Format Specification
MDF Format
Version 3.0

Revision History:

Date	Version	Contents
03/10/2000	1.0	Technical documentation of current status
03/12/2001	1.3	Several corrections
05.02.2002	1.4	Data type “String” and “Byte Array” added. Conversion formulas “ASAP2 Rational Conversion formula”, “ASAP2 Textual Conversion formula”, “ASAP2 Text table Conversion formula”, “Date”, “Time” added. Implementation hints removed.
29.07.2002	1.5	Several corrections
01.08.2002	1.6	minor editorial changes
19.08.2002	2.0	enhancements: • support for COMPU_VTAB_RANGE (CCBLOCK) • display identifier in CNBLOCK • additional byte offset in CNBLOCK
04.09.2002	2.1	review with Vector
14.11.2002	2.2	updated description of record sorting based on time

Table of Contents

1. Introduction

For recording, exchanging, and post-measurement analysis, the Measure Data Format (MDF) is well established in the automotive industry. The MDF format provides

- exchange between a number of tools in the automotive industry
- compact description of data
- fast access to general file info independent of the file length

1.1. Scope of This Document

This document serves to specify MDF version 3.0.

1.2. Conventions

1.3. Abbreviations

CCBLOCK	Channel Conversion BLOCK
CGBLOCK	Channel Group BLOCK
CNBLOCK	ChanNel BLOCK
DGBLOCK	Data Group BLOCK
HDBLOCK	HeaDer BLOCK
IDBLOCK	IDentification BLOCK
MDF	Measure Data Format
NIL	NIL pointer (0x00000000)
PRBLOCK	PRogram BLOCK
TXBLOCK	TeXt BLOCK

1.4. Outline

Chapter 2 describes the conventions for extending and updating the format. Chapter 3 describes the structure of the MDF file and the various block types. Chapter 4 describes how data is written, i.e. sorted or unsorted. Chapter 5 (Appendix) shows the hex dump of an actual MDF file.

2. MDF Version Handling

The MDF version consists of a major version number and a minor version number, e.g. V3.0 has the major version number "3" and the minor version number "0".

minor version number	Changes in the MDF file that may not result in a misinterpretation of the data may be done by only changing the minor version number.
major version number	Changes in the MDF format that may result in a misinterpretation of the data require a change of the major version number. A tool that evaluates the MDF file may generate a warning or error message when reading a MDF file that has a higher major version number than what is supported by the tool.

2.1. Rules to Ensure MDF Compatibility between Versions

To ensure a high degree of compatibility, new entries are only appended to the blocks. This implies the following consequences for the evaluation tool:

1. If a tool detects a block that has a smaller block length than expected by the version supported by the tool, the additional fields are set to their default values. This is the case, if the tool supports a later MDF version than the file is encoded in.
2. If the tool detects a block that has a larger block length than expected by the version supported by the tool, the additional fields are ignored. This is the case, if the tools supports a previous MDF version compared to the one the file is encoded with. In this case, the tool may interpret the measurement data in the file incorrectly; thus the MDF major version number has to be increased when introducing such a change.

3. MDF General Block Format

The MDF file is composed of a series of data blocks. The blocks include pointers to each other that are stored in data of type LINK. A link is a relative byte position within the file, starting at the beginning of the file.

The file always starts with the file identifier IDBLOCK. The file header HDBLOCK follows at byte position 64. All other blocks are exclusively linked with each other via LINKs.

With the exception of the IDBLOCK, the "Block Size" field indicates the size of each block. To ensure upward compatibility, the block sizes specified in this document should be considered the minimum block sizes in each case.

The following figure gives an overview of the general block structure of an MDF file:

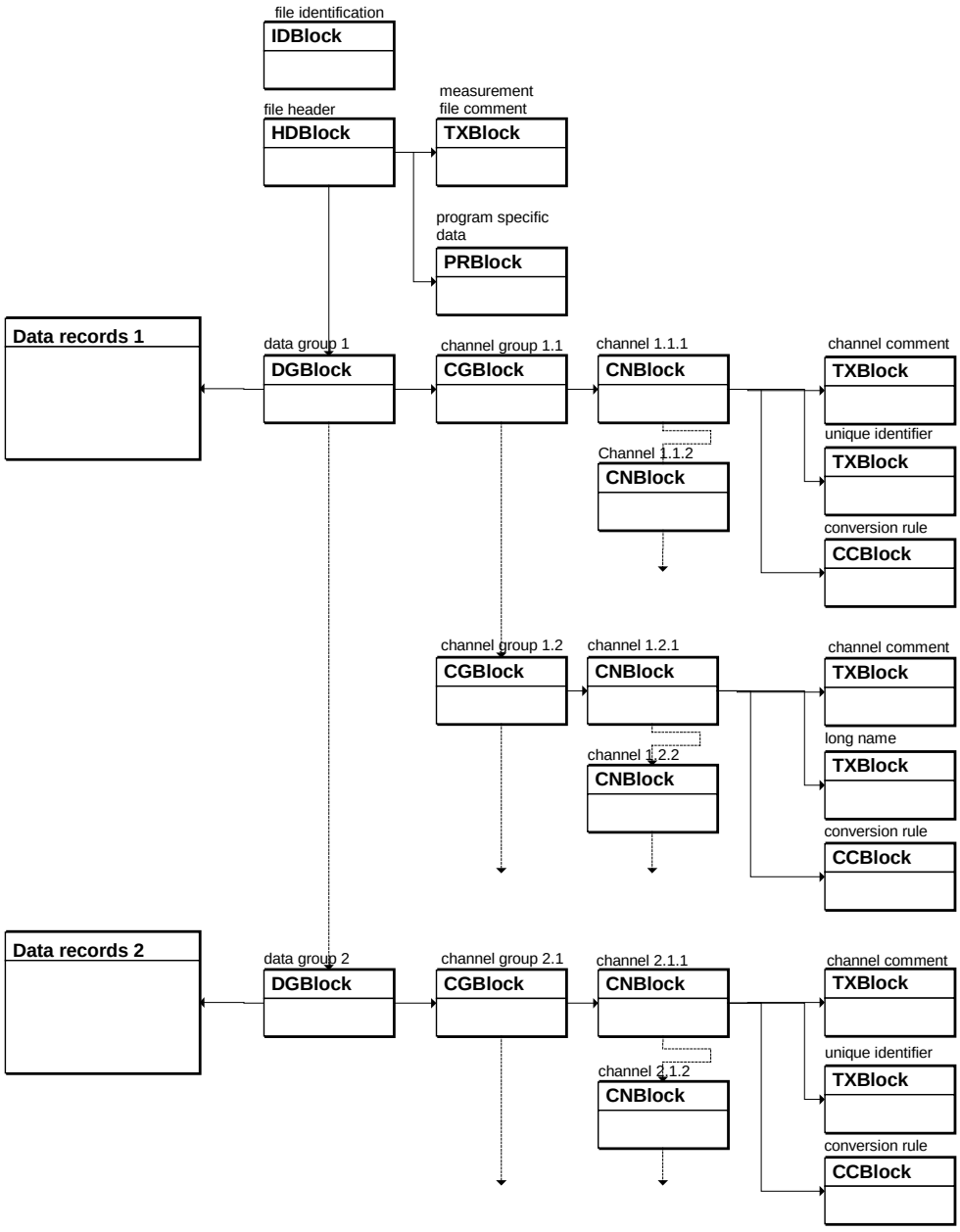

figure 1: MDF file block structure and linkage

The specification also shows an example of each block type. The HEX dump of the entire sample file is included in the attachment.

3.1. Definition of Data Types Used

Data Type	Format
CHAR	1 byte representing a character (C data type: char). The storage of character strings may or may not be terminated by a zero byte.
UINT8	8-bit unsigned integer
UINT16	16-bit unsigned integer
UINT32	32-bit unsigned integer
BOOL	Boolean variable, stored as 16-bit value
	If contents != 0 then TRUE, if contents == 0 then FALSE
REAL	Floating-point compliant with IEEE 754, double precision (64 bits)
LINK	32-bit signed integer, used as byte position within the file. If a LINK is nil (corresponds to 0), this means the LINK cannot be de-referenced.

3.2. Overview of Block Types Used

Block Type	Description	Purpose
IDBLOCK	Identification block	Identification of the file as MDF file
HDBLOCK	Header block	General description of the measurement file
TXBLOCK	Text block	Contains a String with variable length
PRBLOCK	Program block	Contains proprietary data of the application generating the MDF file
DGBLOCK	Data group block	Description of data block that may refer to one or several channel groups
CGBLOCK	Channel group block	Description of a channel group, i.e. signals which are always measured jointly
CNBLOCK	Channel block	Description of a channel
CCBLOCK	Channel conversion block	Description of a conversion formula for a channel

3.3. The File Identification Block IDBLOCK

The IDBLOCK always begins at file position 0. It contains information to identify the file. This includes information about the source of the file and general format specifications.

3.3.1. Block Structure of IDBLOCK

Data Type	Number	Description
CHAR	8	File identifier, always contains "MDF ". ("MDF" followed by five spaces)
CHAR	8	Format identifier, a textual representation of the format version for display, e.g. "3.00 "
CHAR	8	Program identifier, to identify the program which generated the MDF file
UINT16	1	Byte order
		0 = Little endian
UINT16	1	Floating-point format used
		0 = Floating-point format compliant with IEEE 754 standard
UINT16	1	Version number of the MDF , i.e. 300 for this version
UINT16	1	Reserved
CHAR	2	Reserved
CHAR	30	Reserved

3.3.2. Example of IDBLOCK

```
00000000  4d 44 46 20 20 20 20 20 32 2e 30 30 20 20 20 20  MDF     2.00
00000010  54 47 54 53 56 52 32 30 00 00 00 00 c8 00 00 00  TGTSVR20........
00000020  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000030  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
```

Field	Contents
File identifier	"MDF "
Format identifier	"2.00 "
Program identifier	"TGTSVR20"
Byte order	0 (Little endian)
Floating-point format	0 (floating-point format compliant with IEEE 754)
Version number	200

3.4. The Header Block HDBLOCK

The HDBLOCK always begins at file position 64. It contains general information about the contents of the measured data file.

3.4.1. Block Structure of HDBLOCK

Data Type	Number	Description
CHAR	2	Block type identifier, always "HD"
UINT16	1	Block size of this block in bytes (entire HDBLOCK)
LINK	1	Pointer to the first file group block (DGBLOCK)
LINK	1	Pointer to the measurement file comment text (TXBLOCK) (NIL allowed)
LINK	1	Pointer to program block (PRBLOCK) (NIL allowed)
Uint16	1	Number of data groups
CHAR	10	Date at which the recording was started in "DD:MM:YYYY" format
CHAR	8	Time at which the recording was started in "HH:MM:SS" format
CHAR	32	Author's name
CHAR	32	Name of organization or department
CHAR	32	Project name
CHAR	32	Measurement object e. g. the vehicle identification

3.4.2. Example of HDBLOCK

```
00000040  48 44 a4 00 e9 04 00 00 e4 00 00 00 00 00 00 00  HD..............
00000050  02 00 30 33 3a 30 33 3a 32 30 30 30 30 39 3a 34  ..03:03:200009:4
00000060  31 3a 33 38 4d 65 69 65 72 00 00 00 00 00 00 00  1:38Meier.......
00000070  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000080  00 00 00 00 45 54 41 53 00 00 00 00 00 00 00 00  ....ETAS........
00000090  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000000a0  00 00 00 00 50 72 6f 6a 65 6b 74 20 58 5a 34 35  ....Projekt XZ45
000000b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000000c0  00 00 00 00 46 61 68 72 7a 65 75 67 20 42 30 38  ....Fahrzeug B08
000000d0  31 35 00 00 00 00 00 00 00 00 00 00 00 00 00 00  15..............
000000e0  00 00 00 00                                      ....
```

Field	Contents
Block identifier	"HD"
Block size	0xA4
Pointer to first file group block	0x000004E9
Pointer to comment	0x000000E4
Pointer to program block	NIL
Number of data groups	2
Date	"03:03:2000"
Time in "HH:MM:SS" format	"09:41:38"
Author's name	"Meier"
Department	"ETAS"
Project name	"Projekt XZ45"
Measurement object	"Fahrzeug B0815"

3.5. The Text Block TXBLOCK

The TXBLOCK contains an optional comment for the measured data file, channel group or signal, or the long name of a signal. The text length results from the block size.

3.5.1. Block Structure of TXBLOCK

Data Type	Number	Description
CHAR	2	Block type identifier, always "TX"
UINT16	1	Block size of this block in bytes (entire TXBLOCK)
CHAR	variable	Text (new line indicated by CR and LF; end of text indicated by 0)

3.5.2. Example of TXBLOCK

Comment for the header block, referenced in the block by LINK 0x000000E4.

```
000000e0                  54 58 05 04 4b 6f 6d 6d 65 6e 74 61       TX..Kommenta
000000f0  72 20 7a 75 72 20 4d 65 73 73 75 6e 67 20 32 20  r zur Messung 2
00000100  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000110  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000120  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000130  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000140  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000150  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000160  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000170  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000180  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000190  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001a0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001b0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001c0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001d0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001e0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001f0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000200  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000210  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000220  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000230  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000240  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000250  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000260  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000270  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000280  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000290  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002a0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002b0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002c0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002d0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002e0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002f0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
```

```
00000300  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000310  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000320  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000330  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000340  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000350  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000360  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000370  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000380  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000390  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003a0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003b0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003c0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003d0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003e0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003f0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000400  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000410  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000420  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000430  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000440  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000450  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000460  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000470  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000480  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000490  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004a0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004b0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004c0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004d0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004e0  20 20 20 20 20 20 20 20 00
```

Field	Contents
Block identifier	"TX"
Block size	0x405
Comment	"Kommentar zur Messung 2", followed by 1001 spaces and terminated by 0.

Note: A file may reserve spaces to allow modifying the comment within its reserved range without the need to rewrite the entire MDF file.

3.6. The Program-Specific Block PRBLOCK

The PRBLOCK contains non standardized data to exchange between the acquisition program and the evaluation program.

3.6.1. Block Structure of PRBLOCK

Data Type	Number	Description
CHAR	2	Block type identifier, always "PR"
UINT16	1	Block size of this block in bytes (entire PRBLOCK)
CHAR	variable	Program-specific data

3.6.2. Example of PRBLOCK

```
00001270                        50 52 25 00 54 68 69 73 20  .......PR%.This
00001280  69 73 20 61 6e 20 65 78 61 6d 70 6c 65 20 66 6f  is an example fo
00001290  72 20 61 6e 20 50 52 42 6c 6f 63 6b              r an PRBlock....
```

3.7. The Data Group Block DGBLOCK

The DGBlock contains the actual measurement data for one ("sorted") or several ("unsorted") channel groups. (see chapter 4 for details)

3.7.1. Block Structure of DGBLOCK

Data Type	Number	Description
CHAR	2	Block type identifier, always "DG"
UINT16	1	Block size of this block in bytes (entire DGBLOCK)
LINK	1	Pointer to next data group block (DGBLOCK) (NIL allowed)
LINK	1	Pointer to next channel group block (CGBLOCK) (NIL allowed)
LINK	1	Reserved
LINK	1	Pointer to the data records (see separate chapter on data storage)
UINT16	1	Number of channel groups
UINT16	1	Number of record IDs in the data block
		0 = data records without record ID 1 = record ID (UINT8) before each data record 2 = record ID (UINT8) before and after each data record
UINT32	1	Reserved

3.7.2. Example of DGBLOCK

The example contains two data group blocks:

```
000004e0                              44 47 1c 00 05 05 00           DG.....
000004f0  00 4e 0f 00 00 00 00 00 00 d7 11 00 00 01 00 00  .N..............
00000500  00 00 00 00 00                                   .....
```

Field	Contents
Block identifier	"DG"
Block size	0x1C
Pointer to next file group block	0x00000505
Pointer to first channel group block	0x00000F4E
Pointer to data records	0x000011D7
Number of channel groups	1
Number of record Ids	0 (i.e., sorted writing)

```
00000500                 44 47 1c 00 00 00 00 00 21 05 00       DG......!..
00000510  00 00 00 00 00 e1 08 00 00 01 00 00 00 00 00 00  ................
00000520  00                                               .
```

Field	Contents
Block identifier	"DG"
Block size	0x1C
Pointer to next file group block	0x00000521
Pointer to first channel group block	NIL
Pointer to data records	0x000008E1
Number of channel groups	1
Number of record Ids	0 (i.e., sorted writing)

3.8. The Channel Group Block CGBLOCK

This block describes the structure of a channel group. A channel group consists of different channels which are measured jointly at the same rate.

3.8.1. Block Structure of CGBLOCK

Data Type	Number	Description
CHAR	2	Block type identifier, always "CG"
UINT16	1	Block size of this block in bytes (entire CGBLOCK)
LINK	1	Pointer to next data Channel group block (CGBLOCK) (NIL allowed)
LINK	1	Pointer to first channel block (CNBLOCK) (NIL allowed)
LINK	1	Pointer to channel group comment text (TXBLOCK) (NIL allowed)
UINT16	1	Record ID
UINT16	1	Number of channels
UINT16	1	Data record size in bytes (without the record ID), i.e. data size of the channel group for each sample
UINT32	1	Number of records

3.8.2. Example of CGBLOCK

Channel group 1:

```
00000f40                                              43 47                CG
00000f50  1a 00 00 00 00 00 79 0f 00 00 68 0f 00 00 01 00  ......y...h.....
00000f60  02 00 05 00 20 00 00 00                          .... ...
```

Field	Contents
Block identifier	"CG"
Block size	0x1A
Pointer to next channel group block	NIL
Pointer to first channel block	0x00000F79
Pointer to comment text	0x00000F68
Record ID	1
Number of channels	2
Record size in bytes	5
Number of records	0x20 (= 32)

The respective comment block:

```
00000f60                        54 58 11 00 52 61 74 65          TX..Rate
00000f70  3a 20 30 2e 31 30 30 73 00                      : 0.100s.
```

Channel group 2:

```
00000520     43 47 1a 00 00 00 00 00 4c 05 00 00 3b 05 00   CG......L...;..
00000530  00 02 00 03 00 05 00 49 01 00 00                  .......I...
```

Field	Contents
Block identifier	"CG"
Block size	0x1A
Pointer to next channel group block	NIL
Pointer to first channel block	0x0000054C
Pointer to comment	0x0000053B
Record ID	2
Number of channels	3
Record size in bytes	5
Number of records	0x149 (= 329)

The respective comment block:

```
00000530                                 54 58 11 00 52            TX..R
00000540  61 74 65 3a 20 30 2e 30 31 30 73 00             ate: 0.010s.
```

3.9. The Channel Block CNBLOCK

This block describes a measurement channel.

3.9.1. Block Structure of CNBLOCK

Data Type	Number	Description
CHAR	2	Block type identifier, always "CN"
UINT16	1	Block size of this block in bytes (entire CNBLOCK)
LINK	1	Pointer to next channel block (CNBLOCK) of this channel group (NIL allowed)
LINK	1	Pointer to the conversion formula (CCBLOCK) of this signal (NIL allowed).
LINK	1	Reserved
LINK	1	Reserved
LINK	1	Pointer to the channel comment (TXBLOCK) of this signal (NIL allowed)
UINT16	1	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)
CHAR	32	Signal name, i.e. the first 32 characters of the ASAM-MCD unique name
CHAR	128	Signal description
UINT16	1	Number of the first bits [0..n] (bit position within a byte: bit 0 is the least significant bit, bit 7 is the most significant bit)
UINT16	1	Number of bits
UINT16	1	Signal data type
		0 = unsigned integer 1 = signed integer (two's complement) 2,3 = IEEE 754 floating-point format 7 = String (NULL terminated) 8 = Byte Array
BOOL	1	Value range – known implementation value
REAL	1	Value range – minimum implementation value
REAL	1	Value range – maximum implementation value
REAL	1	Rate in which the variable was sampled. Unit [s]
LINK	1	Pointer to the ASAM-MCD unique name (TXBLOCK) (NIL allowed)
LINK	1	Pointer to TXBLOCK that contains the signal's display identifier (default: NIL; NIL allowed)
UINT16	1	Byte offset of the signal in the data record in addition to bit offset (default value: 0) *note: this fields shall only be used if the CGBLOCK record size and the actual offset is larger than 8192 Bytes to ensure compatibility; it enables to write data blocks larger than 8kBytes*

Signals of 1 to 64 bits are supported both for unsigned and signed integers. For floating-point number compliant with the IEEE 754 standard, signal with 32, 64, and 80 bits (corresponding to single, double, and extended precision) are supported. This applies both to data and time channels.

note:
To determine the signal data type, the field "number of bits" needs to be evaluated, too.

For the data type String and Byte Array 8 up to 65528 Number of Bits are valid. The number of bits has to be a multiple of 8.

Within one measure file the long names of all signals have to be unique.

3.9.2. Example of CNBLOCK

Time signal from data group 1:

```
00000f70                                 43 4e de 00 9e 10 00           CN.....
00000f80  00 57 10 00 00 00 00 00 00 00 00 00 00 00 00 00  .W..............
00000f90  00 01 00 74 69 6d 65 00 00 00 00 00 00 00 00 00  ...time.........
00000fa0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000fb0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000fc0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000fd0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000fe0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000ff0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001000  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001010  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001020  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001030  00 00 00 00 00 20 00 00 00 00 00 00 00 00 00 00  ..... ..........
00001040  00 00 00 00 00 00 00 00 00 00 00 00 9a 99 99 99  ................
00001050  99 b9 3f 95 10 00 00 00 00 00 00                 ..?........
```

Field	Contents
Block identifier	"CN"
Block size	0xDE
Pointer to next channel block	0x0000109E
Pointer to CCBLOCK of signal	0x00001057
Pointer to comment text of signal	NIL
Channel type	1 (time channel)
Signal name	"time"
Signal description	""
Number of first bit	0
Number of bits	0x20 (= 32)
Signal data type	0 (unsigned integer)
Value range – known implementation value	False
Value range – minimum implementation value	0x0000000000000000 (= 0)
Value range – maximum implementation value	0x0000000000000000 (= 0)
Grid in which the variable was sampled	0x3FB999999999999A (= 0.1 s)
Pointer to TXBLOCK with long name	0x00001095
Pointer to TXBLOCK with display identifier	0x00000000
Byte offset (in addition to bit offset)	0x0000

Long name:

```
00001090              54 58 09 00 74 69 6d 65 00          TX..time.
```

Input_1 signal from channel group 1:

```
00001090                                                 43 4e              CN
000010a0  de 00 00 00 00 00 7c 11 00 00 00 00 00 00 00 00  ......|.........
000010b0  00 00 00 00 00 00 00 00 49 6e 70 75 74 5f 31 5c  ........Input_1\
000010c0  45 54 4b 2d 54 65 73 74 64 65 76 69 63 65 3a 31  ETK-Testdevice:1
000010d0  00 00 00 00 00 00 00 00 53 70 65 65 64 20 00 00  ........Speed ..
000010e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000010f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001100  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001110  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001120  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001130  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001140  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001150  00 00 00 00 00 00 00 00 20 00 08 00 00 00 00 00  ........ .......
00001160  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001170  9a 99 99 99 99 99 b9 3f ba 11 00 00 00 00 00 00  .......?........
00001180  00 00                                            ..
```

Field	Contents
Block identifier	"CN"
Block size	0xDE
Pointer to next channel block	NIL
Pointer to CCBLOCK of signal	0x0000117C
Pointer to comment text of signal	NIL
Channel type	0 (data channel)
Signal name	"Input_1\ETK-Testdevice:1"
Signal description	"Speed"
Number of first bit	0x20 (= 32)
Number of bits	8
Signal data type	0 (unsigned integer)
Value range – known implementation value	False
Value range – minimum implementation value	0x0000000000000000 (= 0)
Value range – maximum implementation value	0x0000000000000000 (= 0)
Grid in which the variable was sampled.	0x3FB999999999999A (= 0.1 s)
Pointer to TXBLOCK with long name	0x000011BA
Pointer to TXBLOCK with display identifier	0x00000000
Byte offset (in addition to bit offset)	0x0000

Long name:

```
000011b0                                 54 58 1d 00 49 6e            TX..In
000011c0  70 75 74 5f 31 5c 45 54 4b 2d 54 65 73 74 64 65  put_1\ETK-Testde
000011d0  76 69 63 65 3a 31 00                             vice:1.
```

Time signal from channel group 2:

```
00000540                                       43 4e de 00              CN..
00000550  71 06 00 00 2a 06 00 00 00 00 00 00 00 00 00 00  q...*...........
00000560  00 00 00 00 01 00 74 69 6d 65 00 00 00 00 00 00  ......time......
00000570  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000580  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000590  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000600  00 00 00 00 00 00 00 00 20 00 00 00 00 00 00 00  ........ .......
00000610  00 00 00 00 00 00 00 00 00 00 00 00 00 00 7b 14  ..............{.
00000620  ae 47 e1 7a 84 3f 68 06 00 00 00 00              .G.z.?h.....
```

Field	Contents
Block identifier	"CN"
Block size	0xDE
Pointer to next channel block	0x0000671
Pointer to CCBLOCK of signal	0x000062A
Pointer to comment text of signal	NIL
Channel type	1 (time channel)
Signal name	"time"
Signal description	""
Number of first bit	0
Number of bits	0x20 (= 32)
Signal data type	0 (unsigned integer)
Value range – known implementation value	False
Value range – minimum implementation value	0x0000000000000000 (= 0)
Value range – maximum implementation value	0x0000000000000000 (= 0)
Grid in which the variable was sampled.	0x3F847AE147AE147B (= 0.01 s)
Pointer to TXBLOCK with long name	0x00000668
Pointer to TXBLOCK with display identifier	0x00000000
Byte offset (in addition to bit offset)	0x0000

Long name:

```
00000660                          54 58 09 00 74 69 6d 65          TX..time
00000670  00                                                      .
```

Bit signal B_RED from channel group 2:

```
00000670     43 4e de 00 a8 07 00 00 4f 07 00 00 00 00 00   CN......O......
00000680  00 00 00 00 00 00 00 00 00 00 00 42 5f 52 45 44  ...........B_RED
00000690  5c 45 54 4b 2d 54 65 73 74 64 65 76 69 63 65 3a  \ETK-Testdevice:
000006a0  31 00 00 00 00 00 00 00 00 00 00 52 65 64 20 4c  1..........Red L
000006b0  45 44 27 73 20 73 74 61 74 65 2e 20 54 68 69 73  ED's state. This
000006c0  20 69 73 20 61 20 6c 6f 67 69 63 61 6c 20 6f 6e   is a logical on
000006d0  2f 6f 66 66 20 76 61 6c 75 65 00 00 00 00 00 00  /off value......
000006e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000006f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000700  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000710  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000720  00 00 00 00 00 00 00 00 00 00 00 20 00 01 00 00  ........... ....
00000730  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000740  00 00 00 7b 14 ae 47 e1 7a 84 3f 8d 07 00 00 00  ...{..G.z.?.....
00000750  00
```

Field	Contents
Block identifier	"CN"
Block size	0xDE
Pointer to next channel block	0x000007A8
Pointer to CCBLOCK of signal	0x0000074F
Pointer to comment text of signal	NIL
Channel type	0 (data channel)
Signal name	"B_RED\ETK-Testdevice:1"
Signal description	"Red LED's state. This is a logical on/off value"
Number of first bit	0x20 (= 32)
Number of bits	1
Signal data type	0 (unsigned integer)
Value range – known implementation value	False
Value range – minimum implementation value	0x0000000000000000 (= 0)
Value range – maximum implementation value	0x0000000000000000 (= 0)
Grid in which the variable was sampled.	0x3F847AE147AE147B (= 0.01 s)
Pointer to TXBLOCK with long name	0x0000078D
Pointer to TXBLOCK with display identifier	0x00000000
Byte offset (in addition to bit offset)	0x0000

Long name:

```
00000780                                              54 58 1b                TX.
00000790  00 42 5f 52 45 44 5c 45 54 4b 2d 54 65 73 74 64  .B_RED\ETK-Testd
000007a0  65 76 69 63 65 3a 31 00                           evice:1.
```

Bit signal B_GREEN from channel group 2:

```
000007a0                                 43 4e de 00 00 00 00 00          CN......
000007b0  86 08 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000007c0  00 00 42 5f 47 52 45 45 4e 5c 45 54 4b 2d 54 65  ..B_GREEN\ETK-Te
000007d0  73 74 64 65 76 69 63 65 3a 31 00 00 00 00 00 00  stdevice:1......
000007e0  00 00 47 72 65 65 6e 20 4c 45 44 27 73 20 73 74  ..Green LED's st
000007f0  61 74 65 2e 20 54 68 69 73 20 69 73 20 61 20 6c  ate. This is a l
00000800  6f 67 69 63 61 6c 20 6f 6e 2f 6f 66 66 20 76 61  ogical on/off va
00000810  6c 75 65 00 00 00 00 00 00 00 00 00 00 00 00 00  lue.............
00000820  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000830  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000840  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000850  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000860  00 00 21 00 01 00 00 00 00 00 00 00 00 00 00 00  ..!.............
00000870  00 00 00 00 00 00 00 00 00 00 7b 14 ae 47 e1 7a  ..........{..G.z
00000880  84 3f c4 08 00 00 00 00                          .?......
```

Field	Contents
Block identifier	"CN"
Block size	0xDE
Pointer to next channel block	NIL
Pointer to CCBLOCK of signal	0x00000886
Pointer to comment text of signal	NIL
Channel type	0 (data channel)
Signal name	"B_GREEN\ETK-Testdevice:1"
Signal description	"Green LED's state. This is a logical on/off value"
Number of first bit	0x21 (= 33)
Number of bits	1
Signal data type	0 (unsigned integer)
Value range – known implementation value	False
Value range – minimum implementation value	0x0000000000000000 (= 0)
Value range – maximum implementation value	0x0000000000000000 (= 0)
Grid in which the variable was sampled.	0x3F847AE147AE147B (= 0.01 s)
Pointer to TXBLOCK with long name	0x000008C4
Pointer to TXBLOCK with display identifier	0x00000000
Byte offset (in addition to bit offset)	0x0000

Long name:

```
000008c0              54 58 1d 00 42 5f 47 52 45 45 4e 5c      TX..B_GREEN\
000008d0  45 54 4b 2d 54 65 73 74 64 65 76 69 63 65 3a 31  ETK-Testdevice:1
000008e0  00 00 00                                         ...
```

3.10. The Channel Conversion Block CCBLOCK

The data records are used to store implementation values. The CCBLOCK serves to specify a conversion formula that can be used to convert these values into physical values with physical units.

3.10.1. Block Structure of CCBLOCK

Data Type	Number	Description
CHAR	2	Block type identifier, always "CC"
UINT16	1	Block size of this block in bytes (entire CCBLOCK)
BOOL	1	Value range – known physical value
REAL	1	Value range – minimum physical value
REAL	1	Value range – maximum physical value
CHAR	20	Physical unit
UINT16	1	Conversion formula identifier
		0 = parametric, linear 1 = tabular with interpolation 2 = tabular 6 = polynomial function 7 = exponential function 8 = logarithmic function 9 = ASAP2 Rational conversion formula 10 = ASAM-MCD2 Text formula 11 = ASAM-MCD2 Text Table, (COMPU_VTAB) 12 = ASAM-MCD2 Text Range Table (COMPU_VTAB_RANGE) 132 = Date (Based on 7 Byte Date data structure) 133 = time (Based on 6 Byte Time data structure) 65535 = 1:1 conversion formula (Int = Phys)
UINT16	1	Number of value pairs for conversion formulas 1, 2, 11 and 12 or number of parameters
...		Parameter (for type 0, 6,7,8, 9) or table (for type 1, 2, 11, or 12) or text (for type 10), depending on the conversion formula identifier. See formula-specific block supplement.

The following specifies the conversion formulas or their representation in CCBLOCK in detail. Int refers to the implementation value stored in the MDF file. Phys is the converted physical value.

3.10.2. CCBLOCK – Parametric, Linear

$$Phys = Int * P2 + P1$$

Data Type	Number	Description
REAL	1	P1
REAL	1	P2

3.10.3. CCBLOCK – Polynomial Function With 6 Parameters

$$Phys = \frac{P2 - [P4 * (Int - P5 - P6)]}{P3 * [Int - P5 - P6] - P1}$$

P6: only needed for twos complement representation:

For 1 Byte values P6* should be set to 256
For 2 Byte values P6* should be set to 65536

It is:

If Int > P6* / 2 – 1 Then P6 = P6*
If Int <= P6* / 2 – 1 Then P6 = 0

Data Type	Number	Description
REAL	1	P1
REAL	1	P2
REAL	1	P3
REAL	1	P4
REAL	1	P5
REAL	1	P6

3.10.4. CCBLOCK – Tabular, With Interpolation

Basis is a table with n break points. The int values are given in an increasing order(strictly monotonous increasing). If a value x is located between two table values, (tablevalue[i] <= x < tablevalue[i+1]), linear interpolation between physvalue[i] and physvalue[i+1] is used. Is x < than Int value 1, Physvalue 1 will be returned. Is x >= than the greatest Int value, Phys value n will be returned.

Data Type	Number	Description
REAL	1	Int value 1
REAL	1	Phys. value 1
…		
REAL	1	Int value n
REAL	1	Phys value n

3.10.5. CCBLOCK – Tabular

Basis is a table with n break points. If a value x is located between two table values, the next lower phys. value is used.

Data Type	Number	Description
REAL	1	Int value 1
REAL	1	Phys. value 1
…		
REAL	1	Int value n
REAL	1	Phys value n

3.10.6. CCBLOCK – Exponential

If Pf = 0:

$$Phys = \frac{\ln\left(\frac{(Int - P7) * P6 - P3}{P1}\right)}{P2}$$

If P1 = 0:

$$Phys = \frac{\ln\left(\frac{P3}{\frac{Int - P7}{P4}} - P6\right)}{P5}$$

Data Type	Number	Description
REAL	1	P1
REAL	1	P2
REAL	1	P3
REAL	1	P4
REAL	1	P5
REAL	1	P6
REAL	1	P7

3.10.7. CCBLOCK – Logarithmic

If P4 = 0:

$$Phys = \frac{e^{\left(\frac{(Int - P7) * P6 - P3}{P1}\right)}}{P2}$$

If P1 = 0:

$$Phys = \frac{e^{\left(\frac{P3}{\frac{Int - P7}{P4}} - P6\right)}}{P5}$$

Data Type	Number	Description
REAL	1	P1
REAL	1	P2
REAL	1	P3
REAL	1	P4
REAL	1	P5
REAL	1	P6
REAL	1	P7

3.10.8. CCBLOCK - ASAP2 Rational conversion formula

$$Int = \frac{P1 * Phys^2 + P2 * Phys + P3}{P4 * Phys^2 + P5 * Phys + P6}$$

See also ASAM-MCD 2MC Keyword RAT_FUNC.

Data type	Number	Description
REAL	1	P1
REAL	1	P2
REAL	1	P3
REAL	1	P4
REAL	1	P5
REAL	1	P6

3.10.9. CCBLOCK - ASAP2 Text formula

With this conversion a given Int value a physical value is assigned by using a calculation rule which consists of a text formula. In the text formula the Int value is specified as X1.

Example: The text formula "X1 * X1 + 1" multiplies the Int value by itself and adds 1 to the result.
See also ASAM-MCD 2MC keyword FORMULA.

Data type	Number	Description
CHAR	256	Text formula

3.10.10. CCBLOCK – ASAM-MCD2 Text Table

With this conversion a given Int value a text is assigned within a table. This can be used to assign bit values or array of bits to verbal descriptions (for example "Gear 1", "Gear 2, "Gear 3", "On", "Off"). See also ASAM-MCD 2MC keyword COMPU_VTAB.

Data type	Number	Description
REAL	1	Int Value 1
CHAR	32	Assigned Text 1
...		
REAL	1	Int Value n
CHAR	32	Assigned Text n

3.10.11. CCBLOCK – ASAM-MCD2 Text Range Table

With this conversion, a text is assigned to a given value range, i.e. the given text is displayed for all values `lower_range ≤ value < upper_range` for float and `lower_range ≤ value ≤ upper_range` for non-float values. The first entry contains the default range (i.e. the DEFAULT string that is to be used in case that there are no other assignments).
This can be used to assign float ranges to verbal descriptions (for example "low", "regular", "high"). See also ASAM-MCD 2MC keyword COMPU_VTAB_RANGE.
Note: Overlapping ranges may not be declared

Data type	Number	Description
REAL	1	undefined (to be ignored)
REAL	1	undefined (to be ignored)
LINK	1	Pointer to TXBLOCK that contains the DEFAULT text
REAL	1	lower range 1
REAL	1	upper range 1
LINK	1	Pointer to TXBLOCK that contains text 1
...		
REAL	1	lower range n
REAL	1	upper range n

LINK	1	Pointer to TXBLOCK that contains the text n

3.10.12. CCBLOCK - Data Structure Date

This conversion formula is only valid for the data type Byte Array consisting of 7 Byte. Additional parameters from the CCBLOCK are not necessary. This representation corresponds to the data type "Date" of the CiA-CANopen-Specification "Application Layer and Communication Profile", Version 4.0. Within the Byte Array the Date is specified in the following way:

Data type	Identifier	Description
UINT16	ms	Bit 0 .. Bit 15: Milliseconds (0 .. 59999)
BYTE	min	Bit 0 .. Bit 5: Minutes (0 .. 59) Bit 6 .. Bit 7: Reserved
BYTE	hour	Bit 0 .. Bit 4: Hours (0 .. 23) Bit 5 .. Bit 6: Reserved Bit 7: 0 = Standard time, 1 = Summer time
BYTE	day	Bit 0 .. Bit 4: Day (1 .. 31) Bit 5 .. Bit 7: Day of week (1 = Monday ... 7 = Sunday)
BYTE	month	Bit 0 .. Bit 5: Month (1 = January .. 12 = December) Bit 6 .. Bit 7: Reserved
BYTE	year	Bit 0 .. Bit 6: Year (0 .. 99) Bit 7: Reserved

3.10.13. CCBLOCK - Data Structure Time

This conversion formula is only valid for the data type Byte Array consisting of 6 Byte. Additional parameters from the CCBLOCK are not necessary. This representation corresponds to the data type "Time" of the CiA-CANopen-Specification "Application Layer and Communication Profile", Version 4.0. Within the Byte Array the Time is specified in the following way:

Data type	Identifier	Description
UINT32	ms	Bit 0 .. Bit 27: Number of Milliseconds since midnight of 01. Jan.1984 Bit 28 .. Bit 31: Reserved
UINT16	days	Bit 0 .. Bit 15: Number of days since 01. Jan.1984 (Can be 0)

3.10.14. Example of CCBLOCK

Conversion formula for time signal from channel group 1:

```
00001050                        43 43 3e 00 00 00 00 00 00          CC>......
00001060  00 00 00 00 00 00 00 00 00 00 00 00 00 00 73 00 00  ..............s..
00001070  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001080  00 00 00 02 00 00 00 00 00 00 00 00 80 2d 43 1c  .............-C.
00001090  eb e2 36 1a 3f                                    ..6.?
```

Field	Contents
Block identifier	"CC"
Block size	0x3E
Value range – known physical value	False
Value range – minimum physical value	0x0000000000000000 (= 0)
Value range – maximum physical value	0x0000000000000000 (= 0)
Physical unit	"s"
Conversion formula identifier	0 (parametric, linear with P1, P2)
Number of parameters	2
P1	0x0000000000000000 (= 0)
P2	0x3F1A36E2EB1C432D (= 0.0001)

Conversion formula for Input_1 signal from channel group 1:

```
00001170                                          43 43 3e 00              CC>.
00001180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001190  00 00 72 65 76 73 00 00 00 00 00 00 00 00 00 00  ..revs..........
000011a0  00 00 00 00 00 00 00 00 02 00 00 00 00 00 00 00  ................
000011b0  00 80 00 00 00 00 00 00 44 40                    ........D@
```

Field	Contents
Block identifier	"CC"
Block size	0x3E
Value range – known physical value	False
Value range – minimum physical value	0x0000000000000000 (= 0)
Value range – maximum physical value	0x0000000000000000 (= 0)
Physical unit	"revs"
Conversion formula identifier	0 (parametric, linear with P1, P2)
Number of parameters	2
P1	0x0000000000000000 (= 0)
P2	0x4044000000000000 (= 40)

Conversion formula for time signal from channel group 2:

```
00000620                                    43 43 3e 00 00 00           CC>...
00000630  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000640  73 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  s...............
00000650  00 00 00 00 00 00 02 00 00 00 00 00 00 00 00 80  ................
00000660  2d 43 1c eb e2 36 1a 3f                          -C...6.?
```

Field	Contents
Block identifier	"CC"
Block size	0x3E
Value range – known physical value	False
Value range – minimum physical value	0x0000000000000000 (= 0)
Value range – maximum physical value	0x0000000000000000 (= 0)
Physical unit	"s"
Conversion formula identifier	0 (parametric, linear with P1, P2)
Number of parameters	2
P1	0x0000000000000000 (= 0)
P2	0x3F1A36E2EB1C432D (= 0.0001)

Conversion formula for B_RED signal from data group 2:

```
00000740                                                 43                C
00000750  43 3e 00 00 00 00 00 00 00 00 00 00 00 00 00 00  C>..............
00000760  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000770  00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00  ................
00000780  00 00 00 00 00 00 00 00 00 00 00 f0 3f           ............?
```

Field	Contents
Block identifier	"CC"
Block size	0x3E
Value range – known physical value	False
Value range – minimum physical value	0x0000000000000000 (= 0)
Value range – maximum physical value	0x0000000000000000 (= 0)
Physical unit	""
Conversion formula identifier	0 (parametric, linear with P1, P2)
Number of parameters	2
P1	0x0000000000000000 (= 0)
P2	0x3FF0000000000000 (= 1)

Conversion formula for B_GREEN signal from channel group 2:

```
00000880                    43 43 3e 00 00 00 00 00 00 00        CC>.......
00000890  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000008a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000008b0  00 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000008c0  00 00 f0 3f                                     ...?
```

Field	Contents
Block identifier	"CC"
Block size	0x3E
Value range – known physical value	False
Value range – minimum physical value	0x0000000000000000 (= 0)
Value range – maximum physical value	0x0000000000000000 (= 0)
Physical unit	""
Conversion formula identifier	0 (parametric, linear with P1, P2)
Number of parameters	2
P1	0x0000000000000000 (= 0)
P2	0x3FF0000000000000 (= 1)

4. MDF Data Format

In general, writing is distinguished between unsorted and sorted writing.
Sorted writing requires that each data block contain only data records of the same channel group. In case of unsorted writing, data records of different channel groups may be included. To be able to distinguish the data records, each is preceded and optionally followed by a record ID consisting of the data type UINT8.
A data block is always related to a data group and may only contain channel groups out of this data group.

The record structure is determined by the number of the first bit and the number of bits in CNBLOCK of each signal. This way, bit sizes can be represented in the form of individual bits. Signals with a number of bits of 8 or higher have to start at a Byte limit. Signals with a number of bits of 7 or lower may not exceed a Byte limit.

For the data type String or Byte Array the number of bits must be a multiple of 8 (only whole Bytes). In addition to that a channel of the data type String or Byte Array has to start on a Byte limit.

4.1. Data Format for Sorted Writing

All the signal values of a channel group constitute a data record. Sorted writing implies that there is exactly one channel group for each data group available. Thus all records in the data block have the same record format.
The data records inside a data block are listed in the sequence of the time stamps.

> Note:
> If the records are not listed based on the time stamps, this should be interpreted as an error.

4.2. Example 1 of Data Blocks

Data of channel group 1:

Record structure:

Bit 0 .. 31	Bit 32	Bit 33
Time channel as 32-bit unsigned integer	B_GREEN as bit variable	B_GREEN as bit variable

Each record required 5 bytes. For 32 records, this results in 160 bytes for the data block of channel group 1:

```
000011d0                        00 00 00 00 00 2c 04 00 00          .....,...
000011e0  35 f4 0b 00 00 99 de 0f 00 00 cb c7 13 00 00 fd  5...............
000011f0  b1 17 00 00 2f 9a 1b 00 00 61 84 1f 00 00 93 6c  ..../....a.....l
00001200  23 00 00 c5 56 27 00 00 f7 3f 2b 00 00 29 29 2f  #...V'...?+..))/
00001210  00 00 5b 12 33 00 00 8d fc 36 00 00 bf e5 3a 00  ..[.3....6....:.
00001220  00 f1 cf 3e 00 00 23 b8 42 00 00 56 a2 46 00 00  ...>..#.B..V.F..
00001230  88 8b 4a 00 00 ba 75 4e 00 00 04 5e 52 00 00 36  ..J...uN...^R..6
00001240  48 56 00 00 68 30 5a 00 00 9a 1a 5e 00 00 cc 03  HV..h0Z....^....
00001250  62 00 00 fe ed 65 00 00 30 d6 69 00 00 62 c0 6d  b....e..0.i..b.m
00001260  00 00 94 a9 71 00 00 c6 93 75 00 00 f8 7c 79 00  ....q....u...|y.
00001270  00 2b 66 7d 00 00 5d                              .+f}..]
```

Data of channel group 2:

Record structure:

Bit 0 .. 31	Bit 32-39
Time channel as 32-bit unsigned integer	Input_1 as 8-bit unsigned integer

Each record required 5 bytes. For 329 records, this results in 1645 bytes for the data block of channel group 2:

```
000008e0     00 00 00 00 00 64 00 00 00 03 c8 00 00 00 03   .....d.........
000008f0  2c 01 00 00 03 90 01 00 00 02 f4 01 00 00 02 58  ,..............X
00000900  02 00 00 01 bc 02 00 00 01 20 03 00 00 00 84 03  ......... ......
00000910  00 00 03 2c 04 00 00 00 90 04 00 00 03 f4 04 00  ...,............
00000920  00 01 58 05 00 00 00 bc 05 00 00 02 20 06 00 00  ..X......... ...
00000930  00 84 06 00 00 02 e8 06 00 00 03 4c 07 00 00 00  ...........L....
00000940  0b 08 00 00 01 6f 08 00 00 01 d3 08 00 00 01 37  .....o.........7
00000950  09 00 00 01 9b 09 00 00 00 ff 09 00 00 00 63 0a  ..............c.
00000960  00 00 02 c7 0a 00 00 01 2b 0b 00 00 03 8f 0b 00  ........+.......
00000970  00 00 f4 0b 00 00 01 58 0c 00 00 02 bc 0c 00 00  .......X........
00000980  03 20 0d 00 00 03 84 0d 00 00 02 e8 0d 00 00 01  . ..............
00000990  4c 0e 00 00 00 b0 0e 00 00 02 14 0f 00 00 00 78  L..............x
000009a0  0f 00 00 01 de 0f 00 00 02 42 10 00 00 02 a6 10  .........B......
000009b0  00 00 02 0a 11 00 00 01 6e 11 00 00 00 d2 11 00  ........n.......
000009c0  00 03 36 12 00 00 01 9a 12 00 00 02 fe 12 00 00  ..6.............
000009d0  03 62 13 00 00 03 c7 13 00 00 03 2b 14 00 00 03  .b.........+....
000009e0  8f 14 00 00 02 f3 14 00 00 00 57 15 00 00 02 bb  ..........W.....
000009f0  15 00 00 00 1f 16 00 00 01 83 16 00 00 01 e7 16  ................
00000a00  00 00 01 4b 17 00 00 01 b1 17 00 00 00 15 18 00  ...K............
00000a10  00 02 79 18 00 00 01 dd 18 00 00 02 41 19 00 00  ..y.........A...
00000a20  03 a5 19 00 00 00 09 1a 00 00 01 6d 1a 00 00 01  ...........m....
00000a30  d1 1a 00 00 00 35 1b 00 00 03 9a 1b 00 00 02 fe  .....5..........
00000a40  1b 00 00 00 62 1c 00 00 02 c6 1c 00 00 00 2a 1d  ....b.........*.
00000a50  00 00 01 8e 1d 00 00 02 f2 1d 00 00 02 56 1e 00  .............V..
00000a60  00 02 ba 1e 00 00 02 1e 1f 00 00 02 84 1f 00 00  ................
00000a70  01 e8 1f 00 00 00 4c 20 00 00 02 b0 20 00 00 01  ......L .... ...
00000a80  14 21 00 00 03 78 21 00 00 01 dc 21 00 00 03 40  .!...x!....!...@
00000a90  22 00 00 00 a4 22 00 00 02 08 23 00 00 03 6e 23  "...."....#...n#
00000aa0  00 00 00 d2 23 00 00 00 36 24 00 00 01 9a 24 00  ....#...6$....$.
00000ab0  00 02 fe 24 00 00 02 62 25 00 00 03 c6 25 00 00  ...$...b%....%..
00000ac0  03 2a 26 00 00 00 8e 26 00 00 00 f2 26 00 00 00  .*&....&....&...
00000ad0  56 27 00 00 01 ba 27 00 00 01 1e 28 00 00 01 82  V'....'....(....
00000ae0  28 00 00 02 e6 28 00 00 02 4a 29 00 00 02 ae 29  (....(...J)....)
00000af0  00 00 03 12 2a 00 00 00 76 2a 00 00 01 da 2a 00  ....*...v*....*.
00000b00  00 01 3f 2b 00 00 02 a3 2b 00 00 00 07 2c 00 00  ..?+....+....,..
00000b10  01 6b 2c 00 00 03 cf 2c 00 00 01 33 2d 00 00 03  .k,....,...3-...
00000b20  97 2d 00 00 01 fb 2d 00 00 03 5f 2e 00 00 02 c3  .-....-..._.....
00000b30  2e 00 00 01 29 2f 00 00 00 8d 2f 00 00 00 f1 2f  ....)/..../..../
00000b40  00 00 00 55 30 00 00 00 b9 30 00 00 01 1d 31 00  ...U0....0....1.
00000b50  00 02 81 31 00 00 03 e5 31 00 00 01 49 32 00 00  ...1....1...I2..
00000b60  03 ad 32 00 00 01 12 33 00 00 00 76 33 00 00 00  ..2....3...v3...
00000b70  da 33 00 00 03 3e 34 00 00 03 a2 34 00 00 00 06  .3...>4....4....
00000b80  35 00 00 01 6a 35 00 00 02 ce 35 00 00 00 32 36  5...j5....5...26
00000b90  00 00 02 96 36 00 00 01 fc 36 00 00 00 60 37 00  ....6....6...`7.
00000ba0  00 00 c4 37 00 00 00 28 38 00 00 01 8c 38 00 00  ...7...(8....8..
00000bb0  02 f0 38 00 00 00 54 39 00 00 02 b8 39 00 00 01  ..8...T9....9...
00000bc0  1c 3a 00 00 00 80 3a 00 00 00 e5 3a 00 00 00 49  .:....:....:...I
00000bd0  3b 00 00 00 ad 3b 00 00 01 11 3c 00 00 03 75 3c  ;....;....<...u<
00000be0  00 00 01 d9 3c 00 00 00 3d 3d 00 00 03 a1 3d 00  ....<...==....=.
00000bf0  00 02 05 3e 00 00 02 69 3e 00 00 03 cf 3e 00 00  ...>...i>....>..
00000c00  00 33 3f 00 00 01 97 3f 00 00 03 fb 3f 00 00 02  .3?....?....?...
00000c10  5f 40 00 00 00 01 c3 40 00 00 00 27 41 00 00 03  _@.....@...'A....
00000c20  41 00 00 00 ef 41 00 00 00 53 42 00 00 01 b8 42  A....A...SB....B
00000c30  00 00 03 1c 43 00 00 00 80 43 00 00 02 e4 43 00  ....C....C....C.
00000c40  00 01 48 44 00 00 00 ac 44 00 00 03 10 45 00 00  ..HD....D....E..
00000c50  02 74 45 00 00 02 d8 45 00 00 03 3c 46 00 00 03  .tE....E...<F...
00000c60  a2 46 00 00 00 06 47 00 00 01 6a 47 00 00 03 ce  .F....G...jG....
00000c70  47 00 00 00 32 48 00 00 02 96 48 00 00 00 fa 48  G...2H....H....H
00000c80  00 00 02 5e 49 00 00 01 c2 49 00 00 03 26 4a 00  ...^I....I...&J.
00000c90  00 02 8b 4a 00 00 01 ef 4a 00 00 01 53 4b 00 00  ...J....J...SK..
00000ca0  00 b7 4b 00 00 03 1b 4c 00 00 03 7f 4c 00 00 02  ..K....L....L...
```

```
00000cb0  e3 4c 00 00 02 47 4d 00 00 01 ab 4d 00 00 01 0f  .L...GM....M....
00000cc0  4e 00 00 01 75 4e 00 00 01 d9 4e 00 00 01 3d 4f  N...uN....N...=O
00000cd0  00 00 00 a1 4f 00 00 00 05 50 00 00 03 69 50 00  ....O....P...iP.
00000ce0  00 03 cd 50 00 00 02 31 51 00 00 02 95 51 00 00  ...P...1Q....Q..
00000cf0  01 f9 51 00 00 00 5e 52 00 00 03 c2 52 00 00 02  ..Q...^R....R...
00000d00  26 53 00 00 00 8a 53 00 00 02 ee 53 00 00 01 52  &S....S....S...R
00000d10  54 00 00 02 b6 54 00 00 00 1a 55 00 00 02 7e 55  T....T....U...~U
00000d20  00 00 03 e2 55 00 00 00 49 56 00 00 01 ad 56 00  ....U...IV....V.
00000d30  00 01 11 57 00 00 01 75 57 00 00 01 d9 57 00 00  ...W...uW....W..
00000d40  00 3d 58 00 00 03 a1 58 00 00 01 05 59 00 00 00  .=X....X....Y...
00000d50  69 59 00 00 02 cd 59 00 00 03 31 5a 00 00 00 95  iY....Y...1Z....
00000d60  5a 00 00 01 f9 5a 00 00 01 5d 5b 00 00 01 c1 5b  Z....Z...][....[
00000d70  00 00 00 25 5c 00 00 03 89 5c 00 00 02 ed 5c 00  ...%\....\....\.
00000d80  00 00 51 5d 00 00 01 b5 5d 00 00 02 1a 5e 00 00  ..Q]....]....^..
00000d90  03 7e 5e 00 00 03 e2 5e 00 00 03 46 5f 00 00 02  .~^....^...F_...
00000da0  aa 5f 00 00 01 0e 60 00 00 03 72 60 00 00 01 d6  ._....`...r`....
00000db0  60 00 00 02 3a 61 00 00 03 9e 61 00 00 03 04 62  `...:a....a....b
00000dc0  00 00 03 68 62 00 00 03 cc 62 00 00 01 30 63 00  ...hb....b...0c.
00000dd0  00 00 94 63 00 00 02 f8 63 00 00 03 5c 64 00 00  ...c....c...\d..
00000de0  00 c0 64 00 00 00 24 65 00 00 00 88 65 00 00 03  ..d...$e....e...
00000df0  ed 65 00 00 02 51 66 00 00 01 b5 66 00 00 03 19  .e...Qf....f....
00000e00  67 00 00 00 7d 67 00 00 02 e1 67 00 00 02 45 68  g...}g....g...Eh
00000e10  00 00 02 a9 68 00 00 02 0d 69 00 00 02 71 69 00  ....h....i...qi.
00000e20  00 01 d7 69 00 00 03 3b 6a 00 00 01 9f 6a 00 00  ...i...;j....j..
00000e30  03 03 6b 00 00 01 67 6b 00 00 02 cb 6b 00 00 02  ..k...gk....k...
00000e40  2f 6c 00 00 03 93 6c 00 00 03 f7 6c 00 00 03 5b  /l....l....l...[
00000e50  6d 00 00 02 c0 6d 00 00 01 24 6e 00 00 00 88 6e  m....m...$n....n
00000e60  00 00 03 ec 6e 00 00 01 50 6f 00 00 03 b4 6f 00  ....n...Po....o.
00000e70  00 01 18 70 00 00 03 7c 70 00 00 00 e0 70 00 00  ...p...|p....p..
00000e80  01 44 71 00 00 03 aa 71 00 00 03 0e 72 00 00 00  .Dq....q....r...
00000e90  72 72 00 00 01 d6 72 00 00 01 3a 73 00 00 02 9e  rr....r...:s....
00000ea0  73 00 00 02 02 74 00 00 03 66 74 00 00 03 ca 74  s....t...ft....t
00000eb0  00 00 00 2e 75 00 00 00 94 75 00 00 00 f8 75 00  ....u....u....u.
00000ec0  00 00 5c 76 00 00 00 c0 76 00 00 01 24 77 00 00  ..\v....v...$w..
00000ed0  01 88 77 00 00 02 ec 77 00 00 02 50 78 00 00 03  ..w....w...Px...
00000ee0  b4 78 00 00 00 18 79 00 00 01 7d 79 00 00 02 e1  .x....y...}y....
00000ef0  79 00 00 03 45 7a 00 00 01 a9 7a 00 00 02 0d 7b  y...Ez....z....{
00000f00  00 00 00 71 7b 00 00 02 d5 7b 00 00 01 39 7c 00  ...q{....{...9|.
00000f10  00 03 9d 7c 00 00 02 01 7d 00 00 01 66 7d 00 00  ...|....}...f}..
00000f20  01 ca 7d 00 00 01 2e 7e 00 00 01 92 7e 00 00 01  ..}....~....~...
00000f30  f6 7e 00 00 02 5a 7f 00 00 03 be 7f 00 00 00 22  .~...Z.........."
00000f40  80 00 00 02 86 80 00 00 00 ea 80 00 00 03        ..............
```

4.3. Example 2 of Data Blocks

The following CN blocks are assumed to be given:

CNBLOCK1	
Signal name	time
Channel type	1
Data type	0
Number of first bit	0
Number of bits	16

CNBLOCK2	
Signal name	ubatt
Channel type	0
Data type	2
Number of first bit	16
Number of bits	32

CNBLOCK3	
Signal name	B_ll
Channel type	0
Data type	0
Number of first bit	48
Number of bits	1

CNBLOCK4	
Signal name	B_vl
Channel type	0
Data type	0
Number of first bit	49
Number of bits	1

CNBLOCK5	
Signal name	dk
Channel type	0
Data type	1
Number of first bit	56
Number of bits	8

According to this specification, a record has the following structure:

Bits 0 .. 15	Bits 16..47	Bit 48	Bit 49	Bits 50..55	Bits 56..63
Time as 16-bit unsigned integer	Ubat as 32-bit float	B_ll as bit variable	B_vl as bit variable	Gap (due to byte alignment)	Dk as 8-bit signed integer

Under "Number of records", the CGBLOCK contains the number of records for this channel group as well as the byte length of a record. In case of sorted writing, all records are stored sequentially in the file.

4.4. Data Format for Unsorted Writing

Unlike for sorted writing, data records from different channel groups may be stored sequentially in a data group here. Each record can be clearly related to a channel group by means of a record ID (of data type UINT8) at the beginning of the record and optionally after the end of each record (see CGBLOCK, Record ID). The record structure itself is identical with the one for sorted writing.

The data records inside a data block are listed for each record type in the sequence of their time stamps.

> Note:
> If the records are not listed based on the time stamps, this should be interpreted as an error.

5. Appendix

The following HEX dump of a sample file is discussed in the previous chapters in detail.

```
00000000  4d 44 46 20 20 20 20 20 32 2e 30 30 20 20 20 20  MDF     2.00
00000010  54 47 54 53 56 52 32 30 00 00 00 00 c8 00 00 00  TGTSVR20........
00000020  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000030  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000040  48 44 a4 00 e9 04 00 00 e4 00 00 00 00 00 00 00  HD..............
00000050  02 00 30 33 3a 30 33 3a 32 30 30 30 30 39 3a 34  ..03:03:200009:4
00000060  31 3a 33 38 4d 65 69 65 72 00 00 00 00 00 00 00  1:38Meier.......
00000070  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000080  00 00 00 00 45 54 41 53 00 00 00 00 00 00 00 00  ....ETAS........
00000090  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000000a0  00 00 00 00 50 72 6f 6a 65 6b 74 20 58 5a 34 35  ....Projekt XZ45
000000b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000000c0  00 00 00 00 46 61 68 72 7a 65 75 67 20 42 30 38  ....Fahrzeug B08
000000d0  31 35 00 00 00 00 00 00 00 00 00 00 00 00 00 00  15..............
000000e0  00 00 00 00 54 58 05 04 4b 6f 6d 6d 65 6e 74 61  ....TX..Kommenta
000000f0  72 20 7a 75 72 20 4d 65 73 73 75 6e 67 20 32 20  r zur Messung 2
00000100  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000110  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000120  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000130  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000140  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000150  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000160  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000170  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000180  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000190  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001a0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001b0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001c0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001d0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001e0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000001f0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000200  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000210  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000220  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000230  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000240  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000250  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000260  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000270  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000280  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000290  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002a0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002b0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002c0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002d0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002e0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000002f0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000300  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000310  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000320  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000330  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000340  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000350  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000360  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000370  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000380  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000390  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003a0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003b0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003c0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003d0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003e0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000003f0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000400  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000410  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000420  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000430  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000440  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000450  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000460  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000470  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000480  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00000490  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004a0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
```

```
000004b0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004c0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004d0  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
000004e0  20 20 20 20 20 20 20 20 00 44 47 1c 00 05 05 00          .DG.....
000004f0  00 4e 0f 00 00 00 00 00 00 d7 11 00 00 01 00 00  .N..............
00000500  00 00 00 00 00 44 47 1c 00 00 00 00 00 21 05 00  .....DG......!..
00000510  00 00 00 00 00 e1 08 00 00 01 00 00 00 00 00 00  ................
00000520  00 43 47 1a 00 00 00 00 00 4c 05 00 00 3b 05 00  .CG......L...;..
00000530  00 02 00 03 00 05 00 49 01 00 00 54 58 11 00 52  .......I...TX..R
00000540  61 74 65 3a 20 30 2e 30 31 30 73 00 43 4e de 00  ate: 0.010s.CN..
00000550  71 06 00 00 2a 06 00 00 00 00 00 00 00 00 00 00  q...*...........
00000560  00 00 00 00 01 00 74 69 6d 65 00 00 00 00 00 00  ......time......
00000570  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000580  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000590  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000005f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000600  00 00 00 00 00 00 00 00 20 00 00 00 00 00 00 00  ........ .......
00000610  00 00 00 00 00 00 00 00 00 00 00 00 00 00 7b 14  ..............{.
00000620  ae 47 e1 7a 84 3f 68 06 00 00 43 43 3e 00 00 00  .G.z.?h...CC>...
00000630  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000640  73 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  s...............
00000650  00 00 00 00 00 00 00 02 00 00 00 00 00 00 00 80  ................
00000660  2d 43 1c eb e2 36 1a 3f 54 58 09 00 74 69 6d 65  -C...6.?TX..time
00000670  00 43 4e de 00 a8 07 00 00 4f 07 00 00 00 00 00  .CN......O......
00000680  00 00 00 00 00 00 00 00 00 00 00 42 5f 52 45 44  ...........B_RED
00000690  5c 45 54 4b 2d 54 65 73 74 64 65 76 69 63 65 3a  \ETK-Testdevice:
000006a0  31 00 00 00 00 00 00 00 00 00 00 52 65 64 20 4c  1..........Red L
000006b0  45 44 27 73 20 73 74 61 74 65 2e 20 54 68 69 73  ED's state. This
000006c0  20 69 73 20 61 20 6c 6f 67 69 63 61 6c 20 6f 6e   is a logical on
000006d0  2f 6f 66 66 20 76 61 6c 75 65 00 00 00 00 00 00  /off value......
000006e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000006f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000700  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000710  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000720  00 00 00 00 00 00 00 00 00 00 00 20 00 01 00 00  ........... ....
00000730  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000740  00 00 00 7b 14 ae 47 e1 7a 84 3f 8d 07 00 00 43  ...{..G.z.?....C
00000750  43 3e 00 00 00 00 00 00 00 00 00 00 00 00 00 00  C>..............
00000760  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000770  00 00 00 00 00 00 00 00 00 00 00 02 00 00 00 00  ................
00000780  00 00 00 00 00 00 00 00 00 00 00 f0 3f 54 58 1b  ............?TX.
00000790  00 42 5f 52 45 44 5c 45 54 4b 2d 54 65 73 74 64  .B_RED\ETK-Testd
000007a0  65 76 69 63 65 3a 31 00 43 4e de 00 00 00 00 00  evice:1.CN......
000007b0  86 08 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000007c0  00 00 42 5f 47 52 45 45 4e 5c 45 54 4b 2d 54 65  ..B_GREEN\ETK-Te
000007d0  73 74 64 65 76 69 63 65 3a 31 00 00 00 00 00 00  stdevice:1......
000007e0  00 00 47 72 65 65 6e 20 4c 45 44 27 73 20 73 74  ..Green LED's st
000007f0  61 74 65 2e 20 54 68 69 73 20 69 73 20 61 20 6c  ate. This is a l
00000800  6f 67 69 63 61 6c 20 6f 6e 2f 6f 66 66 20 76 61  ogical on/off va
00000810  6c 75 65 00 00 00 00 00 00 00 00 00 00 00 00 00  lue.............
00000820  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000830  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000840  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000850  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000860  00 00 21 00 01 00 00 00 00 00 00 00 00 00 00 00  ..!.............
00000870  00 00 00 00 00 00 00 00 00 00 00 7b 14 ae 47 e1 7a  ..........{..G.z
00000880  84 3f c4 08 00 00 43 43 3e 00 00 00 00 00 00 00  .?....CC>.......
00000890  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000008a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000008b0  00 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000008c0  00 00 f0 3f 54 58 1d 00 42 5f 47 52 45 45 4e 5c  ...?TX..B_GREEN\
000008d0  45 54 4b 2d 54 65 73 74 64 65 76 69 63 65 3a 31  ETK-Testdevice:1
000008e0  00 00 00 00 00 00 64 00 00 00 03 c8 00 00 00 03  ......d.........
000008f0  2c 01 00 00 03 90 01 00 00 02 f4 01 00 00 02 58  ,..............X
00000900  02 00 00 01 bc 02 00 00 01 20 03 00 00 00 84 03  ......... ......
00000910  00 00 03 2c 04 00 00 00 90 04 00 00 03 f4 04 00  ...,............
00000920  00 01 58 05 00 00 00 bc 05 00 00 02 20 06 00 00  ..X......... ...
00000930  00 84 06 00 00 02 e8 06 00 00 03 4c 07 00 00 00  ...........L....
00000940  0b 08 00 00 01 6f 08 00 00 01 d3 08 00 00 01 37  .....o.........7
00000950  09 00 00 01 9b 09 00 00 00 ff 09 00 00 00 63 0a  ..............c.
00000960  00 00 02 c7 0a 00 00 01 2b 0b 00 00 03 8f 0b 00  ........+.......
00000970  00 00 f4 0b 00 00 01 58 0c 00 00 02 bc 0c 00 00  .......X........
00000980  03 20 0d 00 00 03 84 0d 00 00 02 e8 0d 00 00 01  . ..............
00000990  4c 0e 00 00 00 b0 0e 00 00 02 14 0f 00 00 00 78  L..............x
000009a0  0f 00 00 01 de 0f 00 00 02 42 10 00 00 02 a6 10  .........B......
000009b0  00 00 02 0a 11 00 00 01 6e 11 00 00 00 d2 11 00  ........n.......
000009c0  00 03 36 12 00 00 01 9a 12 00 00 02 fe 12 00 00  ..6.............
000009d0  03 62 13 00 00 03 c7 13 00 00 03 2b 14 00 00 03  .b.........+....
```

```
000009e0  8f 14 00 00 02 f3 14 00 00 00 57 15 00 00 02 bb  ..........W.....
000009f0  15 00 00 00 1f 16 00 00 01 83 16 00 00 01 e7 16  ................
00000a00  00 00 01 4b 17 00 00 01 b1 17 00 00 00 15 18 00  ...K............
00000a10  00 02 79 18 00 00 01 dd 18 00 00 02 41 19 00 00  ..y.........A...
00000a20  03 a5 19 00 00 00 09 1a 00 00 01 6d 1a 00 00 01  ...........m....
00000a30  d1 1a 00 00 00 35 1b 00 00 03 9a 1b 00 00 02 fe  .....5..........
00000a40  1b 00 00 00 62 1c 00 00 02 c6 1c 00 00 00 2a 1d  ....b.........*.
00000a50  00 00 01 8e 1d 00 00 02 f2 1d 00 00 02 56 1e 00  .............V..
00000a60  00 02 ba 1e 00 00 02 1e 1f 00 00 02 84 1f 00 00  ................
00000a70  01 e8 1f 00 00 00 4c 20 00 00 02 b0 20 00 00 01  ......L .... ...
00000a80  14 21 00 00 03 78 21 00 00 01 dc 21 00 00 03 40  .!...x!....!...@
00000a90  22 00 00 00 a4 22 00 00 02 08 23 00 00 03 6e 23  "...."....#...n#
00000aa0  00 00 00 d2 23 00 00 00 36 24 00 00 01 9a 24 00  ....#...6$....$.
00000ab0  00 02 fe 24 00 00 02 62 25 00 00 03 c6 25 00 00  ...$...b%....%..
00000ac0  03 2a 26 00 00 00 8e 26 00 00 00 f2 26 00 00 00  .*&....&....&...
00000ad0  56 27 00 00 01 ba 27 00 00 01 1e 28 00 00 01 82  V'....'....(....
00000ae0  28 00 00 02 e6 28 00 00 02 4a 29 00 00 02 ae 29  (....(...J)....)
00000af0  00 00 03 12 2a 00 00 00 76 2a 00 00 01 da 2a 00  ....*...v*....*.
00000b00  00 01 3f 2b 00 00 02 a3 2b 00 00 00 07 2c 00 00  ..?+....+....,..
00000b10  01 6b 2c 00 00 03 cf 2c 00 00 01 33 2d 00 00 03  .k,....,...3-...
00000b20  97 2d 00 00 01 fb 2d 00 00 03 5f 2e 00 00 02 c3  .-....-..._.....
00000b30  2e 00 00 01 29 2f 00 00 00 8d 2f 00 00 00 f1 2f  ....)/..../..../
00000b40  00 00 00 55 30 00 00 00 b9 30 00 00 01 1d 31 00  ...U0....0....1.
00000b50  00 02 81 31 00 00 03 e5 31 00 00 01 49 32 00 00  ...1....1...I2..
00000b60  03 ad 32 00 00 01 12 33 00 00 00 76 33 00 00 00  ..2....3...v3...
00000b70  da 33 00 00 03 3e 34 00 00 03 a2 34 00 00 00 06  .3...>4....4....
00000b80  35 00 00 01 6a 35 00 00 02 ce 35 00 00 00 32 36  5...j5....5...26
00000b90  00 00 02 96 36 00 00 01 fc 36 00 00 00 60 37 00  ....6....6...`7.
00000ba0  00 00 c4 37 00 00 00 28 38 00 00 01 8c 38 00 00  ...7...(8....8..
00000bb0  02 f0 38 00 00 00 54 39 00 00 02 b8 39 00 00 01  ..8...T9....9...
00000bc0  1c 3a 00 00 00 80 3a 00 00 00 e5 3a 00 00 00 49  .:....:....:...I
00000bd0  3b 00 00 00 ad 3b 00 00 01 11 3c 00 00 03 75 3c  ;....;....<...u<
00000be0  00 00 01 d9 3c 00 00 00 3d 3d 00 00 03 a1 3d 00  ....<...==....=.
00000bf0  00 02 05 3e 00 00 02 69 3e 00 00 03 cf 3e 00 00  ...>...i>....>..
00000c00  00 33 3f 00 00 01 97 3f 00 00 03 fb 3f 00 00 02  .3?....?....?...
00000c10  5f 40 00 00 01 c3 40 00 00 00 27 41 00 00 03 8b  _@....@...'A....
00000c20  41 00 00 00 ef 41 00 00 00 53 42 00 00 01 b8 42  A....A...SB....B
00000c30  00 00 03 1c 43 00 00 00 80 43 00 00 02 e4 43 00  ....C....C....C.
00000c40  00 01 48 44 00 00 00 ac 44 00 00 03 10 45 00 00  ..HD....D....E..
00000c50  02 74 45 00 00 02 d8 45 00 00 03 3c 46 00 00 03  .tE....E...<F...
00000c60  a2 46 00 00 00 06 47 00 00 01 6a 47 00 00 03 ce  .F....G...jG....
00000c70  47 00 00 00 32 48 00 00 02 96 48 00 00 00 fa 48  G...2H....H....H
00000c80  00 00 02 5e 49 00 00 01 c2 49 00 00 03 26 4a 00  ...^I....I...&J.
00000c90  00 02 8b 4a 00 00 01 ef 4a 00 00 01 53 4b 00 00  ...J....J...SK..
00000ca0  00 b7 4b 00 00 03 1b 4c 00 00 03 7f 4c 00 00 02  ..K....L....L...
00000cb0  e3 4c 00 00 02 47 4d 00 00 01 ab 4d 00 00 01 0f  .L...GM....M....
00000cc0  4e 00 00 01 75 4e 00 00 01 d9 4e 00 00 01 3d 4f  N...uN....N...=O
00000cd0  00 00 00 a1 4f 00 00 00 05 50 00 00 03 69 50 00  ....O....P...iP.
00000ce0  00 03 cd 50 00 00 02 31 51 00 00 02 95 51 00 00  ...P...1Q....Q..
00000cf0  01 f9 51 00 00 00 5e 52 00 00 03 c2 52 00 00 02  ..Q...^R....R...
00000d00  26 53 00 00 00 8a 53 00 00 02 ee 53 00 00 01 52  &S....S....S...R
00000d10  54 00 00 02 b6 54 00 00 00 1a 55 00 00 02 7e 55  T....T....U...~U
00000d20  00 00 03 e2 55 00 00 00 49 56 00 00 01 ad 56 00  ....U...IV....V.
00000d30  00 01 11 57 00 00 01 75 57 00 00 01 d9 57 00 00  ...W...uW....W..
00000d40  00 3d 58 00 00 03 a1 58 00 00 01 05 59 00 00 00  .=X....X....Y...
00000d50  69 59 00 00 02 cd 59 00 00 03 31 5a 00 00 00 95  iY....Y...1Z....
00000d60  5a 00 00 01 f9 5a 00 00 01 5d 5b 00 00 01 c1 5b  Z....Z...][....[
00000d70  00 00 00 25 5c 00 00 03 89 5c 00 00 02 ed 5c 00  ...%\....\....\.
00000d80  00 00 51 5d 00 00 01 b5 5d 00 00 02 1a 5e 00 00  ..Q]....]....^..
00000d90  03 7e 5e 00 00 03 e2 5e 00 00 03 46 5f 00 00 02  .~^....^...F_...
00000da0  aa 5f 00 00 01 0e 60 00 00 03 72 60 00 00 01 d6  ._....`...r`....
00000db0  60 00 00 02 3a 61 00 00 03 9e 61 00 00 03 04 62  `...:a....a....b
00000dc0  00 00 03 68 62 00 00 03 cc 62 00 00 01 30 63 00  ...hb....b...0c.
00000dd0  00 00 94 63 00 00 02 f8 63 00 00 03 5c 64 00 00  ...c....c...\d..
00000de0  00 c0 64 00 00 00 24 65 00 00 00 88 65 00 00 03  ..d...$e....e...
00000df0  ed 65 00 00 02 51 66 00 00 01 b5 66 00 00 03 19  .e...Qf....f....
00000e00  67 00 00 00 7d 67 00 00 02 e1 67 00 00 02 45 68  g...}g....g...Eh
00000e10  00 00 02 a9 68 00 00 02 0d 69 00 00 02 71 69 00  ....h....i...qi.
00000e20  00 01 d7 69 00 00 03 3b 6a 00 00 01 9f 6a 00 00  ...i...;j....j..
00000e30  03 03 6b 00 00 01 67 6b 00 00 02 cb 6b 00 00 02  ..k...gk....k...
00000e40  2f 6c 00 00 03 93 6c 00 00 03 f7 6c 00 00 03 5b  /l....l....l...[
00000e50  6d 00 00 02 c0 6d 00 00 01 24 6e 00 00 00 88 6e  m....m...$n....n
00000e60  00 00 03 ec 6e 00 00 01 50 6f 00 00 03 b4 6f 00  ....n...Po....o.
00000e70  00 01 18 70 00 00 03 7c 70 00 00 00 e0 70 00 00  ...p...|p....p..
00000e80  01 44 71 00 00 03 aa 71 00 00 03 0e 72 00 00 00  .Dq....q....r...
00000e90  72 72 00 00 01 d6 72 00 00 01 3a 73 00 00 02 9e  rr....r...:s....
00000ea0  73 00 00 02 02 74 00 00 03 66 74 00 00 03 ca 74  s....t...ft....t
00000eb0  00 00 00 2e 75 00 00 00 94 75 00 00 00 f8 75 00  ....u....u....u.
00000ec0  00 00 5c 76 00 00 00 c0 76 00 00 01 24 77 00 00  ..\v....v...$w..
00000ed0  01 88 77 00 00 02 ec 77 00 00 02 50 78 00 00 03  ..w....w...Px...
00000ee0  b4 78 00 00 00 18 79 00 00 01 7d 79 00 00 02 e1  .x....y...}y....
00000ef0  79 00 00 03 45 7a 00 00 01 a9 7a 00 00 02 0d 7b  y...Ez....z....{
00000f00  00 00 00 71 7b 00 00 02 d5 7b 00 00 01 39 7c 00  ...q{....{...9|.
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00000f10  00 03 9d 7c 00 00 02 01 7d 00 00 01 66 7d 00 00  ...|....}...f}..
00000f20  01 ca 7d 00 00 01 2e 7e 00 00 01 92 7e 00 00 01  ..}....~....~...
00000f30  f6 7e 00 00 02 5a 7f 00 00 03 be 7f 00 00 00 22  .~...Z........."
00000f40  80 00 00 02 86 80 00 00 00 ea 80 00 00 03 43 47  ..............CG
00000f50  1a 00 00 00 00 00 79 0f 00 00 68 0f 00 00 01 00  ......y...h.....
00000f60  02 00 05 00 20 00 00 00 54 58 11 00 52 61 74 65  .... ...TX..Rate
00000f70  3a 20 30 2e 31 30 30 73 00 43 4e de 00 9e 10 00  : 0.100s.CN.....
00000f80  00 57 10 00 00 00 00 00 00 00 00 00 00 00 00 00  .W..............
00000f90  00 01 00 74 69 6d 65 00 00 00 00 00 00 00 00 00  ...time.........
00000fa0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000fb0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000fc0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000fd0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000fe0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000ff0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001000  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001010  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001020  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001030  00 00 00 00 00 20 00 00 00 00 00 00 00 00 00 00  ..... ..........
00001040  00 00 00 00 00 00 00 00 00 00 00 9a 99 99 99 99  ................
00001050  99 b9 3f 95 10 00 00 43 43 3e 00 00 00 00 00 00  ..?....CC>......
00001060  00 00 00 00 00 00 00 00 00 00 00 00 00 73 00 00  .............s..
00001070  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001080  00 00 00 02 00 00 00 00 00 00 00 00 80 2d 43 1c  .............-C.
00001090  eb e2 36 1a 3f 54 58 09 00 74 69 6d 65 00 43 4e  ..6.?TX..time.CN
000010a0  de 00 00 00 00 00 7c 11 00 00 00 00 00 00 00 00  ......|.........
000010b0  00 00 00 00 00 00 00 00 00 49 6e 70 75 74 5f 31 5c  .........Input_1\
000010c0  45 54 4b 2d 54 65 73 74 64 65 76 69 63 65 3a 31  ETK-Testdevice:1
000010d0  00 00 00 00 00 00 00 00 53 70 65 65 64 20 00 00  ........Speed ..
000010e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
000010f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001100  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001110  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001120  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001130  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001140  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001150  00 00 00 00 00 00 00 00 00 20 00 08 00 00 00 00  ......... ......
00001160  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001170  9a 99 99 99 99 99 b9 3f ba 11 00 00 43 43 3e 00  .......?....CC>.
00001180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00001190  00 00 72 65 76 73 00 00 00 00 00 00 00 00 00 00  ..revs..........
000011a0  00 00 00 00 00 00 00 00 02 00 00 00 00 00 00 00  ................
000011b0  00 80 00 00 00 00 00 00 00 44 40 54 58 1d 00 49 6e  .........D@TX..In
000011c0  70 75 74 5f 31 5c 45 54 4b 2d 54 65 73 74 64 65  put_1\ETK-Testde
000011d0  76 69 63 65 3a 31 00 00 00 00 00 00 2c 04 00 00  vice:1......,...
000011e0  35 f4 0b 00 00 99 de 0f 00 00 cb c7 13 00 00 fd  5...............
000011f0  b1 17 00 00 2f 9a 1b 00 00 61 84 1f 00 00 93 6c  ..../....a.....l
00001200  23 00 00 c5 56 27 00 00 f7 3f 2b 00 00 29 29 2f  #...V'...?+..))/
00001210  00 00 5b 12 33 00 00 8d fc 36 00 00 bf e5 3a 00  ..[.3....6....:.
00001220  00 f1 cf 3e 00 00 23 b8 42 00 00 56 a2 46 00 00  ...>..#.B..V.F..
00001230  88 8b 4a 00 00 ba 75 4e 00 00 04 5e 52 00 00 36  ..J...uN...^R..6
00001240  48 56 00 00 68 30 5a 00 00 9a 1a 5e 00 00 cc 03  HV..h0Z....^....
00001250  62 00 00 fe ed 65 00 00 30 d6 69 00 00 62 c0 6d  b....e..0.i..b.m
00001260  00 00 94 a9 71 00 00 c6 93 75 00 00 f8 7c 79 00  ....q....u...|y.
00001270  00 2b 66 7d 00 00 5d                              .+f}..]
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