HVL Common Code Base Documentation

Release 0.3.3

Mikolaj Rybiński, David Graber

May 08, 2019

Contents:

CHAPTER 1

HVL Common Code Base

Python common code base to control devices used in Christian Franck's High Voltage Lab (HVL), D-ITET, ETH

- Free software: GNU General Public License v3
- **Documentation:**
  - if you're planning to develop start w/ reading "CONTRIBUTING.rst", otherwise either
  - read HVL CCB documentation at RTD, or
  - install *Sphinx* and *sphinx_rtd_theme* Python packages and locally build docs on Windows in git-bash by running:

    ```
    $ ./make.sh docs
    ```

    from a shell with Make installed by running:

    ```
    $ make docs
    ```

    The target index HTML ("docs/_build/html/index.html") will open automatically in your Web browser.

1.1 Features

Manage experiments with `ExperimentManager` instance controlling one or more of the following devices:

- a MBW973 SF6 Analyzer / dew point mirror over a serial connection (COM-ports)
- a LabJack (T7-PRO) device using a LabJack LJM Library for communication
- a Schneider Electric ILS2T stepper motor drive over Modbus TCP

- a Elektro-Automatik PSI9000 DC power supply using VISA over TCP for communication
- a Rhode & Schwarz RTO 1024 oscilloscope using VISA interface over `TCP::INSTR`
- a state-of-the-art HVL in-house Supercube device variants using an OPC UA client

1.2 Credits

This package was created with Cookiecutter and the audreyr/cookiecutter-pypackage project template.

CHAPTER 2

Installation

2.1 Stable release

To install HVL Common Code Base, run this command in your terminal:

```
$ pip install hvl_ccb
```

This is the preferred method to install HVL Common Code Base, as it will always install the most recent stable release.

If you don't have pip installed, this Python installation guide can guide you through the process.

2.2 From sources

The sources for HVL Common Code Base can be downloaded from the GitLab repo.

You can either clone the repository:

```
$ git clone git@gitlab.ethz.ch:hvl_priv/hvl_ccb.git
```

Or download the tarball:

```
$ curl  -OL https://gitlab.ethz.ch/hvl_priv/hvl_ccb/-/archive/master/hvl_ccb.tar.gz
```

Once you have a copy of the source, you can install it with:

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

CHAPTER 3

Usage

To use HVL Common Code Base in a project:

```
import hvl_ccb
```

CHAPTER 4

API Documentation

4.1 hvl_ccb package

4.1.1 Subpackages

hvl_ccb.comm package

Submodules

hvl_ccb.comm.base module

Module with base classes for communication protocols.

class hvl_ccb.comm.base.**CommunicationProtocol**(*config*)
Bases: *hvl_ccb.configuration.ConfigurationMixin*, abc.ABC

Communication protocol abstract base class.

Specifies the methods to implement for communication protocol, as well as implements some default settings and checks.

access_lock = None
Access lock to use with context manager when accessing the communication protocol (thread safety)

close()
Close the communication protocol

open()
Open communication protocol

hvl_ccb.comm.labjack_ljm module

Communication protocol for LabJack using the LJM Library. Originally developed and tested for LabJack T7-PRO.

Makes use of the LabJack LJM Library Python wrapper. This wrapper needs an installation of the LJM Library for Windows, Mac OS X or Linux. Go to: https://labjack.com/support/software/installers/ljm and https://labjack.com/support/software/examples/ljm/python

class hvl_ccb.comm.labjack_ljm.**LJMCommunication**(*configuration*)

Bases: *hvl_ccb.comm.base.CommunicationProtocol*

Communication protocol implementing the LabJack LJM Library Python wrapper.

close() → None
Close the communication port.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

open() → None
Open the communication port.

read_name(**names*) → Union[str, Tuple[str]]
Read one or more inputs by name.

Parameters **names** – one or more names to read out from the LabJack

Returns answer of the LabJack, either single answer or multiple answers in a tuple

write_address(*address: Union[Sequence[int], int], value: Union[Sequence[object], object]*) → None
NOT IMPLEMENTED. Write one or more values to Modbus addresses.

Parameters

- **address** – One or more Modbus address on the LabJack.
- **value** – One or more values to be written to the addresses.

write_name(*name: Union[Sequence[str], str], value: Union[Sequence[object], object]*) → None
Write one value to a named output.

Parameters

- **name** – String or with name of LabJack IO
- **value** – is the value to write to the named IO port

write_names(*names: Sequence[str], values: Sequence[object]*) → None
Write more than one value at once to named outputs.

Parameters

- **names** – is a sequence of strings with names of LabJack IO
- **values** – is a sequence of values corresponding to the list of names

class hvl_ccb.comm.labjack_ljm.**LJMCommunicationConfig**(*device_type: (<class 'str'>, <aenum 'DeviceType'>) = 'ANY', connection_type: (<class 'str'>, <aenum 'ConnectionType'>) = 'ANY', identifier: str = 'ANY'*)

Bases: object

Configuration dataclass for *LJMCommunication*.

class ConnectionType(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.AutoNumberNameEnum*

LabJack connection type.

ANY = 1

ETHERNET = 4

TCP = 3

USB = 2

WIFI = 5

class DeviceType(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.AutoNumberNameEnum*

LabJack device type.

ANY = 1

DIGIT = 4

T4 = 3

T7 = 2

clean_values() → None
Performs value checks on device_type and connection_type.

connection_type = 'ANY'
Can be either string or of enum *ConnectionType*.

device_type = 'ANY'
Can bei either string 'ANY', 'T7', 'T4', 'DIGIT' or of enum *DeviceType*.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

identifier = 'ANY'
The identifier specifies information for the connection to be used. This can be an IP address, serial number, or device name. See the LabJack docs (https://labjack.com/support/software/api/ljm/function-reference/ljmopens/identifier-parameter) for more information.

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

exception hvl_ccb.comm.labjack_ljm.**LJMCommunicationError**
Bases: Exception

Errors coming from LJMCommunication.

hvl_ccb.comm.modbus_tcp module

Communication protocol for modbus TCP ports. Makes use of the pymodbus library.

class hvl_ccb.comm.modbus_tcp.**ModbusTcpCommunication**(*configuration*)
Bases: *hvl_ccb.comm.base.CommunicationProtocol*

Implements the Communication Protocol for modbus TCP.

close()
Close the Modbus TCP connection.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

open() → None
Open the Modbus TCP connection.

Raises ***ModbusTcpConnectionFailedException*** – if the connection fails.

read_holding_registers(*address: int*, *count: int*) → List[int]
Read specified number of register starting with given address and return the values from each register.

Parameters

- **address** – address of the first register
- **count** – count of registers to read

Returns list of *int* values

read_input_registers(*address: int*, *count: int*) → List[int]
Read specified number of register starting with given address and return the values from each register in a list.

Parameters

- **address** – address of the first register
- **count** – count of registers to read

Returns list of *int* values

write_registers(*address: int, values: Union[List[int], int]*)
Write values from the specified address forward.

Parameters

- **address** – address of the first register
- **values** – list with all values

class hvl_ccb.comm.modbus_tcp.**ModbusTcpCommunicationConfig**(*host: str*, *unit: int*, *port: int = 502*)
Bases: object

Configuration dataclass for *ModbusTcpCommunication*.

clean_values()

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

host = None
Host is the IP address of the connected device.

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

port = 502
TCP port

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

unit = None
Unit number to be used when connecting with Modbus/TCP. Typically this is used when connecting to a relay having Modbus/RTU-connected devices.

exception hvl_ccb.comm.modbus_tcp.**ModbusTcpConnectionFailedException**(*string=''*)
Bases: pymodbus.exceptions.ConnectionException

Exception raised when the connection failed.

hvl_ccb.comm.opc module

Communication protocol implementing an OPC UA connection. This protocol is used to interface with the "Supercube" PLC from Siemens.

class hvl_ccb.comm.opc.**OpcUaCommunication**(*config*)
Bases: *hvl_ccb.comm.base.CommunicationProtocol*

Communication protocol implementing an OPC UA connection. Makes use of the package python-opcua.

close() → None
Close the connection to the OPC UA server.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

init_monitored_nodes(*node_id: Union[str, Iterable[str]], ns_index: int*) → None
Initialize monitored nodes.

Parameters

- **node_id** – one or more strings of node IDs.
- **ns_index** – the namespace index the nodes belong to.

open() → None
Open the communication to the OPC UA server.

read(*node_id*, *ns_index*)
Read a value from a node with id and namespace index.

Parameters

- **node_id** – the ID of the node to read the value from
- **ns_index** – the namespace index of the node

Returns the value of the node object.

write(*node_id*, *ns_index*, *value*) → None
Write a value to a node with name `name`.

Parameters

- **node_id** – the id of the node to write the value to.
- **ns_index** – the namespace index of the node.
- **value** – the value to write.

class hvl_ccb.comm.opc.**OpcUaCommunicationConfig**(*host: str*, *endpoint_name: str*, *port: int = 4840*, *sub_handler: hvl_ccb.comm.opc.OpcUaSubHandler = <hvl_ccb.comm.opc.OpcUaSubHandler object>*, *update_period: int = 500*)

Bases: `object`

Configuration dataclass for OPC UA Communciation.

clean_values()
Cleans and enforces configuration values. Does nothing by default, but may be overridden to add custom configuration value checks.

endpoint_name = None
Endpoint of the OPC server, this is a path like 'OPCUA/SimulationServer'

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

host = None
Hostname or IP-Address of the OPC UA server.

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

port = 4840
Port of the OPC UA server to connect to.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

sub_handler = <hvl_ccb.comm.opc.OpcUaSubHandler object>
object to use for handling subscriptions.

update_period = 500
Update period for generating datachange events in OPC UA [milli seconds]

class hvl_ccb.comm.opc.**OpcUaSubHandler**
Bases: object

Base class for subscription handling of OPC events and data change events. Override methods from this class to add own handling capabilities.

To receive events from server for a subscription data_change and event methods are called directly from receiving thread. Do not do expensive, slow or network operation there. Create another thread if you need to do such a thing.

datachange_notification(*node*, *val*, *data*)

event_notification(*event*)

hvl_ccb.comm.serial module

Communication protocol for serial ports. Makes use of the pySerial library.

class hvl_ccb.comm.serial.**SerialCommunication**(*configuration*)
Bases: *hvl_ccb.comm.base.CommunicationProtocol*

Implements the Communication Protocol for serial ports.

ENCODING = 'utf-8'

UNICODE_HANDLING = 'replace'

close()
Close the serial connection.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

open()
Open the serial connection.

read_text() → str
Read one line of text from the serial port. The input buffer may hold additional data afterwards, since only one line is read.

Returns String read from the serial port.

write_text(*text: str*)
Write text to the serial port. The text is encoded and terminated by the configured terminator.

Parameters **text** – Text to send to the port.

class hvl_ccb.comm.serial.**SerialCommunicationConfig**(*port: str*, *baudrate: int*, *parity: (<class 'str'>, <aenum 'Parity'>)*, *stopbits: (<class 'int'>, <class 'float'>, <aenum 'Stopbits'>)*, *bytesize: (<class 'int'>, <aenum 'Bytesize'>)*, *terminator: bytes = b'rn'*, *timeout: (<class 'int'>, <class 'float'>) = 2*)

Bases: object

Configuration dataclass for *SerialCommunication*.

class Bytesize(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Serial communication bytesize.

EIGHTBITS = 8

FIVEBITS = 5

SEVENBITS = 7

SIXBITS = 6

class Parity(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Serial communication parity.

EVEN = 'E'

MARK = 'M'

NAMES = {'E': 'Even', 'M': 'Mark', 'N': 'None', 'O': 'Odd', 'S': 'Space'}

NONE = 'N'

ODD = 'O'

SPACE = 'S'

class Stopbits(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Serial communication stopbits.

ONE = 1

ONE_POINT_FIVE = 1.5

TWO = 2

baudrate = None
Baudrate of the serial port

bytesize = None
Size of a byte, 5 to 8

clean_values()

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

parity = None
Parity to be used for the connection.

port = None
Port is a string referring to a COM-port (e.g. `'COM3'`) or a URL. The full list of capabilities is found on the pyserial documentation.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

stopbits = None
Stopbits setting, can be 1, 1.5 or 2.

terminator = b'\r\n'
The terminator character. Typically this is `b'\r\n'` or `b'\n'`, but can also be `b'\r'` or other combinations.

timeout = 2
Timeout in seconds for the serial port

hvl_ccb.comm.visa module

Communication protocol for VISA. Makes use of the pyvisa library. The backend can be NI-Visa or pyvisa-py.

Information on how to install a VISA backend can be found here: https://pyvisa.readthedocs.io/en/master/getting_nivisa.html

So far only TCPIP SOCKET and TCPIP INSTR interfaces are supported.

class hvl_ccb.comm.visa.**VisaCommunication**(*configuration*)
Bases: *hvl_ccb.comm.base.CommunicationProtocol*

Implements the Communication Protocol for VISA / SCPI.

MULTI_COMMANDS_MAX = 5
The maximum of commands that can be sent in one round is 5 according to the VISA standard.

MULTI_COMMANDS_SEPARATOR = ';'
The character to separate two commands is ; according to the VISA standard.

WAIT_AFTER_WRITE = 0.08
Small pause in seconds to wait after write operations, allowing devices to really do what we tell them before continuing with further tasks.

close() → None
Close the VISA connection and invalidates the handle.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

open() → None
Open the VISA connection and create the resource.

query(**commands*) → Union[str, Tuple[str, ...]]
A combination of write(message) and read.

Parameters **commands** – list of commands

Returns list of values

spoll() → int
Execute serial poll on the device. Reads the status byte register STB. This is a fast function that can be executed periodically in a polling fashion.

Returns integer representation of the status byte

write(**commands*) → None
Write commands. No answer is read or expected.

Parameters **commands** – one or more commands to send

class hvl_ccb.comm.visa.**VisaCommunicationConfig**(*host: str*, *interface_type: (<class 'str'>, <aenum 'InterfaceType'>)*, *board: int = 0*, *port: int = 5025*, *timeout: int = 5000*, *chunk_size: int = 204800*, *open_timeout: int = 1000*, *write_termination: str = 'n'*, *read_termination: str = 'n'*, *visa_backend: str = ''*)
Bases: object

VisaCommunication configuration dataclass.

class InterfaceType(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.AutoNumberNameEnum*

Supported VISA Interface types.

TCPIP_INSTR = 2
VXI-11 protocol

TCPIP_SOCKET = 1
VISA-RAW protocol

board = 0
Board number is typically 0 and comes from old bus systems.

chunk_size = 204800
Chunk size is the allocated memory for read operations. The standard is 20kB, and is increased per default here to 200kB. It is specified in bytes.

clean_values()

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

host = None
IP address of the VISA device. DNS names are currently unsupported.

interface_type = None
Interface type of the VISA connection, being one of *InterfaceType*.

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

open_timeout = 1000
Timeout for opening the connection, in milli seconds.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

port = 5025
TCP port, standard is 5025.

read_termination = '\n'
Read termination character.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

timeout = 5000
Timeout for commands in milli seconds.

visa_backend = ''
Specifies the path to the library to be used with PyVISA as a backend. Defaults to None, which is NI-VISA (if installed), or pyvisa-py (if NI-VISA is not found). To force the use of pyvisa-py, specify '@py' here.

write_termination = '\n'
Write termination character.

exception hvl_ccb.comm.visa.**VisaCommunicationError**
Bases: Exception

Base class for VisaCommunication errors.

Module contents

Communication protocols subpackage.

hvl_ccb.dev package

Subpackages

hvl_ccb.dev.supercube package

Submodules

hvl_ccb.dev.supercube.base module

Base classes for the Supercube device.

class hvl_ccb.dev.supercube.base.**SupercubeBase**(*com*, *dev_config=None*)
Bases: *hvl_ccb.dev.base.SingleCommDevice*

Base class for Supercube variants.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

static default_com_cls()
Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

get_cee16_socket() → bool
Read the on-state of the IEC CEE16 three-phase power socket.

Returns the on-state of the CEE16 power socket

get_door_status(*door: int*) → hvl_ccb.dev.supercube.constants.DoorStatus
Get the status of a safety fence door. See `constants.DoorStatus` for possible returned door statuses.

Parameters **door** – the door number (1..3)

Returns the door status

get_earthing_manual(*number: int*) → bool
TODO: Test get_earthing_manual with device

Get the manual status of an earthing stick. If an earthing stick is set to manual, it is closed even if the system is in states RedReady or RedOperate.

Parameters **number** – number of the earthing stick (1..6)

Returns earthing stick manual status

get_earthing_status(*number: int*) → hvl_ccb.dev.supercube.constants.EarthingStickStatus
Get the status of an earthing stick, whether it is closed, open or undefined (moving).

Parameters **number** – number of the earthing stick (1..6)

Returns earthing stick status

get_measurement_ratio(*channel: int*) → float
TODO: test get_measurement_ratio with device

Get the set measurement ratio of an AC/DC analog input channel. Every input channel has a divider ratio assigned during setup of the Supercube system. This ratio can be read out.

Parameters **channel** – number of the input channel (1..4)

Returns the ratio

get_measurement_voltage(*channel: int*) → float
TODO: test get_measurement_voltage with device

Get the measured voltage of an analog input channel. The voltage read out here is already scaled by the configured divider ratio.

Parameters **channel** – number of the input channel (1..4)

Returns measured voltage

get_status() → hvl_ccb.dev.supercube.constants.SafetyStatus
Get the safety circuit status of the Supercube. :return: the safety status of the supercube's state machine.

get_support_input(*port: int*, *contact: int*) → bool
Get the state of a support socket input.

Parameters

- **port** – is the socket number (1..6)
- **contact** – is the contact on the socket (1..2)

Returns digital input read state

get_support_output(*port: int*, *contact: int*) → bool
Get the state of a support socket output.

Parameters

- **port** – is the socket number (1..6)
- **contact** – is the contact on the socket (1..2)

Returns digital output read state

get_t13_socket(*port: int*) → bool
Read the state of a SEV T13 power socket.

Parameters **port** – is the socket number (1..3)

Returns on-state of the power socket

operate(*state: bool*) → None
Set operate state. If the state is RedReady, this will turn on the high voltage and close the safety switches.

Parameters **state** – set operate state

quit_error() → None
Quits errors that are active on the Supercube.

read(*node_id: str*)
Local wrapper for the OPC UA communication protocol read method.

Parameters **node_id** – the id of the node to read.

Returns the value of the variable

ready(*state: bool*) → None
Set ready state. Ready means locket safety circuit, red lamps, but high voltage still off.

Parameters **state** – set ready state

set_cee16_socket(*state: bool*) → None
Switch the IEC CEE16 three-phase power socket on or off.

Parameters **state** – desired on-state of the power socket

Raises **ValueError** – if state is not of type bool

set_earthing_manual(*number: int*, *manual: bool*) → None
TODO: Test set_earthing_manual with device

Set the manual status of an earthing stick. If an earthing stick is set to manual, it stays closed even if the system is in states RedReady or RedOperate.

Parameters

- **number** – number of the earthing stick (1..6)
- **manual** – earthing stick manual status (True or False)

set_remote_control(*state: bool*) → None
TODO: test set_remote_control with device

Enable or disable remote control for the Supercube. This will effectively display a message on the touch-screen HMI.

Parameters **state** – desired remote control state

set_support_output(*port: int*, *contact: int*, *state: bool*) → None
Set the state of a support output socket.

Parameters

- **port** – is the socket number (1..6)
- **contact** – is the contact on the socket (1..2)
- **state** – is the desired state of the support output

set_support_output_impulse(*port: int*, *contact: int*, *duration: float = 0.2*, *pos_pulse: bool = True*) → None
Issue an impulse of a certain duration on a support output contact. The polarity of the pulse (On-wait-Off or Off-wait-On) is specified by the pos_pulse argument.

This function is blocking.

Parameters

- **port** – is the socket number (1..6)
- **contact** – is the contact on the socket (1..2)
- **duration** – is the length of the impulse in seconds
- **pos_pulse** – is True, if the pulse shall be HIGH, False if it shall be LOW

set_t13_socket(*port: int*, *state: bool*) → None
Set the state of a SEV T13 power socket.

Parameters

- **port** – is the socket number (1..3)
- **state** – is the desired on-state of the socket

start() → None
Starts the device. Sets the root node for all OPC read and write commands to the Siemens PLC object node which holds all our relevant objects and variables.

stop() → None
Stop the Supercube device. Deactivates the remote control and closes the communication protocol.

write(*node_id*, *value*) → None
Local wrapper for the OPC UA communication protocol write method.

Parameters

- **node_id** – the id of the node to read
- **value** – the value to write to the variable

class hvl_ccb.dev.supercube.base.**SupercubeConfiguration**(*namespace_index: int = 3*)
Bases: object

Configuration dataclass for the Supercube devices.

clean_values()
Cleans and enforces configuration values. Does nothing by default, but may be overridden to add custom configuration value checks.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

namespace_index = 3
Namespace of the OPC variables, typically this is 3 (coming from Siemens)

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

class hvl_ccb.dev.supercube.base.**SupercubeOpcUaCommunication**(*config*)
Bases: *hvl_ccb.comm.opc.OpcUaCommunication*

Communication protocol specification for Supercube devices.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.supercube.base.**SupercubeOpcUaCommunicationConfig**(*host: str*, *endpoint_name: str*, *port: int = 4840*, *sub_handler: hvl_ccb.comm.opc.OpcUaSubHand = <hvl_ccb.dev.supercube.base.Super object>*, *update_period: int = 500*)

Bases: *hvl_ccb.comm.opc.OpcUaCommunicationConfig*

Communication protocol configuration for OPC UA, specifications for the Supercube devices.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

sub_handler = <hvl_ccb.dev.supercube.base.SupercubeSubscriptionHandler object>
Subscription handler for data change events

class hvl_ccb.dev.supercube.base.**SupercubeSubscriptionHandler**
Bases: *hvl_ccb.comm.opc.OpcUaSubHandler*

OPC Subscription handler for datachange events and normal events specifically implemented for the Supercube devices.

datachange_notification(*node: opcua.common.node.Node*, *val*, *data*)
In addition to the standard operation (debug logging entry of the datachange), alarms are logged at INFO level using the alarm text.

Parameters

- **node** – the node object that triggered the datachange event
- **val** – the new value
- **data** –

hvl_ccb.dev.supercube.constants module

Constants, variable names for the Supercube OPC-connected devices.

class hvl_ccb.dev.supercube.constants.**AlarmText**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

This enumeration contains textual representations for all error classes (stop, warning and message) of the Supercube system. Use the *AlarmText.get()* method to retrieve the enum of an alarm number.

Alarm1 = 'STOP Emergency Stop 1'

Alarm10 = 'STOP Earthing stick 2 error while opening'

Alarm11 = 'STOP Earthing stick 3 error while opening'

Alarm12 = 'STOP Earthing stick 4 error while opening'

Alarm13 = 'STOP Earthing stick 5 error while opening'

Alarm14 = 'STOP Earthing stick 6 error while opening'

Alarm15 = 'STOP Earthing stick 1 error while closing'

Alarm16 = 'STOP Earthing stick 2 error while closing'

Alarm17 = 'STOP Earthing stick 3 error while closing'

Alarm18 = 'STOP Earthing stick 4 error while closing'

Alarm19 = 'STOP Earthing stick 5 error while closing'

Alarm2 = 'STOP Emergency Stop 2'

Alarm20 = 'STOP Earthing stick 6 error while closing'

Alarm21 = 'STOP Safety fence 1'

Alarm22 = 'STOP Safety fence 2'

Alarm23 = 'STOP OPC connection error'

Alarm24 = 'STOP Grid power failure'

Alarm25 = 'STOP UPS failure'

Alarm26 = 'STOP 24V PSU failure'

Alarm3 = 'STOP Emergency Stop 3'

Alarm4 = 'STOP Safety Switch 1 error'

Alarm41 = 'WARNING Door 1: Use earthing rod!'

Alarm42 = 'MESSAGE Door 1: Earthing rod is still in setup.'

Alarm43 = 'WARNING Door 2: Use earthing rod!'

Alarm44 = 'MESSAGE Door 2: Earthing rod is still in setup.'

Alarm45 = 'WARNING Door 3: Use earthing rod!'

Alarm46 = 'MESSAGE Door 3: Earthing rod is still in setup.'

Alarm47 = 'MESSAGE UPS charge < 85%'

Alarm48 = 'MESSAGE UPS running on battery'

Alarm5 = 'STOP Safety Switch 2 error'

Alarm6 = 'STOP Door 1 lock supervision'

Alarm7 = 'STOP Door 2 lock supervision'

Alarm8 = 'STOP Door 3 lock supervision'

Alarm9 = 'STOP Earthing stick 1 error while opening'

get = <bound method AlarmText.get of <aenum 'AlarmText'>>

not_defined = 'NO ALARM TEXT DEFINED'

class hvl_ccb.dev.supercube.constants.**Alarms**(**args*, ***kwds*)

Bases: hvl_ccb.dev.supercube.constants._AlarmsBase

Alarms enumeration containing all variable NodeID strings for the alarm array.

Alarm1 = '"DB_Alarm_HMI"."Alarm1"'

Alarm10 = '"DB_Alarm_HMI"."Alarm10"'

Alarm100 = '"DB_Alarm_HMI"."Alarm100"'

Alarm101 = '"DB_Alarm_HMI"."Alarm101"'

Alarm102 = '"DB_Alarm_HMI"."Alarm102"'

Alarm103 = '"DB_Alarm_HMI"."Alarm103"'

Alarm104 = '"DB_Alarm_HMI"."Alarm104"'

Alarm105 = '"DB_Alarm_HMI"."Alarm105"'

Alarm106 = '"DB_Alarm_HMI"."Alarm106"'

Alarm107 = '"DB_Alarm_HMI"."Alarm107"'

Alarm108 = '"DB_Alarm_HMI"."Alarm108"'

Alarm109 = '"DB_Alarm_HMI"."Alarm109"'

Alarm11 = '"DB_Alarm_HMI"."Alarm11"'

Alarm110 = '"DB_Alarm_HMI"."Alarm110"'

Alarm111 = '"DB_Alarm_HMI"."Alarm111"'

Alarm112 = '"DB_Alarm_HMI"."Alarm112"'

Alarm113 = '"DB_Alarm_HMI"."Alarm113"'

Alarm114 = '"DB_Alarm_HMI"."Alarm114"'

Alarm115 = '"DB_Alarm_HMI"."Alarm115"'

Alarm116 = '"DB_Alarm_HMI"."Alarm116"'

Alarm117 = '"DB_Alarm_HMI"."Alarm117"'

Alarm118 = '"DB_Alarm_HMI"."Alarm118"'

Alarm119 = '"DB_Alarm_HMI"."Alarm119"'

Alarm12 = '"DB_Alarm_HMI"."Alarm12"'

Alarm120 = '"DB_Alarm_HMI"."Alarm120"'

Alarm121 = '"DB_Alarm_HMI"."Alarm121"'

Alarm122 = '"DB_Alarm_HMI"."Alarm122"'

```
Alarm123 = '"DB_Alarm_HMI"."Alarm123"'
Alarm124 = '"DB_Alarm_HMI"."Alarm124"'
Alarm125 = '"DB_Alarm_HMI"."Alarm125"'
Alarm126 = '"DB_Alarm_HMI"."Alarm126"'
Alarm127 = '"DB_Alarm_HMI"."Alarm127"'
Alarm128 = '"DB_Alarm_HMI"."Alarm128"'
Alarm129 = '"DB_Alarm_HMI"."Alarm129"'
Alarm13 = '"DB_Alarm_HMI"."Alarm13"'
Alarm130 = '"DB_Alarm_HMI"."Alarm130"'
Alarm131 = '"DB_Alarm_HMI"."Alarm131"'
Alarm132 = '"DB_Alarm_HMI"."Alarm132"'
Alarm133 = '"DB_Alarm_HMI"."Alarm133"'
Alarm134 = '"DB_Alarm_HMI"."Alarm134"'
Alarm135 = '"DB_Alarm_HMI"."Alarm135"'
Alarm136 = '"DB_Alarm_HMI"."Alarm136"'
Alarm137 = '"DB_Alarm_HMI"."Alarm137"'
Alarm138 = '"DB_Alarm_HMI"."Alarm138"'
Alarm139 = '"DB_Alarm_HMI"."Alarm139"'
Alarm14 = '"DB_Alarm_HMI"."Alarm14"'
Alarm140 = '"DB_Alarm_HMI"."Alarm140"'
Alarm141 = '"DB_Alarm_HMI"."Alarm141"'
Alarm142 = '"DB_Alarm_HMI"."Alarm142"'
Alarm143 = '"DB_Alarm_HMI"."Alarm143"'
Alarm144 = '"DB_Alarm_HMI"."Alarm144"'
Alarm145 = '"DB_Alarm_HMI"."Alarm145"'
Alarm146 = '"DB_Alarm_HMI"."Alarm146"'
Alarm147 = '"DB_Alarm_HMI"."Alarm147"'
Alarm148 = '"DB_Alarm_HMI"."Alarm148"'
Alarm149 = '"DB_Alarm_HMI"."Alarm149"'
Alarm15 = '"DB_Alarm_HMI"."Alarm15"'
Alarm150 = '"DB_Alarm_HMI"."Alarm150"'
Alarm151 = '"DB_Alarm_HMI"."Alarm151"'
Alarm16 = '"DB_Alarm_HMI"."Alarm16"'
Alarm17 = '"DB_Alarm_HMI"."Alarm17"'
Alarm18 = '"DB_Alarm_HMI"."Alarm18"'
Alarm19 = '"DB_Alarm_HMI"."Alarm19"'
```

```
    Alarm2 = '"DB_Alarm_HMI"."Alarm2"'
    Alarm20 = '"DB_Alarm_HMI"."Alarm20"'
    Alarm21 = '"DB_Alarm_HMI"."Alarm21"'
    Alarm22 = '"DB_Alarm_HMI"."Alarm22"'
    Alarm23 = '"DB_Alarm_HMI"."Alarm23"'
    Alarm24 = '"DB_Alarm_HMI"."Alarm24"'
    Alarm25 = '"DB_Alarm_HMI"."Alarm25"'
    Alarm26 = '"DB_Alarm_HMI"."Alarm26"'
    Alarm27 = '"DB_Alarm_HMI"."Alarm27"'
    Alarm28 = '"DB_Alarm_HMI"."Alarm28"'
    Alarm29 = '"DB_Alarm_HMI"."Alarm29"'
    Alarm3 = '"DB_Alarm_HMI"."Alarm3"'
    Alarm30 = '"DB_Alarm_HMI"."Alarm30"'
    Alarm31 = '"DB_Alarm_HMI"."Alarm31"'
    Alarm32 = '"DB_Alarm_HMI"."Alarm32"'
    Alarm33 = '"DB_Alarm_HMI"."Alarm33"'
    Alarm34 = '"DB_Alarm_HMI"."Alarm34"'
    Alarm35 = '"DB_Alarm_HMI"."Alarm35"'
    Alarm36 = '"DB_Alarm_HMI"."Alarm36"'
    Alarm37 = '"DB_Alarm_HMI"."Alarm37"'
    Alarm38 = '"DB_Alarm_HMI"."Alarm38"'
    Alarm39 = '"DB_Alarm_HMI"."Alarm39"'
    Alarm4 = '"DB_Alarm_HMI"."Alarm4"'
    Alarm40 = '"DB_Alarm_HMI"."Alarm40"'
    Alarm41 = '"DB_Alarm_HMI"."Alarm41"'
    Alarm42 = '"DB_Alarm_HMI"."Alarm42"'
    Alarm43 = '"DB_Alarm_HMI"."Alarm43"'
    Alarm44 = '"DB_Alarm_HMI"."Alarm44"'
    Alarm45 = '"DB_Alarm_HMI"."Alarm45"'
    Alarm46 = '"DB_Alarm_HMI"."Alarm46"'
    Alarm47 = '"DB_Alarm_HMI"."Alarm47"'
    Alarm48 = '"DB_Alarm_HMI"."Alarm48"'
    Alarm49 = '"DB_Alarm_HMI"."Alarm49"'
    Alarm5 = '"DB_Alarm_HMI"."Alarm5"'
    Alarm50 = '"DB_Alarm_HMI"."Alarm50"'
    Alarm51 = '"DB_Alarm_HMI"."Alarm51"'
```

```
    Alarm52 = '"DB_Alarm_HMI"."Alarm52"'
    Alarm53 = '"DB_Alarm_HMI"."Alarm53"'
    Alarm54 = '"DB_Alarm_HMI"."Alarm54"'
    Alarm55 = '"DB_Alarm_HMI"."Alarm55"'
    Alarm56 = '"DB_Alarm_HMI"."Alarm56"'
    Alarm57 = '"DB_Alarm_HMI"."Alarm57"'
    Alarm58 = '"DB_Alarm_HMI"."Alarm58"'
    Alarm59 = '"DB_Alarm_HMI"."Alarm59"'
    Alarm6 = '"DB_Alarm_HMI"."Alarm6"'
    Alarm60 = '"DB_Alarm_HMI"."Alarm60"'
    Alarm61 = '"DB_Alarm_HMI"."Alarm61"'
    Alarm62 = '"DB_Alarm_HMI"."Alarm62"'
    Alarm63 = '"DB_Alarm_HMI"."Alarm63"'
    Alarm64 = '"DB_Alarm_HMI"."Alarm64"'
    Alarm65 = '"DB_Alarm_HMI"."Alarm65"'
    Alarm66 = '"DB_Alarm_HMI"."Alarm66"'
    Alarm67 = '"DB_Alarm_HMI"."Alarm67"'
    Alarm68 = '"DB_Alarm_HMI"."Alarm68"'
    Alarm69 = '"DB_Alarm_HMI"."Alarm69"'
    Alarm7 = '"DB_Alarm_HMI"."Alarm7"'
    Alarm70 = '"DB_Alarm_HMI"."Alarm70"'
    Alarm71 = '"DB_Alarm_HMI"."Alarm71"'
    Alarm72 = '"DB_Alarm_HMI"."Alarm72"'
    Alarm73 = '"DB_Alarm_HMI"."Alarm73"'
    Alarm74 = '"DB_Alarm_HMI"."Alarm74"'
    Alarm75 = '"DB_Alarm_HMI"."Alarm75"'
    Alarm76 = '"DB_Alarm_HMI"."Alarm76"'
    Alarm77 = '"DB_Alarm_HMI"."Alarm77"'
    Alarm78 = '"DB_Alarm_HMI"."Alarm78"'
    Alarm79 = '"DB_Alarm_HMI"."Alarm79"'
    Alarm8 = '"DB_Alarm_HMI"."Alarm8"'
    Alarm80 = '"DB_Alarm_HMI"."Alarm80"'
    Alarm81 = '"DB_Alarm_HMI"."Alarm81"'
    Alarm82 = '"DB_Alarm_HMI"."Alarm82"'
    Alarm83 = '"DB_Alarm_HMI"."Alarm83"'
    Alarm84 = '"DB_Alarm_HMI"."Alarm84"'
```

Alarm85 = '"DB_Alarm_HMI"."Alarm85"'

Alarm86 = '"DB_Alarm_HMI"."Alarm86"'

Alarm87 = '"DB_Alarm_HMI"."Alarm87"'

Alarm88 = '"DB_Alarm_HMI"."Alarm88"'

Alarm89 = '"DB_Alarm_HMI"."Alarm89"'

Alarm9 = '"DB_Alarm_HMI"."Alarm9"'

Alarm90 = '"DB_Alarm_HMI"."Alarm90"'

Alarm91 = '"DB_Alarm_HMI"."Alarm91"'

Alarm92 = '"DB_Alarm_HMI"."Alarm92"'

Alarm93 = '"DB_Alarm_HMI"."Alarm93"'

Alarm94 = '"DB_Alarm_HMI"."Alarm94"'

Alarm95 = '"DB_Alarm_HMI"."Alarm95"'

Alarm96 = '"DB_Alarm_HMI"."Alarm96"'

Alarm97 = '"DB_Alarm_HMI"."Alarm97"'

Alarm98 = '"DB_Alarm_HMI"."Alarm98"'

Alarm99 = '"DB_Alarm_HMI"."Alarm99"'

class hvl_ccb.dev.supercube.constants.**BreakdownDetection**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Node ID strings for the breakdown detection.

TODO: these variable NodeIDs are not tested and/or correct yet.

activated = '"Ix_Allg_Breakdown_activated"'
Boolean read-only variable indicating whether breakdown detection and fast switchoff is enabled in the system or not.

reset = '"Qx_Allg_Breakdown_reset"'
Boolean writable variable to reset the fast switch-off. Toggle to re-enable.

triggered = '"Ix_Allg_Breakdown_triggered"'
Boolean read-only variable telling whether the fast switch-off has triggered. This can also be seen using the safety circuit state, therefore no method is implemented to read this out directly.

class hvl_ccb.dev.supercube.constants.**Door**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for doors.

get = <bound method Door.get of <aenum 'Door'>>

status_1 = '"DB_Safety_Circuit"."Türe 1"."si_HMI_status_door"'

status_2 = '"DB_Safety_Circuit"."Türe 2"."si_HMI_status_door"'

status_3 = '"DB_Safety_Circuit"."Türe 3"."si_HMI_status_door"'

class hvl_ccb.dev.supercube.constants.**DoorStatus**(**args*, ***kwds*)
Bases: aenum.IntEnum

Possible status values for doors.

closed = 2
Door is closed, but not locked.

error = 4
Door has an error or was opened in locked state (either with emergency stop or from the inside).

inactive = 0
not enabled in Supercube HMI setup, this door is not supervised.

locked = 3
Door is closed and locked (safe state).

open = 1
Door is open.

class hvl_ccb.dev.supercube.constants.**EarthingStick**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for all earthing stick statuses (read-only integer) and writable booleans for setting the earthing in manual mode.

manual = <bound method EarthingStick.manual of <aenum 'EarthingStick'>>

manual_1 = '"DB_Safety_Circuit"."Erdpeitsche 1"."sx_earthing_manually"'

manual_2 = '"DB_Safety_Circuit"."Erdpeitsche 2"."sx_earthing_manually"'

manual_3 = '"DB_Safety_Circuit"."Erdpeitsche 3"."sx_earthing_manually"'

manual_4 = '"DB_Safety_Circuit"."Erdpeitsche 4"."sx_earthing_manually"'

manual_5 = '"DB_Safety_Circuit"."Erdpeitsche 5"."sx_earthing_manually"'

manual_6 = '"DB_Safety_Circuit"."Erdpeitsche 6"."sx_earthing_manually"'

status = <bound method EarthingStick.status of <aenum 'EarthingStick'>>

status_1 = '"DB_Safety_Circuit"."Erdpeitsche 1"."si_HMI_Status"'

status_2 = '"DB_Safety_Circuit"."Erdpeitsche 2"."si_HMI_Status"'

status_3 = '"DB_Safety_Circuit"."Erdpeitsche 3"."si_HMI_Status"'

status_4 = '"DB_Safety_Circuit"."Erdpeitsche 4"."si_HMI_Status"'

status_5 = '"DB_Safety_Circuit"."Erdpeitsche 5"."si_HMI_Status"'

status_6 = '"DB_Safety_Circuit"."Erdpeitsche 6"."si_HMI_Status"'

class hvl_ccb.dev.supercube.constants.**EarthingStickStatus**(**args*, ***kwds*)
Bases: aenum.IntEnum

Status of an earthing stick. These are the possible values in the status integer e.g. in *EarthingStick.status_1*.

closed = 1
Earthing is closed (safe).

error = 3
Earthing is in error, e.g. when the stick did not close correctly or could not open.

inactive = 0
Earthing stick is deselected and not enabled in safety circuit. To get out of this state, the earthing has to be enabled in the Supercube HMI setup.

open = 2
Earthing is open (not safe).

class hvl_ccb.dev.supercube.constants.**Errors**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for information regarding error, warning and message handling.

message = '"DB_Meldepuffer"."Hinweis_aktiv"'
Boolean read-only variable telling if a message is active.

quit = '"DB_Meldepuffer"."Quittierbutton"'
Writable boolean for the error quit button.

stop = '"DB_Meldepuffer"."Stop_aktiv"'
Boolean read-only variable telling if a stop is active.

warning = '"DB_Meldepuffer"."Warnung_aktiv"'
Boolean read-only variable telling if a warning is active.

class hvl_ccb.dev.supercube.constants.**GeneralSockets**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

NodeID strings for the power sockets (3x T13 and 1xCEE16).

cee16 = '"Qx_Allg_Socket_CEE16"'
CEE16 socket (writeable boolean).

t13_1 = '"Qx_Allg_Socket_T13_1"'
SEV T13 socket No. 1 (writable boolean).

t13_2 = '"Qx_Allg_Socket_T13_2"'
SEV T13 socket No. 2 (writable boolean).

t13_3 = '"Qx_Allg_Socket_T13_3"'
SEV T13 socket No. 3 (writable boolean).

class hvl_ccb.dev.supercube.constants.**GeneralSupport**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

NodeID strings for the support inputs and outputs.

in_1_1 = '"Ix_Allg_Support1_1"'

in_1_2 = '"Ix_Allg_Support1_2"'

in_2_1 = '"Ix_Allg_Support2_1"'

in_2_2 = '"Ix_Allg_Support2_2"'

in_3_1 = '"Ix_Allg_Support3_1"'

in_3_2 = '"Ix_Allg_Support3_2"'

in_4_1 = '"Ix_Allg_Support4_1"'

in_4_2 = '"Ix_Allg_Support4_2"'

in_5_1 = '"Ix_Allg_Support5_1"'

in_5_2 = '"Ix_Allg_Support5_2"'

in_6_1 = '"Ix_Allg_Support6_1"'

in_6_2 = '"Ix_Allg_Support6_2"'

input = <bound method GeneralSupport.input of <aenum 'GeneralSupport'>>

out_1_1 = '"Qx_Allg_Support1_1"'

out_1_2 = '"Qx_Allg_Support1_2"'

out_2_1 = '"Qx_Allg_Support2_1"'

out_2_2 = '"Qx_Allg_Support2_2"'

out_3_1 = '"Qx_Allg_Support3_1"'

out_3_2 = '"Qx_Allg_Support3_2"'

out_4_1 = '"Qx_Allg_Support4_1"'

out_4_2 = '"Qx_Allg_Support4_2"'

out_5_1 = '"Qx_Allg_Support5_1"'

out_5_2 = '"Qx_Allg_Support5_2"'

out_6_1 = '"Qx_Allg_Support6_1"'

out_6_2 = '"Qx_Allg_Support6_2"'

output = <bound method GeneralSupport.output of <aenum 'GeneralSupport'>>

class hvl_ccb.dev.supercube.constants.**MeasurementsDividerRatio**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for the measurement input scaling ratios. These ratios are defined in the Supercube HMI setup and are provided in the python module here to be able to read them out, allowing further calculations.

TODO: these variable nodeIDs are not tested and/or correct yet.

get = <bound method MeasurementsDividerRatio.get of <aenum 'MeasurementsDividerRatio'>

input_1 = 'Ir_Measure_DividerRatio_1'

input_2 = 'Ir_Measure_DividerRatio_2'

input_3 = 'Ir_Measure_DividerRatio_3'

input_4 = 'Ir_Measure_DividerRatio_4'

class hvl_ccb.dev.supercube.constants.**MeasurementsScaledInput**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for the four analog BNC inputs for measuring voltage. The voltage returned in these variables is already scaled with the set ratio, which can be read using the variables in *MeasurementsDividerRatio*.

TODO: these variable NodeIDs are not tested and/or correct yet.

get = <bound method MeasurementsScaledInput.get of <aenum 'MeasurementsScaledInput'>>

input_1 = 'Qr_Measure_Input1_scaledVoltage'

input_2 = 'Qr_Measure_Input2_scaledVoltage'

input_3 = 'Qr_Measure_Input3_scaledVoltage'

input_4 = 'Qr_Measure_Input4_scaledVoltage'

class hvl_ccb.dev.supercube.constants.**OpcControl**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for supervision of the OPC connection from the controlling workstation to the Supercube.

TODO: this variable nodeID string is not tested and/or correct yet.

active = 'Ix_OPC_active'
writable boolean to enable OPC remote control and display a message window on the Supercube HMI.

class hvl_ccb.dev.supercube.constants.**Power**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings concerning power data.

TODO: these variable NodeIDs are not tested and/or correct yet, they don't exist yet on Supercube side.

current_primary = 'Qr_Power_FU_actualCurrent'
Primary current in ampere, measured by the frequency converter. (read-only)

frequency = 'Ir_Power_FU_Frequency'
Frequency converter output frequency. (read-only)

setup = 'Qi_Power_Setup'
Power setup that is configured using the Supercube HMI. The value corresponds to the ones in *PowerSetup*. (read-only)

voltage_max = 'Iw_Power_maxVoltage'
Maximum voltage allowed by the current experimental setup. (read-only)

voltage_primary = 'Qr_Power_FU_actualVoltage'
Primary voltage in volts, measured by the frequency converter at its output. (read-only)

voltage_slope = 'Ir_Power_dUdt'
Voltage slope in V/s.

voltage_target = 'Ir_Power_TargetVoltage'
Target voltage setpoint in V.

class hvl_ccb.dev.supercube.constants.**PowerSetup**(**args*, ***kwds*)
Bases: aenum.IntEnum

Possible power setups corresponding to the value of variable *Power.setup*.

AC_DoubleStage_150kV = 4
AC voltage with two MWB transformers, one at 100kV and the other at 50kV, resulting in a total maximum voltage of 150kV.

AC_DoubleStage_200kV = 5
AC voltage with two MWB transformers both at 100kV, resulting in a total maximum voltage of 200kV

AC_SingleStage_100kV = 3
AC voltage with MWB transformer set to 100kV maximum voltage.

AC_SingleStage_50kV = 2
AC voltage with MWB transformer set to 50kV maximum voltage.

DC_DoubleStage_280kV = 8
DC voltage with two AC transformers set to 100kV AC each, resulting in 280kV DC in total (or a single stage transformer with Greinacher voltage doubling rectifier)

DC_SingleStage_140kV = 7
DC voltage with one AC transformer set to 100kV AC, resulting in 140kV DC

External = 1
External power supply fed through blue CEE32 input using isolation transformer and safety switches of the Supercube, or using an external safety switch attached to the Supercube Type B.

Internal = 6
Internal usage of the frequency converter, controlling to the primary voltage output of the supercube itself (no measurement transformer used)

NoPower = 0
No safety switches, use only safety components (doors, fence, earthing...) without any power.

class hvl_ccb.dev.supercube.constants.**Safety**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

NodeID strings for the basic safety circuit status and green/red switches "ready" and "operate".

status = '"DB_Safety_Circuit"."si_safe_status"'
Status is a read-only integer containing the state number of the supercube-internal state machine. The values correspond to numbers in *SafetyStatus*.

switchto_operate = '"DB_Safety_Circuit"."sx_safe_switchto_operate"'
Writable boolean for switching to Red Operate (locket, HV on) state.

switchto_ready = '"DB_Safety_Circuit"."sx_safe_switchto_ready"'
Writable boolean for switching to Red Ready (locked, HV off) state.

class hvl_ccb.dev.supercube.constants.**SafetyStatus**(**args*, ***kwds*)
Bases: aenum.IntEnum

Safety status values that are possible states returned from hvl_ccb.dev.supercube.base.Supercube.get_status(). These values correspond to the states of the Supercube's safety circuit statemachine.

Error = 6
System is in error mode.

GreenNotReady = 1
System is safe, lamps are green and some safety elements are not in place such that it cannot be switched to red currently.

GreenReady = 2
System is safe and all safety elements are in place to be able to switch to *ready*.

Initializing = 0
System is initializing or booting.

QuickStop = 5
Fast turn off triggered and switched off the system. Reset FSO to go back to a normal state.

RedOperate = 4
System is locked in red state and in *operate* mode, i.e. high voltage on.

RedReady = 3
System is locked in red state and *ready* to go to *operate* mode.

class hvl_ccb.dev.supercube.constants.**SupercubeOpcEndpoint**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

OPC Server Endpoint strings for the supercube variants.

A = 'Supercube Typ A'

B = 'Supercube Typ B'

hvl_ccb.dev.supercube.typ_a module

Supercube Typ A module.

class hvl_ccb.dev.supercube.typ_a.**SupercubeAOpcUaCommunication**(*config*)
Bases: *hvl_ccb.dev.supercube.base.SupercubeOpcUaCommunication*

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.supercube.typ_a.**SupercubeAOpcUaConfiguration**(*host: str*, *endpoint_name: str = 'Supercube Typ A'*, *port: int = 4840*, *sub_handler: hvl_ccb.comm.opc.OpcUaSubHandler = <hvl_ccb.dev.supercube.base.SupercubeS object at 0x7f00c677b550>*, *update_period: int = 500*)

Bases: *hvl_ccb.dev.supercube.base.SupercubeOpcUaCommunicationConfig*

endpoint_name = 'Supercube Typ A'

force_value(*fieldname*, *value*)

Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]

Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]

Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]

Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

class hvl_ccb.dev.supercube.typ_a.**SupercubeWithFU**(*com*, *dev_config=None*)

Bases: *hvl_ccb.dev.supercube.base.SupercubeBase*

Variant A of the Supercube with frequency converter.

static default_com_cls()

Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

fso_reset() → None

TODO: test fso_reset with device

Reset the fast switch off circuitry to go back into normal state and allow to re-enable operate mode.

get_frequency() → float

TODO: test get_frequency with device

Read the electrical frequency of the current Supercube setup.

Returns the frequency in Hz

get_fso_active() → bool
TODO: test get_fso_active with device

Get the state of the fast switch off functionality. Returns True if it is enabled, False otherwise.

Returns state of the FSO functionality

get_max_voltage() → float
TODO: test get_max_voltage with device

Reads the maximum voltage of the setup and returns in V.

Returns the maximum voltage of the setup in V.

get_power_setup() → hvl_ccb.dev.supercube.constants.PowerSetup
TODO: test get_power_setup with device

Return the power setup selected in the Supercube's settings.

Returns the power setup

get_primary_current() → float
TODO: get_primary_current with device

Read the current primary current at the output of the frequency converter (before transformer).

Returns primary current in A

get_primary_voltage() → float
TODO: test get_primary_voltage with device

Read the current primary voltage at the output of the frequency converter (before transformer).

Returns primary voltage in V

get_target_voltage() → float
TODO: test get_target_voltage with device

Gets the current setpoint of the output voltage value in V. This is not a measured value but is the corresponding function to *set_target_voltage()*.

Returns the setpoint voltage in V.

set_slope(*slope: float*) → None
TODO: test set_slope with device

Sets the dV/dt slope of the Supercube frequency converter to a new value in V/s.

Parameters **slope** – voltage slope in V/s (0..15)

set_target_voltage(*volt_v: float*) → None
TODO: test set_target_voltage with device

Set the output voltage to a defined value in V.

Parameters **volt_v** – the desired voltage in V

hvl_ccb.dev.supercube.typ_b module

Supercube Typ B module.

class hvl_ccb.dev.supercube.typ_b.**SupercubeB**(*com*, *dev_config=None*)
Bases: *hvl_ccb.dev.supercube.base.SupercubeBase*

Variant B of the Supercube without frequency converter but external safety switches.

static default_com_cls()
Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

class hvl_ccb.dev.supercube.typ_b.**SupercubeBOpcUaCommunication**(*config*)
Bases: *hvl_ccb.dev.supercube.base.SupercubeOpcUaCommunication*

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.supercube.typ_b.**SupercubeBOpcUaConfiguration**(*host: str*, *endpoint_name: str = 'Supercube Typ B'*, *port: int = 4840*, *sub_handler: hvl_ccb.comm.opc.OpcUaSubHandler = <hvl_ccb.dev.supercube.base.SupercubeS object at 0x7f00c677b550>*, *update_period: int = 500*)
Bases: *hvl_ccb.dev.supercube.base.SupercubeOpcUaCommunicationConfig*

endpoint_name = 'Supercube Typ B'

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

Module contents

Supercube package with implementation for system versions from 2019 on (new concept with hard-PLC Siemens S7-1500 as CPU).

hvl_ccb.dev.supercube2015 package

Submodules

hvl_ccb.dev.supercube2015.base module

Base classes for the Supercube device.

class hvl_ccb.dev.supercube2015.base.**Supercube2015Base**(*com*, *dev_config=None*)
Bases: *hvl_ccb.dev.base.SingleCommDevice*

Base class for Supercube variants.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

static default_com_cls()
Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

get_cee16_socket() → bool
Read the on-state of the IEC CEE16 three-phase power socket.

Returns the on-state of the CEE16 power socket

get_door_status(*door: int*) → hvl_ccb.dev.supercube2015.constants.DoorStatus
Get the status of a safety fence door. See `constants.DoorStatus` for possible returned door statuses.

Parameters **door** – the door number (1..3)

Returns the door status

get_earthing_manual(*number: int*) → bool
Get the manual status of an earthing stick. If an earthing stick is set to manual, it is closed even if the system is in states RedReady or RedOperate.

Parameters **number** – number of the earthing stick (1..6)

Returns earthing stick manual status

get_earthing_status(*number: int*) → hvl_ccb.dev.supercube2015.constants.EarthingStickStatus
Get the status of an earthing stick, whether it is closed, open or undefined (moving).

Parameters **number** – number of the earthing stick (1..6)

Returns earthing stick status

get_measurement_ratio(*channel: int*) → float
Get the set measurement ratio of an AC/DC analog input channel. Every input channel has a divider ratio assigned during setup of the Supercube system. This ratio can be read out.

Attention: Supercube 2015 does not have a separate ratio for every analog input. Therefore there is only one ratio for `channel = 1`.

Parameters **channel** – number of the input channel (1..4)

Returns the ratio

get_measurement_voltage(*channel: int*) → float
Get the measured voltage of an analog input channel. The voltage read out here is already scaled by the configured divider ratio.

Attention: In contrast to the *new* Supercube, the old one returns here the input voltage read at the ADC. It is not scaled by a factor.

Parameters **channel** – number of the input channel (1..4)

Returns measured voltage

get_status() → hvl_ccb.dev.supercube2015.constants.SafetyStatus
Get the safety circuit status of the Supercube. :return: the safety status of the supercube's state machine.

get_support_input(*port: int*, *contact: int*) → bool
Get the state of a support socket input.

Parameters

- **port** – is the socket number (1..6)
- **contact** – is the contact on the socket (1..2)

Returns digital input read state

get_support_output(*port: int*, *contact: int*) → bool
Get the state of a support socket output.

Parameters

- **port** – is the socket number (1..6)
- **contact** – is the contact on the socket (1..2)

Returns digital output read state

get_t13_socket(*port: int*) → bool
Read the state of a SEV T13 power socket.

Parameters **port** – is the socket number (1..3)

Returns on-state of the power socket

operate(*state: bool*) → None
Set operate state. If the state is RedReady, this will turn on the high voltage and close the safety switches.

Parameters **state** – set operate state

quit_error() → None
Quits errors that are active on the Supercube.

read(*node_id: str*)
Local wrapper for the OPC UA communication protocol read method.

Parameters **node_id** – the id of the node to read.

Returns the value of the variable

ready(*state: bool*) → None
Set ready state. Ready means locket safety circuit, red lamps, but high voltage still off.

Parameters **state** – set ready state

set_cee16_socket(*state: bool*) → None
Switch the IEC CEE16 three-phase power socket on or off.

Parameters **state** – desired on-state of the power socket

Raises **ValueError** – if state is not of type bool

set_earthing_manual(*number: int*, *manual: bool*) → None
Set the manual status of an earthing stick. If an earthing stick is set to manual, it is closed even if the system is in states RedReady or RedOperate.

Parameters

- **number** – number of the earthing stick (1..6)
- **manual** – earthing stick manual status (True or False)

set_remote_control(*state: bool*) → None
Enable or disable remote control for the Supercube. This will effectively display a message on the touch-screen HMI.

Parameters **state** – desired remote control state

set_support_output(*port: int*, *contact: int*, *state: bool*) → None
Set the state of a support output socket.

Parameters

- **port** – is the socket number (1..6)
- **contact** – is the contact on the socket (1..2)
- **state** – is the desired state of the support output

set_support_output_impulse(*port: int*, *contact: int*, *duration: float = 0.2*, *pos_pulse: bool = True*) → None
Issue an impulse of a certain duration on a support output contact. The polarity of the pulse (On-wait-Off or Off-wait-On) is specified by the pos_pulse argument.

This function is blocking.

Parameters

- **port** – is the socket number (1..6)
- **contact** – is the contact on the socket (1..2)
- **duration** – is the length of the impulse in seconds
- **pos_pulse** – is True, if the pulse shall be HIGH, False if it shall be LOW

set_t13_socket(*port: int*, *state: bool*) → None
Set the state of a SEV T13 power socket.

Parameters

- **port** – is the socket number (1..3)
- **state** – is the desired on-state of the socket

start() → None
Starts the device. Sets the root node for all OPC read and write commands to the Siemens PLC object node which holds all our relevant objects and variables.

stop() → None
Stop the Supercube device. Deactivates the remote control and closes the communication protocol.

write(*node_id*, *value*) → None
Local wrapper for the OPC UA communication protocol write method.

Parameters

- **node_id** – the id of the node to read
- **value** – the value to write to the variable

class hvl_ccb.dev.supercube2015.base.**SupercubeConfiguration**(*namespace_index: int = 7*)
Bases: object

Configuration dataclass for the Supercube devices.

clean_values()
Cleans and enforces configuration values. Does nothing by default, but may be overridden to add custom configuration value checks.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

namespace_index = 7
Namespace of the OPC variables, typically this is 3 (coming from Siemens)

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

class hvl_ccb.dev.supercube2015.base.**SupercubeOpcUaCommunication**(*config*)
Bases: *hvl_ccb.comm.opc.OpcUaCommunication*

Communication protocol specification for Supercube devices.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.supercube2015.base.**SupercubeOpcUaCommunicationConfig**(*host: str*, *endpoint_name: str*, *port: int = 4845*, *sub_handler: hvl_ccb.comm.opc.OpcUaSu = <hvl_ccb.dev.supercube2015 object>*, *update_period: int = 500*)

Bases: *hvl_ccb.comm.opc.OpcUaCommunicationConfig*

Communication protocol configuration for OPC UA, specifications for the Supercube devices.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

port = 4845

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

sub_handler = <hvl_ccb.dev.supercube2015.base.SupercubeSubscriptionHandler object>
Subscription handler for data change events

class hvl_ccb.dev.supercube2015.base.**SupercubeSubscriptionHandler**
Bases: *hvl_ccb.comm.opc.OpcUaSubHandler*

OPC Subscription handler for datachange events and normal events specifically implemented for the Supercube devices.

datachange_notification(*node: opcua.common.node.Node*, *val*, *data*)
In addition to the standard operation (debug logging entry of the datachange), alarms are logged at INFO level using the alarm text.

Parameters

- **node** – the node object that triggered the datachange event
- **val** – the new value
- **data** –

hvl_ccb.dev.supercube2015.constants module

Constants, variable names for the Supercube OPC-connected devices.

class hvl_ccb.dev.supercube2015.constants.**AlarmText**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

This enumeration contains textual representations for all error classes (stop, warning and message) of the Supercube system. Use the *AlarmText.get()* method to retrieve the enum of an alarm number.

Alarm0 = 'No Alarm.'

Alarm1 = 'STOP Safety switch 1 error'

Alarm10 = 'STOP Earthing stick 2 error'

Alarm11 = 'STOP Earthing stick 3 error'

Alarm12 = 'STOP Earthing stick 4 error'

Alarm13 = 'STOP Earthing stick 5 error'

Alarm14 = 'STOP Earthing stick 6 error'

Alarm17 = 'STOP Source switch error'

Alarm19 = 'STOP Fence 1 error'

Alarm2 = 'STOP Safety switch 2 error'

Alarm20 = 'STOP Fence 2 error'

Alarm21 = 'STOP Control error'

Alarm22 = 'STOP Power outage'

Alarm3 = 'STOP Emergency Stop 1'

Alarm4 = 'STOP Emergency Stop 2'

Alarm5 = 'STOP Emergency Stop 3'

Alarm6 = 'STOP Door 1 lock supervision'

Alarm7 = 'STOP Door 2 lock supervision'

Alarm8 = 'STOP Door 3 lock supervision'

Alarm9 = 'STOP Earthing stick 1 error'

get = <bound method AlarmText.get of <aenum 'AlarmText'>>

not_defined = 'NO ALARM TEXT DEFINED'

class hvl_ccb.dev.supercube2015.constants.**BreakdownDetection**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Node ID strings for the breakdown detection.

activated = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.Breakdowndetection.connect'
Boolean read-only variable indicating whether breakdown detection and fast switchoff is enabled in the system or not.

reset = 'hvl-ipc.WINAC.Support6OutA'
Boolean writable variable to reset the fast switch-off. Toggle to re-enable.

triggered = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.Breakdowndetection.triggered'
Boolean read-only variable telling whether the fast switch-off has triggered. This can also be seen using the safety circuit state, therefore no method is implemented to read this out directly.

class hvl_ccb.dev.supercube2015.constants.**DoorStatus**(**args*, ***kwds*)
Bases: aenum.IntEnum

Possible status values for doors.

closed = 2
Door is closed, but not locked.

error = 4
Door has an error or was opened in locked state (either with emergency stop or from the inside).

inactive = 0
not enabled in Supercube HMI setup, this door is not supervised.

locked = 3
Door is closed and locked (safe state).

open = 1
Door is open.

class hvl_ccb.dev.supercube2015.constants.**EarthingStick**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for all earthing stick statuses (read-only integer) and writable booleans for setting the earthing in manual mode.

manual = <bound method EarthingStick.manual of <aenum 'EarthingStick'>>

manual_1 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_1.MANUAL'

manual_2 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_2.MANUAL'

manual_3 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_3.MANUAL'

manual_4 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_4.MANUAL'

manual_5 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_5.MANUAL'

manual_6 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_6.MANUAL'

status_1_closed = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_1.CLOSE'

status_1_connected = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_1.CONNECT'

status_1_open = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_1.OPEN'

status_2_closed = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_2.CLOSE'

status_2_connected = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_2.CONNECT'

status_2_open = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_2.OPEN'

status_3_closed = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_3.CLOSE'

status_3_connected = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_3.CONNECT'

status_3_open = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_3.OPEN'

status_4_closed = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_4.CLOSE'

status_4_connected = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_4.CONNECT'

status_4_open = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_4.OPEN'

status_5_closed = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_5.CLOSE'

status_5_connected = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_5.CONNECT'

status_5_open = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_5.OPEN'

status_6_closed = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_6.CLOSE'

status_6_connected = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_6.CONNECT'

status_6_open = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.STICK_6.OPEN'

status_closed = <bound method EarthingStick.status_closed of <aenum 'EarthingStick'>>

status_connected = <bound method EarthingStick.status_connected of <aenum 'EarthingSti

status_open = <bound method EarthingStick.status_open of <aenum 'EarthingStick'>>

class hvl_ccb.dev.supercube2015.constants.**EarthingStickStatus**(**args*, ***kwds*)
Bases: aenum.IntEnum

Status of an earthing stick. These are the possible values in the status integer e.g. in EarthingStick.status_1.

closed = 1
Earthing is closed (safe).

error = 3
Earthing is in error, e.g. when the stick did not close correctly or could not open.

inactive = 0
Earthing stick is deselected and not enabled in safety circuit. To get out of this state, the earthing has to be enabled in the Supercube HMI setup.

open = 2
Earthing is open (not safe).

class hvl_ccb.dev.supercube2015.constants.**Errors**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for information regarding error, warning and message handling.

quit = 'hvl-ipc.WINAC.SYSTEMSTATE.Faultconfirmation'
Writable boolean for the error quit button.

stop = 'hvl-ipc.WINAC.SYSTEMSTATE.ERROR'
Boolean read-only variable telling if a stop is active.

stop_number = 'hvl-ipc.WINAC.SYSTEMSTATE.Errornumber'

class hvl_ccb.dev.supercube2015.constants.**GeneralSockets**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

NodeID strings for the power sockets (3x T13 and 1xCEE16).

cee16 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.CEE16'
CEE16 socket (writeable boolean).

t13_1 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.T13_1'
SEV T13 socket No. 1 (writable boolean).

t13_2 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.T13_2'
SEV T13 socket No. 2 (writable boolean).

t13_3 = 'hvl-ipc.WINAC.SYSTEM_COMPONENTS.T13_3'
SEV T13 socket No. 3 (writable boolean).

class hvl_ccb.dev.supercube2015.constants.**GeneralSupport**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

NodeID strings for the support inputs and outputs.

in_1_1 = 'hvl-ipc.WINAC.Support1InA'

in_1_2 = 'hvl-ipc.WINAC.Support1InB'

in_2_1 = 'hvl-ipc.WINAC.Support2InA'

in_2_2 = 'hvl-ipc.WINAC.Support2InB'

in_3_1 = 'hvl-ipc.WINAC.Support3InA'

in_3_2 = 'hvl-ipc.WINAC.Support3InB'

in_4_1 = 'hvl-ipc.WINAC.Support4InA'

in_4_2 = 'hvl-ipc.WINAC.Support4InB'

in_5_1 = 'hvl-ipc.WINAC.Support5InA'

in_5_2 = 'hvl-ipc.WINAC.Support5InB'

in_6_1 = 'hvl-ipc.WINAC.Support6InA'

in_6_2 = 'hvl-ipc.WINAC.Support6InB'

input = <bound method GeneralSupport.input of <aenum 'GeneralSupport'>>

out_1_1 = 'hvl-ipc.WINAC.Support1OutA'

out_1_2 = 'hvl-ipc.WINAC.Support1OutB'

out_2_1 = 'hvl-ipc.WINAC.Support2OutA'

out_2_2 = 'hvl-ipc.WINAC.Support2OutB'

out_3_1 = 'hvl-ipc.WINAC.Support3OutA'

out_3_2 = 'hvl-ipc.WINAC.Support3OutB'

out_4_1 = 'hvl-ipc.WINAC.Support4OutA'

out_4_2 = 'hvl-ipc.WINAC.Support4OutB'

out_5_1 = 'hvl-ipc.WINAC.Support5OutA'

out_5_2 = 'hvl-ipc.WINAC.Support5OutB'

out_6_1 = 'hvl-ipc.WINAC.Support6OutA'

out_6_2 = 'hvl-ipc.WINAC.Support6OutB'

output = <bound method GeneralSupport.output of <aenum 'GeneralSupport'>>

class hvl_ccb.dev.supercube2015.constants.**MeasurementsDividerRatio**(**args*, ***kwds*)

Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for the measurement input scaling ratios. These ratios are defined in the Supercube HMI setup and are provided in the python module here to be able to read them out, allowing further calculations.

get = <bound method MeasurementsDividerRatio.get of <aenum 'MeasurementsDividerRatio'>

input_1 = 'hvl-ipc.WINAC.SYSTEM_INTERN.DivididerRatio'

class hvl_ccb.dev.supercube2015.constants.**MeasurementsScaledInput**(**args*, ***kwds*)

Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings for the four analog BNC inputs for measuring voltage. The voltage returned in these variables is already scaled with the set ratio, which can be read using the variables in *MeasurementsDividerRatio*.

get = <bound method MeasurementsScaledInput.get of <aenum 'MeasurementsScaledInput'>>

input_1 = 'hvl-ipc.WINAC.SYSTEM_INTERN.AI1Volt'

input_2 = 'hvl-ipc.WINAC.SYSTEM_INTERN.AI2Volt'

input_3 = 'hvl-ipc.WINAC.SYSTEM_INTERN.AI3Volt'

input_4 = 'hvl-ipc.WINAC.SYSTEM_INTERN.AI4Volt'

class hvl_ccb.dev.supercube2015.constants.**Power**(**args*, ***kwds*)

Bases: *hvl_ccb.utils.enum.ValueEnum*

Variable NodeID strings concerning power data.

current_primary = 'hvl-ipc.WINAC.SYSTEM_INTERN.FUCurrentprim'
Primary current in ampere, measured by the frequency converter. (read-only)

frequency = 'hvl-ipc.WINAC.FU.Frequency'
Frequency converter output frequency. (read-only)

setup = 'hvl-ipc.WINAC.FU.TrafoSetup'
Power setup that is configured using the Supercube HMI. The value corresponds to the ones in *PowerSetup*. (read-only)

voltage_max = 'hvl-ipc.WINAC.FU.maxVoltagekV'
Maximum voltage allowed by the current experimental setup. (read-only)

voltage_primary = 'hvl-ipc.WINAC.SYSTEM_INTERN.FUVoltageprim'
Primary voltage in volts, measured by the frequency converter at its output. (read-only)

voltage_slope = 'hvl-ipc.WINAC.FU.dUdt_-1'
Voltage slope in V/s.

voltage_target = 'hvl-ipc.WINAC.FU.SOLL'
Target voltage setpoint in V.

class hvl_ccb.dev.supercube2015.constants.**PowerSetup**(**args*, ***kwds*)

Bases: `aenum.IntEnum`

Possible power setups corresponding to the value of variable *Power.setup*.

AC_DoubleStage_150kV = 3
AC voltage with two MWB transformers, one at 100kV and the other at 50kV, resulting in a total maximum voltage of 150kV.

AC_DoubleStage_200kV = 4
AC voltage with two MWB transformers both at 100kV, resulting in a total maximum voltage of 200kV

AC_SingleStage_100kV = 2
AC voltage with MWB transformer set to 100kV maximum voltage.

AC_SingleStage_50kV = 1
AC voltage with MWB transformer set to 50kV maximum voltage.

DC_DoubleStage_280kV = 7
DC voltage with two AC transformers set to 100kV AC each, resulting in 280kV DC in total (or a single stage transformer with Greinacher voltage doubling rectifier)

DC_SingleStage_140kV = 6
DC voltage with one AC transformer set to 100kV AC, resulting in 140kV DC

External = 0
External power supply fed through blue CEE32 input using isolation transformer and safety switches of the Supercube, or using an external safety switch attached to the Supercube Type B.

Internal = 5
Internal usage of the frequency converter, controlling to the primary voltage output of the supercube itself (no measurement transformer used)

class hvl_ccb.dev.supercube2015.constants.**Safety**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

NodeID strings for the basic safety circuit status and green/red switches "ready" and "operate".

status_error = 'hvl-ipc.WINAC.SYSTEMSTATE.ERROR'

status_green = 'hvl-ipc.WINAC.SYSTEMSTATE.GREEN'

status_ready_for_red = 'hvl-ipc.WINAC.SYSTEMSTATE.ReadyForRed'
Status is a read-only integer containing the state number of the supercube-internal state machine. The values correspond to numbers in *SafetyStatus*.

status_red = 'hvl-ipc.WINAC.SYSTEMSTATE.RED'

switchto_green = 'hvl-ipc.WINAC.SYSTEMSTATE.GREEN_REQUEST'

switchto_operate = 'hvl-ipc.WINAC.SYSTEMSTATE.switchon'
Writable boolean for switching to Red Operate (locket, HV on) state.

switchto_ready = 'hvl-ipc.WINAC.SYSTEMSTATE.RED_REQUEST'
Writable boolean for switching to Red Ready (locked, HV off) state.

class hvl_ccb.dev.supercube2015.constants.**SafetyStatus**(**args*, ***kwds*)
Bases: aenum.IntEnum

Safety status values that are possible states returned from hvl_ccb.dev.supercube.base.Supercube.get_status(). These values correspond to the states of the Supercube's safety circuit statemachine.

Error = 6
System is in error mode.

GreenNotReady = 1
System is safe, lamps are green and some safety elements are not in place such that it cannot be switched to red currently.

GreenReady = 2
System is safe and all safety elements are in place to be able to switch to *ready*.

Initializing = 0
System is initializing or booting.

QuickStop = 5
Fast turn off triggered and switched off the system. Reset FSO to go back to a normal state.

RedOperate = 4
System is locked in red state and in *operate* mode, i.e. high voltage on.

RedReady = 3
System is locked in red state and *ready* to go to *operate* mode.

class hvl_ccb.dev.supercube2015.constants.**SupercubeOpcEndpoint**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.ValueEnum*

OPC Server Endpoint strings for the supercube variants.

A = 'OPC.SimaticNET.S7'

B = 'OPC.SimaticNET.S7'

hvl_ccb.dev.supercube2015.typ_a module

Supercube Typ A module.

class hvl_ccb.dev.supercube2015.typ_a.**Supercube2015WithFU**(*com*, *dev_config=None*)
Bases: *hvl_ccb.dev.supercube2015.base.Supercube2015Base*

Variant A of the Supercube with frequency converter.

static default_com_cls()
Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

fso_reset() → None
Reset the fast switch off circuitry to go back into normal state and allow to re-enable operate mode.

get_frequency() → float
Read the electrical frequency of the current Supercube setup.

Returns the frequency in Hz

get_fso_active() → bool
Get the state of the fast switch off functionality. Returns True if it is enabled, False otherwise.

Returns state of the FSO functionality

get_max_voltage() → float
Reads the maximum voltage of the setup and returns in V.

Returns the maximum voltage of the setup in V.

get_power_setup() → hvl_ccb.dev.supercube2015.constants.PowerSetup
Return the power setup selected in the Supercube's settings.

Returns the power setup

get_primary_current() → float
Read the current primary current at the output of the frequency converter (before transformer).

Returns primary current in A

get_primary_voltage() → float
Read the current primary voltage at the output of the frequency converter (before transformer).

Returns primary voltage in V

get_target_voltage() → float
Gets the current setpoint of the output voltage value in V. This is not a measured value but is the corresponding function to *set_target_voltage()*.

Returns the setpoint voltage in V.

set_slope(*slope: float*) → None
Sets the dV/dt slope of the Supercube frequency converter to a new value in V/s.

Parameters **slope** – voltage slope in V/s (0..15‘000)

set_target_voltage(*volt_v: float*) → None
Set the output voltage to a defined value in V.

Parameters **volt_v** – the desired voltage in V

class hvl_ccb.dev.supercube2015.typ_a.**SupercubeAOpcUaCommunication**(*config*)
Bases: *hvl_ccb.dev.supercube2015.base.SupercubeOpcUaCommunication*

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.supercube2015.typ_a.**SupercubeAOpcUaConfiguration**(*host: str, endpoint_name: str = 'OPC.SimaticNET.S7', port: int = 4845, sub_handler: hvl_ccb.comm.opc.OpcUaSubHand = <hvl_ccb.dev.supercube2015.base. object at 0x7f00c5bc3748>, update_period: int = 500*)
Bases: *hvl_ccb.dev.supercube2015.base.SupercubeOpcUaCommunicationConfig*

endpoint_name = 'OPC.SimaticNET.S7'

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

Module contents

Supercube package with implementation for the old system version from 2015 based on Siemens WinAC soft-PLC on an industrial 32bit Windows computer.

Submodules

hvl_ccb.dev.base module

Module with base classes for devices.

class hvl_ccb.dev.base.**Device**(*dev_config=None*)
Bases: *hvl_ccb.configuration.ConfigurationMixin*, abc.ABC

Base class for devices. Implement this class for a concrete device, such as measurement equipment or voltage sources.

Specifies the methods to implement for a device.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

start() → None
Start or restart this Device. To be implemented in the subclass.

stop() → None
Stop this Device. To be implemented in the subclass.

exception hvl_ccb.dev.base.**DeviceExistingException**
Bases: Exception

Exception to indicate that a device with that name already exists.

class hvl_ccb.dev.base.**DeviceSequenceMixin**(*devices: Dict[str, hvl_ccb.dev.base.Device]*)
Bases: abc.ABC

Mixin that can be used on a device or other classes to provide facilities for handling multiple devices in a sequence.

add_device(*name: str*, *device: hvl_ccb.dev.base.Device*) → None
Add a new device to the device sequence.

Parameters

- **name** – is the name of the device.
- **device** – is the instantiated Device object.

Raises *DeviceExistingException* –

apply_to_devices(*func: Callable[[hvl_ccb.dev.base.Device], object]*) → Dict[str, object]
Apply a function to all devices in this sequence.

Parameters **func** – is a function that takes a device as an argument.

Returns a sequence of objects returned by the called function.

get_device(*name: str*) → hvl_ccb.dev.base.Device
Get a device by name.

Parameters **name** – is the name of the device.

Returns the device object from this sequence.

remove_device(*name: str*) → hvl_ccb.dev.base.Device
Remove a device from this sequence and return the object.

Parameters **name** – is the name of the device.

Returns device object.

start() → None
Start all devices in this sequence in their added order.

stop() → None
Stop all devices in this sequence in their reverse order.

class hvl_ccb.dev.base.**EmptyConfig**
Bases: object

Empty configuration dataclass that is the default configuration for a Device.

clean_values()
Cleans and enforces configuration values. Does nothing by default, but may be overridden to add custom configuration value checks.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

class hvl_ccb.dev.base.**SingleCommDevice**(*com*, *dev_config=None*)
Bases: *hvl_ccb.dev.base.Device*, abc.ABC

Base class for devices with a single communication protocol.

com
Get the communication protocol of this device.

Returns an instance of CommunicationProtocol subtype

static default_com_cls() → Type[hvl_ccb.comm.base.CommunicationProtocol]
Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

start() → None
Open the associated communication protocol.

stop() → None
Close the associated communication protocol.

hvl_ccb.dev.ea_psi9000 module

Device class for controlling a Elektro Automatik PSI 9000 power supply over VISA.

It is necessary that a backend for pyvisa is installed. This can be NI-Visa oder pyvisa-py (up to know, all the testing was done with NI-Visa)

class hvl_ccb.dev.ea_psi9000.**PSI9000**(*com: Union[hvl_ccb.dev.ea_psi9000.PSI9000VisaCommunication, hvl_ccb.dev.ea_psi9000.PSI9000VisaCommunicationConfig, dict], dev_config: Union[hvl_ccb.dev.ea_psi9000.PSI9000Config, dict, None] = None*)
Bases: *hvl_ccb.dev.visa.VisaDevice*

Elektro Automatik PSI 9000 power supply.

MS_NOMINAL_CURRENT = 2040

MS_NOMINAL_VOLTAGE = 80

SHUTDOWN_CURRENT_LIMIT = 0.1

SHUTDOWN_VOLTAGE_LIMIT = 0.1

check_master_slave_config() → None
Checks if the master / slave configuration and initializes if successful

Raises ***PSI9000Error*** – if master-slave configuration failed

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

static default_com_cls()
Return the default communication protocol for this device type, which is VisaCommunication.

Returns the VisaCommunication class

get_output() → bool
Reads the current state of the DC output of the source. Returns True, if it is enabled, false otherwise.

Returns the state of the DC output

get_system_lock() → bool
Get the current lock state of the system. The lock state is true, if the remote control is active and false, if not.

Returns the current lock state of the device

get_ui_lower_limits() → Tuple[float, float]
Get the lower voltage and current limits. A lower power limit does not exist.

Returns Umin in V, Imin in A

get_uip_upper_limits() → Tuple[float, float, float]
Get the upper voltage, current and power limits.

Returns Umax in V, Imax in A, Pmax in W

get_voltage_current_setpoint() → Tuple[float, float]
Get the voltage and current setpoint of the current source.

Returns Uset in V, Iset in A

measure_voltage_current() → Tuple[float, float]
Measure the DC output voltage and current

Returns Umeas in V, Imeas in A

set_lower_limits(*voltage_limit: float = None*, *current_limit: float = None*) → None
Set the lower limits for voltage and current. After writing the values a check is performed if the values are set correctly.

Parameters

- **voltage_limit** – is the lower voltage limit in V
- **current_limit** – is the lower current limit in A

Raises ***PSI9000Error*** – if the limits are out of range

set_output(*target_onstate: bool*) → None
Enables / disables the DC output.

Parameters **target_onstate** – enable or disable the output power

Raises ***PSI9000Error*** – if operation was not successful

set_system_lock(*lock: bool*) → None
Lock / unlock the device, after locking the control is limited to this class unlocking only possible when voltage and current are below the defined limits

Parameters **lock** – True: locking, False: unlocking

set_upper_limits(*voltage_limit: float = None*, *current_limit: float = None*, *power_limit: float = None*) → None
Set the upper limits for voltage, current and power. After writing the values a check is performed if the values are set. If a parameter is left blank, the maximum configurable limit is set.

Parameters

- **voltage_limit** – is the voltage limit in V
- **current_limit** – is the current limit in A
- **power_limit** – is the power limit in W

Raises ***PSI9000Error*** – if limits are out of range

set_voltage_current(*volt: float*, *current: float*) → None
Set voltage and current setpoints.

After setting voltage and current, a check is performed if writing was successful.

Parameters

- **volt** – is the setpoint voltage: 0..81.6 V (1.02 * 0-80 V) (absolute max, can be smaller if limits are set)
- **current** – is the setpoint current: 0..2080.8 A (1.02 * 0 - 2040 A) (absolute max, can be smaller if limits are set)

Raises ***PSI9000Error*** – if the desired setpoint is out of limits

start() → None
Start this device.

stop() → None
Stop this device. Turns off output and lock, if enabled.

class hvl_ccb.dev.ea_psi9000.**PSI9000Config**(*spoll_interval: (<class 'int'>, <class 'float'>) = 0.5*, *spoll_start_delay: (<class 'int'>, <class 'float'>) = 2*, *power_limit: (<class 'int'>, <class 'float'>) = 43500*, *voltage_lower_limit: (<class 'int'>, <class 'float'>) = 0.0*, *voltage_upper_limit: (<class 'int'>, <class 'float'>) = 10.0*, *current_lower_limit: (<class 'int'>, <class 'float'>) = 0.0*, *current_upper_limit: (<class 'int'>, <class 'float'>) = 2040.0*)
Bases: *hvl_ccb.dev.visa.VisaDeviceConfig*

Elektro Automatik PSI 9000 power supply device class. The device is communicating over a VISA TCP socket.

Using this power supply, DC voltage and current can be supplied to a load with up to 2040 A and 80 V (using all four available units in parallel). The maximum power is limited by the grid, being at 43.5 kW available through the CEE63 power socket.

clean_values() → None
Cleans and enforces configuration values. Does nothing by default, but may be overridden to add custom configuration value checks.

current_lower_limit = 0.0
Lower current limit in A, depending on the experimental setup.

current_upper_limit = 2040.0
Upper current limit in A, depending on the experimental setup.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

power_limit = 43500
Power limit in W depending on the experimental setup. With 3x63A, this is 43.5kW. Do not change this value, if you do not know what you are doing. There is no lower power limit.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

voltage_lower_limit = 0.0
Lower voltage limit in V, depending on the experimental setup.

voltage_upper_limit = 10.0
Upper voltage limit in V, depending on the experimental setup.

exception hvl_ccb.dev.ea_psi9000.**PSI9000Error**
Bases: Exception

Base error class regarding problems with the PSI 9000 supply.

class hvl_ccb.dev.ea_psi9000.**PSI9000VisaCommunication**(*configuration*)
Bases: *hvl_ccb.comm.visa.VisaCommunication*

Communication protocol used with the PSI 9000 power supply.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.ea_psi9000.**PSI9000VisaCommunicationConfig**(*host: str*, *interface_type: (<class 'str'>, <aenum 'InterfaceType'>) = <InterfaceType.TCPIP_SOCKET: 1>*, *board: int = 0*, *port: int = 5025*, *timeout: int = 5000*, *chunk_size: int = 204800*, *open_timeout: int = 1000*, *write_termination: str = 'n'*, *read_termination: str = 'n'*, *visa_backend: str = ''*)
Bases: *hvl_ccb.comm.visa.VisaCommunicationConfig*

Visa communication protocol config dataclass with specification for the PSI 9000 power supply.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

interface_type = 1

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

hvl_ccb.dev.labjack module

Labjack Device for hvl_ccb. Originally developed and tested for LabJack T7-PRO.

Makes use of the LabJack LJM Library Python wrapper. This wrapper needs an installation of the LJM Library for Windows, Mac OS X or Linux. Go to: https://labjack.com/support/software/installers/ljm and https://labjack.com/support/software/examples/ljm/python

class hvl_ccb.dev.labjack.**LabJack**(*com*, *dev_config=None*)
Bases: *hvl_ccb.dev.base.SingleCommDevice*

LabJack Device. This class is tested with a LabJack T7-Pro and should work with T4, T7 and DIGIT communicating through the LJM Library. Other or older hardware versions and variants of LabJack devices are not supported.

class CjcType(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.NameEnum*

CJC slope and offset

internal = (1, 0)

lm34 = (55.56, 255.37)

class TemperatureUnit(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.NameEnum*

Temperature unit (to be returned)

C = 1

F = 2

K = 0

class ThermocoupleType(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.NameEnum*

Thermocouple type; NONE means disable thermocouple mode.

C = 30

E = 20

J = 21

K = 22

NONE = 0

PT100 = 40

PT1000 = 42

PT500 = 41

R = 23

S = 25

T = 24

static default_com_cls()
Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

get_ain(*channel: int*) → float
Read the voltage of an analog input.

Parameters **channel** – is the AIN number (0..254)

Returns the read voltage

get_sbus_rh(*number: int*) → float
Read the relative humidity value from a serial SBUS sensor.

Parameters **number** – port number (0..22)

Returns relative humidity in %RH

get_sbus_temp(*number: int*) → float
Read the temperature value from a serial SBUS sensor.

Parameters **number** – port number (0..22)

Returns temperature in Kelvin

get_serial_number() → int
Returns the serial number of the connected LabJack.

Returns Serial number.

read_thermocouple(*pos_channel: int*) → float
Read the temperature of a connected thermocouple.

Parameters **pos_channel** – is the AIN number of the positive pin

Returns temperature in specified unit

set_ain_differential(*pos_channel: int*, *differential: bool*) → None
Sets an analog input to differential mode or not. T7-specific: For base differential channels, positive must be even channel from 0-12 and negative must be positive+1. For extended channels 16-127, see Mux80 datasheet.

Parameters

- **pos_channel** – is the AIN number (0..12)

- **differential** – True or False

Raises *LabJackError* – if parameters are unsupported

set_ain_range(*channel: int*, *ain_range: float*) → None
Set the range of an analog input port.

Possible values for `ain_range` are:

- 10 => +- 10 V
- 1 => +- 1 V
- 0.1 => +- 0.1 V
- 0.01 => +- 0.01 V

Parameters

- **channel** – is the AIN number (0..254)
- **ain_range** – is the range specifier

set_ain_resolution(*channel: int*, *resolution: int*) → None
Set the resolution index of an analog input port.

For a T7 Pro values between 0-12 are allowed. 0 will set the resolution index to default value.

Parameters

- **channel** – is the AIN number (0..254)
- **resolution** – is the resolution index

set_ain_thermocouple(*pos_channel: int, thermocouple: Union[None, str, hvl_ccb.dev.labjack.LabJack.ThermocoupleType], cjc_address: int = 60050, cjc_type: Union[str, hvl_ccb.dev.labjack.LabJack.CjcType] = <CjcType.internal: (1, 0)>, vrange: float = 0.01, resolution: int = 10, unit: Union[str, hvl_ccb.dev.labjack.LabJack.TemperatureUnit] = <TemperatureUnit.K: 0>*) → None
Set the analog input channel to thermocouple mode.

Parameters

- **pos_channel** – is the analog input channel of the positive part of the differential pair
- **thermocouple** – None to disable thermocouple mode, or string specifying the thermocouple type
- **cjc_address** – modbus register address to read the CJC temperature
- **cjc_type** – determines cjc slope and offset, 'internal' or 'lm34'
- **vrange** – measurement voltage range (10, 1, 0.1, 0.01)
- **resolution** – resolution index (T7 Pro: 0-12)
- **unit** – is the temperature unit to be returned ('K', 'C' or 'F')

Raises *LabJackError* – if parameters are unsupported

start() → None
Start the Device.

stop() → None
Stop the Device.

exception hvl_ccb.dev.labjack.**LabJackError**
Bases: Exception

Errors of the LabJack device.

hvl_ccb.dev.mbw973 module

Device class for controlling a MBW 973 SF6 Analyzer over a serial connection.

The MBW 973 is a gas analyzer designed for gas insulated switchgear and measures humidity, SF6 purity and SO2 contamination in one go. Manufacturer homepage: https://www.mbw.ch/products/sf6-gas-analysis/973-sf6-analyzer/

class hvl_ccb.dev.mbw973.**MBW973**(*com*, *dev_config=None*)
Bases: *hvl_ccb.dev.base.SingleCommDevice*

MBW 973 dew point mirror device class.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

static default_com_cls()
Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

is_done() → bool
Poll status of the dew point mirror and return True, if all measurements are done.

Returns True, if all measurements are done; False otherwise.

read(*cast_type: Type[CT_co] = <class 'str'>*)
Read value from *self.com* and cast to *cast_type*. Raises *ValueError* if read text (*str*) is not convertible to *cast_type*, e.g. to *float* or to *int*.

Returns Read value of *cast_type* type.

read_float() → float
Convenience wrapper for *self.read()*, with typing hint for return value.

Returns Read *float* value.

read_int() → int
Convenience wrapper for *self.read()*, with typing hint for return value.

Returns Read *int* value.

read_measurements() → Dict[str, float]
Read out measurement values and return them as a dictionary.

Returns Dictionary with values.

set_measuring_options(*humidity: bool = True*, *sf6_purity: bool = False*) → None
Send measuring options to the dew point mirror.

Parameters

- **humidity** – Perform humidity test or not?
- **sf6_purity** – Perform SF6 purity test or not?

start() → None
Start this device. Opens the communication protocol and retrieves the set measurement options from the device.

start_control() → None
Start dew point control to acquire a new value set.

stop() → None
Stop the device. Closes also the communication protocol.

write(*value*) → None
Send *value* to *self.com*.

Parameters **value** – Value to send, converted to *str*.

class hvl_ccb.dev.mbw973.**MBW973Config**(*polling_interval: (<class 'int'>, <class 'float'>) = 2*)
Bases: object

Device configuration dataclass for MBW973.

clean_values()

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

polling_interval = 2
Polling period for *is_done* status queries [in seconds].

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

exception hvl_ccb.dev.mbw973.**MBW973ControlRunningException**
Bases: *hvl_ccb.dev.mbw973.MBW973Error*

Error indicating there is still a measurement running, and a new one cannot be started.

exception hvl_ccb.dev.mbw973.**MBW973Error**
Bases: Exception

General error with the MBW973 dew point mirror device.

exception hvl_ccb.dev.mbw973.**MBW973PumpRunningException**
Bases: *hvl_ccb.dev.mbw973.MBW973Error*

Error indicating the pump of the dew point mirror is still recovering gas, unable to start a new measurement.

class hvl_ccb.dev.mbw973.**MBW973SerialCommunication**(*configuration*)
Bases: *hvl_ccb.comm.serial.SerialCommunication*

Specific communication protocol implementation for the MBW973 dew point mirror. Already predefines device-specific protocol parameters in config.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.mbw973.**MBW973SerialCommunicationConfig**(*port: str, baudrate: int = 9600, parity: (<class 'str'>, <aenum 'Parity'>) = <Parity.NONE: 'N'>, stopbits: (<class 'int'>, <aenum 'Stopbits'>) = <Stopbits.ONE: 1>, bytesize: (<class 'int'>, <aenum 'Bytesize'>) = <Bytesize.EIGHTBITS: 8>, terminator: bytes = b'r', timeout: (<class 'int'>, <class 'float'>) = 3*)
Bases: *hvl_ccb.comm.serial.SerialCommunicationConfig*

baudrate = 9600
Baudrate for MBW973 is 9600 baud

bytesize = 8
One byte is eight bits long

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

parity = 'N'
MBW973 does not use parity

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

stopbits = 1
MBW973 does use one stop bit

terminator = b'\r'
The terminator is only CR

timeout = 3
use 3 seconds timeout as default

class hvl_ccb.dev.mbw973.**Poller**(*period: float*, *callback: Callable*)
Bases: object

Wrapper for the threading.Timer class to periodically poll data.

start() → None
Start the polling timer.

stop() → None
Stop the polling timer.

timer_callback() → None
Callback method that is called every time the timer elapses. It calls the specified user callback function and restarts the timer.

hvl_ccb.dev.rs_rto1024 module

Python module for the Rhode & Schwarz RTO 1024 oscilloscope. The communication to the device is through VISA, type TCPIP / INSTR.

class hvl_ccb.dev.rs_rto1024.**RTO1024**(*com: Union[hvl_ccb.dev.rs_rto1024.RTO1024VisaCommunication, hvl_ccb.dev.rs_rto1024.RTO1024VisaCommunicationConfig, dict]*, *dev_config: Union[hvl_ccb.dev.rs_rto1024.RTO1024Config, dict]*)
Bases: *hvl_ccb.dev.visa.VisaDevice*

Device class for the Rhode & Schwarz RTO 1024 oscilloscope.

SHORT_PAUSE_SECONDS = 0.1
time for short wait periods (depends on both device and network/connection)

class TriggerModes(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.AutoNumberNameEnum*

Enumeration for the three available trigger modes.

AUTO = 1

FREERUN = 3

NORMAL = 2

names = <bound method RTO1024.TriggerModes.names of <aenum 'TriggerModes'>>

backup_waveform(*filename: str*) → None
Backup a waveform file from the standard directory specified in the device configuration to the standard backup destination specified in the device configuration. The filename has to be specified without .bin or path.

Parameters **filename** – The waveform filename without extension and path

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

static default_com_cls()
Return the default communication protocol for this device type, which is VisaCommunication.

Returns the VisaCommunication class

file_copy(*source: str*, *destination: str*) → None
Copy a file from one destination to another on the oscilloscope drive. If the destination file already exists, it is overwritten without notice.

Parameters

- **source** – absolute path to the source file on the DSO filesystem
- **destination** – absolute path to the destination file on the DSO filesystem

Raises ***RTO1024Error*** – if the operation did not complete

get_timestamps() → List[float]
Gets the timestamps of all recorded frames in the history and returns them as a list of floats.

Returns list of timestamps in [s]

Raises ***RTO1024Error*** – if the timestamps are invalid

list_directory(*path: str*) → List[Tuple[str, str, int]]
List the contents of a given directory on the oscilloscope filesystem.

Parameters **path** – is the path to a folder

Returns a list of filenames in the given folder

load_configuration(*filename: str*) → None
Load current settings from a configuration file. The filename has to be specified without base directory and '.dfl' extension.

Information from the manual *ReCaLl* calls up the instrument settings from an intermediate memory identified by the specified number. The instrument settings can be stored to this memory using the command **SAV* with the associated number. It also activates the instrument settings which are stored in a file and loaded using *MMEMory:LOAD:STATe* .

Parameters **filename** – is the name of the settings file without path and extension

local_display(*state: bool*) → None
Enable or disable local display of the scope.

Parameters **state** – is the desired local display state

prepare_ultra_segmentation() → None
Make ready for a new acquisition in ultra segmentation mode. This function does one acquisition without ultra segmentation to clear the history and prepare for a new measurement.

run_continuous_acquisition() → None
Start acquiring continuously.

run_single_acquisition() → None
Start a single or Nx acquisition.

save_configuration(*filename: str*) → None
Save the current oscilloscope settings to a file. The filename has to be specified without path and '.dfl' extension, the file will be saved to the configured settings directory.

Information from the manual *SAVe* stores the current instrument settings under the specified number in an intermediate memory. The settings can be recalled using the command **RCL* with the associated number. To transfer the stored instrument settings to a file, use *MMEMory:STORe:STATe* .

Parameters **filename** – is the name of the settings file without path and extension

save_waveform_history(*filename: str*, *channel: int*, *waveform: int = 1*) → None
Save the history of one channel and one waveform to a .bin file. This function is used after an acquisition using sequence trigger mode (with or without ultra segmentation) was performed.

Parameters

- **filename** – is the name (without extension) of the file
- **channel** – is the channel number
- **waveform** – is the waveform number (typically 1)

Raises ***RTO1024Error*** – if storing waveform times out

set_acquire_length(*timerange: float*) → None
Defines the time of one acquisition, that is the time across the 10 divisions of the diagram.

- Range: 250E-12 … 500 [s]
- Increment: 1E-12 [s]
- *RST = 0.5 [s]

Parameters **timerange** – is the time for one acquisition. Range: 250e-12 … 500 [s]

set_channel_position(*channel: int*, *position: float*) → None
Sets the vertical position of the indicated channel as a graphical value.

- Range: -5.0 … 5.0 [div]
- Increment: 0.02
- *RST = 0

Parameters

- **channel** – is the channel number (1..4)
- **position** – is the position. Positive values move the waveform up, negative values move it down.

set_channel_range(*channel: int*, *v_range: float*) → None
Sets the voltage range across the 10 vertical divisions of the diagram. Use the command alternatively instead of set_channel_scale.

- Range for range: Depends on attenuation factors and coupling. With 1:1 probe and external attenuations and 50 Ω input coupling, the range is 10 mV to 10 V. For 1 MΩ input coupling, it is 10 mV to 100 V. If the probe and/or external attenuation is changed, multiply the range values by the attenuation factors.
- Increment: 0.01
- *RST = 0.5

Parameters

- **channel** – is the channel number (1..4)

- **v_range** – is the vertical range [V]

set_channel_scale(*channel: int*, *scale: float*) → None
Sets the vertical scale for the indicated channel. The scale value is given in volts per division.

- Range for scale: depends on attenuation factor and coupling. With 1:1 probe and external attenuations and 50 Ω input coupling, the vertical scale (input sensitivity) is 1 mV/div to 1 V/div. For 1 MΩ input coupling, it is 1 mV/div to 10 V/div. If the probe and/or external attenuation is changed, multiply the values by the attenuation factors to get the actual scale range.
- Increment: 1e-3
- *RST = 0.05

See also: set_channel_range

Parameters

- **channel** – is the channel number (1..4)
- **scale** – is the vertical scaling [V/div]

set_channel_state(*channel: int*, *state: bool*) → None
Switches the channel signal on or off.

Parameters

- **channel** – is the input channel (1..4)
- **state** – is True for on, False for off

set_reference_point(*percentage: int*) → None
Sets the reference point of the time scale in % of the display. If the "Trigger offset" is zero, the trigger point matches the reference point. ReferencePoint = zero pint of the time scale

- Range: 0 … 100 [%]
- Increment: 1 [%]
- *RST = 50 [%]

Parameters **percentage** – is the reference in %

set_repetitions(*number: int*) → None
Set the number of acquired waveforms with RUN Nx SINGLE. Also defines the number of waveforms used to calculate the average waveform.

- Range: 1 … 16777215
- Increment: 10
- *RST = 1

Parameters **number** – is the number of waveforms to acquire

set_trigger_level(*channel: int*, *level: float*, *event_type: int = 1*) → None
Sets the trigger level for the specified event and source.

- Range: -10 to 10 V
- Increment: 1e-3 V
- *RST = 0 V

Parameters

- **channel** – indicates the trigger source.
  - 1..4 = channel 1 to 4, available for all event types 1..3
  - 5 = external trigger input on the rear panel for analog signals, available for A-event type = 1
  - 6..9 = not available
- **level** – is the voltage for the trigger level in [V].
- **event_type** – is the event type. 1: A-Event, 2: B-Event, 3: R-Event

set_trigger_mode(*mode: Union[str, hvl_ccb.dev.rs_rto1024.RTO1024.TriggerModes]*) → None
Sets the trigger mode which determines the behavior of the instrument if no trigger occurs.

Parameters **mode** – is either auto, normal, or freerun.

Raises ***RTO1024Error*** – if an invalid triggermode is selected

set_trigger_source(*channel: int*, *event_type: int = 1*) → None
Set the trigger (Event A) source channel.

Parameters

- **channel** – is the channel number (1..4)
- **event_type** – is the event type. 1: A-Event, 2: B-Event, 3: R-Event

start() → None
Start the RTO1024 oscilloscope and bring it into a defined state and remote mode.

stop() → None
Stop the RTO1024 oscilloscope, reset events and close communication. Brings back the device to a state where local operation is possible.

stop_acquisition() → None
Stop any acquisition.

class hvl_ccb.dev.rs_rto1024.**RTO1024Config**(*waveforms_path: str*, *settings_path: str*, *backup_path: str*, *spoll_interval: (<class 'int'>, <class 'float'>) = 0.5*, *spoll_start_delay: (<class 'int'>, <class 'float'>) = 2*, *command_timeout_seconds: (<class 'int'>, <class 'float'>) = 60*)
Bases: *hvl_ccb.dev.visa.VisaDeviceConfig*, hvl_ccb.dev.rs_rto1024._RTO1024ConfigDefaultsBase, hvl_ccb.dev.rs_rto1024._RTO1024ConfigBase

Configdataclass for the RTO1024 device.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

exception hvl_ccb.dev.rs_rto1024.**RTO1024Error**
Bases: Exception

class hvl_ccb.dev.rs_rto1024.**RTO1024VisaCommunication**(*configuration*)
Bases: *hvl_ccb.comm.visa.VisaCommunication*

Specialization of VisaCommunication for the RTO1024 oscilloscope

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.rs_rto1024.**RTO1024VisaCommunicationConfig**(*host: str*, *interface_type: (<class 'str'>, <aenum 'InterfaceType'>)* = *<InterfaceType.TCPIP_INSTR: 2>*, *board: int = 0*, *port: int = 5025*, *timeout: int = 5000*, *chunk_size: int = 204800*, *open_timeout: int = 1000*, *write_termination: str = 'n'*, *read_termination: str = 'n'*, *visa_backend: str = ''*)
Bases: *hvl_ccb.comm.visa.VisaCommunicationConfig*

Configuration dataclass for VisaCommunication with specifications for the RTO1024 device class.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

interface_type = 2

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

hvl_ccb.dev.se_ils2t module

Device class for controlling a Schneider Electric ILS2T stepper drive over modbus TCP.

class hvl_ccb.dev.se_ils2t.**ILS2T**(*com*, *dev_config=None*)
Bases: *hvl_ccb.dev.base.SingleCommDevice*

Schneider Electric ILS2T stepper drive class.

ACTION_JOG_VALUE = 0
The single action value for *ILS2T.Mode.JOG*

class ActionsPtp
Bases: enum.IntEnum

Allowed actions in the point to point mode (*ILS2T.Mode.PTP*).

ABSOLUTE_POSITION = 0

RELATIVE_POSITION_MOTOR = 2

RELATIVE_POSITION_TARGET = 1

DEFAULT_IO_SCANNING_CONTROL_VALUES = {'action': 2, 'continue_after_stop_cu': 0, 'dis
Default IO Scanning control mode values

class Mode
Bases: enum.IntEnum

ILS2T device modes

JOG = 1

PTP = 3

class Ref16Jog
Bases: enum.Flag

Allowed values for ILS2T ref_16 register (the shown values are the integer representation of the bits), all in Jog mode = 1

FAST = 4

NEG = 2

NEG_FAST = 6

NONE = 0

POS = 1

POS_FAST = 5

class RegAddr

Bases: enum.IntEnum

ILS2T Modbus Register Adresses

ACCESS_ENABLE = 282

FLT_INFO = 15362

FLT_MEM_DEL = 15112

FLT_MEM_RESET = 15114

IO_SCANNING = 6922

JOGN_FAST = 10506

JOGN_SLOW = 10504

POSITION = 7706

RAMP_ACC = 1556

RAMP_DECEL = 1558

RAMP_N_MAX = 1554

RAMP_TYPE = 1574

SCALE = 1550

TEMP = 7200

VOLT = 7198

class RegDatatype(**args*, ***kwds*)

Bases: aenum.Enum

Modbus Register Datatypes

From the manual of the drive:

datatype	byte	min	max
INT8	1 Byte	-128	127
UINT8	1 Byte	0	255
INT16	2 Byte	-32_768	32_767
UINT16	2 Byte	0	65_535
INT32	4 Byte	-2_147_483_648	2_147_483_647
UINT32	4 Byte	0	4_294_967_295
BITS	just 32bits	N/A	N/A

INT32 = (-2147483648, 2147483647)

is_in_range(*value: int*) → bool

class State

Bases: enum.IntEnum

State machine status values

ON = 6

QUICKSTOP = 7

READY = 4

absolute_position(*position: int*) → None
Turn the motor until it reaches the absolute position. This function does not enable or disable the motor automatically.

Parameters **position** – absolute position of motor in user defined steps.

absolute_position_and_wait(*position: int*) → None
Enable motor, perform absolute position and wait until done, disable.

Parameters **position** – absolute position of motor in user defined steps.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

static default_com_cls()
Get the class for the default communication protocol used with this device.

Returns the type of the standard communication protocol for this device

disable() → None
Disable the driver of the stepper motor and enable the brake.

do_ioscanning_write(***kwargs*) → None
Perform a write operation using IO Scanning mode.

Parameters **kwargs** – Keyword-argument list with options to send, remaining are taken from the defaults.

enable() → None
Enable the driver of the stepper motor and disable the brake.

get_dc_volt() → float
Read the DC supply voltage of the motor.

Returns DC input voltage.

get_error_code() → Dict[int, Dict[str, Any]]
Read all messages in fault memory. Will read the full error message and return the decoded values. At the end the fault memory of the motor will be deleted. In addition, reset_error is called to re-enable the motor for operation.

Returns Dictionary with all information

get_position() → int
Read the position of the drive and store into status.

Returns Position step value

get_status() → Dict[str, int]
Perform an IO Scanning read and return the status of the motor.

Returns dict with status information.

get_temperature() → int
Read the temperature of the motor.

Returns Temperature in degrees Celsius.

jog_run(*direction: bool = True*, *fast: bool = False*) → None
Slowly turn the motor in positive direction.

jog_stop() → None
Stop turning the motor in Jog mode.

quickstop() → None
Stops the motor with high deceleration rate and falls into error state. Reset with *reset_error* to recover into normal state.

relative_step(*steps: int*) → None
Turn the motor the relative amount of steps. This function does not enable or disable the motor automatically. positive numbers -> CW negative numbers -> CCW

Parameters **steps** – Number of steps to turn the motor.

relative_step_and_wait(*steps: int*) → None
Enable motor, perform relative steps and wait until done, disable.

Parameters **steps** – Number of steps.

reset_error() → None
Resets the motor into normal state after quick stop or another error occured.

set_jog_speed(*slow: int = 60*, *fast: int = 180*) → None
Set the speed for jog mode. Default values correspond to startup values of the motor.

Parameters

- **slow** – RPM for slow jog mode.
- **fast** – RPM for fast jog mode.

set_max_acceleration(*rpm_minute: int*) → None
Set the maximum acceleration of the motor.

Parameters **rpm_minute** – revolution per minute per minute

set_max_deceleration(*rpm_minute: int*) → None
Set the maximum deceleration of the motor.

Parameters **rpm_minute** – revolution per minute per minute

set_max_rpm(*rpm: int*) → None
Set the maximum RPM.

Parameters **rpm** – revolution per minute (0 < rpm <= RPM_MAX)

Raises ***ILS2TException*** – if RPM is out of range

set_ramp_type(*ramp_type: int = -1*) → None

Set the ramp type. There are two options available: 0: linear ramp -1: motor optimized ramp

Parameters **ramp_type** – 0: linear ramp | -1: motor optimized ramp

start() → None
Start this device.

stop() → None
Stop this device. Disables the motor (applies brake), disables access and closes the communication protocol.

user_steps(*steps: int = 16384*, *revolutions: int = 1*) → None
Define steps per revolution. Default is 16384 steps per revolution. Maximum precision is 32768 steps per revolution.

Parameters

- **steps** – number of steps in *revolutions*.

- **revolutions** – number of revolutions corresponding to *steps*.

class hvl_ccb.dev.se_ils2t.**ILS2TConfig**(*rpm_max_init: int = 1500*)
Bases: object

Configuration for the ILS2T stepper motor device.

clean_values()
Cleans and enforces configuration values. Does nothing by default, but may be overridden to add custom configuration value checks.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

is_configdataclass = True

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

rpm_max_init = 1500
initial maximum RPM for the motor, can be set up to 3000 RPM. The user is allowed to set a new max RPM at runtime using *ILS2T.set_max_rpm()*, but the value must never exceed this configuration setting.

exception hvl_ccb.dev.se_ils2t.**ILS2TException**
Bases: Exception

Exception to indicate problems with the SE ILS2T stepper motor.

class hvl_ccb.dev.se_ils2t.**ILS2TModbusTcpCommunication**(*configuration*)
Bases: *hvl_ccb.comm.modbus_tcp.ModbusTcpCommunication*

Specific implementation of Modbus/TCP for the Schneider Electric ILS2T stepper motor.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

class hvl_ccb.dev.se_ils2t.**ILS2TModbusTcpCommunicationConfig**(*host: str*, *unit: int = 255*, *port: int = 502*)
Bases: *hvl_ccb.comm.modbus_tcp.ModbusTcpCommunicationConfig*

Configuration dataclass for Modbus/TCP communciation specific for the Schneider Electric ILS2T stepper motor.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

unit = 255
The unit has to be 255 such that IO scanning mode works.

exception hvl_ccb.dev.se_ils2t.**IoScanningModeValueError**
Bases: *hvl_ccb.dev.se_ils2t.ILS2TException*

Exception to indicate that the selected IO scanning mode is invalid.

exception hvl_ccb.dev.se_ils2t.**ScalingFactorValueError**
Bases: *hvl_ccb.dev.se_ils2t.ILS2TException*

Exception to indicate that a scaling factor value is invalid.

hvl_ccb.dev.visa module

class hvl_ccb.dev.visa.**VisaDevice**(*com: Union[hvl_ccb.comm.visa.VisaCommunication, hvl_ccb.comm.visa.VisaCommunicationConfig, dict], dev_config: Union[hvl_ccb.dev.visa.VisaDeviceConfig, dict, None] = None*)
Bases: *hvl_ccb.dev.base.SingleCommDevice*

Device communicating over the VISA protocol using VisaCommunication.

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

static default_com_cls() → Type[hvl_ccb.comm.visa.VisaCommunication]
Return the default communication protocol for this device type, which is VisaCommunication.

Returns the VisaCommunication class

get_error_queue() → str
Read out error queue and logs the error.

Returns Error string

get_identification() → str
Queries *"*IDN?"* and returns the identification string of the connected device.

Returns the identification string of the connected device

reset() → None
Send *"*RST"* and *"*CLS"* to the device. Typically sets a defined state.

spoll_handler()
Reads the status byte and decodes it. The status byte STB is defined in IEEE 488.2. It provides a rough overview of the instrument status.

Returns

start() → None
Start the VisaDevice. Sets up the status poller and starts it.

Returns

stop() → None
Stop the VisaDevice. Stops the polling thread and closes the communication protocol.

Returns

wait_operation_complete(*timeout: float = None*) → bool
Waits for a operation complete event. Returns after timeout [s] has expired or the operation complete event has been caught.

Parameters **timeout** – Time in seconds to wait for the event

Returns True, if OPC event is caught, False if timeout expired

class hvl_ccb.dev.visa.**VisaDeviceConfig**(*spoll_interval: (<class 'int'>, <class 'float'>) = 0.5, spoll_start_delay: (<class 'int'>, <class 'float'>) = 2*)
Bases: hvl_ccb.dev.visa._VisaDeviceConfigDefaultsBase, hvl_ccb.dev.visa._VisaDeviceConfigBase

Configdataclass for a VISA device.

force_value(*fieldname*, *value*)
Forces a value to a dataclass field despite the class being frozen.

Parameters

- **fieldname** – name of the field
- **value** – value to assign

classmethod keys() → Sequence[str]
Returns a list of all configdataclass fields key-names.

Returns a list of strings containing all keys.

classmethod optional_defaults() → Dict[str, object]
Returns a list of all configdataclass fields, that have a default value assigned and may be optionally specified on instantiation.

Returns a list of strings containing all optional keys.

classmethod required_keys() → Sequence[str]
Returns a list of all configdataclass fields, that have no default value assigned and need to be specified on instantiation.

Returns a list of strings containing all required keys.

class hvl_ccb.dev.visa.**VisaStatusPoller**(*target: Callable*, *interval: float = 0.5*, *start_delay: float = 5*)

Bases: threading.Thread

Thread to periodically poll the status byte of a VISA device.

run() → None
Threaded method.

Returns

stop() → None
Gracefully stop the poller.

Returns

Module contents

Devices subpackage.

hvl_ccb.utils package

Submodules

hvl_ccb.utils.enum module

class hvl_ccb.utils.enum.**AutoNumberNameEnum**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.StrEnumBase*, aenum.AutoNumberEnum

Auto-numbered enum with names used as string representation, and with lookup and equality based on this representation.

class hvl_ccb.utils.enum.**NameEnum**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.StrEnumBase*

Int enum with names used as string representation, and with lookup and equality based on this representation.

class hvl_ccb.utils.enum.**StrEnumBase**(**args*, ***kwds*)
Bases: aenum.Enum

String representation-based equality and lookup.

class hvl_ccb.utils.enum.**ValueEnum**(**args*, ***kwds*)
Bases: *hvl_ccb.utils.enum.StrEnumBase*

Enum with string representation of values used as string representation, and with lookup and equality based on this representation.

Attention: to avoid errors, best use together with *unique* enum decorator.

hvl_ccb.utils.typing module

Additional Python typing module utilities

hvl_ccb.utils.typing.**check_generic_type**(*value*, *type_*, *name='instance'*)
Check if *value* is of a generic type *type_*. Raises *TypeError* if it's not.

Parameters

- **name** – name to report in case of an error
- **value** – value to check
- **type** – generic type to check against

hvl_ccb.utils.typing.**is_generic**(*type_*)
Check if class is a user-defined generic type, for example *Union[int, float]* but not *List*.

Parameters **type** – type to check

hvl_ccb.utils.typing.**is_type_hint**(*type_*)
Check if class is a generic type, for example *Union* or *List[int]*

Parameters **type** – type to check

Module contents

4.1.2 Submodules

hvl_ccb.configuration module

Facilities providing classes for handling configuration for communication protocols and devices.

class hvl_ccb.configuration.**ConfigurationMixin**(*configuration*)
Bases: abc.ABC

Mixin providing configuration to a class.

config
ConfigDataclass property.

Returns the configuration

static config_cls()
Return the default configdataclass class.

Returns a reference to the default configdataclass class

configuration_save_json(*path: str*) → None
Save current configuration as JSON file.

Parameters **path** – path to the JSON file.

classmethod from_json(*filename: str*)
Instantiate communication protocol using configuration from a JSON file.

Parameters **filename** – Path and filename to the JSON configuration

hvl_ccb.configuration.**configdataclass**(*direct_decoration=None*, *frozen=True*)
Decorator to make a class a configdataclass. Types in these dataclasses are enforced. Implement a function clean_values(self) to do additional checking on value ranges etc.

It is possible to inherit from a configdataclass and re-decorate it with @configdataclass. In a subclass, default values can be added to existing fields. Note: adding additional non-default fields is prone to errors, since the order has to be respected through the whole chain (first non-default fields, only then default-fields).

Parameters **frozen** – defaults to True. False allows to later change configuration values. Attention: if configdataclass is not frozen and a value is changed, typing is not enforced anymore!

hvl_ccb.experiment_manager module

Main module containing the top level ExperimentManager class. Inherit from this class to implement your own experiment functionality in another project and it will help you start, stop and manage your devices.

exception hvl_ccb.experiment_manager.**ExperimentError**
Bases: Exception

Exception to indicate that the current status of the experiment manager is on ERROR and thus no operations can be made until reset.

class hvl_ccb.experiment_manager.**ExperimentManager**(*devices: Dict[str, hvl_ccb.dev.base.Device]*)
Bases: *hvl_ccb.dev.base.DeviceSequenceMixin*

Experiment Manager can start and stop communication protocols and devices. It provides methods to queue commands to devices and collect results.

add_device(*name: str*, *device: hvl_ccb.dev.base.Device*) → None
Add a new device to the manager. If the experiment is running, automatically start the device. If a device with this name already exists, raise an exception.

Parameters

- **name** – is the name of the device.
- **device** – is the instantiated Device object.

Raises ***DeviceExistingException*** –

finish() → None
Stop experimental setup, stop all devices.

is_error() → bool
Returns true, if the status of the experiment manager is *error*.

Returns True if on error, false otherwise

is_finished() → bool
Returns true, if the status of the experiment manager is *finished*.

Returns True if finished, false otherwise

is_running() → bool
Returns true, if the status of the experiment manager is *running*.

Returns True if running, false otherwise

run() → None
Start experimental setup, start all devices.

start() → None
Alias for ExperimentManager.run()

status
Get experiment status.

Returns experiment status enum code.

stop() → None
Alias for ExperimentManager.finish()

class hvl_ccb.experiment_manager.**ExperimentStatus**
Bases: enum.Enum

Enumeration for the experiment status

```
ERROR = 5
FINISHED = 4
FINISHING = 3
INITIALIZED = 0
RUNNING = 2
STARTING = 1
```

4.1.3 Module contents

Top-level package for HVL Common Code Base.

CHAPTER 5

Contributing

Contributions are welcome, and they are greatly appreciated! Every little bit helps, and credit will always be given.

You can contribute in many ways:

5.1 Types of Contributions

5.1.1 Report Bugs

Report bugs at https://gitlab.ethz.ch/hvl_priv/hvl_ccb/issues.

If you are reporting a bug, please include:

- Your operating system name and version.
- Any details about your local setup that might be helpful in troubleshooting.
- Detailed steps to reproduce the bug.

5.1.2 Fix Bugs

Look through the GitLab issues for bugs. Anything tagged with "bug" and "help wanted" is open to whoever wants to implement it.

5.1.3 Implement Features

Look through the GitLab issues for features. Anything tagged with "enhancement" and "help wanted" is open to whoever wants to implement it.

5.1.4 Write Documentation

HVL Common Code Base could always use more documentation, whether as part of the official HVL Common Code Base docs, in docstrings, or even on the web in blog posts, articles, and such.

5.1.5 Submit Feedback

The best way to send feedback is to file an issue at https://gitlab.ethz.ch/hvl_priv/hvl_ccb/issues.

If you are proposing a feature:

- Explain in detail how it would work.
- Keep the scope as narrow as possible, to make it easier to implement.
- Remember that this is a volunteer-driven project, and that contributions are welcome :)

5.2 Get Started!

Ready to contribute? Here's how to set up *hvl_ccb* for local development.

1. Clone *hvl_ccb* repo from GitLab.

   $ git clone git@gitlab.ethz.ch:your_name_here/hvl_ccb.git

2. Install your local copy into a virtualenv. Assuming you have virtualenvwrapper installed, this is how you set up your fork for local development:

```
$ mkvirtualenv hvl_ccb
$ cd hvl_ccb/
$ python setup.py develop
$ pip install -r requirements_dev.txt
```

3. Create a branch for local development:

```
$ git checkout -b name-of-your-bugfix-or-feature
```

   Now you can make your changes locally.

4. When you're done making changes, check that your changes pass flake8 and the tests, including testing other Python versions with tox:

```
$ flake8 hvl_ccb tests
$ python setup.py test or py.test
$ tox
```

   To get flake8 and tox, just pip install them into your virtualenv. You can also use the provided make-like shell script to run flake8 and tests:

```
$ ./make.sh lint
$ ./make.sh test
```

5. Commit your changes and push your branch to GitLab:

```
$ git add .
$ git commit -m "Your detailed description of your changes."
$ git push origin name-of-your-bugfix-or-feature
```

6. Submit a merge request through the GitLab website.

5.3 Merge Request Guidelines

Before you submit a merge request, check that it meets these guidelines:

1. The merge request should include tests.
2. If the merge request adds functionality, the docs should be updated. Put your new functionality into a function with a docstring, and add the feature to the list in README.rst.
3. The merge request should work for Python 3.7. Check https://gitlab.ethz.ch/hvl_priv/hvl_ccb/merge_requests and make sure that the tests pass for all supported Python versions.

5.4 Tips

- To run tests from a single file:

```
$ py.test tests/test_hvl_ccb.py
```

  or a single test function:

```
$ py.test tests/test_hvl_ccb.py::test_command_line_interface
```

- To add dependency, edit appropriate `*requirements` variable in the `setup.py` file and re-run:

```
$ python setup.py develop
```

- To generate a PDF version of the Sphinx documentation instead of HTML use:

```
$ rm -rf docs/hvl_ccb.rst docs/modules.rst docs/_build && sphinx-apidoc -o docs/␣
↪hvl_ccb && python -msphinx -M latexpdf docs/ docs/_build
```

  This command can also be run through the make-like shell script:

```
$ ./make.sh docs-pdf
```

  This requires a local installation of a LaTeX distribution, e.g. MikTeX.

5.5 Deploying

A reminder for the maintainers on how to deploy. Create release-N.M.K branch. Make sure all your changes are committed (including an entry in HISTORY.rst). Then run:

```
$ bumpversion patch # possible: major / minor / patch
$ git push
$ git push --tags
$ make release
```

Merge the release branch into master and devel branches with `--no-ff` flag.

Optionally, go to https://gitlab.ethz.ch/hvl_priv/hvl_ccb/tags/vM.N.P/release/edit and add release notes (e.g. changes lists).

CHAPTER 6

Credits

6.1 Development Lead

- Mikołaj Rybiński <mikolaj.rybinski@id.ethz.ch>
- David Graber <graber@eeh.ee.ethz.ch>

6.2 Contributors

- Henrik Menne <henrik.menne@eeh.ee.ethz.ch>

CHAPTER 7

History

7.1 current

- Use PyPI labjack-ljm (no external dependencies)

7.2 0.3.2 (2019-05-08)

- INSTALLATION.rst with LJMPython prerequisite info

7.3 0.3.1 (2019-05-02)

- readthedocs.org support

7.4 0.3 (2019-05-02)

- Prevent an automatic close of VISA connection when not used.
- Rhode & Schwarz RTO 1024 oscilloscope using VISA interface over TCP::INSTR.
- Extended tests incl. messages sent to devices.
- Added Supercube device using an OPC UA client
- Added Supercube 2015 device using an OPC UA client (for interfacing with old system version)

7.5 0.2.1 (2019-04-01)

- Fix issue with LJMPython not being installed automatically with setuptools.

7.6 0.2.0 (2019-03-31)

- LabJack LJM Library communication wrapper and LabJack device.
- Modbus TCP communication protocol.
- Schneider Electric ILS2T stepper motor drive device.
- Elektro-Automatik PSI9000 current source device and VISA communication wrapper.
- Separate configuration classes for communication protocols and devices.
- Simple experiment manager class.

7.7 0.1.0 (2019-02-06)

- Communication protocol base and serial communication implementation.
- Device base and MBW973 implementation.

CHAPTER 8

Indices and tables

- genindex
- modindex
- search

Python Module Index

h

Index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W