
asammdf Documentation

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asammdf is a fast parser/editor for ASAM (Association for Standardisation of Automation and Measuring Systems) MDF (Measurement Data Format) files.

asammdf supports both MDF version 3 and 4 formats.

asammdf works on Python 2.7, and Python ≥ 3.4

CHAPTER 1

Project goals

The main goals for this library are:

- to be faster than the other Python based mdf libraries
- to have clean and easy to understand code base

Features

- read sorted and unsorted MDF v3 and v4 files
- files are loaded in RAM for fast operations
 - for low memory computers or for large data files there is the option to load only the metadata and leave the raw channel data (the samples) unread; this of course will mean slower channel data access speed
- extract channel data, master channel and extra channel information as *Signal* objects for unified operations with v3 and v4 files
- time domain operation using the *Signal* class
 - Pandas data frames are good if all the channels have the same time based
 - usually a measurement will have channels from different sources at different rates
 - the *Signal* class facilitates operations with such channels
- remove data group by index or by specifying a channel name inside the target data group
- append new channels
- convert to different mdf version
- add and extract attachments
- mdf 4.10 zipped blocks

Major features still not implemented

- functionality related to sample reduction block (but the class is defined)
- mdf 3 channel dependency functionality
- functionality related to trigger blocks (but the class is defined)
- handling of unfinished measurements (mdf 4)
- mdf 4 channel arrays
- xml schema for TXBLOCK and MDBLOCK

CHAPTER 4

Dependencies

asammdf uses the following libraries

- numpy : the heart that makes all tick
- numexpr : for formula based channel conversions
- blosc : optionally used for in memory raw channel data compression
- matplotlib : for Signal plotting

Features

- read sorted and unsorted MDF v3 files
- **files are loaded in RAM for fast operations**
 - for low memory computers or for large data files there is the option to load only the metadata and leave the raw channel data (the samples) unread; this of course will mean slower channel data access speed
- extract channel data, master channel and extra channel information (unit, conversion rule)
- remove data group by index or by specifying a channel name inside the target data group
- append new channels
- convert to different mdf version

Major features still not implemented

- functionality related to sample reduction block (but the class is defined)
- mdf 3 channel dependency functionality
- functionality related to trigger blocks (but the class is defined)
- handling of unfinished measurements (mdf 4)
- mdf 4 channel arrays
- xml schema for TXBLOCK and MDBLOCK

CHAPTER 7

Installation

asammdf is available on

- github: <https://github.com/danielhrisca/asammdf/>
- PyPI: <https://pypi.org/project/asammdf/>

```
pip install asammdf
```


MDF

This class acts as a proxy for the MDF3 and MDF4 classes. All attribute access is delegated to the underlying *file* attribute (MDF3 or MDF4 object). See MDF3 and MDF4 for available extra methods.

class `asammdf.mdf.MDF` (*name=None, load_measured_data=True, compression=False, version='3.20'*)
Unified access to MDF v3 and v4 files.

Parameters **name** : string

mdf file name

load_measured_data : bool

load data option; default *True*

- if *True* the data group binary data block will be loaded in RAM
- if *False* the channel data is read from disk on request

compression : bool

compression option for data group binary data block; default *False*

version : string

mdf file version ('3.00', '3.10', '3.20', '3.30', '4.00', '4.10', '4.11'); default '3.20'

Methods

`convert`

convert (*to, compression=False*)
convert MDF to other versions

Parameters **to** : str

new mdf version from ('3.00', '3.10', '3.20', '3.30', '4.00', '4.10', '4.11')

compression : bool

enable raw channel data compression for out MDF; default *False*

Returns **out** : MDF

new MDF object

MDF3 and MDF4 classes

MDF3

asammdf tries to emulate the mdf structure using Python builtin data types.

The *header* attribute is an OrderedDict that holds the file metadata.

The *groups* attribute is a dictionary list with the following keys:

- *data_group* : DataGroup object
- *channel_group* : ChannelGroup object
- *channels* : list of Channel objects with the same order as found in the mdf file
- *channel_conversions* : list of ChannelConversion objects in 1-to-1 relation with the channel list
- *channel_sources* : list of SourceInformation objects in 1-to-1 relation with the channels list
- *data_block* : DataBlock object
- *texts* : dictionary containing TextBlock objects used throughout the mdf
 - *channels* : list of dictionaries that contain TextBlock objects related to each channel
 - * *long_name_addr* : channel long name
 - * *comment_addr* : channel comment
 - * *display_name_addr* : channel display name
 - *channel group* : list of dictionaries that contain TextBlock objects related to each channel group
 - * *comment_addr* : channel group comment
 - *conversion_tab* : list of dictionaries that contain TextBlock objects related to VATB and VTABR channel conversions
 - * *text_{n}* : n-th text of the VTABR conversion

The *file_history* attribute is a TextBlock object.

The *channel_db* attribute is a dictionary that holds the (*data group index*, *channel index*) pair for all signals. This is used to speed up the *get_signal_by_name* method.

The *master_db* attribute is a dictionary that holds the *channel index* of the master channel for all data groups. This is used to speed up the *get_signal_by_name* method.

API

class `asammdf.mdf3.MDF3` (*name=None*, *load_measured_data=True*, *compression=False*, *version='3.20'*)

If the *name* exist it will be loaded otherwise an empty file will be created that can be later saved to disk

Parameters *name* : string

mdf file name

load_measured_data : bool

load data option; default *True*

- if *True* the data group binary data block will be loaded in RAM
- if *False* the channel data is read from disk on request

compression : bool

compression option for data group binary data block; default *False*

version : string

mdf file version ('3.00', '3.10', '3.20' or '3.30'); default '3.20'

Attributes

name	(string) mdf file name
groups	(list) list of data groups
header	(OrderedDict) mdf file header
file_history	(TextBlock) file history text block; can be None
load_measured_data	(bool) load measured data option
compression	(bool) measured data compression option
version	(int) mdf version
channels_db	(dict) used for fast channel access by name; for each name key the value is a (group index, channel index) tuple
masters_db	(dict) used for fast master channel access; for each group index key the value is the master channel index

Methods

<code>append</code>
<code>get</code>
<code>get_channel_data</code>
<code>get_master_data</code>
<code>info</code>
<code>remove</code>
<code>save</code>

append (*signals*, *acquisition_info='Python'*)

Appends a new data group.

Parameters *signals* : list

list on *Signal* objects

acquisition_info : str

acquisition information; default 'Python'

Examples

```
>>> # case 1 conversion type None
>>> s1 = np.array([1, 2, 3, 4, 5])
>>> s2 = np.array([-1, -2, -3, -4, -5])
>>> s3 = np.array([0.1, 0.04, 0.09, 0.16, 0.25])
>>> t = np.array([0.001, 0.002, 0.003, 0.004, 0.005])
>>> names = ['Positive', 'Negative', 'Float']
>>> units = ['+', '-', '.f']
>>> info = {}
>>> s1 = Signal(samples=s1, timestamps=t, unit='+', name='Positive')
>>> s2 = Signal(samples=s2, timestamps=t, unit='-', name='Negative')
>>> s3 = Signal(samples=s3, timestamps=t, unit='.flts', name='Floats')
>>> mdf = MDF3('new.mdf')
>>> mdf.append([s1, s2, s3], 'created by asammdf v1.1.0')
>>> # case 2: VTAB conversions from channels inside another file
>>> mdf1 = MDF3('in.mdf')
>>> ch1 = mdf1.get("Channel1_VTAB")
>>> ch2 = mdf1.get("Channel2_VTABR")
>>> sigs = [ch1, ch2]
>>> mdf2 = MDF3('out.mdf')
>>> mdf2.append(sigs, 'created by asammdf v1.1.0')
```

get (*name=None, group=None, index=None, raster=None*)

Gets channel samples. Channel can be specified in two ways:

- using the first positional argument *name*
- using the group number (keyword argument *group*) and the channel number (keyword argument *index*). Use *info* method for group and channel numbers

If the *raster* keyword argument is not *None* the output is interpolated accordingly

Parameters *name* : string

name of channel

group : int

0-based group index

index : int

0-based channel index

raster : float

time raster in seconds

Returns *vals, t, unit, conversion* : (numpy.array, numpy.array, string, dict | None)

The conversion is *None* except for the VTAB and VTABR conversions. The conversion keys are:

- for VTAB conversion:
 - raw - numpy.array for X-axis
 - phys - numpy.array of strings for Y-axis

- type - conversion type = `CONVERSION_TYPE_VTAB`
- for VTABR conversion:
 - lower - numpy.array for lower range
 - upper - numpy.array for upper range
 - phys - numpy.array of strings for Y-axis
 - type - conversion type = `CONVERSION_TYPE_VTABR`

The conversion information can be used by the *append* method for the *info* argument

Raises `MdfError` :

- * if the channel name is not found
- * if the group index is out of range
- * if the channel index is out of range

`get_channel_data` (*name=None, group=None, index=None, data=None, return_info=False*)

get channel values. The channel is identified by name (*name* argument) or by the group and channel indexes (*group* and *index* arguments). *data* argument is used internally by the *get* method to avoid double work. By default only the channel values are returned. If the *return_info* argument is set then name, unit and conversion info is returned as well

Parameters *name* : str

channel name in target group

group : int

group index

index : int

channel index

data : bytes

data groups's raw channel data

return_info : bool

enables returning extra information (name, unit, conversion)

Returns *vals* : numpy.array

channel values; if *return_info* is False

vals, name, conversion, unit : numpy.array, str, dict, str

channel values, channel name, channel conversion, channel unit: if *return_info* is True

`get_master_data` (*name=None, group=None, data=None*)

get master channel values only. The group is identified by a channel name (*name* argument) or by the index (*group* argument). *data* argument is used internally by the *get* method to avoid double work.

Parameters *name* : str

channel name in target group

group : int

group index

data : bytes

data groups's raw channel data

Returns **t** : numpy.array

master channel values

info()

get MDF information as a dict

Examples

```
>>> mdf = MDF3('test.mdf')
>>> mdf.info()
```

remove (*group=None, name=None*)

Remove data group. Use *group* or *name* keyword arguments to identify the group's index. *group* has priority

Parameters **name** : string

name of the channel inside the data group to be removed

group : int

data group index to be removed

Examples

```
>>> mdf = MDF3('test.mdf')
>>> mdf.remove(group=3)
>>> mdf.remove(name='VehicleSpeed')
```

save (*dst=None*)

Save MDF to *dst*. If *dst* is *None* the original file is overwritten

MDF version 3 blocks

The following classes implement different MDF version3 blocks.

Channel Class

class `asammdf.mdf3.Channel` (***kargs*)

CNBLOCK class derived from *dict*

The Channel object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using any of the following presented keys - when creating a new Channel

The keys have the following meaning:

- *id* - Block type identifier, always “CN”
- *block_len* - Block size of this block in bytes (entire CNBLOCK)

- next_ch_addr** - Pointer to next channel block (CNBLOCK) of this channel group (NIL allowed)
- conversion_addr** - Pointer to the conversion formula (CCBLOCK) of this signal (NIL allowed)
- source_depend_addr** - Pointer to the source-depending extensions (CEBLOCK) of this signal (NIL allowed)
- ch_depend_addr** - Pointer to the dependency block (CDBLOCK) of this signal (NIL allowed)
- comment_addr** - Pointer to the channel comment (TXBLOCK) of this signal (NIL allowed)
- channel_type** - Channel type
 - 0 = data channel
 - 1 = time channel for all signals of this group (in each channel group, exactly one channel must be defined as time channel) The time stamps recording in a time channel are always relative to the start time of the measurement defined in HDBLOCK.
- short_name** - Short signal name, i.e. the first 31 characters of the ASAM-MCD name of the signal (end of text should be indicated by 0)
- description** - Signal description (end of text should be indicated by 0)
- start_offset** - Start offset in bits to determine the first bit of the signal in the data record. The start offset N is divided into two parts: a “Byte offset” ($= N \div 8$) and a “Bit offset” ($= N \bmod 8$). The channel block can define an “additional Byte offset” (see below) which must be added to the Byte offset.
- bit_count** - Number of bits used to encode the value of this signal in a data record
- data_type** - Signal data type
- range_flag** - Value range valid flag
- min_raw_value** - Minimum signal value that occurred for this signal (raw value)
- max_raw_value** - Maximum signal value that occurred for this signal (raw value)
- sampling_rate** - Sampling rate for a virtual time channel. Unit [s]
- long_name_addr** - Pointer to TXBLOCK that contains the ASAM-MCD long signal name
- display_name_addr** - Pointer to TXBLOCK that contains the signal’s display name (NIL allowed)
- additional_byte_offset** - Additional Byte offset of the signal in the data record (default value: 0).

Parameters **file_stream** : file handle

mdf file handle

address : int

block address inside mdf file

Examples

```
>>> with open('test.mdf', 'rb') as mdf:
...     ch1 = Channel(file_stream=mdf, address=0xBA52)
>>> ch2 = Channel()
>>> ch1.name
'VehicleSpeed'
>>> ch1['id']
b'CN'
```

Attributes

name	(str) full channel name
address	(int) block address inside mdf file

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

ChannelConversion Class

class `asammdf.mdf3.ChannelConversion` (***kargs*)
CCBLOCK class derived from *dict*

The ChannelConversion object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using any of the following presented keys - when creating a new ChannelConversion

The first keys are common for all conversion types, and are followed by conversion specific keys. The keys have the following meaning:

- common keys
 - id* - Block type identifier, always “CC”
 - block_len* - Block size of this block in bytes (entire CCBLOCK)
 - range_flag* - Physical value range valid flag:
 - min_phy_value* - Minimum physical signal value that occurred for this signal
 - max_phy_value* - Maximum physical signal value that occurred for this signal
 - unit* - Physical unit (string should be terminated with 0)
 - conversion_type* - Conversion type (formula identifier)
 - ref_param_nr* - Size information about additional conversion data
- specific keys
 - linear conversion
 - **b* - offset
 - **a* - factor

*CANapeHiddenExtra - sometimes CANape appends extra information; not compliant with MDF specs

–ASAM formula conversion

*formula - equation as string

–polynomial or rational conversion

*P1 .. P6 - factors

–exponential or logarithmic conversion

*P1 .. P7 - factors

–tabular with or without interpolation (grouped by *n*)

*raw_{n} - n-th raw integer value (X axis)

*phys_{n} - n-th physical value (Y axis)

–text table conversion

*param_val_{n} - n-th integers value (X axis)

*text_{n} - n-th text value (Y axis)

–text range table conversion

*lower_{n} - n-th lower raw value

*upper_{n} - n-th upper raw value

*text_{n} - n-th text value

Parameters `file_stream` : file handle
 mdf file handle

address : int
 block address inside mdf file

Examples

```
>>> with open('test.mdf', 'rb') as mdf:
...     cc1 = ChannelConversion(file_stream=mdf, address=0xBA52)
>>> cc2 = ChannelConversion(conversion_type=0)
>>> cc1['b'], cc1['a']
0, 100.0
```

Attributes

address	(int) block address inside mdf file
----------------	-------------------------------------

Methods

clear

Continued on next page

Table 8.4 – continued from previous page

copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

ChannelDependency Class

`class asammdf.mdf3.ChannelDependency (**kargs)`
CDBLOCK class derived from *dict*

Currently the ChannelDependency object can only be created using the *file_stream* and *address* keyword parameters when reading from file

The keys have the following meaning:

- id* - Block type identifier, always “CD”
- block_len* - Block size of this block in bytes (entire CDBLOCK)
- data* - Dependency type
- sd_nr* - Total number of signals dependencies (m)
- for each dependency there is a group of three keys:
 - dg_{n}* - Pointer to the data group block (DGBLOCK) of signal dependency *n*
 - cg_{n}* - Pointer to the channel group block (DGBLOCK) of signal dependency *n*
 - ch_{n}* - Pointer to the channel block (DGBLOCK) of signal dependency *n*
- there can also be optional keys which describe dimensions for the N-dimensional dependencies:
 - dim_{n}* - Optional: size of dimension *n* for N-dimensional dependency

Parameters *file_stream* : file handle
mdf file handle
address : int
block address inside mdf file

Attributes

address	(int) block address inside mdf file
----------------	-------------------------------------

Methods

clear
Continued on next page

Table 8.5 – continued from previous page

<code>copy</code>	Generic (shallow and deep) copying operations.
<code>fromkeys</code>	
<code>get</code>	
<code>items</code>	
<code>keys</code>	
<code>pop</code>	
<code>popitem</code>	
<code>setdefault</code>	
<code>update</code>	
<code>values</code>	

ChannelExtension Class

class `asammdf.mdf3.ChannelExtension` (**kargs)
 CEBLOCK class derived from *dict*

The ChannelExtension object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using any of the following presented keys - when creating a new ChannelExtension

The first keys are common for all conversion types, and are followed by conversion specific keys. The keys have the following meaning:

- common keys
 - id - Block type identifier, always “CE”
 - block_len - Block size of this block in bytes (entire CEBLOCK)
 - type - Extension type identifier
- specific keys
 - for DIM block
 - *module_nr - Number of module
 - *module_address - Address
 - *description - Description
 - *ECU_identification - Identification of ECU
 - *reserved0' - reserved
 - for Vector CAN block
 - *CAN_id - Identifier of CAN message
 - *CAN_ch_index - Index of CAN channel
 - *message_name - Name of message (string should be terminated by 0)
 - *sender_name - Name of sender (string should be terminated by 0)
 - *reserved0 - reserved

Parameters *file_stream* : file handle
 mdm file handle

address : int

block address inside mdf file

Attributes

address	(int) block address inside mdf file
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Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

ChannelGroup Class

class `asammdf.mdf3.ChannelGroup` (**kargs)

CGBLOCK class derived from *dict*

The ChannelGroup object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using any of the following presented keys - when creating a new ChannelGroup

The keys have the following meaning:

- id** - Block type identifier, always “CG”
- block_len** - Block size of this block in bytes (entire CGBLOCK)
- next_cg_addr** - Pointer to next channel group block (CGBLOCK) (NIL allowed)
- first_ch_addr** - Pointer to first channel block (CNBLOCK) (NIL allowed)
- comment_addr** - Pointer to channel group comment text (TXBLOCK) (NIL allowed)
- record_id** - Record ID, i.e. value of the identifier for a record if the DGBLOCK defines a number of record IDs > 0
- ch_nr** - Number of channels (redundant information)
- samples_byte_nr** - Size of data record in Bytes (without record ID), i.e. size of plain data for a each recorded sample of this channel group
- cycles_nr** - Number of records of this type in the data block i.e. number of samples for this channel group
- sample_reduction_addr** - only since version 3.3. Pointer to first sample reduction block (SRBLOCK) (NIL allowed) Default value: NIL.

Parameters `file_stream` : file handle

mdf file handle

address : int

block address inside mdf file

Examples

```
>>> with open('test.mdf', 'rb') as mdf:
...     cg1 = ChannelGroup(file_stream=mdf, address=0xBA52)
>>> cg2 = ChannelGroup(sample_bytes_nr=32)
>>> hex(cg1.address)
0xBA52
>>> cg1['id']
b'CG'
```

Attributes

address	(int) block address inside mdf file
----------------	-------------------------------------

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

DataGroup Class

class `asammdf.mdf3.DataGroup` (**kargs)
DGBLOCK class derived from *dict*

The DataGroup object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using any of the following presented keys - when creating a new DataGroup

The keys have the following meaning:

- *id* - Block type identifier, always “DG”
- *block_len* - Block size of this block in bytes (entire DGBLOCK)

- `next_dg_addr` - Pointer to next data group block (DGBLOCK) (NIL allowed)
- `first_cg_addr` - Pointer to first channel group block (CGBLOCK) (NIL allowed)
- `trigger_addr` - Pointer to trigger block (TRBLOCK) (NIL allowed)
- `data_block_addr` - Pointer to the data block (see separate chapter on data storage)
- `cg_nr` - Number of channel groups (redundant information)
- `record_id_nr` - Number of record IDs in the data block
- `reserved0` - since version 3.2; Reserved

Parameters `file_stream` : file handle

mdf file handle

address : int

block address inside mdf file

Attributes

address	(int) block address inside mdf file
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Methods

<code>clear</code>	
<code>copy</code>	Generic (shallow and deep) copying operations.
<code>fromkeys</code>	
<code>get</code>	
<code>items</code>	
<code>keys</code>	
<code>pop</code>	
<code>popitem</code>	
<code>setdefault</code>	
<code>update</code>	
<code>values</code>	

FileIdentificationBlock Class

class `asammdf.mdf3.FileIdentificationBlock` (***kargs*)

IDBLOCK class derived from *dict*

The TriggerBlock object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using the classmethod *from_text*

The keys have the following meaning:

- `file_identification` - file identifier
- `version_str` - format identifier
- `program_identification` - program identifier

- `byte_order` - default byte order
- `float_format` - default floating-point format
- `mdf_version` - version number of MDF format
- `code_page` - code page number
- `reserved0` - reserved
- `reserved1` - reserved
- `unfinalized_standard_flags` - Standard Flags for unfinalized MDF
- `unfinalized_custom_flags` - Custom Flags for unfinalized MDF

Parameters `file_stream` : file handle

mdf file handle

version : int

mdf version in case of new file

Attributes

address	(int) block address inside mdf file; should be 0 always
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Methods

<code>clear</code>	
<code>copy</code>	Generic (shallow and deep) copying operations.
<code>fromkeys</code>	
<code>get</code>	
<code>items</code>	
<code>keys</code>	
<code>pop</code>	
<code>popitem</code>	
<code>setdefault</code>	
<code>update</code>	
<code>values</code>	

HeaderBlock Class

class `asammdf.mdf3.HeaderBlock` (***kargs*)
HDBLOCK class derived from *dict*

The TriggerBlock object can be created in two modes:

- using the *file_stream* - when reading from file
- using the classmethod *from_text*

The keys have the following meaning:

- `id` - Block type identifier, always “HD”
- `block_len` - Block size of this block in bytes (entire HDBLOCK)

- `first_dg_addr` - Pointer to the first data group block (DGBLOCK)
- `comment_addr` - Pointer to the measurement file comment text (TXBLOCK) (NIL allowed)
- `program_addr` - Pointer to program block (PRBLOCK) (NIL allowed)
- `dg_nr` - Number of data groups (redundant information)
- `date` - Date at which the recording was started in “DD:MM:YYYY” format
- `time` - Time at which the recording was started in “HH:MM:SS” format
- `author` - author name
- `organization` - organization
- `project` - project name
- `subject` - subject

Since version 3.2 the following extra keys were added:

- `abs_time` - Time stamp at which recording was started in nanoseconds.
- `tz_offset` - UTC time offset in hours (= GMT time zone)
- `time_quality` - Time quality class
- `timer_identification` - Timer identification (time source),

Parameters `file_stream` : file handle

mdf file handle

Attributes

address	(int) block address inside mdf file; should be 64 always
----------------	----------------------------------------------------------

Methods

<code>clear</code>	
<code>copy</code>	Generic (shallow and deep) copying operations.
<code>fromkeys</code>	
<code>get</code>	
<code>items</code>	
<code>keys</code>	
<code>pop</code>	
<code>popitem</code>	
<code>setdefault</code>	
<code>update</code>	
<code>values</code>	

ProgramBlock Class

class `asammdf.mdf3.ProgramBlock` (***kargs*)
 PRBLOCK class derived from *dict*

The ProgramBlock object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using any of the following presented keys - when creating a new ProgramBlock

The keys have the following meaning:

- id* - Block type identifier, always “PR”
- block_len* - Block size of this block in bytes (entire PRBLOCK)
- data* - Program-specific data

Parameters *file_stream* : file handle

mdf file handle

address : int

block address inside mdf file

Attributes

address	(int) block address inside mdf file
----------------	-------------------------------------

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

SampleReduction Class

class `asammdf.mdf3.SampleReduction` (**kargs)

SRBLOCK class derived from *dict*

Currently the SampleReduction object can only be created by using the *file_stream* and *address* keyword parameters - when reading from file

The keys have the following meaning:

- id* - Block type identifier, always “SR”
- block_len* - Block size of this block in bytes (entire SRBLOCK)
- next_sr_addr* - Pointer to next sample reduction block (SRBLOCK) (NIL allowed)
- data_block_addr* - Pointer to the data block for this sample reduction
- cycles_nr* - Number of reduced samples in the data block.

- `time_interval` - Length of time interval [s] used to calculate the reduced samples.

Parameters `file_stream` : file handle

mdf file handle

address : int

block address inside mdf file

Attributes

address	(int) block address inside mdf file
----------------	-------------------------------------

Methods

<code>clear</code>	
<code>copy</code>	Generic (shallow and deep) copying operations.
<code>fromkeys</code>	
<code>get</code>	
<code>items</code>	
<code>keys</code>	
<code>pop</code>	
<code>popitem</code>	
<code>setdefault</code>	
<code>update</code>	
<code>values</code>	

TextBlock Class

class `asammdf.mdf3.TextBlock` (***kargs*)

TXBLOCK class derived from *dict*

The ProgramBlock object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using the classmethod *from_text*

The keys have the following meaning:

- id* - Block type identifier, always “TX”
- block_len* - Block size of this block in bytes (entire TXBLOCK)
- text* - Text (new line indicated by CR and LF; end of text indicated by 0)

Parameters `file_stream` : file handle

mdf file handle

address : int

block address inside mdf file

text : bytes

bytes for creating a new TextBlock

Examples

```
>>> tx1 = TextBlock.from_text('VehicleSpeed')
>>> tx1.text_str
'VehicleSpeed'
>>> tx1['text']
b'VehicleSpeed'
```

Attributes

address	(int) block address inside mdf file
text_str	(str) text data as unicode string

Methods

clear	
copy	Generic (shallow and deep) copying operations.
from_text	
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

TriggerBlock Class

class asammdf.mdf3.**TriggerBlock** (***kargs*)

TRBLOCK class derived from *dict*

The TriggerBlock object can be created in two modes:

- using the *file_stream* and *address* keyword parameters - when reading from file
- using the classmethod *from_text*

The keys have the following meaning:

- id* - Block type identifier, always “TX”
- block_len* - Block size of this block in bytes (entire TRBLOCK)
- text_addr* - Pointer to trigger comment text (TXBLOCK) (NIL allowed)
- trigger_events_nr* - Number of trigger events *n* (0 allowed)
- trigger_{n}_time* - Trigger time [s] of trigger event *n*

- trigger_{n}_pretime - Pre trigger time [s] of trigger event *n*
- trigger_{n}_posttime - Post trigger time [s] of trigger event *n*

Parameters **file_stream** : file handle

mdf file handle

address : int

block address inside mdf file

Attributes

address	(int) block address inside mdf file
----------------	-------------------------------------

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

MDF4

asammdf tries to emulate the mdf structure using Python builtin data types.

The *header* attribute is an OrderedDict that holds the file metadata.

The *groups* attribute is a dictionary list with the following keys:

- data_group : DataGroup object
- channel_group : ChannelGroup object
- channels : list of Channel objects with the same order as found in the mdf file
- channel_conversions : list of ChannelConversion objects in 1-to-1 relation with the channel list
- channel_sources : list of SourceInformation objects in 1-to-1 relation with the channels list
- data_block : DataBlock object
- texts : dictionary containing TextBlock objects used throughout the mdf
 - channels : list of dictionaries that contain TextBlock objects related to each channel
 - * name_addr : channel name
 - * comment_addr : channel comment

- `channel_group` : list of dictionaries that contain TextBlock objects related to each channel group
 - * `acq_name_addr` : channel group acquisition comment
 - * `comment_addr` : channel group comment
- `conversion_tab` : list of dictionaries that contain TextBlock objects related to TABX and RTABX channel conversions
 - * `text_{n}` : n-th text of the VTABR conversion
 - * `default_addr` : default text
- `conversions` : list of dictionaries that contain TextBlock objects related to channel conversions
 - * `name_addr` : conversions name
 - * `unit_addr` : channel unit_addr
 - * `comment_addr` : conversion comment
 - * `formula_addr` : formula text; only valid for algebraic conversions
- `sources` : list of dictionaries that contain TextBlock objects related to channel sources
 - * `name_addr` : source name
 - * `path_addr` : source path_addr
 - * `comment_addr` : source comment

The `file_history` attribute is a list of (FileHistory, TextBlock) pairs .

The `channel_db` attribute is a dictionary that holds the (*data group index*, *channel index*) pair for all signals. This is used to speed up the `get_signal_by_name` method.

The `master_db` attribute is a dictionary that holds the *channel index* of the master channel for all data groups. This is used to speed up the `get_signal_by_name` method.

API

```
class asammdf.mdf4.MDF4 (name=None, load_measured_data=True, compression=False, version='4.00')
```

If the *name* exist it will be loaded otherwise an empty file will be created that can be later saved to disk

Parameters *name* : string

mdf file name

load_measured_data : bool

load data option; default *True*

- if *True* the data group binary data block will be loaded in RAM
- if *False* the channel data is read from disk on request

compression : bool

compression option for data group binary data block; default *False*

version : string

mdf file version ('4.00', '4.10', '4.11'); default '4.00'

Attributes

name	(string) mdf file name
groups	(list) list of data groups
header	(HeaderBlock) mdf file header
file_history	(list) list of (FileHistory, TextBlock) pairs
comment	(TextBlock) mdf file comment
identification	(FileIdentificationBlock) mdf file start block
load_measured_data	(bool) load measured data option
compression	(bool) measured data compression option
version	(int) mdf version
channels_db	(dict) used for fast channel access by name; for each name key the value is a (group index, channel index) tuple
masters_db	(dict) used for fast master channel access; for each group index key the value is the master channel index

Methods

append
attach
extract_attachment
get
get_channel_data
get_master_data
info
remove
save

append (*signals*, *source_info*='Python')

Appends a new data group.

Parameters **signals** : list

list on *Signal* objects

acquisition_info : str

acquisition information; default 'Python'

Examples

```
>>> # case 1 conversion type None
>>> s1 = np.array([1, 2, 3, 4, 5])
>>> s2 = np.array([-1, -2, -3, -4, -5])
>>> s3 = np.array([0.1, 0.04, 0.09, 0.16, 0.25])
>>> t = np.array([0.001, 0.002, 0.003, 0.004, 0.005])
>>> names = ['Positive', 'Negative', 'Float']
>>> units = ['+', '-', '.f']
>>> info = {}
>>> s1 = Signal(samples=s1, timestamps=t, unit='+', name='Positive')
>>> s2 = Signal(samples=s2, timestamps=t, unit='-', name='Negative')
>>> s3 = Signal(samples=s3, timestamps=t, unit='flts', name='Floats')
```

```

>>> mdf = MDF4('new.mf4')
>>> mdf.append([s1, s2, s3], 'created by asammdf v1.1.0')
>>> # case 2: VTAB conversions from channels inside another file
>>> mdf1 = MDF4('in.mf4')
>>> ch1 = mdf1.get("Channel1_VTAB")
>>> ch2 = mdf1.get("Channel2_VTABR")
>>> sigs = [ch1, ch2]
>>> mdf2 = MDF4('out.mf4')
>>> mdf2.append(sigs, 'created by asammdf v1.1.0')

```

attach (*data*, *file_name=None*, *comment=None*, *compression=True*, *mime='application/octet-stream'*)
 attach embedded attachment as application/octet-stream

Parameters *data* : bytes

data to be attached

file_name : str

string file name

comment : str

attachment comment

compression : bool

use compression for embedded attachment data

mime : str

mime type string

extract_attachment (*index*)

extract attachemnt *index* data. If it is an embedded attachment, then this method creates the new file according to the attachemnt file name information

Parameters *index* : int

attachment index

Returns *data* : bytes | str

attachment data

get (*name=None*, *group=None*, *index=None*, *raster=None*)

Gets channel samples. Channel can be specified in two ways:

- using the first positional argument *name*
- using the group number (keyword argument *group*) and the channel number (keyword argument *index*). Use *info* method for group and channel numbers

If the *raster* keyword argument is not *None* the output is interpolated accordingly

Parameters *name* : string

name of channel

group : int

0-based group index

index : int

0-based channel index

raster : float

time raster in seconds

Returns **vals, t, unit, conversion** : (numpy.array, numpy.array, string, dict | None)

The conversion is *None* except for the VTAB and VTABR conversions. The conversion keys are:

- for TABX conversion:
 - raw - numpy.array for X-axis
 - phys - numpy.array of strings for Y-axis
 - type - conversion type = CONVERSION_TYPE_TABX
 - default - default bytes value
- for RTABX conversion:
 - lower - numpy.array for lower range
 - upper - numpy.array for upper range
 - phys - numpy.array of strings for Y-axis
 - type - conversion type =
 - default - default bytes value

The conversion information can be used by the *append* method for the *info* argument

Raises **MdfError** :

- * if the channel name is not found
- * if the group index is out of range
- * if the channel index is out of range

get_channel_data (*name=None, group=None, index=None, data=None, signal_data=None, return_info=False*)

get channel values. The channel is identified by name (*name* argument) or by the group and channel indexes (*group* and *index* arguments). *data* argument is used internally by the *get* method to avoid double work. By default only the channel values are returned. If the *return_info* argument is set then name, unit and conversion info is returned as well

Parameters **name** : str

channel name in target group

group : int

group index

index : int

channel index

data : bytes

data groups's raw channels data

signal_data : bytes

data from SDBLOCKS of VLDS channels

return_info : bool

enables returning extra information (name, unit, conversion)

Returns **vals** : numpy.array

channel values; if *return_info* is False

vals, name, conversion, unit : numpy.array, str, dict, str

channel values, channel name, channel conversion, channel unit: if *return_info* is True

get_master_data (*name=None, group=None, data=None*)

get master channel values only. The group is identified by a channel name (*name* argument) or by the index (*group* argument). *data* argument is used internally by the *get* method to avoid double work.

Parameters **name** : str

channel name in target group

group : int

group index

data : bytes

data groups's raw channel data

Returns **t** : numpy.array

master channel values

info ()

get MDF information as a dict

Examples

```
>>> mdf = MDF4('test.mdf')
>>> mdf.info()
```

remove (*group=None, name=None*)

Remove data group. Use *group* or *name* keyword arguments to identify the group's index. *group* has priority

Parameters **name** : string

name of the channel inside the data group to be removed

group : int

data group index to be removed

Examples

```
>>> mdf = MDF4('test.mdf')
>>> mdf.remove(group=3)
>>> mdf.remove(name='VehicleSpeed')
```

save (*dst=None*)

Save MDF to *dst*. If *dst* is *None* the original file is overwritten

MDF version 4 blocks

The following classes implement different MDF version3 blocks.

AttachmentBlock Class

class `asammdf.mdf4.AttachmentBlock` (**kargs)
ATBLOCK class

When adding new attachments only embedded attachemnts are allowed, with keyword argument *data* of type bytes

Methods

<code>clear</code>	
<code>copy</code>	Generic (shallow and deep) copying operations.
<code>extract</code>	
<code>fromkeys</code>	
<code>get</code>	
<code>items</code>	
<code>keys</code>	
<code>pop</code>	
<code>popitem</code>	
<code>setdefault</code>	
<code>update</code>	
<code>values</code>	

Channel Class

class `asammdf.mdf4.Channel` (**kargs)
CNBLOCK class

Methods

<code>clear</code>	
<code>copy</code>	Generic (shallow and deep) copying operations.
<code>fromkeys</code>	
<code>get</code>	
<code>items</code>	
<code>keys</code>	
<code>pop</code>	
<code>popitem</code>	
<code>setdefault</code>	
<code>update</code>	
<code>values</code>	

ChannelConversion Class

```
class asammdf.mdf4.ChannelConversion(**kargs)
    CCBLOCK class
```

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

ChannelGroup Class

```
class asammdf.mdf4.ChannelGroup(**kargs)
    CGBLOCK class
```

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

DataGroup Class

```
class asammdf.mdf4.DataGroup(**kargs)
    DGBLOCK class
```

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

DataList Class

class `asammdf.mdf4.DataList` (**kargs)
DLBLOCK class

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

DataBlock Class

class `asammdf.mdf4.DataBlock` (**kargs)
DTBLOCK class Raw channel dta can be compressed to save RAM; set the *compression* keyword argument to True when instantiating the object

Parameters **compression** : bool

enable raw channel data compression in RAM

address : int

DTBLOCK address inside the file

file_stream : int

file handle

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

FileIdentificationBlock Class

```
class asammdf.mdf4.FileIdentificationBlock(**kargs)
    IDBLOCK class
```

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

HeaderBlock Class

```
class asammdf.mdf4.HeaderBlock(**kargs)
    HDBLOCK class
```

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	

Continued on next page

Table 8.24 – continued from previous page

setdefault
update
values

SourceInformation Class

class asammdf.mdf4.**SourceInformation** (**kargs)
SIBLOCK class

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

FileHistory Class

class asammdf.mdf4.**FileHistory** (**kargs)
FHBLOCK class

Methods

clear	
copy	Generic (shallow and deep) copying operations.
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

TextBlock Class

class asammdf.mdf4.**TextBlock** (**kargs)
common TXBLOCK and MDBLOCK class

Methods

clear	
copy	Generic (shallow and deep) copying operations.
from_text	
fromkeys	
get	
items	
keys	
pop	
popitem	
setdefault	
update	
values	

classmethod from_text (*text*, *meta=False*)

Create a TextBlock from a str or bytes

Parameters **text** : str | bytes

input text

meta : bool

enable meta text block

Examples

```
>>> t = TextBlock.from_text(b'speed')
>>> t['id']
b'##TX'
>>> t.text_str
speed
>>> t = TextBlock.from_text('mass', meta=True)
>>> t['id']
b'##MD'
```

Notes about *compression* and *load_measured_data* arguments

By default *MDF* object use no compression and the raw channel data is loaded into RAM. This will give you the best performance from *asammdf*.

However if you reach the physical memmory limit *asammdf* gives you two options

1. use the *compression* flag: raw channel data is loaded into RAM but it is compressed. The default compression library is *blosc* and as a fallback *zlib* is used (slower). The advange is that you save RAM, but in return you will pay the compression/decompression time penalty in all operations (file open, getting channel data, saving to disk, converting).
2. use the *load_measured_data* flag: raw channel data is not read.

MDF defaults

Advantages

- best performance

Disadvantages

- highest RAM usage

Use case

- when data fits inside the system RAM

MDF with compression

Advantages

- lower RAM usage than *default*
- allows saving to disk and appending new data

Disadvantages

- slowest

Use case

- when *default* data exceeds RAM and you need to append and save

MDF with load_measured_data

Advantages

- lowest RAM usage
- faster than *compression*

Disadvantages

- ReadOnly mode: appending and saving is not possible

Use case

- when *default* data exceeds RAM and you only want to extract information from the file

Note: See benchmarks for the effects of using the flags.

Signal

class `asammdf.signal.Signal` (*samples=None, timestamps=None, unit='', name='', conversion=None*)

The Signal represents a signal described by its samples and timestamps. It can do arithmetic operations against other Signal or numeric type. The operations are computed in respect to the timestamps (time correct). The integer signals are not interpolated, instead the last value relative to the current timestamp is used. *samples*, *timestamps* and *name* are mandatory arguments.

Parameters *samples* : numpy.array

signal samples
timestamps : numpy.array
 signal timestamps
unit : str
 signal unit
name : str
 signal name
conversion : dict
 dict describing the channel conversion , default *None*

Methods

astype
 cut
 interp
 plot

astype (*np_type*)
 returns new *Signal* with samples of dtype *np_type*

cut (*start*, *stop*)
 Cuts the signal according to the *start* and *stop* values, by using the insertion indexes in the signal's *time* axis.

Parameters **start** : float
 start timestamp for cutting
stop : float
 stop timestamp for cutting

Returns **outsig** : *Signal*
 new *Signal* cut from the original

Examples

```

>>> new_sig = old_sig.cut(1.0, 10.5)
>>> new_sig.timestamps[0], new_sig.timestamps[-1]
0.98, 10.48

```

interp (*new_timestamps*)
 returns a new *Signal* interpolated using the *new_timestamps*

plot ()
 plot *Signal* samples

Examples

Working with MDF

```

from asammdf import MDF, Signal
import numpy as np

# create 3 Signal objects

timestamps = np.array([0.1, 0.2, 0.3, 0.4, 0.5], dtype=np.float32)

# uint8
s_uint8 = Signal(samples=np.array([0, 1, 2, 3, 4], dtype=np.uint8),
                  timestamps=timestamps,
                  name='Uint8_Signal',
                  unit='u1')

# int32
s_int32 = Signal(samples=np.array([-20, -10, 0, 10, 20], dtype=np.int32),
                  timestamps=timestamps,
                  name='Int32_Signal',
                  unit='i4')

# float64
s_float64 = Signal(samples=np.array([-20, -10, 0, 10, 20], dtype=np.int32),
                    timestamps=timestamps,
                    name='Float64_Signal',
                    unit='f8')

# create empty MDf version 4.00 file
mdf4 = MDF(version='4.00')

# append the 3 signals to the new file
signals = [s_uint8, s_int32, s_float64]
mdf4.append(signals, 'Created by Python')

# save new file
mdf4.save('my_new_file.mf4')

# convert new file to mdf version 3.10 with compression of raw channel data
mdf3 = mdf4.convert(to='3.10', compression=True)
print(mdf3.version)
# prints >>> 3.10

# get the float signal
sig = mdf3.get('Float64_Signal')
print(sig)
# prints >>> Signal { name="Float64_Signal":          s=[-20 -10   0  10  20] t=[ 0.1  0.2
→      0.2          0.30000001  0.40000001  0.5          ] unit="f8"
→ conversion=None }

```

Working with Signal

```

from asammdf import Signal
import numpy as np

```

```

# create 3 Signal objects with different time stamps

# uint8 with 100ms time raster
timestamps = np.array([0.1 * t for t in range(5)], dtype=np.float32)
s_uint8 = Signal(samples=np.array([t for t in range(5)], dtype=np.uint8),
                  timestamps=timestamps,
                  name='Uint8_Signal',
                  unit='u1')

# int32 with 50ms time raster
timestamps = np.array([0.05 * t for t in range(10)], dtype=np.float32)
s_int32 = Signal(samples=np.array(list(range(-500, 500, 100)), dtype=np.int32),
                  timestamps=timestamps,
                  name='Int32_Signal',
                  unit='i4')

# float64 with 300ms time raster
timestamps = np.array([0.3 * t for t in range(3)], dtype=np.float32)
s_float64 = Signal(samples=np.array(list(range(2000, -1000, -1000)), dtype=np.int32),
                   timestamps=timestamps,
                   name='Float64_Signal',
                   unit='f8')

prod = s_float64 * s_uint8
prod.name = 'Uint8_Signal * Float64_Signal'
prod.unit = '*'
prod.plot()

pow2 = s_uint8 ** 2
pow2.name = 'Uint8_Signal ^ 2'
pow2.unit = 'u1^2'
pow2.plot()

allsum = s_uint8 + s_int32 + s_float64
allsum.name = 'Uint8_Signal + Int32_Signal + Float64_Signal'
allsum.unit = '+'
allsum.plot()

# inplace operations
pow2 *= -1
pow2.name = '- Uint8_Signal ^ 2'
pow2.plot()

```


Intro

The benchmarks were done using two test files (for mdf version 3 and 4) of around 170MB. The files contain 183 data groups and a total of 36424 channels.

asamdf 2.1.0 was compared against *mdfreader 0.2.5*. *mdfreader* seems to be the most used Python package to handle MDF files, and it also supports both version 3 and 4 of the standard.

The three benchmark categories are file open, file save and extracting the data for all channels inside the file(36424 calls). For each category two aspects were noted: elapsed time and peak RAM usage.

Dependencies

You will need the following packages to be able to run the benchmark script

- psutil
- mdfreader

x64 Python results

The test environment used for 64 bit tests had:

- Python 3.6.1 (v3.6.1:69c0db5, Mar 21 2017, 18:41:36) [MSC v.1900 64 bit (AMD64)]
- Windows-7-6.1.7601-SP1
- Intel64 Family 6 Model 94 Stepping 3, GenuineIntel (i7-6820Q)
- 16GB installed RAM

The notations used in the results have the following meaning:

- nodata = MDF object created with load_measured_data=False (raw channel data no loaded into RAM)
- compression = MDF object created with compression=True (raw channel data loaded into RAM and compressed)
- noconvert = MDF object created with convertAfterRead=False

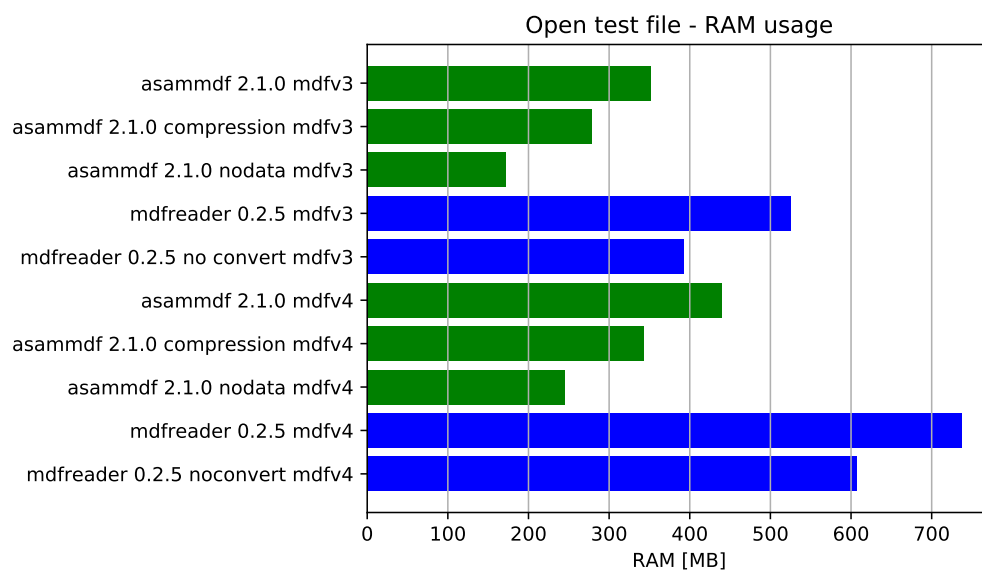
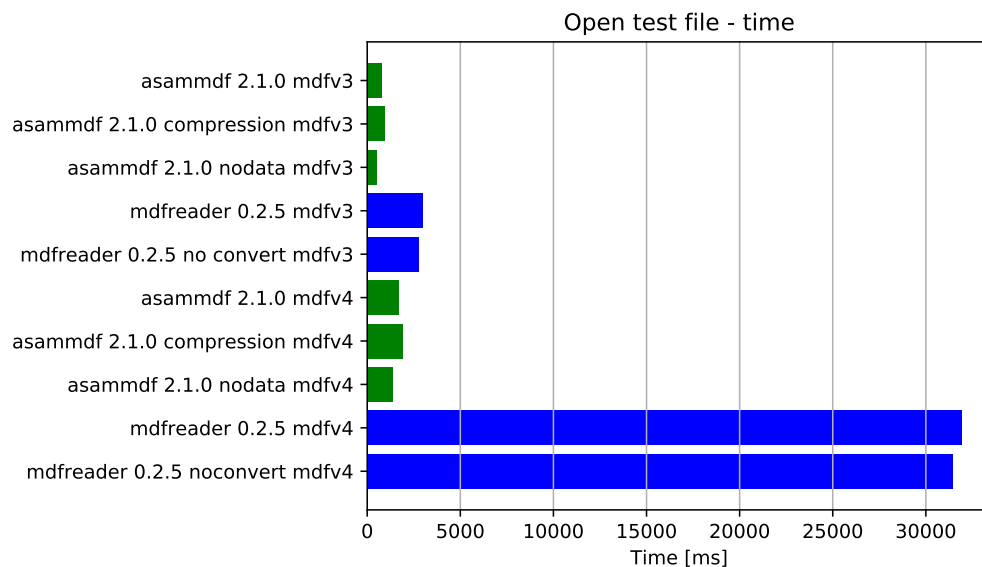
Raw data

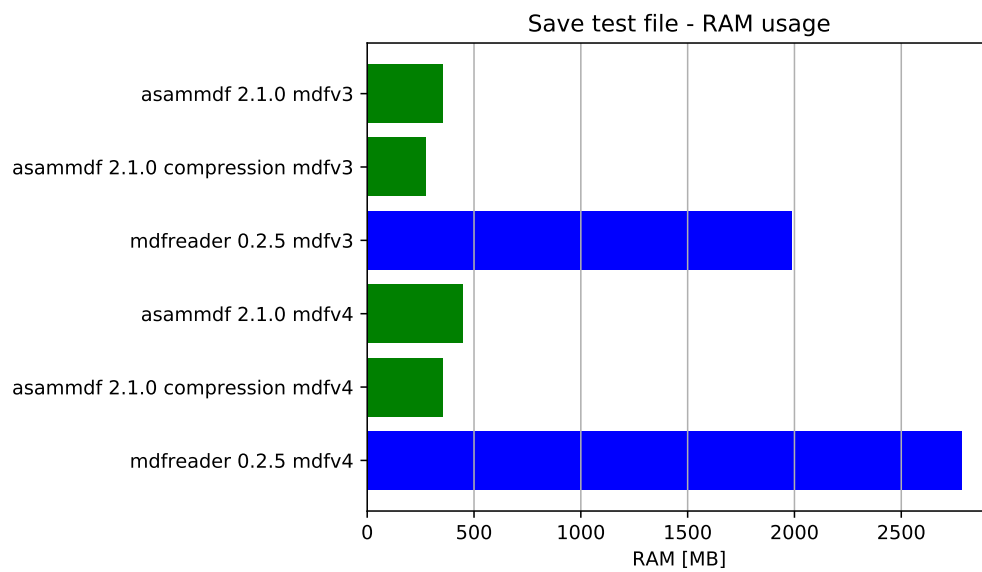
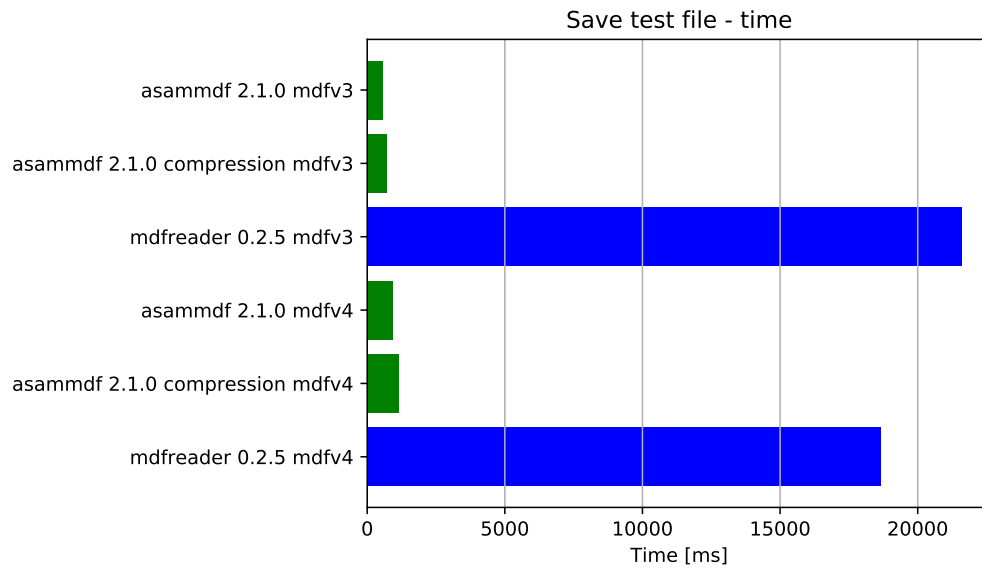
Open file	Time [ms]	RAM [MB]
asammdf 2.1.0 mdv3	801	352
asammdf 2.1.0 compression mdv3	946	278
asammdf 2.1.0 nodata mdv3	490	172
mdfreader 0.2.5 mdv3	2962	525
mdfreader 0.2.5 no convert mdv3	2740	392
asammdf 2.1.0 mdv4	1674	440
asammdf 2.1.0 compression mdv4	1916	343
asammdf 2.1.0 nodata mdv4	1360	245
mdfreader 0.2.5 mdv4	31915	737
mdfreader 0.2.5 noconvert mdv4	31425	607

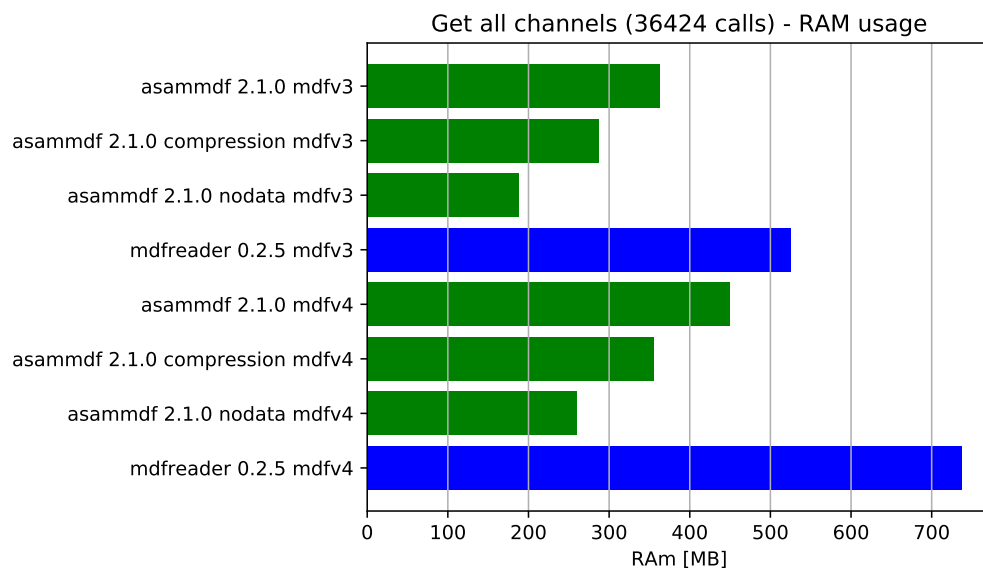
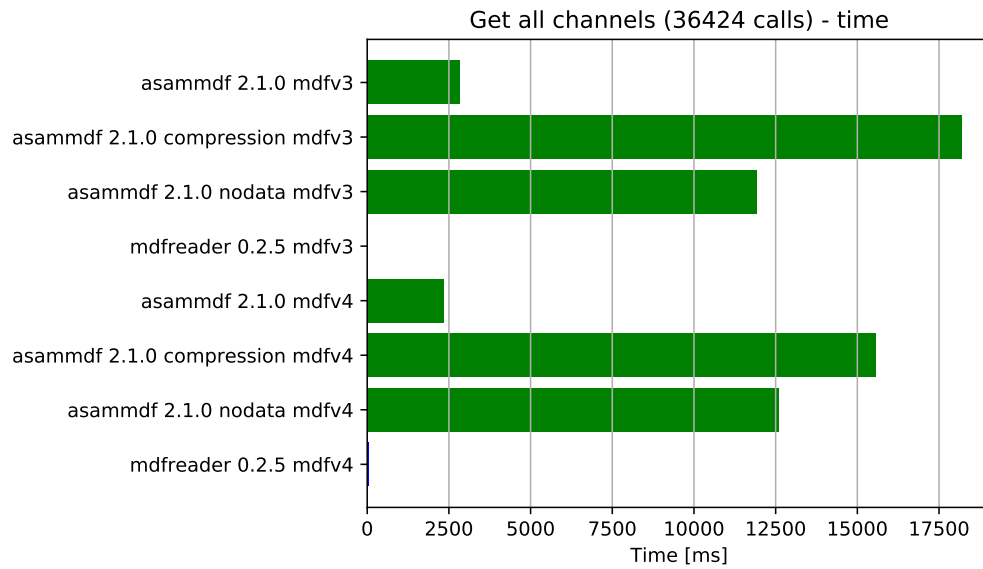
Save file	Time [ms]	RAM [MB]
asammdf 2.1.0 mdv3	575	353
asammdf 2.1.0 compression mdv3	705	276
mdfreader 0.2.5 mdv3	21591	1985
asammdf 2.1.0 mdv4	913	447
asammdf 2.1.0 compression mdv4	1160	352
mdfreader 0.2.5 mdv4	18666	2782

Get all channels (36424 calls)	Time [ms]	RAM [MB]
asammdf 2.1.0 mdv3	2835	363
asammdf 2.1.0 compression mdv3	18188	287
asammdf 2.1.0 nodata mdv3	11926	188
mdfreader 0.2.5 mdv3	29	525
asammdf 2.1.0 mdv4	2338	450
asammdf 2.1.0 compression mdv4	15566	355
asammdf 2.1.0 nodata mdv4	12598	260
mdfreader 0.2.5 mdv4	39	737

Graphical results







x86 Python results

The test environment used for 32 bit tests had:

- Python 3.6.1 (v3.6.1:69c0db5, Mar 21 2017, 17:54:52) [MSC v.1900 32 bit (Intel)]
- Windows-7-6.1.7601-SP1
- Intel64 Family 6 Model 94 Stepping 3, GenuineIntel (i7-6820Q)
- 16GB installed RAM

The notations used in the results have the following meaning:

- nodata = MDF object created with load_measured_data=False (raw channel data no loaded into RAM)
- compression = MDF object created with compression=True (raw channel data loaded into RAM and compressed)
- noconvert = MDF object created with convertAfterRead=False

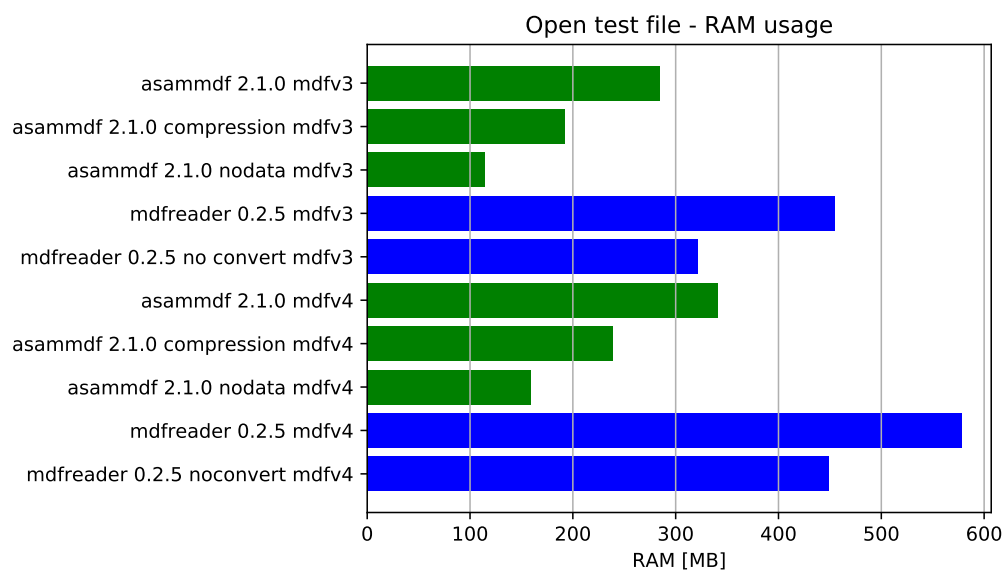
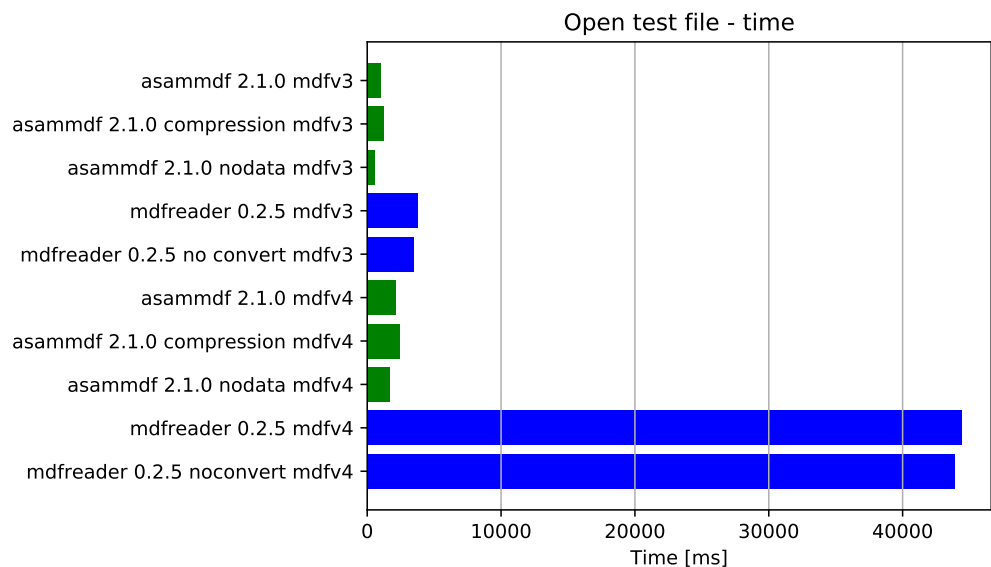
Raw data

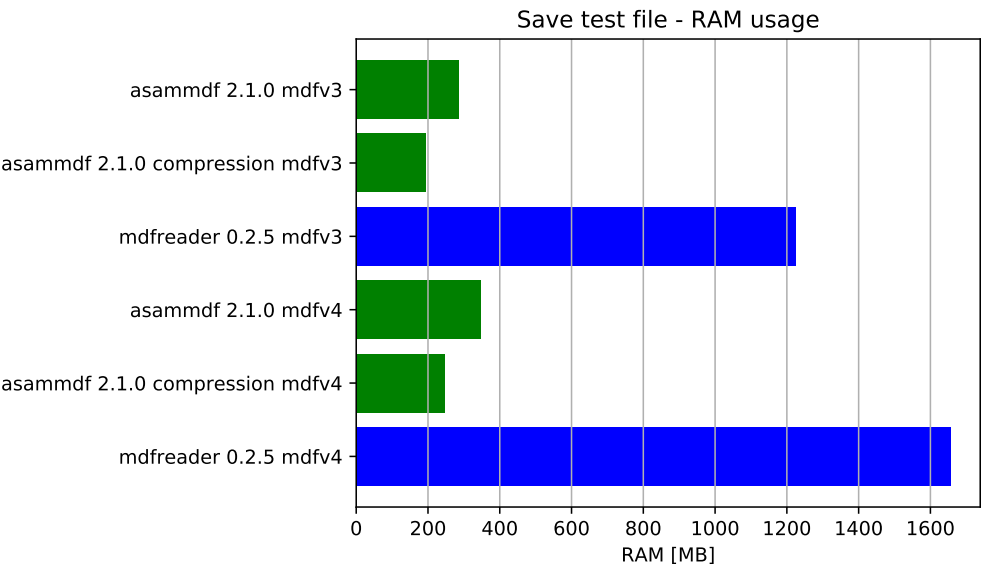
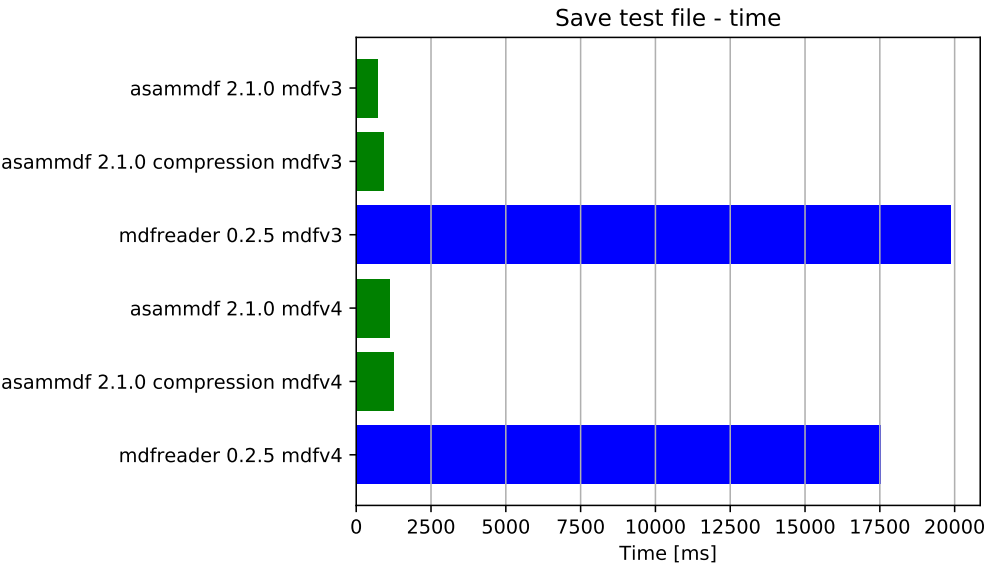
Open file	Time [ms]	RAM [MB]
asammdf 2.1.0 mdfv3	1031	284
asammdf 2.1.0 compression mdfv3	1259	192
asammdf 2.1.0 nodata mdfv3	584	114
mdfreader 0.2.5 mdfv3	3809	455
mdfreader 0.2.5 no convert mdfv3	3498	321
asammdf 2.1.0 mdfv4	2109	341
asammdf 2.1.0 compression mdfv4	2405	239
asammdf 2.1.0 nodata mdfv4	1686	159
mdfreader 0.2.5 mdfv4	44400	578
mdfreader 0.2.5 noconvert mdfv4	43867	449

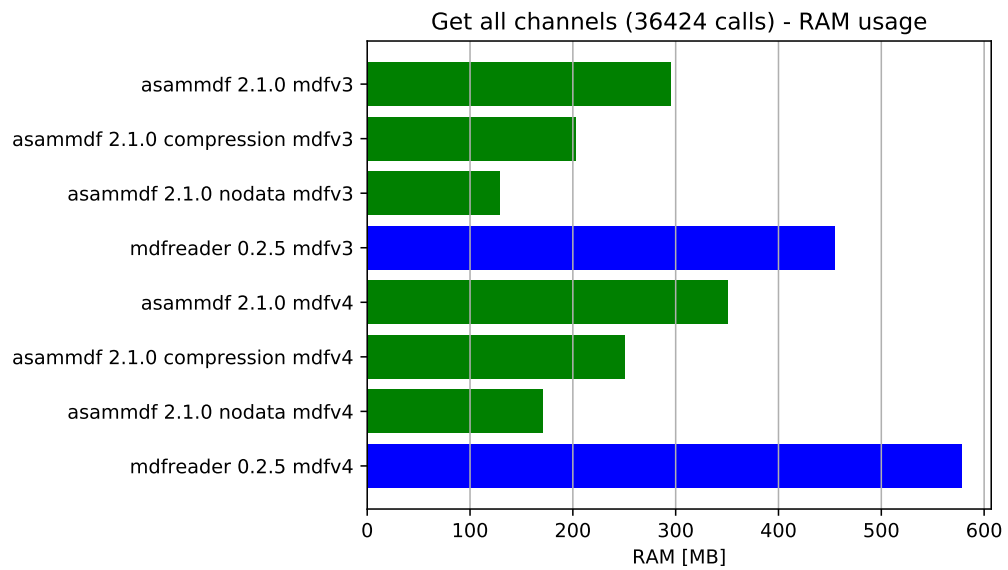
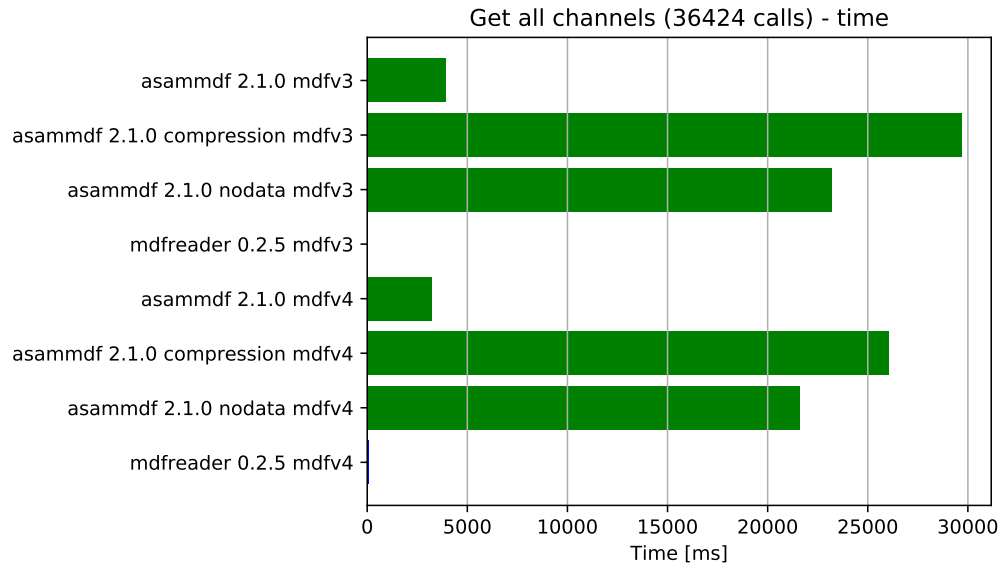
Save file	Time [ms]	RAM [MB]
asammdf 2.1.0 mdfv3	713	286
asammdf 2.1.0 compression mdfv3	926	194
mdfreader 0.2.5 mdfv3	19862	1226
asammdf 2.1.0 mdfv4	1109	347
asammdf 2.1.0 compression mdfv4	1267	246
mdfreader 0.2.5 mdfv4	17518	1656

Get all channels (36424 calls)	Time [ms]	RAM [MB]
asammdf 2.1.0 mdfv3	3943	295
asammdf 2.1.0 compression mdfv3	29682	203
asammdf 2.1.0 nodata mdfv3	23215	129
mdfreader 0.2.5 mdfv3	38	455
asammdf 2.1.0 mdfv4	3227	351
asammdf 2.1.0 compression mdfv4	26070	250
asammdf 2.1.0 nodata mdfv4	21619	171
mdfreader 0.2.5 mdfv4	51	578

Graphical results







CHAPTER 10

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- `modindex`
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