFC-1057] and are encoded/decoded using the eXternal Data Representation standard [RFC-1014].

References

- VXI-11 – *TCP/IP Instrument Protocol Specification (Revision 1.0)*, **VXIbus Consortium**, July 1995.
- RFC-1057 – *RPC: Remote Procedure Call Protocol Specification (Version 2)*, **Sun Microsystems**, June 1988.
- RFC-1014 – *XDR: External Data Representation Standard*, **Sun Microsystems**, June 1987.

class msl.equipment.vxi11.**OperationFlag**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

VXI-11: Additional information concerning how a request is carried out.

NULL = 0

WAITLOCK = 1

END = 8

TERMCHRSET = 128

class msl.equipment.vxi11.**MessageType**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RPC: The message type.

CALL = 0

REPLY = 1

class msl.equipment.vxi11.**ReplyStatus**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RPC: Message reply status.

MSG_ACCEPTED = 0

MSG_DENIED = 1

class msl.equipment.vxi11.**AcceptStatus**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RPC: Message accepted status.

SUCCESS = 0

PROG_UNAVAIL = 1

PROG_MISMATCH = 2

PROC_UNAVAIL = 3

GARBAGE_ARGS = 4

class msl.equipment.vxi11.**RejectStatus**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RPC: Message rejected status.

RPC_MISMATCH = 0

AUTH_ERROR = 1

class msl.equipment.vxi11.**AuthStatus**(*value*, *names=None*, ***, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

Bases: IntEnum

RPC: Authorization status.

AUTH_BADCRED = 1

AUTH_REJECTEDCRED = 2

AUTH_BADVERF = 3

AUTH_REJECTEDVERF = 4

AUTH_TOOWEAK = 5

class msl.equipment.vxi11.**RPCClient**(*host*)

Bases: object

Remote Procedure Call implementation for a client.

Parameters
host (str) – The hostname or IP address of the remote device.

append(*data*)

Append data to the body of the current RPC message.

Parameters
data (bytes or memoryview) – The data to append.

append_opaque(*text*)

Append a variable-length string to the body of the current RPC message.

Parameters
text (memoryview, bytes or str) – The data to append.

property chunk_size

The maximum number of bytes to receive at a time from the socket.

Type
int

close()

Close the RPC socket, if one is open.

connect(*port*, *timeout=10*)

Connect to a specific port on the device.

Parameters

- **port** (int) – The port number to connect to.
- **timeout** (float or None, optional) – The maximum number of seconds to wait for the connection to be established.

get_buffer()

Get the data in the buffer.

Returns
bytearray – The data in the current RPC message.

get_port(*prog*, *vers*, *prot*, *timeout=10*)

Call the Port Mapper procedure to determine which port to use for a program.

This method will automatically open and close the socket connection.

Parameters

- **prog** (int) – The program number to get the port number of.
- **vers** (int) – The version number of *prog*.
- **prot** (int) – The socket protocol family type to use when sending requests to *prog* (IPPROTO_TCP or IPPROTO_UDP).
- **timeout** (float or None, optional) – The maximum number of seconds to wait to get the port value.

Returns

int – The port number that corresponds to *prog*.

init(*prog*, *vers*, *proc*)

Construct a new RPC message.

Parameters

- **prog** (int) – The program number.
- **vers** (int) – The version number of program.
- **proc** (int) – The procedure number within the program to be called.

interrupt_handler()

Override this method to be notified of a service interrupt.

This method gets called if an interrupt is received during a *read()*. It does not continuously poll the device.

read()

Read an RPC message, check for errors, and return the procedure-specific data.

Returns

memoryview – The procedure-specific data.

set_timeout(*timeout*)

Set the socket timeout value.

Parameters

timeout (float) – The timeout, in seconds, to use for the socket.

property socket

The reference to the socket.

Type

socket

static unpack_opaque(*data*)

Unpack and return a variable-length string.

Parameters

data (bytes, bytearray or memoryview) – The data to unpack.

Returns

bytes, bytearray or memoryview – The unpacked data.

write()

Write the RPC message that is in the buffer.

check_reply(*message*)

Checks the message for errors and returns the procedure-specific data.

Parameters

message (memoryview) – The reply from an RPC message.

Returns

memoryview or None – The reply or None if the transaction id does not match the value that was used in the corresponding *write()* call.

class msl.equipment.vxi11.**VXIClient**(*host*)

Bases: *RPCClient*

Base class for a VXI-11 program.

Parameters

host (str) – The hostname or IP address of the remote device.

read_reply()

Check the RPC message for an error and return the remaining data.

Returns

memoryview – The reply data.

class msl.equipment.vxi11.**CoreClient**(*host*)

Bases: *VXIClient*

Communicate with the *Device Core* program on the remote device.

Parameters

host (str) – The hostname or IP address of the remote device.

create_link(*device*, *lock_device*, *lock_timeout*)

Create a link.

Parameters

- **device** (bytes or str) – Name of the device to link with.
- **lock_device** (bool) – Whether to attempt to lock the device.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.

Returns

- int – The link ID.
- int – The port number of the *Device Async* program (see *AsyncClient*).
- int – The maximum data size the device will accept on a *device_write()*.

device_write(*lid*, *io_timeout*, *lock_timeout*, *flags*, *data*)

Write data to the specified device.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **io_timeout** (int) – Time, in milliseconds, to wait for I/O to complete.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **data** (memoryview, bytes or str) – The data to write.

Returns

int – The number of bytes written.

device_read(*lid*, *request_size*, *io_timeout*, *lock_timeout*, *flags*, *term_char*)

Read data from the device.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **request_size** (int) – The number of bytes requested.
- **io_timeout** (int) – Time, in milliseconds, to wait for I/O to complete.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **term_char** (int) – The termination character. Valid only if *flags* is *TERMCHRSET*.

Returns

- int – The reason(s) the read completed.
- memoryview – A view of the data (the RPC header is removed).

device_readstb(*lid*, *flags*, *lock_timeout*, *io_timeout*)

Read the status byte from the device.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.
- **io_timeout** (int) – Time, in milliseconds, to wait for I/O to complete.

Returns

int – The status byte.

device_trigger(*lid*, *flags*, *lock_timeout*, *io_timeout*)

Send a trigger to the device.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.
- **io_timeout** (int) – Time, in milliseconds, to wait for I/O to complete.

device_clear(*lid*, *flags*, *lock_timeout*, *io_timeout*)

Send the *clear* command to the device.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.
- **io_timeout** (int) – Time, in milliseconds, to wait for I/O to complete.

device_remote(*lid*, *flags*, *lock_timeout*, *io_timeout*)

Place the device in a remote state wherein all programmable local controls are disabled.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.
- **io_timeout** (int) – Time, in milliseconds, to wait for I/O to complete.

device_local(*lid*, *flags*, *lock_timeout*, *io_timeout*)

Place the device in a local state wherein all programmable local controls are enabled.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.
- **io_timeout** (int) – Time, in milliseconds, to wait for I/O to complete.

device_lock(*lid*, *flags*, *lock_timeout*)

Acquire a device's lock.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.

device_unlock(*lid*)

Release a lock acquired by *device_lock()*.

Parameters

lid (int) – Link id from *create_link()*.

device_enable_srq(*lid*, *enable*, *handle*)

Enable or disable the sending of *device_intr_srq* RPCs by the network instrument server.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **enable** (bool) – Whether to enable or disable interrupts.

- **handle** (bytes) – Host specific data (maximum length is 40 characters).

device_docmd(*lid*, *flags*, *io_timeout*, *lock_timeout*, *cmd*, *network_order*, *datasize*, *data_in*)

Allows for a variety of operations to be executed.

Parameters

- **lid** (int) – Link id from *create_link()*.
- **flags** (int or *OperationFlag*) – Operation flags to use.
- **io_timeout** (int) – Time, in milliseconds, to wait for I/O to complete.
- **lock_timeout** (int) – Time, in milliseconds, to wait on a lock.
- **cmd** (int) – Which command to execute.
- **network_order** (bool) – Client's byte order.
- **datasize** (int) – Size of individual data elements.
- **data_in** (bytes or str) – Data input parameters.

Returns

bytes – The results defined by *cmd*.

destroy_link(*lid*)

Destroy the link.

Parameters

lid (int) – Link id from *create_link()*.

create_intr_chan(*host_addr*, *host_port*, *prog_num*, *prog_vers*, *prog_family*)

Inform the network instrument server to establish an interrupt channel.

Parameters

- **host_addr** (int) – Host servicing the interrupt.
- **host_port** (int) – Valid port number on the client.
- **prog_num** (int) – Program number.
- **prog_vers** (int) – Program version number.
- **prog_family** (int) – The underlying socket protocol family type (IPPROTO_TCP or IPPROTO_UDP).

destroy_intr_chan()

Inform the network instrument server to close its interrupt channel.

class msl.equipment.vxi11.**AsyncClient**(*host*)

Bases: *VXIClient*

Communicate with the *Device Async* program on the remote device.

Parameters

host (str) – The hostname or IP address of the remote device.

device_abort(*lid*)

Stops an in-progress call.

Parameters
lid (int) – Link id from *create_link()*.

msl.equipment.vxi11.**find_vxi11**(*hosts=None*, *timeout=1*)

Find all VXI-11 devices that are on the network.

The RPC port-mapper protocol (RFC-1057, Appendix A) broadcasts a message via UDP to port 111 for VXI-11 device discovery.

Parameters

- **hosts** (list of str, optional) – The IP address(es) on the computer to use to broadcast the message. If not specified, then broadcast on all network interfaces.
- **timeout** (float, optional) – The maximum number of seconds to wait for a reply.

Returns
dict – The information about the VXI-11 devices that were found.

1.7 License

1.8 Developers

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1.9 Release Notes

1.9.1 Version 0.1.0 (2023-06-18)

Initial release.

It is also the last release to support Python 2.7, 3.5, 3.6 and 3.7

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