



# CAN-CLOCK

## Real Time Clock with CAN Interface



### Software Manual

to Product C.2836.xx



## NOTE

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<b>Document file:</b>	I:\texte\Doku\MANUALS\CAN\CBM\CAN-CLOCK\Englisch\CAN-Clock_11s.en9
<b>Date of print:</b>	02.12.2005

<b>Firmware version:</b>	1.12
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### Changes in the Chapters

The changes in the document listed below affect changes in the firmware as well as changes in the description of facts only.

Chapter	Changes versus previous version
-	First English version

Technical details are subject to change without further notice.

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# Contents

<b>1. Overview</b>	3
1.1 Table of Important Identifiers and Messages for CANopen	3
<b>2. Assignment of the Tx-PDOs</b>	4
<b>3. Assignment of the Rx-PDOs</b>	5
<b>4. Implemented CANopen objects</b>	6
4.1 Overview of Communication Parameters	6
4.2 Description of the Communication Parameters	7
4.2.1 COB-ID_Time_Stamp_Object (1012 <sub>h</sub> )	7
4.2.2 Receive PDO Communication Parameter (1400 <sub>h</sub> )	8
4.2.3 Receive PDO Mapping Parameter (1600 <sub>h</sub> )	9
4.2.4 Object Transmit PDO Communication Parameter (1800 <sub>h</sub> )	10
4.2.5 Transmit PDO Mapping Parameter (1A00 <sub>h</sub> )	11
4.3 Overview of the Manufacturer-Specific Objects	12
4.4 Description of the Manufacturer-Specific Objects	13
4.4.1 <i>hour</i> in UTC (2100 <sub>h</sub> )	13
4.4.2 <i>minute</i> in UTC (2101 <sub>h</sub> )	14
4.4.3 <i>second</i> in UTC (2102 <sub>h</sub> )	15
4.4.4 <i>year</i> in UTC (2103 <sub>h</sub> )	16
4.4.5 <i>month</i> in UTC (2104 <sub>h</sub> )	17
4.4.6 <i>day</i> in UTC (2105 <sub>h</sub> )	18
4.4.7 <i>hour</i> (2110 <sub>h</sub> )	19
4.4.8 <i>minute</i> (2111 <sub>h</sub> )	20
4.4.9 <i>second</i> (2112 <sub>h</sub> )	21
4.4.10 <i>year</i> (2113 <sub>h</sub> )	22
4.4.11 <i>month</i> (2114 <sub>h</sub> )	23
4.4.12 <i>day</i> (2115 <sub>h</sub> )	24
4.4.13 <i>period_of_timestamp</i> (2200 <sub>h</sub> )	25
4.4.14 <i>mode</i> (2300 <sub>h</sub> )	26
4.4.15 <i>time_difference</i> (2301 <sub>h</sub> )	27
4.4.16 <i>coding_switch</i> (2FFF <sub>h</sub> )	28

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# 1. Overview

The CAN-CLOCK module provides the current date and the current time as timestamp and via a Tx-PDO. Time can be preset via Rx-PDO.

## 1.1 Table of Important Identifiers and Messages for CANopen

CAN-Identifier [Hex]	Name	Length	Data [Hex]	Description
0	NMT	2	02 xx	module enters the state <i>stopped</i>
0	NMT	2	01 xx	Start (module enters the state <i>operational</i> )
0	NMT	2	80 xx	module enters the state <i>preoperational</i>
0	NMT	2	81 xx	Reset module
0	NMT	2	82 xx	Reset communication
180 <sub>h</sub> + <i>Node-ID</i>	Tx-PDO1	6 bytes	user data	from CAN-CLOCK-module (Tx/transmit-PDO)
200 <sub>h</sub> + <i>Node-ID</i>	Rx-PDO1	6 bytes	user data	to CAN-CLOCK-module (Rx/receive-PDO)
580 <sub>h</sub> + <i>Node-ID</i>	Tx-SDO	0...8 bytes	parameter	SDO from CAN-CLOCK (Tx)
600 <sub>h</sub> + <i>Node-ID</i>	Rx-SDO	0...8 bytes	parameter	SDO to CAN-CLOCK (Rx)
700 <sub>h</sub> + <i>Node-ID</i>	NMT	1 bytes	identifier	Node guarding

xx = *Node-ID* or xx = 00 if all CANopen nodes shall be addressed.

## 2. Assignment of the Tx-PDOs

The module transmits only the Tx-PDO1. The table below shows the assignment of the Tx-PDOs:

Byte (big endian)						
0	1	2	3	4	5	6, 7
<i>hour</i>	<i>minute</i>	<i>second</i>	<i>year</i>	<i>month</i>	<i>day</i>	<i>not used</i>

### Meaning of the variables:

The time reference of the returned time value is defined in the parameter *mode* in object 2300<sub>h</sub> (see page 26). For example the returned time value can be specified in lokal time (*mode* = 1)

<i>hour</i> ...	output of hours	valid range of values: 0...23 <sub>d</sub> (0...17 <sub>h</sub> )
<i>minute</i> ...	output of minutes	valid range of values: 0...59 <sub>d</sub> (0...3B <sub>h</sub> )
<i>second</i> ...	output of seconds	valid range of values: 0...59 <sub>d</sub> (0...3B <sub>h</sub> )
<i>year</i> ...	output of the year	valid range of values: 0...99 <sub>d</sub> (0...63 <sub>h</sub> ), given in the number of years since the year 2000
<i>month</i> ...	output of the month	valid range of values: 1...12 <sub>d</sub> (1...0C <sub>h</sub> )
<i>day</i> ...	output of the day	valid range of values: 1...31 <sub>d</sub> (1...1F <sub>h</sub> )

### Example:

Byte-no.:	0	1	2	3	4	5
Variable:	<i>hour</i>	<i>minute</i>	<i>second</i>	<i>year</i>	<i>month</i>	<i>day</i>
Value [Hex]:	0E	2A	08	05	0B	1C
Value [Dec]:	14	42	08	05	11	28

determined time: 14:42:08 on November 28th, 2005

### 3. Assignment of the Rx-PDOs

The module evaluates only the Rx-PDO1. The following table shows the assignment of the Rx-PDOs:

Byte (big endian)						
0	1	2	3	4	5	6, 7
<i>hour_utc</i>	<i>minute_utc</i>	<i>second_utc</i>	<i>year_utc</i>	<i>month_utc</i>	<i>day_utc</i>	<i>not used</i>

#### Meaning of the variables:

In the Rx-PDOs the time reference for the time values is always UTC (coordinated universal time).

*hour\_utc*... input of hours in UTC      valid range of values: 0...23<sub>d</sub> (0...17<sub>h</sub>)

*minute\_utc*... input of minutes in UTC      valid range of values: 0...59<sub>d</sub> (0...3B<sub>h</sub>)

*second\_utc*... input of seconds in UTC      valid range of values: 0...59<sub>d</sub> (0...3B<sub>h</sub>)

*year\_utc*... input of the year in UTC      valid range of values: 0...99<sub>d</sub> (0...63<sub>h</sub>),  
given in the number of years since 2000

*month\_utc*... input of the month in UTC      valid range of values: 1...12<sub>d</sub> (1...0C<sub>h</sub>)

*day\_utc*... input of the day in UTC      valid range of values: 1...31<sub>d</sub> (1...1F<sub>h</sub>)

## 4. Implemented CANopen objects

### 4.1 Overview of Communication Parameters

The format of the communication parameters can be taken from CiA DS-301, Chapter 9.1. The module supports only the communication parameters listed in the table below.

Index [Hex]	Name	Subindex	Type	Access	Default
1000	<i>Device Type</i>	-	Unsigned32	ro	0006 0191 <sub>h</sub>
1001	<i>Error Register</i>	-	Unsigned8	ro	Error-Code
1008	<i>Manufacturer's Device Name</i>	-	Visible String	ro	CLK
1009	<i>Manufacturer's Hardware Version (see: DS-301)</i>	-	Visible String	ro	1.0 1*)
100A	<i>Manufacturer's Software Version</i>	-	Visible String	ro	1.0 1*)
100B	<i>Node-ID</i>	-	Unsigned32	ro	Coding switch - adjustment
100C	<i>Guard Time</i>	-	Unsigned16	rw	0 Sec.
100D	<i>Life Time Factor</i>	-	Unsigned8	rw	0
100E	<i>Node Guarding ID</i>	-	Unsigned32	ro	700 <sub>h</sub> +Node-ID
1012	<i>COB-ID Time Stamp Object</i>	-	Unsigned32	rw	0000 0100 <sub>h</sub>
1400	<i>Receive PDO Communication Parameter</i>	0,1,2	PDOCommPar	ro	see chapter "PDO-Mapping" on page 8 f.f.
1600	<i>Receive PDO Mapping Parameter</i>	0...6	PDOMapping	ro	
1800	<i>Transmit PDO Communication Parameter</i>	0...5	PDOCommPar	ro	
1A00	<i>Transmit PDO Mapping Parameter</i>	0...6	PDOMapping	ro	

ro - Read Only, rw - Read/Write

1\*) depending on hardware/software version

## 4.2 Description of the Communication Parameters

### 4.2.1 COB-ID\_Time\_Stamp\_Object (1012<sub>h</sub>)

<b>INDEX</b>	<b>1012<sub>h</sub></b>
Name	<i>COB-ID_Time_Stamp_Object</i>
Data Type	unsigned 32
Access Type	rw
Default Value	0000 0100 <sub>h</sub>

#### Values of the parameters:

Value <i>COB-ID_Time_Stamp_Object</i> [Hex]	Meaning
0000 0100	no time stamp producer
4000 0100	CAN-Clock is time stamp producer

This object defines according to CiA DS301 with bit 30, if the CAN-Clock module works as time stamp producer or not. The bits 0...29 define on which CAN identifier the time stamp will be transmitted. The reception of time stamps is not provided in this firmware implementation.

The module does not work as time stamp producer in the default-setting.

With object 2200<sub>h</sub> it can be defined how often the time stamp can be transmitted. In the default-setting the time stamp is transmitted once per second.

#### 4.2.2 Receive PDO Communication Parameter (1400<sub>h</sub>)

Object ‘Receive PDO Communication Parameter 1400<sub>h</sub>’ contains the communication parameters for the Rx-PDO1.

<b>INDEX</b>	<b>1400<sub>h</sub></b>
Name	<i>receive PDO parameter</i>
Data Type	PDOCommPar

Index [Hex]	Subindex	Description	Range of values [Hex]	Default	Data type	R/W
<b>1400</b>	0	<i>no_of_entries</i>	2	2 <sub>h</sub>	unsigned 8	ro
	1	<i>COB_ID used by PDO1</i>	1... 8000 07FF	200 <sub>h</sub> + Node-ID	unsigned 32	ro
	2	<i>transmission type</i>	0...FF	255 <sub>d</sub>	unsigned 8	ro

Only *transmission type* 255 is supported.

### 4.2.3 Receive PDO Mapping Parameter (1600<sub>h</sub>)

Object ‘Receive PDO Mapping Parameter 1600<sub>h</sub>’ contains the mapping parameters for the Rx-PDO1 the CAN-Clock is able to receive.

<b>INDEX</b>	<b>1600<sub>h</sub></b>
Name	<i>receive PDO mapping</i>
Data Type	PDO Mapping

The following table shows the assignment of the Receive PDO Mapping Parameter in the default configuration:

Index [Hex]	Subindex	Description	Range of values [Hex]	Default	Data type	R/W
<b>1600</b>	0	<i>no_of_entries</i>	6	6 <sub>h</sub>	unsigned 8	ro
	1	<i>object_1_to_be_mapped</i>	0...FFFF FFFF	2100 0008 <sub>h</sub>	unsigned 32	ro
	2	<i>object_2_to_be_mapped</i>	0...FFFF FFFF	2101 0008 <sub>h</sub>	unsigned 32	ro
	3	<i>object_3_to_be_mapped</i>	0...FFFF FFFF	2102 0008 <sub>h</sub>	unsigned 32	ro
	4	<i>object_4_to_be_mapped</i>	0...FFFF FFFF	2103 0008 <sub>h</sub>	unsigned 32	ro
	5	<i>object_5_to_be_mapped</i>	0...FFFF FFFF	2104 0008 <sub>h</sub>	unsigned 32	ro
	6	<i>object_6_to_be_mapped</i>	0...FFFF FFFF	2105 0008 <sub>h</sub>	unsigned 32	ro

#### 4.2.4 Object Transmit PDO Communication Parameter (1800<sub>h</sub>)

This object contains the communication parameters for the Tx-PDO1.

<b>INDEX</b>	<b>1800<sub>h</sub></b>
Name	<i>transmit PDO parameter</i>
Data Type	PDOCommPar

Index [Hex]	Sub-index	Description	Range of values [Hex]	Default	Data type	R/W
<b>1800</b>	0	<i>number_of_entries</i>	0..FF	5	unsigned8	ro
	1	<i>COB-ID used by PDO</i>	1...8000 07FF	4000 0180 <sub>h</sub> +Node-ID	unsigned32	ro
	2	<i>transmission type</i>	0..FF	255 <sub>d</sub>	unsigned8	rw
	3	<i>inhibit time</i>	0..FFFF	50 <sub>d</sub>	unsigned16	ro
	4	<i>reserved</i>	0..FF	0	unsigned8	const
	5	<i>event timer</i>	0..FFFF	1000 <sub>d</sub>	unsigned16	rw

#### 4.2.5 Transmit PDO Mapping Parameter (1A00<sub>h</sub>)

The object ‘Transmit PDO Mapping Parameter 1A00<sub>h</sub>’ contains the mapping for the Tx-PDO1.

<b>INDEX</b>	<b>1A00<sub>h</sub></b>
Name	<i>transmit PDO mapping</i>
Data Type	PDO Mapping

The following table shows the assignment of the Transmit PDO Mapping Parameters:

Index	Subindex	Description	Range of values [Hex]	Default	Data type	R/W
<b>1A00</b>	0	<i>number of entries</i>	0..FF	6 <sub>h</sub>	unsigned 8	ro
	1	<i>object_1_to_be_mapped</i>	2100 0008, 2110 0008 <sup>1*)</sup>	2100 0008 <sub>h</sub>	unsigned 32	ro
	2	<i>object_2_to_be_mapped</i>	2101 0008, 2111 0008 <sup>1*)</sup>	2101 0008 <sub>h</sub>	unsigned 32	ro
	3	<i>object_3_to_be_mapped</i>	2102 0008, 2112 0008 <sup>1*)</sup>	2102 0008 <sub>h</sub>	unsigned 32	ro
	4	<i>object_4_to_be_mapped</i>	2103 0008, 2113 0008 <sup>1*)</sup>	2103 0008 <sub>h</sub>	unsigned 32	ro
	5	<i>object_5_to_be_mapped</i>	2104 0008, 2114 0008 <sup>1*)</sup>	2104 0008 <sub>h</sub>	unsigned 32	ro
	6	<i>object_6_to_be_mapped</i>	2105 0008, 2115 0008 <sup>1*)</sup>	2105 0008 <sub>h</sub>	unsigned 32	ro

<sup>1\*)</sup> The value of the *object\_to\_be\_mapped* depends on the *mode* selected in object 2300<sub>h</sub> (see page 26).

*mode* = 0 values 2100 0008<sub>h</sub> - 2105 0008<sub>h</sub> (default)

the time is given in UTC, as described in the objects 2100<sub>h</sub>-2105<sub>h</sub>

*mode* = 1,2 values 2110 0008<sub>h</sub> - 2115 0008<sub>h</sub>

the time is given in local time (*mode* = 1) or in DCF77-time (*mode* = 2), as described in the objects 2110<sub>h</sub>-2115<sub>h</sub>

### 4.3 Overview of the Manufacturer-Specific Objects

Index [Hex]	Name	Data Type	Access
2100	<i>hour_utc</i>	unsigned8	rw
2101	<i>minute_utc</i>	unsigned8	rw
2102	<i>second_utc</i>	unsigned8	rw
2103	<i>year_utc</i>	unsigned8	rw
2104	<i>month_utc</i>	unsigned8	rw
2105	<i>day_utc</i>	unsigned8	rw
2110	<i>hour</i> <sup>1*)</sup>	unsigned8	ro
2111	<i>minute</i> <sup>1*)</sup>	unsigned8	ro
2112	<i>second</i> <sup>1*)</sup>	unsigned8	ro
2113	<i>year</i> <sup>1*)</sup>	unsigned8	ro
2114	<i>month</i> <sup>1*)</sup>	unsigned8	ro
2115	<i>day</i> <sup>1*)</sup>	unsigned8	ro
2200	<i>period_of_timestamp</i>	unsigned16	rw
2300	<i>mode</i>	unsigned8	rw
2301	<i>time_difference</i>	signed16	rw
2FFF	<i>coding_switch</i>	unsigned8	ro

<sup>1\*)</sup>... The time values are given according to the time reference as specified in *modus* (object 2300<sub>h</sub>, see page 26), e.g.: local time or DCF77-time.

## 4.4 Description of the Manufacturer-Specific Objects

### 4.4.1 *hour* in UTC (2100<sub>h</sub>)

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2100</b>	0	<i>hour_utc</i>	00...17	-	unsigned 8	rw

Range of values: 0...23<sub>d</sub> (0...17<sub>h</sub>)

Unit: Hours

This object transfers the number of hours since midnight in UTC (coordinated universal time).

#### 4.4.2 *minute* in UTC (2101<sub>h</sub>)

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2101</b>	0	<i>minute_utc</i>	00...3B	-	unsigned 8	rw

Range of values: 0...59<sub>d</sub> (0...3B<sub>h</sub>)

Unit: Minutes

This object transfers the number of minutes since the last clock hour in UTC (coordinated universal time).

**4.4.3 *second* in UTC (2102<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2102</b>	0	<i>second_utc</i>	00...3B	-	unsigned 8	rw

Range of values: 0...59<sub>d</sub> (0...3B<sub>h</sub>)

Unit: Seconds

This object transfers the seconds since the last completed minute in UTC (coordinated universal time).

#### 4.4.4 *year* in UTC (2103<sub>h</sub>)

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2103</b>	0	<i>year_utc</i>	00...63	-	unsigned 8	rw

Range of values: 0...99<sub>d</sub> (0...3B<sub>h</sub>)

Unit: Years

This object transfers the number of years since the year 2000 in UTC (coordinated universal time).

**4.4.5 month in UTC (2104<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2104</b>	0	<i>month_utc</i>	01...0C	-	unsigned 8	rw

Range of values: 1...12<sub>d</sub> (1...0C<sub>h</sub>)

Unit: Month

This object transfers the current month in UTC (coordinated universal time).

#### 4.4.6 *day* in UTC (2105<sub>h</sub>)

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2105</b>	0	<i>day_utc</i>	01...31	-	unsigned 8	rw

Range of values: 1...31<sub>d</sub> (1...1F<sub>h</sub>)

Unit: Day

This object transfers the current day of month in UTC (coordinated universal time).

**4.4.7 hour (2110<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2110</b>	0	<i>hour</i>	00...17	-	unsigned 8	ro

Range of values: 0...23<sub>d</sub> (0...17<sub>h</sub>)

Unit: Hour (e.g. in local time as CET)

This object transfers the number of hours since midnight in the time reference as defined in *mode* in object 2300<sub>h</sub> (see page 26), e.g. in the local time.

**4.4.8 *minute* (2111<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2111</b>	0	<i>minute</i>	00...3B	-	unsigned 8	ro

Range of values: 0...59<sub>d</sub> (0...3B<sub>h</sub>)

Unit: Minute (e.g. in local time as CET)

This object transfers the number of minutes since the last clock hour in the time reference as defined in *mode* in object 2300<sub>h</sub> (see page 26), e.g. in the local time.

**4.4.9 *second* (2112<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2112</b>	0	<i>second</i>	00...3B	-	unsigned 8	ro

Range of values: 0...59<sub>d</sub> (0...3B<sub>h</sub>)

Unit: Seconds (e.g. in local time as CET)

This object transfers the number of seconds since the last completed minute in the time reference as defined in *mode* in object 2300<sub>h</sub> (see page 26), e.g. in the local time.

**4.4.10 year (2113<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2113</b>	0	<i>year</i>	00...63	-	unsigned 8	ro

Range of values: 0...99<sub>d</sub> (0...3B<sub>h</sub>)

Unit: Year (e.g. in local time as CET)

This object transfers the number of years since the year 2000 in the time reference as defined in *mode* in object 2300<sub>h</sub> (see page 26), e.g. in the local time.

**4.4.11 month (2114<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2114</b>	0	<i>month</i>	01...0C	-	unsigned 8	ro

Range of values: 1...12<sub>d</sub> (1...0C<sub>h</sub>)

Unit: Month (e.g. in local time as CET)

This object transfers the current month in the time reference as defined in *mode* in object 2300<sub>h</sub> (see page 26), e.g. in the local time.

**4.4.12 day(2115<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2115</b>	0	<i>day</i>	01...31	-	unsigned 8	ro

Range of values: 1...31<sub>d</sub> (1...1F<sub>h</sub>)

Unit: Day (e.g. in local time as CET)

This object transfers the current month in the time reference as defined in *mode* in object 2300<sub>h</sub> (see page 26), e.g. in the local time.

**4.4.13 *period\_of\_timestamp* (2200<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2200</b>	0	<i>period_of_timestamp</i>	0000...FFFF	1000	unsigned 16	rw

Range of values: 0...65535 ms

This object contains the repetition rate of the time stamp in milliseconds as defined in CiA DS-301.

If the module transmits a time stamp and if so, on which CAN identifier the time stamp is transmitted is defined via Object 1012<sub>h</sub>. In the default setting the module transmits the time stamp once per second on the 11-bit CAN identifier 100<sub>h</sub>.

**4.4.14 *mode* (2300<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2300</b>	0	<i>mode</i>	0, 1, 2	0	unsigned 8	rw

This object defines in which *mode* the time is calculated for the objects from 2110<sub>h</sub> to 2115<sub>h</sub>. The parameter *mode* contains the reference time.

**Values of the parameters:**

Value <i>mode</i> [Hex]	Meaning
0	time in UTC
1	time in local time, the time zone offset to UTC has to be defined in object 2301 <sub>h</sub> .
2	DCF77 time

**4.4.15 *time\_difference* (2301<sub>h</sub>)**

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
<b>2301</b>	0	<i>time_difference</i>	FD30 ... 0348	0	signed 16	rw

Range of values: -720...+840 min

In this object the time offset of the local time to the coordinated universal time (UTC) has to be defined. The offset to UTC has to be specified in minutes.

The value *time\_difference* is used for the calculation of the local time in the objects from 2110<sub>h</sub> to 2115h.

**Example:**

The local time shall be calculated as Central European Time (CET, winter).

It is:

$$\text{CET} = \text{UTC} + 1 \text{ hour}$$

The offset is +1hour or 60 minutes. Because the offset has to be specified in minutes, the entry (hexadecimal) is: *time\_difference* = 3C<sub>h</sub>

Note that during summer the summer time is observed, and CEST is used instead.

#### 4.4.16 *coding\_switch* (2FFF<sub>h</sub>)

Index [Hex]	Subindex [Dec]	Description	Range of values [Hex]	Default [Dec]	Data type	R/W
2FFF	0	<i>coding_switch</i>	00...FF	-	unsigned 8	ro

This object contains the current coding switch setting:

Index: 2FFF<sub>h</sub>, subindex: 0

Bit:	7	6	5	4	3	2	1	0
Assignment:	<i>coding_switch SW101</i>				<i>coding_switch SW100</i>			