

# TC.CANOPEN Manual

**Option**

---



[1001]  
ParameterName=Error  
Register  
ObjectType=0x07  
DataType=0x0005  
AccessType=ro  
DefaultValue=0x00

---

DO6130.0031 V02.62

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The actual version of the TC.CAN Manual can be found on the internet page [www.regatron.com](http://www.regatron.com).

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Tab. 1

## Manual

| Overview                                |  |
|---|--|
| <b>Manual</b>                           | <b>TC.CANOPEN Manual; DO6130.0031 V02.62</b> |
| <b>Valid of versions starting from:</b> |  |
| TopCon Main Firmware                    | Up to version V4.11.45                       |
| CAN Open Card Firmware                  | Up to version V0.09                          |

Tab. 2 Subject to technical changes

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## 1. Information

### 1.1. Safety notes


Before using the option TC.CANOPEN the operating manual of the TopCon power supply unit must be read. The safety notes in the operating manual must be observed and the necessary measures must be taken.

### 1.2. Used Used Pictograms and Signal Words


Important notes are marked with the following symbols throughout this operating manual:

| Hazard and warning information  |  |
|---|--|
| Pictogram   | Meaning  |
| <br><b>DANGER</b>   | For an immediate hazard that will result in serious injuries or fatality.  |
| <br><b>Warning</b> | For an immediate hazard that can result in serious injuries or fatality.   |
| <br><b>CAUTION</b> | For a possibly hazardous situation that can result in serious injuries or fatality.                                |
| <b>CAUTION</b>  | For a possibly hazardous situation that could result in damage to the product or another item in its surroundings. |


Tab. 3 Basic hazard and warning information

| Further warning and hazard information  |  |
|---|--|
| Pictogram   | Meaning  |
|  | DANGER, WARNING or CAUTION due to electrical power |

Tab. 4 Symbols included in the table can be used for more specific depiction of warning information from Tab. 3 "Basic hazard and warning information".

| Instructions  |                       |
|---|-----------------------|
| Pictogram   | Meaning               |
|  | Important information |

Tab. 5 Mandatory signs that are important for the operation of the device or the software

| General notes   |  |
|---|--|
| Pictogram   | Meaning                                      |
|  | Tip, for working efficiently with the device |

Tab. 6 Additional information, so that you can find possibly important information quickly

## 2. Specifications and attributes

### 2.1. Description

The option TC.CANOPEN enables the TopCon Quadro power supply to be programmed by a controller over CAN bus. The CANopen protocol allows the integration of the TopCon power supply into an existing CANopen network.

### 2.2. Specification of the CANopen protocol

The CANopen protocol is based on the CiA Draft Standard 301 V4.02.

**The following slave functionality is provided:**

- **SDO** (Service Data Object) communication (1 Server SDO)
- **PDO** (Process Data Object) communication with fix mapping (4 Receive PDO, 4 Transmit PDO)
- **SYNC** (Synchronisation Object) is supported, but not generated.
- **Producer Heartbeat**
- **EMCY** (Emergency) messages (only send)
- **NMT** (Network Management) commands including boot up message



CANopen first always transmits the lowest-order byte.



### 3. CANopen

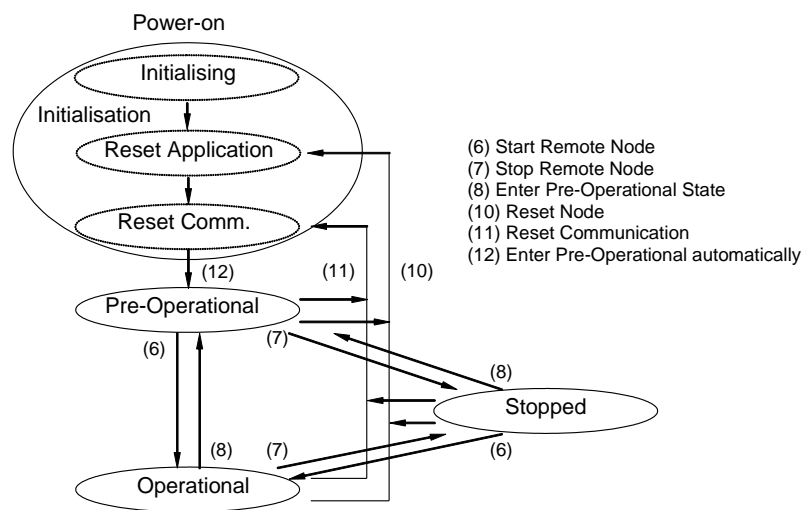


The detailed specifications of the protocols and mechanisms are present in the document „CANopen Application Layer and Communication Profile CiA Draft Standard 301“. This document is available at: [www.can-cia.de](http://www.can-cia.de) .

In the following only an overview will be given

#### 3.1. NMT state machine

The following drawing shows the implemented NMT (Network Management) state machine:



After power-on and accomplishment of the initialization the node autonomously changes to the “pre-operational” state. In this state the node can be configured by means of SDO communication. After accomplished configuration the node can be switched to the state “operational” by means of NMT command. In this state the PDO communication can be started.

The following table shows the possible states for the communication objects:

| Communications object | Initialisation | Pre-Operational | Operational | Stopped |
|-----------------------|----------------|-----------------|-------------|---------|
| PDO                   |                |                 | √           |         |
| SDO                   |                | √               | √           |         |
| SYNC                  |                | √               | √           |         |
| EMCY                  |                | √               | √           |         |
| Boot-Up               | √              |                 |             |         |
| NMT                   |                | √               | √           | √       |

Tab. 7

### 3.2. SDO communication

By means of SDO communication data can be directly read from the object directory or written into the object directory. SDO communication is always a point to point communication, that is to say always between two CAN nodes.

**The following protocols are differenced:**

- Segmented transfer
- Expedited transfer
- Block transfer (optional)

### 3.3. Emergency Object

Emergency objects are set off when a device internal error occurs. Emergency objects are sent out by an emergency producer and can be received by one or several consumers. The reaction triggered by an emergency object is device dependant. An emergency object is sent out only once per error.

8 bytes which define the occurred error are transmitted by an emergency object.

### 3.4. Heartbeat protocol

A heartbeat producer cyclically sends a heartbeat object into the CAN bus. One or several consumers monitor whether the object observes a determined cycle. If this object is missing an error is triggered by the monitoring consumer.

Sending out of the heartbeat objects occurs after writing to the object 0x1017 with a value  $\neq 0$ .

### 3.5. PDO Communication

The PDO communication is a transmission of data from a producer to one or several consumers. There are two utilization Types: the first is sending of data, the second is receiving of data. To do so transmit PDO (TPDO) and receive PDO (RPDO) are available. Devices which support TPDO are PDO producers. Devices which support RPDO are PDO consumers.

Data which are transmitted by a PDO come from the object directory. The PDO mapping parameters indicate which data in which length and sequence are transmitted. Maximum 8 bytes (64 bit) can be transmitted per PDO.

It is defined for each PDO object when the data in a TPDO is taken over, when the TPDO is sent out and when the data is taken out of the RPDO at the consumer. This information is stored in the PDO communication parameters under transmission Type.

Synchronous transmission: data takeover / data withdrawal are always synchronous with the SYNC object on the CAN bus.

Asynchronous transmission: data takeover / data withdrawal are independent of SYNC object. In this case the device profile defines when data takeover / data withdrawal occur.

**There are two possible PDO protocols:**

- Write PDO protocol
- Read PDO protocol

#### 3.5.1. Write PDO protocol

A PDO producer sends a PDO object to the CAN bus. One or several consumers receive the PDO. The receipt of the data is not acknowledged

#### 3.5.2. Read PDO Protocol

One or several PDO consumers send a remote transmit request (RTR) to the CAN bus. The PDO producer of the requested PDO sends the PDO after receipt of the RTR.

## 4. Configuration

### 4.1. Installation

The option TC.CANOPEN is completely installed by the manufacturer. No additional installation steps are necessary.

For TopCon power supplies of the Quadro series it is possible to install the option TC.CANOPEN at a later stage. To do so the power supply unit must be returned to the manufacturer.

### 4.2. Setting of the module ID (node address)

Before the power supply unit is switched on, the module ID must be set on the rear panel by means of the binary coded turn switches AH and AL as hexadecimal value.

|                             |   |
|-----------------------------|---|
| Module-ID =<br>16 * AH + AL | Valid value range: 1...127 (01H...7FH)<br>(Setting=0 adjust to 1) |
|-----------------------------|---|

#### Examples:

- Example 1:  
The device is to be addressed on address 29 (decimal).  
↳ AH is to be set on value "1",  
AL on value "D" (1DH).
- Example 2:  
AH is set to „0“ and AL to „0“ (00H)  
↳ The setting is adjusted to the value 01H. The device can be addressed on address 1.

### 4.3. Setting of the bit rate



Before the power supply unit is switched on, the bit rate must be set by means of the binary coded turn switch BR.

Depending on the set bit rate the length of the bus line is restricted. The specified max. bus length is an approximate value and also depends on the other devices on the bus.

| BR | Bit rate   | max. bus length |
|----|------------|-----------------|
| 1  | 10k Bit/s  | 1000 m          |
| 2  | 20 kBit/s  | 1000 m          |
| 3  | 50 kBit/s  | 1000 m          |
| 4  | 125 kBit/s | 500 m           |
| 5  | 250 kBit/s | 250 m           |
| 6  | 500 kBit/s | 100 m           |
| 7  | 800 kBit/s | 50 m            |

Tab. 8

All other settings lead to a bit rate of 250kBit/s. By default the turn switch BR is set to 6 in other words to a bit rate of 500kBit/s.

## 4.4. Connection

The TC.CANOPEN interface is equipped with two 9 pol DSUB connectors. This allows an easy integration into an existing CAN network. Both connectors labeled with “CAN” are identical and 1:1 connected to each other.

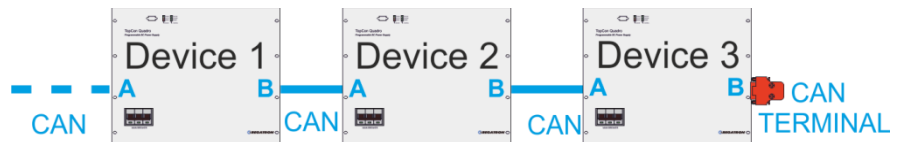
### 4.4.1. TopCon amid CAN network

One „CAN“ connector on the TopCon is to be connected through a CAN cable with the device before TopCon, the other connector on the TopCon with the device after.



### 4.4.2. TopCon is last device or single slave in CAN network

Connect one „CAN“ connector on TopCon through a CAN cable with the second last device in the network. The other “CAN” connector on TopCon is to be covered with a CAN terminal connector (120Ω between CAN-L und CAN-H).



### 4.4.3. Pin assignment

The two „CAN“ connectors have the following pin assignments:

| Pin | Signal                     |
|-----|----------------------------|
| 1   | Not assigned <sup>1)</sup> |
| 2   | CAN-L                      |
| 3   | CAN GND                    |
| 4   | Not assigned <sup>1)</sup> |
| 5   | Shield                     |
| 6   | GND (CAN GND)              |
| 7   | CAN-H                      |
| 8   | Not assigned <sup>1)</sup> |
| 9   | Not assigned <sup>1)</sup> |

Tab. 9 <sup>1)</sup>Not assigned, but internally connected 1:1.

## 5. Use of the RS-232 interface

If the option TC.CANOPEN is installed the RS-232 interface on the front of the TopCon device cannot be used. Therefore a RS232 interface is available on the TC.CANOPEN card.

Under CAN operation the use of the RS-232 interface is limited in the following way:

- No RS232 communication is possible in the CANopen state „Operational“.
- In the case there is no communication over the CAN bus communication over RS232 can be performed in the CANopen state „Pre-Operational“.

## 6. Use of the HMI/RCU

If the option TC.CANOPEN is installed and a HMI is installed or a RCU is connected to the TopCon device the following restrictions concerning the manipulation occurs:

- After Power-On the HMI and/or the RCU are in the remote state.
- In the CANopen state „Pre-Operational“ and in the CANopen state „Stopped“ the HMI or RCU can be switched to local control. Settings over the can BUS are ignored.
- During the change to the CANopen state „Operational“ the HMI and/or the RCU are switched to remote state automatically. A manual switch back to local state on the HMI and/or RCU is not possible during CANopen state „Operational“.



## 7. Object directory

The object directory is an essential component of a CANopen participant. Here all configuration and process data is stored and retrieved. The directory is organized in the form of a table.

To each entry a 16bit number is assigned, the so called index. Consequently 65536 entries are possible. Each of these entries can consist of maximum 256 components. The Sub index (8bit) identifies these components.

Indices and sub-indices always appear in hexadecimal notation in this document.

All entries consist of:

- an object name
- a data Type
- an attribute which defines the access rights

If an entry consists of several components, then the component with Sub index 0x00 indicates the maximum number the following sub-indices.

The object directory is, as the following table shows, subdivided in several blocks:

| Index           | Object                           |
|-----------------|----------------------------------|
| 0x0000          | Not used                         |
| 0x0001 – 0x001F | Static data Types                |
| 0x0020 – 0x003F | Complex data Types               |
| 0x0040 – 0x005F | Manufacturer specific data Types |
| 0x1000 – 0x1FFF | Communication profile (DS-301)   |
| 0x2000 – 0x5FFF | Not used                         |

Tab. 10

### 7.1. Definitions

In the following the below listed terms and abbreviations are used:

| Index           | Object                                     |
|-----------------|--|
| ro              | Only read access (read-only)               |
| rw              | Read and write access (read-write)         |
| Module-ID       | Set address                                |
| COB-ID          | Identification of the communication object |
| 0x2000 – 0x5FFF | Manufacturer specific objects              |

Tab. 11

## 7.2. Communication profile

The following table shows all objects of the communication profile which are supported by the device:

| Index  | Name                                   | Type                 | Meaning  | Page |
|--------|--|----------------------|--|------|
| 0x1000 | Device Type                            | Unsigned32           | Device profile                                 | 19   |
| 0x1001 | Error Register                         | Unsigned8            | Internal errors                                | 19   |
| 0x1003 | Pre-defined Error Field                | Array<br>Unsigned32  | Memory of the last 16 occurred errors          | 20   |
| 0x1005 | COB-ID SYNC message                    | Unsigned32           | COB-ID for the synchronization message         | 20   |
| 0x1008 | Manufacturer Device name               | Visible String       | Device name                                    | 21   |
| 0x1009 | Manufacturer Hardware Version          | Visible String       | Hardware version                               | 21   |
| 0x100A | Manufacturer Software Version          | Visible String       | Software version                               | 21   |
| 0x1010 | Store Parameters                       | Record               | Save parameters in non-volatile memory         | 21   |
| 0x1014 | COB-ID Emergency Object                | Unsigned32           | COB-ID for the emergency object                | 22   |
| 0x1017 | Producer Heartbeat Time                | Unsigned16           | Time between two generated heartbeats          | 22   |
| 0x1018 | Identity Object                        | Record Identity      | Device information                             | 23   |
| 0x1200 | Server SDO Parameter                   | Record SDO Parameter | Parameter for the Server SDO                   | 23   |
| 0x1400 | Receive PDO 1 Communication Parameter  | Record PDO Parameter | Communication parameter for the receipt PDO 1  | 24   |
| 0x1401 | Receive PDO 2 Communication Parameter  | Record PDO Parameter | Communication parameter for the receipt PDO 2  | 24   |
| 0x1402 | Receive PDO 3 Communication Parameter  | Record PDO Parameter | Communication parameter for the receipt PDO 3  | 24   |
| 0x1403 | Receive PDO 4 Communication Parameter  | Record PDO Parameter | Communication parameter for the receipt PDO 4  | 24   |
| 0x1600 | Receive PDO 1 Mapping Parameter        | Record PDO Mapping   | Mapping parameter for the receipt PDO 1        | 26   |
| 0x1601 | Receive PDO 2 Mapping Parameter        | Record PDO Mapping   | Mapping parameter for the receipt PDO 2        | 26   |
| 0x1602 | Receive PDO 3 Mapping Parameter        | Record PDO Mapping   | Mapping parameter for the receipt PDO 3        | 26   |
| 0x1603 | Receive PDO 4 Mapping Parameter        | Record PDO Mapping   | Mapping parameter for the receipt PDO 4        | 26   |
| 0x1800 | Transmit PDO 1 Communication Parameter | Record PDO Parameter | Communication parameter for the transmit PDO 1 | 28   |
| 0x1801 | Transmit PDO 2 Communication Parameter | Record PDO Parameter | Communication parameter for the transmit PDO 2 | 28   |
| 0x1802 | Transmit PDO 3 Communication Parameter | Record PDO Parameter | Communication parameter for the transmit PDO 3 | 28   |

Continuation of the table next page

| Index  | Name                                   | Type                 | Meaning  | Page |
|--------|--|----------------------|--|------|
| 0x1803 | Transmit PDO 4 Communication Parameter | Record PDO Parameter | Communication parameter for the transmit PDO 4 | 28   |
| 0x1A00 | Transmit PDO 1 Mapping Parameter       | Record PDO Mapping   | Mapping parameter for the transmit PDO 1       | 30   |
| 0x1A01 | Transmit PDO 2 Mapping Parameter       | Record PDO Mapping   | Mapping parameter for the transmit PDO 2       | 30   |
| 0x1A02 | Transmit PDO 3 Mapping Parameter       | Record PDO Mapping   | Mapping parameter for the transmit PDO 3       | 30   |
| 0x1A03 | Transmit PDO 4 Mapping Parameter       | Record PDO Mapping   | Mapping parameter for the transmit PDO 4       | 30   |

Tab. 12

### 7.2.1. Object 0x1000: Device Type

The CANopen node is not implemented according to a standardized profile.

| Index 0x1000 |             |            |           |            |
|--------------|-------------|------------|-----------|------------|
| Sub index    | Name        | Type       | Attribute | Default    |
| 0x00         | Device Type | Unsigned32 | ro        | 0x00000000 |

Tab. 13

### 7.2.2. Object 0x1001: Error Register

Internal errors are shown in this register.  
The error register is part of the emergency message.

| Index 0x1001 |                |           |           |         |
|--------------|----------------|-----------|-----------|---------|
| Sub index    | Name           | Type      | Attribute | Default |
| 0x00         | Error Register | Unsigned8 | ro        | -       |

Tab. 14

The following table shows the structure:

Bit 0 is set at each error. Additionally set bits specify the error more precisely.

| Bit | Meaning                 |
|-----|-------------------------|
| 0   | General error           |
| 1   | Current                 |
| 2   | Voltage                 |
| 3   | Temperature             |
| 4   | Communication           |
| 5   | Device profile specific |
| 6   | Reserved                |
| 7   | Manufacturer specific   |

Tab. 15

## 7.2.3. Object 0x1003: Pre-defined Error Field

### 7.2.3.1. Structure

|                        |     |        |            |     |       |
|------------------------|-----|--------|------------|-----|-------|
| Bit 31                 | ... | Bit 16 | Bit 15     | ... | Bit 0 |
| Additional information |     |        | Error code |     |       |

The error code is alike the error code of the emergency message. Additional information contains the lower 16Bit of the Manufacturer Error Field of the emergency message. By writing 0 to sub index 0x00 the error memory will be deleted.

| Index 0x1003 |                         |            |           |         |
|--------------|-------------------------|------------|-----------|---------|
| Sub index    | Name                    | Type       | Attribute | Default |
| 0x00         | Number of errors        | Unsigned8  | rw        | 0       |
| 0x01         | Pre-defined Error Field | Unsigned32 | ro        | -       |
| ...          | ...                     | ...        | ...       | ...     |
| 0x10         | Pre-defined Error Field | Unsigned32 | ro        | -       |

Tab. 16

In Subindex 0x00 the actual number of stored errors can be retrieved. A new error is always inserted in Sub index 0x01. All existing errors are shifted down by one Sub index. Maximum 16 errors will be stored. If more than 16 errors occur, the oldest will be deleted.

## 7.2.4. Object 0x1005: COB-ID SYNC message

### 7.2.4.1. Structure

|          |     |        |        |     |       |
|----------|-----|--------|--------|-----|-------|
| Bit 31   | ... | Bit 16 | Bit 15 | ... | Bit 0 |
| Always 0 |     |        | COB-ID |     |       |

The object defines the COB-ID for the synchronization message.

| Index 0x1005 |                     |            |       |            |
|--------------|---------------------|------------|-------|------------|
| Sub index    | Name                | Type       | Attr. | Default    |
| 0x00         | COB-ID SYNC message | Unsigned32 | rw    | 0x00000080 |

Tab. 17

### 7.2.5. Object 0x1008: Manufacturer Device Name

The object determines the device name of the power supply.

| Index 0x1008 |                          |                |       |                 |
|--------------|--------------------------|----------------|-------|-----------------|
| Sub index    | Name                     | Type           | Attr. | Default         |
| 0x00         | Manufacturer Device Name | Visible String | ro    | „TopCon Quadro“ |

Tab. 18

### 7.2.6. Object 0x1009: Manufacturer Hardware Version

The object determines the actual hardware version of the power supply.

| Index 0x1009 |                               |                |       |         |
|--------------|-------------------------------|----------------|-------|---------|
| Sub index    | Name                          | Type           | Attr. | Default |
| 0x00         | Manufacturer Hardware Version | Visible String | ro    | „V4.x“  |

Tab. 19

### 7.2.7. Object 0x100A: Manufacturer Software Version

The object determines the actual software version of the power supply.

| Index 0x100A |                               |                |       |                         |
|--------------|-------------------------------|----------------|-------|-------------------------|
| Sub index    | Name                          | Type           | Attr. | Default                 |
| 0x00         | Manufacturer Software Version | Visible String | ro    | Actual software version |

Tab. 20

### 7.2.8. Object 0x1010: Store Parameters

Stores parameters in non-volatile memory.

Only parameters marked so in the object overviews (please see 7.2 and 7.3) can be stored. In order to avoid storage of parameters by mistake, storage is only executed when a specific signature is written to subindex 0x01. This signature is 0x65766173 („save“). The parameters are restored after reset or power cycle.

| Index 0x1010 |   |           |       |            |
|--------------|---|-----------|-------|------------|
| Sub index    | Name                                      | Type      | Attr. | Default    |
| 0x00         | Number of supported entries               | Unsigned8 | ro    | 1          |
| 0x01         | Storage functionality/<br>Storage command |           | rw    | 0x00000001 |

Tab. 21

## 7.2.9. Object 0x1014: COB-ID Emergency Object

| Index 0x1014 |                         |            |       |                    |
|--------------|-------------------------|------------|-------|--------------------|
| Sub index    | Name                    | Type       | Attr. | Default            |
| 0x00         | COB-ID Emergency Object | Unsigned32 | ro    | 0x80<br>+Module-ID |

Tab. 22

### 7.2.9.1. Structure

|                          |                        |        |        |     |       |
|--------------------------|------------------------|--------|--------|-----|-------|
| Bit 31                   | Bit 30                 | Bit 11 | Bit 10 | ... | Bit 0 |
| 0 / 1<br>valid / invalid | Reserved<br>(always 0) |        | COB-ID |     |       |

## 7.2.10. Object 0x1017: Producer Heartbeat Time

The object determines the time in [ms] between 2 sent heartbeat messages. If the time is set to 0, no heartbeat will be sent. The transmission starts as soon as there is a value unequal 0.

| Index 0x1017 |                         |            |       |         |
|--------------|-------------------------|------------|-------|---------|
| Sub index    | Name                    | Type       | Attr. | Default |
| 0x00         | Producer Heartbeat Time | Unsigned16 | rw    | 0       |

Tab. 23

## 7.2.11. Object 0x1018: Identity Object

The object specifies the used device.

### 7.2.11.1. Structure

Structure:

|                |     |        |                |     |       |
|----------------|-----|--------|----------------|-----|-------|
| Bit 31         | ... | Bit 16 | Bit 15         | ... | Bit 0 |
| Major-Rev.-Nr. |     |        | Minor-Rev.-Nr. |     |       |

The revision number relates to the CANopen behavior. The major-rev. number contains the CANopen functionality. If the functionality is changed, the major-rev. number is increased. The minor-rev. number identifies different versions with identical CANopen behavior.

| Index 0x1018 |                             |            |       |                        |
|--------------|-----------------------------|------------|-------|------------------------|
| Sub index    | Name                        | Type       | Attr. | Default                |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 4                      |
| 0x01         | Vendor ID                   | Unsigned32 | ro    | 0x000001C4             |
| 0x02         | Device description          | Unsigned32 | ro    | 0                      |
| 0x03         | Revision number             | Unsigned32 | ro    | Actual revision number |
| 0x04         | Serial number               | Unsigned32 | ro    | Actual serial number   |

Tab. 24

## 7.2.12. Object 0x1200: Server SDO

The object defines the server SDO communication.

### 7.2.12.1. Structure

|                          |        |                        |        |     |       |
|--------------------------|--------|------------------------|--------|-----|-------|
| Bit 31                   | Bit 30 | Bit 11                 | Bit 10 | ... | Bit 0 |
| 0 / 1<br>valid / invalid |        | Reserved<br>(always 0) | COB-ID |     |       |

| Index 0x1008 |                                 |            |       |                     |
|--------------|---------------------------------|------------|-------|---------------------|
| Sub index    | Name                            | Type       | Attr. | Default             |
| 0x00         | Number of supported entries     | Unsigned8  | ro    | 2                   |
| 0x01         | COB-ID Client<br>-> Server (Rx) | Unsigned32 | ro    | 0x600<br>+Module-ID |
| 0x02         | COB-ID Server<br>-> Client (Tx) | Unsigned32 | ro    | 0x580<br>+Module-ID |

Tab. 25



### 7.2.13. Object 0x1400-0x1403: Receive PDO Communication Parameter

With these objects the communication parameters of RPDO1, RPDO2, RPDO3 and RPDO4 are set.

#### 7.2.13.1. Structure

|                          |               |                        |                  |
|--------------------------|---------------|------------------------|------------------|
| Bit 31                   | Bit 30        | Bit 29 ... Bit 11      | Bit 10 ... Bit 0 |
| 0 / 1<br>valid / invalid | 1<br>(no RTR) | Reserved<br>(always 0) | COB-ID           |

Tab. 26 Bit 31 must first be set to 1, when entering a new COB-ID.

The transmission type defines when the data from the RPDO is taken over into the process and how the PDO of the other node is sent. The following values are possible:

| Transmission type    | PDO transmissions      | Description  |
|----------------------|------------------------|--|
| 0                    | Non cyclic synchronous | Take over data of last RPDO at each SYNC. The PDO is not cyclically sent.                                |
| 1-240<br>(x=1...240) | Cyclic synchronous     | Take over data of last RPDO at each SYNC. The PDO is not cyclically sent. The PDO is sent every x. SYNC. |
| 254                  | asynchronous           | Data of RPDO is taken over at receipt independently from SYNC.   |

Tab. 27

The data takeover behavior at RPDO is equal for the transmission types 0 to 240.

**7.2.13.2. Communication parameter for RPDO1**

| Index 0x1400 |                             |            |       |                          |
|--------------|-----------------------------|------------|-------|--------------------------|
| Sub index    | Name                        | Type       | Attr. | Default                  |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2                        |
| 0x01         | COB-ID RPDO1                | Unsigned32 | rw    | 0x40000200+<br>Module-ID |
| 0x02         | transmission type           | Unsigned8  | rw    | 254                      |

Tab. 28

**7.2.13.3. Communication parameter for RPDO2**

| Index 0x1401 |                             |            |       |                          |
|--------------|-----------------------------|------------|-------|--------------------------|
| Sub index    | Name                        | Type       | Attr. | Default                  |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2                        |
| 0x01         | COB-ID RPDO2                | Unsigned32 | rw    | 0x40000300+<br>Module-ID |
| 0x02         | transmission type           | Unsigned8  | rw    | 254                      |

Tab. 29

**7.2.13.4. Communication parameter for RPDO3**

| Index 0x1402 |                             |            |       |                          |
|--------------|-----------------------------|------------|-------|--------------------------|
| Sub index    | Name                        | Type       | Attr. | Default                  |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2                        |
| 0x01         | COB-ID RPDO3                | Unsigned32 | rw    | 0x40000400+<br>Module-ID |
| 0x02         | transmission type           | Unsigned8  | rw    | 254                      |

Tab. 30

**7.2.13.5. Communication parameter for RPDO4**

| Index 0x1403 |                             |            |       |                          |
|--------------|-----------------------------|------------|-------|--------------------------|
| Sub index    | Name                        | Type       | Attr. | Default                  |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2                        |
| 0x01         | COB-ID RPDO4                | Unsigned32 | rw    | 0x40000500+<br>Module-ID |
| 0x02         | transmission type           | Unsigned8  | rw    | 254                      |

Tab. 31

## 7.2.14. Object 0x1600-0x1603: Receive PDO Mapping Parameter

These objects define which data is transmitted with RPDO1, RPDO2, RPDO3 and RPDO4.

### 7.2.14.1. Structure

|        |     |        |           |     |        |                |     |       |
|--------|-----|--------|-----------|-----|--------|----------------|-----|-------|
| Bit 31 | ... | Bit 16 | Bit 30    | ... | Bit 11 | Bit 10         | ... | Bit 0 |
| Index  |     |        | Sub index |     |        | Number of Bits |     |       |

Index: Index of the object which is transmitted.

Sub index: Sub index of the object which is transmitted.

Number of Bits: Size of the object in bits. The sum of the bits must not exceed 64 (8Byte \* 8Bit)

### 7.2.14.2. Mapping parameter for RPDO1

| Index 0x1600 |                             |            |       |            |
|--------------|-----------------------------|------------|-------|------------|
| Sub index    | Name                        | Type       | Attr. | Default    |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 1          |
| 0x01         | 1. mapped object            | Unsigned32 | ro    | 0x20100010 |

Tab. 32

### 7.2.14.3. Mapping parameter for RPDO2

| Index 0x1601 |                             |            |       |            |
|--------------|-----------------------------|------------|-------|------------|
| Sub index    | Name                        | Type       | Attr. | Default    |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 1          |
| 0x01         | 1. mapped object            | Unsigned32 | ro    | 0x20110010 |

Tab. 33

### 7.2.14.4. Mapping parameter for RPDO3

| Index 0x1602 |                             |            |       |            |
|--------------|-----------------------------|------------|-------|------------|
| Sub index    | Name                        | Type       | Attr. | Default    |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2          |
| 0x01         | 1. mapped object            | Unsigned32 | ro    | 0x20120010 |
| 0x02         | 2. mapped object            | Unsigned32 | ro    | 0x20130010 |

Tab. 34

### 7.2.14.5. Mapping parameter for RPDO4

| Index 0x1603 |                             |            |       |            |
|--------------|-----------------------------|------------|-------|------------|
| Sub index    | Name                        | Type       | Attr. | Default    |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 1          |
| 0x01         | 1. mapped object            | Unsigned32 | ro    | 0x20140010 |

Tab. 35

## 7.2.15. Object 0x1800-0x1803: Transmit PDO Communication Parameter

With these objects the communication parameters of the TPDO1, TPDO2, TPDO3 and TPDO4 are set.

### 7.2.15.1. Structure

Bit 31 must first be set to 1 when entering a new COB-ID.

|                          |                        |        |        |     |       |
|--------------------------|------------------------|--------|--------|-----|-------|
| Bit 31                   | Bit 30                 | Bit 11 | Bit 10 | ... | Bit 0 |
| 0 / 1<br>valid / invalid | Reserved<br>(always 0) |        | COB-ID |     |       |

The transmission type defines when the data is taken over into the TPDO and when the TPDO is sent.

The following values are possible:

| Transmission type    | PDO transmissions         | Description   |
|----------------------|---------------------------|---|
| 1-240<br>(x=1...240) | cyclic<br>synchronous     | The TPDO is cyclically composed and sent at every x. SYNC.  |
| 252                  | synchronous<br>Only RTR   | The TPDO is composed at each SYNC but sent only with a RTR. |
| 253                  | a synchronous<br>Only RTR | The TPDO is composed and sent on receipt of a RTR.          |

Tab. 36

The data takeover behavior at TPDO is equal for the transmission types 0 to 240.

### 7.2.15.2. Communication parameter for TPDO1

| Index 0x1800 |                             |            |       |                     |
|--------------|-----------------------------|------------|-------|---------------------|
| Sub index    | Name                        | Type       | Attr. | Default             |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2                   |
| 0x01         | COB-ID TPDO1                | Unsigned32 | rw    | 0x180<br>+Module-ID |
| 0x02         | Transmission type           | Unsigned8  | rw    | 253                 |

Tab. 37

**7.2.15.3. Communication parameter for TPDO2**

| Index 0x1801 |                             |            |       |                         |
|--------------|-----------------------------|------------|-------|-------------------------|
| Sub index    | Name                        | Type       | Attr. | Default                 |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2                       |
| 0x01         | COB-ID TPDO2                | Unsigned32 | rw    | 0x80000280+<br>Modul-ID |
| 0x02         | Transmission type           | Unsigned8  | rw    | 253                     |

Tab. 38

**7.2.15.4. Communication parameter for TPDO3**

| Index 0x1802 |                             |            |       |                         |
|--------------|-----------------------------|------------|-------|-------------------------|
| Sub index    | Name                        | Type       | Attr. | Default                 |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2                       |
| 0x01         | COB-ID TPDO3                | Unsigned32 | rw    | 0x80000380+<br>Modul-ID |
| 0x02         | Transmission type           | Unsigned8  | rw    | 253                     |

Tab. 39

**7.2.15.5. Communication parameter for TPDO4**

| Index 0x1803 |                             |            |       |                         |
|--------------|-----------------------------|------------|-------|-------------------------|
| Sub index    | Name                        | Type       | Attr. | Default                 |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2                       |
| 0x01         | COB-ID TPDO4                | Unsigned32 | rw    | 0x80000480+<br>Modul-ID |
| 0x02         | Transmission type           | Unsigned8  | rw    | 253                     |

Tab. 40

## 7.2.16. Object 0x1A00-0x1A03: Transmit PDO Mapping Parameter

These objects define which data is transmitted with TPDO1, TPDO2, TPDO3 and TPDO4.

### 7.2.16.1. Structure

|        |     |        |           |     |       |                |     |       |
|--------|-----|--------|-----------|-----|-------|----------------|-----|-------|
| Bit 31 | ... | Bit 16 | Bit 15    | ... | Bit 8 | Bit 7          | ... | Bit 0 |
| Index  |     |        | Sub index |     |       | Number of Bits |     |       |

Index: Index of the object which is transmitted.

Sub index: Sub index of the object which is transmitted.

Number of Bits: Size of the object in bits. The sum of the bits must not exceed 64 (8Byte \* 8Bit)

### 7.2.16.2. Mapping parameter for TPDO1

| Index 0x1A00 |                             |            |       |            |
|--------------|-----------------------------|------------|-------|------------|
| Sub index    | Name                        | Type       | Attr. | Default    |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 4          |
| 0x01         | 1. mapped object            | Unsigned32 | ro    | 0x20200010 |
| 0x02         | 2. mapped object            | Unsigned32 | ro    | 0x20210010 |
| 0x03         | 3. mapped object            | Unsigned32 | ro    | 0x20220010 |
| 0x04         | 4. mapped object            | Unsigned32 | ro    | 0x20230010 |

Tab. 41

### 7.2.16.3. Mapping parameter for TPDO2

| Index 0x1A01 |                             |           |       |         |
|--------------|-----------------------------|-----------|-------|---------|
| Sub index    | Name                        | Type      | Attr. | Default |
| 0x00         | Number of supported entries | Unsigned8 | ro    | 0       |

Tab. 42

### 7.2.16.4. Mapping parameter for TPDO3

| Index 0x1A02 |                             |           |       |         |
|--------------|-----------------------------|-----------|-------|---------|
| Sub index    | Name                        | Type      | Attr. | Default |
| 0x00         | Number of supported entries | Unsigned8 | ro    | 0       |

Tab. 43

### 7.2.16.5. Mapping parameter for TPDO4

| Index 0x1A03 |                             |           |       |         |
|--------------|-----------------------------|-----------|-------|---------|
| Sub index    | Name                        | Type      | Attr. | Default |
| 0x00         | Number of supported entries | Unsigned8 | ro    | 0       |

Tab. 44



### 7.3. Manufacturer related objects

The table below lists all objects not defined by a standard.

| Index    | Name                | Type       | Description                           | Page |
|----------|---------------------|------------|---------------------------------------|------|
| 0x2000   | Nominal voltage     | Signed16   | Nominal voltage in [V]                | 33   |
| 0x2001   | Maximum current     | Signed16   | Maximum current [A]                   | 33   |
| 0x2002   | Nominal power       | Signed16   | Nominal power in [kW]                 | 33   |
| 0x2003   | Internal resistance | Signed16   | Nominal internal resistance in [mΩ]   | 34   |
| 0x2010 * | Voltage reference   | Signed16   | Definition of voltage                 | 34   |
| 0x2011 * | Current reference   | Signed16   | Definition of current                 | 35   |
| 0x2012 * | Power reference     | Signed16   | Definition power                      | 35   |
| 0x2013 * | Internal resistance | Signed16   | Definition of internal resistance     | 36   |
| 0x2014   | Command             | Unsigned16 | Sets unit to STOP / RUN / ERROR RESET | 37   |
| 0x2020   | Actual voltage      | Signed16   | Actual value of voltage               | 38   |
| 0x2021   | Actual current      | Signed16   | Actual value of current               | 38   |
| 0x2022   | Actual power        | Signed16   | Actual value of power level           | 39   |
| 0x2023   | State of output     | Unsigned16 | State of output                       | 40   |
| 0x2030 * | Overvoltage level   | Unsigned16 | Overvoltage trip level                | 41   |
| 0x2031 * | Overcurrent level   | Unsigned16 | Overcurrent trip level                | 41   |
| 0x2100   | Register Read/Write | Record     | Read/Write Access to TopCon Registers | 42   |

Tab. 45 \* Parameter which can be stored in non-volatile memory (please see 7.2.8).

### 7.3.1. Object 0x2000: Nominal voltage

This object defines the nominal voltage of the unit in [V].

Is the unit a master in a multi-unit system (i.e. parallel connection) the information of the system are displayed.

| Index 0x2000 |                 |          |       |              |
|--------------|-----------------|----------|-------|--------------|
| Sub index    | Name            | Type     | Attr. | Default      |
| 0x00         | Nominal voltage | Signed16 | ro    | Unit related |

Tab. 46

### 7.3.2. Object 0x2001: Maximum current

This object defines the nominal current of the unit in [A].

Is the unit a master in a multi-unit system (i.e. parallel connection) the information of the system are displayed.

| Index 0x2001 |                 |          |       |              |
|--------------|-----------------|----------|-------|--------------|
| Sub index    | Name            | Type     | Attr. | Default      |
| 0x00         | Maximum current | Signed16 | ro    | Unit related |

Tab. 47

### 7.3.3. Object 0x2002: Nominal power

This object defines the nominal power of the unit in [kW].

Is the unit a master in a multi-unit system (i.e. parallel connection) the information of the system are displayed.

| Index 0x2002 |               |          |       |              |
|--------------|---------------|----------|-------|--------------|
| Sub index    | Name          | Type     | Attr. | Default      |
| 0x00         | Nominal power | Signed16 | ro    | Unit related |

Tab. 48

### 7.3.4. Object 0x2003: Nominal internal resistance

This object defines the internal resistance of the unit in [mΩ].

Is the unit a master in a multi-unit system (i.e. parallel connection) the information of the system are displayed.

| Index 0x2003 |                             |          |       |              |
|--------------|-----------------------------|----------|-------|--------------|
| Sub index    | Name                        | Type     | Attr. | Default      |
| 0x00         | Nominal internal resistance | Signed16 | ro    | Unit related |

Tab. 49

### 7.3.5. Object 0x2010: Voltage reference

This object defines the set value for output voltage of the unit. Please keep in mind, that the overall voltage span (object 0x2000 ; Nominal voltage ) is quantized into 4000 parts. The desired set value therefore is to be defined in parts as a fraction of 4000.

| Index 0x2010 |                   |          |       |         |
|--------------|-------------------|----------|-------|---------|
| Sub index    | Name              | Type     | Attr. | Default |
| 0x00         | Voltage reference | Signed16 | rw    | -       |

Tab. 50



**CAUTION**

#### Danger of life by the output voltage!

Depending on the device type the output voltage can be very dangerous!

- ⇒ Protect the output terminals from accidental touch.
- ⇒ Pay attention to the safety instructions in the TopCon manual and follow the instructions.

**Example:** The nominal voltage of the unit: 100 V.

- A set value of 33.5 volts is to be set.

$$Partvalue = 33.5V \cdot \frac{4000}{100V} = 1340$$

- ↳ Send a part value of 1340 to the object 0x2010.

### 7.3.6. Object 0x2011: Current reference

This object defines the set value for output current of the unit. Please keep in mind, that the overall current span (object 0x2001; Maximum current) is quantized into 4000 parts. The desired set value therefore is to be defined in parts as a fraction of 4000.

| Index 0x2011 |                   |          |       |         |
|--------------|-------------------|----------|-------|---------|
| Sub index    | Name              | Type     | Attr. | Default |
| 0x00         | Current reference | Signed16 | rw    | -       |

Tab. 51

**Example:** The maximum current of the unit: 800 A.

- A set value of 150 A is to be set.

$$Partvalue = 150A \cdot \frac{4000}{800A} = 750$$

↳ Send a part value of 750 to the object 0x2011.

### 7.3.7. Object 0x2012: Power reference

This object defines the set value for output power of the unit. Please keep in mind, that the overall power span (object 0x2002; Nominal power) is quantized into 4000 parts. The desired set value therefore is to be defined in parts as a fraction of 4000.

| Index 0x2012 |                 |          |       |         |
|--------------|-----------------|----------|-------|---------|
| Sub index    | Name            | Type     | Attr. | Default |
| 0x00         | Power reference | Signed16 | rw    | -       |

Tab. 52

**Example:** The nominal power of the unit: 32kW.

- A set value of 10 kW is to be set.  $Partvalue = 10kW \cdot \frac{4000}{32kW} = 1250$

↳ Send a part value of 1250 to the object 0x2012.

### 7.3.8. Object 0x2013: Internal resistance refernce

This object defines the set value for the unit's internal resistance. Please keep in mind, that the overall internal resistance span (object 0x2003; Maximal internal resistance) is quantized into 4000 parts. The desired set value therefore is to be defined in parts as a fraction of 4000.

| Index 0x2013 |                     |          |       |         |
|--------------|---------------------|----------|-------|---------|
| Sub index    | Name                | Type     | Attr. | Default |
| 0x00         | Internal resistance | Signed16 | rw    | -       |

Tab. 53

**Example:** The nominal internal resistance of the unit: 1000mΩ.

- A set value of 200mΩ is to be set.

$$Partvalue = 200m\Omega \cdot \frac{4000}{1000m\Omega} = 800$$

↳ Send a part value of 800 to the object 0x2013.

### 7.3.9. Object 0x2014: Run command

This object controls the RUN / STOP – state of the unit.

| Index 0x2014 |                  |            |       |         |
|--------------|------------------|------------|-------|---------|
| Sub index    | Name             | Type       | Attr. | Default |
| 0x00         | Run/Stop command | Unsigned16 | rw    | -       |

Tab. 54



#### CAUTION

#### Danger of life by the Output voltage!

Depending on the device type the output voltage can be very dangerous.

- ⇒ Protect the output terminals from accidental touch.
- ⇒ Pay attention to the safety instructions in the TopCon manual and follow the instructions.

The following states are recognized:

| Command | Description                 |
|---------|-----------------------------|
| 0       | Output disabled, STOP state |
| 1       | Output enabled, RUN state   |
| 2       | Reset error condition       |

Tab. 55

### 7.3.10. Object 0x2020: Actual voltage

This object gives the actual output voltage as fractional part of the nominal voltage. A part value of 4000 equals to the Nominal voltage set in Object 0x2000.

| Index 0x2020 |                |          |       |         |
|--------------|----------------|----------|-------|---------|
| Sub index    | Name           | Type     | Attr. | Default |
| 0x00         | Actual voltage | Signed16 | ro    | -       |

Tab. 56

**Example:** Read-out of the object 0x2020 gives a part value of 4150.

- The nominal voltage value is 400 V<sub>DC</sub>.

$$\text{Spannung} = 415 \cdot \frac{400\text{V}}{4000} = 41.5\text{V}$$

↳ The actual measured output voltage equals to 41.5 V<sub>DC</sub>

### 7.3.11. Object 0x2021: Actual current

This object gives the actual output current as fractional part of the maximum current. A part value of 4000 equals to the maximum current set in object 0x2001.

| Index 0x2021 |                |          |       |         |
|--------------|----------------|----------|-------|---------|
| Sub index    | Name           | Type     | Attr. | Default |
| 0x00         | Actual current | Signed16 | ro    | -       |

Tab. 57

**Example:** Read-out of object 0x2021 gives a part value of 3921.

- The maximum current value is 100 A.

$$\text{Actual\_current} = 3921 \cdot \frac{100\text{A}}{4000} = 98.025\text{A}$$

↳ The actual measured output current equals to 98.025 A<sub>DC</sub>

### 7.3.12. Object 0x2022: Actual power

This object gives the actual output power as fractional part of the nominal power. A part value of 4000 equals to the Nominal power set in Object 0x2002.

| Index 0x2022 |              |          |       |         |
|--------------|--------------|----------|-------|---------|
| Sub index    | Name         | Type     | Attr. | Default |
| 0x00         | Actual power | Signed16 | ro    | -       |

Tab. 58

**Example:** Read-out of object 0x2022 gives a part value of 2300.

- The nominal power is 16 kW.

$$Actual\_power = 2300 \cdot \frac{16kW}{4000} = 9.2kW$$

↳ The actual measured output power equals to 9.2 kW



### 7.3.13. Object 0x2023: State of the DC-output and operation mode

| Index 0x2023 |                 |            |       |         |
|--------------|-----------------|------------|-------|---------|
| Sub index    | Name            | Type       | Attr. | Default |
| 0x00         | DC-output state | Unsigned16 | ro    | -       |

Tab. 59 This object defines the actual state of DC output and the unit operational mode.

The table below lists the meaning of the object bit values:

| Bit | Function                                |
|-----|---|
| 0   | 0 = Output disabled, 1 = Output enabled |
| 1   | 1 = Unit is in voltage control mode     |
| 2   | 1 = Unit is in current control mode     |
| 3   | 1 = Unit is in power control mode       |
| 4   |   |
| 5   |   |
| 6   |   |
| 7   |   |
| 8   |   |
| 9   |   |
| 10  |   |
| 11  |   |
| 12  |   |
| 13  |   |
| 14  | 1 = Warning                             |
| 15  | 1 = Error                               |

Tab. 60

### 7.3.14. Object 0x2030: Overvoltage level

This object defines the overvoltage trip level. A value of 4000 equals to the Nominal voltage in Object 0x2000. A 10% margin above the Nominal voltage setting is allowed therefore part values up to 4400 are accepted.

| Index 0x2030 |                   |            |       |         |
|--------------|-------------------|------------|-------|---------|
| Sub index    | Name              | Type       | Attr. | Default |
| 0x00         | Overvoltage level | Unsigned16 | rw    | -       |

Tab. 61

**Example:** An overvoltage level of 840 V<sub>DC</sub> is to be set while a nominal voltage of 800 V<sub>DC</sub> is given. This is 105% of nominal voltage, therefore  $1.05 \times 4000 = 4200$  is the part value to be stored in Object 0x2030.

### 7.3.15. Object 0x2031: Overcurrent level

This object defines the actual trip level for overcurrent protection. A value of 4000 equals to the maximum current value given in Object 0x2001.

| Index 0x2031 |                   |            |       |         |
|--------------|-------------------|------------|-------|---------|
| Sub index    | Name              | Type       | Attr. | Default |
| 0x00         | Overcurrent level | Unsigned16 | rw    | -       |

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### 7.3.16. Object 0x2100: Register Read / Write

| Index 0x2100 |                             |            |       |         |
|--------------|-----------------------------|------------|-------|---------|
| Sub index    | Name                        | Type       | Attr. | Default |
| 0x00         | Number of supported entries | Unsigned8  | ro    | 2       |
| 0x01         | Address                     | Unsigned32 | rw    | 0       |
| 0x02         | Value                       | Unsigned16 | rw    | -       |

Tab. 63



This object is to be used only in special situations. For example to set control parameters that cannot be set by RS232 and TopControl. If required please contact the manufacturer prior to using this object.

After writing the address of the required register to sub index 0x01 the value of the register can be read or written.

**Devices up to version V4.19.99:**

The address (Sub index 0x01) allows a 16-bit value, which addresses the desired register.

**Devices from Version V4.20.00:**

The address (Sub index 0x01) allows a 24-bit value, which addresses the desired register.

## 8. Emergency error codes

An emergency object transmits an error code, divided into:

- „Emergency error code“,
- „Error register“
- “Manufacturer specific Error Field“.

### 8.1.1.1. Structure

|                      |     |        |                |                                   |     |        |  |
|----------------------|-----|--------|----------------|-----------------------------------|-----|--------|--|
| Byte 0               | ... | Byte 1 | Byte 2         | Byte 3                            | ... | Byte 7 |  |
| Emergency Error code |     |        | Error Register | Manufacturer specific Error Field |     |        |  |



CANopen transmits LSB bits first.

### 8.1.1.2. Example for a „Gatedrive-A-Error“:

|        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|
| Byte 0 | Byte 1 | Byte 2 | Byte 3 | Byte 4 | Byte 5 | Byte 6 | Byte 7 |
| 0x00   | 0x23   | 0x03   | 0x23   | 0x00   | 0x00   | 0x00   | 0x00   |

| Emergency Code 0x0000 |                                   |                           |
|-----------------------|-----------------------------------|---------------------------|
| Error Register        | Manufacturer specific Error Field | Description               |
| 0x00                  | 0x0000000000                      | Error reset or „No error“ |

Tab. 64

| Emergency Code 0x2100 |                                   |  |
|-----------------------|-----------------------------------|--|
| Error Register        | Manufacturer specific Error Field | Description                                  |
| 0x03                  | 0x0000000149                      | IBC IGBT error                               |
| 0x03                  | 0x000000014B                      | IBC overcurrent in phase L1, L2 or L3        |
| 0x03                  | 0x0000000160                      | IBC overcurrent in phase L1                  |
| 0x03                  | 0x0000000161                      | IBC overcurrent phase L2                     |
| 0x03                  | 0x0000000162                      | IBC overcurrent phase L3                     |
| 0x03                  | 0x0000000163                      | IBC DC offset of the phase currents too high |

Tab. 65

| Emergency Code 0x2200 |                                   |                                |
|-----------------------|-----------------------------------|--------------------------------|
| Error Register        | Manufacturer specific Error Field | Description                    |
| 0x03                  | 0x0000000022                      | Primary overcurrent            |
| 0x03                  | 0x0000000130                      | IBC gatedrive-1 error          |
| 0x03                  | 0x0000000131                      | IBC gatedrive-2 error          |
| 0x03                  | 0x0000000132                      | IBC gatedrive-3 error          |
| 0x03                  | 0x0000000134                      | IBC overcurrent Isek           |
| 0x03                  | 0x0000000135                      | IBC overcurrent IL             |
| 0x03                  | 0x0000000136                      | IBC overcurrent Iout           |
| 0x03                  | 0x0000000137                      | IBC overcurrent Isys           |
| 0x03                  | 0x0000000138                      | IBC short-circuit current Isek |

Tab. 66

| Emergency Code 0x2300 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description   |
| 0x03                  | 0x0000000020                      | I2t – Monitoring calls for an error                     |
| 0x03                  | 0x0000000021                      | DC-Output overcurrent, user set trip level voided       |
| 0x03                  | 0x0000000023                      | Gatedrive-A error                                       |
| 0x03                  | 0x0000000024                      | Gatedrive-B error                                       |
| 0x03                  | 0x0000000025                      | DC-Output overcurrent, temperature-derated value voided |
| 0x03                  | 0x0000000026                      | TC.LIN output overcurrent                               |
| 0x03                  | 0x0000000027                      | TC.LIN overload   |
| 0x03                  | 0x0000000028                      | Arc detection limit exceeded                            |
| 0x03                  | 0x0000000029                      | output Q4 overcurrent ( user limit)                     |
| 0x03                  | 0x000000002A                      | output Q4 overcurrent (current limited by temperature)  |

Tab. 67

| Emergency Code 0x3100 |                                   |                              |
|-----------------------|-----------------------------------|------------------------------|
| Error Register        | Manufacturer specific Error Field | Description                  |
| 0x05                  | 0x0000000142                      | IBC mains frequency too high |
| 0x05                  | 0x0000000143                      | IBC mains frequency too low  |
| 0x05                  | 0x0000000144                      | IBC mains voltage too high   |
| 0x05                  | 0x0000000145                      | IBC mains voltage too low    |
| 0x05                  | 0x0000000148                      | IBC power factor too low     |

Tab. 68

| Emergency Code 0x3200 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description                                       |
| 0x05                  | 0x0000000040                      | TC.LIN +5V supply too high                        |
| 0x05                  | 0x0000000041                      | TC.LIN +5V supply too low                         |
| 0x05                  | 0x0000000043                      | +5V supply low                                    |
| 0x05                  | 0x0000000044                      | +5V supply high                                   |
| 0x05                  | 0x0000000045                      | +15V supply low                                   |
| 0x05                  | 0x0000000046                      | +15V supply high                                  |
| 0x05                  | 0x0000000047                      | -15V supply low ( absolute value )                |
| 0x05                  | 0x0000000048                      | -15V supply high ( absolute value )               |
| 0x05                  | 0x0000000049                      | Intermediate DC voltage low                       |
| 0x05                  | 0x000000004A                      | Intermediate DC voltage high                      |
| 0x05                  | 0x000000004B                      | +24V supply low                                   |
| 0x05                  | 0x000000004C                      | +24V supply high                                  |
| 0x05                  | 0x000000004D                      | Fast voltage transient on DC intermediate voltage |
| 0x05                  | 0x000000004E                      | TC.LIN +15V supply too high                       |
| 0x05                  | 0x000000004F                      | TC.LIN +15V supply too low                        |
| 0x05                  | 0x0000000110                      | IBC +24V supply too low                           |
| 0x05                  | 0x0000000111                      | IBC +24V supply too high                          |
| 0x05                  | 0x0000000112                      | IBC +15V supply too low                           |
| 0x05                  | 0x0000000113                      | IBC +15V supply too high                          |
| 0x05                  | 0x0000000114                      | IBC +5V supply too low                            |
| 0x05                  | 0x0000000115                      | IBC +5V supply too high                           |
| 0x05                  | 0x000000013C                      | IBC over-voltage Uout                             |
| 0x05                  | 0x000000013D                      | IBC over-voltage Uclamp                           |
| 0x05                  | 0x000000013E                      | IBC over-voltage intermediate circuit             |
| 0x05                  | 0x0000000140                      | IBC intermediate circuit too low                  |
| 0x05                  | 0x0000000141                      | IBC DC-link voltage too high                      |

Tab. 69

| Emergency Code 0x3300 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description   |
| 0x05                  | 0x0000000030                      | Overvoltage on DC output                            |
| 0x05                  | 0x0000000031                      | Voltage difference to sensed voltage too high       |
| 0x05                  | 0x0000000032                      | TC.LIN output over-voltage                          |
| 0x05                  | 0x0000000033                      | Negative sense voltage measured (reverse polarity!) |
| 0x05                  | 0x0000000034                      | RPP voltage is unstable                             |

Tab. 70

| Emergency Code 0x4200 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description   |
| 0x09                  | 0x0000000050                      | Rectifier temperature too high                          |
| 0x09                  | 0x0000000051                      | IGBT temperature too high                               |
| 0x09                  | 0x0000000052                      | TC.LIN output stage K1 is too high                      |
| 0x09                  | 0x0000000053                      | TC.LIN output stage K2 is too high                      |
| 0x09                  | 0x0000000054                      | TC.LIN PCB temperatur is too high                       |
| 0x09                  | 0x0000000055                      | Device inside temperature is too high                   |
| 0x09                  | 0x0000000104                      | IBC heat sink is too high                               |
| 0x09                  | 0x0000000105                      | IBC PCB temperature is too high                         |
| 0x09                  | 0x000000014A                      | IBC overtemperature of the regenerating units heat sink |

Tab. 71

| Emergency Code 0x5000 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description                                       |
| 0x01                  | 0x0000000000                      | Hardware error (internal communication)           |
| 0x81                  | 0x0000000003                      | Flash memory full                                 |
| 0x81                  | 0x0000000004                      | Error during writing to EEPROM                    |
| 0x81                  | 0x0000000005                      | Flash Timeout error                               |
| 0x81                  | 0x0000000006                      | ADC Sequence error                                |
| 0x81                  | 0x0000000007                      | No valid EEPROM table present                     |
| 0x81                  | 0x0000000009                      | Run state not possible, thyristor not switched on |
| 0x81                  | 0x000000000B                      | ADC Timeout error                                 |
| 0x81                  | 0x000000000C                      | ADC DMA Interrupt missing                         |
| 0x81                  | 0x0000000080                      | Voltage preset value signal AD overrange          |
| 0x81                  | 0x0000000081                      | Current preset value signal AD overrange          |
| 0x81                  | 0x0000000082                      | Current preset value signal AD overrange          |
| 0x81                  | 0x0000000083                      | Resistance preset value signal AD overrange       |
| 0x81                  | 0x0000000084                      | Voltage A/D overrange                             |
| 0x81                  | 0x0000000085                      | Current A/D overrange                             |
| 0x81                  | 0x0000000086                      | Sense signal A/D overrange                        |
| 0x81                  | 0x0000000087                      | System voltage A/D overrange                      |
| 0x81                  | 0x0000000088                      | System current A/D overrange                      |
| 0x81                  | 0x0000000089                      | DC link voltage signal AD overrange               |
| 0x81                  | 0x000000008A                      | Primary current signal AD overrange               |

Tab. 72

| Emergency Code 0x5000 |                                   |  |
|-----------------------|-----------------------------------|--|
| Error Register        | Manufacturer specific Error Field | Description  |
| 0x81                  | 0x000000008B                      | DC-link voltage AC-signal AD overrange                     |
| 0x81                  | 0x0000000090                      | AD overrange +5V supply                                    |
| 0x81                  | 0x0000000091                      | AD overrange +15V supply                                   |
| 0x81                  | 0x0000000092                      | AD overrange -15V supply                                   |
| 0x81                  | 0x0000000093                      | AD overrange +24V supply                                   |
| 0x81                  | 0x0000000094                      | IGBT temperature signal AD overrange                       |
| 0x81                  | 0x0000000095                      | Rectifier temperature signal AD overrange                  |
| 0x81                  | 0x0000000096                      | Temperature2 signal AD overrange                           |
| 0x81                  | 0x0000000097                      | PCB temperature signal AD overrange                        |
| 0x81                  | 0x00000000A0                      | Voltage set value signal AD underrange                     |
| 0x81                  | 0x00000000A1                      | Current set value signal AD underrange                     |
| 0x81                  | 0x00000000A2                      | Power set value signal AD underrange                       |
| 0x81                  | 0x00000000A3                      | Restistance set value signal AD underrange                 |
| 0x81                  | 0x00000000A4                      | Module voltage signal AD underrange                        |
| 0x81                  | 0x00000000A5                      | Module current signal AD underrange                        |
| 0x81                  | 0x00000000A6                      | Sense voltage signal AD underrange                         |
| 0x81                  | 0x00000000A7                      | System voltage signal AD underrange                        |
| 0x81                  | 0x00000000A8                      | System current signal AD underrange                        |
| 0x81                  | 0x00000000A9                      | DC link voltage signal AD underrange                       |
| 0x81                  | 0x00000000AA                      | Primary current signal AD underrange                       |
| 0x81                  | 0x00000000AB                      | DC-link voltage AC signal AD underrange                    |
| 0x81                  | 0x00000000B0                      | AD underrange +5V supply                                   |
| 0x81                  | 0x00000000B1                      | AD underrange +15V supply                                  |
| 0x81                  | 0x00000000B2                      | AD underrange -15V supply                                  |
| 0x81                  | 0x00000000B3                      | AD underrange +24V supply                                  |
| 0x81                  | 0x00000000B4                      | IGBT temperature signal AD underrange                      |
| 0x81                  | 0x00000000B5                      | Rectifier temperature signal AD underrange                 |
| 0x81                  | 0x00000000B6                      | Temperature 2 signal AD underrange                         |
| 0x81                  | 0x00000000B7                      | PCB temperature signal AD underrange                       |
| 0x81                  | 0x0000000106                      | IBC heat sink temperature sensor is not connected          |
| 0x81                  | 0x0000000107                      | IBC inverter heat sink temperature sensor is not connected |
| 0x81                  | 0x000000014E                      | IBC inverter error   |

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| Emergency Code 0x6100 |                                   |  |
|-----------------------|-----------------------------------|--|
| Error Register        | Manufacturer specific Error Field | Description  |
| 0x81                  | 0x0000000000                      | Invalid system state                               |
| 0x81                  | 0x0000000001                      | Invalid module state                               |
| 0x81                  | 0x0000000002                      | Calculation overflow                               |
| 0x81                  | 0x0000000008                      | Ordered state not available                        |
| 0x81                  | 0x000000000A                      | No active controller                               |
| 0x81                  | 0x000000000D                      | Internal debug error                               |
| 0x81                  | 0x000000000E                      | Call for an invalid interrupt routine              |
| 0x81                  | 0x000000000F                      | Old EEPROM table loaded                            |
| 0x81                  | 0x0000000010                      | PDSP packet checksum error                         |
| 0x81                  | 0x0000000011                      | Wrong PDSP version                                 |
| 0x81                  | 0x0000000012                      | PDSP error   |
| 0x81                  | 0x0000000013                      | Queue overflow during writing                      |
| 0x81                  | 0x0000000014                      | Too many PDSP packets received                     |
| 0x81                  | 0x000000001A                      | Unknown SCI status bit                             |
| 0x81                  | 0x000000001B                      | Unknown CAN status bit                             |
| 0x81                  | 0x000000001C                      | Unknown PDSP packet received                       |
| 0x81                  | 0x000000001D                      | Receive of a packet from a non initialized mailbox |
| 0x81                  | 0x000000001E                      | Fail of PDSP communication                         |
| 0x81                  | 0x0000000070                      | Checksum error detected by modulator DSP           |
| 0x81                  | 0x0000000071                      | Checksum error detected by main DSP                |
| 0x81                  | 0x0000000072                      | Transmit queue full                                |
| 0x81                  | 0x0000000073                      | SPI Transmit Register full                         |
| 0x81                  | 0x0000000074                      | SPI Receive Register full                          |
| 0x81                  | 0x0000000075                      | Communication with the modulator too slow          |
| 0x81                  | 0x0000000076                      | Unknown ID/Command detected by modulator DSP       |
| 0x81                  | 0x0000000077                      | Unknown ID/Command detected by main DSP            |
| 0x81                  | 0x0000000078                      | VzGain too low                                     |
| 0x81                  | 0x0000000079                      | IprimGain too low                                  |
| 0x81                  | 0x000000007A                      | Manual start not allowed during error condition    |
| 0x81                  | 0x000000007B                      | Overflow during reading of modulator Scope Buffers |
| 0x81                  | 0x000000007C                      | Modulator communication failed                     |
| 0x81                  | 0x000000007D                      | Wrong version of modulator software                |

Tab. 74

| Emergency Code 0x6100 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description                                 |
| 0x81                  | 0x000000007F                      | Unknown state Bit received by the modulator |
| 0x81                  | 0x00000000E3                      | Incompatible PLD Version                    |
| 0x81                  | 0x00000000E4                      | Incompatible IBC Version                    |
| 0x81                  | 0x00000000FF                      | Actual value FIFO (multi-unit) is full      |
| 0x81                  | 0x0000000100                      | IBC Power-Up after a Watchdog Reset         |
| 0x81                  | 0x0000000101                      | IBC Power-Up after software reset           |
| 0x81                  | 0x0000000102                      | IBC EEPROM queue overflow                   |
| 0x81                  | 0x0000000120                      | IBC communication Watchdog                  |
| 0x81                  | 0x0000000121                      | IBC communication SPI error                 |
| 0x81                  | 0x0000000122                      | IBC LVDS error                              |
| 0x81                  | 0x0000000146                      | IBC PLL error                               |
| 0x81                  | 0x0000000147                      | IBC Timeout when turning on to the mains    |
| 0x81                  | 0x000000014C                      | IBC self-check                              |
| 0x81                  | 0x00000001E0                      | Power-Up after a watchdog reset             |
| 0x81                  | 0x00000001EF                      | PWM shutdown due to an unknown source       |
| 0x81                  | 0x00000001F0                      | Unknown CAN mailbox                         |
| 0x81                  | 0x00000001F1                      | Talk error in the IBC communication         |

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| Emergency Code 0x7000 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description   |
| 0x81                  | 0x00000000C0                      | No CFL received by slave unit                                     |
| 0x81                  | 0x00000000C1                      | Invalid CFL received by slave unit                                |
| 0x81                  | 0x00000000C2                      | No EOL received by slave unit                                     |
| 0x81                  | 0x00000000C3                      | Invalid EOL received by slave unit                                |
| 0x81                  | 0x00000000C4                      | No software match between TC.LIN CAN Protocol and the master unit |
| 0x81                  | 0x00000000C5                      | Not all RFL Sub-frames from slaves received                       |
| 0x81                  | 0x00000000C6                      | TC.LIN meldet sich nicht am CAN Bus                               |
| 0x81                  | 0x00000000C7                      | Not all RFL Sub-frames from HMI/RCU received                      |
| 0x81                  | 0x00000000C8                      | CAN Protokoll Version ist nicht bei allen Geräten identisch       |
| 0x81                  | 0x00000000C9                      | No software match between master and slave unit(s)                |
| 0x81                  | 0x00000000CA                      | Slave CAN protocol version does not match the master              |
| 0x81                  | 0x00000000CB                      | No CFL received by the HMI/RCU                                    |
| 0x81                  | 0x00000000CC                      | Invalid CFL received by the HMI/RCU                               |
| 0x81                  | 0x00000000CD                      | No EOL received by the HMI/RCU                                    |
| 0x81                  | 0x00000000CE                      | Invalid EOL received by the HMI/RCU                               |
| 0x81                  | 0x00000000CF                      | Slave module ID is not unique                                     |
| 0x81                  | 0x00000000D0                      | HMI/RCU module ID is not unique                                   |
| 0x81                  | 0x00000000D1                      | More than one master in the system                                |
| 0x81                  | 0x00000000D2                      | Nominal power mismatches from master and slave unit               |
| 0x81                  | 0x00000000D3                      | Nominal voltage mismatches from master and slave unit             |
| 0x81                  | 0x00000000D4                      | Nominal current mismatches form master and slave unit             |
| 0x81                  | 0x00000000D5                      | Number of devices in series mismatches with the default           |
| 0x81                  | 0x00000000D6                      | Number of devices in parallel mismatches with the default         |
| 0x81                  | 0x00000000D7                      | All slave ID's must be fully numbered                             |
| 0x81                  | 0x00000000D8                      | All HMI ID's must be fully numbered                               |
| 0x81                  | 0x00000000D9                      | No CFL received by slave unit                                     |

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| Emergency Code 0x7000 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description   |
| 0x81                  | 0x00000000DA                      | Slave number does not agree with the default            |
| 0x81                  | 0x00000000DB                      | Multiload device number does not agree with the default |
| 0x81                  | 0x00000000DC                      | Invalid slave ID (value outside of the valid range)     |
| 0x81                  | 0x00000000DD                      | Invalid HMI ID (value outside of the valid range)       |
| 0x81                  | 0x00000000DE                      | Invalid TC.LIN ID                                       |
| 0x81                  | 0x00000000DF                      | TC.LIN ID is not unique                                 |
| 0x81                  | 0x00000000E0                      | Internal parameter of the ReGen system are not set      |
| 0x81                  | 0x00000000E1                      | TC.LIN is not activated                                 |
| 0x81                  | 0x00000000E2                      | Nominal TC.LIN voltage is not consistent                |
| 0x81                  | 0x00000000E5                      | Not all slaves in series connection are Q4 capable      |
| 0x81                  | 0x00000000F0                      | Sense in series connection or with RMB not allowed      |

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| Emergency Code 0x8100 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description   |
| 0x11                  | 0x0000000015                      | SCI checksum error  |
| 0x11                  | 0x0000000016                      | SCI parity error  |
| 0x11                  | 0x0000000017                      | SCI overrun error   |
| 0x11                  | 0x0000000018                      | SCI framing error   |
| 0x11                  | 0x0000000019                      | SCI break error   |
| 0x11                  | 0x000000001F                      | SCI Timeout within talk frame   |
| 0x11                  | 0x0000000060                      | CAN controller set to „Bus-Off“<br>(in multi-unit operation or HMI)   |
| 0x11                  | 0x0000000061                      | CAN controller on „error passive“<br>(in multi-unit operation or HMI) |
| 0x11                  | 0x0000000062                      | CAN controller: WDIF Bit (in multi-unit operation<br>or HMI)          |
| 0x11                  | 0x0000000063                      | CAN controller: AAIF Bit<br>(in multi-unit operation or HMI)          |
| 0x11                  | 0x0000000064                      | CAN controller: RMLIF Bit<br>(in multi-unit operation or HMI)         |
| 0x11                  | 0x0000000065                      | HMI not responding  |
| 0x11                  | 0x0000000066                      | CAN TX queue full   |
| 0x11                  | 0x0000000067                      | Slave not responding  |
| 0x11                  | 0x0000000068                      | RMB not connected   |
| 0x11                  | 0x0000000069                      | Slave loss of data from master unit                                   |
| 0x11                  | 0x000000006A                      | TC.LIN not responding   |
| 0x11                  | 0x000000006B                      | TC.LIN CAN error  |
| 0x11                  | 0x000000006C                      | RS232 Watchdog error  |
| 0x11                  | 0x000000006D                      | IBC receive error   |
| 0x11                  | 0x000000006E                      | IBC send error  |
| 0x11                  | 0x000000006F                      | IBC Talk timeout  |
| 0x11                  | 0x00000001F3                      | CAN TX queue full   |
| 0x11                  | 0x00000001F4                      | CAN RX queue full   |
| 0x11                  | 0x00000001F5                      | SCI checksum error  |
| 0x11                  | 0x00000001F6                      | SCI parity error  |
| 0x11                  | 0x00000001F7                      | SCI overrun error   |
| 0x11                  | 0x00000001F8                      | SCI framing error   |
| 0x11                  | 0x00000001F9                      | SCI break error   |
| 0x11                  | 0x00000001FF                      | SCI timeout within a talk-frame                                       |

Tab. 78

| Emergency Code 0x8110 |                                   |                  |
|-----------------------|-----------------------------------|------------------|
| Error Register        | Manufacturer specific Error Field | Description      |
| 0x11                  | 0x0000000000                      | CAN message lost |

Tab. 79

| Emergency Code 0x8111 |                                   |                  |
|-----------------------|-----------------------------------|------------------|
| Error Register        | Manufacturer specific Error Field | Description      |
| 0x11                  | 0x0000000000                      | Transmit aborted |

Tab. 80

| Emergency Code 0x8112 |                                   |                            |
|-----------------------|-----------------------------------|----------------------------|
| Error Register        | Manufacturer specific Error Field | Description                |
| 0x11                  | 0x0000000000                      | CAN receive queue overflow |

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| Emergency Code 0x8200 |                                   |  |
|-----------------------|-----------------------------------|--|
| Error Register        | Manufacturer specific Error Field | Description                              |
| 0x11                  | 0x0000000000                      | Protocol error (parameter exceeds limit) |

Tab. 82

| Emergency Code 0x9000 |                                   |                                      |
|-----------------------|-----------------------------------|--------------------------------------|
| Error Register        | Manufacturer specific Error Field | Description                          |
| 0x81                  | 0x00000000F2                      | Interlock circuit open               |
| 0x81                  | 0x00000000F3                      | External switch-off of modulator-PWM |
| 0x81                  | 0x000000014F                      | IBC Interlock circuit disconnected   |
| 0x81                  | 0x0000000150                      | IBC Interlock circuit disconnected   |

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| Emergency Code 0xF000 |                                   |   |
|-----------------------|-----------------------------------|---|
| Error Register        | Manufacturer specific Error Field | Description   |
| 0x81                  | 0x000000002F                      | Error in a user-specific function                             |
| 0x81                  | 0x00000000F1                      | Incorrect enabling code for software open                     |
| 0x81                  | 0x00000000F4                      | Safety relay is open  |
| 0x81                  | 0x00000000F5                      | Interlock missing 0-level                                     |
| 0x81                  | 0x00000000F6                      | Interlock circuit closed, but safety relays open              |
| 0x81                  | 0x00000000F7                      | no enable signal  |
| 0x81                  | 0x00000000FA                      | A TC.MRC rack has not switched within a reasonable period     |
| 0x81                  | 0x00000000FB                      | A TC.MRC rack has an error                                    |
| 0x81                  | 0x00000000FC                      | ReGen error   |
| 0x81                  | 0x00000000FD                      | Switch bridge error   |
| 0x81                  | 0x00000000FE                      | bipolar switch error  |
| 0x81                  | 0x0000000151                      | IBC safety relay is open                                      |
| 0x81                  | 0x0000000152                      | IBC interlock circuit is closed, but the safety relay is open |

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| Emergency Code 0xFF00 |                                   |                       |
|-----------------------|-----------------------------------|-----------------------|
| Error Register        | Manufacturer specific Error Field | Description           |
| 0x81                  | 0x000000002B                      | Error 2B <sup>1</sup> |
| 0x81                  | 0x000000002C                      | Error 2C <sup>1</sup> |
| 0x81                  | 0x000000002D                      | Error 2D <sup>1</sup> |
| 0x81                  | 0x000000002E                      | Error 2E <sup>1</sup> |
| 0x81                  | 0x0000000035                      | Error 35 <sup>1</sup> |
| 0x81                  | 0x0000000036                      | Error 36 <sup>1</sup> |
| 0x81                  | 0x0000000037                      | Error 37 <sup>1</sup> |
| 0x81                  | 0x0000000038                      | Error 38 <sup>1</sup> |
| 0x81                  | 0x0000000039                      | Error 39 <sup>1</sup> |
| 0x81                  | 0x000000003A                      | Error 3A <sup>1</sup> |
| 0x81                  | 0x000000003B                      | Error 3B <sup>1</sup> |
| 0x81                  | 0x000000003C                      | Error 3C <sup>1</sup> |
| 0x81                  | 0x000000003D                      | Error 3D <sup>1</sup> |
| 0x81                  | 0x000000003E                      | Error 3E <sup>1</sup> |
| 0x81                  | 0x000000003F                      | Error 3F <sup>1</sup> |
| 0x81                  | 0x0000000042                      | Error 42 <sup>1</sup> |
| 0x81                  | 0x0000000056                      | Error 56 <sup>1</sup> |
| 0x81                  | 0x0000000057                      | Error 57 <sup>1</sup> |
| 0x81                  | 0x0000000058                      | Error 58 <sup>1</sup> |
| 0x81                  | 0x0000000059                      | Error 59 <sup>1</sup> |
| 0x81                  | 0x000000005A                      | Error 5A <sup>1</sup> |
| 0x81                  | 0x000000005B                      | Error 5B <sup>1</sup> |
| 0x81                  | 0x000000005C                      | Error 5C <sup>1</sup> |
| 0x81                  | 0x000000005D                      | Error 5D <sup>1</sup> |
| 0x81                  | 0x000000005E                      | Error 5E <sup>1</sup> |
| 0x81                  | 0x000000005F                      | Error 5F <sup>1</sup> |
| 0x81                  | 0x000000007E                      | Error 7E <sup>1</sup> |
| 0x81                  | 0x000000008C                      | Error 8C <sup>1</sup> |
| 0x81                  | 0x000000008D                      | Error 8D <sup>1</sup> |
| 0x81                  | 0x000000008E                      | Error 8E <sup>1</sup> |
| 0x81                  | 0x000000008F                      | Error 8F <sup>1</sup> |
| 0x81                  | 0x0000000098                      | Error 98 <sup>1</sup> |

Continuation of the table next page – <sup>1</sup> Refer to the actual TopCon manual



| Emergency Code 0xFF00 |                                   |                       |
|-----------------------|-----------------------------------|-----------------------|
| Error Register        | Manufacturer specific Error Field | Description           |
| 0x81                  | 0x0000000099                      | Error 99 <sup>1</sup> |
| 0x81                  | 0x000000009A                      | Error 9A <sup>1</sup> |
| 0x81                  | 0x000000009B                      | Error 9B <sup>1</sup> |
| 0x81                  | 0x000000009C                      | Error 9C <sup>1</sup> |
| 0x81                  | 0x000000009D                      | Error 9D <sup>1</sup> |
| 0x81                  | 0x000000009E                      | Error 9E <sup>1</sup> |
| 0x81                  | 0x000000009F                      | Error 9F <sup>1</sup> |
| 0x81                  | 0x00000000AC                      | Error AC <sup>1</sup> |
| 0x81                  | 0x00000000AD                      | Error AD <sup>1</sup> |
| 0x81                  | 0x00000000AE                      | Error AE <sup>1</sup> |
| 0x81                  | 0x00000000AF                      | Error AF <sup>1</sup> |
| 0x81                  | 0x00000000B8                      | Error B8 <sup>1</sup> |
| 0x81                  | 0x00000000B9                      | Error B9 <sup>1</sup> |
| 0x81                  | 0x00000000BA                      | Error BA <sup>1</sup> |
| 0x81                  | 0x00000000BB                      | Error BB <sup>1</sup> |
| 0x81                  | 0x00000000BC                      | Error BC <sup>1</sup> |
| 0x81                  | 0x00000000BD                      | Error BD <sup>1</sup> |
| 0x81                  | 0x00000000BE                      | Error BE <sup>1</sup> |
| 0x81                  | 0x00000000BF                      | Error BF <sup>1</sup> |
| 0x81                  | 0x00000000E6                      | Error E6 <sup>1</sup> |
| 0x81                  | 0x00000000E7                      | Error E7 <sup>1</sup> |
| 0x81                  | 0x00000000E8                      | Error E8 <sup>1</sup> |
| 0x81                  | 0x00000000E9                      | Error E9 <sup>1</sup> |
| 0x81                  | 0x00000000EA                      | Error EA <sup>1</sup> |
| 0x81                  | 0x00000000EB                      | Error EB <sup>1</sup> |
| 0x81                  | 0x00000000EC                      | Error EC <sup>1</sup> |
| 0x81                  | 0x00000000ED                      | Error ED <sup>1</sup> |
| 0x81                  | 0x00000000EE                      | Error EE <sup>1</sup> |
| 0x81                  | 0x00000000EF                      | Error EF <sup>1</sup> |
| 0x81                  | 0x00000000F8                      | Error F8 <sup>1</sup> |
| 0x81                  | 0x00000000F9                      | Error F9 <sup>1</sup> |
| 0x81                  | 0x0000000103                      | Error G3 <sup>1</sup> |
| 0x81                  | 0x0000000108                      | Error G8 <sup>1</sup> |
| 0x81                  | 0x0000000109                      | Error G9 <sup>1</sup> |
| 0x81                  | 0x000000010A                      | Error GA <sup>1</sup> |
| 0x81                  | 0x000000010B                      | Error GB <sup>1</sup> |

Continuation of the table next page – <sup>1</sup> Refer to the actual TopCon manual

| Emergency Code 0xFF00 |                                   |                       |
|-----------------------|-----------------------------------|-----------------------|
| Error Register        | Manufacturer specific Error Field | Description           |
| 0x81                  | 0x000000010C                      | Error GC <sup>1</sup> |
| 0x81                  | 0x000000010D                      | Error GD <sup>1</sup> |
| 0x81                  | 0x000000010E                      | Error GE <sup>1</sup> |
| 0x81                  | 0x000000010F                      | Error GF <sup>1</sup> |
| 0x81                  | 0x0000000116                      | Error H6 <sup>1</sup> |
| 0x81                  | 0x0000000117                      | Error H7 <sup>1</sup> |
| 0x81                  | 0x0000000118                      | Error H8 <sup>1</sup> |
| 0x81                  | 0x0000000119                      | Error H9 <sup>1</sup> |
| 0x81                  | 0x000000011A                      | Error HA <sup>1</sup> |
| 0x81                  | 0x000000011B                      | Error HB <sup>1</sup> |
| 0x81                  | 0x000000011C                      | Error HC <sup>1</sup> |
| 0x81                  | 0x000000011D                      | Error HD <sup>1</sup> |
| 0x81                  | 0x000000011E                      | Error HE <sup>1</sup> |
| 0x81                  | 0x000000011F                      | Error HF <sup>1</sup> |
| 0x81                  | 0x0000000123                      | Error J3 <sup>1</sup> |
| 0x81                  | 0x0000000124                      | Error J4 <sup>1</sup> |
| 0x81                  | 0x0000000125                      | Error J5 <sup>1</sup> |
| 0x81                  | 0x0000000126                      | Error J6 <sup>1</sup> |
| 0x81                  | 0x0000000127                      | Error J7 <sup>1</sup> |
| 0x81                  | 0x0000000128                      | Error J8 <sup>1</sup> |
| 0x81                  | 0x0000000129                      | Error J9 <sup>1</sup> |
| 0x81                  | 0x000000012A                      | Error JA <sup>1</sup> |
| 0x81                  | 0x000000012B                      | Error JB <sup>1</sup> |
| 0x81                  | 0x000000012C                      | Error JC <sup>1</sup> |
| 0x81                  | 0x000000012D                      | Error JD <sup>1</sup> |
| 0x81                  | 0x000000012E                      | Error JE <sup>1</sup> |
| 0x81                  | 0x000000012F                      | Error JF <sup>1</sup> |
| 0x81                  | 0x0000000133                      | Error K3 <sup>1</sup> |
| 0x81                  | 0x0000000139                      | Error K9 <sup>1</sup> |
| 0x81                  | 0x000000013A                      | Error KA <sup>1</sup> |

Continuation of the table next page – <sup>1</sup> Refer to the actual TopCon manual

| Emergency Code 0xFF00 |                                   |                       |
|-----------------------|-----------------------------------|-----------------------|
| Error Register        | Manufacturer specific Error Field | Description           |
| 0x81                  | 0x000000013B                      | Error KB <sup>1</sup> |
| 0x81                  | 0x000000013F                      | Error KF <sup>1</sup> |
| 0x81                  | 0x0000000153                      | Error M3 <sup>1</sup> |
| 0x81                  | 0x0000000154                      | Error M4 <sup>1</sup> |
| 0x81                  | 0x0000000155                      | Error M5 <sup>1</sup> |
| 0x81                  | 0x0000000156                      | Error M6 <sup>1</sup> |
| 0x81                  | 0x0000000157                      | Error M7 <sup>1</sup> |
| 0x81                  | 0x0000000158                      | Error M8 <sup>1</sup> |
| 0x81                  | 0x0000000159                      | Error M9 <sup>1</sup> |
| 0x81                  | 0x000000015A                      | Error MA <sup>1</sup> |
| 0x81                  | 0x000000015B                      | Error MB <sup>1</sup> |
| 0x81                  | 0x000000015C                      | Error MC <sup>1</sup> |
| 0x81                  | 0x000000015D                      | Error MD <sup>1</sup> |
| 0x81                  | 0x000000015E                      | Error ME <sup>1</sup> |
| 0x81                  | 0x000000015F                      | Error MF <sup>1</sup> |
| 0x81                  | 0x0000000164                      | Error N4 <sup>1</sup> |
| 0x81                  | 0x0000000165                      | Error N5 <sup>1</sup> |
| 0x81                  | 0x0000000166                      | Error N6 <sup>1</sup> |
| 0x81                  | 0x0000000167                      | Error N7 <sup>1</sup> |
| 0x81                  | 0x0000000168                      | Error N8 <sup>1</sup> |
| 0x81                  | 0x0000000169                      | Error N9 <sup>1</sup> |
| 0x81                  | 0x000000016A                      | Error NA <sup>1</sup> |
| 0x81                  | 0x000000016B                      | Error NB <sup>1</sup> |
| 0x81                  | 0x000000016C                      | Error NC <sup>1</sup> |
| 0x81                  | 0x000000016D                      | Error ND <sup>1</sup> |
| 0x81                  | 0x000000016E                      | Error NE <sup>1</sup> |
| 0x81                  | 0x000000016F                      | Error NF <sup>1</sup> |
| 0x81                  | 0x0000000170                      | Error P0 <sup>1</sup> |
| 0x81                  | 0x0000000171                      | Error P1 <sup>1</sup> |
| 0x81                  | 0x0000000172                      | Error P2 <sup>1</sup> |
| 0x81                  | 0x0000000173                      | Error P3 <sup>1</sup> |
| 0x81                  | 0x0000000174                      | Error P4 <sup>1</sup> |
| 0x81                  | 0x0000000175                      | Error P5 <sup>1</sup> |
| 0x81                  | 0x0000000176                      | Error P6 <sup>1</sup> |
| 0x81                  | 0x0000000177                      | Error P7 <sup>1</sup> |
| 0x81                  | 0x0000000178                      | Error P8 <sup>1</sup> |
| 0x81                  | 0x0000000179                      | Error P9 <sup>1</sup> |

Continuation of the table next page – <sup>1</sup> Refer to the actual TopCon manual

| Emergency Code 0xFF00 |                                   |                       |
|-----------------------|-----------------------------------|-----------------------|
| Error Register        | Manufacturer specific Error Field | Description           |
| 0x81                  | 0x000000017A                      | Error PA <sup>1</sup> |
| 0x81                  | 0x000000017B                      | Error PB <sup>1</sup> |
| 0x81                  | 0x000000017C                      | Error PC <sup>1</sup> |
| 0x81                  | 0x000000017D                      | Error PD <sup>1</sup> |
| 0x81                  | 0x000000017E                      | Error PE <sup>1</sup> |
| 0x81                  | 0x000000017F                      | Error PF <sup>1</sup> |
| 0x81                  | 0x0000000180                      | Error Q0 <sup>1</sup> |
| 0x81                  | 0x0000000181                      | Error Q1 <sup>1</sup> |
| 0x81                  | 0x0000000182                      | Error Q2 <sup>1</sup> |
| 0x81                  | 0x0000000183                      | Error Q3 <sup>1</sup> |
| 0x81                  | 0x0000000184                      | Error Q4 <sup>1</sup> |
| 0x81                  | 0x0000000185                      | Error Q5 <sup>1</sup> |
| 0x81                  | 0x0000000186                      | Error Q6 <sup>1</sup> |
| 0x81                  | 0x0000000187                      | Error Q7 <sup>1</sup> |
| 0x81                  | 0x0000000188                      | Error Q8 <sup>1</sup> |
| 0x81                  | 0x0000000189                      | Error Q9 <sup>1</sup> |
| 0x81                  | 0x000000018A                      | Error QA <sup>1</sup> |
| 0x81                  | 0x000000018B                      | Error QB <sup>1</sup> |
| 0x81                  | 0x000000018C                      | Error QC <sup>1</sup> |
| 0x81                  | 0x000000018D                      | Error QD <sup>1</sup> |
| 0x81                  | 0x000000018E                      | Error QE <sup>1</sup> |
| 0x81                  | 0x000000018F                      | Error QF <sup>1</sup> |
| 0x81                  | 0x0000000190                      | Error R0 <sup>1</sup> |
| 0x81                  | 0x0000000191                      | Error R1 <sup>1</sup> |
| 0x81                  | 0x0000000192                      | Error R2 <sup>1</sup> |
| 0x81                  | 0x0000000193                      | Error R3 <sup>1</sup> |
| 0x81                  | 0x0000000194                      | Error R4 <sup>1</sup> |
| 0x81                  | 0x0000000195                      | Error R5 <sup>1</sup> |
| 0x81                  | 0x0000000196                      | Error R6 <sup>1</sup> |

Continuation of the table next page – <sup>1</sup> Refer to the actual TopCon manual

| Emergency Code 0xFF00 |                                   |                       |
|-----------------------|-----------------------------------|-----------------------|
| Error Register        | Manufacturer specific Error Field | Description           |
| 0x81                  | 0x0000000197                      | Error R7 <sup>1</sup> |
| 0x81                  | 0x0000000198                      | Error R8 <sup>1</sup> |
| 0x81                  | 0x0000000199                      | Error R9 <sup>1</sup> |
| 0x81                  | 0x000000019A                      | Error RA <sup>1</sup> |
| 0x81                  | 0x000000019B                      | Error RB <sup>1</sup> |
| 0x81                  | 0x000000019C                      | Error RC <sup>1</sup> |
| 0x81                  | 0x000000019D                      | Error RD <sup>1</sup> |
| 0x81                  | 0x000000019E                      | Error RE <sup>1</sup> |
| 0x81                  | 0x000000019F                      | Error RF <sup>1</sup> |
| 0x81                  | 0x00000001A0                      | Error S0 <sup>1</sup> |
| 0x81                  | 0x00000001A1                      | Error S1 <sup>1</sup> |
| 0x81                  | 0x00000001A2                      | Error S2 <sup>1</sup> |
| 0x81                  | 0x00000001A3                      | Error S3 <sup>1</sup> |
| 0x81                  | 0x00000001A4                      | Error S4 <sup>1</sup> |
| 0x81                  | 0x00000001A5                      | Error S5 <sup>1</sup> |
| 0x81                  | 0x00000001A6                      | Error S6 <sup>1</sup> |
| 0x81                  | 0x00000001A7                      | Error S7 <sup>1</sup> |
| 0x81                  | 0x00000001A8                      | Error S8 <sup>1</sup> |
| 0x81                  | 0x00000001A9                      | Error S9 <sup>1</sup> |
| 0x81                  | 0x00000001AA                      | Error SA <sup>1</sup> |
| 0x81                  | 0x00000001AB                      | Error SB <sup>1</sup> |
| 0x81                  | 0x00000001AC                      | Error SC <sup>1</sup> |
| 0x81                  | 0x00000001AD                      | Error SD <sup>1</sup> |
| 0x81                  | 0x00000001AE                      | Error SE <sup>1</sup> |
| 0x81                  | 0x00000001AF                      | Error SF <sup>1</sup> |
| 0x81                  | 0x00000001B0                      | Error T0 <sup>1</sup> |
| 0x81                  | 0x00000001B1                      | Error T1 <sup>1</sup> |
| 0x81                  | 0x00000001B2                      | Error T2 <sup>1</sup> |
| 0x81                  | 0x00000001B3                      | Error T3 <sup>1</sup> |
| 0x81                  | 0x00000001B4                      | Error T4 <sup>1</sup> |
| 0x81                  | 0x00000001B5                      | Error T5 <sup>1</sup> |
| 0x81                  | 0x00000001B6                      | Error T6 <sup>1</sup> |
| 0x81                  | 0x00000001B7                      | Error T7 <sup>1</sup> |
| 0x81                  | 0x00000001B8                      | Error T8 <sup>1</sup> |
| 0x81                  | 0x00000001B9                      | Error T9 <sup>1</sup> |
| 0x81                  | 0x00000001BA                      | Error TA <sup>1</sup> |

Continuation of the table next page – <sup>1</sup> Refer to the actual TopCon manual

| Emergency Code 0xFF00 |                                   |                       |
|-----------------------|-----------------------------------|-----------------------|
| Error Register        | Manufacturer specific Error Field | Description           |
| 0x81                  | 0x00000001BB                      | Error TB <sup>1</sup> |
| 0x81                  | 0x00000001BC                      | Error TC <sup>1</sup> |
| 0x81                  | 0x00000001BD                      | Error TD <sup>1</sup> |
| 0x81                  | 0x00000001BE                      | Error TE <sup>1</sup> |
| 0x81                  | 0x00000001BF                      | Error TF <sup>1</sup> |
| 0x81                  | 0x00000001C0                      | Error U0 <sup>1</sup> |
| 0x81                  | 0x00000001C1                      | Error U1 <sup>1</sup> |
| 0x81                  | 0x00000001C2                      | Error U2 <sup>1</sup> |
| 0x81                  | 0x00000001C3                      | Error U3 <sup>1</sup> |
| 0x81                  | 0x00000001C4                      | Error U4 <sup>1</sup> |
| 0x81                  | 0x00000001C5                      | Error U5 <sup>1</sup> |
| 0x81                  | 0x00000001C6                      | Error U6 <sup>1</sup> |
| 0x81                  | 0x00000001C7                      | Error U7 <sup>1</sup> |
| 0x81                  | 0x00000001C8                      | Error U8 <sup>1</sup> |
| 0x81                  | 0x00000001C9                      | Error U9 <sup>1</sup> |
| 0x81                  | 0x00000001CA                      | Error UA <sup>1</sup> |
| 0x81                  | 0x00000001CB                      | Error UB <sup>1</sup> |
| 0x81                  | 0x00000001CC                      | Error UC <sup>1</sup> |
| 0x81                  | 0x00000001CD                      | Error UD <sup>1</sup> |
| 0x81                  | 0x00000001CE                      | Error UE <sup>1</sup> |
| 0x81                  | 0x00000001CF                      | Error UF <sup>1</sup> |
| 0x81                  | 0x00000001D0                      | Error V0 <sup>1</sup> |
| 0x81                  | 0x00000001D1                      | Error V1 <sup>1</sup> |
| 0x81                  | 0x00000001D2                      | Error V2 <sup>1</sup> |
| 0x81                  | 0x00000001D3                      | Error V3 <sup>1</sup> |
| 0x81                  | 0x00000001D4                      | Error V4 <sup>1</sup> |
| 0x81                  | 0x00000001D5                      | Error V5 <sup>1</sup> |
| 0x81                  | 0x00000001D6                      | Error V6 <sup>1</sup> |
| 0x81                  | 0x00000001D7                      | Error V7 <sup>1</sup> |
| 0x81                  | 0x00000001D8                      | Error V8 <sup>1</sup> |

Continuation of the table next page – <sup>1</sup> Refer to the actual TopCon manual

| Emergency Code 0xFF00 |                                   |                       |
|-----------------------|-----------------------------------|-----------------------|
| Error Register        | Manufacturer specific Error Field | Description           |
| 0x81                  | 0x00000001D9                      | Error V9 <sup>1</sup> |
| 0x81                  | 0x00000001DA                      | Error VA <sup>1</sup> |
| 0x81                  | 0x00000001DB                      | Error VB <sup>1</sup> |
| 0x81                  | 0x00000001DC                      | Error VC <sup>1</sup> |
| 0x81                  | 0x00000001DD                      | Error VD <sup>1</sup> |
| 0x81                  | 0x00000001DE                      | Error VE <sup>1</sup> |
| 0x81                  | 0x00000001DF                      | Error VF <sup>1</sup> |
| 0x81                  | 0x00000001E1                      | Error W1 <sup>1</sup> |
| 0x81                  | 0x00000001E2                      | Error W2 <sup>1</sup> |
| 0x81                  | 0x00000001E3                      | Error W3 <sup>1</sup> |
| 0x81                  | 0x00000001E4                      | Error W4 <sup>1</sup> |
| 0x81                  | 0x00000001E5                      | Error W5 <sup>1</sup> |
| 0x81                  | 0x00000001E6                      | Error W6 <sup>1</sup> |
| 0x81                  | 0x00000001E7                      | Error W7 <sup>1</sup> |
| 0x81                  | 0x00000001E8                      | Error W8 <sup>1</sup> |
| 0x81                  | 0x00000001E9                      | Error W9 <sup>1</sup> |
| 0x81                  | 0x00000001EA                      | Error WA <sup>1</sup> |
| 0x81                  | 0x00000001EB                      | Error WB <sup>1</sup> |
| 0x81                  | 0x00000001EC                      | Error WC <sup>1</sup> |
| 0x81                  | 0x00000001ED                      | Error WD <sup>1</sup> |
| 0x81                  | 0x00000001EE                      | Error WE <sup>1</sup> |
| 0x81                  | 0x00000001F2                      | Error X2 <sup>1</sup> |
| 0x81                  | 0x00000001FA                      | Error XA <sup>1</sup> |
| 0x81                  | 0x00000001FB                      | Error XB <sup>1</sup> |
| 0x81                  | 0x00000001FC                      | Error XC <sup>1</sup> |
| 0x81                  | 0x00000001FD                      | Error XD <sup>1</sup> |
| 0x81                  | 0x00000001FE                      | Error XE <sup>1</sup> |

Tab. 85 <sup>1</sup> Refer to the actual TopCon manual

## 9. Glossary

|                  |  |
|------------------|--|
| <b>CAN Node</b>  | A communication unit connected to CAN bus.   |
| <b>CiA</b>       | <b>CAN in Automation.</b> International organisation for development of supervisory CAN protocols.   |
| <b>COB-ID</b>    | <b>Communication Object Identifier.</b> Identification of a communication object, consisting of function code and module-ID.   |
| <b>EMCY</b>      | <b>Emergency Object.</b> Intended for transmission of error codes. An EMCY is transmitted only once in asynchronous mode.  |
| <b>NMT</b>       | <b>Network Management.</b> Commands for the control of state machines inside slaves.   |
| <b>Master</b>    | CAN Node which is able to configure and control all remaining CAN nodes. Transmits NMT code.   |
| <b>Module-ID</b> | Address of a CAN node. An address is an unique number in the range of 1 .... 127.  |
| <b>PDO</b>       | <b>Process Data Object.</b> Used for transmission of general process data. A PDO contains only data which is readable by all active CAN nodes.                           |
| <b>RTR</b>       | <b>Remote Transmit Request.</b> Request for transmission of a PDO. RTR contains no data.   |
| <b>SDO</b>       | <b>Service Data Object.</b> Configures a specific CAN node. A SDO query causes a SDO reply. The SDO communication takes place between a NMT master and a specific slave. |
| <b>Slave</b>     | CAN node which only receives commands from NMT master.   |
| <b>SYNC</b>      | <b>Synchronisation Object.</b> This is to synchronize several nodes together and is sent periodically over the bus.  |