

# **TC.GSS Grid-tie Source Sink**

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## **Bidirectional DC power supply**



**With the  
TopControl application**

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Preliminary Version V00.06

## General

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## Identification

### Device hardware

Information on the device is to be found on the type plate on the rear side of the TopCon TC.GSS power supply.

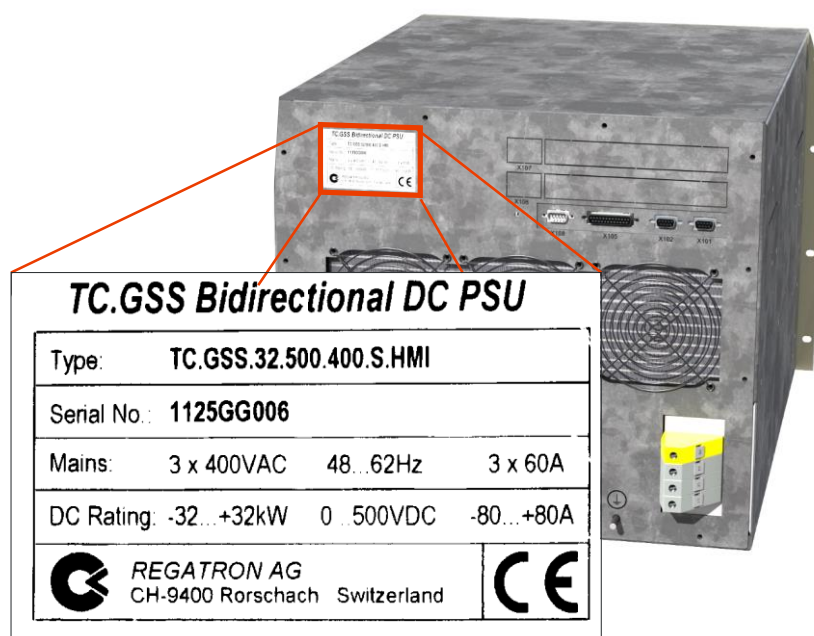


Fig. 1 Example - information on the device type, serial number as well as input and output data on the TopCon TC.GSS power supply.

## Manufacturer

Information on the manufacturer	
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## Instructions

Version overview	
<b>Operating instructions</b>	<b>Manual - TopCon TC.GSS; V00.06; 24.09.2013</b>
<b>For following modules:</b>	
TopCon MainDSP	From version V4.20.XX
HMI	From version V5.08.00
TopControl	From version V4.01.72

Table 1      Subject to technical change without notice.  
              xx: valid for all sub-versions.

## **General information on the manual**

### **Purpose of the manual**

This manual provides information on the usage of the TopCon TC.GSS bidirectional DC power supply. It serves as instructions and as a reference work. Familiarise yourself with the contents of these operating instructions to operate the device efficiently.

### **Availability of the manual**

The manual must be available at all times to the personnel who are operating the device.

### **Actuality of the manual**

The TopCon TC.GSS bidirectional DC power supply is a new product on which there may be changes to the operation and scope of operation during the initial phase.

The first printed edition addresses this situation and is published as a preliminary version. You can download the latest version of the manual from the web site [www.regatron.com](http://www.regatron.com).



## Using the manual

In its description the manual first provides an overview and then discusses the details of a function or situation.

If it is necessary, instructions on how to perform actions are given step by step after explanatory text, figures and tables.

This aspect is reflected in the layout, which is broken down as follows:

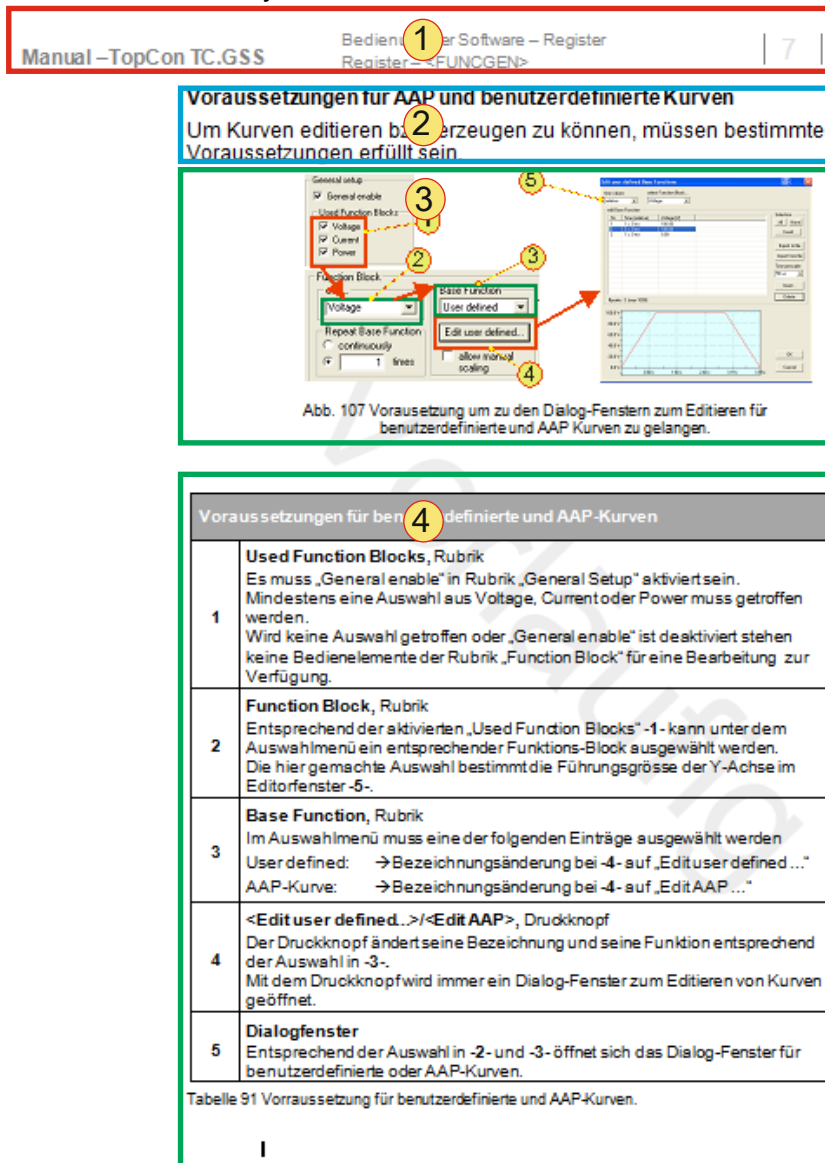


Fig. 2 Example page – layout of a page of the document

**-1- The header**

... contains the title of the instructions, the chapter numbers and chapter headings with the related sub-chapters so that you do not lose the overview even in the midst of explanations that cover several pages.

**-2- Informative text**

... contains important notes, prerequisites for specific situations and introduces you to specific topics.

**-3- Figures**

... say more than words to illustrate the majority of the topics. Important details within the figure are referred to using item numbers, boxes and arrows.

**-4- Tables**

... provide the information in concise form for reference and provide information on the item numbers used in the figure above.

**-5- The footer**

... contains the publication date, the manual version and the current page number.

A short explanation of specific symbols in the manual:


Symbol	Meaning
<Bezeichnung>	Text in angle brackets refers to software and hardware buttons, as well as tabs in the software.
<b>-1-</b>	Item numbers in descriptions, in instructions on how to perform actions or in tables.
●	The dot is used to mark lists and instructions for performing actions.
↳	The result arrow marks the description of a consequence of an action.
⇒	The double arrow marks preventive instructions that occur in information on hazards.
→	The single arrow is used as a result or reference arrow in tables.
	Item numbers with and without reference lines in figures refer to important details.

Table 2 Explanation of symbols in the document.

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## 1. Product description

### 1.1. Product usage and restrictions

#### **Feeding and regenerative operation with several TopCon TC.GSS power supplies.**

The system is used as a constant current, voltage and power source or current/power sink. To be able to obtain higher power, current or voltage, several TopCon modules can be connected in series or in parallel.

#### **Restriction on usage**

TopCon TC.GSS power supplies connected in series are not allowed to exceed a total DC voltage of 1500 V<sub>DC</sub>.

If you do not observe this specification:

- You will fall outside the scope of the Low voltage directive.
- You will do so at your own risk.

### 1.2. Conformity

In the countries of the European Union (EU), to place integrated TopCon systems on the market the overall system must comply in particular with the following standards:

- 2006/95/EC              Low voltage directive
- 2004/108/EC            EMC directive

A CE declaration of conformity on the TC.GSS power supply is included in the appendix to these instructions, see chapter 10.3, page 295.

#### **Note**



If this system is expanded with additional devices or integrated into an overall system, in the European Union a new declaration of conformity must be prepared prior to placing on the market.

## 1.3. Features

### 1.3.1. Description of the model identifier

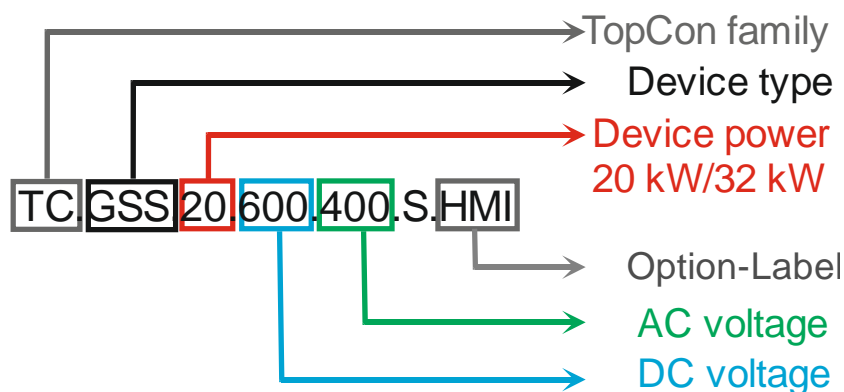


Fig. 3 Structure of the model identifier

### 1.3.2. Model range

The model range has the following common parameters on the mains side:

- Nominal voltage 400 V (see Table 3, unterhalb)  
mains input AC: 3 x 360-440 VAC, at frequency: 48 - 62 Hz  
(for further information: see related data sheets)
- Depending on your requirements, it is also possible to manufacture other models.

#### Standard models with nominal voltage 400 V

Voltage (V <sub>bc</sub> )	Power (kW)	Current (A) <sup>2</sup> Q1/Q4 operation	Dimensions width x height <sup>1</sup> x depth (mm)	Weight (kg)	Type
0 – 400	0 – 20	0 – ±63	19" x 9U x 594	90	TC.GSS.20.400.400.S
0 – 400	0 – 32	0 – ±100	19" x 9U x 594	90	TC.GSS.32.400.400.S
0 – 500	0 – 20	0 – ±50	19" x 9U x 594	90	TC.GSS.20.500.400.S
0 – 500	0 – 32	0 – ±80	19" x 9U x 594	90	TC.GSS.32.500.400.S
0 – 600	0 – 20	0 – ±42	19" x 9U x 594	90	TC.GSS.20.600.400.S
0 – 600	0 – 32	0 – ±67	19" x 9U x 594	90	TC.GSS.32.600.400.S

Table 3 TC.GSS standard models (U<sub>in</sub> = 400V, Europe).

<sup>1</sup> 1U = 1HE = 44.4mm = 1 ¾ inch

<sup>2</sup> 1st quadrant (Q1) operation: "+" sign; 4th quadrant (Q4) operation: "-" sign



#### 1.4. Mechanical data on the TC.GSS power supply

### 1.4.1. TC.GSS dimensions

### Rear view

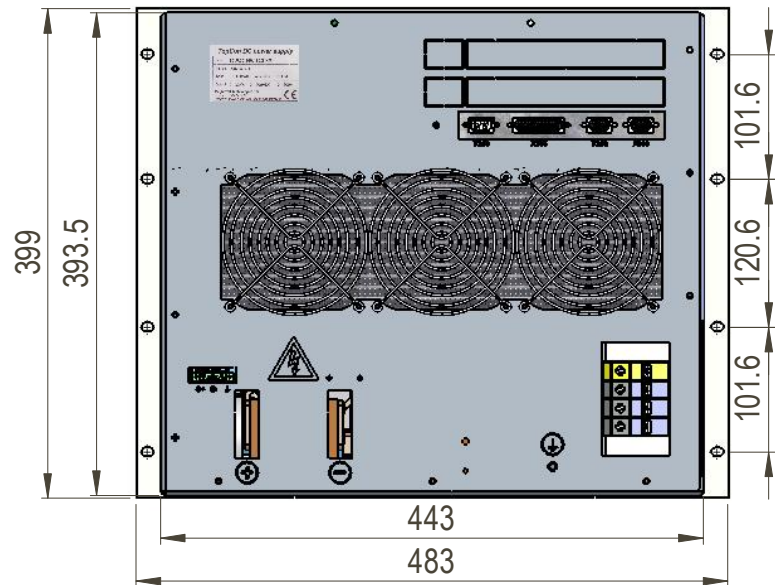


Fig. 4 TopCon TC.GSS rear view

### Side view

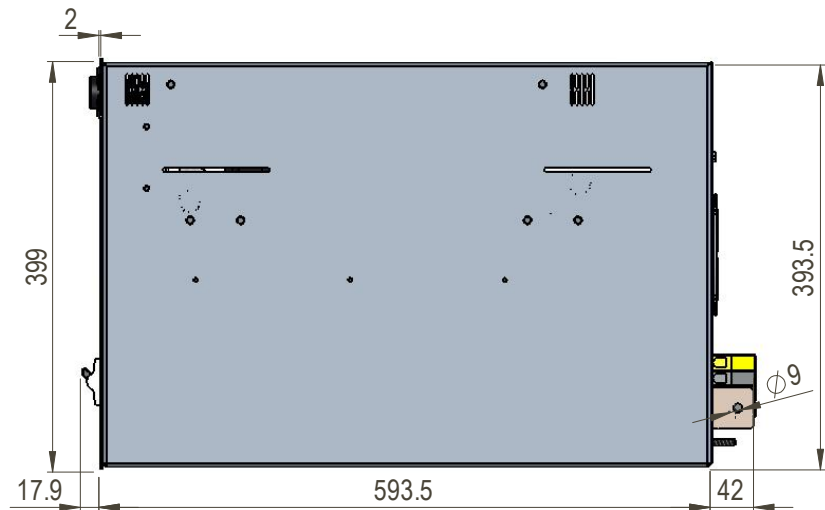


Fig. 5 TopCon TC.GSS side view

### 1.4.2. TC.GSS weight

Power class	Device total weight
20 kW	~90 kg
32 kW	~90 kg

Table 4 Information on the device weight.  
The weight may vary slightly depending on the hardware option.

## 1.5. Ambient conditions

Ambient conditions for standard devices <sup>1</sup>	
<b>Maximum ambient temperature</b>	
Storage temperature	-25 – 70 °C
Cooling air temperature in operation	5 – 40 °C
<b>Ventilation type</b>	
Standard	Internal water cooling with a fully integrated liquid-air heat exchanger with 3 regulated fans.
Liquid cooled (LC) (option)	Internal water cooling with a fully integrated liquid-liquid heat exchanger. (see chapter 5.2.1, Seite 71)
<b>Atmospheric humidity</b>	15 – 85 %, non-condensing
<b>Installation altitude</b>	0 – 2000 m above sea level
<b>Ingress protection (IEC 60529)</b>	
Basic version <sup>2</sup>	IP 20
<b>Utilisation category</b>	
Protection class	I
Overvoltage category	III
Degree of soiling	2

Table 5 Ambient conditions for the TopCon TC.GSS power supply.  
<sup>1</sup> Versions with extended characteristics may vary from this information.  
<sup>2</sup> In accordance with standard IEC 60068-2-6.

## 1.6. Position of the interfaces

### 1.6.1. Overview of the front side of the device

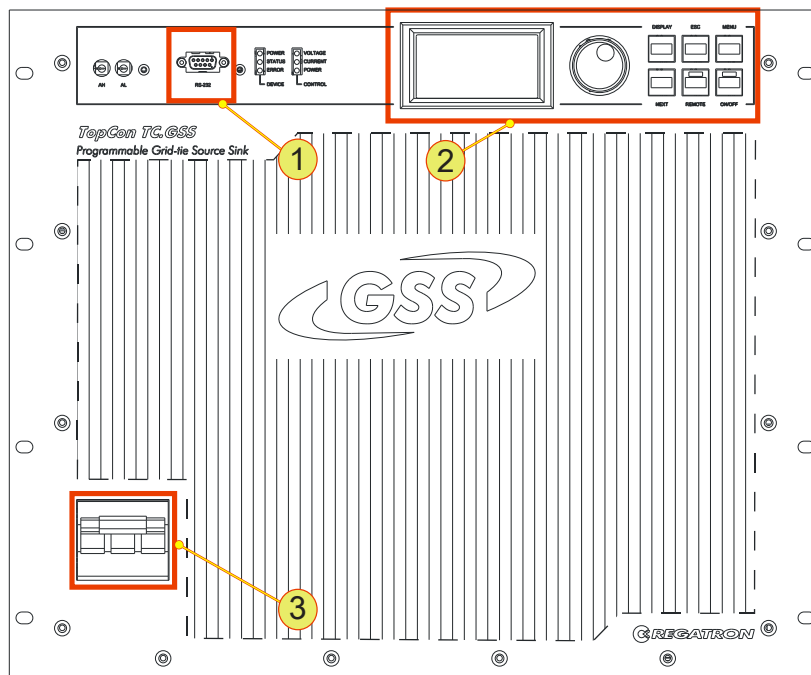


Fig. 6 Opening a new user level in the <Preferences> window.

Interfaces - front side	
1	<b>RS-232</b> For information on connecting the interface to a PC see chapter 0, page 160.
2	<b>Human Machine Interface (HMI), option</b> For function description see chapter 7.3, page 131
3	<b>Main circuit breaker</b> For technical information see chapter 10.1.1, page 262

## 1.6.2. Overview of the rear side of the device

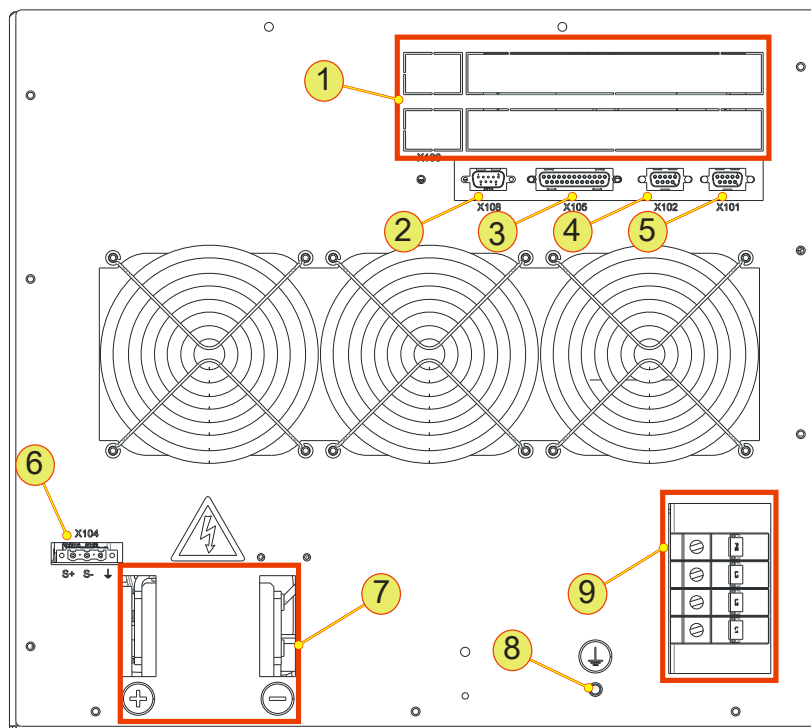
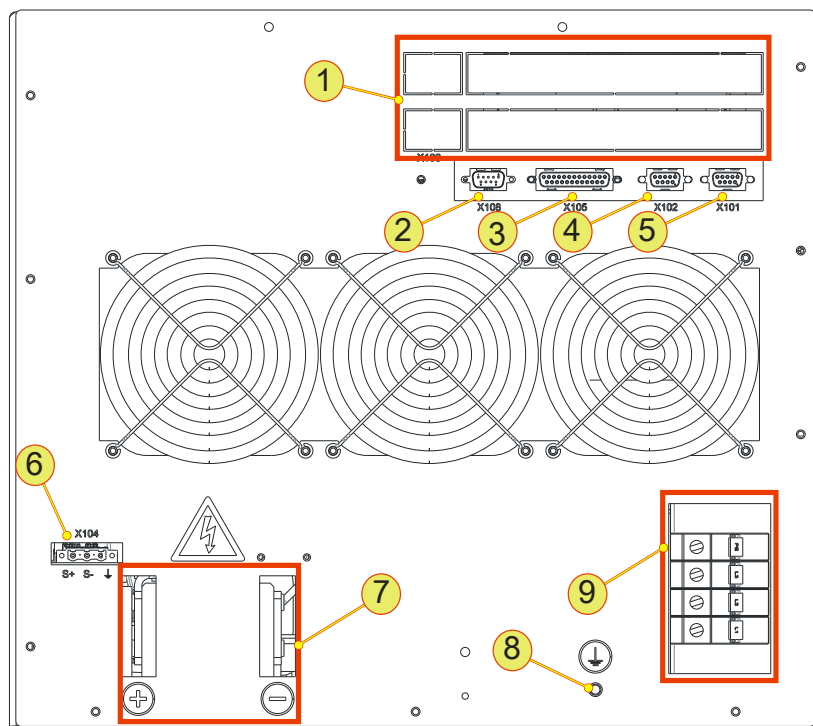


Fig. 7 Position of the interfaces on the rear side of the device.

Interfaces - rear side	
1	<b>Placeholders for optional interfaces</b>
2	<b>System current sense – X108</b> For technical data see chapter 10.1.6.8, page 274 Currently this interface is not supported.
3	<b>Analogue-digital interface – X105</b> For technical data see chapter 10.1.6.6, page 271 For function description on device operation see chapter 7.2, page 120.
4	<b>CAN bus – X102</b> For technical data see chapter 10.1.6.4, page 269 For function description on single device see chapter 4.3.2, page 46. For function description on multi-unit system see chapter 4.4.3, page 59.
5	<b>CAN bus – X101</b> For technical data see chapter 10.1.6.4, page 269 For function description on single device see chapter 4.3.2, page 46. For function description on multi-unit system see chapter 4.4.3, page 59

Be continued on the next page



Position of the interfaces on the rear side of the device.

Interfaces - rear side (continued)	
6	<b>Sense – X104</b> For technical data see chapter 10.1.6.5, page 270. For function description on single device see chapter 4.3.1, page 41.
7	<b>RS232 Rear (option) – X106</b> For technical data see chapter 10.1.6.3, page 268.
8	<b>ISR (option) – X107</b> For technical data see chapter 10.1.6.7, page 273. For function description on device operation see chapter 7.2, page 120.
7	<b>DC current bars</b>
8	<b>Earthing pin</b> For the connection of an additional earth.
9	<b>Mains connection, AC connection terminals</b>

Table 6 Interfaces on the rear side of the device

## 1.7. Technical data

### 1.7.1. Protection functions

Overvoltage protection	
In operation as current source	Voltage limiting
In case of malfunction	Electronic inhibit
Response threshold <sup>1 2</sup>	0 – 110 %
Response time <sup>2</sup>	50 µs – 1600 ms

Table 7 TC.GSS power supply overvoltage protection

<sup>1</sup> Referred to nominal voltage

<sup>2</sup> Adjustable via the device operation from chapter 7, page 119.

Overcurrent protection	
In operation as voltage source	Current limiting
In case of malfunction	Electronic inhibit
Response threshold <sup>1 2</sup>	0 – 110 %
Response time <sup>2</sup>	50 µs – 1600 ms

Table 8 TC.GSS power supply overcurrent protection.

<sup>1</sup> Referred to maximum current

<sup>2</sup> Adjustable via the device operation from chapter 7, page 119.

### 1.7.2. Technical information on the interfaces

All information can be found in the appendix from chapter 10.1, page 262

## 2. Safety

### 2.1. General information on safety and hazards

#### Scope and applicability

The general information applies to all TopCon low-voltage systems. The user(s) has (have) the obligation to avoid the risks and hazards mentioned by means of the rigorous application of specialist electrical rules.

The system is subject to the Low voltage directive, it is to be operated by adequately trained and instructed personnel.

### 2.2. Categorisation of the hazard areas

The assessment of the effects of hazards from low-voltage systems with a flow of energy for feed and possibly regeneration is divided into the following areas:

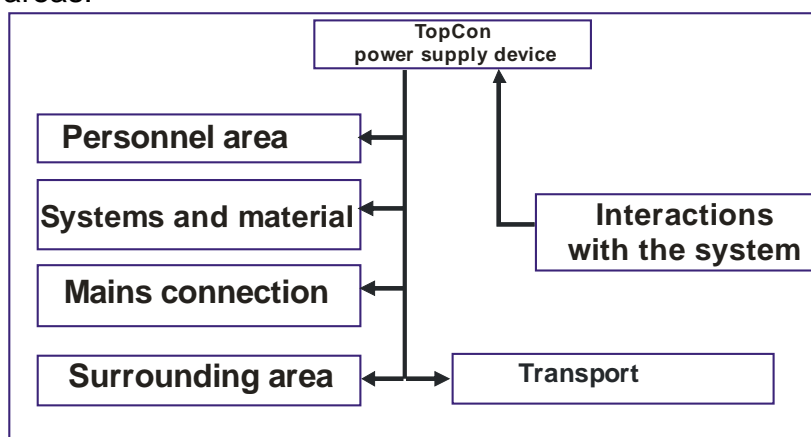


Fig. 8 Categorisation of the hazard areas.

The hazard areas stated are explained in the sub-sections of this chapter that follow.

### 2.2.1. Personnel area

The utmost attention is to be paid to the hazards for individuals. There are various risks and hazards, of these the most important are mentioned here.

#### **Electric shock**

A low-voltage system can produce electrical potentials that can be dangerous or even fatal for individuals. During work on the system the following guidelines are to be observed:

##### a) **Work in electrically isolated state**

This is the recommended way of working, it should be rigorously applied during all connection and wiring work. Follow the rules:

1. Electrically isolate
2. Secure against switching back on.
3. Short-circuit
4. Connect to earth
5. Report and instruct

After shut down, the short-circuiting of the outputs and earthing are particularly important for safety reasons if reactive loads or loads that store energy (accumulators, capacitors, ULTRACAP etc.) are used.

##### b) **Work in the vicinity of live parts**

In these circumstances an increased hazard potential is to be expected. Minimise the risks by means of:

1. Guards
2. Covers
3. Insulating encapsulation, cladding
4. Impose separation by means of mechanical features, protective grilles
5. Supervision, reporting



**c) Work on live equipment**

It is imperative this form of working is avoided. If it cannot be avoided, careful work preparation is essential.

Pay attention to the following:

1. The personnel must be specially trained.  
(see NIV Art 26 )
2. Work in accordance with recognised specialist methods.
3. Controlled personal protective equipment must be available.  
(passive protection)
4. Organisation of the working area.
5. Supervision and preparatory measures. (Active protection)
6. Use appropriate protection against physical contact throughout.  
Set up a suitable EMERGENCY STOP chain and test it at regular intervals!  
Mark all wires and cables to prevent mistakes.

**Electrical heating**

TopCon electrical power supply systems operate with significant amounts of energy. High currents can cause heating of cables and wires. In particular, during unmonitored endurance tests insulation fires and short-circuits may be caused.

- At particular risk are connectors, switchgear and cable terminals. Check these parts particularly carefully and at regular intervals.
- Use wiring material suitable and stipulated for your application with the related insulation class!
- Monitor your system actively or passively using appropriate sensors or by monitoring parameters.

**Arcing and sparking on opening contacts**

In relation to DC systems, note that on opening a circuit through which a current is flowing, arcing with very high energies can be produced depending on the inductance!

In some circumstances this arcing can result in burns, damage to the eyes as well as damage, destruction or fire on parts of the system.

The usage of normal mains contactors as isolating devices in DC circuits is not recommended! Instead use DC contactors. In case of doubt contact the related manufacturer.

Take into consideration that the protective devices on the TopCon low-voltage system cannot detect an arc as a fault condition, as this situation may be a required function.

**Risk of mechanical injury**

As on all electrical installations, mechanical injuries to the head and hands may be caused on removing and fitting covers, wire and cable connections.

Always use the correct tool. If necessary protect the head and hands against injuries due to cuts and impacts.

### 2.2.2. Systems and material area

#### Risk of fire

In case of fire, electrically isolate the system immediately, on the one hand to interrupt the supply of energy and on the other hand to shut down the fans.

Fight the fire from bottom to top in accordance with the rules in your organisation using suitable fire fighting equipment (CO2 fire extinguisher). If possible use fire extinguishers with asphyxiation action to keep the secondary damage low.

#### Electromagnetic fields

Like any electrical system, TopCon low-voltage systems produce electrical and magnetic fields. However, these fields comply fully with the usual standards.

Note, however, that particularly the EM fields from your cables and equipment connected could nevertheless produce interference on objects in the immediate area.

Note the following:

- Keep data carriers and PC-based measuring environments an adequate distance from live cables to prevent interference and data loss.
- Protect highly-sensitive sensors and instruments.
- Test effects on communication networks, in particular radio networks.
- Make individuals with electronic implants aware that implants may be affected.

#### Noise and noise level

The inductive elements as well as the fans on the TopCon low voltage system produce a lower or higher noise level dependent on the operating mode. However, in the immediate vicinity of the cabinet this noise is under the tolerance limit that would make acoustic protection equipment necessary.

The usage of acoustic protection equipment or acoustic insulation measures can, however, be necessary in specific circumstances.

#### Mechanical damage

Incorrect operation of the systems can result in mechanical damage to the downstream equipment and systems.

In particular, on the supply of power to drives it is to be ensured that excessively high speeds cannot result on load shedding.

The monitoring of the maximum speed with intervention in the safety chain is recommended above all if the system runs unmonitored.

### **Handling stores containing large amounts of energy**

Modern energy storage systems are able to absorb very large amounts of energy. This situation has the following consequences:

- The cabling should not just comply with the maximum charging and discharging currents to be expected, to some extent significantly higher peak currents are to be expected during switching processes.
- Unlike the TopCon low-voltage system, which is fully current-limited, in the case of stores containing large amounts of energy a short-circuit or failure can be very serious. Due to the high currents serious injuries and serious damage can be caused.

The following, incomplete list indicates some this damage:

1. Burning of wires and connectors
2. Sparking
3. Fires, insulation fires
4. Arcing, welding
5. Electric shocks

Note the following points:

1. Never short-circuit energy stores to discharge them!  
Always use a suitable discharge resistor of appropriate power rating!
2. Visibly secure a discharged energy store using a short-circuit bridge.
3. Always monitor the maximum storage voltage, also during practical test operation.
4. Use a device that clearly indicates the charge state of the energy store, e.g. by monitoring the low-voltage limit.

### 2.2.3. Mains connection area

TopCon TC.GSS power supplies are operated with 400V/480V 3~ AC. When they are switched on there may be an uneven load on the 3 phases; this uneven load may cause older residual current circuit breakers to trip.

Here a modern make of residual current circuit breaker is to be used that will tolerate such asymmetries during the switch-on process.

### 2.2.4. Surrounding area

TopCon TC.GSS power supplies are generally forced air cooled. Despite the very high efficiency, a power loss occurs in the components that must be dissipated in the form of heat to the surroundings. The energy is dissipated with the aid of forced ventilation to the rear of the TopCon TC.GSS power supply.

It is to be ensured that the rooms in which TopCon TC.GSS power supplies operate are cool and therefore the heat produced can actually be removed.

- Active cooling is, however, generally unnecessary.
- The forced ventilation discharges air from the rear side of the TopCon power supply.

It is to be ensured that there are no undesirable effects (e.g. stirring up of dust or sand, deformation due to the action of heat etc.) due to the flow of air and the heat, which at high load may be powerful.

On TopCon models with the water cooling option, a large portion of the power loss produced is dissipated via the cooling circuit.

Here it is to be ensured the cooling liquid feed is not too warm. Further requirements on the cooling liquid are given in the option description from p. 71.

### 2.2.5. Transport area

TopCon power supplies are always supplied with 2 strong carrying handles (steel sheet). These handles are inserted in the slots in the side of case and make it possible to transport the device easily.



Fig. 9 Attaching the carrying handles to transport a TopCon power supply.

Due the high weight it is advisable to carry the device between 3-4 people and whenever possible to use a trolley.

Remove the carrying handles after transporting the TopCon power supply and store them in a safe place.

**On lifting the system using a crane:**

In any circumstance it is recommended to attach blocks of wood to the corners of the cabinet to prevent twisting/distortion of the cabinet structure (see Fig. 10).

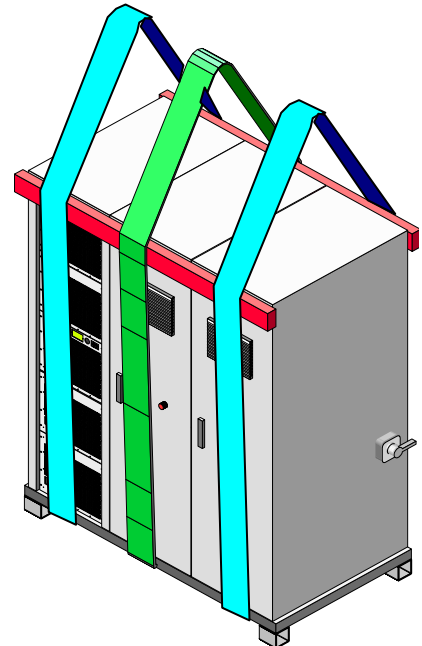


Fig. 10 Usage of blocks of wood as protection against mechanical damage (lifting using 2 (better 3) carrying straps)

- It is imperative you remove all cable connections prior to moving the system!
- Note that between switching off the power supply and disconnecting the power cables on the output side, it is necessary to wait at least 15 min for discharging.
- Keep all doors closed during the transport of cabinets.
- Pay attention to protruding parts such as main switch, controls and fan covers. They must not be damaged by transport aids (straps, blocks of wood, etc.).

### 2.2.6. Area related to interaction with the system

Compliance with the design data for the specific system is a prerequisite for malfunction-free operation.

Load systems can have significant effects on the power source. The following points are to be noted:

1. The maximum voltage specified is not allowed to be exceeded.
2. Protective measures must be provided against voltage spikes on the load side and their function must be monitored (voltage spikes could damage the filter capacitors and semiconductors in the system).
3. Periodic overcurrents are to be avoided.
4. The DC ripple currents produced on the load side are to be monitored to avoid overloading filter capacitors; in case of doubt ask the manufacturer.

The system is always to be operated within the permissible temperature range. High temperatures will reduce the service life of various modules.

## 2.3. Safety pictograms used

Important information in these operating instructions is marked with the following symbols:




Hazard and warning information	
Pictogram	Meaning
 <b>DANGER</b>	For an immediate hazard that will result in serious injuries or fatality.
 <b>WARNING</b>	For an immediate hazard that can result in serious injuries or fatality.
 <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.

Table 9 Basic hazard and warning information.



Further warning and hazard information	
Pictogram	Meaning
	DANGER, WARNING or CAUTION due to electrical power
	DANGER, WARNING or CAUTION related to suspended load

Table 10 Symbols included in the table can be used for more specific depiction of warning information from Table 9 "Basic hazard and warning information".




Instructions	
Pictogram	Meaning
	Important information

Table 11 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.

Table 12 Additional information, so that you can find possibly important information quickly.

### 3. Layout and function

#### Overview of the function

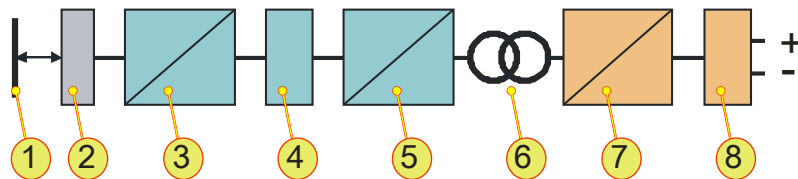
The development, optimisation and testing of modern energy storage systems is increasingly demanding programmable active feed/regeneration systems. More and more, significant amounts of energy are handled such that the dissipative conversion into heat losses does not represent a sensible alternative to power regeneration.

The TopCon TC.GSS series is the first fully digital power supply that controls both energy directions for feeding the load and regeneration from the load.

Examples of possible applications:

- Testing and evaluating battery systems
- Developing and debugging drive trains
- Simulation of on-board power systems for road vehicles and aircraft
- Test systems for electrical propulsion drives, lifts, cranes, light railways
- Evaluation and tests on hybrid concepts
- Electrical processes in process engineering

#### Topology – inside the device



-1- MAINS; -2- FILTER; -3- PFC/ RECTIFIER/ INVERTER;  
-4- DC INTERMEDIATE CIRCUIT; -5- RECTIFIER/ INVERTER;  
-6- TRANSFORMER; -7- RECTIFIER/ INVERTER;  
-8- OUTPUT FILTER

The new device series is based on the latest concepts and by means of the multiple utilisation of the power stages ensures optimum performance and compactness. The high frequency regeneration inverter/rectifier eliminates the familiar problems with passive 6-pulse rectifiers during feeding operation (PFC functionality). Due to the medium frequency transformer coupling, complete isolation between mains and DC load circuit is achieved.

## 4. Controls and displays and operating modes

### 4.1. Controls and displays

#### 4.1.1. Elements of the TopCon TC.GSS standard interface

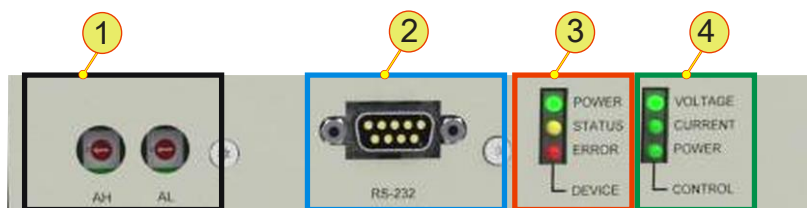


Fig. 11 Standard controls on the front side of the device.

Standard controls (cf. Fig. 11)	
<b>1</b>	<b>Device address selection switch</b> For multi-unit operation Standard: covered by plastic caps AH: Upper address range AL: Lower address range
<b>2</b>	<b>RS-232, interface</b> For operation via a PC using the TopControl application see chapter 7.4.3.1, page 160.
<b>3</b>	<b>DEVICE, LED indicator</b> Indication of the device status Green: POWER Yellow: STATUS/WARNING Red: ERROR
<b>4</b>	<b>CONTROL, LED indicator</b> Green LED illuminates in front of the related label for the operating state: VOLTAGE: Voltage control CURRENT: Current control POWER: Power control

Table 13 Overview of the standard controls.

### 4.1.2. Controls on the HMI (option)

#### Human Machine Interface (HMI)

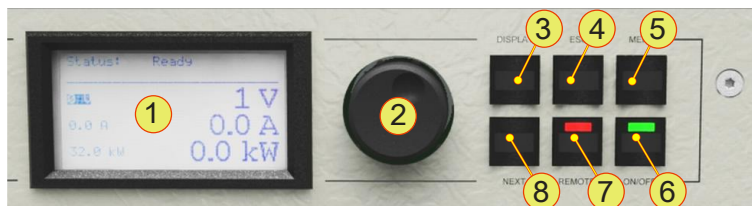


Fig. 12 Controls for the optional HMI (or the RCU).

Standard controls (cf. Fig. 12)	
1	<b>LC display</b> Indication of the actual device settings and various menus
2	<b>&lt;JogDial&gt;</b> , rotary selector switch For the selection of menu items and scaling of parameters
3	<b>&lt;DISPLAY&gt;</b> , button Return to the last interactive display used
4	<b>&lt;ESC&gt;</b> , button Active on main screen and system screen
5	<b>&lt;MENU&gt;</b> , button Opens the main menu.
6	<b>&lt;ON/OFF&gt;</b> , switch ON: Green LED illuminated. On reaching the operating state the output value set is present on the device output. OFF: Green LED is off, device output is electrically isolated.
7	<b>&lt;REMOTE&gt;</b> , switch Change over as to whether the TC.GSS power supply is to be remotely controlled. Deactivated: Red LED off. HMI is ready for entries. Activated: Red LED illuminated. HMI is remotely controlled, only indicates the device state.
8	<b>&lt;NEXT&gt;</b> , button In case of two-page menus for data entry used to jump to next page.

Table 14 Controls on the HMI or RCU.  
For detailed information on the usage of the HMI (or RCU)  
see chapter 7.3, page 131

## 4.2. Operating modes

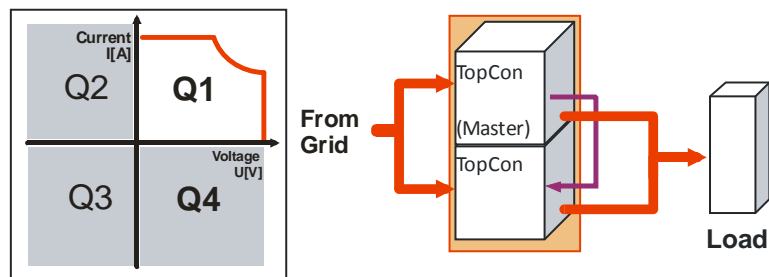
### 4.2.1. Feeding and regenerative operation

The digitally controlled TC.GSS power supply is a bidirectional electrical power supply that provides two operating modes in the four quadrant field. Feeding and regenerative operation.

#### Feeding operation (Q1):

Feeding operation is achieved via positive set values for DC current and positive DC voltage.

Q1: Feeding mode

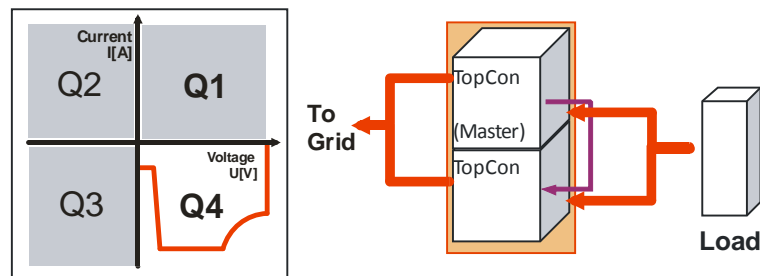


The energy flows from the electrical supply system to the item under test (load).

#### Regenerative operation (Q4):

Regenerative operation is achieved via a negative set value for the DC current and a positive set value for the DC voltage. Due to the negative current the power is also negative.

Q4: Regenerative mode



The energy flows from the item under test (load) to the electrical supply system.

#### Multi-unit system operation

If several TC.GSS power supplies are utilised in a multi-unit system, the overall system is controlled by a master device. Multi-unit operation is possible for Q1 and Q4 operation.

#### Operation

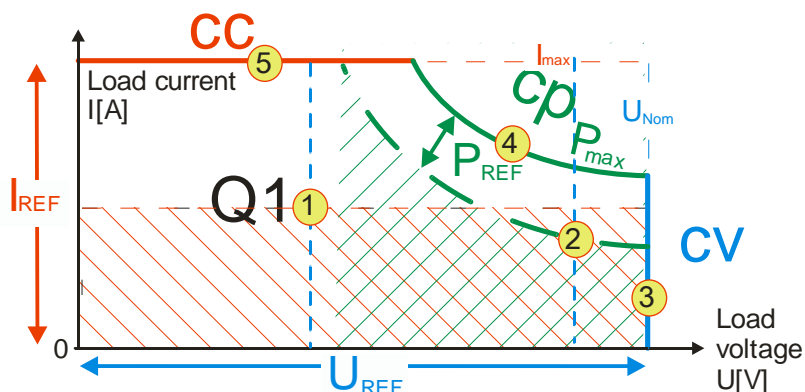
All set values can be specified either via the operating panel HMI (option), from an external PC using the TopControl application or using an analogue interface.

**4.2.1.1. Q1 operation – operating states**

Positive flow of current: current flows from the power supply to the load (positive current)

Set values for Q1 operation	
Voltage set value $U_{REF}$	Voltage reference value. Value range: <b>0 ... <math>U_{Nom}</math></b> ; $U_{Nom}$ is the device-specific limit (for continuous load).
Current set value $I_{REF}$	Current reference value. Value range: <b>0 ... <math>I_{Nom}</math></b> ; $I_{Nom}$ is the device-specific limit (for continuous load).
Power set value $P_{REF}$	Power reference value. Value range: <b>0 ... <math>P_{max}</math></b> ; $P_{max}$ is given by the power characteristics of the device.

Table 15 Set values for Q1 operation.



Controller behaviour in Q1 operation at different operating points.

The operating points are examples for different areas within the operating characteristic.

- **Operating point -1-**  
Voltage control cv with a  $U_{Load}$  limit at  $U_{REF}$  or current control cc with an  $I_{Load}$  limit at  $I_{REF}$ .
- **Operating point -2-**  
Voltage control cv with a  $U_{Load}$  limit at  $U_{REF}$  or power control cp with a  $P_{Load}$  limit at  $P_{REF}$ .
- **Operating point -3-**  
Voltage control cv with a  $U_{Load}$  limit at  $U_{REF}=U_{Nom}$ .
- **Operating point -4-**  
Power control cp with a  $P_{Load}$  limit at  $P_{REF}=P_{max}$ .
- **Operating point -5-**  
Current control cc with an  $I_{Load}$  limit at  $I_{max}$ .

**4.2.1.2. Q4 operation operating states**

Negative flow of current: current flows from the load to the power supply

Set values for Q4 operation	
Voltage set value $U_{REF}$	Voltage reference value. Value range: $0 \dots U_{Nom}$ ; $U_{Nom}$ is the device-specific limit.
Current set value $I_{LimitQ4}$	Current reference value. Value range: $-I_{max} \dots 0$ ; $I_{max}$ is the device-specific limit.
Power set value $P_{LimitQ4}$	Power reference value. Value range: $-P_{max} \dots 0$ ; $P_{max}$ is given by the power characteristics of the device.

Table 16 Set values for Q4 operation.

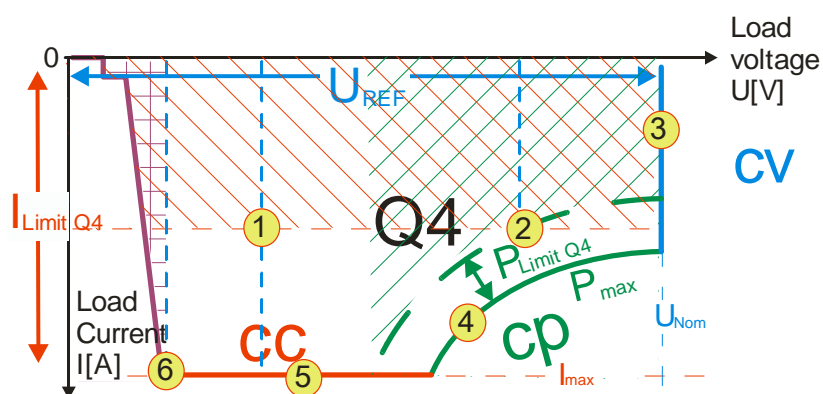


Fig. 13

Controller behaviour in Q4 operation at different operating points.

The operating points are examples for different areas within the operating characteristic.

- Operating point -1-:  
Voltage control cv with a  $U_{Load}$  limit at  $U_{REF}$  or current control cc with an  $I_{Load}$  limit at  $I_{LimitQ4}$ .
- Operating point -2-:  
Voltage control cv with a  $U_{Load}$  limit at  $U_{REF}$  or power control cp, from  $P_{Load}$  to  $P_{LimitQ4}$ .
- Operating point -3-:  
Voltage control cv with a  $U_{Load}$  limit at  $U_{REF}=U_{Nom}$ .
- Operating point -4-:  
Power control cp, from  $P_{Load}$  to  $P_{LimitQ4}=P_{max}$ .
- Operating point -5-:  
Current control cc with an  $I_{Load}$  limit at  $I_{LimitQ4}=I_{max}$ .

- Operating point **-6-**:  
Current or voltage control.  
In the area of operating point -6- the load current is reduced within the device at low load voltages  $U_{Load}$ .

### Dynamic consideration of the control error at the set value limit

#### Decision as to which control is used.

There are 3 control types in the power supply:

- Voltage control
- Current control
- Power control

Which control is used is explained in the following sketch of the principle of operation.

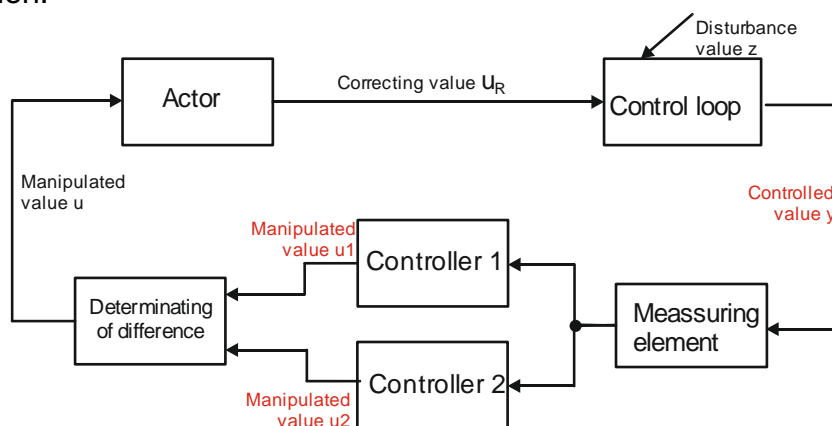


Fig. 14 Control principle – example with 2 controllers and their manipulated value u

The decision in limit cases as to which controller defines the manipulated value u is decided via the magnitude of the manipulated value u.

- If the difference between the manipulated value u and the controlled value y  $|u1-y| > |u2-y| \rightarrow$  control is via controller 2.
- If the difference between the manipulated value u and the controlled value y  $|u1-y| < |u2-y| \rightarrow$  control is via controller 1.



The following cases are defined by the properties of the load connected and the operating mode:

- **Actual value  $\leq$  reference value:**  
Depending on which control difference is smaller the following occurs:  
Voltage control cv with a  $U_{Load}$  limit at  $U_{REF}$  or  
current control cc with an  $I_{Load}$  limit at  $I_{REF}$  or  
power control cp with a  $P_{Load}$  limit at  $P_{REF}$
- **Actual value  $>$  reference value:**  
The control does not allow the reference value to be exceeded.  
For example, the voltage control attempts to maintain  $U_{Load} = U_{REF}$ . During this process the load current  $I_{Load}$  can also be negative until the current limit  $I_{LimitQ4} = -I_{max}$  or the power limit  $P_{LimitQ4} = -P_{max}$  is reached. → Change from Q1 to Q4 operation.

#### **Q4 operation: example case for load voltage $U_L$ with reactive loads:**

At  $I_L = I_{LimitQ4}$ , the current control starts to limit, during this process  $U_L$  increases.

- If  $U_L \leq U_{Nom}$  the current control cc remains with  $I_{LimitQ4}$  as the limit.
- If  $U_L > U_{Nom}$  voltage control cv with the device safety limit  $U_{max} = 1.1 * U_{Nom}$ .  
If  $U_{max}$  is reached, the device switches off for safety reasons.

## 4.2.2. Setting operating states

### 4.2.2.1. Setting the set values via the TopControl application

For further information on the usage of the software see chapter 7.4.8.1, page 175.

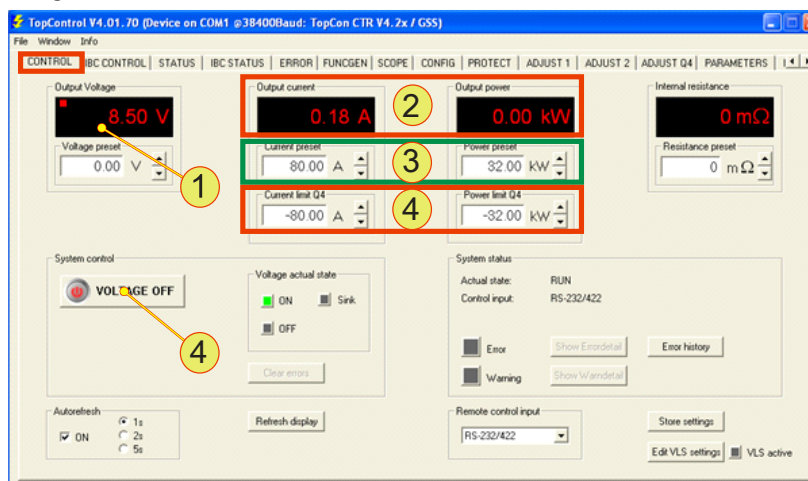


Fig. 15 <CONTROL> tab - TopControl application window

### Procedure

- Set the required voltage -1-.
- Set the required set values for current and power -1-.  
“+” sign = Q1 operation; “-” sign = Q4 operation
- For Q4 operation set the current set value ILimitQ4 and the power set value PLimitQ4 -4-.
- Start the flow of energy between the AC side and DC side using <VOLTAGE ON>.

#### 4.2.2.2. Setting set values via HMI

For further information on the operation of the HMI see chapter 7.3, page 131.



The specification of the parameters using the HMI is only fully suitable for Q1 operation.

For Q4 operation it is only possible to specify set values for the current, voltage and power, but not for the limit values.

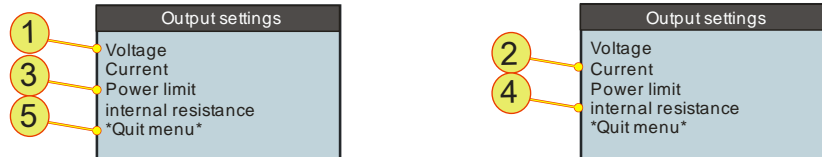


Fig. 16 Output settings display - HMI window

#### Procedure for Q1/Q4 operation

- Set the required voltage **-1-**.
- Set the required set values for current and power **-2-**.  
“+” sign = Q1 operation; “-” sign = Q4 operation
- For Q1 operation set the corresponding limit values for the power **-3-**.
- Start the flow of energy from the AC side to the DC side using the <ON/OFF> switch on the HMI panel.

#### 4.2.2.3. Setting set values via the analogue interface X105

For further information on the operation of the device via the analogue interface X105 see chapter 7.2 , page 120.



## 4.3. Single device operation – special aspects

### 4.3.1. Sense connection

To compensate for the voltage drop over the load cables, TopCon power supplies have a “**Sense**” connection feature.

The voltage can be measured directly at the test specimen and controlled more accurately.

If this sense function is not required, the connection is simply left unconnected.



Modifications and restrictions apply for multi-unit systems. First read this section to become familiar with the principle. You will find a further description on the usage of the function in multi-unit systems in the chapter on multi-unit systems.

(See chapter 4.4.2.1, Seite 58).

#### Characteristics of the sense function

On the usage of the sense function the following characteristics apply to the overall system:

- The controller compensates for losses that result in particular due to high load currents and high cable resistances.
- The load cable may be interrupted in operation.
- The maximum voltage compensation is adjustable.
- The voltage difference between device output and sense sensor can be monitored

TopControl: Voltage sensing - Error level.

The device will shut down with an error message if the limit is exceeded.

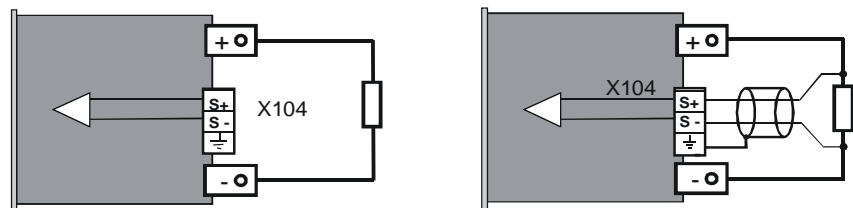


Fig. 17 Connection of load without/with sense functionality.

## Connection cables

On selecting a sense cable you must take into account the following:

- **Cable cross-section: 0.5 mm<sup>2</sup>, per cable**  
Single cables are mostly adequate.
- **Cable resistance: can be ignored**  
Only a low current flows through the sense cable.  
(OP-Amp input)
- **Voltage class**  
The sense cable must correspond to the voltage class of the device. (In particular from 800 V output voltage, as many cables are not approved for 800 V).
- **EMI shielding/coupling of interference**  
Use shielded cables to prevent the coupling of electrical interference onto the sense input.



Increase the interference immunity by means of simple measures:

- Simply twist the sense cables.
- Lay the sense cables physically separate from power cables.

## Software requirements

The following conditions must be met for the sense function to be supported and so that it can be activated.

- Main DSP firmware: **from V4.11.33**
- TopControl application: **from V4.01.12**
- User rights for the activation of the sense function in the TopControl application: **“Advanced User”** (see chapter 7.4.4, page 162)
- Connection must be established between TopCon TC.GSS power supply and TopControl application, see chapter 7.4.3.1, Seite 160.
- **State: “VOLTAGE\_OFF”**  
The sense function can only be activated if there is no voltage present on activation.

### Sense activation/deactivation in the TopControl application

The sense function can be found on the **<CONFIG>** -1- tab, and the parameters defined in the “Voltage sensing” -2- group.

The entire function is activated/deactivated via the “Use sense input” -3- check box.

For information on the significance of the parameters see chapter 7.4.8.5, Seite 219.

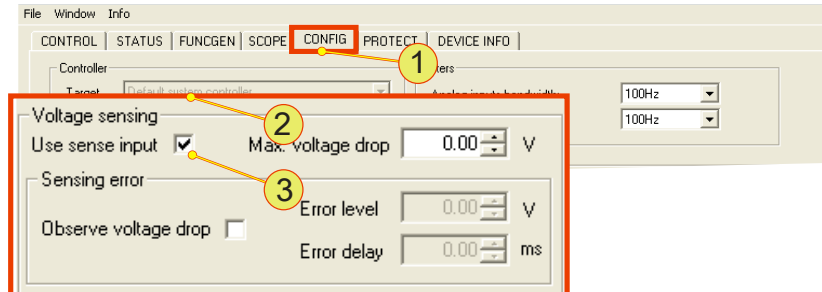


Fig. 18 Configuration of the sense function in TopControl.

### Sense actual value indication

On the activation of the sense function, the following indications alternate:

- **<CONTROL>** tab  
The labels “Output Voltage” -1- and “Output Power” -1- change to “Sense Voltage” -2- and “Sense Power” -2-

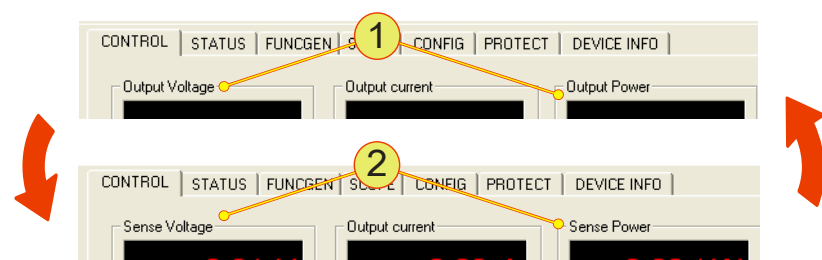


Fig. 19 Indication change between output voltage and sense voltage.

- **<STATUS>** -3- tab  
Along with the indication of the output values -1- the sense actual values -2- are also displayed.

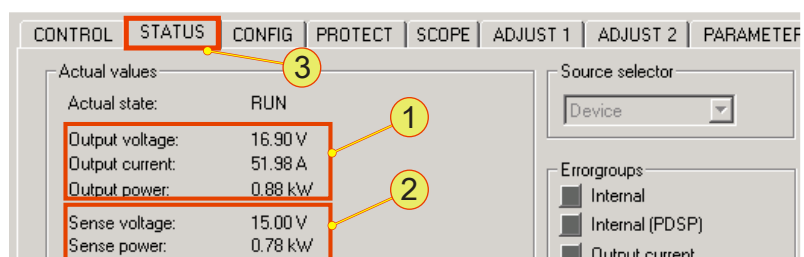


Fig. 20 Indication of the output values.

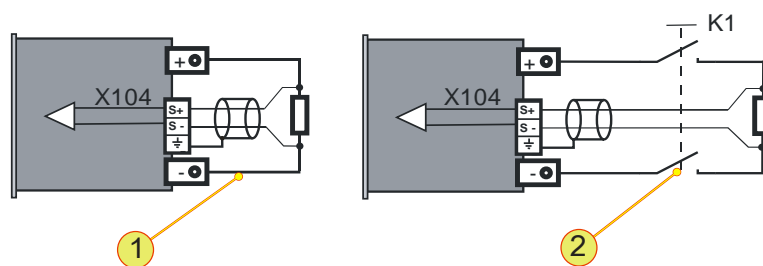
**Sense configuration**

Fig. 21 Connection of load with sense function, not switched -1- or switched -2-.

The sense cables are connected directly across the load. Here it is allowed to install a switch (contactor) -2- in the load circuit. The maximum output voltage  $U_{out}$  can be configured via the software. The output voltage can be limited via the value configured. For further information on the significance of the parameters see chapter 7.4.8.1 ,page 175.

**Output of the sense voltage via the analogue interface X105**

With the sense function activated, the analogue sense voltage actual value can be used for the indication via the analogue interface X105.

For further information on the pin definition of X105 see chapter 10.1.6.6, page 271.



**Sense function indication change**

- **On the <CONTROL> tab**  
If the corresponding sense actual values cannot be achieved, the sense indication (voltage or power) changes from red (normal state) -1- to yellow -2-.



Fig. 22 Indication of the sense actual values. Example voltage value in normal state -1- and actual value is not reached -2-.

- **On the front panel**  
The related LED on the front panel of the TopCon TC.GSS power supply starts to flash.



Fig. 23 Flashing LED with the sense function  
VOLTAGE LED -1- , POWER LED -2-

**The following cases will produce an indication change:**

- **Max voltage drop**  
The value set on the <CONFIG> tab <Max voltage drop> is insufficient to compensate for the voltage drop over the load cable.
- **The required sense voltage is not reached**  
The maximum module voltage allowed is insufficient to achieve the required sense voltage.
- **The required sense power is not reached**  
The maximum module power allowed is insufficient to achieve the required sense power.

### 4.3.2. CAN communication (X101/X102)

TopCon power supplies that are operated in a multi-unit system require system-internal communication via the related interfaces X101/X102.

The tasks of the individual TopCon power supplies and their peripheral modules, e.g. RCUs and series controllers are controlled via the CAN communication. At the same time the CAN communication is used for communication between the system master and the slaves assigned.

The interfaces X101 and X102 have the following tasks:

- CAN interface, for the communication
- Interlock connection



The related interface must always be “terminated”, i.e. fitted with the related dummy plugs or a bus connection.

#### 4.3.2.1. Assignment of interface and dummy plug

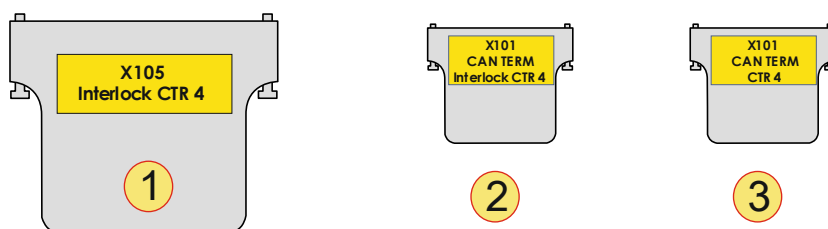


Fig. 24 Schematic illustration of the D-Sub dummy plugs used with their labelling.

Dummy plug	
1	<b>Interlock connector, D-Sub, 25-pin (dummy plug)</b> Label: “ <b>X105; Interlock CTR 4</b> ” Is connected on the rear side of all devices to interface X105.
2	<b>Interlock or CAN-Term, D-Sub, 9-pin (dummy plug)</b> Label: “ <b>X101; CAN TERM; Interlock CTR 4</b> ” Is connected to interface X101 on the rear side of the device at the start of the CAN multi-unit system.
3	<b>CAN-Term, D-Sub, 9-pin (dummy plug)</b> Label: “ <b>X101; CAN TERM;</b> ” Is connected to interface X102 on the rear side of the device at the end of the CAN multi-unit system.

Table 17 Dummy plugs and their labelling.



Only one CAN-Term is allowed to be connected to a single device. Independent of whether X101 or X102 is used.

#### 4.3.2.2. Establishment of communication connection TopCon with/without HMI and RCU

In the following the configuration of a TopCon power supply and its peripheral devices is considered.

With the possible combinations of HMI and RCU, there are 4 standard configurations for a TopCon power supply.

For further information on multi-unit systems with at least 2 or more TopCon TC.GSS power supplies, see from chapter 4.4.3, page 59.

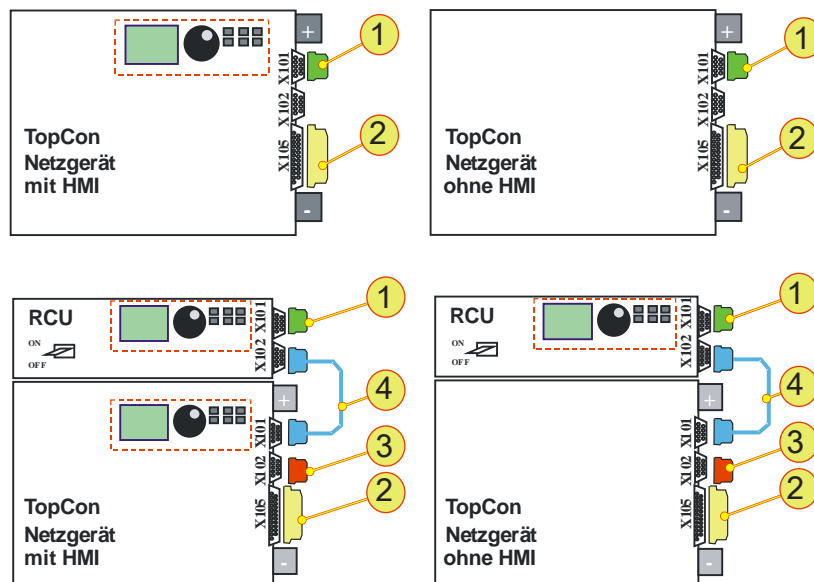


Fig. 25 Circuit diagram for TopCon with HMI (left) and without HMI (right).

No.	Function	Dummy plug used	Device	Interface
1	“Interlock” + “CAN TERM”	Dummy plug X101	TopCon RCU	X101
2	“Interlock”	Dummy plug X105	TopCon	X105
3	“CAN TERM”	Dummy plug X102	TopCon	X102
4	“CAN CABLE”	---	TopCon RCU	X101/ X102

Table 18 Allocation of components to chapter 4.3.2.1, page 46.

### 4.3.3. Interlock output inhibit

TopCon TC.GSS power supplies have a feature for rapidly inhibiting the output using an interlock signal.

All external EMERGENCY STOP contacts must close the interlock circuit for operation to be possible.

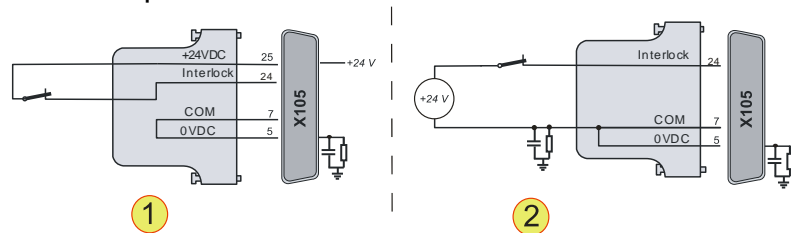


Fig. 26 Example interlock circuit on the interface X105.  
-1- External EMERGENCY STOP button with internal voltage source.  
-2- External EMERGENCY STOP switch with external voltage source.

#### With interrupted interlock circuit

- The power stage is switched off directly via a hardware link.
- The controller remains switched on.
- The device changes to the state: “Error”.



To work using the TC.GSS power supply (or a system with TopCon modules), check that the interlock circuit is actually closed.



Ensure that the correct dummy plug has been used for the termination of the interface X101.

For further information see chapter 4.3.2.1, page 46.

The description of the interlock circuit for multi-unit systems is different due to the utilisation of the interface X102 for the different devices in the system.  
For further information see Fig. 31, Seite 60.

### 4.3.4. Interlock circuit with X101 and X105

#### Ring structure of the interlock circuit

The interlock circuit makes it possible to setup a safety infrastructure. The basis for the function is an electrical ring structure that must be closed for operation.

Safety elements -2- (e.g. EMERGENCY STOP buttons) can interrupt the ring and as a result switch off the TopCon power supply.



For higher safety requirements, e.g. safety class 1, the option: ISR (Integrated Safety Relay) is available.

For further information see chapter 5.2.2, Seite 77.

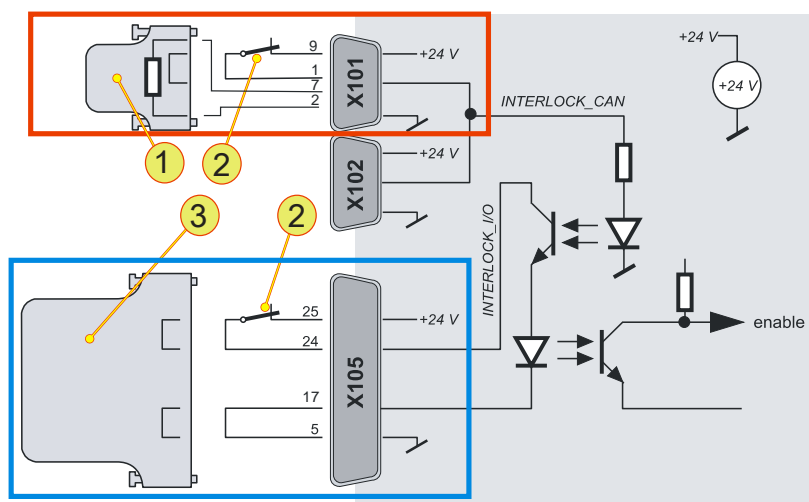


Fig. 27 Explanation of function of interlock circuit for single device.

Connection of the interlock circuit	
1	<b>Dummy plug X101</b> Safety circuit is closed using a jumper. Terminating resistor for the CAN bus
2	<b>External EMERGENCY STOP button</b>
3	<b>Dummy plug X105</b> Safety circuit is closed using a jumper.

Table 19 Connection of the interlock circuit.

### Interfaces used for the interlock circuit

- X101/X102**  
 Suitable for external **EMERGENCY STOP button**.  
**In multi-unit systems** the interlock circuit is interrupted immediately on the operation of an EMERGENCY STOP. All devices in the multi-unit system are shut down simultaneously.
- X105**  
 Suitable for an external **EMERGENCY STOP button on a single device**. The interlock contact is interrupted on the local single device.  
 In the multi-unit system the shutdown signal is only passed on via the internal device communication with a delay.

To be able to place a TopCon power supply in operation, these interfaces must be connected appropriately.



### Use dummy plugs supplied!

In the simplest configuration corresponding dummy plugs must be fitted to the two interfaces X101 and X105.

### 4.3.5. Internal system status and troubleshooting

This section explains the internal control processes. It will help you to better understand the system messages, in particular warnings and error messages provided by the device in various ways.

#### 4.3.5.1. Monitoring device-internal processes

The internal processes are monitored using a state machine. For the correct starting and during the operation of the device, the state machine works through the following tasks:

- The device self-test is started.
- The charging of the intermediate circuit is monitored.
- It reacts to user commands.
- Warning and error flags are polled and the resulting state changes are made.

## Device states

As a consequence there exist different device states:

State	Description
ST_POWERUP	Initialisation phase, CAN login, all modules asynchronous
ST_READY	All modules ready, output electrically isolated, fans off <sup>1</sup>
ST_RUN	Output live, controlled to set values, fans on
ST_WARN	As for ST_RUN, at least one warning flag set
ST_ERROR	Error in at least one module, output electrically isolated, fans off <sup>1</sup>
ST_STOP	Stop state for software update
FATAL_ERROR	Internal communication failed

Table 20 Internal system states.

<sup>1</sup>Depending on the temperature, the fans may continue to operate at reduced speed.

The device state is output to the exterior on the following interfaces:

- Device and control/LEDs (light emitting diode on the front panel)  
Green: POWER  
Yellow: STATUS  
Red: ERROR  
For information on the control console see chapter 4.1, page 31.
- Digital outputs  
The relay contacts are operated in a corresponding manner and permit the connection of external status indications.  
For further information see chapter 4.3.5.3, page 53.

## 4.3.5.2. Indications on DEVICE and CONTROL LEDs

State of the device	DEVICE and CONTROL LEDs on the front of the device			
	“READY”	“STATUS”	“ERROR”	“CV”; “CC” and “CP”
Power UP	OFF	ON	OFF	OFF
STOP	ON	ON	OFF	OFF
READY	ON	FLASHING <sup>3)</sup>	OFF	OFF
RUN	ON <sup>1)</sup>	OFF	OFF	ON <sup>2)</sup>
warn	ON <sup>1)</sup>	FLASHING <sup>3)</sup>	OFF	ON <sup>2)</sup>
Error	ON	OFF <sup>4)</sup>	FLASHING <sub>3)</sub>	OFF
FATAL ERROR <sup>5)</sup>	FLASHING <sup>5)</sup>	FLASHING <sup>5)</sup>	FLASHING <sup>5)</sup>	OFF

Table 21 Indication of the system status via LED indication (front).

<sup>1</sup> Flashing, if a discharge device is active.<sup>2</sup> One of the three LEDs, as per the actual control mode.<sup>3</sup> Flashing code as per the error table or warning table (see chapter on troubleshooting).<sup>4</sup> Flashing, if a warning is active at the same time.<sup>5</sup> The three LEDs are flashing together: internal communication failed.

## Description of the shutdown process

Changing the position of the main switch does not shut down the TC.GSS power supply immediately, instead a shutdown process is initiated. In particular, the discharge of the internal capacitors takes a certain amount of time during which the device is still live internally and to some extent the outputs are still live.

As long as the shutdown process is running:

- The three DEVICE LEDs form a running light.
- The HMI display indicates “shutting down...”

For this reason it is imperative to wait until this process is complete before undertaking further tasks on the device.



On devices with 10 and 16 kW the shutdown process is so fast that there is no indication and no delays.



**4.3.5.3. Indications via digital outputs (relays)**

The internal system status of the TC.GSS power supply is output to the exterior via the relay connections. External signalling devices or a superior system controller that monitors several devices can be connected via the relays. The device state can then be evaluated.

State	RELAY 1	RELAY 2	RELAY 3
	“OK/ALARM”	“RUN”	“WARN”
<b>Power UP</b>	OPEN	OPEN	OPEN
<b>STOP</b>	OPEN	OPEN	OPEN
<b>READY</b>	CLOSED	OPEN	OPEN/CLOSED <sup>1</sup>
<b>RUN</b>	CLOSED	CLOSED	OPEN
<b>warn</b>	CLOSED	CLOSED	CLOSED
<b>Error</b>	OPEN	OPEN	OPEN/CLOSED <sup>1</sup>
<b>FATAL ERROR</b>	OPEN	OPEN	CLOSED

Table 22 Indication of the system status using relays (interface X105).

<sup>1</sup> Closed if there is a warning, otherwise open.**4.3.5.4. Monitoring function - current monitoring concept**

The current limiting is intended on the one hand to protect the device (above all the semiconductors) against damage, on the other hand certain monitoring functions can also be used to protect the load connected.

Monitoring	Protection in case of	Implementation	Time range
Short-circuit monitoring by IGBT driver	Transformer saturation, hardware faulty	Hardware level fixed	3 µs – 6 µs
Monitoring of $I_{\text{Primary}}$	Transformer saturation	Hardware	10 µs – 50 µs
Monitoring of $I_{\text{Secondary}}$	High load current peaks (electrical power supply or load protection)	Software	50 µs – 10 ms
$I^2t$ algorithm $I_{\text{Secondary}}$	Temporary overload (electrical power supply or load protection), “fuse substitute”	Software	10 ms – as req. <sup>1</sup>
Current limiting by the controller	Output current too high (load protection)	Software	1 ms – ∞

Table 23 Properties of the internal monitoring functions in the TopCon.

<sup>1</sup> The maximum value is defined by the specific  $I^2t$  value

#### 4.3.5.5. Causes of errors

There are various reasons for undesired, possibly erroneous system states:

- Faulty component
- System limits are reached or exceeded.
- Application error by the user  
E.g. selected limits exceeded.

#### 4.3.5.6. Division into group and detail errors (warnings)

To be able to troubleshoot errors as quickly and accurately as possible, the possible errors and warnings are divided into 16 group errors. Each of these group errors is in turn broken down into 16 detail errors. The list of all errors and possible rectification measures is given in the appendix. For information on the error list, see 10.2.2, Seite 277.

The **group errors, detail errors and warnings** are output as follows:

- **Direct indication via TopControl or HMI/RCU**
- **LED flashing codes on the front of the device**  
Group and detail errors are indicated sequentially as flashing codes on the red “ERROR” light emitting diode on the front of the device.  
Warnings are indicated via the yellow “STATUS” light emitting diode on the front panel.  
Output in the form of flashing codes is important in multi-unit systems, as in this case as a rule only one TC.GSS power supply has a HMI user interface. However, all TC.GSS power supplies have the LED indicator.
- **Output via digital outputs (relays)**  
For further information see chapter 4.3.5.3, Seite 53.

#### 4.3.5.7. Error and warning indication on the front panel LEDs

The number of flashes indicates the possible reasons for the malfunction (group error and detail error). The complete flashing code comprises the following: <Flashes for group error><Pause in flashing><Flashes for detail error>

The following illustration shows a period in the indication cycle.

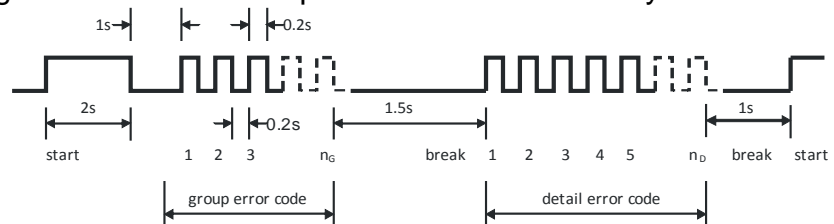


Fig. 28 Structure of the flashing code for error/warning indication via LED.

### Flashing code sequence with errors or warnings

5. Error codes and warning codes are identical.  
All errors and warnings are output one after the other based on the scheme in Fig. 28, Seite 54.
6. After the output of the last error or warning the flashing sequence starts again with the first error or first warning.

For information on the rectification of errors using the error list see chapter 10.2, Seite 275.

### Practical example

After switching on the TopCon Quadro power supply and setting the set values, the device is activated (On/Off). The buzzer comes on and an error code is indicated via the light emitting diodes:

Count the flashes:

- Group error code = 16,
- Detail error code = 3.

Reference to the error code list shows that an interlock error has been detected (F-2).



Note that the error coding is in hexadecimal.  $F_{\text{Hex}} = 15_{10}$ , 3 is the third element in 0, 1, 2, 3....

The indication on the HMI or in TopControl is: 0... 15 or 0 ... $F_{\text{Hex}}$ . The flashing code on the "ERROR" LED does not have a zero and therefore assumes the counting order 1...16. 0 signifies a pause in the flashing.

#### 4.3.5.8. Acknowledging an error

After the occurrence of an error, the device remains in the ERROR state until the reason for the error has been rectified (as per error list) and the error has been acknowledged.

It is possible to acknowledge an error via the following interfaces:

- HMI  
Using the **<ESC>** button on the front of the device
- TopControl  
Using the **<Clear error>** button on the **<CONTROL>** tab
- Analogue interface X105  
Positive edge on pin 8 with 10-24 V relative to ground

## 4.4. Multi-unit system

### 4.4.1. Introduction

Due to the fully digital control of the TC.GSS power supplies, all control signals are exchanged between the devices within a multi-unit system without losses.

#### Multi-unit system

A multi-unit system can only be made up of TC.GSS power supplies of the same type (model number).

The devices can be connected together in the following operating modes:

- **Serial**  
To increase the output voltage, the outputs of all devices are connected **in series**.
- **Parallel**  
To increase the output current, the outputs of all devices are connected **in parallel**.
- **Matrix**  
Some of the systems are connected as a serial multi-unit system, at least two of these serial configurations are connected in parallel.
- **Multiple load**  
Each device supplies **a load** and is not connected with any other device or only to one connection terminal on another device.

In principle the operating modes act on two areas:

- **Load connections**  
The outputs on the TC.GSS power supplies are connected accordingly in the serial, parallel, multiple load or in the matrix multi-unit system.  
The related total output value is distributed evenly over all TC.GSS power supplies in the multi-unit system.
- **Internal communication**  
All devices in the multi-unit system are taken into account during internal system communication by means of device addressing.  
Along with the TC.GSS power supplies this aspect also covers the HMI and RCU.

#### System communication

The system communication in multi-unit systems is ensured by the digital exchange of data (CAN). The wiring is undertaken with individual point-point connections between the devices (modules) as well using the terminating resistors at the two physical ends of the bus structure.



**A multi-unit system with max. 7 devices is recommended.** Theoretically up to 64 devices can be connected to the bus. From approx. 8 devices the communication is reduced. As a result, the dynamic performance of individual devices cannot be achieved with more than 8 devices.

Here it is recommended to use the **Multi-Rack Controller (MRC)**, for information on the realisation of larger multi-unit systems see dedicated instructions.

#### **Device addressing**

The device address comprises an upper address range (AH) and a lower address range (AL).

During the configuration of the related address range, the device type and the master-slave principle play a role, along with the type of configuration.

#### **Master-slave principle**

The set values are provided to the master device, e.g. via HMI or the PC using the TopControl application.

The master device passes on the parameters to its slaves via the internal system communication. The individual slave devices in the multi-unit system convert the set values specified into the related output values.

### **4.4.2. Load connection on devices in multi-unit operation**

#### **Multi-unit system supplied from the factory**

The load connection is configured on multi-unit systems supplied from the factory. The minus and plus connections on the individual TC.GSS power supplies are combined to form a system load terminal. The load is connected to this load terminal.

Special aspects of the multi-unit system in relation to the interlock circuit and the sense function are taken into account.

#### 4.4.2.1. Sense function in a multi-unit system

##### Configuration of the sense function

For information on the sense function and the configuration of the single device see chapter 4.3.1, Seite 41.

##### Serial multi-unit system

In the serial multi-unit system the sense cables are not allowed to be connected! An attempt to activate the sense function will result in an error message on the related device.

##### Parallel multi-unit system

The sense function can be used in a parallel multi-unit system. All devices in the multi-unit system must be connected to the sense cable connected and the sense function must be configured in the controller.

Example sense configuration in a parallel multi-unit system with two TC.GSS power supplies:

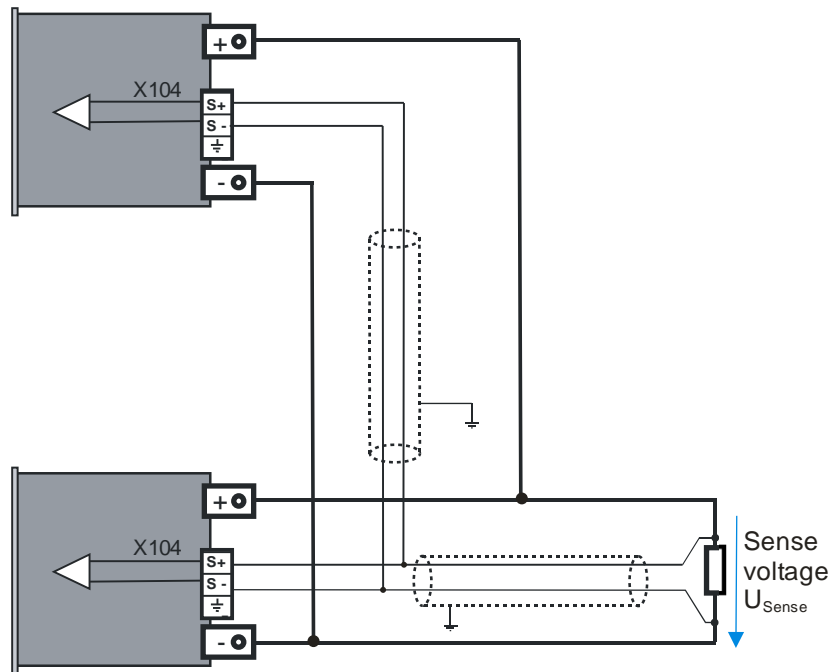


Fig. 29 Circuit diagram for load and sense cables in multi-unit operation

### 4.4.3. Internal system communication

#### 4.4.3.1. Hardware required for the multi-unit system

##### Allocation of interface using dummy plug

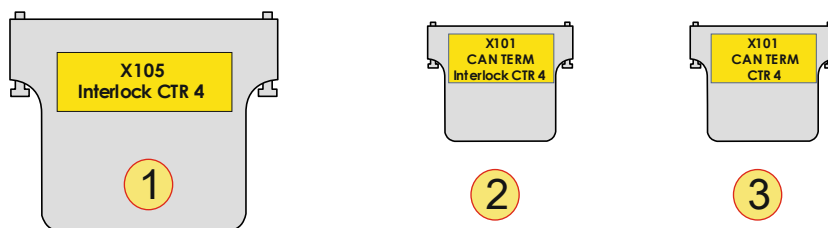


Fig. 30 Schematic illustration of the D-Sub dummy plugs used with their labelling.

Dummy plug	
1	<b>Interlock connector, D-Sub, 25-pin (dummy plug)</b> Label: "X105; Interlock CTR 4" Is connected on the rear side of all devices to interface X105.
2	<b>Interlock or CAN-Term, D-Sub, 9-pin (dummy plug)</b> Label: "X101; CAN TERM; Interlock CTR 4" Is connected to interface X101 on the rear side of the device at the start of the CAN multi-unit system.
3	<b>CAN-Term, D-Sub, 9-pin (dummy plug)</b> Label: "X101; CAN TERM;" Is connected to interface X102 on the rear side of the device at the end of the CAN multi-unit system.

Table 24 Dummy plugs and their labelling.

For a wiring diagram for multiple power supplies see Fig. 31, Seite 60.

#### 4.4.3.2. Interlock circuit in a multi-unit system

If the interlock circuit is used in a multi-unit system, there are changes compared to operation using an individual power supply. The principles of function and usage with a single device are described in the interlock circuit chapter 4.3.4, page 48 and interlock output inhibit chapter 4.3.3, Seite 48.

So that a multi-unit system can also be operated with a single interlock contact, the interlock circuit for all devices in the system must be supplied from a 24 V auxiliary supply (any device).



Note that the dummy plugs for the interfaces X101/X102 have similar cases, however internally the interlock wiring is different and therefore a differentiation must be made!

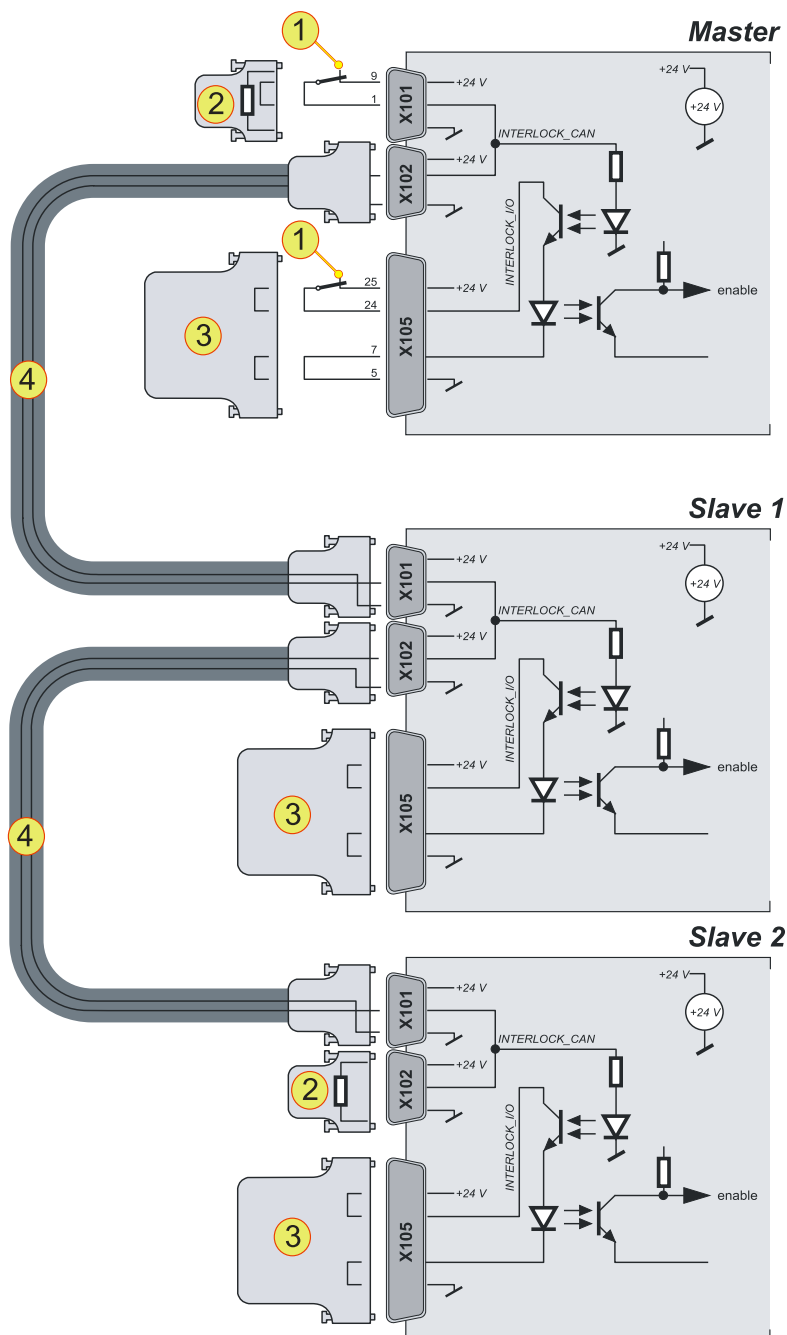


Fig. 31 Interlock connection scheme for TC.GSS power supplies via the CAN cable and the related dummy plugs.



Interlock modules in accordance with Fig. 31	
1	External EMERGENCY STOP button that can interrupt the interlock circuit.
2	Dummy plug <b>"X101; CAN TERM; Interlock CTR 4"</b> Is connected to interface X101 on the rear side so that the interlock circuit is not interrupted. (If there is no circuit -1-). Dummy plug: <b>"X101 CAN TERM"</b> Is connected to interface X102 on the rear side of the last device in the multi-unit system (if there is no circuit).
3	Dummy plug <b>"X105; Interlock CTR 4"</b> Is connected to interface X105 on the rear side so that the interlock circuit is not interrupted.
4	CAN cable connects interface X102 on the first device to the interface X101 on the following device.

Table 25 Connection of dummy plugs to the related interfaces in the multi-unit system.

#### 4.4.3.3. Multi-unit system with TopCon power supplies

##### Master-slave principle on power supplies in the multi-unit system

The set values are provided to the master device, e.g. via HMI or the PC using the TopControl application.

The master device passes on the parameters to its slaves via the internal system communication. The individual slave devices in the multi-unit system convert the set values specified into the related output values.

##### Limits of a multi-unit system

- Only one master is allowed per multi-unit system.
- Per multi-unit system at full bandwidth maximum number of devices: 7  
(From 8 devices, the bandwidth can be reduced)  
Devices such as HMI or RCU also count in a multi-unit system.
- A device address is only allowed to occur once in the multi-unit system.
- Several multi-unit systems can be connected via a Multi-Rack Controller (MRC) to form a large multi-unit system.

### Display of the operating parameters for individual devices

The most important operating parameters are sent continuously by the slave devices to the master and can be displayed there, e. g., using the TopControl application.

### Errors in the multi-unit system

Control of the state information in the multi-unit system:

- Slave devices follow the state of the master device.
- Each single device (module) can independently enter the “WARN” or “ERROR” state and trigger the entire system to change to this state.
- Acknowledging an error will affect the entire system.

### Addressing of master and slave devices

The addresses of multi-unit system devices comprise an upper address range (AH) and lower address range (AL).

The device is defined as a master or slave device depending on the value used for the address.

- **Master device**  
AL: 0; AH: 0
- **Slave device**  
The value for the address is always > 0, whether in the AL or AH address range.

### Addressing on power supplies in the multi-unit system

Whether the issue is a single device or a multi-unit system of TopCon, the device addresses are used to allocate the TopCon to its logical position in the multi-unit system

The device address comprises an upper address range (AH) and a lower address range (AL).

During the configuration of the related address range, the device type and the master-slave principle play a role, along with the type of configuration.

### Configuration of the addresses via the rotary switch

The device address is configured via the rotary switches. Default values are AH: 0; AL: 0



Fig. 32 Rotary switch AH -1- for the upper address range  
Rotary switch AL -2- for the lower address range

Addressing for a parallel multi-unit system

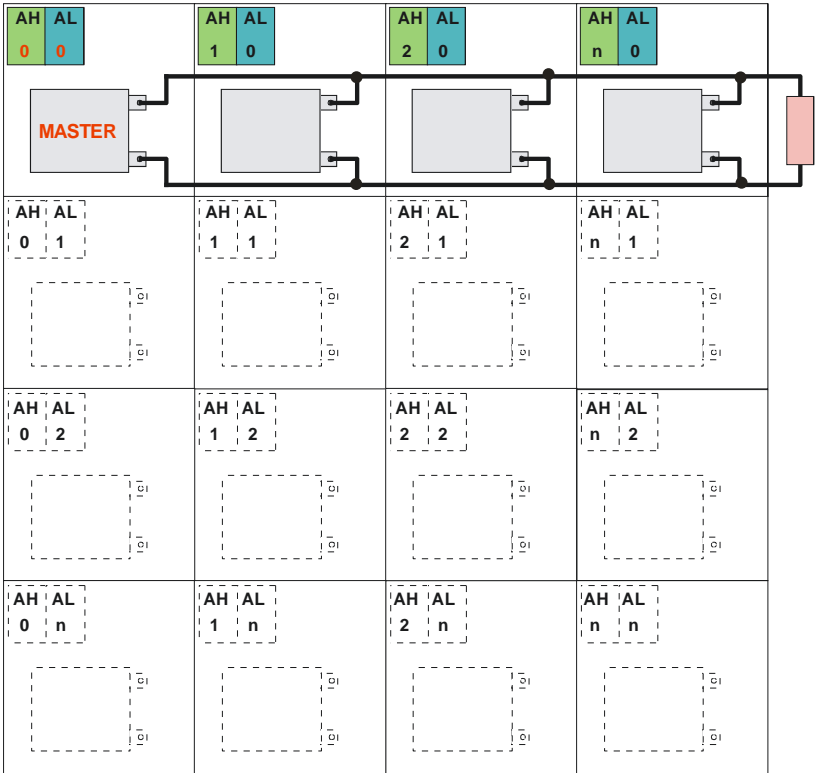


Fig. 33 Example definition for device addresses with 4 TopCon in parallel.

Addressing for a serial multi-unit system

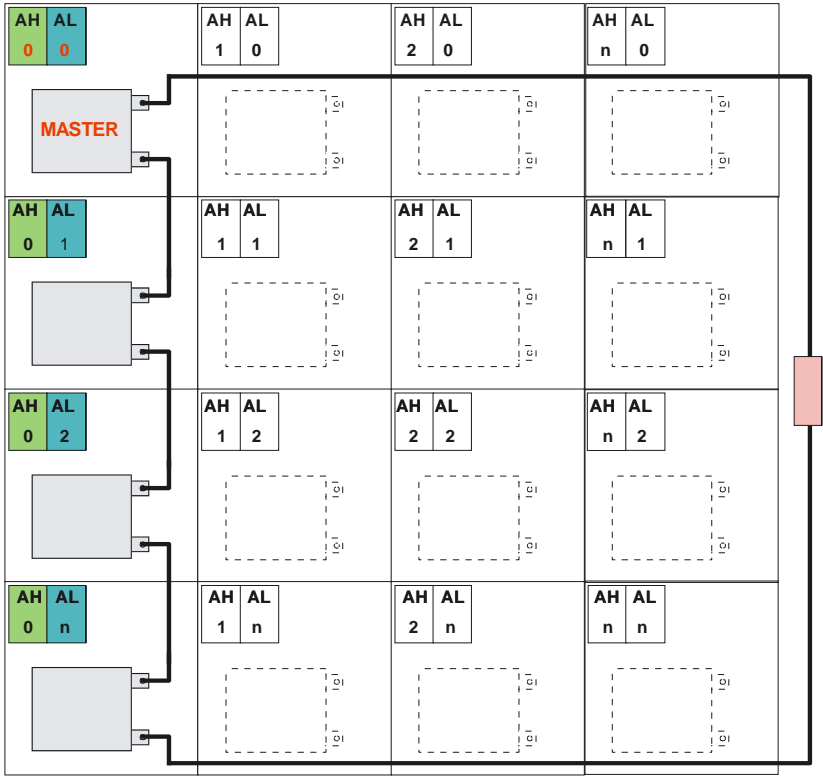


Fig. 34 Example definition for device addresses with 4 TopCon in series.

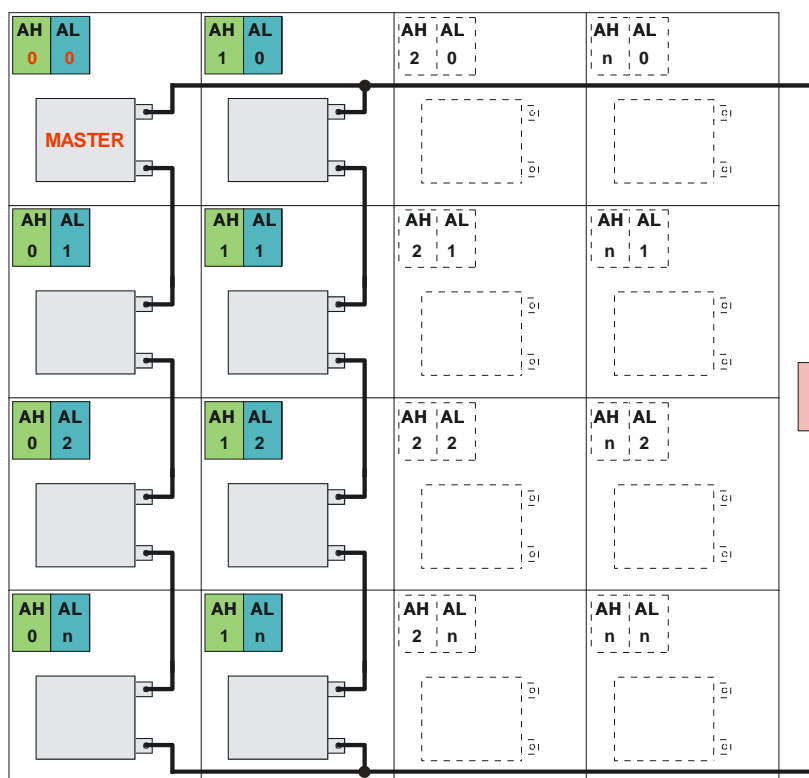
**Addressing for a matrix multi-unit system**

Fig. 35 Example definition for device addresses with 8 TopCon in a matrix. 2 serial strings of 4 devices each are connected in parallel.

**4.4.3.4. ID addresses on several HMI/RCU (option) in a multi-unit system**

The optional display and data entry devices HMI and RCU have equal priority.



HMI devices directly installed in the power supply are not necessarily responsible for the display and entry of the data for the device. In principle all HMI devices in the multi-unit system only display the overall system parameters.

**Master-slave principle for HMI/RCU (option)**

Using the master HMI/RCU the parameters for the overall system can be displayed and changed.

**Specifications for the multi-unit system**

- There can only be one master.
- Each ID number is only allowed to occur once in the multi-unit system.
- In case of a single device combination of HMI/RCU and TC.GSS power supply, HMI/RCU must be defined as the master. This definition corresponds to ID address 1.

### Addressing with HMI/RCU (option) in a multi-unit system

Whether the issue is a single device or a multi-unit system of TopCons, the device addresses for HMI/RCU are used to allocate the HMI to its logical position in the multi-unit system

#### ID addresses

- Master HMI/RCU with ID address: 1
- Slaves with ID address: > 1  
Slave 1 = 2; Slave 2 = 3; Slave 3 = 4; etc.

#### Configuration of ID addresses on the HMI/RCU

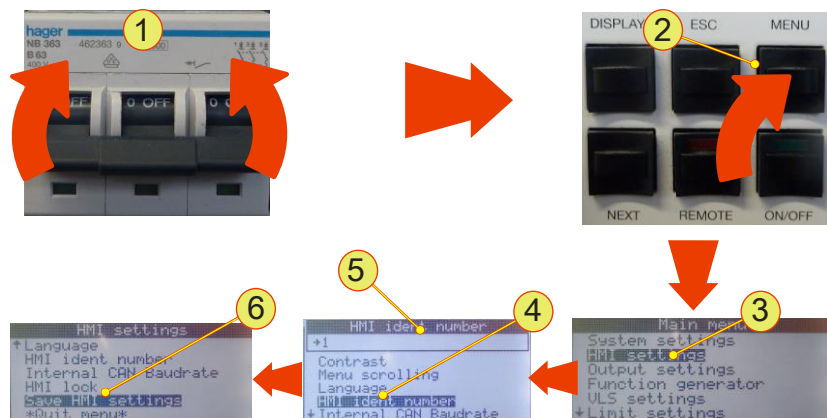


Fig. 36 Configuration of ID addresses on HMI/RCU

#### Opening the settings menu

- Switch on the device -1-.
- Press the <Menu> button -2-.
- Using the JogDial find the “HMI settings” -3- menu item and accept your selection by pressing the JogDial.
- Select the “HMI ident number” -4- menu item using the JogDial and accept this selection.
- Select the address ID -5-.  
(Master: 1, slave: > 1)
- Save the HMI settings -6-.
- Repeat the procedure for all HMI/RCUs in the multi-unit system with sequential addressing.

## 4.4.3.5. Examples for multi-unit system configurations of the hardware

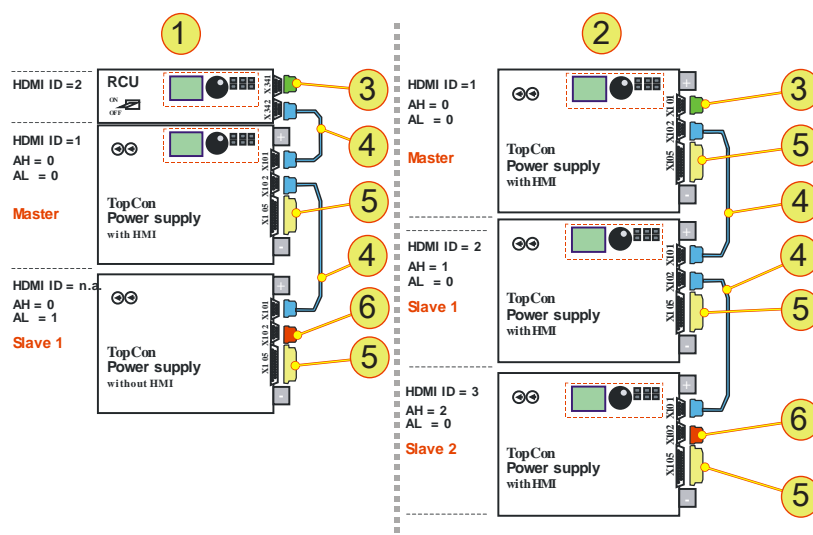


Fig. 37 Examples for systems with corresponding system communication. Master-slave configuration with address specification and hardware configuration

No	Description
1	<b>2 TC.GSS power supplies</b> 1 master device with HMI, 1 slave device without HMI, 1 RCU
2	<b>3 TC.GSS power supplies</b> 1 master device with HMI, 1 slave device 1 with HMI, 1 slave device 2 with HMI
3	<b>Interlock with CAN-Term</b> D-Sub, 9-pin
4	<b>CAN cable</b> D-Sub, 9-pin, 2 plugs
5	<b>Interlock</b> D-Sub, 25-pin
6	<b>CAN-TERM</b> D-Sub, 9-pin

Table 26 Description and position of the hardware for Fig. 37 oben

#### 4.4.3.6. Multi-unit system and TopControl application



Only the master is configured in the multi-unit system using the TopControl application.

##### Necessary conditions for configuration:

- The master device in the multi-unit system must be connected to a PC on which the TopControl application is running.
- CAN connection to all devices in the multi-unit system see chapter 4.4.3.3, Seite 61.

##### Procedure for the multi-unit system configuration using TopControl

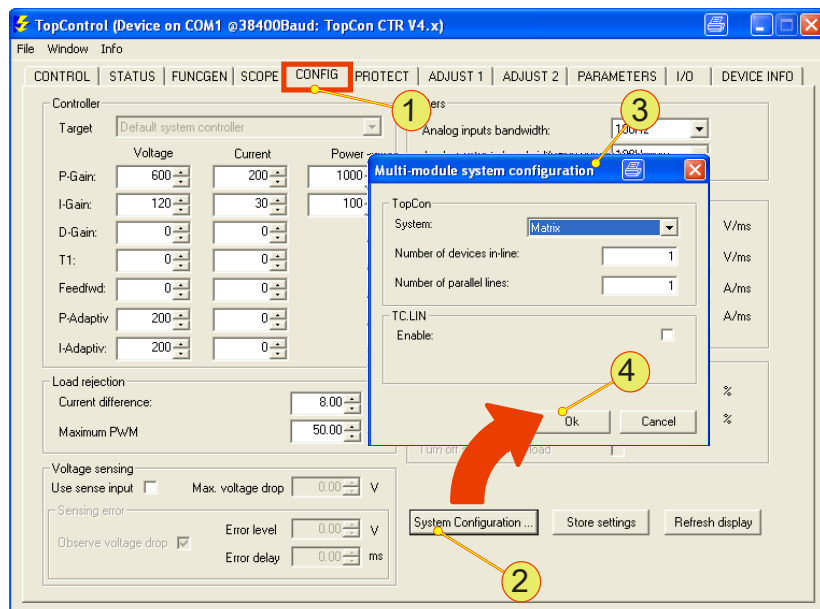


Fig. 38 Setting up multi-unit system using TopControl

- On the <CONFIG> -1- tab press the <System Configuration...> -2- button.  
↳ The “Multi module system configuration” -3- window opens.
- Set the parameters for the multi-unit system.  
For further information on the meaning and entry of the parameters see Table 115, Seite 224.
- Accept your entries using the <OK> -4- button.  
↳ A message appears with the rest of the procedure.
- Set up the addresses of all the devices in the multi-unit system, as per chapter 4.4.3.3, Seite 62.
- Restart all devices to complete the multi-unit system configuration. During this process switch back on all devices within 10 s. The master device last.



## 5. Options and system options

### 5.1. Overview

#### Definition

Regatron considers the term option to cover characteristics that expand the functionality of a TC.GSS power supply and that can be purchased.

In principle the options can be divided into 3 main groups:

- **Hardware options**  
Additional hardware that is built into the device, attached to the device, or that can be formed from device combinations (system options).
- **Software options**  
Functions that are enabled using an enable key.
- **Interface options**  
Additional hardware interfaces mostly with additional software, or protocols.

#### In this chapter

In this chapter options are described with a varying degree of detail:

- Frequently procured options are given special attention in this chapter.

The following options are described:

Hardware option	Name	Chapter	Page
Liquid cooling	LC	5.2.1	71
Integrated safety relay	ISR	5.2.2	77
Internal resistance simulation	Internal Resistance Extension IRXTS	5.2.3	79

Table 27 Hardware and system options for TopCon TC.GSS.

Software option	Name	Chapter	Page
Function generator	TFE	5.3.1	81
PV simulation Solar array simulator	SAS Control	5.3.2	84
Rechargeable battery management	Akku Control	5.3.3	87

Table 28 Software options for TopControl.

Interface option	Name	Chapter	Page
Serial interface, rear side	RS-232 REAR	5.4.3	90
Serial interface, differential	RS-422	5.4.4	91
Universal Serial Bus	USB	5.4.5	92
Controller Area Network	CAN/CANOpen	5.4.6	93
Parallel IEC bus, standard 488	IEEE488 with SCPI command set/ GPIB	5.4.7	94
RS-232 to Ethernet converter	ipEther 232	5.4.8	95

Table 29 Interface options for TopCon TC.GSS.

## 5.2. Hardware options

### 5.2.1. Liquid cooling option (Liquid cooling LC)

Optionally the integrated liquid cooling on the Regatron TopCon TC.GSS can be connected to an external cooling system.

The advantages of liquid cooling:

- **Noise reduction**

The majority of the power loss is removed via the liquid cooling. The noise emissions are reduced to 30 % of the total emissions.

- **Greater temperature tolerance**

The device can be used in areas with a higher ambient temperature if the cooling liquid is correspondingly pre-cooled or is connected to a larger cooling water system.

## 5.2.1.1. Mechanical properties

## Dimensions

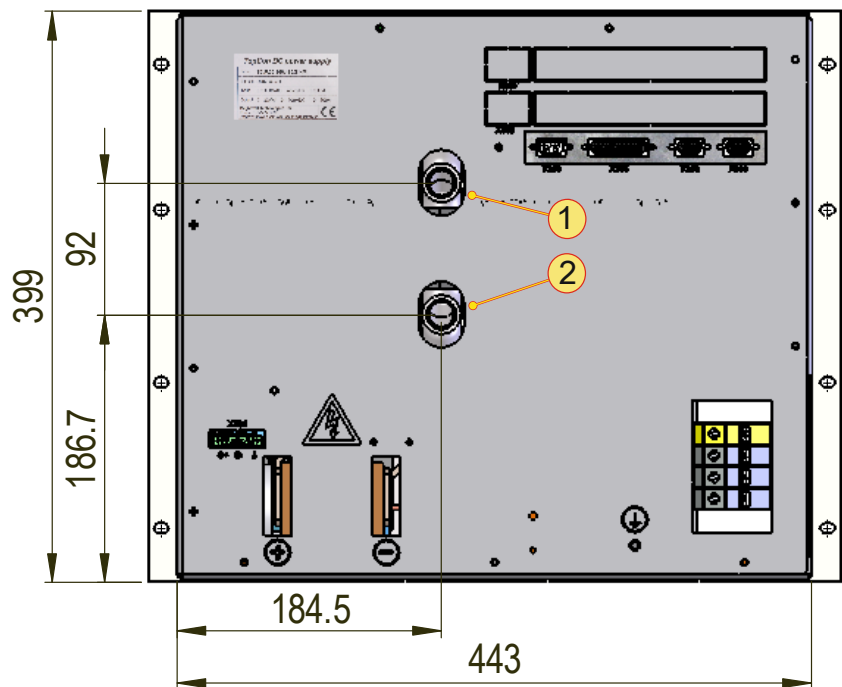


Fig. 39 Position of the hose connection fittings on a 9 U device.

Cooling liquid supply connections	
1	<b>Input</b> , standard: G ½" hose connection fitting
2	<b>Output</b> , standard: G ½" hose connection fitting

Table 30 Connections on TC.GSS power supplies.

**5.2.1.2. Characteristics of a water cooling circuit****General information on the heat exchanger**

Parameter	TC.P.20	TC.P.32
Connections	On rear side of device, G 1/2"	
Cooling medium (KM) <sup>1</sup>	Purified water, alternatively heat exchanger liquids, non-corrosive	
Heat sink material	Corrosion-resistant steel	
KM <sup>1</sup> specific heat capacity	4.2 kJ/kgK (water)	
Thermal rating	1.5 kW	2.0 kW
Recommended flow rate KM	4 – 6 l/min	
Minimum KM flow rate for $dT \leq 10$ K, $dT \triangleq$ temp. difference between inlet and outlet temp. of the cool- ing liquid.	2.5 l/min	

Table 31 Characteristics of the liquid cooling.

<sup>1</sup>If you use cooling liquid with different parameter values contact Regatron support.**CAUTION****Damage due to condensation!**

Damage in the device due to condensed water is excluded from the warranty.

Reason:

- **Due to cooling liquid temperatures < 15 °C.**  
In case of an ambient temperature of 21 °C and relative atmospheric humidity of  $\geq 70$  %.

Avoidance:

- ⇒ Keep the feed temperature at a temperature level > 15 °C to avoid condensation inside the device and on the supply cable.
- ⇒ In case of doubt contact Regatron support.

### Cooling liquid data



In general the quality of normal purified, soft and largely chlorine-free drinking water is adequate.

The installation of fine filters will keep back fine sludge particles.

Your local water utility will be able to provide detailed information on the water quality. For information on the water quality see Table 32, unterhalb

### Information on the cooling medium

The quality of the cooling medium will have a long-term effect on the system performance. Avoid the following processes by using suitable measures:

- The deposition of foreign bodies on the heat exchanger surfaces.
- Electrolytic and/or chemical corrosion.
- The deposition of fine sludge.
- Coating with foreign substances and as a result degradation of the heat transfer.

### Recommended characteristics of water as a cooling medium

Parameter	Unit	Limit value with single flow <sup>1</sup>
ph-value	-	6 - 10
Total hardness	[°dH] <sup>2</sup>	6 - 15
Substances that can be removed by filtering	[mg/l]	< 30
Free chlorine	[mg/l]	< 0.5
Sulphate	[mg/l]	< 300
Sulphide	[mg/l]	< 5

Table 32 Recommended water quality with liquid cooling.

<sup>1</sup> The flow is in a closed system

<sup>2</sup> °dH = German hardness figure (= 10 mg CaO/l)

Hardness figures are dependent on the country and may therefore vary.

### 5.2.1.3. Pressure drop as a function of the volume flow rate



The maximum permissible cooling liquid pressure is 16 bar = 16000 hPa.

The pressure drops for feed pipes, manifolds and pressure and flow rate sensors are also to be taken into account.

In particular, on the parallel supply of several power supplies an appropriate safety margin is to be included.

Recommended volume flow rate -1- 4 l/min – 6 l/min.

#### Graph – pressure drop-volume flow rate

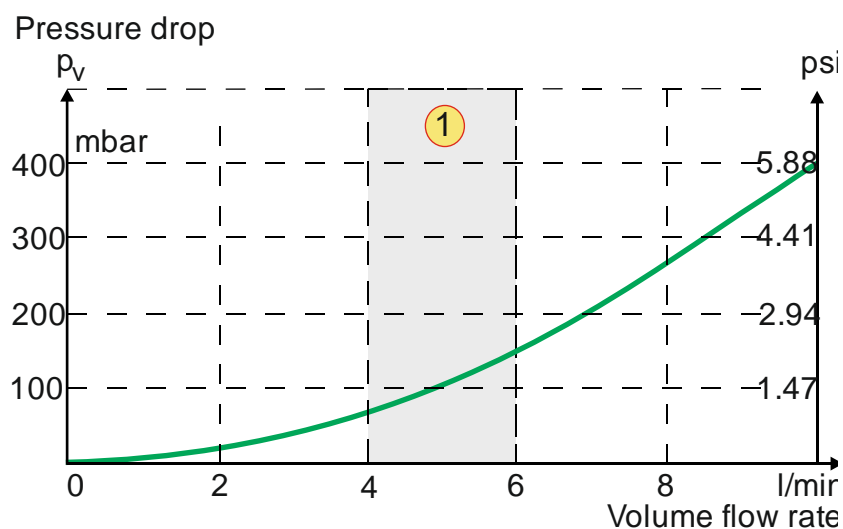


Fig. 40 Pressure drop as a function of the volume flow rate.

**5.2.1.4. Connection variants – examples**

Various connections can be screwed to the power supply to suit the specific needs.

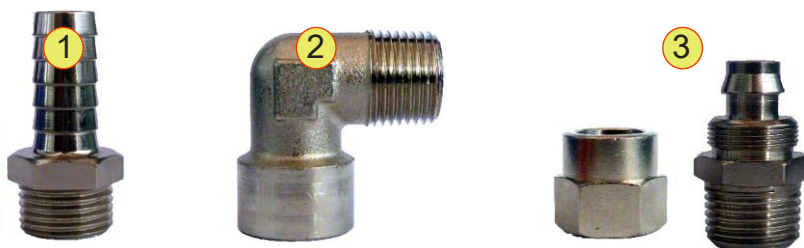


Fig. 41 Connection examples

Connection variants	
1	<b>Hose connection fitting</b> Standard hose connection for hose clip. Male thread: G1/2" Hose connection: Inside: 13 mm; Outside: 16 mm
2	<b>L-piece</b> L-piece with male thread and female thread Male thread: G1/2" Female thread: G1/2"
3	<b>Hose connection with union nut</b> For a reusable and secure hose connection. Male thread: G1/2" Hose diameter: Inside 13 mm/Outside 16 mm

Table 33 Examples for cooling liquid connections.

**Installing a cooling liquid connection**

- Apply thread sealant to the turns on the thread to seal the connection.  
During this process follow the recommendations from the manufacturer of the sealant.  
Example: LOCTITE® 542
- Screw the connection into the 1/2" connection on the power supply and tighten.
- Fasten the pipe system.



Check the system for leaks at 8 bar for 10 min., as per the standard EN50178.



### 5.2.2. Integrated safety relay option

Standard applied: EN ISO 13849-1:2006

The flow of up to 32kW of energy is interrupted between the mains connection and the DC connection by the integrated safety relay.

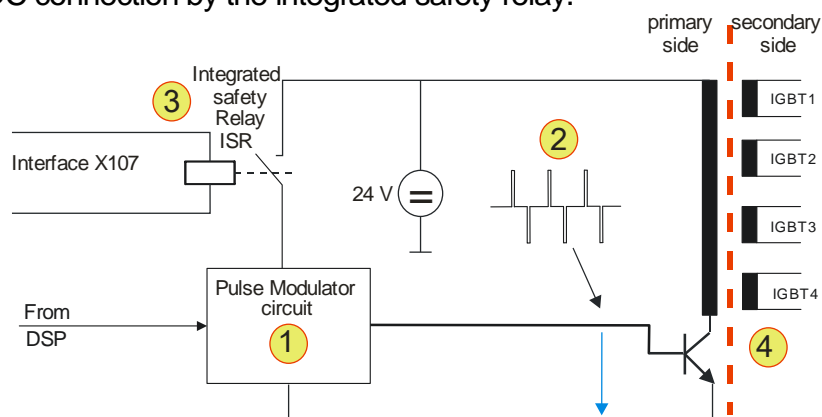


Fig. 42 Diagram of the principle of the energy transfer.

Using a PWM generator -1- a pulse-width controlled AC voltage is generated -2-. This is applied to the primary side of four transformers. On their secondary side the supply for the electrically isolated gate driver (IGBT) -4- is generated via a rectifier and smoothing elements.

The positively driven safety relay -3- interrupts the supply to the primary side. The pulse-width controlled AC voltage -2- is no longer generated. There is no further flow of energy on the secondary side. Correct function is ensured by the positively-driven contacts on the relay.

### Example EMERGENCY STOP circuit

The interface can be connected to an EMERGENCY STOP mushroom head button or to an external safety circuit.

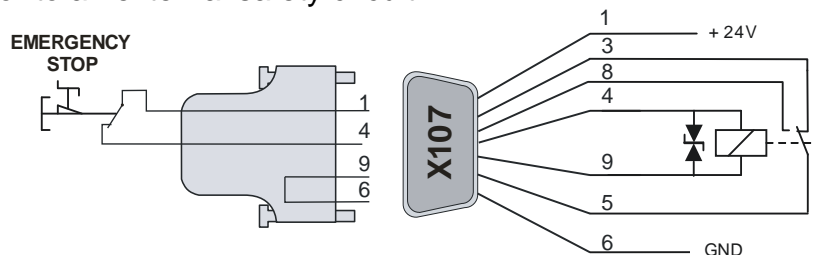


Fig. 43 Circuit example with EMERGENCY STOP.

For further information on the pin definition for the interface X107 see chapter 10.1.6.7, page 273.

### Bypassing the ISR function

If the ISR option is available, but is not required for an EMERGENCY STOP mushroom head button or external safety circuit, the interfaces must be terminated using “X107 Safety-Shutdown” dummy plug.

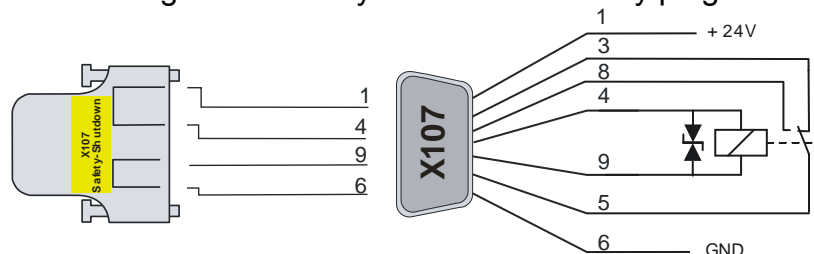


Fig. 44 Circuit example, bypassing the activated ISR interface.

### 5.2.3. Internal Resistance Extensions (IRXTS) option

#### Function

The TopCon power supply can simulate the static internal resistance of a source.

#### The basic problem

Due to the digital control, the TC.GSS power supply does not have any apparent internal resistance.

#### The solution

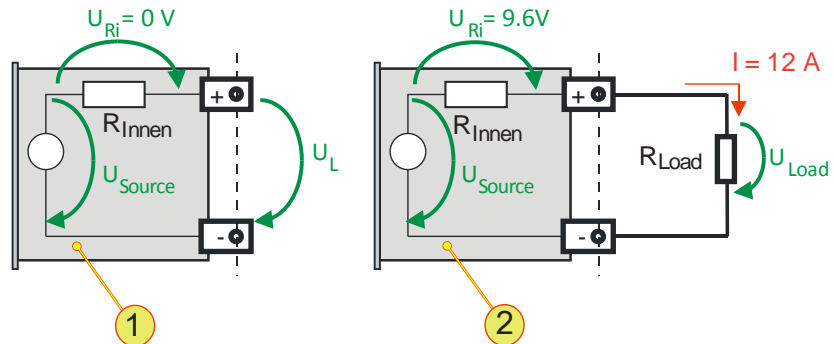


Fig. 45 Internal resistance simulation

- 1- TopCon source with no load and internal resistance
- 2- TopCon source with load and internal resistance

#### Example calculation

The TC.GSS power supply simulates a rechargeable battery with an internal resistance  $R_{\text{Internal}} = 0.8 \Omega$  and a no-load voltage  $U_L = 48 \text{ V}$ .

A load current  $I = 12 \text{ A}$  flows, the voltage at the load  $U_{\text{Load}}$  is reduced by 20 % from  $U_L$

#### Differentiation between cases - no-load

No-load voltage  $U_L = U_{\text{Source}} - U_{Ri} = 48 \text{ V} - 0 \text{ V} = 48 \text{ V} \rightarrow U_L = U_{\text{source}}$   
 No-load current  $I = 0 \text{ A}$

#### Differentiation between cases - load

Voltage drop  $U_{Ri} = I * R_{\text{Internal}} = 12 \text{ A} * 0.8 \Omega = 9.6 \text{ V}$

Load voltage  $U_{\text{Load}} = U_{\text{Source}} - U_{Ri} = 48 \text{ V} - 9.6 \text{ V} = 38.4 \text{ V}$

80 % of  $U_{\text{source}}$

**Internal resistance extension**

Simulation options	Internal resistance [mΩ]
Standard internal resistance	0 to 1000
With option IRXTS	0 to 32000
Customer request <sup>1</sup>	Over 32000

Table 34 Overview of internal resistance simulation options  
<sup>1</sup> In consultation with Regatron support

You can obtain further information from your sales partner and Regatron support.

## 5.3. Software options

### 5.3.1. Function generator (TFE/TopCon Function Engine) option

#### Introduction

The activated function generator can specify set values for voltage, current and power in the form of pre-defined or user-defined functions for the control of the TC.GSS power supply.

Here individual function blocks are combined into function sequences that can be triggered by events.

The points on the user-defined functions and the AAP characteristic curves to be used can be created and modified using TopControl or by utilising a function library (DLL).

It is possible to use the “function generator (TFE)” in the demo mode. Within the TopControl application, e.g. sequences of functions can be defined. However, the function curves can only be transferred to a TC.GSS power supply and used after the activation of this option.



For a description of the parameter entry for the function generator TFE via the TopControl application see chapter 7.4.8.3, Seite 183.

For information on calling defined function sequences for the function generator via the HMI see Table 62, Seite 148.

#### Function Block (FB)

A function block can be formed from various base functions for voltage, current and/or output power.

The following functions for which the parameters can be set as required are available:

- Time-dependent standard functions: square, triangle, sine
- Arbitrary time-dependent functions (user-defined)
- Arbitrary functions (AAP, e.g.  $I = f(U)$ )

#### Function Sequence (FS)

A function sequence comprises at least one function block. As a consequence a sequence has the following properties:

- Each function block contains base functions (e.g. sine wave with symmetry, offset and possibly exponential decay curve elements)
- The function blocks can be repeated 1 to n-times, or can be defined as continuous functions. In addition, the functions can be given further parameters, e.g., a pause between the repetitions.

- In the case of several reference values within a function sequence, several function blocks can be active at the same time.
- ↳ The shortest function block defines the duration of the function sequence.
- ↳ The pause time and the number of repetitions apply equally to all function blocks within a function sequence.

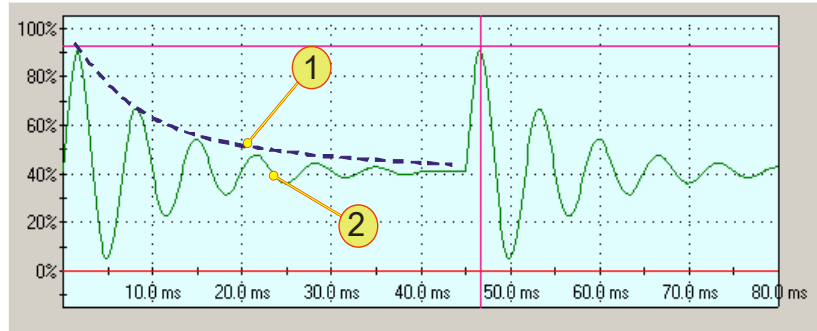


Fig. 46 Example of the capabilities of the function generator.  
 -1- Exponential envelope, specified in the TFE  
 -2- Result: a sine wave function that decays correspondingly -1-.  
 In the example 2 repetitions have been defined.

#### The following events (“Trigger mode”) can trigger a function sequence:

- VOLTAGE ON (“Voltage on”)
 

As soon as the output power is activated at the output of the power supply.
- Manual triggering (“Manual”)
 

Manual triggering is possible in the TopControl application or with the aid of the HMI/RCU.
- Analogue interface X105 (“High level on X105/19”)
 

If there is a high level on pin 19 of the interface.

#### Definition of reference values prior to a trigger event

The nature of the trigger can be specified in the TopControl application and HMI/RCU. Up until the trigger event, the set values specified by the active interface apply, e.g.:

- RS-232 interface
 

Set values defined via the TopControl application.
- HMI/RCU
 

Set values defined via HMI/RCU.
- Analogue interface X105
 

Set values defined via the analogue interface.

**Definition of reference values after the completion of a function sequence (“After Function Sequence finished”)**

After a function sequence has been completed, a reference value can be defined as follows:

- “VOLTAGE OFF” (“Voltage off”)  
The device output is electrically isolated.
- Actual reference values are retained directly from the function block (“Hold level”).
- From the active set value interface.  
Set values are defined via this interface.

**Maximum number of function sequences in the TopCon power supply:**

- Up to 256 **time-dependent standard function sequences**.
- In the case of **arbitrary time-dependent (user-defined) function sequences** the number is dependent on the number of points.  
A maximum of 1000 points is possible.
- In the case of **arbitrary function sequences** (user-defined AAP) the number is dependent on number of points.  
A maximum of 64 points is possible; these points can be distributed unevenly.

The function sequences saved in the power supply can be called via the following interfaces:

- HMI (RCU).
- RS-232 interface.  
TopControl application.  
Using custom programs via function libraries.

**The parameters summarised**

Setting	Value range – TopControl	Value range – HMI
Base function	Sine, square, triangle, user-defined, AAP	
Amplitude	0...100 %, resolution: 12 bits	
Offset	Standard: 0 – 100 % Bipolar: -100 % – +100 %	Resolution: 12 bits Resolution: 12 bits
Symmetry	0...100 % (only with triangle and square)	
Frequency	0.001 Hz – 1 kHz	0.01 Hz – 320 Hz
Exponential envelope (time constant)	0.1 ms – 100000 s	10 ms – 320 s
Rectify negative amplitude	Yes/no	Cannot be changed, Standard: no
Amplitude polarity	Unipolar/bipolar	Cannot be changed, Standard: bipolar
No. of repetitions of the base function	1 – 65535 or continuous	0 – 32000 (0 $\hat{=}$ continuous)

Table 35 Possible function generator settings with comparison between TopControl and HMI.

**Loading and saving function sequences**

All the settings can be saved in the non-volatile memory (flash) and loaded again. It is also possible to set that when the power supply is started (power-up), a previously saved function sequence is loaded automatically. Several function sequences can be saved. 64kB of memory are available for this feature. Without user-defined curve shapes, up to 256 function sequences can be saved. In the case of user-defined curves (4 bytes per point) the number reduces accordingly.

The function sequences are saved in a sequence number (1...1000) that can be selected and can be called again using this number. It is also possible to call the function sequences from the HMI. On saving a function sequence via TopControl it is also possible to give an arbitrarily defined name (up to 31 characters) as well as the date and time.

**Restrictions and information**

The function generator makes it possible to specify complex set value curves. For the output values on the power supply to also be able to follow these set value curves, the following points are to be noted:



The gradient limiters

(can be adjusted in the TopControl application on the <CONFIG> tab → Slopes) are also active during function generator operation. If, e.g., steeper edges are defined in the function generator, it may be necessary to increase these slope values.

Small control parameters prevent fast control movements.

(can be adjusted in the TopControl application <CONFIG> tab → Controller)

The control parameters depend heavily on the load. In the specific case the current or voltage curve should be checked using an oscilloscope or the Scope function integrated in TopControl to optimally adapt the control parameters.

In addition, it is to be noted that a TopCon power supply in the basic version cannot absorb any energy from the load side, i.e. in case of set value steps the control time constant is dependent on the load impedance.

Negative set values can only be processed in combination with an AC-polarity reverse bridge or Q14 system (see options chapter 5.2, Seite 71). A TopCon power supply without AC-polarity reverse bridge interprets negative set values as zero.

### 5.3.2. Solar Array Simulator (SAS) option - SASControl

#### Function

The function generator for the TopCon power supply is switched to the AAP mode with a function  $I = f(U)$  and can behave like a solar panel in accordance with this function.

By overlaying on another AAP characteristic curve, the effect of solar irradiation and temperature on the solar panel can be simulated. During this process it is possible to “softly” overlay linearly from one AAP characteristic curve to another.

The solar array simulator can be used for photovoltaic simulation (PV simulation).

#### The basic problem

On photovoltaic installations the energy from light is converted into electrical power. The DC produced is fed back to the grid via an inverter.

(Conversion of the DC from the solar panel to 230 V 1~ or 400 V 3~ AC.)

During inverter production and development the TopCon power supply can be used as a solar panel simulator for testing inverters.

## The solution

Modules required for this usage

- TopCon Quadro power supply
- SASControl option

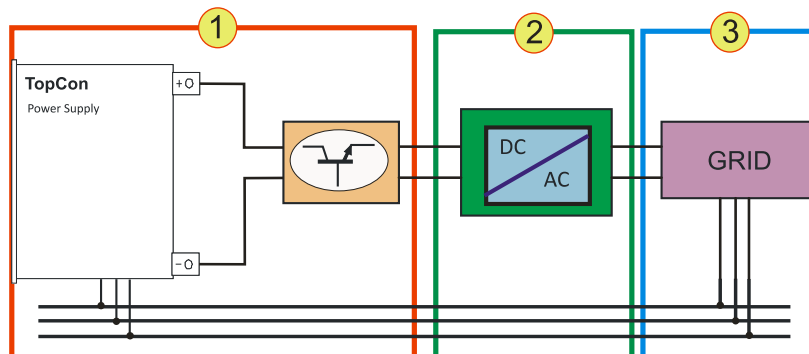


Fig. 47 Usage of the TopCon power supply as a test stand

Test stand - modules	
1	<b>TC.GSS power supply with TC.LIN</b> The TopCon simulates a solar panel with its function generator TFE. The TC.LIN helps to improve the dynamic performance of the system, during the process greater accuracy is required.
2	<b>Test object: inverter</b>
3	<b>Grid</b> The grid can be real or also be a simulation so that the test object can be operated in an environment that closely represents reality.

Table 36

## Improvement of dynamic performance using the TC-LIN linear series controller

A further improvement in the dynamic performance of the system is provided by the usage of the downstream TC.LIN linear series controller. The linear series controller communicates with the TopCon power supply. While the TopCon power supply defines the signal “coarsely”, the TC.LIN modifies the output signal with high dynamic performance and accuracy (5  $\mu$ s cycle time, 14.5-bit resolution). The combination of the TopCon Quadro power supply and the TC.LIN linear series controller can be used very flexibly and at the same time at high powers for the realistic simulation of small to medium solar panels.

This functionality is largely controlled from the TopControl application. Alternatively the functionality can be controlled via the DLL for custom programs.

### 5.3.3. Akku-Control option – rechargeable battery maintenance charging curves

Research and development on environmentally friendly vehicle concepts is closely linked to the ability to store or temporarily store electrical energy. Electrochemical and also capacitive stores have specific applications – however a common feature is the highly dynamic usage of storage during vehicle operation.

To test the resilience of modern storage systems in relation to charging/dischARGE cycles and microcycles, bidirectional power supply systems are required that can apply to the stores the loads due to the cycles that occur during vehicle operation as well as boundary loads.

In the context of sensible energy management, the regenerative energy that is produced must be fed back to the supply system with high efficiency. This statement applies in general only at higher loads. On small energy stores it is often sensible to discharge using a dissipative load, because energy recovery to the grid is only economical from higher quantities of energy.

The characteristics for the rechargeable battery management in the Regatron software AkkuControl are:

- Feature for charging and discharging a rechargeable battery via constant current or constant power.
- Largely arbitrarily programmable charging/discharging cycles e.g. standard curves or specified values for different rechargeable battery types.
- 8-channel long-term data acquisition for current, voltage, power, temperature (up to 4 external temperature channels), etc.
- Adaptive sampling of the measured values, with larger curve changes the measuring frequency is increased automatically (can be configured as required).

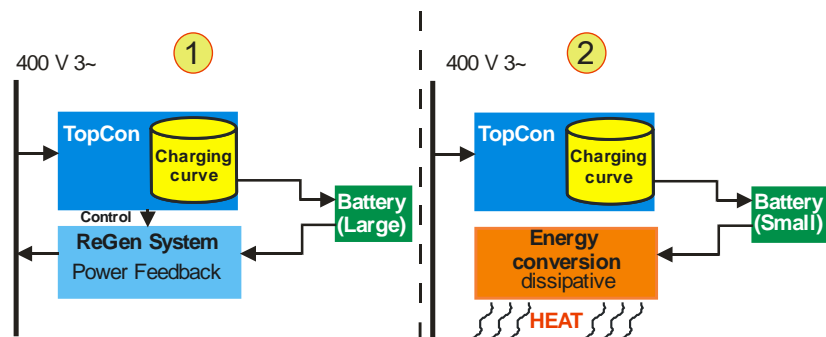


Fig. 48 Overview of "Akku-Management" with large rechargeable batteries -1- and small rechargeable batteries -2-

## 5.4. Interface options

### 5.4.1. Functionality as a function of an optional interface

	CAN/CANOpen	IEEE488	HMI/RCU	RS-232 REAR, RS-422
Read/write register (low-level function)	X	X	X	X
Read system information	X	X	X	X
Reference values: set/specify	X	X	X	X
Read actual values	X	X	X	X
Read errors/warnings	X	X	X	X
Function generator: standard functions (sine, square, triangle)	X <sup>1), 2)</sup>	X <sup>1), 2)</sup>	X <sup>2)</sup>	X <sup>2)</sup>
Function generator: AAP function → call	X <sup>1), 2)</sup>	X <sup>1), 2)</sup>	X <sup>2)</sup>	X <sup>2)</sup>
Function generator: AAP function → define	–	–	–	X <sup>2)</sup>
SCOPE function	–	–	–	X

Table 37 Overview of dependencies between task category and interface

<sup>1</sup> Increased effort required.

<sup>2</sup> Only in combination with the option FUNCGEN (TFE)..

## 5.4.2. Overview of possible interface combinations

	Analogue	HMI	RCU	RS-232 REAR	RS-232	RS-422	USB	Ethernet	IEEE488	CAN/CANOpen	Profibus
Analogue	○ <sup>P</sup>	●	●	●	●	●	●	●	●	●	● <sup>2</sup>
HMI	●	○ <sup>P</sup>	●	●	●	●	●	●	●	●	●
RCU	●	●	●	●	●	●	●	●	●	●	●
RS-232 REAR	●	●	●	○ <sup>P</sup>	○ <sup>P</sup>	○ <sup>P</sup>	○ <sup>S</sup>	● <sup>3</sup>	○ <sup>P</sup>	↑	● <sup>1</sup>
RS-232	●	●	●	○ <sup>P</sup>	○ <sup>P</sup>	○	○ <sup>S</sup>	● <sup>3</sup>	○ <sup>P</sup>	↑	● <sup>1</sup>
RS-422	●	●	●	○ <sup>P</sup>	○ <sup>P</sup>	○ <sup>P</sup>	○ <sup>S</sup>	○ <sup>P</sup>	○	○	○
USB	●	●	●	○ <sup>S</sup>	○ <sup>S</sup>	○ <sup>S</sup>	○ <sup>P</sup>	○ <sup>S</sup>	○	↑	(○)
Ethernet	●	●	●	● <sup>3</sup>	● <sup>3</sup>	○ <sup>P</sup>	○ <sup>S</sup>	○ <sup>P</sup>	○	○	○
IEEE-488	●	●	●	○ <sup>P</sup>	○ <sup>P</sup>	○ <sup>P</sup>	○ <sup>S</sup>	○	○ <sup>P</sup>	○	○
CAN/CANOpen	●	●	●	↑	↑	○	↑	○	○	○ <sup>P</sup>	○
Profibus	● <sup>2</sup>	●	●	● <sup>1</sup>	● <sup>1</sup>	○	(○)	○	○	○	○ <sup>P</sup>

Table 38 Possible combinations of various interfaces

- The two interfaces are possible and function together (autonomous).
- The two interfaces are not possible at the same time.
- (○) Not foreseen/possible at the moment.
- ↑ The two interfaces are possible, CAN/CANOpen interface is dominant.
- 1) External Profibus to RS-232 converter.
- 2) External converter (not bidirectional). Functionality must be checked
- 3) External Ethernet to RS-232 converter.
- P) Only one interface is allowed to be physically active  
E.g. A connection is made to the interface to be activated, while the inactive interface must be disconnected.
- S) Only one interface can be activated via the software.  
The other interface is automatically deactivated.

### 5.4.3. RS-232 REAR interface option – rear side of power supply

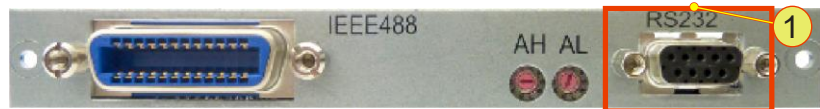


Fig. 49 RS-232 REAR interface -1- in combination with other interfaces on the rear side of the device.

#### Installation location:

The interface is built into the rear side of the device. It can be retrofitted to a device or be already installed on delivery.

#### Combination with other interfaces

- The RS-232 REAR interface takes over the tasks of the RS-232 interface on the front side of the device.

#### Technical characteristics

- Type of bus connection: plug, D-Sub 9-pin
- Interface standard: in accordance with EIA-232

For technical data and information on function, see chapter 10.1.6.3, page 268.

#### 5.4.4. RS-422 interface option – diagnostics and control connection

##### Installation location:

The interface is built into the rear side of the device. It can be retrofitted to a device or be already installed on delivery.

##### Combination with other interfaces

- A maximum of ten RS-422 receivers are allowed to be connected to a transmitter within one transmission device.

##### Technical characteristics

- Type: designed as D-Sub socket, 9 pin
- Interface standard: ITU-T V.11

##### Function

The RS-422 interface is used for high speed data transmission over large distances.

The serial data are transmitted as a voltage difference between two corresponding wires without a reference to ground.

For each signal to be transmitted there is one pair of cores that comprises an inverted signal wire and a non-inverted signal wire that are twisted together.

The receiver only evaluates the difference between the two wires such that common mode interference up to 7 V on the transmission cable will not corrupt the data signal.

You can obtain further information from Regatron support.

### 5.4.5. USB interface option – Universal Serial Bus



Fig. 50 USB interface -1- in combination with RS-232 REAR interface -2-.

#### Installation of the interfaces

The interface is built into the rear side of the device. It can be retrofitted to a device or be already installed on delivery.

#### Combination with other interfaces

- The interface is always supplied in combination with the RS-232 REAR interface.
- The RS-232 REAR interface takes over the tasks of the RS-232 interface on the front side of the device.

#### Technical characteristics

- Type: socket for USB plugs of type B (see Fig. 50 oben)
- Interface standard: USB 1.1

#### Function

This is a serial interface and corresponds to the functionality of the RS-232 interface. The USB interface is used for the transparent transmission of data and can as a consequence be utilised both using the DLL and directly at the low protocol level.

The USB driver for the PC included must be installed for it to be possible to detect and operate the TC.GSS power supply from the operating system.



#### 5.4.6. CAN/CANOpen® interface option



Fig. 51 CAN bus interface -1- in combination with RS-232 REAR interface -2-.

##### Installation of the interfaces

The interface is built into the rear side of the device. It can be already installed in a device on delivery.

Only Regatron can retrofit this interface.

##### Combination with other interfaces

- The interface is always supplied in combination with the RS-232 REAR interface.
- The RS-232 REAR interface takes over the tasks of the RS-232 interface on the front side of the device.
- An active CAN/CANOpen® interface has a higher priority than HMI/RCU control units connected and therefore implements its commands instead.

##### Technical characteristics

- Type of bus connection: plug, D-Sub 9-pin
- CANOpen protocol: CiA standard 301 V 4.02

##### Function

Unlike the internal CAN bus in the device, which is responsible for the internal flow of information in the device and that is supplied as standard, the optional CAN/CanOpen® interface is used for the connection of devices from other manufacturers.

As a real-time system the CAN bus can be used for controlled systems.

The CAN bus is a serial two-wire bus that combines a high transmission speed with the communication protocol CANOpen®. By means of its collision management a lasting communication blockage on the bus is prevented.

The utilisation of the CAN/CANOpen® interface makes it possible to connect the TopCon power supply to a type of communication network in widespread use in industry.

You will find further information in the instructions supplied with the order.

### 5.4.7. IEEE488 – GPIB option (General Purpose Interface Bus)

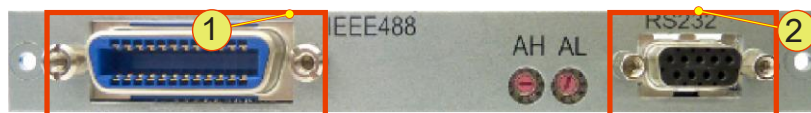


Fig. 52 IEEE488 bus interface -1- in combination with RS-232 REAR interface -2-.

#### Installation of the interfaces

The interface is built into the rear side of the device. It can be already installed in a device on delivery.

Only Regatron can retrofit this interface.

#### Combination with other interfaces

- It is not possible to operate an active IEEE488 interface and the RS-232 interface at the same time.
- Combination with other interfaces is not possible.

#### Technical characteristics

- Type of bus connection: socket, Centronics 24-pin
- SCPI command set: standard IEEE488.2  
expanded with TopCon control commands

#### Function

Using commercially available Centronics connectors and the IEEE488 interface, TopCon power supplies can be operated independently. During this process specific TopCon control commands are interpreted and executed on the interface board.

Using the IEEE488.2 standard SCPI command set, straightforward connection to other network devices, instrumentation and electrical devices with support for the interface is possible.

You will find further information in the instructions supplied with the order.

### 5.4.8. TC-Ethernet option

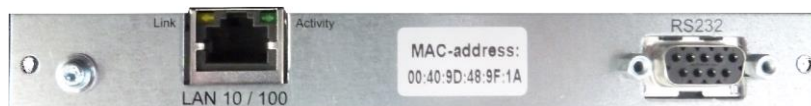


Fig. 53 TC-Ethernet interface -1- in combination with RS-232 REAR interface -2-.

#### Installation of the interfaces

The interface is built into the rear side of the device. It can be already installed in a device on delivery or retrofitted.

#### Combination with other interfaces

- It is not possible to operate an active TC-Ethernet interface and the RS-232 interface at the same time.
- Combination with other interfaces is not possible.

#### Technical characteristics

- Type of bus connection: socket, RJ45

#### 5.4.8.1. Conditions for the Ethernet interface

##### Standard configuration of the interface card

- DHCP server: the card is configured for the allocation of IP addresses by a DHCP server.
- APIPA: If an address is not allocated by a DHCP server in a specific time window, the card automatically assigns itself an IP address (APIPA).

#### Crossover cable

The Ethernet interface card cannot switch automatically between a crossover cable and an uncrossed network cable. If the other end does not support Auto-MDI(x), you will need a crossover cable for the installation.

#### 5.4.8.2. Installation of the device driver

##### Preparation

First integrate all network devices in your company's network before you run the driver setup on the PC with the TopControl application.

Make a note of the MAC addresses and the device name along with its location. You will find the MAC address on the panel on the interface card.

You can then search for specific devices later.

### Procedure for a static IP address or dynamic IP address on the TC.GSS power supply

- For procedure for a static IP address
- For procedure for a dynamic IP address  
see chapter 5.4.8.2, page 97.

### Procedure for assigning a static IP address to the power supplies

You will find further information on the various buttons on the subsequent “TCEthernet interface” submenu in chapter 5.4.8.6, page 103.

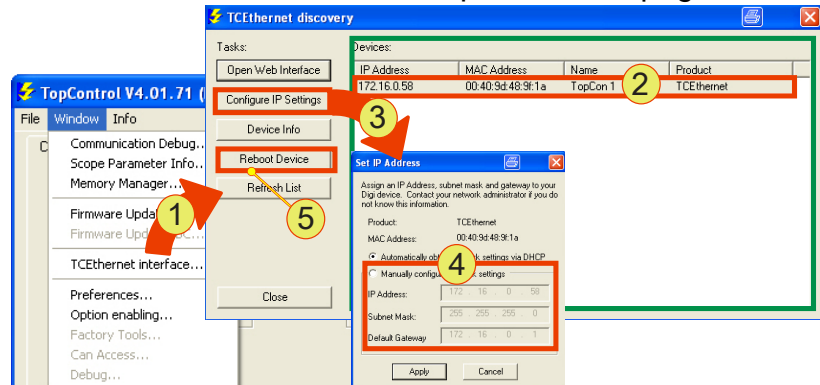


Fig. 54 Sequence in the TopControl application

### Procedure

- It is best to contact your system administrator prior to installation.
- First integrate all TC.GSS power supplies in your company's network.  
The best method is to assign the IP addresses using a DHCP server.
- Start the TopControl application and in the “Window” menu item select the “TCEthernet interface...” -1- submenu item.
  - ↳ The “TCEthernet discovery” windows opens.
- Mark the required TC.GSS power supply -2- in the list.
- Click the “Configure IP Settings” -3- button.
  - ↳ The “Set IP Address” windows opens.
- Activate “Manually configure network Settings” -4-
  - ↳ The boxes for the static IP address assignment can then be edited.
- Enter your network settings.
- Click the “Reboot” -5- button so that the new settings are applied by the network card.

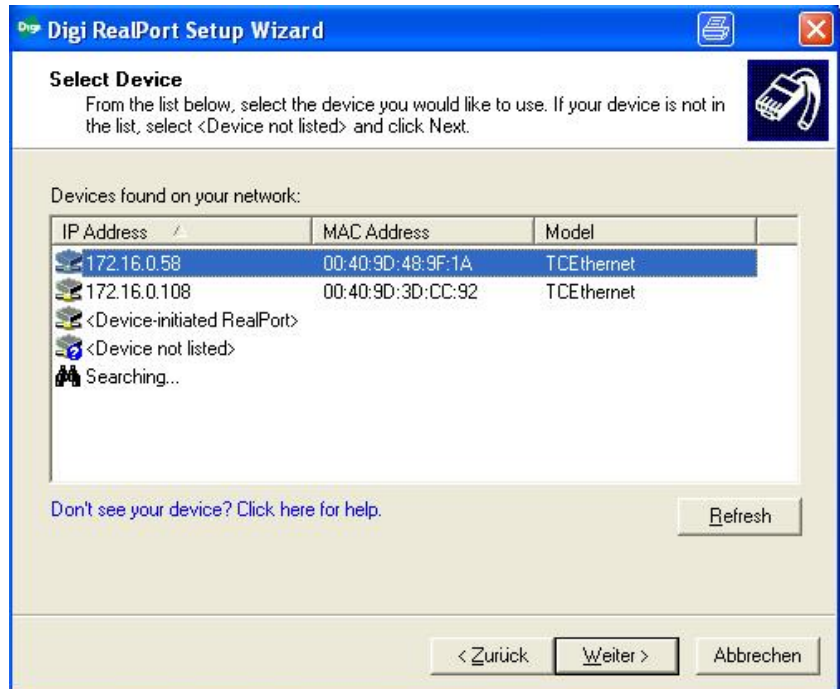
- Repeat this procedure for all TC.GSS power supplies.
- Make a note of the IP and MAC address allocated, after you have refreshed the list.
- Undertake the driver setup for each power supply using the static IP addresses in the network, as per chapter 5.4.8.2, page 97.
- You have completed the setup of the static IP addresses.
- Optionally you can rename the interfaces in the Device Manager or assign a new host name via the web interface.

### Driver installation with allocation of IP address and COM port

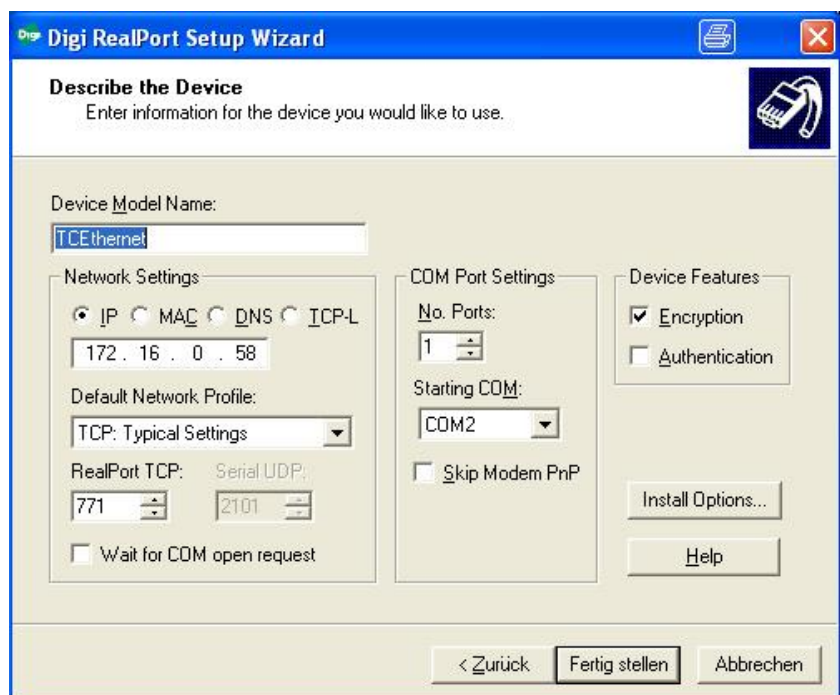
Start the setup program “Setup.exe” on the installation CD supplied.



- Click the <Next> button
- ↳ The “Select Device” window opens



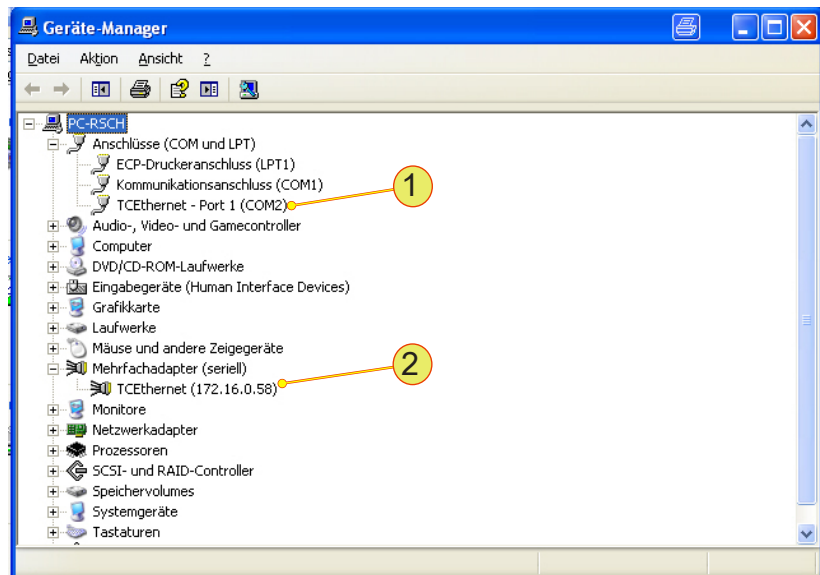
- Click the “Refresh” button so that all devices are displayed
- Select a device (TCEthernet interface) (marked in blue).
- ↳ All interface parameters for the setup process are automatically applied.
- Click the <NEXT> button
- ↳ The “Describe the Device” windows opens.



- Click the <Finish> button  
Do not change any parameters!
- The installation starts.  
The installation process takes some time until it is completed.

#### 5.4.8.3. Indication of the Ethernet card in the Device Manager in the operating system

- Open the Device Manager.
  - 1- Allocation of the Com port via your IP address for the interface
  - 2- Indication of the interface card in “Mehrfachadapter (seriell)”





## Changing the name in the Device Manager

If the IP address is changed (e.g. by a DHCP server) the allocation of the device and COM port is lost.

The following entries must be entered again in case of a new IP address.

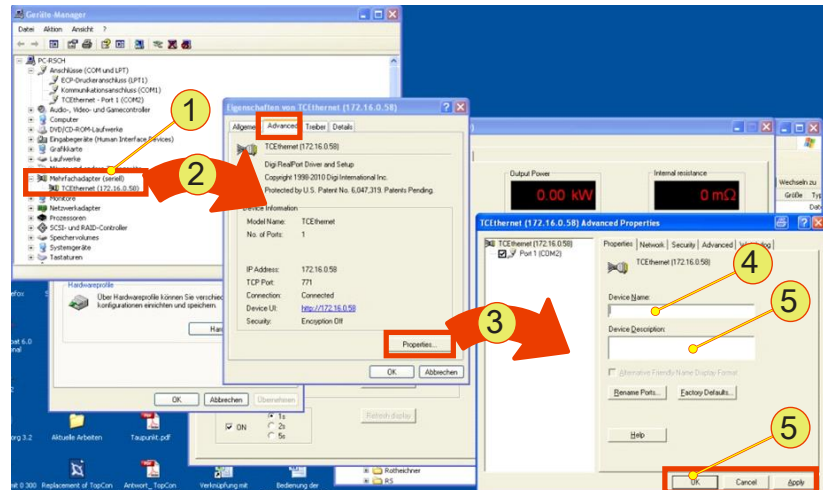


Fig. 55

### Procedure

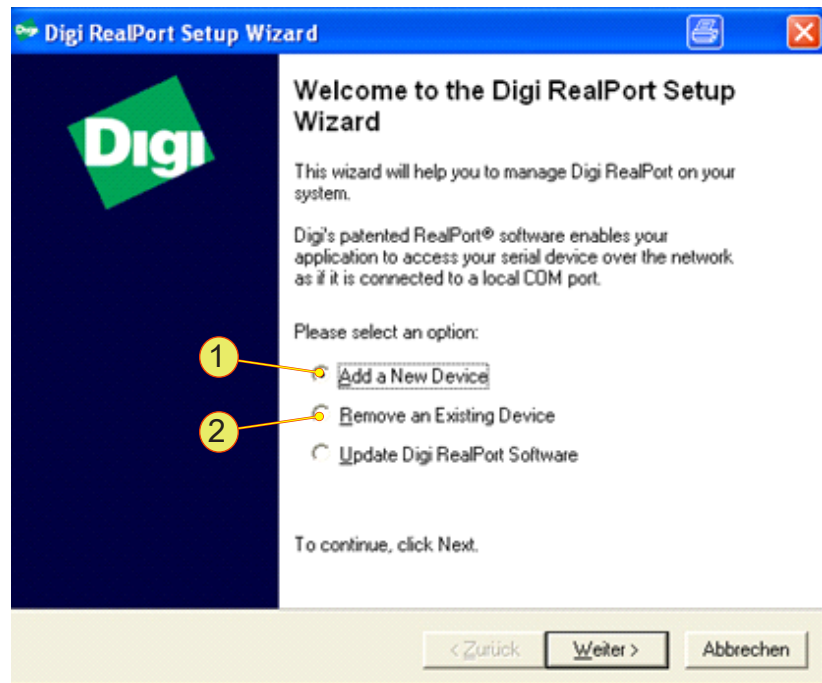
- Open the Device Manager.
- Click the required device under “Multiple adapter (seriell)”
  - 1- using the left mouse button
  - Click with the right mouse button “Properties” on the context menu
- ↳ The “Properties of TCEthernet...”
  - 2- window opens
- Select the <Advanced> tab
- Click the <Properties> -3- button
- Select the <Properties> tab in the “Advanced Properties” window
- Type the name -4- and description -5-
- Accept your changes using “Apply” or “OK” -6-



#### 5.4.8.4. Adding a new COM port driver and removing an old COM port driver

##### Adding a new device

- Start the driver setup program on the driver CD supplied.
- Select “Add a New Device” -1- in the start window.



- Proceed as in “Installation of a device driver”, see chapter 5.4.8.2, page 97.

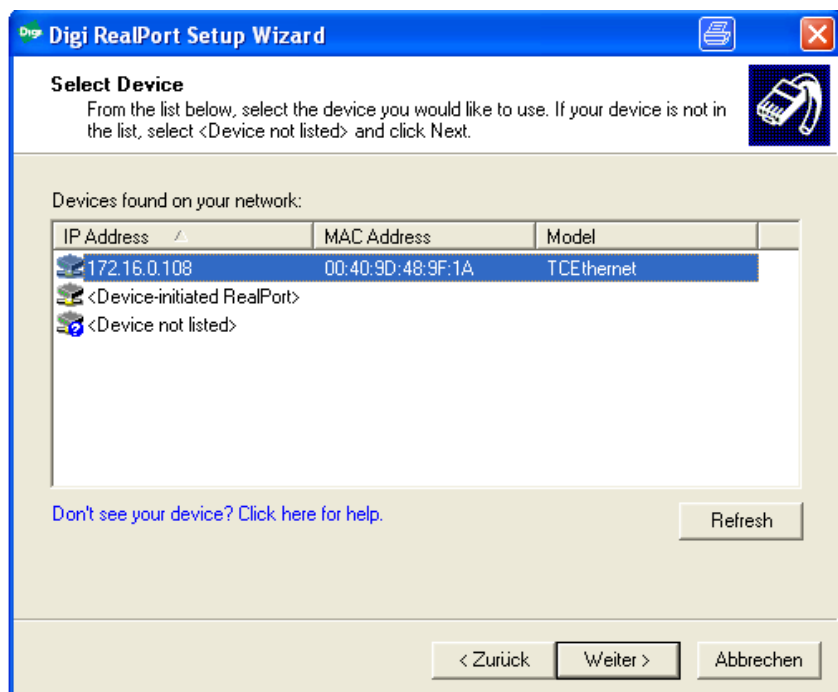
#### 5.4.8.5. Removing a COM port driver

Uninstall the IP addresses and Com ports shown in the Device Manager that have become superfluous in the “Ports” group.

- Start the setup program setup.exe on the installation CD supplied.
- ↳ The setup program detects device drivers already installed
- Select “Remove Existing Device” -2- and accept your selection using “Next”.



↳ A window for selecting from the device drivers installed opens.



- Select the required driver and accept your selection using the “Next” button
- ↳ The selected driver is uninstalled.
- ↳ The entries are removed from the system Device Manager.
- ↳ The entries are no longer available for the automatic establishment of a connection in TopControl.

## 5.4.8.6. TopControl submenu - TCEthernet Interfaces

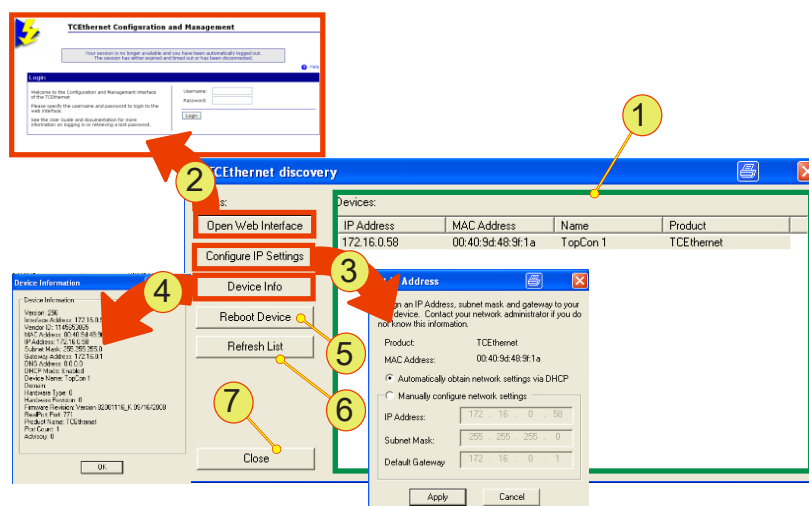
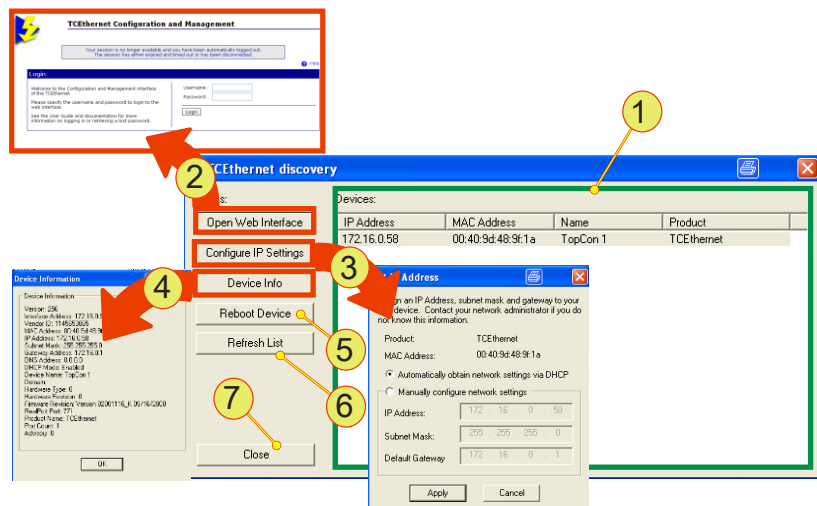


Fig. 56 Setting up the TCEthernet interface

Entries on the TCEthernet Interfaces submenu	
1	<b>List</b> Indication of the IP address, MAC address and the name (if one has been assigned). TCEthernet is the product name for the Ethernet card. Update the list using the button -6-. Selected power supplies (rows) can be edited in -2- and -3-.
2	<b>&lt;Open Web interface&gt;</b> , button Opens in your web browser a configuration page from the Ethernet card manufacturer. You can obtain online help in English using the "Help" link. Access data: User: administrator Password: kilowatt
3	<b>"Set IP Address"</b> , dialog box Configuration of the Ethernet card selected in -1-. You can select between the manual and automatic allocation of an IP address. Please contact your system administrator before you make changes. To apply changes you must reboot the Ethernet card using -5-.
4	<b>"Device Information"</b> , window Network and software version information on the Ethernet interface card selected in -1-.

Continued on next page.



Entries on the TCEthernet Interfaces submenu (continued)	
5	<b>&lt;Reboot Device&gt;</b> , button Reboots the Ethernet interface selected in -1-. The power supply is not rebooted!
6	<b>&lt;Refresh List&gt;</b> , button Refreshes the list -1-
7	<b>&lt;Close&gt;</b> , button for closing the window.

Table 39 Parameters on the TCEthernet interface submenu

5.4.8.7. Connecting the power supply to TopControl

The TopControl application automatically connects to a power supply via the Ethernet after it is started.

Pay attention to the following points:

- The serial interface RS-232 is not allowed to be connected directly to a power supply.
- The power supply with the lowest COM port is selected automatically.

Connect a power supply to the TopControl application using the following console command:

'C:\Program Files\Regatron\TopControl\TopControl.exe /COMStart=5  
/COMEnd=5'

In this example communication is with the device with COM port 5. "COM-Start" defines the start of the COM port search range and "COMEnd" the end of the COM port search range.

You can create a desktop shortcut for each power supply with the related console command.

In this way you can access different power supplies with a click of the mouse.

## 6. Installation and commissioning

### 6.1. Installation

#### 6.1.1. Transport

TopCon power supplies are always supplied with 2 strong carrying handles (steel sheet). These handles are inserted in the slots in the side of case and make it possible to transport the device easily.



Fig. 57 Attaching the carrying handles to transport a TopCon power supply.

Due to the high weight it is advisable to carry the device between 3-4 people and whenever possible to use a trolley or crane.

Remove the carrying handles after transporting the TopCon power supply and store them in a safe place.

#### 6.1.2. Building in the device

These installation instructions apply to standard TopCon TC.GSS power supplies with a complete case and internal liquid cooling with 3 fans on the rear of the device.

**CAUTION Possible damage!**

- Due to soiling and foreign bodies at the installation location.
- Due to a build-up of heat.

Avoidance:

- ⇒ The installation location must be free of conductive and aggressive substances as well as moisture.
- ⇒ No foreign bodies such as drilling swarf or screws are to be allowed to fall into the system.
- ⇒ It imperative you observe the minimum distances during installation.
- ⇒ The ventilation openings on the front panel and rear wall of the devices must not be covered or sealed under any circumstances.

**Case installation/delivery with case**

TopCon TC.GSS power supplies are installed in standard cases or switch cabinets either separately or in multi-unit systems.

In the standard design TopCon TC.GSS power supplies are intended to be installed in standard 19" cases and switch cabinets with an external air flow. In this case they are to be placed on rails or shelves and fastened at the points provided on the front panel.

Number of screws:

- For 9 U devices typically: 6 x screws M6.

On installation in cases or switch cabinets, the following points are to be noted:

- Use robust rails or shelves (from the case/cabinet manufacturer): the cases for TopCon TC.GSS power supplies must be in contact over the full installation depth. At the rear a cross-member is to be installed for additional fastening of the power supplies.
- Suitable transport aids must be used for the installation and removal of the power supplies. E. g. fit the carrying handles supplied in the side walls of the power supplies. The power supplies are to be lifted at these handles.

## Cooling

In the standard version TopCon TC.GSS are equipped with internal liquid cooling and 3 fans on the heat exchanger on the rear of the device. For this reason the supply of cooling air is to be ensured while complying with the maximum permissible temperature and humidity.

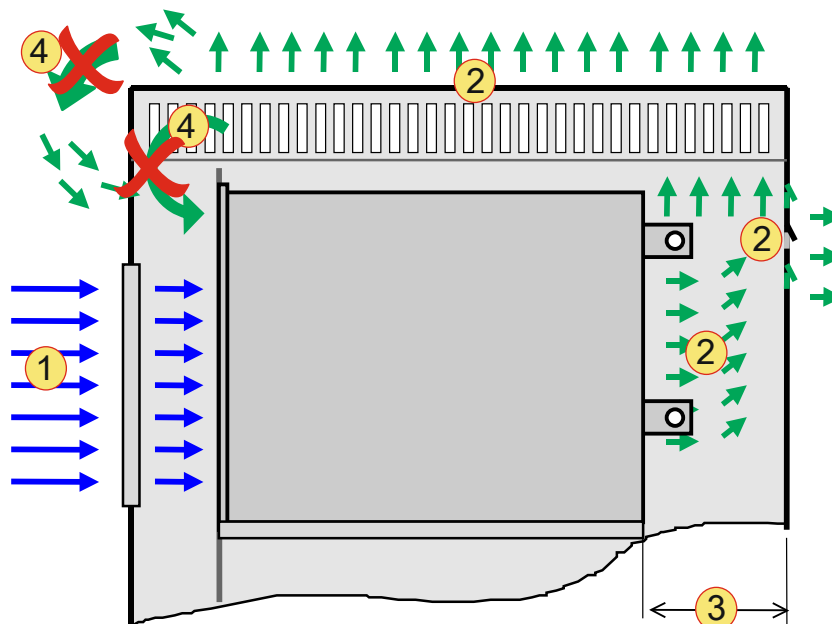


Fig. 58 Scheme of the passage of the air on installation in a cabinet case.

1	Air supply
2	Air exhaust,
3	Depth to the rear wall, 150 mm
4	Air short-circuit, must be prevented

Table 40 Schematic illustration of the cooling air flow.

For the supply and removal of cooling air, sufficiently large, suitable cases with corresponding inlet and outlet openings for the passage of the cooling air are to be used.

**Air supply -1-:** The cooling air is drawn in at the front. The air must be supplied unhindered, any air filters necessary are to be installed in the cabinet door or directly on the front of the power supplies. For an adequate supply of air, an inlet opening of at least 300 mm x 300 mm is to be provided per power supply and, if necessary, covered with a correspondingly large air filter.

**Air removal -2-:** The cooling air discharged from the power supplies at the rear. It is imperative there is adequate clearance for the passage of the air: at least 150 mm deep -3- over the full width of the power supply.

The cooling air can be discharged via the roof and/or rear wall. During this process an “air short-circuit” -4- must be avoided.  
(Directly drawing back in discharged cooling air)

### **Liquid cooling**

In the case of TopCon TC.GSS power supplies with water-water heat exchangers that you always provide enough space for the connections for your cooling system within a switch cabinet.

Further information in chapter 5.2.1, Seite 71.



## 6.2. Commissioning

### 6.2.1. General

TopCon TC.GSS power supplies are prepared so that they can be installed, wired and interference suppressed in accordance with the applicable regulations with as little effort as possible. Nevertheless, the responsibility for the compliance of systems and machines with built-in TopCon TC.GSS power supplies remains with the manufacturer of the system or machine.

On the usage of the electrical power supply in certain application areas, the related applicable standards and health and safety regulations are to be followed.

### 6.2.2. Safety information



#### WARNING

#### Possible mortal danger due to electric shock!

Avoidance:

- ⇒ Never connect or disconnect electrical connections while they are live.
- ⇒ Do not open the device if it is in operation, as it contains live parts.
- ⇒ Lay cables carrying high currents using an adequate cable cross-section.
- ⇒ Wait min. 15 minutes!  
In the devices built-in there can be dangerous voltages after switching off the mains voltage, as well as in case of loads that store energy.
- ⇒ Only use the devices for the intended application and type of load.  
In particular, the mains voltage and load must match the information on the type plate, as well as the settings on the device.
- ⇒ Protection against touching the output current bars!  
E.g. by fitting a suitable case.

### 6.2.3. Electrical connections

#### 6.2.3.1. Electrical installation – general

Prior to installation and commissioning, these operating instructions as well as any other information and instructions are to be read carefully.



#### **WARNING**

#### **Possible mortal danger due to electric shock!**

- Due to tampering with electrical modules

Avoidance:

- ⇒ The electrical installation is to be undertaken by personnel with electrical training.
- ⇒ Never connect or disconnect electrical connections while they are live.

#### **General check**

The correlation of the modules and documentation supplied must be checked:

1. Do the type plates match the order and delivery documentation?
2. Are the device nominal data suitable for the intended application?
3. Do the cables/connector supplied match the intended connections?

During the installation work, pay particular attention to the following:

1. Never connect or disconnect electrical connections while they are live!
2. Lay cables carrying high currents using an adequate cable cross-section as per VDE0110!
3. Ensure correct earthing of each power supply to a common PE rail!
4. It is imperative cable shields are connected via the cable clamps and/or connector cases to earth or the case on the power supplies using large area connections!
5. Follow measures for compliance with EMC regulations in the following section on electromagnetic compatibility Seite 111.
6. Provide safety shutdown feature (EMERGENCY STOP/interlock) and test it!

### Electromagnetic compatibility

TopCon TC.GSS power supplies have interference protection and suppression filters on all power and signal connections such that, on correct installation, compliance is achieved with the applicable IEC and EN standards in relation to interference.

The following standards are applicable:

- Interference immunity: EN 61000-6-2
- Interference emission: EN 61000-6-4

For the interference protection components to be able to perform their function, the following conditions must apply:

- Large area earthing suitable for EMI.
- Shield mains and load connection.  
(Depending on load and installation situation)
- Connect both ends of shields to earth.  
(Depending on load and installation situation)

### Interference immunity

The system must be fully earthed (encompassing all parts) and earthed suitable for EMI.

Correct earthing and shielding of the cable connections are key elements for interference immunity.

- All cable shields must be connected to earth potential at both ends using large area connections.
- Ideally shielded connectors are used that are earthed directly via the earthed sockets on the electrical power supply.
- Star topology earthing (suitable for EMI) of the device.

### Interference suppression

TopCon TC.GSS power supplies have integrated interference suppression. For the interference protection components to be able to perform their function, the following conditions must apply:

- Large area earthing suitable for EMI.
- Shield mains and load connection.  
Depending on load and installation situation.
- Connect both ends of shields to earth.  
Depending on load and installation situation.

### 6.2.3.2. Mains connection

The mains connection is made via the terminals L1, L2, L3 and PE. The N conductor is not used and any direction of rotation is acceptable.

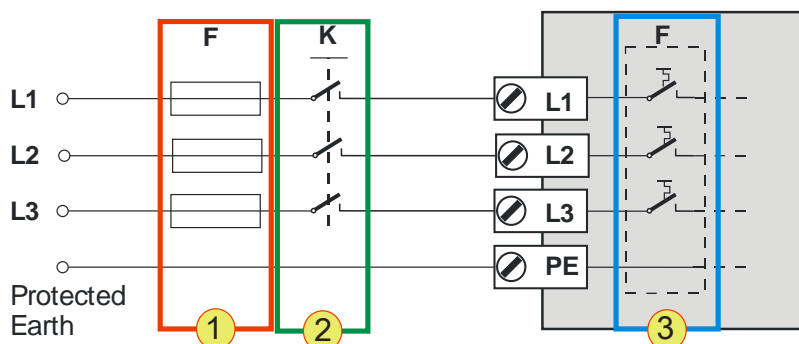


Fig. 59 Circuit diagram – mains connection to the TC.GSS power supplies.

#### Protection of the TopCon power supply

- Circuit breaker F -3-**  
 The internal circuit breaker is designed for the related current and power consumption of the TopCon power supply.
- External main switch K (option) -2-**  
 The external main switch is mostly used for devices in a multi-unit system in a switch cabinet.
- Fuse F -1-**  
 In case of cable lengths over 3 m, a fuse must be included in the circuit in accordance with VDE636.  
 The rating is to be selected as appropriate, see Table 41, page 112.
- Cable cross-section**  
 The external cables must have the necessary cable cross-section, see Table 41, page 112.

Mains connection/ mains voltage				
<b>Fuse</b>				
400 V <sub>AC</sub>	25 A	35 A	50 A	80 A
<b>Connection cross-section</b>				
400 V <sub>AC</sub>	10 mm <sup>2</sup>	10 mm <sup>2</sup>	16 mm <sup>2</sup>	25 mm <sup>2</sup>

Table 41 Specification of fuse and connection cross-section.

**Usage of an earth leakage circuit breaker**

If you want to use an earth leakage circuit breaker, please take note of the varying requirements for protection against fire and the protection of individuals.

Regatron recommends the usage of an earth leakage circuit breaker sensitive to AC and DC leakage currents.

**6.2.3.3. DC connection/load connection**

The output connections are laid to the rear side of the device as current bars.

For the load connection you must pay attention to the following aspects:

- Use a cable cross-section to suit the device power and nominal voltage. (See Table 42, unterhalb.)
- Screw cable to current bars using cable lugs  
Hole diameter: 9 mm

Follow the standards applicable to the related application and type of cable laying. The values in the table are only a recommendation.

Nominal voltage on DC side	Cross-section [mm <sup>2</sup> ] – cable on DC side	
	20 kW device	32 kW device
50 V	95	150
100 V	70	70
200 V	35	50
500 V	16	25
1000 V	6	10
1200 V	6	10

Table 42 Cross-section sizing for the load cable as a function of the output voltage.

For cable lengths of more than 5 m the next size cross-section up should be selected to keep the voltage drop over the load cable in limits.

## 6.3. Switching on and off a TopCon power supply

### 6.3.1. Prior to switching on for the first time

Prior to switching on for the first time, the following points are to be checked:

- Does the information on the type plate match the mains connection and load?
- Mains connection correctly wired?  
Adequate cable cross-section used?  
For further information see chapter 6.2.3.2, page 112.
- Loads connected with correct polarity?  
For further information see chapter 6.2.3.3, page 113.
- Control signals connected correctly?  
For information on X101/X102 see chapter 4.3.2, page 46.
- For information on X105 see chapter 7.2, page 120.
- Interlock inhibit wired?  
For further information see 4.3.3, page 48.

#### Preparing interlock and communication bus correctly

- Connect the control interface (X105) to the 25-pin dummy plug (device rear side)
  - ↳ The CAN bus for the device communication is connected.
  - ↳ Situation: no RCU (Remote Control Unit) available.  
The communication and interlock interface (X101) on the rear side of the TopCon power supply is terminated using the “Interlock and CAN-Term” dummy plug (9-pin) (device rear side).
  - ↳ Situation: RCU (Remote Control Unit) available.  
Connect the connection cable to the communication and interlock interface (X101) on the rear side of the TopCon power supply. The other end is connected to the RCU interface (X101). The “Interlock and CAN-Term” dummy plug is connected to connector X102 on the RCU. (Device rear side)

## 6.3.2. Switching on and off a TopCon power supply

### 6.3.2.1. Switching on the device

- Switch on main switch.  
On the front of the TopCon TC.GSS power supply in the form of a triple switch.
- ↳ The TopCon power supply is booted.  
The signal processor is initialised and a device self-test performed.
- ↳ Can be seen on the HMI/RCU during the login process:  
Login: HMI login on the system  
System information screen:  
The system information screen appears for approx. 5 s and changes to the main screen.
- ↳ At the end of the successful start process, the green “Power” LED on the front of the device illuminates.

### 6.3.2.2. Switching off the device

- Switch off the device via the main switch.
- ↳ The shutdown process is indicated on the front of the TopCon power supply as a running light on the STATUS LED.  
The running light continues until the internal energy stores are discharged.

### 6.3.2.3. Device self-test

The duration of the device self-test is approx. 5 seconds. In multi-unit operation the system is also configured and the communication between the power supplies connected checked for correct function.

Self-test reports status: “OK”.

- READY light emitting diode (green) illuminates continuously.
- The device is ready.
- State machine changes to the “READY” state.  
For further information see chapter 4.3.5, page 50.

**Self-test reports status: “Error”.**

- Error light emitting diode (red) illuminates or flashes.  
Flashing code on the ERROR light emitting diode indicates the reason for the error.  
For further information see chapter 10.2, from Seite 275.
- State machine changes to the “ERROR” state.  
For further information see chapter 4.3.5, page 50.
- If the state machine remains in the “ERROR” state after a repeated start attempt, look for the reasons for the error using the “TopControl” application and take the necessary corrective measures.

### Parameterisation

If possible do not make any changes to the factory settings, as the factory settings take into account your needs, the operation foreseen and your individual applications in the majority of cases.

If you nevertheless need to make application-specific settings, you can make them using the TopControl application from your PC.

However, prior to changing the settings we recommend undertaking the function test described in the following and only then changing the settings. In particular for monitoring values, ramp functions or controller settings.



#### 6.3.2.4. Function test

Condition for the function test:

- Mains voltage switched on.
- Connected load.

Vary the procedure depending on which interface you use.

- With analogue interface X105  
The control signal VOLTAGE\_ON can be applied from a possible input device (e.g. PLC, 12 V<sub>DC</sub> power supply) via the interface X105. Set values can also be defined via this interface.  
For further information see chapter 7.2.3, Seite 122.
- With the HMI (option)  
Set values can be defined via a rotary switch on the related menu.  
Further information from chapter 7.3.4, Seite 134.
- With the RS-232 interface  
In combination with a PC and the TopControl application the set values can be defined on the <CONTROL> tab and the device switched on.  
For further information see chapter 7.4.8.1, page 175

Check the output voltage or current to ensure it matches the set values.

Please note that, depending on the configuration of ramp functions, the set values specified may in some circumstances only be reached after the related ramp functions/time have been completed.

**Error-free state**

After you have set the set values, the following occurs in the error-free state:

- The output is switched on and regulated to the related set value defined.
- The device is in the state: RUNNING,  
One CONTROL LED illuminates depending on the controller that is providing the limiting.  
CV for voltage controller  
CC for current controller  
CP for power controller

**Error state**

In the error state a flashing error code is output on the front via the CONTROL LED.

For further information see chapter 10.2, from Seite 275.

If there is no output voltage at the device, check the interlock circuit using the related dummy plugs.

For further information see chapter 4.3.3, Seite 48.

## 7. Device operation

### 7.1. Interface hierarchy

In principle, all interfaces have the same priority, i.e. control can be transferred to another interface at any time.

An exception is the interfaces CANOpen, USB and GPIB.

There is an interface hierarchy during the power-up process. Depending on which interface was saved previously in the device as “activated”, control is superimposed via the system state. Settings from an interface lower in the hierarchy can be overwritten by a interface higher up in the hierarchy.

#### Interface hierarchy during power-up

1. **HMI/RCU (optional)**

All settings from interfaces lower in the hierarchy are overwritten by the HMI /RCU interface provided this interface is in the active state.

In the case of multi-unit systems with several active HMI /RCU interfaces, the interface that was switched on first takes over the control. If several active HMI are switched on at the same time, the selection is random.

The HMI/RCU interface can be set to “passive” such that it does not make any attempt to take control.

2. **Analogue interface X105**

If the HMI is set to “passive” and there is a high level on pin 20, the analogue interface takes over control.

For further information see chapter 7.2, page 120.

3. **RS-232 (TopControl application)**

If the HMI and the analogue interface are not activated, the RS-232 interface takes over control.

The different interfaces can be selected on this interface using a PC with the TopControl application. It is also possible to transfer set values to the TopCon.

4. **CAN/CANOpen (optional)  
and USB (optional) as well as GPIB (optional)**

If the CAN/CANOpen interface is allocated the function of exclusive control over all interfaces, it is first in the hierarchy.

Exclusive control means that a change in the interface configuration via other interfaces is no longer allowed and the analogue interface is switched off.

HMI/RCU settings are overwritten.

Further information can be found in the CANOpen instructions.

## 7.2. Analogue interface

### Short description of the analogue interface

The operation of the analogue interface is defined by the pin definition for the analogue interface X105.

Set values can be specified by applying a reference voltage to the inputs for U, I, P, R on the analogue interface.

- **Pin definition** of the analogue interface X105  
For further information see 10.1.6.6, page 271.
- **Activation** of the analogue interface for remote programming  
For further information see chapter 7.2.1, page 120.
- **Utilisation of the Multi Rack Controller (MRC)**  
Operation of the master devices in several multi-unit systems to form a large multi-unit system.

### 7.2.1. Activation of the analogue interface for remote control

The analogue interface can be activated via all the interfaces in the device, and also via the analogue interface itself.

#### Activation of the analogue interface without HMI for remote control

The analogue interface is activated via itself.

Activation is via pin 20 on the digital input on the analogue interface by means of the following signals:

- Rising edge from 0 V to 24 V.
- If the ANALOG\_REFERENCE\_SELECT signal has already reached the high level of 24 V on power-up.

For information on the pin definition see Table 147, page 271.

Pay attention to the interface hierarchy.

### Activation of the analogue interface with HMI (option) for remote control

Using the “analogue” selection in the HMI, the control over the system can be transferred to the analogue interface.

If this setting is to be retained on the next system start, to save the settings the RS-232 interface and the TopControl application must be used.

The HMI interface does not have any feature for saving settings.

### Activation of the analogue interface via RS-232 using the TopControl application for remote control

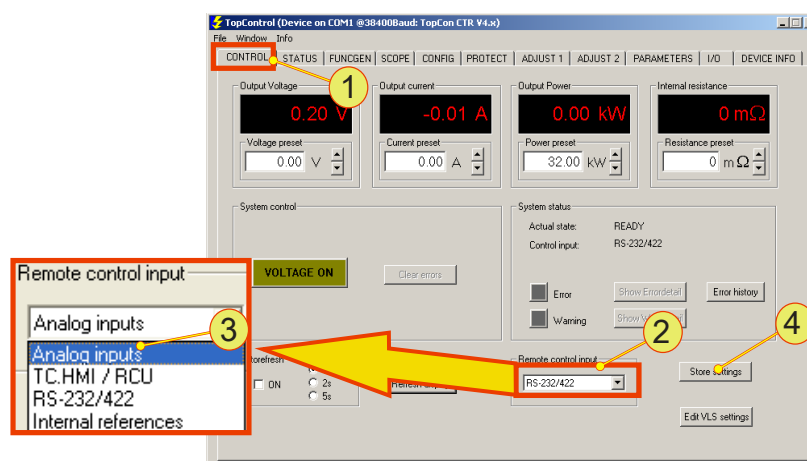


Fig. 60 Activation of the analogue interface via the <Remote control input> list box.

The remote control is transferred to the analogue interface as follows:

- On the <CONTROL> -1- tab, select in the <Remote control input> -2- list box the “Analog inputs” -3- entry.
- If the analogue interface is to be activated the next time the TC.GSS power supply is powered up, you must save the selection using the <Store Settings> -4- button.

## 7.2.2. Remote programming

### Isolation of the signal inputs

All four analogue inputs for current  $I_{REF}$ , voltage  $V_{REF}$ , internal resistance  $R_{REF}$  and power  $P_{REF}$  are fully isolated, as a result external isolating amplifiers are not required.

### Reference ground

The reference ground is common for all analogue inputs and must be connected to the reference potential of the supplying signal source.

If individual set values are not required, these inputs can be left unconnected or connected to the analogue reference earth.

### Digital entry

The set values for current  $I_{REF}$ , voltage  $V_{REF}$ , power  $P_{REF}$  and internal resistance  $R_{REF}$  can also be entered digitally via the RS-232 interface instead of using analogue specification.

## 7.2.3. Remote programming – switching on/off the device

Condition: the interface has been activated.

The control signal **VOLTAGE\_ON** controls the power section of the electrical power supply and is coupled directly to the state machine for the device and system control.

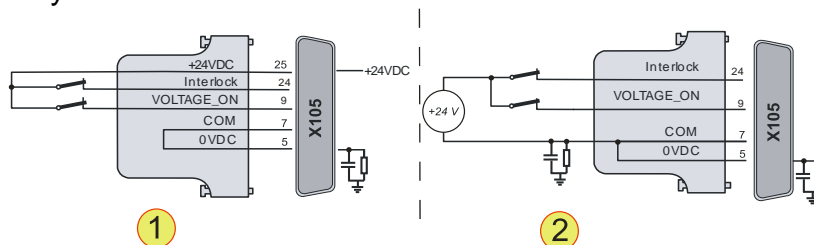


Fig. 61 On/Off control of the TC.GSS power supply.  
-1- External ON/OFF contact with internal voltage source.  
-2- External ON/OFF contact with external voltage source.

Pin	Analogue control	Function
9	<b>VOLTAGE_ON</b>	Device switched on: 24 VDC are present Device switched off: open connection

Table 43 Switching states **VOLTAGE\_ON**

### Use dummy plugs supplied!

In the simplest configuration the related dummy plug must be used; this plug is fitted to interface connection X105. For information on dummy plugs see chapter 4.3.2.1, page 46

### 7.2.4. Remote programming for current and voltage

If this set value setting is not required, these inputs can be left unconnected or connected to the analogue reference earth.

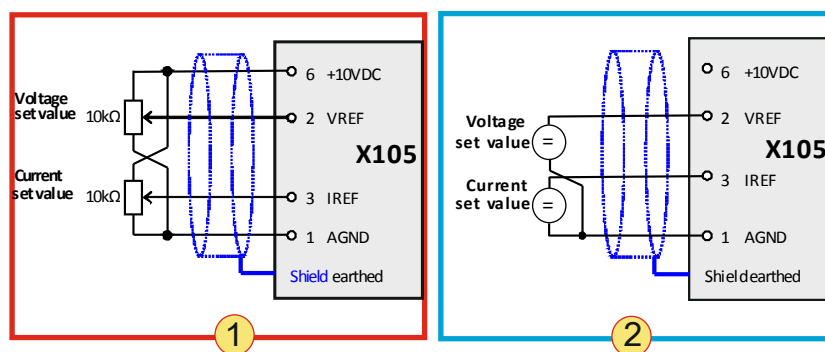


Fig. 62 Analogue set value specification using potentiometers -1-.  
Analogue set value specification using external sources -2-.

Pin	Analogue control	Function
2	<b>Voltage <math>V_{REF}</math></b> 0...10 V or 0...10 kΩ	Voltage $U_{max} = U_{nom} * [0.. 100\%]$ where $V_{REF} \triangleq [0.. 100\%]$
3	<b>Current <math>I_{REF}^1</math></b> -10V ...0...10 V or 0...10 kΩ	Current $I_{max} = I_{nom} * [-100\% ... 0 ... 100\%]$ where $I_{REF} \triangleq [-100\% ... 0 ... 100\%]$

Table 44 Factory pin definition and value range for the manipulated values  $V_{REF}$  and  $I_{REF}$ .  
<sup>1</sup> Only positive set values can be specified with a resistor (0 ... 10 KΩ).

### 7.2.5. Power limit and internal resistance simulation

If this set value setting is not required, these inputs can be left unconnected or connected to the analogue reference earth.

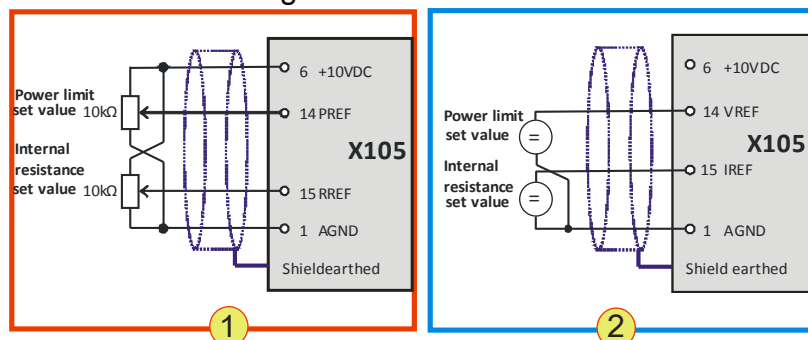


Fig. 63 Analogue specification of power limit and internal resistance.  
Only positive analogue set values can be specified with potentiometers (0 ... 10 KΩ) -1-.  
Analogue set value specification using external sources -2-

#### Standard input values

Pin	Analogue control	Function
14	<b>Power limit <math>P_{REF}</math></b> 10...0 V or 0 ... 10 KΩ	Output power $P_{max} = P_{nom} * [0... 100\%]$ where $P_{REF} \triangleq [0... 100\%]$
15	<b>Internal res. <math>R_{REF}</math></b> 0...10 V or 0 ... 10 KΩ	Internal resistance $R_{REF} = 0...1000 \text{ m}\Omega$

Table 45 Factory pin definition and value range for the manipulated values  $P_{REF}$  and  $R_{REF}$   
Only positive set values can be specified with a resistor (0 ... 10 KΩ).

#### Internal resistance extension (option)

With an optional internal resistance extension, the same pin definition and specification values apply.



#### For the power limit the specification is inverted!

In the case the power limit input voltage  $P_{REF} = 0 \text{ V}$ , there will not be any limiting of the maximum power, i.e. the power limit is set to the (full) nominal power. For this reason the power limit is set correspondingly on operation via pin 14 ( $P_{REF}$ ).

#### Changing the power input to bipolar inputs

The output power can be changed to bipolar inputs using a configuration flag.

Power limit  $P_{REF}$ : -10 V... 0 ... 10 V ;  $P_{REF} \triangleq [-100\% ... 0 ... 100\%]$



If necessary, please contact Regatron support.



**Internal resistance input as Q4 parameter input**

Using a configuration flag the internal resistance input can be used for nQ4 parameter inputs as follows:

1. See standard resistance input parameters
2.  $I_{LimitQ4}$  parameter  
 $R_{REF}: 0..10\text{ V} \triangleq 0 \dots -I_{LimitQ4}$ ;  
Where  $P_{LimitQ}$  must be specified via TopControl.
3.  $P_{LimitQ4}$  parameter  
 $R_{REF}: 0..10\text{ V} \triangleq 0 \dots -P_{LimitQ4}$ ;  
Where  $I_{LimitQ}$  must be specified via TopControl.



If necessary, please contact Regatron support.

### 7.2.6. Digital outputs (relay contact)

These relay contacts can be used, e.g., for a Versatile Limit Switch (VLS).

For further information on VLS see chapter 7.2.7, below

As standard the definition of the digital outputs is as follows:

Name	Meaning	X105 Pin no.	Contact type
DIGOUT_1	OK/ALARM	Pin 10, 11	Closed $\triangleq$ OK OK = Device ready for operation
DIGOUT_2	RUN	Pin 12, 13	Closed $\triangleq$ Run RUN = "VOLTAGE_ON"
DIGOUT_3	WARN	Pin 21, 22, 23	Change-over contact WARN $\triangleq$ Warning

Table 46 Standard function of the X105 relay outputs.  
Maximum switching current 1 A; maximum switching voltage: 125 V  
The rest of the pin definition for X105 is listed in Table 147, page 271.

### 7.2.7. Versatile Limit Switch (VLS)

#### 7.2.7.1. Description of VLS function

Using the VLS function the following analogue outputs on the X105 interface can be monitored:

- Voltage
- Current
- Power

If programmed limit values are not respected, an output relay is switched.

You can select the type of relay that is operated via the interface X105:

- "Warn" relay (normally open)
- "Run" relay (normally open)
- "OK/Alarm" relay (normally closed/normally open)

For further information see chapter 7.2.6, oben.

The following VLS functions can be selected:

- Exceeding a threshold
- Dropping below a threshold
- Entering a window  
Defined value range is reached
- Leaving window  
Defined value range is left

Each threshold can also be assigned a hysteresis range above or below a threshold value.

A value of zero will deactivate the hysteresis.

Programmable switching delays help to suppress brief irrelevant transients (settling processes, pulses).

Due to the cyclical digital sampling, rapid changes (duration  $< 50\mu\text{s}$ ) on the signals monitored may not be detected in some circumstances.

### Exceeding or dropping below a threshold

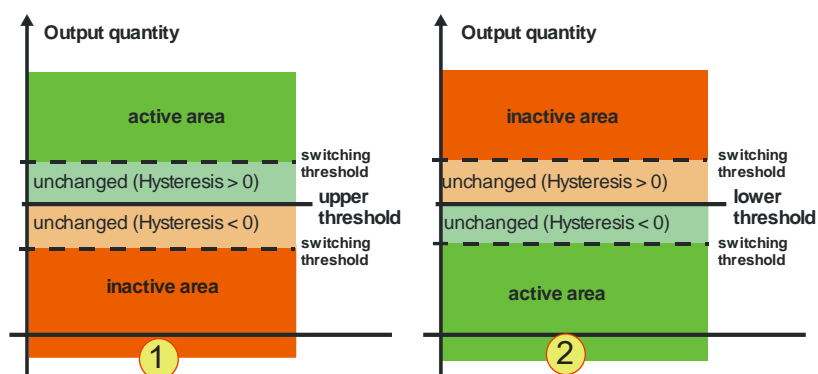


Fig. 64 VLS functions:  
Exceeding the threshold -1-  
Dropping below the threshold -2-

### Entering a window/leaving a window

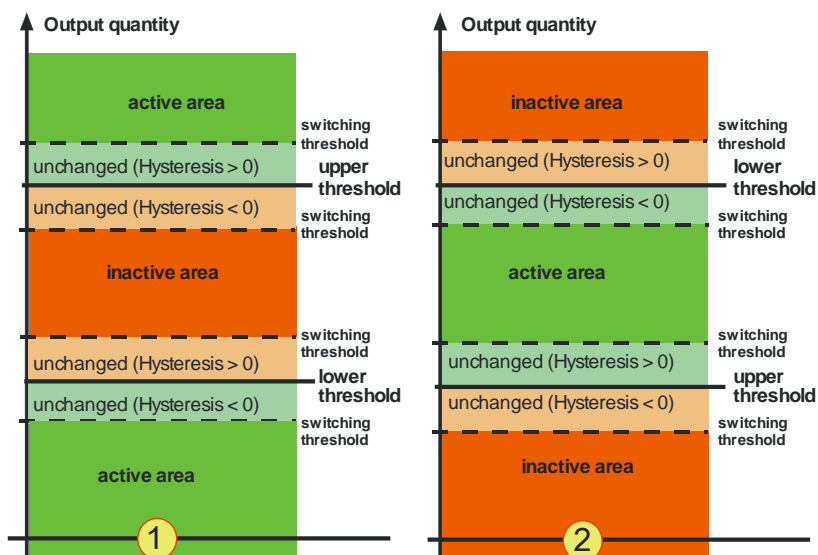


Fig. 65 VLS function:  
Leaving a window -1-  
Entering a window -2-

## Switching behaviour – time dimension

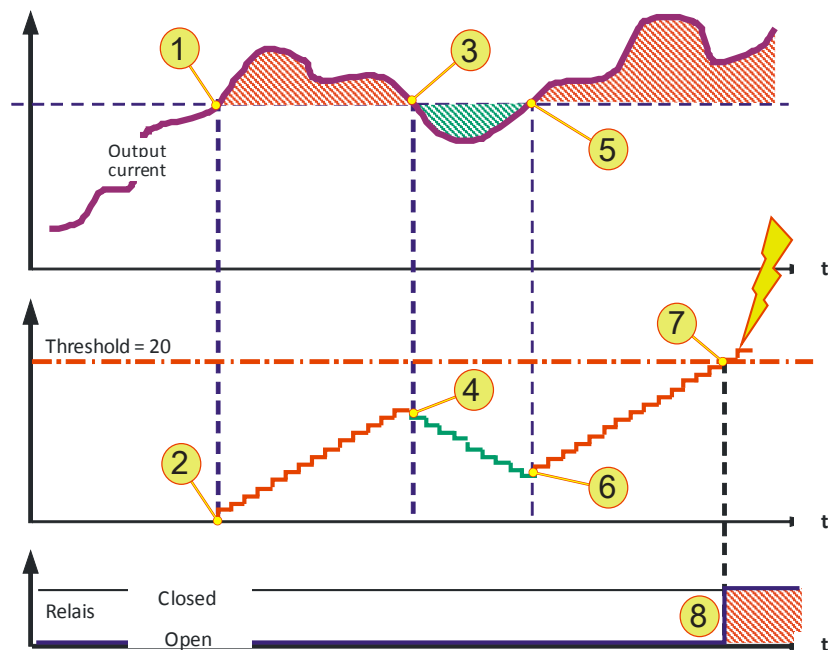


Fig. 66 Explanation of the VLS example (time dimension)

Along with the consideration of the dimension stated above, parameters can be set for the behaviour over time. The switching behaviour for the selected relay is also defined by various (timers) counters that evaluate the VLS state of the TC.GSS power supply.

The following explanatory example from Fig. 66 assumes the active-to-inactive delay = 20 ms the hysteresis set = 0 V.

The current curve exceeds the threshold **-1-**, as a consequence it is in the active range. The active counter now counts up, as per the limit value set, ("inactive-to-active delay") **-2-**.

In this example the current drops back below the (lower) hysteresis threshold **-3-**. From this point in time the counter counts down **-4-**. From point **-5-** the monitored current increases again over the upper hysteresis value and the counter counts up again **-6-**.

Once the counter has reached the limit value set (as per the delay parameter) **-7-**, the required relay is closed or opened depending on the configuration **-8-**.

This process is setup similarly for the opposite direction using the "active-to-inactive delay" counter.

### 7.2.7.2. Programming VLS in TopControl

VLS can be programmed using the TopControl application supplied (from V4.01.35).

The data are then transferred directly to the TC.GSS power supply. VLS then operates independent of the TopControl application, i.e. continued connection to the PC is not necessary.

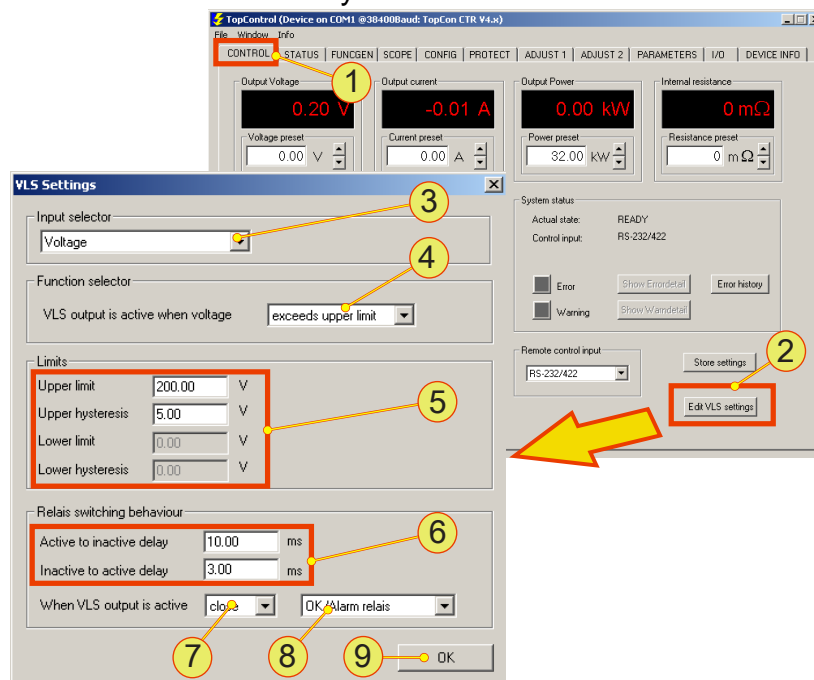


Fig. 67 The “VLS Settings” window is opened via the <CONTROL> -1- tab and the <Edit VLS settings> -2- button.

Window - VLS Settings	
3	<p><b>Input selector</b>, list box</p> <p>“None VLS deactivated” VLS function is switched off → All text boxes are grey, no entries can be made</p> <p>“Voltage”, “Current”, “Power” Related text boxes can be edited → The units change depending on the selection made.</p>
4	<p><b>Function selector</b>, “VLS output is active when voltage” list box</p> <p>Defines the range in which the relay is activated. The following options are available:</p> <ul style="list-style-type: none"> <li>exceeds upper limit – Exceeding a threshold</li> <li>falls below lower limit – Dropping below a threshold</li> <li>is inside window – Entering a window</li> <li>is outside window – Leaving a window</li> </ul>
5	<p><b>Limits</b>, text boxes</p> <p>Defines the related thresholds and hysteresis for the selected range. Depending on the selection in -4-, different text boxes are activated.</p>
6	<p><b>Relais switching behavior</b>, text boxes</p> <p>The adjustable switching delay between the active and the inactive range helps to ignore brief fluctuations in the output value.</p>
7	<p><b>Relais switching behavior</b>, list box – switching state</p> <p>Selection of whether the relay is to be closed or opened in the active range. The switching state is inverted in the non-active range.</p>
8	<p><b>Relais switching behavior</b>, list box – relay type</p> <p>The following selection is possible:</p> <ul style="list-style-type: none"> <li>“OK/Alarm” relay (normally open/normally closed),</li> <li>“Warn” relay (normally open),</li> <li>“Run” relay (normally open).</li> </ul>
9	<p><b>&lt;OK&gt;</b>, button</p> <p>Closes the VLS window.</p>

Table 47 Window for the VLS function.

7.3. HMI and RCU

7.3.1. Case designs

The HMI and RCU are available in three different forms



Fig. 68 Installation forms for the control unit (HMI/RCU)

Case designs for HMI/RCU	
1	<b>HMI, Human Machine Interface</b> Directly built into the front panel on the single TopCon power supply.
2	<b>RCU front panel, Remote Control Unit</b> Built into a system cabinet, as front panel with 2 U.
3	<b>RCU device, Remote Control Unit</b> Remote Control Unit is built into a dedicated case with 2 U.

Table 48 HMI/RCU - different forms

### 7.3.2. Short description/terminology

#### Function of the Human Machine Interface (HMI), option

Clear system control is made possible by the indication on the display via text menus. Along with the entry of system parameters, the system status is also output.



HMI devices directly installed in the power supply are not necessarily responsible for the display and entry of the data for the device. In principle all HMI devices in the multi-unit system only display the overall system parameters.

#### Function of the Remote Control Unit (RCU), option

RCU devices have the same functionality as HMIs, they are a device variant with a dedicated case.

In addition, the RCUs can also have an interlock switch on the front.

#### Function

As per the analogue interface, using the HMI reference values such as current, voltage and power can be specified, the voltage switched on/off and warnings and errors acknowledged.

In addition, the HMI provides the following features:

- Plain text indication of errors and warnings.
- Error thresholds for overcurrent and overvoltage.
- Adjustment of the bandwidth of the analogue inputs and outputs (set and actual values).
- Linear internal resistance simulation.
- Selection of the active interface (analogue, HMI or RS232).
- Permanent storage of the selected settings (HMI specific settings as well as system settings).
- Setting the function and characteristics of the Versatile Limit Switch (VLS).

With TFE (function generator) option:

- Loading/activation of a function sequence in the flash.
- Changing function generator settings  
(Note: a user-defined function can only be changed using the TopControl application)



### Multi-unit system

On usage in a multi-unit system, the data are forwarded from the master to the slaves and in this way an entire multi-unit system can be operated from a single HMI unit. Depending on the reference values required, the related data are forwarded via the internal communication interface (CAN bus, X101/X102) to the slaves and automatically implemented there.

In the opposite direction (= from the slaves to the master) various items of information, in particular the error and warning data are forwarded and output there.



HMI devices directly installed in the power supply are not necessarily responsible for the display and entry of the data for the device. In principle all HMI devices in the multi-unit system only display the overall system parameters.

### HMI identification

All HMI or RCU must be equipped with a unique identifier (ID). Important for the sequence:

- The identifier sequence must start with 1 (for master).
- The identifier sequence must be contiguous.

#### 7.3.3. Technical data on the HMI

The HMI comprises, as an interface component, inputs and outputs and the support interfaces: communication and electrical power supply.

Technical data on the HMI/RCU	
Communication	<b>Communication bus</b> Internal proprietary based on CAN Version: V2.0 B (communication with electrical power supply, RCU via interface X101)
Electrical power supply	<b>Internal (HMI) or via RCU connection</b> RCU connection cable (communication and supply cable)
Controls	For further information see Table 50, Seite 134.

Table 49 Technical data on the HMI/RCU

### 7.3.4. Operation of the HMI (option)/RCU (option)

#### 7.3.4.1. Controls on the HMI/RCU



Fig. 69 Controls for the optional HMI (or the RCU).

Standard controls (cf. Fig. 12)	
1	<b>LC display</b> Indication of the actual device settings and various menus 160x80 pixels, font: black, background: blue-grey constant LED background lighting, contrast can be selected Buzzer
2	<b>&lt;JogDial&gt;</b> , rotary selector switch Mechanical rotary encoder with detent and integrated button. For the selection of menu items and scaling of parameters.
3	<b>&lt;DISPLAY&gt;</b> , button Cycles entire main window.
4	<b>&lt;ESC&gt;</b> , button Leaves the actual window and return to the next level up in the hierarchy. Acknowledges error messages and warnings.
5	<b>&lt;MENU&gt;</b> , button Opens the main menu.
6	<b>&lt;ON/OFF&gt;</b> , switch ON: Green LED illuminated. In the operating state the output value set is present at the device output. OFF: Green LED is off, device output is electrically isolated
7	<b>&lt;REMOTE&gt;</b> , switch Change over as to whether the TC.GSS power supply is to be remotely controlled. Deactivated: Red LED off. HMI is ready for entries. Activated: Red LED illuminated. HMI is remotely controlled and indicates the device state.
8	<b>&lt;NEXT&gt;</b> , button In case of multiple page menus for data entry used to jump to next page.

Table 50 Controls on the HMI or RCU.

### 7.3.4.2. HMI/RCU navigation concept

The basic functions of the TopCon power supply can be controlled fully via the HMI or the RCU.

There are 3 different levels in the navigation within the HMI/RCU:

- **DISPLAY level**  
Indication of the most important system data in main windows.  
On system start the HMI is at the system level. The individual main windows can be opened one after the other using the <DISPLAY> button.  
Individual menu windows are also displayed at the DISPLAY level depending on the option activated.  
For an overview of the DISPLAY level, see Fig. 72, Seite 137.
- **MENU level**  
Menu windows have an inverse heading.  
The main menu window can be opened explicitly using the <MENU> button. Each individual submenu is opened using the JogDial and left again using the <ESC> button.  
For an overview of the MENU level see Fig. 73, Seite 138.
- **DATA INPUT level**  
You can open the data input level using the JogDial. A text box is selected by clicking the related cursor position. The value can be changed using the JogDial.

#### Navigation aids within windows

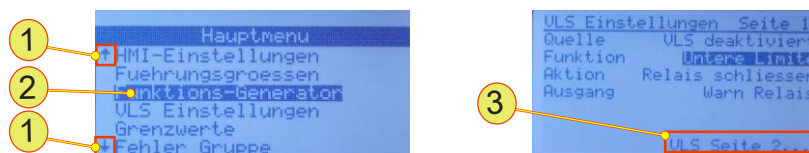


Fig. 70 Window from the DISPLAY level

Navigation aids in windows	
1	<b>Down/up arrow</b> The window content is longer than the DISPLAY. The arrow direction indicates the direction of the hidden information. Using the JogDial you can navigate in the required direction.
2	<b>Cursor</b> Indicates the actual entry position within a window.
3	<b>Links</b> Are mostly in a clearly separate position if there are several pages on a topic or if a window can be left using a navigation item.

Table 51 Navigation within DISPLAY windows

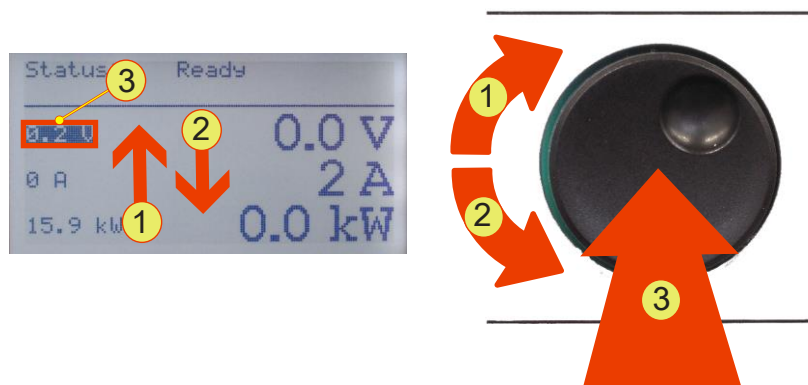
**Working with the JogDial (rotary selector wheel)**

Fig. 71 JogDial for navigating, accepting or setting values

Functions of the JogDial - navigation	
1	<b>Navigate up</b> The cursor on the display jumps from one entry to the next entry down as long as the JogDial is turned. On reaching the entry at the top, the cursor starts to jump from bottom to top again.
2	<b>Navigate down</b> The cursor on the display jumps from one entry to the next entry down as long as the JogDial is turned. On reaching the entry at the bottom, the cursor starts to jump from top to bottom again.
3	<b>Select</b> By pressing the JogDial once the actual selection (cursor position) is selected. Depending on the selection you can define a value or open a submenu.

Table 52 Navigation using the JogDial on the HMI menus

Functions of the JogDial - DATA INPUT level	
1	<b>Increase the value</b> The value is increased as long as the JogDial is turned or until the maximum value is reached.
2	<b>Reduce the value</b> The value is decreased as long as the JogDial is turned or until the minimum value is reached.
3	<b>Accept your entry</b> The value entered is accepted by pressing the JogDial once and the data input mode is left for the navigation mode.

Table 53 Entry of parameters using the JogDial in individual menu windows

## 7.3.4.3. Navigation overview – display level

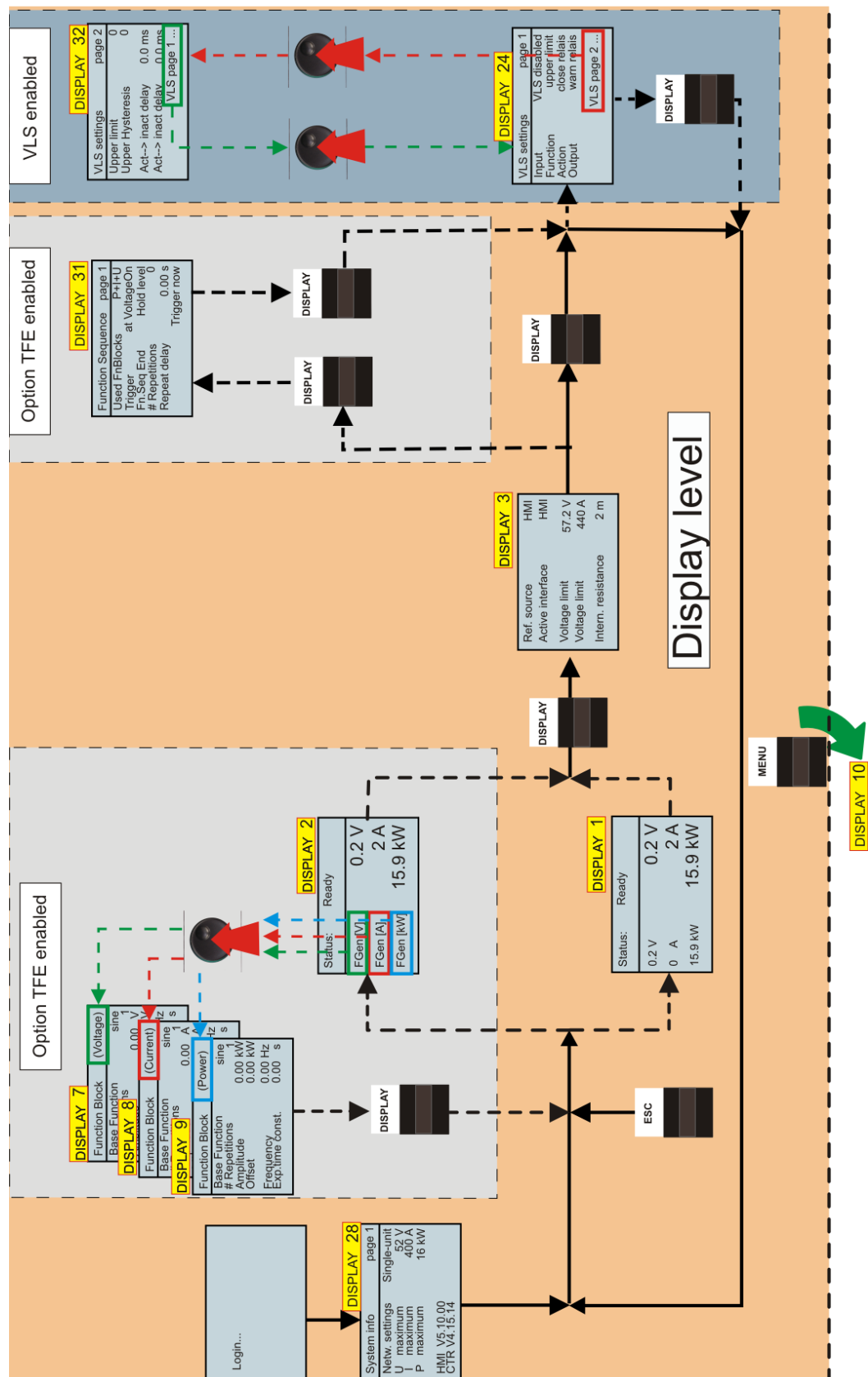


Fig. 72 Overview of HMI operation: DISPLAY level

## 7.3.4.4. Navigation overview – menu level

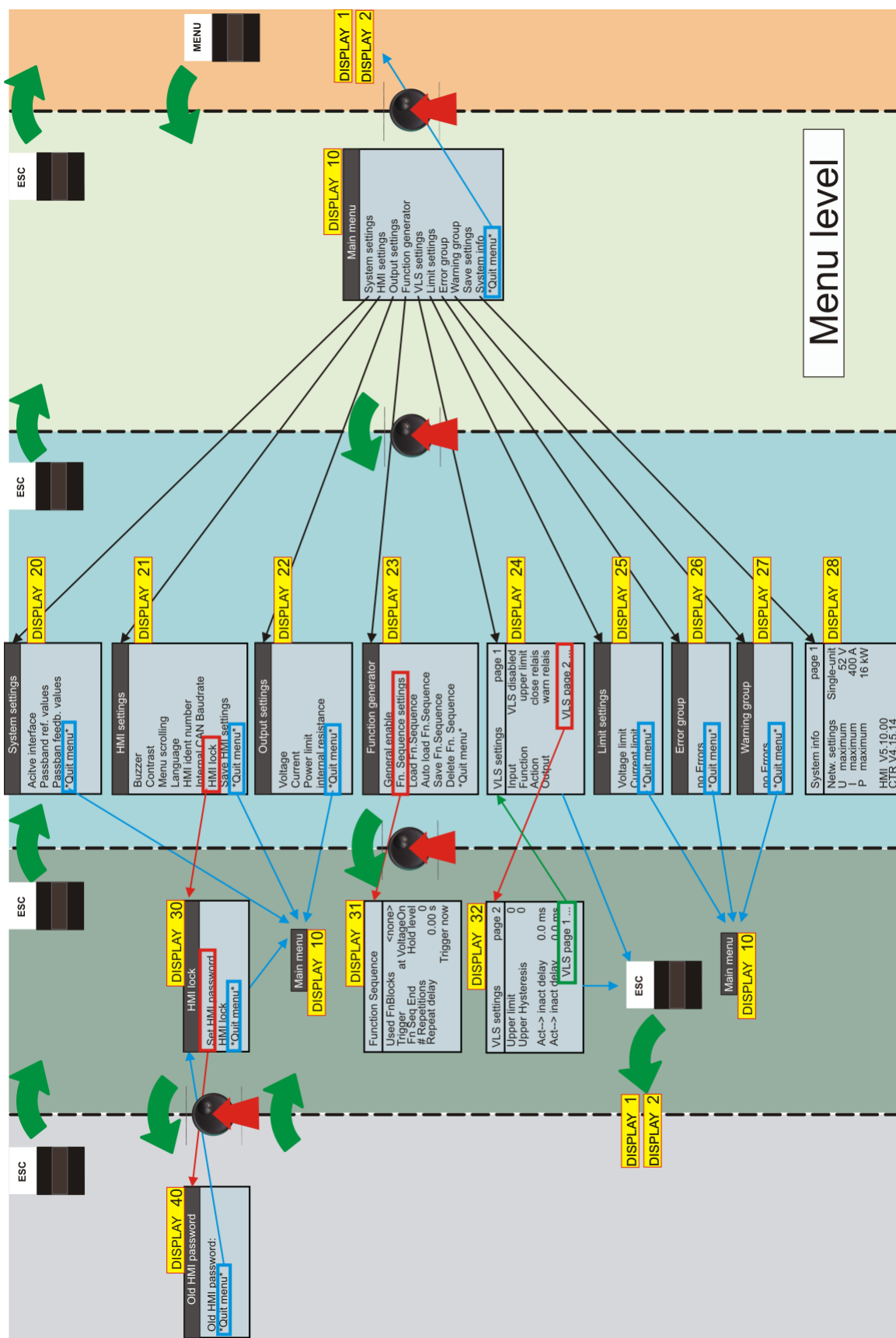


Fig. 73 Overview of HMI operation: MENU level

## 7.3.4.5. DISPLAY level – windows and their information

## During the start process

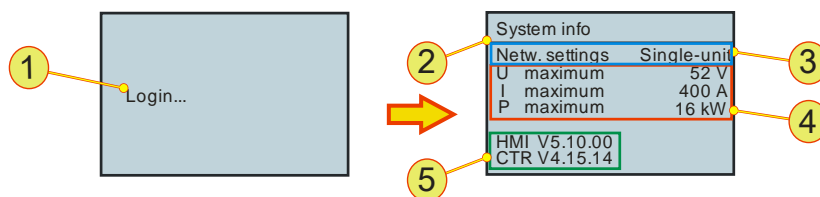


Fig. 74 Login and start information on a single device TP.C.16.52.400.S

Login and system information – DISPLAY 1	
1	<b>Login</b> , read-only indication Duration of indication approx. 5 s, while the TC.GSS power supply is initialised.
2	<b>System info</b> , read-only indication Indicates following key system data -3-, -4-, -5- Duration of indication approx. 5 s.
3	<b>Operating mode</b> , read-only indication Indication of the possible operating modes: Single device Multi-unit system
4	<b>Device parameters</b> , read-only indication Parameters for the maximum values that the device reaches in the hardware. Maximum voltage $U_{Max}$ , maximum current $I_{Max}$ , maximum power $P_{Max}$ .
5	<b>Version information</b> , read-only indication firmware HMI (Human Machine Interface) CTR (TopCon controller board)

Table 54 Login and device status on starting the system

## Main screen – DISPLAY 1

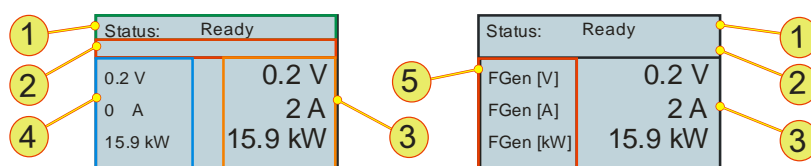


Fig. 75 Main screen without (DISPLAY 1), left, and with enabled and activated TFE option (DISPLAY 2), right

Main screen without/with enabled option TFE – DISPLAY 1, 2	
1	<b>Status line</b> The system state is displayed: Ready: Device is ready for operation, the output is electrically isolated and the power semiconductor is inhibited. Running: Device is in operation, the output is providing power. If a load is connected current flows. Warning: Device is still in operation, warning limit is exceeded, an error may be approaching, e.g. over-temperature. Indication: warning in the message bar -2-. Error: Device is not ready for operation, the output is electrically isolated and the power semiconductor is inhibited. Indication: error in the message bar -2- Stop: Is generated by the TopControl application on an update to the firmware for the TC.GSS power supply. The control electronics are inhibited. The output is electrically isolated and the power semiconductor is inhibited. After the update the device must be switched off briefly via the circuit breaker and then switched back on again.
2	<b>Message bar</b> Short description in case of error messages and warnings. E.g. "Communication" message if the interlock connector is not fitted.
3	<b>Actual values</b> Indication of the actual output values: voltage U, current I and power P.
4	<b>Set values</b> Indication of the reference values: voltage U, current I and power P.
5	<b>TFE display</b> If the function generator option is enabled and activated, set value -4- changes to "FGen". The change in the indication to "FGen" appears as per the function sequence set. See DISPLAY 23, 31 function generator Fig. 82, Seite 147.

Table 55 Parameters on the main screen DISPLAY 1, 2



## System screen – DISPLAY 3

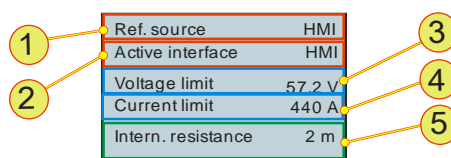


Fig. 76 Parameter entry in DISPLAY 3

System screen – DISPLAY 3	
1	<b>Ref. source</b> Indication of the interface that is specifying the set values for the TC.GSS power supply. (Can e.g. be defined by TopControl.) If a set value source is not defined, the active interface -2- is displayed.
2	<b>Active interface<sup>2</sup></b> , menu item Selection of the actual interface with which the device is to be operated. The selection has an effect on parameters in the system settings – DISPLAY 20, Table 58, Seite 143. Possible interface selections: Internal: Is not used. RS232 <sup>3</sup> : Interface see paragraph. HMI: Human-Machine-Interface Analog: Interface X105, see paragraph
3	<b>Voltage limit</b> , text box [V] Selection of the voltage $U_{\text{limit}}$ from which the device indicates an overvoltage error and the output is electrically isolated. Value range: $0 \text{ V} - 1.1 * U_{\text{Max}}$ ; default: $1.1 * U_{\text{Max}}$
4	<b>Current limit</b> , text box [A] Selection of the current $I_{\text{limit}}$ from which the device indicates an overcurrent error and the output is electrically isolated. Value range: $0 \text{ V} - 1.1 * I_{\text{Max}}$ ; default: $1.1 * I_{\text{Max}}$
5	<b>Intern. resistance<sup>1</sup></b> , text box [mΩ] Default: up to upper value limit 1000 mΩ. As an option the value limit can be extended to 32000 mΩ.

Table 56 HMI screens and menu (selection)

<sup>1</sup> Can be expanded on customer request.<sup>2</sup> Active interface: defines the active control interface: the message "HMI ist passiv" (HMI is passive) means that the HMI is not the active interface or there is more than one HMI in the system and another HMI has the "master role".<sup>3</sup> RS232: the selection of the RS232 menu item activates both the RS232 and also the optional RS422/USB interface. To avoid conflicts it is only allowed to use one interface.

## 7.3.4.6. MENU level – windows and their information

## Main menu – DISPLAY 10

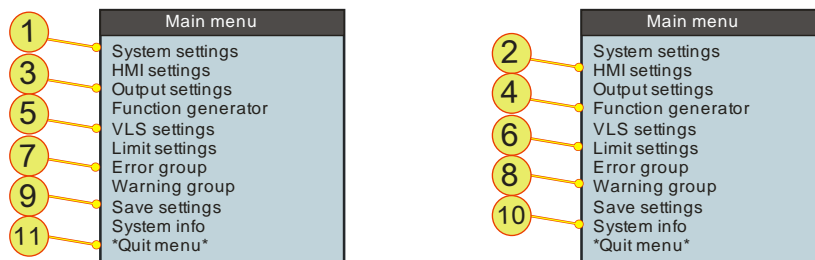


Fig. 77 Main menu DISPLAY10 is used to open windows for entering various options and parameters.

Main menu – DISPLAY 10	
1	<b>System settings</b> , navigation item Opens DISPLAY 20, see Fig. 78, Seite 19.
2	<b>HMI settings</b> , navigation item Opens DISPLAY 21, see Fig. 79, Seite 144.
3	<b>Output settings</b> , navigation item Opens DISPLAY 22, see Fig. 81, Seite 146.
4	<b>Function generator</b> , navigation item Opens DISPLAY 23, see Fig. 82, Seite 147.
5	<b>VLS settings</b> , navigation item Opens DISPLAY 24, see Fig. 84, Seite 151.
6	<b>Limit settings</b> , navigation item Opens DISPLAY 25, see Fig. 86, Seite 153.
7	<b>Error group</b> , navigation item Opens DISPLAY 26, see Fig. 87, Seite 154.
8	<b>Warning group</b> , navigation item Opens DISPLAY 27, see Fig. 87, Seite 154.
9	<b>Save settings</b> , menu item All changes made are saved and are available again on the next system start.
10	<b>System info</b> , navigation item Opens DISPLAY 28, see Fig. 74, Seite 139.
11	<b>*Quit menu*</b> , Return to the DISPLAY level to DISPLAY 1, 2, see Fig. 75 Seite 140.

Table 57 Navigation items on DISPLAY10 for opening other windows.

## System settings – DISPLAY 20



Fig. 78 System settings

System settings – DISPLAY 20	
1	<b>Active interface<sup>1,2</sup></b> , menu item Selection of the actual interface with which the device is to be operated. Corresponds to parameters of the same name in DISPLAY 3, Table 56, Seite 141.
2	<b>Passband ref. values</b> , menu item Cut-off frequency for the input filter for the reference values is set. Value range: 0.1 Hz – 1.6 kHz, in 15 steps.
3	<b>Passband feedb. values</b> , menu item Cut-off frequency for the output filter for the actual values is set. Value range: 0.1 Hz – 1.6 kHz, in 15 steps.
4	<b>*Quit menu*</b> , Return one level up in the hierarchy.

Table 58 <sup>1</sup>Active interface: defines the active control interface: the message "HMI ist passiv" (HMI is passive) means that the HMI is not the active interface or there is more than one HMI in the system and another HMI has the "master role".  
<sup>2</sup>RS232: the selection of the RS232 menu item activates both the RS232 and also the optional RS422/USB interface. To avoid conflicts it is only allowed to use one interface.

## HMI settings – DISPLAY 21

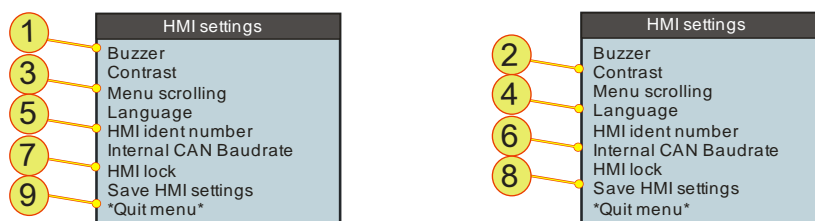


Fig. 79 HMI settings to change the properties of the HMI.

HMI settings – DISPLAY 21	
1	<b>Buzzer</b> , menu item Built-in buzzer outputs a tone in case of an error. Selection: On/Off; On $\triangleq$ Buzzer tone; Off $\triangleq$ No Buzzer tone; default: ON
2	<b>Contrast</b> , menu item Value range: 0 % - 100 %; 0 % $\triangleq$ White; 100 % $\triangleq$ Black; default: 35 %
3	<b>Menu scrolling</b> , menu item Cursor position reacts as per the direction of rotation of the JogDial. Selection: "Clockwise down"/"Clockwise up" default: "Clockwise up"
4	<b>Language</b> , menu item Selection: German/English
5	<b>HMI ident number</b> , menu item Value range: 1 – 16; default: 1 ( $\triangleq$ Master)
6	<b>Internal CAN baud rate</b> , menu item The transmission rate on the CAN bus is displayed.
7	<b>HMI lock</b> , navigation item Open the submenu, see Table 60, Seite 145.
8	<b>Save HMI settings</b> , menu item This menu item causes the HMI settings to be saved immediately. Settings are retained also if the device is switched off in the meantime. The display can be left using the <ESC> button or by confirming again using the JogDial.
9	<b>*Quit menu*</b> , Return one level up in the hierarchy.

Table 59 HMI settings

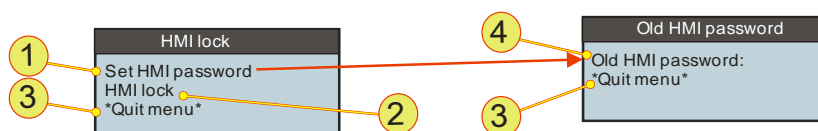
**HMI lock and setting password – DISPLAY 30/40**

Fig. 80 HMI lock, the HMI can be locked against changes using a password.

HMI lock and setting password – DISPLAY 30, 40	
1	<b>Set HMI password</b> , navigation item If you want to define a new password. Open the “Old HMI password” window – DISPLAY 40
2	<b>HMI lock/HMI unlock</b> , menu item The HMI can be protected against changes. For the locking and unlocking process, the correct password must be entered at the password prompt. Default password: 0
3	<b>*Quit menu*</b> , Return one level up in the hierarchy.
4	<b>Old HMI password/New HMI password</b> First you must confirm the old password before you can enter a new password. Value range: 0 - 32767; default: 0

Table 60 Locking the HMI using a password.  
The password comprises a number that can be selected.

**CAUTION Do not forget your password!**

If you have forgotten your password, it is only possible to reset the password with a hardware reset after contacting support.

Avoidance:

⇒ Make a note of your password and keep it in a safe place!

## Output settings – DISPLAY 22



Fig. 81 Entry of the output settings – DISPLAY22

Output settings – DISPLAY22	
1	<b>Voltage</b> , menu item [V] Specification of the set value for the voltage $U_{Set}$ Value range: 0 V – $U_{Max}$ ; default: 0 V
2	<b>Current</b> , menu item [A] Specification of the set value for the current $I_{Set}$ Value range: 0 A – $I_{Max}$ ; default: 0 A
3	<b>Power limit</b> , menu item [kW] Specification of the set value for the power $P_{Set}$ Value range: 0 kW – $P_{Max}$ ; default: $P_{Max}$
4	<b>Internal resistance</b> , menu item [mΩ] Specification of the set value for the internal resistance $R_{Set}$ Value range <sup>1</sup> : 0 mΩ - 1000 mΩ; default: 0 mΩ
5	<b>*Quit menu*</b> , Return one level up in the hierarchy.

Table 61 Entry of the output settings – DISPLAY 22

<sup>1</sup>The value range can be increased as an option. If required, please contact Regatron support.

## Function generator – DISPLAY 23



Fig. 82 Function generator – DISPLAY 23



For information on the properties and a description of the features of the function generator see chapter 5.3.1, Seite 81.

Function generator – DISPLAY23	
1	<b>General enable</b> , menu item Function generator is activated or deactivated.
2	<b>Fn.Sequence settings</b> , menu item Opens the function sequence window.
3	<b>Load Fn. Sequence</b> , menu item The required function sequence number is entered using the JogDial and loaded after acceptance (by pressing JogDial). The process can be cancelled using the ESC button. Value range: 0 - 1000
4	<b>Auto load Fn.Sequence</b> , menu item Automatically loads the function sequence given on each powerup. To save these settings permanently, the *Save settings* menu item must be selected on the HMI main menu.
5	<b>Save Fn.Sequence</b> , menu item The required function sequence number is entered using the JogDial and saved after acceptance (by pressing JogDial). <b>Sequence number does not exist in the memory:</b> There is a confirmation on saving <b>Sequence number has already been saved once:</b> Confirmation prompt as to whether the existing sequence number is to be overwritten. The process can be cancelled using the ESC button Value range: 0 - 1000

The table is continued on the next page.

Function generator – DISPLAY23	
6	<p><b>Delete Fn.Sequence,</b> The required function sequence number is entered using the JogDial and deleted after acceptance (by pressing JogDial).</p> <p><b>Sequence number entered exists:</b> Confirmation of the deletion process Confirmation can be closed using &lt;ESC&gt;.</p> <p><b>Sequence number entered does not exist:</b> Message that the sequence number does not exist Message can be closed using &lt;ESC&gt;.</p> <p>Value range: 0 - 1000</p>
7	<b>*Quit menu*</b> , Return one level up in the hierarchy.

Table 62 Function generator – DISPLAY 23



## Function Sequence – DISPLAY 31

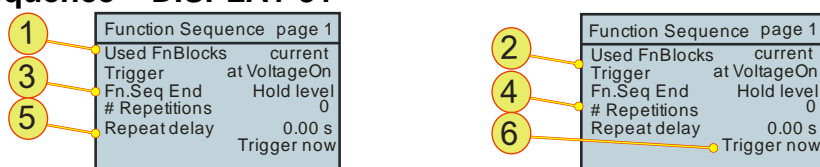


Fig. 83 Settings for the individual function sequences

Function Sequence – DISPLAY 31	
1	<p><b>Used FnBlocks</b>, menu item</p> <p>Function blocks selected here have a direct effect on the indication in the Display mode. (see especially DISPLAY 2).</p> <p>Possible selections:</p> <p><b>none:</b> All function blocks are deactivated.</p> <p><b>Voltage:</b> Voltage function block is active.</p> <p><b>Current:</b> Current function block is active.</p> <p><b>Power:</b> Power function block is active.</p> <p><b>U+I:</b> Voltage and current function blocks are active.</p> <p><b>U+P:</b> Voltage and power function blocks are active.</p> <p><b>I+P:</b> Current and power function blocks are active.</p> <p><b>U+I+P:</b> All function blocks are active.</p>
2	<p><b>Trigger</b>, menu item</p> <p>Event that triggers the function block selected in -1-:</p> <p><b>atVoltageOn:</b> As soon as device output is switched live.</p> <p><b>Manual:</b> Manual triggering via TopControl or HMI/RCU via -6-.</p> <p><b>Pin on X105:</b> As soon as there is a high level on pin 19 on interface X105.</p>
3	<p><b>FnSeq End</b>, menu item</p> <p>On continuous repetition -4- FnSeq End has no significance.</p> <p>Selection of the output setting that is present on the output after the end of a function sequence:</p> <p><b>VoltageOff:</b> The output is electrically isolated.</p> <p><b>Hold level:</b> Last set values in the function block are present on the output.</p> <p><b>Std. setvalues:</b> The set values on the active interface are present on the output.</p>
4	<p><b># Repetitions</b>, menu item</p> <p>Number of times a function block is repeated.</p> <p>Value range: 0 – 65000; 0 <math>\hat{=}</math> Continuous; default: 0</p>

The table is continued on the next page.

Function Sequence – DISPLAY 31 (continued)	
5	<b>Repeat delay</b> Waiting time between function block repetitions. Value range: 0 - 650 s; step width: 0.01 s ; default: 0 s
6	<b>Trigger now</b> , menu item Manual trigger, starts a function block. (Press the JogDial) Conditions: Trigger -2- is set to "Manual". The device is switched on (voltage on).

Table 63 Function generator – function sequence blocks – DISPLAY 23

## VLS settings (page 1) – DISPLAY 24

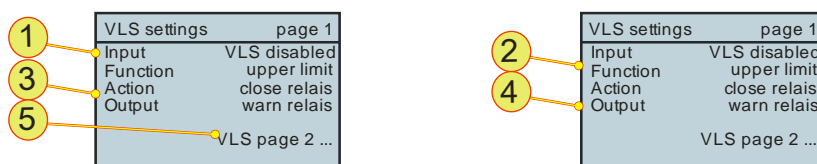


Fig. 84 VLS settings page 1 – DISPLAY 24

VLS settings page 1 – DISPLAY 24	
1	<b>Input</b> , menu item Selection of the actual values to which the VLS function reacts: <b>VLS disabled:</b> The VLS function is disabled. DISPLAY 5 and DISPLAY 6 cannot be seen on the DISPLAY. <b>Voltage:</b> VLS reacts to the actual value for the output voltage. <b>Current:</b> VLS reacts to the actual value for the output current. <b>Power:</b> VLS reacts to the actual value for the output power.
2	<b>Function</b> , menu item Selection of the thresholds from -1- at which the VLS function reacts: <b>upper limit:</b> VLS reacts to an upper signal threshold. <b>lower limit:</b> VLS reacts to a lower signal threshold. <b>inside window:</b> VLS reacts to signals within threshold window. <b>outside window:</b> VLS reacts to signals that are outside a threshold window.
3	<b>Action</b> , menu item How the switching relay defined in -4- is to react: <b>open relais:</b> The relay is to open when the state set in -2- occurs. <b>close relais:</b> The relay is to close when the state set in -2- occurs.
4	<b>Output</b> , menu item Which relay is to be operated with VLS. <b>warn relais, run relais, OK/alarm relais.</b>
5	<b>VLS page 2 ...</b> , navigation item Continue to page 2 of the VLS settings – DISPLAY32

Table 64 VLS settings page 1 – DISPLAY 24

## VLS settings (page 2) – DISPLAY 32



Fig. 85 VLS settings page 2 – DISPLAY 32

VLS settings page 2 – DISPLAY 32	
1	<b>Upper limit or Lower limit, menu item<sup>1</sup> [V], [A], [kW]</b> Whether the upper limit or lower limit can be entered depends on the function selected on VLS page 1 (DISPLAY 24). See Table 64, Seite 151. Input range: Voltage <sup>1</sup> : $-2 \cdot U_{Max} - 2 \cdot U_{Max}$ Current <sup>1</sup> : $-2 \cdot I_{Max} - 2 \cdot I_{Max}$ Power <sup>1</sup> : $-2 \cdot P_{Max} - 2 \cdot P_{Max}$
2	<b>Upper hysteresis or Lower hysteresis, menu item<sup>1</sup> [V], [A], [kW]</b> Whether the upper hysteresis or lower hysteresis can be entered depends on the function selected on VLS page 1 (DISPLAY 24). See Table 64, Seite 151. Value range: Voltage <sup>1</sup> : $-2 \cdot U_{Max} - 2 \cdot U_{Max}$ Current <sup>1</sup> : $-2 \cdot I_{Max} - 2 \cdot I_{Max}$ Power <sup>1</sup> : $-2 \cdot P_{Max} - 2 \cdot P_{Max}$
3	<b>Act--&gt; inact delay, menu item [ms]</b> Delay from the active to the inactive state. Value range: 0 ms – 3600 ms; step width: 0.1 ms; default: 0 ms.
4	<b>Inact--&gt; act delay, menu item [ms]</b> Delay from the inactive to the active state. Value range: 0 ms – 3600 ms; step width: 0.1 ms; default: 0 ms.
5	<b>VLS page 1 ..., navigation item</b> Return to page 1 of the VLS settings – DISPLAY24

Table 65 VLS settings page 2 – DISPLAY 24

<sup>1</sup>Unit is dependent on the source selected on VLS page 1 Table 64.

Limit settings – DISPLAY 25

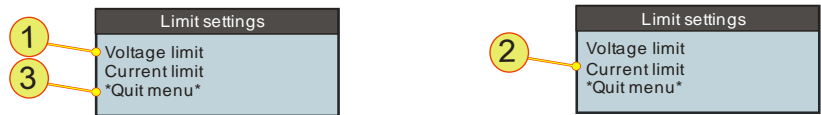


Fig. 86 Limit settings – DISPLAY 25

Limit settings – DISPLAY25	
1	<b>Voltage limit<sup>1</sup></b> , menu item [V] Value range <sup>2</sup> : 0 V – 1.1* U <sub>Max</sub>
2	<b>Current limit<sup>1</sup></b> , menu item [A] Value range <sup>2</sup> : 0 A – 1.1* I <sub>Max</sub>
3	<b>*Quit menu*</b> , Return one level up in the hierarchy.

Table 66 Limit settings – DISPLAY 25  
<sup>1</sup> Value at which the device switches to the error state.  
(over-voltage/current protection)  
<sup>2</sup> Maximum value is device-dependent

## Warning group and Error group – DISPLAY 26/27



Fig. 87 Indication of errors – DISPLAY 26 and warnings DISPLAY 27.

Warning group and Error group – DISPLAY 26, 27	
1	<p>Indication of error status, ready-only indication and navigation item</p> <p><b>Message with no errors:</b></p> <p>“no Errors”</p> <p>Not a navigation item, cannot be selected</p> <p>→Quit message using -3-.</p> <p><b>Message with error:</b></p> <p>&lt;Error group&gt;&lt;Short description&gt;</p> <p>Navigation item, can be selected</p> <p>→Message can be clicked using JogDial.</p> <p>A more detailed error description is displayed.</p>
2	<p>Indication of warning status, read-only indication and navigation item</p> <p><b>Message with no warnings:</b></p> <p>“no Warnings”</p> <p>Not a navigation item, cannot be selected</p> <p>→Quit message using -3-.</p> <p><b>Message with warning:</b></p> <p>&lt;Error group&gt;&lt;Short description&gt;</p> <p>Navigation item, can be selected</p> <p>→Message can be clicked using JogDial.</p> <p>A more detailed warning description is displayed.</p>
3	<b>*Quit menu*</b> , Return one level up in the hierarchy.

Table 67 Warning and error indications

<sup>1</sup> For a detailed description and information of troubleshooting please see the warning and error list in the appendix, see chapter 10.2, Seite 275.

### 7.3.5. Troubleshooting using the HMI

(HMI: Human Maschine Interface)

#### 7.3.5.1. Acknowledging warning and error messages

If error states occur, the electrical power supply changes to the Error operating state.

The electrical power supply is returned to the Ready state by acknowledging the error messages (<Escape> button on the main screen) if the reason for the error has been rectified.

Acknowledging will delete all actual warnings and error messages.

→Prior to acknowledging, all messages in the error and warning lists must be analysed. In particular the error and warning sub-groups provide further, more detailed information on the error or the warning.

#### 7.3.5.2. Error during initialisation

Errors that occur during the initialisation are indicated in a separate window. After the error window is acknowledged, the main screen appears. The electrical power supply is in the Error state and the message Login Error is displayed in the message bar on the main screen. After eliminating the reason for the error, a restart (switch off and on at the circuit breaker) is required:

The following initialisation errors are displayed in an error window.

Error	Reason and correction
"No call for login"	The internal CAN connection cable between device and HMI is not correctly connected. →HMI: contact manufacturer. →RCU: check seating of cable connection between RCU and X101 interface, otherwise contact manufacturer.

Table 68 Error description, HMI initialisation (login error)

### 7.3.5.3. Error during operation

The errors that occur during operation are indicated both in the message bar on the main screen and on the Error group menu – DISPLAY. A differentiation is to be made between descriptions for group errors and detail errors. Detail errors are combined into a group error. Only the group error appears in the message bar, the detail errors can be checked on the menu.

For a complete list of all group and detail errors, as well as the warnings, see chapter 10.2, Seite 275.

The communication errors listed in the following table are initially displayed in a separate window. After the selection knob or **<Escape>** is pressed, the separate window disappears and the message *Communication Error* appears in the message bar on the main menu. The electrical power supply changes to the *Error* operating state.

Error	Reason and correction
CAN controller error	The CAN controller is in the Bus-Off state.
No data received by HMI	The HMI or RCU is not receiving any data. →Check the connection of the connection cable between power supply and RCU →CANTERM terminating resistor present on the end of the CAN bus?

Table 69 Error description for HMI errors during operation



In the TopControl application error lists can be further broken down. The error list can also be cleared using the TopControl command “Clear Errors”.

### 7.3.5.4. Warnings during operation

The warnings that occur during operation are indicated both in the message bar on the main screen and on the *Warning group* menu. A differentiation is to be made between descriptions for group warnings and detail warnings. Detail warnings are combined into a group warning. Only the group warning appears in the message bar, the detail warnings can be checked on the menu.

For a complete list of all group and detail errors, as well as the warnings, see chapter 10.2, Seite 275.



## 7.4. TopControl application

### 7.4.1. Introduction

The user-friendly TopControl application is included with the power supply.

It enables you as the user to communicate with the power supply. The connection is made via the RS-232 serial interface from a PC and its Windows operating system.

The functionality of TopControl includes:

- Switching on/off the output voltage.
- Setting the reference/set values.
- Indication of the actual values.
- Indication of warning and error states.  
(Including the error history)
- Indication of further information on the TopCon power supply.
- Software oscilloscope: "Scope".  
Recording and analysis of various variables (set values, actual values, system state, etc.).

By means of a user concept it is possible to access advanced functionality in password-protected levels:

- Configuration of multi-unit operation.
- Online access to PID control parameters  
Adaptation of the control characteristics of the power supply to the load-specific situation.
- Linear ramp functions.  
Programming of linear ramp functions for voltage activation and set value steps (set value gradient limiter).
- Setting the limit values.
- Adjustment, modification of internal system parameters.
- Reading the version states of the software.
- Firmware update.

On the procurement of the TFE/function generator option the functionality is expanded:

- Function generator for time-dependent function curves  
Complete control of the function generator via user-defined functions  $U = f(t)$ ,  $I = f(t)$ ,  $P = f(t)$  and time-dependent set values (incl. import from Excel .csv files)
- Definition of function curves that can be freely selected  
 $U = f(I)$ ,  $U = f(P)$ ,  $I = f(U)$ ,  $I = f(P)$ , ...
- Curves can be loaded, run, created and saved, e.g. photovoltaic and rechargeable battery charging curves.

## 7.4.2. Hardware and software requirements

### 7.4.2.1. Hardware

The current PC generation surpasses by a long way the minimum hardware requirements for the TopControl application.

Hardware required by TopControl

Resource	Minimum requirement
Computer	X86 computer (Pentium or later)
RAM	8 MB
Spare hard disk space	4 MB
Drive	CD-ROM (for software installation)
Interface	RS-232/COM (@ 38400 baud)
Internet interface	Internet access useful, e.g. for software updates, or data exchange, but not necessary.

Table 70 Minimum hardware required for the TopControl application.



### No serial interface on the PC

Communication as a virtual COM port can be established between the PC and TC.GSS power supply using a USB-to-serial adapter.

As an alternative, the following options are available for the TC.GSS power supply:

- USB interface option (USB)  
The TC.GSS power supply can be operated via a USB interface.
- Ethernet option  
The TC.GSS power supply can be operated via the Ethernet using the Ethernet-to-RS232 converter.



### No CD-ROM drive

The installation software can be transferred to a USB memory stick on another computer with a CD-ROM and then installed on the remote computer from the USB memory stick.

#### 7.4.2.2. Software

The TopControl application will run on the following operating systems:

Operating system	Comment
<b>MS Windows</b>	Win2k <sup>®</sup> , 32/64-bit systems: WinXp <sup>®</sup> , Vista <sup>®</sup> , Win 7 <sup>®</sup>
<b>LINUX</b>	Can only be used via a Windows emulator

Table 71 Minimum operating system required for the TopControl application.

#### 7.4.3. Installation of the software

TopControl is supplied with an installation program. Follow the instructions in the installation program, which will correctly install the application on the Windows system.

An older version of TopControl on the computer will be uninstalled first and the new version installed.



If older versions of the TopControl application are not uninstalled automatically, the application must be uninstalled manually. For this purpose use the operating system's uninstall wizard.

#### 7.4.3.1. Connection between PC and TopCon power supply

**CAUTION** Possible damaging of interface RS-232 by:

- Peak current and static electricity

Avoidance:

- ⇒ All devices with a connection via RS-232 should not have voltage at the interface, before the connection is mechanically produced.

Conditions for a successful connection between the PC with the TopControl application and the TopCon power supply:

- 1:1 RS-232 interface cable (commercially available)  
The interface cable is included in the items supplied with the power supply.
- The Rx and Tx data wires are not crossed.
- Connection of the PC's COMx serial interface to the power supply's RS-232 serial interface.
- The power supply must be connected to the electrical supply system and the circuit breaker switched on.

### 7.4.3.2. Start/communication with the TopCon power supply

#### Procedure on establishing communication

- Switch on the power supply.
- Start the TopControl application.
- ↳ The software searches for the COM ports from port 0..10.  
A connection is made automatically to the first TopCon power supply connected via the serial interface.
- ↳ If the TopCon power supply is not detected by the TopControl application, the following message window appears.

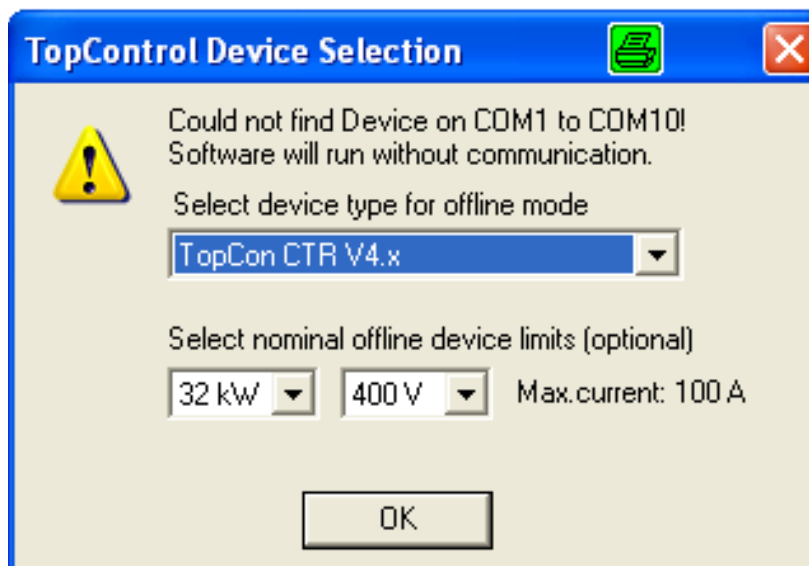


Fig. 88 Message window if TopControl does not detect the TC.GSS power supply.

- ↳ The software is run in the Offline mode as soon as you accept the message using the <OK> button.
- ↳ Check the RS-232 connections!
- ↳ Is the interface perhaps in use by another program or another instance of TopControl?
- ↳ If the virtual COM port > 10, you can connect a power supply to the TopControl application using the following console command:  
'C:\Program Files\Regatron\TopControl\TopControl.exe /COMStart=5 /COMEnd=5'  
Where COMStart= start of search and COMEnd= end of search
- ↳ If the connection problem persists, please contact Regatron support.



If the communication between the TopControl application and the TopCon power supply fails, the connection can be re-established manually.

**Procedure for a connection after communication failure**

- On the menu bar select <Connect> on the <File> menu.  
Or restart the TopControl application.
- ↳ Communication is re-established.

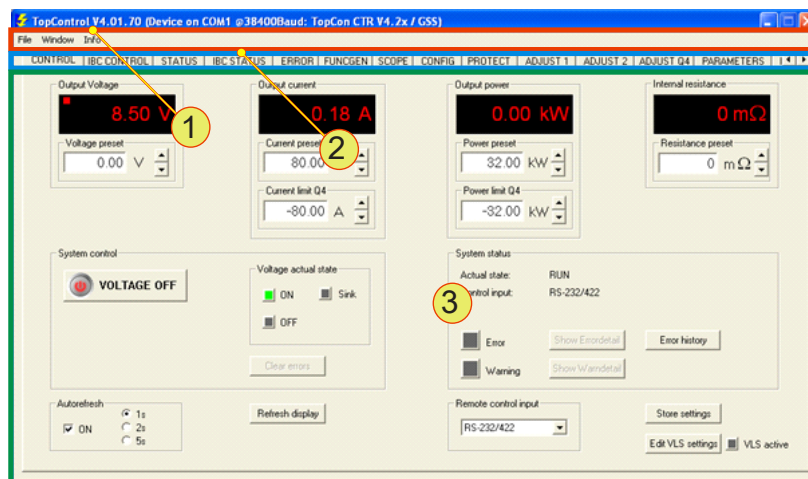
**7.4.4. Function areas of the software user interface**

Fig. 89 Overview of the individual function areas of the graphic user interface for the software.

Function areas of the graphic user interface	
1	<b>Menu bar</b> The individual menu items are primarily used for communication, system maintenance and activating options.
2	<b>Tab</b> Different functions are allocated to the related tabs. The number of tabs visible may change depending on the functionality provided by enabled options or user rights.
3	<b>Indication and configuration area</b> The parameters for the functions that are allocated to a tab are indicated and configured here.

Table 72 Explanation of the function areas on the graphic user interface.

### 7.4.5. TopControl - user levels and password



An HMI password is independent of a TopControl password. The authorisation concepts for the HMI and TopControl have no effect on each other.

#### 7.4.5.1. The user level concept

In the TopControl application there are different user levels that are assigned corresponding authorisations.

Depending on the program window currently open, if the level of authorisation is insufficient some menu items will not be available or it will not be possible to open some tabs.

On the other hand menu items and tabs (with the related functionality) that are available can be opened and used.

#### The concept for the access control/password

To change from one user level to another user level, it may be necessary to enter a password (see Table 73, unterhalb).

User level	Description
<b>Standard User</b>	A password is not required (default configuration on delivery).
<b>Advanced User</b>	The password required is: " <b>kilowatt</b> " After restarting the software, the password remains valid without limitation.
<b>Power User</b>	" <b>Single-day-password</b> ": A password is required and can be requested from Regatron support. This password is only valid on the day it is issued.
<b>Factory</b>	This user level is reserved for Regatron.

Table 73 Authorisation concept for access to the user levels.

## Changing to a different user level

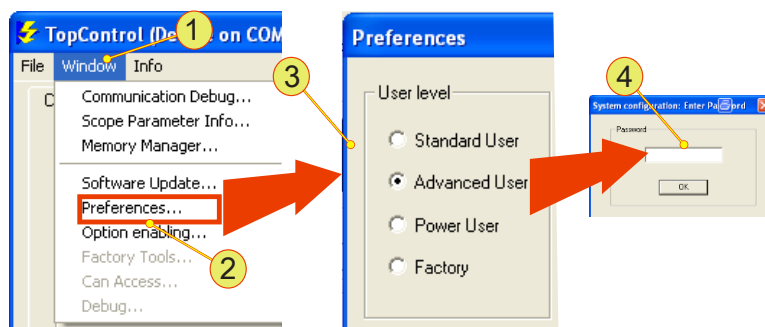


Fig. 90 Opening a new user level in the <Preferences> window.

### Procedure:

- Select the <Preferences> -2- menu item on the <Window> -1- menu on the menu bar.
  - ↳ The “Preferences” -3- window opens.
- Select the new user level and accept your selection using <Save and exit>.
  - ↳ The dialog box for entering the password-4- appears.
- After you have entered the password and accepted the password using <OK>, re-start the TopControl application.
  - ↳ The next time the program starts you must first enter the password before the required functionality is displayed in the software.



**7.4.6. Menu bar – user level and functionality**

User level	Functionality available on the menu													
Menu	File				Window									Info
Standard User	☑			☑	☑	☑			☑	☑				☑
Advanced User	☑		☑	☑	☑	☑		☑	☑	☑				☑
Power User	☑		☑	☑	☑	☑	☑	☑	☑	☑				☑
Factory	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
	Connect./Disconnect	Load/Save/, Save As...	Parameters	Exit	Communication Debug	Scope Parameter Info...	Memory Manager...	Software Updates...	Preferences...	Option enabling...	Factory Tools	CAN Access...	Debug... *	(About-Dialog)

☑ = Access to the functionality is allowed in this user level

\* = The Debug mode is disabled in all devices supplied.

Table 74 Menu functionality as a function of the user level.

## 7.4.6.1. Tabs - user level and functionality

Available tabs	User level				
CONTROL	☑	☑	☑	☑	175
STATUS	☑	☑	☑	☑	178
ERROR	☑	☑	☑	☑	
FUNCGEN	☑	☑	☑	☑	183
SCOPE	☑	☑	☑	☑	199
CONFIG		☑	☑	☑	219
PROTECT		☑	☑	☑	226
ADJUST 1			☑	☑	228
ADJUST 2			☑	☑	220
ADJUST Q4			☑	☑	233
IBC CONTROL				☑	–
IBC STATUS				☑	–
IBC TEST IO				☑	–
IBC TEST WR				☑	–
PARAMETERS			☑	☑	235
I/O CONTROL			☑	☑	230
DEVICE INFO	☑	☑	☑	☑	247
	Standard User	Advanced User	Power User	Factory	See page

☑ = Access to the functionality is possible/allowed in this user level

Table 75 Functionality on the tabs as a function of the user level.



The Factory user is only for use by the manufacturer. Tabs that require the “Factory” user level are not displayed in normal operation and are not further addressed in this manual.

## 7.4.7. Using the software – menu bar

### 7.4.7.1. Menu – File

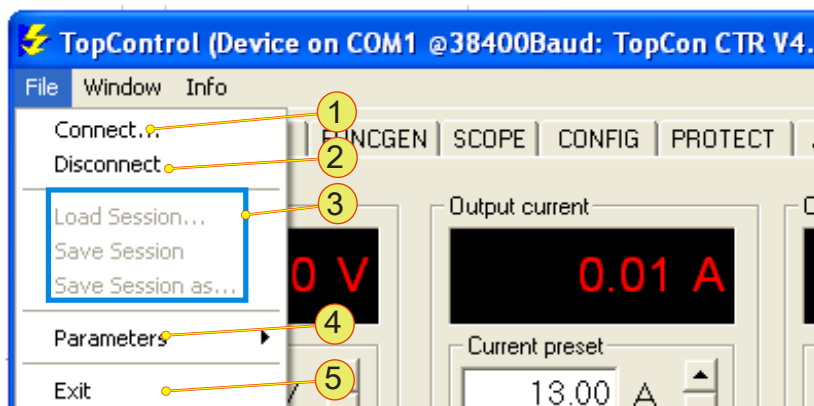


Fig. 91 Items on the File menu.

Items on the File menu	
1	<b>Connect...</b> TopControl attempts to establish a connection to an active TC.GSS power supply via the COM interface. Once a device has been found, communication is initialised. For information on establishing a connection, see chapter 7.4.3.2, Seite 161.
2	<b>Disconnect</b> Closes the active connection. If the TopCon is in the "Voltage On" status, the software outputs a warning that must be accepted using Ok so that the connection can be closed.
3	<b>Functions reserved for the manufacturer</b> Only for use by the manufacturer!
4	<b>Parameters</b> , user level required: "Advanced User" Store to file... TopCon GSS power supply parameters are saved as a gridfile. Restore from File Parameters saved as a gridfile are written to the TC.GSS power supply. For further information see Table 77, Seite 168.
5	<b>Exit</b> The TopControl application is quit.

Table 76 Items on the "File" menu on the menu bar.

## Saving and writing parameters

It is possible to save all the parameters that are displayed in TopControl as a gridfile or to restore parameters from a gridfile.



Before you change control parameters, you should save a gridfile with your system settings on the PC.

You can then restore the original settings.

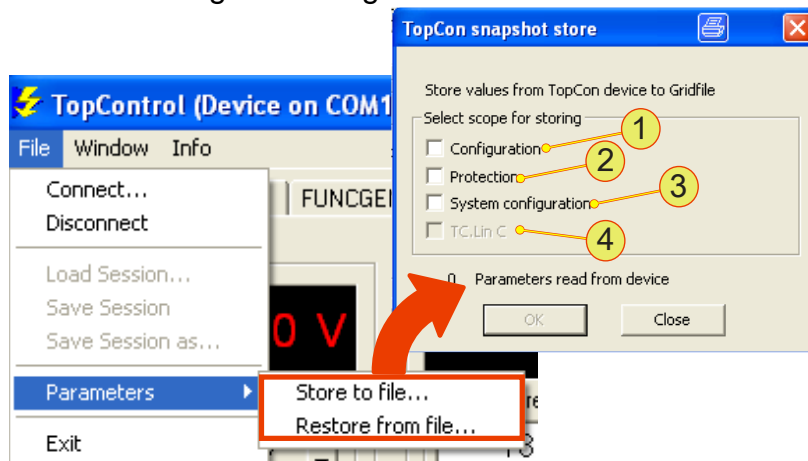


Fig. 92 Selecting the parameters that are to be saved or loaded.

Parameters - meaning	
1	<b>Configuration</b> , check box All parameters from the <CONFIG> tab are used.
2	<b>Protection</b> , check box All parameters from the <PROTECT> tab are used.
3	<b>System configuration</b> , check box Parameters for the operation of the TopCon GSS power supply in a multi-unit system. The parameters can be found on the <CONFIG> tab after clicking the <System Configuration> button.
4	<b>TC.Lin C</b> These parameters are available if you operate a TC.LIN with the TopCon.

Table 77 List and meaning of parameters that can be opened on the "Parameters" submenu, "Store to file..." or "Restore from file...".  
It is possible to select more than one set of parameters.

## 7.4.7.2. Menu – Window

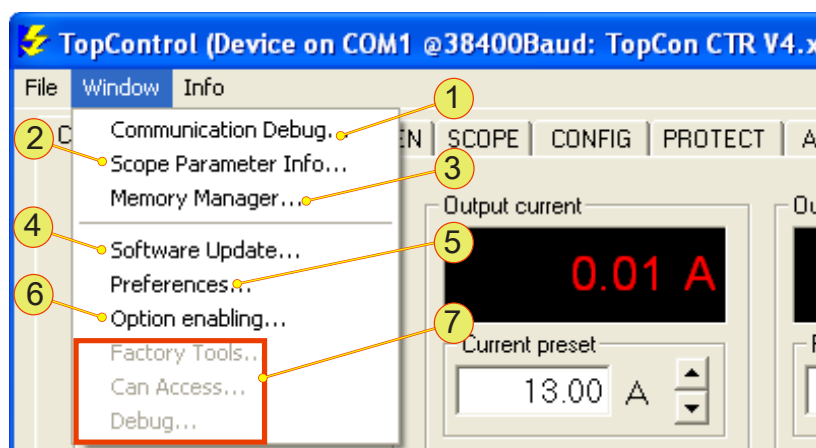


Fig. 93 Items on the "Window" menu.

Items on the Window menu	
1	<b>Communication Debug...,</b> menu item Indication of the communication between the TopControl application and the TopCon power supply in a new window. Only the reference data exchanged are displayed.
2	<b>Scope Parameters Info...,</b> menu item All variables and their values from the last scope recording are indicated. For information on the <Scope> tab, see chapter 7.4.8.4, Seite 199.
3	<b>Memory Manager...,</b> user level required: "Power User" Functions for sending values directly to the TopCon power supply and for reading values (RAM, flash).
4	<b>Software Update...</b> Opens a dialog box using which the following software can be updated: Firmware: Main DSP, Peripheral DSP, Modulator DSP Interfaces: CAN+USB interface, GPIB interface For information on the rest of the procedure, please contact support.
5	<b>Preferences...</b> Opens a dialog box for the following entries: User level to be used to access TopControl. Default folders for gridfiles, var files and init files.
6	<b>Option enabling...</b> Opens a dialog box using which program options can be activated by entering an enable key. See procedure in chapter 9.4, page 256.
7	<b>Functions reserved for the manufacturer</b> Only for use by the manufacturer!

Table 78 Items on the Window menu.



## Setting the preferences

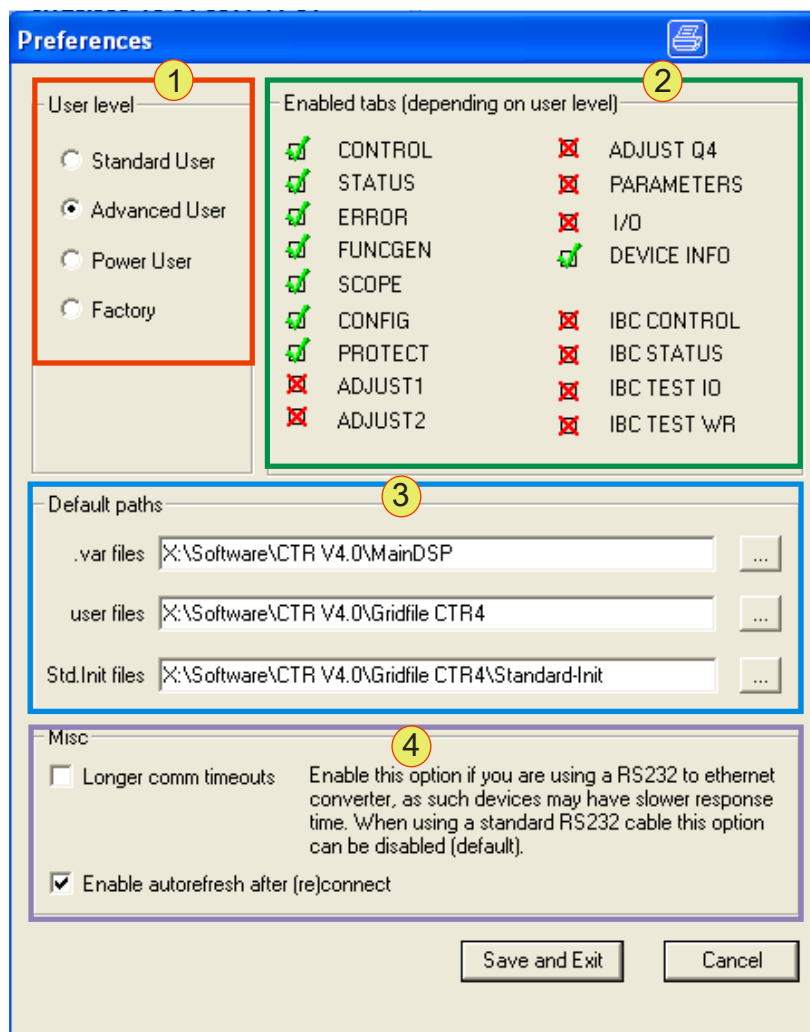


Fig. 94 Preferences window.

Settings made in **-1-**, **-3-** and **-4-** are only applied after they have been accepted by clicking the <Save and Exit> button.

- ↳ The “Preferences” window is closed.
- ↳ Close the window without applying any changes using the <Cancel> button.

Preferences – meaning of parameters	
1	<b>User level</b> , list of options Selection of the user level. The indication in <b>-2-</b> changes as a function of the selection. For information on changing the user level, see chapter 7.4.5.1, Seite 163.
2	<b>Enabled tabs</b> , read-only indication Indication of which tabs (functions) are available. Whether the tabs are available depends on the user level <b>-1-</b> . For allocation of functions to user levels, see Table 75, Seite 166.
3	<b>Default paths</b> , text boxes (or corresponding <...> button) User files:           Default folder for gridfiles You can define a specific folder from which the gridfiles are loaded or to which they are saved. .var files and Std. Init files: Only for use by the manufacturer!
4	<b>Misc, check boxes</b> Longer comm timeouts: Activation necessary if you use an RS232-to-Ethernet converter and there are communication problems. Default: cleared Enable autorefresh after (re)connect: Automatic updating of the parameters after (re)-connection to the TC.GSS power supply. Default: selected

Table 79 Parameters in the Preferences window.



7.4.7.3. Menu – Info



Fig. 95 Indication of the program version.

Info – version indication	
1	<b>TopControl Version</b> , read-only indication Indication of the actual version of the software installed.
2	<b>TopCon DLL Version</b> , read-only indication Indication of the program library actually installed for custom software usage.

Table 80 Indication of the software version.



State the related version numbers in case of need for support

#### 7.4.8. Using the software – tabs



This section describes the tabs in TopControl.

Note that the tabs available depend on the actual user level, see chapter 7.4.4, Seite 162.

## 7.4.8.1. Tab – &lt;CONTROL&gt;

User level: from Standard User

You can specify on the <CONTROL> tab the set values (presets) for the outputs; the actual values along with the possible errors and warnings are displayed.

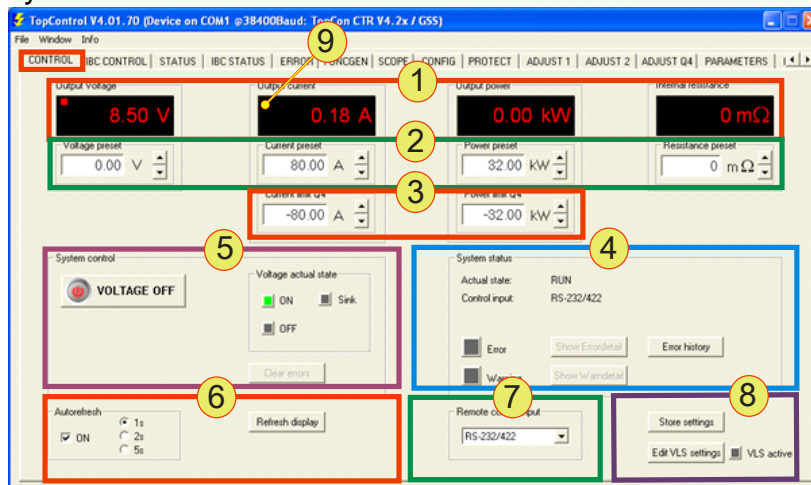


Fig. 96 Parameters on the <CONTROL> tab.

Tab – CONTROL	
1	<b>Output</b> , indication of actual values Output Voltage, Output Current, Output Power, Internal resistance Controller indicator: See <b>-8-</b> , red indication $\triangleq$ Normal indication
2	<b>Preset</b> , text boxes for set values (reference values) for Q1 Voltage preset, Current preset, Power preset, Resistance preset The related maximum value for the input is dependent on the limit value set on the <PROTECT> tab, chapter 7.4.8.6, Seite 226.
3	<b>Limit Q4</b> Current limit Q4 and Power limit Q4 Specification of the regenerative current and regenerative power The related maximum value for the input is dependent on the limit value set on the <PROTECT> tab, chapter 7.4.8.6, page 226.

The table is continued on the next page.

Tab – CONTROL (continued)							
4	<p><b>System control</b>, group</p> <p><b>&lt;VOLTAGE ON/OFF&gt; button</b></p> <p>&lt;VOLTAGE ON&gt; On actuation the label changes to VOLTAGE OFF The power supply output provides power if there is a load. “Voltage actual state” read-only indication changes to ON (green).</p> <p>&lt;VOLTAGE OFF&gt; On actuation the label changes to VOLTAGE ON. The power supply output is electrically isolated. “Voltage actual state” read-only indication changes to OFF (red).</p> <p><b>&lt;Clear errors&gt; button</b></p> <p>Actual errors are acknowledged, but are retained in the error history. The reason for the error should be rectified first.</p>						
5	<p><b>System status</b>, read-only indication of system state RUN, READY, ERROR indication Control input indicates the interface set in <b>-6-</b>. For information on the Error and Warning indication as well as the &lt;Show Errordetail&gt; and &lt;Show Warndetail&gt; buttons see Table 82, Seite 177.</p>						
6	<p><b>Autorefresh</b>, check box</p> <p>The window is refreshed cyclically if the check box is selected. Default: the check box is selected. The times for refreshing the indication that can be selected: 1 s, 2 s, 5 s; default: 1 s &lt;Refresh display&gt; button refreshes the window immediately.</p>						
7	<p><b>Remote control input</b>, list box</p> <p>The following interfaces for device remote control can be selected:</p> <table border="0"> <tr> <td>Analog inputs</td><td>For information on analogue remote programming see chapter 7.2.2, Seite 122.</td></tr> <tr> <td>TC.HMI/RCU</td><td>For information on programming via HMI/RCU also in a multi-unit system see chapter 4.4.3.4, Seite 65.</td></tr> <tr> <td>RS-232/422</td><td>For information on programming via RS-232 e.g. using TopControl see chapter 7.4, page 157.</td></tr> </table> <p>Internal references Only for use by the manufacturer!</p>	Analog inputs	For information on analogue remote programming see chapter 7.2.2, Seite 122.	TC.HMI/RCU	For information on programming via HMI/RCU also in a multi-unit system see chapter 4.4.3.4, Seite 65.	RS-232/422	For information on programming via RS-232 e.g. using TopControl see chapter 7.4, page 157.
Analog inputs	For information on analogue remote programming see chapter 7.2.2, Seite 122.						
TC.HMI/RCU	For information on programming via HMI/RCU also in a multi-unit system see chapter 4.4.3.4, Seite 65.						
RS-232/422	For information on programming via RS-232 e.g. using TopControl see chapter 7.4, page 157.						
8	<p><b>Settings</b></p> <p>&lt;Store settings&gt; Settings made are written directly to the flash memory for the TopCon GSS power supply. The TopCon continues to use these settings, even when the TC.GSS power supply is switched on again.</p> <p>&lt;Edit VLS settings&gt; Opens the “Versatile limit switch” function. For information on parameterisation via TopControl see chapter 7.2.7.2, Seite 129.</p>						
9	<p><b>Controller indicator</b></p> <p>The position of the red square indicates the active controller. I.e. whether the device is in current, voltage or power limiting. The same as the “Control” LED indication on the HMI.</p> <table border="0"> <tr> <td>Red indication</td><td>Normal indication</td></tr> <tr> <td>Yellow indication</td><td>Only with sense function activated</td></tr> </table> <p>For further information see chapter 4.3.1, Seite 41.</p>	Red indication	Normal indication	Yellow indication	Only with sense function activated		
Red indication	Normal indication						
Yellow indication	Only with sense function activated						

Table 81 Parameters on the &lt;CONTROL&gt; tab.

## Troubleshooting in &lt;System status&gt; group

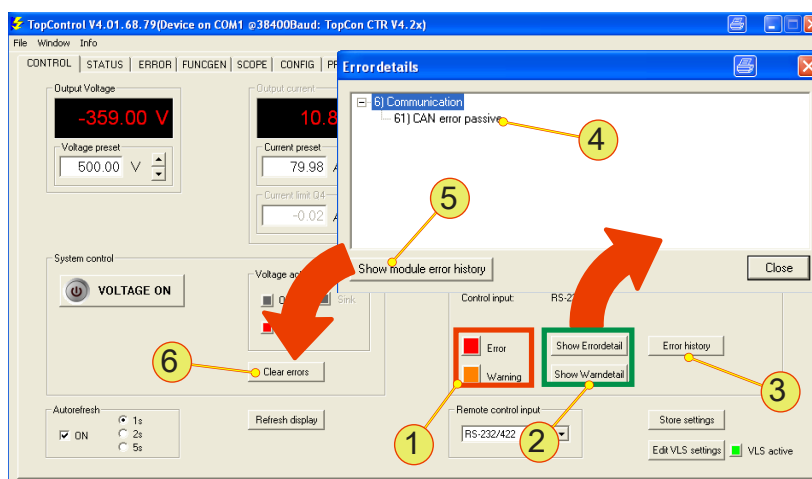


Fig. 97 Screenshots of the System status group and the "Errordetails" dialog box.

System status group – parameter description	
1	<b>Error or warning indication</b> Red colour: There is an error. Orange colour: There is a warning. Grey colour: There is no error or warning.
2	<b>Buttons<sup>1</sup></b> <Show Errordetail> <b>In case of an error</b> Button is activated (black font). Makes it possible to open error messages -4-. <b>No error</b> Button is deactivated (grey font). Not possible to open the error messages -4-. <Show Warndetail> Same as in <Show Errordetail>, only for warnings.
3	<b>&lt;Error history&gt;</b> , button List of the error messages that have occurred is opened.
4	<b>Error-/Warndetails<sup>1</sup></b> , dialog box for indicating errors/warnings An error indicated is listed in the related error group. An error description has an error code and error keywords. This information is used for troubleshooting using an error list. For error list see chapter 10.2.2, Seite 277.
5	<b>&lt;Show module error history&gt;</b> see -3-.
6	<b>&lt;Clear errors&gt;</b> button After the reason for the error has been rectified with the aid of the information indicated -4- and the error list, the error status can be reset using the <Clear errors> buttons. The device is then ready for operation again.

Table 82 Parameters in the System status group.

<sup>1</sup> Similar procedure for warnings.

## 7.4.8.2. Tab – &lt;STATUS&gt;

User level: from Standard User

The <STATUS> tab indicates important values in an overview, such as voltages, currents and temperatures.

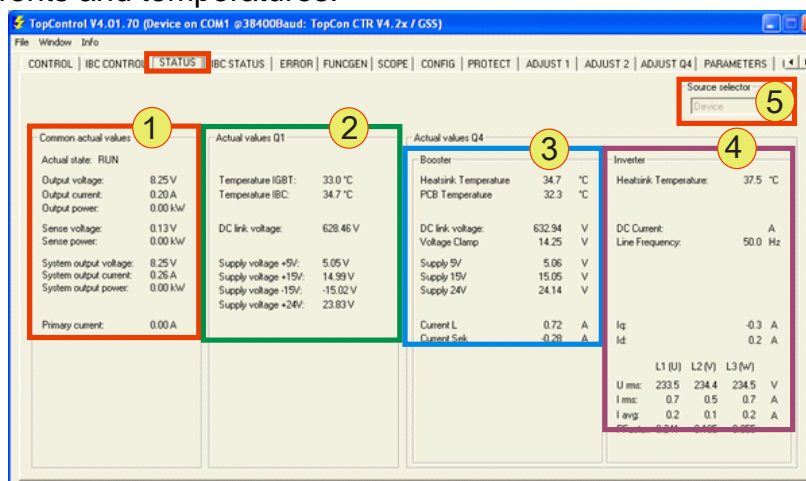


Fig. 98 Parameters on the <STATUS> tab.

STATUS tab – overview	
1	<b>Common actual values</b> For further information see Table 84, Seite 179.
2	<b>Actual values Q1</b> For further information see Table 85, Seite 180.
3	<b>Actual values Q4 – Booster</b> For further information on the booster parameters see Table 86, Seite 181.
4	<b>Actual values Q4 – Inverter</b> For further information see Table 87, Seite 182.
5	<b>Source selector, list box</b> Selection active On the master device in the multi-unit system. Selection inactive On single device, or slave device in a multi-unit system. Possible selections with Source selector active: “Master” All parameters are displayed. “Slave 0xXX” Only “Common actual values” -1- group is displayed. “System” Only “Common actual values” -1- group is displayed.

Table 83 Overview of the groups on the <STATUS> tab

**Group – “Common actual values”**

This group is always visible independent of the selection in “Source selector”.

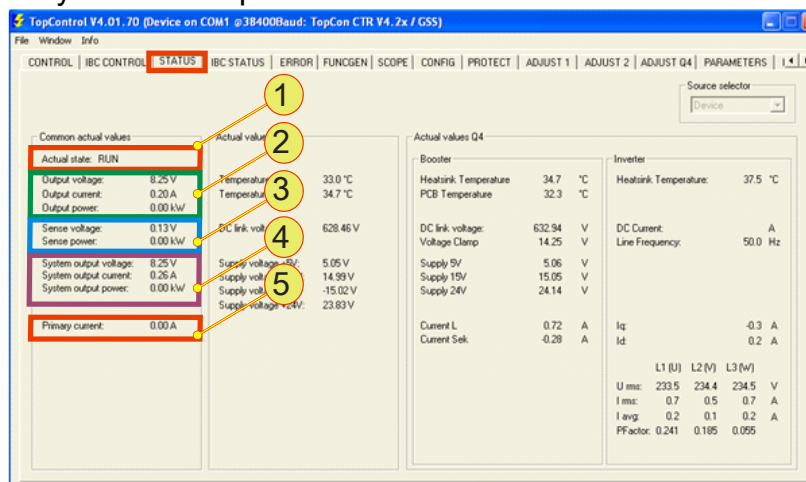


Fig. 99 “Common actual values” group on <STATUS>.

STATUS tab – “Common actual values” group	
1	<b>Actual state</b> , read-only indication Indicates the actual system status of the master device or slave device, depending on the selection in “Source selector” <sup>1</sup> . For further information on system states see Table 20, Seite 51
2	<b>Output voltage/current/power</b> , read-only indications The actual values for the output voltage, output current and output power are displayed. The actual values are dependent on the selection in “Source selector” <sup>1</sup> .
3	<b>Sense voltage/power</b> , read-only indication The sense power indicated is calculated from the sense voltage measured and the actual current. (Actual current value is dependent on “Source selector” <sup>1</sup> ).
4	<b>System output voltage/current/power</b> , read-only indication The system parameters indicated (system output voltage, output voltage and output power) are determined from the type of configuration in the multi-unit system. For further information on multi-unit operation see Table 115, page 224.
5	<b>Primary current</b> , read-only indication Indication of the device internal primary current (DC intermediate circuit to the output transformer). The indication is dependent on the selection in “Source selector” <sup>1</sup> .

Table 84 “Common actual values” group.  
<sup>1</sup> Depending on “Source selector”

Group – “Actual values Q1”

Visible with “Source selector” selection:  
“Master” or “Device” (single device).

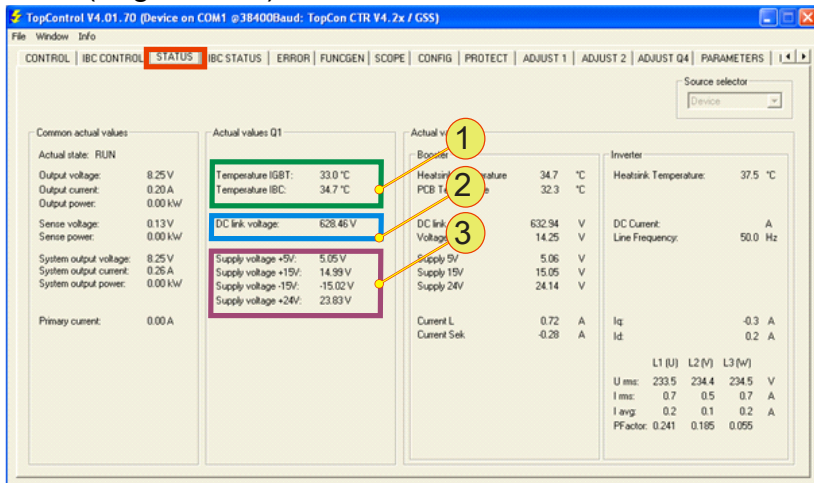


Fig. 100 “Common actual values” group on <STATUS>.

STATUS tab – “Actual values Q1” group	
1	<b>Temperature [°C]</b> , read-only indications Temperature IGBT Indicates the IGBT temperature on the heat sink Temperature Rectifier Indicates the rectifier temperature on the heat sink.
2	<b>DC link voltage [V]</b> , read-only indication Indication of the intermediate circuit voltage.
3	<b>Supply voltage [V]</b> Indication of the supply voltage for the controller board. Comparison of set values and actual values. If there are large differences between the values, an error message is output.

Table 85 “Actual values Q1” group.



**Group – “Actual values Q4” – “Booster”**

Visible with “Source selector” selection:  
“Master” or “Device” (single device).

Indication of actual parameters for the booster.

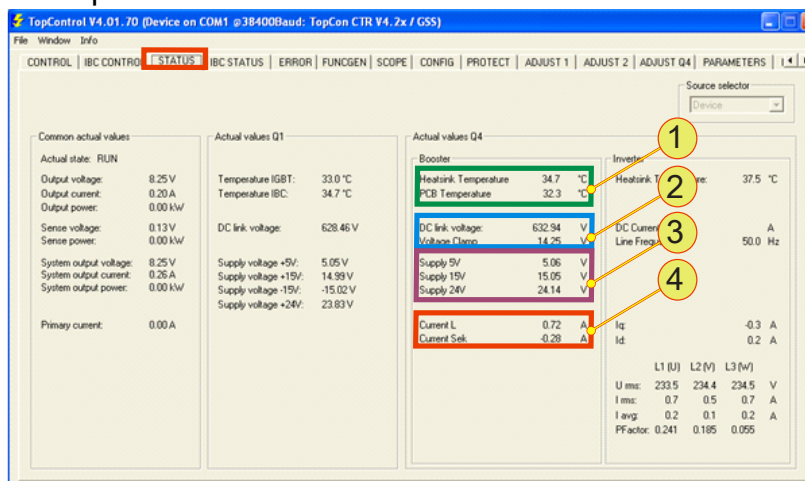


Fig. 101 Group – “Actual values Q4” – “Booster”

STATUS tab – “Actual values Q4” group – “Booster”	
<b>1</b>	<b>Temperature</b> Heatsink Temp. Booster heat sink temperature. PCB Temp. Temperature on the circuit board for the booster.
<b>2</b>	<b>Voltages</b> DC link voltage Intermediate circuit voltage Voltage Clamp Voltage at the charging capacitor for the booster.
<b>3</b>	<b>Supply voltages</b> Indication of the supply voltage for the booster board. Comparison of set values and actual values. If there are large differences between the values, an error message is output.
<b>4</b>	<b>Current</b> Current L Current in the storage choke for the booster. Current Sek Current on the secondary side of the transformer.

Table 86 Group – “Actual values Q4” – “Booster”

**Group – “Actual values Q4” – “Inverter”**

Visible with “Source selector” selection:  
“Master” or “Device” (single device).

Indication of actual parameters for the inverter.

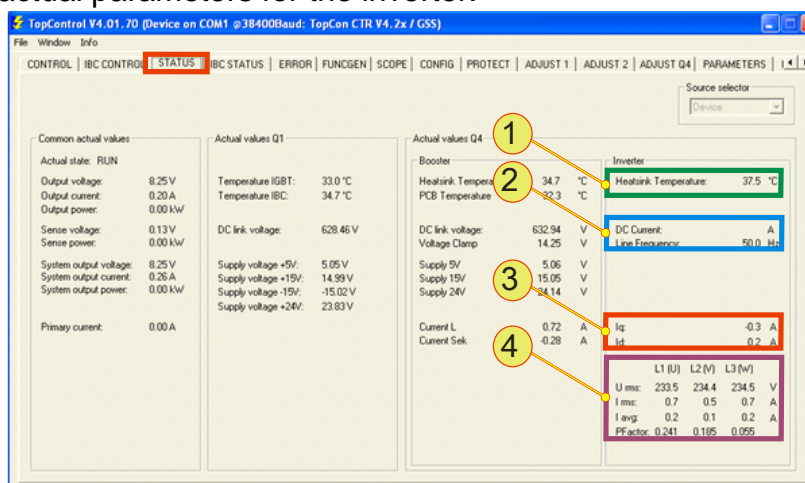


Fig. 102 Group – “Actual values Q4” – “Inverter”

STATUS tab – “Actual values Q4” group – “Inverter”	
1	<b>Heatsink Temperature</b> , read-only indication [°C] Inverter heat sink temperature
2	<b>DC Current</b> , read-only indication [A] Indication of the inverter DC current for the regeneration <b>Line Frequency</b> , read-only indication [Hz] Indication of the actual mains frequency present
3	<b>Current</b> I <sub>q</sub> Reactive current term (imaginary term) of the total current I <sub>d</sub> Active current term (real term) of the total current
4	<b>Three-phase AC current and voltage</b> Indication of the actual Q4 parameters as a table Columns: Phase values at the transformer coils L1(U), L2 (V), L3 ( W) Rows: U <sub>max</sub> : Maximum AC voltage per phase I <sub>max</sub> : Maximum AC current per phase I <sub>avg</sub> : DC term per phase P <sub>Factor</sub> : Power factor cosφ (relationship between active power and apparent power)

Table 87

Group – “Actual values Q4” – “Inverter”

## 7.4.8.3. Tab – &lt;FUNCGEN&gt;

## Option name

TFEAAPControl (TopCon Function Generator Engine)

User level: from Standard User

If the TFEAAPControl option is not enabled, it can be operated in the Demo mode. Only enabled functions can be run in the TC.GSS power supply.

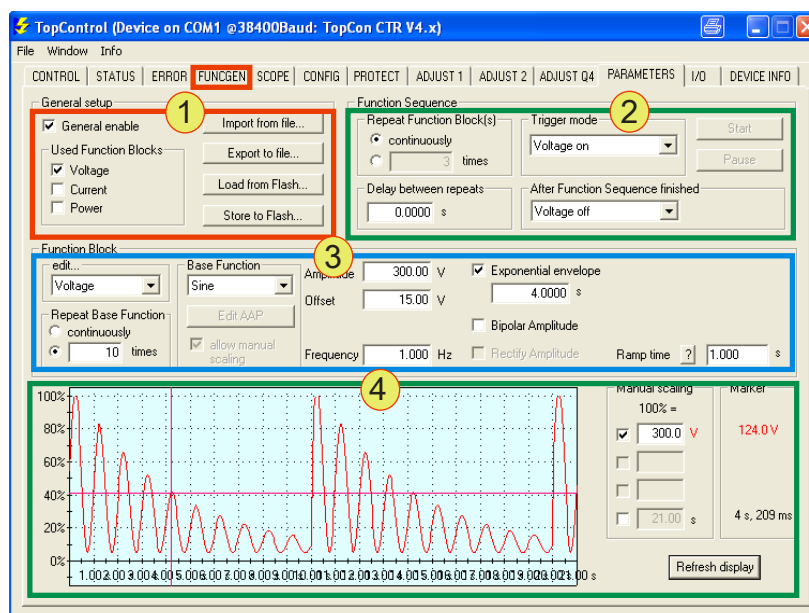


Fig. 103 Overview of the &lt;FUNCGEN&gt; tab.

The FUNCGEN tab can be divided into four groups to describe the individual function units of the function generator.

Overview of the groups on the <FUNCGEN> tab	
1	<b>General setup</b> , see Table 89, Seite 184 Here the function generator can be switched on and off, reference values can be searched for and functions loaded or saved.
2	<b>Function Sequence</b> , see Table 91, Seite 188 Function definitions -3- made are combined into function sequences. A pause is defined after a function sequence or which reference value is to be present on the output before or after a function sequence.
3	<b>Function Block</b> , see Table 93, Seite 192 Definition of the function parameters for the base functions from -1- that are used as the basis for function blocks. For information on the creation of user-defined and AAP curves see Table 94, Seite 193.
4	<b>Function indication</b> Graphic of the functions sequences defined using -3- and -2-.

Table 88 Group overview on the &lt;FUNCGEN&gt; tab.

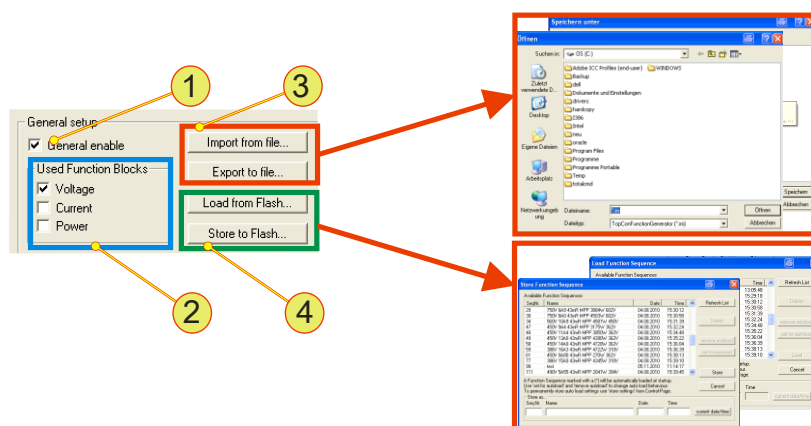
**“General setup” group on the <FUNCGEN> tab**

Fig. 104 “General setup” group on the &lt;FUNCGEN&gt; tab - overview.

<FUNCGEN> tab – “General setup” group	
1	<b>“General enable”, check box</b> Selected: The function generator is switched on. Parameters can be entered. Cleared: The function generator is switched off. Entire register is not available. No parameters can be entered.
2	<b>“Used Function Blocks”, group of check boxes</b> The following reference values can be selected separately or in combination to define one or more function blocks: “Voltage”, “Current”, “Power”
3	<b>&lt;Import from file...&gt;/&lt;Export to file...&gt;, buttons</b> Saves or loads a function sequence from the file system on the computer. For further information see Fig. 106, Seite 187.
4	<b>&lt;Load from Flash...&gt;/&lt;Store to Flash...&gt;, buttons</b> Saves or loads a function sequence from the internal non-volatile memory (flash) in the TC.GSS power supply. For further information see Table 90, Seite 186.

Table 89 Parameters in the “General setup” group - overview.

## Saving/loading function sequences via the flash memory in the TC.GSS power supply

The window in Fig. 105, unterhalb appears on saving a function sequence.

The window for loading has a similar structure.

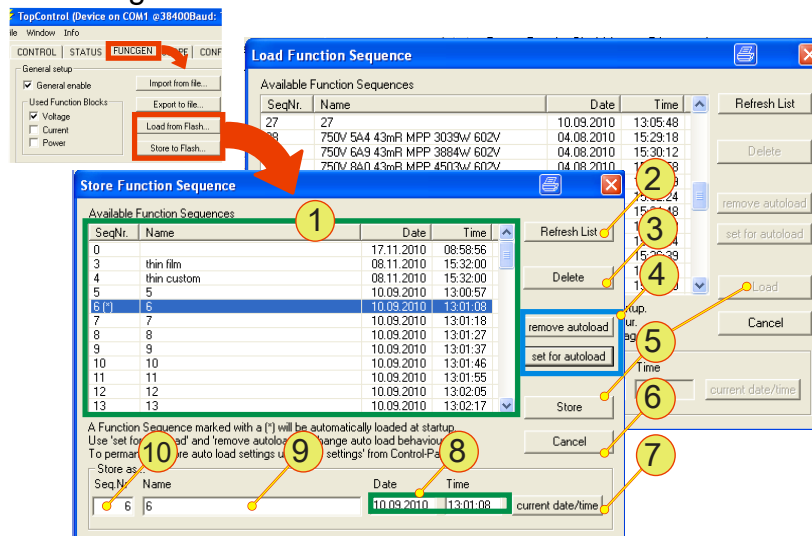


Fig. 105 Opening the “Store Function Sequence” or “Load Function Sequence” window.

<FUNCGEN> tab – “Store/Load Function Sequence” window	
1	<b>Available Function Sequences</b> , list The list contains all the “function sequences” saved in the non-volatile memory in the TopCon GSS power supply. The list can be refreshed using the button -2-.
2	<b>&lt;Refresh List&gt;</b> , button Refreshes the list -1- with the data from the non-volatile memory (flash) on the TC.GSS power supply.
3	<b>&lt;Delete&gt;</b> , button Permanently deletes an entry from the non-volatile memory (flash) on the TC.GSS power supply after a confirmation prompt.
4	<b>&lt;remove autoloading&gt;/&lt;set for autoloading&gt;</b> , buttons A function sequence can be started automatically on “Startup” of the TopCon GSS power supply. <set for autoloading> has the following effect: →Entry marked in blue in the list -1- is labelled with: “(*)” in the “Seq.Nr” column”. <remove autoloading> has the following effect: →The Autoloading label “(*)” is removed from the list entry. The changes made must be made known to the TC.GSS power supply. On the <CONTROL> tab click the “Store Settings” button, see Fig. 96, Seite 175.

The table is continued overleaf.

“Store/Load Function Sequence” window (continued)	
	<p><b>&lt;Store&gt;</b>, button in the “Store Function Sequence” window Saves the actual function sequence in the sequence number <b>-10-</b> given (1...1000). The content of <b>-8-</b>, <b>-9-</b>, <b>-10-</b> is used for the save. If the sequence number exists: Confirmation prompt as to whether the existing “Function Sequence” is to be overwritten.</p>
5	<p><b>&lt;Load&gt;</b>, button in the “Load Function Sequence” window The button is activated by selecting a function sequence on the list <b>-1-</b>. (Selecting: click using the left mouse button) →The selected function sequence is loaded from the non-volatile memory in the TopCon GSS power supply to the TopControl application. →The “Load Function Sequence” window is closed at the end loading process. →All parameters loaded are indicated on the &lt;FUNCGEN&gt; tab and the curve shown in the preview.</p>
6	<p><b>Cancel</b>, button Closes the dialog box and has the following effect: →Settings for remove autoload are retained. →Settings for set for autoload are retained. →Function sequences are not loaded. →Function sequences are not saved. →Function sequences deleted remain deleted! The changes made must be made known to the TC.GSS power supply. On the &lt;CONTROL&gt; tab click the &lt;Store settings&gt; button, see Fig. 96, Seite 175.</p>
7	<p><b>&lt;current date/time&gt;</b>, button This button sets the actual date and time; values can also be modified manually in the “Date” and “Time” <b>-8-</b> boxes.</p>
8	<p><b>Date/Time</b>, text box Date and time entry can be edited manually or generated automatically via <b>-7-</b>.</p>
9	<p><b>Name</b>, text box Manual label entry for the function sequence. Label length: maximum 30 alphanumeric characters.</p>
10	<p><b>Seq.Nr</b>, text box Entry of the function sequence number. Entry: numeric; value range: 1 – 1000 In case of duplicate numbers, a message appears on saving.</p>

Table 90 Parameters in the “Store Function Sequence” and  
“Load Function Sequence” window.



Use e.g. the key data for a curve to label a function sequence. If there are several curves on the list **-1-** you will then be able to identify the characteristics of the curve from the label.

## Saving/loading functions via the file system

The parameter set on the <FUNCGEN> tab can be saved in an ini file -**1**- in the folder you select -**2**- in the file system -**3**- or loaded again from there -**3**-.

File extensions: \*.ini

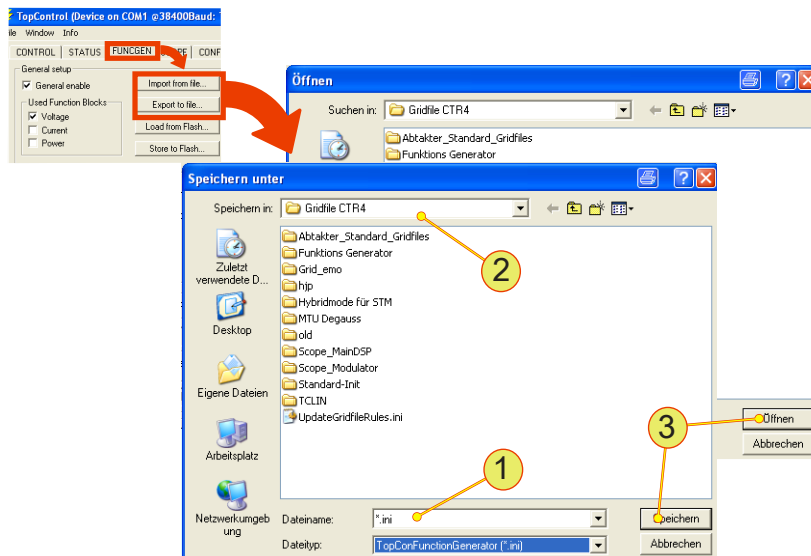


Fig. 106 “Save As” and “Open” window. The dialog boxes are the same except for -3-.



Use parameter settings for the name -**1**-, e.g. the key data for the function set in the parameters. If there are several files in a folder -**2**- you will be able to identify the characteristics of the curve from the name.

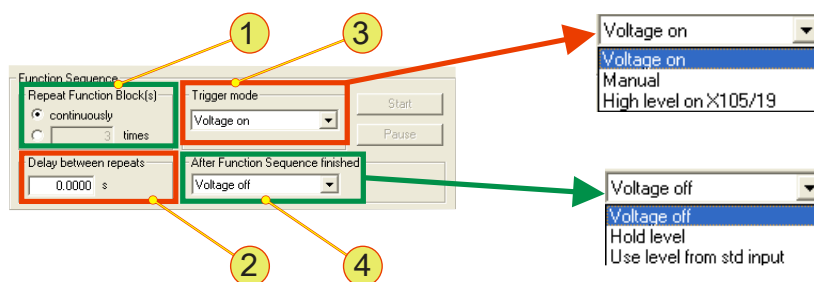
**“Function Sequence” group on the <FUNCGEN> tab**

Fig. 107 “Function Sequence” group.

<FUNCGEN> tab – “Function Sequence” group	
1	<b>Repeat Function Block(s), group</b> <b>“continuously”, option</b> Selected: →The function sequence is repeated continuously. →“times” text box is deactivated. <b>“times” option and text box</b> Selected: →The function sequence is repeated the number of times entered. →“continuously” option is cleared. Value range: 1 – 276447231 (repetitions)
2	<b>Delay between repeats, text box</b> Pause between the repetitions of a function sequence. Value range: 0 s – 100000 s, step width: 0.0001 s; default: 0 s
3	<b>“Trigger mode”, list box</b> The event that triggers a function is defined. “Voltage on” Function sequence is triggered as soon as there is power present on the device output. (See <CONTROL> tab, actuation of the <VOLTAGE ON> button). “Manual” Manual triggering via the <Start> button in TopControl, see Fig. 108, Seite 189 or via HMI/RCU see Table 63, Seite 150. “High level on X105/19” There is a high level on interface X105 on pin 19. Condition: Device status “VOLTAGE_ON” (power at the device output).
4	<b>After Function Sequence finished, list box</b> State of the device output after the end of the function sequence. “Voltage off” No power at the output. “Hold level” The last value in the function sequence is present on the output. “Use level from std. input” It is attempted to reach the reference value specified by the active interface on the device output.

Table 91 Parameters in the “Function Sequence” group.



## Manual triggering

Conditions for manual triggering are:  
(i.e. the <Start> button can be clicked)

- In the “Trigger mode” list box the entry “Manual” has been selected.
- The TC.GSS power supply is in the “VOLTAGE\_ON” state, see <CONTROL> tab.

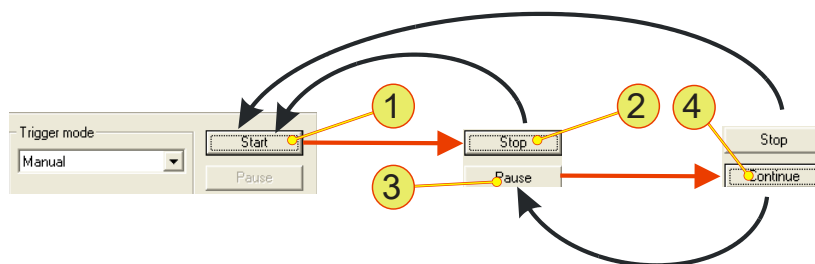


Fig. 108 Options during manual triggering.

<FUNCGEN> tab – “Trigger mode” group	
1	<b>&lt;Start&gt;</b> , button is clicked → Trigger event triggers the function sequence. → Button changes the function to <Stop> -2- → <Pause> -3- button is activated. If in Table 91, Seite 188 a specific number of function runs has been defined, the button changes automatically to <Stop> -2-.
2	<b>&lt;Stop&gt;</b> , button is clicked → Function sequence is ended and the TC.GSS power supply adopts the output value set in Table 91, Seite 188. → Function sequence can be started again via <Start> -1-.
3	<b>&lt;Pause&gt;</b> button is clicked → The function sequence is paused. → The actual output value is retained. → Button changes the function to <Continue> -4-.
4	<b>&lt;Continue&gt;</b> button is clicked → The function sequence is continued. → Button changes the function to <Pause> -3-.

Table 92 Manual triggering.

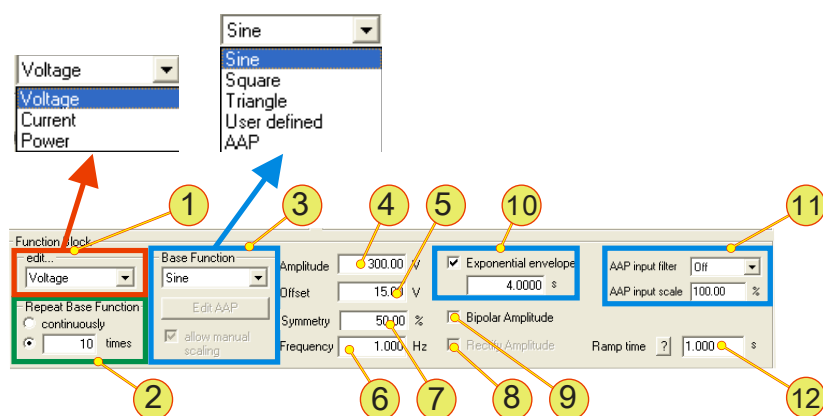
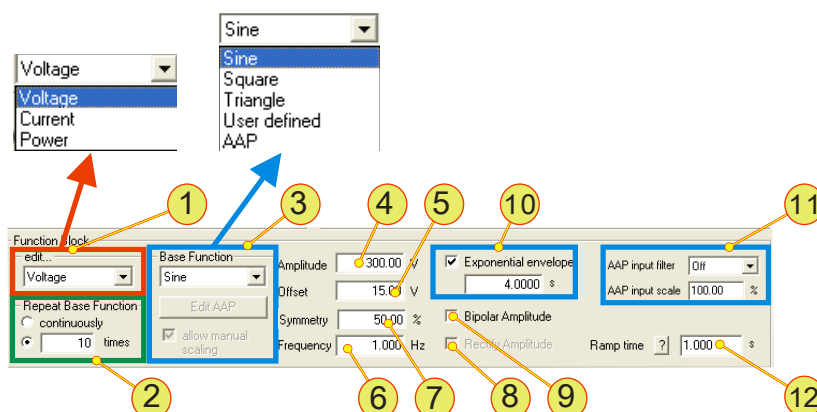
**“Function Block” group in the <FUNCGEN> tab**

Fig. 109 Overview of the “Function Block” group.

<FUNCGEN> tab – “Function Block” group	
1	<b>Edit<sup>1</sup></b> , list box It is possible to select up to 3 reference values for which the parameters can be set independently: Voltage, Current, Power.
2	<b>Repeat Base Function<sup>1</sup></b> , option and text box <b>“continuously”</b> Is selected → The base function selected in -3- runs continuously. → The “times” text box is deactivated. Is cleared → The “times” text box is activated. <b>“times”</b> The number of times the base function is run. Value range: 1 – 65535 (runs)

<sup>1</sup> Selection and activation is dependent on the selection “used Function Blocks” from Table 89, Seite 184.  
The table is continued on the next page.



Overview of the “Function Block” group.

<b>&lt;FUNCGEN&gt; tab – “Function Block” group (continued)</b>	
<b>3</b>	<p><b>Base Function</b>, group</p> <p>Entries in the list box for the base functions:</p> <p>“Sine”                      For sine function→hidden: <b>-7-</b>, <b>-11-</b></p> <p>“Square”                    For square function→hidden: <b>-11-</b></p> <p>“Triangle”                  For triangle function→hidden: <b>-11-</b></p> <p>“User defined”            For user-defined function                                         →hidden: <b>-6-</b>, <b>-7-</b>, <b>-11-</b>                                         →selected: “Edit user defined...”, button                                         →selected: “allow manual scaling”, check box.                                         For further information on the creation of user-defined curves see Fig. 111, Seite 195.</p> <p>“AAP”                        For Application Area Programming function                                         →hidden: <b>-6-</b>, <b>-7-</b>, <b>-11-</b>                                         →selected: “Edit AAP”, button                                         →selected: “allow manual scaling”, check box                                         For further information on the creation of an AAP function see Fig. 112, Seite 197.</p> <p><b>allow manual scaling</b>, check box</p> <p>Selected:                    Activated for entry: <b>-4-</b>, <b>-5-</b>                                         User-defined function or AAP curves is scaled to the amplitude <b>-4-</b> and offset <b>-5-</b> to be entered.</p> <p>Cleared                      Deactivated for entry: <b>-4-</b>, <b>-5-</b>                                         The amplitude and offset values are defined by the function definition for the user-defined functions or AAP curve.</p>
<b>4</b>	<p><b>Amplitude</b>, text box, the unit depends on the reference value in <b>-1-</b> Entry of the amplitude value for the base function.</p> <p>Depending on the selection in <b>-3-</b> the text box is activated or not available.</p> <p>Value range:              Negative nominal value – positive nominal value</p>
<b>5</b>	<p>Offset, <b>text box</b>, the unit depends on the reference value in <b>-1-</b> Offset value for the base function</p> <p>Depending on the selection in <b>-3-</b> the text box is activated or not available.</p> <p>Value range:              Negative nominal value – positive nominal value</p>

The table is continued on the next page.

<FUNCGEN> tab – “Function Block” group (continued)	
6	<b>Frequency</b> , text box Frequency for the base function. Cannot be applied to user-defined function and with AAP. There the time is defined individually for each separate point or there is no time dependency. Value range: 0.001 Hz – 1000 Hz
7	<b>Symmetry</b> , text box [%] Ratio between positive signal value and the period, like that for the positive signal edge for the triangle, or signal pulse for square Value range: 0 % – 100 %; default 50 %
8	<b>Rectify Amplitude</b> , check box To select “Rectify Amplitude” -9- must be selected. For user-defined and AAP functions this check box cannot be selected. (See “Base Function” group -3-). Selected: Rectification of negative amplitudes (positive values only) Cleared No rectification.
9	<b>Bipolar Amplitude</b> , check box Defines the value range for the base functions: Sine, square and triangle Value range (amplitude -4-): Selected: Function values between - Amplitude and + Amplitude. Cleared: Function values between 0 and +Amplitude.
10	<b>Exponential envelope</b> , check box and text box [s] Activates and deactivates an exponentially decaying amplitude envelope over the entire length of the function block. The information on the time constant is given in seconds. Within this time the amplitude falls to 37 %. The envelope starts after the amplitude has passed the maximum value for the first time (sine: after ¼ of the first period). In case of user-defined functions, on the other hand, the envelope starts only after the first period. The envelope only affects the amplitude, not the offset. Value range: 0.0001 s – 100000 s, step width: 0.0001 s, default : 0.0001 s
11	<b>AAP input filter</b> , list box Is ready for an entry if in the “Base Function” -3- “AAP” is selected in the list box. Using the input low pass filter, interference on the signal input (X axis on the AAP curve) can be filtered out. Value range: 0.1 Hz – 1600 Hz TP cut-off frequency, default: Off, Step width: doubling of the previous value <b>AAP input scale</b> , text box [%] Is ready for an entry if in the “Base Function” -3- group “APP” is selected in the list box and “allow manual scaling” is selected. The curve is compressed on the input side (X axis of the AAP curve) to the percentage entered. Value range: 0 % – 100 %, step width 1 %, default: 100 %
12	<b>Ramp time</b> , text box For applications see online help using the TopControl <?> button Value range: 0 – 86400 s; step sequence: 0.001 s; default: 0 s

Table 93 Parameters in the “Function Block” group.

## Conditions for AAP and user-defined curves

To be able to edit and create curves, certain conditions must be met.

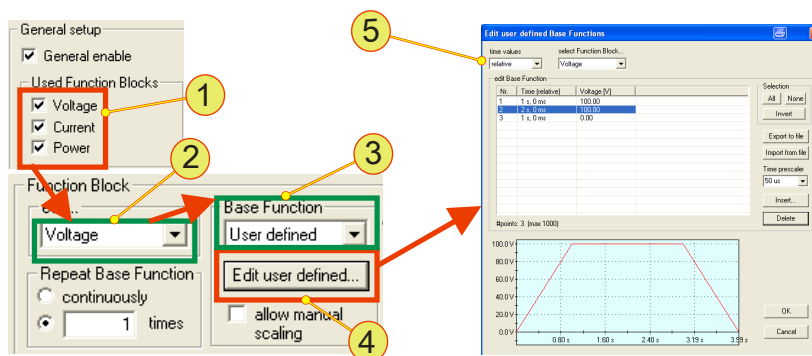


Fig. 110 Condition for opening the windows for editing user-defined and AAP curves.

Conditions for user-defined and AAP curves	
1	<b>Used Function Blocks, group</b> "General enable" in "General Setup" group must be selected. At least one selection from Voltage, Current or Power must be made. If a selection is not made or "General enable" is cleared, none of controls in the "Function Block" group box for editing are available.
2	<b>Function Block, group</b> Depending on the "Used Function Blocks" -1- selected a corresponding function block can be selected in the list box. The selection made here defines the reference value for the Y axis in the editor window -5-.
3	<b>Base Function, group</b> One of the following entries must be selected in the list box User defined: →The label for -4- changes to "Edit user defined..." AAP curve: →The label for -4- changes to "Edit AAP..."
4	<b>&lt;Edit user defined...&gt;/&lt;Edit AAP&gt;, button</b> The button changes its label and its function to suit the selection in -3-. A window for editing curves is always opened using the button.
5	<b>Window</b> Depending on the selection in -2- and -3- the window for user-defined or AAP curves opens.

Table 94 Conditions for user-defined and AAP curves.



## Creating user-defined functions ("User defined Base Functions")

"User-defined functions" are reference value functions in relation to the time axis.

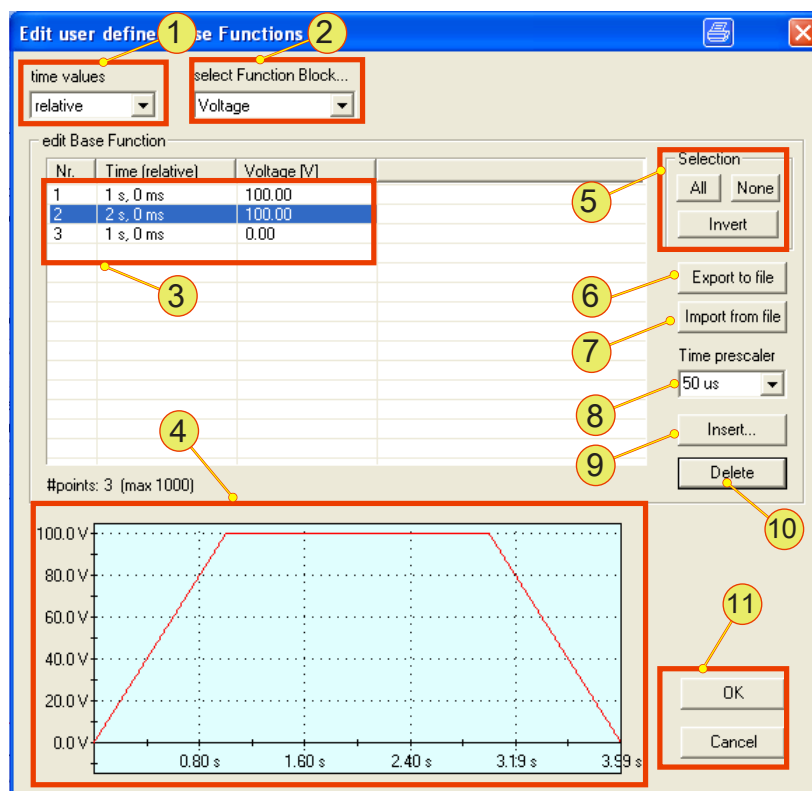


Fig. 111 Function generator - example of a user-defined function.

### "Edit user defined Functions" window – parameters

1	<b>time values</b> , list box relative:           The time information for a point refers to the previous point. absolute:           The time information for a point refers to the start of the curve. The selection has an effect on the position of points, see , -9-
2	<b>select Function Block...</b> , list box The list box contains the reference values that are selected in the "General setup" group. See "Conditions for user-defined curves" Table 94, Seite 193.
3	<b>edit Base Function</b> , list If the times specified are changed via the Time prescaler -8-, the time information is recalculated accordingly. The amplitude of the reference value remains constant. Edit points by double-clicking the line using the left mouse button.

The table is continued on the next page.

“Edit user defined Functions” window – parameters (continued)	
4	<b>Function indication</b> The curve of the values defined in -3- is displayed.
5	<b>Selection, group</b> All All list entries are selected. None All list entry selections are cleared. Invert List entries that are not selected are selected. All list entry selections are cleared.
6	<b>&lt;Export to file&gt;</b> , button opens dialog box In the dialog box opened the entries from the list of points -3- can be saved as a CSV file in a folder in the file system.
7	<b>&lt;Import from file&gt;</b> , button opens dialog box In the dialog box opened the entries for the list of points -3- can be imported from a CSV file in the file system. Existing entries in the list are overwritten during the import.
8	<b>Time prescaler</b> , combined data entry box and list box The entry or selection made here will affect the following points: →The time value for the actual point (list -3-) →New points entered. The following specified values can be selected: <b>Specified value Value range</b> (relative to the previous point) 50 µs 0.05 ms – 3,27675 s 1 ms 1 ms – 65,535 s 10 ms 0.01 s – 10 min + 55.35 s 100 ms 0.1 s – 109 min + 13.5 s 1 s 0.02 min – 18 h + 12.25 min 3 s 0.05 min – 54 h + 36.75 min
9	<b>&lt;Insert...&gt;</b> , button opens dialog box A dialog box is opened for the entry of points. The input range for the time values is dependent on the Time Prescaler settings -8-. The maximum reference value depends on the performance data of the TopCon GSS power supply. The position at which new points are inserted depends on “time values” -1-: In the case of “relative”:   →A new point is inserted at the end of the list, if a point is not selected in the list -3-. →A new point is inserted in front of a selected point in the list -3-. In the case of “absolute”: The point is placed in the window as a function of the time information in the list. If an entry for a time value already exists, it is overwritten. Value range: 1 point – 1000 points
10	<b>&lt;Delete&gt;</b> , button Deletes all points selected in the list after a confirmation prompt.
11	<b>&lt;OK&gt;</b> , <b>&lt;Cancel&gt;</b> , buttons close the window In the case of <Cancel> no changes are applied, while with <OK> the function sequence is written to the TC.GSS power supply again.

Table 95 Parameters in the “Edit user defined Functions” window.



## Creating AAP functions

Unlike the so-called “user-defined functions” considered up to now, which describe reference values in relation to time, in the AAP area the dependency of one reference value in relation to another is considered.

The AAP characteristic curve is created with the aid of the TopControl application (or using a custom program). Points can also be loaded via a CSV file.

If you import function parameters via a CSV file, pay attention to the data series you have defined as the reference values for the input (X axis) and the output (Y axis) so that you obtain the desired result.

The window for editing AAP curves has a similar structure to the window for user-defined functions and has the same functionality.

The various areas of the editor window are described below. For explanations on the remaining controls, please refer to “Creating user-defined functions”, see Table 95, Seite 196.

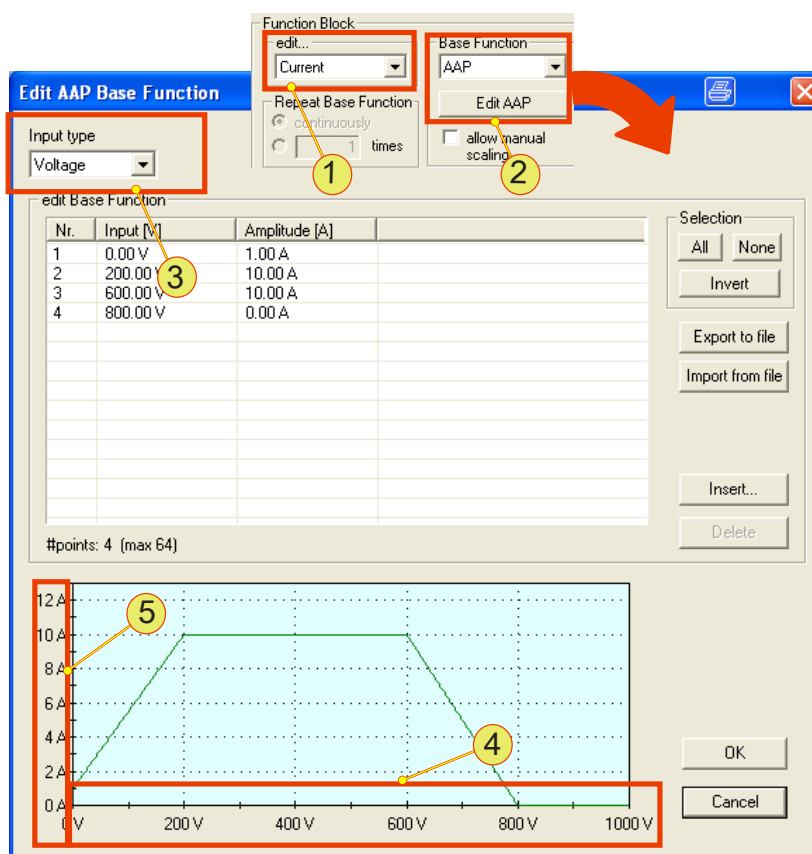


Fig. 112 Function generator example for creating an AAP function.

“Edit user AAP Base Function” window – parameters	
1	<b>edit...</b> , list box Selected reference value is used as output value (Y axis) <b>-5-</b> .
2	<b>Base Function</b> , list box and button Selecting “AAP” and clicking the “Edit AAP” button opens the window for editing AAP functions. See “Conditions for AAP and user-defined curves”, Seite 193
3	<b>Input type</b> , list box Selected reference value is used as input value (X axis) <b>-4-</b> . Reference values that have not been defined in <b>-1-</b> can be selected.
4	<b>Read-only indication</b> , X axis <sup>1</sup> The reference value that has been selected in <b>-1-</b> .
5	<b>Read-only indication</b> , Y axis <sup>1</sup> The reference value that has been selected in <b>-3-</b> .

Table 96 Editing AAP functions.

<sup>1</sup>The related parameter value is always limited by the performance data for the device.

#### 7.4.8.4. Tab – <SCOPE>

User level: from Standard User

The Scope function is an easy to use “8-channel storage oscilloscope”. It can record any of the internal digital parameters in the TopCon TC.GSS power supply.

Among others, the following variable groups can be recorded using the SCOPE function:

- Actual and set values  
Voltage, current, power etc. (digital and analogue)
- Device-internal parameters, such as temperature, controller signals, system state/error signals, intermediate circuit voltage, transformer current, internal 24 V supply, etc.

The firmware has an internal data buffer **-2-** for 8 x 1024 data words of 16/32 bits each. As a consequence up to four variables can be sampled at the same time with the maximum frequency of 20 kHz.

TopControl acts as the user interface and provides control information **-4-** to the SCOPE function **-1-** that runs continuously in the TopCon power supply. The data are acquired in the power supply itself **-2-**. The data **-2-** are then uploaded for display in the TopControl application **-3-**.

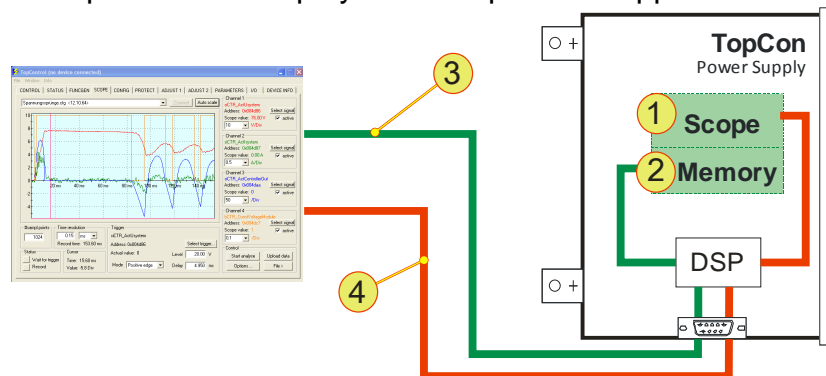


Fig. 113 Principle of the built-in SCOPE function.

The recording can either be started “immediately”, or after a certain trigger event.

Characteristics of a trigger event:

- An event can take place before or after data recording.
- An event can react to a positive/negative edge.

The SCOPE function is used in various ways.

- Graphic analyse of the output values (e.g. for recording load characteristics).
- Assessing/optimising the control behaviour.
- Troubleshooting/debugging.

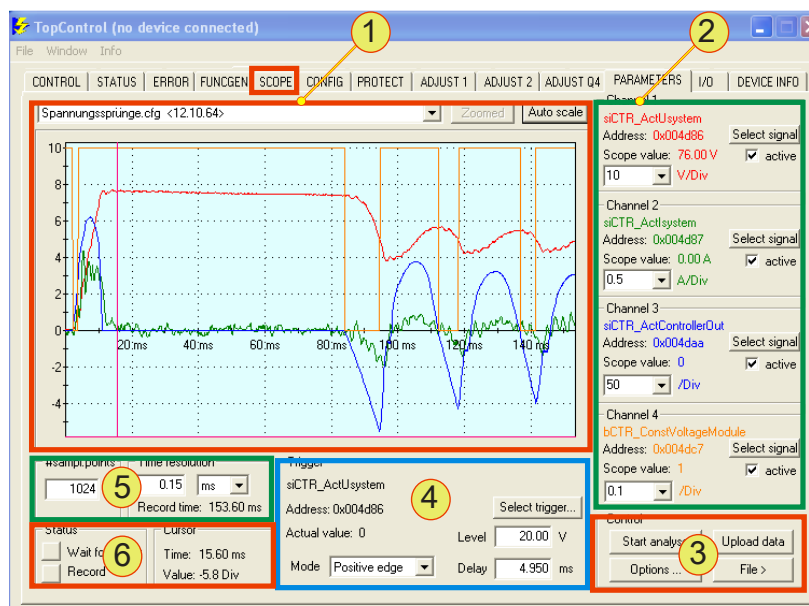


Fig. 114 Overview of the &lt;SCOPE&gt; tab.

<SCOPE> tab –overview	
1	<b>Scope display</b> Indication of the signals that have been detected on the related channels -2-. The values recorded can be zoomed and measured on the screen. See “Scope display” group Fig. 115, Seite 201.
2	<b>Channel selection</b> 8 channels are available that can be indicated simultaneously on the display -1-. Signals for recording can be defined in each channel. See “Channel” group Fig. 119, Seite 205.
3	<b>Control, group</b> Triggering the measuring process, saving/loading the scope configuration and the values to be recorded. See “Control” group Fig. 121, Seite 213.
4	<b>Trigger, group</b> Define the trigger signal, the trigger level and any delay as well as the trigger edge on a signal. See Fig. 123, Seite 215.
5	<b>Time resolution/sampl. Points, groups</b> Definition of the scope and temporal resolution by the number of points.
6	<b>Status/Cursor, groups</b> Status indication for the scope and indication of the cursor position.

Table 97 &lt;SCOPE&gt; tab – overview.

## Scope display group

The scope display depends on the following factors:

- Number of channels selected.
- Resolution/scaling in X and Y axis.
- Zoom factor set.

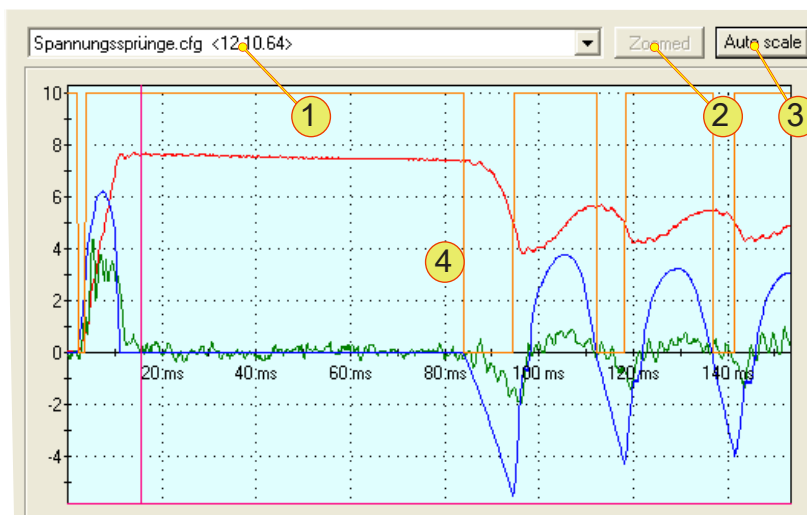


Fig. 115 Scope display group on the <SCOPE> tab.

Scope display group – parameters	
1	<b>List box</b> This list box contains the list of the scope configurations available and makes it possible to quickly change between different recording configurations. Default configuration: "Scope configuration001.cfg"
2	<b>&lt;Zoomed&gt;</b> , button is only active if the zoom function is in use. If zoom in use: →Button is green. →Button is activated. Button active   If the button is clicked the display returns to the full indication of the data. →The button is deactivated.
3	<b>&lt;Auto scale&gt;</b> , button Sets the zoom such that the curves shown are optimally indicated in both axis ranges.
4	<b>Display</b> Display with 4 curves and max. 4 comparison/reference curves. Abscissa (X axis): represents the time axis. Ordinate (Y axis): representation is dependent on the selected signal variable. In the scope display many functions can be used via the cursor (possibly with additional buttons). See "Navigation in the scope display" Fig. 116, Seite 202.

Table 98 Parameters in the scope display group.

## Navigation in the scope display

Within the display it is possible to navigate, measure and zoom in/out using the mouse, the keyboard or a combination of both. The position is indicated using a cursor.

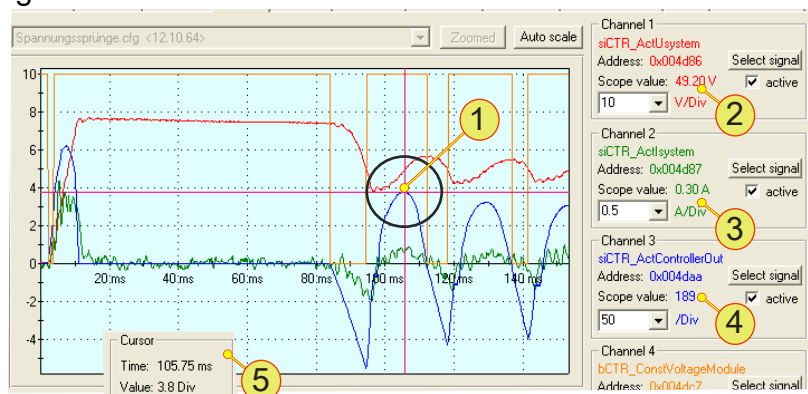


Fig. 116 Indication of the cursor position in the scope display.

The actual position of the cursor **-5-** in the scope display can be seen from red cross-wires **-1-**. The Y axis position is indicated for each channel **-2-**, **-3-**, **-4-**. The X position for the time axis is equally applicable to all signals recorded.

The zoom functions	
Element	Function in the graphic
Hold left mouse button + drag diagonally	Zoom box is drawn and the display correspondingly zoomed on releasing the mouse button. Up to 5 zoom settings are possible.
Click right mouse button	Reset zoom one setting. → Previous view back to the original view.
Turn mouse wheel (forward/backward)	Zoom in/zoom out in X and Y direction
[Ctrl] + turn mouse wheel (forward/backward)	Zoom in/zoom out in X direction
[Shift] + Turn mouse wheel (forward/backward)	Zoom in/zoom out in Y direction
Hold right mouse button + drag <b>Condition:</b> Zoom function already in use	Move the area displayed as a function of the cursor movement.

Table 99 Zoom functions in the scope display.

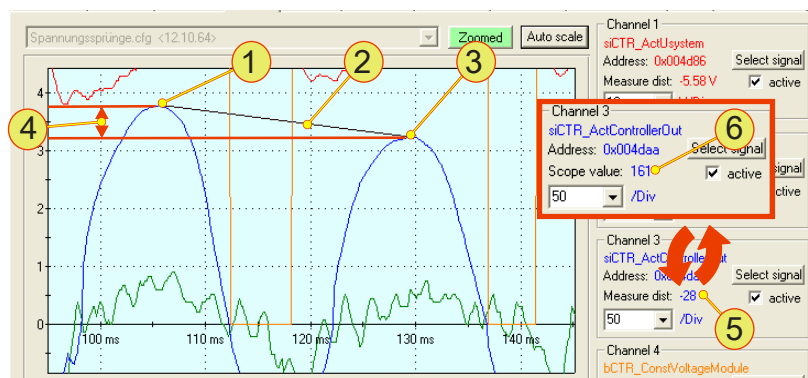


Fig. 117 Difference measurement with the aid of the scope and reading the values.

Difference measurement – function and indication	
Element	Function in the graphic
[Ctrl] + click left mouse button	Start difference measurement <b>-4-</b> . The new reference point <b>-1-</b> for a measurement is the actual cursor position in the display. Indication of the time difference: A black line <b>-2-</b> appears that connects the reference point <b>-1-</b> and a new cursor position <b>-3-</b> .
Click left mouse button <sup>1</sup>	Define new reference point <b>-1-</b> .
Hold [Ctrl] <sup>1</sup> Release [Ctrl] <sup>1</sup>	Difference measurement indication <b>-5-</b> per channel Absolute measurement indication <b>-6-</b> per channel
Click right mouse button <sup>1</sup>	Reset difference measurement. →The black connecting line <b>-2-</b> disappears. →Original display

Table 100 Difference measurement via the display on the <SCOPE> tab.

<sup>1</sup> Condition is a started difference measurement.

## Reference signals

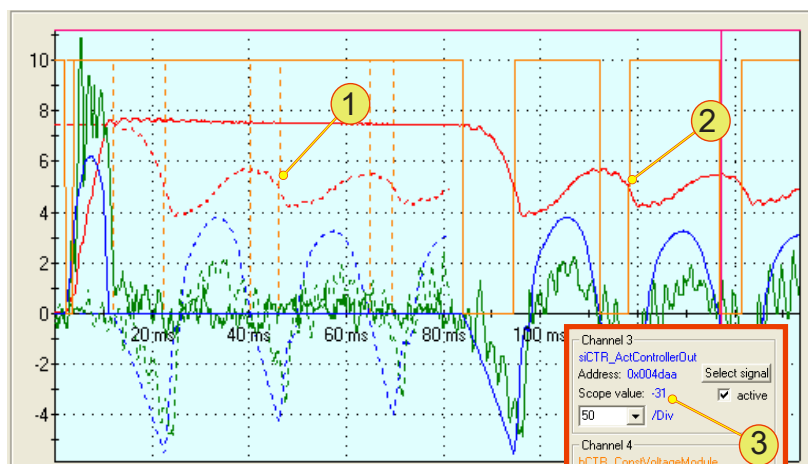


Fig. 118 Moved reference signal and original signal.  
Reference signals -1- are shown dotted.

The condition for the usage of reference signals is a defined reference signal with which other signals can be compared.

See “set as reference signal” Table 109, Seite 214.

Reference signals -1- are shown dotted on the scope display.

Using reference signals – function and display	
Element + condition	Function in the graphic
[Space] + right mouse button + drag	Move reference signal-1- (X axis)
[Space] + click right mouse button	Reference signals -1- are moved back to the original position.
[Space]	Change the measured value indication -3- per channel between cursor value for the original signal -2- and reference signal -1-

Table 101 Using reference signals.

## Channel group

Channels 1 to 8 are available for indicating signals on the scope display. The input options are described for “Channel 1” as an example.

Standard signals are supplied with the TopControl. An important exception here for a single device or multi-unit system is the output values: current, voltage, power and sense voltage.

Prepare a scope with the standard signals (current, voltage and controller parameters) and send it by e-mail to Regatron support, if you need assistance.

For an example of a standard scope see chapter 9.5, Seite 257.



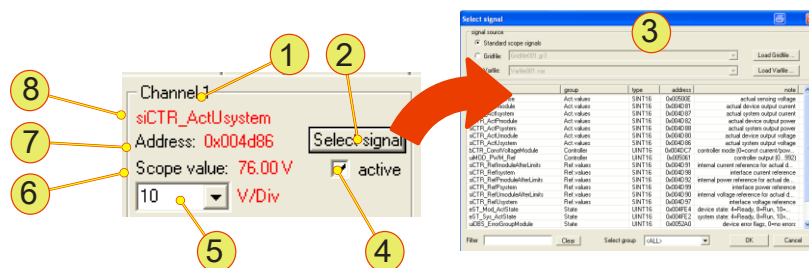


Fig. 119 “Channel1” group on the &lt;SCOPE&gt; tab.

Channel group – parameters	
1	<b>Channel X</b> , Text read-only indication of the channel name: $\triangle$ Channel 1 – 4
2	<b>Select signal</b> , button opens window -3- To define the related signal variables for the channel.
3	<b>Select signal</b> , window Selection of the required signals or signal variables For further information see “Select signal” Fig. 120, Seite 207.
4	<b>active</b> , check box Selected: The related channel is activated and records data. →A selection can be made in list box -5-. →Recorded data are shown on the display. Cleared: The channel and its data indication are disabled.
5	<b>Scope value</b> , list box The resolution for the ordinate (Y axis) is defined. The unit is dependent on the signal selected. The resolution is normalised, i.e. several channels can be shown at the same time on one X axis. Value range: 0.001 – 100000 [unit]/div.; steps: 1, 2, 5 multiplied by the related factor from 0.01 to 10000 in steps of ten
6	<b>Scope value</b> , read-only indication Indicates the actual channel value at the time represented by the actual X axis position of the cursor The unit indicated is dependent on the selected signal -3-. Difference measurement indication if difference measurement is activated, for further information see Fig. 117, Seite 203.
7	<b>Address</b> , read-only indication The address range in the memory in the TC.GSS power supply in which the signal variable is saved. Indication of the address in hex code.
8	<b>Signal name</b> Indication of the signal name, e.g. “siCTR_ActUmodule” for the output voltage from a single device.

Table 102 Parameters for the “Channel” group.



**“Select signal” window**

The parameters for the standard scope signals and the usage of grid-files are described using the <Parameters> tab, see chapter 7.4.8.8, page 231.

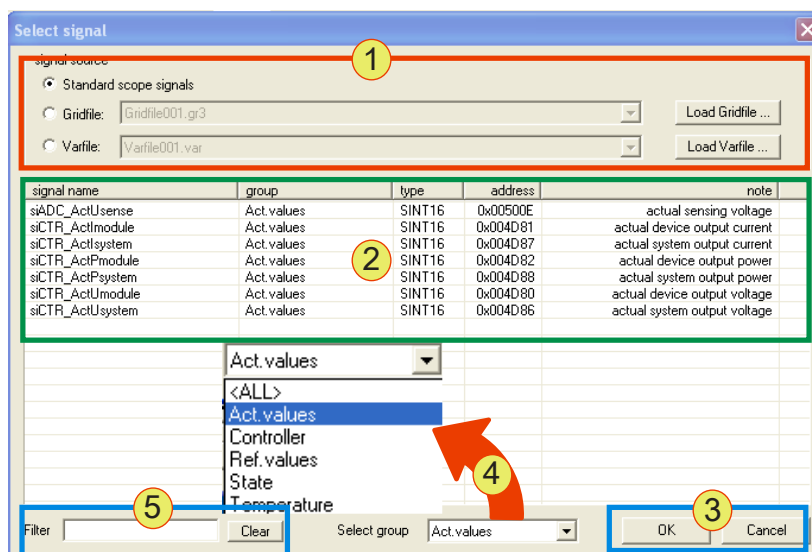


Fig. 120 “Select signal” window from <SCOPE> tab.

“Select signal” window – parameters	
1	<p><b>Signal source</b>, options, list box</p> <p>Standard scope signals: default.</p> <p>Gridfile: List with variable names/address allocations can be loaded using the &lt;Load Gridfile ...&gt; button and displayed for selection in -2-. Gridfiles are necessary for specific solutions and can be requested from support if required. See &lt;Parameters&gt; tab chapter 7.4.8.10, page 235</p> <p>Varfile: Only for use by the manufacturer.</p>
2	<p><b>Signal list</b></p> <p>Indication of the signals available that vary depending on the “Signal source” - 1-. Double-clicking a variable (line) selects this variable, closes this dialog box and opens the main window again. Alternatively: click once and press &lt;OK&gt; -3-</p> <p>signal name: Name of the signal/variable</p> <p>group: Group name of the signals. Every signal is allocated to a group that can be indicated as part of the specific group using -4-.</p> <p>type: Variable type. Here 16-bit integer signed</p> <p>address: Address in the memory in the TC.GSS power supply</p> <p>note: Concise description of the signal variables</p>

The table is continued on the next page.

“Select signal” window – parameters (continued)	
3	<p><b>&lt;OK&gt;/&lt;Cancel&gt;</b>, buttons</p> <p><b>&lt;OK&gt;</b>            Accept the selected signal variable (blue background) and return to the &lt;SCOPE&gt; tab view →The signal variable is selected for the channel.</p> <p><b>&lt;Cancel&gt;</b>        Return to the &lt;SCOPE&gt; tab view without applying a signal variable to the channel.</p>
4	<p><b>Select group</b>, list box</p> <p>Only the variables that are part of the selected signal group are indicated in the signal list <b>-2-</b>. Mostly a group is divided into the variables for a single device (“..module”) or for a multi-unit system (“...system”). The following signal groups from the standard gridfile are available:</p> <p>Act. values        Group of actual values (output values).</p> <p>Controller        Indication of the active controller and its operation.</p> <p>Ref. values        Reference values, are defined internally in the device or via an interface.</p> <p>State              Signal variables for the device status or system status, such as READY, RUN, WARN, ERROR etc. A corresponding output value is assigned to each status, see the description in the “note” column in the signal list <b>-2-</b>.</p> <p>Temperature      Signal variables for the device-internal temperature at the heat sinks for the IGBT and the rectifier.</p>
5	<p><b>Filter</b>, text box</p> <p>It is possible to enter individual letters. A search is made for the string entered and the list updated immediately, independent of the position of the letters in the variable name.</p> <p>Two colour states for the text box indicate the match status</p> <p>Green              String exists.</p> <p>Red                String does not exist.</p> <p>White              Filter is inactive, text box blank</p>

Table 103 Parameters in the “Select signal” window.

**Description of the standard scope gridfile**

The following signals are arranged as per their group membership (“group” or “select group”) in the standard gridfile. See Table 103, Seite 208.

Actual values group – “Act.values”	
<b>siADC_ActUsense</b>	<b>Actual device sense voltage</b> Value range: 0 – 4000; (4000 $\triangleq$ Nominal voltage) Device role: Valid for master and slave
<b>siCTR_ActImodule</b>	<b>Actual device output current</b> Value range: 0 – 4000; (4000 $\triangleq$ Maximum current) Device role: Valid for master and slave
<b>siCTR_ActIsystem</b>	<b>Actual multi-unit system output current.</b> $\triangleq$ The sum of all power supplies connected in parallel. Single device operation: Module current $\triangleq$ System current Value range: 0 – 4000; (4000 $\triangleq$ System nominal current) Refresh: 300 $\mu$ s x number of slaves Device role: Valid for master
<b>siCTR_ActPmodule</b>	<b>Actual device output power</b> Value range: 0 – 4000; (4000 $\triangleq$ Nominal power) Device role: Valid for master and slave
<b>siCTR_ActPsystem</b>	<b>Actual multi-unit system output power.</b> $\triangleq$ The sum of all power supply powers. Single device operation: Module power $\triangleq$ System power Value range: 0 – 4000; (4000 $\triangleq$ System nominal power) Refresh: 300 $\mu$ s x number of slaves Device role: Valid for master
<b>siCRT_ActUmodule</b>	<b>Actual device output voltage</b> Value range: 0 – 4000; (4000 $\triangleq$ Nominal voltage) Device role: Valid for master and slave
<b>siCTR_ActUsystem</b>	<b>Actual multi-unit system output voltage.</b> $\triangleq$ The sum of all power supplies connected in series. In single device operation: Module voltage $\triangleq$ System voltage Value range: 0 – 4000; (4000 $\triangleq$ System nominal voltage) Refresh: 300 $\mu$ s x number of slaves Device role: Valid for master

Table 104 Description of the variables that are allocated to the “Act.values” group.

Controller values group – “Controller”	
<b>bCTR_Const</b> <b>VoltageModule</b>	<b>Actual controller mode</b> The following controller modes are indicated: Value “0”:           Constant current (or constant power) Value “1”:           Constant voltage
<b>uiMOD_PWM_Ref</b>	Actual controller correcting value pulse width modulation value Value range:       0 – 992; (992 $\triangleq$ 100 % operation)

Table 105 Description of the variables that are allocated to the “Controller” group.

Device temperature group – “Temperature”	
siADC_ActGRTemp	<b>Actual rectifier temperature</b>
siADC_ActIGBTTemp	<b>Actual IGBT heat sink temperature</b>

Table 106 Description of the temperature variables that are allocated to the “Temperature” group.

Reference values group – “Ref.values”	
<b>siCTR_Ref ImoduleAfterLimits</b>	<b>Module current reference value</b> for the module controller In single device operation: $\triangleq$ RefIsystem after ramp and internal resistance correction Value range: 0 – 4000; (4000 $\triangleq$ Maximum current) Device role: Valid for master
<b>siCTR_RefIsystem</b>	<b>System current reference value</b> (set value) Value range: 0 – 4000; Single device operation: 4000 $\triangleq$ Nominal device current Multi-unit operation: 4000 $\triangleq$ Nominal system current Reference value via analogue, RS-232, HMI/RCU interface Device role: Valid for master
<b>siCTR_Ref PmoduleAfterLimits</b>	<b>Voltage reference value for the module controller</b> Single device operation: $\triangleq$ RefPsystem after ramp and internal resistance correction Value range: 0 – 4000; (4000 $\triangleq$ Maximum current) Device role: Valid for master
<b>siCTR_RefPsystem</b>	<b>Voltage reference value for the module controller</b> Value range: 0 – 4000; Single device operation: 4000 $\triangleq$ Nominal device power Multi-unit operation: 4000 $\triangleq$ Nominal system power Reference value via analogue, RS-232, HMI/RCU interface Device role: Valid for master
<b>siCTR_Ref UmoduleAfterLimits</b>	<b>Module voltage reference value</b> for the module controller Single device operation: $\triangleq$ RefUsystem after ramp and internal resistance correction Value range: 0 – 4000; (4000 $\triangleq$ Maximum voltage) Device role: Valid for master
<b>siCTR_RefUsystem</b>	<b>System voltage reference value</b> (set value) Value range: 0 – 4000; Single device operation: 4000 $\triangleq$ Nominal device voltage Multi-unit operation: 4000 $\triangleq$ System nominal voltage Reference value Via analogue, RS-232, HMI/RCU interface Device role: Valid for master

Table 107 Description of the reference values that are allocated to the “Ref.values” group (set values).

Device/system state group – “State”	
eST_Mod_ActState	<b>Actual device state</b> Value range: 0 – 14; 2 $\triangleq$ POWERUP; 4 $\triangleq$ READY 8 $\triangleq$ RUNNING; 10 $\triangleq$ WARNING 12 $\triangleq$ ERROR; 14 $\triangleq$ STOP Refresh: 1 ms Device role: Valid for master and slave
eST_Sys_ActState	<b>Actual system state</b> Value range: 0 – 14; see eST_Mod_ActState Refresh: 1 ms Device role: Valid for master
uiOBS_Error GroupModule	<b>Device group error</b> Each bit (of a total of 16 bits) signifies an error category. However, decimal numbers are indicated. Value range: 0 – 65535;
uiOBS_Error GroupSystem	<b>System group error</b> Similar to uiOBS_ErrorGroupModule Combination of modules in master and slave devices involved.

Table 108 Description of the states that are allocated to the “State” group.



## Control group

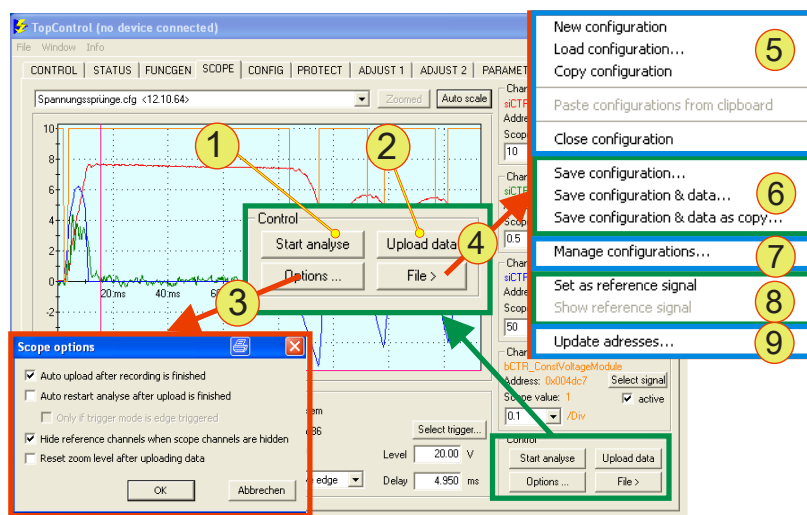


Fig. 121 “Control” group on the &lt;SCOPE&gt; tab and its submenus.

“Control” group – parameters	
1	<p><b>&lt;Start analyse&gt; &lt;Stop analyse&gt;</b>, button</p> <p><b>&lt;Start analyse&gt;</b> Starts the recording process          → Button changes to <b>&lt;stop analyse&gt;</b>          → TopControl waits for a trigger event, see “Trigger” group Table 110, Seite 216.</p> <p><b>&lt;Stop analyse&gt;</b> Stops the recording process          → Button changes to <b>&lt;Start analyse&gt;</b></p>
2	<p><b>&lt;Update data&gt;</b>, button</p> <p>Starts the transfer and indication of the data recorded from the TC.GSS power supply to the TopControl application.</p>
3	<p><b>&lt;Options...&gt;</b>, button</p> <p>Opens the “SCOPE option” window with automation options.          Meaning of the check boxes if they are selected:</p> <p>“Auto upload...” Transfer the data immediately from the TC.GSS power supply to the TopControl application. (Recommended)</p> <p>“Auto restart...” Recording is repeated immediately.          Optional restriction: only with trigger set</p> <p>“Hide reference channels...”          The related reference signal for deactivated signal channel is hidden. (Recommended)</p> <p>“Reset zoom after uploading data...”          Indication is reset when new data are uploaded.</p>
4	<p><b>&lt;File&gt;</b>, button</p> <p>Opens the submenu for editing <b>-5-, -6-, -7-, -8-, -9-</b>.</p>

<sup>1</sup> Scope file is included in the list box. See Fig. 115, Seite 201.  
 The table is continued on the next page.

“Control” group – parameters (continued)	
5	<p><b>New/Load/Copy and close configuration</b>, submenu</p> <p>“New ...”: Add a new scope configuration file. The &lt;SCOPE&gt; tab is set to the default values.</p> <p>“Load ...”<sup>1</sup>: Loads a scope configuration with its data onto the &lt;SCOPE&gt; tab from the computer’s file system. Alternatively drag &amp; drop can be used. An entry is added to the list box.</p> <p>“Copy ...”<sup>1</sup>: The actual scope with its data is copied and indicated as a new configuration file.</p> <p>“Close ...”: Actual scope is closed after a conformation prompt.</p>
6	<p><b>Save configuration</b>, submenu</p> <p>The following save options can be selected:</p> <ul style="list-style-type: none"> <li>Only scope configuration parameters</li> <li>Scope configuration parameters &amp; data</li> <li>Scope configuration parameters &amp; data as copy</li> </ul>
7	<p><b>Manage configuration</b>, submenu</p> <p>The “Scope configuration Manager” window is opened. Configuration files can be loaded, saved and deleted.</p> <p>To select files: click the related line using the left mouse button.</p>
8	<p><b>Set as reference signal</b>, submenu</p> <p>The reference signals are for comparisons that can be indicated in addition to the actual signal data set.</p> <p>Reference signals are shown dotted on the scope display.</p> <p>For further information see Fig. 118, page 204.</p>
9	<p><b>Update addresses</b><sup>2</sup>, submenu</p> <p>For experienced users.</p> <p>If configurations were created for a different firmware version, the address allocation for the variables indicated may no longer be correct. Using this menu item the addresses for the selected channel signals are applied from the gridfile/var file to be selected (and therefore the related destination addresses corrected).</p>

Table 109 Parameters in the “Control” group

<sup>1</sup> Scope file is included in the list box. See Fig. 115, Seite 201.<sup>2</sup> If the scope configuration actually displayed does not match the firmware, a warning is output. Contact support!

### “Trigger” group

A scope trigger is defined and activated. As soon as the defined trigger event occurs -2-, data are recorded for the scope display; the trigger signal itself does not necessarily need to be recorded on the scope.

The signal data flow in the TC.GSS power supply is cached similar to a storage oscilloscope. During the recording the TopControl application does not need to be connected to the power supply. After the end of recording, the signal curve can be loaded into the TopControl application and the data displayed in the scope window -3-.

- In case of Trigger Delay time > 0:  
The trigger event occurs inside the scope window -3-.
- In case of Trigger Delay time < 0:  
The trigger event occurs outside the scope window -3-.

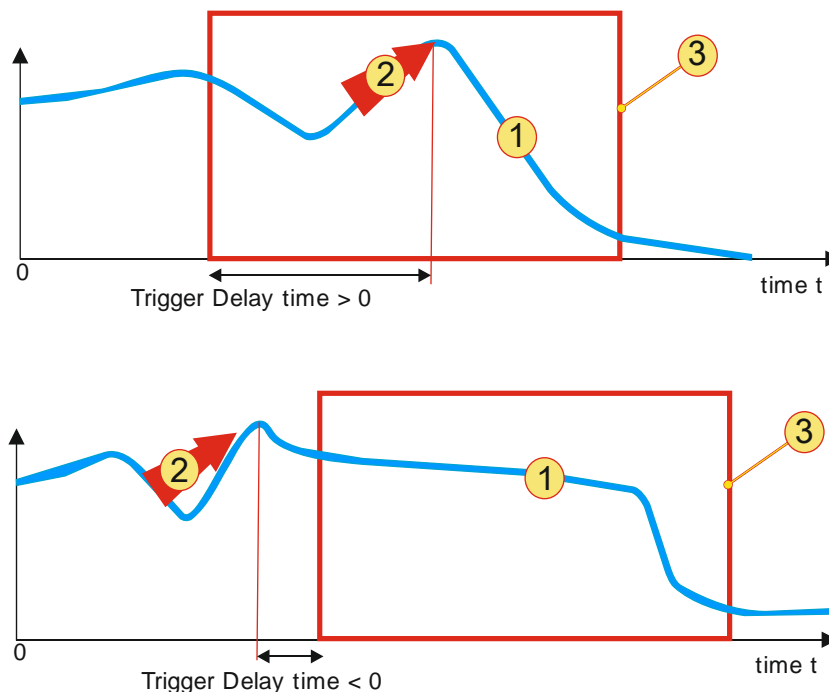


Fig. 122 “Trigger” group – meaning of the Trigger Delay time.  
-1- Signal; -2- Trigger event; -3- Scope window.

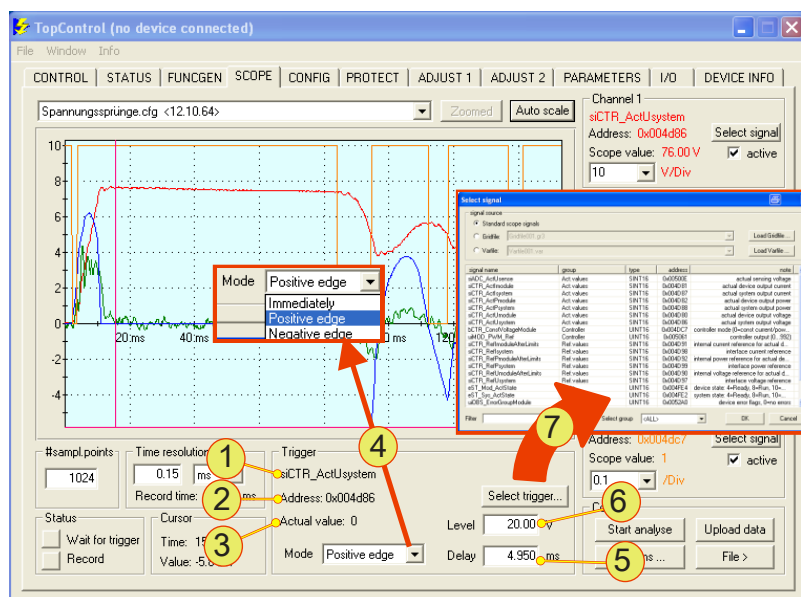


Fig. 123 “Trigger” group with controls.

“Trigger” group – parameters	
1	<b>Read-only indication</b> The trigger signal actually used is indicated. The signal variable is defined via “Select Trigger” -7-.
2	<b>Address</b> , read-only indication in hex Address of the TC.GSS power supply memory. The address is defined by the signal variables, see -7-
3	<b>Actual Value</b> , read-only indication The actual ordinate value (X axis) for the signal variables indicated in -1- is indicated.
4	<b>Mode</b> , list box Selection how the trigger is produced. Immediately      The trigger is to be immediate, without delay, trigger threshold etc. →Text boxes -5- and -6- are deactivated for the entry. Positive edge      On a positive edge on the trigger signal. Negative edge      On a negative edge on the trigger signal.
5	<b>Delay</b> , text box, unit dependent on Time resolution A scope recording is not to start on the occurrence of the trigger event, but with a delay or even before. Delay negativ      Scope output starts with a delay after a trigger event. Delay positiv      Scope output starts in advance of a trigger event. The value range and its unit are dependent on the time resolutions and sampling rate selected in Table 111, Seite 217.
6	<b>Level</b> , text box Entry for a threshold; the unit is dependent on the signal selected. Trigger event: the threshold is reached. →Start of scope display, with delay selected -5-
7	<b>Select trigger</b> , button The “Select signal” window is opened to select a trigger signal. For further information see Table 103, Seite 208.

Table 110 Parameters in the “Trigger” group.

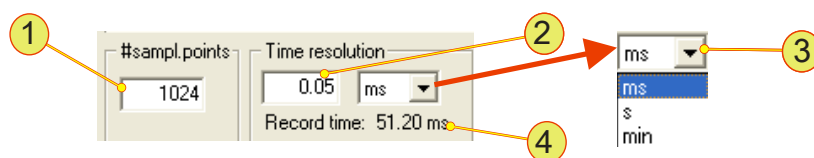
**“Time resolution” and “#sampl. points” groups**

Fig. 124 “Time resolution” and “#sampl. points” groups.

“Time resolution”/“#sample points” groups – parameters	
1	<b>#sampl.points</b> , text box Number of measurement points (MP) on a signal curve that are saved. The more measurement points are saved, the longer the transfer from the memory from the memory in the TopCon to TopControl will take. Value range: 1 – 1024 MP; default: 1024 MP; step width: 1 MP
2	<b>Time resolution</b> , text box Period between two measurement points -1- The value range is dependent on the unit selected -3- Value range: 50 $\mu$ s – 3276.75 min.
3	<b>Time resolution</b> , list box Selection between ms, s, min.
4	<b>Record time</b> , read-only indication The maximum recording time is the product of “Time resolution” -2- and “#sample. points” -1-

Table 111 Parameters for the “Time resolution” and “#sample.points” groups.

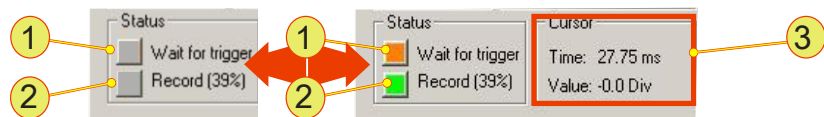
**“Status” and “Cursor” groups**

Fig. 125 “Status” and “Cursor” groups – read-only indication.

“Status”/“Cursor” groups – read-only indication	
<b>1</b>	<b>Wait for trigger</b> , read-only indication As soon as the recording process has been opened via “Start Analyse” and if immediate start was not selected (immediately mode), the scope waits for a trigger event. Indicator: Orange read-only indication.
<b>2</b>	<b>Record (X %)</b> , read-only indication Grey indication Recording not activated. Green indication Recording activated, % indication of the recording time up to now, see “Record time”, Table 111 Seite 217.
<b>3</b>	<b>Cursor</b> , group Indicates the actual position of the cursor cross-wires. See navigation in the scope display Fig. 116, Seite 202.

Table 112 Parameters in the “Time resolution” and “#sample points” groups.

#### 7.4.8.5. Tab – <CONFIG>

User level: from Advanced User

The “CONFIG” (Configuration) tab contains various parameter fields with which the power supply’s internal values can be changed.

For instance the parameters for the P, I and D control terms can be displayed, internal filters and the behaviour on load shedding modified. Also the behaviour in relation to sense errors can be configured.

The controller parameters are set from the factory such that they cover a load range as large as possible. If necessary, these parameters can be adapted to special loads to optimise the controller dynamic behaviour.



If necessary the parameters can be optimised on site by experts from the sales partner or the manufacturer.

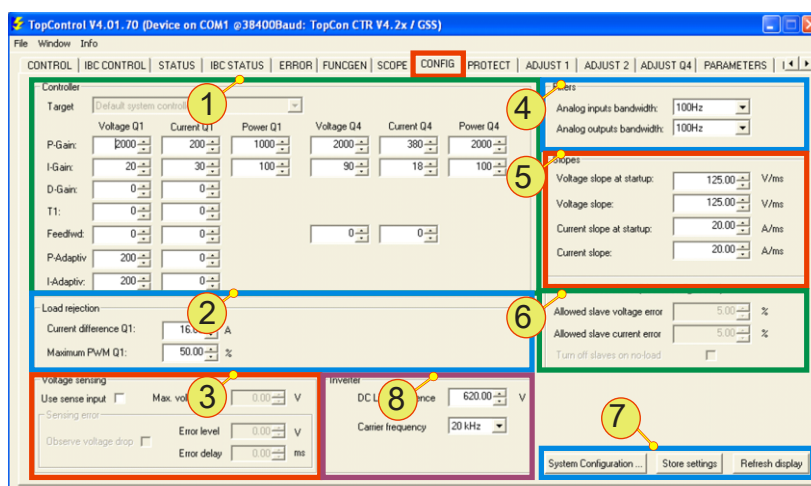


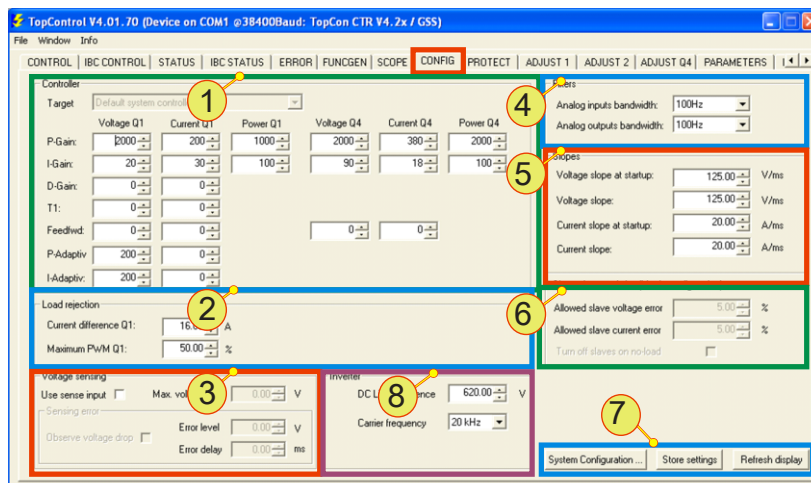
Fig. 126 <CONFIG> tab – parameters.

<CONFIG> tab – parameters	
1	<b>Controller, group</b> Controller parameters for voltage, current and power control P-Gain Proportional term for the gain (constant) for operating state Q1 and Q4 I-Gain Integrating controller term For operating state Q1 and Q4 D-Gain Differential controller term T1 Delay term for the D-gain Feedfwd Portion of the input that is forwarded directly to the output. For operating state Q1 and Q4 I-Adaptiv <sup>1</sup> Additional gain in the lower current and voltage range. P-Adaptiv <sup>1</sup> Additional gain in the lower current and voltage range.
2	<b>Load rejection, group</b> Current difference Control difference value (current here). If the limit value set is exceeded, the control value is set to Maximum PWM. If the output current from the power supply drops by more than the threshold given within 50 µs, the power stage is immediately returned to the % value given for the actual operation. This feature is useful to avoid voltage rises that are produced on fast load changes. The value should not be selected too small, as otherwise the regulation will be poor. Maximum PWM Maximum pulse-width modulation [%] is activated as controller value if the current difference exceeds the limit value specified.
3	<b>Voltage sensing, group</b> For further information on the parameters see Table 114, Seite 223
4	<b>Filters, group</b> Analog input bandwidth: cut-off frequency for the analogue output filter (actual values) Analog output bandwidth: cut-off frequency for the analogue input filter (set values)

Parameters on the <CONFIG> tab.

<sup>1</sup>The non-linear characteristic can be partially compensated by the additional gain  
 The table is continued on the next page.





&lt;CONFIG&gt; tab – parameters.

## &lt;CONFIG&gt; tab – parameters (continued)

5	<p><b>Slopes, group</b> Ramps for limiting the set value slope, these do not change the set values and have no effect on the controller. With the internal function generator the ramps are used to limit the rate change of the function.</p> <p>Voltage slope at startup: (Ramp) <math>Steigung = \frac{dU}{dt}</math> with “VOLTAGE ON”</p> <p>Voltage slope: (Ramp) <math>Steigung = \frac{dU}{dt}</math></p> <p>Current slope at startup: (Ramp) <math>Steigung = \frac{dI}{dt}</math> with “VOLTAGE ON”</p> <p>Current slope: (Ramp) <math>Steigung = \frac{dI}{dt}</math></p>
6	<p><b>Slave characteristics (Matrix configuration), group</b> Parameters for the optimisation of the control behaviour in multi-unit operation. Can only be set on the master device in the multi-unit system.</p> <p>Allowed slave voltage error<sup>1</sup>      Entry of the deviation allowed in [%] from the set value for the output voltage.</p> <p>Allowed slave current error<sup>1</sup>      Entry of the deviation allowed in [%] from the set value for the output current.</p> <p>Turn off slaves on no-load      If selected: If a load is not connected, the slaves are shut down. Master device remains in operation.</p>

Parameters on the <CONFIG> tab.  
The table is continued on the next page.

<CONFIG> tab – parameters (continued)	
7	<p><b>Buttons</b></p> <p><b>&lt;System Configuration...&gt;</b>, button opens a new window The “Multi-module system configuration” window opens to make settings for the multi-unit system. See Fig. 128, Seite 224</p> <p><b>&lt;Store settings&gt;</b>, button Settings made on the &lt;CONFIG&gt; tab are permanently saved. The actual parameter set is saved from the RAM to the flash PROM in the TC.GSS power supply.</p> <p><b>&lt;Refresh display&gt;</b> The indication on the tab is manually refreshed.</p>
8	<p><b>Inverter, group</b></p> <p>The following parameters are exposed only for the customer support . Make no changes, without previous contact with the customer service</p> <p>DC Link Reference: Voltage set value of DC link voltage Value range: 0 ... 800 V, default: <math>\sim U_{NOM}</math></p> <p>Carrier frequency: Switching frequency The output ripple changes accordingly of the frequency choice Value range: 8 kHz, 12 kHz, 16 kHz, 20 kHz</p>

Table 113 Parameters on the &lt;CONFIG&gt; tab.

**“Voltage sensing” group**

Condition for the usage of the sense function:

- TC.GSS power supplies not connected in series
- Connection of the interface to the overall circuit

Activation of the sense function has an effect on the display of the following tabs:

- <CONTROL> tab
- <STATUS> tab

For further information on the hardware, sense activation and its effects see chapter 4.3.1, page 41.

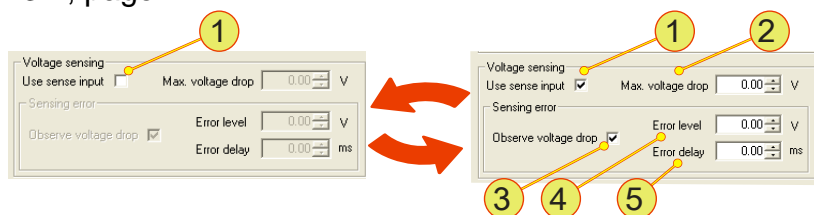


Fig. 127 “Voltage sensing” group – parameters.

“Voltage sensing” group – parameters	
1	<b>Use sense input, check box</b> Selected: Function is switched on. All entries and check boxes for “Voltage sensing” can be edited. The following changes occur on the tabs: →<CONTROL> tab labelled with sense →<STATUS> tab - sense parameters available Cleared: Function is switched off
2	<b>Max. voltage drop, text box</b> Maximum voltage compensation. The output voltage $U_{out}$ is as a maximum = $U_{set} + \text{Max. Voltage drop}$ , where the reference value $U_{set}$ is defined via TopControl, analogue interface, HMI/RCU or internally via the function generator.
3	<b>Observe voltage drop, check box</b> Selected: Monitoring of the voltage difference $U_{out} - U_{sense}$ →“Error level” / “Error delay” text boxes are activated. Cleared: Function is switched off →“Error level” / “Error delay” text boxes are deactivated.
4	<b>Error level, text box</b> If the threshold set for the voltage difference $U_{out} - U_{sense}$ is exceeded, the device switches to the error status.
5	<b>Error delay, text box</b> An “Error level” must be present for the time set before the device switches to the error status.

Table 114 Parameters in the “Voltage sensing” group.

## Multi-module system configuration dialog box

The following conditions must be met for multi-unit system operation:

- Entries are made on the master device in the multi-unit system.
- The master-slave principle on all devices involved in the multi-unit system see chapter 4.4.3.3, page 61.

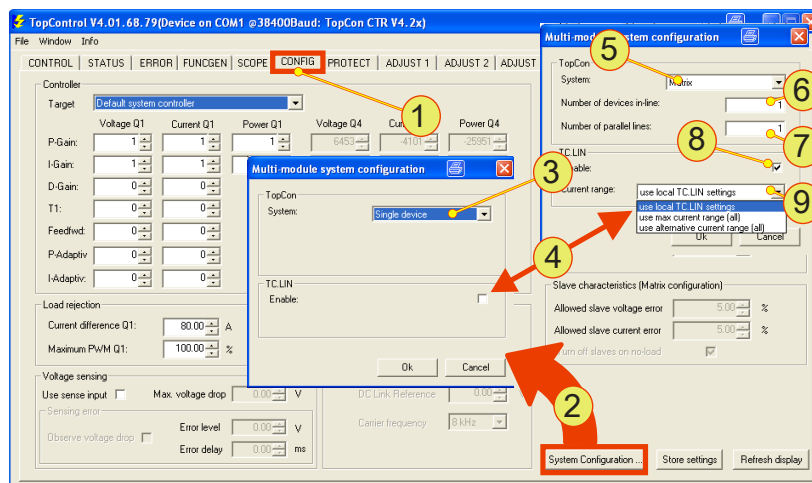


Fig. 128 The “Multi-module system configuration” dialog box is opened via the <CONFIG> -1- tab by clicking the <System Configuration...> -2- button.

Multi-module system configuration - parameters	
3	<b>&lt;System&gt;</b> , list box Single Device    Device on its own. →Hidden: -4-, -5- Multi-Load       Although devices are remotely controlled from the master device and they are connected via CAN, their power outputs are not connected together. Each slave device has its own load. Identical set values are specified for each device. →Visible -4- Matrix             See Table 116, Seite 225.
	4 <b>&lt;Number of devices in-line&gt;</b> <sup>1</sup> , numeric box Number of device in a multi-unit system that are connected in series.
	5 <b>&lt;Number of parallel lines&gt;</b> <sup>1</sup> , numeric box Number of device in a multi-unit system that are connected in parallel.
6	<b>&lt;Enable&gt;</b> <sup>2</sup> , check box for TC.LIN
7	<b>&lt;Current Range&gt;</b> <sup>2</sup> , list box for TC.LIN

Table 115 Parameters in the “Multi-module system configuration” dialog box on the <CONFIG> tab.

<sup>1</sup> See Table 116, page 225 for examples.

<sup>2</sup> Visible, if the TC.LIN option is fitted.

The following combinations of the <Number of devices in-line> **-4-** and <Number of parallel lines> **-5-** entries from Table 115, Seite 224 yield the following matrix.

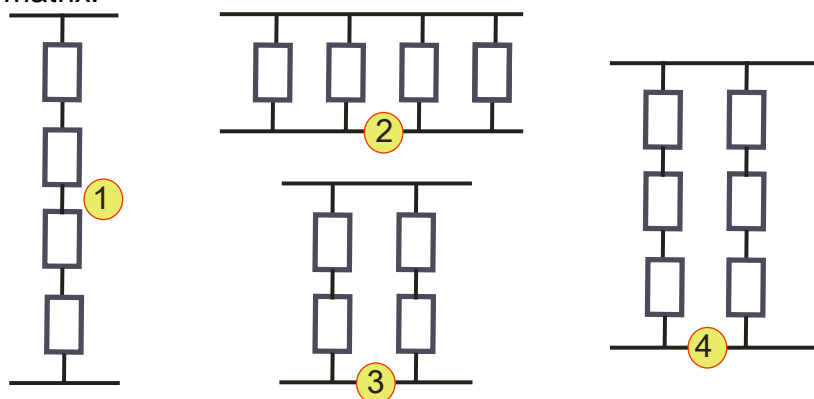


Fig. 129 Example multi-unit operation of TC.GSS power supplies.  
It is not possible to determine the position of the master device from the matrix illustration. However, the master device always has the address AH= 0 and AL=0.

Configuration of devices in a multi-unit system - examples				
Setting	4 serial devices	4 parallel devices	2x2 devices as matrix	3x2 devices as matrix
	-1-	-2-	-3-	-4-
<Number of devices inline>	4	1	2	3
<Number of parallel lines>	1	4	2	2

Table 116 Example entries for multi-unit system configuration.

**7.4.8.6. Tab – <PROTECT>**

User level: from Advanced User

On the <PROTECT> tab all limit values can be set to protect a load connected, and also the internal modules from overload.

**Example  $I^2t$  parameter**

The integral of the load limit from the semiconductors defines the maximum current allowed in a semiconductor that is allowed to flow through the semiconductor in a limited time before the semiconductor is damaged.

A limit value for a load can be derived from this parameter. The square of the current is included in the calculation.

Calculation example for the Error Limit

$I_{LoadNom}$  : Nominal current for the load e.g. 100 A

$I_{LoadMax}$  : Maximum overload current: 150 A for 5 s

$$\begin{aligned}\Rightarrow \text{Error Limit} &= t * (I_{LastMax}^2 - I_{LastNOM}^2) \\ &= 5s * (150^2 A^2 - 100^2 A^2) \\ &= 62500 A^2s\end{aligned}$$

**CAUTION    Damage to the load possible!**

Modified parameters can change the various safety limits for the TC.GSS power supply to such an extent that the following damage may result:

- Damage to a load connected.

Avoidance:

- ⇒ Before you change parameters, make sure that these changes are really necessary.
- ⇒ Contact support before you make changes to parameters.
- ⇒ Check your parameter changes for mistakes before you save them to the TC.GSS power supply.

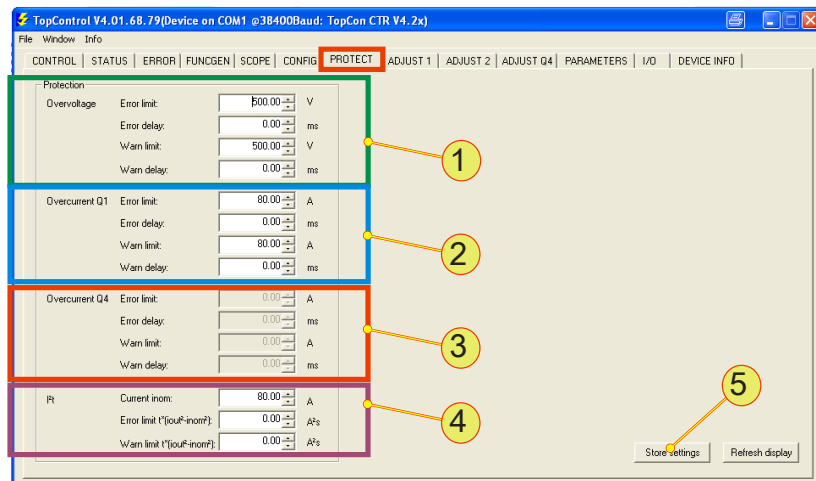


Fig. 130 <PROTECT> tab – parameters.

<PROTECT> tab – parameters	
1	<p><b>Overvoltage</b>, overvoltage with following text boxes</p> <p><b>Error limit</b> Threshold from which the device switches to the error state. Value range [V]: 0 – 1.1 *U<sub>NOM</sub>;</p> <p><b>Error delay</b> Min. period for which the “Error limit” must be exceeded before the device switches to the error state. Value range [ms]: 0 – 1638.35;</p> <p><b>Warn limit</b> Threshold from which the device switches to the warning state. Value range [V]: 0 – 1.1 *U<sub>NOM</sub>;</p> <p><b>Warn delay</b> Min. period for which the “Warn limit” must be exceeded before the device switches to the warning state. Value range [ms]: 0 – 1638.35;</p>
2	<p><b>Overcurrent Q1</b>, overcurrent in Q1 operation with following text boxes The meaning is similar to the boxes in -1-.</p> <p><b>Error limit</b> Value range [A]: 0 – 1.1 *I<sub>Max</sub>;</p> <p><b>Error delay</b> Value range [ms]: 0 – 1638.35;</p> <p><b>Warn limit</b> Value range [A]: 0 – 1.1 *I<sub>Max</sub>;</p> <p><b>Warn delay</b> Value range [ms]: 0 – 1638.35;</p>
3	<p><b>Overcurrent Q4</b>, overcurrent in Q4 operation with following text boxes The meaning is similar to the boxes in -1-.</p> <p><b>Error limit</b> Value range [A]: 0 – 1.1 *I<sub>Max</sub>;</p> <p><b>Error delay</b> Value range [ms]: 0 – 1638.35;</p> <p><b>Warn limit</b> Value range [A]: 0 – 1.1 *I<sub>Max</sub>;</p> <p><b>Warn delay</b> Value range [ms]: 0 – 1638.35;</p>

The table is continued on next page.

<PROTECT> tab – parameters (continued)	
4	<p><b>I<sup>2</sup>t</b>, with following text boxes For explanation and example calculation see “Example I<sup>2</sup>t parameter , Seite 226</p> <p><b>Current inom</b>      Nominal value for the load connected</p> <p><b>Error limit</b>        Threshold that causes an overcurrent error. Value range is device-dependent. (time value required)</p> <p><b>Warn limit</b>         Threshold that causes an overcurrent warning. Value range is device-dependent. (time value required)</p>
5	<p><b>Store settings</b>, button Settings made on the &lt;PROTECT&gt; tab are permanently saved. The actual parameter set is saved from the RAM to the flash PROM in the TC.GSS power supply.</p>

Table 117 Error and warning thresholds on the &lt;PROTECT&gt; tab.

**7.4.8.7. Tab – <ADJUST 1>**

User level: from Power User

Any adjustments to the measured value acquisition on the inputs and outputs necessary during the test and setup phase for the TopCon GSS power supply can be made using the parameters on the <ADJUST 1> tab.

For further information on analogue remote programming, see chapter 7.2.4, page 123Seite 123.

**CAUTION Damage possible due to decalibration!**

Changes to the parameters can cause damage to the load connected:

- The control circuit may overshoot, which will involve current and voltage spikes that can irreparably damage the semi-conductors.
- Damage to a load connected due to excessively high voltage, current or power steps.
- Incorrect or imprecise display is possible.

Avoidance:

- ⇒ Before you change parameters, make sure a calibration is really necessary.
- ⇒ Contact support before you make changes to parameters.
- ⇒ Check your procedure for the calibration again before you save modified parameters on the TC.GSS power supply.



In the TopControl application the analogue input signals on interface X105 are allocated the following numerical values as set values that are displayed on the tab:

Input/output signal -10 V  $\triangleq$  -4000 numerical value

Input/output signal 0 V  $\triangleq$  0 numerical value

Input/output signal 10 V  $\triangleq$  4000 numerical value

In the case of recalibration, please contact Regatron support.

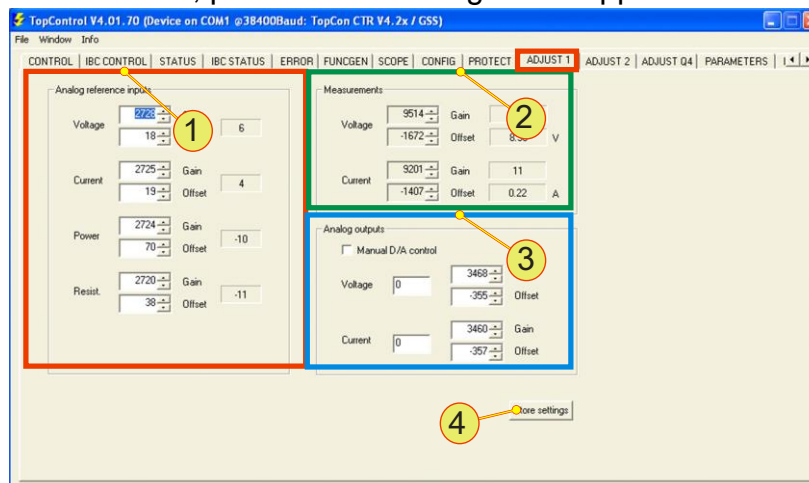


Fig. 131 Overview of <ADJUST 1> tab.

<ADJUST 1> tab – parameter overview	
1	<b>Analog reference inputs, group</b> Adjustment of the analogue inputs on interface X105 for voltage, current, power and internal resistance. The maximum and minimum signal level on the analogue input X105 is calibrated using the gain and the offset. The indication on the right shows the numerical value actually measured.
2	<b>Measurements, group</b> Adjustment of the indication for the voltage and current measured value acquisition indication via the arrow buttons. The related actual normalised value is indicated on the right.
3	<b>Analog outputs, group</b> Adjustment of the analogue outputs on interface X105 for voltage and current. The maximum and minimum signal level on the analogue output X105 is calibrated using the gain and the offset. The “Manual D/A control” check box switches on the manual calibration. I.e. the “Voltage” and “Current” values are output on the analogue outputs.
4	<b>Store settings, button</b> Settings made on the <ADJUST1> tab are permanently saved. The actual parameter set is saved from the RAM to the flash PROM in the TC.GSS power supply.

Table 118 Overview of the <ADJUST 1> tab.



#### 7.4.8.8. Tab – <ADJUST 2>

User level: from Power User

The necessary internal adjustments can be made during the test and setup phase for a TopCon using the parameters on the <ADJUST 2> tab.

#### CAUTION Damage possible due to decalibration!

Changes to parameters can cause damage to TC.GSS power supplies:

- Damage to a load connected due to excessively high voltage, current or power steps.
- Incorrect or imprecise display is possible.

Avoidance:

- ⇒ Before you change parameters, make sure a calibration is really necessary.
- ⇒ Contact support before you make changes to parameters.
- ⇒ Check your procedure for the calibration again before you save modified parameters on the TC.GSS power supply



In the case of recalibration, please contact Regatron support.

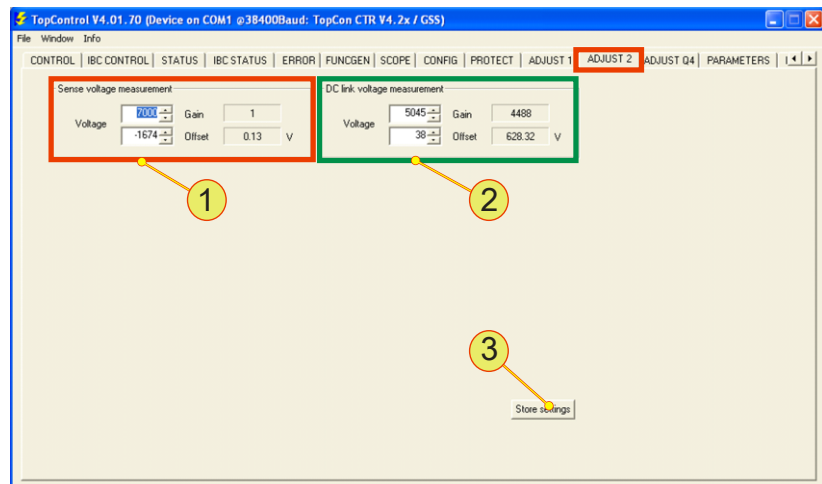


Fig. 132 Overview of <ADJUST 2> tab.

<ADJUST 2> tab – parameter overview	
1	<b>Sense voltage measurement, group</b> Calibration of the sense. The maximum and minimum sense voltage is calibrated using the gain and the offset. The indication on the right shows the allocation between the actual measured value and the sense voltage.
2	<b>DC link voltage measurement, group</b> Calibration of the intermediate circuit voltage measured value. The maximum and minimum intermediate circuit voltage is calibrated using the gain and the offset. The indication on the right shows the allocation between the actual measured value and the sense voltage.
3	<b>Store settings, button</b> Settings made on the <ADJUST 2> tab are permanently saved. The actual parameter set is saved from the RAM to the flash PROM in the TC.GSS power supply.

Table 119 Overview of the &lt;ADJUST 2&gt; tab.

**7.4.8.9. Tab – <ADJUST Q4>**

User level: from Power User

The necessary internal adjustments can be made during the test and setup phase for a TopCon TC.GSS power supply using the parameters on the <ADJUST Q4> tab.

The maximum and minimum parameter value is calibrated using the gain and the offset.

The indication on the right shows the allocation between the actual measured value and the voltage.

The value for the offset or gain can be set in the boxes while the actual parameter set is displayed on the right.

**CAUTION****Damage possible due to decalibration!**

Changes to parameters can cause damage to TC.GSS power supplies:

- Damage to a load connected due to excessively high voltage, current or power values.

Avoidance:

- ⇒ Please contact Regatron support first if you are uncertain.
- ⇒ Check changes to parameters for safety's sake, prior to saving to the TC.GSS power supply.



In the case of recalibration, please contact Regatron support.

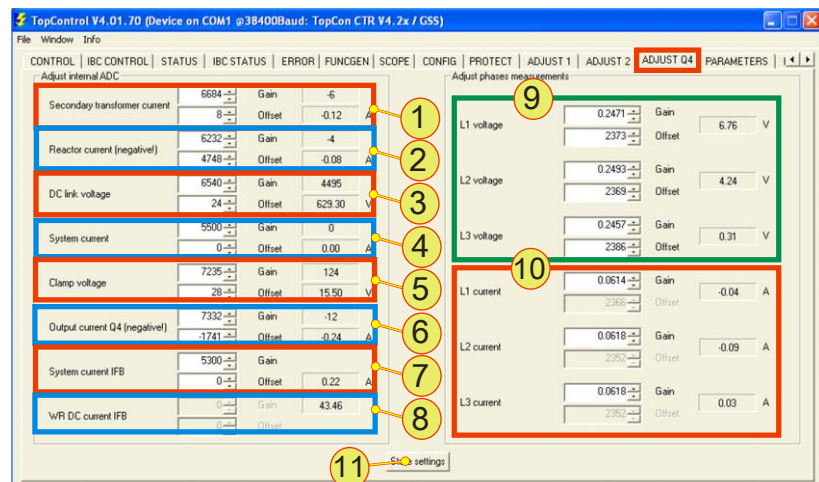


Fig. 133 Overview of <ADJUST Q4> tab.

<ADJUST Q4> tab – parameter overview	
1	<b>Secondary transformer current</b> Current on the secondary side of the transformer. Effect on the Current sek indication on the <STATUS> tab <sup>1</sup>
2	<b>Reactor current (negative)</b> Current in the storage choke for the booster. Effect on the “Current L” indication on the <STATUS> tab <sup>1</sup>
3	<b>DC link voltage</b> Intermediate circuit voltage. Effect on the “DC link voltage” indication on the <STATUS> tab <sup>1</sup>
4	<b>System current</b> Specified current $I_{REF}$ on the analogue interface X105.
5	<b>Clamp voltage</b> Voltage at the charging capacitor for the booster. Effect on the “Voltage Clamp” indication on the <STATUS> tab <sup>1</sup>
6	<b>Output current Q4 (negative)</b> Actual value for the output current. Effect on the “Output current” indication on the <STATUS> tab <sup>1</sup>
7	<b>System current IFB</b> The actual value of the output current is determined via a current sensor on interface X108.
8	<b>WR DC current IFB</b> DC term on the AC side. The DC term should always be 0 A.
9	<b>Phase voltages</b> Phase voltage for each phase L1, L2, L3 See $U_{max}$ on the <STATUS> tab <sup>1</sup>
10	<b>Phase currents</b> Phase current for each phase L1, L2, L3 Effect on the I <sub>max</sub> indication on the <STATUS> tab <sup>1</sup>
11	<b>Store settings</b> Settings made on the <ADJUST Q4> tab are permanently saved. The actual parameter set is saved from the RAM to the flash PROM in the TC.GSS power supply.

Table 120 &lt;Adjust Q4&gt; tab

<sup>1</sup> For <STATUS> tab overview see chapter 7.4.8.2, page 178.

#### 7.4.8.10. Tab – <PARAMETERS>

User level: from Power User

The <PARAMETERS> tab is used to modify internal control parameters. TopCon is a reactive system that communicates with other systems (e.g. user interface) via these control parameters. These control parameters are saved in so-called gridfiles.

Gridfiles contain the allocation of variable names to the actual hardware addresses used in the controller. This allocation may change on firmware version changes. The variable/address allocation can be edited via the <PARAMETERS> tab.

Appropriate gridfiles are provided by Regatron support.

#### **CAUTION**      **Damage to the TopCon power supply possible!**

- Modified hardware addresses can cause the system in the TopCon GSS power supply to crash continuously.
- Modified parameters and variables can change the safety limits in the TopCon GSS power supply, which can cause damage to the device.

Avoidance:

- ⇒ Please contact Regatron support first.
- ⇒ Only make changes that are absolutely necessary.
- ⇒ Make changes carefully, take your time with the changes.
- ⇒ If the firmware and gridfile version do not match, a warning appears. Contact support immediately.

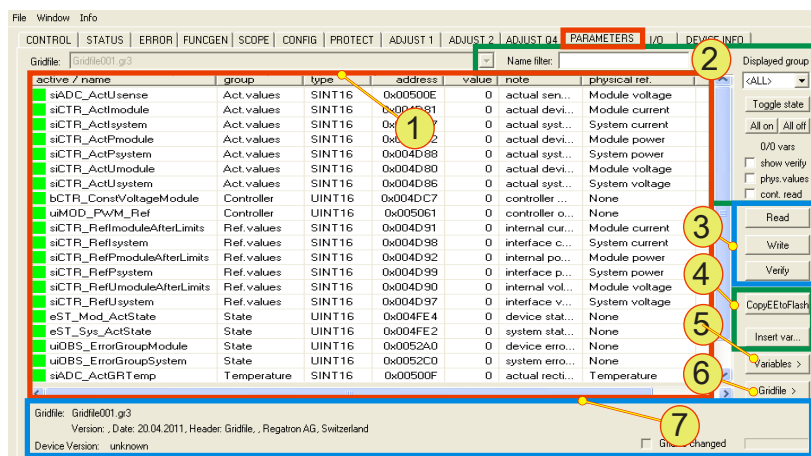


Fig. 134 Overview of the &lt;PARAMETERS&gt; tab.

<PARAMETERS> tab – overview	
1	<b>Parameter list</b> The characteristics of the parameters in a gridfile are shown in list form.
2	<b>Filtering and grouping</b> The parameter list -1- can be grouped and filtered such that certain signals are hidden or shown. See Fig. 136, Seite 239.
3	<b>TopCon memory</b> By clicking the related button an edited parameter list can be written (“Write”) to the memory in the TopCon GSS power supply, and verified (“Verify”) or read (“Read”). For repeated reading from the memory, the “cont. read” -2- check box must be selected.
4	<b>Factory</b> Only for use by the manufacturer!
5	<b>Factory</b> Only for use by the manufacturer or only in consultation with Regatron. It is possible to insert new parameters or edit parameters manually.
6	<b>&lt;Gridfile&gt;</b> , button opens new submenu Gridfiles can be loaded and saved, see Fig. 137, page 241.
7	<b>Read-only indication</b> Indicates the location of the actual gridfile in the file system and the firmware version that matches the gridfile is shown beside “Device Version”. Gridfile and firmware version must match.

Table 121 Overview of the &lt;PARAMETERS&gt; tab.



## Parameter list

active / name	group	type	address	value	note	physical ref.
siADC_ActUsense	Act.values	SINT16	0x00500E	0	actual sen...	Module voltage
siCTR_ActImodule	Act.values	SINT16	0x004D81	0	actual devi...	Module current
siCTR_ActIsystem	Act.values	SINT16	0x004D87	0	actual syst...	System current
siCTR_ActPmod	Act.va	SINT16	0x004D86	0	actual do...	Module po
siCTR_ActPsystem	Act.values	SINT16	0x004D88	0	actual syst...	System power

Fig. 135 Overview of the columns in the parameter list.

Parameter list – meaning of the columns	
1	<b>active</b> , read-only indication Variables can be in 4 states: Green Variable is active → Can be saved in the TopCon. After variable verification: match Yellow Variable is active → Can be saved in the TopCon. After variable verification: no match (caution) Grey Variable is inactive → Cannot be saved in the TopCon and cannot be verified. Red Transmission error/access error during the last “Read”/“Verify” or “Write” action
2	<b>name</b> , read-only indication The variables are sorted alphabetically by their name within a group -3-. The list can be filtered the variable names or parts of the names, see Table 123, page 240.
3	<b>group</b> , read-only indication The groups with their variables are sorted alphabetically. There is no restriction on the group name. The group meaning and its name may vary depending on the gridfile. For information on filtering and grouping see Table 123, page 240.
4	<b>type</b> , read-only indication Indication of the variable format: UINT16 16-bit [0...65535]; unsigned SINT16 16-bit [-32768...32767]; signed BYTE 8-bit [0...255]; unsigned HEX 16-bit <sub>hex</sub> [0...0XFFFF] (hexadecimal format) BIN 16-bit <sub>B</sub> [0000000000000000...1111111111111111] Binary format (2 <sup>0</sup> , 2 <sup>1</sup> , 2 <sup>2</sup> , 2 <sup>3</sup> ,...) BITx Bit position in 16-bit word. (0...15) x ≙ Bit position with state “1” or “0”
5	<b>address</b> , read-only indication Address in the memory in the TC.GSS power supply. Addresses are not allowed to be changed in existing gridfiles!

The table is continued on the next page.

Parameter list – meaning of the columns (continued)	
6	<p><b>value</b>, read-only indication</p> <p>Variable value. The indication is dependent on the type <b>-4-</b>. The following value indications are possible, see check boxes Table 123, Seite 240:</p> <p>Numerical value Value range is dependent on the variable selected.</p> <p>Physical Indication of the physical value with unit, if the value has a “Physical ref” allocation <b>-8-</b>.</p> <p>Verifying Numerical value or physical value is indicated with the values saved in the TopCon for verification. The values saved in the TopCon are indicated in brackets. Indication only if “verify” has been run and “show verify” is selected, see Table 123, Seite 240.</p>
7	<p><b>note</b></p> <p>Comment field with useful information on the content of the variables. Up to 60 alphanumeric characters.</p>
8	<p><b>physical ref.</b></p> <p>Information on the reference values, e.g. whether they are system values or module (device) values etc. Correct allocation makes it possible to indicate the variable value as a physical value, e.g. in [V] for Volt, instead of normalised.</p>

Table 122 Meaning of the columns in the parameter list.

## Filtering and grouping

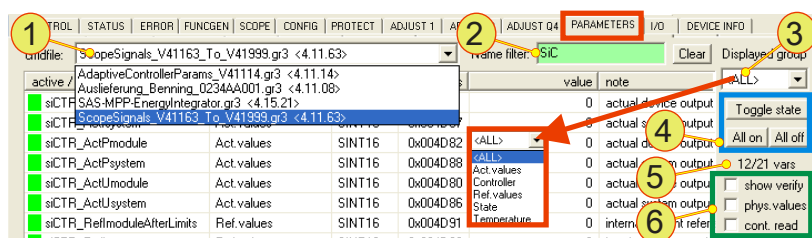
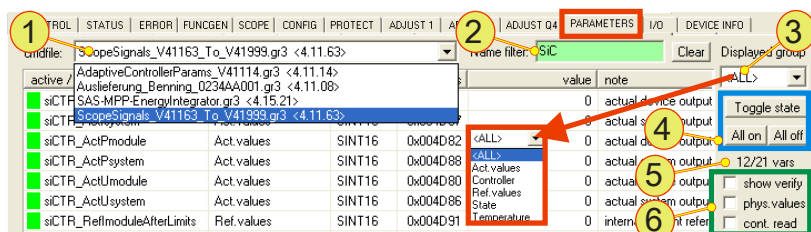


Fig. 136 Overview of the filtering and grouping functions.

Filtering and grouping	
1	<p><b>Gridfile</b>, list box and read-only indication</p> <p>Colour of the list box</p> <p>White If several gridfiles are loaded, it is possible to search for the required grid file.</p> <p>Grey With one gridfile loaded → selection not possible. With no gridfile loaded.</p>
2	<p><b>name filter</b>, text box</p> <p>It is possible to enter individual letters. A search is made for the string entered and the list updated immediately, independent of the position of the letters in the variable name.</p> <p>With a group filter active, the search is made within the variables group.</p> <p>Two colour states for the text box indicate the match status:</p> <p>green Filter active. String exists.</p> <p>red Filter active. String does not exist.</p> <p>white Filter inactive.</p> <p>&lt;Clear&gt; Entries made are cleared using the button. → All variables are indicated in the parameter list as a function of the group filter.</p>
3	<p><b>Displayed group</b>, list box</p> <p>The contents of the list box may vary depending on which groups are defined in a gridfile. Only variables that are allocated to the group selected in the list box are indicated in the parameter list.</p> <p>Default: ALL</p>

The table is continued on the next page.



Overview of the filtering and grouping functions.

Filtering and grouping (continued)	
4	<p><b>Variable activation</b>, button group</p> <p>The activation status of the variables can be changed. Two states are possible, see Table 122, Seite 238 description of the parameter list:</p> <p>green<sup>1</sup> Variable is active → Can be saved, read and checked in the TopCon.</p> <p>grey<sup>1</sup> Variable is inactive → Can be saved, read and checked in the TopCon.</p> <p>Meaning of the buttons:</p> <p>&lt;Toggle state&gt; The state of the selected (with blue background) rows is changed.</p> <p>&lt;All on&gt; All variables in the parameter list are activated (green).</p> <p>&lt;All off&gt; All variables in the parameter list are deactivated (grey).</p>
5	<p><b>x/y vars</b>, read-only indication</p> <p>x <math>\hat{=}</math> Number of filtered and indicated variables (parameter list).</p> <p>y <math>\hat{=}</math> Total number of variables in the gridfile.</p>
6	<p><b>Check boxes</b></p> <p>Effects if the following check boxes are selected:</p> <p>show verify Numerical value or physical value is indicated in the parameter list compared with the values saved in the TopCon. The values saved in the TopCon are indicated in brackets.</p> <p>phys. values The physical value and unit are indicated in the parameter list in the "value" column.</p> <p>cont. read Continuous reading of variables from the TopCon memory, as soon as the "Read" button is clicked. See Table 121, Seite 236.</p>

Table 123 Filtering and grouping – description of the options.

<sup>1</sup> A deactivated variable can be switched between active and inactive by double-clicking using the right mouse button.

## Handling gridfiles

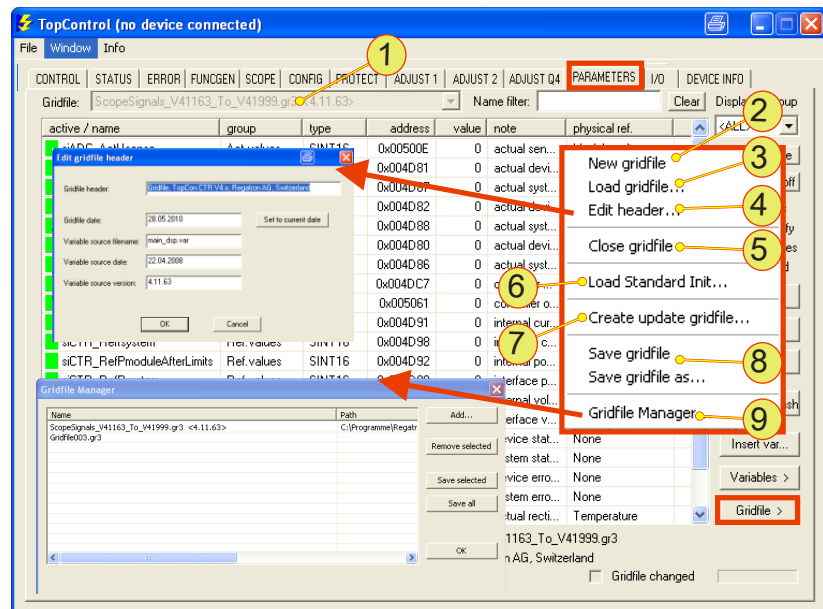


Fig. 137 The “Gridfile” submenu on the &lt;PARAMETERS&gt; tab.

“Gridfile” button – submenu	
1	<b>Indication/list box actual gridfile</b>
2	<b>New gridfile</b> , menu item → An empty gridfile list opens and a new gridfile name appears in the box -1-: GridfileXXX.gr3; (XXX≅0...999)
3	<b>Load gridfile...</b> , menu item opens Explorer window Load one or more gridfiles from the required folder. → The name of the gridfile loaded appears in the box -1-.
4	<b>Edit header...</b> , menu item opens window In the “Edit Gridfile header...” window the meta data for a new gridfile can be defined or the meta data for an existing gridfile can be changed. Contact Regatron support first.
5	<b>Close gridfile</b> , menu item The gridfile indicated in the list box -1- is closed. → The gridfile is no longer included in the parameter list.
6	<b>Load Standard init...</b> , Only for use by the manufacturer!
7	<b>Create update gridfile...</b> , Only for use by the manufacturer!
8	<b>Save gridfile/Save gridfile as...</b> , menu item opens window The following parameters can be selected on saving the gridfile: → Folder in the file system → Name of the gridfile. File extension: file_name.gr3
9	<b>Gridfile Manager</b> , submenu opens window Points -3-, -5-, -8- are combined in the window. As a result several gridfiles can also be edited at the same time.

Table 124 Meaning of the parameters on the “Gridfile” submenu.



## 7.4.8.11. Tab – &lt;I/O&gt;

User level: from Power User

On the <I/O> tab tests can be undertaken on the hardware, especially the interface X105.

- Status indication for the digital inputs.
- Function tests can be undertaken on the digital outputs.
- Internal device test can be disabled and the fan function can be controlled manually.

For further information on the pin definition and interface description for interface X105, see chapter 10.1.6.6, page 271.

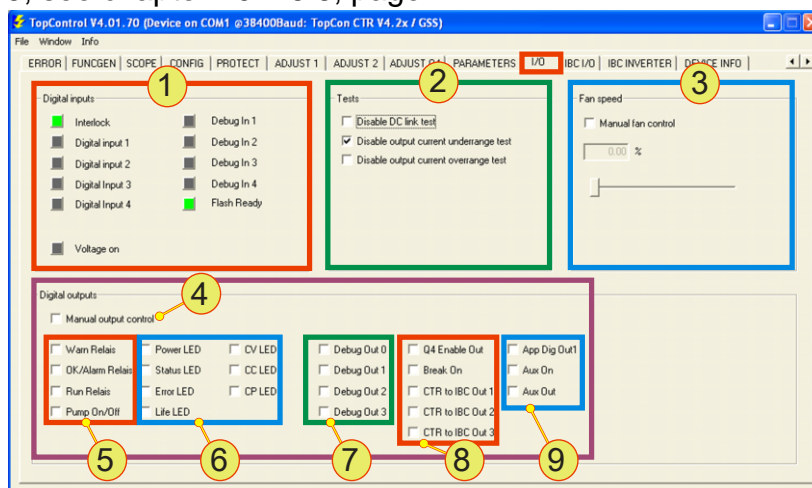
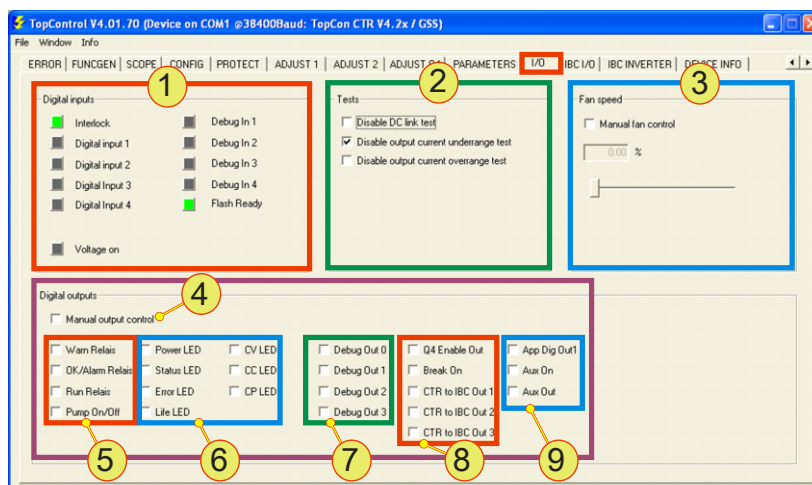


Fig. 138 Overview of <I/O> tab.

<I/O> tab – parameter overview	
1	<p><b>Digital inputs</b>, group with status read-only indications</p> <p>Depending on the status      Green <math>\hat{=}</math> Active    Grey <math>\hat{=}</math> Inactive</p> <p>Interlock      Pin name on the interface: INTERLOCK_IN_+</p> <p>Digital input 1-4      Pin name on the interface: APP_DIGITALIN_1-4</p> <p>Debug In 1-4      Only for use by the manufacturer!</p> <p>Flash Ready      Only for use by the manufacturer!</p> <p>Voltage on      Pin name on the interface: VOLTAGE_ON</p>
2	<p><b>Tests</b>, group with check boxes</p> <p><b>Disable DC link test</b> Disable the intermediate circuit voltage monitoring.</p> <p><b>Disable output current underrange test</b> Disable the negative output current monitoring.</p> <p><b>Disable output current overrange test</b> Disable the AD measuring range limit monitoring for the output current.</p>
2	<p><b>External (front) LED:</b> Power LED "POWER"; Status LED "STATUS"; Error LED "ERROR"; CV LED "VOLTAGE"; CC LED "CURRENT"; CP LED "POWER"</p> <p><b>Internal LED:</b> Life LED; Exception LED Only for use by the manufacturer! LEDs on the controller board.</p> <p><b>Digital outputs:</b></p> <p>Warn Relais      Pin name on the interface: WARN_a/b/c</p> <p>OK/Alarm Relais      Pin name on the interface: OK/ALARM_a/b</p> <p>Run Relais      Pin name on the interface: RUN_a/b</p> <p>Debug Out 0-2      Only for use by the manufacturer! Internal test points on the controller board.</p>
3	<p><b>Fan speed</b>, group</p> <p>Manual fan control If selected, the speed of the fan can be controlled manually using the slide.</p>
4	<p><b>Digital outputs</b>, group with check boxes</p> <p><b>Manual output control</b>      <b>is selected</b> (manual operation): →The LEDs no longer indicate the device status. →Digital outputs are no longer operated. →The LEDs on the front panel are turned on using check boxes. →The internal LEDs on the controller board are turned on using check boxes. →The digital outputs are operated using check boxes.</p> <p><b>Manual output control in cleared:</b> →All check boxes <b>-5-</b> to <b>-9-</b> can be selected.</p>

The table is continued on the next page.





Overview of &lt;I/O&gt; tab.

<I/O> tab – parameter overview	
5	<b>Digital outputs:</b> Warn Relais Pin WARN_a/b/c on X105 is set high. OK/Alarm Relais Pin OK/ALARM_a/b on X105 is set high. Run Relais Pin RUN_a/b on X105 is set high. Pump On/Off Switch on the water pump for the internal cooling.
6	<b>External (front) LEDs:</b> are switched on Power LED "POWER"; Status LED "STATUS"; Error LED "ERROR"; CV LED "VOLTAGE"; CC LED "CURRENT"; CP LED "POWER" <b>Internal LED:</b> Life LED is switched on Only for use by the manufacturer! LED on the controller board.
7	<b>Debug Out 1-4</b> Only for use by the manufacturer!
8	<b>Q4 Enable out</b> Pin Q4 Enable on X101/X102 is set high. <b>Break on</b> For the discharge device option, pin is set high to activate the discharge device. <b>CTR to IBC 1..3</b> Only for use by the manufacturer!
9	<b>App Dig Out1</b> The App Dig In1 pin on the X105 interface is defined as an output on activation. The pin is set low. <b>Aux on</b> Only for use by the manufacturer! <b>Aux out</b> Only for use by the manufacturer!

Table 125 Parameters on the &lt;I/O&gt; tab – some parameters relate to interface X105. For the pin definition of X105 see chapter 10.1.6.6, page 271.



## 7.4.8.12. Tab – &lt;DEVICE INFO&gt;

User level: from Standard User

The tab contains information on the TC.GSS power supply; the information is combined into various groups. E.g. device data, device identification and software version.



Please keep the information from the “Identification” and “Software versions” groups at hand on contacting Regatron support.

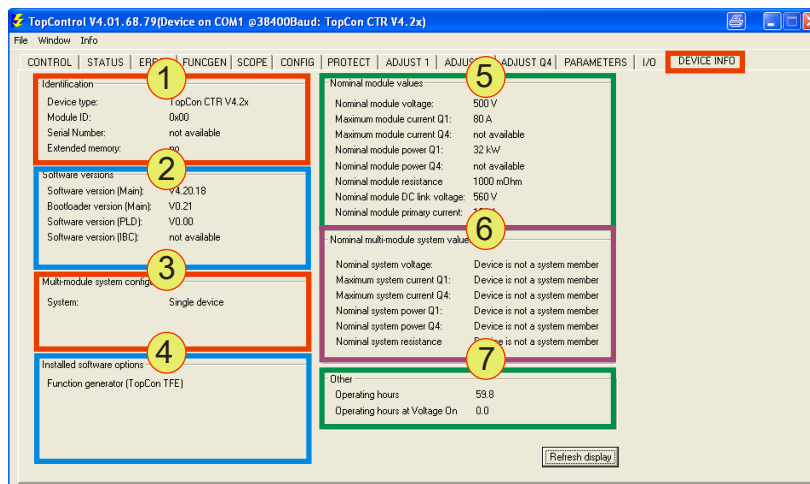


Fig. 139 Parameters on the <DEVICE INFO> tab.

<DEVICE INFO> tab – parameter overview	
1	<b>Identification</b> , group with read-only indications General device information. The module ID in a multi-unit system is dependent on the address settings on the front of the device and is only applied after restarting the TopCon GSS power supply. (Devices: master $\triangle$ ID = 0, slave $\triangle$ ID > 0)
2	<b>Software versions</b> , group with read-only indications Information on the firmware for the DSPs Main, PDSP, MDSP and actual bootloader version. In case of additional option boards, their firmware versions are also indicated.
3	<b>Multi module system configuration</b> , group with read-only indications General system information, if the TC.GSS power supply is operated in a multi-unit system.
4	<b>Installed software options</b> , group with read-only indications Indication of the software options that are enabled for the related TC.GSS power supply.

The table is continued on the next page.

<DEVICE INFO> tab – parameter overview (continued)	
5	<b>Nominal module values</b> , group with read-only indications TC.GSS power supply data.
6	<b>Nominal multi-module system values</b> , group with read-only indications System data if the TC.GSS power supply is operated in a multi-unit system.
7	<b>Other</b> , group with read-only indications Operating hours    Operating hours for which the TopCon power supply has been switched on. Operating hours at Voltage On Operating hours for which the TopCon power supply was in operation.

Table 126    Parameter overview for the &lt;DEVICE INFO&gt; tab.

## 8. Maintenance

### 8.1. Maintenance tasks

#### Determination of the operating hours

The operating hours represent the time during which the supply voltage is present at the device independent of the operating state.

The number of operating hours is indicated in the TopControl application on the <DEVICE INFO> tab. See chapter 7.4.8.12, Seite 247.

#### 8.1.1. Maintenance of the hardware

In principle the electronics in the TopCon TC.GSS power supply are maintenance-free.

However, the following components require maintenance depending on the number of operating hours:

- Fans
- Electrolytic capacitors.

##### 8.1.1.1. Fans

The TopCon TC.GSS power supplies contain 3 temperature-regulated, ball bearing mounted fans to cool the electrical and electronic components.

Life-expectancy – fans	
Life-expectancy per fan with an average ambient temperature of 40 °C	40,000 operating hours

Table 127 Life expectancy of electrical fans.

Use a torch and check at regular, intervals with the device switched on, whether the fans are rotating.

##### 8.1.1.2. Electrolytic capacitors

TopCon TC.GSS power supplies have electrolytic capacitors in the DC intermediate circuit.

Life expectancy – capacitors	
Life-expectancy of the electrolytic capacitors with an average ambient temperature of 40 °C	100,000 operating hours

Table 128 Life expectancy of electrolytic capacitors.

## 8.2. Maintenance of the software and firmware

### 8.2.1. Version of the TopControl application

The TopControl application is subject to a continuous process of further development.

An update to the latest software version makes it possible for you to use new functions and software improvements.



Fig. 140 Indication of the version of the TopControl application.

Using “Info” on the menu bar you can open a window with the actual version of the application **-1-** and the version of the function library (DLL) **-2-**.

You will find further information in “Using the software – menu bar” see chapter 7.4.7, Seite 167.

### Updating the TopControl application

TopControl is supplied with an installation program. Follow the instructions in the installation program, which will correctly install the application on the Windows system.

An older version of TopControl on the computer will be uninstalled first and the new version installed.

If older versions of the TopControl application are not uninstalled automatically, the application must be uninstalled manually. For this purpose use the operating system's uninstall wizard.

### 8.2.2. TopCon firmware version

You will find further information in “Determination of the system information” chapter 9.2, Seite 253.

#### Updating the firmware versions

**CAUTION**      **Damage can be caused by the following points!**

- If the TC.GSS power supply is updated unnecessarily, the device may cease to function, as gridfiles and firmware update must match.
- A firmware update is not fully completed.

Avoidance:

- ⇒ Prior to a firmware update, contact support to clarify if an update is necessary.
- ⇒ Only update the firmware if necessary.  
If your application works without problems, an update is not necessary.

## 9. Support

### You will receive assistance from Regatron support:

- In case of questions on hardware and software, interfaces and maintenance.
- On the procedure in the event of a repair.



### Prepare for contacting support!

If you contact Regatron support, you can make the process more efficient with the following information:

- Contact data:  
About your company, your sales partner
- System information:  
Device type, serial number, description of error, software versions

### 9.1. Contact information



If you compile the following information in an e-mail and send this e-mail to support in advance, support will then have this information available already when you ring.

Contact data	
1	<b>Name of company</b> The name of your company
2	<b>Contact person</b> Your name or the name of the person responsible for the problem in your company with whom further contact will be made.
3	<b>Contact details</b> E-mail address, telephone number (extension)
4	<b>Sales partner or supplier</b> Name of the sales partners or supplier's company and name of the employee in this company.
5	<b>Any support number, S 12345678</b> If you have already received a support number or enquiry number for your problem from support.

Table 129 Important contact information for support.



System information	
1	<b>Hardware and software information</b> Software version and firmware version, device serial number or device input and output data for single devices or multi-unit systems.
2	<b>Description of error</b> Information that documents the situation and the state of the system using measured results, logs, scope, screenshots and photographs

Table 130 Important system information for support.

## 9.2. How to contact support

Regatron TopCon support  
Kirchstrasse 11  
CH – 9400 Rorschach  
SWITZERLAND

E-mail: [tc.support@regatron.ch](mailto:tc.support@regatron.ch)

Phone: +41 (0)71 846 67 44

Fax: +41 (0)71 846 67 77

Web: [www.regatron.com](http://www.regatron.com)

## 9.3. Determination of the system information

### 9.3.1. Software versions



Fig. 141 Indication of the version of the TopControl application.

In the TopControl application, the actual version of the application -1- and version of the function library (DLL) -2- are indicated in the “About Top Control” window using “Info” on the menu bar.

Provide this information to support as contact information.

“Using the software – menu bar”, see chapter 7.4.7, Seite 167.

### 9.3.2. Firmware versions and device information

#### Device hardware

Information on the device is to be found on the type plate on the rear side of the TC.GSS power supply.

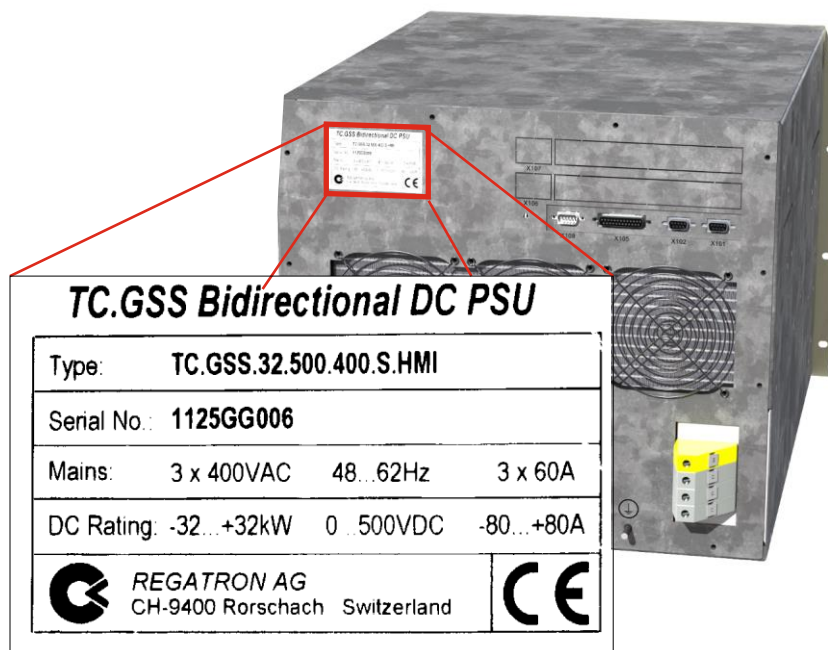


Fig. 142 Example - information on the device type, serial number as well as input and output data on the TC.GSS power supply.

## Device hardware and firmware

The <DEVICE INFO> tab contains a large amount of information on individual devices and the multi-unit system, as well as the various firmware versions in the individual device modules.

The best method is to take a screenshot of the <DEVICE INFO> tab and send it to support as part of the contact information.

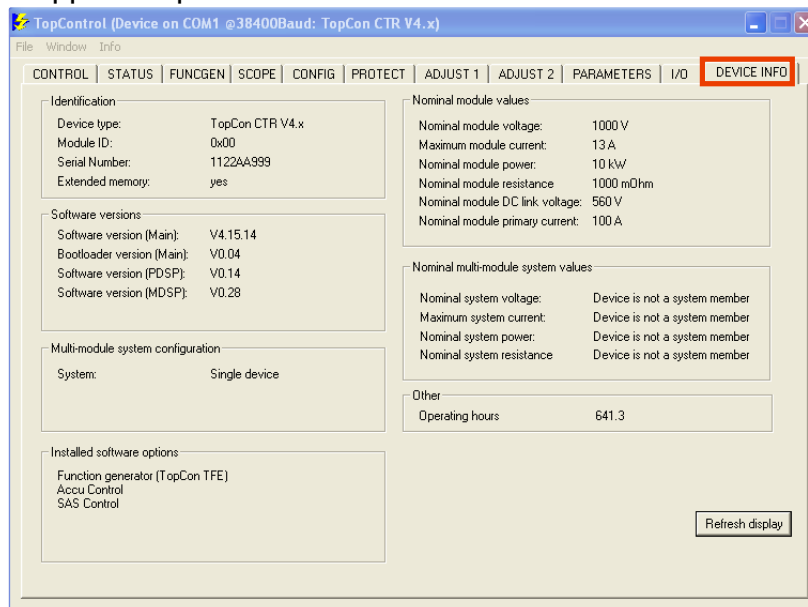


Fig. 143 Example – screenshot of the <DEVICE INFO> tab with all information on device hardware and firmware.

For further information on the <Device INFO> tab, see chapter 7.4.8.12, Seite 247.

Alternatively, it is possible to read the software versions for the HMI and controller board as well as the operating mode via the display for the HMI. For further information see chapter 7.3.4.3, Seite 137.

## 9.4. Enabling software options

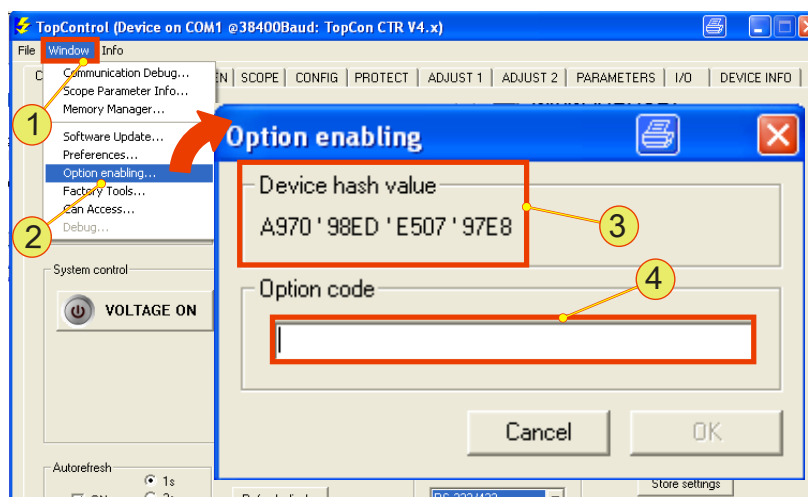


Fig. 144 “Option enabling” window for enabling software options.

### Procedure:

- On the menu bar open the “Window” -1- menu.
- Click the “Option enabling...” -2- submenu item.
- ↳ The “Option enabling” window opens.
- Send the “Device hash value” -3- for the TC.GSS power supply connected to Regatron support.
- You will receive from support an “Option code” that you must enter in the text box -4- as soon as possible.
- Accept your entry using the <OK> button.
- ↳ The software option has been successfully enabled.

## 9.5. Producing a standard scope

Using the SCOPE function the following signals can be recorded that are useful for diagnostics by support:

- Input and output signals for the actual values and set values  
Voltage, current, power etc. (digital and analogue)
- Device-internal parameters, such as temperature, controller signals, system state/error signals, intermediate circuit voltage, transformer current, internal 24 V supply, etc.

The procedure is described based on default settings and default signal variables. To be able to make your specific settings, you will find further information in “Scope tab”, chapter 7.4.8.4, Seite 199.

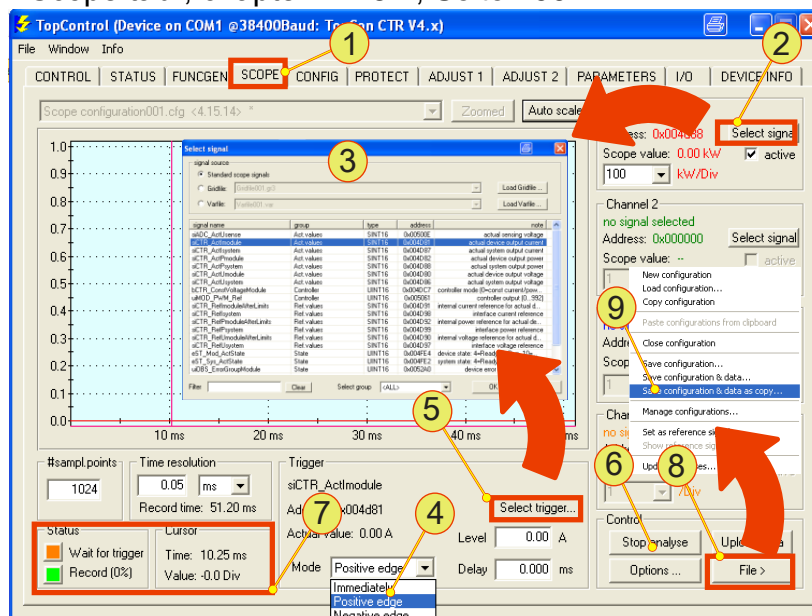


Fig. 145 Overview of the <SCOPE> tab with the controls.

- Open the <SCOPE> -1- tab.
- Using the related <Select signal> -2- button, select the following default signals variables from the “Select signal” -3- window for each channel.

Chan nel	Variable	Description
1	siCTR_ActUmodule	Output voltage of the single device
2	siCTR_ActImodule	Output current of the single device
3	uiMOD_PWM_Ref	Pulse-width modulation
4	bCTR_ConstVoltageModule	Controller mode

Table 131 Default signal variables for a scope recording.

- In the list box **-4-** select “positive edge”.
  - ↳ <Select trigger...> **-5-** button is activated for the entry.
- Using the <Select trigger...> **-5-** button in the “Select signal” **-3-** window, select the trigger signal.  
(Here in the example: siCTR\_ActUmodule)
- Enter the related trigger level.
- Start the scope recording using the <Start analyse> **-6-** button.
  - ↳ The button **-6-** changes function and label to <Stop analyse>.
  - ↳ The indication changes in the “Status” **-7-** group.
    - “Wait for trigger” read-only indication changes to orange.
    - “Record” read-only indication changes to green.
  - ↳ Storage and indication on the scope are automatic.  
(Condition: correctly set trigger parameters)
- Save the scope and data using a folder and name of your choice using the <File> **-8-** button and the “Save configuration & data as copy” **-9-** submenu item.
- Send the scope file as part of the contact information to your sales partner or Regatron support using your e-mail client.

## 9.6. Device return

Use the original packaging to return the device.

If you no longer have the device packaging at hand, you can order new packaging via Regatron support.

### 9.6.1.1. Packaging sequence – standard packaging

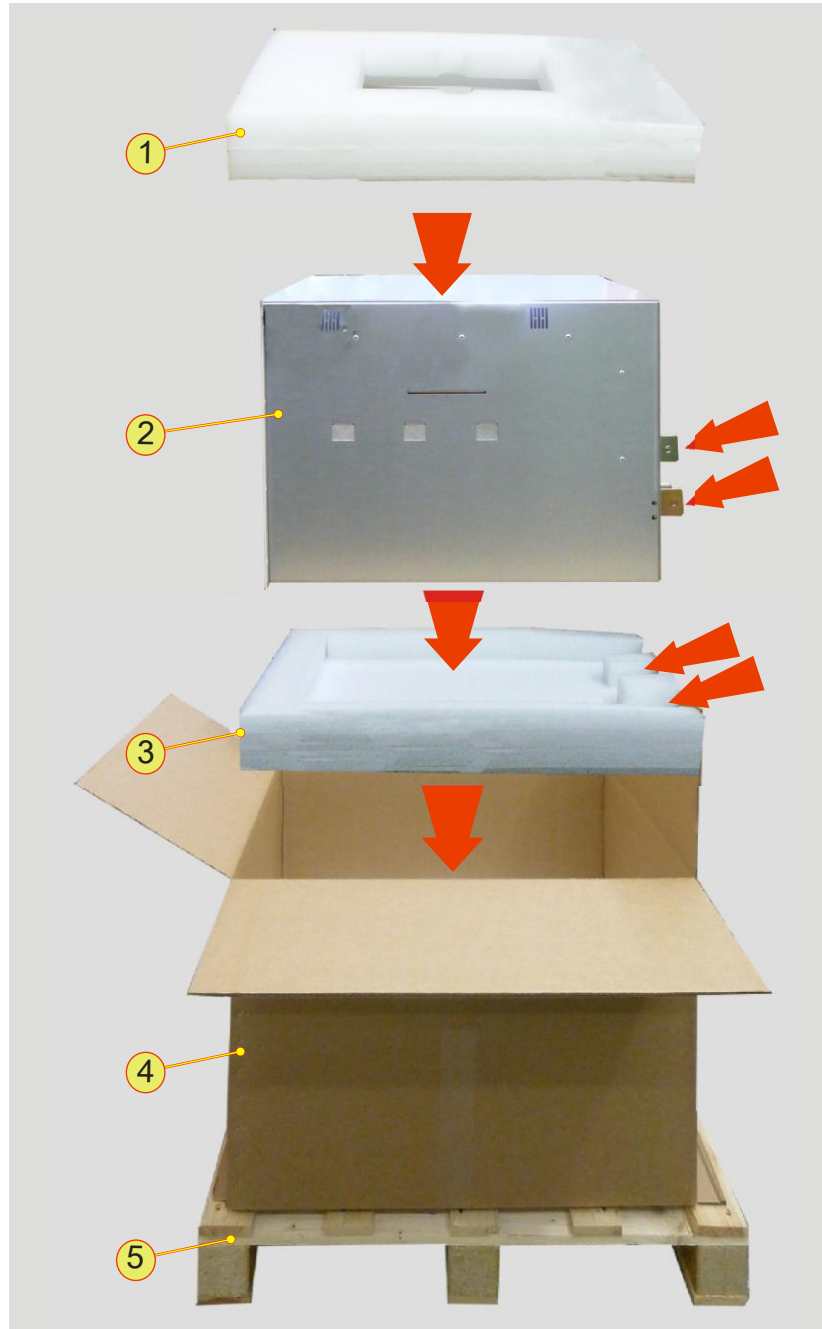


Fig. 146 Arrangement of standard shipping packaging for a TC.GSS power supply with 9 U.

Elements of the original shipping packaging	
1	<b>Cover</b> Upper cover with cut-out for the box of accessories. Varies for 9U and 6 U devices.
2	<b>TopCon power supply with 9U</b> 6 U devices are a little lower.
3	<b>Bottom</b> Lower protective support with space on the rear side for the current bars on the TopCon power supply. Varies for 9 U and 6 U devices.
4	<b>Cardboard box</b> Varies for 9 U and 6 U devices.
5	<b>Transport pallet</b> , disposable pallet 120 x 80 mm The cardboard box is firmly strapped to the disposable pallet.

Table 132 Packaging material for standard packaging.

#### 9.6.1.2. Optional packaging protection

For certain transport routes it can be necessary to protect TopCon power supplies against damage with additional transport protection.

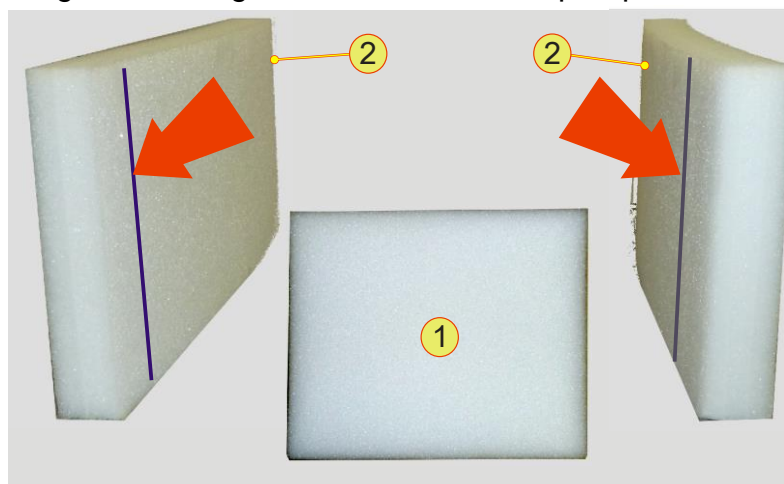


Fig. 147 Additional packaging material.

Optional additional protection	
1	<b>Device front protection</b> Provides additional protection for the front side of the device
2	<b>Side protection</b> The side protection has slits for the protruding front panel on the TC.GSS power supply.

Table 133 Additional packaging material.



## 9.7. Disposal with due care for the environment



Electrical equipment is too valuable for household waste.

On the disposal of electrical equipment, comply with national laws.

## 10. Appendix

### 10.1. Technical data

#### 10.1.1. Mains connection

Device type	TC.P.20	TC.P.32
Connection type	3 LPE (without neutral conductor)	
Mains voltage (3-phase, phase to phase)	400 V <sub>eff</sub> : 360 V <sub>eff</sub> – 440 V <sub>eff</sub> ;	
Mains frequency	48 – 62 Hz	
Permissible mains imbalance	< 3%	
Connection rating	25 kVA	40 kVA
Model 400 VAC (3-phase)	32 A <sub>eff</sub>	50 A <sub>eff</sub>
Inrush current <sup>1</sup>	< 15 A	
Nominal current Circuit breaker <sup>2</sup>	40 A	63 A
Breaking capacity Circuit breaker <sup>2</sup>	10 kA	
Power factor (cos φ)	~ 0.99	
Efficiency approx.	~92 %	~92 %
Power loss approx.	1.5 kW	2.0 kW

Table 134 Electrical parameters for the various TopCon TC.GSS power classes.  
For further information please refer to the related data sheet.

<sup>1</sup> At nominal voltage on the mains connection.

<sup>2</sup> Built-in circuit breaker. For further information on the

### 10.1.2. Leakage current

The following leakage current events are produced by the correct function of the mains filter.

Leakage current condition	Total leakage current	Frequency range				
		50 Hz	≤ 100 Hz	150 Hz	≤ 1 kHz	> 1 kHz
"Voltage ON" without load	100 mA	1 mA	2 mA	2 mA	3 mA	100 mA
"Voltage ON" with full load	114 mA	5 mA	5 mA	1 mA	6 mA	114 mA

Table 135 Leakage current – Measured result on a TC.GSS power supply with 32 kW XXXX (still needs to be expanded) with no load and with load.



If you want to use an earth leakage trip, use a device with an expanded frequency range.

Please take note of the varying requirements for protection against fire and the protection of individuals.



Regatron recommends the usage of an earth leakage circuit breaker sensitive to AC and DC leakage currents.

## 10.1.3. Control and regulation parameters

Remote programming	
<b>Analogue operation X105</b>	Input impedance 20 k $\Omega$
Voltage set value	0 – 10 V <sub>DC</sub> for 0 – 100 % V <sub>nom</sub>
Current set value	0 – $\pm 10$ V <sub>DC</sub> for 0 – $\pm 100$ % I <sub>max</sub>
Power limit <sup>4</sup>	10 – 0 V <sub>DC</sub> for 0 – 100 % P <sub>nom</sub>
Internal resistance simulation <sup>4,3</sup>	0 – 10 V <sub>DC</sub> for 0 – R <sub>max</sub>
<b>Digital operation (interfaces)</b>	RS-232 <sup>1</sup> ; HMI <sup>2</sup> ; TC.CANOpen <sup>2</sup> ; TC.GPIB <sup>2</sup> ; TC.USB <sup>2</sup>
Isolation in relation to mains voltage	2500 V <sub>AC</sub>

Table 136 Analogue and digital operation. <sup>1</sup>Standard, <sup>2</sup>Option  
<sup>3</sup>Maximum resistance value as standard 1.2  $\Omega$  or optional : 3.2  $\Omega$   
<sup>4</sup>The values are depended of a configuration flag refer to chapter 7.2.5, page 124.

Accuracy – measurement resolution <sup>1</sup>	
Analogue input and output	0.1 % at 10-bit resolution
Actual voltage	0.025 % at 12-bit resolution
Actual current	0.025 % at 12-bit resolution
Temperature measurement	0.2 C

Table 137 Measuring accuracy of the TC.GSS power supply.  
<sup>1</sup>Absolute value or referred to nominal values.

Times	
<b>Starting time</b>	
Control electronics <sup>1</sup>	5.0 s
Power section <sup>2</sup>	0.1 s
<b>Cycle times</b>	
Power section	25.0 µs
Voltage and current controllers	50.0 µs
Power controller	50.0 µs
Protection and monitoring	50.0 µs
State machine	1.0 ms
System communication	1.0 ms

Table 138 Starting and cycle times for a TC.GSS power supply.

<sup>1</sup>After switching on the mains voltage. <sup>2</sup>After output voltage enable.

#### 10.1.4. Output

Device power class	20 kW	30 kW
<b>Control range</b>		
Output voltage <sup>1</sup>	0 – 100 %	
Output current <sup>1</sup>	0 – 100 %	
Output voltage and current	See separate technical data sheets	
Residual ripple	See separate technical data sheets	
Isolation to earth and power line	See separate technical data sheets	

Table 139 DC output parameters.

<sup>1</sup> Referred to nominal values, with Ohmic load.

### 10.1.5. Protection functions

Overvoltage protection	
In operation as current source	Voltage limiting
In case of malfunction	Electronic inhibit
Response threshold <sup>12</sup>	0 – 110 %
Response time <sup>2</sup>	50 µs – 1600 ms

Table 140 TC.GSS power supply overvoltage protection

<sup>1</sup> Referred to nominal voltage<sup>2</sup> Adjustable

Overcurrent protection	
In operation as voltage source	Current limiting
In case of malfunction	Electronic inhibit
Response threshold <sup>12</sup>	0 – 110 %
Response time <sup>2</sup>	50 µs – 1600 ms

Table 141 TC.GSS power supply overcurrent protection.

<sup>1</sup> Referred to maximum current<sup>2</sup> Adjustable

### 10.1.6. Interfaces – pin definition

#### 10.1.6.1. General electrical *properties*

All interfaces are insulated from each other and also from earth. The insulation voltage is min. 125 V before a flashover can occur.

Electrical characteristics of internal auxiliary supply:

Internal auxiliary supply 24 V <sub>DC</sub>	
Voltage (max.)	24 V <sub>DC</sub>
Current (max.)	0.2 A

#### 10.1.6.2. Pin definition D-Sub plug

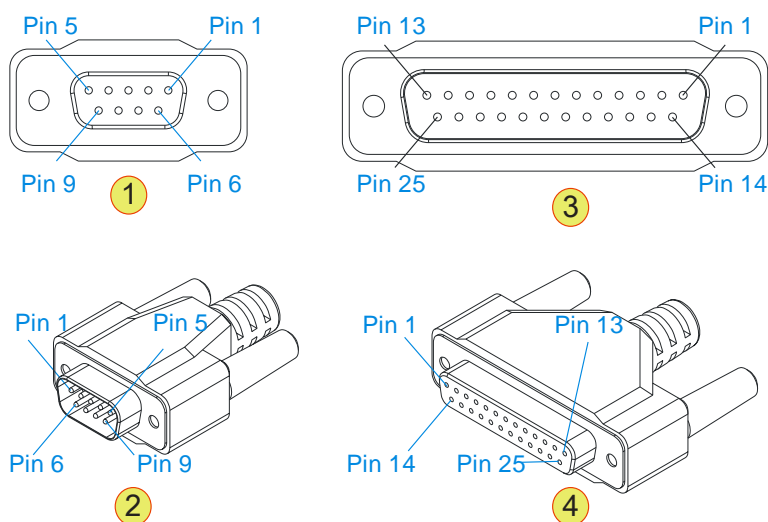


Fig. 148 -1- D-Sub 9 pin socket; -2- D-Sub 9 pin plug  
-3- D-Sub 25 pin socket; -4- D-Sub 25 pin plug

**10.1.6.3. RS-232 interfaces**

Connection: D-Sub socket 9-pin

TopControl end				PC end
Pin	Description	I/O	Signal	Signal
1	not connected (n.c.)	-	-	-
2	Transmit data	O	<b>TXD</b>	<b>RXD</b>
3	Receive data	I	<b>RXD</b>	<b>TXD</b>
4	n.c.	-	-	-
5	Common ground	-	<b>GND</b>	<b>GND</b>
6	n.c.	-	-	-
7	n.c.	-	-	-
8	n.c.	-	-	-
9	n.c.	-	-	-
	Connected to earth	-	<b>Shield</b>	-

Table 142 Pin definition RS-232.  
n.c.: not connected.**CAUTION Possible damaging of interface RS-232 by:**

- Peak current and static electricity

Avoidance:

⇒ All devices with a connection via RS-232 should not have voltage at the interface, before the connection is mechanically produced.



**10.1.6.4. CAN bus – interfaces X101/X102**

Connection: D-Sub socket 9-pin

Pin definition – CAN bus interface			
Pin	Signal	I/O	Description
1	INTERLOCK_CAN	I	Interlock CAN
2	CAN_L	I/O	CAN low
3	GND_CAN	O	CAN common
4	Q4_Enable	I/O	
5	I_Sys	O	
6	AGND	O	CAN common
7	CAN_H	I/O	CAN high
8	0 VDC I/O	O	Auxiliary supply common
9	+24 VDC I/O	O	Auxiliary supply + 24 V <sub>DC</sub>
	Shield		Connected with PE

Table 143 Pin definition on the interfaces X101/X102 as per **Fehler! Verweisquelle konnte nicht gefunden werden..**

Recommended cable characteristics for the system communication

Properties	Description
Characteristic impedance	120 ± 20 Ω
Cable cross-section	4 x 2 x 0.14 mm <sup>2</sup> with shielding
Twisting	In pairs 1 + 8/2 + 7/3 + 6/4 + 5
Recommended types	Dätwyler Uninet –4P, Dätwyler Uninet –4P flex

Table 144 Pin definition on the interfaces X101/X102 as per

10.1.6.5. Sense interface X104

Connection: socket, 3-pin

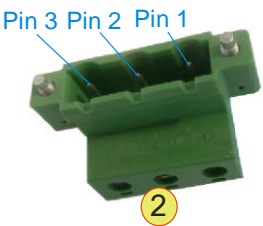
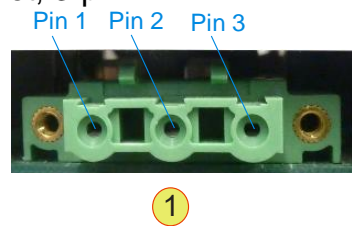


Fig. 149 -1- 3 pin socket; . -2- 3 pin plug

Pin definition – sense			
Pin	Signal	I/O	Description
1	S+	I	Sense positive pole
2	S-	I	Sense negative pole
3	GND	I	Ground connected with PE

Table 145 Pin definition on the interfaces X101/X102 as per

General electrical properties – sense	
Pins used	Pin 1, 2, 3
Current consumption (max.)	Approx. 1 mA at $U_{NOM}$
Voltage (max.)	$U_{NOM}$
Reference ground	Pin 3

Table 146Electrical properties of the interface X104

## 10.1.6.6. Analogue-digital interface – interface X105

Pin definition – analogue/digital interface			
Pin	Signal	I/O	Description
1	AGND	I	Analogue ground for pins 2–4, 14–16
2	VREF	I	Voltage setpoint
3	IREF	I	Current setpoint
4	IACT	O	Current feedback
5	0 V <sub>DC</sub>	O	0 V <sub>DC</sub> I/O ground for pin 25
6	+10 V <sub>DC</sub>	O	Analogue reference voltage
7	COM	I	(connected with Pin 17) 0V <sub>DC</sub> DigIn; Common ground for pins 8–9, 18–20, 24
8	APP_DIGITALIN_4; CLEAR_ERROR	I	Digital input
9	VOLTAGE_ON	I	Digital input
10	OK/ALARM_b	O	Relay output 1 normally open
11	OK/ALARM_a	O	Relay output 1 common
12	RUN_b	O	Relay output 2 normally open
13	RUN_a	O	Relay output 2 common
14	PREF	I	Power limit analogue input
15	RREF	I	Ri-simulation analogue input
16	VACT	O	Voltage feedback output
17	COM	I	(connected to pin 7) Common ground to pins 8–9, 18–20, 24
18	APP_DIGITALIN_1	I	Digital input
19	APP_DIGITALIN_2	I	Digital input
20	APP_DIGITALIN_3; ANAOG_REFERENCE_SELECT	I	Digital input (Analogue reference voltage)
21	WARN_a	O	Relay output 3 normally open
22	WARN_b	O	Relay output 3 normally closed
23	WARN_c	O	Relay output 3 common
24	INTERLOCK_IN_+	I	Input Interlock +
25	+24 V <sub>DC</sub>	O	Auxiliary supply + 24 V <sub>DC</sub>

Table 147 Pin definition for the X105 interface.

Electrical properties – analogue/digital interface	
Analogue inputs	
Pins used	Pin 2, 3, 14, 15
Input voltage range <sup>1</sup>	0 – 10 V <sub>DC</sub> (or -10 V <sub>DC</sub> – 10 V <sub>DC</sub> )
Input impedance	20 kΩ
Reference ground	Pin 1
Analogue outputs	
Pins used	Pin 4, 16
Output voltage range <sup>1</sup>	0 – 10 V <sub>DC</sub> (or -10V <sub>DC</sub> – 10 V <sub>DC</sub> )
Output impedance	335 Ω
Reference ground	Pin 1
Digital inputs	
Pins used	Pin 18, 19, 20
Input voltage range	High level: 10 V <sub>DC</sub> – 28 V <sub>DC</sub> Low level: 0 V <sub>DC</sub> – 2 V <sub>DC</sub>
Input impedance	4.7 kΩ
Reference ground	Pin 1
Digital outputs	
Pins used	Pin 10, 11, 12, 13, 21, 22, 23
Switching voltage (max.)	30 V <sub>DC</sub>
Switching current (max.)	1 A
Reference ground	Pin 1

Table 148 Electrical properties – analogue/digital interface.

<sup>1</sup> Can be changed to bipolar signal voltage using a configuration flag.  
If necessary contact Regatron support.

Mechanical properties – analogue/digital interface	
Type of connection	D-Sub 25-pin; socket

Table 149 Mechanical properties – analogue/digital interface

**10.1.6.7. ISR interface – X107 (option)**

On the usage of the ISR option the interface is used to communicate with the integrated safety relay.

Pin definition – integrated safety relay ISR (option)			
Pin	Signal	I/O	Description
1	+24 VDC I/O	O	Auxiliary supply + 24 V <sub>DC</sub>
2	---	I	---
3	NC	I/O	NC (Normally closed)
4	A1	I/O	Relay coil pin 1
5	Common	I	ISR Common
6	GND I/O	I/O	Auxiliary ground for pin -1-
7	--	I/O	---
8	NO	I/O	NO (Normally open)
9	A2	O	Relay coil pin 2
	Shield		Connected with PE

Table 150 Pin definition on the interfaces X107 (option)

Electrical properties	
Integrated safety relay ISR (option)	
Pins used	Pin 1, 2, 3
Current consumption (max.)	Approx. 1 mA at U <sub>NOM</sub>
Voltage (max.)	U <sub>NOM</sub>
Reference ground	Pin 6

Table 151 Electrical properties – ISR interface (option).

Mechanical properties – ISR (option)	
Type of connection	D-Sub 9-pin; socket

Table 152 Mechanical properties – ISR (option).

**10.1.6.8. System current sense - interface X108**

The interface X108 is not currently supported.

Pin	Signal	I/O	Description
1	Res1	I/O	Res signal
2	A_Res	I	Res analogue input
3	Q4_Enable	I/O	Indicates the active quadrant Q4 with 24 V <sub>DC</sub>
4	AGND	I/O	GND Isys, current sensor for pin -5-
5	I_Sys	I	System current from current sensor; to the shunt resistors
6	+15V	O	+15 V supply for current sensor, max. 200mA
7	-15V	O	- 15 V supply for current sensor, max. 200mA
8	GND_IO	O	Auxiliary ground for pin -9-
9	24V IO	O	Auxiliary supply + 24 V <sub>DC</sub>
	Shield		Connected with PE

Table 153 Pin definition for the System current sense interface.

Electrical properties – System current sense	
Current consumption (max.)	I <sub>NOM</sub> approx. 2000 A
Reference ground	Pin 4

Table 154 Electrical properties – System current sense interface.

Mechanical properties – System current sense	
Type of connection	D-Sub 9-pin; socket

Table 155 Mechanical properties – System current sense interface.

## 10.2. Error list

### 10.2.1. Introduction

#### Division into group and detail errors

To be able to troubleshoot errors as quickly and accurately as possible, the possible errors are divided into 16 group errors. Each of these group errors is in turn broken down into 16 detail errors.

The group and detail errors can be identified by direct digital access (via TopControl or HMI/RCU). Group errors and detail errors are also indicated sequentially on the front panel via a flashing code on the red “ERROR” light emitting diode.

There is the same mechanism for warnings. They are indicated on the front panel via the yellow “STATUS” light emitting diode or can be polled via TopControl and HMI/RCU.

#### Acknowledging an error

On the occurrence of an error, the device remains in the ERROR state until the error is acknowledged and the device signals this state correspondingly with the digital outputs (relay) and the light emitting diodes on the front panel.

The positive edge on the **Clear Error** signal is used to acknowledge an error. The digital input provided for this purpose or the related control parameter (direct digital access) is used.

#### Control signals in case of an error

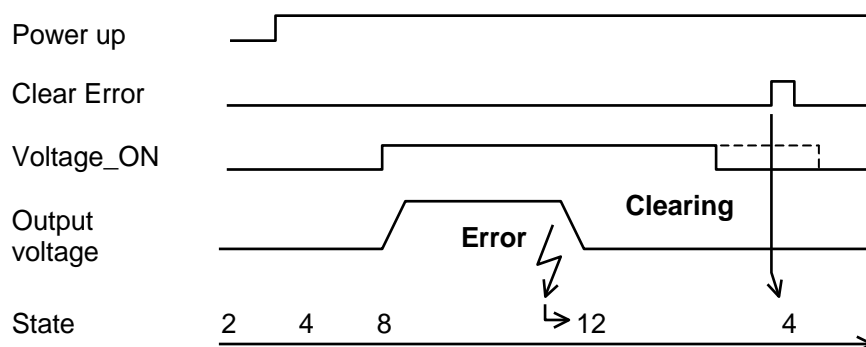


Fig. 150 Control signals in case of an error.

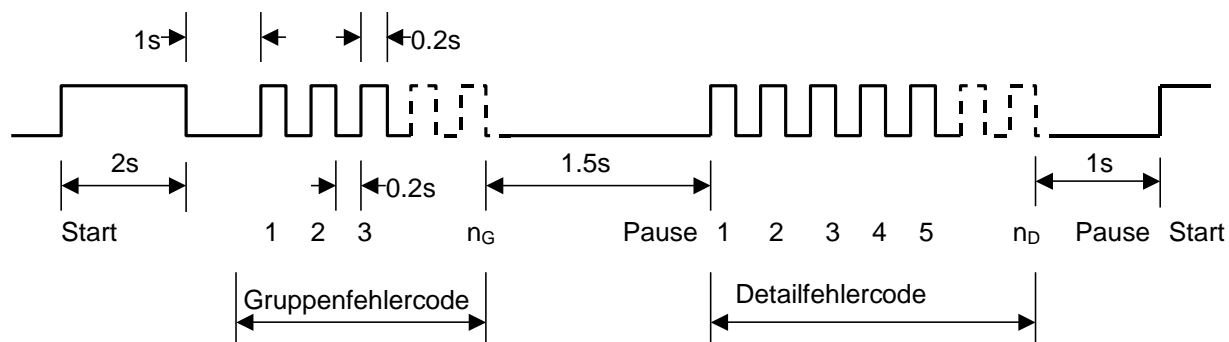
#### Errors and acknowledging

The warnings are also saved until they are acknowledged. The positive edge of the **Clear Error** signal is used for this purpose.

Errors can also be acknowledged via the TopControl application and via the HMI/RCU.

## Error and warning indication on the front panel LEDs

The number of flashes indicates the possible reasons for the malfunction (group error and detail error). The following illustration shows a period in the indication cycle.



Errors are indicated via the red ERROR LED; warnings via the yellow STATUS LED.

Error codes and warning codes are identical. All errors and warnings are output one after the other based on the scheme above. Then the flashing sequence starts again with the first error or first warning.

The chapter Overview of detail errors and detail warning codes lists all flashing codes and provides information on the reason for the error and how to rectify it.



**10.2.2. Overview of group error codes and group warning codes****Indication of the reason for the malfunction**

Flashing code	Group error	TopControl/HMI indication <sup>1)</sup>
1	Internal error	0) Internal
2	PDSP error	1) Internal (PDSP)
3	Error due to the output current	2) Output current
4	Error due to the output voltage	3) Output voltage
5	Error in the electrical power supply	4) Supply
6	Temperature error	5) Temperature
7	Communication error	6) Communication
8	Modulator error	7) Internal (Modulator)
9	AD_Ovrange_1-error	8) Internal (AD overrange 1)
10	AD_Ovrange_2-error	9) Internal (AD overrange 2)
11	AD_Underange_1-error	A) Internal (AD underrange 1)
12	AD_Underange_2-error	B) Internal (AD underrange 2)
13	Login error	C) Login
14	Configuration error	D) Configuration
15	-- (not used)	E) Not def.(group 14)
16	Interlock open, miscellaneous	F) Interlock open, Miscellaneous

<sup>1)</sup> On the HMI/RCU there is not enough space to output the errors or warnings with as much detail as in TopControl. I.e. the text may be indicated truncated. The code in front of the text is however identical in TopControl and HMI/RCU

The above list provides an overview of all existing group errors. Some of the groups can also occur as warnings via the same group code.

The code prefix [ 0) ...F) ] helps to clearly identify the error group/warning group. This code appears both in TopControl ("Show Errordetail"/"Show Warndetail" buttons) and also on the HMI/RCU (Error/Warning menu).

**Overview of detail errors and detail warning codes**

The following table lists all detail errors. Some of the detail errors can also occur as warnings with the same code.

The error or the warning can be identified using the flashing code in column 1 based on the number of flashes on the front panel LEDs.

The "TopControl/HMI indication" column contains the exact wording in TopControl ("Show Errordetail"/"Show Warndetail" button). The texts are truncated on the HMI/RCU for space reasons. The errors can however be unambiguously identified from the code given first.

**10.2.2.1. Error group 0) Internal**

Group error: 0) Internal			
Flashing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
1-1	00) Invalid systemstate	Invalid state has been detected.	→ On repeated occurrence contact the manufacturer
1-2	01) Invalid module state	For debug purposes	
1-3	02) Calculation Overflow	Overflow in internal calculation trapped	Wrong parameter set → → After a software update ensure that all parameters supplied have been loaded and saved
1-5	04) EEPROM table write	Error on writing the device parameters to the non-volatile memory	Update from V4.11.33 or earlier to V4.11.34 or later → After power up "Store settings" and restart device.
1-6	05) Flash timeout	Timeout occurred on writing/deleting a flash sector	→ On repeated occurrence contact the manufacturer
1-7	06) ADC sequence	AD-converter sequence in wrong order	Heavy EMI pulse affecting AD data stream → Earth devices using large area connections → Locate source of EMI, e.g. contactors without free-wheeling diodes
1-8	07) Invalid EEPROM table	Device parameter table empty or invalid	→ On repeated occurrence contact the manufacturer
1-9	08) Requested state not available	Unexpected state transition detected. For debug purposes	
1-10	09) Thyristor not switched on	Thyristor for bypassing the intermediate circuit charge resistor is not switched on (nominal condition). For debug purposes	
1-11	0A) No active controller defined	An active controller has not been defined. For debug purposes	
1-12	0B) ADC timeout	Timeout occurred during actual value acquisition	Subsequent error for error 06 → See above, error 06
1-13	0C) ADC DMA interrupt missing	Actual value acquisition incomplete	
1-15	0E) Invalid interrupt routine called	Unexpected interrupt routine has been called. For debug purposes	→ On repeated occurrence contact the manufacturer
1-16	0F) Old EEPROM table loaded	Version in device parameter table does not match actual software	Occurs after a firmware update on the MainDSP → After a software update ensure that all parameters supplied have been loaded and saved. See also software update instructions

**10.2.2.2. Error group 1) Internal (PDSP)**

Group error: 1) Internal (PDSP)			
Flashing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
2-1	10) PDSP package checksum	System communication malfunction	Heavy EMI pulse → Earth devices using large area connections → Locate source of EMI, e.g. contactors without free-wheeling diodes
2-2	11) Wrong PDSP SW version	Peripheral DSP version does not match the MainDSP version	- During a software update the peripheral DSP has not yet been updated to the latest state - Latest parameters not loaded after software update → Undertake software update exactly as stated in the instructions
2-3	12) PDSP fault	Internal has occurred.	→ On repeated occurrence contact the manufacturer
2-4	13) Write queue overrun		
2-5	14) Too many PDSP packages		
2-6	15) SCI checksum	Various RS232 errors	- Interference on RS232 cable → Earth devices using large area connections → Possibly use shorter cable → Possibly use shielded cable → Avoid earth loops, electrically isolate RS232 → Locate source of EMI, e.g. contactors without free-wheeling diodes
2-7	16) SCI parity		
2-8	17) SCI overrun		
2-9	18) SCI framing		
2-10	19) SCI break		
			- Wrong RS232 timing set (baud rate, stop bit, parity bit, ...) → For correct values see operating instructions
			- Level switching on RS232 after switching on or off a PC/laptop (Error 18) ) → Connect RS232 cable only after starting the PC/laptop or disconnect prior to switch off → Update the peripheral DSP to V0.11
			- Incorrect inactive RS232 level on host side as long as interface is not opened (Error 18) ) → Update the peripheral DSP to V0.11 → Start TopControl and leave to run to open the interface. The error cannot be acknowledged

Group error: 1) Internal (PDSP) (continued)			
Flashing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
2-11	1A) Unknown SCI status bit	Undefined internal communication. For debug purposes	→ On repeated occurrence contact the manufacturer
2-12	1B) Unknown CAN status bit		
2-13	1C) Unknown PDSP package		
2-14	1D) Package from not initialised mailbox	CAN package received from a mailbox that is not initialised. For debug purposes	Occurs once in firmware V4.11.30 in multi-unit operation from 4 devices on login. Can be ignored in this case → Acknowledge error → For >3 devices in the multi-unit system: use later firmware
2-15	1E) PDSP communication stopped	Communication with the peripheral DSP has failed	→ On repeated occurrence contact the manufacturer
2-16	1F) SCI timeout within a talk frame	Timeout on the reception of a TALK frame via RS232	- RS232 communication has been interrupted or distorted → See above, error 15-19)
			- Subsequent error for error 18) → See above, error 15-19)
			- Excessively slow implementation of the TALK protocol on the host side (PC) → All bytes in a TALK frame must be sent within 5ms (peripheral DSP version V0.09/V0.10) or within 200ms (from peripheral DSP version V0.11)

## 10.2.2.3. Error group 2) Output current

Group error: 2) Output current			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
3-1	20) i2t	Calculate energy loss $[(I_{limit})^2 - (I_{out})^2] * t$ exceeds limit value $I^2t_{max}$	Current above $I_{limit}$ for a time → Reduce load → Adjust $I_{limit}$ or $I^2t_{max}$ to the load
3-2	21) Overcurrent I <sub>sek</sub>	Output current exceeds level set for a specific time.	Controller overshooting on set value steps → Reduce set value ramp → Reduce control parameters
			Controller oscillation → Reduce control parameters
			Hard switching of a low resistance load results in current spikes from the output capacitors → Reduce brief voltage drop by connecting external capacitor/series indicator → After consultation with the manufacturer, it may be possible to increase the delay
3-3	22) Overcurrent I <sub>prim</sub>	Transformer current exceeds level set (level is temperature-dependent)	Controller overshooting on set value steps → Reduce gradient on the set value ramp → Reduce control parameters
			Hard switching of a low resistance load (faster and larger voltage drop) → Reduce brief voltage drop by connecting external capacitor/series indicator → Reduce control parameters
			Hardware fault → Rectification by manufacturer
3-4	23) Gatedrive A fault	Hardware current monitoring. Short-circuit detection with direct shutdown of the power stage	→ See above “22) Overcurrent I <sub>prim</sub> ”
3-5	24) Gatedrive B fault		
3-6	25) Overcurrent I <sub>sek</sub> (level derated by temperature)	As for 21) shutdown level has been reduced due to high temperature (from 110% to 100% of maximum device current)	→ See above “21) Overcurrent I <sub>sek</sub> ”
3-7	26) TCLIN Overcurrent	Current exceeds permitted limit	→ Reduce load
3-8	27) TCLIN Overload	Safe Operating Area limit (SOA) exceeded, excessively high transients have occurred	Controller is unstable → Reduce gain → Reduce drop voltage

**10.2.2.4. Error group 3) Output voltage**

Group error: 3) Output voltage			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
4-1	30) Overvoltage	Voltage has exceeded level set for a pre-defined time	Load shedding with high voltage already → Activate load shedding detection → Increase control parameters Use adaptive control parameters → Connect an additional capacitor → After consultation with the manufacturer, it may be possible to increase the error delay
			Controller oscillation → Reduce control parameters. Possibly increase P term
			Overshooting on set value step → Reduce gradient on the set value ramp → Reduce control parameters → Overshooting with no load: use adaptive voltage control parameters
4-2	31) Max. sense voltage drop reached	Difference between module voltage and sense voltage has exceeded the limit set for a specific time (delay) → Adjust monitoring level and delay to actual situation. → Possibly deactivate monitoring, if not required → Use lower resistance load feed cable → Do not disconnect load feed cable	
4-3	32) TCLIN Over-voltage	Voltage exceeds limit	Controller is unstable → Reduce gain → Reduce drop voltage → Reduce input voltage

## 10.2.2.5. Error group 4) Supply

Group error: 4) Supply			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
5-1	40) TCLIN +5V too high	Supply voltage exceeds/is below permitted limits	-) Internal power supply faulty -) Other error on board → Restart, if necessary contact support
5-2	41) TCLIN +5V too low		
5-4	43) +5V too low	Internal supply voltage outside the valid range	Subsequent error from 24V too low/too high → See below, error 4B/4C)
5-5	44) +5V too high		Subsequent error for error 07) (wrong gain values) → See above, error 07)
5-6	45) +15V too low		Hardware fault → Rectification by manufacturer
5-7	46) +15V too high		
5-8	47) -15V too low		
5-9	48) -15V too high		
5-10	49) DC link voltage too low	Intermediate circuit voltage too low.  (It may not be possible to achieve output values. )	Mains voltage too low → Check mains voltage Feed cable cross-section too small → Select cable with sufficiently large cross-section Poor contact on one or more mains phases → Pay attention to clean connection and fix cable firmly Hardware fault → Rectification by manufacturer
5-11	4A) DC link voltage too high	Intermediate circuit voltage too high; shutdown as protection for DC intermediate circuit and power stage	Mains voltage too high → Check mains voltage
5-12	4B) +24V too low	24V supply voltage too low	Error if no load connected: mains voltage too low → Check mains voltage
			Error only in case of load → See also reason for error 49)
			External load on the 24V supply excessive → Do not load 24V output above max. specified current
			Hardware fault → Rectification by manufacturer
5-13	4C) +24V too high	24V supply voltage too high	Mains voltage too high → Check mains voltage
			Hardware fault → Rectification by manufacturer
5-14	4D) Fast voltage drop on DC link	Voltage drop on intermediate circuit voltage within a short time (above all on load connection/start) (possible damage to the intermediate circuit components)	Mains cable cross-section too small → Select cable with sufficiently large cross-section
			Failure of a mains phase → Check mains phase voltages → Pay attention to clean connection and fix cable firmly
			Intermediate circuit thyristor is not switching → Rectification by manufacturer
			Hardware fault → Rectification by manufacturer
5-15	4E) TCLIN +15V too high	Supply voltage exceeds/is below permitted limits	-) Internal power supply faulty -) Other error on board → Restart, if necessary contact support
5-16	4F) TCLIN +15V too low		

**10.2.2.6. Error group 5) Temperature**

Group error: 5) Temperature			
Flash ing code	TopControl/ HMI indication	Description	Possible reason → Measure to rectify
6-1	50) Rectifier temp. too high	Heat sink temperature in the area of the output rectifier or IGBT power stage too high	Flow of inlet or outlet cooling air obstructed → Replace any clogged filters. Create sufficient space for inlet and outlet air
6-2	51) IGBT temp. too high		- Ambient temperature too high - Load current too high (pay attention to temperature derating) → Reduce ambient temperature → Adjust load to the ambient temperature (derating)
6-3	52) TCLIN K1 temperature too high	Heat sink temperature at measuring point K1 or K2 too high	-) Cooling is not operating satisfactorily → Check air inlet/outlet?, fans ok? -) Power loss excessive → Reduce drop voltage -) NTC K1/K2 /PCB has cable break, other defect → Contact support
6-4	53) TCLIN K2 temperature too high		
6-5	54) TCLIN PCB temperature too high	Temperature of the printed circuit board too high	



## 10.2.2.7. Error group 6) Communication

Group error: 6) Communication			
Flashin g code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
7-1	60) CAN bus off	CAN controller error	CAN bus terminating resistor not connected → A bus terminating resistor is required at both ends of the bus
7-2	61) CAN error passive		Master-slave cable not connected correctly. → Ensure all cables on all bus clients are correctly seated
			Inadmissible Y cabling of the CAN bus → In case of stubs keep to the maximum length of 30cm
			High levels of interference affect the CAN bus → Locate possible sources of interference and try switching off
			Master-slave cable faulty → Replace cable
			Bus clients other than TopCon causing interference on the bus → Remove all bus clients that are not TopCon masters, slaves or HMI/RCU
7-3	62) CAN write to mailbox denied	Internal conflict between DSP and CAN controller	→ On repeated occurrence contact the manufacturer
7-4	63) CAN transmission aborted		
7-5	64) CAN receive message lost		
7-6	65) HMI/RCU does not respond	The master is not receiving a response from the operating panel HMI or RCU	Supply voltage too low for related RCU → Check RCU supply voltage
			Communication error → See above, error 60/61)
7-7	66) CAN transmit queue overrun	Internal conflict between DSP and CAN controller	→ On repeated occurrence contact the manufacturer
7-8	67) Slave does not respond	The master is not receiving any data from one or more slaves	Communication error → See above, error 60/61)
			Slave has been switched off → Check mains supply for the slave
7-9	68) RMB not connected	Optional external measurement box (RMB) is not connected	Supply voltage for the RBM is too low → Check supply voltage
			Fibre optic not connected or connected incorrectly → Check correct seating of the fibre optic
7-10	69) Slave does not get data from master	A slave is not receiving data from the master	Master has been switched off → Check mains supply to the master
			Communication error → See above, error 60/61)
			Subsequent error for a failed login or an incorrect system configuration → See below, group error C) and D) (Also pay attention to any error message from the master)
7-11	6A) TCLIN does not respond	The communication between TopCon master and TCLIN has been interrupted, but was working before.	Connector on the CAN cable is loose. → Connect cable and fasten, re-start system.
7-12	6B) TCLIN CAN error	General error on the CAN interface	→ Restart system, if necessary contact support

**10.2.2.8. Error group 7) Internal (Modulator)**

Group error: 7) Internal (Modulator)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
8-1	70) Invalid checksum (Modulator)	Checksum for the communication between MainDSP and modulator is incorrect	Heavy external interference → Locate possible sources of interference and try switching off
8-2	71) Invalid checksum (Main)		- Incompatible software version between MainDSP and modulator (Error cannot be acknowledged, or occurs again immediately) - SyncTime set incorrectly → Undertake software update exactly as stated in the instructions
8-3	72) Modulator queue overrun	Internal buffer overflow trapped, it was not possible to send all the data to the modulator	→ On repeated occurrence contact the manufacturer
8-4	73) Transmit register full	Transmit/receive register in the MainDSP full unexpectedly	Subsequent error due to noise interference coupling → See above, error 70/71)
8-5	74) Receive register full		
8-7	76) Undefined ID (Modulator)	Unknown data packets in the communication	Incompatible software versions between MainDSP and modulator → Undertake software update exactly as stated in the instructions
8-8	77) Undefined ID (Main)		Error as a consequence of external noise coupling → See above, error 70/71)
8-9	78) VZ gain too low	Internal overflow trapped on calibrating the AD-converter gain	→ After a software update ensure that all parameters supplied have been loaded and saved
8-10	79) Iprim gain too low		
8-11	7A) Still in fault condition	It has been attempted to start the modulator manually while it is still in the error state	→ Acknowledge error and try again
8-12	7B) Fault on reading scope buffer	Internal error on reading the modulator's data buffer	→ On repeated occurrence contact the manufacturer
8-13	7C) Modulator communication stopped	The modulator is not supplying any interrupt signals to the MainDSP	The modulator has been stopped/has failed → Contact manufacturer
8-14	7D) Wrong Modulator Version	Modulator version does not match the MainDSP software. Is only detected from MainDSP V4.11.33	- During a software update the modulator has not yet been updated to the latest state - Latest parameters not loaded after software update → Undertake software update exactly as stated in the instructions
8-16	7F) Unknown modulator error bit	Undefined error bit in the communication between MainDSP and modulator	Error as a consequence of external noise coupling → See above, error 70/71)
			Incompatible software version between MainDSP and modulator → Contact manufacturer

**10.2.2.9. Error group 8) Internal (AD overrange 1)**

Group error: 8) Internal (AD overrange 1)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
9-5	84) Output voltage overrange	AD-converter for the output voltage measurement at upper limit	Overvoltage → See above, error 30) *)
9-6	85) Output current overrange	AD-converter for the output current measurement at upper limit	Overcurrent → See above, error 21) *)
9-7	86) Sense voltage overrange	AD-converter for the sense voltage measurement at upper limit	Overvoltage → See above, error 30) *)
9-8	87) System voltage overrange	AD-converter for the RMB voltage measurement at upper limit	Overvoltage → See above, error 30) *)
9-9	88) System current overrange	AD-converter for the RMB current measurement at upper limit	Overcurrent → See above, error 21) *)

**10.2.2.10. Error group 9) Internal (AD overrange 2)**

Group error: 9) Internal (AD overrange 2)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
10-1	90) +5V overrange	AD-converter for the internal supply monitoring at upper limit	Internal supply voltages too high → See above, related supply error (group error 4)
10-2	91) +15V overrange		
10-3	92) -15V overrange		
10-4	93) +24V overrange		
10-5	94) IGBT temperature overrange	AD-converter for the IGBT temperature sensor at upper limit	Heat sink temperature lower than approx. 0°C → Operate device at higher ambient temperature
			Temperature sensor not connected or faulty → Contact manufacturer
10-6	95) Rectifier temperature overrange	AD-converter for the rectifier temperature sensor at upper limit	Temperature sensor not connected or faulty → Contact manufacturer

**10.2.2.11. Error group A) Internal (AD underrange 1)**

Group error: A) Internal (AD underrange 1)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
11-5	A4) Output voltage underrange	AD-converter for the output voltage measurement at lower limit	Negative voltage due to controller oscillation → Reduce control parameters
			Negative voltage due to special load conditions → After consultation with the manufacturer, it may be possible to deactivate this error message, if there is no risk for the device
11-6	A5) Output current underrange	AD-converter for the output current measurement at lower limit	Negative current due to controller oscillation → Reduce control parameters
			Negative current due to special load conditions → After consultation with the manufacturer, it may be possible to deactivate this error message, if there is no risk for the device
11-7	A6) Sense voltage under-range	AD-converter for the sense voltage measurement at lower limit	→ See above, error A4)
11-8	A7) System voltage underrange	AD-converter for the RMB voltage measurement at lower limit	→ See above, error A4)
11-9	A8) System current underrange	AD-converter for the RMB current measurement at lower limit	→ See above, error A5)

**10.2.2.12. Error group B) Internal (AD underrange 2)**

Group error: B) Internal (AD underrange 2)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
12-5	B4) IGBT temperature underrange	AD-converter for the IGBT or rectifier heat sink temperature sensor at lower limit	Temperature sensor faulty → Contact manufacturer
12-6	B5) Rectifier temperature underrange		

## 10.2.2.13. Error group C) Login

Group error: C) Login			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
13-1	C0) Slave did not receive CFL <sup>1)</sup>	The slave has not received a request to log into the system	A master has not been defined → Ensure that a master (module ID=0) is available
			Master device was switched on before the slave was switched on → Always switch on master at the same time or after all slaves (maintain 10-secondf timeout)
			Master device was not switched off after the end of the 10s slave timeout → Also switch on master within 10s of switching on the slaves
			Master-slave cable not connected → Check cabling
			There is no voltage at the controller board for the mas- ter (LEDs remain off on switching on) → On repeated occurrence contact the manufacturer
			TC.GSS power supplies in generation 3 and 4 (TopCon Quadro) are not CAN-compatible → Only use devices in the same generation in a multi-unit system
			Subsequent error for a CAN bus error → See above, error 60/61)
13-2	C1) Slave re- ceived invalid CFL <sup>1)</sup>	Invalid login attempt	Subsequent error for error C0) → See above, error C0)
13-3	C2) Slave did not receive EOL		Communication error → See above, error 60/61)
13-4	C3) Slave re- ceived incom- plete EOL		
<sup>1)</sup> These errors cannot be detected by the master. They only occur on the slave.			
13-5	C4) TCLIN CAN protocol version is not identical	Master and TCLIN cannot communicate	TCLIN has a different CAN version to the master → Firmware update on TC.LIN or TC.P master
13-6	C5) Master did not receive all RFL subframes from slaves	Missing CAN initialisa- tion packets detected	Communication error during the initialisation phase → See above, error 60/61)

Group error: C) Login (continued)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
13-7	C6) TCLIN missing	The TopCon master is not finding a TCLIN on system start	The TopCon master cannot establish the connection. → Restart: switch on TC.LIN before TC.P → Check CAN cable
13-8	C7) Master did not receive all RFL subframes from HMI/RCU		
13-9	C8) CAN protocol version is not identical	The same CAN protocol or the same software is not installed on all devices	→ The software versions on devices involved must be identical to the versions on the master device
13-10	C9) Software version is not identical		
13-11	CA) Slave CAN protocol version is not identical		
13-12	CB) HMI/RCU CAN protocol version is not identical	The HMI/RCU version does not match the actual firmware	→ Contact the manufacturer to obtain compatible versions
-- <sup>2)</sup>	CC) HMI/RCU did not receive CFL	The HMI/RCU has not received a request to log into the system	A master has not been defined → Ensure that a TopCon master (module ID=0) is available
			There is no voltage at the controller board for the master (LEDs remain off on switching on) → On repeated occurrence contact the manufacturer
			Master device was switched on before the HMI/RCU was switched on → Always switch on master at the same time or after all HMI/RCU (maintain 10-second timeout)
			Master device was not switched on after the end of the 10s HMI/RCU timeout → Also switch on master within 10s of switching on the HMI/RCU
			Master slave cable or RCU cable not connected → Check cabling
			TC.GSS power supplies in generation 3 will only run with HMI firmware V1.xx.yy. TopCon power supplies in generation 4 (TopCon Quadro) will only run with HMI firmware V4.xx.yy or V11.xx.yy → Only operate compatible devices in a multi-unit system.
			Subsequent error for a CAN bus error → See above, error 60/61)

Group error: C) Login (continued)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
-- <sup>2)</sup>	CD) HMI/RCU received invalid CFL	Invalid login attempt	Subsequent error for error CC) → See above, error CC)
	CE) HMI/RCU did not receive EOL		Communication error → See above, error 60/61)
	CF) HMI/RCU received incomplete EOL		Incorrect CAN protocol → Only use compatible HMI and controller board software
<sup>2)</sup> These errors cannot be detected on the master device. For this reason there is also no flashing code and error can only be indicated on an HMI/RCU, but not in TopControl.			

**10.2.2.14. Error group D) Configuration**

Group error: D) Configuration			
Flashing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
14-1	D0) Slave ID not unique	Module ID for a slave is identical to the module ID for another slave	→ Each slave requires a unique module ID.
14-2	D1) HMI/RCU ID not unique	The same HMI/RCU-ID has been assigned several times.	→ Each HMI/RCU requires a unique HMI-ID (HMI identifier)
14-3	D2) More than one master in system	More than one master has been detected	→ In each system there must be exactly one TopCon (module ID=0).
14-4	D3) Nominal power of a slave not consistent	Nominal power of a module does not match that of the master	→ The nominal data for all modules in a multi-unit system must be identical to those for the master device
14-5	D4) Nominal voltage of a slave not consistent	Nominal voltage for a module does not match that of the master	
14-6	D5) Nominal current of a slave not consistent	Nominal current for a module does not match that of the master	
14-7	D6) Number of devices in series config. does not correspond with the given value	The number of devices in the series or parallel circuit does not match the data specified	The module IDs have been configured incorrectly → Set module IDs correctly as per instructions and required configuration
			Pre-setting is different to the actual number of modules in the series or parallel circuit → Connect same number of devices as specified → Adjust setting to the actual number of devices using TopControl
14-8	D7) Number of devices in parallel config. does not correspond with the given value		One or more slaves have not been detected → See above, error C0)



Group error: D) Configuration (continued)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
14-9	D8) All slave ID's have to be numbered without a gap	The module IDs are not sequential	→ All module IDs must be sequential. For information on the meaning of sequential, see multi-unit system chapter (for a parallel configuration, sequential means e.g. ID [hexadecimal] = 00, 10, 20, ...) The value 'uiCAN_MaxNumModuleParallel' must be set identically in all modules. Default: 8.
14-10	D9) All HMI/RCU ID's have to be numbered without a gap	The HMI IDs are not sequential	→ All HMI IDs must be sequentially numbered starting with 1.
14-11	DA) Number of slaves does correspond with the given value	Total number of devices does not match the data specified	→ See above, error D6/D7)
14-12	DB) Number of multiload modules does not correspond with the given value		
14-13	DC) Invalid slave ID (out of range)	Module ID for a slave outside the valid range	→ It is not possible to connect more than 8 devices in series or on parallel
14-14	DD) Invalid HMI/RCU ID (out of range)	HMI ID outside the valid range	→ Configure the ID via the HMI.
14-15	DE) TCLIN ID invalid	Master detecting invalid TCLIN ID	→ Check IDs for the TCLIN individually / set
14-16	DF) TCLIN ID not unique	Master detecting several TCLIN with same ID	→ Check IDs for the TCLIN individually / set

#### 10.2.2.15. Error group E) Not def.(group 14)

Group error: E) Not def.(group 14)			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
Errors in group E) do not currently exist and are for further additions.			

## 10.2.2.16. Error group F) Miscellaneous

Group error: F) Miscellaneous			
Flash ing code	TopControl/HMI indication	Description	Possible reason → Measure to rectify
16-1	F0) Voltage sensing not allowed in series con-figuration	It is not allowed to activate the sense functionality on operation in series → Only use sense functionality in single operation or in a parallel multi-unit system	
16-2	F1) Wrong option code	An invalid option code has been entered → Enter option code again correctly, if necessary contact the manufacturer	
16-3	F2) Interlock	As soon as the interlock circuit is disconnected, the power stage shuts down.	Interlock circuit has not been wired (for correct wiring see operating instructions) → Fit suitable connectors to interface X105 and X101/X102 → Connect interlock circuit differently, e.g. using relay contacts
			Interlock circuit has been opened by external protection circuit → Check why the protection circuit has tripped
16-4	F3) External PWM shutdown	Shutdown of the power stage caused by an external signal	The signal is normally not wired to the output. I.e. only very heavy EMI could cause this error → Locate source of EMI, e.g. contactors without free-wheeling diodes
16-5	F4) Security relays open		→ On repeated occurrence contact the manufacturer
16-11	FA) Any Rack system did not change to voltage-on or –off within specified timeout		Customer-specific error
16-12	FB) Any Rack system has errors, or dummy plug missing		Customer-specific error
16-13	FC) ReGen error	Error in an optional external regeneration unit	→ See separate documentation on the overall system
16-14	FD) AC-Switch error	Error in the external polarity reverse bridge (simple variant with contactors)	→ See software documentation V11.09.00
16-15	FE) AC-Bridge error	Error in external TopCon bipolar switch (TopCon option)	→ See operating instructions for the bipolar switch
16-16	FF) FIFO queue for actual values full	Buffer for actual value synchronisation in multi-unit operation is full	Subsequent error for a CAN communication error [Group error 6] ] → See group error 6)

### 10.3. Declaration CE marketing

## DECLARATION OF CONFORMITY CE-Marking

The manufacturer: Regatron AG  
Kirchstrasse 11  
CH - 9400 Rorschach  
Switzerland

hereby declares that

the products: Bidirectional High/Power DC Supply TopCon TC.GSS series

**Model**

TC.GSS.20.400.400.S<sup>[a] [b]</sup>

TC.GSS.32.400.400.S<sup>[a] [b]</sup>

TC.GSS.20.500.400.S<sup>[a] [b]</sup>

TC.GSS.32.500.400.S<sup>[a] [b]</sup>

TC.GSS.20.600.400.S<sup>[a] [b]</sup>

TC.GSS.32.600.400.S<sup>[a] [b]</sup>

**Legend**

<sup>[a]</sup> = .HMI (optional)

<sup>[b]</sup> = .LC (optional)

are in conformity with the provisions of the following Council Directives

**Low Voltage Directive 2006/95/EC**

**EMC Directive 2004/108/EC**

and are in conformity with the following harmonized standards:

**EN 50178: 1997**

**EN 61000-6-2: 2005**

**EN 61000-6-4: 2007**

**environments**

**Electronic equipment for use in power installations**

**Electromagnetic compatibility (EMC):**

**Generic standard – Immunity for industrial environments**

**Electromagnetic compatibility (EMC):**

**Generic standard – Emission standard for industrial**

Year of CE marking: 11

Rorschach, September 20<sup>th</sup>, 2011

Regatron AG



T. Hardmeier / Managing Director



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