

---

# python-can

*Release 4.3.1*

**unknown**

**Apr 29, 2024**



## CONTENTS

<b>1</b>	<b>Installation</b>	<b>3</b>
<b>2</b>	<b>Configuration</b>	<b>7</b>
<b>3</b>	<b>Library API</b>	<b>11</b>
<b>4</b>	<b>Hardware Interfaces</b>	<b>71</b>
<b>5</b>	<b>Virtual Interfaces</b>	<b>135</b>
<b>6</b>	<b>Plugin Interface</b>	<b>143</b>
<b>7</b>	<b>Other CAN bus tools</b>	<b>145</b>
<b>8</b>	<b>Scripts</b>	<b>147</b>
<b>9</b>	<b>Developer's Overview</b>	<b>155</b>
<b>10</b>	<b>History</b>	<b>159</b>
<b>11</b>	<b>Known Bugs</b>	<b>161</b>
	<b>Python Module Index</b>	<b>163</b>
	<b>Index</b>	<b>165</b>



The **python-can** library provides Controller Area Network support for [Python](#), providing common abstractions to different hardware devices, and a suite of utilities for sending and receiving messages on a CAN bus.

**python-can** runs any where Python runs; from high powered computers with commercial *CAN to USB* devices right down to low powered devices running linux such as a BeagleBone or RaspberryPi.

More concretely, some example uses of the library:

- Passively logging what occurs on a CAN bus. For example monitoring a commercial vehicle using its [OBD-II port](#).
- Testing of hardware that interacts via CAN. Modules found in modern cars, motorcycles, boats, and even wheelchairs have had components tested from Python using this library.
- Prototyping new hardware modules or software algorithms in-the-loop. Easily interact with an existing bus.
- Creating virtual modules to prototype CAN bus communication.

Brief example of the library in action: connecting to a CAN bus, creating and sending a message:

```

1  #!/usr/bin/env python
2
3  """
4  This example shows how sending a single message works.
5  """
6
7  import can
8
9
10 def send_one():
11     """Sends a single message."""
12
13     # this uses the default configuration (for example from the config file)
14     # see https://python-can.readthedocs.io/en/stable/configuration.html
15     with can.Bus() as bus:
16         # Using specific buses works similar:
17         # bus = can.Bus(interface='socketcan', channel='vcan0', bitrate=250000)
18         # bus = can.Bus(interface='pcan', channel='PCAN_USBBUS1', bitrate=250000)
19         # bus = can.Bus(interface='ixxat', channel=0, bitrate=250000)
20         # bus = can.Bus(interface='vector', app_name='CANalyzer', channel=0, bitrate=250000)
21         # ...
22
23         msg = can.Message(
24             arbitration_id=0xC0FFEE, data=[0, 25, 0, 1, 3, 1, 4, 1], is_extended_id=True
25         )
26
27         try:
28             bus.send(msg)
29             print(f"Message sent on {bus.channel_info}")
30         except can.CanError:
31             print("Message NOT sent")
32
33
34 if __name__ == "__main__":
35     send_one()

```

Contents:



## INSTALLATION

Install the `can` package from PyPi with `pip` or similar:

```
$ pip install python-can
```

**Warning:** As most likely you will want to interface with some hardware, you may also have to install platform dependencies. Be sure to check any other specifics for your hardware in [Hardware Interfaces](#).

Many interfaces can install their dependencies at the same time as `python-can`, for instance the interface `serial` includes the `pyserial` dependency which can be installed with the `serial` extra:

```
$ pip install python-can[serial]
```

### 1.1 GNU/Linux dependencies

Reasonably modern Linux Kernels (2.6.25 or newer) have an implementation of `socketcan`. This version of `python-can` will directly use `socketcan` if called with Python 3.3 or greater, otherwise that interface is used via `ctypes`.

### 1.2 Windows dependencies

#### 1.2.1 Kvaser

To install `python-can` using the Kvaser CANLib SDK as the backend:

1. Install Kvaser's latest Windows CANLib drivers.
2. Test that Kvaser's own tools work to ensure the driver is properly installed and that the hardware is working.

## 1.2.2 PCAN

Download and install the latest driver for your interface:

- [Windows](#) (also supported on *Cygwin*)
- [Linux](#) (also works without, see also *Linux installation*)
- [macOS](#)

Note that PCANBasic API timestamps count seconds from system startup. To convert these to epoch times, the uptime library is used. If it is not available, the times are returned as number of seconds from system startup. To install the uptime library, run `pip install python-can[pcan]`.

This library can take advantage of the [Python for Windows Extensions](#) library if installed. It will be used to get notified of new messages instead of the CPU intensive polling that will otherwise have be used.

## 1.2.3 IXXAT

To install `python-can` using the IXXAT VCI V3 or V4 SDK as the backend:

1. Install IXXAT's latest [Windows VCI V3 SDK or VCI V4 SDK \(Win10\) drivers](#).
2. Test that IXXAT's own tools (i.e. MiniMon) work to ensure the driver is properly installed and that the hardware is working.

## 1.2.4 NI-CAN

Download and install the NI-CAN drivers from [National Instruments](#).

Currently the driver only supports 32-bit Python on Windows.

## 1.2.5 neoVI

See *Intrepid Control Systems neoVI*.

## 1.2.6 Vector

To install `python-can` using the XL Driver Library as the backend:

1. Install the [latest drivers](#) for your Vector hardware interface.
2. Install the [XL Driver Library](#) or copy the `vxlapl.dll` and/or `vxlapl64.dll` into your working directory.
3. Use Vector Hardware Configuration to assign a channel to your application.



### 1.2.7 CANTact

CANTact is supported on Linux, Windows, and macOS. To install `python-can` using the CANTact driver backend:

```
python3 -m pip install "python-can[cantact]"
```

If `python-can` is already installed, the CANTact backend can be installed separately:

```
pip install cantact
```

Additional CANTact documentation is available at [cantact.io](https://cantact.io).

### 1.2.8 CanViewer

`python-can` has support for showing a simple CAN viewer terminal application by running `python -m can.viewer`. On Windows, this depends on the [windows-curses](#) library which can be installed with:

```
python -m pip install "python-can[viewer]"
```

## 1.3 Installing python-can in development mode

A “development” install of this package allows you to make changes locally or pull updates from the Git repository and use them without having to reinstall. Download or clone the source repository then:

```
python setup.py develop
```



## CONFIGURATION

Usually this library is used with a particular CAN interface, this can be specified in code, read from configuration files or environment variables.

See `can.util.load_config()` for implementation.

### 2.1 In Code

The `can` object exposes an `rc` dictionary which can be used to set the **interface** and **channel**.

```
import can
can.rc['interface'] = 'socketcan'
can.rc['channel'] = 'vcan0'
can.rc['bitrate'] = 500000
from can.interface import Bus

bus = Bus()
```

You can also specify the interface and channel for each `Bus` instance:

```
import can

bus = can.interface.Bus(interface='socketcan', channel='vcan0', bitrate=500000)
```

### 2.2 Configuration File

On Linux and macOS systems the config file is searched in the following paths:

1. `~/can.conf`
2. `/etc/can.conf`
3. `$HOME/.can`
4. `$HOME/.canrc`

On Windows systems the config file is searched in the following paths:

1. `%USERPROFILE%/can.conf`
2. `can.ini` (current working directory)
3. `%APPDATA%/can.ini`

The configuration file sets the default interface and channel:

```
[default]
interface = <the name of the interface to use>
channel = <the channel to use by default>
bitrate = <the bitrate in bits/s to use by default>
```

The configuration can also contain additional sections (or context):

```
[default]
interface = <the name of the interface to use>
channel = <the channel to use by default>
bitrate = <the bitrate in bits/s to use by default>

[HS]
# All the values from the 'default' section are inherited
channel = <the channel to use>
bitrate = <the bitrate in bits/s to use. i.e. 500000>

[MS]
# All the values from the 'default' section are inherited
channel = <the channel to use>
bitrate = <the bitrate in bits/s to use. i.e. 125000>
```

```
from can.interface import Bus

hs_bus = Bus(config_context='HS')
ms_bus = Bus(config_context='MS')
```

## 2.3 Environment Variables

Configuration can be pulled from these environmental variables:

- CAN\_INTERFACE
- CAN\_CHANNEL
- CAN\_BITRATE
- CAN\_CONFIG

The CAN\_CONFIG environment variable allows to set any bus configuration using JSON.

For example:

```
CAN_INTERFACE=socketcan CAN_CONFIG={"receive_own_messages": true, "fd": true}
```

## 2.4 Interface Names

Lookup table of interface names:

Name	Documentation
"canalystii"	<i>CANalyst-II</i>
"cantact"	<i>CANTact CAN Interface</i>
"etas"	<i>ETAS</i>
"gs_usb"	<i>Geschwister Schneider and candleLight</i>
"iscan"	<i>isCAN</i>
"ixxat"	<i>IXXAT Virtual Communication Interface</i>
"kvaser"	<i>Kvaser's CANLIB</i>
"neousys"	<i>Neousys CAN Interface</i>
"neovi"	<i>Intrepid Control Systems neoVI</i>
"nican"	<i>National Instruments NI-CAN</i>
"nixnet"	<i>National Instruments NI-XNET</i>
"pcan"	<i>PCAN Basic API</i>
"robotell"	<i>Robotell CAN-USB interface</i>
"seeedstudio"	<i>Seeed Studio USB-CAN Analyzer</i>
"serial"	<i>CAN over Serial</i>
"slcan"	<i>CAN over Serial / SLCAN</i>
"socketcan"	<i>SocketCAN</i>
"socketcand"	<i>socketcand Interface</i>
"systec"	<i>SYSTEC interface</i>
"udp_multicast"	<i>Multicast IP Interface</i>
"usb2can"	<i>USB2CAN Interface</i>
"vector"	<i>Vector</i>
"virtual"	<i>Virtual</i>

Additional interface types can be added via the *Plugin Interface*.



## LIBRARY API

The main objects are the *Bus* and the *Message*. A form of CAN interface is also required.

---

**Hint:** Check the backend specific documentation for any implementation specific details.

---

### 3.1 Bus

The *BusABC* class provides a wrapper around a physical or virtual CAN Bus.

An interface specific instance is created by calling the *Bus()* function with a particular interface, for example:

```
vector_bus = can.Bus(interface='vector', ...)
```

The created bus is then able to handle the interface specific software/hardware interactions while giving the user the same top level API.

A thread safe bus wrapper is also available, see *Thread safe bus*.

#### 3.1.1 Transmitting

Writing individual messages to the bus is done by calling the *send()* method and passing a *Message* instance.

```
with can.Bus() as bus:
    msg = can.Message(
        arbitration_id=0xC0FFEE,
        data=[0, 25, 0, 1, 3, 1, 4, 1],
        is_extended_id=True
    )
    try:
        bus.send(msg)
        print(f"Message sent on {bus.channel_info}")
    except can.CanError:
        print("Message NOT sent")
```

Periodic sending is controlled by the *broadcast manager*.

### 3.1.2 Receiving

Reading from the bus is achieved by either calling the `recv()` method or by directly iterating over the bus:

```
with can.Bus() as bus:
    for msg in bus:
        print(msg.data)
```

Alternatively the `Listener` api can be used, which is a list of various `Listener` implementations that receive and handle messages from a `Notifier`.

### 3.1.3 Filtering

Message filtering can be set up for each bus. Where the interface supports it, this is carried out in the hardware or kernel layer - not in Python. All messages that match at least one filter are returned.

Example defining two filters, one to pass 11-bit ID `0x451`, the other to pass 29-bit ID `0xA0000`:

```
filters = [
    {"can_id": 0x451, "can_mask": 0x7FF, "extended": False},
    {"can_id": 0xA0000, "can_mask": 0x1FFFFFFF, "extended": True},
]
bus = can.interface.Bus(channel="can0", interface="socketcan", can_filters=filters)
```

See `set_filters()` for the implementation.

### 3.1.4 Bus API

`can.Bus(channel=None, interface=None, config_context=None, ignore_config=False, **kwargs)`

Create a new bus instance with configuration loading.

Instantiates a CAN Bus of the given `interface`, falls back to reading a configuration file from default locations.

---

**Note:** Please note that while the arguments provided to this class take precedence over any existing values from configuration, it is possible that other parameters from the configuration may be added to the bus instantiation. This could potentially have unintended consequences. To prevent this, you may use the `ignore_config` parameter to ignore any existing configurations.

---

#### Parameters

- **channel** (`str` / `int` / `None`) – Channel identification. Expected type is backend dependent. Set to `None` to let it be resolved automatically from the default *Configuration*.
- **interface** (`str` / `None`) – See *Interface Names* for a list of supported interfaces. Set to `None` to let it be resolved automatically from the default *Configuration*.
- **config\_context** (`str` / `None`) – Extra ‘context’, that is passed to config sources. This can be used to select a section other than ‘default’ in the configuration file.
- **ignore\_config** (`bool`) – If `True`, only the given arguments will be used for the bus instantiation. Existing configuration sources will be ignored.
- **kwargs** (*Any*) – interface specific keyword arguments.

#### Raises



- **`CanInterfaceNotImplementedError`** – if the interface isn't recognized or cannot be loaded
- **`CanInitializationError`** – if the bus cannot be instantiated
- **`ValueError`** – if the `channel` could not be determined

**Return type**`BusABC`

**class** `can.BusABC(channel, can_filters=None, **kwargs)`

The CAN Bus Abstract Base Class that serves as the basis for all concrete interfaces.

This class may be used as an iterator over the received messages and as a context manager for auto-closing the bus when done using it.

Please refer to *Error Handling* for possible exceptions that may be thrown by certain operations on this bus.

**Parameters**

- **`channel`** (*Any*)
- **`can_filters`** (*Sequence*[*CanFilter* | *CanFilterExtended*] | *None*)
- **`kwargs`** (*object*)

**`RECV_LOGGING_LEVEL = 9`**

Log level for received messages

**`channel_info = 'unknown'`**

a string describing the underlying bus and/or channel

**property `filters`:** *Sequence*[*CanFilter* | *CanFilterExtended*] | *None*

Modify the filters of this bus. See *set\_filters()* for details.

**`flush_tx_buffer()`**

Discard every message that may be queued in the output buffer(s).

**Return type***None*

**property `protocol`:** *CanProtocol*

Return the CAN protocol used by this bus instance.

This value is set at initialization time and does not change during the lifetime of a bus instance.

**`recv(timeout=None)`**

Block waiting for a message from the Bus.

**Parameters**

**`timeout`** (*float* | *None*) – seconds to wait for a message or *None* to wait indefinitely

**Returns**

*None* on timeout or a *Message* object.

**Raises**

**`CanOperationError`** – If an error occurred while reading

**Return type***Message* | *None*

**abstract send**(*msg*, *timeout=None*)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

**Parameters**

- **msg** (*Message*) – A message object.
- **timeout** (*float* / *None*) – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. None blocks indefinitely.

**Raises**

*CanOperationError* – If an error occurred while sending

**Return type**

None

**send\_periodic**(*msgs*, *period*, *duration=None*, *store\_task=True*, *modifier\_callback=None*)

Start sending messages at a given period on this bus.

The task will be active until one of the following conditions are met:

- the (optional) duration expires
- the Bus instance goes out of scope
- the Bus instance is shutdown
- *stop\_all\_periodic\_tasks()* is called
- the task's *stop()* method is called.

**Parameters**

- **msgs** (*Message* / *Sequence[Message]*) – Message(s) to transmit
- **period** (*float*) – Period in seconds between each message
- **duration** (*float* / *None*) – Approximate duration in seconds to continue sending messages. If no duration is provided, the task will continue indefinitely.
- **store\_task** (*bool*) – If True (the default) the task will be attached to this Bus instance. Disable to instead manage tasks manually.
- **modifier\_callback** (*Callable[[Message], None]* / *None*) – Function which should be used to modify each message's data before sending. The callback modifies the *data* of the message and returns None.

**Returns**

A started task instance. Note the task can be stopped (and depending on the backend modified) by calling the task's *stop()* method.

**Return type**

*CyclicSendTaskABC*

---

**Note:** Note the duration before the messages stop being sent may not be exactly the same as the duration specified by the user. In general the message will be sent at the given rate until at least **duration** seconds.

---

---

**Note:** For extremely long-running Bus instances with many short-lived tasks the default api with `store_task==True` may not be appropriate as the stopped tasks are still taking up memory as they are associated with the Bus instance.

---

**set\_filters**(*filters=None*)

Apply filtering to all messages received by this Bus.

All messages that match at least one filter are returned. If *filters* is *None* or a zero length sequence, all messages are matched.

Calling without passing any filters will reset the applied filters to *None*.

**Parameters**

**filters** (*Sequence*[*CanFilter* | *CanFilterExtended*] | *None*) – A iterable of dictionaries each containing a “can\_id”, a “can\_mask”, and an optional “extended” key:

```
[{"can_id": 0x11, "can_mask": 0x21, "extended": False}]
```

A filter matches, when `<received_can_id> & can_mask == can_id & can_mask`. If `extended` is set as well, it only matches messages where `<received_is_extended> == extended`. Else it matches every messages based only on the arbitration ID and mask.

**Return type**

*None*

**shutdown**()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

**Return type**

*None*

**property state:** *BusState*

Return the current state of the hardware

**stop\_all\_periodic\_tasks**(*remove\_tasks=True*)

Stop sending any messages that were started using *send\_periodic()*.

---

**Note:** The result is undefined if a single task throws an exception while being stopped.

---

**Parameters**

**remove\_tasks** (*bool*) – Stop tracking the stopped tasks.

**Return type**

*None*

**class** *can*.**BusState**(*value*)

The state in which a *can*.*BusABC* can be.

**ACTIVE** = 1

**ERROR** = 3

**PASSIVE** = 2

```
class can.bus.CanProtocol(value)
```

The CAN protocol type supported by a [can.BusABC](#) instance

```
CAN_20 = 1
```

```
CAN_FD = 2
```

```
CAN_XL = 3
```

### 3.1.5 Thread safe bus

This thread safe version of the [BusABC](#) class can be used by multiple threads at once. Sending and receiving is locked separately to avoid unnecessary delays. Conflicting calls are executed by blocking until the bus is accessible.

It can be used exactly like the normal [BusABC](#):

```
# 'socketcan' is only an example interface, it works with all the others too
my_bus = can.ThreadSafeBus(interface='socketcan', channel='vcan0')
my_bus.send(...)
my_bus.recv(...)
```

```
class can.ThreadSafeBus(*args, **kwargs)
```

Contains a thread safe [can.BusABC](#) implementation that wraps around an existing interface instance. All public methods of that base class are now safe to be called from multiple threads. The send and receive methods are synchronized separately.

Use this as a drop-in replacement for [BusABC](#).

---

**Note:** This approach assumes that both [send\(\)](#) and [\\_recv\\_internal\(\)](#) of the underlying bus instance can be called simultaneously, and that the methods use [\\_recv\\_internal\(\)](#) instead of [recv\(\)](#) directly.

---

## 3.2 Message

```
class can.Message(timestamp=0.0, arbitration_id=0, is_extended_id=True, is_remote_frame=False,
                  is_error_frame=False, channel=None, dlc=None, data=None, is_fd=False, is_rx=True,
                  bitrate_switch=False, error_state_indicator=False, check=False)
```

The [Message](#) object is used to represent CAN messages for sending, receiving and other purposes like converting between different logging formats.

Messages can use extended identifiers, be remote or error frames, contain data and may be associated to a channel.

Messages are always compared by identity and never by value, because that may introduce unexpected behaviour. See also [equals\(\)](#).

[copy\(\)/deepcopy\(\)](#) is supported as well.

Messages do not support “dynamic” attributes, meaning any others than the documented ones, since it uses [\\_\\_slots\\_\\_](#).

To create a message object, simply provide any of the below attributes together with additional parameters as keyword arguments to the constructor.

#### Parameters

- **check** (*bool*) – By default, the constructor of this class does not strictly check the input. Thus, the caller must prevent the creation of invalid messages or set this parameter to *True*, to raise an *Error* on invalid inputs. Possible problems include the *dlc* field not matching the length of *data* or creating a message with both *is\_remote\_frame* and *is\_error\_frame* set to *True*.
- **timestamp** (*float*)
- **arbitration\_id** (*int*)
- **is\_extended\_id** (*bool*)
- **is\_remote\_frame** (*bool*)
- **is\_error\_frame** (*bool*)
- **channel** (*str* | *int* | *None*)
- **dlc** (*int* | *None*)
- **data** (*bytes* | *bytearray* | *int* | *Iterable[int]* | *None*)
- **is\_fd** (*bool*)
- **is\_rx** (*bool*)
- **bitrate\_switch** (*bool*)
- **error\_state\_indicator** (*bool*)

**Raises**

**ValueError** – If and only if *check* is set to *True* and one or more arguments were invalid

One can instantiate a *Message* defining data, and optional arguments for all attributes such as arbitration ID, flags, and timestamp.

```
>>> from can import Message
>>> test = Message(data=[1, 2, 3, 4, 5])
>>> test.data
bytearray(b'\x01\x02\x03\x04\x05')
>>> test.dlc
5
>>> print(test)
Timestamp:      0.000000    ID: 00000000    X Rx          DL:  5    01 02_
↪ 03 04 05
```

The *arbitration\_id* field in a CAN message may be either 11 bits (standard addressing, CAN 2.0A) or 29 bits (extended addressing, CAN 2.0B) in length, and python-can exposes this difference with the *is\_extended\_id* attribute.

**timestamp****Type**

*float*

The timestamp field in a CAN message is a floating point number representing when the message was received since the epoch in seconds. Where possible this will be timestamped in hardware.

**arbitration\_id****Type**

*int*

The frame identifier used for arbitration on the bus.

The arbitration ID can take an int between 0 and the maximum value allowed depending on the `is_extended_id` flag (either  $2^{11} - 1$  for 11-bit IDs, or  $2^{29} - 1$  for 29-bit identifiers).

```
>>> print(Message(is_extended_id=False, arbitration_id=100))
Timestamp:      0.000000    ID:      064    S Rx          DL:  0
```

## data

### Type

`bytearray`

The data parameter of a CAN message is exposed as a **bytearray** with length between 0 and 8.

```
>>> example_data = bytearray([1, 2, 3])
>>> print(Message(data=example_data))
Timestamp:      0.000000    ID: 00000000    X Rx          DL:  3    01_
↪ 02 03
```

A *Message* can also be created with bytes, or lists of ints:

```
>>> m1 = Message(data=[0x64, 0x65, 0x61, 0x64, 0x62, 0x65, 0x65, 0x66])
>>> print(m1.data)
bytearray(b'deadbeef')
>>> m2 = Message(data=b'deadbeef')
>>> m2.data
bytearray(b'deadbeef')
```

## dlc

### Type

`int`

The DLC (Data Length Code) parameter of a CAN message is an integer between 0 and 8 representing the frame payload length.

In the case of a CAN FD message, this indicates the data length in number of bytes.

```
>>> m = Message(data=[1, 2, 3])
>>> m.dlc
3
```

---

**Note:** The DLC value does not necessarily define the number of bytes of data in a message.

Its purpose varies depending on the frame type - for data frames it represents the amount of data contained in the message, in remote frames it represents the amount of data being requested.

---

## channel

### Type

`str` or `int` or `None`

This might store the channel from which the message came.

## is\_extended\_id

**Type**

bool

This flag controls the size of the `arbitration_id` field. Previously this was exposed as `id_type`.

```
>>> print(Message(is_extended_id=False))
Timestamp:      0.000000    ID:      000    S Rx          DL:  0
>>> print(Message(is_extended_id=True))
Timestamp:      0.000000    ID: 00000000    X Rx          DL:  0
```

**Note:** The initializer argument and attribute `extended_id` has been deprecated in favor of `is_extended_id`, but will continue to work for the 3.x release series.

**is\_error\_frame****Type**

bool

This boolean parameter indicates if the message is an error frame or not.

```
>>> print(Message(is_error_frame=True))
Timestamp:      0.000000    ID: 00000000    X Rx E          DL:  0
```

**is\_remote\_frame****Type**

bool

This boolean attribute indicates if the message is a remote frame or a data frame, and modifies the bit in the CAN message's flags field indicating this.

```
>>> print(Message(is_remote_frame=True))
Timestamp:      0.000000    ID: 00000000    X Rx R          DL:  0
```

**is\_fd****Type**

bool

Indicates that this message is a CAN FD message.

**is\_rx****Type**

bool

Indicates whether this message is a transmitted (Tx) or received (Rx) frame

**bitrate\_switch****Type**

bool

If this is a CAN FD message, this indicates that a higher bitrate was used for the data transmission.

**error\_state\_indicator****Type**

bool

If this is a CAN FD message, this indicates an error active state.

`__str__()`

A string representation of a CAN message:

```
>>> from can import Message
>>> test = Message()
>>> print(test)
Timestamp:      0.000000    ID: 00000000    X Rx          DL:  0
>>> test2 = Message(data=[1, 2, 3, 4, 5])
>>> print(test2)
Timestamp:      0.000000    ID: 00000000    X Rx          DL:  5    01
↳ 02 03 04 05
```

The fields in the printed message are (in order):

- timestamp,
- arbitration ID,
- flags,
- data length (DL),
- and data.

The flags field is represented as one, two or three letters:

- X if the `is_extended_id` attribute is set, otherwise S,
- E if the `is_error_frame` attribute is set,
- R if the `is_remote_frame` attribute is set.

The arbitration ID field is represented as either a four or eight digit hexadecimal number depending on the length of the arbitration ID (11-bit or 29-bit).

Each of the bytes in the data field (when present) are represented as two-digit hexadecimal numbers.

`equals(other, timestamp_delta=1e-06, check_channel=True, check_direction=True)`

Compares a given message with this one.

#### Parameters

- **other** (`Message`) – the message to compare with
- **timestamp\_delta** (`float` / `None`) – the maximum difference in seconds at which two timestamps are still considered equal or `None` to not compare timestamps
- **check\_channel** (`bool`) – whether to compare the message channel
- **check\_direction** (`bool`) – whether to compare the messages' directions (Tx/Rx)

#### Returns

True if and only if the given message equals this one

#### Return type

`bool`



## 3.3 Notifier and Listeners

### 3.3.1 Notifier

The Notifier object is used as a message distributor for a bus. The Notifier uses an event loop or creates a thread to read messages from the bus and distributes them to listeners.

**class** `can.Notifier`(*bus*, *listeners*, *timeout=1.0*, *loop=None*)

Manages the distribution of `Message` instances to listeners.

Supports multiple buses and listeners.

---

**Note:** Remember to call `stop()` after all messages are received as many listeners carry out flush operations to persist data.

---

#### Parameters

- **bus** (`BusABC` | `List[BusABC]`) – A *Bus* or a list of buses to listen to.
- **listeners** (`Iterable[Listener` | `Callable[[Message], Awaitable[None]` | `None]`) – An iterable of *Listener* or callables that receive a `Message` and return nothing.
- **timeout** (`float`) – An optional maximum number of seconds to wait for any `Message`.
- **loop** (`AbstractEventLoop` | `None`) – An `asyncio` event loop to schedule the listeners in.

**add\_bus**(*bus*)

Add a bus for notification.

#### Parameters

**bus** (`BusABC`) – CAN bus instance.

#### Return type

`None`

**add\_listener**(*listener*)

Add new Listener to the notification list. If it is already present, it will be called two times each time a message arrives.

#### Parameters

**listener** (`Listener` | `Callable[[Message], Awaitable[None]` | `None`) – Listener to be added to the list to be notified

#### Return type

`None`

**exception:** `Exception` | `None`

Exception raised in thread

**remove\_listener**(*listener*)

Remove a listener from the notification list. This method throws an exception if the given listener is not part of the stored listeners.

#### Parameters

**listener** (`Listener` | `Callable[[Message], Awaitable[None]` | `None`) – Listener to be removed from the list to be notified

**Raises****ValueError** – if *listener* was never added to this notifier**Return type**

None

**stop**(*timeout=5*)Stop notifying Listeners when new *Message* objects arrive and call *stop()* on each Listener.**Parameters****timeout** (*float*) – Max time in seconds to wait for receive threads to finish. Should be longer than timeout given at instantiation.**Return type**

None

### 3.3.2 Listener

The Listener class is an “abstract” base class for any objects which wish to register to receive notifications of new messages on the bus. A Listener can be used in two ways; the default is to **call** the Listener with a new message, or by calling the method **on\_message\_received**.

Listeners are registered with *Notifier* object(s) which ensure they are notified whenever a new message is received.

```

1  #!/usr/bin/env python
2
3  import time
4  import can
5
6
7  def main():
8      with can.Bus(receive_own_messages=True) as bus:
9          print_listener = can.Printer()
10         can.Notifier(bus, [print_listener])
11
12         bus.send(can.Message(arbitration_id=1, is_extended_id=True))
13         bus.send(can.Message(arbitration_id=2, is_extended_id=True))
14         bus.send(can.Message(arbitration_id=1, is_extended_id=False))
15
16         time.sleep(1.0)
17
18
19  if __name__ == "__main__":
20     main()

```

Subclasses of Listener that do not override **on\_message\_received** will cause *NotImplementedError* to be thrown when a message is received on the CAN bus.

**class can.Listener**

The basic listener that can be called directly to handle some CAN message:

```

listener = SomeListener()
msg = my_bus.recv()

# now either call

```

(continues on next page)

(continued from previous page)

```

listener(msg)
# or
listener.on_message_received(msg)

# Important to ensure all outputs are flushed
listener.stop()

```

**on\_error(exc)**

This method is called to handle any exception in the receive thread.

**Parameters**

**exc** (*Exception*) – The exception causing the thread to stop

**Return type**

None

**abstract on\_message\_received(msg)**

This method is called to handle the given message.

**Parameters**

**msg** (*Message*) – the delivered message

**Return type**

None

**abstract stop()**

Stop handling new messages, carry out any final tasks to ensure data is persisted and cleanup any open resources.

Concrete implementations override.

**Return type**

None

There are some listeners that already ship together with *python-can* and are listed below. Some of them allow messages to be written to files, and the corresponding file readers are also documented here.

---

**Note:** Please note that writing and the reading a message might not always yield a completely unchanged message again, since some properties are not (yet) supported by some file formats.

---



---

**Note:** Additional file formats for both reading/writing log files can be added via a plugin reader/writer. An external package can register a new reader by using the `can.io.message_reader` entry point. Similarly, a writer can be added using the `can.io.message_writer` entry point.

The format of the entry point is `reader_name=module:classname` where `classname` is a *can.io.generic.BaseIOHandler* concrete implementation.

```

entry_points={
    'can.io.message_reader': [
        '.asc = my_package.io.asc:ASCReader'
    ]
},

```

### 3.3.3 BufferedReader

#### class `can.BufferedReader`

A `BufferedReader` is a subclass of [Listener](#) which implements a **message buffer**: that is, when the `can.BufferedReader` instance is notified of a new message it pushes it into a queue of messages waiting to be serviced. The messages can then be fetched with [get\\_message\(\)](#).

Putting in messages after [stop\(\)](#) has been called will raise an exception, see [on\\_message\\_received\(\)](#).

##### Attr `is_stopped`

True if the reader has been stopped

##### `get_message(timeout=0.5)`

Attempts to retrieve the message that has been in the queue for the longest amount of time (FIFO). If no message is available, it blocks for given timeout or until a message is received (whichever is shorter), or else returns `None`. This method does not block after `can.BufferedReader.stop()` has been called.

##### Parameters

**timeout** (*float*) – The number of seconds to wait for a new message.

##### Returns

the received `can.Message` or `None`, if the queue is empty.

##### Return type

`Message` | `None`

##### `on_message_received(msg)`

Append a message to the buffer.

##### Raises

`BufferError` if the reader has already been stopped

##### Parameters

**msg** (`Message`)

##### Return type

`None`

##### `stop()`

Prohibits any more additions to this reader.

##### Return type

`None`

#### class `can.AsyncBufferedReader(**kwargs)`

A message buffer for use with [asyncio](#).

See [Asyncio support](#) for how to use with `can.Notifier`.

Can also be used as an asynchronous iterator:

```
async for msg in reader:
    print(msg)
```

##### Parameters

**kwargs** (*Any*)

**async get\_message()**

Retrieve the latest message when awaited for:

```
msg = await reader.get_message()
```

**Returns**

The CAN message.

**Return type**

[Message](#)

**on\_message\_received(msg)**

Append a message to the buffer.

Must only be called inside an event loop!

**Parameters**

**msg** ([Message](#))

**Return type**

None

**stop()**

Stop handling new messages, carry out any final tasks to ensure data is persisted and cleanup any open resources.

Concrete implementations override.

**Return type**

None

### 3.3.4 RedirectReader

**class** can.[RedirectReader](#)(*bus*, \**args*, \*\**kwargs*)

A RedirectReader sends all received messages to another Bus.

**Parameters**

- **bus** ([BusABC](#))
- **args** (*Any*)
- **kwargs** (*Any*)

**on\_message\_received(msg)**

This method is called to handle the given message.

**Parameters**

**msg** ([Message](#)) – the delivered message

**Return type**

None

## 3.4 File IO

### 3.4.1 Reading and Writing Files

`can.LogReader(filename, **kwargs)`

Find and return the appropriate *MessageReader* instance for a given file suffix.

**The format is determined from the file suffix which can be one of:**

- .asc *can.ASCReader*
- .blf *can.BLFReader*
- .csv *can.CSVReader*
- .db *can.SqliteReader*
- .log *can.CanutilsLogReader*
- .mf4 *can.MF4Reader* (optional, depends on *asammdf*)
- .trc *can.TRCReader*

Gzip compressed files can be used as long as the original files suffix is one of the above (e.g. filename.asc.gz).

Exposes a simple iterator interface, to use simply:

```
for msg in can.LogReader("some/path/to/my_file.log"):
    print(msg)
```

#### Parameters

- **filename** (*str* | *os.PathLike[str]*) – the filename/path of the file to read from
- **kwargs** (*Any*)

#### Raises

**ValueError** – if the filename’s suffix is of an unknown file type

#### Return type

*MessageReader*

---

**Note:** There are no time delays, if you want to reproduce the measured delays between messages look at the *can.MessageSync* class.

---

---

**Note:** This function itself is just a dispatcher, and any positional and keyword arguments are passed on to the returned instance.

---

`can.Logger(filename, **kwargs)`

Find and return the appropriate *MessageWriter* instance for a given file suffix.

**The format is determined from the file suffix which can be one of:**

- .asc *can.ASCWriter*
- .blf *can.BLFWriter*
- .csv: *can.CSVWriter*

- .db *can.SqliteWriter*
- .log *can.CanutilsLogWriter*
- .mf4 *can.MF4Writer* (optional, depends on *asammdf*)
- .trc *can.TRCWriter*
- .txt *can.Printer*

Any of these formats can be used with gzip compression by appending the suffix *.gz* (e.g. *filename.asc.gz*). However, third-party tools might not be able to read these files.

The **filename** may also be *None*, to fall back to *can.Printer*.

The log files may be incomplete until *stop()* is called due to buffering.

#### Parameters

- **filename** (*str* | *PathLike[str]* | *None*) – the filename/path of the file to write to, may be a path-like object or *None* to instantiate a *Printer*
- **kwargs** (*Any*)

#### Raises

**ValueError** – if the filename’s suffix is of an unknown file type

#### Return type

*MessageWriter*

---

**Note:** This function itself is just a dispatcher, and any positional and keyword arguments are passed on to the returned instance.

---

```
can.io.logger.MESSAGE_WRITERS: Final[Dict[str, Type[MessageWriter]]] = {'.asc': <class
'can.io.asc.ASCWriter'>, '.blf': <class 'can.io.blf.BLFWriter'>, '.csv': <class
'can.io.csv.CSVWriter'>, '.db': <class 'can.io.sqlite.SqliteWriter'>, '.log': <class
'can.io.canutils.CanutilsLogWriter'>, '.mf4': <class 'can.io.mf4.MF4Writer'>, '.trc':
<class 'can.io.trc.TRCWriter'>, '.txt': <class 'can.io.printer.Printer'>}
```

A map of file suffixes to their corresponding *can.io.generic.MessageWriter* class

```
can.io.player.MESSAGE_READERS: Final[Dict[str, Type[MessageReader]]] = {'.asc': <class
'can.io.asc.ASCReader'>, '.blf': <class 'can.io.blf.BLFReader'>, '.csv': <class
'can.io.csv.CSVReader'>, '.db': <class 'can.io.sqlite.SqliteReader'>, '.log': <class
'can.io.canutils.CanutilsLogReader'>, '.mf4': <class 'can.io.mf4.MF4Reader'>, '.trc':
<class 'can.io.trc.TRCReader'>}
```

A map of file suffixes to their corresponding *can.io.generic.MessageReader* class

## 3.4.2 Printer

```
class can.Printer(file=None, append=False, **kwargs)
```

Bases: *MessageWriter*

The Printer class is a subclass of *Listener* which simply prints any messages it receives to the terminal (stdout). A message is turned into a string using *\_\_str\_\_()*.

#### Attr write\_to\_file

*True* if this instance prints to a file instead of standard out

#### Parameters

- **file** (*TextIO* / *None*) – An optional path-like object or a file-like object to “print” to instead of writing to standard out (stdout). If this is a file-like object, it has to be opened in text write mode, not binary write mode.
- **append** (*bool*) – If set to *True* messages, are appended to the file, else the file is truncated
- **kwargs** (*Any*)

**file\_size()**

Return an estimate of the current file size in bytes.

**Return type**

*int*

**on\_message\_received(msg)**

This method is called to handle the given message.

**Parameters**

**msg** (*Message*) – the delivered message

**Return type**

*None*

### 3.4.3 CSVWriter

**class** `can.CSVWriter(file, append=False, **kwargs)`

Bases: *TextIOMessageWriter*

Writes a comma separated text file with a line for each message. Includes a header line.

The columns are as follows:

name of column	format description	example
timestamp	decimal float	1483389946.197
arbitration_id	hex	0x00dadada
extended	1 == True, 0 == False	1
remote	1 == True, 0 == False	0
error	1 == True, 0 == False	0
dlc	int	6
data	base64 encoded	WzQyLCA5XQ==

Each line is terminated with a platform specific line separator.

**Parameters**

- **file** (*TextIO*) – a path-like object or a file-like object to write to. If this is a file-like object, it has to open in text write mode, not binary write mode.
- **append** (*bool*) – if set to *True* messages are appended to the file and no header line is written, else the file is truncated and starts with a newly written header line
- **kwargs** (*Any*)

**on\_message\_received(msg)**

This method is called to handle the given message.

**Parameters**

**msg** (*Message*) – the delivered message



**Return type**

None

**class** `can.CSVReader(file, **kwargs)`Bases: `TextIOMessageReader`

Iterator over CAN messages from a .csv file that was generated by `CSVWriter` or that uses the same format as described there. Assumes that there is a header and thus skips the first line.

Any line separator is accepted.

**Parameters**

- **file** (`TextIO`) – a path-like object or as file-like object to read from If this is a file-like object, it has to be opened in text read mode, not binary read mode.
- **kwargs** (*Any*)

### 3.4.4 SqliteWriter

**class** `can.SqliteWriter(file, table_name='messages', **kwargs)`Bases: `MessageWriter`, `BufferedReader`

Logs received CAN data to a simple SQL database.

The sqlite database may already exist, otherwise it will be created when the first message arrives.

Messages are internally buffered and written to the SQL file in a background thread. Ensures that all messages that are added before calling `stop()` are actually written to the database after that call returns. Thus, calling `stop()` may take a while.

**Attr str table\_name**

the name of the database table used for storing the messages

**Attr int num\_frames**

the number of frames actually written to the database, this excludes messages that are still buffered

**Attr float last\_write**

the last time a message was actually written to the database, as given by `time.time()`

**Parameters**

- **file** (`TextIO` | `BinaryIO` | `GzipFile` | `None`)
- **table\_name** (*str*)
- **kwargs** (*Any*)

---

**Note:** When the listener's `stop()` method is called the thread writing to the database will continue to receive and internally buffer messages if they continue to arrive before the `GET_MESSAGE_TIMEOUT`.

If the `GET_MESSAGE_TIMEOUT` expires before a message is received, the internal buffer is written out to the database file.

However if the bus is still saturated with messages, the Listener will continue receiving until the `MAX_TIME_BETWEEN_WRITES` timeout is reached or more than `MAX_BUFFER_SIZE_BEFORE_WRITES` messages are buffered.

---



---

**Note:** The database schema is given in the documentation of the loggers.

---

**Parameters**

- **file** (*TextIO* | *BinaryIO* | *GzipFile* | *None*) – a *str* or path like object that points to the database file to use
- **table\_name** (*str*) – the name of the table to store messages in
- **kwargs** (*Any*)

**Warning:** In contrary to all other readers/writers the Sqlite handlers do not accept file-like objects as the *file* parameter.

**GET\_MESSAGE\_TIMEOUT** = 0.25

Number of seconds to wait for messages from internal queue

**MAX\_BUFFER\_SIZE\_BEFORE\_WRITES** = 500

Maximum number of messages to buffer before writing to the database

**MAX\_TIME\_BETWEEN\_WRITES** = 5.0

Maximum number of seconds to wait between writes to the database

**stop()**

Stops the reader and writes all remaining messages to the database. Thus, this might take a while and block.

**class** can.SqliteReader(*file*, *table\_name*='messages', *\*\*kwargs*)

Bases: *MessageReader*

Reads recorded CAN messages from a simple SQL database.

This class can be iterated over or used to fetch all messages in the database with *read\_all()*.

Calling *len()* on this object might not run in constant time.

**Attr str table\_name**

the name of the database table used for storing the messages

**Parameters**

- **file** (*TextIO* | *BinaryIO* | *GzipFile* | *None*)
- **table\_name** (*str*)
- **kwargs** (*Any*)

---

**Note:** The database schema is given in the documentation of the loggers.

---

**Parameters**

- **file** (*TextIO* | *BinaryIO* | *GzipFile* | *None*) – a *str* path like object that points to the database file to use
- **table\_name** (*str*) – the name of the table to look for the messages
- **kwargs** (*Any*)

**Warning:** In contrary to all other readers/writers the Sqlite handlers do not accept file-like objects as the *file* parameter. It also runs in *append=True* mode all the time.

**read\_all()**

Fetches all messages in the database.

**Return type**

Generator[*can.Message*]

**stop()**

Closes the connection to the database.

**Database table format**

The messages are written to the table `messages` in the sqlite database by default. The table is created if it does not already exist.

The entries are as follows:

Name	Data type	Note
ts	REAL	The timestamp of the message
arbitration_id	INTEGER	The arbitration id, might use the extended format
extended	INTEGER	1 if the arbitration id uses the extended format, else 0
remote	INTEGER	1 if the message is a remote frame, else 0
error	INTEGER	1 if the message is an error frame, else 0
dlc	INTEGER	The data length code (DLC)
data	BLOB	The content of the message

**3.4.5 ASC (.asc Logging format)**

ASCWriter logs CAN data to an ASCII log file compatible with other CAN tools such as Vector CANalyzer/CANoe and other. Since no official specification exists for the format, it has been reverse-engineered from existing log files. One description of the format can be found [here](#).

---

**Note:** Channels will be converted to integers.

---

**class** `can.ASCWriter`(*file*, *channel=1*, *\*\*kwargs*)

Bases: *TextIOMessageWriter*

Logs CAN data to an ASCII log file (.asc).

The measurement starts with the timestamp of the first registered message. If a message has a timestamp smaller than the previous one or None, it gets assigned the timestamp that was written for the last message. If the first message does not have a timestamp, it is set to zero.

**Parameters**

- **file** (*TextIO*) – a path-like object or as file-like object to write to If this is a file-like object, it has to be opened in text write mode, not binary write mode.
- **channel** (*int*) – a default channel to use when the message does not have a channel set
- **kwargs** (*Any*)

**log\_event**(*message*, *timestamp=None*)

Add a message to the log file.

**Parameters**

- **message** (*str*) – an arbitrary message
- **timestamp** (*float* / *None*) – the absolute timestamp of the event

**Return type**

None

**on\_message\_received(msg)**

This method is called to handle the given message.

**Parameters**

**msg** (*Message*) – the delivered message

**Return type**

None

**stop()**

Closes the underlying file-like object and flushes it, if it was opened in write mode.

**Return type**

None

ASCReader reads CAN data from ASCII log files .asc, as further references can-utils can be used: [asc2log](#), [log2asc](#).

**class** `can.ASCReader`(*file*, *base*='hex', *relative\_timestamp*=*True*, *\*\*kwargs*)

Bases: *TextIOMessageReader*

Iterator of CAN messages from a ASC logging file. Meta data (comments, bus statistics, J1939 Transport Protocol messages) is ignored.

**Parameters**

- **file** (*TextIO*) – a path-like object or as file-like object to read from If this is a file-like object, it has to be opened in text read mode, not binary read mode.
- **base** (*str*) – Select the base(hex or dec) of id and data. If the header of the asc file contains base information, this value will be overwritten. Default “hex”.
- **relative\_timestamp** (*bool*) – Select whether the timestamps are *relative* (starting at 0.0) or *absolute* (starting at the system time). Default *True* = *relative*.
- **kwargs** (*Any*)

### 3.4.6 Log (.log can-utils Logging format)

CanutilsLogWriter logs CAN data to an ASCII log file compatible with *can-utils* <<https://github.com/linux-can/can-utils>> As specification following references can-utils can be used: [asc2log](#), [log2asc](#).

**class** `can.CanutilsLogWriter`(*file*, *channel*='vcan0', *append*=*False*, *\*\*kwargs*)

Bases: *TextIOMessageWriter*

Logs CAN data to an ASCII log file (.log). This class is compatible with “candump -L”.

If a message has a timestamp smaller than the previous one (or 0 or None), it gets assigned the timestamp that was written for the last message. If the first message does not have a timestamp, it is set to zero.

**Parameters**

- **file** (*TextIO*) – a path-like object or as file-like object to write to If this is a file-like object, it has to be opened in text write mode, not binary write mode.
- **channel** (*str*) – a default channel to use when the message does not have a channel set

- **append** (*bool*) – if set to *True* messages are appended to the file, else the file is truncated
- **kwargs** (*Any*)

**on\_message\_received**(*msg*)

This method is called to handle the given message.

#### Parameters

**msg** – the delivered message

**CanutilsLogReader** reads CAN data from ASCII log files .log

**class** can.CanutilsLogReader(*file*, **\*\*kwargs**)

Bases: *TextIOMessageReader*

Iterator over CAN messages from a .log Logging File (candump -L).

---

**Note:** .log-format looks for example like this:

```
(0.0) vcan0 001#8d00100100820100
```

---

#### Parameters

- **file** (*TextIO*) – a path-like object or as file-like object to read from If this is a file-like object, is has to opened in text read mode, not binary read mode.
- **kwargs** (*Any*)

### 3.4.7 BLF (Binary Logging Format)

Implements support for BLF (Binary Logging Format) which is a proprietary CAN log format from Vector Informatik GmbH.

The data is stored in a compressed format which makes it very compact.

---

**Note:** Channels will be converted to integers.

---

**class** can.BLFWriter(*file*, **append=False**, **channel=1**, **compression\_level=-1**, **\*\*kwargs**)

Bases: *FileIOMessageWriter*

Logs CAN data to a Binary Logging File compatible with Vector's tools.

#### Parameters

- **file** (*BinaryIO*) – a path-like object or as file-like object to write to If this is a file-like object, is has to opened in mode "wb+".
- **channel** (*int*) – Default channel to log as if not specified by the interface.
- **append** (*bool*) – Append messages to an existing log file.
- **compression\_level** (*int*) – An integer from 0 to 9 or -1 controlling the level of compression. 1 (Z\_BEST\_SPEED) is fastest and produces the least compression. 9 (Z\_BEST\_COMPRESSION) is slowest and produces the most. 0 means that data will be stored without processing. The default value is -1 (Z\_DEFAULT\_COMPRESSION). Z\_DEFAULT\_COMPRESSION represents a default compromise between speed and compression (currently equivalent to level 6).

- **kwargs** (*Any*)

**application\_id** = 5

Application identifier for the log writer

**file\_size()**

Return an estimate of the current file size in bytes.

**Return type**

*int*

**log\_event**(*text*, *timestamp=None*)

Add an arbitrary message to the log file as a global marker.

**Parameters**

- **text** (*str*) – The group name of the marker.
- **timestamp** (*float*) – Absolute timestamp in Unix timestamp format. If not given, the marker will be placed along the last message.

**max\_container\_size** = 131072

Max log container size of uncompressed data

**on\_message\_received**(*msg*)

This method is called to handle the given message.

**Parameters**

**msg** – the delivered message

**stop()**

Stops logging and closes the file.

The following class can be used to read messages from BLF file:

**class** `can.BLFReader`(*file*, *\*\*kwargs*)

Bases: *BinaryIOMessageReader*

Iterator of CAN messages from a Binary Logging File.

Only CAN messages and error frames are supported. Other object types are silently ignored.

**Parameters**

- **file** (*BinaryIO*) – a path-like object or as file-like object to read from If this is a file-like object, it has to be opened in binary read mode, not text read mode.
- **kwargs** (*Any*)

### 3.4.8 MF4 (Measurement Data Format v4)

Implements support for MF4 (Measurement Data Format v4) which is a proprietary format from ASAM (Association for Standardization of Automation and Measuring Systems), widely used in many automotive software (Vector CANape, ETAS INCA, dSPACE ControlDesk, etc.).

The data is stored in a compressed format which makes it compact.

---

**Note:** MF4 support has to be installed as an extra with for example `pip install python-can[mf4]`.

---

---

**Note:** Channels will be converted to integers.

---



---

**Note:** MF4Writer does not support the append mode.

---

**class** `can.MF4Writer`(*file*, *database=None*, *compression\_level=2*, *\*\*kwargs*)

Bases: `BinaryIOMessageWriter`

Logs CAN data to an ASAM Measurement Data File v4 (.mf4).

MF4Writer does not support append mode.

If a message has a timestamp smaller than the previous one or None, it gets assigned the timestamp that was written for the last message. If the first message does not have a timestamp, it is set to zero.

#### Parameters

- **file** (`BinaryIO` / `GzipFile`) – A path-like object or as file-like object to write to. If this is a file-like object, it has to be opened in binary write mode, not text write mode.
- **database** (`str` / `os.PathLike[str]` / `None`) – optional path to a DBC or ARXML file that contains message description.
- **compression\_level** (`int`) – compression option as integer (default 2) \* 0 - no compression \* 1 - deflate (slower, but produces smaller files) \* 2 - transposition + deflate (slowest, but produces the smallest files)
- **kwargs** (`Any`)

**file\_size()**

Return an estimate of the current file size in bytes.

#### Return type

`int`

**on\_message\_received**(*msg*)

This method is called to handle the given message.

#### Parameters

**msg** (`Message`) – the delivered message

#### Return type

`None`

**stop()**

Closes the underlying file-like object and flushes it, if it was opened in write mode.

#### Return type

`None`

The MDF format is very flexible regarding the internal structure and it is used to handle data from multiple sources, not just CAN bus logging. MDF4Writer will always create a fixed internal file structure where there will be three channel groups (for standard, error and remote frames). Using this fixed file structure allows for a simple implementation of MDF4Writer and MF4Reader classes. Therefore MF4Reader can only replay files created with MF4Writer.

The following class can be used to read messages from MF4 file:

**class** `can.MF4Reader`(*file*, *\*\*kwargs*)

Bases: [`BinaryIOMessageReader`](#)

Iterator of CAN messages from a MF4 logging file.

The MF4Reader only supports MF4 files that were recorded with python-can.

**Parameters**

- **file** ([`BinaryIO`](#) / [`GzipFile`](#)) – a path-like object or as file-like object to read from If this is a file-like object, it has to be opened in binary read mode, not text read mode.
- **kwargs** ([`Any`](#))

**stop()**

Closes the underlying file-like object and flushes it, if it was opened in write mode.

**Return type**

None

### 3.4.9 TRC

Implements basic support for the TRC file format.

---

**Note:** Comments and contributions are welcome on what file versions might be relevant.

---

**class** `can.TRCWriter`(*file*, *channel=1*, *\*\*kwargs*)

Bases: [`TextIOMessageWriter`](#)

Logs CAN data to text file (.trc).

The measurement starts with the timestamp of the first registered message. If a message has a timestamp smaller than the previous one or None, it gets assigned the timestamp that was written for the last message. If the first message does not have a timestamp, it is set to zero.

**Parameters**

- **file** ([`TextIO`](#)) – a path-like object or as file-like object to write to If this is a file-like object, it has to be opened in text write mode, not binary write mode.
- **channel** ([`int`](#)) – a default channel to use when the message does not have a channel set
- **kwargs** ([`Any`](#))

**on\_message\_received(msg)**

This method is called to handle the given message.

**Parameters**

**msg** ([`Message`](#)) – the delivered message

**Return type**

None

The following class can be used to read messages from TRC file:

**class** `can.TRCReader`(*file*, *\*\*kwargs*)

Bases: [`TextIOMessageReader`](#)

Iterator of CAN messages from a TRC logging file.

**Parameters**



- **file** (*TextIO*) – a path-like object or as file-like object to read from If this is a file-like object, it has to be opened in text read mode, not binary read mode.
- **kwargs** (*Any*)

### 3.4.10 Rotating Loggers

**class** `can.io.BaseRotatingLogger(**kwargs)`

Bases: *MessageWriter*, *ABC*

Base class for rotating CAN loggers. This class is not meant to be instantiated directly. Subclasses must implement the *should\_rollover()* and *do\_rollover()* methods according to their rotation strategy.

The rotation behavior can be further customized by the user by setting the *namer* and *rotator* attributes after instantiating the subclass.

These attributes as well as the methods *rotation\_filename()* and *rotate()* and the corresponding docstrings are carried over from the python builtin *BaseRotatingHandler*.

Subclasses must set the *\_writer* attribute upon initialization.

#### Parameters

- **file** – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all
- **mode** – the mode that should be used to open the file, see *open()*, ignored if *file* is *None*
- **kwargs** (*Any*)

**abstract** *do\_rollover()*

Perform rollover.

#### Return type

*None*

**namer:** `Callable[[str | os.PathLike[str]], str | os.PathLike[str]] | None = None`

If this attribute is set to a callable, the *rotation\_filename()* method delegates to this callable. The parameters passed to the callable are those passed to *rotation\_filename()*.

**on\_message\_received(*msg*)**

This method is called to handle the given message.

#### Parameters

**msg** (*Message*) – the delivered message

#### Return type

*None*

**rollover\_count:** `int = 0`

An integer counter to track the number of rollovers.

**rotate(*source*, *dest*)**

When rotating, rotate the current log.

The default implementation calls the *rotator* attribute of the handler, if it's callable, passing the *source* and *dest* arguments to it. If the attribute isn't callable (the default is *None*), the source is simply renamed to the destination.

#### Parameters

- **source** (*str* | *PathLike*[*str*]) – The source filename. This is normally the base filename, e.g. “test.log”
- **dest** (*str* | *PathLike*[*str*]) – The destination filename. This is normally what the source is rotated to, e.g. “test\_#001.log”.

**Return type**

None

**rotation\_filename**(*default\_name*)

Modify the filename of a log file when rotating.

This is provided so that a custom filename can be provided. The default implementation calls the *namer* attribute of the handler, if it's callable, passing the default name to it. If the attribute isn't callable (the default is *None*), the name is returned unchanged.

**Parameters**

**default\_name** (*str* | *PathLike*[*str*]) – The default name for the log file.

**Return type***str* | *PathLike*[*str*]

**rotator:** *Callable*[[*str* | *os.PathLike*[*str*], *str* | *os.PathLike*[*str*]], *None*] | *None* = *None*

If this attribute is set to a callable, the *rotate()* method delegates to this callable. The parameters passed to the callable are those passed to *rotate()*.

**abstract should\_rollover**(*msg*)

Determine if the rollover conditions are met.

**Parameters**

**msg** (*Message*)

**Return type***bool***stop()**

Stop handling new messages.

Carry out any final tasks to ensure data is persisted and cleanup any open resources.

**Return type**

None

**abstract property writer:** *FileIOMessageWriter*

This attribute holds an instance of a writer class which manages the actual file IO.

**class** *can.SizedRotatingLogger*(*base\_filename*, *max\_bytes*=0, *\*\*kwargs*)

Bases: *BaseRotatingLogger*

Log CAN messages to a sequence of files with a given maximum size.

The logger creates a log file with the given *base\_filename*. When the size threshold is reached the current log file is closed and renamed by adding a timestamp and the rollover count. A new log file is then created and written to.

This behavior can be customized by setting the *namer* and *rotator* attribute.

Example:

```

from can import Notifier, SizedRotatingLogger
from can.interfaces.vector import VectorBus

bus = VectorBus(channel=[0], app_name="CANape", fd=True)

logger = SizedRotatingLogger(
    base_filename="my_logfile.asc",
    max_bytes=5 * 1024 ** 2, # =5MB
)
logger.rollover_count = 23 # start counter at 23

notifier = Notifier(bus=bus, listeners=[logger])

```

The `SizedRotatingLogger` currently supports the formats

- .asc: `can.ASCWriter`
- .blf `can.BLFWriter`
- .csv: `can.CSVWriter`
- .log `can.CanutilsLogWriter`
- .txt `can.Printer` (if pointing to a file)

---

**Note:** The `can.SqliteWriter` is not supported yet.

---

The log files on disk may be incomplete due to buffering until `stop()` is called.

#### Parameters

- **base\_filename** (`str` / `os.PathLike[str]`) – A path-like object for the base filename. The log file format is defined by the suffix of `base_filename`.
- **max\_bytes** (`int`) – The size threshold at which a new log file shall be created. If set to 0, no rollover will be performed.
- **kwargs** (`Any`)

#### `do_rollover()`

Perform rollover.

#### Return type

None

#### `should_rollover(msg)`

Determine if the rollover conditions are met.

#### Parameters

**msg** (`Message`)

#### Return type

bool

#### property writer: `FileIOMessageWriter`

This attribute holds an instance of a writer class which manages the actual file IO.

### 3.4.11 Replaying Files

**class** `can.MessageSync(messages, timestamps=True, gap=0.0001, skip=60.0)`

Used to iterate over some given messages in the recorded time.

Creates an new **MessageSync** instance.

#### Parameters

- **messages** (*Iterable*[*Message*]) – An iterable of *can.Message* instances.
- **timestamps** (*bool*) – Use the messages' timestamps. If False, uses the *gap* parameter as the time between messages.
- **gap** (*float*) – Minimum time between sent messages in seconds
- **skip** (*float*) – Skip periods of inactivity greater than this (in seconds).

Example:

```
import can

with can.LogReader("my_logfile.asc") as reader, can.Bus(interface="virtual") as bus:
    for msg in can.MessageSync(messages=reader):
        print(msg)
        bus.send(msg)
```

## 3.5 Asyncio support

The `asyncio` module built into Python 3.4 and later can be used to write asynchronous code in a single thread. This library supports receiving messages asynchronously in an event loop using the *can.Notifier* class.

There will still be one thread per CAN bus but the user application will execute entirely in the event loop, allowing simpler concurrency without worrying about threading issues. Interfaces that have a valid file descriptor will however be supported natively without a thread.

You can also use the *can.AsyncBufferedReader* listener if you prefer to write coroutine based code instead of using callbacks.

### 3.5.1 Example

Here is an example using both callback and coroutine based code:

```
#!/usr/bin/env python

"""
This example demonstrates how to use async IO with python-can.
"""

import asyncio
from typing import List

import can
from can.notifier import MessageRecipient
```

(continues on next page)

(continued from previous page)

```

def print_message(msg: can.Message) -> None:
    """Regular callback function. Can also be a coroutine."""
    print(msg)

async def main() -> None:
    """The main function that runs in the loop."""

    with can.Bus(
        interface="virtual", channel="my_channel_0", receive_own_messages=True
    ) as bus:
        reader = can.AsyncBufferedReader()
        logger = can.Logger("logfile.asc")

        listeners: List[MessageRecipient] = [
            print_message, # Callback function
            reader, # AsyncBufferedReader() listener
            logger, # Regular Listener object
        ]
        # Create Notifier with an explicit loop to use for scheduling of callbacks
        loop = asyncio.get_running_loop()
        notifier = can.Notifier(bus, listeners, loop=loop)
        # Start sending first message
        bus.send(can.Message(arbitration_id=0))

        print("Bouncing 10 messages...")
        for _ in range(10):
            # Wait for next message from AsyncBufferedReader
            msg = await reader.get_message()
            # Delay response
            await asyncio.sleep(0.5)
            msg.arbitration_id += 1
            bus.send(msg)

        # Wait for last message to arrive
        await reader.get_message()
        print("Done!")

        # Clean-up
        notifier.stop()

if __name__ == "__main__":
    asyncio.run(main())

```

## 3.6 Broadcast Manager

The broadcast manager allows the user to setup periodic message jobs. For example sending a particular message at a given period. The broadcast manager supported natively by several interfaces and a software thread based scheduler is used as a fallback.

This example shows the socketcan backend using the broadcast manager:

```

1  #!/usr/bin/env python
2
3  """
4  This example exercises the periodic sending capabilities.
5
6  Expects a vcan0 interface:
7
8      python3 -m examples.cyclic
9
10 """
11
12 import logging
13 import time
14
15 import can
16
17 logging.basicConfig(level=logging.INFO)
18
19
20 def simple_periodic_send(bus):
21     """
22     Sends a message every 20ms with no explicit timeout
23     Sleeps for 2 seconds then stops the task.
24     """
25     print("Starting to send a message every 200ms for 2s")
26     msg = can.Message(
27         arbitration_id=0x123, data=[1, 2, 3, 4, 5, 6], is_extended_id=False
28     )
29     task = bus.send_periodic(msg, 0.20)
30     assert isinstance(task, can.CyclicSendTaskABC)
31     time.sleep(2)
32     task.stop()
33     print("stopped cyclic send")
34
35
36 def limited_periodic_send(bus):
37     """Send using LimitedDurationCyclicSendTaskABC."""
38     print("Starting to send a message every 200ms for 1s")
39     msg = can.Message(
40         arbitration_id=0x12345678, data=[0, 0, 0, 0, 0, 0], is_extended_id=True
41     )
42     task = bus.send_periodic(msg, 0.20, 1, store_task=False)
43     if not isinstance(task, can.LimitedDurationCyclicSendTaskABC):
44         print("This interface doesn't seem to support LimitedDurationCyclicSendTaskABC")
45         task.stop()

```

(continues on next page)

(continued from previous page)

```

46         return
47
48     time.sleep(2)
49     print("Cyclic send should have stopped as duration expired")
50     # Note the (finished) task will still be tracked by the Bus
51     # unless we pass `store_task=False` to bus.send_periodic
52     # alternatively calling stop removes the task from the bus
53     # task.stop()
54
55
56 def test_periodic_send_with_modifying_data(bus):
57     """Send using ModifiableCyclicTaskABC."""
58     print("Starting to send a message every 200ms. Initial data is four consecutive 1s")
59     msg = can.Message(arbitration_id=0x0CF02200, data=[1, 1, 1, 1])
60     task = bus.send_periodic(msg, 0.20)
61     if not isinstance(task, can.ModifiableCyclicTaskABC):
62         print("This interface doesn't seem to support modification")
63         task.stop()
64         return
65     time.sleep(2)
66     print("Changing data of running task to begin with 99")
67     msg.data[0] = 0x99
68     task.modify_data(msg)
69     time.sleep(2)
70
71     task.stop()
72     print("stopped cyclic send")
73     print("Changing data of stopped task to single ff byte")
74     msg.data = bytearray([0xFF])
75     msg.dlc = 1
76     task.modify_data(msg)
77     time.sleep(1)
78     print("starting again")
79     task.start()
80     time.sleep(1)
81     task.stop()
82     print("done")
83
84
85 # Will have to consider how to expose items like this. The socketcan
86 # interfaces will continue to support it... but the top level api won't.
87 # def test_dual_rate_periodic_send():
88 #     """Send a message 10 times at 1ms intervals, then continue to send every 500ms"""
89 #     msg = can.Message(arbitration_id=0x123, data=[0, 1, 2, 3, 4, 5])
90 #     print("Creating cyclic task to send message 10 times at 1ms, then every 500ms")
91 #     task = can.interface.MultiRateCyclicSendTask('vcan0', msg, 10, 0.001, 0.50)
92 #     time.sleep(2)
93 #
94 #     print("Changing data[0] = 0x42")
95 #     msg.data[0] = 0x42
96 #     task.modify_data(msg)
97 #     time.sleep(2)

```

(continues on next page)

(continued from previous page)

```
98 #
99 #     task.stop()
100 #     print("stopped cyclic send")
101 #
102 #     time.sleep(2)
103 #
104 #     task.start()
105 #     print("starting again")
106 #     time.sleep(2)
107 #     task.stop()
108 #     print("done")
109
110
111 def main():
112     """Test different cyclic sending tasks."""
113     reset_msg = can.Message(
114         arbitration_id=0x00, data=[0, 0, 0, 0, 0, 0], is_extended_id=False
115     )
116
117     # this uses the default configuration (for example from environment variables, or a
118     # config file) see https://python-can.readthedocs.io/en/stable/configuration.html
119     with can.Bus() as bus:
120         bus.send(reset_msg)
121
122         simple_periodic_send(bus)
123
124         bus.send(reset_msg)
125
126         limited_periodic_send(bus)
127
128         test_periodic_send_with_modifying_data(bus)
129
130         # print("Carrying out multirate cyclic test for {} interface".format(interface))
131         # can.rc['interface'] = interface
132         # test_dual_rate_periodic_send()
133
134     time.sleep(2)
135
136
137 if __name__ == "__main__":
138     main()
```



### 3.6.1 Message Sending Tasks

The class based api for the broadcast manager uses a series of `mixin classes`. All mixins inherit from `CyclicSendTaskABC` which inherits from `CyclicTask`.

**class** `can.broadcastmanager.CyclicTask`

Abstract Base for all cyclic tasks.

**abstract stop()**

Cancel this periodic task.

**Raises**

`CanError` – If stop is called on an already stopped task.

**Return type**

None

**class** `can.broadcastmanager.CyclicSendTaskABC(messages, period)`

Message send task with defined period

**Parameters**

- **messages** (`Sequence[Message]` / `Message`) – The messages to be sent periodically.
- **period** (`float`) – The rate in seconds at which to send the messages.

**Raises**

`ValueError` – If the given messages are invalid

**class** `can.broadcastmanager.LimitedDurationCyclicSendTaskABC(messages, period, duration)`

Message send task with a defined duration and period.

**Parameters**

- **messages** (`Sequence[Message]` / `Message`) – The messages to be sent periodically.
- **period** (`float`) – The rate in seconds at which to send the messages.
- **duration** (`float` / `None`) – Approximate duration in seconds to continue sending messages. If no duration is provided, the task will continue indefinitely.

**Raises**

`ValueError` – If the given messages are invalid

**class** `can.broadcastmanager.MultiRateCyclicSendTaskABC(channel, messages, count, initial_period, subsequent_period)`

A Cyclic send task that supports switches send frequency after a set time.

Transmits a message *count* times at *initial\_period* then continues to transmit messages at *subsequent\_period*.

**Parameters**

- **channel** (`int` / `str`) – See interface specific documentation.
- **messages** (`Sequence[Message]` / `Message`)
- **count** (`int`)
- **initial\_period** (`float`)
- **subsequent\_period** (`float`)

**Raises**

`ValueError` – If the given messages are invalid

```
class can.ModifiableCyclicTaskABC(messages, period)
```

**Parameters**

- **messages** (*Sequence*[*Message*] | *Message*) – The messages to be sent periodically.
- **period** (*float*) – The rate in seconds at which to send the messages.

**Raises**

**ValueError** – If the given messages are invalid

```
modify_data(messages)
```

Update the contents of the periodically sent messages, without altering the timing.

**Parameters**

**messages** (*Sequence*[*Message*] | *Message*) – The messages with the new *Message.data*.

Note: The arbitration ID cannot be changed.

Note: The number of new cyclic messages to be sent must be equal to the original number of messages originally specified for this task.

**Raises**

**ValueError** – If the given messages are invalid

**Return type**

None

```
class can.RestartableCyclicTaskABC(messages, period)
```

Adds support for restarting a stopped cyclic task

**Parameters**

- **messages** (*Sequence*[*Message*] | *Message*) – The messages to be sent periodically.
- **period** (*float*) – The rate in seconds at which to send the messages.

**Raises**

**ValueError** – If the given messages are invalid

```
abstract start()
```

Restart a stopped periodic task.

**Return type**

None

```
class can.broadcastmanager.ThreadBasedCyclicSendTask(bus, lock, messages, period, duration=None,
                                                       on_error=None, modifier_callback=None)
```

Fallback cyclic send task using daemon thread.

Transmits *messages* with a *period* seconds for *duration* seconds on a *bus*.

The *on\_error* is called if any error happens on *bus* while sending *messages*. If *on\_error* present, and returns False when invoked, thread is stopped immediately, otherwise, thread continuously tries to send *messages* ignoring errors on a *bus*. Absence of *on\_error* means that thread exits immediately on error.

**Parameters**

- **on\_error** (*Callable*[[*Exception*], *bool*] | *None*) – The callable that accepts an exception if any error happened on a *bus* while sending *messages*, it shall return either True or False depending on desired behaviour of *ThreadBasedCyclicSendTask*.
- **bus** (*BusABC*)

- `lock` (`allocate_lock`)
- `messages` (`Sequence`[`Message`] | `Message`)
- `period` (`float`)
- `duration` (`float` | `None`)
- `modifier_callback` (`Callable`[[`Message`], `None`] | `None`)

**Raises**

`ValueError` – If the given messages are invalid

**start()**

Restart a stopped periodic task.

**Return type**

`None`

**stop()**

Cancel this periodic task.

**Raises**

`CanError` – If stop is called on an already stopped task.

**Return type**

`None`

## 3.7 Error Handling

There are several specific `Exception` classes to allow user code to react to specific scenarios related to CAN busses:

```
Exception (Python standard library)
+-- ...
+-- CanError (python-can)
+-- CanInterfaceNotImplementedError
+-- CanInitializationError
+-- CanOperationError
+-- CanTimeoutError
```

Keep in mind that some functions and methods may raise different exceptions. For example, validating typical arguments and parameters might result in a `ValueError`. This should always be documented for the function at hand.

**exception** `can.exceptions.CanError`(`message=""`, `error_code=None`)

Bases: `Exception`

Base class for all CAN related exceptions.

If specified, the error code is automatically appended to the message:

```
>>> # With an error code (it also works with a specific error):
>>> error = CanOperationError(message="Failed to do the thing", error_code=42)
>>> str(error)
'Failed to do the thing [Error Code 42]'
>>>
>>> # Missing the error code:
>>> plain_error = CanError(message="Something went wrong ...")
```

(continues on next page)

(continued from previous page)

```
>>> str(plain_error)
'Something went wrong ...'
```

**Parameters**

- **error\_code** (*int* / *None*) – An optional error code to narrow down the cause of the fault
- **error\_code** – An optional error code to narrow down the cause of the fault
- **message** (*str*)

**Return type**

None

**exception** `can.exceptions.CanInitializationError`(*message=""*, *error\_code=None*)

Bases: `CanError`

Indicates an error the occurred while initializing a `can.BusABC`.

If initialization fails due to a driver or platform missing/being unsupported, a `CanInterfaceNotImplementedError` is raised instead. If initialization fails due to a value being out of range, a `ValueError` is raised.

**Example scenarios:**

- Try to open a non-existent device and/or channel
- Try to use an invalid setting, which is ok by value, but not ok for the interface
- The device or other resources are already used

**Parameters**

- **message** (*str*)
- **error\_code** (*int* / *None*)

**Return type**

None

**exception** `can.exceptions.CanInterfaceNotImplementedError`(*message=""*, *error\_code=None*)

Bases: `CanError`, `NotImplementedError`

Indicates that the interface is not supported on the current platform.

**Example scenarios:**

- No interface with that name exists
- The interface is unsupported on the current operating system or interpreter
- The driver could not be found or has the wrong version

**Parameters**

- **message** (*str*)
- **error\_code** (*int* / *None*)

**Return type**

None

**exception** `can.exceptions.CanOperationError(message="", error_code=None)`

Bases: `CanError`

Indicates an error while in operation.

**Example scenarios:**

- A call to a library function results in an unexpected return value
- An invalid message was received
- The driver rejected a message that was meant to be sent
- Cyclic redundancy check (CRC) failed
- A message remained unacknowledged
- A buffer is full

**Parameters**

- **message** (`str`)
- **error\_code** (`int` / `None`)

**Return type**

`None`

**exception** `can.exceptions.CanTimeoutError(message="", error_code=None)`

Bases: `CanError`, `TimeoutError`

Indicates the timeout of an operation.

**Example scenarios:**

- Some message could not be sent after the timeout elapsed
- No message was read within the given time

**Parameters**

- **message** (`str`)
- **error\_code** (`int` / `None`)

**Return type**

`None`

`can.exceptions.error_check(error_message=None, exception_type=<class 'can.exceptions.CanOperationError'>)`

Catches any exceptions and turns them into the new type while preserving the stack trace.

**Parameters**

- **error\_message** (`str` / `None`)
- **exception\_type** (`Type[CanError]`)

**Return type**

`Generator[None, None, None]`

## 3.8 Bit Timing Configuration

**Attention:** This feature is experimental. The implementation might change in future versions.

The CAN protocol, specified in ISO 11898, allows the bitrate, sample point and number of samples to be optimized for a given application. These parameters, known as bit timings, can be adjusted to meet the requirements of the communication system and the physical communication channel.

These parameters include:

- **tseg1:** The time segment 1 (TSEG1) is the amount of time from the end of the sync segment until the sample point. It is expressed in time quanta (TQ).
- **tseg2:** The time segment 2 (TSEG2) is the amount of time from the sample point until the end of the bit. It is expressed in TQ.
- **sjw:** The synchronization jump width (SJW) is the maximum number of TQ that the controller can resynchronize every bit.
- **sample point:** The sample point is defined as the point in time within a bit where the bus controller samples the bus for dominant or recessive levels. It is typically expressed as a percentage of the bit time. The sample point depends on the bus length and propagation time as well as the information processing time of the nodes.

Fig. 1: Bit Timing and Sample Point

For example, consider a bit with a total duration of 8 TQ and a sample point at 75%. The values for TSEG1, TSEG2 and SJW would be 5, 2, and 2, respectively. The sample point would be 6 TQ after the start of the bit, leaving 2 TQ for the information processing by the bus nodes.

---

**Note:** The values for TSEG1, TSEG2 and SJW are chosen such that the sample point is at least 50% of the total bit time. This ensures that there is sufficient time for the signal to stabilize before it is sampled.

---



---

**Note:** In CAN FD, the arbitration (nominal) phase and the data phase can have different bit rates. As a result, there are two separate sample points to consider.

---

Another important parameter is **f\_clock**: The CAN system clock frequency in Hz. This frequency is used to derive the TQ size from the bit rate. The relationship is  $f\_clock = (tseg1 + tseg2 + 1) * bitrate * brp$ . The bit rate prescaler value **brp** is usually determined by the controller and is chosen to ensure that the resulting bit time is an integer value. Typical CAN clock frequencies are 8-80 MHz.

In most cases, the recommended settings for a predefined set of common bit rates will work just fine. In some cases, however, it may be necessary to specify custom bit timings. The [BitTiming](#) and [BitTimingFd](#) classes can be used for this purpose to specify bit timings in a relatively interface agnostic manner.

[BitTiming](#) or [BitTimingFd](#) can also help you to produce an overview of possible bit timings for your desired bit rate:

```
>>> import contextlib
>>> import can
...
>>> timings = set()
```

(continues on next page)

(continued from previous page)

```

>>> for sample_point in range(50, 100):
...     with contextlib.suppress(ValueError):
...         timings.add(
...             can.BitTiming.from_sample_point(
...                 f_clock=8_000_000,
...                 bitrate=250_000,
...                 sample_point=sample_point,
...             )
...         )
...
>>> for timing in sorted(timings, key=lambda x: x.sample_point):
...     print(timing)
BR: 250_000 bit/s, SP: 50.00%, BRP: 2, TSEG1: 7, TSEG2: 8, SJW: 4, BTR: C176h, CLK: 8MHz
BR: 250_000 bit/s, SP: 56.25%, BRP: 2, TSEG1: 8, TSEG2: 7, SJW: 4, BTR: C167h, CLK: 8MHz
BR: 250_000 bit/s, SP: 62.50%, BRP: 2, TSEG1: 9, TSEG2: 6, SJW: 4, BTR: C158h, CLK: 8MHz
BR: 250_000 bit/s, SP: 68.75%, BRP: 2, TSEG1: 10, TSEG2: 5, SJW: 4, BTR: C149h, CLK: 8MHz
BR: 250_000 bit/s, SP: 75.00%, BRP: 2, TSEG1: 11, TSEG2: 4, SJW: 4, BTR: C13Ah, CLK: 8MHz
BR: 250_000 bit/s, SP: 81.25%, BRP: 2, TSEG1: 12, TSEG2: 3, SJW: 3, BTR: 812Bh, CLK: 8MHz
BR: 250_000 bit/s, SP: 87.50%, BRP: 2, TSEG1: 13, TSEG2: 2, SJW: 2, BTR: 411Ch, CLK: 8MHz
BR: 250_000 bit/s, SP: 93.75%, BRP: 2, TSEG1: 14, TSEG2: 1, SJW: 1, BTR: 010Dh, CLK: 8MHz

```

It is possible to specify CAN 2.0 bit timings using the config file:

```

[default]
f_clock=8000000
brp=1
tseg1=5
tseg2=2
sjw=1
nof_samples=1

```

The same is possible for CAN FD:

```

[default]
f_clock=80000000
nom_brp=1
nom_tseg1=119
nom_tseg2=40
nom_sjw=40
data_brp=1
data_tseg1=29
data_tseg2=10
data_sjw=10

```

A `dict` of the relevant config parameters can be easily obtained by calling `dict(timing)` or `{**timing}` where `timing` is the `BitTiming` or `BitTimingFd` instance.

Check [Configuration](#) for more information about saving and loading configurations.

**class** `can.BitTiming`(*f\_clock*, *brp*, *tseg1*, *tseg2*, *sjw*, *nof\_samples=1*, *strict=False*)

Bases: `Mapping`

Representation of a bit timing configuration for a CAN 2.0 bus.

The class can be constructed in multiple ways, depending on the information available. The preferred way is using CAN clock frequency, prescaler, tseg1, tseg2 and sjw:

```
can.BitTiming(f_clock=8_000_000, brp=1, tseg1=5, tseg2=1, sjw=1)
```

Alternatively you can set the bitrate instead of the bit rate prescaler:

```
can.BitTiming.from_bitrate_and_segments(
    f_clock=8_000_000, bitrate=1_000_000, tseg1=5, tseg2=1, sjw=1
)
```

It is also possible to specify BTR registers:

```
can.BitTiming.from_registers(f_clock=8_000_000, btr0=0x00, btr1=0x14)
```

or to calculate the timings for a given sample point:

```
can.BitTiming.from_sample_point(f_clock=8_000_000, bitrate=1_000_000, sample_
    ↪point=75.0)
```

### Parameters

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **brp** (*int*) – Bit rate prescaler.
- **tseg1** (*int*) – Time segment 1, that is, the number of quanta from (but not including) the Sync Segment to the sampling point.
- **tseg2** (*int*) – Time segment 2, that is, the number of quanta from the sampling point to the end of the bit.
- **sjw** (*int*) – The Synchronization Jump Width. Decides the maximum number of time quanta that the controller can resynchronize every bit.
- **nof\_samples** (*int*) – Either 1 or 3. Some CAN controllers can also sample each bit three times. In this case, the bit will be sampled three quanta in a row, with the last sample being taken in the edge between TSEG1 and TSEG2. Three samples should only be used for relatively slow baudrates.
- **strict** (*bool*) – If True, restrict bit timings to the minimum required range as defined in ISO 11898. This can be used to ensure compatibility across a wide variety of CAN hardware.

### Raises

**ValueError** – if the arguments are invalid.

**classmethod** **from\_bitrate\_and\_segments**(*f\_clock, bitrate, tseg1, tseg2, sjw, nof\_samples=1, strict=False*)

Create a *BitTiming* instance from bitrate and segment lengths.

### Parameters

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **bitrate** (*int*) – Bitrate in bit/s.
- **tseg1** (*int*) – Time segment 1, that is, the number of quanta from (but not including) the Sync Segment to the sampling point.
- **tseg2** (*int*) – Time segment 2, that is, the number of quanta from the sampling point to the end of the bit.



- **sjw** (*int*) – The Synchronization Jump Width. Decides the maximum number of time quanta that the controller can resynchronize every bit.
- **nof\_samples** (*int*) – Either 1 or 3. Some CAN controllers can also sample each bit three times. In this case, the bit will be sampled three quanta in a row, with the last sample being taken in the edge between TSEG1 and TSEG2. Three samples should only be used for relatively slow baudrates.
- **strict** (*bool*) – If True, restrict bit timings to the minimum required range as defined in ISO 11898. This can be used to ensure compatibility across a wide variety of CAN hardware.

**Raises**

**ValueError** – if the arguments are invalid.

**Return type**

[BitTiming](#)

**classmethod** **from\_registers**(*f\_clock*, *btr0*, *btr1*)

Create a [BitTiming](#) instance from registers btr0 and btr1.

**Parameters**

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **btr0** (*int*) – The BTR0 register value used by many CAN controllers.
- **btr1** (*int*) – The BTR1 register value used by many CAN controllers.

**Raises**

**ValueError** – if the arguments are invalid.

**Return type**

[BitTiming](#)

**classmethod** **iterate\_from\_sample\_point**(*f\_clock*, *bitrate*, *sample\_point*=69.0)

Create a [BitTiming](#) iterator with all the solutions for a sample point.

**Parameters**

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **bitrate** (*int*) – Bitrate in bit/s.
- **sample\_point** (*int*) – The sample point value in percent.

**Raises**

**ValueError** – if the arguments are invalid.

**Return type**

[Iterator](#)[[BitTiming](#)]

**classmethod** **from\_sample\_point**(*f\_clock*, *bitrate*, *sample\_point*=69.0)

Create a [BitTiming](#) instance for a sample point.

This function tries to find bit timings, which are close to the requested sample point. It does not take physical bus properties into account, so the calculated bus timings might not work properly for you.

The [oscillator\\_tolerance\(\)](#) function might be helpful to evaluate the bus timings.

**Parameters**

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **bitrate** (*int*) – Bitrate in bit/s.

- **sample\_point** (*int*) – The sample point value in percent.

**Raises**

**ValueError** – if the arguments are invalid.

**Return type**

*BitTiming*

**property f\_clock:** *int*

The CAN system clock frequency in Hz.

**property bitrate:** *int*

Bitrate in bits/s.

**property brp:** *int*

Bit Rate Prescaler.

**property tq:** *int*

Time quantum in nanoseconds

**property nbt:** *int*

Nominal Bit Time.

**property tseg1:** *int*

Time segment 1.

The number of quanta from (but not including) the Sync Segment to the sampling point.

**property tseg2:** *int*

Time segment 2.

The number of quanta from the sampling point to the end of the bit.

**property sjw:** *int*

Synchronization Jump Width.

**property nof\_samples:** *int*

Number of samples (1 or 3).

**property sample\_point:** *float*

Sample point in percent.

**property btr0:** *int*

Bit timing register 0 for SJA1000.

**property btr1:** *int*

Bit timing register 1 for SJA1000.

**oscillator\_tolerance**(*node\_loop\_delay\_ns=250.0, bus\_length\_m=10.0*)

Oscillator tolerance in percent according to ISO 11898-1.

**Parameters**

- **node\_loop\_delay\_ns** (*float*) – Transceiver loop delay in nanoseconds.
- **bus\_length\_m** (*float*) – Bus length in meters.

**Return type**

*float*

**recreate\_with\_f\_clock**(*f\_clock*)

Return a new *BitTiming* instance with the given *f\_clock* but the same bit rate and sample point.

**Parameters**

**f\_clock** (*int*) – The CAN system clock frequency in Hz.

**Raises**

**ValueError** – if no suitable bit timings were found.

**Return type**

*BitTiming*

```
class can.BitTimingFd(f_clock, nom_brp, nom_tseg1, nom_tseg2, nom_sjw, data_brp, data_tseg1, data_tseg2,
                     data_sjw, strict=False)
```

Bases: *Mapping*

Representation of a bit timing configuration for a CAN FD bus.

The class can be constructed in multiple ways, depending on the information available. The preferred way is using CAN clock frequency, bit rate prescaler, tseg1, tseg2 and sjw for both the arbitration (nominal) and data phase:

```
can.BitTimingFd(
    f_clock=80_000_000,
    nom_brp=1,
    nom_tseg1=59,
    nom_tseg2=20,
    nom_sjw=10,
    data_brp=1,
    data_tseg1=6,
    data_tseg2=3,
    data_sjw=2,
)
```

Alternatively you can set the bit rates instead of the bit rate prescalers:

```
can.BitTimingFd.from_bitrate_and_segments(
    f_clock=80_000_000,
    nom_bitrate=1_000_000,
    nom_tseg1=59,
    nom_tseg2=20,
    nom_sjw=10,
    data_bitrate=8_000_000,
    data_tseg1=6,
    data_tseg2=3,
    data_sjw=2,
)
```

It is also possible to calculate the timings for a given pair of arbitration and data sample points:

```
can.BitTimingFd.from_sample_point(
    f_clock=80_000_000,
    nom_bitrate=1_000_000,
    nom_sample_point=75.0,
    data_bitrate=8_000_000,
    data_sample_point=70.0,
)
```

Initialize a `BitTimingFd` instance with the specified parameters.

#### Parameters

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **nom\_brp** (*int*) – Nominal (arbitration) phase bitrate prescaler.
- **nom\_tseg1** (*int*) – Nominal phase Time segment 1, that is, the number of quanta from (but not including) the Sync Segment to the sampling point.
- **nom\_tseg2** (*int*) – Nominal phase Time segment 2, that is, the number of quanta from the sampling point to the end of the bit.
- **nom\_sjw** (*int*) – The Synchronization Jump Width for the nominal phase. This value determines the maximum number of time quanta that the controller can resynchronize every bit.
- **data\_brp** (*int*) – Data phase bitrate prescaler.
- **data\_tseg1** (*int*) – Data phase Time segment 1, that is, the number of quanta from (but not including) the Sync Segment to the sampling point.
- **data\_tseg2** (*int*) – Data phase Time segment 2, that is, the number of quanta from the sampling point to the end of the bit.
- **data\_sjw** (*int*) – The Synchronization Jump Width for the data phase. This value determines the maximum number of time quanta that the controller can resynchronize every bit.
- **strict** (*bool*) – If True, restrict bit timings to the minimum required range as defined in ISO 11898. This can be used to ensure compatibility across a wide variety of CAN hardware.

#### Raises

**ValueError** – if the arguments are invalid.

**classmethod** `from_bitrate_and_segments(f_clock, nom_bitrate, nom_tseg1, nom_tseg2, nom_sjw, data_bitrate, data_tseg1, data_tseg2, data_sjw, strict=False)`

Create a `BitTimingFd` instance with the bitrates and segments lengths.

#### Parameters

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **nom\_bitrate** (*int*) – Nominal (arbitration) phase bitrate in bit/s.
- **nom\_tseg1** (*int*) – Nominal phase Time segment 1, that is, the number of quanta from (but not including) the Sync Segment to the sampling point.
- **nom\_tseg2** (*int*) – Nominal phase Time segment 2, that is, the number of quanta from the sampling point to the end of the bit.
- **nom\_sjw** (*int*) – The Synchronization Jump Width for the nominal phase. This value determines the maximum number of time quanta that the controller can resynchronize every bit.
- **data\_bitrate** (*int*) – Data phase bitrate in bit/s.
- **data\_tseg1** (*int*) – Data phase Time segment 1, that is, the number of quanta from (but not including) the Sync Segment to the sampling point.
- **data\_tseg2** (*int*) – Data phase Time segment 2, that is, the number of quanta from the sampling point to the end of the bit.

- **data\_sjw** (*int*) – The Synchronization Jump Width for the data phase. This value determines the maximum number of time quanta that the controller can resynchronize every bit.
- **strict** (*bool*) – If True, restrict bit timings to the minimum required range as defined in ISO 11898. This can be used to ensure compatibility across a wide variety of CAN hardware.

**Raises**

**ValueError** – if the arguments are invalid.

**Return type**

*BitTimingFd*

**classmethod** **iterate\_from\_sample\_point**(*f\_clock*, *nom\_bitrate*, *nom\_sample\_point*, *data\_bitrate*, *data\_sample\_point*)

Create an *BitTimingFd* iterator with all the solutions for a sample point.

**Parameters**

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **nom\_bitrate** (*int*) – Nominal bitrate in bit/s.
- **nom\_sample\_point** (*int*) – The sample point value of the arbitration phase in percent.
- **data\_bitrate** (*int*) – Data bitrate in bit/s.
- **data\_sample\_point** (*int*) – The sample point value of the data phase in percent.

**Raises**

**ValueError** – if the arguments are invalid.

**Return type**

*Iterator*[*BitTimingFd*]

**classmethod** **from\_sample\_point**(*f\_clock*, *nom\_bitrate*, *nom\_sample\_point*, *data\_bitrate*, *data\_sample\_point*)

Create a *BitTimingFd* instance for a sample point.

This function tries to find bit timings, which are close to the requested sample points. It does not take physical bus properties into account, so the calculated bus timings might not work properly for you.

The *oscillator\_tolerance()* function might be helpful to evaluate the bus timings.

**Parameters**

- **f\_clock** (*int*) – The CAN system clock frequency in Hz.
- **nom\_bitrate** (*int*) – Nominal bitrate in bit/s.
- **nom\_sample\_point** (*int*) – The sample point value of the arbitration phase in percent.
- **data\_bitrate** (*int*) – Data bitrate in bit/s.
- **data\_sample\_point** (*int*) – The sample point value of the data phase in percent.

**Raises**

**ValueError** – if the arguments are invalid.

**Return type**

*BitTimingFd*

**property f\_clock: int**

The CAN system clock frequency in Hz.

**property nom\_bitrate: int**

Nominal (arbitration phase) bitrate.

**property nom\_brp: int**

Prescaler value for the arbitration phase.

**property nom\_tq: int**

Nominal time quantum in nanoseconds

**property nbt: int**

Number of time quanta in a bit of the arbitration phase.

**property nom\_tseg1: int**

Time segment 1 value of the arbitration phase.

This is the sum of the propagation time segment and the phase buffer segment 1.

**property nom\_tseg2: int**

Time segment 2 value of the arbitration phase. Also known as phase buffer segment 2.

**property nom\_sjw: int**

Synchronization jump width of the arbitration phase.

The phase buffer segments may be shortened or lengthened by this value.

**property nom\_sample\_point: float**

Sample point of the arbitration phase in percent.

**property data\_bitrate: int**

Bitrate of the data phase in bit/s.

**property data\_brp: int**

Prescaler value for the data phase.

**property data\_tq: int**

Data time quantum in nanoseconds

**property dbt: int**

Number of time quanta in a bit of the data phase.

**property data\_tseg1: int**

TSEG1 value of the data phase.

This is the sum of the propagation time segment and the phase buffer segment 1.

**property data\_tseg2: int**

TSEG2 value of the data phase. Also known as phase buffer segment 2.

**property data\_sjw: int**

Synchronization jump width of the data phase.

The phase buffer segments may be shortened or lengthened by this value.

**property data\_sample\_point: float**

Sample point of the data phase in percent.

**oscillator\_tolerance**(*node\_loop\_delay\_ns=250.0, bus\_length\_m=10.0*)

Oscillator tolerance in percent according to ISO 11898-1.

**Parameters**

- **node\_loop\_delay\_ns** (*float*) – Transceiver loop delay in nanoseconds.
- **bus\_length\_m** (*float*) – Bus length in meters.

**Return type**

*float*

**recreate\_with\_f\_clock**(*f\_clock*)

Return a new *BitTimingFd* instance with the given *f\_clock* but the same bit rates and sample points.

**Parameters**

**f\_clock** (*int*) – The CAN system clock frequency in Hz.

**Raises**

**ValueError** – if no suitable bit timings were found.

**Return type**

*BitTimingFd*

## 3.9 Utilities

**can.detect\_available\_configs**(*interfaces=None*)

Detect all configurations/channels that the interfaces could currently connect with.

This might be quite time-consuming.

Automated configuration detection may not be implemented by every interface on every platform. This method will not raise an error in that case, but will rather return an empty list for that interface.

**Parameters**

**interfaces** (*None* | *str* | *Iterable[str]*) – either - the name of an interface to be searched in as a string, - an iterable of interface names to search in, or - *None* to search in all known interfaces.

**Return type**

*list[dict]*

**Returns**

an iterable of dicts, each suitable for usage in the constructor of *can.BusABC*.

## 3.10 Internal API

Here we document the odds and ends that are more helpful for creating your own interfaces or listeners but generally shouldn't be required to interact with python-can.

### 3.10.1 BusABC

The `BusABC` class, as the name suggests, provides an abstraction of a CAN bus. The bus provides a wrapper around a physical or virtual CAN Bus.

An interface specific instance of the `BusABC` is created by the `Bus` class, see `Bus` for the user facing API.

### 3.10.2 Extending the BusABC class

Concrete implementations must implement the following:

- `send()` to send individual messages
- `_recv_internal()` to receive individual messages (see note below!)
- set the `channel_info` attribute to a string describing the underlying bus and/or channel

They might implement the following:

- `flush_tx_buffer()` to allow discarding any messages yet to be sent
- `shutdown()` to override how the bus should shut down
- `_send_periodic_internal()` to override the software based periodic sending and push it down to the kernel or hardware.
- `_apply_filters()` to apply efficient filters to lower level systems like the OS kernel or hardware.
- `_detect_available_configs()` to allow the interface to report which configurations are currently available for new connections.
- `state()` property to allow reading and/or changing the bus state.

---

**Note:** *TL;DR:* Only override `_recv_internal()`, never `recv()` directly.

Previously, concrete bus classes had to override `recv()` directly instead of `_recv_internal()`, but that has changed to allow the abstract base class to handle in-software message filtering as a fallback. All internal interfaces now implement that new behaviour. Older (custom) interfaces might still be implemented like that and thus might not provide message filtering:

---

Concrete instances are usually created by `can.Bus()` which takes the users configuration into account.

### Bus Internals

Several methods are not documented in the main `can.BusABC` as they are primarily useful for library developers as opposed to library users.

**abstract** `BusABC.__init__(channel, can_filters=None, **kwargs)`

Construct and open a CAN bus instance of the specified type.

Subclasses should call though this method with all given parameters as it handles generic tasks like applying filters.

#### Parameters

- **channel** (*Any*) – The can interface identifier. Expected type is backend dependent.
- **can\_filters** (*Sequence*[`CanFilter` | `CanFilterExtended`] | `None`) – See `set_filters()` for details.



- **kwargs** (*dict*) – Any backend dependent configurations are passed in this dictionary

**Raises**

- **ValueError** – If parameters are out of range
- **CanInterfaceNotImplementedError** – If the driver cannot be accessed
- **CanInitializationError** – If the bus cannot be initialized

`BusABC.__iter__()`

Allow iteration on messages as they are received.

```
for msg in bus:
    print(msg)
```

**Yields**

*Message* msg objects.

**Return type**

*Iterator*[*Message*]

`BusABC.__str__()`

Return str(self).

**Return type**

*str*

`BusABC.__weakref__`

list of weak references to the object (if defined)

`BusABC._recv_internal(timeout)`

Read a message from the bus and tell whether it was filtered. This methods may be called by `recv()` to read a message multiple times if the filters set by `set_filters()` do not match and the call has not yet timed out.

New implementations should always override this method instead of `recv()`, to be able to take advantage of the software based filtering provided by `recv()` as a fallback. This method should never be called directly.

---

**Note:** This method is not an `@abstractmethod` (for now) to allow older external implementations to continue using their existing `recv()` implementation.

---



---

**Note:** The second return value (whether filtering was already done) may change over time for some interfaces, like for example in the Kvaser interface. Thus it cannot be simplified to a constant value.

---

**Parameters**

**timeout** (*float*) – seconds to wait for a message, see `send()`

**Returns**

1. a message that was read or None on timeout
2. a bool that is True if message filtering has already been done and else False

**Raises**

- **CanOperationError** – If an error occurred while reading

- **NotImplementedError** – if the bus provides it's own `recv()` implementation (legacy implementation)

**Return type**

`Tuple[Message | None, bool]`

**BusABC.\_apply\_filters(filters)**

Hook for applying the filters to the underlying kernel or hardware if supported/implemented by the interface.

**Parameters**

**filters** (`Sequence[CanFilter | CanFilterExtended] | None`) – See `set_filters()` for details.

**Return type**

`None`

**BusABC.\_send\_periodic\_internal(msgs, period, duration=None, modifier\_callback=None)**

Default implementation of periodic message sending using threading.

Override this method to enable a more efficient backend specific approach.

**Parameters**

- **msgs** (`Sequence[Message] | Message`) – Messages to transmit
- **period** (`float`) – Period in seconds between each message
- **duration** (`float | None`) – The duration between sending each message at the given rate. If no duration is provided, the task will continue indefinitely.
- **modifier\_callback** (`Callable[[Message], None] | None`)

**Returns**

A started task instance. Note the task can be stopped (and depending on the backend modified) by calling the `stop()` method.

**Return type**

`CyclicSendTaskABC`

**static BusABC.\_detect\_available\_configs()**

Detect all configurations/channels that this interface could currently connect with.

This might be quite time consuming.

May not to be implemented by every interface on every platform.

**Returns**

an iterable of dicts, each being a configuration suitable for usage in the interface's bus constructor.

**Return type**

`List[AutoDetectedConfig]`

### 3.10.3 About the IO module

Handling of the different file formats is implemented in `can.io`. Each file/IO type is within a separate module and ideally implements both a *Reader* and a *Writer*. The reader usually extends `can.io.generic.BaseIOHandler`, while the writer often additionally extends `can.Listener`, to be able to be passed directly to a `can.Notifier`.

#### Adding support for new file formats

This assumes that you want to add a new file format, called *canstore*. Ideally add both reading and writing support for the new file format, although this is not strictly required.

1. Create a new module: `can/io/canstore.py` (or simply copy some existing one like `can/io/csv.py`)
2. Implement a reader `CanstoreReader` (which often extends `can.io.generic.BaseIOHandler`, but does not have to). Besides from a constructor, only `__iter__(self)` needs to be implemented.
3. Implement a writer `CanstoreWriter` (which often extends `can.io.generic.BaseIOHandler` and `can.Listener`, but does not have to). Besides from a constructor, only `on_message_received(self, msg)` needs to be implemented.
4. Add a case to `can.io.player.LogReader`'s `__new__()`.
5. Document the two new classes (and possibly additional helpers) with docstrings and comments. Please mention features and limitations of the implementation.
6. Add a short section to the bottom of `doc/listeners.rst`.
7. Add tests where appropriate, for example by simply adding a test case called `class TestCanstoreFileFormat(ReaderWriterTest)` to `test/logformats_test.py`. That should already handle all of the general testing. Just follow the way the other tests in there do it.
8. Add imports to `can/__init__.py` and `can/io/__init__.py` so that the new classes can be simply imported as `from can import CanstoreReader, CanstoreWriter`.

#### IO Utilities

Contains generic base classes for file IO.

**class** `can.io.generic.BaseIOHandler`(*file*, *mode*='rt', *\*\*kwargs*)

A generic file handler that can be used for reading and writing.

Can be used as a context manager.

##### Attr *file*

the file-like object that is kept internally, or *None* if none was opened

##### Parameters

- **file** (*TextIO* | *BinaryIO* | *GzipFile* | *None*) – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all
- **mode** (*str*) – the mode that should be used to open the file, see `open()`, ignored if *file* is *None*
- **kwargs** (*Any*)

##### `stop()`

Closes the underlying file-like object and flushes it, if it was opened in write mode.

##### Return type

*None*

**class** can.io.generic.**MessageWriter**(*file*, *mode*='rt', **\*\*kwargs**)

The base class for all writers.

**Parameters**

- **file** (*TextIO* | *BinaryIO* | *GzipFile* | *None*) – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all
- **mode** (*str*) – the mode that should be used to open the file, see `open()`, ignored if *file* is *None*
- **kwargs** (*Any*)

**class** can.io.generic.**FileIOMessageWriter**(*file*, *mode*='wt', **\*\*kwargs**)

A specialized base class for all writers with file descriptors.

**Parameters**

- **file** (*TextIO* | *BinaryIO* | *GzipFile*) – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all
- **mode** (*str*) – the mode that should be used to open the file, see `open()`, ignored if *file* is *None*
- **kwargs** (*Any*)

**file\_size()**

Return an estimate of the current file size in bytes.

**Return type**

*int*

**class** can.io.generic.**TextIOMessageWriter**(*file*, *mode*='wt', **\*\*kwargs**)

**Parameters**

- **file** (*TextIO*) – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all
- **mode** (*str*) – the mode that should be used to open the file, see `open()`, ignored if *file* is *None*
- **kwargs** (*Any*)

**class** can.io.generic.**BinaryIOMessageWriter**(*file*, *mode*='wt', **\*\*kwargs**)

**Parameters**

- **file** (*BinaryIO* | *GzipFile*) – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all
- **mode** (*str*) – the mode that should be used to open the file, see `open()`, ignored if *file* is *None*
- **kwargs** (*Any*)

**class** can.io.generic.**MessageReader**(*file*, *mode*='rt', **\*\*kwargs**)

The base class for all readers.

**Parameters**

- **file** (*TextIO* | *BinaryIO* | *GzipFile* | *None*) – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all

- **mode** (*str*) – the mode that should be used to open the file, see `open()`, ignored if *file* is *None*
- **kwargs** (*Any*)

```
class can.io.generic.TextIOMessageReader(file, mode='rt', **kwargs)
```

#### Parameters

- **file** (*TextIO*) – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all
- **mode** (*str*) – the mode that should be used to open the file, see `open()`, ignored if *file* is *None*
- **kwargs** (*Any*)

```
class can.io.generic.BinaryIOMessageReader(file, mode='rt', **kwargs)
```

#### Parameters

- **file** (*BinaryIO* | *GzipFile*) – a path-like object to open a file, a file-like object to be used as a file or *None* to not use a file at all
- **mode** (*str*) – the mode that should be used to open the file, see `open()`, ignored if *file* is *None*
- **kwargs** (*Any*)

### 3.10.4 Other Utilities

Utilities and configuration file parsing.

```
can.util.cast_from_string(string_val)
```

Perform trivial type conversion from *str* values.

#### Parameters

**string\_val** (*str*) – the string, that shall be converted

#### Return type

*str* | *int* | *float* | *bool*

```
can.util.channel2int(channel)
```

Try to convert the channel to an integer.

#### Parameters

**channel** (*str* | *int* | *None*) – Channel string (e.g. “can0”, “CAN1”) or an integer

#### Returns

Channel integer or *None* if unsuccessful

#### Return type

*int* | *None*

```
can.util.check_or_adjust_timing_clock(timing, valid_clocks)
```

Adjusts the given timing instance to have an *f\_clock* value that is within the allowed values specified by *valid\_clocks*. If the *f\_clock* value of timing is already within *valid\_clocks*, then *timing* is returned unchanged.

#### Parameters

- **timing** (*T2*) – The *BitTiming* or *BitTimingFd* instance to adjust.

- **valid\_clocks** (*Iterable*[*int*]) – An iterable of integers representing the valid *f\_clock* values that the timing instance can be changed to. The order of the values in *valid\_clocks* determines the priority in which they are tried, with earlier values being tried before later ones.

**Returns**

A new *BitTiming* or *BitTimingFd* instance with an *f\_clock* value within *valid\_clocks*.

**Raises**

*CanInitializationError* – If no compatible *f\_clock* value can be found within *valid\_clocks*.

**Return type**

*T2*

`can.util.deprecated_args_alias(deprecation_start, deprecation_end=None, **aliases)`

Allows to rename/deprecate a function kwarg(s) and optionally have the deprecated kwarg(s) set as alias(es)

Example:

```
@deprecated_args_alias("1.2.0", oldArg="new_arg", anotherOldArg="another_new_arg")
def library_function(new_arg, another_new_arg):
    pass

@deprecated_args_alias(
    deprecation_start="1.2.0",
    deprecation_end="3.0.0",
    oldArg="new_arg",
    obsoleteOldArg=None,
)
def library_function(new_arg):
    pass
```

**Parameters**

- **deprecation\_start** (*str*) – The *python-can* version, that introduced the *DeprecationWarning*.
- **deprecation\_end** (*str* | *None*) – The *python-can* version, that marks the end of the deprecation period.
- **aliases** (*str* | *None*) – keyword arguments, that map the deprecated argument names to the new argument names or *None*.

**Return type**

*Callable*[[*Callable*[[~P1], *TI*], *Callable*[[~P1], *TI*]]

`can.util.dlc2len(dlc)`

Calculate the data length from DLC.

**Parameters**

**dlc** (*int*) – DLC (0-15)

**Returns**

Data length in number of bytes (0-64)

**Return type**

*int*

`can.util.len2dlc(length)`

Calculate the DLC from data length.

**Parameters**

**length** (*int*) – Length in number of bytes (0-64)

**Returns**

DLC (0-15)

**Return type**

*int*

`can.util.load_config(path=None, config=None, context=None)`

Returns a dict with configuration details which is loaded from (in this order):

- `config`
- `can.rc`
- Environment variables `CAN_INTERFACE`, `CAN_CHANNEL`, `CAN_BITRATE`
- Config files `/etc/can.conf` or `~/.can` or `~/.canrc` where the latter may add or replace values of the former.

Interface can be any of the strings from `can.VALID_INTERFACES` for example: `kvaser`, `socketcan`, `pcan`, `usb2can`, `ixxat`, `nican`, `virtual`.

---

**Note:** The key `bustype` is copied to `interface` if that one is missing and does never appear in the result.

---

**Parameters**

- **path** (*TextIO* | *BinaryIO* | *GzipFile* | *str* | *PathLike[str]* | *None*) – Optional path to config file.
- **config** (*Dict[str, Any]* | *None*) – A dict which may set the ‘interface’, and/or the ‘channel’, or neither. It may set other values that are passed through.
- **context** (*str* | *None*) – Extra ‘context’ pass to config sources. This can be used to section other than ‘default’ in the configuration file.

**Returns**

A config dictionary that should contain ‘interface’ & ‘channel’:

```
{
    'interface': 'python-can backend interface to use',
    'channel': 'default channel to use',
    # possibly more
}
```

Note `None` will be used if all the options are exhausted without finding a value.

All unused values are passed from `config` over to this.

**Raises**

`CanInterfaceNotImplementedError` if the `interface` name isn’t recognized

**Return type**

*BusConfig*

`can.util.load_environment_config(context=None)`

Loads config dict from environmental variables (if set):

- CAN\_INTERFACE
- CAN\_CHANNEL
- CAN\_BITRATE
- CAN\_CONFIG

if context is supplied, “\_{context}” is appended to the environment variable name we will look at. For example if context=“ABC”:

- CAN\_INTERFACE\_ABC
- CAN\_CHANNEL\_ABC
- CAN\_BITRATE\_ABC
- CAN\_CONFIG\_ABC

**Parameters**

**context** (*str* | *None*)

**Return type**

*Dict*[*str*, *str*]

`can.util.load_file_config(path=None, section='default')`

Loads configuration from file with following content:

```
[default]
interface = socketcan
channel = can0
```

**Parameters**

- **path** (*TextIO* | *BinaryIO* | *GzipFile* | *str* | *PathLike*[*str*] | *None*) – path to config file. If not specified, several sensible default locations are tried depending on platform.
- **section** (*str*) – name of the section to read configuration from.

**Return type**

*Dict*[*str*, *str*]

`can.util.set_logging_level(level_name)`

Set the logging level for the “can” logger.

**Parameters**

**level\_name** (*str*) – One of: ‘critical’, ‘error’, ‘warning’, ‘info’, ‘debug’, ‘subdebug’, or the value *None* (=default). Defaults to ‘debug’.

**Return type**

*None*

`can.util.time_perfcouter_correlation()`

Get the *perf\_counter* value nearest to when *time.time()* is updated



Computed if the default timer used by *time.time* on this platform has a resolution higher than 10s, otherwise the current time and perf\_counter is directly returned. This was chosen as typical timer resolution on Linux/macOS is ~1s, and the Windows platform can vary from ~500s to 10ms.

Note this value is based on when *time.time()* is observed to update from Python, it is not directly returned by the operating system.

**Returns**

(t, performance\_counter) time.time value and time.perf\_counter value when the time.time is updated

**Return type**

*Tuple*[float, float]



## HARDWARE INTERFACES

**python-can** hides the low-level, device-specific interfaces to controller area network adapters in interface dependant modules. However as each hardware device is different, you should carefully go through your interface's documentation.

---

**Note:** The *Interface Names* are listed in [Configuration](#).

---

The following hardware interfaces are included in python-can:

### 4.1 CANalyst-II

CANalyst-II is a USB to CAN Analyzer device produced by Chuangxin Technology.

Install: `pip install "python-can[canalystii]"`

#### 4.1.1 Supported platform

Windows, Linux and Mac.

---

**Note:** The backend driver depends on [pyusb](#) so a [pyusb](#) backend driver library such as `libusb` must be installed. On Windows a tool such as [Zadig](#) can be used to set the Canalyst-II USB device driver to `libusb-win32`.

---

#### 4.1.2 Limitations

##### Multiple Channels

The USB protocol transfers messages grouped by channel. Messages received on channel 0 and channel 1 may be returned by software out of order between the two channels (although inside each channel, all messages are in order). The timestamp field of each message comes from the hardware and shows the exact time each message was received. To compare ordering of messages on channel 0 vs channel 1, sort the received messages by the timestamp field first.

### 4.1.3 Backend Driver

The backend driver module *canalystii* <<https://pypi.org/project/canalystii>> must be installed to use this interface. This open source driver is unofficial and based on reverse engineering. Earlier versions of python-can required a binary library from the vendor for this functionality.

### 4.1.4 Bus

```
class can.interfaces.canalystii.CANalystIIBus(channel=(0, 1), device=0, bitrate=None, timing=None,
                                             can_filters=None, rx_queue_size=None, **kwargs)
```

#### Parameters

- **channel** (*int* | *Sequence[int]* | *str*) – Optional channel number, list/tuple of multiple channels, or comma separated string of channels. Default is to configure both channels.
- **device** (*int*) – Optional USB device number. Default is 0 (first device found).
- **bitrate** (*int* | *None*) – CAN bitrate in bits/second. Required unless the *bit\_timing* argument is set.
- **timing** (*BitTiming* | *BitTimingFd* | *None*) – Optional *BitTiming* instance to use for custom bit timing setting. If this argument is set then it overrides the *bitrate* argument. The *f\_clock* value of the timing instance must be set to 8\_000\_000 (8MHz) for standard CAN. CAN FD and the *BitTimingFd* class are not supported.
- **can\_filters** (*Sequence[CanFilter | CanFilterExtended]* | *None*) – Optional filters for received CAN messages.
- **rx\_queue\_size** (*int* | *None*) – If set, software received message queue can only grow to this many messages (for all channels) before older messages are dropped
- **kwargs** (*Dict[str, Any]*)

## 4.2 CANTact CAN Interface

Interface for CANTact devices from Linklayer Labs

```
class can.interfaces.cantact.CantactBus(channel, bitrate=500000, poll_interval=0.01, monitor=False,
                                       timing=None, **kwargs)
```

Bases: *BusABC*

CANTact interface

#### Parameters

- **channel** (*int*) – Channel number (zero indexed, labeled on multi-channel devices)
- **bitrate** (*int*) – Bitrate in bits/s
- **monitor** (*bool*) – If true, operate in listen-only monitoring mode
- **timing** (*BitTiming* | *BitTimingFd* | *None*) – Optional *BitTiming* instance to use for custom bit timing setting. If this argument is set then it overrides the *bitrate* argument. The *f\_clock* value of the timing instance must be set to 24\_000\_000 (24MHz) for standard CAN. CAN FD and the *BitTimingFd* class are not supported.
- **poll\_interval** (*float*)

- **kwargs** (*Any*)

**send**(*msg*, *timeout=None*)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

#### Parameters

- **msg** (*Message*) – A message object.
- **timeout** – If > 0, wait up to this many seconds for message to be ACK’ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. None blocks indefinitely.

#### Raises

*CanOperationError* – If an error occurred while sending

**shutdown**()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

## 4.3 ETAS

This interface adds support for CAN interfaces by [ETAS](#). The ETAS [BOA](#) (Basic Open API) is used.

### 4.3.1 Installation

Install the “ETAS ECU and Bus Interfaces – Distribution Package”.

**Warning:** Only Windows is supported by this interface.

The Linux kernel v5.13 (and greater) natively supports ETAS ES581.4, ES582.1 and ES584.1 USB modules. To use these under Linux, please refer to the [SocketCAN](#) interface documentation.

### 4.3.2 Configuration

The simplest configuration file would be:

```
[default]
interface = etas
channel = ETAS://ETH/ES910:abcd/CAN:1
```

Channels are the URIs used by the underlying API.

To find available URIs, use [detect\\_available\\_configs\(\)](#):

```
configs = can.interface.detect_available_configs(interfaces="etas")
for c in configs:
    print(c)
```

### 4.3.3 Bus

```
class can.interfaces.etas.EtasBus(channel, can_filters=None, receive_own_messages=False,  
                                bitrate=1000000, fd=True, data_bitrate=2000000, **kwargs)
```

Construct and open a CAN bus instance of the specified type.

Subclasses should call though this method with all given parameters as it handles generic tasks like applying filters.

#### Parameters

- **channel** (*str*) – The can interface identifier. Expected type is backend dependent.
- **can\_filters** (*Sequence*[*CanFilter* | *CanFilterExtended*] | *None*) – See [set\\_filters\(\)](#) for details.
- **kwargs** (*dict*) – Any backend dependent configurations are passed in this dictionary
- **receive\_own\_messages** (*bool*)
- **bitrate** (*int*)
- **fd** (*bool*)
- **data\_bitrate** (*int*)

#### Raises

- **ValueError** – If parameters are out of range
- **CanInterfaceNotImplementedError** – If the driver cannot be accessed
- **CanInitializationError** – If the bus cannot be initialized

#### flush\_tx\_buffer()

Discard every message that may be queued in the output buffer(s).

#### Return type

None

#### send(msg, timeout=None)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

#### Parameters

- **msg** (*Message*) – A message object.
- **timeout** (*float* | *None*) – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. None blocks indefinitely.

#### Raises

**CanOperationError** – If an error occurred while sending

#### Return type

None

#### shutdown()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

**Return type**

None

**property state:** *BusState*

Return the current state of the hardware

## 4.4 Geschwister Schneider and candleLight

Windows/Linux/Mac CAN driver based on usbfs or WinUSB WCID for Geschwister Schneider USB/CAN devices and candleLight USB CAN interfaces.

Install: `pip install "python-can[gs_usb]"`

Usage: pass device `index` (starting from 0) if using automatic device detection:

```
import can

bus = can.Bus(interface="gs_usb", channel=dev.product, index=0, bitrate=250000)
```

Alternatively, pass `bus` and `address` to open a specific device. The parameters can be got by `pyusb` as shown below:

```
import usb
import can

dev = usb.core.find(idVendor=0x1D50, idProduct=0x606F)
bus = can.Bus(
    interface="gs_usb",
    channel=dev.product,
    bus=dev.bus,
    address=dev.address,
    bitrate=250000
)
```

### 4.4.1 Supported devices

Geschwister Schneider USB/CAN devices and bytewerk.org candleLight USB CAN interfaces such as candleLight, canable, cantact, etc.

### 4.4.2 Supported platform

Windows, Linux and Mac.

**Note:** The backend driver depends on `pyusb` so a `pyusb` backend driver library such as `libusb` must be installed.

On Windows a tool such as `Zadig` can be used to set the USB device driver to `libusb-win32`.

### 4.4.3 Supplementary Info

The firmware implementation for Geschwister Schneider USB/CAN devices and candleLight USB CAN can be found in `candle-usb/candleLight_fw`. The Linux kernel driver can be found in `linux/drivers/net/can/usb/gs_usb.c`.

The `gs_usb` interface in `python-can` relies on upstream `gs_usb` package, which can be found in <https://pypi.org/project/gs-usb/> or [https://github.com/jxltom/gs\\_usb](https://github.com/jxltom/gs_usb).

The `gs_usb` package uses `pyusb` as backend, which brings better cross-platform compatibility.

Note: The bitrate 10K, 20K, 50K, 83.333K, 100K, 125K, 250K, 500K, 800K and 1M are supported in this interface, as implemented in the upstream `gs_usb` package's `set_bitrate` method.

**Warning:** Message filtering is not supported in Geschwister Schneider USB/CAN devices and bytewerk.org candleLight USB CAN interfaces.

### 4.4.4 Bus

```
class can.interfaces.gs_usb.GsUsbBus(channel, bitrate, index=None, bus=None, address=None,
                                     can_filters=None, **kwargs)
```

#### Parameters

- **channel** – usb device name
- **index** – device number if using automatic scan, starting from 0. If specified, bus/address shall not be provided.
- **bus** – number of the bus that the device is connected to
- **address** – address of the device on the bus it is connected to
- **can\_filters** – not supported
- **bitrate** – CAN network bandwidth (bits/s)

```
send(msg, timeout=None)
```

Transmit a message to the CAN bus.

#### Parameters

- **msg** (`Message`) – A message object.
- **timeout** (`float` | `None`) – timeout is not supported. The function won't return until message is sent or exception is raised.

#### Raises

`CanOperationError` – if the message could not be sent

```
shutdown()
```

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.



## 4.5 isCAN

Interface for isCAN from [Thorsis Technologies GmbH](#), former ifak system GmbH.

### 4.5.1 Bus

**class** `can.interfaces.iscan.IscanBus(channel, bitrate=500000, poll_interval=0.01, **kwargs)`

isCAN interface

#### Parameters

- **channel** (*str* / *int*) – Device number
- **bitrate** (*int*) – Bitrate in bits/s
- **poll\_interval** (*float*) – Poll interval in seconds when reading messages

**exception** `can.interfaces.iscan.IscanError(function, error_code, arguments)`

#### Parameters

**error\_code** (*int*)

#### Return type

None

## 4.6 IXXAT Virtual Communication Interface

Interface to [IXXAT](#) Virtual Communication Interface V3 SDK. Works on Windows.

The Linux ECI SDK is currently unsupported, however on Linux some devices are supported with [SocketCAN](#).

The [send\\_periodic\(\)](#) method is supported natively through the on-board cyclic transmit list. Modifying cyclic messages is not possible. You will need to stop it, and then start a new periodic message.

### 4.6.1 Configuration

The simplest configuration file would be:

```
[default]
interface = ixxat
channel = 0
```

Python-can will search for the first IXXAT device available and open the first channel. `interface` and `channel` parameters are interpreted by frontend `can.interfaces.interface` module, while the following parameters are optional and are interpreted by IXXAT implementation.

- `receive_own_messages` (default False) Enable self-reception of sent messages.
- `unique_hardware_id` (default first device) Unique hardware ID of the IXXAT device.
- `extended` (default True) Allow usage of extended IDs.
- `fd` (default False) Enable CAN-FD capabilities.
- `rx_fifo_size` (default 16 for CAN, 1024 for CAN-FD) Number of RX mailboxes.
- `tx_fifo_size` (default 16 for CAN, 128 for CAN-FD) Number of TX mailboxes.

- `bitrate` (default 500000) Channel bitrate.
- `data_bitrate` (defaults to 2Mbps) Channel data bitrate (only `canfd`, to use when `message_bitrate_switch` is used).
- `sjw_abr` (optional, only `canfd`) Bus timing value sample jump width (arbitration).
- `tseg1_abr` (optional, only `canfd`) Bus timing value tseg1 (arbitration).
- `tseg2_abr` (optional, only `canfd`) Bus timing value tseg2 (arbitration).
- `sjw_dbr` (optional, only used if baudrate switch enabled) Bus timing value sample jump width (data).
- `tseg1_dbr` (optional, only used if baudrate switch enabled) Bus timing value tseg1 (data).
- `tseg2_dbr` (optional, only used if baudrate switch enabled) Bus timing value tseg2 (data).
- `ssp_dbr` (optional, only used if baudrate switch enabled) Secondary sample point (data).

## 4.6.2 Filtering

The CAN filters act as an allow list in IXXAT implementation, that is if you supply a non-empty filter list you must explicitly state EVERY frame you want to receive (including RTR field). The `can_id/mask` must be specified according to IXXAT behaviour, that is bit 0 of `can_id/mask` parameters represents the RTR field in CAN frame. See IXXAT VCI documentation, section “Message filters” for more info.

## 4.6.3 List available devices

In case you have connected multiple IXXAT devices, you have to select them by using their unique hardware id. The function `detect_available_configs()` can be used to generate a list of *BusABC* constructors (including the channel number and unique hardware ID number for the connected devices).

```
>>> import can
>>> configs = can.detect_available_configs("ixxat")
>>> for config in configs:
...     print(config)
{'interface': 'ixxat', 'channel': 0, 'unique_hardware_id': 'HW441489'}
{'interface': 'ixxat', 'channel': 0, 'unique_hardware_id': 'HW107422'}
{'interface': 'ixxat', 'channel': 1, 'unique_hardware_id': 'HW107422'}
```

You may also get a list of all connected IXXAT devices using the function `get_ixxat_hwids()` as demonstrated below:

```
>>> from can.interfaces.ixxat import get_ixxat_hwids
>>> for hwid in get_ixxat_hwids():
...     print("Found IXXAT with hardware id '%s'." % hwid)
Found IXXAT with hardware id 'HW441489'.
Found IXXAT with hardware id 'HW107422'.
```

## 4.6.4 Bus

```
class can.interfaces.ixxat.IXXATBus(channel, can_filters=None, receive_own_messages=False,
                                   unique_hardware_id=None, extended=True, fd=False,
                                   rx_fifo_size=None, tx_fifo_size=None, bitrate=500000,
                                   data_bitrate=2000000, sjw_abr=None, tseg1_abr=None,
                                   tseg2_abr=None, sjw_dbr=None, tseg1_dbr=None, tseg2_dbr=None,
                                   ssp_dbr=None, **kwargs)
```

The CAN Bus implemented for the IXXAT interface.

Based on the C implementation of IXXAT, two different dlls are provided by IXXAT, one to work with CAN, the other with CAN-FD.

This class only delegates to related implementation (in `calib_vcinpl` or `canlib_vcinpl2`) class depending on `fd` user option.

### Parameters

- **channel** (*int*) – The Channel id to create this bus with.
- **can\_filters** – See `can.BusABC.set_filters()`.
- **receive\_own\_messages** (*bool*) – Enable self-reception of sent messages.
- **unique\_hardware\_id** (*int* / *None*) – UniqueHardwareId to connect (optional, will use the first found if not supplied)
- **extended** (*bool*) – Default True, enables the capability to use extended IDs.
- **fd** (*bool*) – Default False, enables CAN-FD usage.
- **rx\_fifo\_size** (*int* / *None*) – Receive fifo size (default 1024 for fd, else 16)
- **tx\_fifo\_size** (*int* / *None*) – Transmit fifo size (default 128 for fd, else 16)
- **bitrate** (*int*) – Channel bitrate in bit/s
- **data\_bitrate** (*int*) – Channel bitrate in bit/s (only in CAN-Fd if baudrate switch enabled).
- **sjw\_abr** (*int* / *None*) – Bus timing value sample jump width (arbitration). Only takes effect with fd enabled.
- **tseg1\_abr** (*int* / *None*) – Bus timing value tseg1 (arbitration). Only takes effect with fd enabled.
- **tseg2\_abr** (*int* / *None*) – Bus timing value tseg2 (arbitration). Only takes effect with fd enabled.
- **sjw\_dbr** (*int* / *None*) – Bus timing value sample jump width (data). Only takes effect with fd and baudrate switch enabled.
- **tseg1\_dbr** (*int* / *None*) – Bus timing value tseg1 (data). Only takes effect with fd and bitrate switch enabled.
- **tseg2\_dbr** (*int* / *None*) – Bus timing value tseg2 (data). Only takes effect with fd and bitrate switch enabled.
- **ssp\_dbr** (*int* / *None*) – Secondary sample point (data). Only takes effect with fd and bitrate switch enabled.

### `flush_tx_buffer()`

Flushes the transmit buffer on the IXXAT

**send**(*msg*, *timeout=None*)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

**Parameters**

- **msg** (*Message*) – A message object.
- **timeout** (*float* / *None*) – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. None blocks indefinitely.

**Raises**

*CanOperationError* – If an error occurred while sending

**Return type**

None

**shutdown**()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

**Return type**

None

**property state:** *BusState*

Return the current state of the hardware

## Implementation based on vcinpl.dll

```
class can.interfaces.ixxat.canlib_vcinpl.IXXATBus(channel, can_filters=None,
                                                receive_own_messages=False,
                                                unique_hardware_id=None, extended=True,
                                                rx_fifo_size=16, tx_fifo_size=16, bitrate=500000,
                                                **kwargs)
```

The CAN Bus implemented for the IXXAT interface.

**Warning:** This interface does implement efficient filtering of messages, but the filters have to be set in `__init__` using the `can_filters` parameter. Using `set_filters()` does not work.

**Parameters**

- **channel** (*int*) – The Channel id to create this bus with.
- **can\_filters** – See *can.BusABC.set\_filters()*.
- **receive\_own\_messages** (*bool*) – Enable self-reception of sent messages.
- **unique\_hardware\_id** (*int* / *None*) – unique\_hardware\_id to connect (optional, will use the first found if not supplied)
- **extended** (*bool*) – Default True, enables the capability to use extended IDs.
- **rx\_fifo\_size** (*int*) – Receive fifo size (default 16)
- **tx\_fifo\_size** (*int*) – Transmit fifo size (default 16)

- **bitrate** (*int*) – Channel bitrate in bit/s

#### **flush\_tx\_buffer()**

Flushes the transmit buffer on the IXXAT

#### **send**(*msg*, *timeout=None*)

Sends a message on the bus. The interface may buffer the message.

##### **Parameters**

- **msg** (*Message*) – The message to send.
- **timeout** (*float* / *None*) – Timeout after some time.

##### **Raise**

:class:CanTimeoutError :class:CanOperationError

##### **Return type**

None

#### **shutdown()**

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

#### **property state:** *BusState*

Return the current state of the hardware

**class** can.interfaces.ixxat.canlib\_vcinpl.**CyclicSendTask**(*scheduler*, *msgs*, *period*, *duration*,  
*resolution*)

A message in the cyclic transmit list.

Message send task with a defined duration and period.

##### **Parameters**

- **messages** – The messages to be sent periodically.
- **period** – The rate in seconds at which to send the messages.
- **duration** – Approximate duration in seconds to continue sending messages. If no duration is provided, the task will continue indefinitely.

##### **Raises**

**ValueError** – If the given messages are invalid

#### **pause()**

Pause transmitting message (keep it in the list).

#### **start()**

Start transmitting message (add to list if needed).

#### **stop()**

Stop transmitting message (remove from list).

## Implementation based on vcinpl2.dll

```
class can.interfaces.ixxat.canlib_vcinpl2.IXXATBus(channel, can_filters=None,
                                                  receive_own_messages=False,
                                                  unique_hardware_id=None, extended=True,
                                                  rx_fifo_size=1024, tx_fifo_size=128,
                                                  bitrate=500000, data_bitrate=2000000,
                                                  sjw_abr=None, tseg1_abr=None,
                                                  tseg2_abr=None, sjw_dbr=None,
                                                  tseg1_dbr=None, tseg2_dbr=None,
                                                  ssp_dbr=None, **kwargs)
```

The CAN Bus implemented for the IXXAT interface.

**Warning:** This interface does implement efficient filtering of messages, but the filters have to be set in `__init__` using the `can_filters` parameter. Using `set_filters()` does not work.

### Parameters

- **channel** (*int*) – The Channel id to create this bus with.
- **can\_filters** – See `can.BusABC.set_filters()`.
- **receive\_own\_messages** (*int*) – Enable self-reception of sent messages.
- **unique\_hardware\_id** (*int* / *None*) – unique\_hardware\_id to connect (optional, will use the first found if not supplied)
- **extended** (*bool*) – Default True, enables the capability to use extended IDs.
- **rx\_fifo\_size** (*int*) – Receive fifo size (default 1024)
- **tx\_fifo\_size** (*int*) – Transmit fifo size (default 128)
- **bitrate** (*int*) – Channel bitrate in bit/s
- **data\_bitrate** (*int*) – Channel bitrate in bit/s (only in CAN-Fd if baudrate switch enabled).
- **sjw\_abr** (*int* / *None*) – Bus timing value sample jump width (arbitration).
- **tseg1\_abr** (*int* / *None*) – Bus timing value tseg1 (arbitration)
- **tseg2\_abr** (*int* / *None*) – Bus timing value tseg2 (arbitration)
- **sjw\_dbr** (*int* / *None*) – Bus timing value sample jump width (data)
- **tseg1\_dbr** (*int* / *None*) – Bus timing value tseg1 (data). Only takes effect with fd and bitrate switch enabled.
- **tseg2\_dbr** (*int* / *None*) – Bus timing value tseg2 (data). Only takes effect with fd and bitrate switch enabled.
- **ssp\_dbr** (*int* / *None*) – Secondary sample point (data). Only takes effect with fd and bitrate switch enabled.

### flush\_tx\_buffer()

Flushes the transmit buffer on the IXXAT

### send(msg, timeout=None)

Sends a message on the bus. The interface may buffer the message.

### Parameters

- **msg** (*Message*) – The message to send.
- **timeout** (*float* / *None*) – Timeout after some time.

**Raise**

:class:CanTimeoutError :class:CanOperationError

**Return type**

None

**shutdown()**

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

**class** can.interfaces.ixxat.canlib\_vcinpl2.**CyclicSendTask**(*scheduler, msgs, period, duration, resolution*)

A message in the cyclic transmit list.

Message send task with a defined duration and period.

**Parameters**

- **messages** – The messages to be sent periodically.
- **period** – The rate in seconds at which to send the messages.
- **duration** – Approximate duration in seconds to continue sending messages. If no duration is provided, the task will continue indefinitely.

**Raises**

**ValueError** – If the given messages are invalid

**pause()**

Pause transmitting message (keep it in the list).

**start()**

Start transmitting message (add to list if needed).

**stop()**

Stop transmitting message (remove from list).

## 4.6.5 Internals

The IXXAT *BusABC* object is a fairly straightforward interface to the IXXAT VCI library. It can open a specific device ID or use the first one found.

The frame exchange *does not involve threads* in the background but is explicitly instantiated by the caller.

- **recv()** is a blocking call with optional timeout.
- **send()** is not blocking but may raise a *VCLError* if the TX FIFO is full

RX and TX FIFO sizes are configurable with *rx\_fifo\_size* and *tx\_fifo\_size* options, defaulting to 16 for both.

## 4.7 Kvaser's CANLIB

Kvaser's CANLib SDK for Windows (also available on Linux).

### 4.7.1 Bus

**class** `can.interfaces.kvaser.canlib.KvaserBus(channel, can_filters=None, timing=None, **kwargs)`

The CAN Bus implemented for the Kvaser interface.

#### Parameters

- **channel** (*int*) – The Channel id to create this bus with.
- **can\_filters** (*list*) – See `can.BusABC.set_filters()`.
- **timing** (*BitTiming* / *BitTimingFd* / *None*)

Backend Configuration

#### Parameters

- **timing** (*BitTiming* / *BitTimingFd* / *None*) – An instance of *BitTiming* or *BitTimingFd* to specify the bit timing parameters for the Kvaser interface. If provided, it takes precedence over the all other timing-related parameters. Note that the *f\_clock* property of the *timing* instance must be 16\_000\_000 (16MHz) for standard CAN or 80\_000\_000 (80MHz) for CAN FD.
- **bitrate** (*int*) – Bitrate of channel in bit/s
- **accept\_virtual** (*bool*) – If virtual channels should be accepted.
- **tseg1** (*int*) – Time segment 1, that is, the number of quanta from (but not including) the Sync Segment to the sampling point. If this parameter is not given, the Kvaser driver will try to choose all bit timing parameters from a set of defaults.
- **tseg2** (*int*) – Time segment 2, that is, the number of quanta from the sampling point to the end of the bit.
- **sjw** (*int*) – The Synchronization Jump Width. Decides the maximum number of time quanta that the controller can resynchronize every bit.
- **no\_samp** (*int*) – Either 1 or 3. Some CAN controllers can also sample each bit three times. In this case, the bit will be sampled three quanta in a row, with the last sample being taken in the edge between TSEG1 and TSEG2. Three samples should only be used for relatively slow baudrates.
- **driver\_mode** (*bool*) – Silent or normal.
- **single\_handle** (*bool*) – Use one Kvaser CANLIB bus handle for both reading and writing. This can be set if reading and/or writing is done from one thread.
- **receive\_own\_messages** (*bool*) – If messages transmitted should also be received back. Only works if single\_handle is also False. If you want to receive messages from other applications on the same computer, set this to True or set single\_handle to True.
- **fd** (*bool*) – If CAN-FD frames should be supported.
- **exclusive** (*bool*) – Don't allow sharing of this CANlib channel.
- **override\_exclusive** (*bool*) – Open the channel even if it is opened for exclusive access already.



- **data\_bitrate** (*int*) – Which bitrate to use for data phase in CAN FD. Defaults to arbitration bitrate.
- **channel** (*int*)
- **can\_filters** (*Sequence*[*CanFilter* | *CanFilterExtended*] | *None*)

**flash**(*flash=True*)

Turn on or off flashing of the device's LED for physical identification purposes.

**flush\_tx\_buffer**()

Wipeout the transmit buffer on the Kvaser.

**send**(*msg*, *timeout=None*)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

#### Parameters

- **msg** (*Message*) – A message object.
- **timeout** – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. None blocks indefinitely.

#### Raises

*CanOperationError* – If an error occurred while sending

**shutdown**()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

## 4.7.2 Internals

The Kvaser *Bus* object with a physical CAN Bus can be operated in two modes; *single\_handle* mode with one shared bus handle used for both reading and writing to the CAN bus, or with two separate bus handles. Two separate handles are needed if receiving and sending messages in different threads (see [Kvaser documentation](#)).

**Warning:** Any objects inheriting from *Bus* should *not* directly use the interface handle(/s).

### Message filtering

The Kvaser driver and hardware only supports setting one filter per handle. If one filter is requested, this is will be handled by the Kvaser driver. If more than one filter is needed, these will be handled in Python code in the *recv* method. If a message does not match any of the filters, *recv()* will return None.

## Custom methods

This section contains Kvaser driver specific methods.

`KvaserBus.get_stats()`

Retrieves the bus statistics.

Use like so:

```
>>> stats = bus.get_stats()
>>> print(stats)
std_data: 0, std_remote: 0, ext_data: 0, ext_remote: 0, err_frame: 0, bus_load: 0.0
↪%, overruns: 0
```

### Returns

bus statistics.

### Return type

[BusStatistics](#)

**class** `can.interfaces.kvaser.structures.BusStatistics`

This structure is used with the method `get_stats()`.

### property `bus_load`

The bus load, expressed as an integer in the interval 0 - 10000 representing 0.00% - 100.00% bus load.

### property `err_frame`

Number of error frames.

### property `ext_data`

Number of received extended (29-bit identifiers) data frames.

### property `ext_remote`

Number of received extended (29-bit identifiers) remote frames.

### property `overruns`

Number of overruns.

### property `std_data`

Number of received standard (11-bit identifiers) data frames.

### property `std_remote`

Number of received standard (11-bit identifiers) remote frames.

## 4.8 Neosys CAN Interface

This kind of interface can be found for example on Neosys POC-551VTC One needs to have correct drivers and DLL (Share object for Linux) from [Neosys](#).

Beware this is only tested on Linux kernel higher than v5.3. This should be drop in with Windows but you have to replace with correct named DLL

**class** `can.interfaces.neosys.NeosysBus(channel, device=0, bitrate=500000, **kwargs)`

Bases: [BusABC](#)

Neosys CAN bus Class

**Parameters**

- **channel** – channel number
- **device** – device number
- **bitrate** – bit rate.

**send**(*msg*, *timeout=None*)

**Parameters**

- **msg** – message to send
- **timeout** – timeout is not used here

**Return type**

None

**shutdown**()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

## 4.9 Intrepid Control Systems neoVI

---

**Note:** This ICS neoVI documentation is a work in progress. Feedback and revisions are most welcome!

---

Interface to [Intrepid Control Systems neoVI](#) API range of devices via [python-ics](#) wrapper on Windows.

### 4.9.1 Installation

This neoVI interface requires the installation of the ICS neoVI DLL and `python-ics` package.

- **Download and install the Intrepid Product Drivers**  
[Intrepid Product Drivers](#)
- **Install python-can with the neovi extras:**

```
pip install python-can[neovi]
```

### 4.9.2 Configuration

An example `can.ini` file for windows 7:

```
[default]
interface = neovi
channel = 1
```

### 4.9.3 Bus

**class** `can.interfaces.ics_neovi.NeoViBus(channel, can_filters=None, **kwargs)`

The CAN Bus implemented for the python\_ics interface [https://github.com/intrepidcs/python\\_ics](https://github.com/intrepidcs/python_ics)

#### Parameters

- **channel** (*int* or *str* or *list(int)* or *list(str)*) – The channel ids to create this bus with. Can also be a single integer, netid name or a comma separated string.
- **can\_filters** (*list*) – See `can.BusABC.set_filters()` for details.
- **receive\_own\_messages** (*bool*) – If transmitted messages should also be received by this bus.
- **use\_system\_timestamp** (*bool*) – Use system timestamp for can messages instead of the hardware time stamp
- **serial** (*str*) – Serial to connect (optional, will use the first found if not supplied)
- **bitrate** (*int*) – Channel bitrate in bit/s. (optional, will enable the auto bitrate feature if not supplied)
- **fd** (*bool*) – If CAN-FD frames should be supported.
- **data\_bitrate** (*int*) – Which bitrate to use for data phase in CAN FD. Defaults to arbitration bitrate.
- **override\_library\_name** – Absolute path or relative path to the library including filename.

#### Raises

- **ImportError** – If *python-ics* is not available
- **CanInitializationError** – If the bus could not be set up. May or may not be a *ICSInitializationError*.

**exception** `can.interfaces.ics_neovi.ICSApiError(error_code, description_short, description_long, severity, restart_needed)`

Indicates an error with the ICS API.

#### Parameters

- **error\_code** (*int*)
- **description\_short** (*str*)
- **description\_long** (*str*)
- **severity** (*int*)
- **restart\_needed** (*int*)

**exception** `can.interfaces.ics_neovi.ICSSInitializationError(error_code, description_short, description_long, severity, restart_needed)`

#### Parameters

- **error\_code** (*int*)
- **description\_short** (*str*)
- **description\_long** (*str*)
- **severity** (*int*)

- `restart_needed` (*int*)

**exception** `can.interfaces.ics_neovi.ICSOperationError`(*error\_code*, *description\_short*, *description\_long*, *severity*, *restart\_needed*)

#### Parameters

- `error_code` (*int*)
- `description_short` (*str*)
- `description_long` (*str*)
- `severity` (*int*)
- `restart_needed` (*int*)

## 4.10 National Instruments NI-CAN

This interface adds support for NI-CAN controllers by [National Instruments](#).

**Warning:** NI-CAN only seems to support 32-bit architectures so if the driver can't be loaded on a 64-bit Python, try using a 32-bit version instead.

**Warning:** CAN filtering has not been tested thoroughly and may not work as expected.

### 4.10.1 Bus

**class** `can.interfaces.nican.NicanBus`(*channel*, *can\_filters*=None, *bitrate*=None, *log\_errors*=True, *\*\*kwargs*)

The CAN Bus implemented for the NI-CAN interface.

**Warning:** This interface does implement efficient filtering of messages, but the filters have to be set in `__init__` using the `can_filters` parameter. Using `set_filters()` does not work.

#### Parameters

- `channel` (*str*) – Name of the object to open (e.g. “CAN0”)
- `bitrate` (*int* | None) – Bitrate in bit/s
- `can_filters` (*Sequence*[*CanFilter* | *CanFilterExtended*] | None) – See `can.BusABC.set_filters()`.
- `log_errors` (*bool*) – If True, communication errors will appear as CAN messages with `is_error_frame` set to True and `arbitration_id` will identify the error (default True)

#### Raises

- `CanInterfaceNotImplementedError` – If the current operating system is not supported or the driver could not be loaded.
- `NicanInitializationError` – If the bus could not be set up.

**exception** `can.interfaces.nican.NicanError(function, error_code, arguments)`

Error from NI-CAN driver.

**Parameters**

**error\_code** (*int*)

**Return type**

None

**exception** `can.interfaces.nican.NicanInitializationError(function, error_code, arguments)`

**Parameters**

**error\_code** (*int*)

**Return type**

None

## 4.11 National Instruments NI-XNET

This interface adds support for NI-XNET CAN controllers by [National Instruments](#).

---

**Note:** NI-XNET only supports windows platforms.

---

### 4.11.1 Bus

**class** `can.interfaces.nixnet.NiXNETcanBus(channel='CAN1', bitrate=500000, timing=None, can_filters=None, receive_own_messages=False, can_termination=False, fd=False, fd_bitrate=None, poll_interval=0.001, **kwargs)`

Bases: [BusABC](#)

The CAN Bus implemented for the NI-XNET interface.

**Parameters**

- **channel** (*str*) – Name of the object to open (e.g. 'CAN0')
- **bitrate** (*int*) – Bitrate in bits/s
- **timing** ([BitTiming](#) / [BitTimingFd](#) / *None*) – Optional [BitTiming](#) or [BitTimingFd](#) instance to use for custom bit timing setting. The *f\_clock* value of the timing instance must be set to 40\_000\_000 (40MHz). If this parameter is provided, it takes precedence over all other timing-related parameters like *bitrate*, *fd\_bitrate* and *fd*.
- **can\_filters** (*list*) – See [can.BusABC.set\\_filters\(\)](#).
- **receive\_own\_messages** (*bool*) – Enable self-reception of sent messages.
- **poll\_interval** (*float*) – Poll interval in seconds.
- **can\_termination** (*bool*)
- **fd** (*bool*)
- **fd\_bitrate** (*int* / *None*)
- **kwargs** (*Any*)

**Raises**

**`CanInitializationError`** – If starting communication fails

**`send(msg, timeout=None)`**

Send a message using NI-XNET.

**Parameters**

- **`msg`** (`can.Message`) – Message to send
- **`timeout`** (`float`) – Max time to wait for the device to be ready in seconds, None if time is infinite

**Raises**

**`can.exceptions.CanOperationError`** – If writing to transmit buffer fails. It does not wait for message to be ACKed currently.

**Return type**

None

**`reset()`**

Resets network interface. Stops network interface, then resets the CAN chip to clear the CAN error counters (clear error passive state). Resetting includes clearing all entries from read and write queues.

**Return type**

None

**`shutdown()`**

Close object.

**Return type**

None

## 4.12 PCAN Basic API

Interface to [Peak-System](#)'s PCAN-Basic API.

### 4.12.1 Configuration

Here is an example configuration file for using [PCAN-USB](#):

```
[default]
interface = pcan
channel = PCAN_USBBUS1
state = can.bus.BusState.PASSIVE
bitrate = 500000
```

**`channel`** (default "PCAN\_USBBUS1")

CAN interface name. Valid `channel` values:

```
PCAN_ISABUSx
PCAN_DNGBUSx
PCAN_PCIBUSx
PCAN_USBBUSx
PCAN_PCCBUSx
PCAN_LANBUSx
```

Where `x` should be replaced with the desired channel number starting at 1.

**state** (default `can.bus.BusState.ACTIVE`)

BusState of the channel

**bitrate** (default `500000`)

Channel bitrate

## 4.12.2 Linux installation

Beginning with version 3.4, Linux kernels support the PCAN adapters natively via [SocketCAN](#), refer to: [PCAN](#).

## 4.12.3 Bus

```
class can.interfaces.pcan.PcanBus(channel='PCAN_USBBUS1', device_id=None, state=BusState.ACTIVE,
                                   timing=None, bitrate=500000, receive_own_messages=False,
                                   **kwargs)
```

A PCAN USB interface to CAN.

On top of the usual [Bus](#) methods provided, the PCAN interface includes the [flash\(\)](#) and [status\(\)](#) methods.

### Parameters

- **channel** (*str*) – The can interface name. An example would be ‘PCAN\_USBBUS1’. Alternatively the value can be an int with the numerical value. Default is ‘PCAN\_USBBUS1’
- **device\_id** (*int*) – Select the PCAN interface based on its ID. The device ID is a 8/32bit value that can be configured for each PCAN device. If you set the `device_id` parameter, it takes precedence over the `channel` parameter. The constructor searches all connected interfaces and initializes the first one that matches the parameter value. If no device is found, an exception is raised.
- **state** (`can.bus.BusState`) – BusState of the channel. Default is ACTIVE
- **timing** (`BitTiming` / `BitTimingFd` / `None`) – An instance of `BitTiming` or `BitTimingFd` to specify the bit timing parameters for the PCAN interface. If this parameter is provided, it takes precedence over all other timing-related parameters. If this parameter is not provided, the bit timing parameters can be specified using the `bitrate` parameter for standard CAN or the `fd`, `f_clock`, `f_clock_mhz`, `nom_brp`, `nom_tseg1`, `nom_tseg2`, `nom_sjw`, `data_brp`, `data_tseg1`, `data_tseg2`, and `data_sjw` parameters for CAN FD. Note that the `f_clock` value of the `timing` instance must be 8\_000\_000 for standard CAN or any of the following values for CAN FD: 20\_000\_000, 24\_000\_000, 30\_000\_000, 40\_000\_000, 60\_000\_000, 80\_000\_000.
- **bitrate** (*int*) – Bitrate of channel in bit/s. Default is 500 kbit/s. Ignored if using CanFD.
- **receive\_own\_messages** (*bool*) – Enable self-reception of sent messages.
- **fd** (*bool*) – Should the Bus be initialized in CAN-FD mode.
- **f\_clock** (*int*) – Clock rate in Hz. Any of the following: 20000000, 24000000, 30000000, 40000000, 60000000, 80000000. Ignored if not using CAN-FD. Pass either `f_clock` or `f_clock_mhz`.
- **f\_clock\_mhz** (*int*) – Clock rate in MHz. Any of the following: 20, 24, 30, 40, 60, 80. Ignored if not using CAN-FD. Pass either `f_clock` or `f_clock_mhz`.
- **nom\_brp** (*int*) – Clock prescaler for nominal time quantum. In the range (1..1024) Ignored if not using CAN-FD.



- **nom\_tseg1** (*int*) – Time segment 1 for nominal bit rate, that is, the number of quanta from (but not including) the Sync Segment to the sampling point. In the range (1..256). Ignored if not using CAN-FD.
- **nom\_tseg2** (*int*) – Time segment 2 for nominal bit rate, that is, the number of quanta from the sampling point to the end of the bit. In the range (1..128). Ignored if not using CAN-FD.
- **nom\_sjw** (*int*) – Synchronization Jump Width for nominal bit rate. Decides the maximum number of time quanta that the controller can resynchronize every bit. In the range (1..128). Ignored if not using CAN-FD.
- **data\_brp** (*int*) – Clock prescaler for fast data time quantum. In the range (1..1024) Ignored if not using CAN-FD.
- **data\_tseg1** (*int*) – Time segment 1 for fast data bit rate, that is, the number of quanta from (but not including) the Sync Segment to the sampling point. In the range (1..32). Ignored if not using CAN-FD.
- **data\_tseg2** (*int*) – Time segment 2 for fast data bit rate, that is, the number of quanta from the sampling point to the end of the bit. In the range (1..16). Ignored if not using CAN-FD.
- **data\_sjw** (*int*) – Synchronization Jump Width for fast data bit rate. Decides the maximum number of time quanta that the controller can resynchronize every bit. In the range (1..16). Ignored if not using CAN-FD.
- **auto\_reset** (*bool*) – Enable automatic recovery in bus off scenario. Resetting the driver takes ~500ms during which it will not be responsive.
- **kwargs** (*Any*)

**flash**(*flash*)

Turn on or off flashing of the device's LED for physical identification purposes.

**get\_device\_number**()

Return the PCAN device number.

**Return type**

*int*

**Returns**

PCAN device number

**reset**()

Command the PCAN driver to reset the bus after an error.

**send**(*msg*, *timeout=None*)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

**Parameters**

- **msg** (*Message*) – A message object.
- **timeout** – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. None blocks indefinitely.

**Raises**

*CanOperationError* – If an error occurred while sending

**set\_device\_number**(*device\_number*)

Set the PCAN device number.

**Parameters**

**device\_number** – new PCAN device number

**Return type**

bool

**Returns**

True if device number set successfully

**shutdown**()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

**property state**

Return the current state of the hardware

**status**()

Query the PCAN bus status.

**Return type**

int

**Returns**

The status code. See values in **basic.PCAN\_ERROR\_**

**status\_is\_ok**()

Convenience method to check that the bus status is OK

**status\_string**()

Query the PCAN bus status.

**Returns**

The status description, if any was found.

**Return type**

str | None

## 4.13 Robotell CAN-USB interface

An USB to CAN adapter sold on Aliexpress, etc. with the manufacturer name Robotell printed on the case. There is also a USB stick version with a clear case. If the description or screenshots refer to **EmbeddedDebug** or **EmbeddedConfig** the device should be compatible with this driver. These USB devices are based on a STM32 controller with a CH340 serial interface and use a binary protocol - NOT compatible with SLCAN

See <https://www.amobbs.com/thread-4651667-1-1.html> for some background on these devices.

This driver directly uses either the local or remote (not tested) serial port. Remote serial ports will be specified via special URL. Both raw TCP sockets as also RFC2217 ports are supported.

Usage: use **port** or **URL[@baurate]** to open the device. For example use **/dev/ttyUSB0@115200** or **COM4@9600** for local serial ports and **socket://192.168.254.254:5000** or **rfc2217://192.168.254.254:5000** for remote ports.

### 4.13.1 Bus

**class** `can.interfaces.robotell.robotellBus`(*channel*, *ttyBaudrate*=115200, *bitrate*=None, *rtscts*=False, *\*\*kwargs*)

robotell interface

#### Parameters

- **channel** (*str*) – port of underlying serial or usb device (e.g. `/dev/ttyUSB0`, `COM8`, ...) Must not be empty. Can also end with `@115200` (or similarly) to specify the baudrate.
- **ttyBaudrate** (*int*) – baudrate of underlying serial or usb device (Ignored if set via the `channel` parameter)
- **bitrate** (*int*) – CAN Bitrate in bit/s. Value is stored in the adapter and will be used as default if no bitrate is specified
- **rtscts** (*bool*) – turn hardware handshake (RTS/CTS) on and off

**get\_serial\_number**(*timeout*)

Get serial number of the slcan interface.

#### Parameters

**timeout** (*int* | *None*) – seconds to wait for serial number or *None* to wait indefinitely

#### Returns

*None* on timeout or a *str* object.

#### Return type

*str* | *None*

**send**(*msg*, *timeout*=None)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

#### Parameters

- **msg** (*Message*) – A message object.
- **timeout** – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. *None* blocks indefinitely.

#### Raises

**CanOperationError** – If an error occurred while sending

**set\_auto\_bus\_management**(*auto\_man*)

#### Parameters

**auto\_man** (*bool*) – Enable/disable automatic bus management

**set\_auto\_retransmit**(*retrans\_flag*)

#### Parameters

**retrans\_flag** (*bool*) – Enable/disable automatic retransmission of unacknowledged CAN frames

**set\_bitrate**(*bitrate*)

#### Raises

**ValueError** – if *bitrate* is greater than 1000000

**Parameters****bitrate** (*int*) – Bitrate in bit/s**set\_hw\_filter**(*filterid*, *enabled*, *msgid\_value*, *msgid\_mask*, *extended\_msg*)**Raises****ValueError** – if *filterid* is not between 1 and 14**Parameters**

- **filterid** (*int*) – ID of filter (1-14)
- **enabled** (*bool*) – This filter is enabled
- **msgid\_value** (*int*) – CAN message ID to filter on. The test unit does not accept an extended message ID unless bit 31 of the ID was set.
- **msgid\_mask** (*int*) – Mask to apply to CAN message ID
- **extended\_msg** (*bool*) – Filter operates on extended format messages

**set\_serial\_rate**(*serial\_bps*)**Parameters****serial\_bps** (*int*) – Set the baud rate of the serial port (not CAN) interface**shutdown**()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

## 4.14 Seeed Studio USB-CAN Analyzer

SKU: 114991193

Links:

- <https://www.seeedstudio.com/USB-CAN-Analyzer-p-2888.html>
- [https://github.com/SeeedDocument/USB-CAN\\_Analyzer](https://github.com/SeeedDocument/USB-CAN_Analyzer)
- <https://copperhilltech.com/blog/usbcan-analyzer-usb-to-can-bus-serial-protocol-definition/>

### 4.14.1 Installation

This interface has additional dependencies which can be installed using pip and the optional extra `seedstudio`. That will include the dependency `pyserial`:

```
pip install python-can[seedstudio]
```

### 4.14.2 Interface

```
can.interfaces.seedstudio.SeedBus
```

A bus example:

```
bus = can.interface.Bus(interface='seedstudio', channel='/dev/ttyUSB0', bitrate=500000)
```

### 4.14.3 Configuration

```
SeedBus(channel,
         baudrate=2000000,
         timeout=0.1,
         frame_type='STD',
         operation_mode='normal',
         bitrate=500000)
```

#### CHANNEL

The serial port created by the USB device when connected.

#### TIMEOUT

Only used by the underlying serial port, it probably should not be changed. The serial port baudrate=2000000 and rtscts=false are also matched to the device so are not added here.

#### FRAMETYPE

- “STD”
- “EXT”

#### OPERATIONMODE

- “normal”
- “loopback”
- “silent”
- “loopback\_and\_silent”

#### BITRATE

- 1000000
- 800000
- 500000
- 400000
- 250000
- 200000
- 125000
- 100000
- 50000
- 20000
- 10000

- 5000

## 4.15 CAN over Serial

A text based interface. For example use over serial ports like `/dev/ttyS1` or `/dev/ttyUSB0` on Linux machines or COM1 on Windows. Remote ports can be also used via a special URL. Both raw TCP sockets as also RFC2217 ports are supported: `socket://192.168.254.254:5000` or `rfc2217://192.168.254.254:5000`. In addition a virtual loopback can be used via `loop://` URL. The interface is a simple implementation that has been used for recording CAN traces.

---

**Note:** The properties `extended_id`, `is_remote_frame` and `is_error_frame` from the class:~`can.Message` are not in use. This interface will not send or receive flags for this properties.

---

### 4.15.1 Bus

```
class can.interfaces.serial.serial_can.SerialBus(channel, baudrate=115200, timeout=0.1,
                                                rtscts=False, *args, **kwargs)
```

Enable basic can communication over a serial device.

---

**Note:** See `_recv_internal()` for some special semantics.

---

#### Parameters

- **channel** (*str*) – The serial device to open. For example “`/dev/ttyS1`” or “`/dev/ttyUSB0`” on Linux or “`COM1`” on Windows systems.
- **baudrate** (*int*) – Baud rate of the serial device in bit/s (default 115200).

**Warning:** Some serial port implementations don’t care about the baudrate.

- **timeout** (*float*) – Timeout for the serial device in seconds (default 0.1).
- **rtscts** (*bool*) – turn hardware handshake (RTS/CTS) on and off

#### Raises

- `CanInitializationError` – If the given parameters are invalid.
- `CanInterfaceNotImplementedError` – If the serial module is not installed.

`_recv_internal(timeout)`

Read a message from the serial device.

#### Parameters

**timeout** (*float* | *None*) –

**Warning:** This parameter will be ignored. The timeout value of the channel is used.

**Returns**

Received message and `False` (because no filtering as taken place).

**Warning:** Flags like `is_extended_id`, `is_remote_frame` and `is_error_frame` will not be set over this function, the flags in the return message are the default values.

**Return type**

`Tuple[Message | None, bool]`

## 4.15.2 Internals

The frames that will be sent and received over the serial interface consist of six parts. The start and the stop byte for the frame, the timestamp, DLC, arbitration ID and the payload. The payload has a variable length of between 0 and 8 bytes, the other parts are fixed. Both, the timestamp and the arbitration ID will be interpreted as 4 byte unsigned integers. The DLC is also an unsigned integer with a length of 1 byte.

**Serial frame format**

	Start of frame	Timestamp	DLC	Arbitration ID	Payload	End of frame
<b>Length (Byte)</b>	1	4	1	4	0 - 8	1
<b>Data type</b>	Byte	Unsigned 4 byte integer	Unsigned 1 byte integer	Unsigned 4 byte integer	Byte	Byte
<b>Byte order</b>	-	Little-Endian	Little-Endian	Little-Endian	-	-
<b>Description</b>	Must be 0xAA	Usually s, ms or µs since start of the device	Length in byte of the payload	-	-	Must be 0xBB

**Examples of serial frames****CAN message with 8 byte payload**

CAN message	
Arbitration ID	Payload
1	0x11 0x22 0x33 0x44 0x55 0x66 0x77 0x88

Serial frame																
Start of frame	Timestamp			DLC	Arbitration ID				Payload						End of frame	
0xAA	0x66	0x73	0x00	0x08	0x01	0x00	0x00	0x11	0x22	0x33	0x44	0x55	0x66	0xBB		
	0x00				0x00			0x77	0x88							

### CAN message with 1 byte payload

CAN message	
Arbitration ID	Payload
1	0x11

Serial frame		Timestamp	DLC	Arbitration ID	Payload	End of frame
Start of frame						
0xAA	0x66 0x73 0x00 0x00	0x01	0x01 0x00 0x00 0x00	0x11	0xBB	

### CAN message with 0 byte payload

CAN message	
Arbitration ID	Payload
1	None

Serial frame		Timestamp	DLC	Arbitration ID	End of frame
Start of frame					
0xAA	0x66 0x73 0x00 0x00	0x00	0x01 0x00 0x00 0x00	0xBB	

## 4.16 CAN over Serial / SLCAN

A text based interface: compatible to slcan-interfaces (slcan ASCII protocol) should also support LAWICEL direct. These interfaces can also be used with socketcan and slcand with Linux. This driver directly uses either the local or remote serial port, it makes slcan-compatible interfaces usable with Windows also. Remote serial ports will be specified via special URL. Both raw TCP sockets as also RFC2217 ports are supported.

Usage: use `port` or `URL[@baudrate]` to open the device. For example use `/dev/ttyUSB0@115200` or `COM4@9600` for local serial ports and `socket://192.168.254.254:5000` or `rfc2217://192.168.254.254:5000` for remote ports.

### 4.16.1 Supported devices

---

**Todo:** Document this.

---



## 4.16.2 Bus

```
class can.interfaces.slcan.slcanBus(channel, ttyBaudrate=115200, bitrate=None, btr=None,
                                   sleep_after_open=2, rtscts=False, timeout=0.001, **kwargs)
```

slcan interface

### Parameters

- **channel** (*str*) – port of underlying serial or usb device (e.g. /dev/ttyUSB0, COM8, ...) Must not be empty. Can also end with @115200 (or similarly) to specify the baudrate.
- **ttyBaudrate** (*int*) – baudrate of underlying serial or usb device (Ignored if set via the channel parameter)
- **bitrate** (*int* | *None*) – Bitrate in bit/s
- **btr** (*str* | *None*) – BTR register value to set custom can speed
- **poll\_interval** – Poll interval in seconds when reading messages
- **sleep\_after\_open** (*float*) – Time to wait in seconds after opening serial connection
- **rtscts** (*bool*) – turn hardware handshake (RTS/CTS) on and off
- **timeout** (*float*) – Timeout for the serial or usb device in seconds (default 0.001)
- **kwargs** (*Any*)

### Raises

- **ValueError** – if both bitrate and btr are set or the channel is invalid
- **CanInterfaceNotImplementedError** – if the serial module is missing
- **CanInitializationError** – if the underlying serial connection could not be established

```
get_serial_number(timeout)
```

Get serial number of the slcan interface.

### Parameters

**timeout** (*float* | *None*) – seconds to wait for serial number or *None* to wait indefinitely

### Returns

*None* on timeout or a *str* object.

### Return type

*str* | *None*

```
get_version(timeout)
```

Get HW and SW version of the slcan interface.

### Parameters

**timeout** (*float* | *None*) – seconds to wait for version or *None* to wait indefinitely

### Returns

tuple (hw\_version, sw\_version) WHERE int hw\_version is the hardware version or *None* on timeout int sw\_version is the software version or *None* on timeout

### Return type

*Tuple*[*int* | *None*, *int* | *None*]

```
send(msg, timeout=None)
```

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

**Parameters**

- **msg** ([Message](#)) – A message object.
- **timeout** ([float](#) / *None*) – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. *None* blocks indefinitely.

**Raises**

[CanOperationError](#) – If an error occurred while sending

**Return type**

*None*

**set\_bitrate(*bitrate*)****Parameters**

**bitrate** ([int](#)) – Bitrate in bit/s

**Raises**

[ValueError](#) – if **bitrate** is not among the possible values

**Return type**

*None*

**set\_bitrate\_reg(*btr*)****Parameters**

**btr** ([str](#)) – BTR register value to set custom can speed

**Return type**

*None*

**shutdown()**

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

**Return type**

*None*

### 4.16.3 Internals

---

**Todo:** Document the internals of slcan interface.

---

## 4.17 SocketCAN

The SocketCAN documentation can be found in the [Linux kernel docs](#) in the **networking** directory. Quoting from the SocketCAN Linux documentation:

The socketcan package is an implementation of CAN protocols (Controller Area Network) for Linux. CAN is a networking technology which has widespread use in automation, embedded devices, and automotive fields. While there have been other CAN implementations for Linux based on character devices, SocketCAN uses the Berkeley socket API, the Linux network stack and implements the CAN device drivers as

network interfaces. The CAN socket API has been designed as similar as possible to the TCP/IP protocols to allow programmers, familiar with network programming, to easily learn how to use CAN sockets.

---

**Important:** *python-can* versions before 2.2 had two different implementations named `socketcan_ctypes` and `socketcan_native`. These were removed in version 4.0.0 after a deprecation period.

---

### 4.17.1 Socketcan Quickstart

The CAN network driver provides a generic interface to setup, configure and monitor CAN devices. To configure bit-timing parameters use the program `ip`.

#### The virtual CAN driver (vcan)

The virtual CAN interfaces allow the transmission and reception of CAN frames without real CAN controller hardware. Virtual CAN network devices are usually named ‘vcanX’, like `vcan0` `vcan1` `vcan2`.

To create a virtual can interface using `socketcan` run the following:

```
sudo modprobe vcan
# Create a vcan network interface with a specific name
sudo ip link add dev vcan0 type vcan
sudo ip link set vcan0 up
```

#### Real Device

`vcan` should be substituted for `can` and `vcan0` should be substituted for `can0` if you are using real hardware. Setting the bitrate can also be done at the same time, for example to enable an existing `can0` interface with a bitrate of 1MB:

```
sudo ip link set can0 up type can bitrate 1000000
```

#### CAN over Serial / SLCAN

SLCAN adapters can be used directly via *CAN over Serial / SLCAN*, or via *SocketCAN* with some help from the `slcand` utility which can be found in the `can-utils` package.

To create a `socketcan` interface for an SLCAN adapter run the following:

```
slcand -f -o -c -s5 /dev/ttyAMA0
ip link set up slcan0
```

Names of the interfaces created by `slcand` match the `slcan\d+` regex. If a custom name is required, it can be specified as the last argument. E.g.:

```
slcand -f -o -c -s5 /dev/ttyAMA0 can0
ip link set up can0
```

## PCAN

Kernels  $\geq 3.4$  supports the PCAN adapters natively via [SocketCAN](#), so there is no need to install any drivers. The CAN interface can be brought like so:

```
sudo modprobe peak_usb
sudo modprobe peak_pci
sudo ip link set can0 up type can bitrate 500000
```

## Intrepid

The Intrepid Control Systems, Inc provides several devices (e.g. ValueCAN) as well as Linux module and user-space daemon to make it possible to use them via SocketCAN.

Refer to below repositories for installation instructions:

- [Intrepid kernel module](#)
- [Intrepid user-space daemon](#)

## Send Test Message

The [can-utils](#) library for Linux includes a *cansend* tool which is useful to send known payloads. For example to send a message on *vcan0*:

```
cansend vcan0 123#DEADBEEF
```

## CAN Errors

A device may enter the “bus-off” state if too many errors occurred on the CAN bus. Then no more messages are received or sent. An automatic bus-off recovery can be enabled by setting the “restart-ms” to a non-zero value, e.g.:

```
sudo ip link set canX type can restart-ms 100
```

Alternatively, the application may realize the “bus-off” condition by monitoring CAN error frames and do a restart when appropriate with the command:

```
ip link set canX type can restart
```

Note that a restart will also create a CAN error frame.

## List network interfaces

To reveal the newly created *can0* or a *vcan0* interface:

```
ifconfig
```

## Display CAN statistics

```
ip -details -statistics link show vcan0
```

## Network Interface Removal

To remove the network interface:

```
sudo ip link del vcan0
```

### 4.17.2 Wireshark

Wireshark supports socketcan and can be used to debug *python-can* messages. Fire it up and watch your new interface.

To spam a bus:

```
import time
import can

interface = 'socketcan'
channel = 'vcan0'

def producer(id):
    """:param id: Spam the bus with messages including the data id."""
    bus = can.Bus(channel=channel, interface=interface)
    for i in range(10):
        msg = can.Message(arbitration_id=0xc0ffee, data=[id, i, 0, 1, 3, 1, 4, 1], is_
        ↪extended_id=False)
        bus.send(msg)

    time.sleep(1)

producer(10)
```

With debugging turned right up this looks something like this:

```
>>> producer(10)
INFO:can.socketcan_native:Created a socket
DEBUG:can.socketcan_native:Binding socket to channel=vcan0
DEBUG:can.socketcan_native:We've been asked to write a message to the bus
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x00\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x00\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:We've been asked to write a message to the bus
DEBUG:can.socketcan_native:We've been asked to write a message to the bus
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x01\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x02\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x03\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x04\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:We've been asked to write a message to the bus
DEBUG:can.socketcan_native:We've been asked to write a message to the bus
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x05\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x06\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:We've been asked to write a message to the bus
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x07\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x08\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x09\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x0A\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x0B\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x0C\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x0D\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x0E\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x0F\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x10\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x11\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x12\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x13\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x14\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x15\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x16\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x17\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x18\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x19\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x1A\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x1B\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x1C\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x1D\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x1E\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x1F\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
DEBUG:can.socketcan_native:Received: can_id=c0ffee, can_dlc=8, data=b'\n\x20\x00\x00\x00\x00\x00\x00\x00'
DEBUG:can.socketcan_native:CAN: Standard
```

The process to follow bus traffic is even easier:

```
for message in Bus(can_interface):
    print(message)
```

### 4.17.3 Reading and Timeouts

Reading a single CAN message off of the bus is simple with the `bus.recv()` function:

```
import can

bus = can.Bus(channel='vcan0', interface='socketcan')
message = bus.recv()
```

By default, this performs a blocking read, which means `bus.recv()` won't return until a CAN message shows up on the socket. You can optionally perform a blocking read with a timeout like this:

```
message = bus.recv(1.0) # Timeout in seconds.

if message is None:
    print('Timeout occurred, no message.')
```

If you set the timeout to `0.0`, the read will be executed as non-blocking, which means `bus.recv(0.0)` will return immediately, either with a `Message` object or `None`, depending on whether data was available on the socket.

#### 4.17.4 Filtering

The implementation features efficient filtering of `can_id`'s. That filtering occurs in the kernel and is much much more efficient than filtering messages in Python.

#### 4.17.5 Broadcast Manager

The `socketcan` interface implements thin wrappers to the linux *broadcast manager* socket api. This allows the cyclic transmission of CAN messages at given intervals. The overhead for periodic message sending is extremely low as all the heavy lifting occurs within the linux kernel.

The `BusABC` initialized for `socketcan` interface transparently handles scheduling of CAN messages to Linux BCM via `send_periodic()`:

```
with can.interface.Bus(interface="socketcan", channel="can0") as bus:
    task = bus.send_periodic(...)
```

More examples that uses `send_periodic()` are included in `python-can/examples/cyclic.py`.

The `task` object returned by `send_periodic()` can be used to halt, alter or cancel the periodic message task:

**class** `can.interfaces.socketcan.CyclicSendTask(bcm_socket, task_id, messages, period, duration=None)`

A SocketCAN cyclic send task supports:

- setting of a task duration
- modifying the data
- stopping then subsequent restarting of the task

Construct and `start()` a task.

##### Parameters

- **bcm\_socket** (*socket*) – An open BCM socket on the desired CAN channel.
- **task\_id** (*int*) – The identifier used to uniquely reference particular cyclic send task within Linux BCM.
- **messages** (*Sequence[Message] / Message*) – The messages to be sent periodically.
- **period** (*float*) – The rate in seconds at which to send the messages.
- **duration** (*float / None*) – Approximate duration in seconds to send the messages for.

##### `modify_data(messages)`

Update the contents of the periodically sent CAN messages by sending TX\_SETUP message to Linux kernel.

The number of new cyclic messages to be sent must be equal to the original number of messages originally specified for this task.

---

**Note:** The messages must all have the same `arbitration_id` like the first message.

---

##### Parameters

- **messages** (*Sequence[Message] / Message*) – The messages with the new `can.Message.data`.

**Return type**

None

**start()**

Restart a periodic task by sending TX\_SETUP message to Linux kernel.

It verifies presence of the particular BCM task through sending TX\_READ message to Linux kernel prior to scheduling.

**Raises**

**ValueError** – If the task referenced by `task_id` is already running.

**Return type**

None

**stop()**

Stop a task by sending TX\_DELETE message to Linux kernel.

This will delete the entry for the transmission of the CAN-message with the specified `task_id` identifier. The message length for the command TX\_DELETE is `{[bcm_msg_head]}` (only the header).

**Return type**

None

## 4.17.6 Buffer Sizes

Currently, the sending buffer size cannot be adjusted by this library. However, [this issue](#) describes how to change it via the command line/shell.

## 4.17.7 Bus

The `SocketcanBus` specializes `BusABC` to ensure usage of SocketCAN Linux API. The most important differences are:

- usage of SocketCAN BCM for periodic messages scheduling;
- filtering of CAN messages on Linux kernel level;
- usage of nanosecond timings from the kernel.

```
class can.interfaces.socketcan.SocketcanBus(channel="", receive_own_messages=False,  
                                             local_loopback=True, fd=False, can_filters=None,  
                                             ignore_rx_error_frames=False, **kwargs)
```

A SocketCAN interface to CAN.

It implements `can.BusABC._detect_available_configs()` to search for available interfaces.

Creates a new socketcan bus.

If setting some socket options fails, an error will be printed but no exception will be thrown. This includes enabling:

- that own messages should be received,
- CAN-FD frames and
- error frames.

**Parameters**



- **channel** (*str*) – The can interface name with which to create this bus. An example channel would be ‘vcan0’ or ‘can0’. An empty string ‘’ will receive messages from all channels. In that case any sent messages must be explicitly addressed to a channel using *can.Message.channel*.
- **receive\_own\_messages** (*bool*) – If transmitted messages should also be received by this bus.
- **local\_loopback** (*bool*) – If local loopback should be enabled on this bus. Please note that local loopback does not mean that messages sent on a socket will be readable on the same socket, they will only be readable on other open sockets on the same machine. More info can be read on the socketcan documentation: See <https://www.kernel.org/doc/html/latest/networking/can.html#socketcan-local-loopback1>
- **fd** (*bool*) – If CAN-FD frames should be supported.
- **can\_filters** (*Sequence[CanFilter | CanFilterExtended] | None*) – See *can.BusABC.set\_filters()*.
- **ignore\_rx\_error\_frames** – If incoming error frames should be discarded.

**RECV\_LOGGING\_LEVEL** = 9

Log level for received messages

**channel\_info** = 'unknown'

a string describing the underlying bus and/or channel

**property filters:** *Sequence[CanFilter | CanFilterExtended] | None*

Modify the filters of this bus. See *set\_filters()* for details.

**flush\_tx\_buffer()**

Discard every message that may be queued in the output buffer(s).

**Return type**

None

**property protocol:** *CanProtocol*

Return the CAN protocol used by this bus instance.

This value is set at initialization time and does not change during the lifetime of a bus instance.

**recv**(*timeout=None*)

Block waiting for a message from the Bus.

**Parameters**

**timeout** (*float | None*) – seconds to wait for a message or None to wait indefinitely

**Returns**

None on timeout or a *Message* object.

**Raises**

*CanOperationError* – If an error occurred while reading

**Return type**

*Message* | None

**send**(*msg, timeout=None*)

Transmit a message to the CAN bus.

**Parameters**

- **msg** (*Message*) – A message object.

- **timeout** (*float* / *None*) – Wait up to this many seconds for the transmit queue to be ready. If not given, the call may fail immediately.

**Raises**

*CanError* – if the message could not be written.

**Return type**

*None*

**send\_periodic**(*msgs*, *period*, *duration=None*, *store\_task=True*, *modifier\_callback=None*)

Start sending messages at a given period on this bus.

The task will be active until one of the following conditions are met:

- the (optional) duration expires
- the Bus instance goes out of scope
- the Bus instance is shutdown
- *stop\_all\_periodic\_tasks()* is called
- the task's *stop()* method is called.

**Parameters**

- **msgs** (*Message* / *Sequence[Message]*) – Message(s) to transmit
- **period** (*float*) – Period in seconds between each message
- **duration** (*float* / *None*) – Approximate duration in seconds to continue sending messages. If no duration is provided, the task will continue indefinitely.
- **store\_task** (*bool*) – If True (the default) the task will be attached to this Bus instance. Disable to instead manage tasks manually.
- **modifier\_callback** (*Callable[[Message], None]* / *None*) – Function which should be used to modify each message's data before sending. The callback modifies the *data* of the message and returns *None*.

**Returns**

A started task instance. Note the task can be stopped (and depending on the backend modified) by calling the task's *stop()* method.

**Return type**

*CyclicSendTaskABC*

---

**Note:** Note the duration before the messages stop being sent may not be exactly the same as the duration specified by the user. In general the message will be sent at the given rate until at least **duration** seconds.

---

---

**Note:** For extremely long-running Bus instances with many short-lived tasks the default api with *store\_task==True* may not be appropriate as the stopped tasks are still taking up memory as they are associated with the Bus instance.

---

**set\_filters**(*filters=None*)

Apply filtering to all messages received by this Bus.

All messages that match at least one filter are returned. If *filters* is *None* or a zero length sequence, all messages are matched.

Calling without passing any filters will reset the applied filters to None.

#### Parameters

**filters** (*Sequence*[*CanFilter* | *CanFilterExtended*] | *None*) – A iterable of dictionaries each containing a “can\_id”, a “can\_mask”, and an optional “extended” key:

```
[{"can_id": 0x11, "can_mask": 0x21, "extended": False}]
```

A filter matches, when `<received_can_id> & can_mask == can_id & can_mask`. If `extended` is set as well, it only matches messages where `<received_is_extended> == extended`. Else it matches every messages based only on the arbitration ID and mask.

#### Return type

None

#### shutdown()

Stops all active periodic tasks and closes the socket.

#### Return type

None

#### property state: *BusState*

Return the current state of the hardware

#### stop\_all\_periodic\_tasks(remove\_tasks=True)

Stop sending any messages that were started using *send\_periodic()*.

---

**Note:** The result is undefined if a single task throws an exception while being stopped.

---

#### Parameters

**remove\_tasks** (*bool*) – Stop tracking the stopped tasks.

#### Return type

None

## 4.18 socketcand Interface

*Socketcand* is part of the *Linux-CAN* project, providing a Network-to-CAN bridge as a Linux daemon. It implements a specific *TCP/IP* based communication protocol to transfer CAN frames and control commands.

The main advantage compared to UDP-based protocols (e.g. virtual interface) is, that TCP guarantees delivery and that the message order is kept.

Here is a small example dumping all can messages received by a *socketcand* daemon running on a remote Raspberry Pi:

```
import can

bus = can.interface.Bus(interface='socketcand', host="10.0.16.15", port=29536, channel=
↳ "can0")

# loop until Ctrl-C
try:
    while True:
```

(continues on next page)

(continued from previous page)

```

msg = bus.recv()
print(msg)
except KeyboardInterrupt:
    pass

```

The output may look like this:

```

Timestamp: 1637791111.209224    ID: 000006fd    X Rx    DLC: 8    c4 10 e3
↳ 2d 96 ff 25 6b
Timestamp: 1637791111.233951    ID: 000001ad    X Rx    DLC: 4    4d 47 c7
↳ 64
Timestamp: 1637791111.409415    ID: 000005f7    X Rx    DLC: 8    86 de e6
↳ 0f 42 55 5d 39
Timestamp: 1637791111.434377    ID: 00000665    X Rx    DLC: 8    97 96 51
↳ 0f 23 25 fc 28
Timestamp: 1637791111.609763    ID: 0000031d    X Rx    DLC: 8    16 27 d8
↳ 3d fe d8 31 24
Timestamp: 1637791111.634630    ID: 00000587    X Rx    DLC: 8    4e 06 85
↳ 23 6f 81 2b 65

```

This interface also supports `detect_available_configs()`.

```

import can
import can.interfaces.socketcand

cfg = can.interfaces.socketcand._detect_available_configs()
if cfg:
    bus = can.Bus(**cfg[0])

```

The socketcand daemon broadcasts UDP beacons every 3 seconds. The default detection method waits for slightly more than 3 seconds to receive the beacon packet. If you want to increase the timeout, you can use `can.interfaces.socketcand.detect_beacon()` directly. Below is an example which detects the beacon and uses the configuration to create a socketcand bus.

```

import can
import can.interfaces.socketcand

cfg = can.interfaces.socketcand.detect_beacon(6000)
if cfg:
    bus = can.Bus(**cfg[0])

```

### 4.18.1 Bus

```

class can.interfaces.socketcand.SocketCanDaemonBus(channel, host, port, tcp_tune=False,
                                                    can_filters=None, **kwargs)

```

Bases: `BusABC`

Connects to a CAN bus served by socketcand.

It implements `can.BusABC._detect_available_configs()` to search for available interfaces.

It will attempt to connect to the server for up to 10s, after which a `TimeoutError` exception will be thrown.

If the handshake with the socketcand server fails, a `CanError` exception is thrown.

**Parameters**

- **channel** – The can interface name served by socketcand. An example channel would be ‘vcan0’ or ‘can0’.
- **host** – The host address of the socketcand server.
- **port** – The port of the socketcand server.
- **tcp\_tune** – This tunes the TCP socket for low latency (TCP\_NODELAY, and TCP\_QUICKACK). This option is not available under windows.
- **can\_filters** – See `can.BusABC.set_filters()`.

**send(msg, timeout=None)**

Transmit a message to the CAN bus.

**Parameters**

- **msg** – A message object.
- **timeout** – Ignored

**shutdown()**

Stops all active periodic tasks and closes the socket.

`can.interfaces.socketcand.detect_beacon(timeout_ms=3100)`

Detects socketcand servers

This is what `can.detect_available_configs()` ends up calling to search for available socketcand servers with a default timeout of 3100ms (socketcand sends a beacon packet every 3000ms).

Using this method directly allows for adjusting the timeout. Extending the timeout beyond the default time period could be useful if UDP packet loss is a concern.

**Parameters**

**timeout\_ms** (*int*) – Timeout in milliseconds to wait for socketcand beacon packets

**Returns**

See `detect_available_configs()`

**Return type**

`List[AutoDetectedConfig]`

## 4.18.2 Socketcand Quickstart

The following section will show how to get the stuff installed on a Raspberry Pi with a MCP2515-based CAN interface, e.g. available from [Waveshare](#). However, it will also work with any other socketcan device.

### Install CAN Interface for a MCP2515 based interface on a Raspberry Pi

Add the following lines to `/boot/config.txt`. Please take care on the frequency of the crystal on your MCP2515 board:

```
dtparam=spi=on
dtoverlay=mcp2515-can0,oscillator=12000000,interrupt=25,spimaxfrequency=10000000
```

Reboot after `/boot/config.txt` has been modified.

## Enable socketcan for can0

Create config file for systemd-networkd to start the socketcan interface automatically:

```
cat >/etc/systemd/network/80-can.network <<'EOT'
[Match]
Name=can0
[CAN]
BitRate=250K
RestartSec=100ms
EOT
```

Enable systemd-networkd on reboot and start it immediately (if it was not already started):

```
sudo systemctl enable systemd-networkd
sudo systemctl start systemd-networkd
```

## Build socketcand from source

```
# autoconf is needed to build socketcand
sudo apt-get install -y autoconf
# clone & build sources
git clone https://github.com/linux-can/socketcand.git
cd socketcand
./autogen.sh
./configure
make
```

## Install socketcand

```
make install
```

## Run socketcand

```
./socketcand -v -i can0
```

During start, socketcand will prompt its IP address and port it listens to:

```
Verbose output activated

Using network interface 'eth0'
Listen address is 10.0.16.15
Broadcast address is 10.0.255.255
creating broadcast thread...
binding socket to 10.0.16.15:29536
```

## 4.19 SYSTEC interface

Windows interface for the USBCAN devices supporting up to 2 channels based on the particular product. There is support for the devices also on Linux through the *SocketCAN* interface and for Windows using this *syspec* interface.

### 4.19.1 Installation

The interface requires installation of the **USBCAN32.dll** library. Download and install the driver for specific **SYSTEC** device.

### 4.19.2 Supported devices

The interface supports following devices:

- GW-001 (obsolete),
- GW-002 (obsolete),
- Multiport CAN-to-USB G3,
- USB-CANmodul1 G3,
- USB-CANmodul2 G3,
- USB-CANmodul8 G3,
- USB-CANmodul16 G3,
- USB-CANmodul1 G4,
- USB-CANmodul2 G4.

### 4.19.3 Configuration

The simplest configuration would be:

```
interface = syspec
channel = 0
```

Python-can will search for the first device found if not specified explicitly by the `device_number` parameter. The `interface` and `channel` are the only mandatory parameters. The interface supports two channels 0 and 1. The maximum number of entries in the receive and transmit buffer can be set by the parameters `rx_buffer_entries` and `tx_buffer_entries`, with default value 4096 set for both.

Optional parameters:

- `bitrate` (default 500000) Channel bitrate in bit/s
- `device_number` (default first device) The device number of the USB-CAN
- `rx_buffer_entries` (default 4096) The maximum number of entries in the receive buffer
- `tx_buffer_entries` (default 4096) The maximum number of entries in the transmit buffer
- `state` (default `BusState.ACTIVE`) `BusState` of the channel
- `receive_own_messages` (default `False`) If messages transmitted should also be received back

#### 4.19.4 Bus

**class** `can.interfaces.systec.ucanbus.UcanBus(channel, can_filters=None, **kwargs)`

The CAN Bus implemented for the SYSTEC interface.

##### Parameters

- **channel** (*int*) – The Channel id to create this bus with.
- **can\_filters** (*list*) – See `can.BusABC.set_filters()`.

Backend Configuration

##### Parameters

- **bitrate** (*int*) – Channel bitrate in bit/s. Default is 500000.
- **device\_number** (*int*) – The device number of the USB-CAN. Valid values: 0 through 254. Special value 255 is reserved to detect the first connected device (should only be used, in case only one module is connected to the computer). Default is 255.
- **state** (`can.bus.BusState`) – BusState of the channel. Default is ACTIVE.
- **receive\_own\_messages** (*bool*) – If messages transmitted should also be received back. Default is False.
- **rx\_buffer\_entries** (*int*) – The maximum number of entries in the receive buffer. Default is 4096.
- **tx\_buffer\_entries** (*int*) – The maximum number of entries in the transmit buffer. Default is 4096.

##### Raises

- **ValueError** – If invalid input parameter were passed.
- **CanInterfaceNotImplementedError** – If the platform is not supported.
- **CanInitializationError** – If hardware or CAN interface initialization failed.

**static** `create_filter(extended, from_id, to_id, rtr_only, rtr_too)`

Calculates AMR and ACR using CAN-ID as parameter.

##### Parameters

- **extended** (*bool*) – if True parameters from\_id and to\_id contains 29-bit CAN-ID
- **from\_id** (*int*) – first CAN-ID which should be received
- **to\_id** (*int*) – last CAN-ID which should be received
- **rtr\_only** (*bool*) – if True only RTR-Messages should be received, and rtr\_too will be ignored
- **rtr\_too** (*bool*) – if True CAN data frames and RTR-Messages should be received

##### Returns

Returns list with one filter containing a “can\_id”, a “can\_mask” and “extended” key.

`flush_tx_buffer()`

Flushes the transmit buffer.

##### Raises

**CanError** – If flushing of the transmit buffer failed.



**send**(*msg*, *timeout=None*)

Sends one CAN message.

When a transmission timeout is set the firmware tries to send a message within this timeout. If it could not be sent the firmware sets the “auto delete” state. Within this state all transmit CAN messages for this channel will be deleted automatically for not blocking the other channel.

**Parameters**

- **msg** ([can.Message](#)) – The CAN message.
- **timeout** (*float*) – Transmit timeout in seconds (value 0 switches off the “auto delete”)

**Raises**

[CanOperationError](#) – If the message could not be sent.

**shutdown**()

Shuts down all CAN interfaces and hardware interface.

**property state**

Return the current state of the hardware

## 4.19.5 Internals

### Message filtering

The interface and driver supports only setting of one filter per channel. If one filter is requested, this is will be handled by the driver itself. If more than one filter is needed, these will be handled in Python code in the `recv` method. If a message does not match any of the filters, `recv()` will return `None`.

### Periodic tasks

The driver supports periodic message sending but without the possibility to set the interval between messages. Therefore the handling of the periodic messages is done by the interface using the [ThreadBasedCyclicSendTask](#).

## 4.20 USB2CAN Interface

The [USB2CAN](#) is a cheap CAN interface based on an ARM7 chip (STR750FV2). There is support for this device on Linux through the [SocketCAN](#) interface and for Windows using this `usb2can` interface.

Support though windows is achieved through a DLL very similar to the way the PCAN functions. The API is called CANAL (CAN Abstraction Layer) which is a separate project designed to be used with VSCP which is a socket like messaging system that is not only cross platform but also supports other types of devices.

## 4.20.1 Installation

1. To install on Windows download the USB2CAN Windows driver. It is compatible with XP, Vista, Win7, Win8/8.1. (Written against driver version v1.0.2.1)
2. Install the appropriate version of `pywin32` (win32com)
3. Download the USB2CAN CANAL DLL from the USB2CAN website. Place this in either the same directory you are running `usb2can.py` from or your DLL folder in your python install. Note that only a 32-bit version is currently available, so this only works in a 32-bit Python environment.

## 4.20.2 Internals

This interface originally written against CANAL DLL version v1.0.6.

### Interface Layout

- **usb2canabstractionlayer.py**

This file is only a wrapper for the CANAL API that the interface expects. There are also a couple of constants here to try and make dealing with the bitwise operations for flag setting a little easier. Other than that this is only the CANAL API. If a programmer wanted to work with the API directly this is the file that allows you to do this. The CANAL project does not provide this wrapper and normally must be accessed with C.

- **usb2canInterface.py**

This file provides the translation to and from the python-can library to the CANAL API. This is where all the logic is and setup code is. Most issues if they are found will be either found here or within the DLL that is provided

- **serial\_selector.py**

See the section below for the reason for adding this as it is a little odd. What program does is if a serial number is not provided to the `usb2canInterface` file this program does WMI (Windows Management Instrumentation) calls to try and figure out what device to connect to. It then returns the serial number of the device. Currently it is not really smart enough to figure out what to do if there are multiple devices. This needs to be changed if people are using more than one interface.

## 4.20.3 Interface Specific Items

There are a few things that are kinda strange about this device and are not overly obvious about the code or things that are not done being implemented in the DLL.

1. You need the Serial Number to connect to the device under Windows. This is part of the “setup string” that configures the device. There are a few options for how to get this.
  1. Use `usb2canWin.py` to find the serial number.
  2. Look on the device and enter it either through a prompt/barcode scanner/hardcode it. (Not recommended)
  3. Reprogram the device serial number to something and do that for all the devices you own. (Really Not Recommended, can no longer use multiple devices on one computer)
2. In `usb2canabstractionlayer.py` there is a structure called `CanalMsg` which has a unsigned byte array of size 8. In the `usb2canInterface` file it passes in an unsigned byte array of size 8 also which if you pass less than 8 bytes in it stuffs it with extra zeros. So if the data `"01020304"` is sent the message would look like `"0102030400000000"`.

There is also a part of this structure called `sizeData` which is the actual length of the data that was sent not the stuffed message (in this case would be 4). What then happens is although a message of size 8 is sent to the device only the first 4 bytes of information would be sent. This is done because the DLL expects a length of 8 and nothing else. So to make it compatible that has to be sent through the wrapper. If `usb2canInterface` sent an array of length 4 with `sizeData` of 4 as well the array would throw an incompatible data type error.

3. The masking features have not been implemented currently in the CANAL interface in the version currently on the USB2CAN website.

**Warning:** Currently message filtering is not implemented. Contributions are most welcome!

#### 4.20.4 Bus

```
class can.interfaces.usb2can.Usb2canBus(channel=None, dll='usb2can.dll', flags=8, *, bitrate=500000,
                                         serial=None, **kwargs)
```

Interface to a USB2CAN Bus.

This interface only works on Windows. Please use `socketcan` on Linux.

##### Parameters

- **channel** (*str* / *None*) – The device’s serial number. If not provided, Windows Management Instrumentation will be used to identify the first such device.
- **bitrate** (*int*) – Bitrate of channel in bit/s. Values will be limited to a maximum of 1000 Kbps. Default is 500 Kbps
- **flags** (*int*) – Flags to directly pass to open function of the `usb2can` abstraction layer.
- **dll** (*str*) – Path to the DLL with the CANAL API to load Defaults to ‘`usb2can.dll`’
- **serial** (*str* / *None*) – Alias for *channel* that is provided for legacy reasons. If both *serial* and *channel* are set, *serial* will be used and *channel* will be ignored.

Construct and open a CAN bus instance of the specified type.

Subclasses should call though this method with all given parameters as it handles generic tasks like applying filters.

##### Parameters

- **channel** (*str* / *None*) – The can interface identifier. Expected type is backend dependent.
- **can\_filters** – See `set_filters()` for details.
- **kwargs** (*dict*) – Any backend dependent configurations are passed in this dictionary
- **dll** (*str*)
- **flags** (*int*)
- **bitrate** (*int*)
- **serial** (*str* / *None*)

##### Raises

- **ValueError** – If parameters are out of range
- **CanInterfaceNotImplementedError** – If the driver cannot be accessed
- **CanInitializationError** – If the bus cannot be initialized

## 4.20.5 Exceptions

**exception** `can.interfaces.usb2can.usb2canabstractionlayer.CanalError(value)`

An enumeration.

## 4.20.6 Miscellaneous

**class** `can.interfaces.usb2can.Usb2CanAbstractionLayer(dll='usb2can.dll')`

A low level wrapper around the usb2can library.

Documentation: [http://www.8devices.com/media/products/usb2can/downloads/CANAL\\_API.pdf](http://www.8devices.com/media/products/usb2can/downloads/CANAL_API.pdf)

**Parameters**

`dll` (*str* | *os.PathLike[str]*) – the path to the usb2can DLL to load

**Raises**

*CanInterfaceNotImplementedError* – if the DLL could not be loaded

**blocking\_receive**(*handle, msg, timeout*)

**Return type**

*CanalError*

**blocking\_send**(*handle, msg, timeout*)

**Return type**

*CanalError*

**close**(*handle*)

**Return type**

*CanalError*

**get\_library\_version**()

**get\_statistics**(*handle, statistics*)

**Return type**

*CanalError*

**get\_status**(*handle, status*)

**Return type**

*CanalError*

**get\_vendor\_string**()

**get\_version**()

**open**(*configuration, flags*)

Opens a CAN connection using *CanalOpen()*.

**Parameters**

- **configuration** (*str*) – the configuration: “device\_id; baudrate”
- **flags** (*int*) – the flags to be set

**Returns**

Valid handle for CANAL API functions on success

**Raises***CanInterfaceNotImplementedError* – if any error occurred**receive**(*handle*, *msg*)**Return type***CanalError***send**(*handle*, *msg*)**Return type***CanalError*

## 4.21 Vector

This interface adds support for CAN controllers by *Vector*. Only Windows is supported.

### 4.21.1 Configuration

By default this library uses the channel configuration for CANalyzer. To use a different application, open **Vector Hardware Configuration** program and create a new application and assign the channels you may want to use. Specify the application name as `app_name='Your app name'` when constructing the bus or in a config file.

Channel should be given as a list of channels starting at 0.

Here is an example configuration file connecting to CAN 1 and CAN 2 for an application named “python-can”:

```
[default]
interface = vector
channel = 0, 1
app_name = python-can
```

### 4.21.2 VectorBus

```
class can.interfaces.vector.VectorBus(channel, can_filters=None, poll_interval=0.01,
                                     receive_own_messages=False, timing=None, bitrate=None,
                                     rx_queue_size=16384, app_name='CANalyzer', serial=None,
                                     fd=False, data_bitrate=None, sjw_abr=2, tseg1_abr=6,
                                     tseg2_abr=3, sjw_dbr=2, tseg1_dbr=6, tseg2_dbr=3, **kwargs)
```

Bases: *BusABC*

The CAN Bus implemented for the Vector interface.

**Parameters**

- **channel** (*int* | *Sequence[int]* | *str*) – The channel indexes to create this bus with. Can also be a single integer or a comma separated string.
- **can\_filters** (*Sequence[CanFilter | CanFilterExtended]* | *None*) – See *can.BusABC*.
- **receive\_own\_messages** (*bool*) – See *can.BusABC*.

- **timing** (*BitTiming* / *BitTimingFd* / *None*) – An instance of *BitTiming* or *BitTimingFd* to specify the bit timing parameters for the VectorBus interface. The *f\_clock* value of the timing instance must be set to 8\_000\_000 (8MHz) or 16\_000\_000 (16MHz) for CAN 2.0 or 80\_000\_000 (80MHz) for CAN FD. If this parameter is provided, it takes precedence over all other timing-related parameters. Otherwise, the bit timing can be specified using the following parameters: *bitrate* for standard CAN or *fd*, *data\_bitrate*, *sjw\_abr*, *tseg1\_abr*, *tseg2\_abr*, *sjw\_dbr*, *tseg1\_dbr*, and *tseg2\_dbr* for CAN FD.
- **poll\_interval** (*float*) – Poll interval in seconds.
- **bitrate** (*int* / *None*) – Bitrate in bits/s.
- **rx\_queue\_size** (*int*) – Number of messages in receive queue (power of 2). CAN: range 16...32768 CAN-FD: range 8192...524288
- **app\_name** (*str* / *None*) – Name of application in *Vector Hardware Config*. If set to *None*, the channel should be a global channel index.
- **serial** (*int* / *None*) – Serial number of the hardware to be used. If set, the channel parameter refers to the channels ONLY on the specified hardware. If set, the *app\_name* does not have to be previously defined in *Vector Hardware Config*.
- **fd** (*bool*) – If CAN-FD frames should be supported.
- **data\_bitrate** (*int* / *None*) – Which bitrate to use for data phase in CAN FD. Defaults to arbitration bitrate.
- **sjw\_abr** (*int*) – Bus timing value sample jump width (arbitration).
- **tseg1\_abr** (*int*) – Bus timing value tseg1 (arbitration)
- **tseg2\_abr** (*int*) – Bus timing value tseg2 (arbitration)
- **sjw\_dbr** (*int*) – Bus timing value sample jump width (data)
- **tseg1\_dbr** (*int*) – Bus timing value tseg1 (data)
- **tseg2\_dbr** (*int*) – Bus timing value tseg2 (data)
- **kwargs** (*Any*)

#### Raises

- ***CanInterfaceNotImplementedError*** – If the current operating system is not supported or the driver could not be loaded.
- ***CanInitializationError*** – If the bus could not be set up. This may or may not be a *VectorInitializationError*.

**send**(*msg*, *timeout=None*)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

#### Parameters

- **msg** (*Message*) – A message object.
- **timeout** (*float* / *None*) – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. None blocks indefinitely.

#### Raises

- ***CanOperationError*** – If an error occurred while sending

**Return type**

None

**flush\_tx\_buffer()**

Flush the TX buffer of the bus.

Implementation does not use function `xlCanFlushTransmitQueue` of the XL driver, as it works only for XL family devices.

**Warning:** Using this function will flush the queue and send a high voltage message (ID = 0, DLC = 0, no data).

**Return type**

None

**shutdown()**

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

**Return type**

None

**static popup\_vector\_hw\_configuration(wait\_for\_finish=0)**

Open vector hardware configuration window.

**Parameters**

**wait\_for\_finish** (*int*) – Time to wait for user input in milliseconds.

**Return type**

None

**static get\_application\_config(app\_name, app\_channel)**

Retrieve information for an application in Vector Hardware Configuration.

**Parameters**

- **app\_name** (*str*) – The name of the application.
- **app\_channel** (*int*) – The channel of the application.

**Returns**

Returns a tuple of the hardware type, the hardware index and the hardware channel.

**Raises**

**`can.interfaces.vector.VectorInitializationError`** – If the application name does not exist in the Vector hardware configuration.

**Return type**

*Tuple*[*int* | *XL\_HardwareType*, *int*, *int*]

**static set\_application\_config(app\_name, app\_channel, hw\_type, hw\_index, hw\_channel, \*\*kwargs)**

Modify the application settings in Vector Hardware Configuration.

This method can also be used with a channel config dictionary:

```
import can
from can.interfaces.vector import VectorBus
```

(continues on next page)

(continued from previous page)

```

configs = can.detect_available_configs(interfaces=['vector'])
cfg = configs[0]
VectorBus.set_application_config(app_name="MyApplication", app_channel=0, **cfg)

```

**Parameters**

- **app\_name** (*str*) – The name of the application. Creates a new application if it does not exist yet.
- **app\_channel** (*int*) – The channel of the application.
- **hw\_type** (*int* / *XL\_HardwareType*) – The hardware type of the interface. E.g `XL_HardwareType.XL_HWTYPE_VIRTUAL`
- **hw\_index** (*int*) – The index of the interface if multiple interface with the same hardware type are present.
- **hw\_channel** (*int*) – The channel index of the interface.
- **kwargs** (*Any*)

**Raises**

**`can.interfaces.vector.VectorInitializationError`** – If the application name does not exist in the Vector hardware configuration.

**Return type**

None

**set\_filters(filters=None)**

Apply filtering to all messages received by this Bus.

All messages that match at least one filter are returned. If *filters* is *None* or a zero length sequence, all messages are matched.

Calling without passing any filters will reset the applied filters to *None*.

**Parameters**

**filters** (*Sequence*[*CanFilter* / *CanFilterExtended*] | *None*) – A iterable of dictionaries each containing a “can\_id”, a “can\_mask”, and an optional “extended” key:

```
[{"can_id": 0x11, "can_mask": 0x21, "extended": False}]
```

A filter matches, when `<received_can_id> & can_mask == can_id & can_mask`. If `extended` is set as well, it only matches messages where `<received_is_extended> == extended`. Else it matches every messages based only on the arbitration ID and mask.

**Return type**

None

**recv(timeout=None)**

Block waiting for a message from the Bus.

**Parameters**

**timeout** (*float* / *None*) – seconds to wait for a message or *None* to wait indefinitely

**Returns**

*None* on timeout or a *Message* object.

**Raises**

**`CanOperationError`** – If an error occurred while reading



**Return type**`Message` | `None`**send\_periodic**(*msgs*, *period*, *duration=None*, *store\_task=True*, *modifier\_callback=None*)

Start sending messages at a given period on this bus.

The task will be active until one of the following conditions are met:

- the (optional) duration expires
- the Bus instance goes out of scope
- the Bus instance is shutdown
- `stop_all_periodic_tasks()` is called
- the task's `stop()` method is called.

**Parameters**

- **msgs** (`Message` | `Sequence[Message]`) – Message(s) to transmit
- **period** (`float`) – Period in seconds between each message
- **duration** (`float` | `None`) – Approximate duration in seconds to continue sending messages. If no duration is provided, the task will continue indefinitely.
- **store\_task** (`bool`) – If True (the default) the task will be attached to this Bus instance. Disable to instead manage tasks manually.
- **modifier\_callback** (`Callable[[Message], None]` | `None`) – Function which should be used to modify each message's data before sending. The callback modifies the `data` of the message and returns `None`.

**Returns**

A started task instance. Note the task can be stopped (and depending on the backend modified) by calling the task's `stop()` method.

**Return type**`CyclicSendTaskABC`


---

**Note:** Note the duration before the messages stop being sent may not be exactly the same as the duration specified by the user. In general the message will be sent at the given rate until at least **duration** seconds.

---



---

**Note:** For extremely long-running Bus instances with many short-lived tasks the default api with `store_task==True` may not be appropriate as the stopped tasks are still taking up memory as they are associated with the Bus instance.

---

**stop\_all\_periodic\_tasks**(*remove\_tasks=True*)

Stop sending any messages that were started using `send_periodic()`.

---

**Note:** The result is undefined if a single task throws an exception while being stopped.

---

**Parameters**

- **remove\_tasks** (`bool`) – Stop tracking the stopped tasks.

**Return type**

None

### 4.21.3 Exceptions

**exception** `can.interfaces.vector.VectorError(error_code, error_string, function)`Bases: `CanError`**exception** `can.interfaces.vector.VectorInitializationError(error_code, error_string, function)`Bases: `VectorError`, `CanInitializationError`**exception** `can.interfaces.vector.VectorOperationError(error_code, error_string, function)`Bases: `VectorError`, `CanOperationError`

### 4.21.4 Miscellaneous

`can.interfaces.vector.get_channel_configs()`

Read channel properties from Vector XL API.

**Return type**`List[VectorChannelConfig]`**class** `can.interfaces.vector.VectorChannelConfig(name, hw_type, hw_index, hw_channel, channel_index, channel_mask, channel_capabilities, channel_bus_capabilities, is_on_bus, connected_bus_type, bus_params, serial_number, article_number, transceiver_name)`Bases: `NamedTuple`

NamedTuple which contains the channel properties from Vector XL API.

**Parameters**

- **name** (`str`)
- **hw\_type** (`int` / `XL_HardwareType`)
- **hw\_index** (`int`)
- **hw\_channel** (`int`)
- **channel\_index** (`int`)
- **channel\_mask** (`int`)
- **channel\_capabilities** (`XL_ChannelCapabilities`)
- **channel\_bus\_capabilities** (`XL_BusCapabilities`)
- **is\_on\_bus** (`bool`)
- **connected\_bus\_type** (`XL_BusTypes`)
- **bus\_params** (`VectorBusParams` / `None`)
- **serial\_number** (`int`)
- **article\_number** (`int`)
- **transceiver\_name** (`str`)

---

```
class can.interfaces.vector.canlib.VectorBusParams(bus_type, can, canfd)
```

```
Bases: NamedTuple
```

**Parameters**

- **bus\_type** (*XL\_BusTypes*)
- **can** (*VectorCanParams*)
- **canfd** (*VectorCanFdParams*)

```
class can.interfaces.vector.canlib.VectorCanParams(bitrate, sjw, tseg1, tseg2, sam, output_mode,  
                                                    can_op_mode)
```

```
Bases: NamedTuple
```

**Parameters**

- **bitrate** (*int*)
- **sjw** (*int*)
- **tseg1** (*int*)
- **tseg2** (*int*)
- **sam** (*int*)
- **output\_mode** (*XL\_OutputMode*)
- **can\_op\_mode** (*XL\_CANFD\_BusParams\_CanOpMode*)

```
class can.interfaces.vector.canlib.VectorCanFdParams(bitrate, data_bitrate, sjw_abr, tseg1_abr,  
                                                    tseg2_abr, sam_abr, sjw_dbr, tseg1_dbr,  
                                                    tseg2_dbr, output_mode, can_op_mode)
```

```
Bases: NamedTuple
```

**Parameters**

- **bitrate** (*int*)
- **data\_bitrate** (*int*)
- **sjw\_abr** (*int*)
- **tseg1\_abr** (*int*)
- **tseg2\_abr** (*int*)
- **sam\_abr** (*int*)
- **sjw\_dbr** (*int*)
- **tseg1\_dbr** (*int*)
- **tseg2\_dbr** (*int*)
- **output\_mode** (*XL\_OutputMode*)
- **can\_op\_mode** (*XL\_CANFD\_BusParams\_CanOpMode*)

```
class can.interfaces.vector.xldefine.XL_HardwareType(value)
```

```
Bases: IntEnum
```

```
An enumeration.
```

```
XL_HWTYPE_NONE = 0
```

```
XL_HWTYPE_VIRTUAL = 1
XL_HWTYPE_CANCARDX = 2
XL_HWTYPE_CANAC2PCI = 6
XL_HWTYPE_CANCARDY = 12
XL_HWTYPE_CANCARDXL = 15
XL_HWTYPE_CANCASEXL = 21
XL_HWTYPE_CANCASEXL_LOG_OBSOLETE = 23
XL_HWTYPE_CANBOARDXL = 25
XL_HWTYPE_CANBOARDXL_PXI = 27
XL_HWTYPE_VN2600 = 29
XL_HWTYPE_VN2610 = 29
XL_HWTYPE_VN3300 = 37
XL_HWTYPE_VN3600 = 39
XL_HWTYPE_VN7600 = 41
XL_HWTYPE_CANCARDXLE = 43
XL_HWTYPE_VN8900 = 45
XL_HWTYPE_VN8950 = 47
XL_HWTYPE_VN2640 = 53
XL_HWTYPE_VN1610 = 55
XL_HWTYPE_VN1630 = 57
XL_HWTYPE_VN1640 = 59
XL_HWTYPE_VN8970 = 61
XL_HWTYPE_VN1611 = 63
XL_HWTYPE_VN5240 = 64
XL_HWTYPE_VN5610 = 65
XL_HWTYPE_VN5620 = 66
XL_HWTYPE_VN7570 = 67
XL_HWTYPE_VN5650 = 68
XL_HWTYPE_IPCLIENT = 69
XL_HWTYPE_VN5611 = 70
XL_HWTYPE_IPSERVER = 71
```

```
XL_HWTYPE_VN5612 = 72
XL_HWTYPE_VX1121 = 73
XL_HWTYPE_VN5601 = 74
XL_HWTYPE_VX1131 = 75
XL_HWTYPE_VT6204 = 77
XL_HWTYPE_VN1630_LOG = 79
XL_HWTYPE_VN7610 = 81
XL_HWTYPE_VN7572 = 83
XL_HWTYPE_VN8972 = 85
XL_HWTYPE_VN0601 = 87
XL_HWTYPE_VN5640 = 89
XL_HWTYPE_VX0312 = 91
XL_HWTYPE_VH6501 = 94
XL_HWTYPE_VN8800 = 95
XL_HWTYPE_IPCL8800 = 96
XL_HWTYPE_IPSRV8800 = 97
XL_HWTYPE_CSMCAN = 98
XL_HWTYPE_VN5610A = 101
XL_HWTYPE_VN7640 = 102
XL_HWTYPE_VX1135 = 104
XL_HWTYPE_VN4610 = 105
XL_HWTYPE_VT6306 = 107
XL_HWTYPE_VT6104A = 108
XL_HWTYPE_VN5430 = 109
XL_HWTYPE_VTSSERVICE = 110
XL_HWTYPE_VN1530 = 112
XL_HWTYPE_VN1531 = 113
XL_HWTYPE_VX1161A = 114
XL_HWTYPE_VX1161B = 115
XL_HWTYPE_VGNSS = 116
XL_HWTYPE_VXLAPINIC = 118
```

```
XL_MAX_HWTYPE = 120
```

```
class can.interfaces.vector.xldefine.XL_ChannelCapabilities(value)
```

```
    Bases: IntFlag
```

```
    An enumeration.
```

```
    XL_CHANNEL_FLAG_TIME_SYNC_RUNNING = 1
```

```
    XL_CHANNEL_FLAG_NO_HWSYNC_SUPPORT = 1024
```

```
    XL_CHANNEL_FLAG_SPDIF_CAPABLE = 16384
```

```
    XL_CHANNEL_FLAG_CANFD_BOSCH_SUPPORT = 536870912
```

```
    XL_CHANNEL_FLAG_CMACTLICENSE_SUPPORT = 1073741824
```

```
    XL_CHANNEL_FLAG_CANFD_ISO_SUPPORT = 2147483648
```

```
class can.interfaces.vector.xldefine.XL_BusCapabilities(value)
```

```
    Bases: IntFlag
```

```
    An enumeration.
```

```
    XL_BUS_COMPATIBLE_CAN = 1
```

```
    XL_BUS_ACTIVE_CAP_CAN = 65536
```

```
    XL_BUS_COMPATIBLE_LIN = 2
```

```
    XL_BUS_ACTIVE_CAP_LIN = 131072
```

```
    XL_BUS_COMPATIBLE_FLEXRAY = 4
```

```
    XL_BUS_ACTIVE_CAP_FLEXRAY = 262144
```

```
    XL_BUS_COMPATIBLE_MOST = 16
```

```
    XL_BUS_ACTIVE_CAP_MOST = 1048576
```

```
    XL_BUS_COMPATIBLE_DAI0 = 64
```

```
    XL_BUS_ACTIVE_CAP_DAI0 = 4194304
```

```
    XL_BUS_COMPATIBLE_J1708 = 256
```

```
    XL_BUS_ACTIVE_CAP_J1708 = 16777216
```

```
    XL_BUS_COMPATIBLE_KLINE = 2048
```

```
    XL_BUS_ACTIVE_CAP_KLINE = 134217728
```

```
    XL_BUS_COMPATIBLE_ETHERNET = 4096
```

```
    XL_BUS_ACTIVE_CAP_ETHERNET = 268435456
```

```
    XL_BUS_COMPATIBLE_A429 = 8192
```

```
    XL_BUS_ACTIVE_CAP_A429 = 536870912
```

```

class can.interfaces.vector.xldefine.XL_BusTypes(value)
    Bases: IntFlag
    An enumeration.

    XL_BUS_TYPE_NONE = 0

    XL_BUS_TYPE_CAN = 1

    XL_BUS_TYPE_LIN = 2

    XL_BUS_TYPE_FLEXRAY = 4

    XL_BUS_TYPE_AFDX = 8

    XL_BUS_TYPE_MOST = 16

    XL_BUS_TYPE_DAIO = 64

    XL_BUS_TYPE_J1708 = 256

    XL_BUS_TYPE_KLINE = 2048

    XL_BUS_TYPE_ETHERNET = 4096

    XL_BUS_TYPE_A429 = 8192

class can.interfaces.vector.xldefine.XL_OutputMode(value)
    Bases: IntEnum
    An enumeration.

    XL_OUTPUT_MODE_SILENT = 0

    XL_OUTPUT_MODE_NORMAL = 1

    XL_OUTPUT_MODE_TX_OFF = 2

    XL_OUTPUT_MODE_SJA_1000_SILENT = 3

class can.interfaces.vector.xldefine.XL_CANFD_BusParams_CanOpMode(value)
    Bases: IntFlag
    An enumeration.

    XL_BUS_PARAMS_CANOPMODE_CAN20 = 1

    XL_BUS_PARAMS_CANOPMODE_CANFD = 2

    XL_BUS_PARAMS_CANOPMODE_CANFD_NO_ISO = 8

class can.interfaces.vector.xldefine.XL_Status(value)
    Bases: IntEnum
    An enumeration.

    XL_SUCCESS = 0

    XL_PENDING = 1

    XL_ERR_QUEUE_IS_EMPTY = 10

```

```
XL_ERR_QUEUE_IS_FULL = 11
XL_ERR_TX_NOT_POSSIBLE = 12
XL_ERR_NO_LICENSE = 14
XL_ERR_WRONG_PARAMETER = 101
XL_ERR_TWICE_REGISTER = 110
XL_ERR_INVALID_CHAN_INDEX = 111
XL_ERR_INVALID_ACCESS = 112
XL_ERR_PORT_IS_OFFLINE = 113
XL_ERR_CHAN_IS_ONLINE = 116
XL_ERR_NOT_IMPLEMENTED = 117
XL_ERR_INVALID_PORT = 118
XL_ERR_HW_NOT_READY = 120
XL_ERR_CMD_TIMEOUT = 121
XL_ERR_CMD_HANDLING = 122
XL_ERR_HW_NOT_PRESENT = 129
XL_ERR_NOTIFY_ALREADY_ACTIVE = 131
XL_ERR_INVALID_TAG = 132
XL_ERR_INVALID_RESERVED_FLD = 133
XL_ERR_INVALID_SIZE = 134
XL_ERR_INSUFFICIENT_BUFFER = 135
XL_ERR_ERROR_CRC = 136
XL_ERR_BAD_EXE_FORMAT = 137
XL_ERR_NO_SYSTEM_RESOURCES = 138
XL_ERR_NOT_FOUND = 139
XL_ERR_INVALID_ADDRESS = 140
XL_ERR_REQ_NOT_ACCEP = 141
XL_ERR_INVALID_LEVEL = 142
XL_ERR_NO_DATA_DETECTED = 143
XL_ERR_INTERNAL_ERROR = 144
XL_ERR_UNEXP_NET_ERR = 145
XL_ERR_INVALID_USER_BUFFER = 146
```



```
XL_ERR_INVALID_PORT_ACCESS_TYPE = 147
XL_ERR_NO_RESOURCES = 152
XL_ERR_WRONG_CHIP_TYPE = 153
XL_ERR_WRONG_COMMAND = 154
XL_ERR_INVALID_HANDLE = 155
XL_ERR_RESERVED_NOT_ZERO = 157
XL_ERR_INIT_ACCESS_MISSING = 158
XL_ERR_WRONG_VERSION = 160
XL_ERR_CANNOT_OPEN_DRIVER = 201
XL_ERR_WRONG_BUS_TYPE = 202
XL_ERR_DLL_NOT_FOUND = 203
XL_ERR_INVALID_CHANNEL_MASK = 204
XL_ERR_NOT_SUPPORTED = 205
XL_ERR_CONNECTION_BROKEN = 210
XL_ERR_CONNECTION_CLOSED = 211
XL_ERR_INVALID_STREAM_NAME = 212
XL_ERR_CONNECTION_FAILED = 213
XL_ERR_STREAM_NOT_FOUND = 214
XL_ERR_STREAM_NOT_CONNECTED = 215
XL_ERR_QUEUE_OVERRUN = 216
XL_ERROR = 255
XL_ERR_INVALID_DLC = 513
XL_ERR_INVALID_CANID = 514
XL_ERR_INVALID_FDFLAG_MODE20 = 515
XL_ERR_EDL_RTR = 516
XL_ERR_EDL_NOT_SET = 517
XL_ERR_UNKNOWN_FLAG = 518
```

Additional interface types can be added via the [Plugin Interface](#), or by installing a third party package that utilises the [Plugin Interface](#).



## VIRTUAL INTERFACES

There are quite a few implementations for CAN networks that do not require physical CAN hardware. The built in virtual interfaces are:

### 5.1 Virtual

The virtual interface can be used as a way to write OS and driver independent tests. Any *VirtualBus* instances connecting to the same channel (from within the same Python process) will receive each others messages.

If messages shall be sent across process or host borders, consider using the *Multicast IP Interface* and refer to *Virtual Interfaces* for a comparison and general discussion of different virtual interfaces.

#### 5.1.1 Example

```
import can

bus1 = can.interface.Bus('test', interface='virtual')
bus2 = can.interface.Bus('test', interface='virtual')

msg1 = can.Message(arbitration_id=0xabcde, data=[1,2,3])
bus1.send(msg1)
msg2 = bus2.recv()

#assert msg1 == msg2
assert msg1.arbitration_id == msg2.arbitration_id
assert msg1.data == msg2.data
assert msg1.timestamp != msg2.timestamp
```

```
import can

bus1 = can.interface.Bus('test', interface='virtual', preserve_timestamps=True)
bus2 = can.interface.Bus('test', interface='virtual')

msg1 = can.Message(timestamp=1639740470.051948, arbitration_id=0xabcde, data=[1,2,3])

# Messages sent on bus1 will have their timestamps preserved when received
# on bus2
bus1.send(msg1)
msg2 = bus2.recv()
```

(continues on next page)

(continued from previous page)

```

assert msg1.arbitration_id == msg2.arbitration_id
assert msg1.data == msg2.data
assert msg1.timestamp == msg2.timestamp

# Messages sent on bus2 will not have their timestamps preserved when
# received on bus1
bus2.send(msg1)
msg3 = bus1.recv()

assert msg1.arbitration_id == msg3.arbitration_id
assert msg1.data == msg3.data
assert msg1.timestamp != msg3.timestamp

```

## 5.1.2 Bus Class Documentation

```

class can.interfaces.virtual.VirtualBus(channel=None, receive_own_messages=False,
                                       rx_queue_size=0, preserve_timestamps=False,
                                       protocol=CanProtocol.CAN_20, **kwargs)

```

A virtual CAN bus using an internal message queue. It can be used for example for testing.

In this interface, a channel is an arbitrary object used as an identifier for connected buses.

Implements `can.BusABC._detect_available_configs()`; see `_detect_available_configs()` for how it behaves here.

---

**Note:** The timeout when sending a message applies to each receiver individually. This means that sending can block up to 5 seconds if a message is sent to 5 receivers with the timeout set to 1.0.

---

**Warning:** This interface guarantees reliable delivery and message ordering, but does *not* implement rate limiting or ID arbitration/prioritization under high loads. Please refer to the section [Virtual Interfaces](#) for more information on this and a comparison to alternatives.

The constructed instance has access to the bus identified by the channel parameter. It is able to see all messages transmitted on the bus by virtual instances constructed with the same channel identifier.

### Parameters

- **channel** (*Any*) – The channel identifier. This parameter can be an arbitrary value. The bus instance will be able to see messages from other virtual bus instances that were created with the same value.
- **receive\_own\_messages** (*bool*) – If set to True, sent messages will be reflected back on the input queue.
- **rx\_queue\_size** (*int*) – The size of the reception queue. The reception queue stores messages until they are read. If the queue reaches its capacity, it will start dropping the oldest messages to make room for new ones. If set to 0, the queue has an infinite capacity. Be aware that this can cause memory leaks if messages are read with a lower frequency than they arrive on the bus.

- **preserve\_timestamps** (*bool*) – If set to True, messages transmitted via `send()` will keep the timestamp set in the *Message* instance. Otherwise, the timestamp value will be replaced with the current system time.
- **protocol** (*CanProtocol*) – The protocol implemented by this bus instance. The value does not affect the operation of the bus instance and can be set to an arbitrary value for testing purposes.
- **kwargs** (*Any*) – Additional keyword arguments passed to the parent constructor.

#### **static** `_detect_available_configs()`

Returns all currently used channels as well as one other currently unused channel.

---

**Note:** This method will run into problems if thousands of autodetected buses are used at once.

---

#### **Return type**

*List[AutoDetectedConfig]*

#### **send**(*msg*, *timeout=None*)

Transmit a message to the CAN bus.

Override this method to enable the transmit path.

#### **Parameters**

- **msg** (*Message*) – A message object.
- **timeout** (*float* / *None*) – If > 0, wait up to this many seconds for message to be ACK'ed or for transmit queue to be ready depending on driver implementation. If timeout is exceeded, an exception will be raised. Might not be supported by all interfaces. None blocks indefinitely.

#### **Raises**

*CanOperationError* – If an error occurred while sending

#### **Return type**

None

#### **shutdown**()

Called to carry out any interface specific cleanup required in shutting down a bus.

This method can be safely called multiple times.

#### **Return type**

None

## 5.2 Multicast IP Interface

This module implements transport of CAN and CAN FD messages over UDP via Multicast IPv4 and IPv6. This virtual interface allows for communication between multiple processes and even hosts. This differentiates it from the *Virtual* interface, which can only pass messages within a single process but does not require a network stack.

It runs on UDP to have the lowest possible latency (as opposed to using TCP), and because normal IP multicast is inherently unreliable, as the recipients are unknown. This enables ad-hoc networks that do not require a central server but is also a so-called *unreliable network*. In practice however, local area networks (LANs) should most often be sufficiently reliable for this interface to function properly.

---

**Note:** For an overview over the different virtual buses in this library and beyond, please refer to the section *Virtual Interfaces*. It also describes important limitations of this interface.

---

Please refer to the *Bus class documentation* below for configuration options and useful resources for specifying multicast IP addresses.

## 5.2.1 Supported Platforms

It should work on most Unix systems (including Linux with kernel 2.6.22+ and macOS) but currently not on Windows.

## 5.2.2 Example

This example should print a single line indicating that a CAN message was successfully sent from bus\_1 to bus\_2:

```
import time
import can
from can.interfaces.udp_multicast import UdpMulticastBus

# The bus can be created using the can.Bus wrapper class or using UdpMulticastBus_
↳ directly
with can.Bus(channel=UdpMulticastBus.DEFAULT_GROUP_IPv6, interface='udp_multicast') as_
↳ bus_1, \
    UdpMulticastBus(channel=UdpMulticastBus.DEFAULT_GROUP_IPv6) as bus_2:

    # register a callback on the second bus that prints messages to the standard out
    notifier = can.Notifier(bus_2, [can.Printer()])

    # create and send a message with the first bus, which should arrive at the second one
    message = can.Message(arbitration_id=0x123, data=[1, 2, 3])
    bus_1.send(message)

    # give the notifier enough time to get triggered by the second bus
    time.sleep(2.0)
```

## 5.2.3 Bus Class Documentation

```
class can.interfaces.udp_multicast.UdpMulticastBus(channel='ff15:7079:7468:6f6e:6465:6d6f:6d63:6173',
                                                    port=43113, hop_limit=1,
                                                    receive_own_messages=False, fd=True,
                                                    **kwargs)
```

A virtual interface for CAN communications between multiple processes using UDP over Multicast IP.

It supports IPv4 and IPv6, specified via the channel (which really is just a multicast IP address as a string). You can also specify the port and the IPv6 *hop limit*/the IPv4 *time to live* (TTL).

This bus does not support filtering based on message IDs on the kernel level but instead provides it in user space (in Python) as a fallback.

Both default addresses should allow for multi-host CAN networks in a normal local area network (LAN) where multicast is enabled.

**Note:** The auto-detection of available interfaces (see) is implemented using heuristic that checks if the required socket operations are available. It then returns two configurations, one based on the `DEFAULT_GROUP_IPv6` address and another one based on the `DEFAULT_GROUP_IPv4` address.

**Warning:** The parameter `receive_own_messages` is currently unsupported and setting it to `True` will raise an exception.

**Warning:** This interface does not make guarantees on reliable delivery and message ordering, and also does not implement rate limiting or ID arbitration/prioritization under high loads. Please refer to the section [Virtual Interfaces](#) for more information on this and a comparison to alternatives.

#### Parameters

- **channel** (*str*) – A multicast IPv4 address (in `224.0.0.0/4`) or an IPv6 address (in `ff00::/8`). This defines which version of IP is used. See [Wikipedia](#) (“Multicast address”) for more details on the addressing schemes. Defaults to `DEFAULT_GROUP_IPv6`.
- **port** (*int*) – The IP port to read from and write to.
- **hop\_limit** (*int*) – The hop limit in IPv6 or in IPv4 the time to live (TTL).
- **receive\_own\_messages** (*bool*) – If transmitted messages should also be received by this bus. CURRENTLY UNSUPPORTED.
- **fd** (*bool*) – If CAN-FD frames should be supported. If set to false, an error will be raised upon sending such a frame and such received frames will be ignored.
- **can\_filters** – See `set_filters()`.

#### Raises

- **RuntimeError** – If the `msgpack`-dependency is not available. It should be installed on all non Windows platforms via the `setup.py` requirements.
- **NotImplementedError** – If the `receive_own_messages` is passed as `True`.

Construct and open a CAN bus instance of the specified type.

Subclasses should call though this method with all given parameters as it handles generic tasks like applying filters.

#### Parameters

- **channel** (*str*) – The can interface identifier. Expected type is backend dependent.
- **can\_filters** – See `set_filters()` for details.
- **kwargs** (*dict*) – Any backend dependent configurations are passed in this dictionary
- **port** (*int*)
- **hop\_limit** (*int*)
- **receive\_own\_messages** (*bool*)
- **fd** (*bool*)

#### Raises

- **ValueError** – If parameters are out of range
- **CanInterfaceNotImplementedError** – If the driver cannot be accessed
- **CanInitializationError** – If the bus cannot be initialized

**DEFAULT\_GROUP\_IPV4 = '239.74.163.2'**

An arbitrary IPv4 multicast address with “administrative” scope, i.e. only to be routed within administrative organizational boundaries and not beyond it. It should allow for multi-host CAN networks in a normal IPv4 LAN. This is provided as a default fallback channel if IPv6 is (still) not supported.

**DEFAULT\_GROUP\_IPV6 = 'ff15:7079:7468:6f6e:6465:6d6f:6d63:6173'**

An arbitrary IPv6 multicast address with “site-local” scope, i.e. only to be routed within the local physical network and not beyond it. It should allow for multi-host CAN networks in a normal IPv6 LAN. This is the default channel and should work with most modern routers if multicast is allowed.

**fileno()**

Provides the internally used file descriptor of the socket or *-1* if not available.

**Return type**

`int`

**shutdown()**

Close all sockets and free up any resources.

Never throws errors and only logs them.

**Return type**

`None`

## 5.3 Comparison

The following table compares some known virtual interfaces:

Name	Avail- abil- ity	Applicability			Implementation		
		Within Process	Between Pro- cesses	Via (IP) Net- works	Without Central Server	Transport Technology	Serial- ization Format
virtual (this)	<i>in- cluded</i>	✓			✓	Singleton & Mu- tex (reliable)	none
udp_multicast ( <i>doc</i> )	<i>in- cluded</i>	✓	✓	✓	✓	UDP via IP multicast (unre- liable)	custom using <a href="#">msg- pack</a>
christiansandberg/ python-can-remote	<i>exter- nal</i>	✓	✓	✓		Websockets via TCP/IP (reli- able)	custom bi- nary
windelbouwman/ virtualcan	<i>exter- nal</i>	✓	✓	✓		<a href="#">ZeroMQ</a> via TCP/IP (reli- able)	custom bi- nary <sup>1</sup>

<sup>1</sup> The only option in this list that implements interoperability with other languages out of the box. For the others (except the first intra-process one), other programs written in potentially different languages could effortlessly interface with the bus once they mimic the serialization format. The last one, however, has already implemented the entire bus functionality in C++ and *Rust*, besides the Python variant.



## 5.4 Common Limitations

**Guaranteed delivery** and **message ordering** is one major point of difference: While in a physical CAN network, a message is either sent or in queue (or an explicit error occurred), this may not be the case for virtual networks. The `udp_multicast` bus for example, drops this property for the benefit of lower latencies by using unreliable UDP/IP instead of reliable TCP/IP (and because normal IP multicast is inherently unreliable, as the recipients are unknown by design). The other three buses faithfully model a physical CAN network in this regard: They ensure that all recipients actually receive (and acknowledge each message), much like in a physical CAN network. They also ensure that messages are relayed in the order they have arrived at the central server and that messages arrive at the recipients exactly once. Both is not guaranteed to hold for the best-effort `udp_multicast` bus as it uses UDP/IP as a transport layer.

**Central servers** are, however, required by interfaces 3 and 4 (the external tools) to provide these guarantees of message delivery and message ordering. The central servers receive and distribute the CAN messages to all other bus participants, unlike in a real physical CAN network. The first intra-process `virtual` interface only runs within one Python process, effectively the Python instance of `VirtualBus` acts as a central server. Notably the `udp_multicast` bus does not require a central server.

**Arbitration and throughput** are two interrelated functions/properties of CAN networks which are typically abstracted in virtual interfaces. In all four interfaces, an unlimited amount of messages can be sent per unit of time (given the computational power of the machines and networks that are involved). In a real CAN/CAN FD networks, however, throughput is usually much more restricted and prioritization of arbitration IDs is thus an important feature once the bus is starting to get saturated. None of the interfaces presented above support any sort of throttling or ID arbitration under high loads.



## PLUGIN INTERFACE

External packages can register new interfaces by using the `can.interface` entry point in its project configuration. The format of the entry point depends on your project configuration format (*pyproject.toml*, *setup.cfg* or *setup.py*).

In the following example module defines the location of your bus class inside your package e.g. `my_package.subpackage.bus_module` and `classname` is the name of your `can.BusABC` subclass.

```
# Note the quotes around can.interface in order to escape the dot .
[project.entry-points."can.interface"]
interface_name = "module:classname"
```

```
[options.entry_points]
can.interface =
    interface_name = module:classname
```

```
from setuptools import setup

setup(
    # ...,
    entry_points = {
        'can.interface': [
            'interface_name = module:classname'
        ]
    }
)
```

The `interface_name` can be used to create an instance of the bus in the **python-can** API:

```
import can

bus = can.Bus(interface="interface_name", channel=0)
```

## 6.1 Example Interface Plugins

The table below lists interface drivers that can be added by installing additional packages that utilise the plugin API. These modules are optional dependencies of python-can.

---

**Note:** The packages listed below are maintained by other authors. Any issues should be reported in their corresponding repository and **not** in the python-can repository.

---

Name	Description
<a href="#">python-can-canine</a>	CAN Driver for the CANine CAN interface
<a href="#">python-can-cvector</a>	Cython based version of the ‘VectorBus’
<a href="#">python-can-remote</a>	CAN over network bridge
<a href="#">python-can-sontheim</a>	CAN Driver for Sontheim CAN interfaces (e.g. CANfox)

## OTHER CAN BUS TOOLS

In order to keep the project maintainable, the scope of the package is limited to providing common abstractions to different hardware devices, and a basic suite of utilities for sending and receiving messages on a CAN bus. Other tools are available that either extend the functionality of python-can, or provide complementary features that python-can users might find useful.

Some of these tools are listed below for convenience.

### 7.1 CAN Message protocols (implemented in Python)

#### 1. SAE J1939 Message Protocol

- The `can-j1939` module provides an implementation of the CAN SAE J1939 standard for Python, including J1939-22. `can-j1939` uses python-can to provide support for multiple hardware interfaces.

#### 2. CIA CANopen

- The `canopen` module provides an implementation of the CIA CANopen protocol, aiming to be used for automation and testing purposes

#### 3. ISO 15765-2 (ISO TP)

- The `can-isotp` module provides an implementation of the ISO TP CAN protocol for sending data packets via a CAN transport layer.

#### 4. UDS

- The `python-uds` module is a communication protocol agnostic implementation of the Unified Diagnostic Services (UDS) protocol defined in ISO 14229-1, although it does have extensions for performing UDS over CAN utilising the ISO TP protocol. This module has not been updated for some time.
- The `uds` module is another tool that implements the UDS protocol, although it does have extensions for performing UDS over CAN utilising the ISO TP protocol. This module has not been updated for some time.

#### 5. XCP

- The `pyxcp` module implements the Universal Measurement and Calibration Protocol (XCP). The purpose of XCP is to adjust parameters and acquire current values of internal variables in an ECU.

## 7.2 CAN Frame Parsing tools etc. (implemented in Python)

### 1. CAN Message / Database scripting

- The [cantools](#) package provides multiple methods for interacting with can message database files, and using these files to monitor live busses with a command line monitor tool.

### 2. CAN Message / Log Decoding

- The [canmatrix](#) module provides methods for converting between multiple popular message frame definition file formats (e.g. .DBC files, .KCD files, .ARXML files etc.).
- The [pretty\\_j1939](#) module can be used to post-process CAN logs of J1939 traffic into human readable terminal prints or into a JSON file for consumption elsewhere in your scripts.

## 7.3 Other CAN related tools, programs etc.

### 1. Micropython CAN class

- A [CAN class](#) is available for the original micropython pyboard, with much of the same functionality as is available with python-can (but with a different API!).

### 2. ASAM MDF Files

- The [asammdf](#) module provides many methods for processing ASAM (Association for Standardization of Automation and Measuring Systems) MDF (Measurement Data Format) files.

---

**Note:** See also the available plugins for python-can in [Plugin Interface](#).

---

## SCRIPTS

The following modules are callable from `python-can`.

They can be called for example by `python -m can.logger` or `can_logger` (if installed using pip).

## 8.1 can.logger

Command line help, called with `--help`:

```
$ python -m can.logger -h
ldf is not supported
xls is not supported
xlsx is not supported
yaml is not supported
usage: logger.py [-h] [-c CHANNEL]
                  [-i {canalystii,cantact,etas,gs_usb,iscan,ixxat,kvaser,neousys,neovi,
↪ nican,nixnet,pcan,robotell,seedstudio,serial,slcan,socketcan,socketcand,systec,udp_
↪ multicast,usb2can,vector,virtual}]
                  [-b BITRATE] [--fd] [--data_bitrate DATA_BITRATE]
                  [-f LOG_FILE] [-a] [-s FILE_SIZE] [-v]
                  [--filter {<can_id>:<can_mask>,<can_id>~<can_mask>} [{<can_id>:<can_
↪ mask>,<can_id>~<can_mask>} ...]]
                  [--active | --passive]
                  ...
```

Log CAN traffic, printing messages to stdout or to a given file.

positional arguments:

<code>extra_args</code>	The remaining arguments will be used for the interface and logger/player initialisation. For example, <code>`-i vector -c 1 --app-name=MyCanApp`</code> is the equivalent to opening the bus with <code>`Bus('vector', channel=1, app_name='MyCanApp')`</code>
-------------------------	--

options:

<code>-h, --help</code>	show this help message and exit
<code>-c CHANNEL, --channel CHANNEL</code>	Most backend interfaces require some sort of channel. For example with the serial interface the channel might be a rfcomm device: <code>"/dev/rfcomm0"</code> . With the

(continues on next page)

(continued from previous page)

```

socketcan interface valid channel examples include:
"can0", "vcan0".
-i {canalystii,cantact,etas,gs_usb,iscan,ixxat,kvaser,neousys,neovi,nican,nixnet,pcan,
↪robotell,seedstudio,serial,slcan,socketcan,socketcand,systec,udp_multicast,usb2can,
↪vector,virtual}, --interface {canalystii,cantact,etas,gs_usb,iscan,ixxat,kvaser,
↪neousys,neovi,nican,nixnet,pcan,robotell,seedstudio,serial,slcan,socketcan,socketcand,
↪systec,udp_multicast,usb2can,vector,virtual}
    Specify the backend CAN interface to use. If left
    blank, fall back to reading from configuration files.
-b BITRATE, --bitrate BITRATE
    Bitrate to use for the CAN bus.
--fd
    Activate CAN-FD support
--data_bitrate DATA_BITRATE
    Bitrate to use for the data phase in case of CAN-FD.
-f LOG_FILE, --file_name LOG_FILE
    Path and base log filename, for supported types see
    can.Logger.
-a, --append
    Append to the log file if it already exists.
-s FILE_SIZE, --file_size FILE_SIZE
    Maximum file size in bytes. Rotate log file when size
    threshold is reached. (The resulting file sizes will
    be consistent, but are not guaranteed to be exactly
    what is specified here due to the rollover conditions
    being logger implementation specific.)
-v
    How much information do you want to see at the command
    line? You can add several of these e.g., -vv is DEBUG
--filter {<can_id>:<can_mask>,<can_id>~<can_mask>} [{<can_id>:<can_mask>,<can_id>~<can_
↪mask>} ...]
    R|Space separated CAN filters for the given CAN
    interface: <can_id>:<can_mask> (matches when
    <received_can_id> & mask == can_id & mask)
    <can_id>~<can_mask> (matches when <received_can_id> &
    mask != can_id & mask) Fx to show only frames with ID
    0x100 to 0x103 and 0x200 to 0x20F: python -m
    can.viewer -f 100:7FC 200:7F0 Note that the ID and
    mask are always interpreted as hex values
--active
    Start the bus as active, this is applied by default.
--passive
    Start the bus as passive.

```

## 8.2 can.player

```

$ python -m can.player -h
ldf is not supported
xls is not supported
xlsx is not supported
yaml is not supported
usage: player.py [-h] [-c CHANNEL]
               [-i {canalystii,cantact,etas,gs_usb,iscan,ixxat,kvaser,neousys,neovi,
↪nican,nixnet,pcan,robotell,seedstudio,serial,slcan,socketcan,socketcand,systec,udp_
↪multicast,usb2can,vector,virtual}]

```

(continues on next page)



(continued from previous page)

```

[-b BITRATE] [--fd] [--data_bitrate DATA_BITRATE]
[-f LOG_FILE] [-v] [--ignore-timestamps] [--error-frames]
[-g GAP] [-s SKIP]
... input-file

```

Replay CAN traffic.

positional arguments:

extra_args	The remaining arguments will be used for the interface and logger/player initialisation. For example, <code>`-i vector -c 1 --app-name=MyCanApp`</code> is the equivalent to opening the bus with <code>`Bus('vector', channel=1, app_name='MyCanApp')`</code>
input-file	The file to replay. For supported types see <code>can.LogReader</code> .

options:

<code>-h, --help</code>	show this help message and exit
<code>-c CHANNEL, --channel CHANNEL</code>	Most backend interfaces require some sort of channel. For example with the serial interface the channel might be a rfcomm device: <code>"/dev/rfcomm0"</code> . With the socketcan interface valid channel examples include: <code>"can0"</code> , <code>"vcan0"</code> .
<code>-i {canalystii,cantact,etas,gs_usb,iscan,ixxat,kvaser,neousys,neovi,nican,nixnet,pcan,robotell,seedstudio,serial,slcan,socketcan,socketcand,systec,udp_multicast,usb2can,vector,virtual}, --interface {canalystii,cantact,etas,gs_usb,iscan,ixxat,kvaser,neousys,neovi,nican,nixnet,pcan,robotell,seedstudio,serial,slcan,socketcan,socketcand,systec,udp_multicast,usb2can,vector,virtual}</code>	Specify the backend CAN interface to use. If left blank, fall back to reading from configuration files.
<code>-b BITRATE, --bitrate BITRATE</code>	Bitrate to use for the CAN bus.
<code>--fd</code>	Activate CAN-FD support
<code>--data_bitrate DATA_BITRATE</code>	Bitrate to use for the data phase in case of CAN-FD.
<code>-f LOG_FILE, --file_name LOG_FILE</code>	Path and base log filename, for supported types see <code>can.LogReader</code> .
<code>-v</code>	Also print can frames to stdout. You can add several of these to enable debugging
<code>--ignore-timestamps</code>	Ignore timestamps (send all frames immediately with minimum gap between frames)
<code>--error-frames</code>	Also send error frames to the interface.
<code>-g GAP, --gap GAP</code>	<s> minimum time between replayed frames
<code>-s SKIP, --skip SKIP</code>	<s> skip gaps greater than 's' seconds

## 8.3 can.viewer

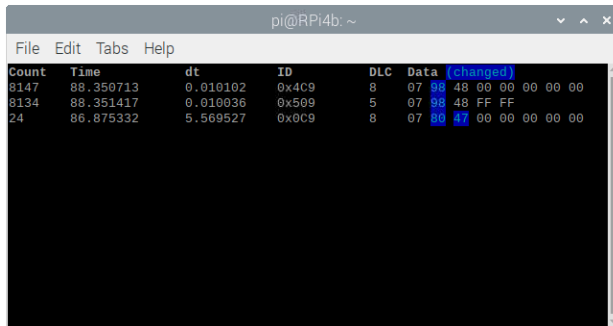
A screenshot of the application can be seen below:

Count	Time	dt	ID	DLC	Data	Parsed values
14	118.884757	39.110070	0x004	8	00 01 00 00 00 00 00 00	
510	123.283816	0.249922	0x080	0		
1177	123.354005	0.117875	0x104	8	02 00 00 00 11 00 70 00	2 0.170000 64.171273
1177	123.352952	0.117906	0x105	8	A4 72 6D 42 11 D3 91 41	59.361954 18.228060
133	123.345939	1.062629	0x106	8	0E BF 57 BC FB 63 2A 3F	-0.013168 0.665588
133	123.346099	1.062508	0x107	8	B7 84 22 C1 1C 75 44 BC	-10.157401 -0.687023
133	123.346326	1.062497	0x108	8	35 E7 31 BD FB 7A F4 3A	-2.488550 0.106870
133	123.346985	1.062441	0x109	8	EC DF B7 BD F2 84 1D 3F	-0.089783 0.615310
133	123.347096	1.062339	0x10A	8	2D 44 1E C1 3D 6F 14 3C	-9.891644 0.5190840
133	123.347336	1.062343	0x10B	8	7C 04 E3 3B BB BF EB BB	0.396947 -0.4122148
133	123.347931	1.062645	0x10C	8	EF D5 62 3B 92 5F 16 BB	0.198314 -0.1314669
133	123.348112	1.062670	0x10D	8	60 B2 F8 BB 82 46 4E 3A	-0.434853 0.0450850
133	123.348338	1.062648	0x10E	8	B4 01 71 BB C0 5F 51 BA	-0.210703 -0.045762
133	123.352078	1.062858	0x10F	8	27 16 09 42 49 09 03 42	34.271633 32.759068
1177	123.354920	0.117775	0x110	8	1D DD 96 BB DA CC 1C BB	-0.263790 -0.137085
1177	123.358016	0.117962	0x119	8	00 00 00 00 D8 58 A8 41	0.000000 21.043381
1177	123.355925	0.117854	0x11F	8	B8 13 02 BC 91 B4 BF BB	-0.454887 -0.335202
133	123.349015	1.062675	0x121	8	6F 7E E1 3B 38 51 28 BD	0.394282 -2.3544608
133	123.349107	1.062563	0x122	8	1B E6 A0 BB 83 B9 43 BC	
133	123.349331	1.062556	0x123	8	7C 51 B3 3B 11 7F 55 3B	
133	123.349958	1.062847	0x124	8	E0 1B 47 BE 5E 14 47 3E	
133	123.350154	1.062819	0x125	8	E1 A3 1C C1 AB 75 8A BE	
133	123.350350	1.062782	0x126	8	F7 43 15 3E 8D 68 18 C1	
133	123.340031	1.062874	0x140	8	5E 95 1E 96 EF 95 60 00	3.823800 3.843000 3.838300 96
133	123.340937	1.062782	0x141	6	01 01 08 05 65 0E	1 1 8 5 368.500000
133	123.341941	1.062762	0x142	8	12 04 01 1A 01 07 60 00	18 4 1 26 1 7 96
133	123.342946	1.062771	0x143	8	00 00 00 00 8A 22 25 04	0.000000 88.420000 106.100000
133	123.343936	1.062737	0x144	8	01 C0 0F 46 00 00 00 0F	1 403.200000 7.000000 0 0 15
133	123.344893	1.062669	0x145	5	00 00 00 00 00	0.000000 0.000000 0
510	123.294528	0.259875	0x181	8	00 00 00 00 00 00 00 00	0 0.000000 0
510	123.284057	0.249957	0x201	8	00 00 00 00 00 00 00 00	
65	122.035098	2.499398	0x281	7	0B 00 0F 00 1E 00 01	11 15 30 100.000000
510	123.284230	0.249805	0x301	6	00 00 00 00 00 00	
65	122.035354	2.499410	0x381	8	50 04 00 00 CD 16 00 00	
1252	123.434077	0.100077	0x701	1	05	
1251	123.410814	0.099982	0x702	1	05	
1241	123.388151	0.100562	0x715	1	05	
2486	123.433095	0.049963	0x77E	1	05	
2486	123.432953	0.049914	0x77F	1	05	
1251	123.392075	0.099990	0x0000007B	4	00 00 00 00	
1251	123.391466	0.099862	0x00000097B	8	00 00 00 00 00 00 00 00	0.000000 0.000000 0.000000
1251	123.391718	0.099909	0x000000E7B	8	0D FD 00 00 0A B8 DA E5	35.810000 0.000000 27.440000 -94.9900000

The first column is the number of times a frame with the particular ID that has been received, next is the timestamp of the frame relative to the first received message. The third column is the time between the current frame relative to the previous one. Next is the length of the frame, the data and then the decoded data converted according to the `-d` argument. The top red row indicates an error frame. There are several keyboard shortcuts that can be used with the viewer script, they function as follows:

- ESCAPE - Quit the viewer script
- q - as ESCAPE

- c - Clear the stored frames
- s - Sort the stored frames
- h - Toggle highlighting of changed bytes in the data field - see the below image
- SPACE - Pause the viewer
- UP/DOWN - Scroll the viewer



A byte in the data field is highlighted blue if the value is different from the last time the message was received.

### 8.3.1 Command line arguments

By default the `can.viewer` uses the *SocketCAN* interface. All interfaces are supported and can be specified using the `-i` argument or configured following *Configuration*.

The full usage page can be seen below:

```
$ python -m can.viewer -h
ldf is not supported
xls is not supported
xlsx is not supported
yaml is not supported
Usage: python -m can.viewer [-c CHANNEL]
                             [-i {canalystii,cantact,etas,gs_usb,iscan,ixxat,kvaser,
↪neousys,neovi,nican,nixnet,pcan,robotell,seedstudio,serial,slcan,socketcan,socketcand,
↪systemec,udp_multicast,usb2can,vector,virtual}]
                             [-b BITRATE] [--fd] [--data_bitrate DATA_BITRATE]
                             [-h] [--version]
                             [-d ('{<id>:<format>,<id>:<format>:<scaling1>:...:<scalingN>,
↪file.txt}',)]
                             [-f ('{<can_id>:<can_mask>,<can_id>~<can_mask>}',)]
                             [-v]
                             ('extra_args',)
```

A simple CAN viewer terminal application written in Python

positional arguments:

extra\_args

The remaining arguments will be used for the interface and logger/player initialisation. For example, ``-i vector -c 1 --app-name=MyCanApp`` is the equivalent to opening the bus with ``Bus('vector', channel=1, app_name='MyCanApp')``

(continues on next page)

(continued from previous page)

## options:

```
-c, --channel CHANNEL
```

Most backend interfaces require some sort of channel.  
For example with the serial interface the channel  
might be a rfcomm device: `"/dev/rfcomm0"`. With the  
socketcan interface valid channel examples include:  
`"can0"`, `"vcan0"`.

```
-i, --interface {canalystii,cantact,etas,gs_usb,iscan,ixxat,kvaser,neousys,neovi,nican,  
↪ nixnet,pcan,robotell,seeedstudio,serial,slcan,socketcan,socketcand,systec,udp_  
↪ multicast,usb2can,vector,virtual}
```

Specify the backend CAN interface to use. If left  
blank, fall back to reading from configuration files.

```
-b, --bitrate BITRATE
```

Bitrate to use for the CAN bus.

```
--fd
```

Activate CAN-FD support

```
--data_bitrate DATA_BITRATE
```

Bitrate to use for the data phase in case of CAN-FD.

## Optional arguments:

```
-h, --help
```

Show this help message and exit

```
--version
```

Show program's version number and exit

```
-d, --decode ('{<id>:<format>,<id>:<format>:<scaling1>:...:<scalingN>,file.txt}',)
```

Specify how to convert the raw bytes into real values.  
The ID of the frame is given as the first argument and the  
↪ format as the second.

The Python struct package is used to unpack the received data  
where the format characters have the following meaning:

```
< = little-endian, > = big-endian
x = pad byte
c = char
? = bool
b = int8_t, B = uint8_t
h = int16, H = uint16
l = int32_t, L = uint32_t
q = int64_t, Q = uint64_t
f = float (32-bits), d = double (64-bits)
```

↪ Fx to convert six bytes with ID `0x100` into `uint8_t`, `uint16` and  
↪ `uint32_t`:

```
$ python -m can.viewer -d "100:<BHL"
```

Note that the IDs are always interpreted as hex values.  
An optional conversion from integers to real units can be given  
as additional arguments. In order to convert from raw integer  
values the values are divided with the corresponding scaling  
↪ value,

similarly the values are multiplied by the scaling value in order  
to convert from real units to raw integer values.  
↪ Fx lets say the `uint8_t` needs no conversion, but the `uint16` and  
↪ the `uint32_t`

needs to be divided by 10 and 100 respectively:

```
$ python -m can.viewer -d "101:<BHL:1:10.0:100.0"
```

Be aware that integer division is performed if the scaling value  
↪ is an integer.

(continues on next page)

(continued from previous page)

```

Multiple arguments are separated by spaces:
$ python -m can.viewer -d "100:<BHL" "101:<BHL:1:10.0:100.0"
Alternatively a file containing the conversion strings separated
↳ by new lines
can be given as input:
$ cat file.txt
100:<BHL
101:<BHL:1:10.0:100.0
$ python -m can.viewer -d file.txt
-f, --filter ('{<can_id>:<can_mask>,<can_id>~<can_mask>}',)
Space separated CAN filters for the given CAN interface:
<can_id>:<can_mask> (matches when <received_can_id> & mask
↳ == can_id & mask)
<can_id>~<can_mask> (matches when <received_can_id> & mask
↳ != can_id & mask)
Fx to show only frames with ID 0x100 to 0x103 and 0x200 to 0x20F:
python -m can.viewer -f 100:7FC 200:7F0
Note that the ID and mask are always interpreted as hex values
How much information do you want to see at the command
-v
line? You can add several of these e.g., -vv is DEBUG

```

## Shortcuts:

Key	Description
ESQ/q	Exit the viewer
c	Clear the stored frames
s	Sort the stored frames
h	Toggle highlight byte changes
SPACE	Pause the viewer
UP/DOWN	Scroll the viewer

## 8.4 can.logconvert

```

$ python -m can.logconvert -h
ldf is not supported
xls is not supported
xlsx is not supported
yaml is not supported
usage: logconvert.py [-h] [-s FILE_SIZE] INFILE OUTFILE

```

Convert a log file from one format to another.

positional arguments:

INFILE	Input filename. The type is dependent on the suffix, see can.LogReader.
OUTFILE	Output filename. The type is dependent on the suffix, see can.Logger.

(continues on next page)

(continued from previous page)

```
options:
  -h, --help            show this help message and exit
  -s FILE_SIZE, --file_size FILE_SIZE
                        Maximum file size in bytes. Rotate log file when size
                        threshold is reached.
```

## DEVELOPER'S OVERVIEW

### 9.1 Contributing

Contribute to source code, documentation, examples and report issues: <https://github.com/hardbyte/python-can>

Note that the latest released version on PyPi may be significantly behind the `main` branch. Please open any feature requests against the `main` branch

There is also a [python-can](#) mailing list for development discussion.

Some more information about the internals of this library can be found in the chapter *Internal API*. There is also additional information on extending the `can.io` module.

### 9.2 Pre-releases

The latest pre-release can be installed with:

```
pip install --upgrade --pre python-can
```

### 9.3 Building & Installing

The following assumes that the commands are executed from the root of the repository:

The project can be built with:

```
pipx run build
pipx run twine check dist/*
```

The project can be installed in editable mode with:

```
pip install -e .
```

The unit tests can be run with:

```
pipx run tox -e py
```

The documentation can be built with:

```
pip install -r doc/doc-requirements.txt
python -m sphinx -an doc build
```

The linters can be run with:

```
pip install -e .[lint]
black --check can
mypy can
ruff check can
pylint can/**/*.py can/io doc/conf.py examples/**/*.py can/interfaces/socketcan
```

## 9.4 Creating a new interface/backend

These steps are a guideline on how to add a new backend to python-can.

- Create a module (either a `*.py` or an entire subdirectory depending on the complexity) inside `can.interfaces`
- Implement the central part of the backend: the bus class that extends `can.BusABC`. See *Extending the BusABC class* for more info on this one!
- Register your backend bus class in `BACKENDS` in the file `can.interfaces.__init__.py`.
- Add docs where appropriate. At a minimum add to `doc/interfaces.rst` and add a new interface specific document in `doc/interface/*`. It should document the supported platforms and also the hardware/software it requires. A small snippet of how to install the dependencies would also be useful to get people started without much friction.
- Also, don't forget to document your classes, methods and function with docstrings.
- Add tests in `test/*` where appropriate. To get started, have a look at `back2back_test.py`: Simply add a test case like `BasicTestSocketCan` and some basic tests will be executed for the new interface.

**Attention:** We strongly recommend using the *Plugin Interface* to extend python-can. Publish a python package that contains your `can.BusABC` subclass and use it within the python-can API. We will mention your package inside this documentation and add it as an optional dependency.

## 9.5 Code Structure

The modules in python-can are:

Module	Description
<i>interfaces</i>	Contains interface dependent code.
<i>bus</i>	Contains the interface independent Bus object.
<i>message</i>	Contains the interface independent Message object.
<i>io</i>	Contains a range of file readers and writers.
<i>broadcastmanager</i>	Contains interface independent broadcast manager code.



## 9.6 Creating a new Release

- Release from the `main` branch (except for pre-releases).
- Update the library version in `__init__.py` using [semantic versioning](#).
- Check if any deprecations are pending.
- Run all tests and examples against available hardware.
- Update `CONTRIBUTORS.txt` with any new contributors.
- For larger changes update `doc/history.rst`.
- Sanity check that documentation has stayed inline with code.
- Create a temporary virtual environment. Run `python setup.py install` and `tox`.
- Create and upload the distribution: `python setup.py sdist bdist_wheel`.
- Sign the packages with `gpg gpg --detach-sign -a dist/python-can-X.Y.Z-py3-none-any.whl`.
- Upload with twine `twine upload dist/python-can-X.Y.Z*`.
- In a new virtual env check that the package can be installed with pip: `pip install python-can==X.Y.Z`.
- Create a new tag in the repository.
- Check the release on [PyPi](#), [Read the Docs](#) and [GitHub](#).



## HISTORY

### 10.1 Background

Originally written at [Dynamic Controls](#) for internal use testing and prototyping wheelchair components.

Maintenance was taken over and the project was open sourced by Brian Thorne in 2010.

### 10.2 Acknowledgements

Originally written by Ben Powell as a thin wrapper around the Kvaser SDK to support the leaf device.

Support for linux socketcan was added by Rose Lu as a summer coding project in 2011. The socketcan interface was helped immensely by Phil Dixon who wrote a leaf-socketcan driver for Linux.

The pcan interface was contributed by Albert Bloomfield in 2013. Support for pcan on Mac was added by Kristian Sloth Lauszus in 2018.

The usb2can interface was contributed by Joshua Villyard in 2015.

The IXXAT VCI interface was contributed by Giuseppe Corbelli and funded by [Weightpack](#) in 2016.

The NI-CAN and virtual interfaces plus the ASCII and BLF loggers were contributed by Christian Sandberg in 2016 and 2017. The BLF format is based on a C++ library by Toby Lorenz.

The scan interface, ASCII listener and log logger and listener were contributed by Eduard Bröcker in 2017.

The NeoVi interface for ICS (Intrepid Control Systems) devices was contributed by Pierre-Luc Tessier Gagné in 2017.

Many improvements all over the library, cleanups, unifications as well as more comprehensive documentation and CI testing was contributed by Felix Divo in 2017 and 2018.

The CAN viewer terminal script was contributed by Kristian Sloth Lauszus in 2018.

The CANalyst-II interface was contributed by Shaoyu Meng in 2018.

@deonvdw added support for the Robotell interface in 2019.

Felix Divo and Karl Ding added type hints for the core library and many interfaces leading up to the 4.0 release.

Eric Evenchick added support for the CANTact devices in 2020.

Felix Divo added an interprocess virtual bus interface in 2020.

@jxltom added the gs\_usb interface in 2020 supporting Geschwister Schneider USB/CAN devices and bytewerk.org candleLight USB CAN devices such as candlelight, canable, cantact, etc.

@jaesc added the nixnet interface in 2021 supporting NI-XNET devices from National Instruments.

Tuukka Pasanen @illuusio added the neosys interface in 2021.

Francisco Javier Burgos Maciá @fjburgos added ixat FD support.

@domologic contributed a socketcand interface in 2021.

Felix N @felixn contributed the ETAS interface in 2021.

Felix Divo unified exception handling across every interface in the lead up to the 4.0 release.

Felix Divo prepared the python-can 4.0 release.

## 10.3 Support for CAN within Python

Python natively supports the CAN protocol from version 3.3 on, if running on Linux (with a sufficiently new kernel):

Python version	Feature	Link
3.3	Initial SocketCAN support	<a href="#">Docs</a>
3.4	Broadcast Management (BCM) commands are natively supported	<a href="#">Docs</a>
3.5	CAN FD support	<a href="#">Docs</a>
3.7	Support for CAN ISO-TP	<a href="#">Docs</a>
3.9	Native support for joining CAN filters	<a href="#">Docs</a>

## KNOWN BUGS

See the project [bug tracker](#) on github. Patches and pull requests very welcome!

---

**Documentation generated**

Apr 29, 2024

---



## PYTHON MODULE INDEX

### C

- `can`, [16](#)
- `can.broadcastmanager`, [42](#)
- `can.exceptions`, [47](#)
- `can.io.generic`, [63](#)
- `can.util`, [65](#)





## Symbols

\_\_init\_\_() (*can.BusABC* method), 60  
 \_\_iter\_\_() (*can.BusABC* method), 61  
 \_\_str\_\_() (*can.BusABC* method), 61  
 \_\_str\_\_() (*can.Message* method), 20  
 \_\_weakref\_\_ (*can.BusABC* attribute), 61  
 \_apply\_filters() (*can.BusABC* method), 62  
 \_detect\_available\_configs() (*can.BusABC* static method), 62  
 \_detect\_available\_configs() (*can.interfaces.virtual.VirtualBus* static method), 137  
 \_recv\_internal() (*can.BusABC* method), 61  
 \_recv\_internal() (*can.interfaces.serial.serial\_can.SerialBus* method), 98  
 \_send\_periodic\_internal() (*can.BusABC* method), 62

## A

ACTIVE (*can.BusState* attribute), 15  
 add\_bus() (*can.Notifier* method), 21  
 add\_listener() (*can.Notifier* method), 21  
 application\_id (*can.BLFWriter* attribute), 34  
 arbitration\_id (*can.Message* attribute), 17  
 ASCReader (class in *can*), 32  
 ASCWriter (class in *can*), 31  
 AsyncBufferedReader (class in *can*), 24

## B

BaseIOHandler (class in *can.io.generic*), 63  
 BaseRotatingLogger (class in *can.io*), 37  
 BinaryIOMessageReader (class in *can.io.generic*), 65  
 BinaryIOMessageWriter (class in *can.io.generic*), 64  
 bitrate (*can.BitTiming* property), 54  
 bitrate\_switch (*can.Message* attribute), 19  
 BitTiming (class in *can*), 51  
 BitTimingFd (class in *can*), 55  
 BLFReader (class in *can*), 34  
 BLFWriter (class in *can*), 33  
 blocking\_receive() (*can.interfaces.usb2can.Usb2CanAbstractionLayer* method), 120

blocking\_send() (*can.interfaces.usb2can.Usb2CanAbstractionLayer* method), 120  
 brp (*can.BitTiming* property), 54  
 btr0 (*can.BitTiming* property), 54  
 btr1 (*can.BitTiming* property), 54  
 BufferedReader (class in *can*), 24  
 Bus() (in module *can*), 12  
 bus\_load (*can.interfaces.kvaser.structures.BusStatistics* property), 86  
 BusABC (class in *can*), 13  
 BusState (class in *can*), 15  
 BusStatistics (class in *can.interfaces.kvaser.structures*), 86

## C

can  
     module, 16  
 can.broadcastmanager  
     module, 42  
 can.exceptions  
     module, 47  
 can.io.generic  
     module, 63  
 can.util  
     module, 65  
 CAN\_20 (*can.bus.CanProtocol* attribute), 16  
 CAN\_FD (*can.bus.CanProtocol* attribute), 16  
 CAN\_XL (*can.bus.CanProtocol* attribute), 16  
 CanalError, 120  
 CANalystIIBus (class in *can.interfaces.canalystii*), 72  
 CanError, 47  
 CanInitializationError, 48  
 CanInterfaceNotImplementedError, 48  
 CanOperationError, 48  
 CanProtocol (class in *can.bus*), 15  
 CantactBus (class in *can.interfaces.cantact*), 72  
 CanTimeoutError, 49  
 CanutilsLogReader (class in *can*), 33  
 CanutilsLogWriter (class in *can*), 32  
 cast\_from\_string() (in module *can.util*), 65  
 channel (*can.Message* attribute), 18  
 channel2int() (in module *can.util*), 65

- [channel\\_info](#) (*can.BusABC* attribute), 13  
[channel\\_info](#) (*can.interfaces.socketcan.SocketcanBus* attribute), 109  
[check\\_or\\_adjust\\_timing\\_clock\(\)](#) (in module *can.util*), 65  
[close\(\)](#) (*can.interfaces.usb2can.Usb2CanAbstractionLayer* method), 120  
[create\\_filter\(\)](#) (*can.interfaces.sysrec.ucanbus.UcanBus* static method), 116  
[CSVReader](#) (class in *can*), 29  
[CSVWriter](#) (class in *can*), 28  
[CyclicSendTask](#) (class in *can.interfaces.ixxat.canlib\_vcinpl*), 81  
[CyclicSendTask](#) (class in *can.interfaces.ixxat.canlib\_vcinpl2*), 83  
[CyclicSendTask](#) (class in *can.interfaces.socketcan*), 107  
[CyclicSendTaskABC](#) (class in *can.broadcastmanager*), 45  
[CyclicTask](#) (class in *can.broadcastmanager*), 45
- ## D
- [data](#) (*can.Message* attribute), 18  
[data\\_bitrate](#) (*can.BitTimingFd* property), 58  
[data\\_brp](#) (*can.BitTimingFd* property), 58  
[data\\_sample\\_point](#) (*can.BitTimingFd* property), 58  
[data\\_sjw](#) (*can.BitTimingFd* property), 58  
[data\\_tq](#) (*can.BitTimingFd* property), 58  
[data\\_tseg1](#) (*can.BitTimingFd* property), 58  
[data\\_tseg2](#) (*can.BitTimingFd* property), 58  
[dbt](#) (*can.BitTimingFd* property), 58  
[DEFAULT\\_GROUP\\_IPv4](#) (*can.interfaces.udp\_multicast.UdpMulticastBus* attribute), 140  
[DEFAULT\\_GROUP\\_IPv6](#) (*can.interfaces.udp\_multicast.UdpMulticastBus* attribute), 140  
[deprecated\\_args\\_alias\(\)](#) (in module *can.util*), 66  
[detect\\_available\\_configs\(\)](#) (in module *can*), 59  
[detect\\_beacon\(\)](#) (in module *can.interfaces.socketcand*), 113  
[dlc](#) (*can.Message* attribute), 18  
[dlc2len\(\)](#) (in module *can.util*), 66  
[do\\_rollover\(\)](#) (*can.io.BaseRotatingLogger* method), 37  
[do\\_rollover\(\)](#) (*can.SizedRotatingLogger* method), 39
- ## E
- [equals\(\)](#) (*can.Message* method), 20  
[err\\_frame](#) (*can.interfaces.kvaser.structures.BusStatistics* property), 86  
[ERROR](#) (*can.BusState* attribute), 15  
[error\\_check\(\)](#) (in module *can.exceptions*), 49  
[error\\_state\\_indicator](#) (*can.Message* attribute), 19  
[EtasBus](#) (class in *can.interfaces.etas*), 74  
[exception](#) (*can.Notifier* attribute), 21  
[ext\\_data](#) (*can.interfaces.kvaser.structures.BusStatistics* property), 86  
[ext\\_remote](#) (*can.interfaces.kvaser.structures.BusStatistics* property), 86
- ## F
- [f\\_clock](#) (*can.BitTiming* property), 54  
[f\\_clock](#) (*can.BitTimingFd* property), 57  
[file\\_size\(\)](#) (*can.BLFWriter* method), 34  
[file\\_size\(\)](#) (*can.io.generic.FileIOMessageWriter* method), 64  
[file\\_size\(\)](#) (*can.MF4Writer* method), 35  
[file\\_size\(\)](#) (*can.Printer* method), 28  
[FileIOMessageWriter](#) (class in *can.io.generic*), 64  
[fileno\(\)](#) (*can.interfaces.udp\_multicast.UdpMulticastBus* method), 140  
[filters](#) (*can.BusABC* property), 13  
[filters](#) (*can.interfaces.socketcan.SocketcanBus* property), 109  
[flash\(\)](#) (*can.interfaces.kvaser.canlib.KvaserBus* method), 85  
[flash\(\)](#) (*can.interfaces.pcan.PcanBus* method), 93  
[flush\\_tx\\_buffer\(\)](#) (*can.BusABC* method), 13  
[flush\\_tx\\_buffer\(\)](#) (*can.interfaces.etas.EtasBus* method), 74  
[flush\\_tx\\_buffer\(\)](#) (*can.interfaces.ixxat.canlib\_vcinpl.IXXATBus* method), 81  
[flush\\_tx\\_buffer\(\)](#) (*can.interfaces.ixxat.canlib\_vcinpl2.IXXATBus* method), 82  
[flush\\_tx\\_buffer\(\)](#) (*can.interfaces.ixxat.IXXATBus* method), 79  
[flush\\_tx\\_buffer\(\)](#) (*can.interfaces.kvaser.canlib.KvaserBus* method), 85  
[flush\\_tx\\_buffer\(\)](#) (*can.interfaces.socketcan.SocketcanBus* method), 109  
[flush\\_tx\\_buffer\(\)](#) (*can.interfaces.sysrec.ucanbus.UcanBus* method), 116  
[flush\\_tx\\_buffer\(\)](#) (*can.interfaces.vector.VectorBus* method), 123  
[from\\_bitrate\\_and\\_segments\(\)](#) (*can.BitTiming* class method), 52  
[from\\_bitrate\\_and\\_segments\(\)](#) (*can.BitTimingFd* class method), 56  
[from\\_registers\(\)](#) (*can.BitTiming* class method), 53  
[from\\_sample\\_point\(\)](#) (*can.BitTiming* class method), 53  
[from\\_sample\\_point\(\)](#) (*can.BitTimingFd* class method), 57
- ## G
- [get\\_application\\_config\(\)](#) (*can.interfaces.vector.VectorBus* static method), 123

`get_channel_configs()` (in module `can.interfaces.vector`), 126  
`get_device_number()` (`can.interfaces.pcan.PcanBus` method), 93  
`get_library_version()` (`can.interfaces.usb2can.Usb2CanAbstractionLayer` method), 120  
`get_message()` (`can.AsyncBufferedReader` method), 24  
`get_message()` (`can.BufferedReader` method), 24  
`GET_MESSAGE_TIMEOUT` (`can.SqliteWriter` attribute), 30  
`get_serial_number()` (`can.interfaces.robotell.robotellBus` method), 95  
`get_serial_number()` (`can.interfaces.slcan.slcanBus` method), 101  
`get_statistics()` (`can.interfaces.usb2can.Usb2CanAbstractionLayer` method), 120  
`get_stats()` (`can.interfaces.kvaser.canlib.KvaserBus` method), 86  
`get_status()` (`can.interfaces.usb2can.Usb2CanAbstractionLayer` method), 120  
`get_vendor_string()` (`can.interfaces.usb2can.Usb2CanAbstractionLayer` method), 120  
`get_version()` (`can.interfaces.slcan.slcanBus` method), 101  
`get_version()` (`can.interfaces.usb2can.Usb2CanAbstractionLayer` method), 120  
`GsUsbBus` (class in `can.interfaces.gs_usb`), 76

**I**

`ICSApiError`, 88  
`ICSInitializationError`, 88  
`ICSOperationError`, 89  
`is_error_frame` (`can.Message` attribute), 19  
`is_extended_id` (`can.Message` attribute), 18  
`is_fd` (`can.Message` attribute), 19  
`is_remote_frame` (`can.Message` attribute), 19  
`is_rx` (`can.Message` attribute), 19  
`IscanBus` (class in `can.interfaces.iscan`), 77  
`IscanError`, 77  
`iterate_from_sample_point()` (`can.BitTiming` class method), 53  
`iterate_from_sample_point()` (`can.BitTimingFd` class method), 57  
`IXXATBus` (class in `can.interfaces.ixxat`), 79  
`IXXATBus` (class in `can.interfaces.ixxat.canlib_vcinpl`), 80  
`IXXATBus` (class in `can.interfaces.ixxat.canlib_vcinpl2`), 82

**K**

`KvaserBus` (class in `can.interfaces.kvaser.canlib`), 84

**L**

`len2dlc()` (in module `can.util`), 66  
`LimitedDurationCyclicSendTaskABC` (class in `can.broadcastmanager`), 45  
`Listener` (class in `can`), 22  
`load_config()` (in module `can.util`), 67  
`load_environment_config()` (in module `can.util`), 67  
`load_file_config()` (in module `can.util`), 68  
`log_event()` (`can.ASCWriter` method), 31  
`log_event()` (`can.BLFWriter` method), 34  
`Logger()` (in module `can`), 26  
`LogReader()` (in module `can`), 26

**M**

`MAX_BUFFER_SIZE_BEFORE_WRITES` (`can.SqliteWriter` attribute), 30  
`max_container_size` (`can.BLFWriter` attribute), 34  
`MAX_TIME_BETWEEN_WRITES` (`can.SqliteWriter` attribute), 30  
`Message` (class in `can`), 16  
`MESSAGE_READERS` (in module `can.io.player`), 27  
`MESSAGE_WRITERS` (in module `can.io.logger`), 27  
`MessageReader` (class in `can.io.generic`), 64  
`MessageSync` (class in `can`), 40  
`MessageWriter` (class in `can.io.generic`), 63  
`MF4Reader` (class in `can`), 35  
`MF4Writer` (class in `can`), 35  
`ModifiableCyclicTaskABC` (class in `can`), 45  
`modify_data()` (`can.interfaces.socketcan.CyclicSendTask` method), 107  
`modify_data()` (`can.ModifiableCyclicTaskABC` method), 46  
module  
   `can`, 16  
   `can.broadcastmanager`, 42  
   `can.exceptions`, 47  
   `can.io.generic`, 63  
   `can.util`, 65  
`MultiRateCyclicSendTaskABC` (class in `can.broadcastmanager`), 45

**N**

`namer` (`can.io.BaseRotatingLogger` attribute), 37  
`nbt` (`can.BitTiming` property), 54  
`nbt` (`can.BitTimingFd` property), 58  
`NeousysBus` (class in `can.interfaces.neousys`), 86  
`NeoViBus` (class in `can.interfaces.ics_neovi`), 88  
`NicanBus` (class in `can.interfaces.nican`), 89  
`NicanError`, 90  
`NicanInitializationError`, 90  
`NiXNETcanBus` (class in `can.interfaces.nixnet`), 90  
`nof_samples` (`can.BitTiming` property), 54  
`nom_bitrate` (`can.BitTimingFd` property), 58

nom\_brp (*can.BitTimingFd* property), 58  
 nom\_sample\_point (*can.BitTimingFd* property), 58  
 nom\_sjw (*can.BitTimingFd* property), 58  
 nom\_tq (*can.BitTimingFd* property), 58  
 nom\_tseg1 (*can.BitTimingFd* property), 58  
 nom\_tseg2 (*can.BitTimingFd* property), 58  
 Notifier (class in *can*), 21

## O

on\_error() (*can.Listener* method), 23  
 on\_message\_received() (*can.ASCWriter* method), 32  
 on\_message\_received() (*can.AsyncBufferedReader* method), 25  
 on\_message\_received() (*can.BLFWriter* method), 34  
 on\_message\_received() (*can.BufferedReader* method), 24  
 on\_message\_received() (*can.CanutilsLogWriter* method), 33  
 on\_message\_received() (*can.CSVWriter* method), 28  
 on\_message\_received() (*can.io.BaseRotatingLogger* method), 37  
 on\_message\_received() (*can.Listener* method), 23  
 on\_message\_received() (*can.MF4Writer* method), 35  
 on\_message\_received() (*can.Printer* method), 28  
 on\_message\_received() (*can.RedirectReader* method), 25  
 on\_message\_received() (*can.TRCWriter* method), 36  
 open() (*can.interfaces.usb2can.Usb2CanAbstractionLayer* method), 120  
 oscillator\_tolerance() (*can.BitTiming* method), 54  
 oscillator\_tolerance() (*can.BitTimingFd* method), 58  
 overruns (*can.interfaces.kvaser.structures.BusStatistics* property), 86

## P

PASSIVE (*can.BusState* attribute), 15  
 pause() (*can.interfaces.ixxat.canlib\_vcinpl.CyclicSendTask* method), 81  
 pause() (*can.interfaces.ixxat.canlib\_vcinpl2.CyclicSendTask* method), 83  
 PcanBus (class in *can.interfaces.pcan*), 92  
 popup\_vector\_hw\_configuration() (*can.interfaces.vector.VectorBus* static method), 123  
 Printer (class in *can*), 27  
 protocol (*can.BusABC* property), 13  
 protocol (*can.interfaces.socketcan.SocketcanBus* property), 109

## R

read\_all() (*can.SQLiteReader* method), 31  
 receive() (*can.interfaces.usb2can.Usb2CanAbstractionLayer* method), 121

recreate\_with\_f\_clock() (*can.BitTiming* method), 54  
 recreate\_with\_f\_clock() (*can.BitTimingFd* method), 59  
 recv() (*can.BusABC* method), 13  
 recv() (*can.interfaces.socketcan.SocketcanBus* method), 109  
 recv() (*can.interfaces.vector.VectorBus* method), 124  
 RECV\_LOGGING\_LEVEL (*can.BusABC* attribute), 13  
 RECV\_LOGGING\_LEVEL (*can.interfaces.socketcan.SocketcanBus* attribute), 109  
 RedirectReader (class in *can*), 25  
 remove\_listener() (*can.Notifier* method), 21  
 reset() (*can.interfaces.nixnet.NiXNETcanBus* method), 91  
 reset() (*can.interfaces.pcan.PcanBus* method), 93  
 RestartableCyclicTaskABC (class in *can*), 46  
 robotellBus (class in *can.interfaces.robotell*), 95  
 rollover\_count (*can.io.BaseRotatingLogger* attribute), 37  
 rotate() (*can.io.BaseRotatingLogger* method), 37  
 rotation\_filename() (*can.io.BaseRotatingLogger* method), 38  
 rotator (*can.io.BaseRotatingLogger* attribute), 38

## S

sample\_point (*can.BitTiming* property), 54  
 send() (*can.BusABC* method), 13  
 send() (*can.interfaces.cantact.CantactBus* method), 73  
 send() (*can.interfaces.etas.EtasBus* method), 74  
 send() (*can.interfaces.gs\_usb.GsUsbBus* method), 76  
 send() (*can.interfaces.ixxat.canlib\_vcinpl.IXXATBus* method), 81  
 send() (*can.interfaces.ixxat.canlib\_vcinpl2.IXXATBus* method), 82  
 send() (*can.interfaces.ixxat.IXXATBus* method), 79  
 send() (*can.interfaces.kvaser.canlib.KvaserBus* method), 85  
 send() (*can.interfaces.neousys.NeousysBus* method), 87  
 send() (*can.interfaces.nixnet.NiXNETcanBus* method), 91  
 send() (*can.interfaces.pcan.PcanBus* method), 93  
 send() (*can.interfaces.robotell.robotellBus* method), 95  
 send() (*can.interfaces.slcan.slcanBus* method), 101  
 send() (*can.interfaces.socketcan.SocketcanBus* method), 109  
 send() (*can.interfaces.socketcand.SocketCanDaemonBus* method), 113  
 send() (*can.interfaces.systec.ucanbus.UcanBus* method), 116  
 send() (*can.interfaces.usb2can.Usb2CanAbstractionLayer* method), 121  
 send() (*can.interfaces.vector.VectorBus* method), 122  
 send() (*can.interfaces.virtual.VirtualBus* method), 137



- [send\\_periodic\(\)](#) (*can.BusABC* method), 14  
[send\\_periodic\(\)](#) (*can.interfaces.socketcan.SocketcanBus* method), 110  
[send\\_periodic\(\)](#) (*can.interfaces.vector.VectorBus* method), 125  
[SerialBus](#) (class in *can.interfaces.serial.serial\_can*), 98  
[set\\_application\\_config\(\)](#) (*can.interfaces.vector.VectorBus* static method), 123  
[set\\_auto\\_bus\\_management\(\)](#) (*can.interfaces.robotell.robotellBus* method), 95  
[set\\_auto\\_retransmit\(\)](#) (*can.interfaces.robotell.robotellBus* method), 95  
[set\\_bitrate\(\)](#) (*can.interfaces.robotell.robotellBus* method), 95  
[set\\_bitrate\(\)](#) (*can.interfaces.slcan.slcanBus* method), 102  
[set\\_bitrate\\_reg\(\)](#) (*can.interfaces.slcan.slcanBus* method), 102  
[set\\_device\\_number\(\)](#) (*can.interfaces.pcan.PcanBus* method), 93  
[set\\_filters\(\)](#) (*can.BusABC* method), 15  
[set\\_filters\(\)](#) (*can.interfaces.socketcan.SocketcanBus* method), 110  
[set\\_filters\(\)](#) (*can.interfaces.vector.VectorBus* method), 124  
[set\\_hw\\_filter\(\)](#) (*can.interfaces.robotell.robotellBus* method), 96  
[set\\_logging\\_level\(\)](#) (in module *can.util*), 68  
[set\\_serial\\_rate\(\)](#) (*can.interfaces.robotell.robotellBus* method), 96  
[should\\_rollover\(\)](#) (*can.io.BaseRotatingLogger* method), 38  
[should\\_rollover\(\)](#) (*can.SizedRotatingLogger* method), 39  
[shutdown\(\)](#) (*can.BusABC* method), 15  
[shutdown\(\)](#) (*can.interfaces.cantact.CantactBus* method), 73  
[shutdown\(\)](#) (*can.interfaces.etas.EtasBus* method), 74  
[shutdown\(\)](#) (*can.interfaces.gs\_usb.GsUsbBus* method), 76  
[shutdown\(\)](#) (*can.interfaces.ixxat.canlib\_vcinpl.IXXATBus* method), 81  
[shutdown\(\)](#) (*can.interfaces.ixxat.canlib\_vcinpl2.IXXATBus* method), 83  
[shutdown\(\)](#) (*can.interfaces.ixxat.IXXATBus* method), 80  
[shutdown\(\)](#) (*can.interfaces.kvaser.canlib.KvaserBus* method), 85  
[shutdown\(\)](#) (*can.interfaces.neousys.NeousysBus* method), 87  
[shutdown\(\)](#) (*can.interfaces.nixnet.NiXNETcanBus* method), 91  
[shutdown\(\)](#) (*can.interfaces.pcan.PcanBus* method), 94  
[shutdown\(\)](#) (*can.interfaces.robotell.robotellBus* method), 96  
[shutdown\(\)](#) (*can.interfaces.slcan.slcanBus* method), 102  
[shutdown\(\)](#) (*can.interfaces.socketcan.SocketcanBus* method), 111  
[shutdown\(\)](#) (*can.interfaces.socketcand.SocketCanDaemonBus* method), 113  
[shutdown\(\)](#) (*can.interfaces.systec.ucanbus.UcanBus* method), 117  
[shutdown\(\)](#) (*can.interfaces.udp\_multicast.UdpMulticastBus* method), 140  
[shutdown\(\)](#) (*can.interfaces.vector.VectorBus* method), 123  
[shutdown\(\)](#) (*can.interfaces.virtual.VirtualBus* method), 137  
[SizedRotatingLogger](#) (class in *can*), 38  
[sjw](#) (*can.BitTiming* property), 54  
[slcanBus](#) (class in *can.interfaces.slcan*), 101  
[SocketcanBus](#) (class in *can.interfaces.socketcan*), 108  
[SocketCanDaemonBus](#) (class in *can.interfaces.socketcand*), 112  
[SqliteReader](#) (class in *can*), 30  
[SqliteWriter](#) (class in *can*), 29  
[start\(\)](#) (*can.broadcastmanager.ThreadBasedCyclicSendTask* method), 47  
[start\(\)](#) (*can.interfaces.ixxat.canlib\_vcinpl.CyclicSendTask* method), 81  
[start\(\)](#) (*can.interfaces.ixxat.canlib\_vcinpl2.CyclicSendTask* method), 83  
[start\(\)](#) (*can.interfaces.socketcan.CyclicSendTask* method), 108  
[start\(\)](#) (*can.RestartableCyclicTaskABC* method), 46  
[state](#) (*can.BusABC* property), 15  
[state](#) (*can.interfaces.etas.EtasBus* property), 75  
[state](#) (*can.interfaces.ixxat.canlib\_vcinpl.IXXATBus* property), 81  
[state](#) (*can.interfaces.ixxat.IXXATBus* property), 80  
[state](#) (*can.interfaces.pcan.PcanBus* property), 94  
[state](#) (*can.interfaces.socketcan.SocketcanBus* property), 111  
[state](#) (*can.interfaces.systec.ucanbus.UcanBus* property), 117  
[status\(\)](#) (*can.interfaces.pcan.PcanBus* method), 94  
[status\\_is\\_ok\(\)](#) (*can.interfaces.pcan.PcanBus* method), 94  
[status\\_string\(\)](#) (*can.interfaces.pcan.PcanBus* method), 94  
[std\\_data](#) (*can.interfaces.kvaser.structures.BusStatistics* property), 86  
[std\\_remote](#) (*can.interfaces.kvaser.structures.BusStatistics* property), 86  
[stop\(\)](#) (*can.ASCWriter* method), 32

stop() (*can.AsyncBufferedReader* method), 25  
 stop() (*can.BLFWriter* method), 34  
 stop() (*can.broadcastmanager.CyclicTask* method), 45  
 stop() (*can.broadcastmanager.ThreadBasedCyclicSendTask* method), 47  
 stop() (*can.BufferedReader* method), 24  
 stop() (*can.interfaces.ixxat.canlib\_vcinpl.CyclicSendTask* method), 81  
 stop() (*can.interfaces.ixxat.canlib\_vcinpl2.CyclicSendTask* method), 83  
 stop() (*can.interfaces.socketcan.CyclicSendTask* method), 108  
 stop() (*can.io.BaseRotatingLogger* method), 38  
 stop() (*can.io.generic.BaseIOHandler* method), 63  
 stop() (*can.Listener* method), 23  
 stop() (*can.MF4Reader* method), 36  
 stop() (*can.MF4Writer* method), 35  
 stop() (*can.Notifier* method), 22  
 stop() (*can.SqliteReader* method), 31  
 stop() (*can.SqliteWriter* method), 30  
 stop\_all\_periodic\_tasks() (*can.BusABC* method), 15  
 stop\_all\_periodic\_tasks() (*can.interfaces.socketcan.SocketcanBus* method), 111  
 stop\_all\_periodic\_tasks() (*can.interfaces.vector.VectorBus* method), 125

## T

TextIOMessageReader (class in *can.io.generic*), 65  
 TextIOMessageWriter (class in *can.io.generic*), 64  
 ThreadBasedCyclicSendTask (class in *can.broadcastmanager*), 46  
 ThreadSafeBus (class in *can*), 16  
 time\_perfcouter\_correlation() (in module *can.util*), 68  
 timestamp (*can.Message* attribute), 17  
 tq (*can.BitTiming* property), 54  
 TRCReader (class in *can*), 36  
 TRCWriter (class in *can*), 36  
 tseg1 (*can.BitTiming* property), 54  
 tseg2 (*can.BitTiming* property), 54

## U

UcanBus (class in *can.interfaces.systec.ucanbus*), 116  
 UdpMulticastBus (class in *can.interfaces.udp\_multicast*), 138  
 Usb2CanAbstractionLayer (class in *can.interfaces.usb2can*), 120  
 Usb2canBus (class in *can.interfaces.usb2can*), 119

## V

VectorBus (class in *can.interfaces.vector*), 121

VectorBusParams (class in *can.interfaces.vector.canlib*), 126  
 VectorCanFdParams (class in *can.interfaces.vector.canlib*), 127  
 VectorCanParams (class in *can.interfaces.vector.canlib*), 127  
 VectorChannelConfig (class in *can.interfaces.vector*), 126  
 VectorError, 126  
 VectorInitializationError, 126  
 VectorOperationError, 126  
 VirtualBus (class in *can.interfaces.virtual*), 136

## W

writer (*can.io.BaseRotatingLogger* property), 38  
 writer (*can.SizedRotatingLogger* property), 39

## X

XL\_BUS\_ACTIVE\_CAP\_A429 (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_ACTIVE\_CAP\_CAN (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_ACTIVE\_CAP\_DAIO (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_ACTIVE\_CAP\_ETHERNET (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_ACTIVE\_CAP\_FLEXRAY (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_ACTIVE\_CAP\_J1708 (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_ACTIVE\_CAP\_KLINE (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_ACTIVE\_CAP\_LIN (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_ACTIVE\_CAP\_MOST (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_COMPATIBLE\_A429 (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_COMPATIBLE\_CAN (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130  
 XL\_BUS\_COMPATIBLE\_DAIO (*can.interfaces.vector.xldefine.XL\_BusCapabilities* attribute), 130

XL_BUS_COMPATIBLE_ETHERNET	130
( <i>can.interfaces.vector.xldefine.XL_BusCapabilities</i> attribute), 130	XL_CANFD_BusParams_CanOpMode (class in <i>can.interfaces.vector.xldefine</i> ), 131
XL_BUS_COMPATIBLE_FLEXRAY	XL_CHANNEL_FLAG_CANFD_BOSCH_SUPPORT
( <i>can.interfaces.vector.xldefine.XL_BusCapabilities</i> attribute), 130	( <i>can.interfaces.vector.xldefine.XL_ChannelCapabilities</i> attribute), 130
XL_BUS_COMPATIBLE_J1708	XL_CHANNEL_FLAG_CANFD_ISO_SUPPORT
( <i>can.interfaces.vector.xldefine.XL_BusCapabilities</i> attribute), 130	( <i>can.interfaces.vector.xldefine.XL_ChannelCapabilities</i> attribute), 130
XL_BUS_COMPATIBLE_KLINE	XL_CHANNEL_FLAG_CMACTLICENSE_SUPPORT
( <i>can.interfaces.vector.xldefine.XL_BusCapabilities</i> attribute), 130	( <i>can.interfaces.vector.xldefine.XL_ChannelCapabilities</i> attribute), 130
XL_BUS_COMPATIBLE_LIN	XL_CHANNEL_FLAG_NO_HWSYNC_SUPPORT
( <i>can.interfaces.vector.xldefine.XL_BusCapabilities</i> attribute), 130	( <i>can.interfaces.vector.xldefine.XL_ChannelCapabilities</i> attribute), 130
XL_BUS_COMPATIBLE_MOST	XL_CHANNEL_FLAG_SPDIF_CAPABLE
( <i>can.interfaces.vector.xldefine.XL_BusCapabilities</i> attribute), 130	( <i>can.interfaces.vector.xldefine.XL_ChannelCapabilities</i> attribute), 130
XL_BUS_PARAMS_CANOPMODE_CAN20	XL_CHANNEL_FLAG_TIME_SYNC_RUNNING
( <i>can.interfaces.vector.xldefine.XL_CANFD_BusParams_CanOpMode</i> attribute), 131	( <i>can.interfaces.vector.xldefine.XL_ChannelCapabilities</i> attribute), 130
XL_BUS_PARAMS_CANOPMODE_CANFD	XL_ChannelCapabilities (class in <i>can.interfaces.vector.xldefine</i> ), 130
( <i>can.interfaces.vector.xldefine.XL_CANFD_BusParams_CanOpMode</i> attribute), 131	XL_ERR_BAD_EXE_FORMAT
XL_BUS_PARAMS_CANOPMODE_CANFD_NO_ISO	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 132
( <i>can.interfaces.vector.xldefine.XL_CANFD_BusParams_CanOpMode</i> attribute), 131	XL_ERR_CANNOT_OPEN_DRIVER
XL_BUS_TYPE_A429 ( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133
XL_BUS_TYPE_AFDX ( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	XL_ERR_CHAN_IS_ONLINE
( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 132
XL_BUS_TYPE_CAN ( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	XL_ERR_CMD_HANDLING
( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 132
XL_BUS_TYPE_DAI0 ( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	XL_ERR_CMD_TIMEOUT ( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 132
XL_BUS_TYPE_ETHERNET	XL_ERR_CONNECTION_BROKEN
( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133
XL_BUS_TYPE_FLEXRAY	XL_ERR_CONNECTION_CLOSED
( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133
XL_BUS_TYPE_J1708 ( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	XL_ERR_CONNECTION_FAILED
( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133
XL_BUS_TYPE_KLINE ( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	XL_ERR_DLL_NOT_FOUND
( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133
XL_BUS_TYPE_MOST ( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	XL_ERR_EDL_NOT_SET ( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133
XL_BUS_TYPE_NONE ( <i>can.interfaces.vector.xldefine.XL_BusTypes</i> attribute), 131	XL_ERR_EDL_RTR ( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133
XL_BusCapabilities (class in <i>can.interfaces.vector.xldefine</i> ), 130	XL_ERR_ERROR_CRC ( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133
XL_BusTypes (class in <i>can.interfaces.vector.xldefine</i> ), 130	

*attribute*), 132

`XL_ERR_HW_NOT_PRESENT`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_HW_NOT_READY`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INIT_ACCESS_MISSING`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_INSUFFICIENT_BUFFER`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INTERNAL_ERROR`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_ACCESS`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_ADDRESS`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_CANID`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_INVALID_CHAN_INDEX`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_CHANNEL_MASK`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_INVALID_DLC` (*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_INVALID_FDFLAG_MODE20`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_INVALID_HANDLE`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_INVALID_LEVEL`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_PORT`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_PORT_ACCESS_TYPE`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_RESERVED_FLD`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_SIZE`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_STREAM_NAME`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_INVALID_TAG` (*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_INVALID_USER_BUFFER`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_NO_DATA_DETECTED`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_NO_LICENSE` (*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_NO_RESOURCES`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_NO_SYSTEM_RESOURCES`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_NOT_FOUND` (*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_NOT_IMPLEMENTED`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_NOT_SUPPORTED`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_NOTIFY_ALREADY_ACTIVE`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_PORT_IS_OFFLINE`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_QUEUE_IS_EMPTY`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 131

`XL_ERR_QUEUE_IS_FULL`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 131

`XL_ERR_QUEUE_OVERRUN`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_REQ_NOT_ACCEP`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 132

`XL_ERR_RESERVED_NOT_ZERO`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_STREAM_NOT_CONNECTED`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133

`XL_ERR_STREAM_NOT_FOUND`  
(*can.interfaces.vector.xldefine.XL\_Status attribute*), 133



<code>XL_ERR_TWICE_REGISTER</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 132	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
<code>XL_ERR_TX_NOT_POSSIBLE</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 132	<code>XL_HWTYPE_CSMCAN</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_ERR_UNEXP_NET_ERR</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 132	<code>XL_HWTYPE_IPCL8800</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_ERR_UNKNOWN_FLAG</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133	<code>XL_HWTYPE_IPCLIENT</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
<code>XL_ERR_WRONG_BUS_TYPE</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133	<code>XL_HWTYPE_IPSERVER</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
<code>XL_ERR_WRONG_CHIP_TYPE</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133	<code>XL_HWTYPE_IPSRV8800</code>
<code>XL_ERR_WRONG_COMMAND</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_ERR_WRONG_PARAMETER</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 132	<code>XL_HWTYPE_NONE</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 127
<code>XL_ERR_WRONG_VERSION</code>	( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133	<code>XL_HWTYPE_VGNSS</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_ERROR</code> ( <i>can.interfaces.vector.xldefine.XL_Status</i> attribute), 133		<code>XL_HWTYPE_VH6501</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_HardwareType</code> (class <i>can.interfaces.vector.xldefine</i> ), 127		<code>XL_HWTYPE_VIRTUAL</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 127
<code>XL_HWTYPE_CANAC2PCI</code>	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128	<code>XL_HWTYPE_VN0601</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_HWTYPE_CANBOARDXL</code>	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128	<code>XL_HWTYPE_VN1530</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_HWTYPE_CANBOARDXL_PXI</code>	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128	<code>XL_HWTYPE_VN1531</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_HWTYPE_CANCARDX</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128		<code>XL_HWTYPE_VN1610</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
<code>XL_HWTYPE_CANCARDXL</code>	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128	<code>XL_HWTYPE_VN1611</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
<code>XL_HWTYPE_CANCARDXLE</code>	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128	<code>XL_HWTYPE_VN1630</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
<code>XL_HWTYPE_CANCARDY</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128		<code>XL_HWTYPE_VN1630_LOG</code>
<code>XL_HWTYPE_CANCASEXL</code>	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128	( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
<code>XL_HWTYPE_CANCASEXL_LOG_OBSOLETE</code>		<code>XL_HWTYPE_VN1640</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
		<code>XL_HWTYPE_VN2600</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
		<code>XL_HWTYPE_VN2610</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
		<code>XL_HWTYPE_VN2640</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
		<code>XL_HWTYPE_VN3300</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
		<code>XL_HWTYPE_VN3600</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
		<code>XL_HWTYPE_VN4610</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129
		<code>XL_HWTYPE_VN5240</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 128
		<code>XL_HWTYPE_VN5430</code> ( <i>can.interfaces.vector.xldefine.XL_HardwareType</i> attribute), 129

`XL_HWTYPE_VN5601` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VX1161B` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VN5610` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 128  
`XL_HWTYPE_VXLAPINIC` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VN5610A` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VN5611` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 128  
`XL_HWTYPE_VN5612` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 128  
`XL_HWTYPE_VN5620` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 131  
`XL_HWTYPE_VN5640` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VN5650` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 128  
`XL_HWTYPE_VN7570` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 131  
`XL_HWTYPE_VN7572` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VN7600` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 128  
`XL_HWTYPE_VN7610` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VN7640` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VN8800` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VN8900` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 128  
`XL_HWTYPE_VN8950` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 128  
`XL_HWTYPE_VN8970` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 128  
`XL_HWTYPE_VN8972` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VT6104A` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VT6204` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VT6306` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VTSSERVICE` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VX0312` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VX1121` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VX1131` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VX1135` (*can.interfaces.vector.xldefine.XL\_HardwareType* attribute), 129  
`XL_HWTYPE_VX1161A` (*can.interfaces.vector.xldefine.XL\_HardwareType*