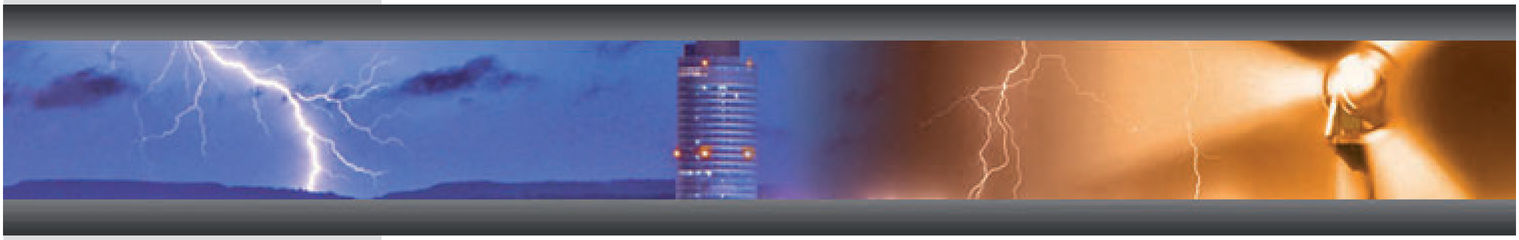

User Manual

REG-D™ Relay for Voltage Control & Transformer Monitoring

GB

Issue: 2016/07

NOTICE!	Please note that these operating instructions may not always contain the latest information concerning the device. Should you require a more recent version of these instructions or have any questions about the product or how to use it, please contact the REGSys™ Support on: +49 (0)911 628108-101 or via email at regsys-support@a-eberle.de

Engineers with experience in secondary systems will know that the perfect technical manual has never been written. After much anticipation from our stakeholders especially customers, this first edition of our new REG-D™ manual is released in the knowledge that the feedback we will receive from users on its content and form, will help us make later editions more comprehensive and easier to navigate. Consider this 1st edition as preliminary.

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Contents

1. User guidance

This user manual contains a summary of the information needed for installation, commissioning and operation.

Read the user manual entirely and do not use the product unless you have understood its content.

1.1 Target group

The user manual is intended for skilled technicians and trained and certified operating personnel.

The contents of this user manual must be accessible to people tasked with the installation and operation of the system.

1.2 Warnings

Structure of the warnings

Warnings are structured as follows:

⚠ SIGNAL WORD!	**Nature and source of the danger.** Consequences if instructions are not obeyed. ➲ Actions to avoid the danger.

Types of warnings

Warnings are distinguished by the type of danger they are warning against:

⚠ DANGER!	Warns of an immediately impending danger that can result in death or serious injuries when not avoided.

⚠ WARNING!	Warns of a potentially dangerous situation that can result in death or serious injuries when not avoided.

⚠ CAUTION!	Warns of a potentially dangerous situation that can result in fairly serious or light injuries when not avoided.

NOTICE!	Warns of a potentially dangerous situation that results in material or environmental damage when not avoided.

1.3 Tips

Tips on the appropriate use of the device and recommendations.

1.4 Other symbols

Instructions

Structure of the instructions:

➲ Instructions for an action.

  ↳ Indication of an outcome, if necessary.

Lists

Structure of unnumbered lists:

- List level 1
  - List level 2

Structure of numbered lists:

1) List level 1
2) List level 1
   1. List level 2
   2. List level 2

1.5 Applicable documentation

For the safe and correct use of the installation, observe the additional documentation that is delivered with the system, as well as the relevant standards and laws.

1.6 Storage

Store the user manual, including the supplied documentation, readily accessible near the system.

2. Scope of delivery

- Relay for Voltage Control & Transformer Monitoring REG-D™
- Terminal diagram in English*
- User manual in English
- Programming and configuration software WinREG*
- Null-modem cable or USB cable (depending on order feature I)*
- Removable spare fuse on circuit board
- Extraction tool (only for REG-D™ as plug-in module)*

If the REG-D ™ is installed in a voltage regulation system, the positions marked * are provided only once per system.

3. Safety instructions

- Follow the operating instructions.
- Keep the operating instructions with the device.
- Regularly instruct staff in all relevant issues regarding occupational safety, the operating instructions and, in particular, the safety instructions they contain.
- Ensure that the device is only operated if in perfect condition. Never use a damaged device (physically damaged or malfunctioning).
- Ensure the device is only operated by qualified personnel.
- Connect and use the device only as specified.
- Operate the device only with the recommended accessories.
- Ensure that the device is operated only in its original condition.
- Ensure that the device is only operated within the permissible rated data (see technical specifications in the appendix, chapter 21).
- Do not install or operate the device in environments where explosive gases, dust or vapours may be present, i.e. that generally do not meet the requirements mentioned in the technical datasheet.
- Clean the device only with cleaning products that comply with the manufacturer's specifications.
- Use only spare parts and auxiliary materials that have been approved by the manufacturer.
- Maintenance and repair of an open REG-D™ Relay for Voltage Control & Transformer Monitoring (plug-in module without housing) must only be carried out by authorised, qualified personnel and must satisfy EMC Directives.
- No supply or control voltage should be applied to a disassembled plug-in module, e.g. open (disassembled) REG-D™ Relay for Voltage Control & Transformer Monitoring, as electrical parts carrying dangerously high voltages could be encountered.

4. Intended use

The Relay for Voltage Control & Transformer Monitoring REG-D™ is designed as a permanently installed measuring and regulation unit for controlling on-load tap changers, and is exclusively intended for use in electrical power engineering facilities and installations, where professionals carry out the necessary work. Professionals are defined as people who are familiar with the installation, assembly, commissioning and operation of such products. They have qualifications that meet the requirements of their activities.

The Relay for Voltage Control & Transformer Monitoring REG-D™ complies with the laws, rules and standards applicable at the time of delivery, in particular with relevant safety and health requirements.

To maintain this condition and ensure safe operation, the operator must follow all the instructions and warnings in the user manual and the technical data must be observed.

A. Eberle GmbH & Co. KG accepts no liability for damage resulting from unauthorized or improper modification or use of the product. Improper modifications of the product without consultation with A. Eberle GmbH & Co. KG can lead to personal injury, property damage and malfunctions.

5. Performance features

The RegSys™ Relay for Voltage Control & Transformer Monitoring system can be used to perform both simple and complex measurement, control and regulation tasks on tap-changing transformers. To help with these numerous and varied tasks, the REG-D™ Relay for Voltage Control & Transformer Monitoring (basic component) can be used with the monitoring modules PAN-D and PAN-A1/A2, as well as with interface components that have binary and analog inputs and outputs. Telecontrol connection (DNP3, IEC 60870-5-101 / 103/104, IEC 61850, MODBUS, etc.) can be realized via an additional telecontrol board module.

The core function of the REG-D™ is the regulator function, in which the actual value and a fixed or load-dependent setpoint value are compared. Depending on the setpoint deviation, the comparison determines the correcting variable for the transformer's tap changer. The regulator's parameters can be fine-tuned to the dynamic time behavior of the grid voltage to obtain a high regulation performance via a low number of switching operations.

Moreover, the Relay for Voltage Control & Transformer Monitoring REG-D™ is capable of using other Relays for Voltage Control & Transformer Monitoring in the REGSys™ family, with parallel operation of up to 10 transformers without additional components. There are different methods to choose from for the control of transformers, which can be used on site according to the circumstances. It is worth noting that additional components are not required because the regulators contain all of the functional units required for parallel operation.

In addition to the regulator, each REG-D™ comes with the current optional features of transformer monitoring, transducer, recorder, statistics and ParaGramer. The Transducer mode displays all of the relevant measured grid quantities. The Recorder mode records the regulated voltage over time as well as two additional selectable quantities. Tap-change position statistics provide a clear overview of all of the tap changer's switching operations, and the ParaGramer displays a single-line diagram of the transformer unit. The ParaGramer is a valuable tool, when setting up parallel operations for several transformers, because it automatically recognizes transformers that are run in parallel.

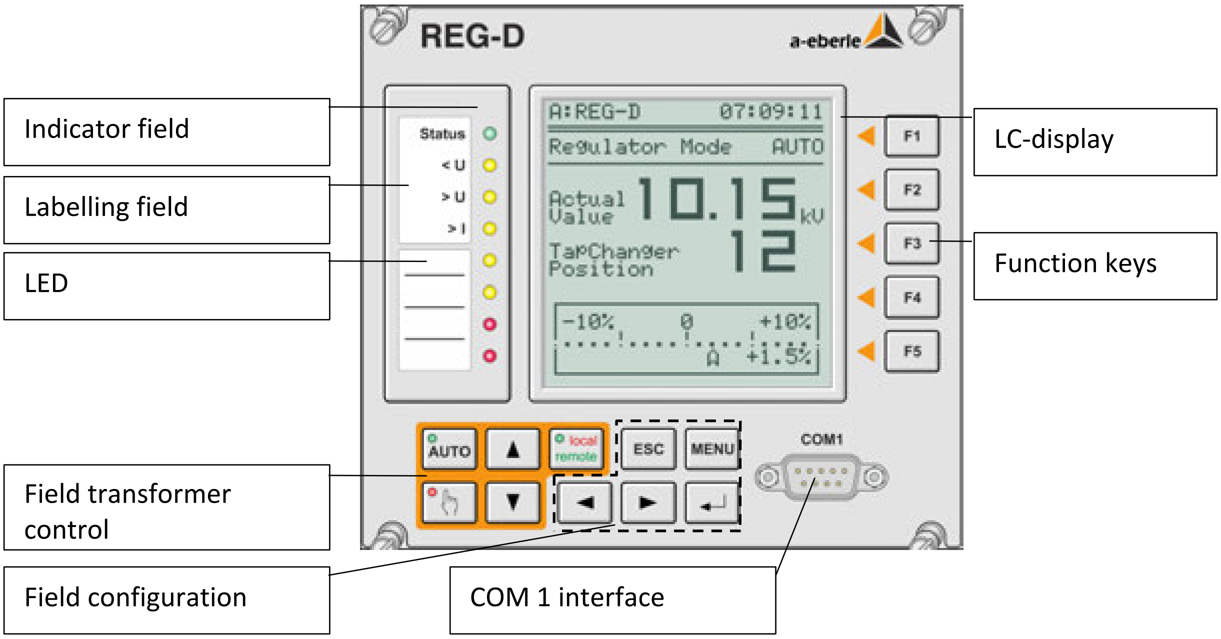
The REG-D™ regulator can be equipped with a powerful transformer monitoring function in conformity with IEC 60354 or IEC 60076. This function enables the operator to view information regarding hot-spot temperature and the transformer's loss of life at any time. If required, the regulator can even activate up to six cooling levels. The oil temperature can either be recorded directly (as a PT100 signal) or through an mA input.

To solve customer-specific requirements, a background program can be loaded into the Relay for Voltage Control & Transformer Monitoring REG-D™. Simple and complex logics can be created, as well as additional custom menus.

As an alternative to direct logging, U, I and cos(φ) measurements, as well as the tap position, can be fed to the REG-D through a serial connection such as an IEC 61850 client function or an mA signal. Switch positions for use, for example, in ParaGramer can also be made available via GOOSE as an alternative to binary signals wired to the regulator.

6. Operation/Indicators

6.1 Indicators, controls and display



The operating level HMI (Human Machine Interface) of the REG-D™ is designed as a membrane keyboard with integrated LEDs.

Indicator and field labels

There are a total of eight indication and eight field labels available. Each label field is intended for one indication (one LED).

The label of each field can be changed at any time by pulling out the labelling strip towards the left from the foil pouch with a suitable tool.

Labelling can be carried out with any standard pen.

Alternatively, a corresponding label can be created on the PC and printed out.

Appropriate templates are found on the WinREG CD or can be downloaded from the A. Eberle website http://www.a-eberle.de.

The indication field status is permanently programmed.

The status LED (green) lights up when the unit is working without problems (status).

- LEDs 5 ... 7 (yellow) are freely programmable for general indications and set with the limits >U, <U and >I on delivery.

>U	limit U exceeded	yellow
<U	below limit U	yellow
> I	limit I exceeded	yellow

- LEDs 1 ... 2 (yellow) are freely programmable for general indications and unassigned in the delivery state.
- LEDs 3 ... 4 (red) are freely programmable, intended primarily for error indications and unassigned in the delivery state.

Transformer control

The transformer control field is associated with five keys.

- The automatic key equiped with an integrated green LED lights up when the regulator is operating in automatic mode.
- The manual key equiped with an integrated red LED lights up when the regulator is operating in manual mode.
- The REG-D™ can be equipped with a local/remote key depending on the order code Y. In the LOCAL position (red), all remote control commands via binary inputs or via a serial connection are suppressed. Remote control is only possible in REMOTE operation (green). If the REG-D™ has no local/remote key, or it is disabled, commands are accepted from all sources.
- Using the "raise" and "lower" keys the transformer can be tap-changed manually (to do that the requirements are that: the regulator is in “manual operation” and it´s state is “local”, or local/remote switching is disabled (feature Localremote = 0)).

Colour scheme of the transformer control field

When designing the operation of REG-D™, it was ensured that all indicator elements of the transformer control field (manual/automatic and local/remote) should glow green whenever the operating personnel leave the control room.

Configuration field

With the following five keys of the configuration field you can configure the Relay for Voltage Control & Transformer Monitoring REG-D™ manually.

- MENU is used to switch between different operating modes and select a specific configuration menu (SETUP 1 ... SETUP 6).
- Enter is used to conform a specific parameter in SETUP menus and to activate custom menus (application menus), where these are available.
- ESC is used to leave any menu, while using the two keys ◄ and ► to move the cursor in the SETUP menus.

Modification of important operating parameters

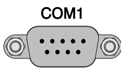
Operationally important configuration changes can only be made while in manual operating mode.

Function keys

The function keys F1 to F5 are designed as softkeys.

The function of the keys is context-controlled and results from the respective menu.

Serial interface COM1



for connection of the Relay for Voltage Control & Transformer Monitoring with a PC or an external device, for example a modem. The COM1 interface can optionally be configured as a USB interface (feature I1).

Operation principle

Operation of the Relay for Voltage Control & Transformer Monitoring REG-D™ is completely menu-guided, and, in principle, the same for any SETUP menu item.

If regulation parameters have to be set or changed, the following operating principles apply:

- Operating mode MANUAL → the operating mode is set to manual operation.
- MENU, MENU → call up display modes 2
- MENU → select the menu item SETUP

By pressing the MENU button one can scroll until the desired parameter appears in the SETUP menu selection.

- Select parameters with the corresponding function key (F1 ... F5).
  Set the value of the parameter with the function keys.
  F1 increases the value in large steps
  F2 increases the value in small steps
  F3 is assigned to special functions in some SETUP menus.
  F4 decreases the value in small steps
  F5 decreases the value in large steps
- When entering a value is finished, the changed value is confirmed with Enter.
- If the entry is password protected, enter the password (see chapter 6.4 Password protection on page 46).
- Return or exit from the SETUP menus with ESC (abort).
  SETUP menus are automatically exited when no key is pressed for about 2 minutes.

Once the desired parameters have been entered, checked and confirmed with Enter, the regulator REG-D™ can be switched back to automatic operating mode with AUTO.

Lamp test

To check functioning of the LEDs on the front panel: press F5.

This test is only possible in the display modes Regulator mode and Statistics mode.

Reset of fault indications

To reset pending fault indications the operating mode must be switched from automatic to manual and then switch back to automatic.

Alternatively, the F5 key can be pressed in the display mode Regulator and Statistics.

The reset of fault indications is also possible remotely using a background program or a SCADA system.

6.2 Display modes

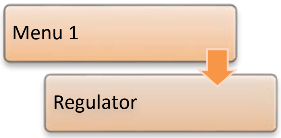
Selection of display modes

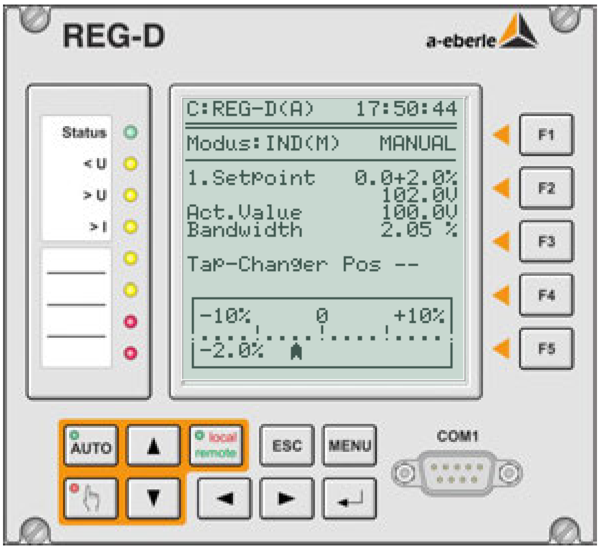
After pressing MENU MENU, the display modes of the Relay for Voltage Control & Transformer Monitoring REG-D™ can be selected.

The following modes, which are explained in detail in the following chapters, are available:

- Regulator
- Transducer mode
- Recorder
- Statistics (monitor)
- ParaGramer
- PQIView
- Logbook

6.2.1 Regulator





In regulator mode, the setpoint value in V (kV) and in % of nominal voltage, the present actual value, the value of the permissible setpoint deviation (bandwidth) and the current tap position of the tap-changing transformer are displayed.

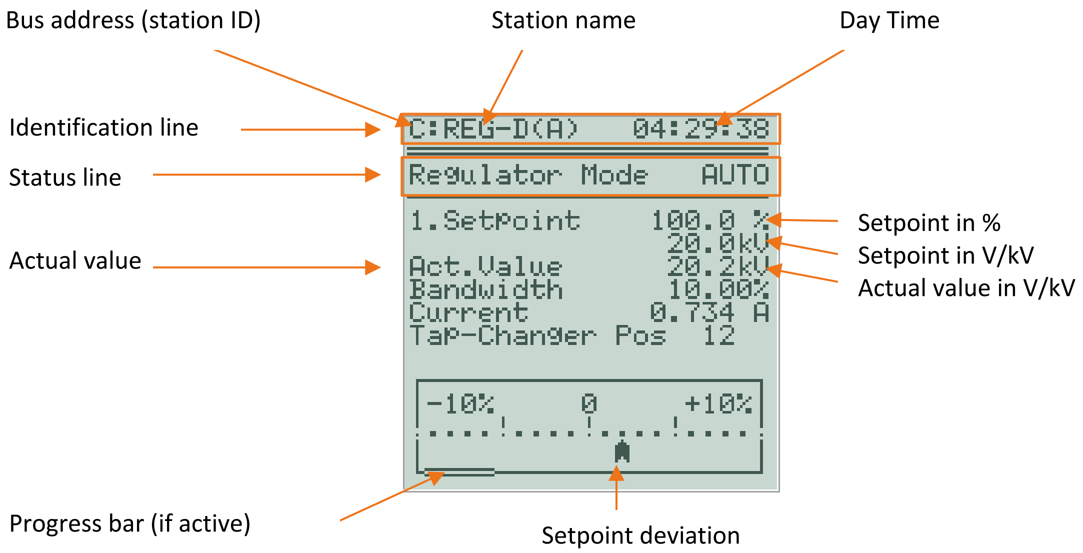
In addition, the current setpoint deviation is visualised aon an analog like gauge with a scale width of ±10% from the setpoint.

If the voltage leaves the tolerance band (bandwidth either the positive or the negative direction), the colour of the scale pointer changes from transparent to black (reverse color scheme).

If necessary, the actual value of the current for the indication may also be selected.

Press the F1 key to switch between the detailed view and the large display. On the large display, the actual measured voltage and tap position are displayed at the top. The graphical display of the actual voltage deviation remains unchanged.

LC-display regulator mode



Highspeed switching is indicated by "<--<".

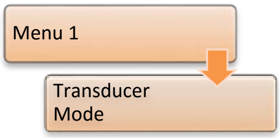
The arrow is transparent when the actual voltage deviation is within the tolerance band.

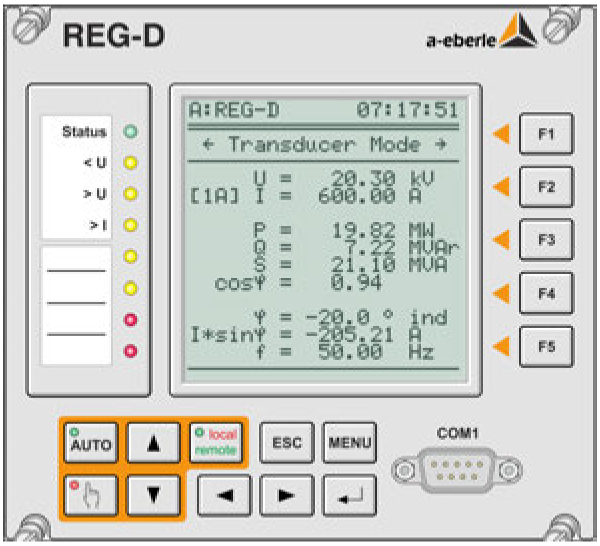
The arrow is black when the actual voltage deviation is greater than tolerance band.

Visualisation of measurement value simulation

If actual value is shown in capital letters as "ACTUAL VALUE" in the display, then the "Measurement value simulation" is switched on (see chapter 7.2.5, page 114)!

6.2.2 Transducer





The above figure shows the transducer basic display available in most cases. Here, voltage, current, power values, cos(φ), phase angle, reactive current, frequency and selected nominal current of the current transformer (value in [ ]) are shown.

Additionally or alternatively to this indication, depending on features and parameters, it is possible that additional transducer screens are accessible. Scrolling through screens is done in a loopwise manner. On arriving to the last screen, you can either scroll back (left arrow) or return to the first page by scrolling further (right arrow or, alternatively with the F2 key).

Display of reactive current I*sinφ in the transducer basic display

Only the reactive current I*sinφ of the transformer is shown in the transducer basic display. The component of this current due to the load and the component due to circulating reactive current cannot be seen in this display. To this end, there is another transducer screen, which is available after selecting a parallel program.

Overview of available displays while in transducer mode

	Display screens				
	Basic display	Three-winding trans-former	Three-winding trans-former (S2)	ARON	Circulating reactive current
Standard	✓				
Standard with parallel program	✓				✓
Three-winding transformer		✓			
Three-winding transformer with parallel program		✓			✓
Three-winding transformer with phase angle measurement	✓	✓			
Three-winding transformer with phase angle measurement and parallel program	✓	✓			✓
Three-winding transformer (S2)		✓	✓		
Three-winding transformer (S2) with parallel pro-gram		✓	✓		✓
ARON measure-ment	✓			✓	
ARON measure-ment with parallel program	✓			✓	✓

✓ Available

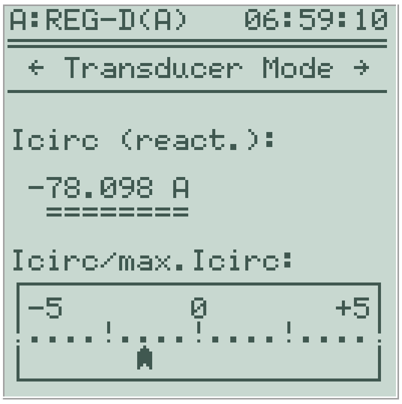
The "Three-winding transformer" or "three-winding transformer with phase angle measurement" (measurement input swap) depends on the activation of the feature 3winding.

Three-winding transformer (S2) is available for devices with hardware feature S2 and firmware ≥ 3.23.

Three-winding transformer and ARON measurement cannot be active simultaneously!

Reactive circulating current display

After selecting a parallel program, a further screen in the transducer mode is available. This can be reached using the left or right arrow keys (alternatively key F2).



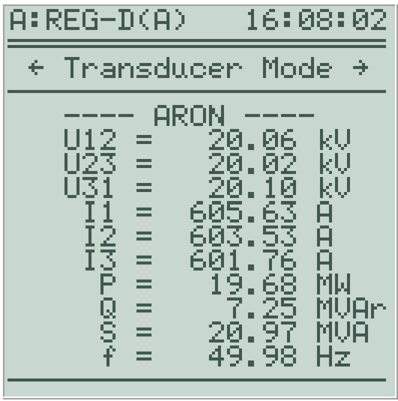
The display of circulating reactive current is used for setting circulating reactive current minimization based on parallel programs, and for the supervision of Master-Follower regulation. The circulating reactive current is the part of the reactive current, which is not generated by the load, but is caused by parallel operation of several transformers.

In the lower part of the screen, the ratio of calculated reactive circulating current to permissible circulating reactive current is indicated graphically in the form of a analog like display.

The fill colour of the pointer changes from transparent to black (reverse color scheme), when the detected reactive circulating current exceeds the set permissible reactive circulating current.

Display of ARON measurement values (feature M2)

If the REG-D™ has the M2 feature and the ARON measurement is enabled (parameter "CT/VT Configuration" = ARON), the regulator provides a transducer mode screen on which the readings of ARON measurements (arbitrarily loaded three-phase grid) are displayed.

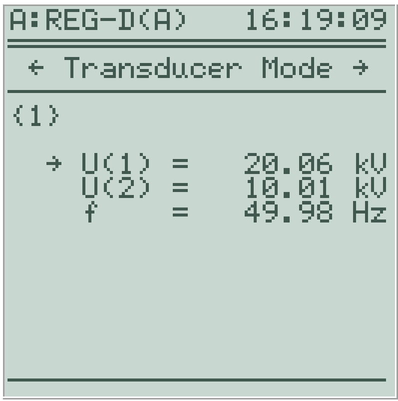


Display of power values

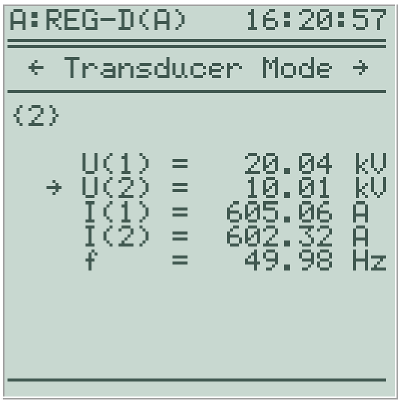
On comparing power values from the ARON display and the transducer basic display there may be differences. This is because calculation of power values in the basic display is always based on symmetrical loading, whereas the ARON values take asymmetry into account.

Three-winding transformer display

If the feature three-winding transformer is released and activated, the three-winding transformer screen is available while in transducer mode, which then serves as an entry screen to the transducer instead of the transducer mode basic display screen. Here both measured voltages, frequency and, if desired, both currents (parameter "Current display" = ON) are displayed. Moreover, the selected regulation voltage is indicated with an arrow and a freely definable three-character string (standard assignment {1}, {2}). If a specific configuration of the 3winding transformer feature is used (with phase angle measurement, measurement input swap) the transducer basic display is available as an additional screen for devices without the S2 feature.

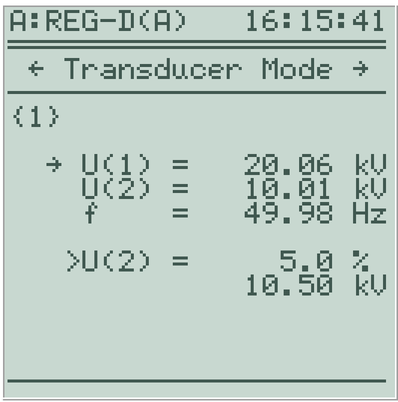


Three-winding transformer view
without limit monitoring,
without current display,
U(1) selected for regulation



Three-winding transformer view
without limit monitoring,
with current display,
U(2) selected for regulation

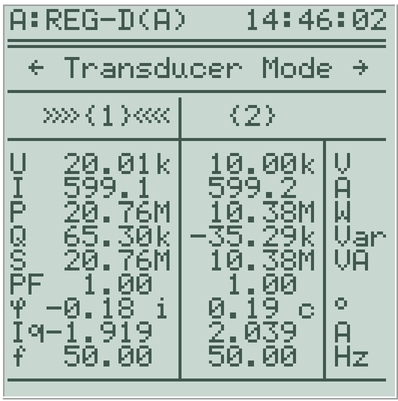
If the feature 3winding is used with limit monitoring, the limit value of the monitored voltage (parameter "3Winding limit >Ub") is also displayed in the transducer mode.



Three-winding view
with limit monitoring without current display, U(1) selected for regulation

Three-winding transformer (S2) display (only devices with the S2 feature, from firmware version 3.23)

Instead of the three-winding transformer basic display, devices with the hardware feature S2 have an expanded and detailed screen on which power values, phase angle, reactive currents and frequencies for both measuring inputs can be displayed simultaneously and independent of the measuring input selected for regulation. The selected regulating voltage is visualised by multiple arrows (>>>>XXX<<<<) (e.g. >>>>{1}<<<< for measurement input 1 using the default name).



Three-winding transformer (S2) view
U(1) selected for regulation

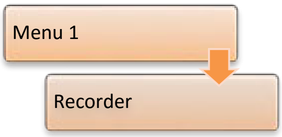
Further information on the feature 3winding can be found in chapter 8.3.5 from page 253 onwards.

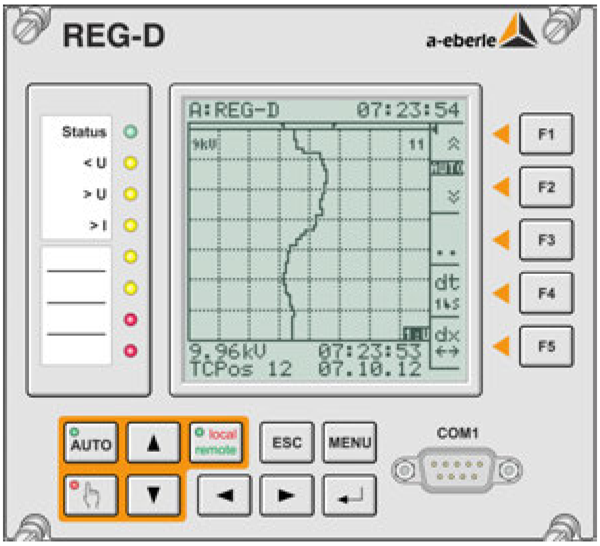
Use of the transducer views when in active simulation mode

In simulation mode, the left and right arrow keys can be used to adjust the simulated voltage. Therefore they cannot be used to scroll pages in transducer mode. The F2 key also has a different function in this mode (increase the simulated current).

➲ Scroll pages in transducer mode with the F1 key when the simulation mode is active.

6.2.3 Recorder





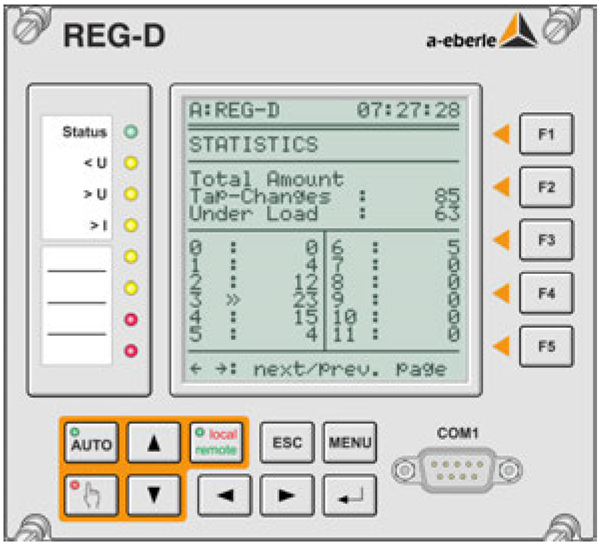
The recorder display mode presents the recorder data of REG-D™ order code S1 on the display.

For further information on the recorder function of the REG-D™, see chapter 8.3.3 page 244.

Recorder demo mode

The recorder is running in demo mode if "DEMO" is displayed in the left of the grid when the recorder is in normal display mode. In this operating mode, the recorder records measured values for a time period of 4 to 6 hours. The oldest values are overwritten at the end of this period. Real process data cannot be read out in demo mode!

6.2.4 Statistics



The display shows the total number of tap changes performed since the last reset of the counter. A distinction is made between tap changes under load and tap changes with less than 5% of the nominal current In (1 A or 5 A).

Tap changes under load are also displayed separately for each tap.

If the tap changer operates under load (I > 0.05 · In), the current tap position is indicated by a double arrow >>.

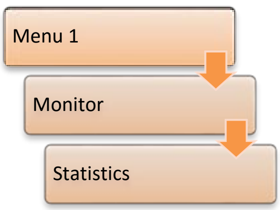
If the load condition is not met, the current tap position is indicated by a single arrow ">".

In conjunction with the recorder, the statistics scree provides valuable clues on the controlled system.

With the parameters time factor and permissible setpoint deviation (bandwidth), an optimum between voltage stability and number of tap changes can be found. This relationship cannot be mathematically ascertained, but is more subject to individual conditions at the respective feeding point.

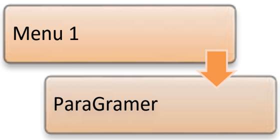
The statistical data can be read and displayed via the operating software.

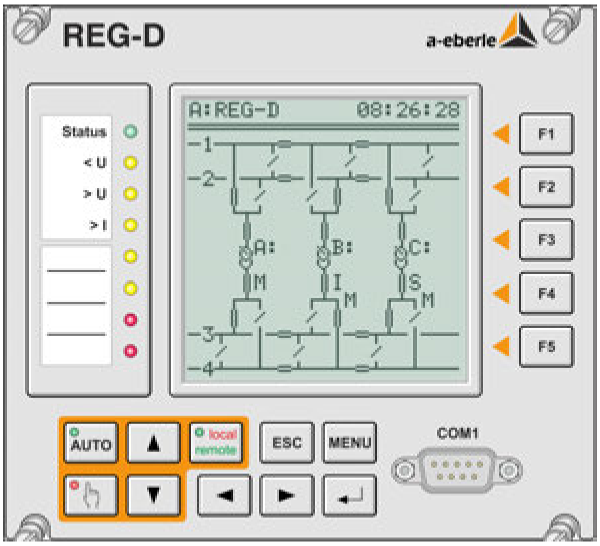
Deleting of statistics can be carried out in "Setup menu -6-\General -3-\Delete tap sums" or via the operating software.



If the regulator has the feature TM (transformer monitoring), this is the F4 key. The statistics mode is then part of the monitor. That is, the monitor must first be selected before statistics mode can be selected.

6.2.5 ParaGramer





The ParaGramer serves as an aid for automatic preparation of parallel operation and on-line display of switching status. The coinage ParaGramer is essentially composed of the terms "parallel" and "one-line diagram". The ParaGramer displays the switching status of each of the transformers in an aggregated single-phase diagram.

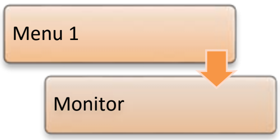
This function is activated in that each regulator is supplied with a complete busbar replica (circuit breakers, isolators, section and coupling positions) to its busbar portion via binary inputs.

Based on the switching states of all of the regulators involved in parallel operation, the system automatically detects which transformer should work in parallel on a busbar with which other transformer(s). The system treats busbars that are connected through couplings as a single busbar.

As shown in the image, both transformers A: and C: are working on busbar 3, while transformer B: is feeding into busbar 4.

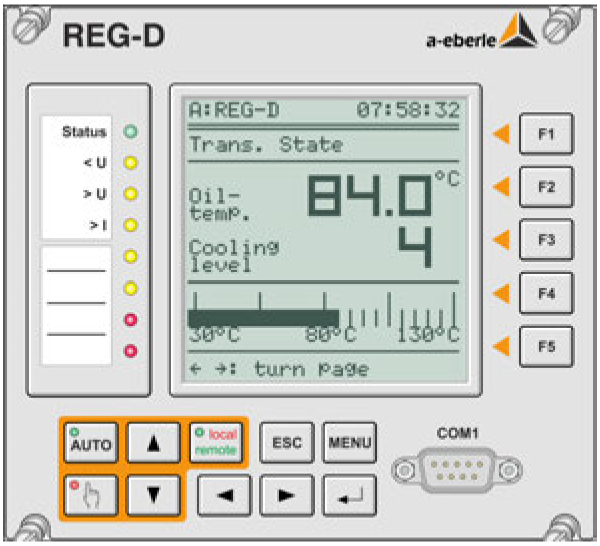
For a description of the ParaGramer feature, see chapter 8.3.2 page 232.

6.2.6 Monitor (software feature TM)



The transformer's main parameters are monitored in the monitoring module. The oil temperature can also be recorded in addition to the tap-changer statistics. Hot-spot temperature is determined from the oil temperature and the winding current, in accordance with IEC 60354 or IEC 60076, and extrapolated on the transformer's remaining lifetime.

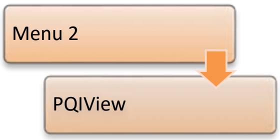
To regulate the temperature, fans can be switched on or off in up to six groups as well as two oil pumps. The oil levels can be monitored and the operating hours of the fans and pumps counted.



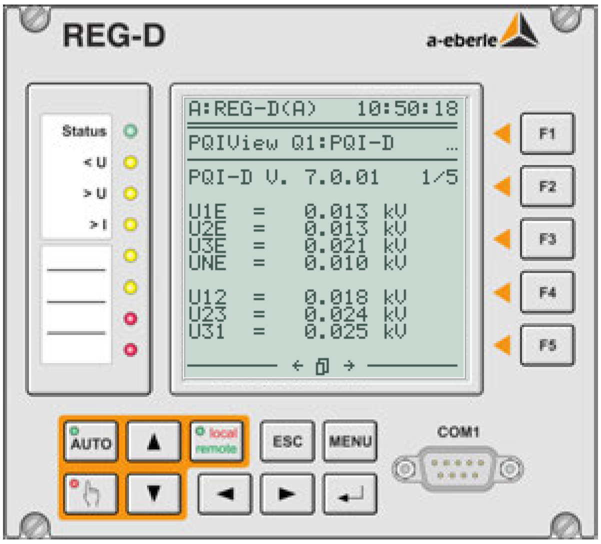
To record the oil temperature, the regulator can be optionally equipped with a PT100 module or an mA input. A total of three slots are available. If required, several temperatures can be recorded through a mA input or PT100.

The feature transformer monitoring (TM) is not part of this manual. The manual for this feature is included in the equipment delivery and can also be downloaded from the website http://www.a-eberle.de.

6.2.7 PQIView

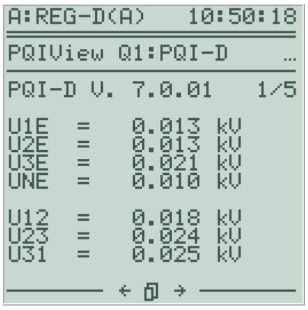


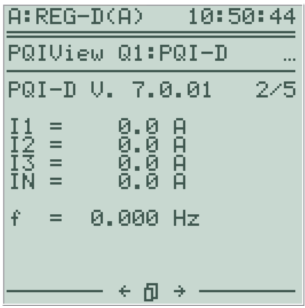
In the PQIView mode, readings from PQI-D(A)s located within the same E-LAN group can be shown on the display of the REG-D™.

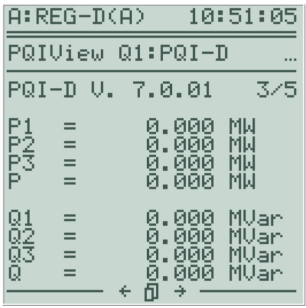


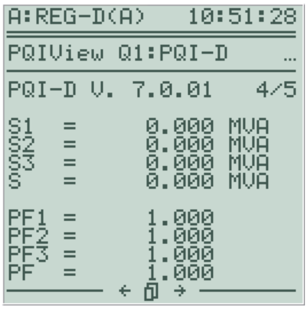
If several PQI-D(A)s are available, use the F1 key to switch between them. The individual pages can be scrolled with F2 ... F5, or the arrow keys ◄ and ►. The number of menu pages and the measurement values displayed differ depending on the device type of the PQI-D(A).

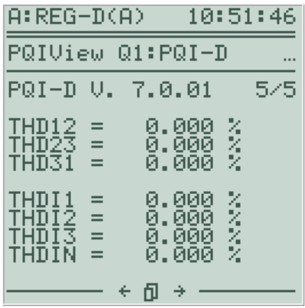
Measurement values and menus on UI devices (devices with current and voltage measurements):



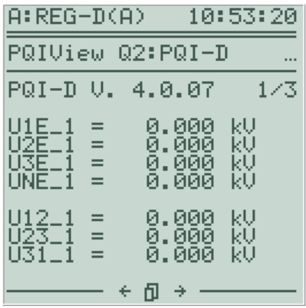


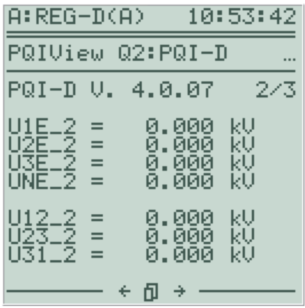


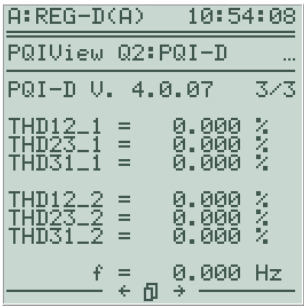




Measurement values and menus on UU devices (devices with voltage measurements):



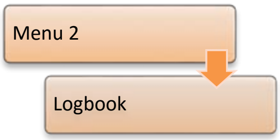




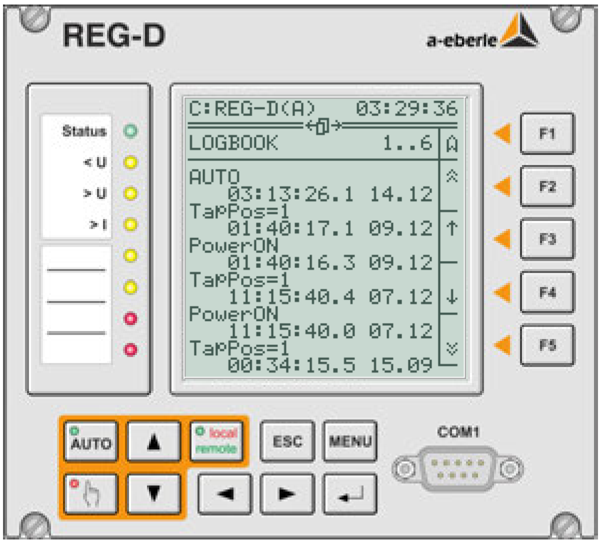
Devices not available

If no PQI-D(A)s are available in the E-LAN, the message "No device found!" is displayed.

6.2.8 Logbook



Predefined events are entered with a time stamp in the logbook and can thus be used for analysing events concerning the Relay for Voltage Control & Transformer Monitoring. The logbook can contain a maximum of 511 entries (up to firmware V2.11 a maximum of 64). If the maximum number of log entries is reached, the oldest logs are deleted in favour of new entries.



The following system events are recorded by default, but can, if necessary, also be disabled with the help of the configuration software REGPara (part of the software program WinREG).

Event	Logbook entry		Description
PowerOn	PowerOn		Power was turned on, or a power-on reset performed
Automatic	Automatic	Manual	The device was switched to automatic/manual operation
Local_Remote	Local	Remote	Local/remote switchover
Up	Up (or TapLimMa/TapLimMi)		The device issued a raise command. In case of activated tap limitation, with a raise command which would violate the configured tap range, the corresponding logbook entry TapLimMa (maximum reached) or TapLimMi (minimum reached) is made.
Down	Down (or TapLimMa/TapLimMi)		The device issued a lower command. In case of activated tap limitation, with a lower command which would violate the configured tap range, the

Event	Logbook entry		Description
			corresponding logbook entry TapLimMa (maximum reached) or TapLimMi (minimum reached) is made.
Tap	TapPos = xx		Tap position
SP index	SP-Index=x		Setpoint index (setpoint 1 ... 4 activated)
Inhibit high	Inh-High:ON	Inh-High:OFF	inhibit high
Inhibit low	Inh-Low:ON	Inh-Low:OFF	inhibit low
Fast-Up	Fast-Up:ON	Fast-Up:OFF	Limit for high-speed forward switching
Fast-Down	Fast-Dwn:ON	Fast-Dwn:OFF	Limit for high-speed backward switching
>U	>U:ON	>U:OFF	Overvoltage limit
<U	<U:ON	<U:OFF	Undervoltage limit
>I	>I:ON	>I:OFF	Overcurrent limit
Simulation	Simul:ON	Simul:OFF	Simulation mode activated/deactivated
Grid breakdown	CNB:ON	CNB:OFF	Creeping Net Breakdown
Hunting	Hunting:ON	Hunting:OFF	Hunting (x taps within a given time)
ClearLog	LOG cleared		Logbook cleared
ClrRecorder	REC cleared		Recorder data cleared
ClearStats	STAT cleared		Statistics data cleared
PanelLogin	PanelLogin-x		User x has logged into the device (password protection)
Status	Status:Error	Status:OK	Status (life contact)
ELanErr	ELANErr:ON	ELANErr:OFF	E-LAN error
TapErr	TapErr:ON	TapErr:OFF	Tap position error (TapErr)
TC-Err	TC-Err:ON	TC-Err:OFF	TC in operation error (TC-Err)

Additionally, the following system events are always logged at the same time. They cannot be disabled via the configuration software REGPara as with the previous system events (part of the software program WinREG).

Event	Logbook entry	Description
RAM restore	RAMresto	Restoration of RAM by means of an existing RAM-Backup (possible from bootloader V2.12), see also chapter 7.2.6 from page 117 onwards.
Time restore	RTC=RAMt RTC=EEPt RTC=RBUt RTC=2000	After a PowerOn, false time information was detected and the time information was restored as well as possible according to the available source. Time sources: RAMt = time source was RAM (MRAM) EEPT = time source was the EPROM RBUt = time source was the RAM-image in flash 2000 = the time was set to 01.01.2000 0:00:00
Master reset	MaRESET	The device was completely reset and RAM initialized again.

Moreover, of all relays, binary inputs and LEDs both the rising and falling flank can be separately logged. These logs are disabled by default due to the limited number of recordable events, but can be activated at any time by use of the configuration software REGPara (part of the software program WinREG).

In addition to these standard events, which are defined by the firmware, custom messages can be entered into the logbook via a background program. These consist of a freely definable text with a length of up to eight characters (e.g. "Custsp_1").

The content of the logbook can be visualised directly on the screen of the REG-D™, and in the service program WinREG. It is also possible to save log entries to a file for archiving on a PC via the service page. Deleting logbook entries is also possible through the service page of WinREG.

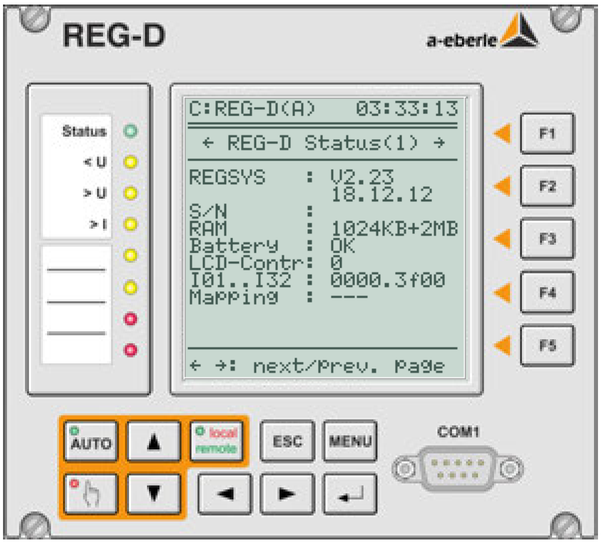
Further logbook entries

REG-D™ firmware versions from V2.13 to V2.17 by default log incorrectly transmitted E-LAN telegrams in the form:

Rnxxxxxx or Lnxxxxxx

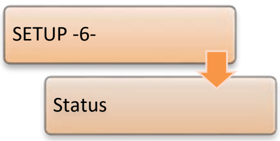
Where R or L stands for E-LAN-R or E-LAN-L and n is the length of the faulty telegram in bytes. Subsequently, the first three bytes of the telegram are recorded in hexadecimal (e.g. R1AE7H3X). These faulty telegrams are automatically detected and transmitted again or corrected. Therefore, the logbook entries introduced for monitoring purposes are removed again using firmware version 2.18 or greater.

6.3 Status



In the status menu information is summarised, which is important for the identification of the system.

REG-D™ Status (1)



In addition to firmware version, battery state, serial number (S/N), etc., REG-D™ status (1) shows the current status of the first 32 binary inputs of the REG-D™. This information is particularly helpful for commissioning.

The inputs 1 through 32 are shown from right to left, in each case 16 binary inputs are shown as a block of four hexadecimal digits. The two blocks are separated by a dot.

By default, the regulator is equipped with 16 inputs. More inputs can be selected with the order code X. Moreover, the binary inputs 17 – 32 can originate from a BIN-D module (COM3 mapping).

The hexadecimal digits are to be interpreted as follows (an example for inputs 1 to 16):

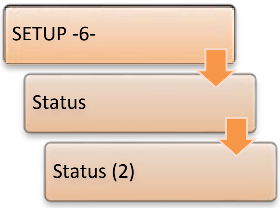
Inputs				Inputs				Inputs				Inputs			
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Signal				**Signal**				**Signal**				**Signal**			
x	-	x	-	x	x	x	x	-	x	x	x	x	x	-	x
Value				**Value**				**Value**				**Value**			
8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1
= HEX A				= HEX F				= HEX 7				= HEX D			
x = ON															
- = OFF															

The binary input situation pictured above would be displayed in the status as 0000.af7d. Display of the status of inputs 17 – 32 is carried out similarly to inputs 1 – 16 before the dot.

In this way, during commissioning of the regulator, it can be unequivocally determined whether a signal is present at the terminals or not.

The point “mapping” indicates whether the channels of a connected ANA-D or BIN D are assigned (mapped) to inputs or outputs of the REG-D™. If the mapping is active the word "active" appears. Otherwise, the symbol "---" indicates that no mapping is active. Further information on the mapping of COM3 devices can be found in chapter 8.2.6 from page 224 onwards.

REG-D™ Status (2)



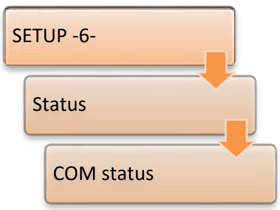
Pressing the right arrow key leads to display status (2), in which the activated additional software features are shown.

A feature affects the regulator in a manner which is not needed for standard operation. If a particular feature is needed, it can be unlocked with the support of A. Eberle service team.

If, for example, in addition to voltage, the regulator needs also to be switched to active and reactive power regulation, the feature PQCTRL must be enabled. After the action is carried out, setpoints 1 and 2 can be used as voltage setpoints, setpoint 3 as active power and setpoint 4 as a reactive power setpoint.

If the regulator is to measure power values according to the ARON configuration, the feature M2 must be enabled, for example. But in this case the hardware requirements of the regulator must also be met (additional current and voltage transformers).

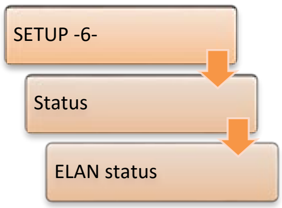
COM status



Pressing the right arrow key once more will display the settings of COM1 and COM2.

A short overview of the current operating mode is shown, the baudrate used, the parity and the handshake of the two COM interfaces.

E-LAN status



Pressing the right arrow key once again displays the settings of the two bus interfaces E-LAN-R and E-LAN-L and provides information on the total number of devices in the network.

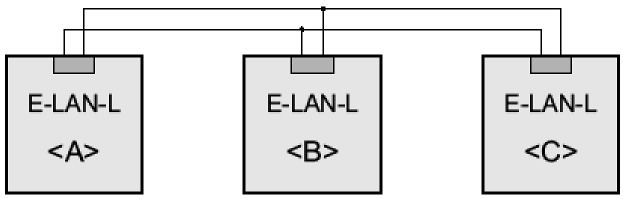
"Users total: 2", for example, shows that only two devices are connected from the assortment in the E-LAN system. In addition to a further REG-D™, the second device could be a Power Quality Interface PQI-D, a Petersen coil regulator REG-DP(A)™, an earth fault-detection-relay EOR-D, etc.

LAN-L users: 0 (0) indicates that at the left E-LAN port there is no other device.

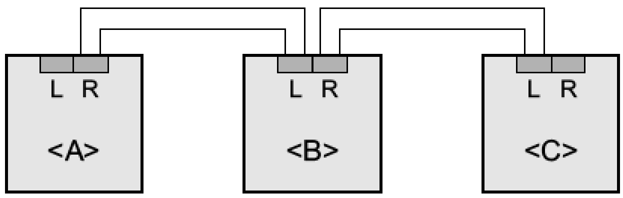
LAN-R users: 1 (1) indicates that the second E-LAN device is directly connected to the right E-LAN port.

The value in brackets shows the type of connection. If devices are directly connected to a port (in bus topology) the value in brackets is always equal to the total number of devices. If several tdevices are connected in line-to-line topology, both numbers differ.

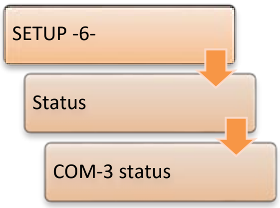
Bus structure



Line-to-line structure



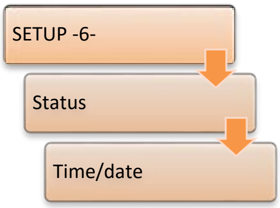
COM-3 status



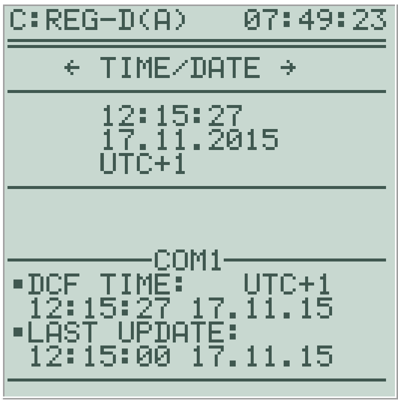
Here the devices connected to the COM3 bus of the REG-D™ are displayed, such as ANA-Ds and BIN-Ds.

The address and the type of available devices can be found in the table at the bottom of the screen. With the F5 key you can scroll to addresses 11 to 15. The F4 key allows access to the monitor settings of the COM3 interface.

Time/date



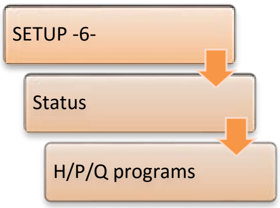
Pressing of the right arrow key once more leads to the time/date status menu. Here are shown the current time, date, the set time zone (here: UTC+1) and the summer time (DST) if used are shown.



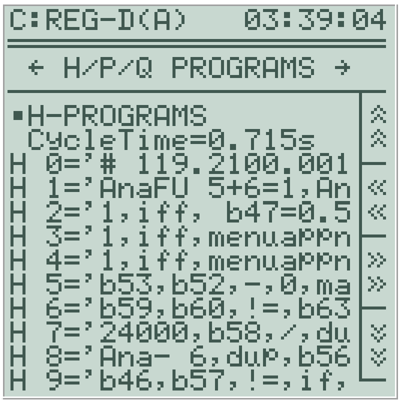
If the time of the REG-D™ is synchronised via a DCF signal, the status of the DCF signal is also displayed here. Hereby are displayed the source of the DCF signal (TBUS, COM1, COM2), the time, date, and time zone of the DCF signal and the time of the last adjustment of the REG-D™ time.

If the DCF signal fails, the DCF time signal is displayed in brackets and the duration of the dropout is displayed in square brackets instead of the time zone. If there is no DCF signal for more than two minutes, the time/date menu changes back to the view without DCF status.

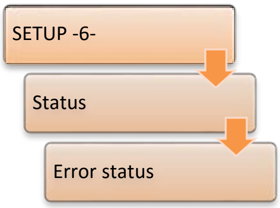
H/P/Q programs



Pressing of the right arrow key omce again leads to the H/P/Q program menu. Here the background program of the REG-D™ is shown. With the F2 ... 5 keys you can scroll right and left, and, up and down respectively.



Error status



Pressing of the right arrow key once again leads to the error status menu. Here the errors of the device, the analog channels and the background program are shown.

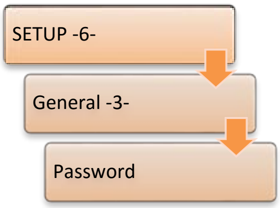
The following error displays are possible:

Device errors	Description
EEPROM-A error	EEPROM REG-CPU error
EEPROM-B error	EEPROM REG-NETZ error
User error A	Test of the status relay with the command statrel*=0
Internal batt. error	Battery empty
COM3 comm. error	Communication error on the COM3 interface
LAN comm. error	Bus/communications error in H program, e.g. addressed station ID does not exist
LAN/L error	Physical (hardware) error on E-LAN L, e.g. wire missing, missing terminating resistors, address collisions (duplicate station IDs)
LAN/R error	Physical (hardware) error on E-LAN R, e.g. wire missing, missing terminating resistors, address collisions (duplicate station IDs)
LON error	Error during communication via LON protocol

Analog channel error
Communication error
Wire break
Configuration error

Error in H-program
General error
Syntax error
Error: Not enough parameters
Error: Too many parameters
Error: Illegal argument range
Error: Number too large
Error: Division by zero
Error: Too many program interlaces
Error: Too many IF/ELSE interlaces
Error: Too many FOR program interlaces
Error: ALL interlaces not possible
Error: Function not available
Error: Beyond Index range
Error: Assignment not possible
Error: Incorrect time/date statement
Error: Extension not useable
Error: Search term not found
Internal error
Error: Only useable in background programs
No access right
Error: Input line too long
Error: ID incorrect
Error: ECS-LAN user unkown
Error: Timeout
Access denied

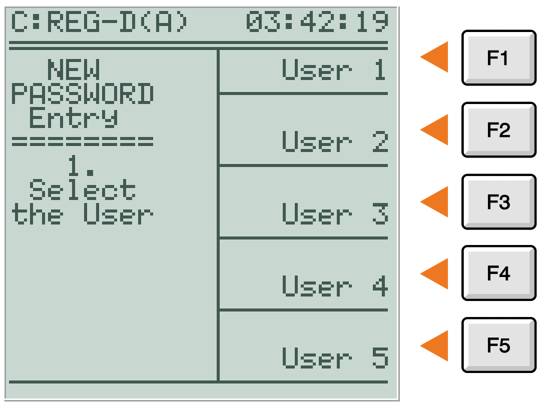
6.4 Password protection



The REG-D™ has a password protection feature that prevents altering setup values (parameters) using the keys on the device. Measurement values and parameters can also be provided with active password protection.

A total of five different users are available: Each user has a six digit password. Each digit of the password can have a value between 1 and 5 (1, 2, 3, 4, 5).

When a user logs on the device it is recorded in the logbook.



Enabling password protection and setting a password

The password protection is activated as soon as a password is assigned to user 1 (master). Other users are also activated by assigning a password to the corresponding user. When assigning a password it has to be entered twice for security reasons. This is done through two successive input dialogs.

Changing a user password

To change a user password, the corresponding user or user 1 must log in first. After logging in, the user whose password is to be changed can do so by using the keys F1 to F5. Subsequently, the new password is set by double entry.

Changing passwords

User 1 can change all passwords (but not see them). All other users can only change their own password.

Disabling password protection or deleting passwords for users 2 ... 5

The password protection is disabled when the password of user 1 is set to "111111". If the passwords of users 2 ... 5 is set to "111111", the password or the corresponding user is deleted. In both cases, user 1 must be logged in to perform the deletion.

Password query (login)

A password query is performed automatically as soon as a password-protected parameter adjustment, or a password protection change, is to be performed. After the selection of a user (only users for which a password has already been assigned can be selected) and entering the correct password, the new value of the parameter is set and the system remains open for five minutes. If any inputs occur during this time, the open time is five minutes. This means that throughout this period further parameter modifications can be performed without re-entering the password. If the REG-D™ has no operation performed on for more than five minutes, the system is closed and the user gets logged out automatically.

Instant activation of password protection

Normally, password protection is first activated five minutes after the last operation of the REG-D™. Pressing the "<" key (left arrow) in the password request menu (SETUP-6-\General -3-\Password) enables password protection immediately.

Deleting the password of user 1

If the password of user 1 is deleted by entering "111111", the entire password protection of the device is disabled. Any existing passwords of users 2 ... 5 are retained. If a password for user 1 is set again, users 2 ... 5 will still be present with their previous passwords.

Forgotten passwords

If you have forgotten the password for the REG-D™, it is possible to disable password protection by entering a device-specific code. For this purpose, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Password protection of COM interfaces

The REG-D™ also has the possibility to protect the COM interfaces (COM1 and COM2) with a password. Password protection of COM interfaces can be activated and managed through the service program of WinREG (versions later than 3.9.6). Here there are six users (user 1 (administrator) + users 2 ... 5, + guest) whose permissions can be customized in five stages (no permissions, local read, local read/write, local read/write and E-LAN read, local and E-LAN read/write).

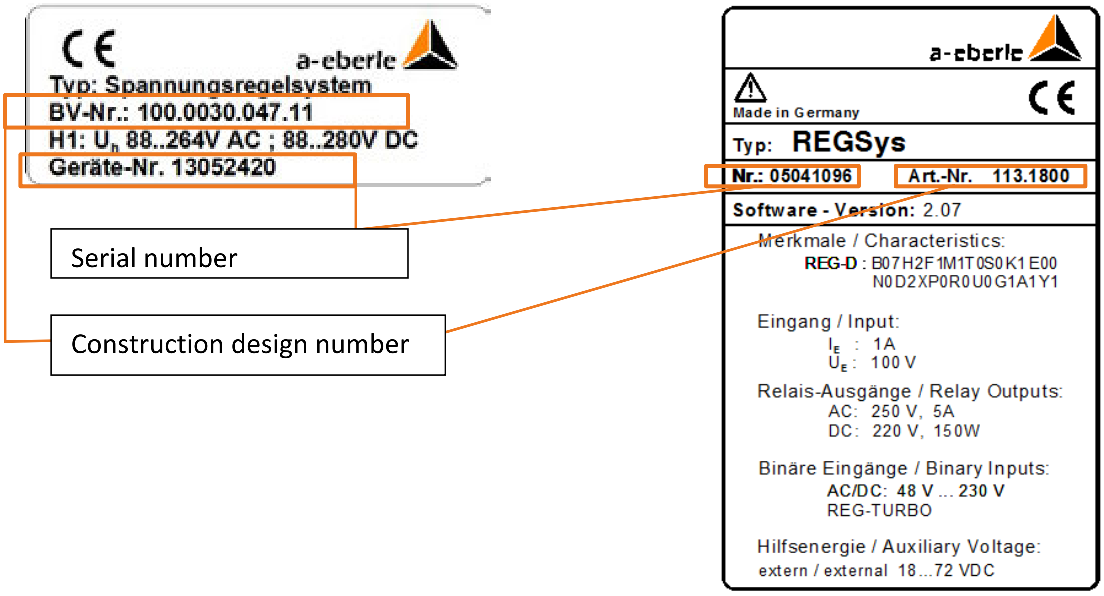
7. Installation and commissioning

7.1 Hardware and connection

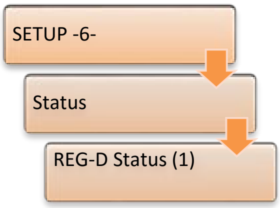
7.1.1 System design and description

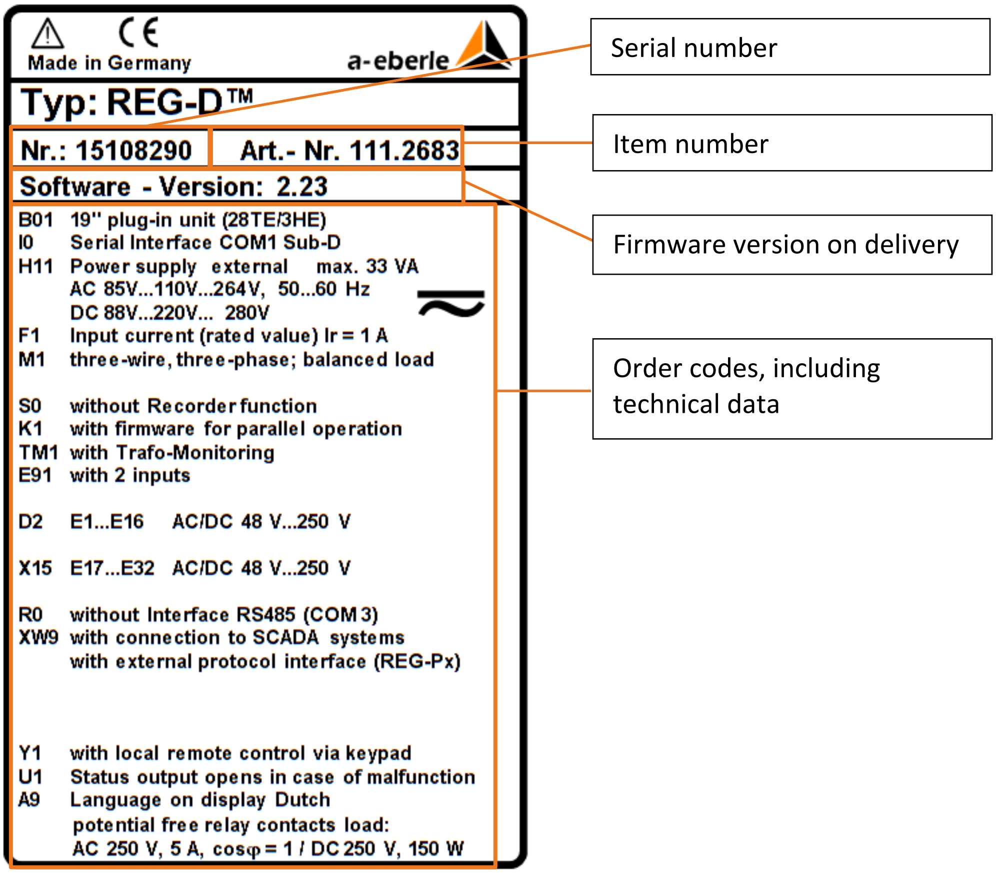
The Relay for Voltage Control & Transformer Monitoring REG-D™ is available in many housing options. These range from 30 HP (horizontal pitch) wide plastic housings to 49 HP wide plastic housings up to a 84 HP wide module rack. The housings are available as wall-mounted or panel-mounted housing. For details about the housing options (wire cross sections, cut-outs, etc.) please refer to the technical data in the appendix, chapter 21. The housing/module racks are mostly fitted with custom wiring. That is, to be able to carry out the wiring, you will need the matching current and/or terminal diagrams for the system. These are supplied with the system. If you do not have the circuit diagrams, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

The unique identifier of the system is a construction design number number. This number describes the whole system with its hardware and software. The building code number is located on the back or side of the housing/module rack.



Moreover, each A. Eberle device (e.g. REG-D™) has a unique serial number (e.g. 13052420) and item number (e.g. 111.2515). These are marked on the type label of each device (plug-in units). The serial number can also be seen in "Setup 6-\Status\REG-D Status(1)" in the line S/N. The type label of individual devices also contains important technical data such as the auxiliary and control voltage ranges and the equipment included (order codes). This information is also found on housing type labels.



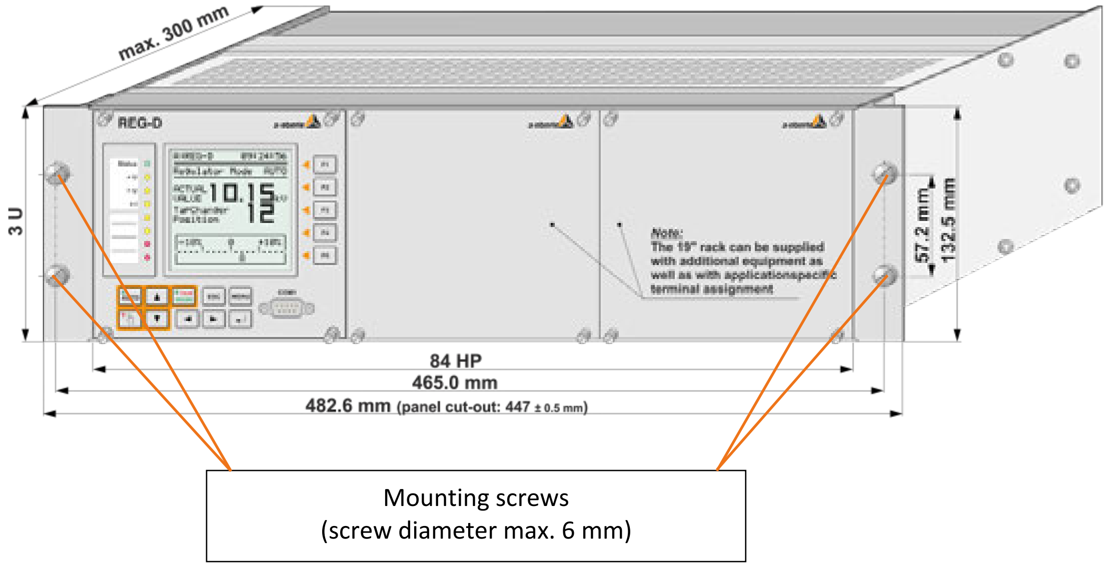


7.1.2 Installation/removal

7.1.2.1 Housing/module rack

19“ module rack

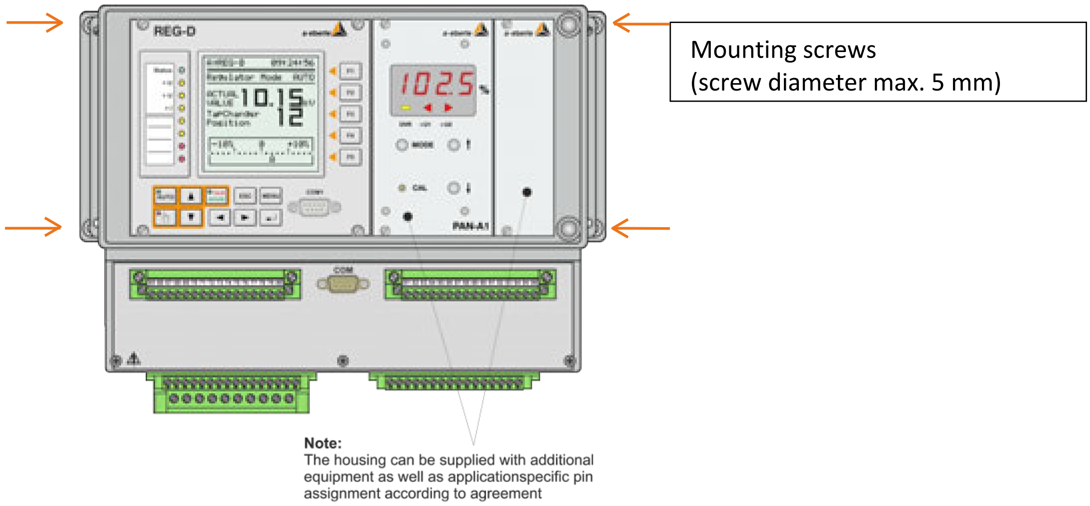
The 19" module rack is designed for installation in an appropriate rack or a swing frame. It can also be placed in an appropriate control panel cut-out. The attachment of the rack is done using four screws on the front.



Wall-mount housing

The wall-mount housing is designed for mounting on a wall or mounting plate. The fixing is done by four screws in the holes provided.

Since hole distances depend on the construction of the housing (30 or 49 HP width), obtain the drilling distances from the technical data in the appendix, chapter 21, or the drawings supplied with the system.

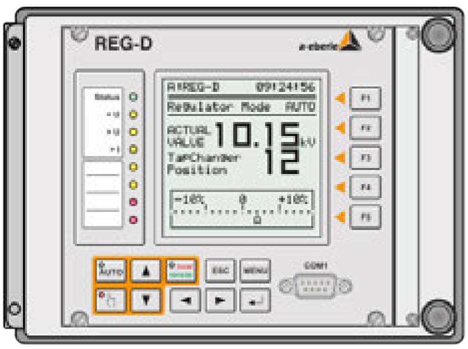


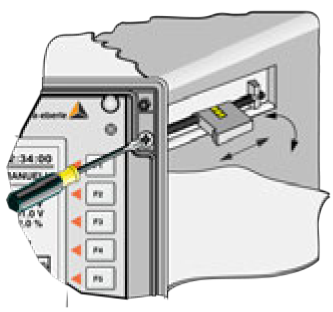
Panel mounting housing

The panel-mounting housing is intended for mounting in a panel or cabinet door. To this end, the panel must be provided with a correspondingly large cut. Since the hole distances depend on the construction of the housing (30 or 49 HP width), obtain the drilling distances from the technical data in the appendix, chapter 21, or the drawings supplied with the system.

Fastening of the housing on the panel is done via four clamping devices, which are mounted on the housing. For this purpose, the housing is first inserted from the front all the way into the cut-out. Subsequently, the holding devices are folded out by turning the corresponding screw. The housing is clamped to the panel by further turning of the screw.

The maximum thickness of the panel is 20 mm.



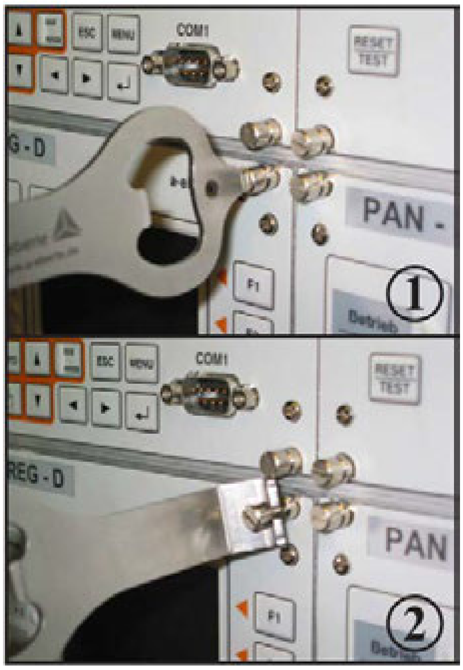


7.1.2.2 REG-D™ plug-in unit

The REG-D™ is designed with plug-in technology. This means that the unit can be removed completely from the module rack / housing by loosening four screws in the front. Hereby, no connections need to be loosened.

NOTICE!	**Switch off auxiliary power before pulling out the plug-in module!** Removal or insertion of the REG-D™ module while under voltage can cause damage to the module. ➲ Switch off the auxiliary power before removing or inserting the plug-in module.

In order to facilitate withdrawal of the unit, every REG-D™ is provided with an extractor tool. This tool can also be used to loosen the fastening screws.



1. Loosening of the four fastening screws

2. Pulling out the plug-in unit

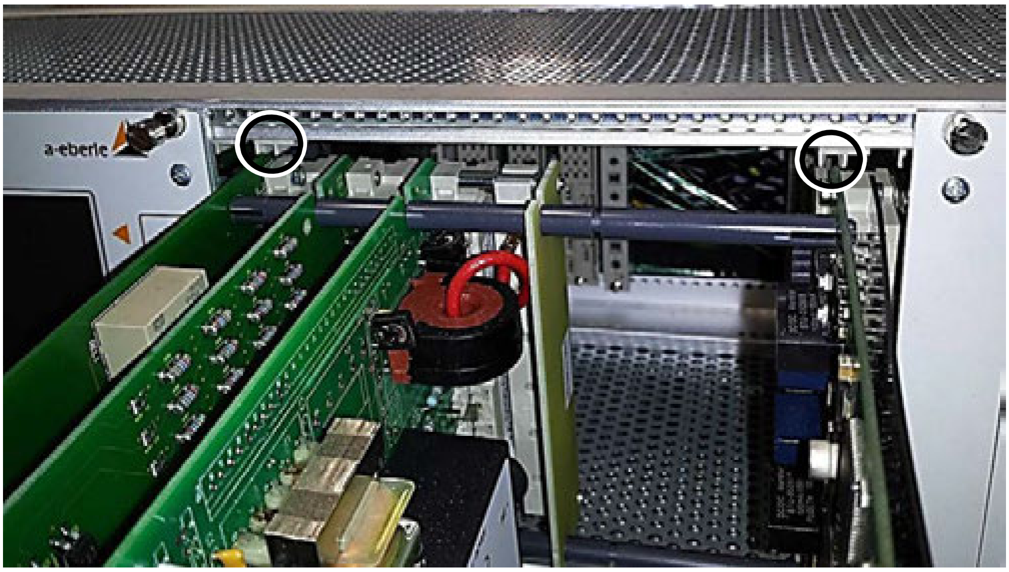
   To avoid jamming, one may first need to loosen the module unit by pulling on a screw in order to then be able to completely withdraw it with a screw on the opposite side.

Shorting circuit current transformers

The housing / module rack in which the REG-D™ is installed has special contacts for current measurement. These contacts are automatically closed when removing the REG-D™, so that the current transformers are short-circuited.

Therefore, external current transformer shorting can be omitted for the REG-D™.

On insertion of the REG-D™, each outer circuit board is inserted into the guide rails of the module rack / housing. The device is then pushed in to the stop. Finally, the four fastening screws are fastened again.



NOTICE!	**Improper installation of plug-in units can cause damage!** The entire unit, or parts such as the plug, can be damaged. ➲ Ensure proper seating of circuit boards in the guide rails. ➲ Do not use force when inserting the plug-in module. ➲ Upon insertion of the plug-in module do not press on the display. ➲ Do not fasten the mounting screws too tightly.

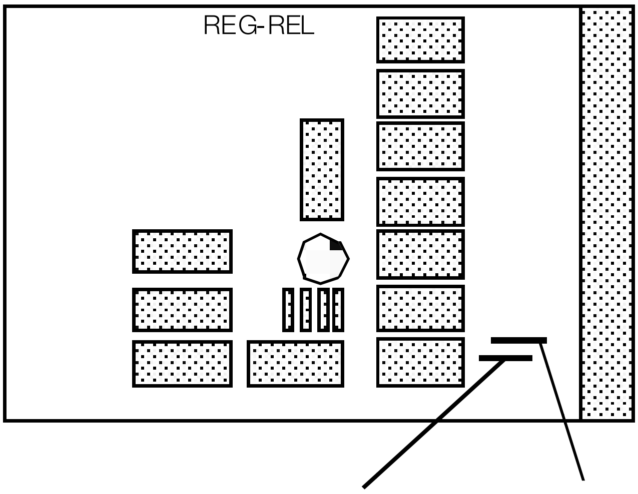
7.1.3 Hardware

7.1.3.1 Status contact

By a corresponding arrangement of a jumper wire on the relay circuit board REG-REL, the binary output status can be used either as a normally open or normally closed contact.

The circuit board is also shown as LP-1 or as multipoint connector R1 in the circuit diagrams.

The position of the jumper wire is shown in the drawing.



Function normally open contact N/O (feature U1)

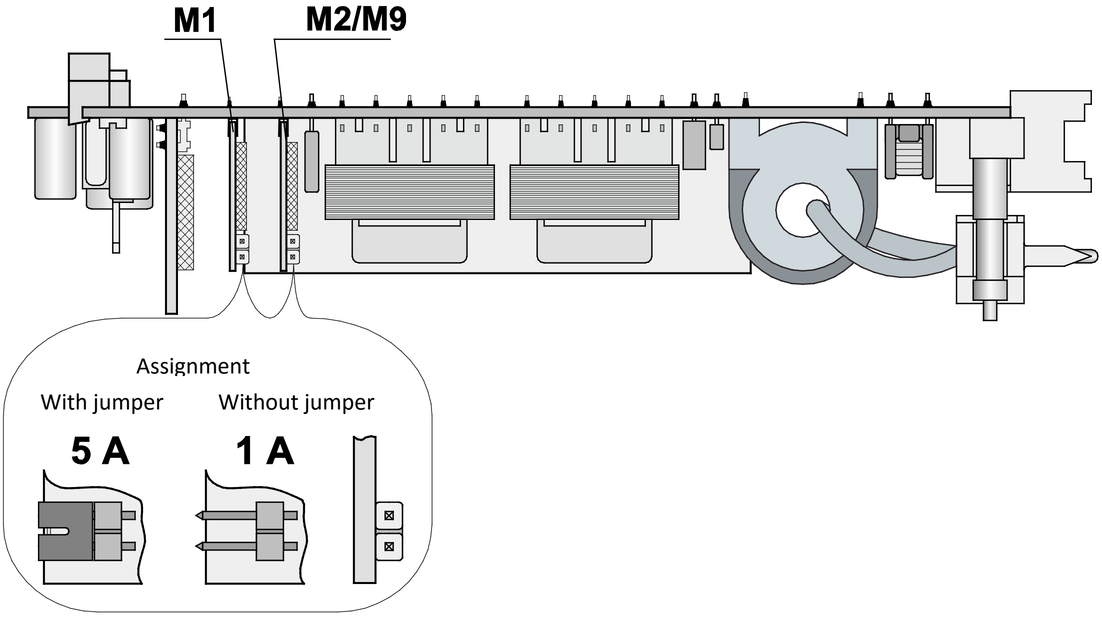
Function normally closed contact N/C (feature U0)

⚠ CAUTION!	**Careful, short circuit!** The status relay can only be used as an N/O or N/C contact. Using both at the same time is not possible. Doing a jumper connection of both wires causes a short circuit. ➲ Never place both jumpers, always only **one**!

7.1.3.2 Current measurement range

With the Relay for Voltage Control & Transformer Monitoring REG-D™, the selection of the nominal current transducer value (1/5A) is carried out in two steps.

In addition to the software-based conversion, a jumper has to be set on the filter card of the REG-NTZ circuit board in the appropriate position. If the jumper is not required (1A), it can be "parked" on one of the two pins.



With the regulator REG-D™, the number of current transformers that need to be adapted from case to case depends on the selected hardware feature. In normal applications only the subprint M1 is equipped. In cases where, for example, the application is an arbitrarily loaded three phase network, or three-winding transformer applications, the subprint M2/M9 is additionally fitted and must also be set to the nominal current transformer value. The jumpers on subprint M1 and M2 must always have the same position (1 or 5A).

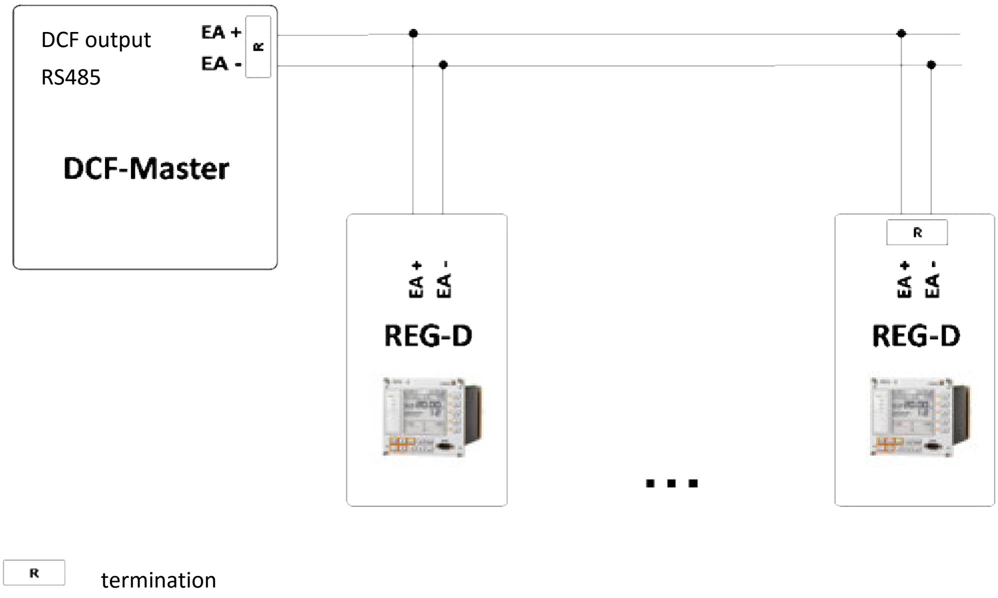
If you need a different application, please contact A. Eberle.

7.1.3.3 DCF input (TimeBus)

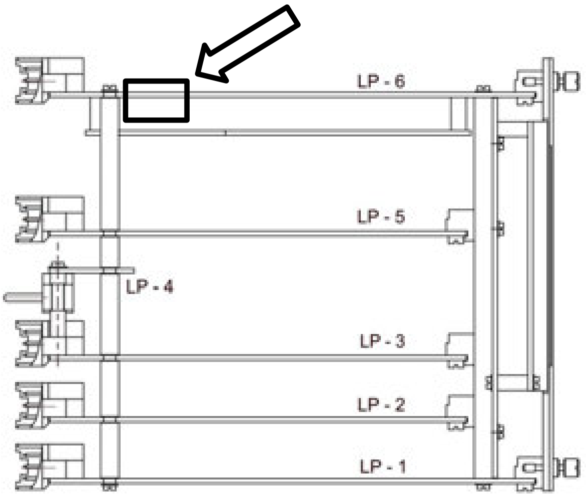
Since May 2009, the REG-D™ hardware has been equipped with a separate input for connection of a DCF time signal. The input is designed for an RS485 level (5V) and can be wired to several devices as a two-wire bus. This means that multiple REG-D™ can be synchronized at the same time from one time source. Time sources can, for example, be a DCF clock, a GPS clock with DCF output, a PQI-D(A) or a REG-PED (NTP to DCF function). The DCF input is only useful with a firmware version V2.22 / V3.22 or later.

If the DCF signal is connected to the DCF input, no further adjustments are necessary.

The status of the DCF signal is shown in the "Setup -6-\Status\Time/Date" menu (chapter 6.3, page 38).



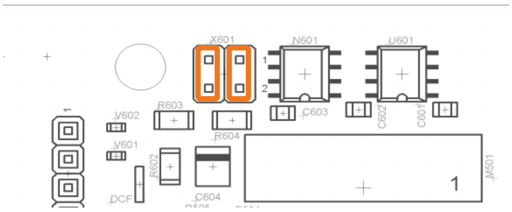
The DCF input has an active termination for the RS485 bus. This should be switched in at the beginning and at the end of the RS485 bus to prevent reflections. Activation of the termination via two jumpers or a switch can be made, depending on the version. The jumpers (X601) or the switch (S601) are located on the CPU board of the REG-D™ in the area of the rear, upper connecting rod.



Version with jumpers (X601):

Plugged jumpers -> termination active

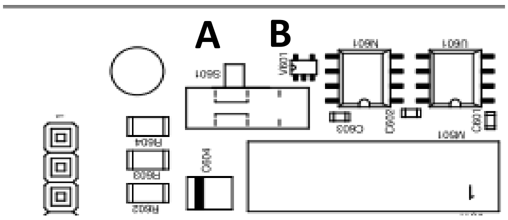
Jumpers not plugged -> termination inactive



Version with switch (X601):

Switch in position A -> termination active

Switch in position B -> termination inactive



7.1.4 Connection

Almost all housings and module racks are equipped with custom internal wiring. That is, to be able to carry out the wiring of the housings or module racks, you will need the matching wiring diagrams for the system. These are supplied with the system. If you do not have the circuit diagrams, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

The wire cross-sections of the different terminal types and tightening torques can be found in the technical data in the appendix, chapter 21.

⚠ WARNING!	**Danger of electric shock!** ➲ When you connect, always follow the five safety rules. ➲ Carry out connections according to the applicable regulations and this user manual. ➲ Upon insertion of the plug-in module do not press on the display. ➲ Do not fasten the mounting screws too tightly.

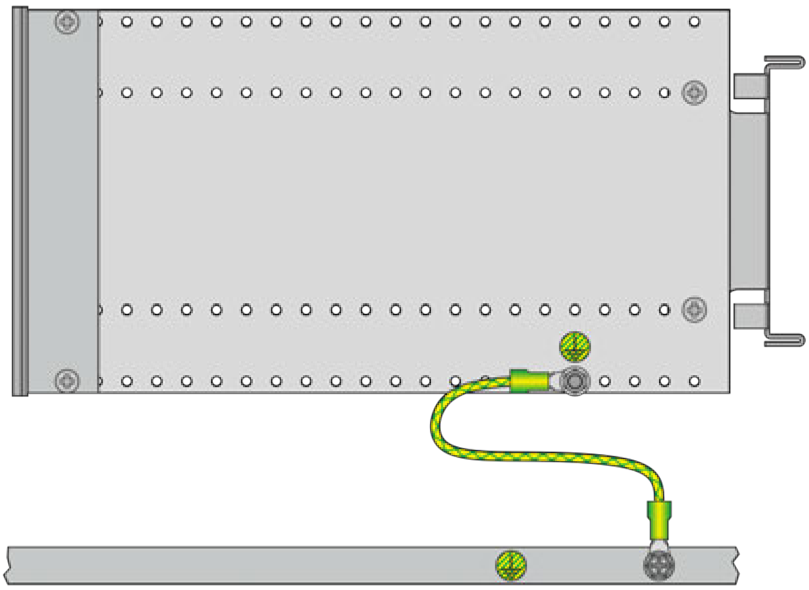
⚠ WARNING!	**Incorrect connection!** The device and/or the system can be damaged. ➲ To make connections always use the associated system drawings. ➲ Pay attention to the nominal values of the auxiliary and control voltages. ➲ Ensure that communication interfaces are not subjected to control or auxiliary voltage.

7.1.4.1 Grounding

The Relay for Voltage Control & Transformer Monitoring REG-D™ must always be grounded with a protective conductor. When connected to an auxiliary power supply with a protective conductor this condition is met. When the auxiliary voltage network has no protective conductor, an additional connection must be established from the protective earth terminal to earth.

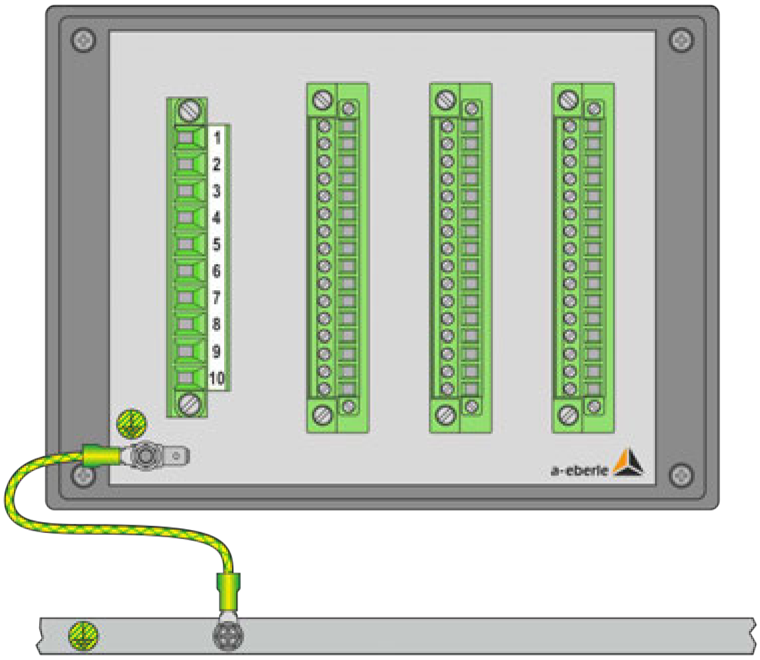
⚠ DANGER!	**Electric shock due to missing ground in case a live conductor touches a housing.** There is danger to life. ➲ Connect the grounding / protective conductor connection of the housing or the rack to the protective earth.

Module rack ground connection



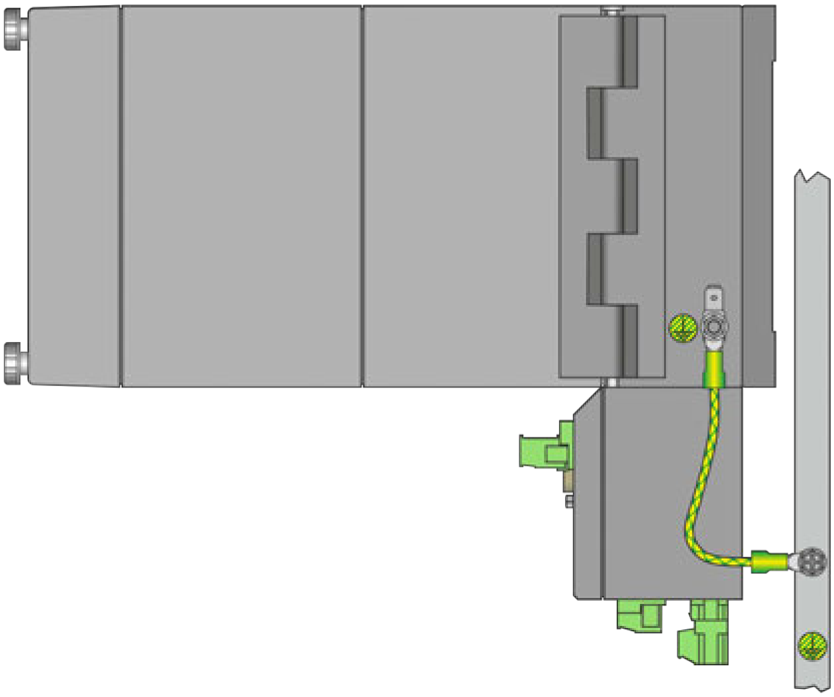
In addition to the side-mounted ground line, the module racks are equipped with another clamp, or a connection point, for a cable lug to connect the protective ground. Both connection points are conductively connected.

Panel housing ground connection



The connection can be made via a ring cable lug (included) or plug cable lug.
The grounding cable is not included.

Wall-mount housing ground connection



The connection can be made via a ring cable lug (included) or plug cable lug.
The grounding cable is not included.

7.1.4.2 Auxiliary voltage

The REG-D™ is available with different auxiliary voltage ranges. This is specified by the order code H. The REG-D™ is internally equipped with a microfuse (5 x 20 mm, slow) for protection against an internal equipment fault. The nominal value (1A or 2A) of the fuse is determined by the auxiliary voltage range (see the table below).

Auxiliary voltage			
Feature	**H0**	**H1/H11**	**H2**
AC (internal)	75 V...185 V	-	-
AC	-	85 ... 264 V	-
DC	-	88 ... 280 V	18 ... 72 V
AC power consumption	≤ 35 VA	≤ 35 VA (H1) ≤ 45 VA (H11)	-
DC power consumption	-	≤ 25 VA (H1) ≤ 35 VA (H11)	≤ 25 VA
Frequency	45 ... 400Hz	45 ... 400Hz	-
Microfuse	T1 250 V	T1 250 V	T2 250 V

The terminal numbers for the auxiliary voltage can be looked up in circuit diagrams.

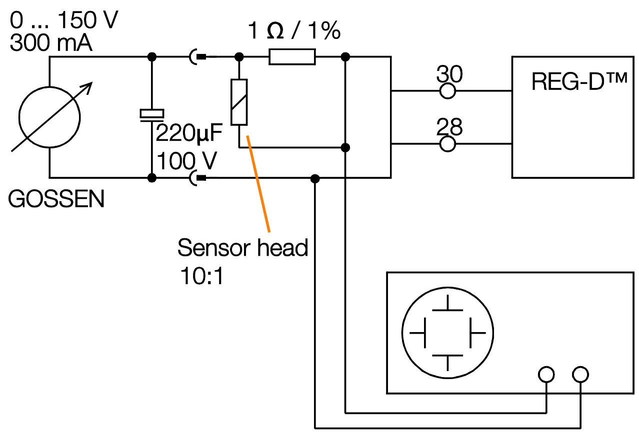
NOTICE!	**Incorrect auxiliary voltage!** If one applies an excessive auxiliary voltage, the device may be destroyed. At a too low auxiliary voltage or with reversed polarity (feature H2), the device does not power up. ➲ Pay attention to the auxiliary voltage range (type label and technical data in the appendix, chapter 21).

Protection of the auxiliary power supply

It is generally recommended that the auxiliary voltage of the voltage regulation system se provided with a fuse. The rated current of the fuse depends on the number and features of the connected devices. Here, in addition to the operating current, the current surge when switching on the auxiliary voltage also determines the choice of the fuse. Therefore, no fuses or circuit breakers with a too low rated current (1/2 A) should be used. In practice, a B10 circuit breaker has proven effective for protecting a single system with a REG-D™ and one more component (e.g. PAN-D) at an auxiliary voltage of 230 VAC.

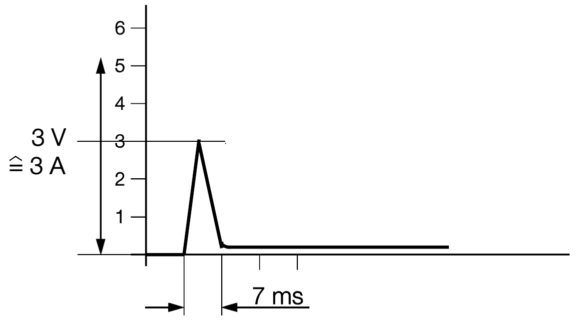
Current consumption of REG-D™

Measuring circuit (100 V DC)



Measurement results

Switch-on spike at 110 V DC



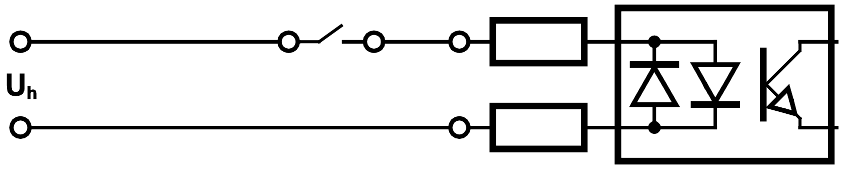
The measured values are intended to provide information on the choice of fuse.

Measurement at	Peak
60 V DC	approx. 2 A
110 V DC	approx. 3 A
110 V AC	approx. 3 A
220 V DC	approx. 5 A
230 V AC	approx. 5 A

7.1.4.3 Binary signals

Binary inputs

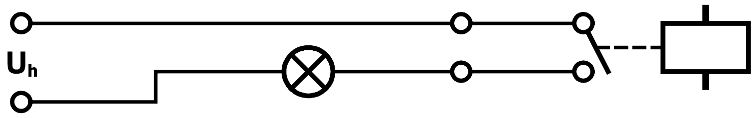
A REG-D™ can be fitted internally with up to 32 binary inputs. The input cards are available with different voltage levels. The voltage range of the fitted binary inputs can be found on the circuit diagrams and the type label (order codes D and X). The terminal numbers of the binary inputs can be looked up in the circuit diagrams. The binary inputs of the REG-D™ are potential-free binary inputs. This means that they have to be controlled by an external control voltage.



NOTICE!	**Incorrect auxiliary voltage!** If one applies an excessive auxiliary voltage, the binary inputs may be destroyed. At a too low control voltage no signal is detected at the inputs. ➲ Pay attention to the auxiliary voltage range (type label and technical data in the appendix, chapter 21).

Binary outputs

The REG-D™ can be fitted internally with up to 19 binary outputs (relays). The capacity of the relays can be found on the type label or in the technical data in the appendix, see chapter 21. The terminal numbers for the binary outputs can be looked up in the circuit diagrams. The relays of the REG-D™ are potential-free binary outputs. This means that they have to be controlled by an external control voltage.



NOTICE!	**Too high current load on the relay** At a too high load the relays may be destroyed. ➲ Obey the technical data for the relay (type label and technical data in the appendix, chapter 21). ➲ Do not connect large consumers directly to the relay of the REG-D™, use coupling relays instead.

NOTICE!	**Switching of inductive or capacitive loads** Switching of inductive or capacitive loads without appropriate protective measures (series resistors, freewheeling diodes, damping networks, etc.) can lead to destruction of the relay. ➲ Obey the technical data for the relay (type label and technical data in the appendix, chapter 21). ➲ Use coupling relays equipped with freewheeling diodes or similar protective circuits.

7.1.4.4 Analog signals

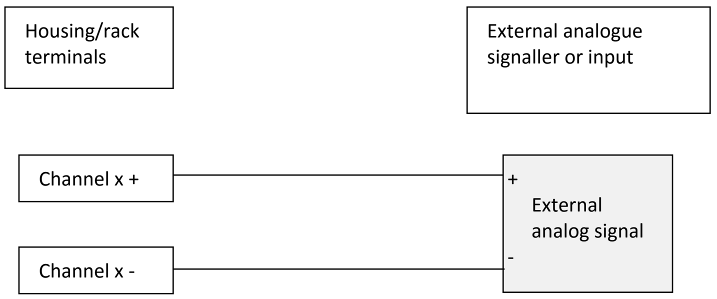
The REG-D™ can be fitted with up to three analog modules. Each module can include one of the following functions:

- two analog inputs
- two analog outputs
- PT100 direct input
- Resistance measuring unit for a resistance coded tap position (tap position potentiometer)

The equipment of the REG-D™ with analog modules can be seen in the circuit diagrams or the type label (order code E). The terminal numbers for the analog channels can be looked up in the circuit diagrams.

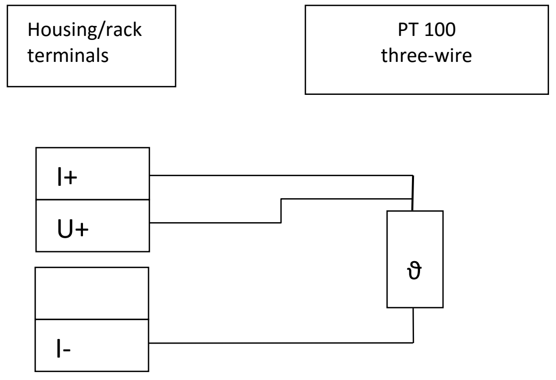
Analog inputs and outputs

The analog inputs are available as mA or low voltage inputs (10 V). The analog outputs are available as mA outputs.



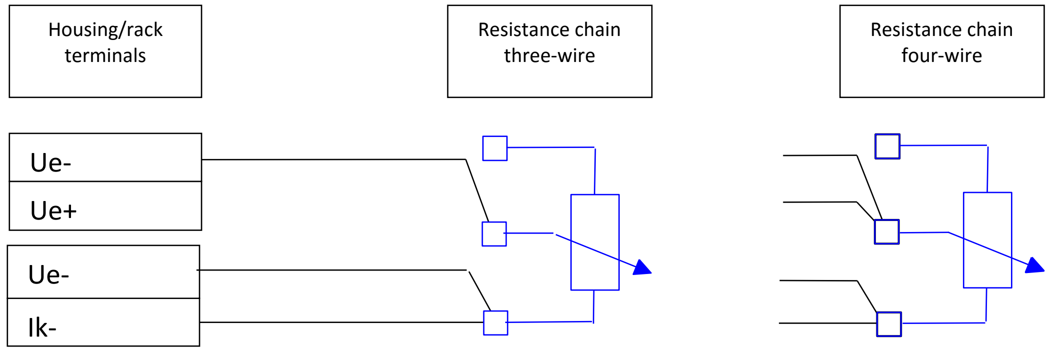
PT100 direct input

The REG-D™ PT100 module is connected with a three-wire circuit to the PT100 resistor.

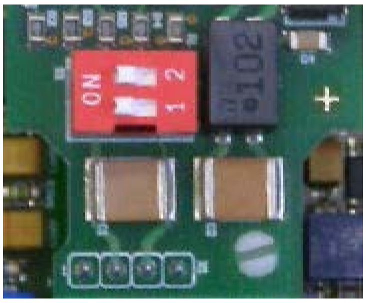


Resistance measuring input for the tap position indication (tap position potentiometer)

For resistance measurement, only one end of the resistance chain as well as the slider is used. The other end remains free. The end of the resistor chain must be chosen so that at the lowest tap position (tap 1), the resistance between the end and the slider is zero Ω.



Selection of three-wire or four-wire connection



The selection of a three-wire or four-wire connection is done with two DIP switches on the resistance input module.

On delivery, the three-wire connection is preset, unless otherwise specified when ordering.

Terminal type	Connection 1	Connection 2
Three-wire connection	ON	ON
Four-wire connection	OFF	OFF

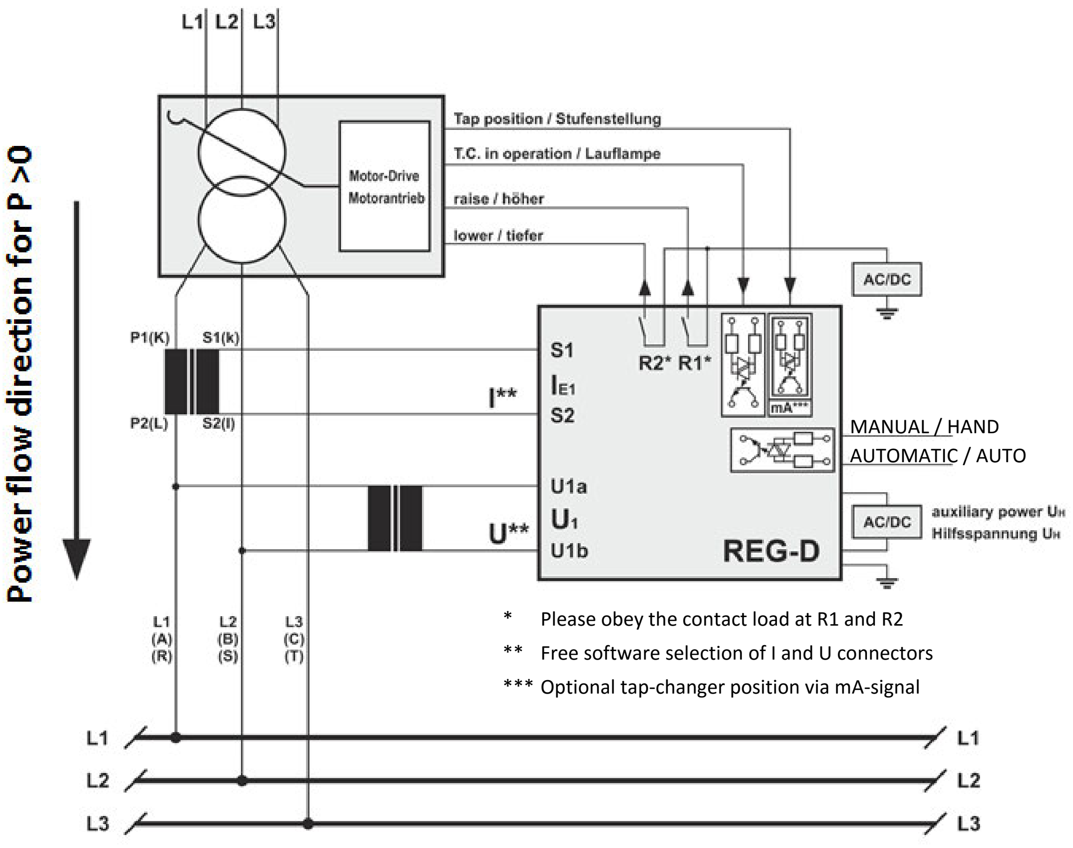
7.1.4.5 Process

The connection of the process (transducer, tap changer, etc.) can be done in many different ways. In the following, a simplified diagram of the signals is shown.

Connecting the current and voltage transformers

Any star or phase voltage can be supplied for regulating the REG-D™. The current can also be taken from any phase. In order for the phase relationships (phase shift between voltage and current) and thus the power calculation and the load flow direction to be correct, the voltages and currents used have to be set in the VT/CT configuration. In addition, on connecting the transducer ensure that the polarity is correct.

- ➲ Pay attention to the nominal values of the voltage and current inputs.
- ➲ Note the A. Eberle definition of power directions (see figure below).
- ➲ On connecting, note the polarity of the transducer (see figure below).



* Please obey the contact load at R1 and R2

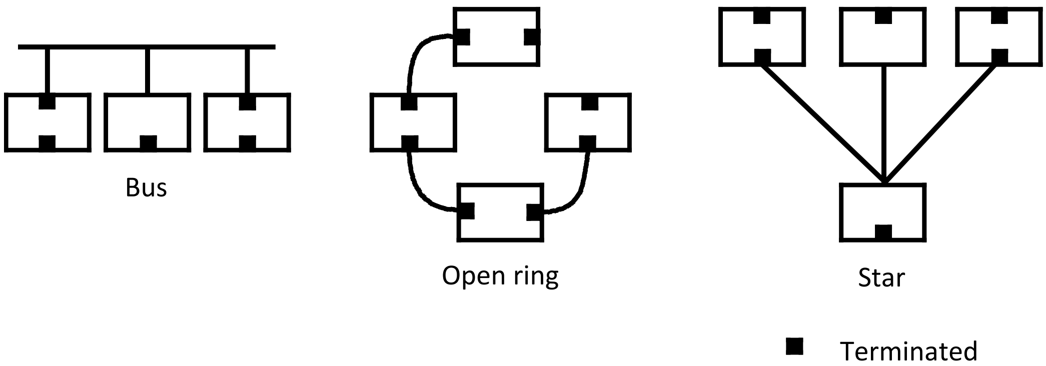
** Free software selection of I and U connectors

*** Optional tap-changer position via mA-signal

7.1.4.6 E-LAN

Characteristics

- Multimaster system architecture, i.e., each station has access to all data of remote stations.
- Max. 255 stations per network, 16 per segment (bus).
- Addressing needs to be unique, whereby the addresses of A:, A1:, ..., A9:, B:, B1:, to Z4: can be assigned.
- PAN-Ds automatically get the address, whereby the PAN-D address is always one higher than the address of the REG-D™.
  Example:
  The address of REG-D™ is N1: → the PAN-D automatically gets the address N2:
- The connection between REG-D™ and PAN-D is exclusive (no other terminals in this segment or bus).
- Physical interface RS 485
- Free choice of topology without additional devices
- Bus structure (two-wire) with terminating resistors at the bus ends
- Line-to-line structure (two-wire or four-wire) between segments of an open ring, suitable for boosters and FO connection.
- Mix of bus and line structure
- Star connection (with E-LAN router)
- Unused E-LAN interfaces have to be terminated.



Configuration	Connection	Max. wire length
REG-D™ — REG-D™	two-wire, direct	400 m
REG-D™ — REG-D™ REG-D™	two-wire, bus (max. 16 devices)	100 m branch line 10 m
REG-D™ — REG-D™	four-wire, direct	1200 m
REG-D™ — Booster — Booster — REG-D™	four-wire, two boosters	4000 m

Recommended cable type: e.g. 2 x 2 x 0.6 ... 0.8 mm^2, twisted pair

The use of non-twisted control lines may also be possible for short distances. This needs to be checked in each case.

Use of the E-LAN GND

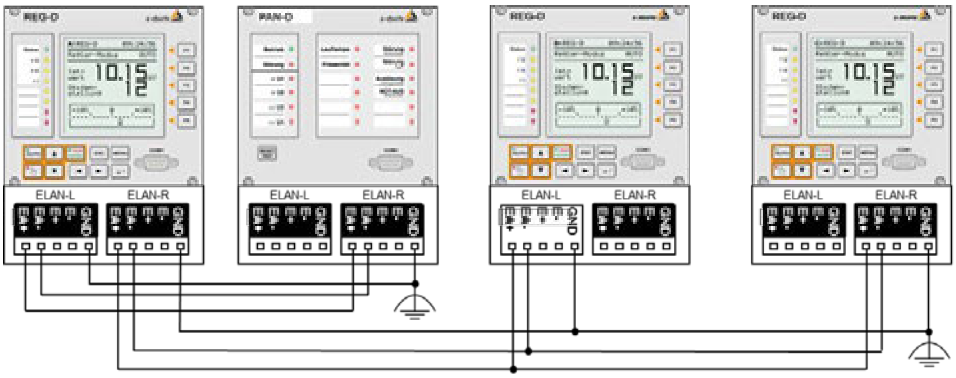
The E-LAN GND terminal is not an earth ground, but a terminal for a potential equalization line, which is connected to all the GND terminals of the connected E-LAN interfaces.

The potential equalization line is additionally led to the twisted pair and may be low-resistance grounded at only one point. This is only a functional earth!

With a bundled installation with disturbing wires, an additional shield may be required. This may only be low-resistance grounded at one point.

Grounding at other points via resistors ≥ 100 Ω is allowed, but unnecessary.

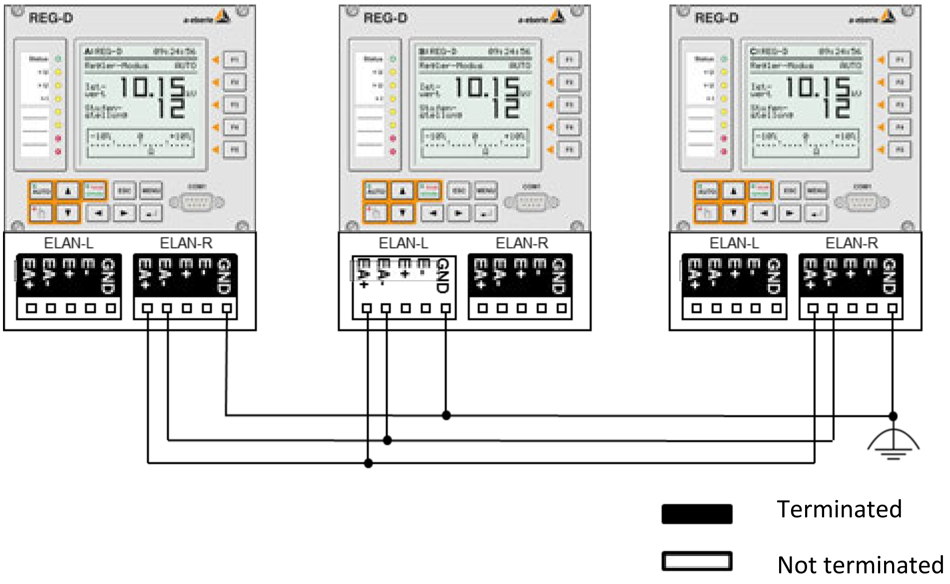
Connection examples for E-LAN REG-D™ with PAN-D and other REG-D™



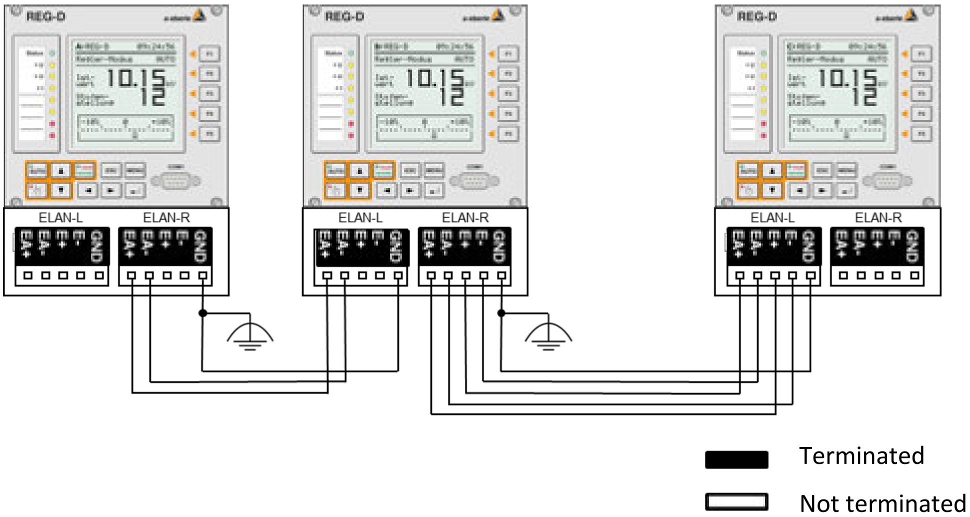
Terminated

Not terminated

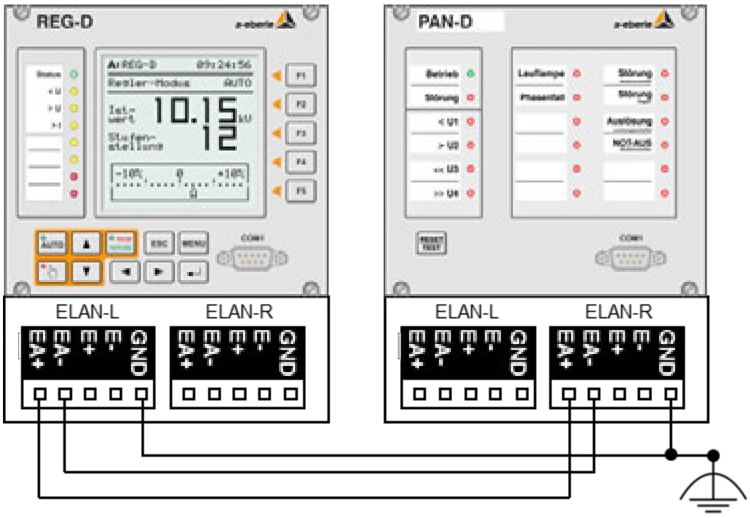
Connection example for E-LAN: 3 x REG-D™ in two-wire bus topology



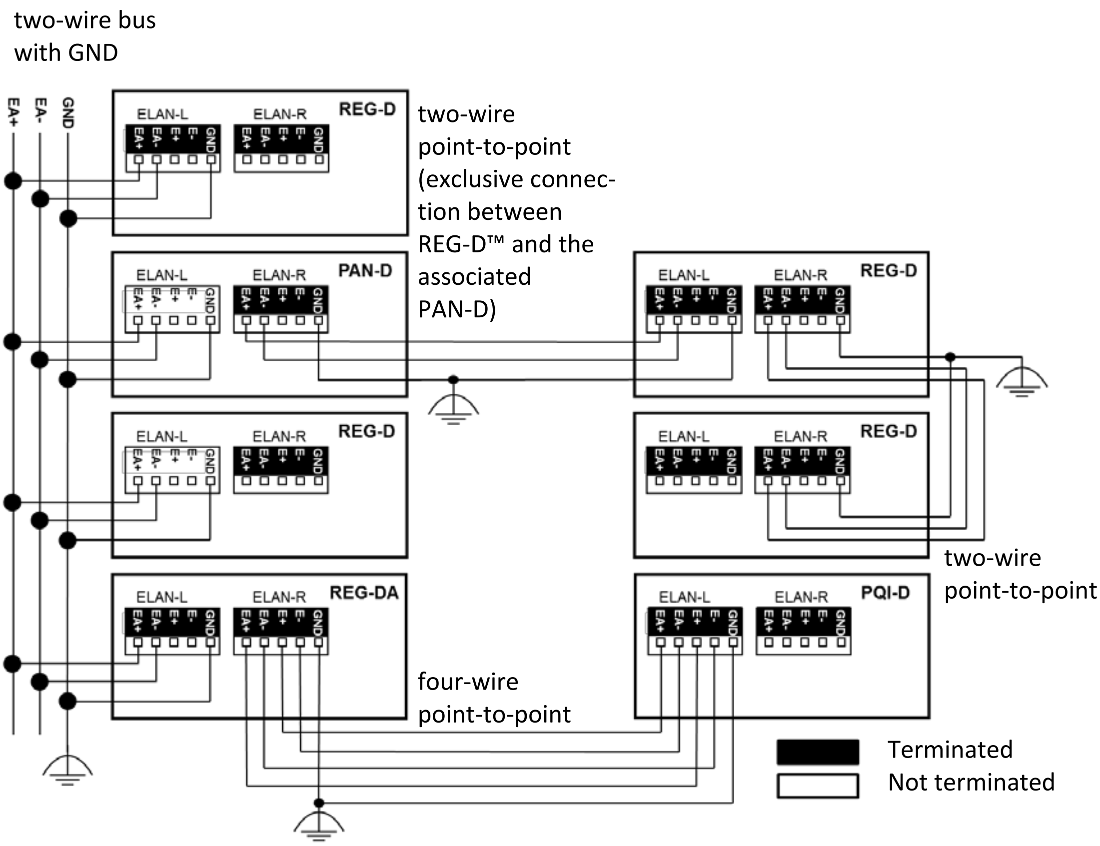
Connection example for E-LAN: 3 x REG-D™ with two-wire and four-wire point-to-point connection



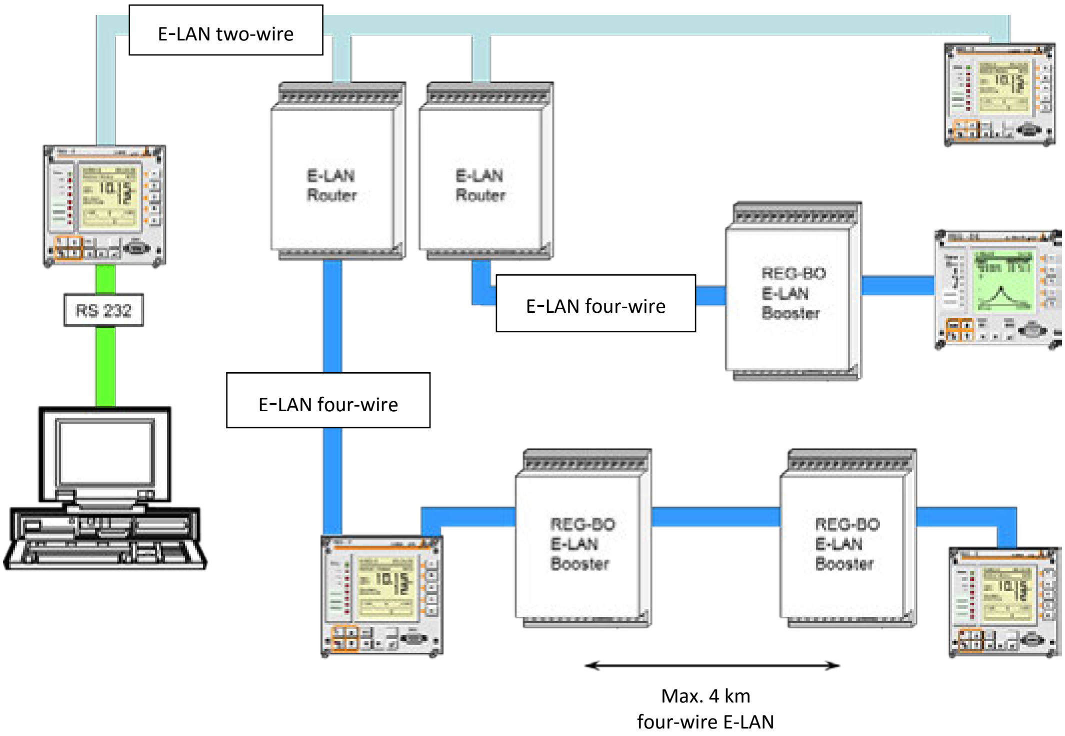
Connection example E-LAN REG-D™ and PAN-D (always two-wire)



Connection example E-LAN: complex network

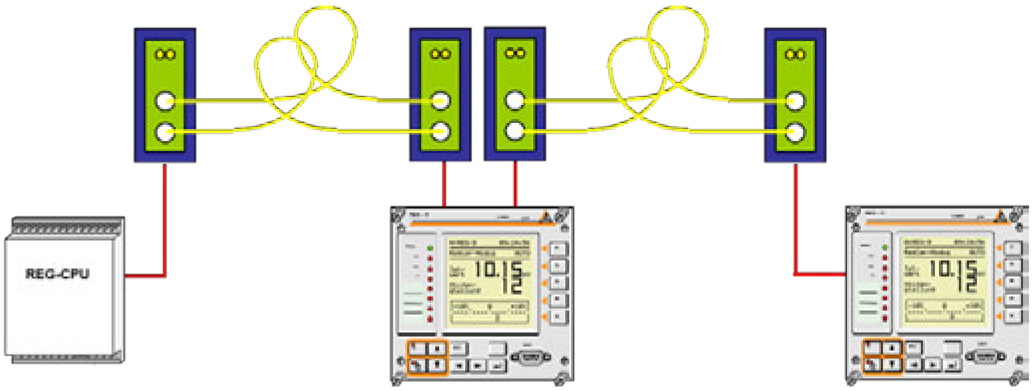


E-LAN router and booster



Use of other media for the E-LAN

For spanning over longer distances, e.g. between two substations:



- Integration of fibre optic connections in the E-LAN
- Connection of a fibre optic coupler – REGSys™ device via four-wire bus

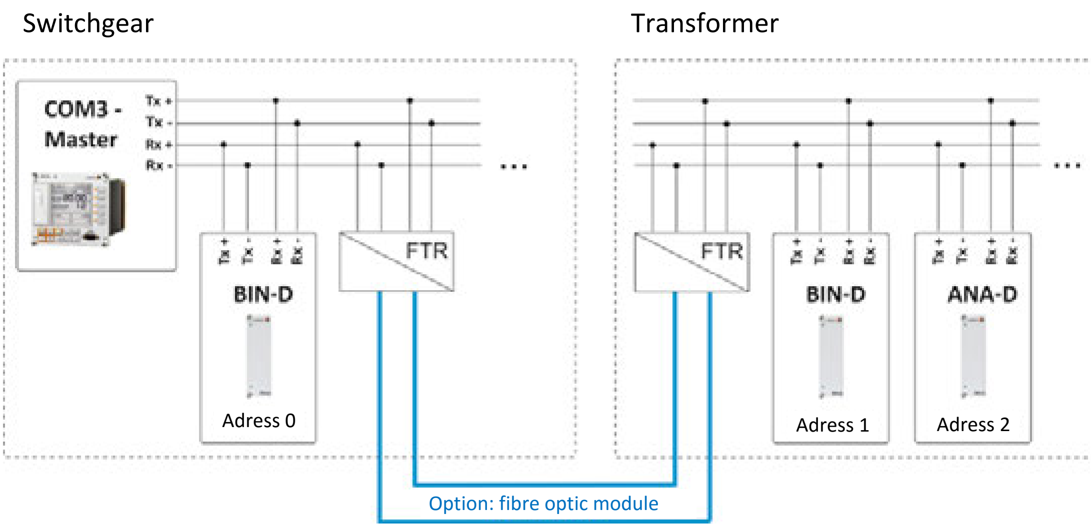
alternative:

- Use of ComServers to rerout/redirect the E-LAN via TCP/IP Ethernet

7.1.4.7 COM3 interface

The REG-D™ COM3 interface is used to connect expansion modules that provide additional inputs and outputs, and is specified via the order code R. The COM3 is operated in master-slave mode. That is, there is a master device (REG-D™) and up to 16 slave devices (ANA-D, BIN-D, COM3/MODBUS converter).

By default, there is a COM3 physically connected to an RS 422 interface using the four-wire- technology, which means that there are separate lines for transmitting and receiving. On request, the COM3 can also be implemented with fibre optic connection. For this purpose, a fibre optic module is installed in the module rack / housing. With this topology, a mix between RS 485 and fibre optics can be used. The fibre optic variant makes sense if certain COM3 components are to be placed in a separate housing.



Line lengths:

RS-422 ≤ 1 km

FO: ≤ 2 km

Recommended cable type:

e.g. 2 x 2 x 0.6…0.8 mm^2, twisted pair

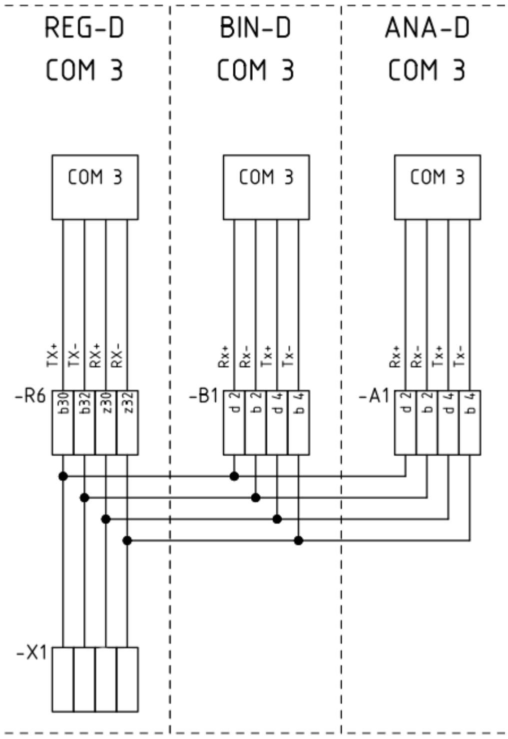
The use of non-twisted control lines may also be possible for short distances. This needs to checked in each case.

In a bundled wire installation, an additional shield may be required. This may only be low-resistance grounded at one point.

The COM3 interface requires no external termination resistors.

Connection:

Example for a REG-D™ with a BIN-D and an ANA-D module



For general information about using the COM3 and the usable modules, refer to chapter 10.1.1 from page 326 onwards.

The allocation and use of COM3 resources in REG-D™ are explained in chapter 8.2.6 from page 224 onwards.

7.2 Setup

7.2.1 Update bootloader and firmware

Below the update of the bootloader , the firmware and online help for the REG-D™ using the REGUpdate program will be explained in detail. For a successful update, a connection cable (null-modem cable with pin assignment as shown on page 80, or, with order code I1, a mini USB cable) and the PC software REGUpdate (update32.exe) are required.

Firmware package

The current firmware including the current bootloader and the necessary PC software REGUpdate (update32.exe) can be found as "firmware packages" on our website http://www.a-eberle.de under "Downloads / Voltage Regulation & Transformer–Monitoring /Firmware / Current firmware". A change history for the REGSys™ firmware since version V1.99 and a firmware archive is also available from the Download Centre.

CAUTION!

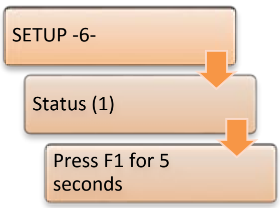
No control function during bootloader mode

As long as the regulator is in bootloader mode, which is mandatory for an update, all functions including the control functions of the REG-D™ are not available.

Connection

For an update of the bootloader, the firmware or the online help the REG-D™ has always to be connected directly to the PC. This means that update over an E-LAN connection is not possible.

Update of the bootloader



The bootloader is required to perform updates. For a bootloader or firmware update you must always switch to the bootloader mode. Since bootloader version V2.12 there is also the possibility of carrying out a RAM-Backup using the bootloader (see also chapter 7.2.6 from page 117 onwards). To see the current version of the bootloader, you need to press F1 for 5 seconds in "Setup -6-\Status\".

When is a bootloader update required?

It is recommended to update the bootloader only if it is really necessary. For example, if the RAM-Backup functionality needs to be used, a bootloader >= version V2.12 must be loaded, if it is not already present.

NOTICE!	**Downgrading the bootloader** Never perform a downgrade of the bootloader (e.g. V2.12 to V2.10). The regulator can be permanently damaged by doing so.

To update the bootloader the following steps are necessary:

1.) With the null-modem cable connect the regulator via COM1 to a free COM interface on the PC. If the REG-D™ is equipped with a USB interface instead of a SUB-D socket, connect COM1 to the PC via the USB cable.

2.) Starting the PC software

Use the program REGUpdate (update32.exe) under any of the operating systems Windows 95/98/NT/XP/7 or 8.

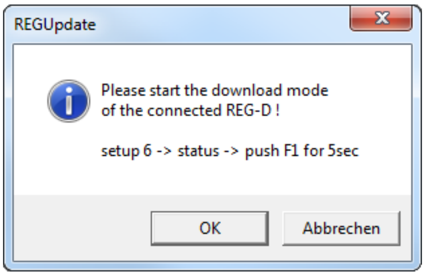
2.1 Select language

2.2 Select the appropriate COM interface on your PC

2.3 Select the connected device (here: REG-D™)

3.) Loading the new bootloader

In the program REGUpdate under "Update / new Bootloader", select file boot_xxx.mot and click on Open. There is an indication that the bootloader needs to be started via "Setup -6- /Status/" pressing F1 for 5 seconds.



The REG-D™ bootloader has its own interface settings. These are visible after starting the bootloader. The baudrate can be set using the F3 key. The settings for flow control (handshake) and parity cannot be selected.

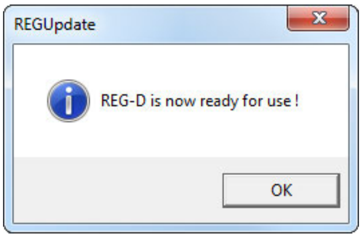
Parameter	Value
Baudrate	115200 (selectable)
Parity	--
Handshake	RTS/CTS

The interfaces (baudrate) must be the same on the PC and the regulator for a successful communication to take place! Compare the settings on the regulator with the settings in the update tool under the menu item: "Configure/Baudrate".

After starting the bootloader on REG-D™ and checking the baudrate, you download the new bootloader by clicking on OK button in the dialog.

A progress bar appears indicating the status of the loading process.

4.) The update has been executed correctly when the following message appears:



Updating firmware

To update the firmware of the REG-D™ the following steps are necessary:

1.) With the null-modem cable connect the regulator via COM1 to a free COM interface on the PC. If the REG-D™ is equipped with a USB interface instead of a SUB-D socket, connect COM1 to the PC via the USB cable.

2.) Starting the PC software

Use the program REGUpdate (update32.exe) under any of the operating systems Windows 95/98/NT/XP/7 or 8.

2.1 Select language

2.2 Select the appropriate COM interface on your PC

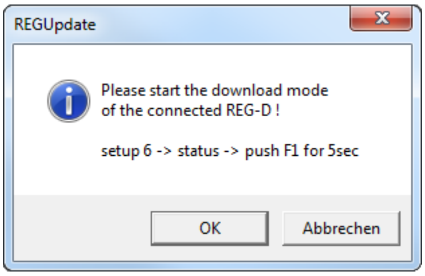
2.3 Select the connected device (here: REG-D™)

3.) Loading the new firmware

In the program REGUpdate, under "Update / new Firmware", select the file for your firmware and click on Open.

Bootloader version	Firmware file name
< V2.00	hr_xxx.moc
>= V2.00	hr_xxx_p.moc

There is an indication that the bootloader needs to be started via "Setup -6-/Status/" pressing F1 for 5 seconds.



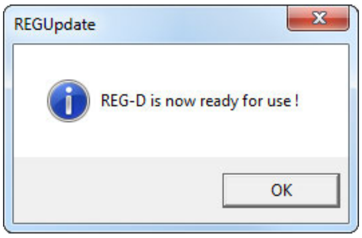
The REG-D™ bootloader has its own interface parameters. These are visible after starting the bootloader. The baudrate can be set using the F3 key. The settings for flow control (handshake) and parity cannot be selected.

Parameter	Value
Baudrate	115200 (selectable)
Parity	--
Handshake	RTS/CTS

The interfaces (baudrate) needs tot be the same on the PC and the regulator! Compare the settings on the regulator with the settings in the update tool under the menu item: "Configure/Baudrate".

After starting the bootloader on the REG-D™ and checking the baudrate, you can download the new firmware by clicking on the OK button in the dialog. A progress bar appears indicating the status of the loading process.

4.) The update has been executed correctly when the following message appears.



Important notes after an upgrade or downgrade of the REG-D™ firmware

1.) After upgrading the firmware of the REG-D™ (e.g. V2.10 → V2.20) any pre-existing RAM-Backup should be replaced by a new RAM-Backup. The reason for this is that new parameters that have been added to a recent firmware do not yet exist in the old RAM-Backup. If a RAM-Backup of a lower firmware version is restored, new parameters are initialized with default values.

2.) After a downgrade of the firmware of REG-D™ (e.g. V2.22 → V2.15) it is essential to take the following steps:

a.) The device must be re-initialized (see "Resetting all parameters via the bootloader" in chapter 7.2.6 RAM-Backup, from page 121 onwards).

b.) An existing RAM-Backup must be performed again (see "Performing RAM-Backup" in chapter 7.2.6 RAM-Backup, from page 117 onwards), or deleted (see "Deleting an existing backup file" in chapter 7.2.6 RAM-Backup, from page 120 onwards).

Updating online help

To update the online help of the REG-D™ the following steps are necessary:

1.) With the null-modem cable connect the regulator via COM1 to a free COM interface on the PC. If the REG-D™ is equipped with a USB interface instead of a SUB-D socket, connect COM1 to the PC via the USB cable.

2.) Starting the PC software

Use the program REGUpdate (update32.exe) under any of the operating systems Windows 95/98/NT/XP/7 or 8.

2.1 Select language

2.2 Select the appropriate COM interface on your PC.

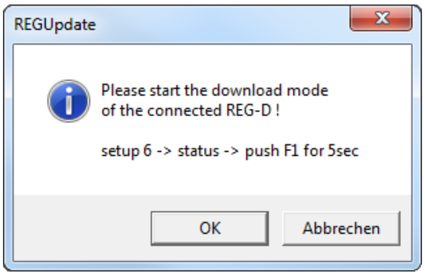
2.3 Select the connected device (here: REG-D™)

3.) Downloading the new online help

In the program REGUpdate, under "Update / new Helptext", select the help file for your bootloader and click on Open.

Bootloader version	File name of help texts
< V2.00	help_xxx.moc
>= V2.00	help_xxx_p.moc

There is an indication that the bootloader needs to be started via "Setup -6-/Status/" by pressing F1 for 5 seconds.



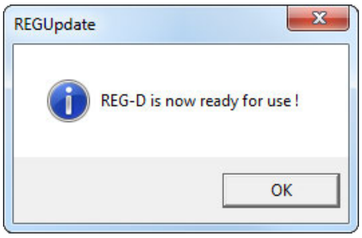
The REG-D™ bootloader has its own interface parameters. These are visible after starting the bootloader. The baudrate can be set using the F3 key. The settings for flow control (handshake) and parity cannot be selected.

Parameter	Value
Baudrate	115200 (selectable)
Parity	--
Handshake	RTS/CTS

The interfaces (baudrate) have to be the same on the PC and the regulator! Compare the settings on the regulator with the settings in the update tool under the menu item: "Configure/Baudrate".

After starting the bootloader on the REG-D™ and checking the baudrate, you can download the new help text file by clicking on the OK button in the dialog. A progress bar appears indicating the status of the loading process.

4.) The update has been executed correctly when the following message appears.

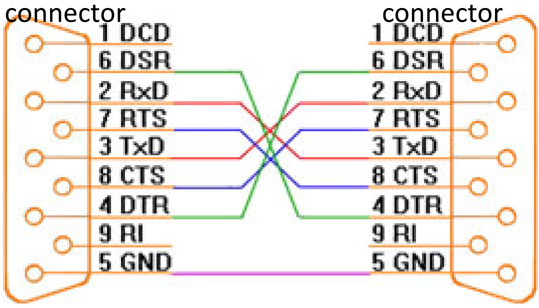


Via the menu item "Update everything" in the Update menu, it is possible to simultaneously start updating the firmware and the help texts. The updates are then successively carried out.

Connection diagram for the null-modem cable

9-pin Sub-D connector

9-pin Sub-D connector

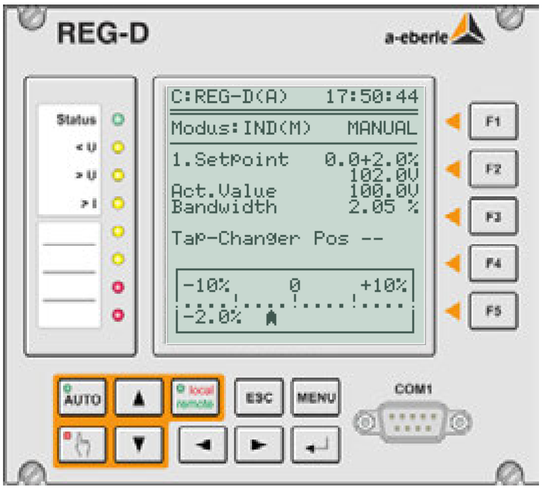


7.2.2 Basic parameter setup

7.2.2.1 System

Menu structure of REG-D™

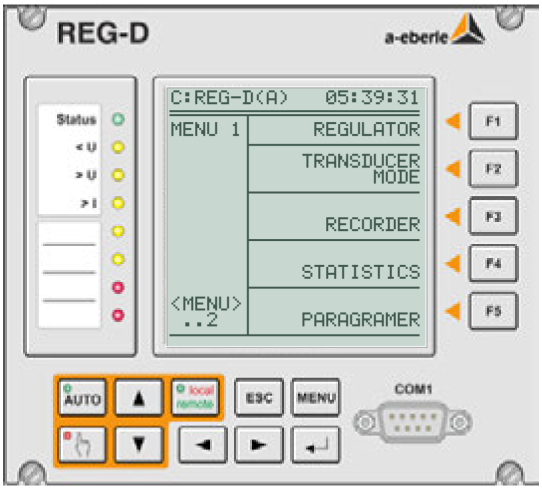
When powering up, the regulator starts in one of the basic regulator modes.

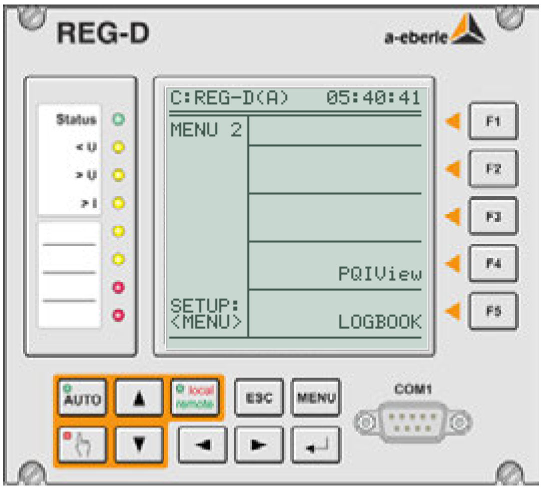


Repeatedly pressing the MENU key leads to the following submenus:

In addition to the MENU key you can also use the arrow keys and to move within the menu structure. Using the ESC key you move back to the previous screen without saving changes made to date. The ENTER key is used to confirm entries and save changes.

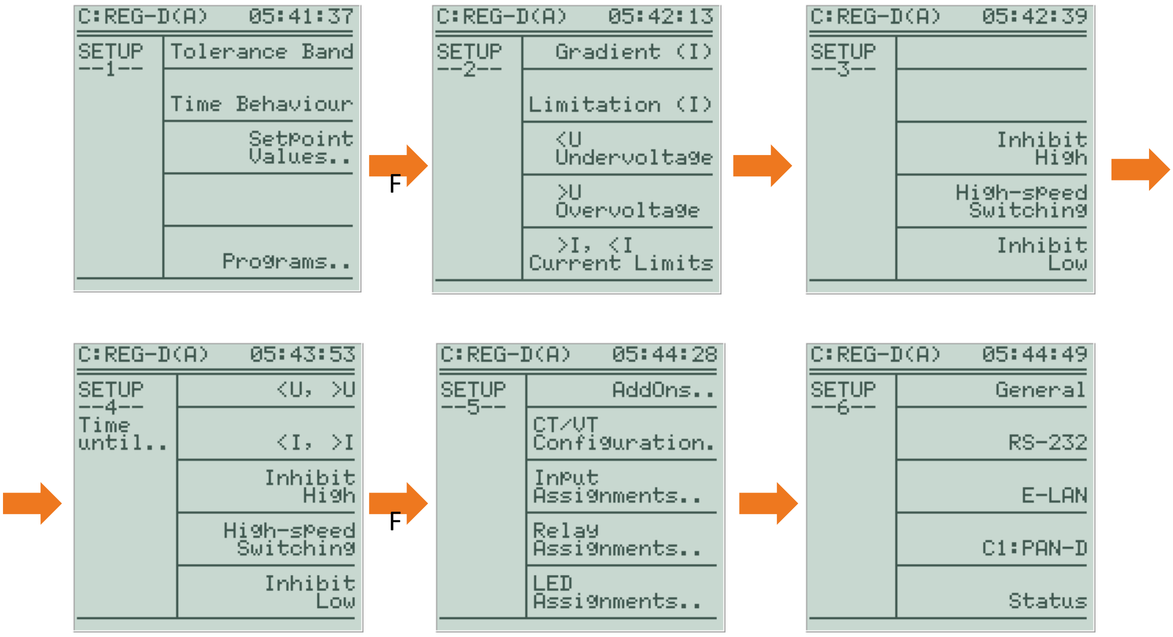
The modes available in MENU 1 and MENU 2 (regulator, transducer mode, recorder, statistics/monitor, PQIView and logbook) each present a basic display mode, accessed via the keys F1 ... F5. When you select one of these modes, the corresponding screen is displayed permanently and can only be changed by changing the selection in MENU 1 or MENU 2 again.





In addition to the available basic display modes, further choices can be made depending on the configuration of the device.

After MENU 1 and MENU 2 you arrive at SETUP 1 to SETUP 6, with which the Relay for Voltage Control & Transformer Monitoring REG-D™ can be configured. The various submenus can be selected again with the keys F1 ... F5.



Station ID

SETUP -6-
General 2
Station ID

Up to 255 different devices can be addressed in the (E-LAN) bus. However, each device needs to be assigned a unique address (ID).

The address range is from A ... A9, B ... B9, ... up to Z4. The ID can always be read in the upper left corner of the panel. The station ID is the part to the left of the colon.

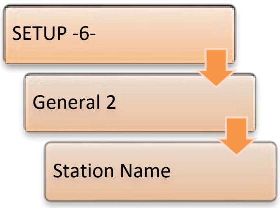
PAN-D

If a PAN-D is available, it is automatically assigned the ID of the directly connected REG-D™ plus one. That is, when the REG-D™ gets the identifier A: the PAN-D gets the address A1:. This has to be taken into account on addressing the Relay for Voltage Control & Transformer Monitoring.

Please note that a change in the station ID may also involve adaptation of the tele-control system configuration, because the station ID is set in the configuration file used.

NOTICE!	**Same station ID** If several devices are connected via E-LAN and have the same station ID, this can lead to malfunction of the devices.

Station name



The station name describes the regulator, i.e., the station name, unlike the station ID, is not used for unique identification in the E-LAN. The station name can, for example, be used for allocation to a transformer. The station name is freely selectable and can be up to eight characters long, where spaces are not allowed (but hyphens and underscores are). The station name (e.g. "Trafo12") is displayed together with the terminal ID (e.g. "B:“) in the upper left corner of the regulator, and also in the WinREG device selection dialog (in this example, "B:Trafo12"), thus making the identification of the device easier.

The station name can easily be entered in WinREG, or alternatively through the REG-D™ panel. In this, the F-keys have the following functions:

F1 Select character set; the four arrow keys are used to select the character that needs to be confirmed with Enter

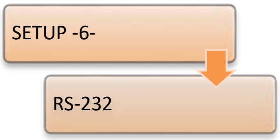
F2 Switch character case

F3 Clipboard

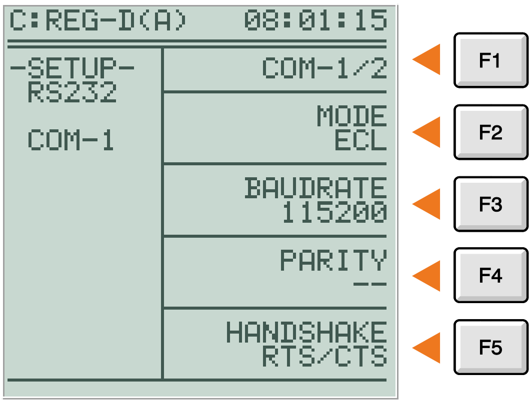
F4 Insert character at current position

F5 Delete character at current position

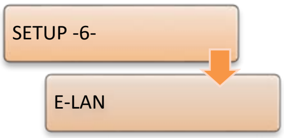
COM 1



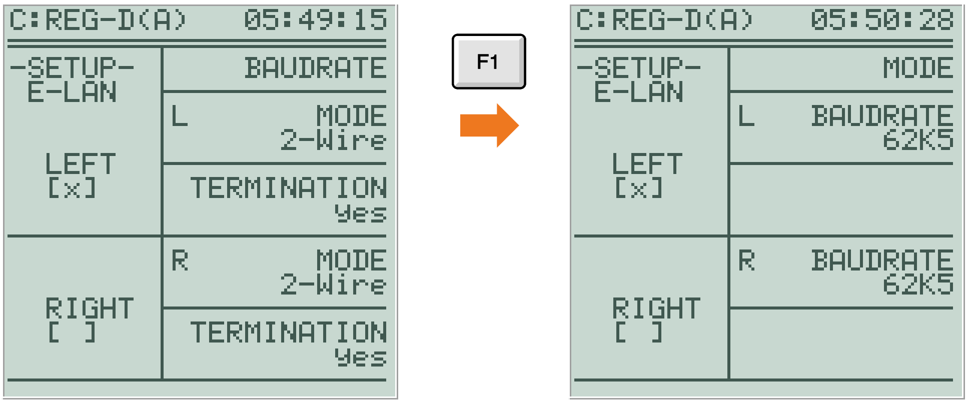
The COM1 interface is accessible as configuration or programming interface via a SUB-D connector on the front panel. Alternatively, the connection can be made via a mini USB cable (order code I1). By default the COM1 mode is ECL. In this mode, the regulator can be accessed using the software WinREG. BAUDRATE, PARITY and HANDSHAKE must match the settings of the connected end device (e.g. PC) to ensure trouble-free communication. The following communication parameters are recommended:



E-LAN (Energy-Local Area Network)

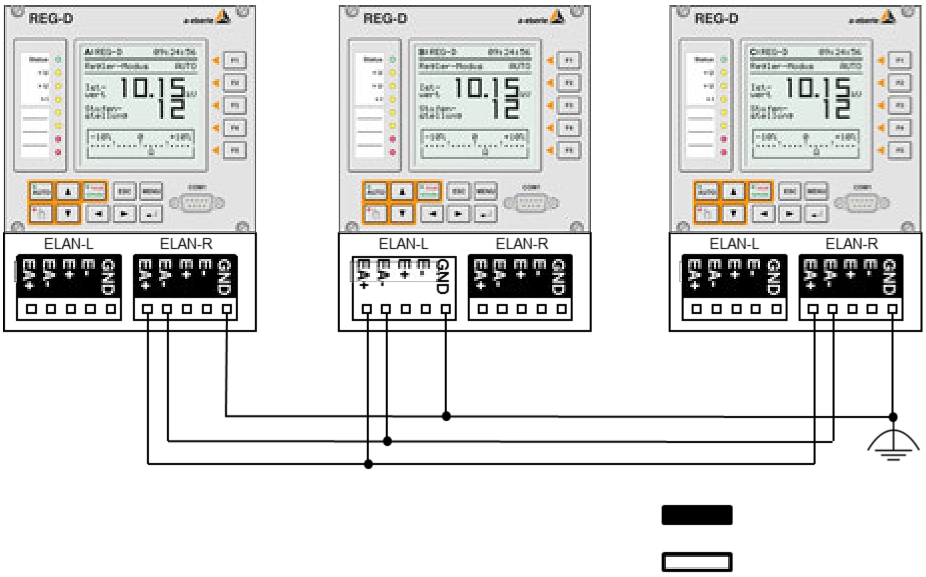


Each regulator provides two E-LAN interfaces, E-LAN LEFT and an E-LAN RIGHT. Each E-LAN interface can be used in a two-wire line or four-wire transmission technology (both RS 485).



For successful communication, the communication parameters (MODE, BAUDRATE) of the connected devices of a bus needs to match.

The configuration for the terminating resistors (only in two-wire mode) is shown in the following figure. The terminating resistor should be set to "no" when a bus consists of more than two devices and the relevant E-LAN interface is not physically at the beginning or end of the bus. In all other cases, the terminating resistors should be set to guarantee the best possible communication.



If the communication on the E-LAN interface is successful, a cross [X] will appear in the brackets of the two interconnected E-LAN interfaces. The X indicates that the neighboring station is recognized.

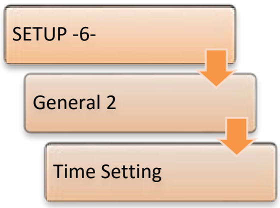
If the communication on an E-LAN interface is faulty, this is indicated with a flashing [X].

For more information about communication via E-LAN, see chapter 7.1.4.6 page 67.

E-LAN between REG-D™ and associated PAN-D

If the Relay for Voltage Control & Transformer Monitoring REG-D™ is operated together with the monitoring unit PAN-D, the E-LAN/L of the REG-D™ needs to be connected with the E-LAN/R of the PAN-D in order to ensure a unique connection between PAN-D and REG-D™. The connection has to be carried out in two-wire technology.

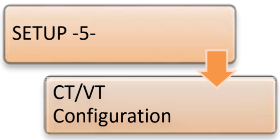
Time settings



The current date, time, the UTC time zone offset and the summer/winter time swith can be adjusted in this menu. For further information, reference should be made at this point to chapter 8.1.9 page 205.

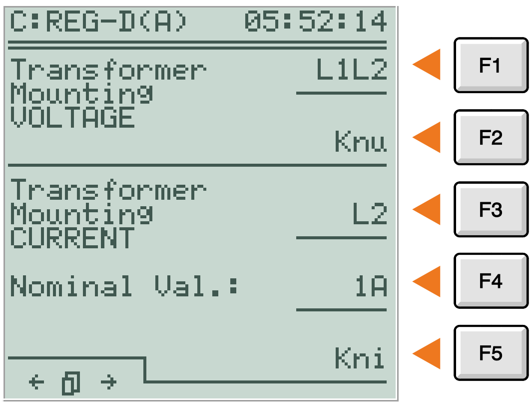
7.2.2.2 Taking measurements

CT/VT Configuration



The configuration of the transducer installation is critical for correct calculation and display of the primary readings.

For voltage regulation, it is not generally necessary to feed the regulator with the current. However, if the display of power values, current influence, active or reactive power regulation, or parallel operation according to the circulating reactive current minimization method shall be used, the current needs to be connected and configured in the CT/VT Configuration menu.

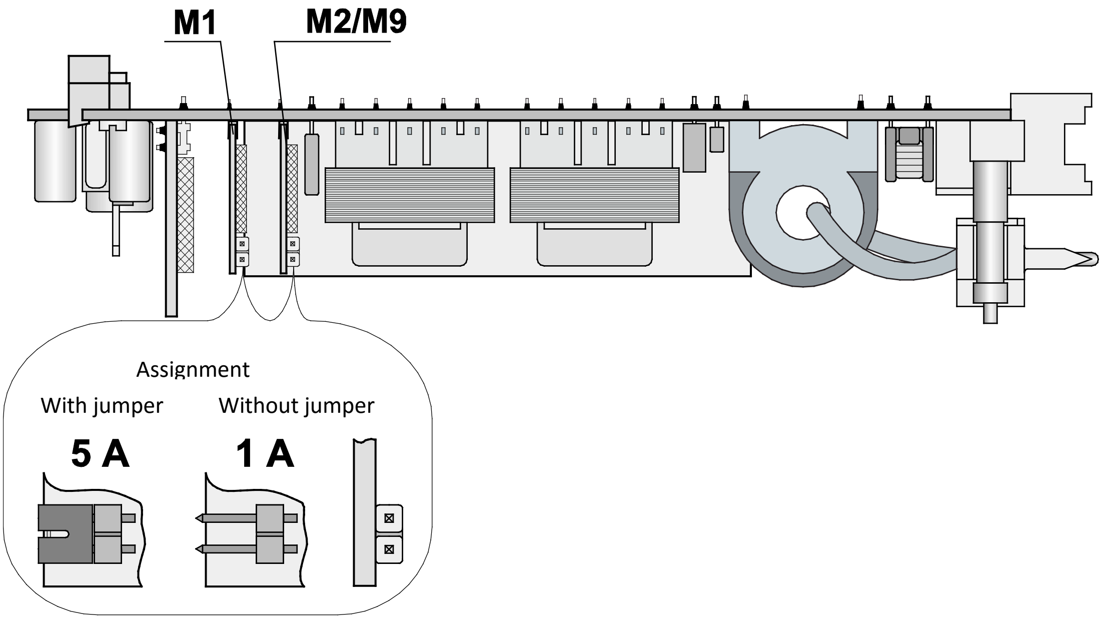


For conversion of the secondary voltage and current measurement values to primary values, the factors Knu and Kni needs to be configured. Knu is to be understood as the ratio of input and output voltage of the voltage transducer. The parameter Kni represents the ratio of input and output current of the current transducer.

Moreover, the nominal value of the current transducer can be set to 1A or 5A in the transducer configuration menu.

Obey the jumper position when changing the nominal current!

Please note that with the Relay for Voltage Control & Transformer Monitoring REG-D™, in addition to the software setting of the nominal value of the current transducer, on the hardware side the jumper position has to be changed on the circuit board REG-NTZ according to the figure below.



With the Relay for Voltage Control & Transformer Monitoring REG-D™, the number of current transformers that need to be changed on demand depends on the selected hardware order code.

In normal applications only the subprint M1 is equipped. In cases where, for example, work is done with arbitrarily loaded three-wire networks, or three-winding transformer applications, the subprint M2/M9 is additionally fitted and also needs to be set to the nominal current transformer value.

Example:	Knu	$= U_{Nom\ prim} / U_{Nom\ sec}$	
	Knu	= 20 kV / 100 V	= 200
	Knu	= 33 kV / 110 V	= 300
	Kni	$= I_{Nom\ prim} / I_{Nom\ sec}$	
	Kni	= 2500 A / 5A	= 500
	Kni	= 2500 A / 1A	= 2500

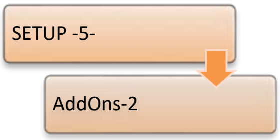
If current measurement is used in addition to the voltage measurement, then the connected phases of the voltage transducers and the current transducers, respectively, need to be configured in order to calculate the phase angle references between voltages and currents correctly.

If the Relay for Voltage Control & Transformer Monitoring REG-D™, for example, has been set up in the menu that the current transducer is installed in the outer conductor L3 and the voltage to be regulated is between L1 and L2, the regulator will internally correct the angle of 90° and supply correct values for all loads and reactive current I*sinφ.

Rotating field

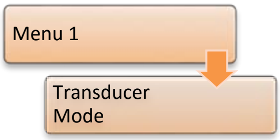
The angle references in the REG-D™ are based on a clockwise rotating field. If you use a phase sequence that produces a left rotating field, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Activating current indication in the regulator basic display

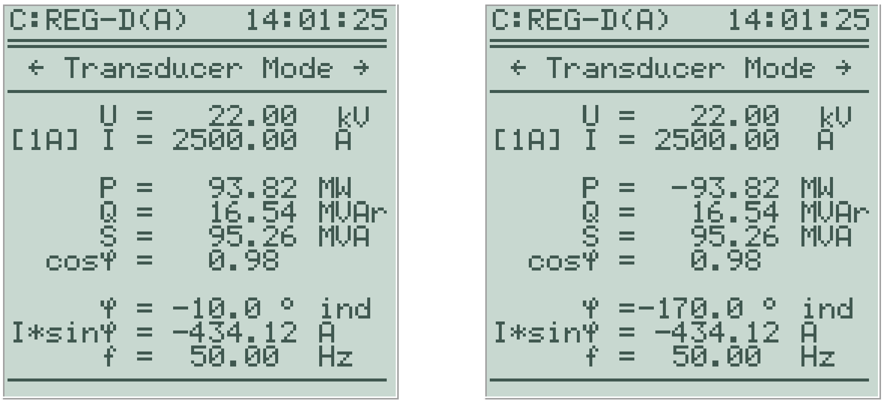


To also show the present current measurement next to the present voltage reading on the regulator basic display, the current display can be activated in the menu “functions”.

Checking the power calculation



If the CT/VT Configuration is set and the voltage and current measurement is wired, the power calculation can be verified. Thus, the settings made can be checked for correctness.

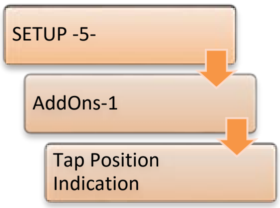


Transducer mode (consumption case [left], reverse power flow case [right])

The voltage is always displayed as the primary phase-phase voltage, the current as primary current. In case of consumption from the grid, the active power is displayed positively. However,in case of reverse power flow, the active power is negative.
The sign of the phase angle φ is negative for inductive loads and in addition is marked with the Index *ind*. For capacitive loads, the sign of the phase angle φ is positive and the index is *cap*.
Moreover, reactive power, apparent power, cosφ, reactive current I*sinφ and the frequency f are indicated in the transducer.

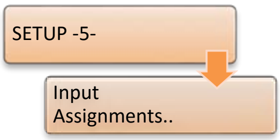
7.2.2.3 Tap position

Tap position indication

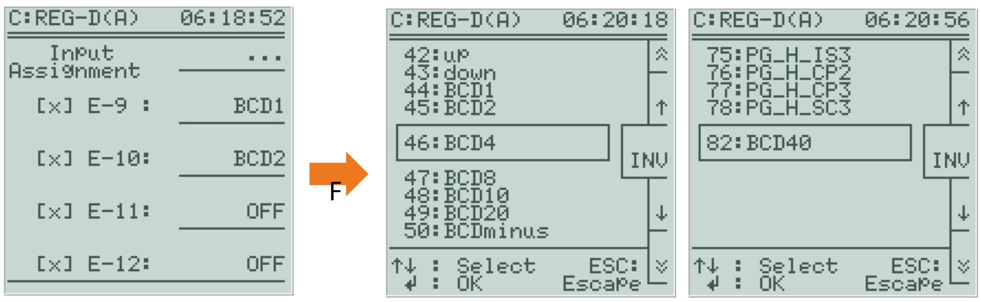


By default, tap position indication in the regulator basic display is shown as "- -". This indicates that the tap position indicator, and thus the tap position evaluation of the Relay for Voltage Control & Transformer Monitoring REG-D™, is disabled. If the tap position of the tap changer, for example, is connected to the regulator via BCD code, the tap position indicator needs to be enabled for correct display and evaluation. For this purpose, the "Tap Position Indication" parameter is set to ON in function menu 1.

BCD-Code configuration



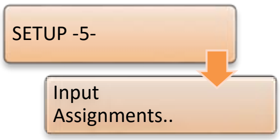
If the tap position of the tap changer is transmitted to the Relay for Voltage Control & Transformer Monitoring REG-D™ in BDC-Code, it will be sufficient that the binary inputs are used with the corresponding functions (BCD1, BCD2, BCD4, BCD8, BCD10, BCD20, BCD40, BCDminus). For a brief introduction in the configuration of the digital inputs, see chapter 7.2.2.6 page 99.



Which binary input is active is shown by means of a cross in square brackets [X] in front of the binary input. After configuration of the BCD-code and activation of tap-position indication, it is recommended that the tap changer also gets tested for correct tap-position indication, if possible.

Instead of a tap-position indication by BCD, the REG-D™ can also read the tap position in binary code (BCD1, BCD2, BCD4, BCD8, BIN16, BIN32). Optionally, an mA signal or a resistance-coded tap-position indicator can be used. For the parameter setting of the analog channels, please refer to chapter 7.2.2.6 page 99.

Configuring the TC in operation signal

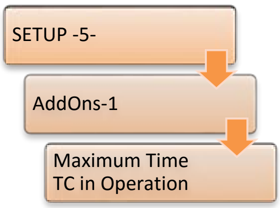


The TC in operation signal indicates that the tap changer is performing a tap change. As in the BCD-code configuration, the "07:TC.i.Op" function must be assigned to one of the binary inputs, so that the regulator interprets the binary input signal as the TC in operation signal.

TC in operation signal with the monitoring unit PAN-D

If the Relay for Voltage Control & Transformer Monitoring REG-D™ is operated together with the monitoring unit PAN-D, the TC in operation signal needs to be connected to the PAN-D. On the REG-D™ there is no need to set a binary input for the TC in operation signal, because the REG-D™ takes over the TC in operation signal (including TC Error) from the PAN-D. If the TC in operation signal is configured on the REG-D™ anyway, it will monitor the TC in operation signal (including TC Error) in addition to the PAN-D.

Maximum TC in operation time and TC Error



The maximum TC in operation time has two different functions, depending on the configuration.

The tap changer is monitored using this parameter as long as the TC in operation signal is read on to the Relay for Voltage Control & Transformer Monitoring REG-D™ as a binary signal. This means that as soon as the TC in operation signal is present for longer than the maximum TC in operation time, a TC Error is raised. The TC Error can, for example, be assigned as a function to a freely programmable relay. The function "14:TC-Err" thereby provides a continuous signal, whereas the function "41:TC-Err+" produces a wiping signal. With this output signal, when required a message can be sent to shut down the motor drive via a relay (emergency stop), or a message placed in the SCADA system.

However, if a binary signal for the TC in operation signal is not used, the parameter maximum TC in operation time has the function that, after a successful tap-change command, no further tap commands are issued for a certain time (Maximum TC in operation time). A new tap command is given at the earliest after expiry of the maximum TC in operation time plus two additional seconds.

The parameter maximum TC in operation time can be determined by measuring the time it takes the tap changer to complete the tap change starting from the time when the tap-change command is issued. The maximum TC in operation time should be set to a value two or three seconds above the measured time to allow a certain tolerance with respect to ageing of the tap changer.

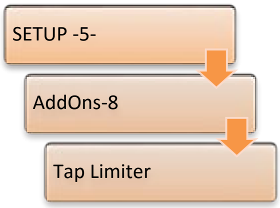
Maximum TC in operation time with the monitoring unit PAN-D

If the Relay for Voltage Control & Transformer Monitoring REG-D™ is operated together with the monitoring unit PAN-D, the maximum TC in operation time has to be configured under "Setup -3-/AddOns-1/Maximum time TC in operation" in the PAN-D.

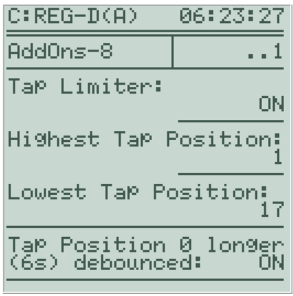
Maximum TC in operation time for tap changer with intermediate tap

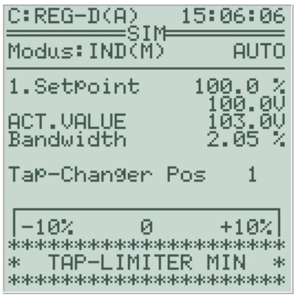
If the tap changer has an intermediate tap, the maximum TC in operation time should be selected based on the cycle time of the intermediate tap (+ tolerance time).

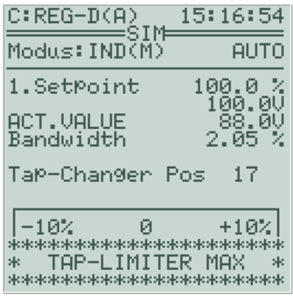
Tap Limiter



If the Relay for Voltage Control & Transformer Monitoring REG-D™ receives a tap indication from the tap changer. A software tap limiter can be activated to either issue no commands beyond the end taps after reaching the end taps, or to limit the available tap range for operational reasons. The tap limiter needs to be enabled first before the top and bottom taps are defined. If one tries to execute a tap command beyond the set boundaries in regulator automatic or manual mode, the message "TAP LIMITER MIN" or "TAP LIMITER MAX" is displayed in the display of the regulator.







Inverse tap changer

When reading the following table, it is assumed that the tap changer is fitted to the primary side of the transformer and the voltage measured on the secondary side.

The default setting of the Relay for Voltage Control & Transformer Monitoring REG-D™ is as defined above for a non-inverse tap changer. Using the software WinREG (REGPara), the tap changer can be configured for the Relay for Voltage Control & Transformer Monitoring REG-D™ as inverse without swapped relays or inverse with swapped relays.

Tap changer	Umax LV	Umin LV	Up tap command	Down tap command
Non inverse	Largest tap	Smallest tap	Up relay operates, tap position increases, voltage increases	Down relay operates, tap position decreases, voltage decreases
Inverse without swapped relays	Smallest tap	Largest tap	Up relay operates, tap position decreases, voltage increases	Down relay operates, tap position increases, voltage decreases
Inverse with swapped relays	Smallest tap	Largest tap	Down relay operates, tap position decreases, voltage increases	Up relay operates, tap position increases, voltage decreases

The **inverse tap changer *without* swapped relays** differs from the non-inverse tap changer from the perspective of the Relay for Voltage Control & Transformer Monitoring REG-D™, in particular with respect to the expected tap position after a tap change. With a "lower" tap-change command, in both cases the "down" relay is energized and the voltage on the low voltage side (LV) decreases. With a non-inverse tap changer, the regulator expects that the tap is reduced by one, with an inverse tap changer, however, the regulator expects that the tap is increased by one. The expected tap change is particularly important for evaluation of the tap-change error "TAPERR", which can be indicated as a SCADA system signal, relay output or LED signal. To prevent false raising of tap-change error "TAPERR", the Relay for Voltage Control & Transformer Monitoring REG-D™ needs to know whether the tap changer is inverse or non-inverse.

The **inverse tap changer *with* swapped relays** differs from the non-inverse tap changer again from the perspective of the Relay for Voltage Control & Transformer Monitoring REG-D™, in particular with respect to the expected tap change. The expected tap change corresponds to the inverse tap changer without swapped relays. In addition, with the inverse tap changer with swapped relays the "up" and "down" relays are swapped, i.e. on a tap-change lower command the "up" relay operates, and vice versa.

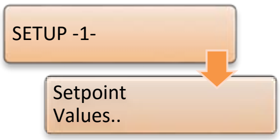
Inverse tap changer

As an alternative to setting the inverse tap changer with swapped relays, the setting of inverse tap changer without swapped relays can be used, whereby either the "up" and "down" relay functions need to be swapped, or the wiring for the "up" and "down" relays switched.

If the Relay for Voltage Control & Transformer Monitoring REG-D™ is operated together with the monitoring unit PAN-D, using the function "Inverse with swapped relays" is not possible. The parameter "Inverse tap changer" must be set to the same value in the REG-D™ and the PAN-D.

7.2.2.4 Regulation

Setpoint

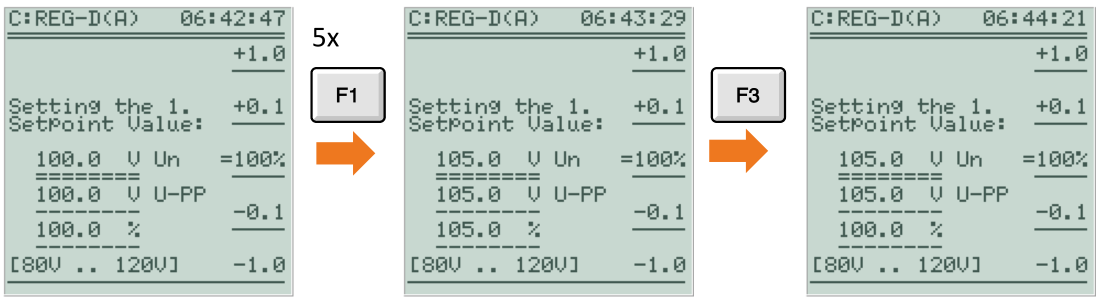


The Relay for Voltage Control & Transformer Monitoring REG-D™ provides up to four setpoints. By default, the first setpoint value is selected. In the setup of setpoint values, the secondary value U_n is shown at the top of the setpoint display, below there is shown the primary value U_{LL} multiplied by the factor Knu. The setpoint can be changed with the keys F1, F2, F4 and F5. Press Enter ↵ to confirm the entry.

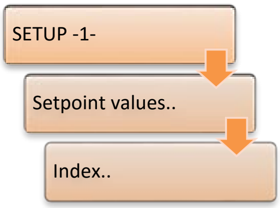
In addition, the 100%-value of the respective setpoint can be defined. The 100%-value constitutes the basis for the regulation display and for the calculation of the absolute limit values, as these are set as percentage values except the limit inhibit high.

Example:

The following figure shows an example of the configuration of the first setpoint to 105.0 V = 100.0 %. By default, the setpoint is set to 100.0 V, which simultaneously corresponds to 100.0 %, i.e. 1.0 % corresponds to 1.0 V. In the next step, the setpoint is increased to 105.0 V. It still applies that 1.0 % corresponds exactly to 1.0 V. Therefore, the percentually represented setpoint increases to 105.0 %. In the final step, the new setpoint value of 105.0 V is defined as 100 % of the value with the F3 key. Now the percentual setpoint is again indicated by 100.0 %. Thus, 1.0 % corresponds exactly to 1.05 V.

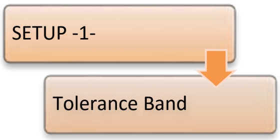


Changing the setpoint index



The active setpoint value is displayed in the regulator's basic display mode. Also, the active setpoint is indicated by an arrow in the menu under Setup. 1. The setpoint index can be changed in the relevant menu with the respective F-key behind the associated setpoint.

Permissible setpoint deviation (Bandwidth Xw_z)



The adjustment of the permissible setpoint deviation depends on two limits. Firstly, it is necessary to take the voltage tolerance accepted by consumers into account. Secondly, the minimum setpoint deviation is determined by the tap increment of the transformer.

The permissible setpoint deviation Xw_z is equally applicable in both the positive and negative directions, i.e., the tolerance band, in which the Relay for Voltage Control & Transformer Monitoring REG-D™ does not perform any automatic regulation, corresponds to twice the permissible setpoint deviation. The minimum voltage bandwidth is therefore calculated using the following formula:

$$\boldsymbol{Xw_z}[\%] \geq \mathbf{0.6} * \boldsymbol{Tap\ increment}[\%]$$

Unstable regulation ("hunting“)

If a permissible setpoint deviation (bandwith Xw_z) is chosen so tight that the tolerance band is smaller than the tap increment of the transformer, the regulator, after having left the tolerance band, will move to the other side of the tolerance band with the next tap change. A stable regulation is not possible in a situation that, one speaks about as "hunting". In addition, it should be noted that with decreasing the permissible setpoint deviation, the wear on the tap changer, i.e. the number of tap changes carried out, will generally increase.

Note the limit base!

The percentual limit for the permissible setpoint deviation (bandwith Xw_z) depends on the parameter limit base, see chapter 7.2.2.5. Limit values, page 97, or chapter 8.1.7 Configuration and functions, from page 185 onwards.

Time behavior

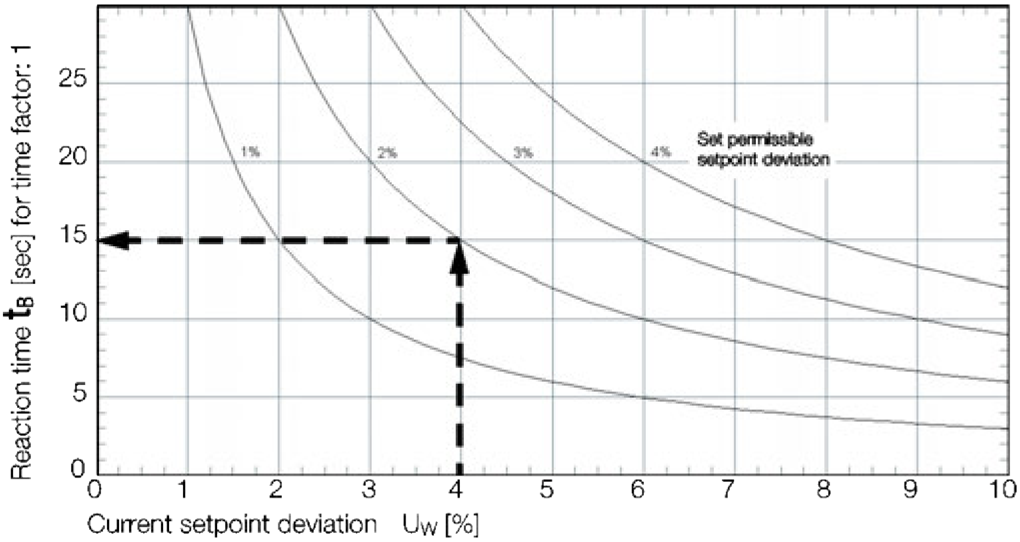
SETUP -1-

Time Behaviour

The golden rule for many multiple feeding points is a calm grid. This requires to implement a regulation that as few switching operations as possible are carried out. The slowdown of the regulation can be achieved by increasing the permissible setpoint deviation (bandwidth Xw_z) or the time factor.

However, this procedure will reach its limit as soon as the interests of consumers are unacceptably affected, i.e. due to excessively large or long-lasting voltage deviations.

The default algorithm **INTEGRAL** ensures that small setpoint deviations remain pending for a long time before a tap command ist issued, whereas large deviations are corrected faster. The characteristic curve should be selected depending on the set permissible setpoint deviation.



Characteristic curve time response INTEGRAL

To affect the reaction time t_B (y-axis) of the algorithm **INTEGRAL** the time factor (which by default is set to 1), can be changed.

The following applies:

$$t_V = t_B * Time\ factor$$

The resulting reaction time t_V is determined when the response time t_B (depending on the current setpoint deviation and the set permissible setpoint deviation) is read from the diagram above and multiplied by the time factor.

Empirical time factor value

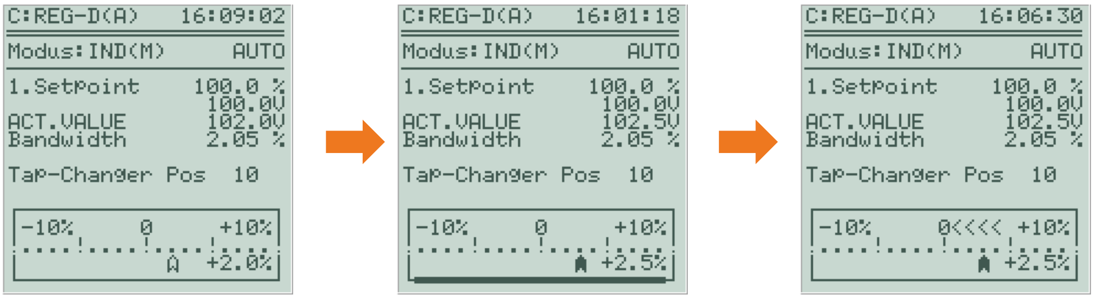
Experience has shown that the time factor for the majority of applications is set to a value between 2 and 3.

However, a general recommendation cannot be given, as the correct time factor arises from the grid topology and the particular application.

Checking the regulation in automatic mode

The selected parameters of permissible setpoint deviation and time behavior can now be tested in interaction, thus checking the settings.

In the lower third of the regulators basic display, the response of regulation in AUTOMATIC mode can be seen next to the current setpoint deviation. If the current setpoint deviation is smaller than the permissible setpoint deviation, the arrow of the current setpoint deviation will not be filled (white) – see the left graph. Once the current setpoint deviation is greater than or equal to the permissible setpoint deviation, the arrow of the current setpoint deviation is filled (black), and a bar indicates the progress of the time behavior – see the middle graph. When the bar is full or has reached the right side, a corresponding tap-change command is issued, which is indicated by four horizontal arrows. At the same time the integration bar is reset – see the right graph below.



7.2.2.5 Limit values

SETUP -2-

<U Undervoltage
>U Overvoltage

The following figure gives an overview of the configurable voltage limits of the Relay for Voltage Control & Transformer Monitoring REG-D™. Starting from the setpoint, the permissible setpoint deviation forms a tolerance band (positive and negative bandwidth), in which there is no automatic voltage reguation.

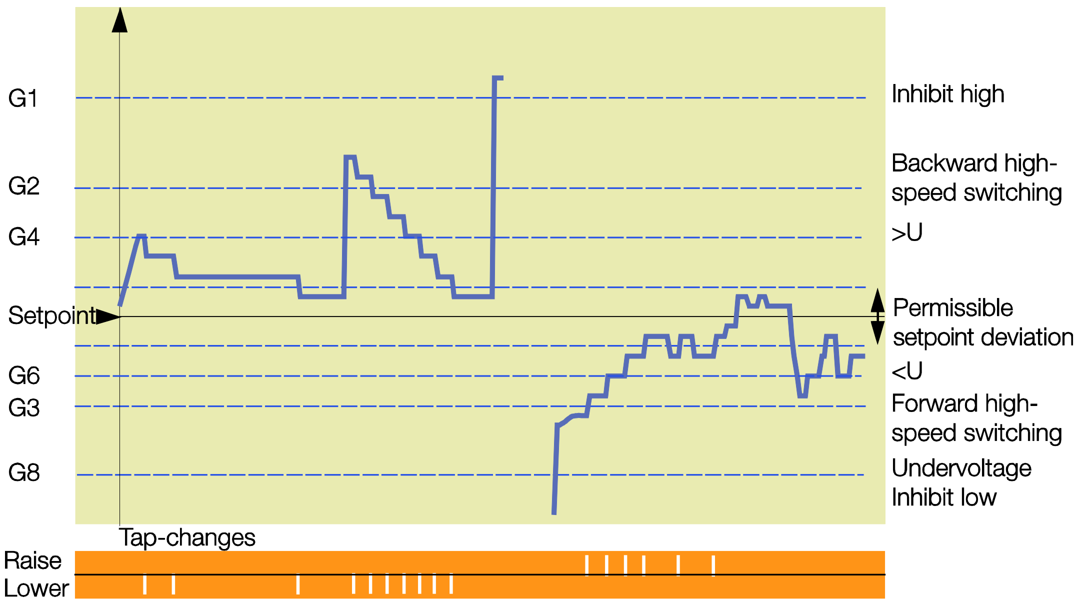
Next, follow the limits overvoltage >U [G4], or undervoltage <U [G6]. Both limits are configured by default as a visual alert on the LEDs of the regulator. Upon reaching the limit, tap commands are locked in the corresponding direction. For example, this means that lower commands are suppressed in case of undervoltage. Hereby, it is taken into consideration whether or not it is an inverse tap changer.

SETUP -3-

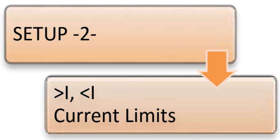
Inhibit High
High-speed
Switching
Inhibit Low

The limits for backward high-speed switching [G2] and forward high-speed switching [G3] are connected. If one of these limits is exceeded, the regulator will perform as many tap changes in the shortest possible time until the voltage is within the tolerance band again.

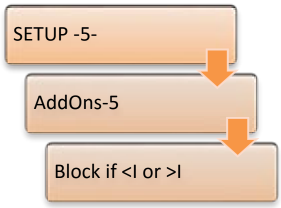
When the inhibit high limit [G1] is exceeded, or the voltage is below the inhibit low limit [G8], regulation is stopped in AUTOMATIC mode, and "Inhibit High" or "Inhibit Low" respectively appear in the regulator basic display.



Overview of the limits of REG-D™

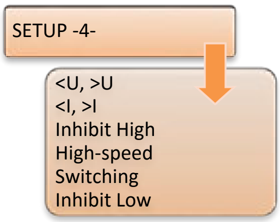


In addition to the indicated voltage limits, two more limits for undercurrent <I and overcurrent >I can be configured. The overcurrent limit again is configured by default as a visual alert on the LEDs of the regulator.



In case of violation of one or both limits, the regulator can also be configured to be blocked if such a case occurs.

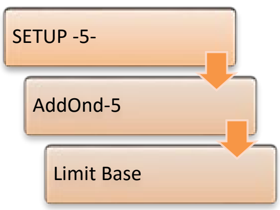
Time delays for limits



All limits can be applied with a certain time delay to suppress short-term limit exceeding.

The switching delay of all limits is set by default to zero seconds (exception: $t_{\text{forward high-speed switching minimum}}$ = 2s).

Limit base



Almost all limits of the regulator REG-D™ are set as percentage values and refer to the active setpoint, provided the limit base is set with respect to the default setting "setpoint". Only the inhibit high limit is specified as an absolute value.

In addition to the limit base "setpoint", for the limits undervoltage <U, overvoltage >U, inhibit low and three-winding limit >Ub, the limit base "Un100V" or "Un110V" can be configured. For the calculation of absolute limit [kV] the following formula applies:

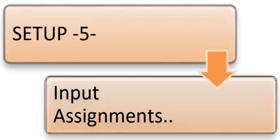
$$\boldsymbol{Limit}\ [\boldsymbol{kV}] = \left(\boldsymbol{Limit\ base}[\boldsymbol{V}] + \boldsymbol{Limit}[\%] * \frac{\mathbf{100\%}\boldsymbol{Value}[\boldsymbol{V}]}{\mathbf{100\%}}\right) * \frac{\boldsymbol{Knu}}{\mathbf{1000}}$$

The 100 % value corresponds to the limit base "setpoint", the 100 % value of the currently selected setpoint. With limit base "Un100V", the 100 % value is equal to 100 V; with limit base "Un110V" it is equal to 110 V.

Application cases for the reference limits Un100V or Un110V are, for example, when one wants to switch between different setpoints, or the active setpoint is incremented or decremented, then the limits <U, > U, inhibit low and three-winding transformer limit >Ub should have independent but fixed absolute values.

7.2.2.6 Input/Output signals

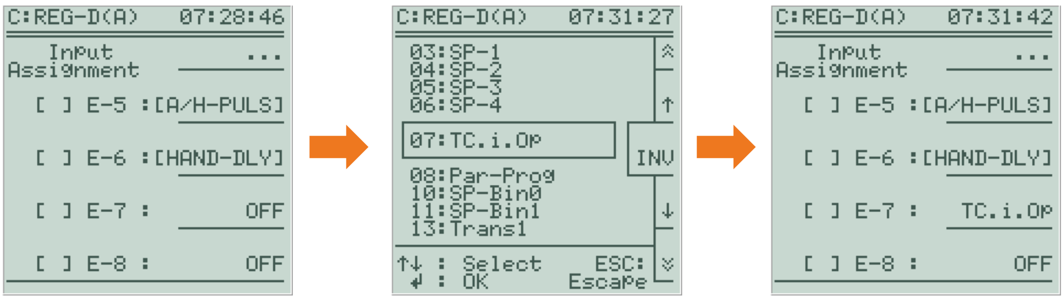
Binary inputs



In the menu of the regulator REG-D™ there are always at least 32 binary inputs visible, even in the case that only the default 16 binary inputs configuration is used. A binary input that is not set can be seen as empty square brackets [ ] in front of the binary input in question, a set binary input is indicated by a cross in the brackets [X].

If a binary input fulfills a specific function in the regulator, the input needs to have the correct input function assigned. A list of all available input functions and the related functional description are be found in chapter 8.2.2 from page 208 onwards.

As an example the configuration of the function TC in operation is shown in the following figure. The unassigned binary input E-7 is selected using the F4 key to assign a function to it. Use the F4 key to go to the function "07:TC.i.Op" and confirm the selection with the Enter key ↵. Then the TC in operation function is assigned to the input E-7.



If an input function needs to be inverted, this can be accomplished in the function selection menu, using the F3 INV key. An inverted function is marked with a minus sign in front of the specific function.

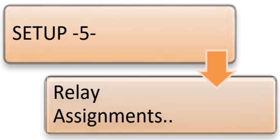
If a binary input is simply to be transferred to the SCADA system, the input in question does not need to have a function assigned. However, it is recommended that the input is set to "01:PROG" to indicate that the input is used. The function "01:PROG" can be used repeatedly and has no default function.

Each input function can only be assigned to one binary input. If several binary inputs have been set to the same function, the message "Dublicate Assignment" will appear at the bottom of the screen. In this case, only the first binary input the function has been assigned to will carry out the function (count: BI1 -> BI64). If you need to have the same function on multiple binary inputs, you should contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Inputs 5 and 6

The inputs 5 and 6 are configured by default as automatic [AUTO] and manual [HAND]. For further information regarding the assignment of inputs 5 and 6, see chapter 8.1.7.1 Manual / Automatic from page 185 onwards..

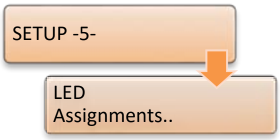
Relays/binary outputs



All available freely-programmable relays of the REG-D™ are listed in the relay mapping. This does not include the permanently assigned relays "Manual/Auto" and "Status". The functional assignment of the relays can be performed analogously to the functional assignment of the binary inputs.

A list of all available relay functions with related functional descriptions is given in chapter 8.2.3 from page 213 onwards.

LEDs



LED mapping contains all freely-programmable LEDs of the regulator. Only the dedicated status LED is not listed. By default, LED 5 is assigned the undervoltage <U function, LED 6 the overvoltage >U function and LED 7 the overcurrent >I function. The functional assignment of the LEDs can be performed analogously to the functional assignment of the binary inputs.

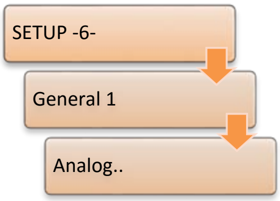
A list of all available LED functions with related functional descriptions is given in chapter 8.2.4 LEDs, from page 217 onwards.

LED sequence

The LEDs are numbered as follows (from top to bottom):

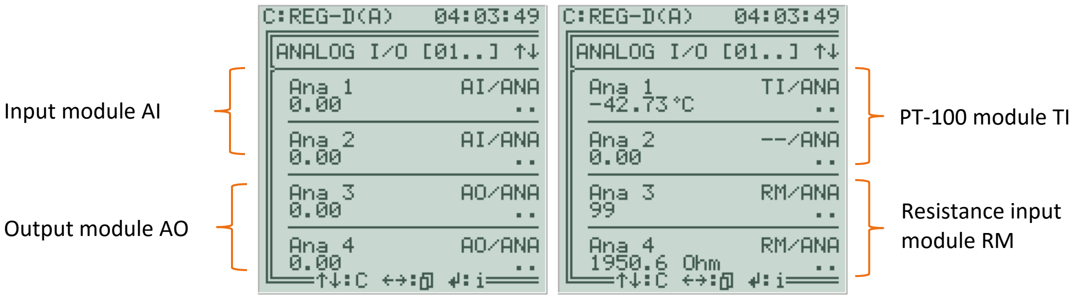
Status – 5 – 6 – 7 – 1 – 2 – 3 – 4.

Analog channels



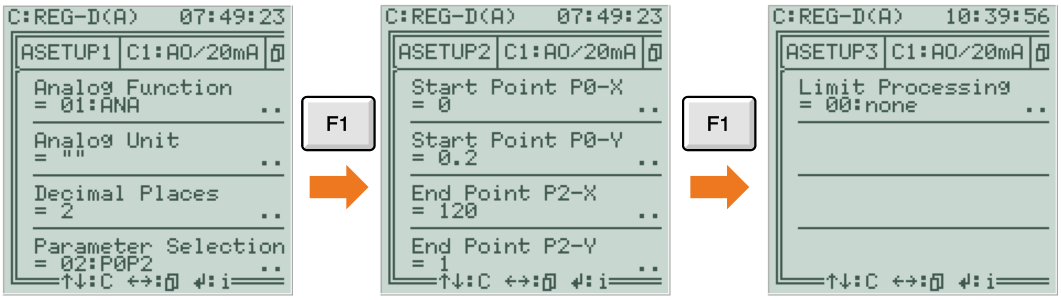
Each regulator can be equipped with up to three analog modules (each with two analog channels). Therefore, six analog channels are available in the analog menu by default. Analog modules are available as pure input or output modules, as PT100 modules and resistance input modules, which are briefly explained separately below. For recognition purposes, the different types in the analog menu are given analog module IDs, such as "AI" for analog input or "AO" for analog output. For information regarding connection of the various analog modules, refer to chapter 7.1.4.4 Analog signals, from page 63 onwards.

Information for retrofitting analog modules can be found in chapter 11. Retrofit of analog channels, from page 331 onwards.



Input and output modules

Analog input (AI) or output modules (AO) each have two channels, which, depending on the module slot, can be found on channels 1&2, 3&4 or 5&6. The individual channel parameters can be accessed using the F key behind the respective channel.



The left graph in the figure shows the first setup page of an analog channel. Under Analog Function a function for an analog channel can be assigned, the same as with the binary inputs, relays and LEDs. A list of all available analog functions with related functional descriptions is given in chapter 8.2.5 from page 221 onwards. Moreover, the unit and the number of decimal places can be configured. Under Parameter Selection, the type of characteristic curve can be set, which is configured on the next setup page 2 (F1 key).

A start point and an end point are defined for the standard curve P0P2, where the y-coordinate corresponds to the normalized mA value and the x-coordinate corresponds to the reference value (see the middle graph). In the figure above, the mA range 4-20 mA (P0-Y = 0.2, P2-Y = 1) corresponds to the reference value of 0-120 (P0-X = 0, P2-X = 120).

Limit Processing can be set on the third setup page. If for example the mA-output signal should always be at least 4 mA, limit processing needs be set to 02:Low.

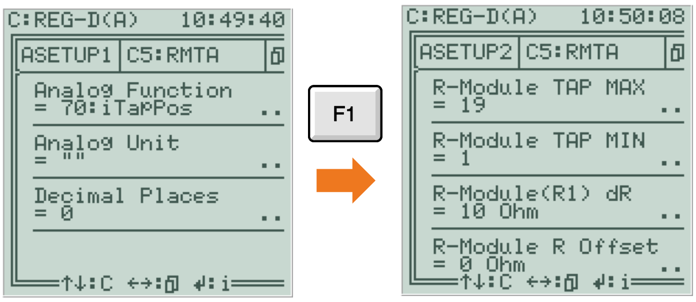
PT100 module

The PT100 module has only one channel available per module (channel 1, 3 or 5) and is indicated as "TI". The second channel of the module (channel 2, 4 or 6) cannot be used and is indicated as "-". If no PT100 sensor is connected, a PT100 module channel indicates a temperature of -42.73°C. Settings such as for the analog inputs or outputs cannot be made in this module as the calibration of each module was done at the factory.

Resistance input module

A resistance input module with the indication "RM" on both module channels, shows the tap position on the first module channel (channel 1, 3 or 5), the measured resistance value in Ω on the second module channel (channel 2, 4 or 6). The parameters are set only through the first module channel.

If the detected tap value of the resistance module provides the regulator with the tap position of the tap changer, The analog function "70: iTapPos" has to be assigned on the first module channel. On the second setup page, in addition to the minimum and maximum tap positions, the resistance value per tap, as well as a possibly existing offset resistance, can be configured.



Note firmware version!

Firmware versions below V2.22 or V3.22 can only evaluate a resistance input module by means of a background program.

For questions regarding this matter, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

7.2.2.7 Background programs

Background programs are customized applications written in the A.Eberle internal programming language REG-L and can consist of H-, P- and Q-lines. Further information about the possibilities of the background programs can be found in chapter 8.4 from page 281 onwards.

The configuration of the Relay for Voltage Control & Transformer Monitoring REG-D™, including the background program, is read using the software WinREG (subprogram REGPara). Thus, it can be checked whether a background program is present on the regulator, and if so, which one. The name of the background program and corresponding design specification (article number) are always listed in program line H0.

Background programs for the Relay for Voltage Control & Transformer Monitoring REG-D™ have the file extension ".rgl" and can be loaded into the regulator using both the software REGUpdate32 (part of the firmware packages available on the website), and the configuration software WinREG (the Service subprogram).

Differences between the original background program and the background program as seen in of WinREG

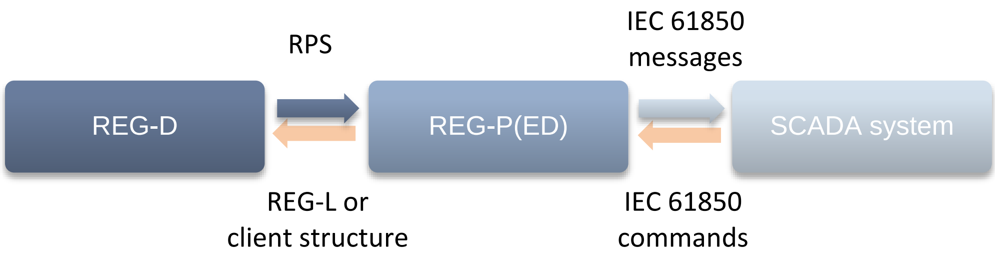
There is usually a difference between loading a background program (.rgl) and loading a background program read out by means of the software using the software WinREG (subprogram REGPara). Only loading the original background program (.rgl) will ensure that all programming sequences are performed correctly, such as the one-time custom setting of input and output functions. It is therefore advisable to use the original background program (.rgl).

7.2.2.8 SCADA system

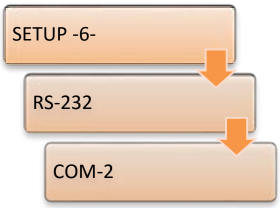
General

Communication between the protocol card (e.g. REG-P(ED)) and the Relay for Voltage Control & Transformer Monitoring REG-D™ is performed using the internal A.Eberle "RPS data structure" (e.g. RPS3 or RPS4). The RPS data structure is independent of the firmware versions of the protocol card and the Relay for Voltage Control & Transformer Monitoring, whereby it should be noted that the RPS3 data structure is implemented since REG-D™ firmware V2.00, the RPS4 data structure since REG-D™ firmware V2.15.

The protocol card (e.g. REG-P(ED)) translates regulator information in accordance with IEC61870-5-101, -103, -104, IEC 61850, MODBUS, SPABUS, PROFI-BUS, DNP 3.0 and LON. Commands from the SCADA system are translated by the protocol card using the regulator's internal programming language REG-L, or updated in the "Client-Structure" and sent to the regulator.



COM 2

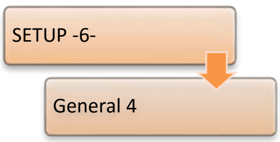


The serial communication between the protocol card (e.g. REG-P(ED)) and the Relay for Voltage Control & Transformer Monitoring REG-D™ is usually carried out via COM2.

Depending on the protocol, the following COM2 interface settings are default:

Protocol	Mode	Baudrate	Parity	Handshake
IEC 61870-5-101	ECL	REG-P: 57600	EVEN	REG-P: XON/XOFF
IEC 61870-5-103	ECL	REG-P: 57600 REG-PE: 115200 REG-PED: 115200	EVEN	REG-P: XON/XOFF REG-PE: XON/XOFF REG-PED: --
IEC 61870-5-104	ECL	REG-PE: 115200 REG-PED: 115200	EVEN	REG-PE: XON/XOFF REG-PED: --
IEC 61850	ECL	REG-PE: 115200 REG-PED: 115200	EVEN	REG-PE: XON/XOFF REG-PED: --
MODBUS	ECL	REG-PM: 57600 REG-PE: 115200 REG-PED: 115200	EVEN	REG-PM: XON/XOFF REG-PE: XON/XOFF REG-PED: --
SPABUS	ECL	REG-PM: 57600	EVEN	REG-PM: XON/XOFF
PROFI-BUS	PROFI	Profi-DP 57600	EVEN	Profi-DP --
DNP 3.0	ECL	REG-P: 57600 REG-PE: 115200 REG-PED: 115200	EVEN	REG-P: XON/XOFF REG-PE: XON/XOFF REG-PED: --
LON	ECL	REG-LON: 115200	EVEN	REG-LON: XON/XOFF
COMServer (CS) COMServer only (CSO)	ECL	REG-P: 115200 REG-PE: 115200 REG-PED: 115200	--	REG-P: RTS/CTS REG-PE: RTS/CTS REG-PED: RTS/CTS
E-LAN extension (CSE)	ELAN-R ELAN-L	REG-PE: 115200 REG-PED: 115200	--	REG-PE: -- REG-PED: --

SCADA system parameters



Depending on the SCADA protocol used, protocol-specific parameters such as IP address, subnet mask, gateway settings, etc. can be set in this menu. On changing this parameter, depending on the protocol, a replication is carried out between the REG-D™ and REG-P(ED), the REG-P(ED) is updated and restarted (see also chapter 8.1.8 SCADA system, from page 203 onwards).

7.2.3 Parallel operation

General and conditions

All parallel programs are intended to minimize the circulating reactive current of parallel-connected transformers. Which parallel program is useful and can be applied due to conditions on the site is explained in detail in chapter 8.1.5.2 from page 167 onwards. Parallel program-specific parameters are also described in chapter 8.1.5.3 from page 170 onwards.

In principle, with all parallel programs (except dcos(φ)) an E-LAN communication is required between the participating Relays for Voltage Control & Transformer Monitoring so that relevant data for parallel operation can be exchanged between the regulators involved.

Further, for the parallel programs dcos(φ), dIsin(φ) and dIsin(φ)[S], in addition to measurement of the regulation voltage, also a current measurement associated with the regulation voltage is required to be able to determine the phase angle and the circulating reactive current.

With the parallel programs Master-Follower, MSI and MSI2 the circulating reactive current can be monitored optionally. However, the determination of the circulating reactive current is not required for these parallel programs, as the circulating reactive current is implicitly minimized by the tap positions (e.g. for identical transformers).

Sign conventions

To understand the calculation of the circulating reactive current and its influence on the voltage regulation, the following sign conventions should be observed:

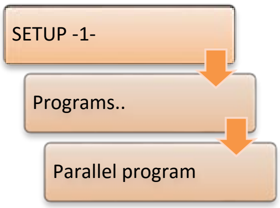
	Positive sign	Negative sign
Active Power P	Consumption case	Reverse power flow case
Reactive power Q	Inductive reactive power consumption	Capacitive reactive power consumption
Phase angle φ	Capacitive reactive power consumption	Inductive reactive power consumption
Reactive current I*sinφ	Capacitive reactive power consumption	Inductive reactive power consumption
Circulating reactive current Icirc	Capacitive reactive power consumption	Inductive reactive power consumption

NOTICE!

Wiring and configuration

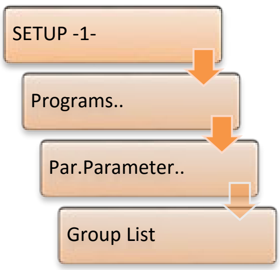
- It needs to be ensured that the voltage and current measurements are correctly configured and wired, so that with active power consumption of the grid (consumption case) the active power P in the transducer has a positive value, and with active power flow feedback of the grid (reverse power flow case), the active power P takes on a negative value in the transducer. In addition, pay attention to the correct wiring of raise and lower relays and correct configuration of the inverse tap changer, so that raise commands always increase the voltage and lower commands always reduce the voltage.
- If these conventions are not consistently obeyed, it may result in unequal taps on the tap changer, and thus an increase of the circulating reactive current which may go as far as tripping the transformer.

Choice of parallel program



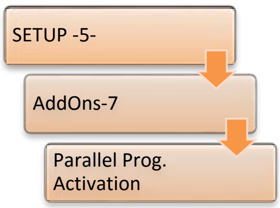
The corresponding parallel program needs to be selected for all involved Relays for Voltage Control & Transformer Monitoring. The parallel programs MSI and MSI2 are only available with the feature ParaGramer activated.

Group list



All regulators operating in parallel are defined in the group list. The group list has to be identical in all participating regulators and may not have any gaps. For the parallel program dcos(φ), which is normally used without E-LAN, the group list is only required if an E-LAN between the participating regulators is available and either the ParaGramer is used or a maximum tap difference of the regulators concerned is to be monitored.

Parallel program activation

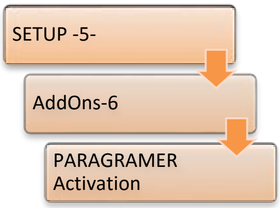


The parallel program activation needs to be set for all regulators that are to participate in the parallel operation.

An exception is the Master-Follower parallel program. With ParaGramer, the first regulator in the group list with activated parallel program activation becomes master. Without the use of ParaGramer, one of the regulators in the group list with an enabled parallel program activation becomes master (the one that first defines itself as master, regardless of placement in the group list).

In addition to permanent activation/deactivation of a parallel program, the parameter can also be set to level or pulse so that parallel program activation/deactivation can be done via binary input using the function "08:Par-Prog". If activation/deactivation is carried out by a SCADA system, the parameter will be actively changed with corresponding SCADA commands.

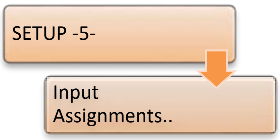
ParaGramer activation



When using the ParaGramer function, the parameter "ParaGramer activation" always needs to be set to ON.

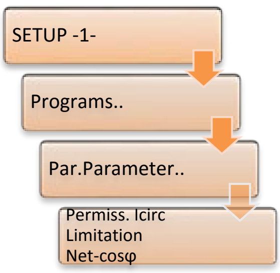
If the feature ParaGramer is enabled, the ParaGramer can be activated. The number of transformers to be placed in ParaGramer is defined using the parameter "ParaGramer activity".

Configuration of ParaGramer



The ParaGramer can be used for the display of parallel operation of transformers. Moreover, using the ParaGramer, parallel operation is automatically detected based on switch positions in all parallel programs except for MSI and MSI2. There are various standard switches available to the ParaGramer, which need to be configured in the input assignments in order to be displayed and evaluated by the ParaGramer. For a detailed explanation of the operation and configuration of ParaGramer, see chapter 8.3.2 from page 232 onwards. An overview of the binary input functions of the ParaGramer is also given in the table of chapter 8.2.2 from page 208 onwards.

Specific configuration of the parallel program dcosφ



The parallel program dcosφ necessarily requires configuration of the Net-cosφ, the Permissible Icirc (permissible circulating reactive current), and the Limitation .

The parameter Net-cosφ has to be configured according to the present grid. When the actual cosφ is equivalent to the parameter Net-cosφ, the regulator assumes that no circulating reactive current is present in parallel operation, but that the total reactive current is consumed in the grid below. The circulating reactive current is calculated from the difference between Net-cosφ and the actual measured cosφ.

The determination of the parameter Permissible Icirc (permissible circulating reactive current) is explained in detail on page 110.

The parameter Limitation limits the influence of the parallel program dcosφ in the regulation of the tap changer. The value of limitation multiplied by the permissible setpoint deviation (bandwidth Xw_z) gives the maximum influence of the parallel program dcos(φ).

Example:

permissible setpoint deviation Xw_z: 2.0 %

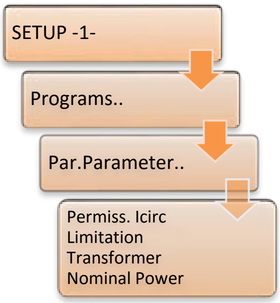
Limitation: 3

→ maximum influence of the parallel program dcos(φ) = 3 * ±2.0% = ±6%

Parameters dependent on the parallel program dcos(φ)

The parameters Permissible Icirc, Limitation and Net-cosφ of the parallel program dcos(φ) are available only when the corresponding parallel program is selected in the previous menu.

Specific configuration of parallel programs dIsin(φ) and dIsin(φ)[S]



For the parallel programs dIsin(φ) and dIsin(φ)[S] the parameter Permissible Icirc is available and can be used for defining the permissible circulating reactive current. The determination of the Permissible Icirc parameter is explained in detail on page 110.

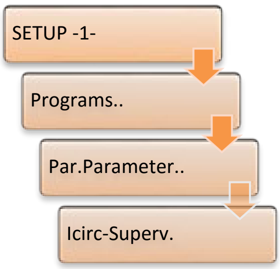
The parameter Limitation is set to 20 by default and is not visible in the menu.

Moreover, different nominal transformer powers can be configured for the parallel program dIsin(φ)[S]. In the parallel program dIsin(φ), it is assumed that the nominal transformer powers are the same, therefore the corresponding parameter in this parallel program is dropped.

Parameters dependent on the parallel programs dIsin(φ) and dIsin(φ)[S]

The parameters Permissible Icirc and Limitation of the parallel programs dIsin(φ) and dIsin(φ)[S] are only available when one of the corresponding parallel programs is selected in the previous menu. The nominal transformer power parameter is only available for the parallel program dIsin(φ)[S].

Specific configuration of the parallel programs Master-Follower, MSI and MSI2

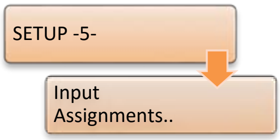


In the parallel programs Master-Follower, MSI and MSI2 an excessively high circulating reactive current can be supervised by using the parameter Icirc-Supervision. In contrast to the parallel regulation procedures dcos(φ), dIsin(φ) and dIsin(φ)[S], the circulating reactive current is not directly included in the regulation, but only represents a limit. If the parameter Icirc-Supervision is exceeded, the regulator switches over to manual mode.

Example: Two identical transformers are operated in the Master-Follower parallel program. If a cable break occurs at the master regulator with the currently active signal BCD04, the tap position feedback will change, for example, from tap 14 to tap 10. The master regulator then drags the slave to its supposed tap, thereby resulting in a real tap difference of four taps, which causes a high circulating reactive current. If the parameter Icirc-Supervision is correspondingly configured, retracing of the slave until the Icirc monitoring limit is reached can be interrupted, since the master and slave switch to manual mode.

Parameters dependent on the parallel programs Master-Follower, MSI and MSI2

The parameter Icirc-Supervision of the parallel programs Master-Follower, MSI and MSI2 is only available when one of the corresponding parallel programs is selected in the previous menu.



In the parallel program MSI, for each Relay for Voltage Control & Transformer Monitoring the status master, slave or independent can be assigned. In addition, in the parallel program MSI2 two separate master-slave groups (master 1&2 and slave 1&2) can be defined. An evaluation of switch position is not provided in these parallel programs in the regulator itself, but can, for example, be supplied externally.

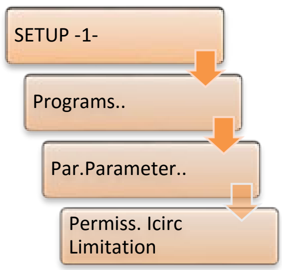
The allocation of master, slave and independent can be done either in ParaGramer itself (the F1 key in ParaGramer), or by means of binary signals, whereby the last positive slope of the selected function is always decisive.

The binary input functions available:

MSI:	64:MSI_Ma	(master)
	65:MSI_Sl	(slave)
	66:MSI_Ind	(independent)
MSI2:	67:MSI_Ma1	(master 1)
	68:MSI_Ma2	(master 2)
	69:MSI_Sl1	(slave 1)
	70:MSI_Sl2	(slave 2)
	66:MSI_Ind	(independent)

The choice of master, slave or independent can also be adjusted via the SCADA system.

Emergency program dcos(φ)!! for parallel programs dIsin(φ) and dIsin(φ)[S]



If there is a failure of the E-LAN connection during active parallel programs dIsin(φ) and dIsin(φ)[S] in AUTOMATIC mode, the E-LAN error and the emergency program dcos(φ)!! are activated after approximately 30 seconds.

The parameters Permissible Icirc and Limitation of the regular dcos(φ) parallel program are used in the emergency program dcos(φ)!!.

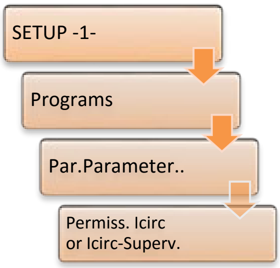
On the other hand, for the parameter Net-cosφ, the cosφ measured at the time of the E-LAN error is used.

It is therefore assumed that the circulating reactive current was perfectly minimized at the time of the failure of the E-LAN bus.

Parameter settings for the parallel emergency program dcos(φ)!!

In order to be able to adjust the parameters Permissible Icirc and Limitation for the emergency program dcos(φ)!! in the Relay for Voltage Control & Transformer Monitoring REG-D™, the parallel program dcos(φ) needs to be temporarily activated for the configuration. Only in this case the parameters will be visible under Par.Parameter.

Determining the regulation influence parameter



As a decision basis for the configuration of Permissible $Icirc_x$, the circulating reactive current change has to be determined per tap of the tap changer involved.

In this first step, the current tap position and the current circulating reactive current for each transformer are noted down in the first step. The actual calculated circulating reactive current of each Relay for Voltage Control & Transformer Monitoring REG-D™ can be viewed on the second page of the transducer display using the arrow keys ◄ ►.

In the second step, a transformer is stepped by one tap, and then the current tap positions and the current circulating reactive currents are noted down. From the difference between the circulating reactive currents of the transformers, the circulating reactive current change per tap can then be determined from the noted values.

In the next step, the procedure is repeated for all other transformers, so that the difference in the circulating reactive current per tap is seen for each tap changer.

The minimum permissible circulating reactive current $Icirc_z$ (Permissible Icirc) is then calculated from the difference of the circulating reactive current per tap according to the following formula:

$$\boldsymbol{Icirc_z[A] \geq 0.6 * \Delta Icirc\ [A]}$$

The permissible circulating reactive current should not be chosen to be less, because the circulating reactive current can otherwise never be compensated, leading to fluctuation of the tap changer ("hunting").

Example: Two non-identical transformers are adjusted by one tap and the differences in the circulating reactive currents determined.

TapPos **Transf. 1**	**TapPos** **Transf. 2**	**Icirc** **Transf. 1**	**Icirc** **Transf. 2**
10	12	-20 A	+20 A
11	12	- 50 A	+ 50 A
11	13	-10 A	+ 10 A

ΔIcirc Transf. 1 = 30 A **ΔIcirc Transf. 2 = 40 A**

➔ Minimum value of the parameter Permissible Icirc:

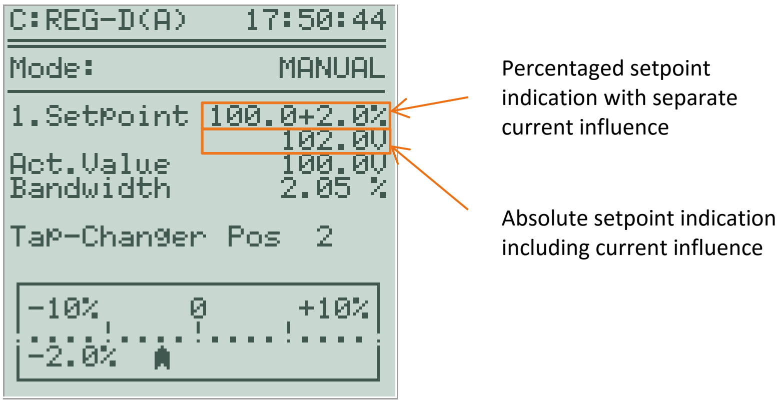
$$Icirc_{z-Transf.\ 1}[A] \geq 0.6 * \Delta Icirc_{z-Transf.\ 1}\ [A] = 0.6 * 30\ A = 18\ A$$
$$Icirc_{z-Transf.\ 2}[A] \geq 0.6 * \Delta Icirc_{z-Transf.\ 2}\ [A] = 0.6 * 40\ A = 24\ A$$

7.2.4 Current influence

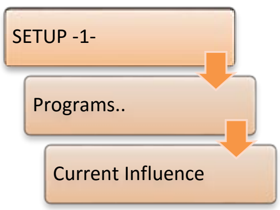
General

With the current-dependent setpoint influence on power flow to the grid below, the setpoint is increased in order to compensate the voltage drop on the line. However, if power from the grid below is consumed, the setpoint should be reduced.

On the regulator basic display mode, the current-dependent setpoint influence is displayed accordingly. The percentaged setpoint indication is divided into two parts. First, the percentual basic setpoint is given, behind it the current-dependent setpoint influence. However, the absolute setpoint indication represents the basic setpoint value plus the current influence.



Choice of current influence program



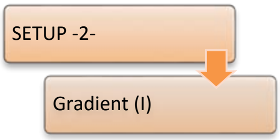
The following current influence programs are available:

- Apparent current
- Active current
- Reactive current
- LDC

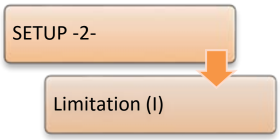
With the current program apparent current, the complete apparent current has an effect on the setpoint value in the range of $-90°\ (ind) \leq \varphi \leq +90°(cap)$. With the current programs active current and reactive current, only the active or reactive component of the apparent current has an effect on the setpoint value in the range of $-180°\ (ind) \leq \varphi \leq +180°(cap)$. For all three current programs, the parameters Gradient (I) and Limitation (I) need to be configured.

In contrast, the current influence program LDC requires beside the parameter Limitation (I) the parameters resistance and reactance. From the line data, this current influence program determines the voltage drop and therefor the current-dependent setpoint influence.

Gradient and Limitation

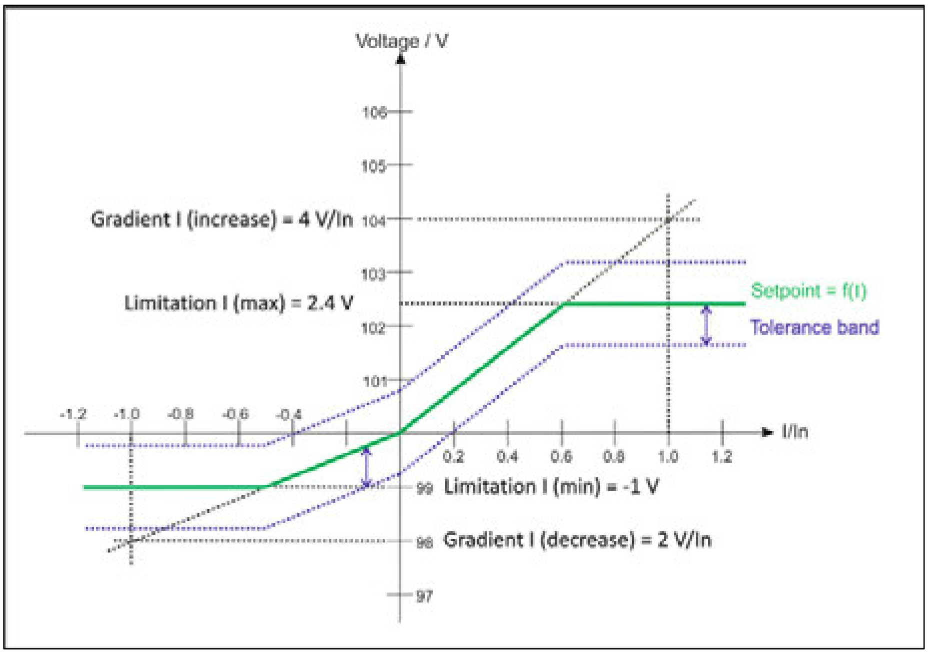


The gradient can be defined separately for the positive range (consumption case) and the negative range (reverse power flow case). The unit of the gradient is volts per nominal current [V/In], whereby the value is understood for the voltage as normalized to 100 V, and for the nominal current normalized to 1.0, which corresponds to the measuring range of the regulator (1/5 A) multiplied by the transducer factor Kni.



The limitation is used for limiting the current-dependent setpoint influence. A maximum and minimum limit can be specified. This is specified in volts [V], normalized to 100 V.

The graph below shows the influence of the parameters Gradient (I) and Limitation (I) for the current influence programs for apparent power, active power and reactive power on the setpoint and the tolerance band as a function of the normalized current.



Note signs

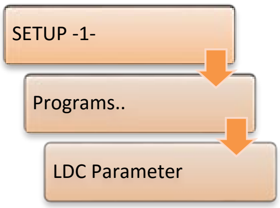
Both the parameters negative and positive Gradient (I) always have a positive sign. The minimum Limitation (I) is configured in the regulator with a negative value, the maximum limitation in the regulator is usually a positive value.

The available parameters depend on the firmware version!

From REG-D™ firmware V2.19 the Limitation (I) can be set separately for the minimum and maximum range. In previous firmware versions a Limitation (I) is configurable which applies to both limits.

From REG-D™ firmware V2.22, the negative and positive gradients are separately adjustable. In previous firmware versions only one Gradient (I) could be configured, which was used for both the consumption case and the reverse power flow case.

Resistance and reactance (LDC procedure)

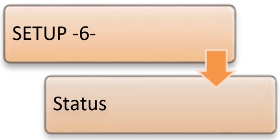


If the current influence program LDC is selected, the menu item LDC Parameter is visible. Here, the resistance (R) and reactance (X) of the compensated line can be specified. From the given values the Relay for Voltage Control & Transformer Monitoring REG-D™ calculates the corresponding setpoint influence based on the current and phase angle.

For more information, see chapter 8.1.4 from page 155 onwards.

7.2.5 Measurement value simulation

Activating measurement value simulation



The simulation of measurement values can be used for testing, presentation or commissioning of the Relay for Voltage Control & Transformer Monitoring.

To prevent the simulation from being turned on accidentally, some operating steps are required, which should ensure that the work with the simulation can only proceed when it is explicitly wanted.

Three different configurations of measurement value simulation are possible, which will be explained in the following. The value of the feature Simmode can be checked in the status menu (scrolling with the arrow keys ◄ and ►).

1. Feature Simmode = 0
   In this mode, a measurement value simulation is not possible. The feature is not listed in the status menu (2) of the regulator.
2. Feature Simmode = 1
   In this mode, a measurement value simulation is only possible in manual mode. On switching from manual mode to automatic mode, the simulation is terminated. Simulation needs to be activated separately in status menu (1) by pressing F5.
3. Feature Simmode = 2
   In this mode, a measurement value simulation is possible in both manual and automatic mode. Simulation needs to be activated separately in the status menu (1) by pressing F5.

By default, the simulation mode is activated on delivery of the regulator, ina way that only allows simulation in manual mode (feature Simmode = 1). If a different kind of measurement value simulation is wanted, this can be changed at any time via the terminal program (subprogram of the configuration software WinREG), using the appropriate commands (e.g. "feature Simmode = 2") .

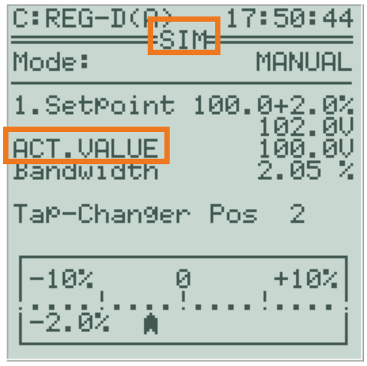
If the simulation is active, it can be disabled via the F5 key in the status menu (1). Simulation terminates automatically 15 minutes after the last key press.

⚠ DANGER!	**Real tap changing!** In active simulation mode it is to be noted that tap-change commands are issued via the raise or lower relays in real time and the tap changer can really be tapped. In particular, during active simulation in automatic mode (Simmode = 2), this can lead to a significant tap change within a short time and thus violate certain voltage limits, which are not regulated by the Relay for Voltage Control & Transformer Monitoring REG-D™ due to the simulation mode.

Display of active measured value simulation

If simulation is active, the word "SIM" will be visible (from REGSys™ firmware V2.22) in the regulator basic display mode and in the transducer mode. Moreover, in the regulator basic display mode the words "Actual value" are written in capital letters with the active simulation mode ("ACTUAL VALUE"), and in status menu (1) the note "Input Simulation" is shown in the lower left corner.

Active simulation mode



Measurement value simulation with PAN-D present

If the Relay for Voltage Control & Transformer Monitoring REG-D™ is used in conjunction with the monitoring unit PAN-D (connected via E-LAN), in simulation mode it should be noted that the simulated voltage is also transmitted to the PAN-D and that during simulation time the PAN-D sees only the simulated voltage and not the real system voltage.

Setting the simulated voltage, current and phase angle

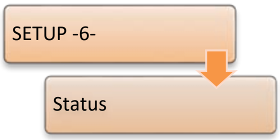
Transducer

Simulated voltage can be adjusted in the regulator basic display mode, in the transducer mode and in the recorder mode by using the arrow keys [◄] and [►]. The left arrow key [◄] reduces the voltage by 0.5 V, the right arrow key [►] increases the voltage by 0.5 V (voltage data normalized to 100 V).

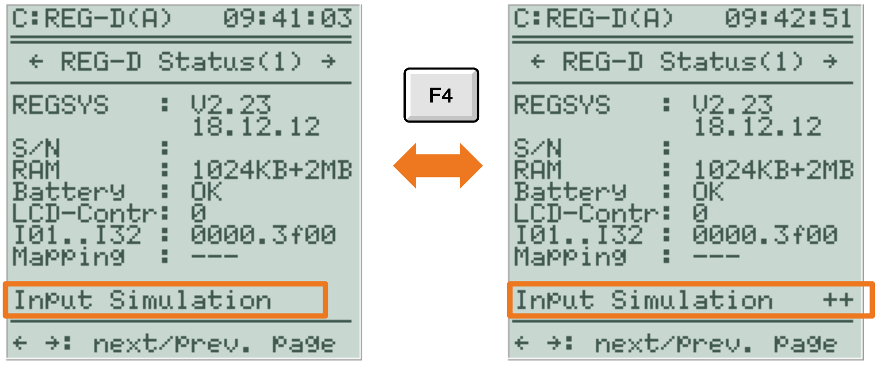
In the transducer, by using the key [F2] the simulated current can be increased by 5% of the nominal current, or by using the key [F3] be reduced by 5% of the nominal current.

In the transducer mode, by using the key [F4] the simulated phase angle can likewise be increased by 1°, or by using the key [F5] be reduced by 1°.

Activation of tap simulation



If the simulation mode is enabled, then in addition to the simulation of voltage, current and phase angle, simulation of tap position can also be added. To do this, the key F4 needs to be pressed in the status menu (1). Tap simulation is indicated with two "++" signs behind the term "Input Simulation".



NOTICE!	**Simulation mode via WinREG** The simulation mode can also easily be enabled or disabled and controlled with the software WinREG. For more information, see chapter 9.7 Service from page 305 onwards.

7.2.6 RAM-Backup

General

The parameters of the Relay for Voltage Control & Transformer Monitoring REG-D™ are kept in the memory (RAM) by an internal battery, and are thus available unchanged after any interruption of the supply voltage. If the battery life is exhausted, the RAM loses data after any interruption of the supply voltage and the regulator will start with default parameters.

To save the parameters independently of the regulator battery, since bootloader firmware version V2.12 it is possible to perform a RAM-Backup of the regulator. Hereby, parameters from the volatile memory (RAM) are secured in the non-volatile memory (flash) of the regulator.

If, in addition, a REG-D™ firmware newer than V2.22 is used, the RAM-Backup is automatically restored in the RAM in case of loss of the parameters, and hence the parameters are restored too. In addition to automatic restoration, there is always the option of manually restoring a RAM-Backup regardless of the firmware of the REG-D™.

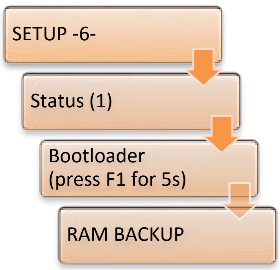
Data backup

It is recommended to carry out a RAM-Backup at the end of commissioning so that the parameters are saved on the spot in case of failure of the internal battery.

REG-D™ devices with MRAM (as of 05/2014 or with the feature S2 as of 09/2013)

In REG-D™ Relays for Voltage Control & Transformer Monitoring manufactured since 05/2014 (with feature S2 from 09/2013) a non-volatile RAM (MRAM) is used. In these devices no RAM-Backup is necessary, and for devices with the feature S2 this is not available in the bootloader.

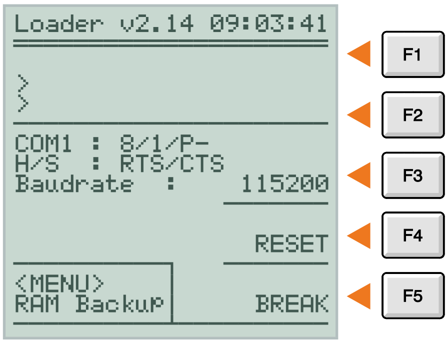
Performing a RAM-Backup



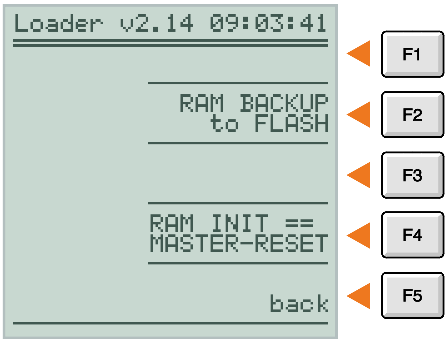
The RAM-Backup can easily be performed from the software WinREG (subprogram Service, see chapter 9.7 Service, from page 305 onwards), but alternatively also carried out directly on the regulator.

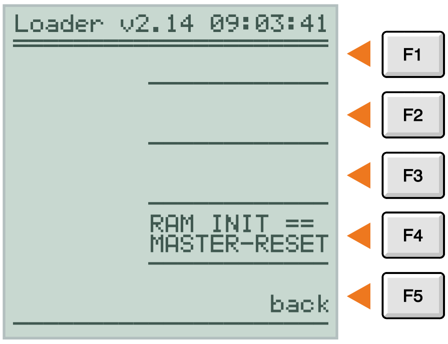
For a manual RAM-Backup, the bootloader first needs to be started by pressing the F1 key in the status menu for 5 seconds.

⚠ WARNING!	**Control function**
	While the regulator is in bootloader mode, all functions including the control functions of the REG-D™ are inoperative.

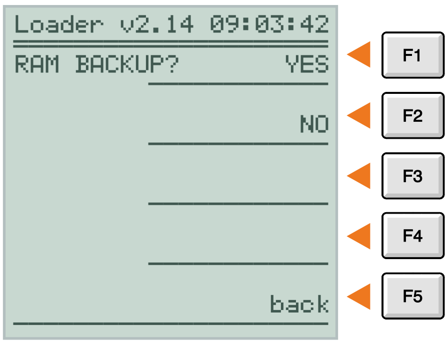


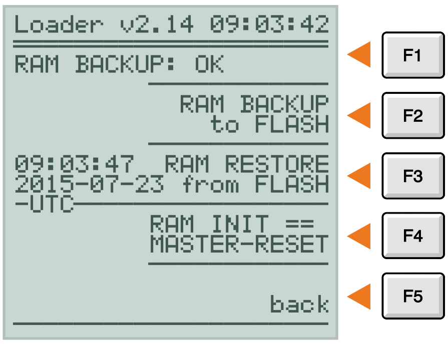
By pressing the MENU key one gets into the RAM-Backup menu. If the REG-D™ has a second flash memory, the screen will appear as shown on the left in the following picture. If the REG-D™ has no second flash memory (or the device already has an MRAM), the screen appears as shown in the following screen on the right. In the latter case, a backup of REG-D™ parameters using the bootloader is not possible.





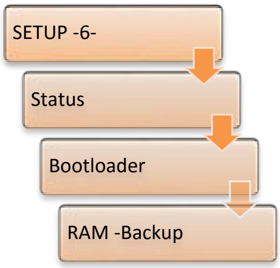
Press F2 to start "RAM-BACKUP to FLASH", i.e., to save the parameters. Confirm with "YES" (F1) on the next screen that you wish to perform a backup, and wait until the screen shows the message "RAM-BACKUP: OK“.





The current RAM-BACKUP is displayed with a UTC time stamp under F3. To exit the bootloader mode, press "back" (F5) and then "RESET" F4.

Restoring RAM-Backup

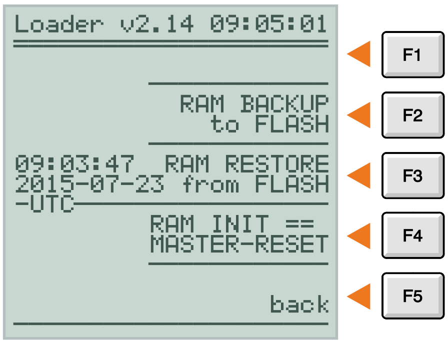


The Restoration of a RAM-Backup can easily be done from the software WinREG (subprogram Service, also see chapter 9.7 Service, from page 305 onwards), but can also be carried out directly on the regulator.

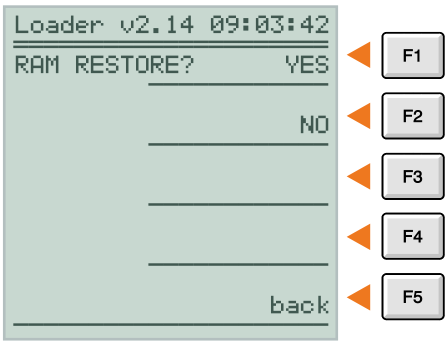
For manual restoration of a RAM-Backup, the bootloader needs to be started first by pressing the key F1 for 5 seconds in the status menu.

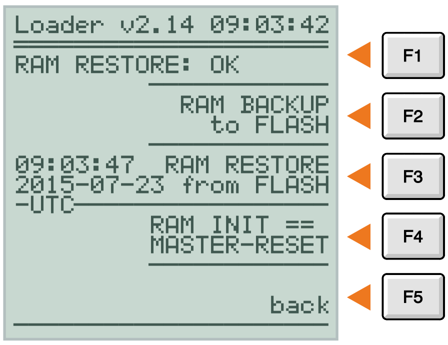
NOTICE!	**Control function** While the regulator is in bootloader mode, all functions including the control functions of the REG-D™ are inoperative. In addition, by restoring the RAM-Backup all parameter changes made since the last RAM-Backup are irretrievably deleted.

By pressing the MENU key one gets into the RAM-Backup menu. The backup of the RAM is shown at the level of the F3 key including the backup time (in UTC time).



The restoring of the parameters is triggered via the key F3 "RAM RESTORE from FLASH" and confirmed with the F1 key. When F1 "RAM RESTORE: OK“ appears at the level of the key, the RAM-Backup has been successfully restored.





The parameters are now fully restored. To exit the bootloader mode, press "back" (F5) and then "RESET" F4.

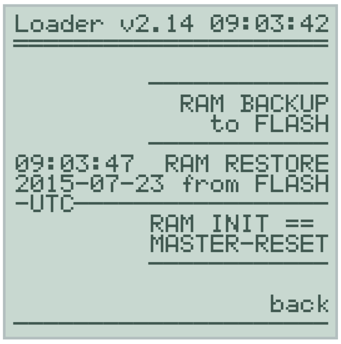
Checking the time setting

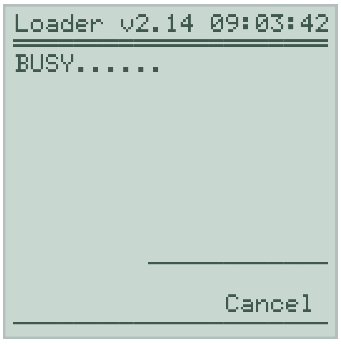
If the restoration of a RAM-Backup is performed due to an empty buffer battery, it will be necessary to check the time setting of the Relay for Voltage Control & Transformer Monitoring REG-D™, and to correct it if necessary.

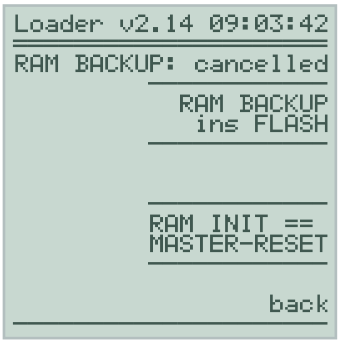
Deleting an existing backup file

If an existing backup file is to be deleted completely and not only overwritten, the following steps needs be taken.

In bootloader mode, switch to the RAM-Backup menu with the MENU key. After a renewed "BACKUP RAM to FLASH" via the F2 key has been triggered, the indicator "BUSY ..." appears in the panel of the regulator. If the RAM-Backup using the F5 key is cancelled, the current RAM-BACKUP is deleted and is then no longer visible.



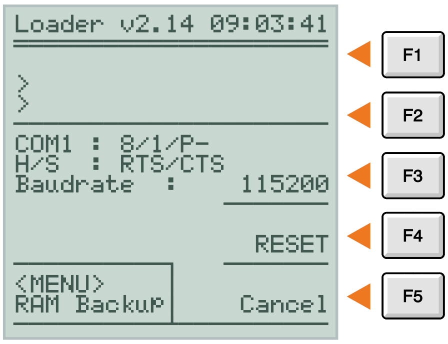


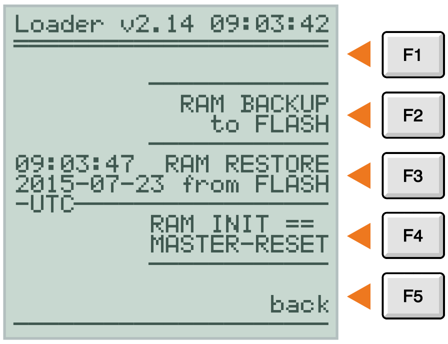


Resetting all parameters via the bootloader

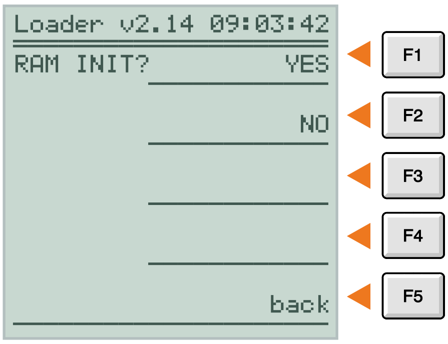
1.) IMPORTANT: If a RAM INIT is performed, all parameters are reset to default. Any existing backup is not removed thereby.

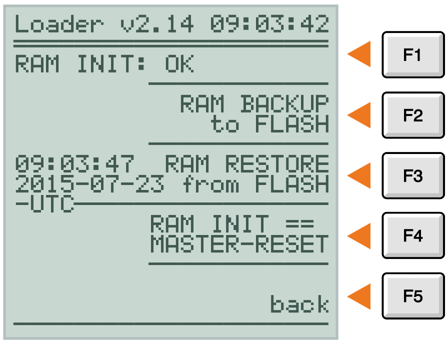
2.) To reset all parameters, a master reset can be performed using the bootloader. Start the bootloader, press MENU and then "RAM INIT == MASTER-RESET" (F4). The master reset using the bootloader is equivalent to the REG-L command "sysreset = 590".





3.) After confirming RAM-INIT with "YES" (F1), a successful reset of the master is confirmed with RAM INIT: OK.



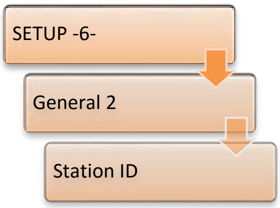


8. Parameters, functions and software features

8.1 Parameters

8.1.1 System

8.1.1.1 Station ID

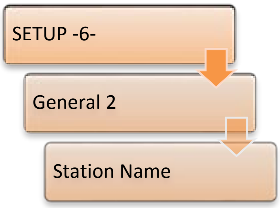


Up to 256 different devices can be addressed via the A. Eberle internal communications bus (E-LAN). However, each device must be assigned a unique address (identifier).

The address space ranges from A ... A9, B ... B9, ... up to Z4.

Using F1 and F2 a letter can be selected, with F2 and F4 an additional digit (e.g. A2).

8.1.1.2 Station name



The regulator name is preferably entered via WinREG, but can also be set according to the following procedure via the regulator keyboard.

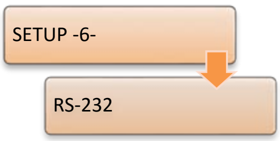
After using the arrow keys ◄ ► to select the corresponding location for the terminal name, the character set can be selected with F1.

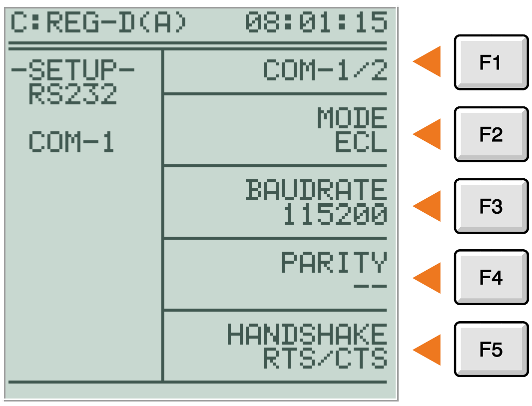
The arrow keys are used to select a particular character that is confirmed with ENTER ↵.

With F2 you can switch between upper and lower case.

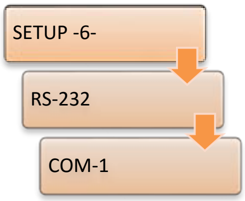
With F4 and F5 characters can be inserted or removed.

8.1.1.3 RS-232





COM-1



The COM1 interface is accessible as both a configuration and programming interface via a SUB-D connector (with the feature I via the mini USB connector) located on the front panel.

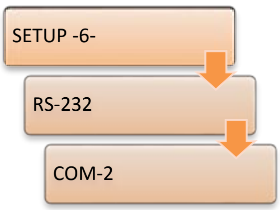
The default setting is selected as ECL. In this mode, the regulator can be accessed using WinREG.

Alternatively, instead of ECL the following mode can be selected:

- With the setting DCF77, and a simultaneous connection to an appropriate recipient, time synchronization can be carried out via DCF77.
- In the PROFI mode, a Profibus module can be addressed.
- With the setting ELAN-L or ELAN-R, the information of the system bus E-LAN can be redirected to COM1.
- The ECLADR mode can be compared to the ECL mode, however it differs by fixing the TX/RX checksum application. Online operation is not possible with this setting. This parameter is only used if several regulators must be interconnected to one COM line by means of a star coupler. ECLADR should only be used by a system specialists from A. Eberle.

BAUDRATE, PARITY and HANDSHAKE must match the setting of the connected end terminal (computer) to ensure an interference-free communication.

COM-2



The COM2 interface is normally used to communicate with the instrumentation and the SCADA system equipment.

For communication with a SCADA system, an integrated or external (recommended) protocol card (see feature list XW90, XW91 or L1, L9) is also required.

The Traffic between the regulator and the protocol interface is realized via the COM2 interface. The protocol card translates regulator information according to IEC 61870-5-101, -103, -104, IEC 61850, MODBUS, SPABUS, PROFI-BU, DNP 3.0, LON into the standarized language, otherwise information from the control centre is translated into an understandable regulator "dialect".

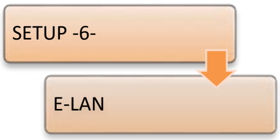
The default mode is ECL, which is usually used for communication with the SCADA system.

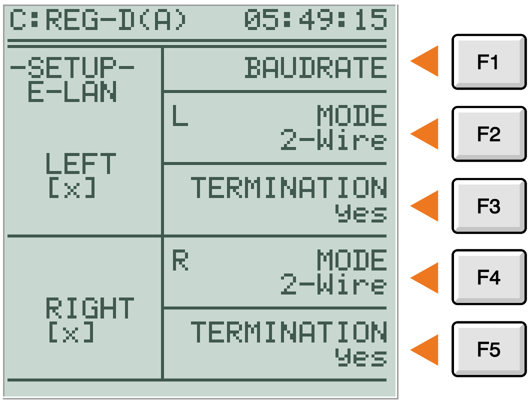
Moreover, the following modes can be set:

- If time synchronization is to be realized via DCF77, the setting DCF77 must be selected. In this case, a suitable receiver must be connected to the COM2 interface.
- The setting ECL+HP opens up the possibility that an output, generated via an H-program, in addition to COM1, is also issued via COM2.
- The mode ECLADR can be compared to the mode ECL, however it differs by setting the TX/RX checksum application. Online operation is not possible with this setting. This parameter is only used if several regulators must be interconnected to one COM line by means of a star coupler. ECLADR should only be used by system specialists from A. Eberle.
- If E-LAN (ELAN-L, ELAN-R) information is to be redirected to the serial interface to carry out modem transmissions at the E-LAN level, the setting must be ELAN-L or PEP-R. Further detailed descriptions will be omitted at this point, because such connections should in any case be implemented in cooperation with the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).
- PROFI is always the right setting for COM2 if a PROFIBUS-DP connection is to be implemented. In this case, an external PROFIBUS-DP module can be controlled via COM2.
- OFF switches off the interface.

BAUDRATE, PARITY and HANDSHAKE must match the setting of the connected end terminal (computer) to ensure interference-free communication.

8.1.1.4 E-LAN





Each regulator provides two complete E-LAN interfaces.

E-LAN LEFT refers to the settings for the left bus

(multipoint connector 6, terminals b6, b8, b10 and b12, see technical data in the appendix, chapter 21).

E-LAN RIGHT refers to the settings for the right bus.

(multipoint connector 6, terminals z6, z8, z10 and z12, see technical data in the appendix, chapter 21).

Each E-LAN interface can be used with a two-wire line or four-wire transmission technology (RS485).

Multipoint connector 6				
Bus-L terminal	Bus-R terminal	Function	Two-wire	Four-wire
b6	z6	EA+	Input and output "+"	Output "+“
b8	z8	EA-	Input and output "-"	Output "-"
b10	z10	E+	No function	Input "+"
b12	z12	E-	No function	Input "-“

Normally a two-wire line is used, because only thus it is possible to have a bus configuration with multiple devices on the same bus line. For this purpose, the integrated terminating resistor must be switched on at the first and the last terminals on the bus (selection: "terminated“).

If the terminating resistors are set improperly, reflections can occur at the cable ends, which make secure data transmission impossible.

For long transmission distances, or if boosters (amplifiers for increasing the signal level for very long transmission paths) must be used, four-wire transmission technology is required. In this case, the necessary terminating resistors are automatically activated. The "terminated" selection is no longer necessary in this case.

If the terminations (only possible with two-wire operation!) and the baud rate are set correctly, and the wiring is done properly, a bracketed [X] will appear in the two mutually connected devices. The [X] signifies that the neighbouring station is recognized.

If the connection cannot be made completely or stably, the devices will respond with a flashing [X].

The following causes may be involved:

1. Wiring error; open or wrong connection.
2. Identical station identifiers (each regulator must be assigned a unique address in the E-LAN group, see chapter 8.1.1.1from page 122 onwards).
3. The baudrate between interconnected regulators is not identical.

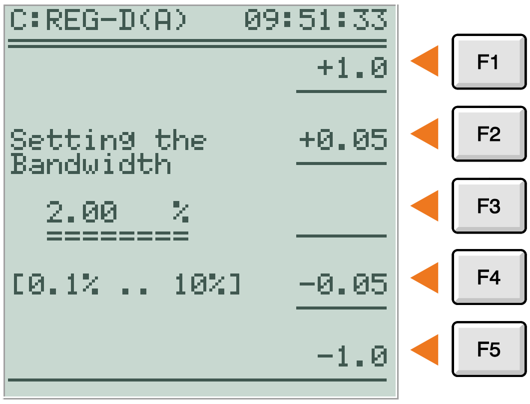
   Example:

   The right E-LAN bus terminal of regulator "A:" is connected to the left E-LAN bus terminal of regulator "B:". Then the condition applies that the same baudrate must be set for the right E-LAN of regulator "A:" as the left E-LAN of regulator "B:".
4. Incorrect termination

   Only the first and last device of a bus segment may be terminated (also see chapter 7.1.4.6 from page 67 onwards). With a four-wire connections this termination occurs automatically.

8.1.2 Basic values

8.1.2.1 Permissible setpoint deviation (bandwidth Xw_z)

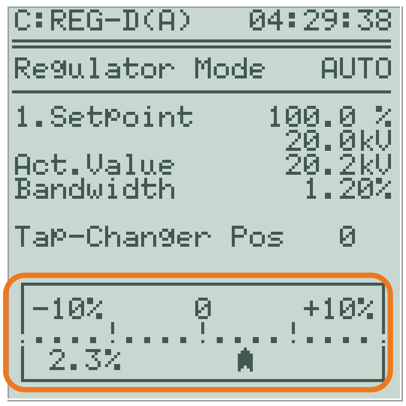


The current setpoint deviation Xw is the difference between the actual value X of the control value and the reference value W (setpoint value). The sign of the setpoint deviation can thus be positive or negative.

To minimize the number of switching operations of the tap changer, deviation of the mains voltage from the setpoint value is tolerated within certain limits, that is, a certain deviation is permissible.

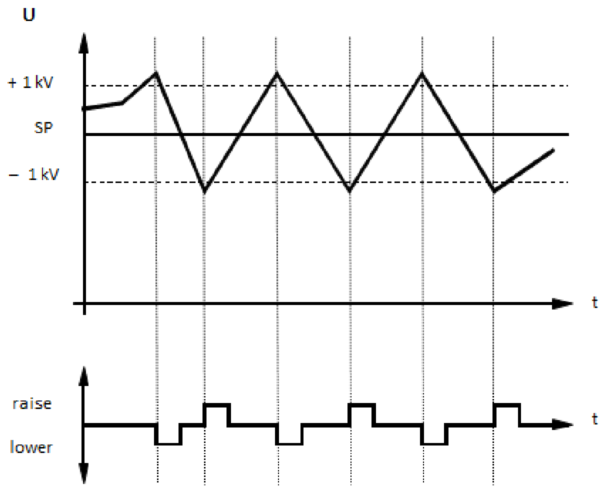
This **permissible setpoint deviation** (bandwidth Xw_z) is given as ±n% of the setpoint value and sets the limits for the maximum permissible relative fluctuation range of the mains voltage below and above the setpoint. Thus, the total tolerance band corresponds to twice the twice the bandwidth Xw_z.

The absolute limits of this tolerance band depend on the magnitude of the setpoint. If the mains voltage dips into this tolerance band, the regulation process in automatic mode is stopped, and the counter (integrator) for the time delay is set to zero, so that after each dip of the mains voltage the regulation/integration only starts again when the mains voltage violates the limits of the tolerance band. Thus, mains voltage fluctuations within the permissible deviation do not trigger a controled tap operation.



Deviation of the mains voltage X from the setpoint value is displayed on the scale of the regulator in an analog manner and in plain text (e.g. +2.3%). The fill colour of the pointer changes from light to dark when the voltage lies outside the permissible setpoint deviation (bandwidth Xw_z).

The tolerance band determined by the permissible setpoint deviation Xw_z (in ±n% of the reference value W) must be greater than the percentage tap increment of the transformer, because otherwise, after execution of a tap command, the changed output voltage of the transformer would again violate the opposite limit of the permissible setpoint deviation. After the time delay interval has expired, a tap command would be issued to reset the tap to the previous transformer tap position. This process would constantly reiterate (hunting), i.e., lead to frequent tap-changes of the transformer and thus result in unwanted fluctuations of the mains voltage (see the figure below).



Example 1: tap change ratio from one step to another step: 2.2 kV
setpoint deviation: 1 kV

A too narrowly set permissible setpoint deviation results in a hunting process.

Therefore, to obtain a sufficient distance from the upper and lower limits of the setpoint deviation, the tolerance band must be greater than the voltage swing caused by a tap change:

$$2 \times |\pm Xw_z\ [\%]| > \Delta U \text{ tap } [\%]$$

or

$$|\pm Xw_z\ [\%]| > 0.5 \times \Delta U \text{ tap } [\%]$$

The permissible setpoint deviation can be set in the range of 0.10% to 10.00% and is independent of the limit base parameter.

Guideline for the permissible setpoint deviation

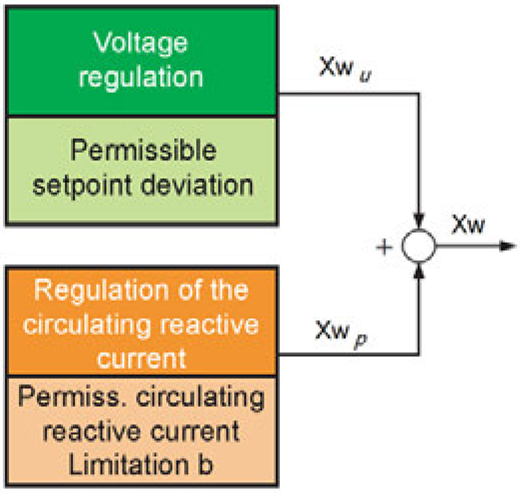
Normally, the following is recommended as a guideline for the minimum permissible setpoint deviation Xw_z:

$$|\pm Xw_z\ [\%]| \geq 0.6 \times \Delta U \text{ tap } [\%]$$

Since the setting of permissible deviation, besides affecting voltage quality, also decisively affects wear of the tap changer, a setting is generally selected that does not correspond to the minimum value (depending on the application). This means that a generally larger value is selected.

Permissible setpoint deviation (bandwidth) for the simultaneous use of a parallel regulation with the circulating reactive current minimization procedure

If, in addition to pure voltage regulation, another circulating reactive current minimization procedure (dIsin(φ), dIsin(φ)[S] or dcos(φ)) is performed, it may be necessary to increase the permissible setpoint deviation.
The reason for this is indicated in the following graph. The resulting influence Xw that leads to tap commands in automatic mode arises from a part Xw_U, of the voltage regulation itself (influence parameter: permissible setpoint deviation), and a part Xw_P of the circulating reactive current regulation (influence parameters: permissible circulating reactive current Icirc + limit).



If a parallel program is used by means of a circulating reactive current minimization procedure, situations may arise in regulation on the grid in which the circulating reactive current regulation adds to the voltage regulation so that the minimum permissible setpoint deviation will be too small according to the above formula (permissible setpoint deviation at least 60% of a tap change ratio). As a result, this may lead to the oscillations described above.

A general recommendation for the minimum permissible setpoint deviation that must be set cannot be given, since this is heavily dependent on grid and transformer specific circumstances. For questions regarding this matter, please contact the A. Eberle REGSys support team at regsys-support@a-eberle.de, +49(0)911/628108-101.

Example for determining the permissible setpoint deviation:

Power transformer 115 kV / 21 kV:

Number of taps ± 9 (tap positions 1..19)

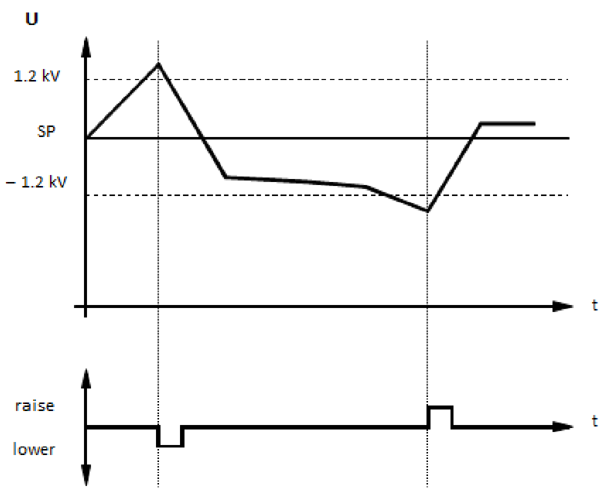
Range (specification for primary side) 96.6 kV ... 133.6 kV

Tap increment: (133.4 - 96.6 kV) 18 taps = 2.0 kV/tap

Assuming that the measured nominal voltage of 100V = 100% (setting of the setpoint deviation, parameter setpoint 1..4 on page 141) corresponds to the undervoltage side nominal voltage of 21 kV or the overvoltage side nominal voltage of 115 kV, the following formula is obtained for the permissible deviation Xw_z:

$$Xw_z \geq 0{,}6 * \left(2{,}04\ kV * \frac{100\ V}{115\ kV} * \frac{100\ \%}{100\ V}\right)$$

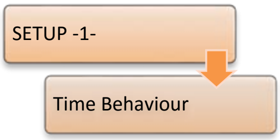
$$Xw_z \geq 1{,}06\ \%$$

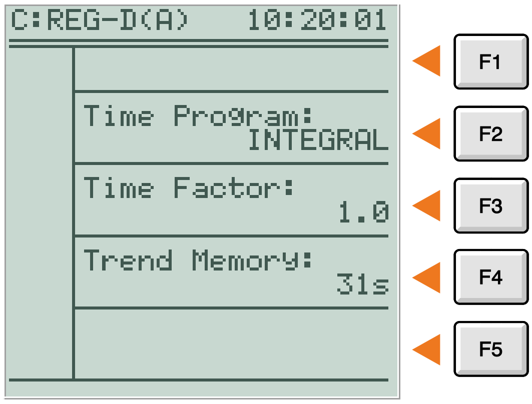


Example 2: tap change ratio: 2 kV
setpoint deviation according to the rule: 1.2 kV

Correctly set permissible setpoint deviation

8.1.2.2 Time behavior





The golden rule for multiple feeding points is a calm network.

This requirement leads to a regulation that has as result few switching operations ordered. Reduced regulation can be achieved by increasing the permissible setpoint deviation (Xw_z) or the reaction time.

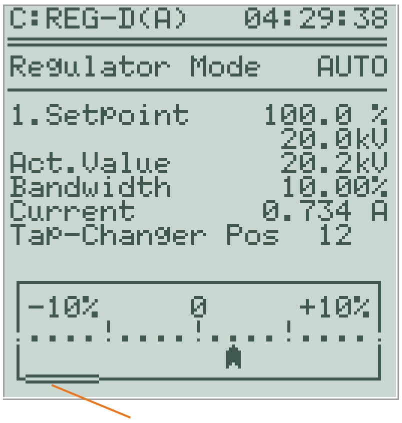
However, this procedure will reach its limit as soon as the interests of consumers are unduly prejudiced, i.e., because of excessively large or long-lasting voltage deviations.

The REG-D™ reaction time in automatic mode depends, beside the current permissible setpoint deviation, on some parameters, which are explained below.

All time based programs have in common that the setpoint deviations are summed up to a specified integral value before the regulator outputs a tap command. Thus, an integration (summation) takes place only when the voltage lies outside the permissible setpoint deviation.

The current setpoint deviation is weighted for the summation according to the selected time program (Integral, Fast Integral, LINEAR, CONST). Depending on the chosen time program, the value the integrator sums up depending on either non-linear, linear or stepped on the amount of the current setpoint deviation.

The mapping rules of the time programs are selected so that large setpoint deviations (voltage deviations) are compensated more rapidly than small ones. With the time program CONST, this compensation can be actively influenced by the choice of the delay times T1 and T2. This means that it is possible to compensate all deviations by the same time.



Progress bar

The "filling level" of the integrator is indicated in the regulator basic display through of a quasi-analog display. Once the voltage leaves the tolerance band, the bar starts to run from the left to right. The speed at which the bar runs depends on the current setpoint deviation and the settings for the time behavior. When the bar reaches the right side of the screen, a tap command is issued.

If the mains voltage drops into the tolerance band (± Xw_z) before reaching the right edge of the screen, the integrator is reset, i.e., no tap command is issued.

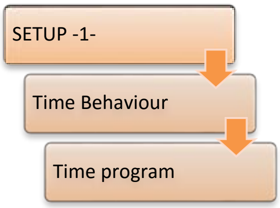
Under certain conditions no tap commands are issued on reaching the right screen edge:

- The TC in operation signal is active or the maximum TC in operation time has not expired (if no TC in operation signal is present/detected).
- A tap command was issued shortly before (5s lock time).
- Tap commands are blocked via REG-L (background program).

Under certain circumstances (for example, overvoltage) it may be necessary to accelerate the reaction time of the regulator. To this end, the "High-speed switching function" (see chapter 8.1.3.6 from page 150 onwards) can be used.

Moreover, with small setpoint deviations or oscillations of the voltage about the tolerance band limits, it may be necessary to perform a tap change. To this end, the "Trend memory" function can be used (see trend memory from page 139 onwards).

Time program



The time program parameter defines the relationship between the current setpoint deviation and the reaction time of the regulator. The user can specify whether the response time is dependent linearly, hyperbolically or in taps on the setpoint deviation.

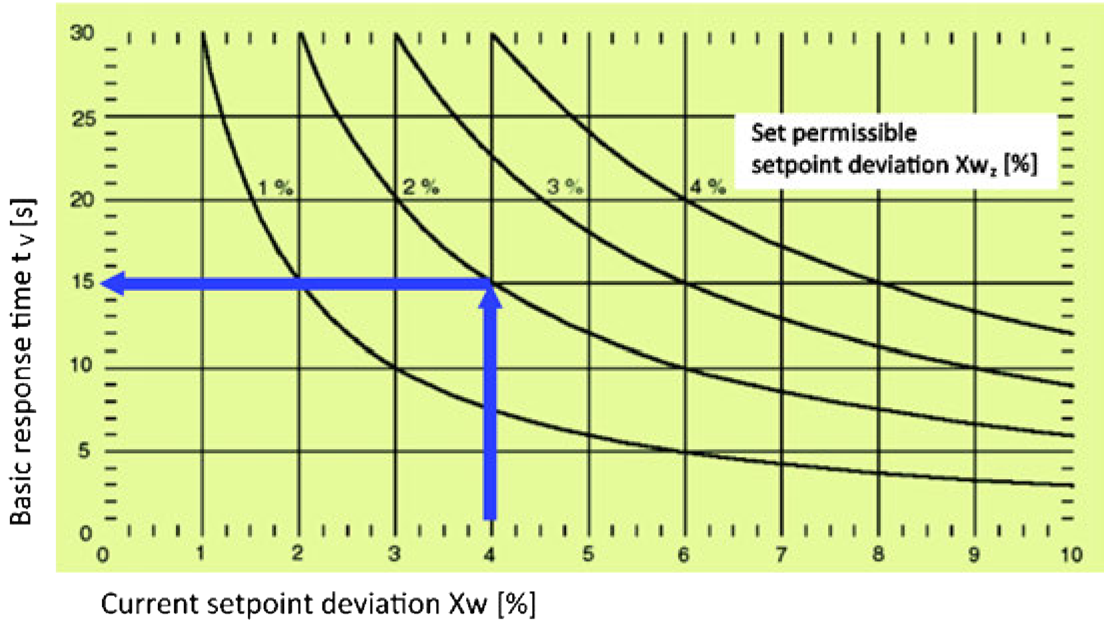
A reaction time independent of the setpoint deviation is also feasible. In order to realize these different possibilities, the REG-D™ has four time programs.

Time program	Characteristic
0:Integral	With increasing setpoint deviation, the reaction time decreases hyperbolically, the time factor is used.
1:Fast_Integral	As with Integral, faster response time corresponds to the time behavior of the analog voltage regulator Fast_Integral, the time factor is used
2:Linear	With increasing setpoint deviation, the reaction time decreases linearly, the time factor is used.
3:CONST	The reaction time is up to twice the permissible setpoint deviation T1 and then T2, the time factor is not used.

Please note that the actual switching delay can be up to 2s greater than the configured switching delay. The difference is due to the selected measurement value averaging procedure.

Time program Integral

With the time program "Integral" there is a non-linear (hyperbolic) relationship between the setpoint deviation and the reaction time. The basic reaction time at constant setpoint deviation can be read from the following chart. Depending on the set permissible setpoint deviation, different characteristics are seen in the diagram.



Example:

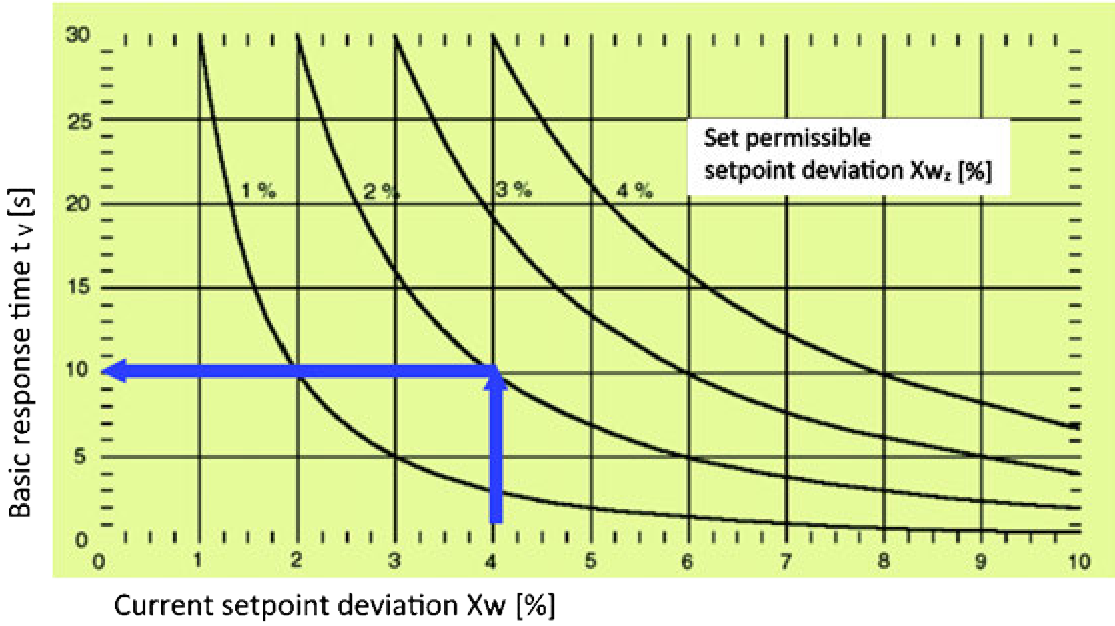
Current setpoint deviation Xw = 4.0%

Set permissible setpoint deviation Xw_z = 2.0%

Basic response time t_V = 15s (with time factor = 1)

Time program Fast Integral

With the time program Fast Integral there is also a hyperbolic relationship between the setpoint deviation and the reaction time. Compared to the time behavior of Integral, the response times with the Fast Integral program are lower. This time behavior corresponds to the analog voltage regulator Fast Integral. The basic reaction time at constant setpoint deviation can be taken from the following chart. Depending on the set permissible setpoint deviation, different characteristics are seen in the diagram.



Example:

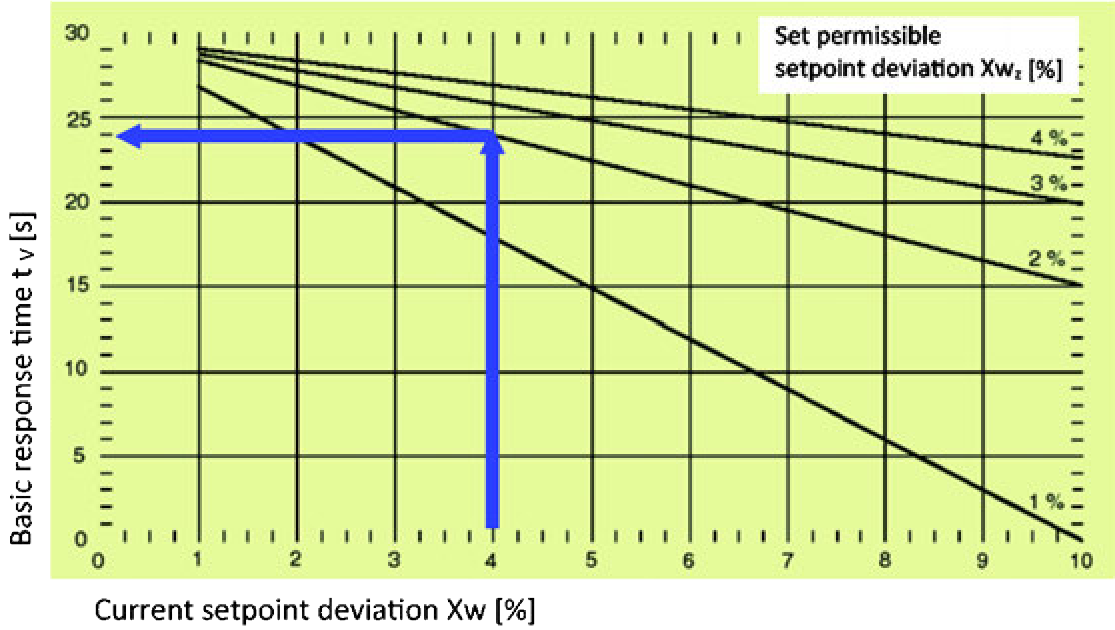
Current setpoint deviation Xw = 4.0%

Set permissible setpoint deviation Xw_z = 2.0%

Basic response time t_V = 10s (with time factor = 1)

Time program LINEAR

With the time program LINEAR, there is a linear relationship between response time and setpoint deviation. Thus, the influence of the momentary setpoint deviation on reaction time is less than with the hyperbolic curves at Integral and Fast Integral. The basic reaction time at constant setpoint deviation can be taken from the following chart. Depending on the set permissible setpoint deviation, different characteristics are seen in the diagram.



Example:

Current setpoint deviation Xw = 4.0%

Set permissible setpoint deviation Xw_z = 2.0%

Basic response time t_V = 24 s (with time factor = 1)

Time program CONST

As regards the time behavior with CONST, the reaction time depends on the setpoint deviation, either the time T1 or the time T2.

|setpoint deviation| < 2 x permiss. setpoint deviation, then reaction time is equal to T1

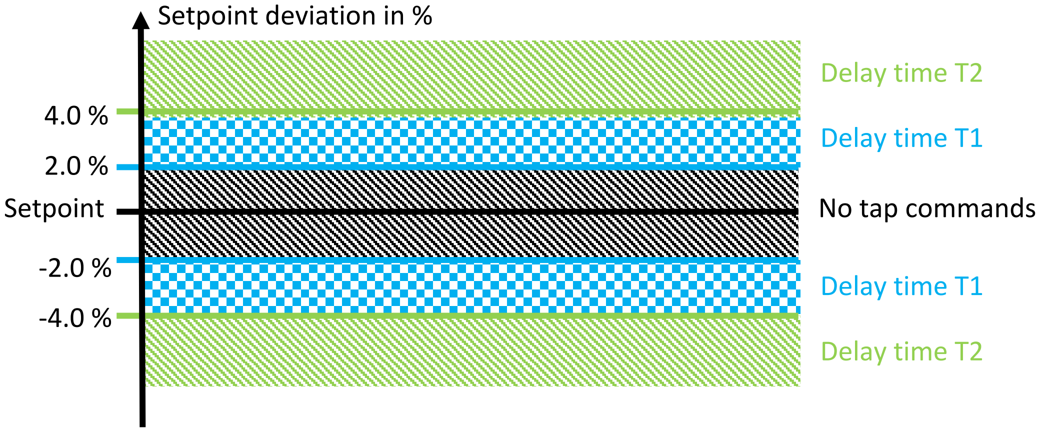
|setpoint deviation| ≥ 2 x permiss. setpoint deviation, then reaction time is equal to T2

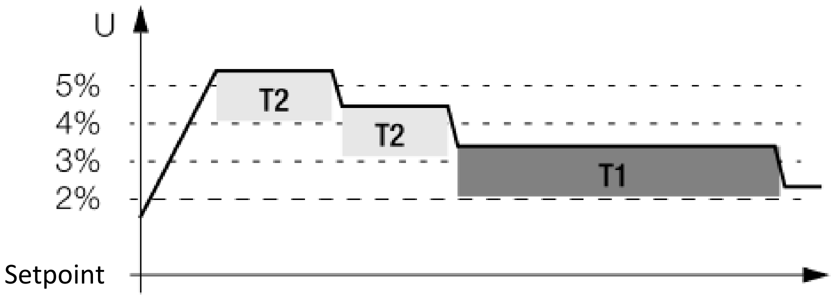
No time factor!

The time factor is not used in this time program!

Example:

Permissible setpoint deviation 2.0 %



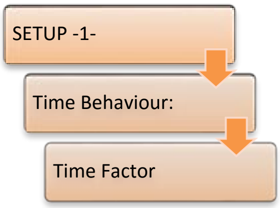


Typical setting for T1/T2

A general recommended setting can be that the time T2 should be shorter than the time T1, since large setpoint deviations must be corrected faster than small setpoint deviations.

If the times T1 and T2 are set equal, then the response time will always be the same regardless of the current setpoint deviation.

Time factor



The time factor is used in the following time programs for adjusting the response time to the requirements of the installation or customer.

- Integral
- Fast Integral
- LINEAR

Taking into account the time factor, the reaction time of the regulator is given by:

$$t_V = t_B \times Time\ factor$$

t_V: reaction time

t_B: basic reaction time of the time program

The time factor can be set in the range of 0.1 to 30. That is, it is possible to speed up the basic reaction time by a factor of 10 (time factor 0.1) or slow down the delay time by a factor of 30 (time factor 30).

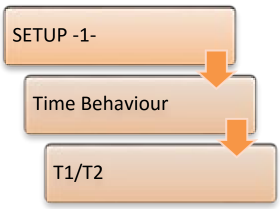
Typical setting of the time factor

In practice, one usually works with a time factor of 2 to 3. A general recommendation cannot be given at this point, since the correct time factor results from the respective existing grid and customer situation.

Time factor in the time program CONST

The time factor parameter is not available in the time program CONST.

T1/T2



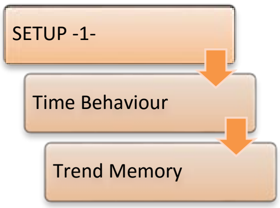
In the menu T1/T2, the reaction times T1 and T2 can be set for the time program CONST. Switching between T1 and T2 is done with the F3 key.

The delay times T1 and T2 can be set in the range 1 to 600s.

Available only with the time program CONST

The parameters T1/T2 are only available with the time program CONST.

Trend memory



Using the parameter "Trend memory" all time programs can be provided with a "short-term memory" of setpoint deviation. The trend memory operates in the following manner:

When voltage leaves the tolerance band, the integration process is started. The regulator changes the tap position after a certain time determined by various parameters (set permissible setpoint deviation, actual setpoint deviation, time factor).

However, if the voltage returns to the preset band and the regulator could not issue a tap command, the integrator is not immediately set to zero, but it reduces its stored value at a constant pace.

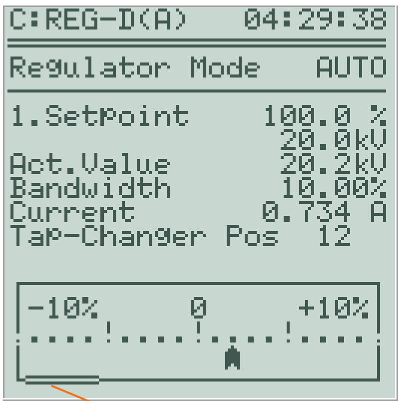
If the voltage leaves the tolerance band again a short time later, the tap command tends to be issued earlier, because the integrator has not yet been emptied and can therefore be completely filled more rapidly.

In contrast, if a tap command is issued, the memory will be reset to zero.

Thus, using the parameter "Trend memory" one can achieve that the integrator is not immediately reset when the voltage returns to the permissible tolerance band. If the voltage leaves the band at a time when the memory is not completely discharged, the regulation algorithm will be able to respond earlier because the integration or filling process does not start from zero, but from a higher level.

The general rule is: For the memory charging process that triggers a tap command in the case of a 100% charge, the time according to the selected time program is critical. However, for complete discharge of the memory at 100% charge, the time configured as trend memory time is critical.

The trend memory can be set in the range of 0 to 60s. A setting of zero is indicated with "---" and means that the function is turned off.



The progress bar runs backwards (according to the set trend memory time).

As long as the memory is being filled – the voltage thus being outside the tolerance band – the progress bar is shown as a black bar. If the voltage returns within the tolerance band, the middle of the bar will be highlighted while emptying the trend memory.

Example:

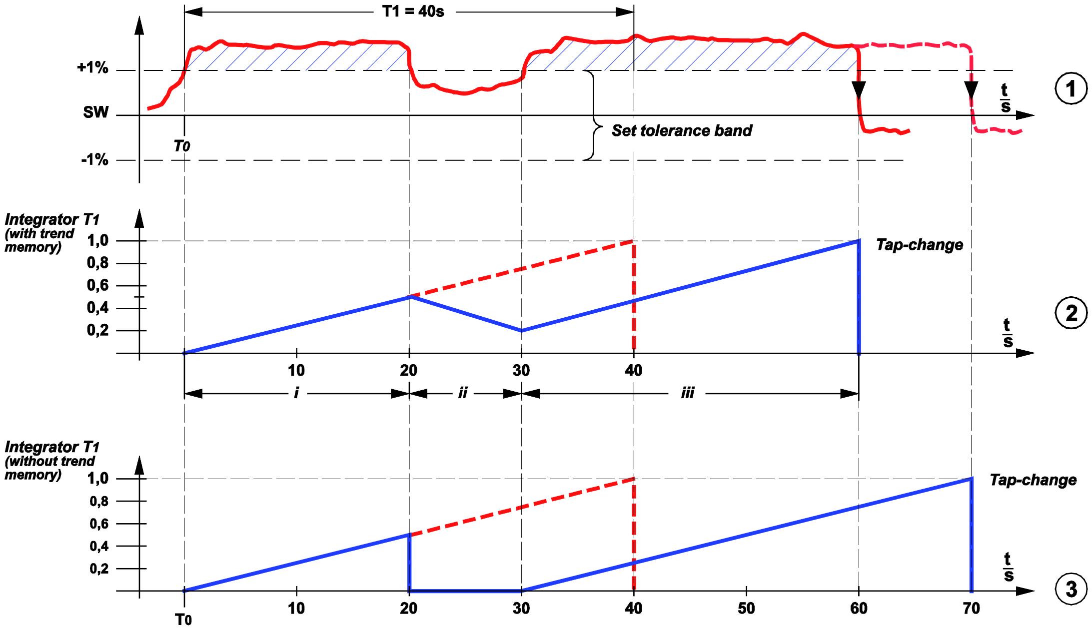
Operation of the trend memory will be explained with an example.

Time program: CONST

T1: 40 seconds

Trend memory: 40 seconds

Permissible setpoint deviation: ±1%



The overall status is illustrated by the three graphs above.

Graph 1 shows the curve of voltage over time. At the time T0 the voltage leaves the tolerance band to return to the band after 20 seconds.

After another 10 seconds, the voltage again leaves the permissible tolerance band to be returned after another 30 seconds due to a down tap command from the regulator, if the trend memory is used.

Without a trend memory, the tap change would be performed only after 40s (see graph 3).

Graph 2 describes filling of the trend memory. When the fill level reaches the normalized value 1, the regulator makes a tap change. However, if the curve reaches the x-axis (value 0) the memory is emptied.

Graph 3 shows the temporal relations without the trend memory. After 20 seconds the integrator for T1 is set to zero, to be recharged after another 10 seconds, starting from zero charge. Now a total of 40 seconds (T1) are needed to fill the memory to such an extent that a setting process can be initiated.

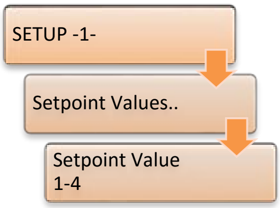
Functioning of the trend memory can best be explained with the aid of graph 2. In order to explain the individual steps better, the diagram is divided into three sections (i ... iii).

Section i: The voltage lies outside the voltage band, the integrator for the time T1 is running. If the voltage remained for 40 seconds outside the tolerance band, the regulator would issue a tap command, but since the voltage returns to the tolerance band already within 20 seconds, integration is interrupted at this point.

Section ii: The integrator for T1 is half charged (with a total of 50%, or 20 seconds!). Now the discharge starts according to the time setting given for the trend memory (100% => 40 seconds).

Section iii: The voltage only remains within the permissible tolerance band for 10 seconds and then again exceeds the allowable voltage range. In this period, the integrator could only be emptied from a fill level of 50% to 25% (25% => 10 seconds). If the voltage remains for 30 seconds outside the band, the regulator will initiate a command process. With the voltage curve selected in the example, the time up to initiation of the control algorithm is shortened from 70 to 60 seconds by use of the trend memory (see graph 3).

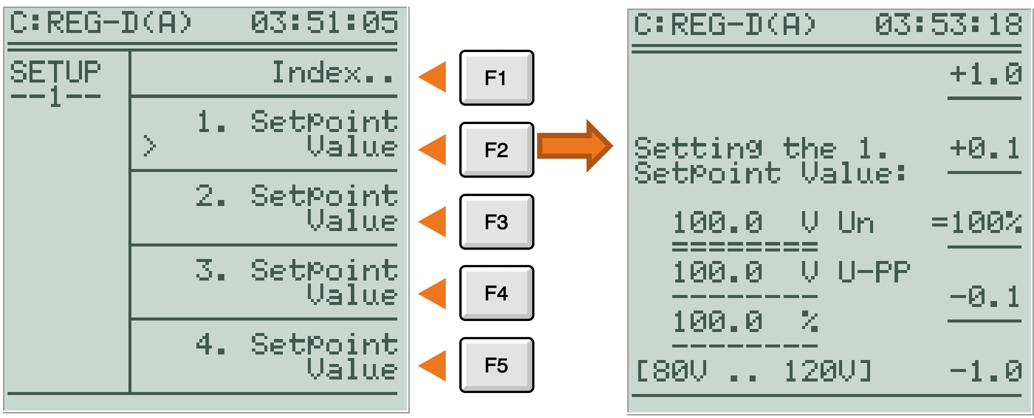
8.1.2.3 Setpoints 1 - 4



The setpoints make the reference value for regulating the tap changer (further details regarding reference value W can be found at the end of the chapter). The active setpoint is located in the middle of the tolerance band (setpoint ± permissible setpoint deviation).

The REG-D™ has four adjustable setpoints.

Generally there are two ways to change a setpoint for regulation. The first is changing the setpoint index. This switches between the four predefined setpoints without changing the value of the setpoint itself. The second way is to leave the setpoint index, and adjust the value of the setpoint. Thus, modification of the individual setpoint can take place via menu, H program, SCADA system, WinREG, arrow keys (only for setpoint 1) and binary inputs (only setpoint 1). Also a combination of changing the setpoint value and changing the setpoint index is possible. For example, setpoint 2 can be used for regulation while setpoint 1 is adjusted. When adjustment has been completed, setpoint 1 is activated through the set point index.



Setting of the setpoint is done with a secondary value (e.g. 101.5 V). This also applies to a setting via REG-L (H-program, WinREG, SCADA system). In addition, indication of the setpoint (phase-to-phase voltage Upp) as a primary value (e.g. 20.3 kV) takes place. For scaling of the primary value, the transformer factor (Knu) of the voltage transformer is used (see chapter 8.1.7.20 CT/VT configuration, from page 198 onwards). When using the three-winding transformer function with two different transformer factors (see chapter 8.3.5 Feature 3winding (three-winding transformer) [protected], from page 253 onwards), scaling is performed with the transformer factor of the currently active winding.

For voltage regulation, the setting range for setpoints is 60 to 140 V. With power regulation, the range is from -140 to 140% of the nominal power (for more information see chapter 8.3.7. Feature PQCtrl [protected], from page 261 onwards).

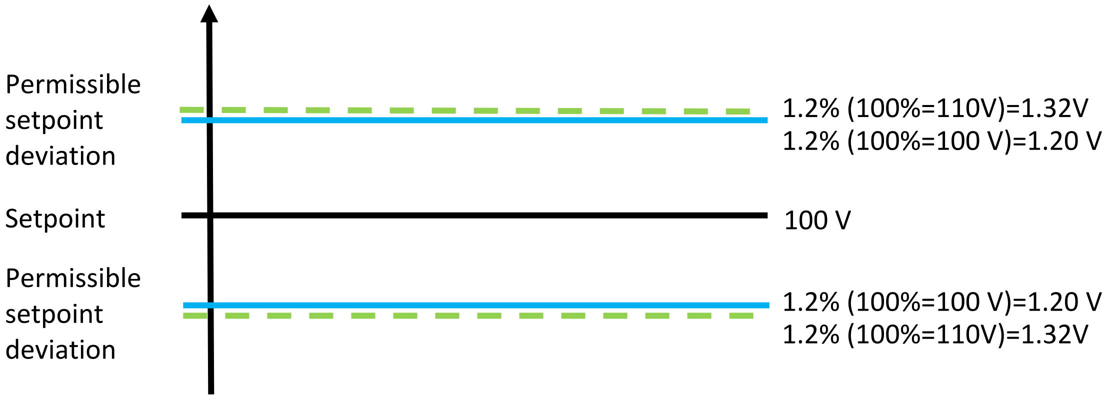
The 100%-value for each setpoint can be defined using the F3 key. Thereby, the currently set setpoint value (e.g. 101.5 V) is defined to be 100%. The 100%-value (also called setpoint deviation) sets the reference value for all limits, which are set as a percentage (so long as the parameter limit base is set to 0:setpoint, see chapter 8.1.7.13 Limit base, from page 193 onwards). That is, if the 100%-value is set to 110 V, for example, 1 % = 1.1 V corresponds for all indications and limits. Since this setting is possible for each setpoint, depending on the setting, switching of the setpoint index (e.g. 1st setpoint -> 2nd setpoint) has an influence on the absolute magnitude (voltage value in volts) of the limits.

The size of the following limit and calculated values depend on the 100%-value:

- Permissible setpoint deviation (tolerance band)
- Current setpoint deviation (display and regulation)
- High-Speed Switching
- Undervoltage <U
- Overvoltage >U
- Shutdown

Example based on permissible setpoint deviation:

1. Setpoint = 100 V = 100 %	1. Setpoint = 100 V = 90,9 % (110 V = 100 %)
Permissible setpoint deviation = 1.2 %	Permissible setpoint deviation = 1.2 %
lower tolerance limit = 98.8 % = 98.8 V	lower tolerance limit = 89.7 % = 98.68 V
upper tolerance limit = 101.2 % = 101.2 V	upper tolerance limit = 92.1 % = 101.32 V



With power regulation (P-/Q-regulation) always apply:

100%-value = 100 V for voltage limits

100%-value = nominal power for power limits (e.g. tolerance band)

High-speed switching for setpoint changes

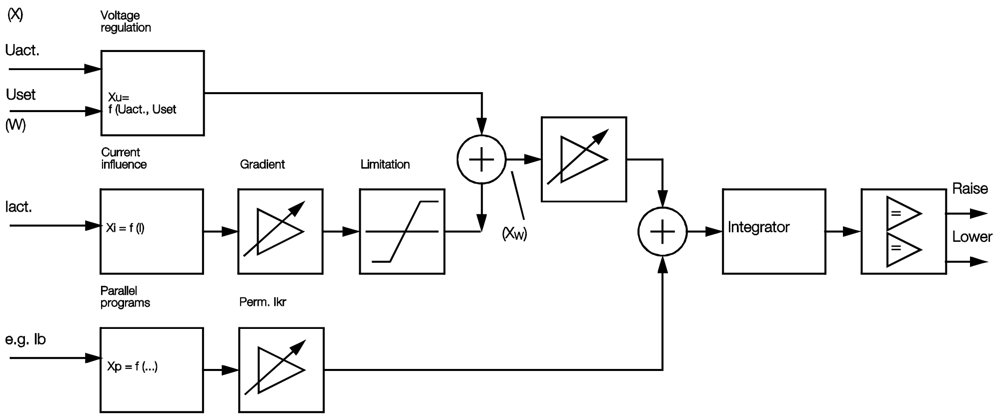
By default, high-speed switching is activated after changing the setpoint. This serves to bring the voltage as quickly as possible to the new setpoint. If this behavior is not desired, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Limited setting range for older devices

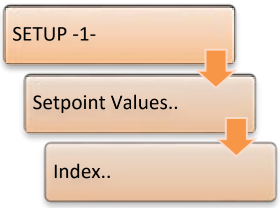
Depending on the hardware configuration of the REG-D™, adjustment of setpoints can be limited to 80 V to 120 V or -120% to 120% with older devices.

Reference value W

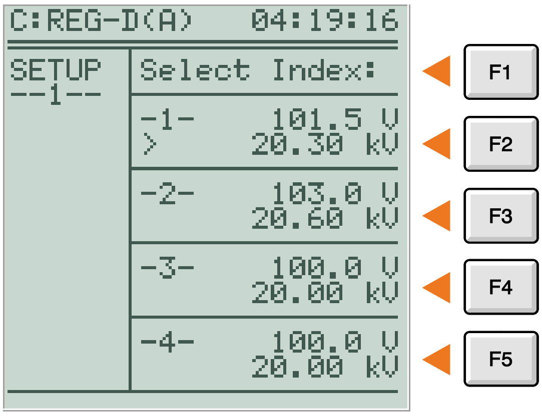
The reference value W for the voltage of the tap-changing transformer can be either a fixed value (setpoint) or a variable value (setpoint + variable component). A variable reference value can, for example, consist of a fixed setpoint and the current influence, for example, to regulate a remote network point with variable load and variable primary voltage. In addition to a fixed or variable reference value W, an active parallel program based on the circulating reactive current minimization procedure (dIsin(φ), dIsin(φ)[S] or dcos(φ)) can influence integration of the selected time program, and hence the issue of of setting tap commands. The interaction is illustrated in the following function diagram.



8.1.2.4 Setpoint index



The setpoint used for regulation can be selected via the setpoint index menu. You can choose between the four pre configured setpoint values 1 – 4. In the selection, the secondary and the primary values are shown for each setpoint.



The setpoint index is selected with the keys F2 to F5. The currently active setpoint is marked by an angle bracket ">".

Additional ways to select setpoint index

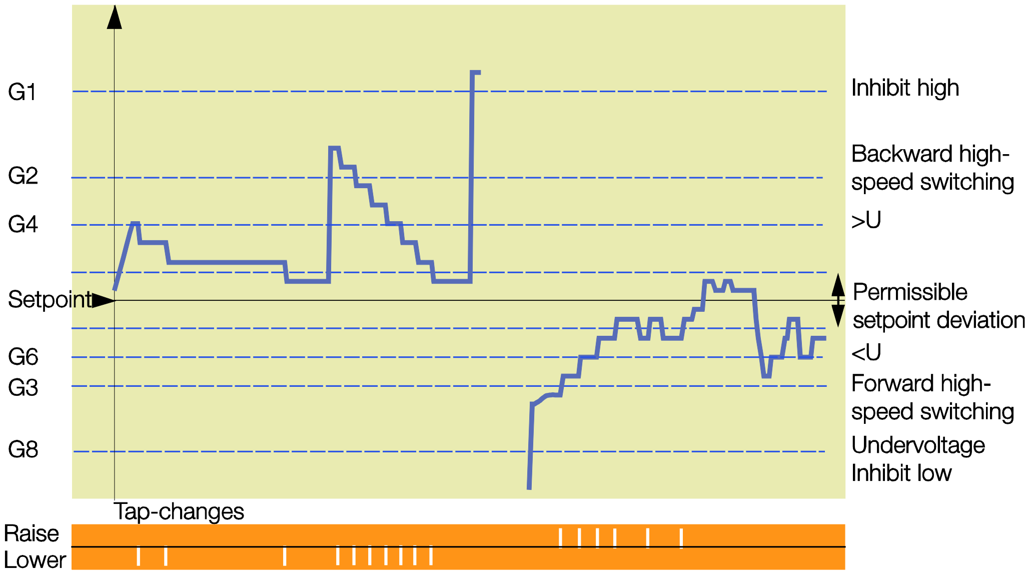
Besides selection via the setpoint index menu, the setpoint index can be switched via binary inputs (see chapter 8.1.7.18 Setpoint adjustment with binary inputs, from page 196 onwards), the arrow keys (see chapter 8.1.7.17 Setpoint adjustment with ←→ keys, from page 196 onwards), the background program, the service module of WinREG and via the SCADA system.

By default, high-speed switching is activated after changing the setpoint This serves to bring the voltage as quickly as possible to the new setpoint. If this behavior is not desired, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

8.1.3 Limit values

8.1.3.1 General

The REG-D™ limit values allow monitoring and reaction to specific events in the power grid (e.g. undervoltage). The following graph shows the available in standard voltage limit values.



Switching hysteresis, switching difference X_{sd}

The difference in the input value between switching the limit signal on and off after vanishing of the limit violation is referred to as switching differential. The switching differential X_{sd} has a standard value of 0.5% of the nominal value of the monitored measured value. It can be customized if necessary, To do so, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

The high-speed switching limit and the limit value >Ub use no hysteresis, because here limit values for activating and deactivating the signal vary (e.g. activation on reaching the high-speed forward switching limit and deactivation on reaching the lower tolerance band limit).

Assignment of the limit signal indicator

Each of the limits listed below is monitored by a respective limit signal indicator For certain limit signal types a special additional function is activated (e.g. high-speed switching).

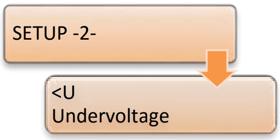
You can select via a menu whether a limit violation activates a binary output or drives an LED. The assignment is carried out via the menu item "Relay/LED assignment" (see chapter 8.2.3 Relays, page 213, or chapter8.2.4 LEDs, page 217). The signals can also be passed on via the SCADA system.

Additional limit values

Any number of additional limit signal indicators can be created using the programming language REG-L (as a background program).

NOTICE!	**Reasonableness of limits!** Incorrect function of limit value monitoring or influence on regulation. ➲ For each limit signal indicator, the limit value can be set arbitrarily within a predetermined range. The user must therefore check the logical relations of the values with each other.

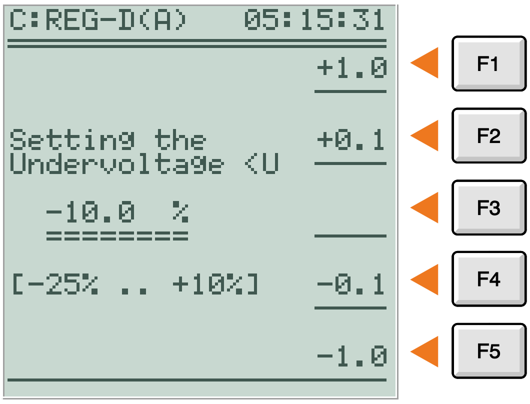
8.1.3.2 <U undervoltage (G6)



The undervoltage <U is a limit value, which only influences regulation in special operating circumstances, and can be configured to a LED or an output relay, if necessary.

If the voltage goes below the limit value <U all down commands are suppressed.

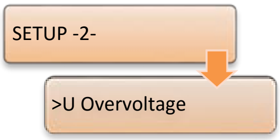
The reference value (setpoint/100 V/110 V) for undervoltage can be selected with the parameter "Limit base" (see chapter 8.1.7.13 Limit base, page 193). Especially when working with multiple setpoints, by selecting a fixed reference value (100 V / 110 V) the limit can be fixed for undervoltage, independent of the setpoint used.



Suppression of the undervoltage message <U

From firmware version 2.00, the <U message is suppressed when the measured voltage is less than 20 V.

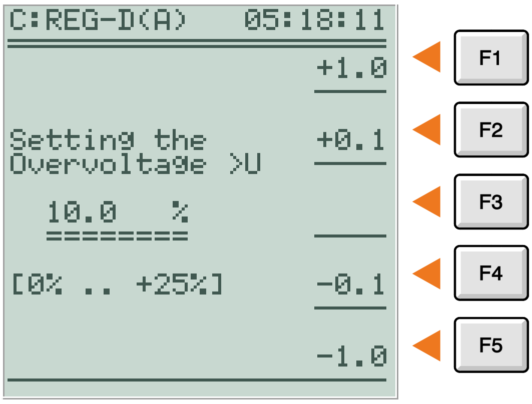
8.1.3.3 >U overvoltage (G4)



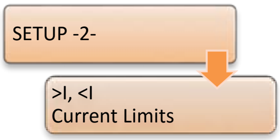
The overvoltage >U is a limit value which only influences regulation in special operating circumstances, and can be configured to a LED or an output relay, if necessary.

If the voltage exceeds the limit >U, all up commands are suppressed.

The reference value (setpoint/100 V / 110 V) for overvoltage can be selected with the parameter "Limit base" (see chapter 8.1.7.13 Limit base, page 193). Especially when working with multiple setpoints, by selecting a fixed reference value (100 V / 110 V) the limit can be fixed for overvoltage, independent of the setpoint used.



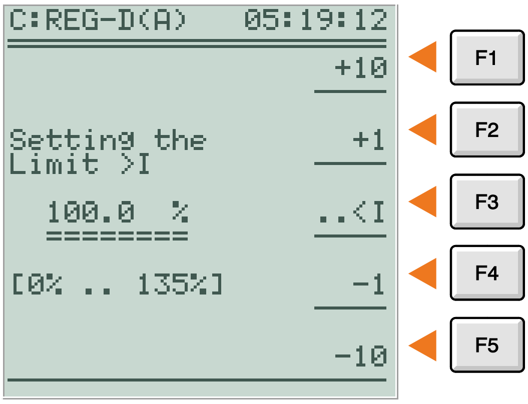
8.1.3.4 Over- and undercurrent limit (>I, <I)



The limits overcurrent and undercurrent are used to monitor the transformer current. The regulator can be optionally inhibited on exceeding or falling below the corresponding limit (no issuing of tap commands.). However, the Inhibit function is only activated if it has been activated previously with the "Shutdown at <I or >I" parameter (see also chapter 8.1.7.14 Block if <I or >I, page 194).

The selected nominal value (1 A or 5 A) always applies as limit base.

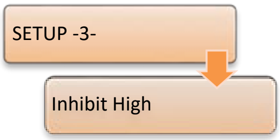
The limit signal can be set to a binary output, if needed. The limit violation can also be signalled by a freely programmable LED. Transmission via the SCADA system is also possible.



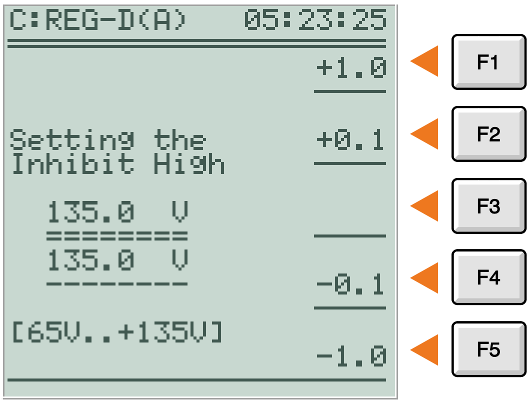
Change between the setting values for overcurrent (>I) and undercurrent (<I) is done by pressing the F3 key.

⚠ WARNING!	**Overcurrent limit as protection against transient overcurrents, e.g. short circuits!** Damage to the tap changer and/or the transformer. ➲ Use the overcurrent limit only for protection of the tap changer against stationary overcurrents, which last more than one second. Due to the measured value averaging procedure, the limit switch is not suitable for short-circuit protection.

8.1.3.5 Inhibit high (G1)



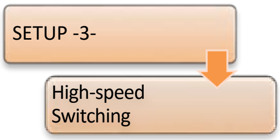
The limit "Inhibit high" is an upper absolute voltage limit, which causes the regulator not to tap further. Exceeding the limit is indicated as plain text on the screen, and, if necessary, can activate a relay that either triggers a protective element or only transmits this as information to the central control. If the voltage becomes lower than the limit (minus hysteresis), the regulator operates in the usual manner. The setting range for Inhibit high is 65 V to 150 V. The voltage is understood as the secondary-side output voltage of the voltage transducer and can only be entered as an absolute value.



The Inhibit high limit as an absolute value

The Inhibit high limit is definable as the only limit set as an absolute value (therefore not as a relative value). The reason for this is that the Inhibit high limit is considered to be the maximum tolerable voltage, beyond which the regulator is stopped and possibly a protective element is triggered. Relative values that relate, for example, to the current setpoint, can, however, cause wandering of this limit on switching between different setpoints. Therefore, the triggering limit can only be set as an absolute value.

8.1.3.6 High speed switching at over-/undervoltage (G2 or G3)



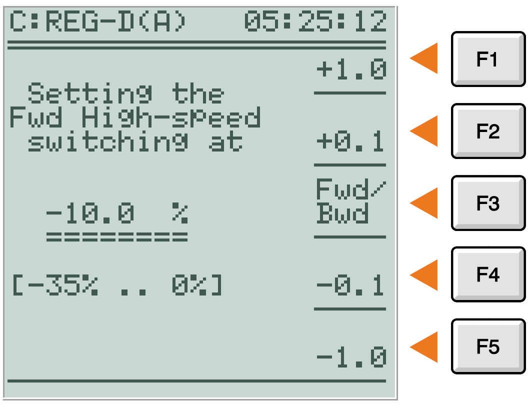
When the voltage leaves the tolerance band, a particular time program will run. The time program determines after which time the regulator issues the first and possibly the next tap commands.

All time programs are based on the consideration that large voltage deviations are corrected rapidly and small voltage deviations slowly.

The high-speed switching limit marks the voltage beyond which the time program is ignored, and the regulator returns the transformer to the voltage band in fast time, which is described by the permissible setpoint deviation parameter.

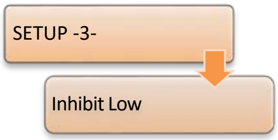
The high-speed switching time is determined by the TC in operation time of the transformer per switching process. With the TC in operation signal connected, the regulator waits with the next tap change until the TC in operation signal switches off. If no TC in operation signal is connected, the switching frequency adjusts itself to the parameter "TC in operation signal maximum time" (see chapter 8.1.6.1 Maximum TC in operation time (run time of motor drive), page 181).

The limit base for the high-speed switching limit is always the setpoint. High-speed switching is enabled when the corresponding limit value is reached. High-speed switching is disabled when the voltage returns to the tolerance band (within the permissible setpoint deviation), or the device is switched to MANUAL mode.



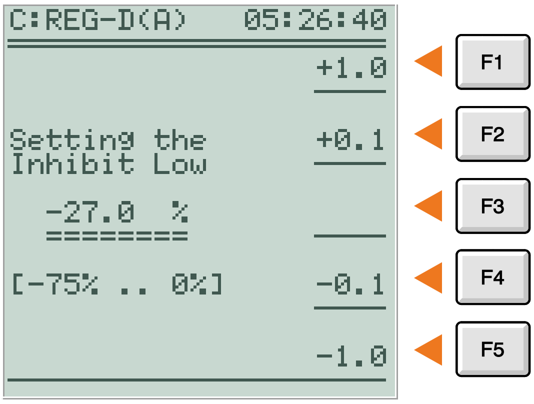
Switching between the setting values for high-speed forward switching (undervoltage) and high-speed backward switching (overvoltage) is accomplished by pressing the F3 key.

8.1.3.7 Inhibit low (G8)

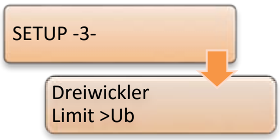


If the voltage goes below the limit for Inhibit low, the regulator shuts down. This means that automatic regulation is blocked and no more tap commands are issued. If the voltage exceeds the limit (plus hysteresis), the regulator operates in the usual manner.

The reference value (setpoint/100 V/110 V) for Inhibit low can be selected with the parameter "Limit base" (see chapter 8.1.7.13 Limit base, page 193). In particular, when working with multiple setpoints, the Inhibit low limit can be fixed regardless of the setpoint used by selecting a fixed reference value (100 V / 110 V).



8.1.3.8 Three-winding limit >Ub (monitoring non-regulated voltage)



The limit >Ub is used to monitor the non-regulated voltage in an application with a three-winding transformer which has only one tap changer. Here, in general one of the two secondary voltages is selected for regulation. The other voltage can be monitored for exceeding an adjustable limit (>Ub). If the limit is reached, then up commands are blocked.

Reaching the limit can be reported via LED, relay or the SCADA system. Moreover, in the transducer display the limit >Ub is prefixed by two exclamation marks (for example, !! >U(2) = 5.0%).

The reference value (setpoint/100 V/110 V) for shutdown can be selected with the parameter "Limit base" (see chapter 8.1.7.13 Limit base, page 193).

The limit >Ub is activated when the limit value is reached and deactivated when the monitored voltage reaches a defined limit value as follows, or the device is switched into the manual mode. Evaluation of the limit >Ub occurs only in AUTOMATIC mode.

Limit value for deactivation of >Ub:

The monitored voltage must be less than the value obtained from adding the reference value (secondary value) to the permissible setpoint deviation (in secondary volts).

Example: Three-winding transformer limit >Ub:

Three-winding transformer: 110 KV -> 20 kV / 10 kV;
transducer factors 20 kV: 200 ± 10 kV: 100

Perm. setpoint deviation 1.5 %

Setpoint value 1:	101 V
100%-value:	100 V
	(Limit base setpoint -> 100%-value of the active setpoint) (Limit base 100 V -> fix 100 V) (Limit base 110 V -> fix 110 V)
>Ub limit value:	5 %
Limit base:	setpoint (reference value)

The 20 kV level is regulated, the 10 kV level is monitored.

<u>Activation >Ub:</u>

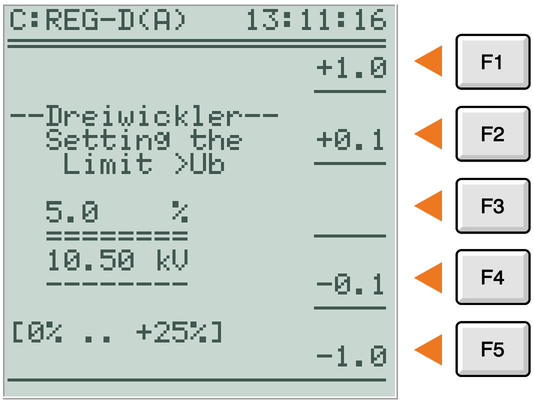
$>Ub_{active}$ = reference value + (>Ub limit * 100%-value/100%) = 101 V + (5% * 100V / 100%) = 106 V -> 10.60 kV

The limit> Ub becomes active as soon as the 10 kV level reaches a voltage of 10.6 kV.

<u>Deactivation >Ub:</u>

$>Ub_{inactive}$ = reference value + (bandwidth * 100%-value/100%) = 101 V + (1.5% * 100V / 100%) = 102.5 V -> 10.25 kV

The limit >Ub becomes inactive as soon as the 10 kV level drops below a voltage of 10.25 kV.

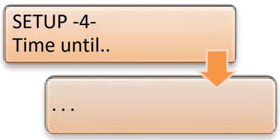


Three-winding transformer application and availability of the parameter "Three-winding transformer limit> Ub"

For a three-winding transformer application, the REG-D™ must have the corresponding hardware equipment (feature M9) and the software feature 3winding activated.

The parameter >Ub is only available when the software feature 3winding with limit monitoring is used (see chapter 8.3.5 Feature 3winding (three-winding transformer) [protected], page 253).

8.1.3.9 Time delay of limit values

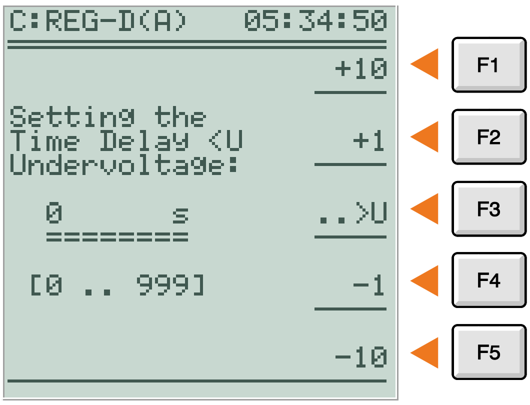


The time difference between reaching the limit value and the signal output is referred to as switching delay.

An separate switching delay can be configured for each of the following limit signal indicators:

- <U undervoltage
- >U overvoltage
- Inhibit high
- Block
- High-speed forward switching (not shorter than 2s adjustable)
- High-speed backward switching
- Over- and undercurrent (only one time delay)

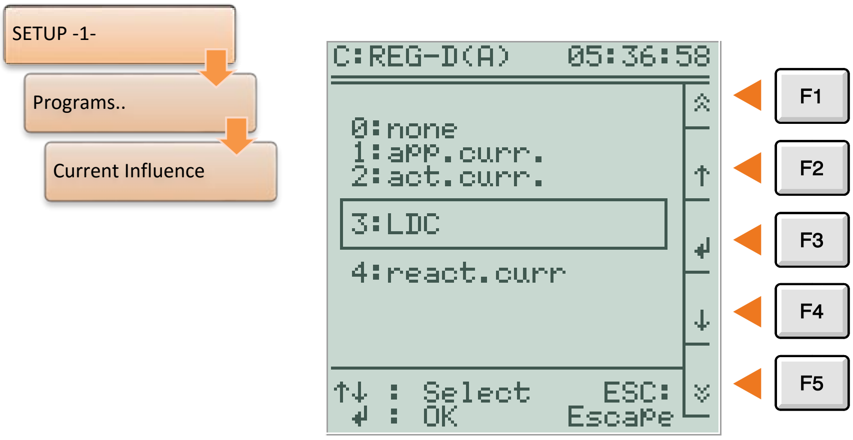
The setting of time delay takes place partly in a common menu (<U and >U, high-speed switching, >I and <I). Here, switching between the individual settings is done with the F3 key.



Actual switching delay

Please note that the actual switching delay can be up to 2s greater than the configured switching delay. The difference is due to the selected measurement value averaging procedure.

8.1.4 Current influence



Current-dependent setpoint influence, setpoint = f (I)

The current-dependent setpoint influence allows dynamic adjustment of setpoint by the load current of the transformer. This, for example, permits compensation of voltage drop on the supply line to the consumers. Moreover, by lowering the voltage setpoint at the transformer, it is possible to oppose voltage increases caused by decentralized grid generation plants.

Display of current influence

For a representation of the regulator basic display with current influence, see chapter 7.2.4 Current influence, page 111.

Total current (only relevant with active parallel operation)

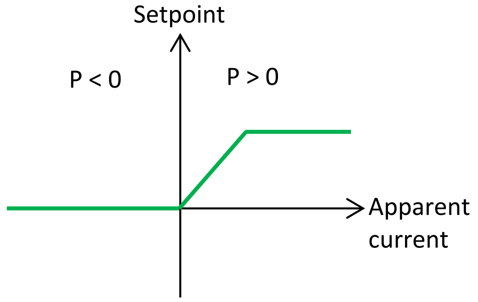
By means of networking the REG-D™ with all transformers connected in parallel via a bus, the currents of all transformers can be summed in one regulator. This total current and the selected slope of the Uf/I_L-characteristic gradient serves as a uniform basis for the current-dependent influence of the reference value W for all regulators.

Due to the use of the normalized total current, setting of the gradient of the $Uf/_L$-characteristic curve can be performed regardless of the number and also the different characteristic data (nominal power, short circuit voltage) of the parallel-switched transformers, so that changes in these parameters require no readjustment of the gradient St_{Nom}.

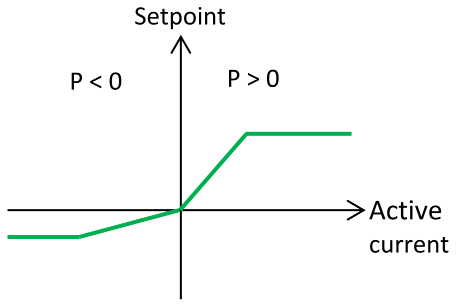
Current programs

In general, the following programs for current-dependent influencing of the setpoint are available:

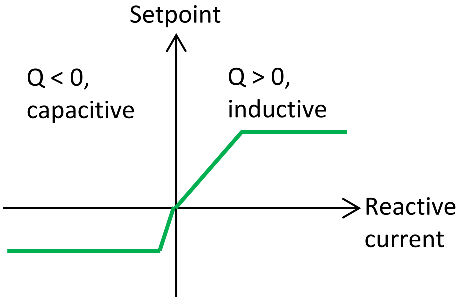
- Apparent current-dependent setpoint influence
  In this program, the apparent current is used to determine the voltage boost. Raising of the setpoint only takes place when the active power is positive. Lowering of the setpoint in case of a reverse power flow does not take place. The current program only uses the parameters "Gradient (I) pos." and "Limitation (I) max."



- Active current-dependent setpoint influence
  This program uses the effective current to determine setpoint change. If a positive active current flows (P > 0, consumption), the setpoint is increased. If a negative active current flows (P < 0, feedback), the setpoint is decreased. The current program will use the parameters "Gradient (I) pos.", "Gradient (I) neg.", "Limitation (I) max." and "Limitation (I) min.".



- Reactive-current dependent setpoint influence
  The reactive current is used to modify the setpoint. The boost/drop is independent of the sign of the active power. With inductive reactive current, a boost takes place, with capacitive reactive current, a drop of the setpoint occurs. The current program will use the parameters "Gradient (I) pos.", "Gradient (I) neg.", "Limitation (I) max." and "Limitation (I) min.".

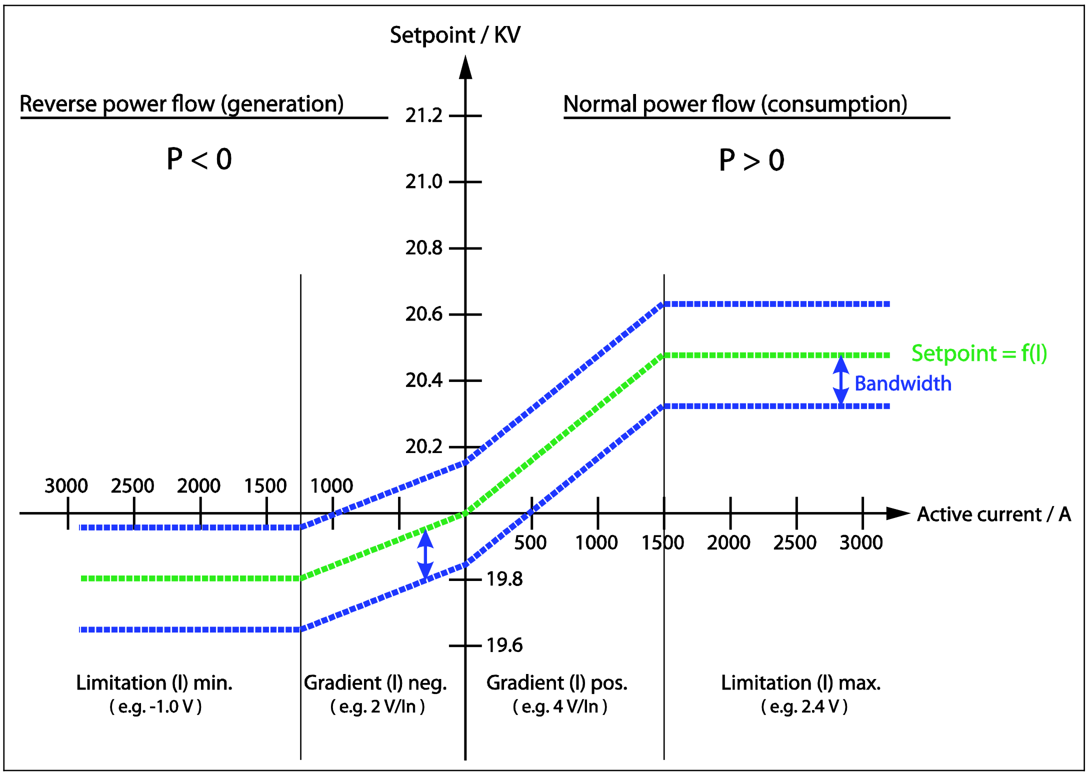


- LDC (Line Drop Compensation)
  Is used to compensate for the voltage drop on a line whose active and reactive resistance is known. Here, the voltage drop on the line is calculated using a simplified line equation. The parameters "Gradient (I) pos." and "Gradient (I) neg." are not used in this procedure.
  The parameters "Limitation (I) min." and "Limitation (I) max." remain effective.

NOTICE!	**Incorrect power direction!** Incorrect function of the current influence and thereby deterioration of the mains voltage. ➲ Correct connection and configuration of the current and voltage transformers (control in transducer mode possible). ➲ Compliance with A. Eberle definitions, such as the active power direction (supply: P>0, see chapter 7.2.2.2 Taking measurement, page 86)

Characteristic curve with Gradient (I) and Limitation (I)

The figure below shows the basic course of the setpoint characteristic curve as a function of transformer current for the example of a 20 kV grid (current transformer 2500 A/1A) and the current-influence program active current.



The basic setpoint of 20.0 kV (setpoint with no effective current) is increased or decreased according to the settings for the slopes and the limits, depending on current and the effective power direction measured by the regulator. The size of the tolerance band hereby remains constant and moves up and down with the setpoint value.

Gradient (I) for the current programs apparent current, active current and reactive current

The influence of current on the setpoint can be set via the parameter Gradient (I). The characteristic curve "Setpoint = f (I)" describes a line through the origin. The origin thereby forms the configured setpoint, which is used for regulation at I = 0. The two parameters "Gradient (I) pos." and "Gradient (I) neg." always have a positive sign as they describe rising straight lines. The setting of the Gradients indicates by how many volts (secondary value) the setpoint is raised or lowered on reaching the nominal current of the current transducer. A value of "Gradient (I) pos." of 4 V/In in the above example means an increase in the nominal value by 4 V (corresponding to 800 V primary) at I = In = 2500 A.

"Gradient (I) pos." Is used in raising the setpoint. "Gradient (I) neg." Is used in lowering the setpoint. Depending on the selected current-influence program, the setpoint is raised or lowered due to the apparent current (only increase), active current or reactive current. Both Gradient settings are not used with the LDC program.

The Gradient (I) can be calculated using the following formula:

$$St = \frac{\Delta U}{Knu \times I_{xd}} \qquad [St] = \frac{V_{sek}}{I_n}$$

Where:

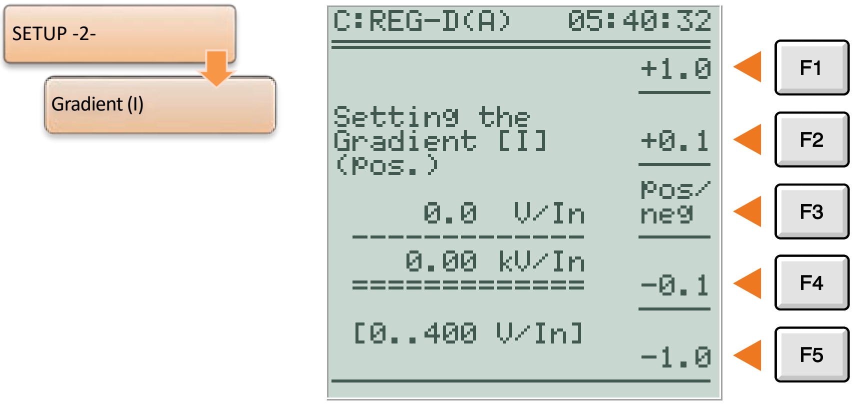
St: Gradient (I) for lowering (neg.) or raising (pos.)

ΔU: lowering or raising of the setpoint as primary value (e.g. 800 V)

Knu: Factor of the voltage transducer

I_{xd}: Current for which ΔU is to be achieved, as a multiple or fraction of the nominal current of the current transformer

$$I_{xd} = \frac{I}{I_n} \times I_n \qquad [I_{xd}] = I_n$$



Switching between "Gradient (I) pos." and "Gradient (I) neg." is done with the F3 key.

Limitation (I)

In order to prevent unwanted high or low setpoints from occurring in modifying the setpoint via current-influence, raising or lowering the setpoint can be restricted via the Limitation (I). After reaching the limitation, the characteristic curve runs horizontally, i.e., the setpoint is no longer being lowered or raised. A value of "Limitation (I) max." of 2.4 V in the above example means limitation of setpoint increase to 2.4 V (corresponding to 20.48 kV primary) at I = In = 1500 A.

In general, a negative value or zero is chosen for the parameter "Limitation (I) min.", a positive value for the parameter "Limitation (I) max.". The limitations are active in all current-influence programs.

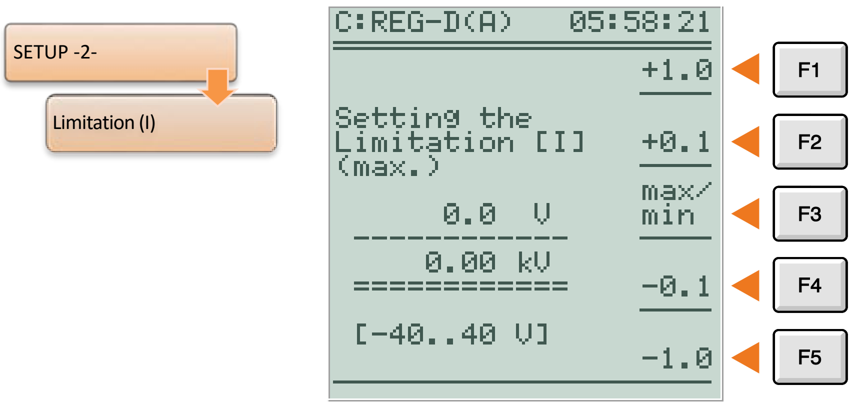
$$B = \frac{\Delta B_{prim}}{Knu} \qquad [B] = V_{sek}$$

Where:

B: Limitation (I) for lowering (neg.) or raising (pos.)

ΔB_{prim}: Limitation (I) for lowering/raising as primary value (e.g. 0.5 kV)

Knu factor of the voltage transducer



Switching between "Limitation (I) max." and "Limitation (I) min." is done with the F3 key.

Example of an active current program

Specifications:

Voltage transducer:	20 kV / 100 V
Current transducer:	2500 A / 5 A
Setpoint without current influence:	20.4 kV

Energy supply (P > 0): Raising the setpoint to 20.8 kV with 800 A active current, max. setpoint = 21.0 kV

$$I_{xdB} = \frac{I}{I_n} \times I_n = \frac{800A}{2500A} \times I_n = 0{,}32 I_n$$

$$St_{pos} = \frac{\Delta U}{KNU \times I_{xdB}} = \frac{400V}{200 \times 0{,}32 I_n} = 6{,}25 \tfrac{V}{I_n}$$

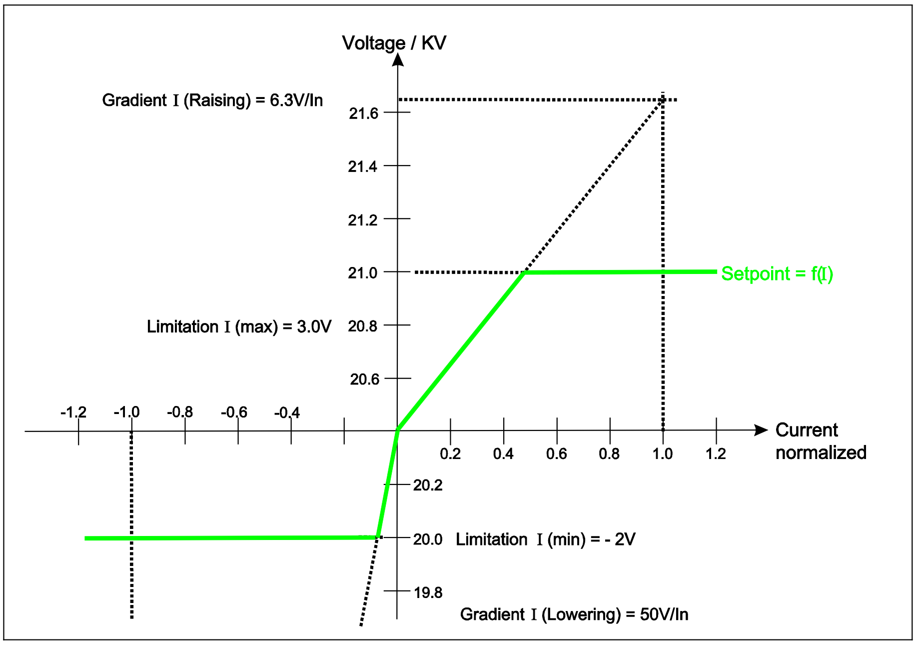
$$B_{\max} = \frac{\Delta B_{prim}}{KNU} = \frac{600V}{200} = 3V$$

Reverse power flow (P < 0): Lowering the setpoint to 20.0 kV with 100 A active current, max. setpoint = 20.0 kV

$$I_{xdR} = \frac{I}{I_n} \times I_n = \frac{100A}{2500A} \times I_n = 0{,}04 I_n$$

$$St_{neg} = \frac{\Delta U}{KNU \times I_{xdR}} = \frac{400V}{200 \times 0{,}04 I_n} = 50 \tfrac{V}{I_n}$$

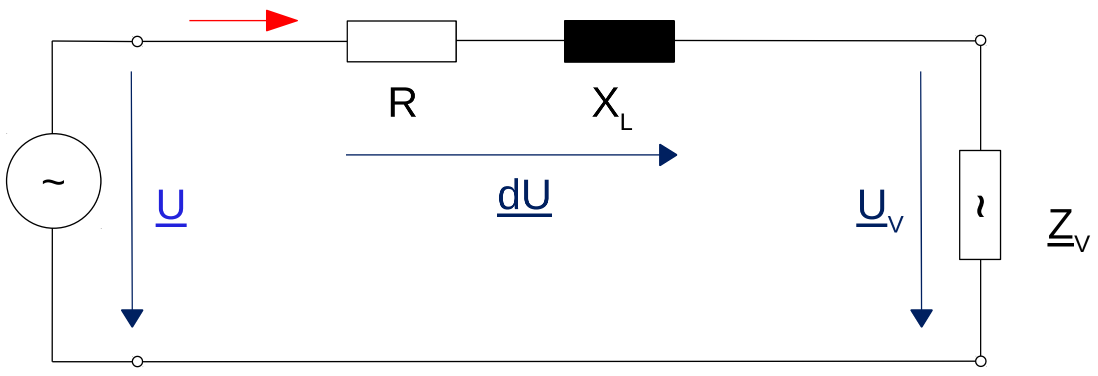
$$B_{\min} = \frac{\Delta B_{prim}}{KNU} = \frac{-400V}{200} = -2V$$



LDC (Line drop compensation)

The LDC program recreates, based on a line model (R and X_L) the line in the regulator, and determines the voltage difference of the effective values between the beginning of the line (transformer) and the selected load point, depending on the current strength and the cosφ and uses it as a correction value for the setpoint.

The LDC program is based on the following simplified line model:



The above circuit diagram gives:

$$-\underline{U} + R * \underline{I} + jX_L * \underline{I} + \underline{U_V} = 0$$
$$\underline{U} - \underline{U_V} = R * \underline{I} + jX_L * \underline{I}$$

with $\underline{U} - \underline{U_V} = \Delta\underline{U}$

and $\underline{I} = I * \cos(\varphi) + j * I * \sin(\varphi)$

$$\Delta\underline{U} = R * I * \cos(\varphi) + j * R * I * \sin(\varphi) + j * X_L * I * cos(\varphi) - X_L * I * \sin(\varphi)$$
$$\Delta\underline{U} = \underbrace{R * I * \cos(\varphi) - X_L * I * \sin(\varphi)}_{\textit{Real part (R)}} + j * \underbrace{[X_L * I * cos(\varphi) + R * I * \sin(\varphi)]}_{\textit{Imaginary part (I)}}$$

Since the Relay for Voltage Control & Transformer Monitoring REG-D™ always uses phase-to-phase voltages as a control value, the voltages $\underline{U}$ and $\underline{U_V}$ of the above figure can be interpreted as phase-to-phase voltages. Since the voltage ΔU is a phase voltage, it must be multiplied by the factor $\sqrt{3}$.

In addition, the following assumptions are made:
$\underline{\mathrm{U}}$ is real ("Position of the indicator" freely selectable). This corresponds to $\mathrm{U} = \mathrm{U_R}$.
The angle at the load point is designated with φ. The difference between φ at the transformer and φ at the load point can usually be ignored. Therefore: $\varphi_{Load} = \varphi_{Trafo}$

For the real and imaginary parts this results in:

$$U_{VR} = U_R - \sqrt{3} * \Delta U_R = U - \sqrt{3} * (R * I * \cos(\varphi) - X_L * I * \sin(\varphi))$$

$$U_{VI} = U_I - \sqrt{3} * \Delta U_I = -\sqrt{3} * (X_L * I * cos(\varphi) + R * I * \sin(\varphi))$$

$$U_V = \sqrt{U_{VR}^2 + U_{VI}^2}$$

Hereby the setpoint influence is given as a secondary value with the factor Knu of the voltage transducer:

$$x_i = \frac{U - U_V}{Knu} \qquad [x_i] = V_{sek}$$

Example:

The following values are configured in the regulator or can be measured:

$U = 20\ kV$
$I = 100\ A$
$\cos(\varphi) = 0\ \ inductive$
$Knu = 200$
$R = 0\ \Omega$
$X = 5\ \Omega$

The voltage U_V is given by:

$U_{VR} = U_R - \sqrt{3} * \Delta U_R = 20\ kV - \sqrt{3} * (100\ A * 5\ \Omega) = 19{,}134\ kV$

$U_{VI} = U_I - \sqrt{3} * \Delta U_I = 0$

$U_V = U_{VR} = 19{,}134\ kV$

The setpoint influence x_i (raising) as a secondary voltage is given by:

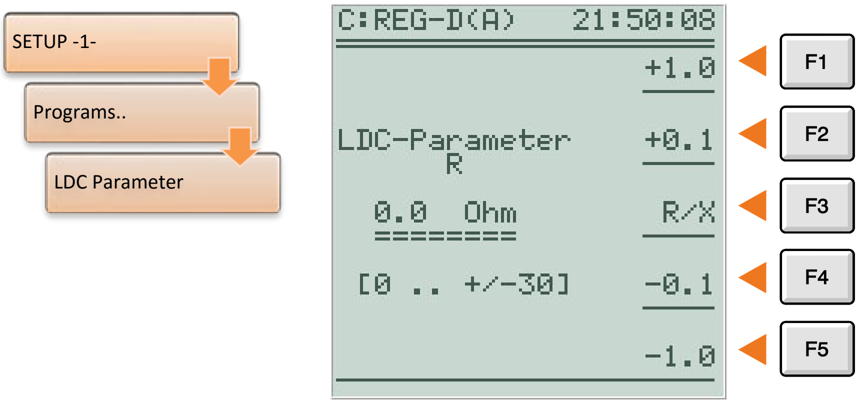
$$x_i = \frac{U - U_V}{Knu} = \frac{20\ kV - 19{,}134\ kV}{200} = 4{,}33\ \mathrm{V}$$

Calculating the voltage drop on a line

The Excel program "Spannungsfall" for calculating the voltage drop on a line is available for download on the A. Eberle Homepage (http://www.a-eberle.de).

LDC parameter

The LDC program uses the parameter R, X, "Limitation (I) min." and "Limitation (I) max." The menu entry LDC parameter is only available after selecting the LDC program.



Switching between R and X is done with the F3 key.

8.1.5 Parallel operation

8.1.5.1 General

If parallel coupled transformers do not have the same data (uk, vector group, number of taps, tap change ratio) or identical transformers stand at different taps, within such a parallel circuit there always flows a reactive current independent of the load current, which increases transformer load, reactive circulating current, and must therefore be avoided.

With parallel operation on a busbar, the terminal voltage of all transformers – even with different tap positions – is forcibly set to the same value. Therefore the voltage of transformers connected in parallel cannot be a regulation criterion by itself. In order to set parallel transformers on a busbar with different parameters to the required voltage and optimum tap position, voltage regulation must be supplemented by circulating reactive current regulation (parallel program dIsin(φ), dIsin(φ)[S] or dcos(φ)). However, if the transformers are the same, a stable parallel operation can be implemented using the voltage and tap position (parallel programs Master-Follower, MSI or MSI2).

A parallel operation of several transformers must always be prepared. As a rule, first the tap positions of the transformers involved in the parallel scheme must be equalized, and the circuit breakers and isolators placed in the appropriate positions. Finally, these switching states must be passed on to the Relay for Voltage Control & Transformer Monitorings involved in the parallel circuit.

The Relay for Voltage Control & Transformer Monitoring REG-D™ is also equipped with the so-called ParaGramer, which is independently able to recognize the switching states of the individual transformers, and which groups regulators automatically according to the switching states, so that only the regulators that supply a common busbar work together in parallel. For a detailed description of the ParaGramer function, see chapter 8.3.2 from page 232 onwards.

Total current
(only relevant when using current influence, see chapter 8.1.4 page 155)

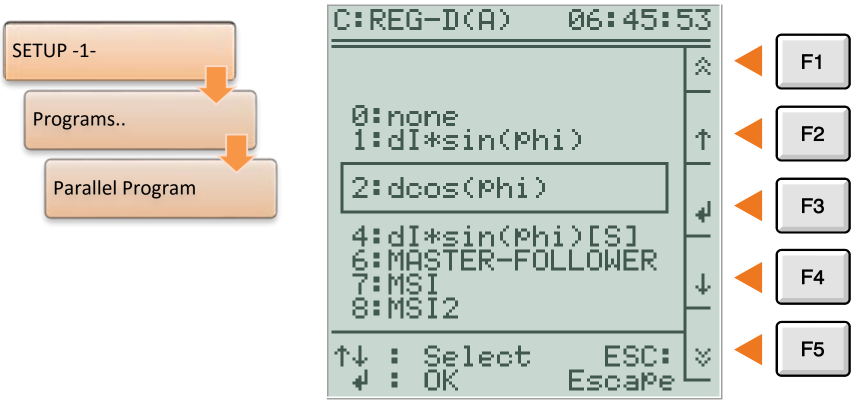
Through networking of all REG-D™ of the parallel coupled transformers via a bus, the currents from all transformers connected in parallel are summed in a regulator for evaluation of the current influence. This total current serves as a uniform basis for the current-dependent influence on the setpoint for all regulators.

Publication "Parallel Regulation of Transformers"

A Publication "Parallel Regulation of Transformers" with further information can be found on the A. Eberle Homepage (http://www.a-eberle.de) in the Download Centre under Publications.

⚠ CAUTION!	**Please note that only REG-D™ Relays for Voltage Control & Transformer Monitoring with the same firmware version may be run in parallel operation. Otherwise, malfunctions may appear in the course of this operation.** The current firmware version can be queried via the keyboard of the regulator. Please press the Menu key until you reach SETUP 6. You can now select the status page of the regulator with F5. In the first and second line appears the firmware version, for example, V2.23 of 18.12.12 (18 December 2012). In case different versions are currently loaded, please use the possibility to download the required firmware from our homepage (http://www.a-eberle.de) or contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

8.1.5.2 Parallel programs



All parallel programs are intended to minimize the circulating reactive current in parallel-connected transformers. Depending on the characteristics of the parallel working transformers (nominal power, tap size, number of taps) and the information made available to the REG-D™ Relays for Voltage Control & Transformer Monitoring (tap position feedback, E-LAN communication, current measurement), there are several parallel programs to choose from. Using the following table, an initial preselection can be made as to which parallel programs are basically eligible, or what requirements need to be considered for a certain parallel program.

Process	Equal nominal power	Unequal nominal power	Same tap size and number	Different tap size and number	Tap position required	Current measurement required	E-LAN communication required
dcos(φ)	yes	yes	yes	yes	O	yes	O
dIsin(φ)	yes	no	yes	yes	O	yes	yes
dIsin(φ)[S]	yes	yes	yes	Yes	O	yes	yes
Master-Follower, MSI/MSI2	yes	yes	yes	no	yes	O	yes

O: Optional for monitoring purposes

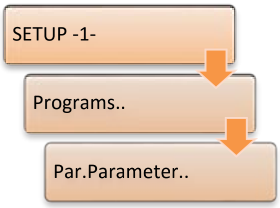
In the following the choices of the parameter parallel program are shown at a glance:

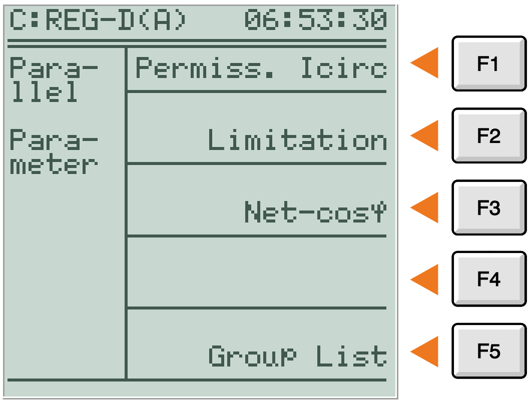
Parallel program	Description
0:no	**No parallel operation**
1:dIsin(φ)	**Circulating reactive current minimization procedure for transformers with the same nominal power** The regulators exchange the respective calculated power values with each other via the communication bus E-LAN and then calculate the circulating reactive current. The circulating reactive current acts on the command variable W as configured.
2:dIsin(φ)	**Circulating reactive current minimization procedure which does not require E-LAN communication** A net-cos(φ) must be defined for each regulator. Deviations from this net cos(φ) will be interpreted as circulating reactive current and act as configured on the reference variable W.
4:dIsin(φ)[S]	**Circulating reactive current minimization procedure for transformers with the same and different nominal power** The parallel program is based on the procedure of dIsin(φ). In addition, the nominal transformer power of the associated transformer must be defined in each Relay for Voltage Control & Transformer Monitoring REG-D™ so that this can be properly included in the calculation of circulating reactive current.
6:Master-Follower	**Master-slave parallel program which works according to the principle of tap equality** The parallel program is usually the first choice, so long as it regards parallel operation of transformers, which are identical or have the same tap change ratio. The master and slave(s) are always at the same tap level or have a permanent tap offset (from firmware V2.24 onwards).
7:MSI	**Master-Slave-Independent parallel program** Corresponds to the Master-Follower parallel procedure, only selection of the function (master, slave, independent) is done explicitly for each regulator (only selectable with activated ParaGramer feature).
8:MSI2	**Master-Slave-Independent parallel program with two busbars** Corresponds to the Master-Follower parallel procedure, only selection of the function (master 1, master 2, slave 1, slave 2, independent) is done explicitly for each regulator (only selectable with activated ParaGramer feature).

Emergency program “dcos(φ)!!!” in case of an E-LAN communication failure of the parallel programs dIsin(φ) and dIsin(φ)[S]

The dcos(φ) parallel program acts as an emergency program in the event of an E-LAN communication failure between the regulators. This is indicated by the text "dcos(φ)!!!“ in the basic regulator display. Hereby the last measured cos(φ) is accepted as Net-cos(φ). This function is only available with the parallel programs dIsin(φ) and dIsin(φ)[S]. When using the parallel programs Master-Follower, MSI and MSI2, the dcos(φ) emergency program is inactive, since current measurement is not absolutely necessary with these programs, and therefore the conditions for the emergency program are not met.

8.1.5.3 Parallel parameters

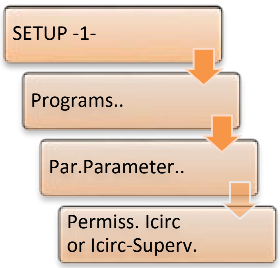




The parallel parameter specifies how much the parallel programs are to engage in regulation and which regulators can participate in the parallel operation.
Different parameters are available depending on the program for transformer parallel regulation:

- Permissible Icirc (influence of circulating reactive current regulation) or Icirc Supervision
- Limitation of the influence of circulating reactive current regulation
- Net-cos(φ) – setpoint of cos(φ) of the grid
- Nominal transformer power
- Transformer group list (identifiers of regulators that can potentially participate in the parallel operation)

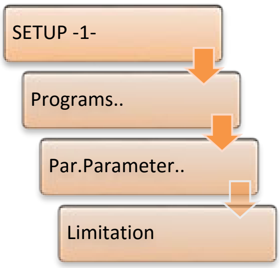
Regulation influence or Icirc monitoring



The menu item Permissible Icirc and Icirc Supervision usually appears when one of the programs dIsinφ, dcos(φ) or dIsin(φ)[S] have been selected. Permissible Icirc is critical for the influence of circulating reactive current regulation. Details for determining the Permissible Icirc parameter can be found at the end of chapter 7.2.3 Parallel operation, from page 105 onwards.

With the programs Master-Follower, MSI and MSI2 selected, the menu item Icirc Supervision appears instead of the menu item Permiss. Icirc. In contrast to the parallel regulatory procedures dcos(φ), dIsin(φ) and dIsin(φ)[S], the circulating reactive current is not directly included in the regulation, but merely represents a limit. If the parameter Icirc Supervision is exceeded, the parallel operation error ParErr will be triggered, which by default causes switching into manual mode of the regulator and the entire parallel group with it.

Limitation



The menu item Limitation appears when the program dcos(φ) is selected. The influence of circulating reactive current regulation in the parallel program dcos(φ) can be constrained to the reference value W by means of limitation. This determinable maximum influence of the parallel program dcos(φ) can, for example, be used for security purposes, so that a strongly differing phase angle in the low load range cannot alter the setpoint without a limit, and hence no great lasting variations in voltage can occur.

Setting Limitation

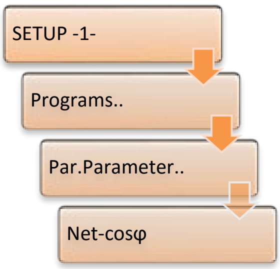
If the parameter Limitation is set to zero, then parallel regulation has no influence on voltage regulation. Thus, parallel regulation is disabled. If the value of the limitation is set very large, then with deviations between the configured and actual net-cosφ, a large effect on voltage stability via the parallel regulation can occur.

➲ For the Limitation setting, choose a meaningful value for the application (such as: 1.5 to 3.0).

Limitation in the case of parallel programs dIsin(φ) and dIsin(φ)[S]

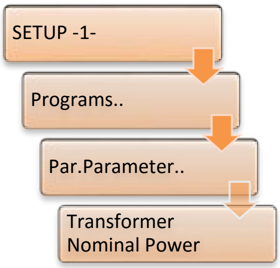
With the selected parallel programs dIsin(φ) and dIsin(φ)[S], since firmware V2.05 the parameter Limitation is no longer available by default. The parameter Limitation is set to the value 20 in the background, i.e., it has practically no influence. If the default value of 20 per terminal (REG-L command RegBGDS) is changed to a value between 0 and 19, or is still set to a value dissimilar to 20 after a firmware update, the parameter Limitation also appears in the menus of the parallel programs dIsin(φ) and dIsin(φ)[S].

Net-cosφ



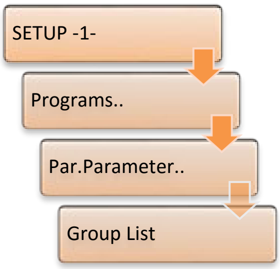
The menu item Net-cos(φ) appears when the parallel program dcos(φ) is chosen. Net-cos(φ) is set to a cos(φ) which prevails in the grid. If the current cos(φ) measured by the Relay for Voltage Control & Transformer Monitoring REG-D™ is equivalent to the configured Net-cos(φ), REG-D™ assumes that no circulating reactive current is present. Should the current cos(φ) measured by the Relay for Voltage Control & Transformer Monitoring REG-D™ deviate from the configured Net-cos(φ), this deviation is interpreted as circulating reactive current.

Nominal transformer power



The menu item Transformer Nominal Power only appears when the program dIsin(φ)[S] has been selected. With the aid of this parameter any Relay for Voltage Control & Transformer Monitoring REG-D™ can obtain the nominal power of the associated transformer, whereby it can be properly taken into account for the calculation of circulating reactive current. Nominal transformer power is not available to the parallel program dIsin(φ), because the same nominal transformer power is assumed in this case by default.

Group list (of possible parallel-coupled transformers)



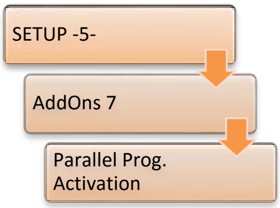
For all programs, except the dcos(φ) procedure, the group list must definitely be entered. The group list must be entered equally in all participating devices that are in parallel operation, i.e., for example, one defines in group list location 1 the device identifier "A:", in group list location 2 the device identifier "B:", in group list location 3 the device identifier "C:" for all devices. Through the group list, each Relay for Voltage Control & Transformer Monitoring is informed of which regulator available in E-LAN is potentially suitable for parallel regulation.

The current parallel state is also indicated by various prefixes in front of the device identifiers registered in the group list. If, for example, a star is shown before the identifiers "A:" and "B:", but not in front of the identifier "C:", it means that the regulators "A:" and "B:" are participating in parallel operation and regulator "C:" is not.

Group lists with the parallel program dcos(φ)

For the parallel program dcos(φ), which is normally used without E-LAN, the group list is only required if an E-LAN between the participating regulators is available, and either the ParaGramer is used or a maximum tap difference of the regulators concerned is to be monitored.

Parallel Prog. Activation



The parameter Parallel Prog. Activation determines how the parallel operation will be activated, i.e., how to switch between single and parallel operation. If the parameter is set to OFF, no parallel operation will take place.

The "ON" setting activates parallel operation. Thus, in the default case (no ParaGramer and no background program), parallel operation can be switched on and off locally on the device. The "ON" setting must also be selected when using the ParaGramer, because, in this case, parallel operation is initiated over the ParaGramer, as a rule.

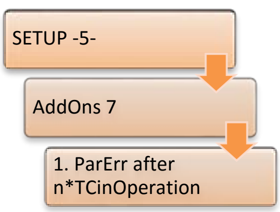
Selecting "LEVEL" causes the selected parallel program to remain active so long as the signal level at the selected binary input is present. By selecting "Pulse" parallel operation can be switched on and off via pulses on the selected binary input. Hereby, a pulse activates parallel operation and the next disables it, and so on. For selection of "Level" and "Pulse" a freely configurable binary input must be assigned the function "08:Par-Prog".

Setting	Behavior
0:OFF	**Parallel operation off**
1:ON	Parallel operation (also switch on with the use of ParaGramer)
2:LEVEL	Activation of parallel operation via a continuous signal to a binary input
3:PULSE	Activation/deactivation of parallel operation by pulses to a binary input

Activation at all parallel devices (exception: Master-Follower without ParaGramer)

The parallel program activation parameter determines how the parallel mode is enabled, that is, recognized. Selection of the parallel program itself is carried out in "Setup -1-\ Program". Activation is independent of the selected parallel program and must always be performed on all regulators working in parallel. Excepted here are regulators operating without ParaGramer in the Master-Follower program. Here, activation of the regulator parallel program which is to be master is sufficient. If activation is still carried out at several regulators, the one where activation was done first becomes master.

1. ParErr after n * TC in Operation time (parallel operation monitoring)



For monitoring tap equality in Master-Follower parallel operation, basically two different operating states in automatic mode must be considered.

In the case of an already active parallel operation, the system assumes that tap equality between master and slave(s) in the parallel program Master-Follower after a master tap change will be re-established at the latest after the time interval "2.5 * maximum TC in operation time". This means that the slave should follow suit within this time interval.

In addition to tap alignment of an already active parallel group after a master tap-change command, the tap alignment of a recently started or changed parallel system must be considered separately. Under changed parallel system is to be understood, for example, the selection of a transformer to an existing parallel circuit, which was supplied by a different busbar or which worked in standby mode. The parameter "1.ParErr after n * TC in operation time" can be used to determine by how many taps a newly selected transformer may differ from the existing transformers running in parallel**,** or which tap difference is permissible when restarting a Master-Follower parallel regulation.

The following applies to starting parallel operation:

- Activation of parallel operation in automatic mode
- Changing the master regulator in automatic mode
- Switching from manual to automatic

When you add a transformer to an existing Master-Follower parallel regulation, the transformer will be introduced tapwise as soon as possible to the group already operating in parallel (status: follower) and finally added to it (status: slave). If alignment is not achieved during the preselected time, parallel coupling is stopped and a parallel operation error (ParErr) triggered. In the standard configuration, this leads to switching the regulator to manual mode.

"1 ParErr after n * TC in operation time“ is a time interval, not a maximum tap difference

The parameter "1 ParErr after n * TC in operation time" (default value = **4**) does not specify the number of taps that the slave/follower can be separated by at the start or selection of the transformer into parallel regulation of the master! In contrast, the parameter indicates a permissible time interval (n * maximum TC in operation time), after which ParErr is triggered due to tap inequality.

Availability of parameters

The parameter "1 ParErr after n * TC in operation time" is only available in the regulator menu if one of the parallel programs Master-Follower, MSI or MSI2 is selected.

It is possible to determine the parameter "1 ParErr after n * TC in operation time“ so that a certain number of taps is possible. The following formula is used to determine the parameter "1 ParErr after n * TC in operation time“ on the basis of permissible number of taps which can be followed:

$$1. ParErr\ after\ n * TC\ in\ operation\ time \geq \left[\left(\frac{T_{runl} + x \times T_{runleff} + (x-1) \times 4s}{T_{runl}}\right) - 0{,}6\right]$$

where:

x :	taps that can be followed before a ParErr is issued
T_{runl}:	maximum TC in operation time
$T_{runleff}$:	effective run time of the tap changer in seconds

Example:

The transformer/regulator to be switched in stands in rest position at tap 5. The group operating in parallel is currently working on tap 8 (x = 3), the motor run time between two taps is 7 seconds (T_{TCinOp_eff} = 7s) and the "maximum TC in operation time“ is 8 seconds (T_{TCinOp} = 8s).

If, regardless of occuring circulating reactive currents, you wish to switch in a transformer which is at level 5 to the parallel working group, the parameter "1 ParErr after n * TC in operation time " must be set to at least 5 according to the following calculation:

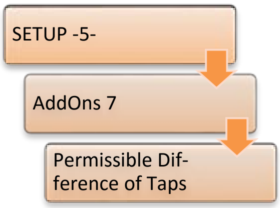
$$1. ParErr\ after\ n * TC\ in\ operation\ time \geq \left[\left(\frac{8s + 3\ \times 7s + (3-1) \times 4s}{8s}\right) - 0{,}6\right]$$

$$1. ParErr\ after\ n * TC\ in\ operation\ time \geq 4{,}025$$

$$1. ParErr\ after\ n * TC\ in\ operation\ time = 5$$

The monitoring algorithm of the parallel program thus waits 5 times the "maximum TC in Operation time" (5 x 8 seconds = 40 seconds) for the connected transformer before a parallel error (ParErr) is triggered. During this time, the new terminal can be "pulled" to the tap of the group under normal circumstances. If it does not participate, the error flag ParErr is set and the whole group switched to manual mode.

Permissible Difference of Taps (monitoring parallel operation)



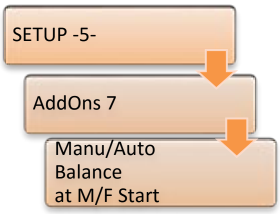
The parameter Permissible Difference of Taps is available with the parallel programs dIsin(φ), dIsin(φ)[S] and dcos(φ). The function is only active when an E-LAN connection exists between the regulators. In the Master-Follower program, no tap difference is allowed (except for a fixed tap offset between the regulators – from firmware V2.24), so the parameter is not displayed here.

The maximum tap difference parameter indicates how many taps transformers working in parallel may run separated from each other. If the permissible difference is exceeded, the parallel operation error (ParErr) is triggered. In the standard configuration, this leads to switching the regulator to MANUAL mode. The parameters can be adjusted in the range from 0 to 6. The setting value 0 is shown as "---" and turns off the monitoring. That is, with a setting of 0 no monitoring of the tap difference takes place.

Availability of the parameter

This parameter is available with the use of the parallel programs dIsin(φ), dIsin(φ)[S] and dcos(φ). The function is only active when an E-LAN connection exists between the regulators. In the Master-Follower program no tap difference is permitted, so the parameter will not be displayed here.

Manual/automatic balance at Master-Follower start:



The manual/automatic state of a group working according to the Master-Follower principle is always the same. This means that when a regulator is switched to manual mode, all regulators in this group switch to manual mode. Switching to automatic mode can only be done from the master regulator.

On connecting a transformer to a parallel group of transformers working on the master-follower principle, matching of the manual/automatic state must take place in case of a manual/automatic state of the group that is different from the other transformer. For this purpose, via the parameter "Manual/automatic balance at Master-Follower start: " you can define which state is dominant.

The setting "MasterPrio" leads to matching the manual/automatic state of the additional transformer with the state of the master regulator of the group.

The selection "HandPrio" means that the whole group is switched to MANUAL, if at least one transformer of the new group is set to MANUAL.

Special behavior: different manual/automatic state in a parallel group

Manual/automatic matching was introduced in firmware version 2.00. The original behavior (up to firmware V1.99), which allowed a different manual/automatic state between regulators, can be activated again on request. For questions regarding this matter, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

8.1.5.4 Detailed explanation of the parallel program "dcos(φ)"

In the following the calculation of circulating reactive current and the effect of the parameters Permiss. Icirc and Limitation on the parallel program dcos(φ) is explained further.

The current circulating reactive current is calculated from the configured Net-cos(φ) and the actual cos(φ). It is assumed that with the Net-cos(φ) the circuit reactive current is equal to zero.

$$Icirc_{current}\ [A] = I_{current}[A] * (sin(\varphi) - sin(\varphi_{net-cos\varphi}))$$

The ratio of current and permissible circulating reactive current forms the basis for the influence of the parallel program dcos(φ) on voltage regulation. The following formula can be used to determine the setpoint influenced by the parallel program dcos(φ) (virtual setpoint):

$$virtual\ SP\ [V] = SP_{curr.}\ [V] + \left(Xw_z[\%] * \frac{Icirc_{current}[A]}{Icirc_{permiss.}[A]} * \frac{100\%Value_{SP\ curr.}\ [V]}{100\%}\right)$$

Example:

Current setpoint $SP_{current}$: 100 V (=100%)

Permissible setpoint deviation Xw_z: 2.0 %

Permissible circulating reactive current $Icirc_{permiss.}$: 50 A

Current circulating reactive current $Icirc_{current}$: -75 A (inductive)

$$virtual\ SP\ [V] = 100\ V + \left(2{,}0\ \% * \frac{-75\ A}{50\ A} * \frac{100\ V}{100\ \%}\right) = 97\ V$$

→ The setpoint drops virtually to 97 V. Thereby down commands are provoked, which reduce the inductive circulating reactive current.

The ratio of current and permissible circulating reactive current in the above formula can be limited using the parameter Limitation. Thus, the parameter Limitation specifies which maximum influence the parallel program can have on voltage regulation. The maximum and minimum virtual setpoint can be calculated using the following formula:

$$\text{virt. } \mathrm{SP_{min/max}}\ [\mathrm{V}] = \mathrm{SP_{curr.}}\ [\mathrm{V}] \pm \left(\mathrm{Xw_z}[\%] * \text{Limitation} * \frac{100\%\mathrm{Value_{SPcurr.}}\ [\mathrm{V}]}{100\%}\right)$$

Example:

Current setpoint:	100 V (=100%)
Permissible setpoint deviation Xw_z:	2.0 %
Limitation:	3

$$virt.\ SP_{min/max}\ [V] = 100\ V \pm \left(2{,}0\ \% * 3 * \frac{100\ V}{100\ \%}\right) = 100\ V\ \pm 6\ V$$

→ The setpoint changes maximum ± 6 V due to the influence of the parallel program dcos(φ).

8.1.5.5 Detailed explanation of the parallel programs "dIsin(φ)" and "dIsin(φ)[S]"

The following describes in detail the effect of the parameters Permiss. Icirc and Transformer Nominal Power on parallel regulation of the parallel programs dIsin(φ) and dIsin(φ)[S].

The current circulating reactive current is determined based on the number of parallel transformers and the nominal transformer power of regulators participating in parallel operation. With the parallel program dIsin(φ)[S], the respective nominal transformer powers are freely programmable; with the parallel program dIsin(φ) all nominal transformer powers are assumed to be equal, whereby input of nominal transformer power can be eliminated. Below follows the method for calculating circulating reactive current in two parallel transformers:

$$Icirc_{\mathrm{current}}\ [A] = I_1[A] * sin(\varphi_1) - \frac{S_{N1}}{S_{N1} + S_{N2}} * Iq_{Ltot}\ [A]$$

$$with \qquad Iq_{Ltot}\ [A] = I_1[A] * sin(\varphi_1) - I_2[A] * sin(\varphi_2)$$

where:

$Icirc_{current}$:	current circulating reactive current
S_{N1}:	nominal power trafo 1
S_{N2}:	nominal power trafo 2
Iq_{Ltot}:	total reactive current without circulating reactive current

The ratio of current and permissible circulating reactive current forms the basis for the effect of the parallel programs dIsin(φ) and dIsin(φ)[S] on voltage regulation. The calculation formula for virtual setpoint corresponds to that of the parallel program dcos(φ), see previous chapter 8.1.5.4, from page 177 onwards.

8.1.5.6 Detailed explanation of the parallel programs “Master-Follower”, “MSI” and “MSI2”

The parallel programs Master-Follower, MSI and MSI2 do not differ in their parallel procedures, but only in the way the parallel programs are activated. While the Master-Follower procedure can be used with or without ParaGramer, the parallel programs MSI and MSI2 can only be used with ParaGramer. For more information on ParaGramer see chapter 8.3.2 ParaGramer including extensions [protected], from page 232 onwards.

For the parallel programs Master-Follower, MSI and MSI2, the circulating reactive current is used for monitoring purposes only, in contrast to the remaining parallel programs. Therefore, the menu item for configuration of permissible circulating reactive current is not designated as "Permiss. Icirc" but "Icirc-Superv.". Calculation of circulating reactive current is carried out according to the calculation of the parallel program dIsin(φ), see chapter 8.1.5.5 Detailed explanation of the parallel programs , from page 178 onwards. If the permissible circulating reactive current is exceeded, the regulator switches to manual, and with it the parallel group as well.

If the parallel mode is enabled, one of the regulators of the parallel group becomes master and the others slaves. If several masters are possible, that regulator becomes master which occupies the lowest place in the group list. (The exception is Master-Follower without ParaGramer: Here the regulator who first recognized the parallel operation becomes master.) If the manual/automatic states of the new parallel group are different, the resulting manual/automatic state depends on the parameter "Manual/automatic balance at Master-Follower start", see chapter 8.1.5.3 from page 170 onwards.

If the parallel group is in manual mode, tap-change commands at the master will lead to tap changes for the entire parallel group. In contrast, tap-change commands at a slave result in no tap changes in the entire parallel group, but only changes in the corresponding slave tap.

If the parallel group is in automatic mode, differentiation must be made between whether it is a just launched or modified parallel system (through activation of parallel operation in automatic mode, change of master regulator in automatic mode, switching from manual to automatic mode), or it is an already active parallel coupling.

In a just started or modified parallel system, if the slaves are on a different tap than the master, the slaves change into follower mode and tap towards the tap position of the master. If the followers reach the tap position of the master within the predetermined time interval "1 ParErr after n * TC in operation time“ (see chapter 8.1.5.3 from page 173 onwards), they switch into slave mode again. If the tap position of the master is not reached within the time interval "1 ParErr after n * TC in operation time “, the parallel operation error (ParErr) is issued, which leads by default to a change of the parallel group to manual.

From the time of reaching tap equality, in automatic mode, the system is already an active parallel coupling. From this point, the slaves are tapped together from the master. It is assumed that the slaves have reached the tap setting of the master after a maximum "2.5 * maximum TC in operation time ". Should this not be the case, the parallel operation error (ParErr) will be issued.

The parameters "Parameter Base Tap Position" and "Sync mode" (firmware V2.24)

From firmware V2.24 it is possible to define a tap offset between regulators participating in parallel operation using the parameter "Parameter Base Tap Position". Later, this option is indicated for the parallel programs Master-Follower, MSI and MSI2 by the text "(Including tap offset)".

Also new from firmware V2.24 is the so-called "Sync mode". If at the beginning of parallel operation slaves are on a different tap than the master, the slaves and the master switch to sync mode. In this mode, in contrast to previous firmware versions, slaves are not necessarily pulled to the tap of the master (including tap offset), but the current voltage of the master is also taken into account. This means that either one of the slaves or the master is tapped, depending on the current voltage, so that, with optimum maintenance of the setpoint of the master, tap equality is restored (including tap offset).

8.1.6 Tap changer

This chapter describes the settings that are directly related to the tap changer or its drive.

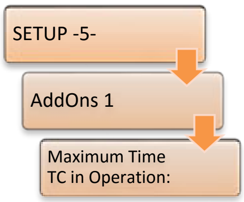
Normal or inverse tap changer

By default the REG-D™ assumes that a too low voltage and an up command is necessary, leading to a higher tap position. If a different behavior is required, this can be accomplished by using the function "Inverse tap changer" or the feature "Invers".

More information about dealing with an inverse tap changer and the feature "Invers" is provided in chapter 8.3.13 from page 268 onwards.

Setting of the inverse feature is only possible via the WinREG software.

8.1.6.1 Maximum TC in operation time (run time of motor drive)



The run time of the motor drive (tap changer) can be monitored with the regulator. On exceeding the set time a signal is issued. This signal can be used to switch off the motor drive. In this way, the tap changer can be protected against overrun.

The first step is to enter the maximum TC in operation time per tap in AddOns-1. As a second step, the TC in operation signal can be assigned to an input (see chapter 8.2.2 Binary inputs, from page 208 onwards). Finally, via a relay output (see chapter 8.2.3 Relays, from page 213 onwards) the message "Disturbed tap changer" can be placed (relay function "14:TC-Err").

The maximum TC in operation time can be set to between 3 and 40 seconds.

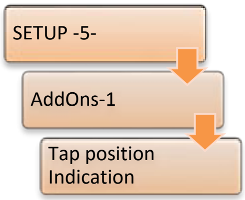
Setting maximum TC in operation time

Measure the run time of the tap changer and enter a value two to three seconds higher for the maximum TC in operation time.

Maximum TC in operation time on using a PAN-D

If a PAN-D is used in addition to the Relay for Voltage Control & Transformer Monitoring REG-D™, the former takes over monitoring of the TC in operation signal. This means that the signal is connected to the PAN-D and the corresponding setting is made there and then passed on to the REG-D™. Setting the maximum TC in operation time on the REG-D™ is then not possible.

8.1.6.2 Tap position indication



If no signals are available for displaying the tap position, the setting "Off" is selected. In regulator mode, the tap position will be displayed as two hyphens "--“.

If, for example, BCD coded signals are available for tap position indication, the setting "ON" is chosen. In regulator mode, the tap position will be shown on the regulator display.

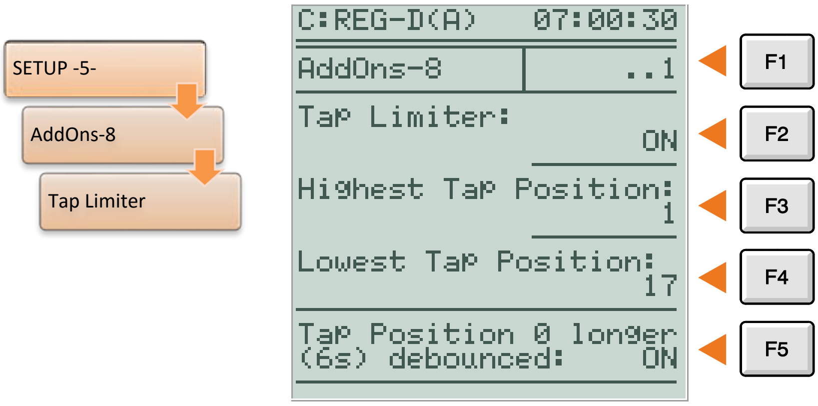
Note:

If an error occurs, (e.g.: BCD signals are applied and the parameter tap position is set to "ON"), check the connections and the selected "Input assignment".

If the software switch for the tap position is set to "ON", even though there is no tap position information available, the regulator shows a tap position 0. This display can lead to a wrong conclusions by the operating personnel.

Please also note that the regulator will automatically check the tap position for correctness. However, a prerequisite is that the tap position is switched on. The error indicator TapErr was introduced to signal wrong position settings. The TapErr becomes active as soon as an illogical tap change is reported. However, since proper display of the tap position is not absolutely necessary for regulation of individual transformers, the default TapErr is only informative. For more information about TapErr see chapter 8.2.7.5 Tap change error (TapErr), from page 228 onwards.

8.1.6.3 Tap limiter



With this function the tap range in which the Relay for Voltage Control & Transformer Monitoring can allow the tap changer to operate can be adjusted. In general, the physically available range of the tap changer is to be set (for example, tap 1 to 19). If the upper tap is reached, then up commands are blocked. If the lower tap is reached, then down commands are blocked. With an inverse tap changer (the feature Invers is set on REG-D™), on reaching the lowest tap, up commands are blocked, as are down commands on reaching the highest tap.

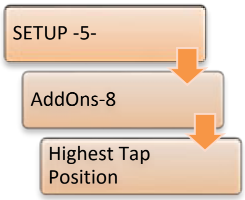
Blocking of tap commands works in the MANUAL and the automatic modes.

If a tap change beyond a tap limit is to be performed, a message appears on the screen that the lowest or highest tap has already been reached.

Setting	Behavior
OFF	**Tap limitation off (no blocking of tap commands on reaching the lowest or highest tap)**
ON	Tap limitation on

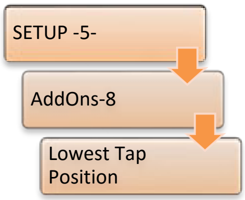
Function depends on tap position indication

The tap limitation function will only work if the tap parameter "Tap Position Indication" ("Setup -5-/AddOns-1") is set to ON. If the tap position indication is disrupted (indicator 99 on the display), the tap limitation will be inactive. This means that tap changes are possible in both directions.



Upper tap

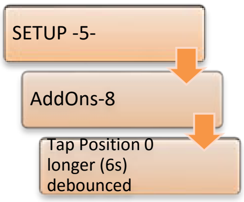
Here the upper tap of the tap limitation is set. The range is from -63 to 63.



Lower tap

Here the lower tap of the tap limitation is set. The range is from -63 to 63.

8.1.6.4 Tap position 0 longer (6s) debounced



The REG-D™ tap position display has a debouncing functionality. This suppresses invalid tap position indications during tap changes of the tap changer. Usually, the tap position display is interrupted during the tap changing process and the regulator will be reporting tap 0 during the switchover time. To suppress a false tap indication during this time, tap 0 has a longer debounce time (6s). This means that tap indication 0 is only assumed after it has been on for at least 6 seconds. For all other tap positions this time is 1s.

But there are application cases in which tap 0 is a normal operating tap, making a longer debounce impractical. With the "Tap 0 debounced longer (6s)" parameter, the longer debounce of tap 0 can be switched off.

Setting	Behavior
OFF	Tap position 0 is used as a normal tap position (e.g. tap indication from -9 to 9) and must therefore not be debounced longer.
ON	The tap position 0 is used as an interruption of the signal, for example, occurring during switchover times, and is thus debounced longer (6s).

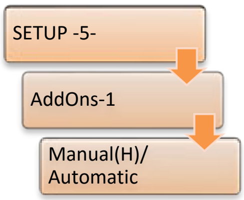
Debouncing when using a TC in operation signal

If a TC in operation signal is used, debouncing of the tap position is of little importance, since in this case the tap position will only be considered valid when the TC in operation signal has dropped.

8.1.7 Configuration and functions

In this chapter are described all parameters that are associated with configuration of the system as well as special functions that have not been described in the area of fundamental values, limits, current influence, or parallel operation.

8.1.7.1 Manual / Automatic



The regulator provides two different ways for switching operating mode (manual/AUTOMATIC) via the binary inputs. In addition to the possibilities described via binary signal below, the manual/automatic state can also be switched serially via a COM interface or via a SCADA system.

<u>Switchover flip/flop</u>

With the E5-PULS setting, a pulse causes the input E5 to switch from MANUAL to AUTOMATIC, a further pulse at this input causes a reverse shift from AUTOMATIC to MANUAL, i.e., each pulse switches the operating mode.

In this mode, manual mode can be switched to via input 6 (Hand-DLY) with a delay. For this purpose, a signal is required that is present at least for the duration of the delay time. The delay time can range between 0 and 60s, and can be set using a REG-L command (RegHandDelay) via a terminal program. By default, this function is inactive (delay time setting = -1) and thus input 6 has no function in the default case.

<u>Bistable switchover</u>

With the setting E5-A/E6-H, a pulse or continuous signal on input E5 causes a switch from MANUAL to AUTOMATIC mode. Further signals to this input do not change the operating mode, i.e., the regulator remains in AUTOMATIC mode.

The changeover from AUTOMATIC to MANUAL is carried out by a pulse or a continuous signal to the input E6. Further signals to this input do not change the operating mode, i.e., the regulator remains in MANUAL mode. The inputs 5 and 6 work flank-oriented, i.e., application of a continuous signal does not lead to fixing the regulator in the corresponding operating mode.

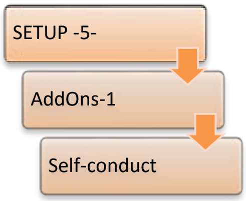
Changeover via binary inputs only in remote mode

If the "Local/Remote" function is used on the regulator, the manual/automatic switchover via the inputs 5 (and 6) only works in the remote operating mode.

<u>Using inputs 5 and 6 **not** for a manual/automatic switchover and share them with the background program</u>

The selection E5 + 6-PROG disables the switchover of the manual/automatic state via inputs 5 (and 6). This allows use of the inputs 5 and 6 in the background program. Remote manual/automatic switchover can then, for example, be effected via a SCADA system (e.g. IEC 61850).

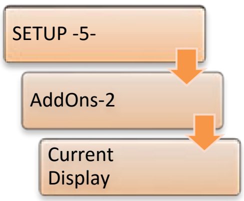
8.1.7.2 Self-conduct (Manual/Auto remains unchanged after reset)



Using the "WITH" setting, the operating mode of the regulator is stored before any failure of the auxiliary voltage, i.e., after restoration of voltage, the regulator is set to AUTOMATIC if it was on AUTOMATIC before the voltage failure, or MANUAL if it was on AUTOMATIC before the voltage failure.

Using the "WITHOUT" setting, the operating mode of the regulator is not stored on an auxiliary voltage failure, i.e., after voltage recurrence, the regulator is always set to MANUAL.

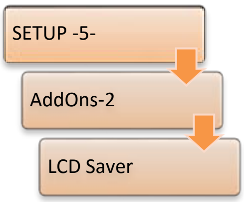
8.1.7.3 Current display



With the setting "ON", current is also indicated in the basic regulator display (detail display).

In the setting "OFF" , no indication of current is given in the regulator basic display. The setting can be used to suppress the value 0.000 A in the display in the absence of a current connection.

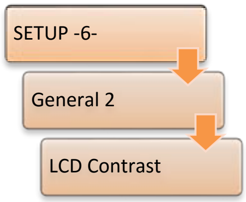
8.1.7.4 LCD saver



If the parameter "ON" is set, the display shuts off one hour after the last keystroke. The backlight switches off about 15 minutes after the last keystroke.

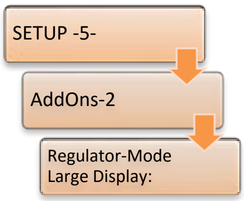
The setting "OFF" means that the display always remains on and only the backlight switches off about 15 minutes after the last keystroke.

8.1.7.5 LCD contrast



Using the contrast setting, the regulator display can be controlled so that it is easy to read from different viewing angles.

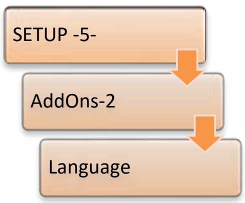
8.1.7.6 Regulator-Mode Large Display



The Regulator-Mode Large Display switches the regulator basic display between detail and large display. When set to "OFF", the detail view of the regulator basic display appears. The setting "ON" selects the large display, which only displays current voltage and tap position.

Note:
In regulator mode, switching back and forth from the normal to the large display is done by pressing F1.

8.1.7.7 Language



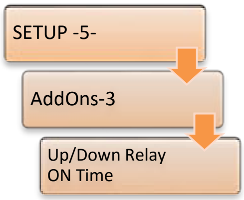
In the submenu Language, the display language of the REG-D™ can be set.

The following languages are available:

1.	German
2.	English
3.	Español (Spanish)
4.	Italiano (Italian)
5.	Francais (French)
6.	Nederl. (Dutch)
7.	Cesky (Czech)
8.	Russki (Russian)
9.	Polski (Polish)
10.	Portug. (Portuguese)

Order feature
The delivery language set depends on order feature A.

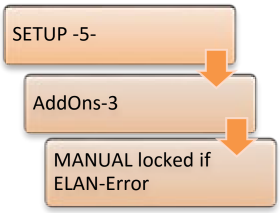
8.1.7.8 Up/down relay on-time



If the regulator issues a tap-change command, the default time of the pulse is **2s**. Especially older motor drives require a longer switch-on time to accept the signal.

Using this menu item, the switch-on time for up and down pulses can be set from 0.5s to 6s in 0.1 s increments.

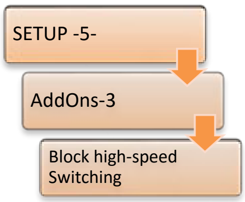
8.1.7.9 Manual locked at E-LAN error



If the "Manual locked at E-LAN error" function is active and an E-LAN error is recognized by a regulator during parallel operation of several transformers, the regulator concerned switches the operating mode from AUTOMATIC to MANUAL. Recognition of the regulator, which must be available in E-LAN, is accomplished via the group list. That is, if an identifier is registered in the group list and not available in E-LAN, locking of MANUAL mode is performed.

In addition, the "Manual locked at E-LAN error" ensures that a return to AUTOMATIC mode is only possible if either the problem is solved or the setting of "Manual locked at E-LAN error" is set from "ON" to "OFF".

8.1.7.10 Block high-speed switching



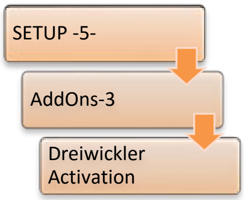
With this parameter it is possible to block high-speed switching. That means that the regulator always uses the reaction time predetermined by the time behavior without considering the high-speed switching limit of the voltage.

By default, high-speed switching is active, i.e., the parameter "Block high-speed switching" is "OFF".

The parameter "Block high-speed switching" only acts on the limits of fast backward and high-speed forward switching

Moreover, high-speed switching can be activated via a binary input or the back-ground program. Furthermore, the 30-second activation of high-speed switching remains active on changing the setpoint.

8.1.7.11 Three-winding activation



With the three-winding transformer activation, use of the three-winding transformer functionality of the REG-D™ can be switched on and off when the REG-D™ has the feature "3winding". If the three-winding function is activated, the voltage to be regulated can be switched via the corresponding binary inputs or via a background program between the measuring inputs 1 and 2. This means that the voltage U1 or U2 can be used for regulation. The respective other voltage can be monitored on a limit. If the three-winding transformer activation is set to "OFF", this switchover possibility is not available.

Required software and hardware features

This parameter is only available when the software feature "3winding" (see chapter 8.3.5 Feature 3winding (three-winding transformer) [protected], from page 253 onwards) is activated, and REG-D™ has the corresponding hardware feature (M9, see Technical Data in the supplement of chapter 21). Otherwise this menu position is empty.

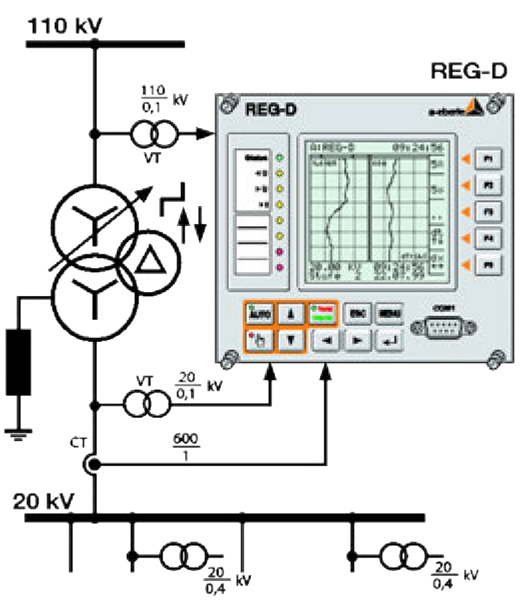
8.1.7.12 Creeping Net Breakdown

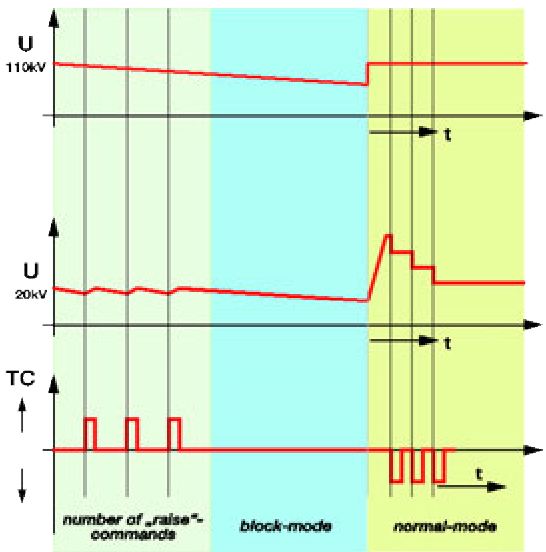
The "Creeping Net Breakdown" function is mainly used where it can be expected that the overvoltage side voltage drops over a certain period due to the grid.

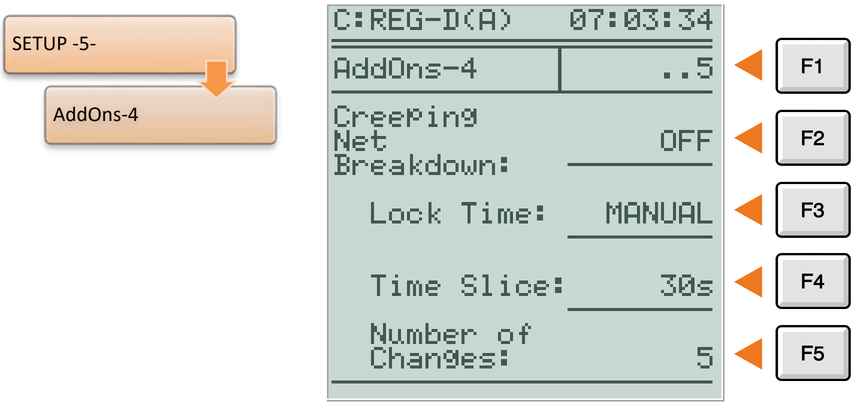
Normally in this case, a Relay for Voltage Control & Transformer Monitoring initially responds with tap changes in the direction of higher voltage to keep the secondary voltage constant. This action may increase the drop on the overvoltage side further, because at a higher voltage generally more power is taken from the upstream grid. If the voltage on the primary side suddenly reverses back to its starting value, the transformer will be at a too high tap (high voltage) and must now be regulated in the direction of lower voltage. Under some circumstances, this behavior can result in the voltage exceeding the triggering limit of protective devices, or that the Inhibit high limit of the regulator is reached, blocking the regulator.

To avoid such situations, the "Creeping Net Breakdown" function was implemented. Basically, there are two operating modes to choose from, with the operating mode PRIM being an extension of the operating mode SEC.

Generally, recognition of Creeping Net Breakdown is based on registering tap change up commands within a specific time window. That is, if the regulator issues an adjustable number of up tap commands within an adjustable time window, the state of Creeping Net Breakdown becomes active. This means that the regulator is either blocked for a certain time or switched to MANUAL mode (depending on the configuration). Once the lock time has passed, or if the voltage has become too high, the regulator will start again with normal regulation. If the regulator has been switched to MANUAL mode due to Creeping Net Breakdown, it must be explicitly set to AUTOMATIC again from outside.







Mode	Function
0:Off	The function "Creeping Net Breakdown" is inactive
1:SEC	The "Creeping Net Breakdown" function uses only voltage measuring input 1 (secondary-side voltage of the transformer and regulation voltage) for evaluation of grid status. Detection is performed by counting the number of up tap-change commands within a defined time window. This operating mode is possible with all hardware equipment. However, here a distinction between disturbances in the upstream grid and load-related voltage fluctuations is not always unambiguously possible.
2:PRIM	In addition to voltage input 1 (regulation voltage), the "Creeping Net Breakdown" function also uses voltage measuring input 2, to which the primary-side voltage of the transformer must be connected for evaluation of grid status. That is, in addition to counting up tap-change commands within a defined time window, the primary voltage is also considered. A prerequisite for recognition of a Creeping Net Breakdown is that the primary voltage has dropped at least 0.1% between two up commands with the PRIM setting. To use these operating modes, the Relay for Voltage Control & Transformer Monitoring requires the hardware feature M3 or M9 (two galvanically isolated voltage measuring inputs).

The behavior that is executed upon detection of the Creeping Net Breakdown can be selected with the "Lock Time" parameter. Generally, there are two different kinds of behavior.

1. The regulator issues no further tap commands, leaving the AUTOMATIC operating mode and remaining in the MANUAL operating mode until a changeover to AUTOMATIC occurs, either by use of the AUTO key or a remote control command.

2. For a selectable lock time (1 min ... 20 min) the regulator blocks all other up tap commands. The lock is released automatically when:
   - the selected lock time has expired, or
   - the first down tap command is issued (that is, if the upper limit of the setpoint deviation is violated).

The time window parameter allows you to specify the time period within which the number of tap changes must must occur. The adjustment is possible in the range 15 to 120 seconds in 15s steps. The "Number of Changes" parameter specifies how many time a up tap command must occur within the time window for a Creeping Net Breakdown to be detected. The value range is from 2 to 6.

If the state of Creeping Net Breakdown is detected, this is shown via a message (CREEPING NBD) in the lower part of the display.

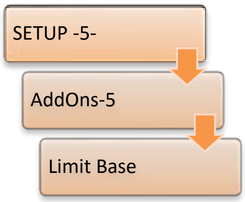
Example:

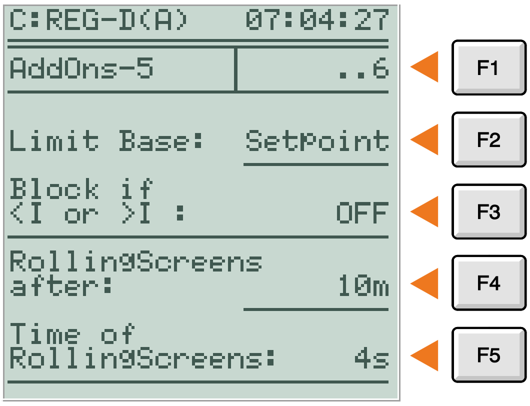
With the settings: mode = PRIM, time window = 60s, number of tap changes = 4 and lock time = 15 min, a Creeping Net Breakdown is detected when the regulator issues an up command four times within 60 seconds and the primary voltage decreases simultaneously. The state of Creeping Net Breakdown is cancelled after 15 minutes or the first down command is issued.

Suppressing the function "High-speed forward switching" (voltage limit)

The "Creeping Net Breakdown" function suppresses high-speed forward switching via the voltage limit. High-speed switching via the binary input and by changing the setpoint remains active. During these high-speed switchings no Creeping Net Breakdown evaluation is performed.

8.1.7.13 Limit base





The limit base for the limits undervoltage (<U), overvoltage (>U) and shutdown can be selected. The remaining limits are either absolute values or always dependent on the setpoint.

If setpoint is chosen as a reference value, the limits change with the respectively set setpoint value. This means that if the setpoint is adjusted, the limits will follow suit.

Example:

Limit base: setpoint
setpoint: 102 V
limit: ± 10%
→ lower limit 92 V
→ upper limit 112 V

If the limit base Un100V or Un110V is selected, the percentages of the limits always refer fixedly to 100 V or 110 V, i.e., a change in the setpoint does not affect the limits <U, >U and shutdown.

Example:

Limit base: Un100 V
Setpoint: 102 V
Limit: ± 10%
→ lower limit 90 V
→ upper limit 110 V

In addition to the basic value, also the underlying 100%-value of the active setpoint is decisive for the calculation of absolute limit. The 100%-value is to be understood as the basis of the percentage calculation. In the above examples, it is always true that the 100%-value is equal to 100 V and thus 1% is equal to 1 V. However, 1% can also correspond to 1.10 V, for example, so long as the 100%-value of the active setpoint is equal to 110 V or the limit base is set to Un110V. The 100%-value for limit base Un100V is always 100 V.

Example:

Setpoint 1 = 102 V, 100%-value = 100 V, limit >U = 10%, limit base = setpoint
Setpoint 2 = 102 V, 100%-value = 110 V, limit >U = 10%, limit base = setpoint

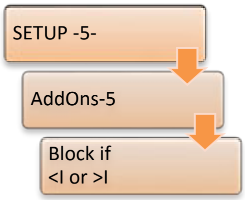
Active setpoint = setpoint 1: limit >U [V]= 102 V + $(10\,\% \times \frac{100\,V}{100\,\%})$ = 112 V

Active setpoint = setpoint 2: limit >U [V]= 102 V + $(10\,\% \times \frac{110\,V}{100\,\%})$ = 113 V

Limit base with P- and Q-setpoints

In the case of regulation on active or reactive power (software feature PQCtrl), 100 V always applies as the limit base as well as 100%-value.

8.1.7.14 Block if <I or >I



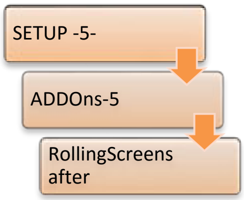
The "Block if <I or >I" parameter, can be used to select the behavior of the regulator in the case of under- or overcurrent.

Setting of "Block if <I or >I"	Action
Off	**No blocking at under- or overcurrent**
>I+<I	Blocking at under- and overcurrent
>I	Blocking at overcurrent
<I	Blocking at undercurrent

The selected design value (1 A or 5 A, or as a primary value 1/5 A x Kni) always applies as limit base (100%-value) for the current limits.

The limits under- or overcurrent can be set in the menu "Setup -2-".

8.1.7.15 Rolling Screens



The RollingScreens function provides an automatic scrolling/changing of the display screens. This means that the most important measured values about the transformer are shown cyclically without inputs send to the device.

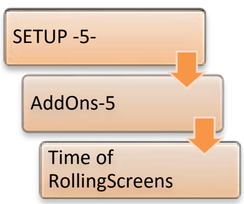
Included in RollingScreens are the following display screens:

- Regulator basic display (large display)
- Transducer mode
- Transducer (U, I, f)
- Transducer (P, Q, S)
- Operating hours (transformer, tap-changer)*
- Temperatures of the transformer monitor (oil and windings) and lifetime consumption*
- Operating status (on/off) of the fan groups and oil pumps*
- Water and gas content*
- CO and H2 content*
- Overload prediction (possible overload and time since excess temperature)*

* These screens are only displayed if the regulator has the feature TM1 (with transformer monitoring).

The rolling screens parameter specifies the time the traversal of display screens starts after no entries on the device. The delay time can be adjusted between 0 to 10 minutes in one minute increments. The setting of 0 minutes means that the function is disabled. When RollingScreens is active, scrolling can be done manually back and forth between the individual screens using the left and right arrow keys.

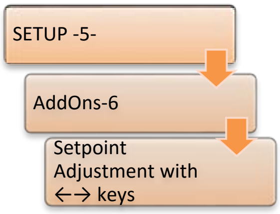
8.1.7.16 Time of RollingScreens



The "Time of RollingScreens" parameter defines how long a screen within the RollingScreens is displayed before it moves to the next screen.

The time can be set to between 3 and 15 seconds.

8.1.7.17 Setpoint adjustment with ←→ keys



The arrow keys ← and → of REG-D™ can be used to adjust the setpoint. This feature must be activated with the parameter "Setpoint adjustment with ←→ keys“.

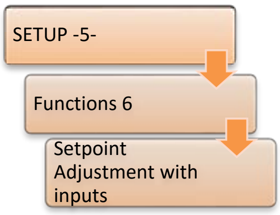
The setpoint (index) is decreased with the left arrow key (←) and increased with the right arrow key (→).

Setting	Action
0:OFF	**No adjustment of setpoint 1**
1:0.1%	Adjustment of setpoint 1 by 0.1%
2:0.2%	Adjustment of setpoint 1 by 0.2 %
3:0.5%	Adjustment of setpoint 1 by 0.5 %
4:1.0%	Adjustment of setpoint 1 by 1.0 %
5:1.5%	Adjustment of setpoint 1 by 1.5 %
6:2.0%	Adjustment of setpoint 1 by 2.0 %
10:PROG	The arrow keys can trigger functions in the background program.
11:SPIndex	Adjusting the setpoint index, for example, switching from SP 1 to SP 2.

Setpoint adjustment only with active setpoint 1

Adjustment of the setpoint in % increments only works when setpoint 1 is active. For setpoint 2 ... 4 there is no adjustment.

8.1.7.18 Setpoint adjustment with binary inputs



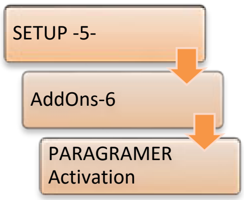
Setpoint 1 can be increased or decreased in % increments via two binary inputs. The increment can be selected via the parameter "Setpoint adjustment with binary inputs ". In addition, the binary input functions "20:SP-incr." and "21:SP-decr." must be assigned to any freely programmable digital inputs. The adjustment works flank oriented, i.e., with each rising flank on one of the inputs an adjustment of the setpoint is carried out in the appropriate direction.

Setting	Action
1:0.1%	Adjustment of setpoint 1 by 0.1%
2:0.2%	Adjustment of setpoint 1 by 0.2 %
3:0.5%	Adjustment of setpoint 1 by 0.5 %
4:1.0%	**Adjustment of setpoint 1 by 1.0 %**
5:1.5%	Adjustment of setpoint 1 by 1.5 %
6:2.0%	Adjustment of setpoint 1 by 2.0 %

Setpoint adjustment always active for setpoint 1

Adjustment of setpoint 1 in 1% increments works even if setpoint 1 is not active. For example, if setpoint 2 is used for regulation and commands arrive for adjusting setpoint 1 at the binary inputs, the latter are placed in the background. For setpoints 2 ... 4 no adjustment via the binary inputs is possible by default.

8.1.7.19 ParaGramer activity



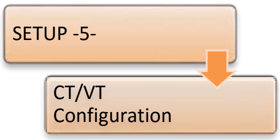
In the event that a system of several transformers/regulators is to decide autonomously which transformer will run in parallel with which other(s), the ParaGramer must be enabled and the maximum number of parallel operating transformers ("ON-1" to "ON-10") entered.

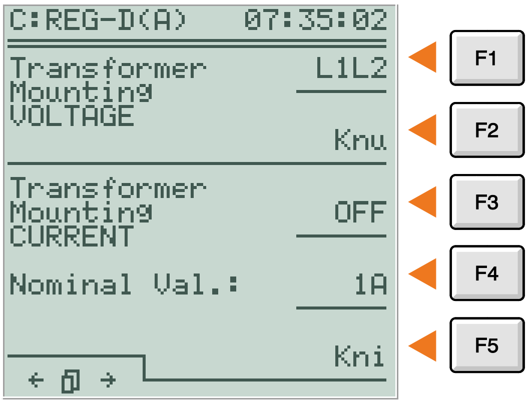
Software feature ParaGramer required

The parameter "ParaGramer activity" is only available when the software feature ParaGramer is enabled. If the feature is not active, the DEMO display of ParaGramer can be activated here. The menu item is then "PARAGRAMER demo activity".

For more information on ParaGramer see chapter 8.3.2 ParaGramer including extensions [protected], from page 232 onwards.

8.1.7.20 CT/VT configuration





In this menu you can determine which phase-to-phase and current will be used for measurement.

In addition, the ratios of external voltage and current transformers, and the nominal value of current can be chosen.

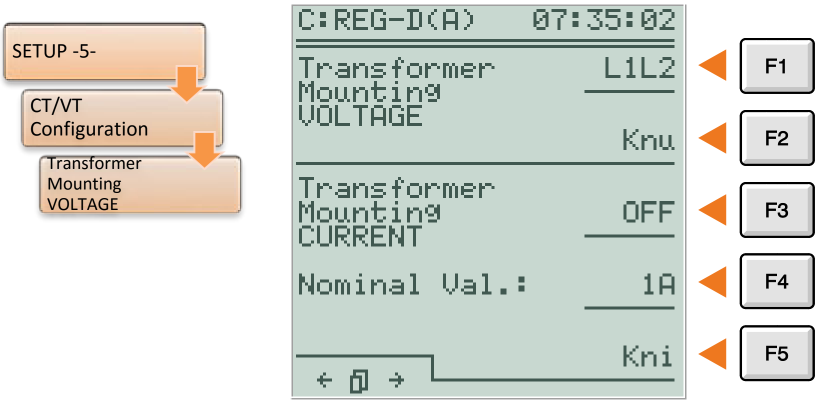
Since the grids at the connection point of a Relay for Voltage Control & Transformer Monitoring are usually considered equally loaded, all power values of the grid can be calculated with sufficient accuracy using just one voltage and current.

Prerequisite: The regulator is informed which external conductors the measurement voltage is measured between, and on which line current is measured.

Connecting the measurement inputs

To connect the measurement inputs to the transducer, use the specific circuit diagram of the corresponding system. This specific circuit diagram is supplied with the voltage regulation system. If you do not have the schematics, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Transformer Mounting Voltage



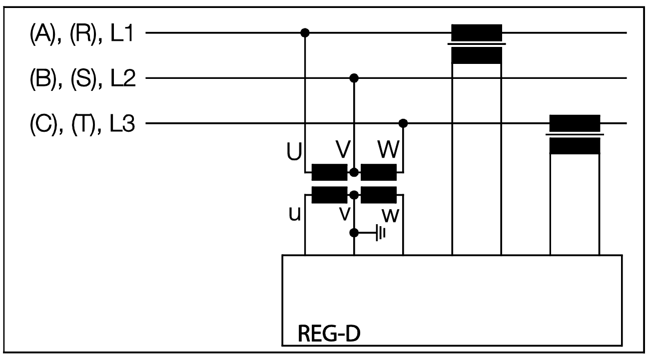
To employ the Relay for Voltage Control & Transformer Monitoring REG-D™ in terms of hardware it is not necessary to assign voltage measurement connections to a particular position in the network (e.g. U12). Regardless of which external conductors the voltage is measured between, the regulator determines the correct angular relationship when the actual connection is set in the CT/VT Configuration menu.

In case the regulator is connected to an asymmetrically loaded grid and correct measured values for active and reactive power is needed, the regulator can also be operated in an Aron measuring circuit (feature M2).

For this purpose, the parameters "Transformer Mounting Voltage" and "Transformer Mounting Current" must each be set to ARON. The connection must be carried out in a correct manner.

Please employ the following circuit diagram.

With an Aron connection the following applies:



Used to regulate voltage in an Aron measurement

Only one delta voltage (U12) is used for regulation even though the regulator measures with an Aron connection.

Factor of the voltage transformer (Knu)

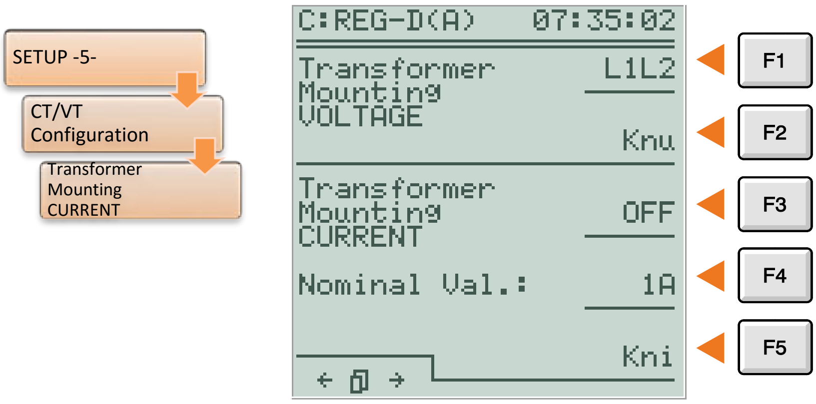
If the primary value of the voltage is to be displayed, the factor Knu for the voltage transformer must be entered.

Example:

20 kV / 100 V → Knu = 200

Please note that the scale for the input of the transformer factor can be switched by pressing F3 and thus adapted to the requirements.

Transformer Mounting Current



To use the Relay for Voltage Control & Transformer Monitoring REG-D™, it is not necessary to assign the current measurement terminals a specific location in the grid in terms of hardware (e.g. I1). Regardless of which phase the current is measured in, the regulator determines the correct angular relationship when the actual connection is set in the CT/VT Configuration menu.

In case the regulator is connected to an asymmetrically loaded grid and correct measured values for active and reactive power is needed, the regulator can also be operated in an Aron measuring circuit (feature M2).

For this purpose, the parameters "Transformer Mounting voltage" and "Transformer Mounting current" must each be set to ARON. The connection must be carried out in a correct manner (see previous point "Transformer Mounting Voltage").

Factor of the current transformer (Kni)

If the primary value of the current is to be displayed, the factor Kni for the current transformer must be entered.

Example:

1000 A / 1 A → Kni = 1000

Please note that the scale for the input of the transformer factor can be switched by pressing F3 and thus adapted to the requirements.

Current measurement range

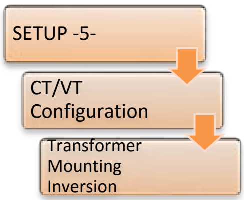
REG-D™ has two current measurement ranges (1/5 A). If the measuring range is to be changed, a jumper must be changed in addition to conversion of the nominal value parameter. For more information, see chapter 7.1.3.2 Current measurement range from page 54 onwards.

Interchanging the transducer connections

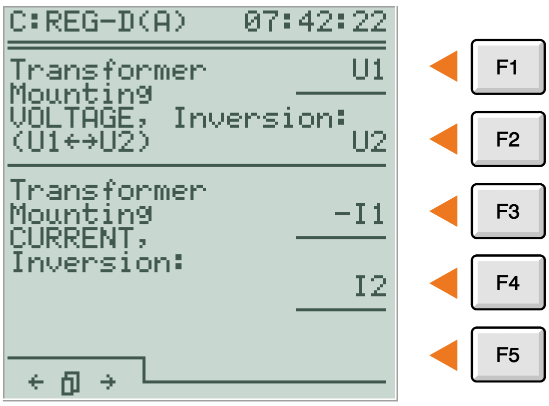
In some applications, it turns out that after commissioning the system, measurement of active powers gives the wrong sign. The erroneous indication is generally due to a faulty connection. If the energy flow direction is to be changed, the connections of the current transducer can be exchanged, for example.

The mechanical reversal of the connections should only be performed when the current transformers are short-circuited on the secondary side, or the system is switched off.

To work around this limitation, the polarity can also be rotated using the menu.



Inversion (180 degree rotation) of voltage and current measurement inputs can be done on page two of the transducer installation menu. This second page is reached by pressing the left arrow key (◄) or the right arrow key (►) in the transducer installation menu.

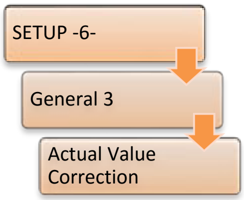


Inversion of individual measurement inputs is accomplished via the keys F1 to F4. Inverted measurement inputs are displayed with a minus sign (e.g. -I1).

Left rotary field

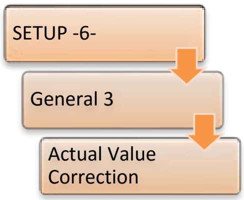
The angle references in the REG-D™ are based on a clockwise rotating field. If you use a phase sequence that produces a left rotating field, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

8.1.7.21 Actual value correction of measurement voltage U_E



The actual value correction of voltage serves to compensate voltage drops on the line and for correcting transducer error between the voltage transformer and REG-D™.

8.1.7.22 Actual value correction of measurement current I_E



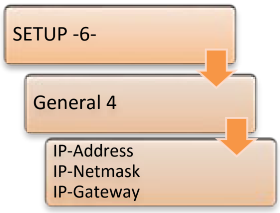
The actual value correction of current is mainly used for correcting transducer error.

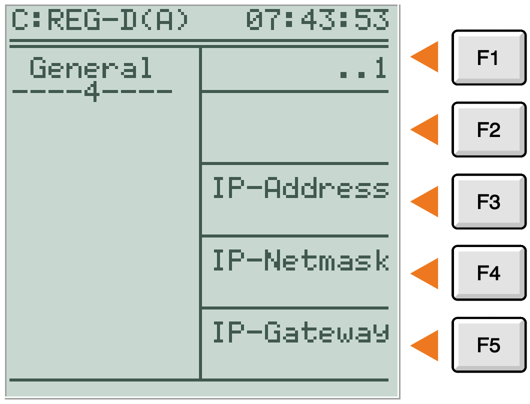
Actual value correction not via WinREG

Correction values for voltage and current are not transmitted when a parameter file is read with WinREG.

Reason:
Correction values are only suitable for a very specific installation location and are presumably not transferable to other installation locations.

8.1.8 SCADA system





Settings in this menu are required only when the regulator is connected along with an interface card (REG-PE or REG-PED) to SCADA systems via Ethernet. The settings only engage when used with IEC 61850 or IEC 60870-5-104.

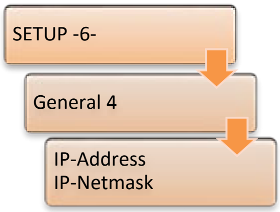
Use/takeover of parameters in the SCADA system coupling module

After a certain time, the SCADA system parameters set in REG-D™ are adopted by the telecontrol board module. That is, the telecontrol board module changes the settings and restarts. The settings in REG-D™ are dominant and always causes the connected telecontrol board module to take over these settings. Change of the SCADA system parameters via the software WinConfig or the WebServer of the SCADA system card is not possible in this case. The parameters must be always modified in the REG-D™.
If the SCADA system parameters in the REG-D™ are set to 0.0.0.0, the telecontrol board module will manage its own settings. The settings can then be changed, for example, via the WinConfig software or the WebServer of the telecontrol board module. The SCADA system parameters adjusted in this way are not taken over by REG-D™.

Configuration of the SCADA system coupling modules

The SCADA system coupling modules can quite easily be configured with the software WinConfig.

IP address and IP subnet mask

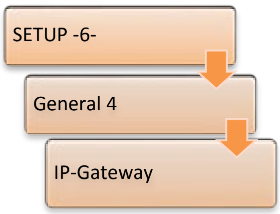


The IP address is the logical address of a device. It is 32 bits or four bytes long and is written separately for easier readability with dots between the four bytes.

A subnet mask is always associated with an IP address, which together with the IP address is a unique identifier of a device within a network. The subnet mask separates physically connected networks into logical networks. Thus, the subnet mask defines how many bytes or bits define the network part and how many belong to the host part. The larger the network part the smaller the available number of possible hosts/devices in the network.

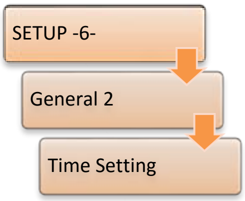
It is recommended to use a class C network with a private IP address (e.g. 192.168.xx), so that up to 254 devices in a network can be addressed (e.g. a transformer station). The associated subnet mask would be 255.255.255.0, so all hosts on the network should have the first three bytes identical (e.g. 192.168.1.) and differ in the last byte (e.g. values between .1 and .254).

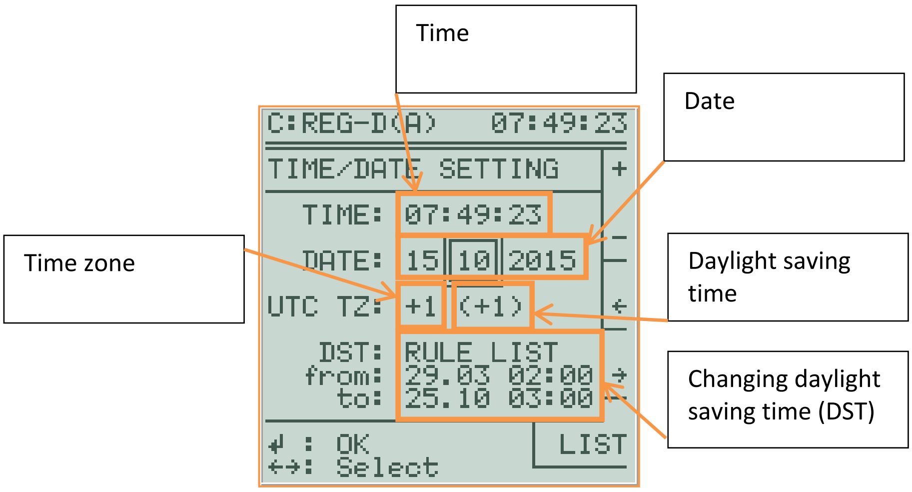
IP gateway



A gateway is the interface for communication with other networks, including the Internet (public IP address, as opposed to private IP addresses), to connect to the control room. Here, for example, the IP address of a router is given, which includes both the private network of the installation as well as the public network.

8.1.9 Time setting





Time, date, time zone (offset from UTC time) and the rules for daylight saving time can be set in the time menu. Use the F1 and F2 keys to change the values.

With the F3 and F4 keys you can switch between the individual values. The F5 key has different functions depending on the selected setting value. If seconds is selected to be set, the F5 key is used to zero the seconds. If a different setting is selected, the F5 key serves as access to the daylight saving time rules.

Summer time (Daylight**S**aving**T**ime**):**

Daylight saving time is activated in the "Time Setting" menu via the DST parameter. If OFF is selected, there is no daylight saving time.

The time for summer/winter time changeover can be defined in the menu for the daylight saving time rule definition. By default, the rules for Central Europe (DST from 02:00 the last Sunday in March to 03:00 the last Sunday in October) are set here.

The changeover times (date and time) for the selected year are displayed in each case.

Rules for daylight saving time change are already available for certain regions and countries. These can be selected using the wizard (F5 key).

If the daylight saving time change is required at a time, which is not present in a predefined list, the rules can be freely configured. For this purpose, the keys F1 and F2 are used to modify the value and the F3 and F4 keys to select the value. The DST rules can be set separately for each year. While editing a rule, the individual constituents are generally represented as a number. The meaning of the selected editing number is displayed in plain text in square brackets below the heading "DST rule list". If an invalid rule is defined, the message "Error in Rule!" appears.

The DST rule list can be exited with the ESC key.

With the rule definitions the following value ranges for the individual parameters can be selected:

Year:	1990 to 2078
Weekday:	Monday … Sunday (from), exact date, Monday … Sunday before
Day:	Last weekday (0), 1. ... 5. weekday, 1 … 31
Month:	January … December
Hour:	-3 days 23h, -2 days 0…23h, -1 day 0…23h, 0…23h, +1 day 0.23h, +2 days 0..2h
Minutes:	0, 15, 30, 45 min

Example:

Daylight saving time begins next Friday after 1 April, at 02:00 and ends on Saturday before the last Sunday in October at 22:00.

Start of DST:	Friday (5), 1, April(4), 02h, 00min
End of DST:	Sunday(7), last (0), October(10), 22:00h-1day(98), 00min

Once the rules are defined, they can be saved with the ENTER key. Then a menu appears where you can choose whether the rules defined apply only to the selected year, from the selected year to 2078, or for all years.

Simple installation via WinREG

Rule setting can also be performed easily via the service program of WinREG (see chapter 9.7 Service, from page 305 onwards).

8.2 Inputs and Outputs

8.2.1 General

In its default configuration, the REG-D™ provides 16 binary inputs (14 freely configurable), 11 relays (9 freely programmable), 8 LEDs (7 freely programmable) and 3 analog module slots, each with a maximum of two analog channels. The freely configurable inputs and outputs can be explicitly switched off, made available to the background program or assigned a preconfigured function.

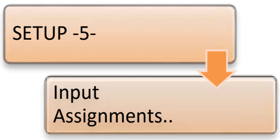
Configuration of the freely configurable binary inputs, relays, LEDs and analog channels is described in chapter 7.2.2.6 Input/Output signals, from page 99 onwards.

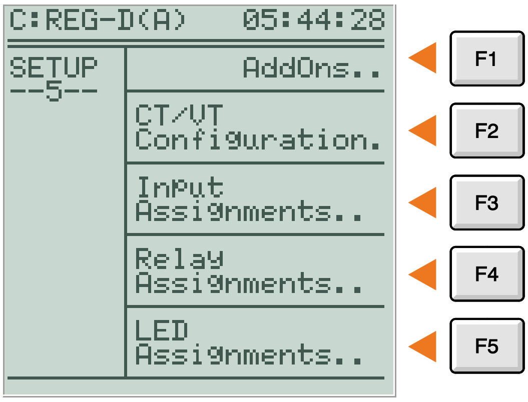
This chapter contains a detailed explanation of all available input and output functions, as well as input and output expansion options of the REG-D™ via COM3. In addition to a description of the function, the firmware version of REG-D™ after which the function is available is also given, as well as availability of functions depending on a software feature. For further information, reference is made at this point to chapter 8.3 Features (software) from page 230 onwards.

Status information and control of binary inputs and outputs via a SCADA system

In general, the status (on or off) of a binary input or relay can be transferred independently of the assigned function via a SCADA system. In order to control a relay from a SCADA system, it must have the function 01:PROG.

8.2.2 Binary inputs





Binary input function	Description	FW version	Only available with feature
00:OFF	The input has no firmware function	from 1.00	
01:PROG	The input is used in background program	from 1.00	
02:SP2Level	Switchover to setpoint 2, level input, when active SP2 otherwise SP1	from 1.15	
03:SP-1	Switchover to setpoint 1, pulse input	from 1.23	
04:SP-2	Switchover to setpoint 2, pulse input	from 1.23	
05:SP-3	Switchover to setpoint 3, pulse input	from 1.23	to 1.99: 4setpoints
06:SP-4	Switchover to setpoint 4, pulse input	from 1.23	to 1.99: 4setpoints
07:TC.i.Op	TC in operation signal from tap changer	from 1.15	
08:Par-Prog	Parallel program activation via binary input, the parameter Parallel Program Activation must be set to level or pulse	from 1.21	
09:3Winding	Switchover of regulation from U1 to U2	from 1.22	3winding
10:SP-Bin0	Setpoint index switchover binary coded, bit 0	from 2.03	
11:SP-Bin1	Setpoint index switchover binary coded, bit 1	from 2.03	
13:Trans1	Passthrough function 1, input state can be reflected on relay/LED	from 1.27	
14:Trans2	Passthrough function 2, input state can be reflected on relay/LED	from 1.27	
15:BuchAlm	Buchholz relay alarm	from 2.03	TM
16:BuchTrip	Buchholz relay triggering	from 2.03	TM

Binary input function	Description	FW version	Only available with feature
17:OilPump	Oil pump 1 running	from 2.03	TM
20:SP-incr.	Increase setpoint 1, step size adjustable	from 1.32	
21:SP-decr.	Decrease setpoint 1, step size adjustable	from 1.32	
22:Manual+	Manual+ input for software feature NLK	from 1.33	NLK
23:lower+	lower+ input for software feature NLK	from 1.33	NLK
24:Inh.Low	Inhibit, automatic regulation is blocked, manual tap command available	from 1.00	
25:Quick	Activate high-speed switching, high-speed switching stops in contrast to limit high-speed switching as soon as signal no longer present	from 1.19	
26:PG_CB	Circuit breaker, undervoltage side (to 1.81: 26:MV_LS)	from 1.77	ParaGramer (4)
27:PG_IS1	Isolator busbar 1, undervoltage side (to 1.81: 27:MV_TRa)	from 1.77	ParaGramer (4)
28:PG_IS2	Isolator busbar 2, undervoltage side (to 1.81: 28:MV_TRb)	from 1.77	ParaGramer (4)
29:PG_CP	Coupling busbar 1 on busbar 2, undervoltage side (to 1.81: 29:MV_QK)	from 1.77	ParaGramer (4) + no 991191
30:PG_SC1	Section busbar 1, undervoltage side (to 1.81: 30:MV_LKra)	from 1.77	ParaGramer (1+3+4)
31:PG_SC2	Section busbar 2, undervoltage side (to 1.81: 30:MV_LKrb)	from 1.77	ParaGramer (1+3+4)
32:PG_CBa	Coupling for feature 991101, undervoltage side	from 1.85	ParaGramer + 991101 (1+3+4)
33:PG_CBb	Coupling b for feature 991101, undervoltage side	from 1.85	ParaGramer + 991101 (1+3+4)
34:PG_H_CB	Circuit breaker, overvoltage side	from 1.85	ParaGramer (4)
35:PG_H_IS1	Isolator busbar 1, overvoltage side	from 1.85	ParaGramer (4)
36:PG_H_IS2	Isolator busbar 2, overvoltage side	from 1.85	ParaGramer (4)

Binary input function	Description	FW version	Only available with feature
37:PG_H_CP	Coupling busbar 1 on busbar 2, overvoltage side	from 1.85	ParaGramer (4) + no 991191
38:PG_H_SC1	Section busbar 1, overvoltage side	from 1.85	ParaGramer (2+3+4)
39:PG_H_SC2	Section busbar 2, overvoltage side	from 1.85	ParaGramer (2+3+4)
40:PG_H_CBa	Monitoring signal for feature 991101, overvoltage side	from 1.85	ParaGramer + 991101 (4)
41:PG_H_CBb	Monitoring signal for feature 991101, overvoltage side	from 1.85	ParaGramer + 991101 (4)
42:up	Issue of an up tap command, only in remote and manual mode	from 1.85	
43:down	Issue of a down tap command, only in remote and manual mode	from 1.85	
44:BCD1	Tap position feedback BCD 1	from 1.85	
45:BCD2	Tap position feedback BCD 2	from 1.85	
46:BCD4	Tap position feedback BCD 4	from 1.85	
47:BCD8	Tap position feedback BCD 8	from 1.85	
48:BCD10	Tap position feedback BCD 10	from 1.85	
49:BCD20	Tap position feedback BCD 20	from 1.85	
50:BCDminus	Tap position feedback sign	from 1.85	
51:BIN16	Binary coded tap position indication value 16, value 1..8 are covered via the BCD input functions	from 1.85	
52:BIN32	Binary coded tap position indication value 32, value 1..8 are covered via the BCD input functions	from 1.85	
53:LR_AH	Manual/automatic input of additional component REG-LR, 0:Manual 1:Auto	from 1.97	
54:LR_STAT	Input status of additional component REG-LR, 0:Fault 1:OK	from 1.97	
55:PG_C1a	Section busbar 1 left from the coupling, undervoltage side	from 1.91	ParaGramer + Crosslink=1/3 (4)
56:PG_C1b	Section busbar 1 right from the coupling, undervoltage side	from 1.91	ParaGramer + Crosslink=1/3 (4)
57:PG_C2a	Section busbar 2 left from the coupling, undervoltage side	from 1.91	ParaGramer + Crosslink=1/3 (4)
58:PG_C2b	Section busbar 2 right from the coupling, undervoltage side	from 1.91	ParaGramer + Crosslink=1/3 (4)

Binary input function	Description	FW version	Only available with feature
59:PG_H_C1a	Section busbar 1 left from the coupling, overvoltage side	from 1.91	ParaGramer + Crosslink=2/3 (4)
60:PG_H_C1b	Section busbar 1 right from the coupling, overvoltage side	from 1.91	ParaGramer + Crosslink=2/3 (4)
61:PG_H_C2a	Section busbar 2 left from the coupling, overvoltage side	from 1.91	ParaGramer + Crosslink=2/3 (4)
62:PG_H_C2b	Section busbar 2 right from the coupling, overvoltage side	from 1.91	ParaGramer + Crosslink=2/3 (4)
63:LR_LR	Local/remote input from additional component REG-LR, 0:Remote - 1:Local	from 1.97	
64:MSI_Ma	Master selection	from 2.02	ParaGramer (+MSI)
65:MSI_Sl	Slave selection	from 2.02	ParaGramer (+MSI)
66:MSI_Ind	Independent selection	from 2.02	ParaGramer (+MSI / MSI2)
67:MSI_Ma1	Master group 1 selection	2.02f / from 2.10f	ParaGramer (+MSI2)
68:MSI_Ma2	Master group 2 selection	2.02f / from 2.10f	ParaGramer (+MSI2)
69:MSI_Sl1	Slave group 1 selection	2.02f / from 2.10f	ParaGramer (+MSI2)
70:MSI_Sl2	Slave group 2 selection	2.02f / from 2.10f	ParaGramer (+MSI2)
71:PG_IS3	Isolator busbar 3, undervoltage side	from 2.12	ParaGramer (1+2)
72:PG_CP2	Coupling busbar 2 after busbar 3, undervoltage side	from 2.12	ParaGramer (1+2)
73:PG_CP3	Coupling busbar 3 after busbar 1, undervoltage side	from 2.12	ParaGramer (1+2)
74:PG_SC3	Section busbar 3, undervoltage side	from 2.12	ParaGramer (1+2)
75:PG_H_IS3	Isolator busbar 3, overvoltage side	from 2.12	ParaGramer (2+3)
76:PG_H_CP2	Coupling busbar 2 after busbar 3, overvoltage side	from 2.12	ParaGramer (2+3)
77:PG_H_CP3	Coupling busbar 3 after busbar 1, overvoltage side	from 2.12	ParaGramer (2+3)

Binary input function	Description	FW version	Only available with feature
78:PG_H_SC3	Section busbar 3, overvoltage side	from 2.12	ParaGramer (2+3)
79:OilPump2	Oil pump 2 running	from 2.15b	TM
82:BCD40	Tap position indicator BCD 40	from 2.22	

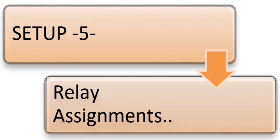
(1) not available with the feature Crosslink = 1 (Crosslink undervoltage side)

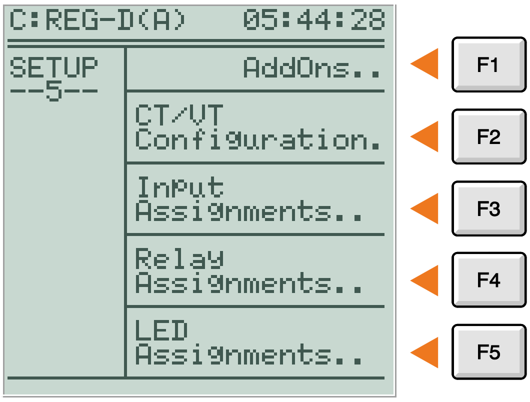
(2) not available with the feature Crosslink = 2 (Crosslink undervoltage side)

(3) not available with the feature Crosslink = 3 (Crosslink undervoltage side)

(4) not available with the parallel program MSI or MSI2

8.2.3 Relays





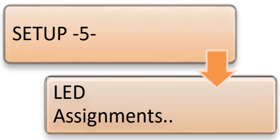
Relay output function	Description	FW version	Only available with feature
00:OFF	The relay has no function and is switched off	from 1.00	
01:PROG	The relay is controlled from the background program	from 1.00	
02:ON	Relay is active, for example, to test the wiring	from 1.00	
03:<U	Undervoltage, below limit <U	from 1.00	
04:>U	Overvoltage, limit >U exceeded	from 1.00	
05:>U+<U	Under- or overvoltage	from 1.00	
06:>I	Overcurrent, limit >I exceeded	from 1.33	
07:SP-1	Setpoint 1 active	from 1.23	
08:SP-2	Setpoint 2 active	from 1.23	
09:SP-3	Setpoint 3 active	from 1.23	to 1.99: 4setpoints
10:SP-4	Setpoint 4 active	from 1.23	to 1.99: 4setpoints
11:Inh.High	Inhibit high	from 1.00	
12:Quick	High-speed switching active	from 1.19	
13:Inhibit	General inhibit (inhibit low, inhibit high, block if <I or >I)	from 1.00	
14:TC-Err	TC in operation signal error	from 1.19	
15:creepNBD	Creeping Net Breakdown	from 1.15	
16:Manual	MANUAL operation	from 1.16	
17:ELAN-Err	ELAN error	from 1.24	
18:Par-Prog	Regulator is in active parallel operation (excluding if regulator is a	from 1.21	

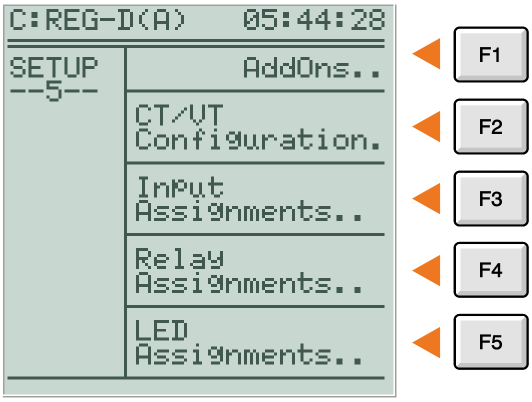
Relay output function	Description	FW version	Only available with feature
	slave; see also relay function "88:ParProg+")		
19:3Winding	Monitored voltage has exceeded limit >Ub	from 1.22	3Winding
20:PhasFail	Phase drop recognized	from 1.27	
21:Com3Err	Communication error COM3	from 2.15	
22:TapMiMa	Min. or max. tap limit reached	from 2.22	
23:Trans1	Passthrough function 1	from 1.27	
24:/Trans1	Passthrough function 1 negated	from 1.27	
25:Trans2	Passthrough function 2	from 1.27	
26:/Trans2	Passthrough function 2 negated	from 1.27	
27:OilAlarm	Oil temperature alarm	from 2.03	TM
28:WndAlarm	Winding temperature alarm	from 2.03	TM
29:WndTrip	Trigger of winding temperature	from 2.03	TM
30:ParErr	Parallel error	from 1.32	
31:up	Up tap command	from 1.31	
32:down	Down tap command	from 1.31	
33:SP-incr.	Setpoint increment	from 1.32	BBN 4.4.3
34:SP-decr.	Setpoint decrement	from 1.32	BBN 4.4.3
35:TapMin	Min. tap limit reached	from 2.22	
36:TapMax	Max. tap limit reached	from 2.22	
37:Manual+	Regulator set to manual by input function 22:Manual+	from 1.33	NLK
38:<I	Below limit <I	from 1.33	
39:InputErr	Several binary inputs with SP-n functions active	from 1.36	
40:AUTO	AUTOMATIC operation	from 1.36	
41:TC-Err+	TC in operation fault, wiper	from 1.39	
42:PANmiss	PAN-D not available	from 1.50	
43:LV_Check	Monitoring of parallel switching for customer specific scheme	from 1.85	991101
44:HV_Check	Monitoring of parallel switching for customer specific scheme	from 1.85	991101
45:HV_Err	Monitoring of parallel switching for customer specific scheme	from 1.85	991101
46:HV_Fail	Monitoring of parallel switching for customer specific scheme	from 1.85	991101
47:Local	Local operation	from 1.99	
48:Remote	Remote operation	from 1.99	
49:Heater	Heating active	from 2.00	TM

Relay output function	Description	FW version	Only available with feature
50:Cooler1	Cooler 1 on	from 2.00	TM
51:Cooler2	Cooler 2 on	from 2.00	TM
52:Cooler3	Cooler 3 on	from 2.00	TM
53:Cooler4	Cooler 4 on	from 2.00	TM
54:Cooler5	Cooler 5 on	from 2.00	TM
55:Cooler6	Cooler 6 on	from 2.00	TM
56:TempTC	Overtemperature tap changer	from 2.00	TM
57:OillvTC-	Tap changer oil level too low	from 2.00	TM
58:OillvTC+	Tap changer oil level too high	from 2.00	TM
59:OillvTr-	Transformer oil level too low	from 2.00	TM
60:OillvTr+	Transformer oil level too high	from 2.00	TM
61:Water	Water limit exceeded	from 2.00	TM
62:Gas	Gas limit exceeded	from 2.00	TM
63:BuchAlm	Buchholz alarm	from 2.00	TM
64:BuchTrip	Buchholz triggering	from 2.00	TM
65:COM2Act	Communication on COM2 active	from 2.00	
66:MSI_Ma	MSI: Master selected	from 2.00	ParaGramer (+MSI)
67:MSI_Sl	MSI: Slave selected	from 2.00	ParaGramer (+MSI)
68:MSI_Ind	MSI: Independent selected	from 2.00	ParaGramer (+MSI / MSI2)
69:TAPERR	Tap change error	from 2.00	
70:HvLvDiff	Different parallel states between over- and undervoltage sides	from 2.00	HVLVCONTROL
71:T60s/1s	Every 60 sec for 1 sec on (second pulse)	from 2.00	
72:Inh.Low	Inhibit low	from 2.00	
73:HUNTING	Hunting detected (hunting function can only be configured via REG-L)	from 2.00	
74:OilPump	Actuation of oil pump	from 2.00	TM
75:MSI_Ma1	MSI2: Master 1 selected	2.02f / from 2.10f	ParaGramer (+MSI2)
76:MSI_Ma2	MSI2: Master 2 selected	2.02f / from 2.10f	ParaGramer (+MSI2)
77:MSI_Sl1	MSI2: Slave 1 selected	2.02f / from 2.10f	ParaGramer (+MSI2)

Relay output function	Description	FW version	Only available with feature
78:MSI_Sl2	MSI2: Slave 2 selected	2.02f / from 2.10f	ParaGramer (+MSI2)
79:T1h/1s	Every 60 min for 1 sec on (hourly second pulse)	from 2.10f	
80:H2	Limit H2 exceeded	from 2.11	
81:CO	CO limit exceeded	from 2.11	
82:dCosEmgy	dcos(φ) emergency program active	from 2.11	
83:PG_INERR	Monitoring of ParaGramer inputs; Prerequisite: same ParaGramer input function 1x normal + 1x inverse used	from 2.13c	ParaGramer
84:OilPump2	Actuating oil pump 2	from 2.15b	TM
85:AMaster	Active master (master with at least one slave)	from 2.22	
86:ASlave	Active slave	from 2.22	
87:Ind	Independent (also master without slave)	from 2.22	
88:ParProg+	Regulator is in active parallel operation (including if regulator is a slave; see also relay function "18:ParProg")	from 2.22	
89:BCD1	Tap position BCD value 1	from 2.22	
90:BCD2	Tap position BCD value 2	from 2.22	
91:BCD4	Tap position BCD value 4	from 2.22	
92:BCD8	Tap position BCD value 8	from 2.22	
93:BCD10	Tap position BCD value 10	from 2.22	
94:BCD20	Tap position BCD value 20	from 2.22	
95:BCD40	Tap position BCD value 40	from 2.22	
96:BCDminus	Tap position BCD minus	from 2.22	
101:Input-01	Binary input 1	from 2.10f	
102:Input-02	Binary input 2	from 2.10f	
...	...	...	
131:Input-31	Binary input 31	from 2.10f	
132:Input-32	Binary input 32	from 2.10f	

8.2.4 LEDs





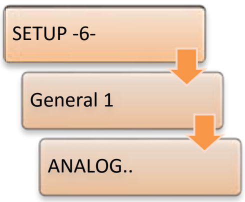
LED - output function	Description	FW version	Only available with feature
00:OFF	The LED has no function and is switched off	from 1.00	
01:PROG	The LED is controlled from the background program	from 1.00	
02:up	Up tap command	from 1.15	
03:down	Down tap command	from 1.15	
04:up/down	Up or down tap command	from 1.15	
05:SP-1	Setpoint 1 active	from 1.23	
06:SP-2	Setpoint 2 active	from 1.23	
07:SP-3	Setpoint 3 active	from 1.23	
08:SP-4	Setpoint 4 active	from 1.23	
09:Inh. High	Inhibit high	from 1.00	
10:Quick	High-speed switching active	from 1.19	
11:Inhibit	General inhibit (inhibit low, inhibit high, block if <I or >I)	from 1.00	
12:TC-Err	TC in operation error	from 1.19	
13:creepNBD	Creeping Net Breakdown	from 1.15	
14:ELAN-L	E-LAN-L is used	from 1.24	
15:ELAN-R	E-LAN-R is used	from 1.24	
16:ELAN-Err	E-LAN error	from 1.24	
17:Par-Prog	Regulator is in active parallel operation (excluding if regulator is a slave; see also LED function "88:ParProg+")	from 1.21	
18:3Winding	Monitored voltage has exceeded limit >Ub	from 1.22	3Winding
19:PhasFail	Phase drop recognized	from 1.27	
20:TapMiMa	Min. or max. tap limit reached	from 2.22	

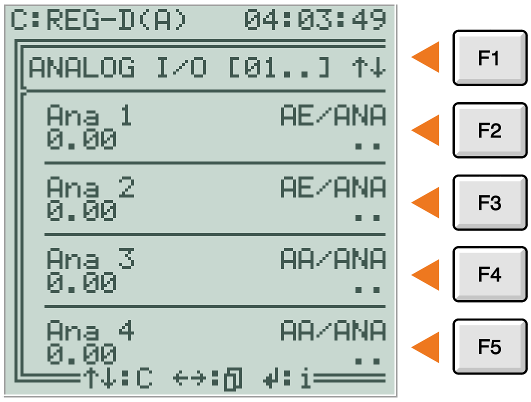
LED - output function	Description	FW version	Only available with feature
21:Com3Err	Communication error COM3	from 2.15	
22:Trans1	Passthrough function 1	from 1.27	
23:/Trans1	Passthrough function 1 negated	from 1.27	
24:Trans2	Passthrough function 2	from 1.27	
25:/Trans2	Passthrough function 2 negated	from 1.27	
26:OilAlarm	Oil temperature alarm	from 2.03	TM
27:WndAlarm	Winding temperature alarm	from 2.03	TM
28:WndTrip	Trigger of winding temperature	from 2.03	TM
29:ParErr	Parallel error	from 1.32	
30:SP-incr.	Setpoint increment	from 1.32	BBN 4.4.3
31:SP-decr.	Setpoint decrement	from 1.32	BBN 4.4.3
32:TapMin	Min. tap limit reached	from 2.22	
33:TapMax	Max. tap limit reached	from 2.22	
34:Manual+	Regulator set to manual by input function 22:Manual+	from 1.33	NLK
35:<I	Below limit <I	from 1.33	
36:InputErr	Several binary inputs with SP-n functions active	from 1.36	
37:PANmiss	PAN-D not available	from 1.50	
38:TC.i.Op	TC in operation	from 1.81	
39:LV_Check	Monitoring of parallel switching for customer specific scheme	from 1.85	991101
40:HV_Check	Monitoring of parallel switching for customer specific scheme	from 1.85	991101
41:HV_Err	Monitoring of parallel switching for customer specific scheme	from 1.85	991101
42:HV_Fail	Monitoring of parallel switching for customer specific scheme	from 1.85	991101
43:Local	Local operation	from 1.99	
44:Remote	Remote operation	from 1.99	
45:<U	Undervoltage, below limit <U	from 2.00	
46:>U	Overvoltage, limit exceeded >U	from 2.00	
47:>I	Overcurrent, limit exceeded >I	from 2.00	
48:Heater	Heating active	from 2.00	TM
49:Cooler1	Cooler 1 on	from 2.00	TM
50:Cooler2	Cooler 2 on	from 2.00	TM
51:Cooler3	Cooler 3 on	from 2.00	TM

LED - output function	Description	FW version	Only available with feature
52:Cooler4	Cooler 4 on	from 2.00	TM
53:Cooler5	Cooler 5 on	from 2.00	TM
54:Cooler6	Cooler 6 on	from 2.00	TM
55:TempTC	Overtemperature tap changer	from 2.00	TM
56:OillvTC-	Tap changer oil level too low	from 2.00	TM
57:OillvTC+	Tap changer oil level too high	from 2.00	TM
58:OillvTr-	Transformer oil level too low	from 2.00	TM
59:OillvTr+	Transformer oil level too high	from 2.00	TM
60:Water	Water limit exceeded	from 2.00	TM
61:Gas	Gas limit exceeded	from 2.00	TM
62:BuchAlm	Buchholz alarm	from 2.00	TM
63:BuchTrip	Buchholz triggering	from 2.00	TM
64:COM1Act	COM1 is used	from 2.00	
65:COM2Act	COM2 is used	from 2.00	
66:MSI_Ma	MSI: Master selected	from 2.00	ParaGramer (+MSI)
67:MSI_Sl	MSI: Slave selected	from 2.00	ParaGramer (+MSI)
68:MSI_Ind	MSI: Independent selected	from 2.00	ParaGramer (+MSI / MSI2)
69:TAPERR	Tap change error	from 2.00	
70:HvLvDiff	Different parallel states between over and undervoltage sides	from 2.00	HVLVCONTROL
71:T60s/1s	Time synchronisation pulse, every 60 sec for 1 sec on	from 2.00	
72:Inh.Low	Inhibit low	from 2.00	
73:HUNTING	Hunting detected (the Hunting function can only be configured via REG-L)	from 2.17	
74:OilPump	Oil pump in	from 2.07	TM
75:MSI_Ma1	MSI2: Master 1 selected	2.02f / from 2.10f	ParaGramer (+MSI2)
76:MSI_Ma2	MSI2: Master 2 selected	2.02f / from 2.10f	ParaGramer (+MSI2)
77:MSI_Sl1	MSI2: Slave 1 selected	2.02f / from 2.10f	ParaGramer (+MSI2)

LED - output function	Description	FW version	Only available with feature
78:MSI_Sl2	MSI2: Slave 2 selected	2.02f / from 2.10f	ParaGramer (+MSI2)
79:T1h/1s	Time synchronisation pulse, every 60 min for 1 sec on	from 2.10f	
80:H2	H2 limit exceeded	from 2.11	TM
81:CO	CO limit exceeded	from 2.11	TM
82:dCosEmgy	dcos(φ) emergency program active	from 2.11	
83:PG_INERR	Monitoring of ParaGramer inputs; Prerequisite: same ParaGramer input function 1x normal + 1x inverse used	from 2.13c	ParaGramer
84:OilPump2	Oil pump actuated or running	from 2.15b	TM
85:AMaster	Active master (master with at least one slave)	from 2.22	
86:ASlave	Active slave	from 2.22	
87:Ind	Independent (also master without slave)	from 2.22	
88:ParProg+	Regulator is in active parallel operation (including if regulator is a slave; see also the LED function "17:ParProg")	from 2.22	
89:BCD1	Tap position BCD value 1	from 2.22	
90:BCD2	Tap position BCD value 2	from 2.22	
91:BCD4	Tap position BCD value 4	from 2.22	
92:BCD8	Tap position BCD value 8	from 2.22	
93:BCD10	Tap position BCD value 10	from 2.22	
94:BCD20	Tap position BCD value 20	from 2.22	
95:BCD40	Tap position BCD value 40	from 2.22	
96:BCDminus	Tap position BCD minus	from 2.22	
101:Input-01	Binary input 1	from 2.10f	
102:Input-02	Binary input 2	from 2.10f	
...	...	...	
131:Input-31	Binary input 31	from 2.10f	
132:Input-32	Binary input 32	from 2.10f	

8.2.5 Analog inputs and outputs





Analog function	Description	FW version	Only available with feature
00:OFF	No function	from 2.00	
01:ANA	Analog channel is used by the background program	from 2.00	
04:oZero	Output on 0	from 2.00	
05:o+FullRng	Output on positive end value (e.g. +20 mA)	from 2.00	
06:o-FullRng	Output on negative end value (e.g. -20 mA)	from 2.00	
07:oU	Output: Regulation voltage [primary value in V, e.g. 20,000 V]	from 2.00	
08:oP	Output: Active power corresponding to the display in the transducer [primary value in W, e.g. 40,000,000 W]	from 2.00	
09:oQ	Output: Reactive power corresponding to the display in the transducer [primary value in VAR, e.g. 25,000,000 VAR]	from 2.00	
10:oS	Output: Apparent power corresponding to the display in the transducer [primary value in VA, e.g. 40,000,000 VA]	from 2.00	
11:oU1	Output: Delta voltage of the first voltage transformer [primary value in V, e.g. 20,000 V]	from 2.00	
12:oU2	Output: Delta voltage of the second voltage transformer [primary value in V, e.g. 20,000 V]	from 2.00	
13:oI1	Output: Current of the first current transducer or with ARON measurement the current I1, corresponding to the	from 2.00	

Analog function	Description	FW version	Only available with feature
	display in the transducer [primary value in A, e.g. 1200 A]		
14:oI2	Output: Current of the second current transducer or with ARON measurement the current I2, corresponding to the display in the transducer [primary value in A, e.g. 1200 A]	from 2.00	
15:oI3	Output: With ARON measurement, the current I3 corresponding to the display in the transducer [primary value in A, e.g. 1200 A]	from 2.00	
16:oPHIDEG	Output: Angle PHI [-180 ... 0 ... +180°]	from 2.00	
17:oCOSPHI	Output: Cos(φ)[-1 ... 1]	from 2.00	
18:oFREQ	Output: Frequency [Hz]	from 2.00	
19:oOilTemp	Output: Oil temperature [°C]	from 2.00	
20:oWindTemp	Output: Winding temperature [°C]	from 2.00	
21:oArU12	Output: With ARON measurement the voltage U12 corresponding to the display in the transducer [primary value in V, e.g. 20,000 V]	from 2.00	M2
22:oArU23	Output: With ARON measurement the voltage U23 corresponding to the display in the transducer [primary value in V, e.g. 20,000 V]	from 2.00	M2
23:oArU31	Output: With ARON measurement the voltage U31 corresponding to the display in the transducer [primary value in V, e.g. 20,000 V]	from 2.00	M2
24:oArP	Output: With ARON measurement, the active power corresponding to the display in the transducer [primary value in W, e.g. 40,000,000 W]	from 2.00	M2
25:oArQ	Output: With ARON measurement, the reactive power corresponding to the display in the transducer [primary value in VAR, e.g. 25,000,000 VAR]	from 2.00	M2
26:oArS	Output: With ARON measurement, the apparent power corresponding to the display in the transducer [primary value in VA, e.g. 40,000,000 VA]	from 2.00	M2
27:oTapPos	Output: Tap position [1]	from 2.07	

Analog function	Description	FW version	Only available with feature
28:oSP-1	Output: Setpoint 1 [secondary value in V, e.g. 101.5 V]	from 2.07	
29:oSP-2	Output: Setpoint 2 [secondary value in V, e.g. 101.5 V]	from 2.07	
30:oSP-3	Output: Setpoint 3 [secondary value in V, e.g. 101.5 V]	from 2.07	
31:oSP-4	Output: Setpoint 4 [secondary value in V, e.g. 101.5 V]	from 2.07	
32:oSP	Output: Active setpoint value [secondary value in V, e.g. 101.5 V]	from 2.22	
33:oSPINF	Output: Active setpoint value with current influence [secondary value in V, e.g. 101.5 V]	from 2.22	
64:iOilTp-TR	Input: Transformer temperature	from 2.00	
65:iOilTp-TC	Input: Tap changer temperature	from 2.00	
66:iOilL-TR	Input: Transformer oil level	from 2.00	
67:iOilL-TC	Input: Tap changer oil level	from 2.00	
68:iWater	Input: Water content	from 2.00	
69:iGas	Input: Gas content	from 2.00	
70:iTapPos	Input: Tap position	from 2.00	
71:iCO	Input: CO content	from 2.11	
72:iH2	Input: H2 content	from 2.11	
73:iWndTp-TR	Input: Transformer winding temperature	from 2.19	

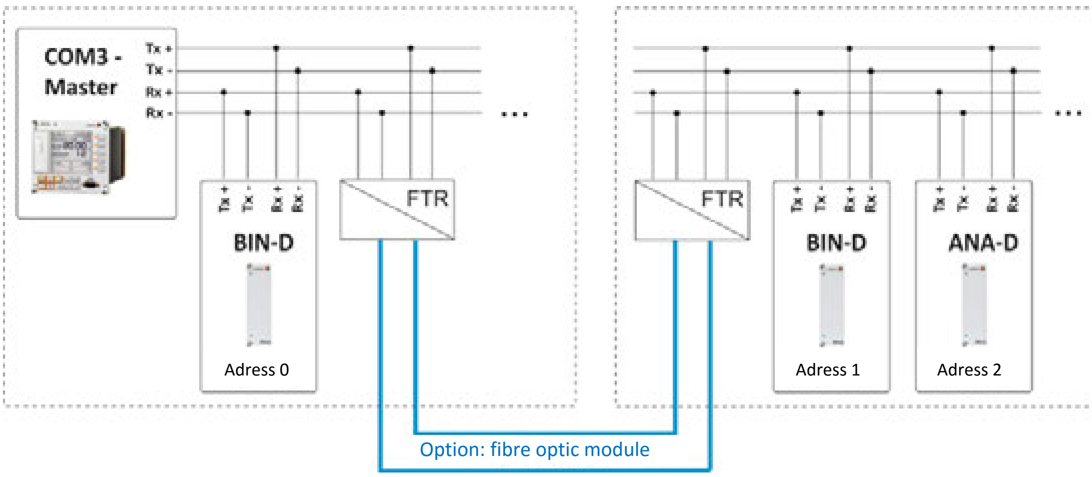
Output of primary values

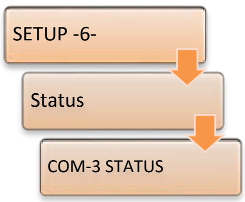
Correct output of calculated primary values (e.g. of the analog function "07:oU") requires configuration of the transformer factors Knu and Kni.

8.2.6 I/O extensions (COM3)

In addition to the standard inputs and outputs of the REG-D™, additional modules (BIN-Ds or ANA-Ds) can be connected to the REG-D™ via the COM3 communication interface to expand the binary and analog inputs and outputs.
BIN-Ds make additional binary signals available (binary inputs, relays, LEDs), ANA-Ds provide additional analog signals (milliamp inputs or outputs).

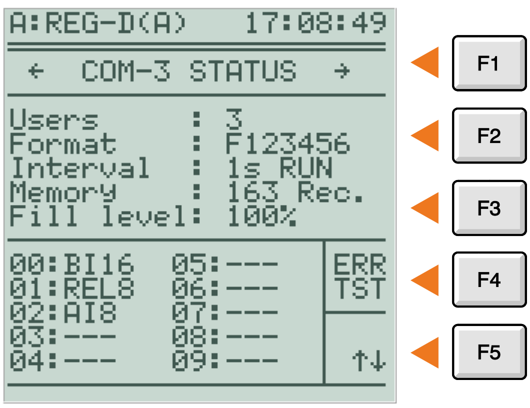
For a detailed description of the hardware side, see chapter 7.1.4.7 COM3 interface from page 72 onwards.





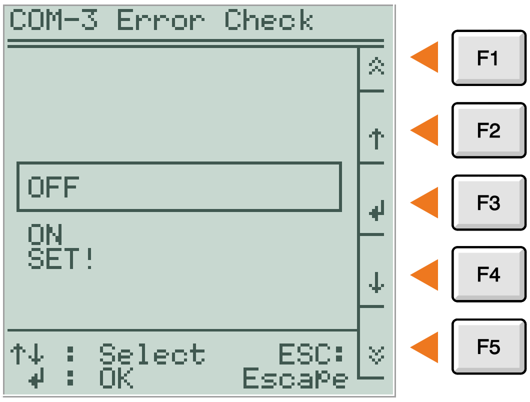
Successful detection of connected COM3 modules can be carried out via the REG-D™ status menu. For this, each module must have a unique address. By way of example in the figure above are shown two BIN-Ds with the address 0 (16 binary inputs [BI16]), and the address 1 (8 relays [REL8]), as well as an ANA-D with address 2 (8 analog inputs [AI8]).

These input/output expansion modules are respectively shown in the COM3 status of REG-D™.



The COM3 interface has a mechanism for error monitoring.

Activation and adjustment can be made in the menu "COM-3 Error Check", which can be reached by pressing the F4 key in the menu "COM3 status".



The following settings are available:

Setting	Description
OFF	Disable monitoring of the COM3 interface.
ON	Enable monitoring of the COM3 interface.
SET!	The current configuration of COM3 (number, address and type of connected device) are stored as a target state and COM3 monitoring is activated.

Monitoring of the COM3 interface is based on the number, the address and the type of devices connected. If at least one of the three above-mentioned properties of the current COM3 configuration does not match the stored COM3 configuration for monitoring, a COM3-Err is triggered. This means that if, for example, at the time of setting COM3 monitoring, two BIN-Ds (16 binary inputs, address 0, and 8 relays, address 1) and one ANA-D (AI8, address 2) are connected to COM3, COM3-Err is triggered when, for example, only two devices can be reached.

Changes to the COM3 configuration

Any change in the number, address or type of devices connected to COM3 triggers an error when COM3 monitoring is enabled. Therefore, after each change of the configuration of COM3, the target state for monitoring must be reset (SET! in the COM-3 Error Check).

COM3 mapping (assignment of the COM3 resources)

Apart from the basic detection of BIN-Ds and ANA-Ds, mapping is crucial for asuccessful use. Any physical input or output must be assigned to a logical (software) input or output. That is, the inputs and outputs connected via COM3 are managed and displayed as internal resources by REG-D™. It is specified, for example, that relay 1 of BIN-D with address 0 is associated with relay 11 of the REG-D™. This software-based mapping between I/O expansion cards and the Relay for Voltage Control & Transformer Monitoring REG-D™ can be read out using the configuration software WinREG (subprogram REGPara), or even changed, if required (via the subprogram Service). For more information, see chapter 9.8 REGPara, from page 314 onwards, or chapter 9.7 Service, from page 305 onwards.

General use of COM3 resources

Use of devices connected to COM3 resources can generally be done in two ways. If the additional inputs and outputs are connected via COM3 mapping with logical (software) inputs and outputs of the firmware, they can be used or set with predefined functions in the menu or via WinREG in the normal way as internal inputs and outputs of REG-D™, or used in the background program.

In addition, direct access to the resources of COM3 devices is possible via the background program without COM3 mapping. This type of access is mainly used with older firmware versions (≤ 2.15), which do not support COM3 mapping.

If both types of access are mixed, it may cause a malfunction.

Assignment of the 16 binary inputs of a BIN-D to binary inputs 17 to 32 of the REG-D™ using DIL switches

Use of a BIN-D with 16 binary inputs, which are to be mapped to the binary inputs 17... 32 of the REG-D™, constitutes an exception to the normal flow. This function can be selected with DIL switch 7 of the BIN-D.

The following applies:

DIP switch 7 = ON -> no assignment to E17 ... 32

DIP switch 7 = OFF -> assignment to E17 ... 32

A COM3 mapping or a background program is not necessary for this purpose. Combination with the normal COM3 mapping is not possible. That is, if more than one BIN-D is to be assigned, total allocation must be carried out via the COM3 mapping mechanism. The DIL switch cannot be used then.

8.2.7 Operating states and error messages

8.2.7.1 General

The REG-D™ comes standard with some functions which serve to monitor the communication of the tap-changer drive and the parallel operation. The respective status and fault messages can be reported by relay, LED and the SCADA system. If additional monitoring functions or status messages are necessary, this can be effected via a background program.

Generation of collective messages

A collective message of the following signals as well as other standard or customer- and application-specific reports can be generated via the background program. For this purpose, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

8.2.7.2 E-LAN error (ELANErr)

The E-LAN error indicates a communication interruption on the E-LAN interfaces. The E-LAN error applies only if there is active parallel operation between the regulators, or if the ParaGramer is used. The display of the E-LAN error is delayed about 30 seconds by default. The delay time is adjustable. To do so, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Termination of unused E-LAN interfaces

Unused E-LAN interfaces that are configured for double-wire operation must be terminated. If that is not the case, false E-LAN errors can be triggered.

8.2.7.3 COM3 error (COM3Err)

The COM3 error indicates a communication interruption to a device (ANA-D, BIN-D) connected to COM3. In order that communication failure of one of the COM3 devices can be recognized, COM3 monitoring must be activated (see chapter 8.2.6 I/O extensions (COM3), from page 224 onwards). The COM3 error is also indicated by blinking of the REG-D™ status LED. As soon as the current configuration of COM3 devices again corresponds to the stored situation, the COM3 error is automatically reset.

8.2.7.4 TC in operation signal error (TCErr)

The TC in operation error is triggered when the TC in operation time detected via the TC in operation signal of the motor drive exceeds the configured maximum TC in operation time. This function is used to monitor the run time of the motor drive and can be used as overrun protection. The output function TC-Err is used to permanently display TC in operation error.

The signal is confirmed as soon as the regulator is switched from manual to automatic, one more error-free tap change is performed, or the F5 key is pressed in regulator or transducer mode. If the error cause is not remedied after confirmation (TC in operation signal is still on), the TC in operation error is activated again after the maximum TC in operation time has elapsed. In order to trigger the motor circuit breaker, the wiping relay output function "41:TC-Err+" can also be used.

8.2.7.5 Tap change error (TapErr)

The tap-change error is used to monitor tap feedback after issue of a tap command. The following tap-change errors are monitored:

- Tap change in the wrong direction (the tap position did not change in the expected direction after a tap-change command)
- Change of tap position by more than one tap, or no change (the tap position did not change to the previously calculated tap after a tap-change command)

The signal is confirmed as soon as the regulator is switched from manual to automatic, or the F5 key is pressed in regulator or transducer mode.

8.2.7.6 Tap position indication error

An error in tap position detection is indicated by the tap position 99. Possible causes for this error are:

- Invalid BCD code, for example, the binary inputs for eight and four are active simultaneously.
- The mA signal for the tap position message lies outside the configured limits (e.g. smaller than four mA).
- Too large total resistance or line discontinuity on detecting tap position via resistance measurement.

Once a correct tap feedback is detected, it will be displayed again instead of the 99. Confirmation is unnecessary.
The fault indicator (tap position 99) in most SCADA system connections is displayed at tap zero.

8.2.7.7 Parallel operation error (ParErr)

The following situations lead to triggering of a parallel operation error:

- The occurrence of a tap difference, which cannot be compensated by the follower (Master-Follower procedure). To reach the tap of the master regulator, the follower regulator has a time window available that is 2.5 times the maximum TC in operation time. Immediately after activation of parallel operation, the time defined by the parameter "1 ParErr after n * TC in operation time“ is available.
- Exceeding the circulating reactive current limit (Icirc supervision) in Master-Follower parallel operation.
- Exceeding the set maximum allowable tap difference in the circulating reactive current minimization procedured (dIsin(φ) and dIsin(φ)[S]).

The parallel operation error is acknowledged as soon as the regulator is switched from manual to automatic, or parallel operation is disabled.
By default, appearance of the parallel operation error leads to switching the regulators involved to MANUAL mode.

8.2.7.8 ParaGramer input error (PG_INERR)

The ParaGramer input error is used to monitor switch feedback for the ParaGramer function. It is only applicable if detection of the switch position is double pole. That is, for each switch position, a respective binary signal for "Switch open" and "Switch closed" is being used. The ParaGramer input error becomes active if both binary signals are on or off, i.e., the switch is in fault position or there is a broken cable. The faulty input status is also indicated by rotation of the corresponding switch in the ParaGramer display.
As soon as the incorrect position feedback is resolved, the ParaGramer input error is automatically confirmed.

Using the ParaGramer input error

The function ParaGramer input error is only available if, for the corresponding switch, both the input function (e.g. "26: PG_CB") and the inverse input function (e.g. "26:-PG_CB") are used on one binary input each.

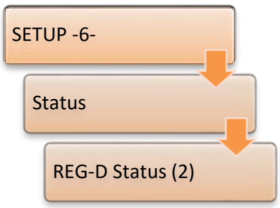
8.2.7.9 dcos(φ) emergency program (dCosEmgy)

The message dcos(φ) emergency program becomes active when communication between the parallel operating regulators is interrupted in parallel operation with dIsin(φ) or dIsin(φ)[S] and the regulator switches to the dcos(φ) emergency program. As soon as communication between the regulators is established again, and the devices switch back into the original parallel program after about 10s, the message is automatically deactivated.

8.3 Features (software)

8.3.1 General and overview

The software features allow customization of REG-D™ functionality based on the customer's and the installation's requirements. This means that they switch certain functions of the REG-D™ on and off without needing to change firmware. Certain features have password protection (protected feature) since they enable either very specific functions or are chargeable.



Switching features on and off is done via a terminal program (e.g. the terminal of the WinREG software). For questions regarding this matter, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Activated features appear in the REG-D™ menu and the WinREG software.

NOTICE!	**Switching on and off and changing features may lead to unintended behavior of the device.** ➲ Features may be only adjusted after consultation with the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Overview of all features

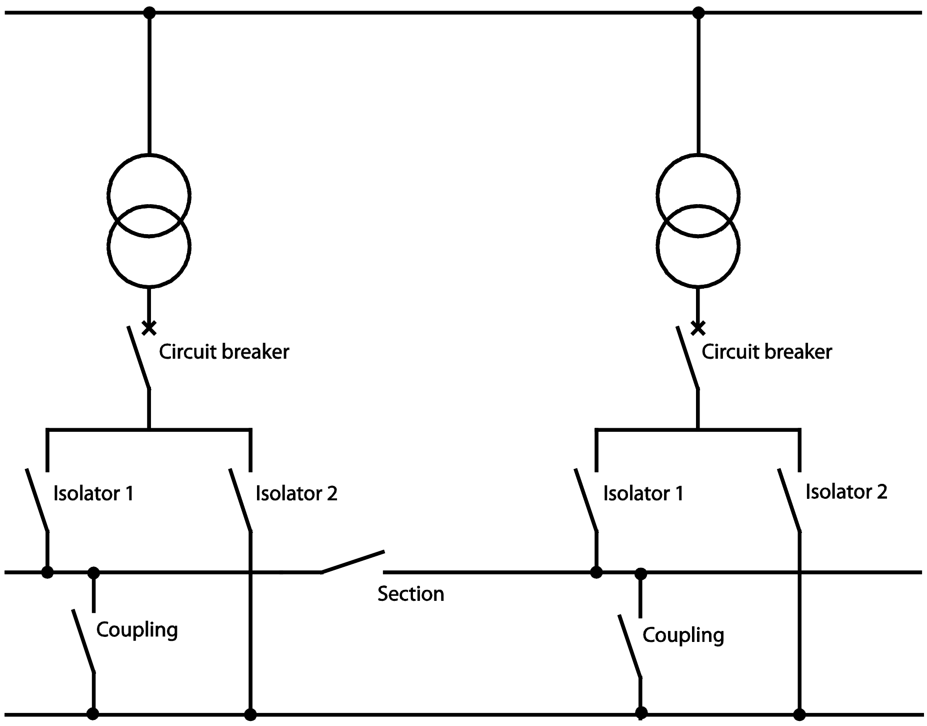
Feature	Description	Dependencies
991101	Customer-specific expansion of the ParaGramer	from FW 1.85
3winding	Three-winding transformer functionality, changeover between measurement inputs U1, I1 and U2, I2	Hardware feature M9 from firmware 1.22 to firmware 1.97 "3winding“
4setpoints	Four setpoints instead of two (from firmware 2.00 always four SPs)	Up two firmware 1.99
Adapt	Adaptation of system messages	from firmware 2.09 and 2.02d/f
BBN4.4.3	Custom feature	from firmware 1.32
Bootload	Enables remote starting of the bootloader	from firmware 2.22
COM2FIX	Fixing the COM2 interface settings	from firmware 2.00
Crosslink	Expansion of ParaGramer, crosswise connection of busbars, cannot be used with a third busbar	from firmware 1.91
DELTAI	Parallel program	from firmware 1.98
EMHAGEN	Custom feature	from firmware 1.30
EnBW	Custom feature	from firmware 1.68

Feature	Description	Dependencies
ESB	Custom feature	from firmware 1.77
HVLVControl	Expansion of ParaGramer, parallel operation is additionally determined on the switch positions of the primary side	from firmware 1.98
Invers	Adjustment of expected tap feedback and the tap commands to an inverse tap changer	from firmware 1.88
LEW	Custom feature	from firmware 1.46
LocalRemote	Activates the local/remote key	from firmware 1.97
M2	ARON measurement for asymmetric grids	Hardware feature M2 from firmware 2.00
MISWAP	Swapping of physical measurement inputs	from firmware 2.00
NLK	Custom feature	from firmware 1.55
ParaGramer	Automatic recognition of parallel operation via the installation topology (feedback of switch positions)	from firmware 1.77
PG_SCHEME_1	Expansion of ParaGramer, special busbar layout with generator	from firmware 2.08
PQCtrl	Active and reactive power regulation, for example, phase-shifting transformer	from firmware 1.86
PrimCtrl	Control of the tap changer based on primary voltage	from firmware 1.73
Qsigned	Reactive power with sign, from FW 2.03 reactive power is displayed by default with sign.	from firmware 1.30
Recorder	Recorder function	from firmware 1.62 up to 1.97 recorder RAM > 256KB
Ringlink	Expansion of ParaGramer, annular busbar, not usable with Crosslink	from firmware 2.19
SimMode	Simulation mode	from firmware 2.00
SR192	Functions for voltage regulation system SR192	from firmware 1.22 not usable with firmware 2.07 to 2.09
SYSCTRL	Adaptation of system behavior part 1	from firmware 2.00
SYSCTRL2	Adaptation of system behavior part 2	from firmware 2.00
TM	The Transformer monitoring function	from firmware 1.99
ULC	Adaptation of the LDC current program	from firmware 1.91
VEW	Custom feature	from firmware 1.58

8.3.2 ParaGramer including extensions [protected]

8.3.2.1 Feature ParaGramer [protected]

ParaGramer is a function of the Relay for Voltage Control & Transformer Monitoring REG-D™ for the purpose of automatic recognition of parallel operation of transformers based on switch positions. The switch positions are transferred via binary signals to the Relays for Voltage Control & Transformer Monitoring and they evaluate what transformers are electrically connected together and thus connected in parallel.



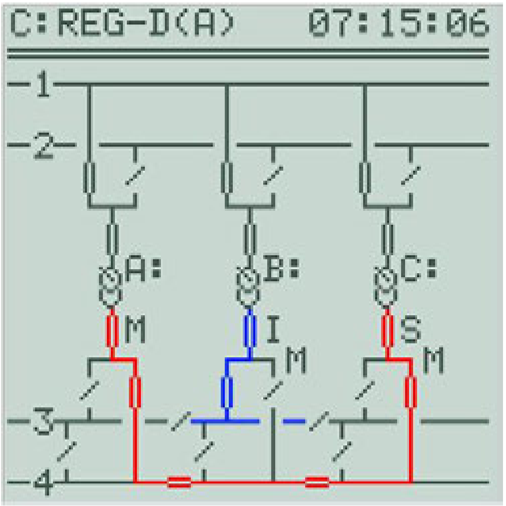
Example of a single-line diagram convertible in ParaGramer

For this purpose, a number of selectable switch positions are available, including, among others, circuit breakers, isolators, sections and couplings.

In addition, several special configurations are available, for example, to take into account both the overvoltage as well as the undervoltage side, to connect crossed busbars (Crosslink), or ringed busbars (Ringlink). These configurations are activated by other features. Prerequisite for these features is always that the feature ParaGramer is activated.

A total of three overvoltage and undervoltage side busbars, and up to ten transformers can be indicated and also shown on the display in ParaGramer.

These open switches are shown as diagonal single lines. Closed switches are displayed as a double line. Switches in fault position are displayed by a rotating line.



Example configuration with two busbars, respectively. All transformers are connected on the overvoltage side to busbar 1, A: and C: are connected to the undervoltage side via busbar 4, and thus parallel to each other, while transformer B: is fedding busbar 3.

The parallel state is presented differently, depending on the parallel program: With the circulating reactive current programs dIsin(φ) and dIsin(φ)[S], parallel operation is displayed with a "P" and single operation with an "I" (independent), while in Master-Follower, MSI and MSI2, depending on the state, "M" for Master, "S" for slave and "I" for independent operation are displayed. In addition, when the regulator could become master, this is indicated by an "M" placed lower.

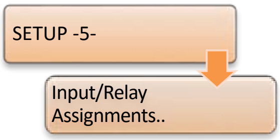
The regulator occupying the lowest place in the group is always selected as master.

Prerequisites

In principle, the following prerequisites must be met to be able to use ParaGramer:

- Each transformer to be regulated must be assigned to a separate Relay for Voltage Control & Transformer Monitoring.
- Each regulator must have the feature ParaGramer enabled, possibly also the special features (e.g. Crosslink), as required.
- A functioning E-LAN connection is required between all regulators.
- There must be a sufficient number of binary inputs available to map the switch positions. Here, each regulator is connected to the switch positions of its "own" transformers. An exception is transmission via a SCADA system, e.g. via GOOSE.

Input/output functions



These switch settings are always available. Although the overvoltage side input functions (with "_H_") can be selected and displayed, they are only evaluated for parallel operation when the feature HVLVControl is enabled.

Input function	Meaning	Comment
26:PG_CB	Undervoltage – circuit breaker	
27:PG_IS1	Undervoltage – isolator busbar 1 (BB 1)	
28:PG_IS2	Undervoltage – isolator (BB 2)	
29:PG_CP	UV – coupling between BB 1 and BB 2	
30:PG_SC1	Undervoltage – section BB 1	Not available with Crosslink=1/3
31:PG_SC2	Undervoltage – section BB 2	Not available with Crosslink=1/3
34:PG_H_CB	Undervoltage – circuit breaker	
35:PG_H_IS1	Overvoltage – isolator BB 1	
36:PG_H_IS2	Overvoltage – isolator BB 2	
37:PG_H_CP	OV – coupling between BB 1 and BB 2	
38:PG_H_SC1	Overvoltage – section BB 1	Not available with Crosslink=2/3
39:PG_H_SC2	Overvoltage – section BB 2	Not available with Crosslink=2/3
71:PG_IS3	Undervoltage – isolator BB 3	
72:PG_CP2	UV – coupling between BB 2 and BB 3	
73:PG_CP3	UV – coupling between BB 1 and BB 3	
74:PG_SC3	Undervoltage – section BB 3	
75:PG_H_IS3	Overvoltage – isolator BB 3	
76:PG_H_CP2	OV – coupling between BB 2 and BB 3	
77:PG_H_CP3	OV – coupling between BB 1 and BB 3	
78:PG_H_SC3	Overvoltage – section BB 3	

Output function	Meaning	Comment
83:PG_INERR	Disruption of ParaGramer inputs*	from 2.13

* The ParaGramer makes available testing of switch feedback. For this purpose, the regulator is supplied with a bipolar switch feedback (1x normally closed, 1x normally open). As soon as the switch feedback is invalid (both binary inputs either on or off), the output function PG_INERR is activated with a time delay. The monitoring function is activated as soon as the same ParaGramer input function is used on two binary inputs, once non-inverse and once inverse.

Parameter

The following parameters must be considered:

Parameter	Description
Parallel Program Activation SETUP -5- AddOns-7 Parallel Prog. Activation	On using the ParaGramer, as a rule parallel program activation is set to 01:ON, because the ParaGramer detects by itself which transformers are in parallel.
ParaGramer Activation SETUP -5- AddOns-6 PARAGRAMER Activation	With ParaGramer activation, the number of transformers that, in principle, can and should be connected in parallel with each other must be set. Exactly this number of transformers are shown In the display.
Parallel Program SETUP -1- Programs.. Parallel Program	A parallel program must be selected. The following parallel programs can be used with ParaGramer: dIsin(φ) dIsin(φ)[S] dcos(φ) Master-Follower MSI (only available with ParaGramer enabled) MSI2 (only available with ParaGramer enabled)
Group List SETUP -1- Programs.. Par.Parameter.. Group List	All regulators that will be used with ParaGramer must be configured in the group list.

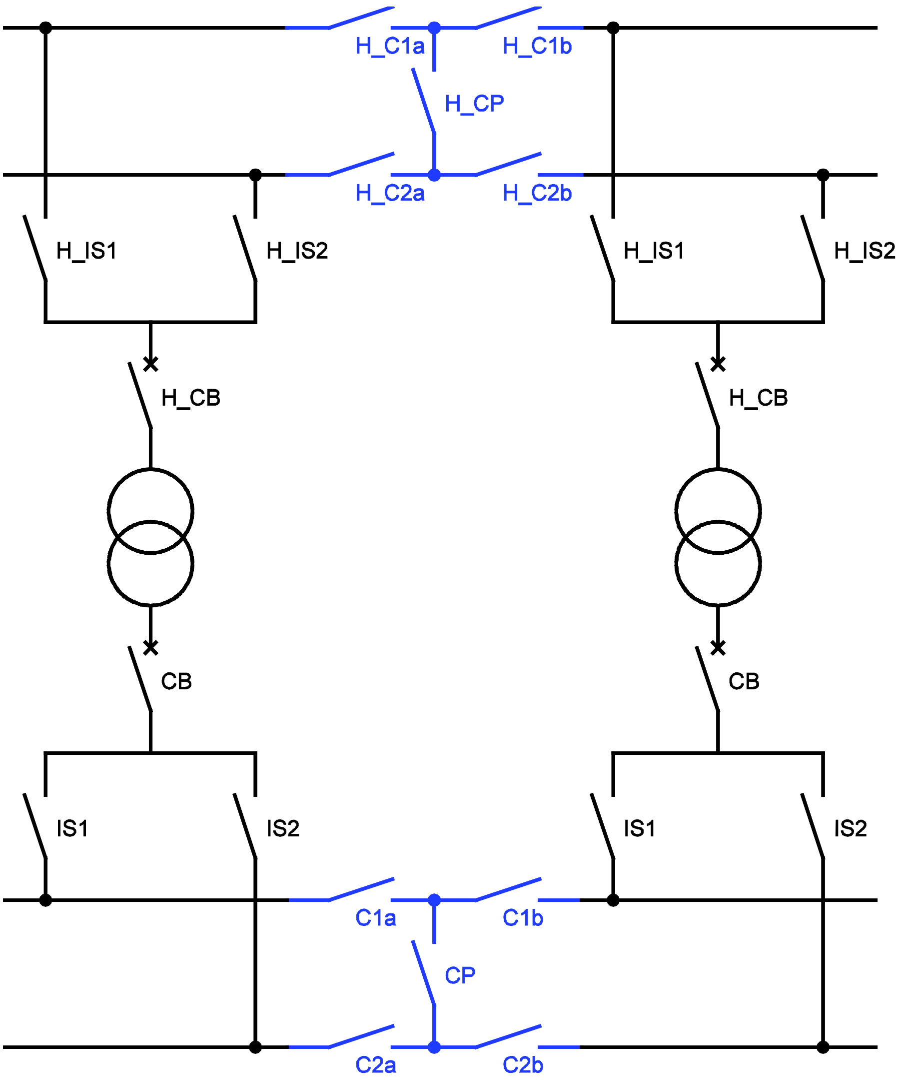
On/off switching

Feature ParaGramer = 0	Feature ParaGramer disabled
Feature ParaGramer = 1	Feature ParaGramer enabled

8.3.2.2 Feature Crosslink [protected]

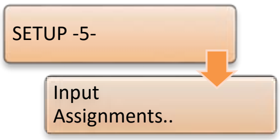
With the Crosslink feature it is possible to connect two busbars crosswise. Instead of sections 1 and 2, respectively a left and a right segment are available. The connection between busbars 1 and 2 is established by the coupling.

For example, it is possible to connect the left part of busbar 1 with the right part of busbar 2.



Crosslink configuration with both the overvoltage and undervoltage side.

Input functions



These switch settings are only available with the feature Crosslink activated. Again, the restriction that the overvoltage side input functions are not used, for recognition of parallel operation without the feature HVLVControl, is valid. Then they are only displayed.

Input function	Meaning	Comment
55:PG_C1a	Undervoltage – section BB 1, left segment	Instead of PG_SC1 Crosslink = 1/3
56:PG_C1b	Undervoltage – section BB 1, right segment	Instead of PG_SC1 Crosslink = 1/3
57:PG_C2a	Undervoltage – section BB 2, left segment	Instead of PG_SC2 Crosslink = 1/3
58:PG_C2b	Undervoltage – section BB 2, right segment	Instead of PG_SC2 Crosslink = 1/3
59:PG_H_C1a	Overvoltage – section BB 1, left segment	Instead of PG_H_SC1 Crosslink = 2/3
60:PG_H_C1b	Overvoltage – section BB 2, right segment	Instead of PG_H_SC1 Crosslink = 2/3
61:PG_H_C2a	Overvoltage – section BB 1, left segment	Instead of PG_H_SC2 Crosslink = 2/3
62:PG_H_C2b	Overvoltage – section BB 2, right segment	Instead of PG_H_SC2 Crosslink = 2/3

Feature coding

<value>	Meaning
1	Only on the undervoltage side
2	Only on the overvoltage side
3	Both over- and undervoltage sides

On/off switching

Activation by: Feature Crosslink = <value>

Deactivation by: Feature Crosslink = 0

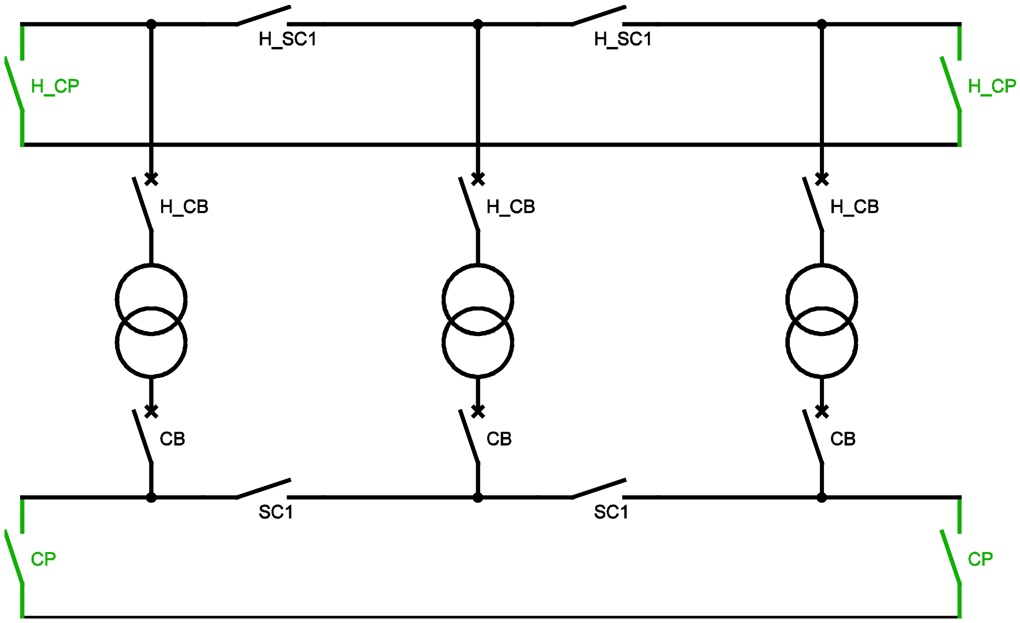
Instruction:

Crosslink cannot be combined with Ringlink. Moreover, with the use of Crosslink the third busbar is dropped.

8.3.2.3 Feature Ringlink [protected]

With the Ringlink feature it is possible to connect two busbars in a ring. The connection between the busbars is carried out by an optional coupling, which acts as a section. If needed, a coupling can be configured on both the first and the last, and even both regulators.

Thus it is possible, for example, to couple the transformers A: and C: in parallel, without the need for separate isolators and/or sections.



Ringlink configuration with both the overvoltage and undervoltage side.

Feature coding

<value>	Meaning
1	Only on the undervoltage side
2	Only on the overvoltage side
3	Both over- and undervoltage sides

On/off switching

Activation by: Feature Ringlink = <value>

Deactivation by: Feature Ringlink = 0

Instruction:

Ringlink cannot be combined with Crosslink. Moreover, use of Ringlink excludes the possibility of using a third busbar.

8.3.2.4 Feature HVLVControl [protected]

By default, only the undervoltage side is taken into account for the automatic detection of parallel operation. If input functions are selected for the overvoltage side, these will be displayed, but not taken into account. If you also wish to consider the switch positions on the overvoltage side, the feature HVLVControl must be enabled.

These restrictions also apply to the special configurations Crosslink and Ringlink.

Output functions

SETUP -5-

Relay Assignments..

Output functions	Meaning	Comment
70:HvLvDiff	Different parallel states between over- and undervoltage sides	from FW 2.00

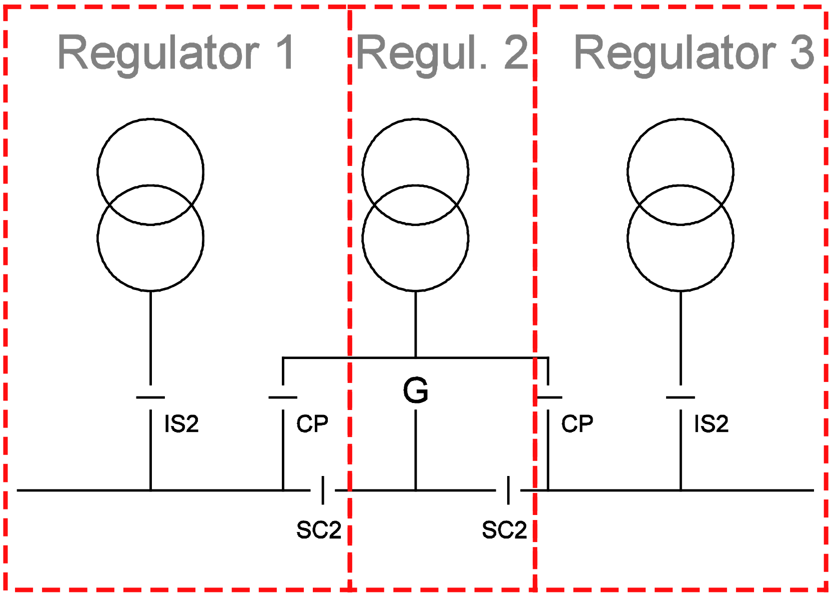
On/off switching

Activation by: Feature HVLVControl = 1
Deactivation by: Feature HVLVControl = 0

8.3.2.5 Feature PG_SCHEME_1 [protected]

The PG_SCHEME_1 feature is a special configuration with a generator in the illustration. It cannot be combined with other ParaGramer features.

Only the following combination is possible:



Configuration of ParaGramer with the feature PG_SCHEME_1.

If an input function is configured wrongly, the switch in question is shown by a rotating bar. In addition, the display will show a message indicating that the input configuration is incorrect.

On/off switching

Activation by: Feature PG_SCHEME_1 = 0
Deactivation by: Feature PG_SCHEME_1 = 1

8.3.2.6 Processing of additional switch positions

If you would like to use switch positions that do not exist in the standard, the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101) can usually help out with an H-program. In this case, for example, two switch positions can be combined and "virtually" mapped as a switch (e.g. two switches used as one isolator).

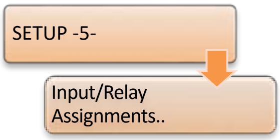
Alternatively, there is the possibility to create logic through external wiring that combines several signals into one.

For ParaGramer, it is only crucial that the transformers be electrically connected, switches can also be "misused" thereby. For more complex mapping, it may also be necessary to use another busbar to detect the electrical switching states correctly.

8.3.2.7 Feature 991101 [protected]

The custom feature 991101 was an extension of the ParaGramer function. With this feature, certain switch positions for monitoring purposes are redundantly assigned to different regulators.

Input/output functions



Input function	Meaning	Comment
32:PG_CBa	Monitoring signal for feature 991101, coupling a	
33:PG_CBb	Monitoring signal for feature 991101, coupling b	
40:PG_H_CBa	Monitoring signal for feature 991101, overcurrent side coupling a	
41:PG_H_CBb	Monitoring signal for feature 991101, overcurrent side coupling b	

Output functions	Meaning	Comment
43:LV_Check	Monitoring of parallel switching for custom scheme	
44:HV_Check	Monitoring of parallel switching for custom scheme	
45:HV_Err	Monitoring of parallel switching for custom scheme	
46:HV_Fail	Monitoring of parallel switching for custom scheme	

On/off switching

Activation by: Feature 991101 = 0
Deactivation by: Feature 991101 = 1

8.3.2.8 ParaGramer via SCADA system

ParaGramer via IEC-61850 GOOSE *light*

With a GOOSE-capable state of the REG-PE(D) firmware for IEC 61850, it is also possible to transmit all switch positions via GOOSE to the Relay for Voltage Control & Transformer Monitoring.

For this purpose, a small addition to the background program is necessary.

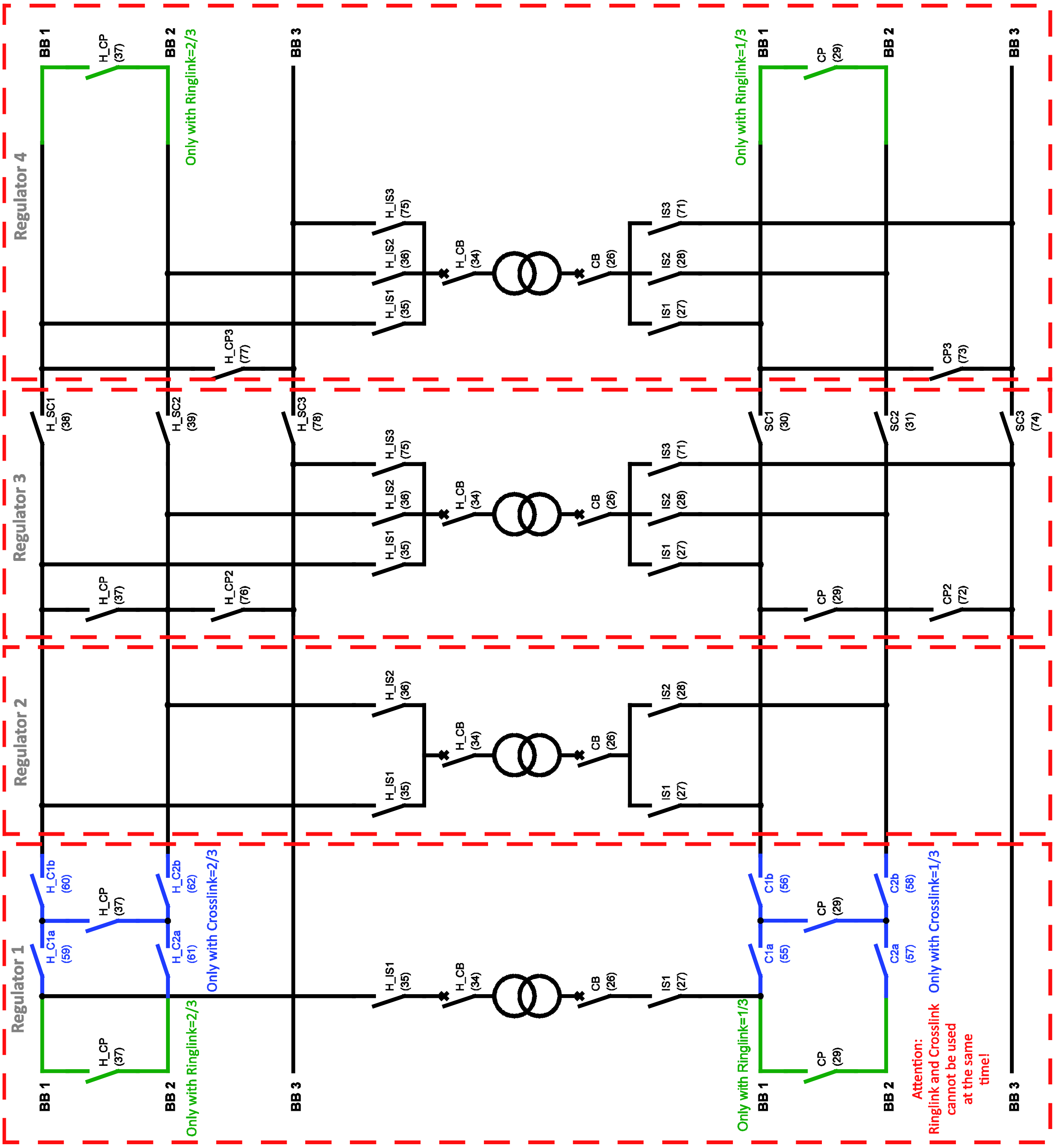
To have the switch positions received via GOOSE incorporated in ParaGramer, previously the binary inputs 33 ... 64 were used. Since these are not usually available in hardware, they are used as "virtual binary inputs" for GOOSE messages. If hardware already exists for the binary inputs 33 ... 64, use of GOOSE for ParaGramer is either not available or available only to a limited extent.

If you are interested in the GOOSE application, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Further applications

If you would like a different method of switch position transmission via SCADA system technology, the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101) will be glad to advise you.

8.3.2.9 Overview of ParaGramer input functions



Overview of all existing ParaGramer switch settings and their configuration. The binary function numbers are shown in brackets.

8.3.3 Feature Recorder [protected]

With this feature the recorder function will be activated. Without activation the recorder is only available as a demo.

Recorder demo mode!

The recorder is running in demo mode if "DEMO" is displayed in the left of the grid when the recorder is in normal display mode. In this operating mode, the recorder records measured values for a time domain of 4 to 6 hours. The oldest values are overwritten at the end of this period. Data cannot be read out in demo mode!

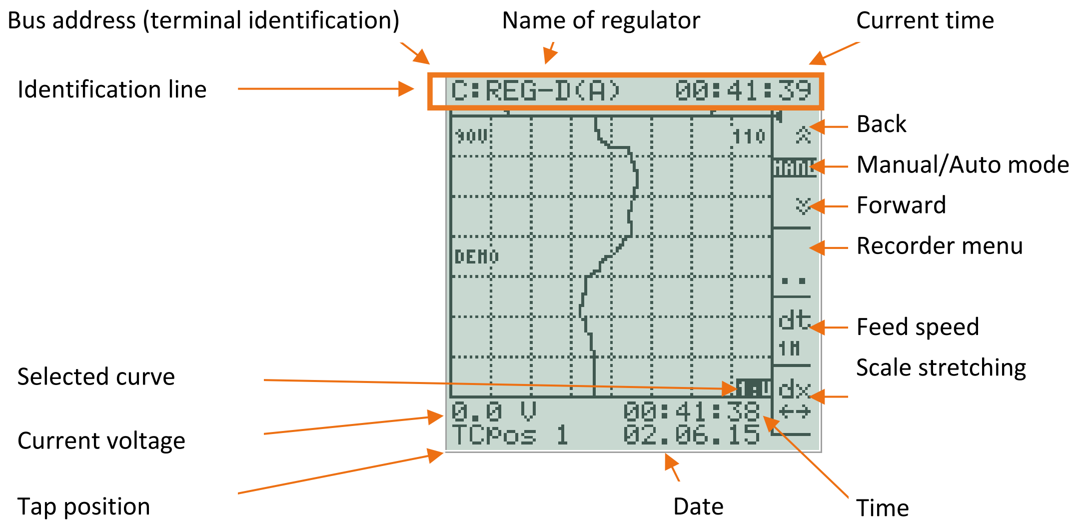
The recorder feature (order feature S1) serves for registration and display of up to three selectable measured values. Besides the measured values, the current tap position*, the setpoint value*, the tolerance band and the manual/automatic state, as well as the time and date are recorded. The time grid for the recording is adjustable.

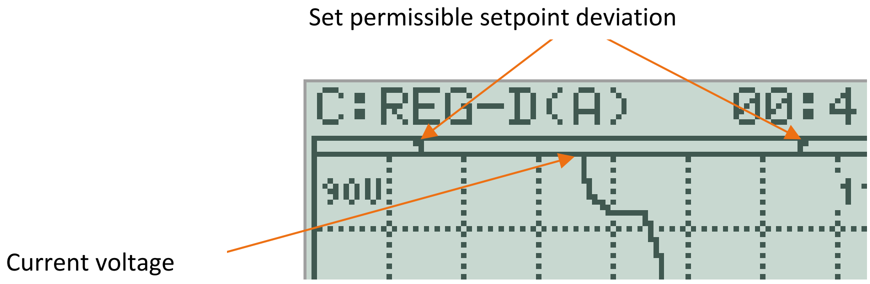
The recorder shows the continuous time course of up to two selectable measured values on the display as a line graph. The current date and time (timestamp) are also recorded. This enables correlated data to be queried by date and time. The average storage time for a channel (e.g. voltage and tap) is about six weeks (recording time < 18.7 days with continuous change of the measured value and the parameter "absolute deviation" = 0).

The stored values can be retrieved and displayed via the keyboard or the operating software REGView (see chapter 9.9 REGView, from page 317 onwards, or chapter 9.10 Collector, from page 322 onwards).

(*requires recording of voltage (function 01:U) on channel 1)

Recorder display





Operation

Press F1 and F2 to access historical data in the recorder's menu. You can view the timestamp for a specific event by pressing F1 and F2 to browse the voltage-time-diagram back to the time reference line (beginning of the grid (top)) and then by reading at the bottom of the grid, time, date, voltage and tap position.

"HIST" is displayed at the bottom of the grid when historical data are displayed. Press ESC to exit display of measured value history at any time.

Time grid

In the recorder basic display, use F4 to select the recorder's feed rate. You can choose from five different times: 14s, 1 min, 2 min, 5 min, 10 min. The "dt" values are related to the time that must pass before a scale division is depicted. Seven available divisions are displayed on the screen. This enables a maximum time domain of 7 x 10 min (70 min) to be displayed on the screen. The shortest time domain with the highest optical resolution is 7 x 14 s (98 seconds).

Regardless of the selected time grid dt (temporal resolution of the display), all of the measured values are stored in an adjustable time grid (standard=1s).

Display value range (dx)

Use 'dx' (F5) to change the value range displayed for the active channel. In dual display mode always the value of the left channel is changed.

The display is enlarged (zoom in) with the F4 key, while the F5 key reduces the display (zoom out). The F3 key provides different types of scaling.

The settings "SP Auto setup" and "SP-centred" can only be used effectively when the voltage to be regulated has been selected on channel 1.

- SP automatic setup:

  One-time automatic adjustment of the display to the value range of the hitherto recorded measured values with the setpoint in the middle of the display area. Scaling then switches to the mode SP-centred.
- SP-centred:

  The setpoint is placed in the middle of the scale and kept there. The graph can be enlarged (zoom in) or reduced (zoom out) with the F4 and F5 keys.
- Manual:

  Use F1, F2, F4 and F5 to change the graph
- Auto setup:

  One-time automatic adjustment of the display to the value range measured to date. Scaling then switches to manual mode.
- Upper limit:

  Enables a fixed end value to be entered for the scale (upper limit)
- Lower limit:

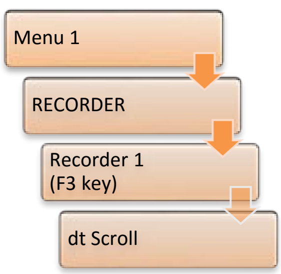
  Enables a fixed start value to be entered for the scale (lower limit)
- Lower limit = 0:

  Sets the start value of the scale to zero

If the scaling type "Manual" is selected, the graph can be scaled using the F1 to F5 keys. Here, the keys have the following function:

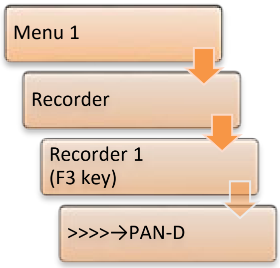
F1:	Right shift the graph	F2: Left shift the graph
F4:	Zoom in (enlarge)	F5: Zoom out (reduce)

Scrolling



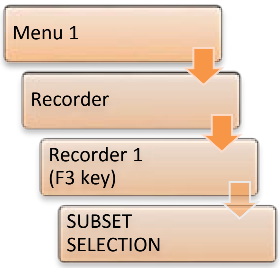
Under Scrolling you can set the jumping distance (for searching with F1 and F2 in recorder mode). This accelerates the search process.

PAN-D recorder



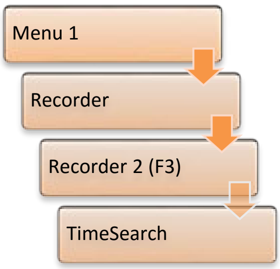
If the connected PAN-D also has the recorder function S1, the recorded data can be displayed on the LCD of the REG-D™. Setup of the PAN-D recorder is also possible. Access to the PAN-D recorder is via the F2 key (>>>>→PAN-D).

Curve selection



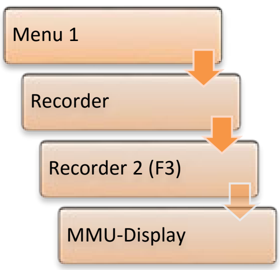
With the parameter subset selection it can be chosen which of the recorded measured values are display on the LCD. This parameter does not affect the recording.

Time search



A specific search date and a specific search time can be set using the item "TimeSearch". After returning to the recorder mode by pressing F3, the time-line diagram for the selected time is displayed.

MMU-Display (multi transducer display, display of derived values)

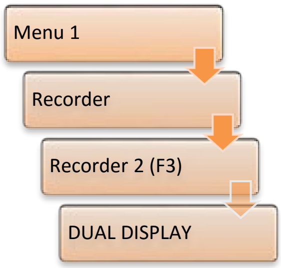


In the recorder 2 menu, display of variables derived from the current cursor value (at the top) can be switched on and off with the F2 key, using "MMU display". This function requires recording of current and voltage, and, optionally, the phase angle. Apparent, active and reactive power can be derived.

If only two measured values are selected for recording (U + I), I and S are displayed numerically.

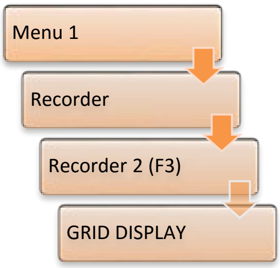
If all three measured values (U + I + φ) are active, I, φ, S, P and Q are displayed numerically.

Dual display



With the menu item "Dual display" (F4), the recorder display can be switched between single and dual channel display. The left and right arrow keys are used to toggle between the displayed channels.

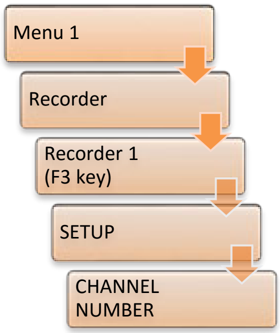
Grid display



The F5 key toggles the grid, which is represented in the recorder basic display for showing scale divisions, on and off.

The Recorder-1 and Recorder-2 menus display the current storage level as a percentage. In addition, the recording duration of data stored in memory is shown in days. This allows an estimation of how long the device can record with the current settings at that operating site before historical data will be overwritten.

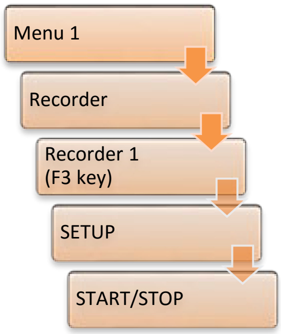
Number of channels



The channel number specifies how many channels are to be recorded. A total of three channels can be recorded.

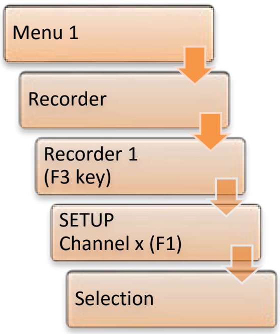
Depending on the channel number, the following parameters for each channel x are separately available.

START/STOP



Pressing F3 starts or stops recording of the measured values.

Selection



Here you can select which measured value is to be recorded on which channel. If the measured value is scaled with a factor, it is displayed in front of the F3 key (range + factor).

Function	Range	Scaling* (factor)	Description
01:U	0 ... 150V	Knu	Voltage
02:I**	+/- 10A	KNI	Current
03:PHI	+/- 180°	1	Phase angle Phi
05:U1	+/- 3200V	Knu 1	Voltage U1
06:U2	+/- 3200V	Knu 2	Voltage U2
07:OilTp-TR	+/- 3200°C	1	Transformer oil temperature
08:WindTemp	+/- 3200°C	1	Winding temperature
101:A1_ANA	Selectable	1	Analog channel 1
102:A2_ANA	Selectable	1	Analog channel 2
103:A3_ANA	Selectable	1	Analog channel 3
104:A4_ANA	Selectable	1	Analog channel 4
105:A5_ANA	Selectable	1	Analog channel 5
106:A6_ANA	Selectable	1	Analog channel 6
...			
AMAX_ANA***	Selectable	1	Analog channel max.

* Scaling is used for the display. This means that specific values are stored, for example, as secondary values and scaled for the display by this value.

** The current is recorded relative to the set nominal value (1/5 A). This means that the value 1 A is recorded if 5 A current is flowing through a 5A transducer. The effective transducer factor (5 x KNI) is used for the display. This behavior must be taken into account when setting the absolute deviation.

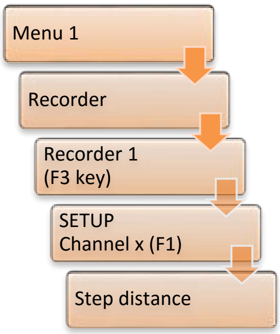
*** The number of analog channels available in the recorder depends on the number of analog channels it has. The max number of channels is 32. The max number of channels with feature S2 is 64.

The function that is allocated to the analog function is contained in the name in the allocation menu. For example, if analog channel 4 is allocated output function oSP (output of the active setpoint), the description is A4_oSP.

Change of a channel assignment!

Once a selection has been made it should only be changed if the stored data have been transferred to a PC. After changing the channel assignment, the recorder function cannot correctly interpret the remaining data. It is therefore recommended to delete the "old data" in this case.

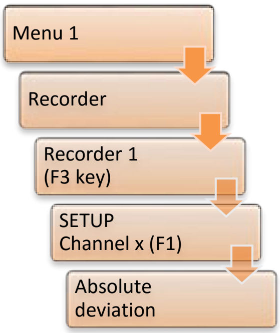
Step distance



The step distance parameter specifies which value range can be recorded and how many decimal places are stored.

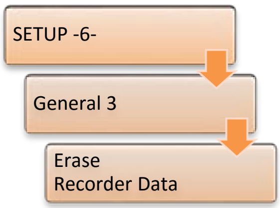
For the measured quantities U, I, Phi, U1, U2, OilTp-Tr and WindTmp, the range of values is fixed and automatically set when the measured value is selected. When an analog channel is recorded, the value range for the measured values is not fixed, which is why the step distance can be selected. The step distance determines the number of decimals used to record the measured values. Because each of the recorder channels can record ±32000 values, setting the number of decimal places defines a specific value range (step distance 0.01 -> value range ±320.00; step distance 0.1 -> value range ±3200.0). The available value range is displayed in front of the F3 key.

Absolute deviation



The absolute deviation defines a dead band for the recording of measured values. This means that a new value is only recorded when the change to the last recorded value is greater than the absolute deviation. This parameter enables the storage space to be reduced for strongly fluctuating measured values.

Deleting recorder data



Recorder data can be deleted in the menu "Setup-6\General-3" by pressing F3 "Erase Recorder Data".

On/off switching

Activation by: Feature RECORDER = 1
Deactivation by: Feature RECORDER = 0

Activation of the recorder feature

The feature is not activated when the REG-D™ only has 256KB RAM. The amount of RAM is given in the menu "Setup -6-\Status\REG-D status (1)". After changing the feature, the regulator must be switched off and on again, or the command SYSRESET= 0 (PowerOn reset, switching on/off) must be executed via REG-L.

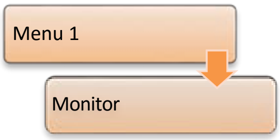
Recorder mode (feature S2)

The recorder mode S2 provides another four recorders, each with 64 channels, in addition to the three channels of recorder S1. The recording interval can be set separately for each.

The data can only be configured and displayed with the operating software. Stored values cannot be displayed on the screen of the REG-D™.

The S2 recorder is only available at REG-D™ devices with the hardware feature S2.

8.3.4 Feature TM (Transformer Monitoring) [protected]



With the TM feature the transformer's main parameters are monitored. The oil temperature is recorded in addition to tap-changer statistics and current. The hot-spot temperature is determined from the oil temperature and the current in accordance with IEC 60354 or IEC 60076, and extrapolated to the transformer's service life consumption. Up to six cooling stages and two oil pumps can be activated depending on the oil or winding temperature. The system monitors the operating times of the fans and controls the individual fan groups, so that an operating time which is as balanced as possible is achieved over the whole operating life. If desired, individual fans can also be permanently assigned to a specific cooling stage.

Additional alarms such as Buchholz alarm and/or Buchholz triggering can be fed into the regulator as digital signals, displayed and sent to a SCADA system for further processing.

For function scope and description of the parameters, please refer to the user manual for the transformer monitor module.

On/off switching

Activation by: Feature TM = 1
Deactivation by: Feature TM = 0

8.3.5 Feature 3winding (three-winding transformer) [protected]

Originally, this feature was developed in order to regulate and monitor three-winding transformers.

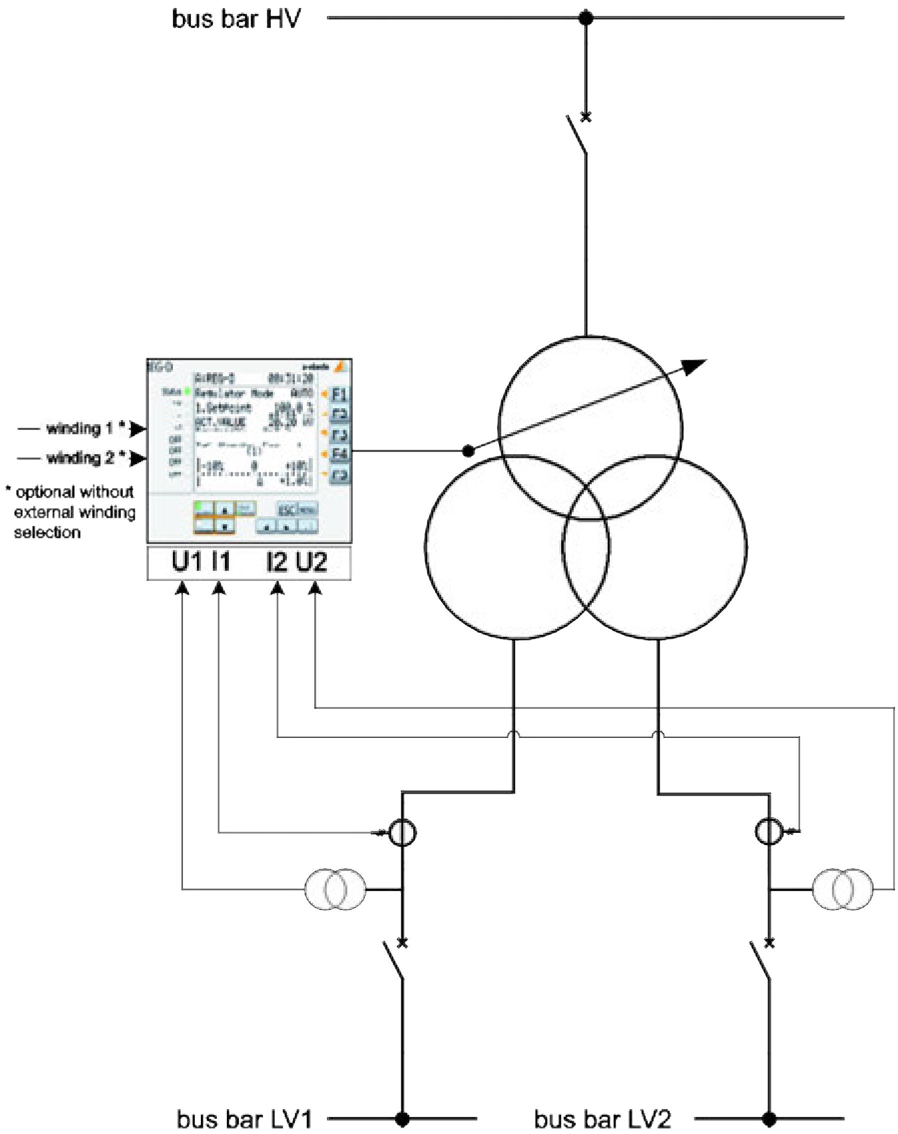
Moreover, it is possible to use the feature for other applications, which require a second voltage (U1, U2) and current measurement (I1, I2).

In these cases, the three-winding software feature is usually combined with a background program to implement customer-specific requirements.

Properties of the three-winding transformer feature

- The same or a different configuration of voltage transformers (VTs) which are assigned to the voltage measuring channels (U1, U2). This means that three-winding transformers with different secondary voltages can be regulated easily. The configuration of current transformers (CTs), which are wired to the current measurement inputs, can also be adjusted separately from one another with the exception of the nominal current of the transducer (1/5 A).
- Display of both secondary voltages in the transducer display mode.
- Voltage, current, cosφ, apparent, active and reactive power can be shown for the respective active measurement input pair (U1, I1 or U2, I2) in the transducer display mode (with hardware feature S2 simultaneous display of all calculated values is also possible).
- The voltage to be regulated on can be selected via binary input, SCADA system or using a background program. For example, selection of the voltage to be regulated on depending on the load of both windings can be done with a background program. This means that regulation is carried out on the voltage of the winding with the higher load, and the other winding is still monitored in parallel (standard solution with three-winding transformers, so long as the currents of the windings are measured).
- The currently regulated busbar or secondary voltage (voltage measuring channel U1 or U2) is indicated on the REG-D™ screen with "{1}" or "{2}", which can also be output via a SCADA system or relay output.
- All parallel programs and current influence algorithms (Z compensation or LDC) can also be used with three-winding applications.
- Even if only the voltages (U1, U2) are measured, the winding to be controlled can be freely selected. It is also possible to make selection dependent on user-definable voltage limits. For this purpose, a background program is used again.

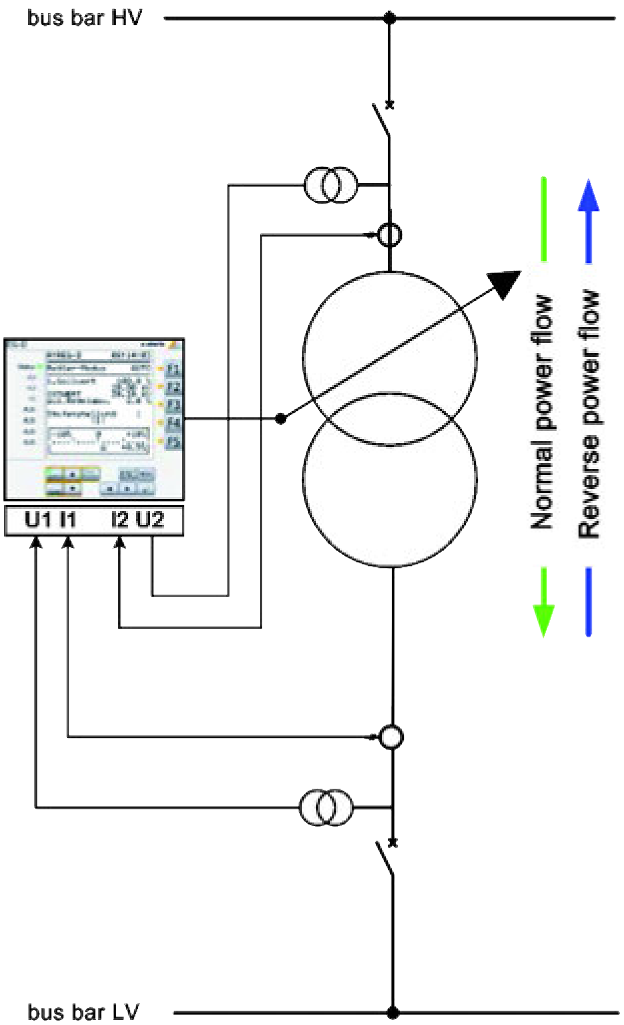
Regulation of three-winding transformers



Wiring diagram for the regulation of three-winding transformers

The voltage to be regulated on can be selected via binary inputs, SCADA system or using a background program. It is possible to supervise the unregulated voltage in parallel to ensure that it remains within certain voltage limits. If a current measurement at the transformer or on the incoming feeder is present, the REG-D™ can automatically select the regulation voltage depending on the load. For this purpose, a background program is used. Generally, it is possible to adapt selection of regulation voltage to each customer request.

Regulation of grid-coupling transformers



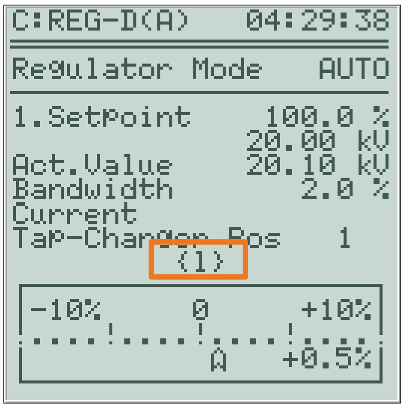
Wiring diagram for the regulation of grid-coupling transformers

In this application, on reverse power flow direction, regulation of the other voltage level or the other grid must be performed. In normal operation the power flow is from the primary to the secondary side of the transformer. Voltage and current are measured on the secondary side, and this side is also regulated.

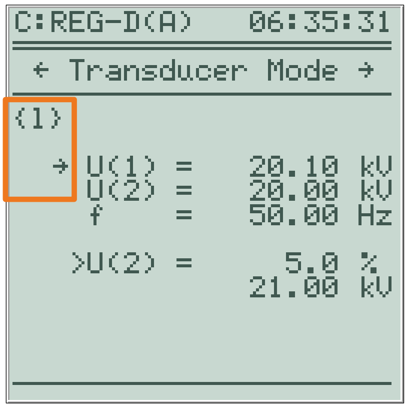
With a reverse power flow, the primary side is regulated. For this purpose, in addition to the voltage and current transformers of the secondary side, the transducers of the primary side are also connected to the REG-D™. Changeover of regulation between the primary and secondary side is performed automatically via the power flow direction, which is determined from the measured values. To regulate the primary side, the up/down tap commands are reversed, so that tap changes are made in the right direction.

General

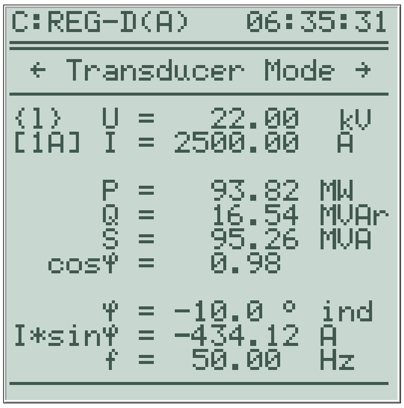
- The voltage used for regulation is displayed on the LC display of the Relay for Voltage Control & Transformer Monitoring. A "{1}" for voltage input 1 and a "{2}" for voltage input 2 are shown in the standard configuration in the regulator basic display.
- Moreover, the index – "{1}" or "{2}" – can also be defined individually (with a maximum three character string).



- In the transducer display can be read both secondary voltages, the frequency and the configured limit for the unregulated voltage being monitored. Monitoring of the unregulated voltage can be activated or deactivated by an adaptation of the feature three-winding transformer. On the one hand, the index of the regulated voltage is shown in the upper left corner with a string corresponding to the basic regulator display. On the other hand, an arrow in front of the corresponding measurement voltage indicates the instantaneously regulated voltage.



- On the second page of the transducer mode, voltage, current, phase angle, and apparent, active and reactive power of the currently regulated measuring input are shown. To activate this display, the feature 3winding needs to be expanded with phase angle measurement (measurement input swap). That is, performance measurement is only possible in the 3winding transformer mode with special measurement input swap (bit B3 = 1). (With hardware feature S2, a simultaneous display of all calculated values is possible.)



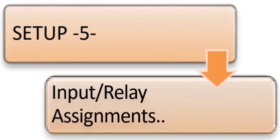
- The menu ("Setup -3-\ Dreiwickler Limit >Ub ") for entering the limit of >Ub is only available after feature activation, the limit can be set in the range 0 ... +25%. The limit depends on the setpoint; exceeding the limit (and thus triggering the message) is not possible in MANUAL mode.
  If the unregulated voltage exceeds the limit value >Ub, up commands of the REG-D™ will be blocked to prevent further increase of the voltage.
- With the feature set, the three-winding transformer functionality can be switched on and off. This is done via the menu ("Setup -5-\AddOns-3") or a REG-L command.
- If the feature is selected and the three-winding transformer is active, a current-dependent setpoint influence should only be set if the special three-winding transformer operating mode with measuring input exchange (bit B3 = 1) is selected.
- The feature is shown under in the status with "3WINDING" (in parentheses with 3winding transformer activation = 0).

Prerequisites

In principle, the following prerequisites must be met to be able to use the feature 3winding:

- The regulator must at least have the hardware feature M3 (two galvanically isolated voltage measurement inputs, one current measurement input), or at best be equipped with hardware feature M9 (two galvanically isolated voltage measurement inputs and two current measurement inputs).

Input/output functions



Input function	Meaning	Comment
09:3Winding	Selection of the voltage to be regulated*	from FW 1.22

* The input function "09:3Winding" (setting is only available after feature 3Winding release) is level-oriented: Input = off → regulation on U1; Input = on → regulation on U2.

If the input function is not used, the voltage to be regulated on can be selected with REG-L:

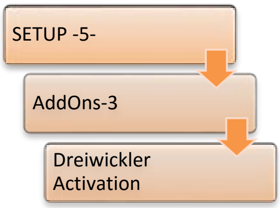
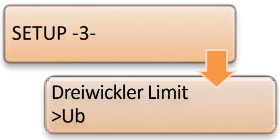
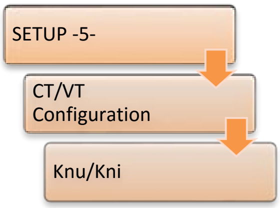
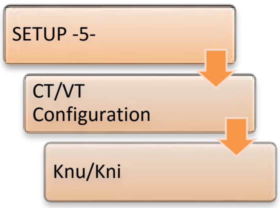
Reg3WSELU = 1: regulated on U1

Reg3WSELU = 2: regulated on U2

Output function	Meaning	Comment
19:3Winding	The limit >Ub is exceeded. The message = ON remains until the monitored voltage again lies within the tolerance band. In MANUAL operating mode the three-winding output remains OFF. If the limit >Ub is exceeded, up commands of the regulator are also blocked.	From firmware 1.22, only in case of 3winding with limit monitoring (bit B2=0).

Parameters

The following parameters must be considered:

Parameter	Description
Activation of three-winding transformer 	Switches use of the three-winding transformer function on and off.
Three-winding transformer limit >Ub 	Limit value for monitoring the unregulated voltage (only for three-winding transformers with limit value monitoring).
Knu2 	Transducer factor for the second voltage measurement input
KNI2 	Transducer factor for the second current measurement input
Designation of busbars	Designation of the two busbars (measurement inputs) using the REG-L commands "Reg3WBusStr 1" or "Reg3WBusStr 2". This may be three characters long. "{1}" or "{2}" are shown as standard.

Feature coding

Bit	Function (when bit is set)	Note
B0	3winding Plus	
B1	3winding (only set bit if no other bit is set)	
B2	No limit monitoring	from V2.00
B3	Use measurement input swap (3winding special)	from V2.00
B4	Use Knu/I 1+2	from V2.00
B5	Select busbar 1 fixed, use no display of busbar	from V2.00

The following values are added for the determination of <bits>:

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Value	128	64	32	16	8	4	2	1

Examples:

3winding mode	<bits>	Note:
3winding deactivated	0	
3winding Plus (see chapter 8.3.6 Feature 3winding Plus (three-winding transformer) [protected], page 261) with limit monitoring	1	
3winding with limit monitoring	2	
3winding with limit monitoring Use Knu/I 1+2	16 or 18	from V2.00
3winding without limit monitoring	4	from V2.00
3winding Plus (see below) without limit monitoring	5	from V2.00
3winding Special (measurement input swap) with limit monitoring	8	from V2.00
3winding Special (measurement input swap) with limit monitoring, with Knu/I 1+2 use	24	from V2.00
3winding Special (measurement input swap) without limit monitoring, with Knu/I 1+2 use	28	from V2.00
3winding Special (measurement input swap) without limit monitoring, with Knu/I 1+2 use, busbar 1 selected fixed	60	from V2.00

On/off switching

Activation by: Feature 3winding = <bits>
Deactivation by: Feature 3winding = 0

8.3.6 Feature 3winding Plus (three-winding transformer) [protected]

Tis feature is like the feature 3winding, however with a fixed assignment of the binary input 8 on relay 3.

This feature is represented in the status screen with "3winding+" (in brackets with 3winding activation = 0).

Note: Up to firmware version V1.97 this feature was called DREIWICKLER.

On/off switching

Activation by: Feature 3winding = 1
Deactivation by: Feature 3winding = 0

8.3.7 Feature PQCtrl [protected]

The feature PQCtrl was developed for regulation of phase shifting transformers, but can also be used for other applications. In case of P/Q regulation, the active and reactive power is controlled rather than the voltage.

Properties of the PQCtrl feature

- The feature PQCtrl can be activated independently of hardware and used with all REG-D™. Hereby, the date of manufacture of the unit is irrelevant. It may be necessary to update the firmware, depending on the existing firmware version in the original REG-D™ hardware.
- Four setpoints are available: two voltage setpoints, one active power and one reactive power setpoint.
- Whether the REG-D™ will operate as a voltage, active power or reactive power regulator, can easily be determined by selecting the appropriate setpoint. For certain applications, selection of setpoints can be limited via a background program.
- Regulation on P or Q in accordance with the setpoint index SPI:

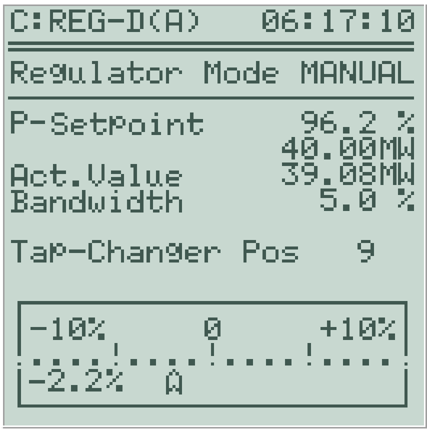
  SPI = = 1 : Standard regulation on the voltage RegUN with SP 1.

  SPI = = 2 : Standard regulation on the voltage RegUN with SP 2.

  SPI = = 3 : Regulation on P with SP 3 (SP is a power value normalized to 100).
  The basic regulator display shows the P-value instead of the voltage value.

  SPI = = 4 : Regulation on Q with SP 4 (SP is a power value normalized to 100).
  The basic regulator display shows the Q-value instead of the voltage value.

- The menus for setting setpoints and indication in the regulator display are adjusted accordingly. No units can be shown on the large regulator display when using P or Q regulation, because of lack of space (except k for kilo).



Regulator basic display with P setpoint

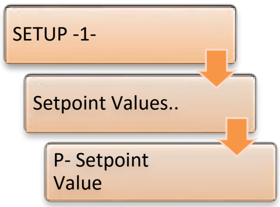
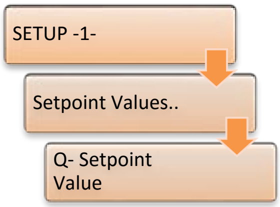
- The active and reactive power setpoints can be set in the range from -140% to +140% of the nominal power. The nominal power is calculated using the following formula:

$$P_r = Q_r = \sqrt{3} \times 100V \times Knu \times I_r \times Kni$$

Pr, Qr:	Nominal power for setpoint
Knu:	Transformer factor of the voltage transformer
Kni:	Transformer factor of the current transformer
Ir:	Nominal current of the current transformer (1 A or 5 A)

- All limits of the REG-D™ are also available with the PQCtrl feature. Thereby, the limits undervoltage <U, overvoltage >U, inhibit low, inhibit high and high-speed switching depend on the measured voltage. As a basis for percentage limits, U-nominal is always used (default: U-nominal=100 V, also when the limit base is set to the setpoint). If the limit base is set to U-nominal = 110 V, the limit base applies in this case not only for the limits undervoltage <U, overvoltage >U and shutdown. The limits overcurrent and undercurrent are derived from the measured current.
- If a monitoring unit PAN-D is being used in addition to the REG-D™, it will always receive a setpoint of 100 V from REG-D™. This only has an effect if the limit base of the PAN-D is set to setpoint.
- The key functions of REG-D™ as a Relay for Voltage Control & Transformer Monitoring, such as transducer mode, recorder, statistics unit, transformer monitoring, logbook, and, of course, free programmability via background programs will also remain intact with the feature PQCtrl.

Parameters

Parameter	Description
Setpoint 3  	Active power setpoint P The setpoint can be set in the range -140% ... +140%. The absolute setpoint based on Knu, Kni and the nominal current of the current transformer is also displayed in the menu.
Setpoint 4  	Reactive power setpoint Q The setpoint can be set in the range -140% ... +140%. The absolute setpoint based on Knu, Kni and the nominal current of the current transformer is also displayed in the menu.

On/off switching

Activation by: Feature PQCTRL = 1
Deactivated by: Feature PQCTRL = 0

Use with firmware <= V1.99

With firmware versions <= V1.99 4SETPOINTS feature must also be activated (Feature 4Setpoints = 1, see chapter 8.3.8 Feature 4Setpoints [protected], page 264).

8.3.8 Feature 4Setpoints [protected]

No longer required as of firmware V2.00

This feature is no longer needed as of V2.00. Four setpoints are always available since this version.

If this feature is set, the regulator can process four setpoints. The menus are extended accordingly and the input and output functions expanded. The choice of four setpoints can be set by pulses on one of the four inputs SP-1 ... SP-4, or by applying a binary coded signal to the two inputs SP-Bin0 .. SP-Bin1 (see the following table).

Setpoint	Input function "10:SP-Bin0"	Input function "11:SP-Bin1"
1	0	0
2	1	0
3	0	1
4	1	1

On/off switching

Activation by: Feature 4SETPOINTS = 1
Deactivation by: Feature 4SETPOINTS = 0

8.3.9 Feature Adapt

This feature is available as of firmware V2.09 / 17.06.2005, also in V2.02d/f.

This feature must be set if one of the following REG-LON versions are used:

- H1_10U
- H1_11P

On/off switching

Activation by: Feature ADAPT = 1
Deactivation by: Feature ADAPT = 0

8.3.10 Feature Bootload

NOTICE!	**As long as the unit is in bootloader mode, no regulation and other actions may take place. Moreover, no communication via E-LAN or to the SCADA system is possible.** ➲ Only activate remote starting of the bootloader when it is absolutely necessary. If the bootloader is not quit, the unit exits the bootloader automatically after 30 minutes.

The Bootload feature allows remote starting of the bootloader. This means that if the feature is set (= 1), the bootloader can be started via REG-L (e.g. the terminal program or the Service program of WinREG).
The feature exists as of firmware V2.22.

On/off switching

Activation by: Feature Bootload = 1
Deactivation by: Feature Bootload = 0

8.3.11 Feature COM2FIX

From firmware version V2.00, with this feature the COM2 interface can be set so that it is no longer adjustable via the panel or REG-L.

Coding of the feature

Bit	Function with B0 = 1	Function with B0 = 0
B0	1: use B1 ... B7	0: Fixation on current setting
B1	0: Mode ECL 1: Mode PROFI	always = 1
B2	always = 0 (reserved)	0: SETCOM2 conditionally blocked 1: SETCOM2 completely blocked
B3	0: Baudrate 57600 1: Baudrate 115200	always = 0 (reserved)
B4	always = 0 (reserved)	always = 0 (reserved)
B5	0: Parity OFF 1: Parity EVEN	always = 0 (reserved)
B7 / B6	0/0: Handshake OFF 0/1: Handshake XON/XOFF 1/0: Handshake RTS/CTS 1/1: reserved	always = 0/0 (reserved)

The following values are added for the determination of <bits>:

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Value	128	64	32	16	8	4	2	1

Examples:

- COM2 fixed on current setting: <bits> = 2
- COM2 fixed on ECL / 57K6 / PE / XON : <bits> = 0b01100001 = 97
- COM2 fixed on PROFI / 57K6 / PE /H- : <bits> = 0b01100001 = 35
- COM2 fixed on ECL / 115200 / PE /H- : <bits> = 0b01100001 = 41

On/off switching

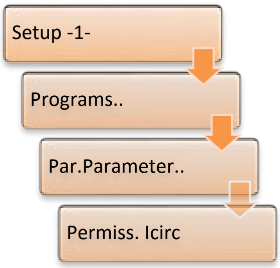
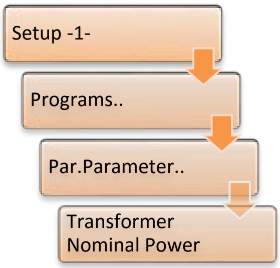
Activation by: Feature COM2FIX = <bits>

Deactivation by: Feature COM2FIX = 0

8.3.12 Feature DELTAI

With the feature set, the parallel program "3: dI" is available (as of firmware V1.98).

Parameters

Parameter	Description
Permiss. Icirc 	Permissible circulating current of the parallel program "dI"
Nominal transformer power 	Nominal transformer power of the parallel program "dI"

On/off switching

Activation by: Feature DELTAI = 1
Deactivation by: Feature DELTAI = 0

8.3.13 Feature Invers

INVERS without exchanging the higher/lower relay

When the feature is activated, on up tap changes the regulator expects a decreasing tap position number, on down tap changes an increasing tap position number.

On/off switching

Activation by: Feature INVERS = 1
Deactivation by: Feature INVERS = 0

INVERS with exchange of up/down relays

When the feature is activated, on up tap changes the regulator expects a decreasing tap position number, versus on down tap changes an increasing tap position number.

In addition, an exchange of the relay outputs for up/down tap changes takes place. The relay and LED functions for up or down and the display of tap-change direction in the basic regulator display are also exchanged.

This feature variant is available from version V1.88; use with a PAN-D is not possible.

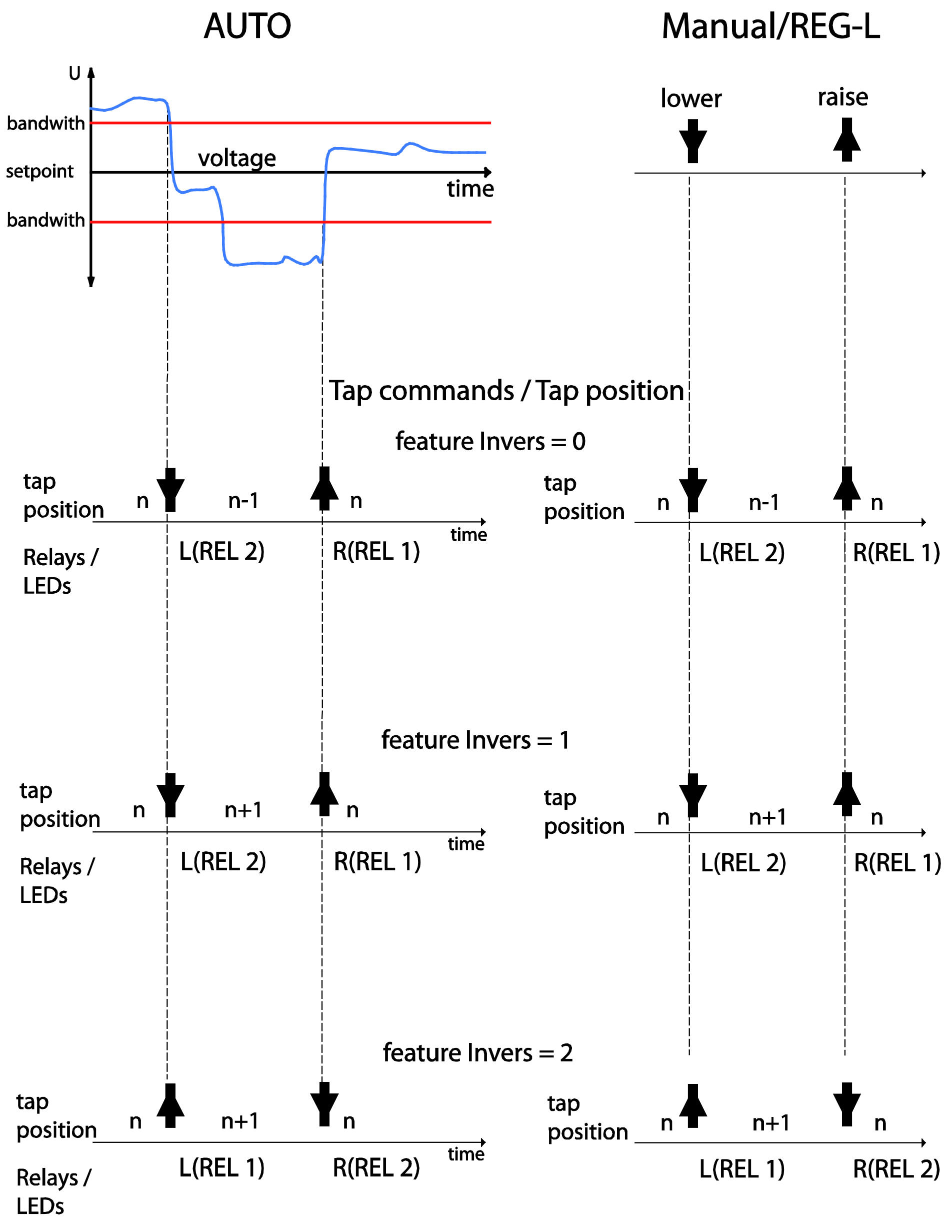
On/off switching

Activation by: Feature INVERS = 2
Deactivation by: Feature INVERS = 0

More information about the Invers feature and its use can be found in chapter 7.2.2.3 Tap position, page 89.

Effect of the Invers feature

Tap changing is triggered by commands in AUTOMATIC or MANUAL / REG-L.

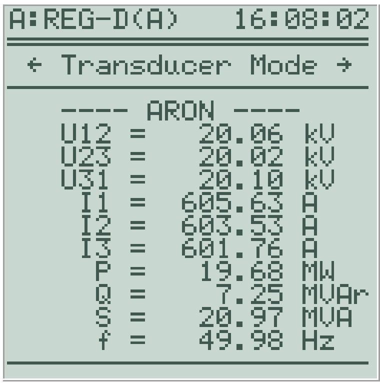


Effect of the Invers feature on the expected tap feedback and use of the up and down relays.

8.3.14 Feature M2 [protected]

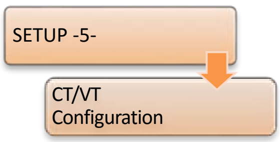
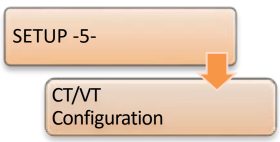
The M2 feature, available from firmware V2.00 onwards, allows also for the measurement of an asymmetric grid using an ARON measurement circuit , with the appropriate transducer equipment (hardware feature M2).

The following measured values must be connected: the L1, L2 and L3 should be connected to the voltage input transducers U1 and U2, I1 to current input transducer 1 and I3 to current input transducer 2. It is essential to ensure correct polarity or these connections.



Display of ARON readings in transducer mode

Parameters

Parameter	Description
Transducer mounting voltage  	For the ARON measurement, the transducer mounting voltage and current must be configured for ARON.
Transducer mounting current  	For the ARON measurement, the transducer mounting voltage and current must be configured for ARON.

On/off switching

Activation by: Feature M2 = 1
Deactivation by: Feature M2 = 0

Notes

- Special case "exchanged current transducer":
  Unless I3 is connected to the current input transducer 1, and I1 to the current input transducer 2, the M2 feature must be = 2. If this feature is already activated, assignment can also be done without access enabling / license code (feature M2 = 2).
- With M2 = 2, the feature MISWAP is deactivated!

8.3.15 Feature MISWAP

From version V2.00, the open feature MISWAP is available to exchange the transducer input wiring U1, U2 and I1, I2 without any hardware modification.

The inversion (polarity reversal) of U1, U2, I1, I2 can also be selected by menu as of firmware V2.17 (inversion of the measuring inputs).

Coding of the feature

7	6	5	4	3	2	1	0	Function
x	x	x	x	0	0	0	0	No exchange
x	x	x	x	0	0	0	1	Exchange of U1 ← → U2
x	x	x	x	0	0	1	0	Exchange of I1 ← → I2
x	x	x	x	0	0	1	1	Exchange of U1 ← → U2 and I1 ← → I2
x	x	x	1	x	x	x	x	Inversion of the 1st voltage transformer U1
x	x	x	0	x	x	x	x	Voltage transformer U1 normal
x	x	1	x	x	x	x	x	Inversion of the 2nd voltage transformer U2
x	x	0	x	x	x	x	x	Voltage transformer U2 normal
x	1	x	x	x	x	x	x	Inversion of the 1st current transformer I1
x	0	x	x	x	x	x	x	Current transformer I1 normal
1	x	x	x	x	x	x	x	Inversion of the 2nd current transformer I2
0	x	x	x	x	x	x	x	Current transformer I2 normal

The following values are added for the determination of <bits>:

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Value	128	64	32	16	8	4	2	1

On/off switching

Activation by: Feature MISWAP = <bits>
Deactivation by: Feature MISWAP = 0

Limited function in conjunction with feature M2 = 2

If the feature M2 = 2 is set, the effect of the feature MISWAP is cancelled and only the exchange I1 ←→ I2 is performed.

8.3.16 Feature Qsigned

According to DIN, the reactive power is an unsigned entity: $Q = \sqrt{s^2 - p^2}$

With the aid of the feature Qsigned, the sign of the reactive power can be activated or deactivated. (The sign always corresponds to the opposite sign of the angle φ.)

Firmware	<bits>=0 (Default)	<bits> = 1	<bits> = 2
V1.30 – V2.02	Q unsigned	Q signed	-
from V2.03	Q signed	Q signed	Q unsigned

On/off switching

Activation by: Feature Qsigned = <bits>
Deactivation by: Feature Qsigned = 0

8.3.17 Feature LocalRemote

The REG-D™ extended keyboard allows you to switch between local and remote, provided the feature LocalRemote is set accordingly. The input functions "54:LR_STAT" and "53:LR_AH", which, in particular, are employed for using a REG-LR, may not be configured.

Switching between local and remote is done with the local/remote key, the selected state being shown with LEDs. The functionality of the local/remote key corresponds to local/remote switching with a binary input. In case of an auxiliary power interruption, the last selected state is maintained.

Moreover, with the Reg-L command RegLR_KEY the local/remote state can be changed in addition to a key operation:

RegLR_KEY = 0 → local

RegLR_KEY = 1 → remote

On/off switching

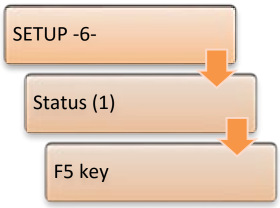
Activation by: Feature LocalRemote = 1
Deactivation by: Feature LocalRemote = 0

Notes

- If the feature LOCALREMOTE = 2, then you can switch between Local(0)/Remote(1)/Off(2); Off means that neither local nor remote blocks are applied, the local/remote display is suppressed.
- If the feature is not activated, the local/remote display is omitted.

8.3.18 Feature SimMode

DANGER!	**Tap commands which are triggered in simulation mode are actually output over the relays.** Since measured voltage is not used in simulation mode, this can lead to impermissible changes in the actual voltage at the transformer! ➲ If the transformer, the regulator is connected to, is in operation, the simulation mode should only be used under extreme caution. Here, tap commands from the regulator to the tap changer must be separated in terms of hardware (e.g. opening of the terminals is required).



From V2.00, switching on measurement value simulation is controlled by means of the feature SIMMODE. The simulation mode can be activated in "Setup -6-/Status/REG-D status (1)" by pressing the F5 key.

Coding of the feature

<value>	Meaning
1	Simulation / tap simulation is allowed, but quit with AUTOMATIC mode
2	Simulation / tap simulation, independent of AUTOMATIC and MANUAL mode, is allowed

On/off switching

Activation by: Feature SimMode = <value>

Deactivation by: Feature SimMode = 0

Note:

The simulation mode automatically terminates 15 minutes after the last key press on the panel of the REG-D™.

8.3.19 Feature SR192 [protected]

NOTICE!	**This feature may not be activated with REG-D™ firmwares V2.07, V2.08 and V2.09, because in these versions the input BE4 = high-speed switching cannot be used.** ➲ Do not activate the feature in the above-mentioned firmware versions. Perform a prior firmware update if activation of the feature is necessary on any relevant device.

This feature controls the assignment of inputs and outputs and switching behavior of the voltage regulation system SR192 (special configuration of REGSys™).

BE2 = 1 selects AUTOMATIC operating mode, BE2 = 0 MANUAL operating mode. While the MANUAL operating mode is dominant with BE2 = 0, i.e., no switching to AUTOMATIC mode via the keyboard, with BE2 = 1 the then activated AUTOMATIC operating mode can be freely switched via the keyboard to MANUAL and then back again to AUTOMATIC. As soon as BE2 is active, Trans1 is set and displayed by LED1. With AUTOMATIC mode relay 3 is switched on, with MANUAL mode relay 3 is switched off.

On/off switching

Activation by: Feature SR192 = 1(2)

Deactivation by: Feature SR192 = 0

Specific, non-changeable input and output assignments

When the feature is selected, the input assignment for BE2 (Trans1), the output assignment for relay 3 (AUTOMATIC), and the LED assignment for LED 1 (Trans1) cannot be changed. Inputs 5 + 6 for remote adjustment of MANUAL/AUTOMATIC are still active, but their adjustment is subject to the same restrictions as in operation via the keypad (see above).

Furthermore, the following applies:

Feature SR192 = 1: BE4 is fixed on high-speed switching.
Feature SR192 = 2: BE1 is fixed on high-speed switching.

8.3.20 Feature SYSCTRL

This is a bit-specific feature for general modification of system features.

Coding of the feature

7	6	5	4	3	2	1	0	Function	Note
x	x	x	x	x	x	x	**1**	**ShowParLimits** ON	
x	x	x	x	x	x	x	**0**	OFF	
x	x	x	x	x	x	**1**	x	**AllowSlaveParChanges** ON	
x	x	x	x	x	x	**0**	x	OFF	
x	x	x	x	x	**1**	x	x	**NoApplicationMenuPasswordProtection** ON	
x	x	x	x	x	**0**	x	x	OFF	
x	x	x	x	**1**	x	x	x	**VirtualTapChangerIndicator** ON	from V2.00
x	x	x	x	**0**	x	x	x	OFF	
x	x	x	x	**1**	x	x	x	**NoStepCommandDuringIndicator** ON	only V1.99
x	x	x	x	**0**	x	x	x	OFF	
x	x	x	**1**	x	x	x	x	**AllowTapSimu** ON	from V2.00
x	x	x	**0**	x	x	x	x	OFF	
x	x	**1**	x	x	x	x	x	**DisableGroupTappingDuringHAND** ON	from V2.00
x	x	**0**	x	x	x	x	x	OFF	
x	**1**	x	x	x	x	x	x	**HandAtParErr** ON	from V2.00
x	**0**	x	x	x	x	x	x	OFF	
1	x	x	x	x	x	x	x	**HandAtTapErr** ON	from V2.00
0	x	x	x	x	x	x	x	OFF	

- **B0: ShowParLimits:**
  With this bit set, the parallel program limitation for all parallel programs (where appropriate) can be entered via the control panel. If the bit is not set, the limitation can only be entered via the control panel when the limit value is not the standard value (20.0). With the dcos(φ) program the limitation can always be entered.

- **B1: AllowSlaveParChanges:**
  With this bit set, the regulator can also be configured during slave operation.

- **B2: NoApplicationMenuPasswordProtection:**
  With this bit set, the application menus are not password protected, i.e., all menu items can be performed without an optional password. A single menu item in the customer-specific application menu can be freed of the password prompt, where the application name (REG-L: MenuAppN) begins with a tilde "~". This tilde is not shown in the menu.

- **B3: VirtualTapChangerIndicator** (available from REG-D™ V2.00):
During the up/down relay switching phase and during TC in operation signal activity, further pending up or down tap commands are generally deleted from V2.00. The bit functionality introduced with V1.99 NoStepCommandDuringIndicator is therefore no longer necessary.
But if the regulator or the corresponding PAN-D is not supplied with TC in operation information, the up/down tap command lock will only engage during the up/down relay switching phase. On setting the VirtualTapChangerIndicator bit, the TC in operation signal activity is simulated, so that the tap command lock can engage during the imaginary TC in operation signal activity in this case.
The parameter maximum time TC in operation (RegTLaufl) determines the activity duration of the virtual TC in operation, there can be no TC in operation failure in the virtual mode. Note: Connection of a TC in operation on the REG-D™ or the PAN-D lead to deactivation of the virtual TC in operation functionality.

- **B3: NoStepCommandDuringIndicator** (only available with REG-D™ V1.99):
New up or down tap commands are erased during the up/down relay switching phase. Once the corresponding relay is de-energized, tap commands are stored and carried out after the cycle time (this depends on the TC in operation time or the actual TC in operation signal activity).
If the bit is set, the tap commands are not only deleted during the up/down relay switching phase, but throughout the entire switching phase.
Note: As of V2.00, tap commands are generally deleted throughout the switching phase (behavior as with the bit set). Bit 3 is indeed ignored, but should be set to 0.

- **B4 : AllowTapSimu** (available from REG-D™ V2.00):
In the AddOns menu, with bit 4 set, tap position can be selected besides 0:OFF and 3:ON and also 4:TapSimu.
If "4:TapSimu" is selected, the tap position is non-volatilely simulated (up commands increment, down commands decrement the tap value, change of tap with REG-L command RegTapNV). The INVERS feature is observed, i.e., with the feature set, up commands reduce the tap value.
The value range is limited to +/-40. The value from RegTAPNV is debounced like a normal input value at 1s, hence the new tap value will only appear after 1s.

- **B5 : DisableGroupTappingDuringHAND** (available from REG-D™ V2.00):
With the bit not set the entire group is tap changed by the master in the manual mode. If the bit is set, tap commands from the master in manual mode are not routed to the group (behavior as in V1.99).

- **B6 : HandAtParErr** (available from REG-D™ V2.00):
With this bit set, the regulator switches to MANUAL mode as soon as a parallel error is present.

- **B7 : HandAtParErr** (available from REG-D™ V2.00):
With this bit set, the regulator switches to MANUAL mode as soon as a tap error is present.

The following values are added for the determination of <bits>:

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Value	128	64	32	16	8	4	2	1

On/off switching

Activation by: Feature SYSCTRL = <bits>
Deactivation by: Feature SYSCTRL = 0

8.3.21 Feature SYSCTRL2

This is a bit-specific feature for general modification of system characteristics.

Coding of the feature

7	6	5	4	3	2	1	0	Function	Note:
x	x	x	x	x	x	x	**1**	**noAutomaticHandAuto** ON	from V2.04
x	x	x	x	x	x	x	**0**	OFF	
x	x	x	x	x	x	**1**	x	**RegLonExtendedMasterSlaveInfo** ON	from V2.09
x	x	x	x	x	x	**0**	x	OFF	
x	x	x	x	x	**1**	x	x	**NoFastOnSPchangeIfVoltageReg** ON	from V2.10
x	x	x	x	x	**0**	x	x	OFF	
x	x	x	x	**1**	x	x	x	**NoFastOnSPchangeIfPowerReg** ON	from V2.10
x	x	x	x	**0**	x	x	x	OFF	
x	x	x	**1**	x	x	x	x	**NoQuickInhibitLow** ON	from V2.11
x	x	x	**0**	x	x	x	x	OFF	
x	x	**1**	x	x	x	x	x	**NoInhibitHighEvaluation** ON	from V2.11
x	x	**0**	x	x	x	x	x	OFF	
x	1	x	x	x	x	x	x	**NoInputRelayLedFunctionInversion** ON	from V2.14
x	0	x	x	x	x	x	x	OFF	

- **B0 : noAutomaticHandAuto**:
  If the bit is set, the manual/automatic state is not aligned (behavior as in V1.99) in parallel operation.

- **B1 : RegLonExtendedMasterSlaveInfo** (available from REG-D™ V2.09 and V2.02e):
  If the bit is set, the following data points in the REGLON structure are modified as follows:

Data point	B1 = 0	B1 = 1
REGLON.TC_Single_Parallel	ParallelProgramActive	IsActiveMaster OR IsSlave
REGLON.TC_Master	(NOT IsSlave) AND ParallelProgramActive AND (ParProg = Master or MasterFollower)	IsActiveMaster

- **B2 : NoFastOnSPchangeIfVoltageReg:**
  Normally (B2 = 0) with voltage regulation and a setpoint change, high-speed switching mode is automatically activated until the voltage value lies wihtin the tolerance band again. If bit B2 is set (B2 = 1), high-speed switching is NOT activated in the case just described.

- **B3 : NoFastOnSPchangeIfPowerReg**:
  Normally (B3 = 0) with power regulation and a setpoint change (setpoint 3 or 4 + software feature PQCtrl), high-speed switching is automatically activated until the power value again lies within the tolerance band. If bit B3 is set (B3 = 1), high-speed switching is NOT activated.

- **B4 : NoQuickInhibitLow:**
  If this bit is set (B4 = 1), no quick shutdown detection with undervoltage (U <60 V) is carried out, so the appropriate time delay must pass before shutdown occurs (inhibit low).
  Processing of the shutdown input or the REG-L shutdown command is not affected by this bit.

- **B5 : NoInhibitHighEvaluation:**
  If this bit is set (B5 = 1), no triggering request (inhibit high) is evaluated and the menu item disappears (the associated REG-L commands can still be used, but without an effect).

- **B6 : NoInputRelayLedFunctionInversion:**
  If this bit is set (B6 = 1), input, relay and LED functions cannot be inverted, the related list boxes correspond to the list boxes used up to V2.12 with F3:ENTER instead of F3:INV. Reason: Forcing the behavior up to and including V2.12.

The following values are added for the determination of <bits>:

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Value	128	64	32	16	8	4	2	1

On/off switching

Activation by: Feature SYSCTRL2 = <bits>
Deactivation by: Feature SYSCTRL2 = 0

8.3.22 Feature PrimCtrl [protected]

The regulator should set specific taps, depending on the primary voltage.

For this purpose, the tap position is indicated with a mapping rule in the usual 100 V (or 110 V) regulation range and processed as an actual value. The primary voltage, which is measured, is used as setpoint. The setpoint setting on the REG-D™ is processed as an additive override to the primary voltage.

On/off switching

Activation by: Feature PRIMCTRL = 1

Deactivation by: Feature PRIMCTRL = 0

8.3.23 Feature ULC [protected]

This is a special current program made according to the wishes of the customer. The parameters X and L known from the LDC are no longer entered in Ohms, but in percentages. in particular, it is possible to enter negative values. It is also necessary to enter the parameters nominal voltage and nominal power, since the nominal current which enters into the calculation is derived from them. After activating the ULC feature, the ULC current program is available. Moreover, all of the above parameters can be entered in the ULC menu.

On/off switching

Activation by: Feature ULC = 1
Deactivated by: Feature ULC = 0

8.3.24 Custom features [protected]

If you have any questions about any of the custom features, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

8.4 Background programs and the programming language REG-L

8.4.1 Programming language REG-L

REG-L is the programming language for all devices of the A. Eberle REGSys™ family:
REG-D™, PAN-D, REG-DA, REG-DP, MMU-D, EOR-D, REG-DMA and REG-DM.
The language is used:

- For communication between REGSys™ devices via E-LAN
- For reading measured values, device states and parameters
- For configuring REGSys™ devices
- In H-programs in order to realize customer-specific additional functions
- For communication with the configuration software WinREG

REG-L is an interpreted language, which uses the inverted Polish notation. This type of notation allows a very effective, short notation. There is a general instruction set which is supported by all devices. In addition to the general instruction set each device knows more commands that are specific to the device.

Instruction syntax

An instruction consists of:
<identifier:><instruction><extension> <parameter1> <para.2> ... =<parameter1> <para.2> ...

- A comma (or ;) separates instructions
- A space separates parameters
- Upper/lower case is not distinguished
- All REG-D™/PAN-D specific instructions begin with the prefix "Reg..."
  (e.g. RegAuto, RegREL, ...)
- further prefixes: "Esp..." for REG-DP; "mmu..." for MMU-D; "Eor..." for EOR-D;
- Help: Is called with "?" and a terminal designation (e.g. "? analog“ or "? syntax“)
- With "? book" the entire help text of the REGSys™ device is issued.

Examples:

RegStufe	=>	returns the current tap position
RegRel 3	=>	returns the state of relay 3
RegRel 3,A1:RegE 1	=>	returns the state of relays 3 and from device A1: the state of input 1

Important instructions

Instruction	Description
hlist	Output of the H program lines
plist	Output of the P program lines
qlist	Output of the Q program lines
err	Error check of the background program
hbreak	Interruption of H-program execution
Help or ?	Online help for a command (e.g. ? regauto)
abs, sin, cos, sqrt, exp, log	Mathematical functions
if (iff), else, endif	Program branches
fori, nexti	Program loops
meld "string“	Generate message on the display
htd	loop time
Reg…	REG-D™ / PAN-D specific instructions (e.g.: RegU, RegAuto, RegE, RegRel,...)

A complete instruction reference and training materials, with examples are available on request from the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

8.4.2 Background programs

Background programs (H-programs) consist of program lines, each with a number of REG-L instructions. A background program consists of the following components:

- H-lines (executed cyclically)
- P-lines (only executed with an explicit call)
- Q-lines (only executed with an explicit call)
- Application menus to enter and display user-specific parameters and values
- User variables to store and transfer user-specific parameters
- User-Definable-Menu (UDM) for creating fully customized screens and complement the background programs. UDMs are only supported by devices with the S2 feature.

In general, background programs created by A. Eberle are delivered as ASCII text files. Each background program includes a description of the functions and the resources used in the form of a PDF file or another ASCII text file. The background programs have device-specific file extensions (*.rgl for REG-D™, *.pnl for PAN-D, *.dpl for REG-DP, *.mml for MMU-D, *.eol for EOR-D). That is, a background program for a REG-D™ is, for example, called "REG-L_example_for_UserManual_V01.rgl".

UDM files are also ASCII text files and can be used on devices with the S2 feature, in addition to, or as a substitute for, the classic background program (e.g. *.rgl). They have the file extension *.udm.

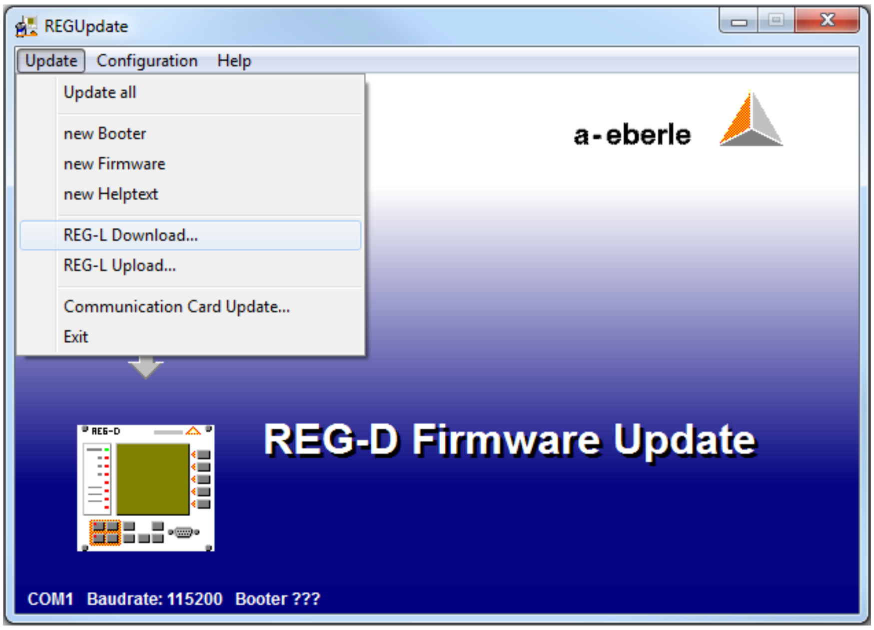
8.4.2.1 Loading H-programs in a device

General

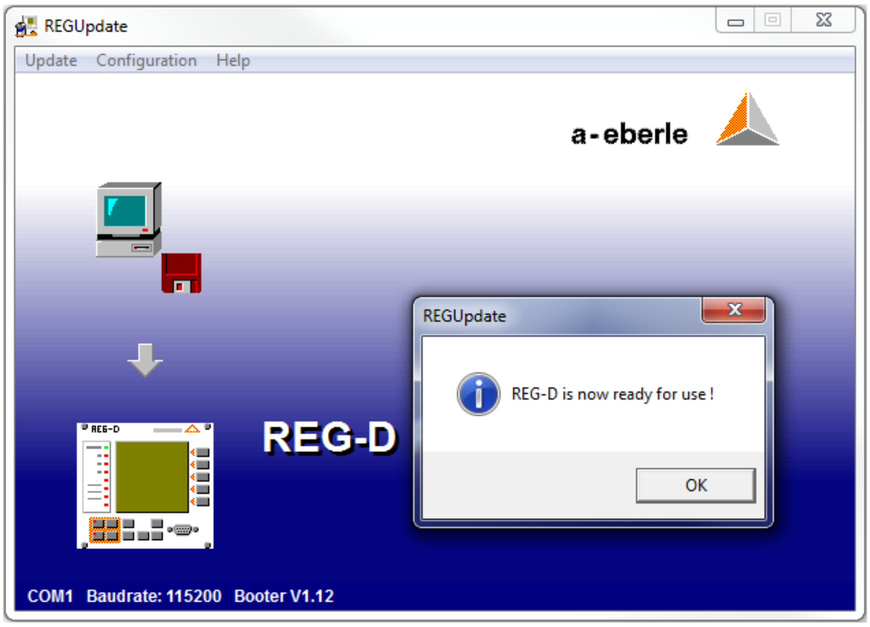
- Establish a connection between the REG-D™ and the PC.
- Set the interface on the regulator under: "Setup -6-\RS232\COM1" or COM2
- The interface (baudrate) used in the program must be set the same as for the regulator!
- Instructions on how to load the background program into the regulator, including allocation of the serial cable are found in the readme file of the background program.

Loading with the software REGUpdate (update32.exe), (classic H-program, no UDM)

- Setting the interface under Configuration
- Selection of H-program under Update -> REG-L Download
- Sending the H-program (only possible on directly connected devices)

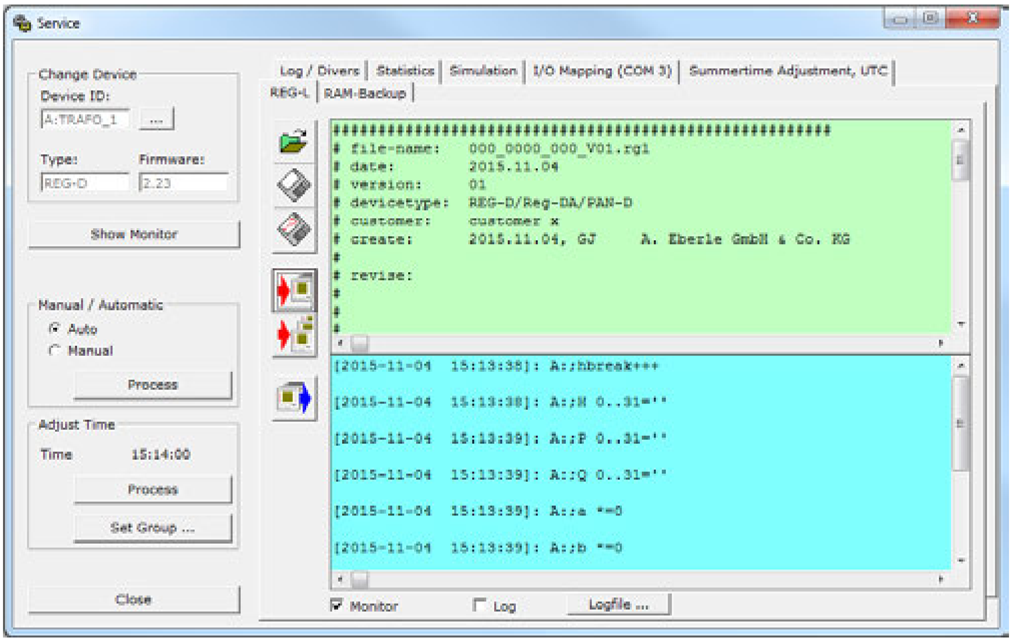


After a successful transfer, a message appears that the REG-D™ is now ready for use again.

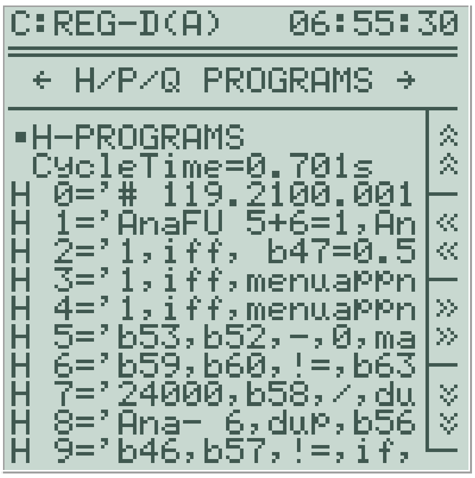


Loading with the service module of WinREG (classical H-program & UDM)

- Set the interface in the WinREG control program under Options -> Connections.
- Start the service and select the H-program (displayed in the green box) in the REG-L tab.
- Send the H-program (possible for all devices in the E-LAN grid).
- The progress of the H-program can be followed in the turquoise window (there may appear error messages).



From firmware versions 2.22/3.22, the background program currently running on the device can also be seen in the status menu ("Setup -6-\Status\H/P/Q" programs). UDM files are not displayed here.



8.4.2.2 Reading H-programs from a device

To read the H-program from the device, the PC software REGUpdate (update32.exe, Update -> REG-L Upload), or the service module of WinREG (REG-L tab) can be used.

The use of the original background program is recommended!

The read out background program file no longer contains any comments, and any REG-L commands executed besides the H/P/Q lines during the download cannot be restored! Therefore, it is always advisable to load the original background program (e.g. the *.rgl file).

8.4.2.3 Deleting H-programs

The background program is deleted by loading an empty background program, as well as via a terminal program. For this purpose, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

9. Configuration and display software WinREG

9.1 General

The WinREG software is used to configure and program the A. Eberle REG-D™ Relay for Voltage Control & Transformer Monitoring. WinREG has a modular structure and consists of several programs for control and configuration of the Relay for Voltage Control & Transformer Monitoring, as well as storage and display of data from it.

WinREG is designed so that a plurality of subprograms can access the connected devices (e.g. Panel and Service) at the same time. An exception is the Terminal. If this is in online mode, no access of another WinREG program is possible via this interface.

The SCADA system connections of the Relay for Voltage Control & Transformer Monitoring are performed using the SCADA system configuration software WinConfig. Instructions for WinConfig software use are not included in this manual.

WinREG version

The following chapters describe WinREG version 3.9 (R6) in detail.

9.2 Installation

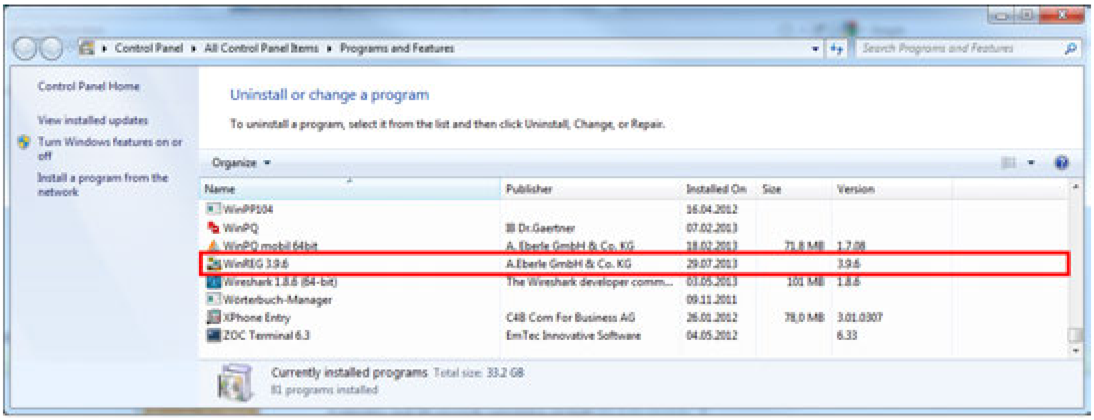
To run the WinREG software, the minimum hardware and software configuration is:

- A Personal Computer with a Pentium core
- 512 MB RAM
- 50 MB free disk space
- A serial interface or an USB with an USB serial adapter,
  or a network card for devices that are connected via TCP/IP
- Windows XP, Vista, Windows 7, Windows 8, Windows Server as of 2003
- Microsoft DotNet Framework 3.5

During installation administrator rights are required

To install the software you start Windows. Do not insert the installation CD-ROM into the CD drive yet.

1. Run the "Software" program in the control panel folder ("Start/Settings/Control Panel").
2. An alphabetical list of all installed programs appears. Check first if WinREG is already listed.



WinREG under installed programs (Windows 7 example)

If that is the case, the older version should be uninstalled first. This applies even if an update is to be installed. The update process is described below.

No new installation in an existing WinREG directory

Absolutely avoid a new installation in an existing WinREG directory containing a previous version which should be retained. If, on the other hand, this is a new installation, or WinREG was uninstalled, please continue with point 6.

3. Click on the line "WinREG" in the program list; it is highlighted. Now click on "Change or remove programs".
   Some queries follow as to whether deletion is actually intended. Confirm these. However, with the request as to whether shared files should be deleted, select "Keep all" (or "Remove none") so as not to delete shared files.

Don't delete the CMMCONN.DAT file

In particular, the CMMCONN.DAT file should not be deleted because it contains your connection settings.

4.
   In particular, the CMMCONN.DAT file should not be deleted because it contains your connection settings.

5. The message that various WinREG program components could not be deleted can be ignored.

6. Uninstallation ends with the message "Uninstallation successfully completed".

7. Now insert the WinREG CD into the appropriate drive.
   Normally, the installer will start automatically. If this automatic start is disabled on your computer, run the program Install.exe from the root directory of your CD drive.

REGSys™ installation program

8. The Home screen appears. You can choose the installation language in the left column and install the programs you need by clicking on the text in the middle column.

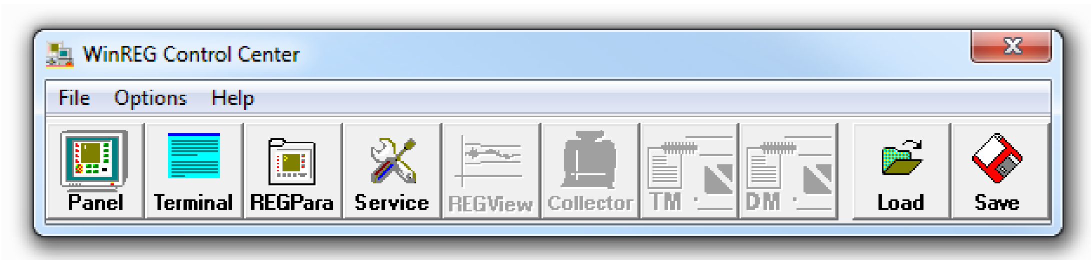
Instruction:

If you received the WinREG installation via email or by other means (A. Eberle Homepage, USB pendrive), please run setup.exe directly. The other steps are identical to installing WinREG from the CD.

9. The program directory c:\programme\a-eberle\WinREG3 is proposed.

10. All further steps are described by appropriate instructions and queries.

11. When the installation is complete, you will find the WinREG Control Center under Start/programs.



WinREG Control Center (standard version)

The control center program contains the panel, terminal, REGSys™ configuration (REGPara), service, desktop load and desktop save.

The additional modules RegView and Collector (collector/recorder) are optional and included only if they have been ordered. The same applies to WinTM and WinDM.

The additional programs RegView, Collector, WinTM and WinDM must be installed separately. If you have installed the additional programs, the respective symbol appears in colour automatically after installing the program.

The panel does not start

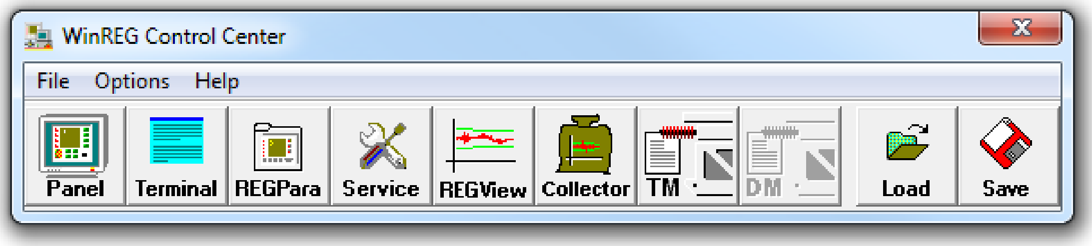
If, after successful installation, the panel does not start and an error message appears instead, then please check the installation of Microsoft DotNet Framework 3.5 on your PC. You can find a version of the Framework, which can be installed without an Internet connection, on the WinREG CD.

USB drivers for devices with the I1 feature

If your REGSys™ device has an interface to COM1 (feature I1) via USB, the desired driver can be installed via the menu item "USB driver for REGSys". If communication with the device takes place via a serial interface (RS232), USB/serial converter, or TCP/IP, installation of the USB driver is not necessary. The driver only works with A. Eberle devices which are equipped with a built-in USB interface. Please use the driver supplied by the manufacturer of the driver for an external USB/serial converter.

9.3 Control Center

The Control Center of the WinREG package unites all of its individual applications: panel, terminal, WinREG configuration, configuration, connection editor and all future add-ons.



WinREG Control Center (including optional Collector, REGVIEW and WinTM)

The Control Center allows:

- Calling each of the WinREG applications
- Saving a snapshot of all applications running on the desktop with position and current device (File\Save desktop)
- Restoring such a snapshot (File\Load desktop)
- Common termination of all currently running WinREG applications, (File\Exit: all)
- Integration of all coming WinREG applications, add-ons and any other applications
- Access to each help file of the WinREG package
- Setting of important operating parameters (Options\Settings)
- Setting connections (Options\Connections)

All applications can also be started from the File menu.

Saving & Retrieving the Desktop

WinREG has a function for storing the image of the current WinREG applications in a file at any time, and loading or retrieving it again later. Both the positions of all WinREG applications and the current devices are recorded.

To generate the image, select the menu item "File\Save desktop", or click on the Save icon in the Control Center and enter an arbitrary name in the subsequent "Save desktop" dialog.

To restore a once stored image, select "File\Load desktop" or click on the load icon in the Control Center and select the desired image from the list of desktop files. Then, all WinREG applications that were active at the time of storing are started and set to the old positions.

Loading can be terminated with the menu item "File\Cancel load desktop". This is especially useful when many applications are to be loaded on a modem connection that is not cumulative, as a click on Cancel will only abort the currently running selection process, not the entire loading process.

Please note that the repeated loading of a desktop file – without terminating the earlier applications again in advance – calls the WinREG applications and places them exactly one above the other.

Setting language

The language of WinREG can be set in the "Options\Language" menu or using the F9 key.

Backing up and restoring connections

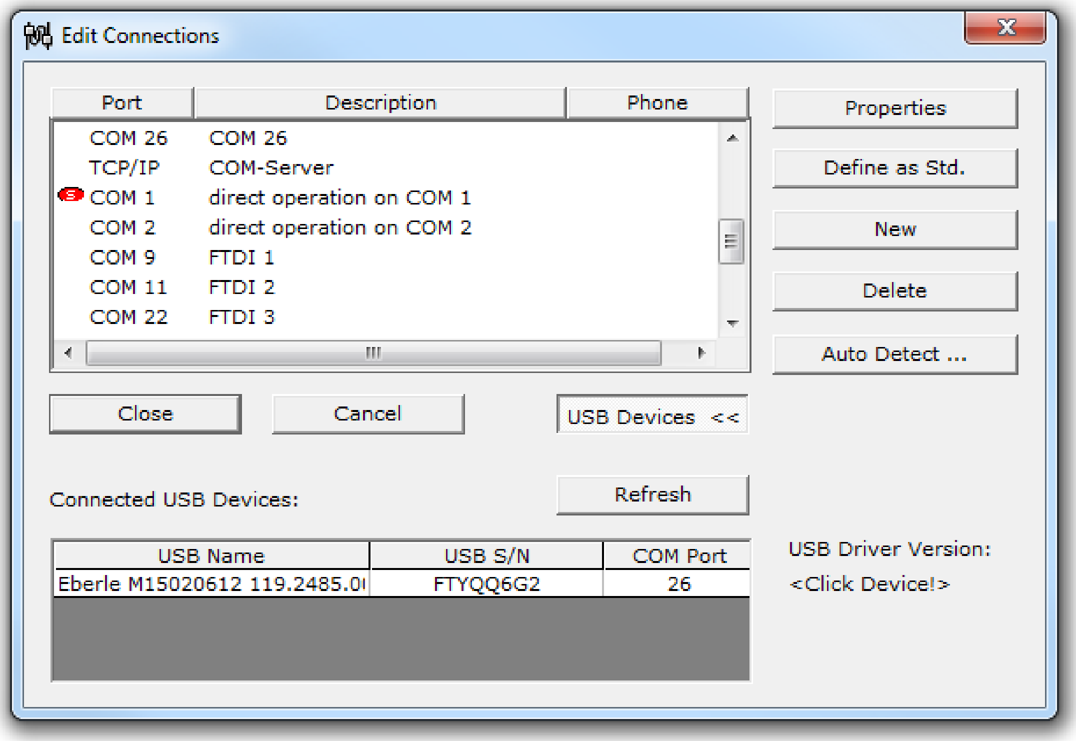
WinREG connections can be backed up to a file and restored from a file via the menu items "Options\Save connections" and "Options\Restore connections". Thereby, for example, all connections of an existing WinREG installation can be moved to a new installation on another PC.

9.4 Communication with an A. Eberle device (e.g. REG-D™)

9.4.1 Connection settings

WinREG's communication connections are set up and managed in the menu "Options\Connections".

The default connection is indicated with a white "S" placed in a red ellipse. This connection is opened as soon as a WinREG subprogram starts.



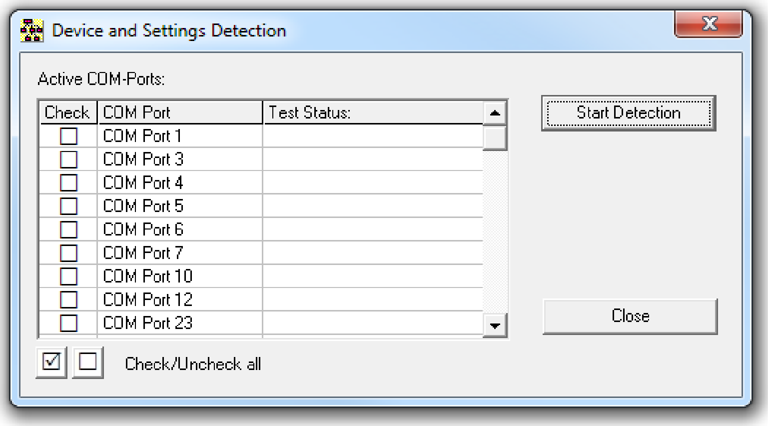
WinREG "Edit Connections"

A. Eberle devices which are equipped with a USB interface (feature I1), are automatically detected by WinREG. If a USB device is connected to the PC, the corresponding driver must be installed first. This driver is included on the WinREG CD. If the WinREG connection dialog opens, a connection is automatically created for each connected A. Eberle USB device. This is confirmed by a message. Subsequently, the desired device can now be selected in the connection list.

With USB devices, the assigned COM interface is displayed in the phone field. This information is useful when the A. Eberle USB device is to be used with a program that does not support automatic recognition. With the "USB device" button details such as driver version of the connected devices can be displayed.

Automatic searching for devices

This function offers the possibility to search for connected A. Eberle devices. The "Device and Settings Detection" wizard opens after pressing the automatic search button.



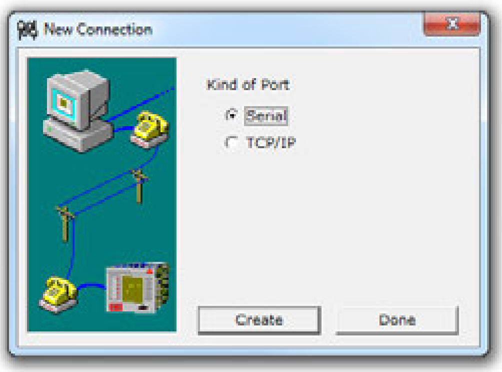
WinREG "Device and Settings Detection "

Here, among the existing COM interfaces, you can select which A. Eberle device should be searched for. After a device is found, a connection for the device can be set. The communication settings are automatically taken over from the device itself.

Manual setup of a COM connection (direct connection, modem, star coupler)

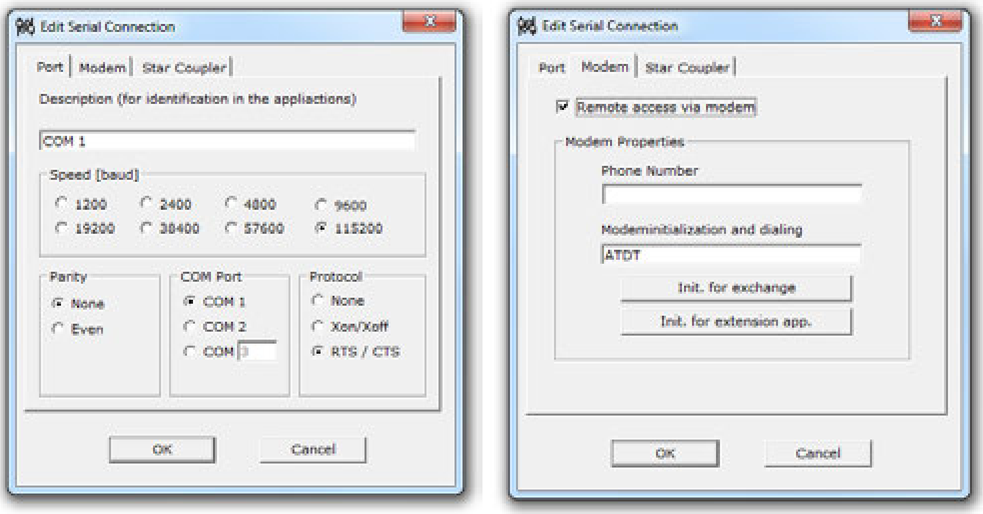
Start setting up the connection by pressing the "New" button in the "Edit Connections" dialog (Options\Connections).

Select the serial interface type and confirm your choice with Create.



Manual setup of a COM connection (1)

In the dialog that opens, set the communication parameters according to the values of the A. Eberle device. The figure shows the default values of the device.



Manual setup of a COM connection (2)

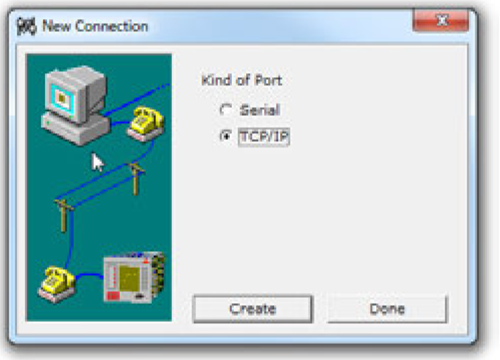
Parameter	Description
Description	Freely selectable text for naming the connection
Speed	Baudrate of the serial communication
Parity	Parity of the serial communication
Interface	COM interface (COM port) on the PC, the COM number can be obtained from the control panel (device manager)
Protocol	Handshake of the serial connection, generally, RTS/CTS is recommended, however, it must be ensured that the interface (particularly USB/serial converters) supports hardware handshake.
Dial the remote network via modem.	Establish a connection via a dial-up modem (e.g. analog modem); do not activate with a direct serial connection (null-modem cable).
Telephone number	Number of the remote site (such as a modem in the substation)
Modem initialization	String prefix for the number which is sent to the modem. By default, the selections ATDT (normal initialization) and ATX3DT0, (extension initialization) are possible. Generally, another string can also be used.
Star coupler Siemens 7XV5550 channel number	Here you can select whether the serial communication is to run via a Siemens 7VX5550 star coupler. The channel number parameter selects the channel on the star coupler to which the A. Eberle device is connected.

Confirm all your entries with OK.

If the newly created connection is to be opened for a WinREG program (e.g. Panel) you want to open, select it as the default connection.

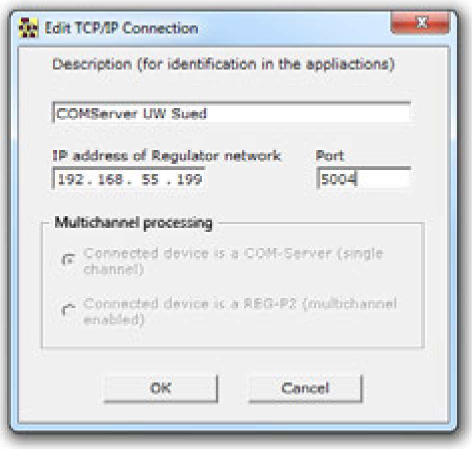
Establishment of a TCP/IP (COMServer) connection

Start setting up the connection by pressing the "New" button in the "Edit Connections" dialog (Options\Connections). Select the interface type TCP/IP and confirm your choice with Create.



Establishment of a TCP/IP (COMServer) connection (1)

In the dialog that opens, set the communication parameters.



Establishment of a TCP/IP (COMServer) connection (2)

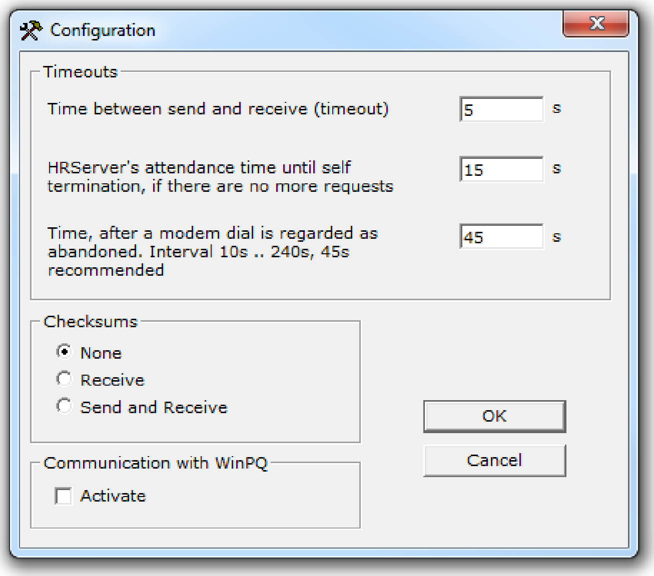
Parameter	Description
Description	Freely selectable text for naming the connection
IP address of the regulator network	IP address of the COM server, which is connected or integrated to the A.Eberle device (REG-P(ED), REG-COM)
Port	TCP/IP port of the COM server on which the communication takes place (often used at A.Eberle: 1023, 5001, 8000)

Confirm your entries with OK.

If the newly created connection is to be opened for a WinREG program (e.g. Panel) you want to open, select it as the default connection.

9.4.2 Other communication parameters

Other parameters regarding the communication in question are located in the menu "Options\Settings".



WinREG settings

Parameter	Description
Time between sending and receiving (timeout)	Monitoring time for communication. If an inquiry by the WinREG receives no response from the device within the set time, the inquiry is terminated.
HRServer waiting time until self-termination…	The HR server is the communication server of WinREG. It runs in the background and coordinates requests from the various subprograms of WinREG to the devices. This time determines how long the HRServer remains active if all WinREG programs are closed. This is helpful, for example, when working with a modem connection and the server does not have to establish the connection again after each program termination and start of another program. With a correspondingly long selected follow-up time, the connection remains open on changing.
Time after which modem dialling is considered failed.	Monitoring time for connection establishment via modem. After the interval further dial attempts are not made.
Checksum procedure	Setting of the checksum procedure for communication between the A. Eberle device and the PC.
Communication with WinPQ	WinREG is able to communicate through the server of the WinPQ software. This allows parallel operation of WinPQ and WinREG via a serial connection. To this end, the WinPQ server must be set to continuous operation and a registry entry set (function in the PQ-Manager).

Parameter	Description
	Caution: If the communication with WinPQ is active, WinREG will try to reach all connections found in WinPQ and WinREG via the PQServer (e.g. COM1, COM3, TCP/IP 192.168.55.199). If the PQServer is not active, WinREG cannot connect.

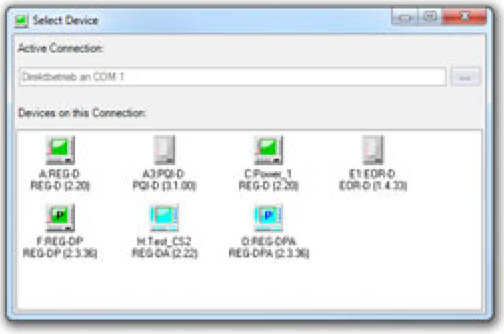
9.5 Panel

With the Panel you can bring your devices directly to the desktop. It displays an accurate replica of each device and its operating options. The current device with identifier and name, as well as the connection used are listed in the title bar.
The Panel can be operated both using the mouse and the keyboard.

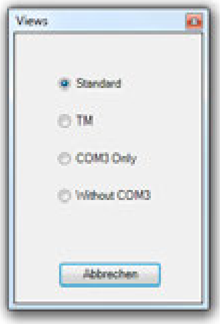
Operation with the mouse

The controls correspond to the buttons on the related device. A (single) click with the left mouse button on a control is equivalent to pressing the relevant button on the unit. Double clicks are unnecessary.

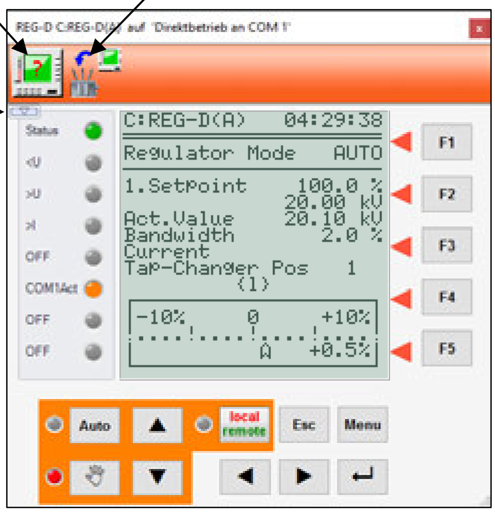
Device selection, alternatively, you can click in the display to change device.



Selection of view.
Here, depending on the device and the software features various views can be switched to.



Button to fold the menu bar out and in.



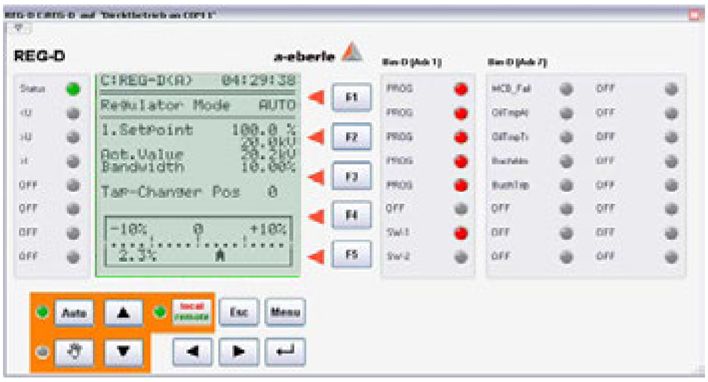
Operation with the keyboard

When operating with the keyboard, the following keys are processed by REG-D™ (upper or lower case letters are not distinguished):

PC key	REG-D function
1	F1 key
2	F2 key
3	F3 key
4	F4 key
5	F5 key
a	Automatic key
h	Manual key
r	Local/remote key
m	Menu key
<	Left arrow key
>	Right arrow key
+	Up arrow key
-	Down arrow key
#	Enter key
!	ESC key
k	Display list of available devices by name
K	Display list of available devices without name

Standard view

Here the main device (e.g. REG-D™) is displayed with the connected COM3 expansion modules BIN-D. If no BIN-D modules are present, only the main device is shown.

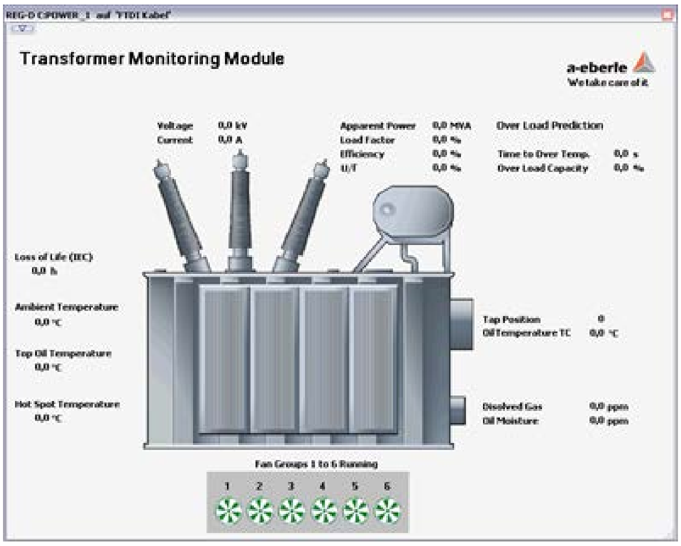


Standard panel view

The designation of the LEDs is taken from the relay or binary input assignment. For this purpose, the channels of the BIN-Ds must be assigned to the inputs and outputs of the REG-D™ (COM3 mapping).
The colours of the LEDs can be set in groups of eight LEDs. This is done via two REG-D™ variables. The colours red (default), green and orange can be selected.

TM view

In the TM view important parameters are displayed for transformer monitoring. This view can only be selected when the REG-D™ has the TM1 feature.



Panel TM view

Only COM3 view

Only the COM3 expansion modules are displayed. The main device (e.g. REG-D™) does not appear in this view.

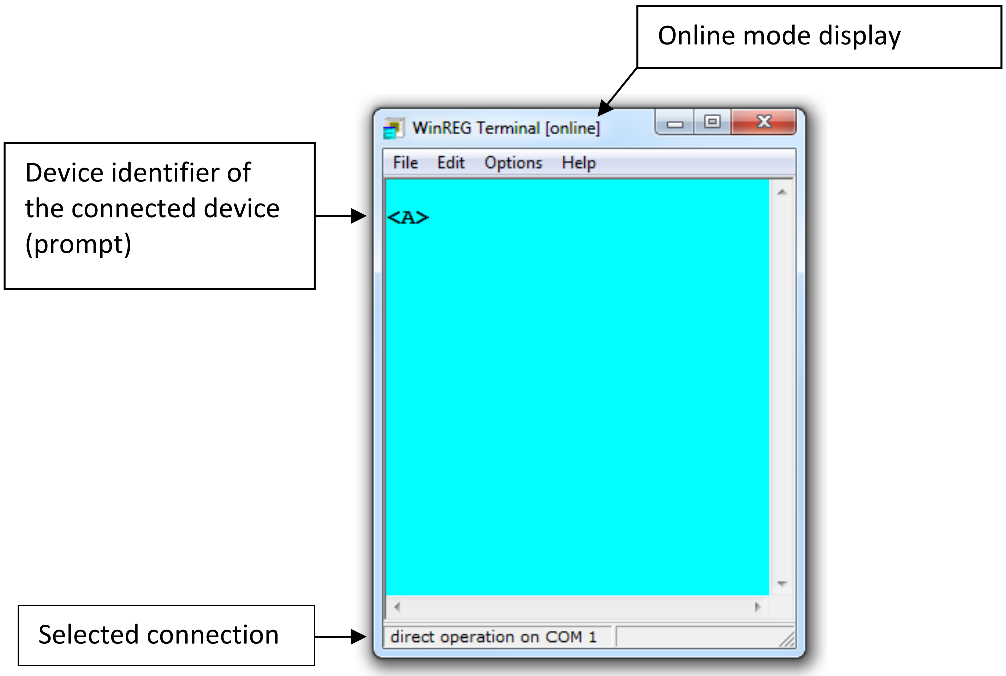
Standard without COM3 view

In this view, only the main device is displayed (e.g. REG-D™), without any existing COM3 expansion modules.

9.6 Terminal

The Terminal opens up the possibilities of direct communication with the system using the programming language REG-L, via which all parameters and functions of the device can be adjusted.

After starting the terminal, the device identifier of the connected device (prompt) appears after pressing the enter key, provided that a connection is correctly established with the device. The connection through which communication is established with the device is visible in the lower left corner and can be changed any time via "File\Connection".



Using "File/Recording" it is possible to record entered commands and responses of the device in a text file. In particular, the recording function is useful for recording the REG-L instruction reference. Under "File/Recording" first enable recording of the terminal and select a text file in which the recording will be saved. Then enter the instruction "? book" in the terminal and press Enter. This will read the entire REG-L instruction reference from the device. This process can take up to 15 minutes to complete. Once the instruction reference has been read out, the recording should be stopped again under "File\Recording".

Moreover, in the Terminal under Options the following settings can be made:

Menu item	Description
Colours	The background and font colours (foreground) of the terminal can be changed.
Fonts	Adjusting the font of the terminal.
Translation	If an OEM font is used, it has to be translated to Windows ANSI to be properly displayed. In this case "Translate" must be activated.
Online mode	In online mode, the interface is completely occupied by the terminal and output on the connection occurs continuously without delay.
ECLADR mode	The ECL address mode can be used to specifically address multiple COM1 interfaces converted to RS485 and mutually connected.
Reset	With Reset, the ongoing dialog can be reset or aborted. For example, readout of the REG-L instruction reference can be terminated.
Settings	Timeout, the time the terminal waits for a response to a sent command, can be configured under settings.

Terminal help menu item

Further information about the terminal is also available in the help menu item of the terminal.

9.7 Service

Service makes it possible to read and archive logbook and tap statistics of the connected devices. Moreover, settings can be made for daylight savings time, allocation of add-on modules, remote control of simulation mode, sending and readout of background programs, as well as RAM-Backup.

9.7.1 General

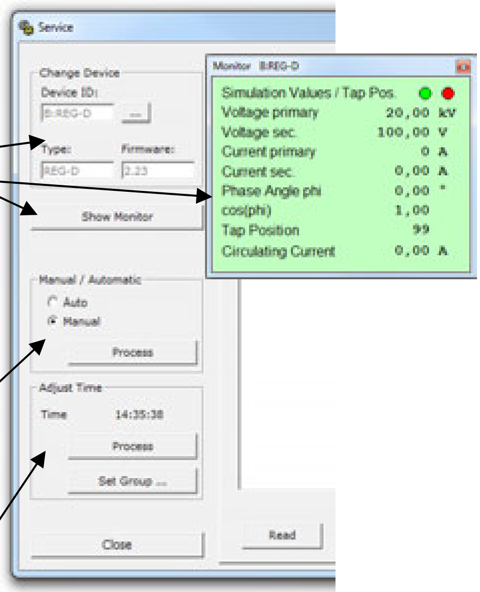
In the left pane of the Service program are located: device selection, a way to switch the manual/automatic state, starting the monitor for measured value display, and setting the time.

Device selection
Device selection opens automatically when an action is to be executed but no device is selected.

Measurement value monitor:
Online display of certain readings.
Also starts automatically if the simulation mode is started via service.

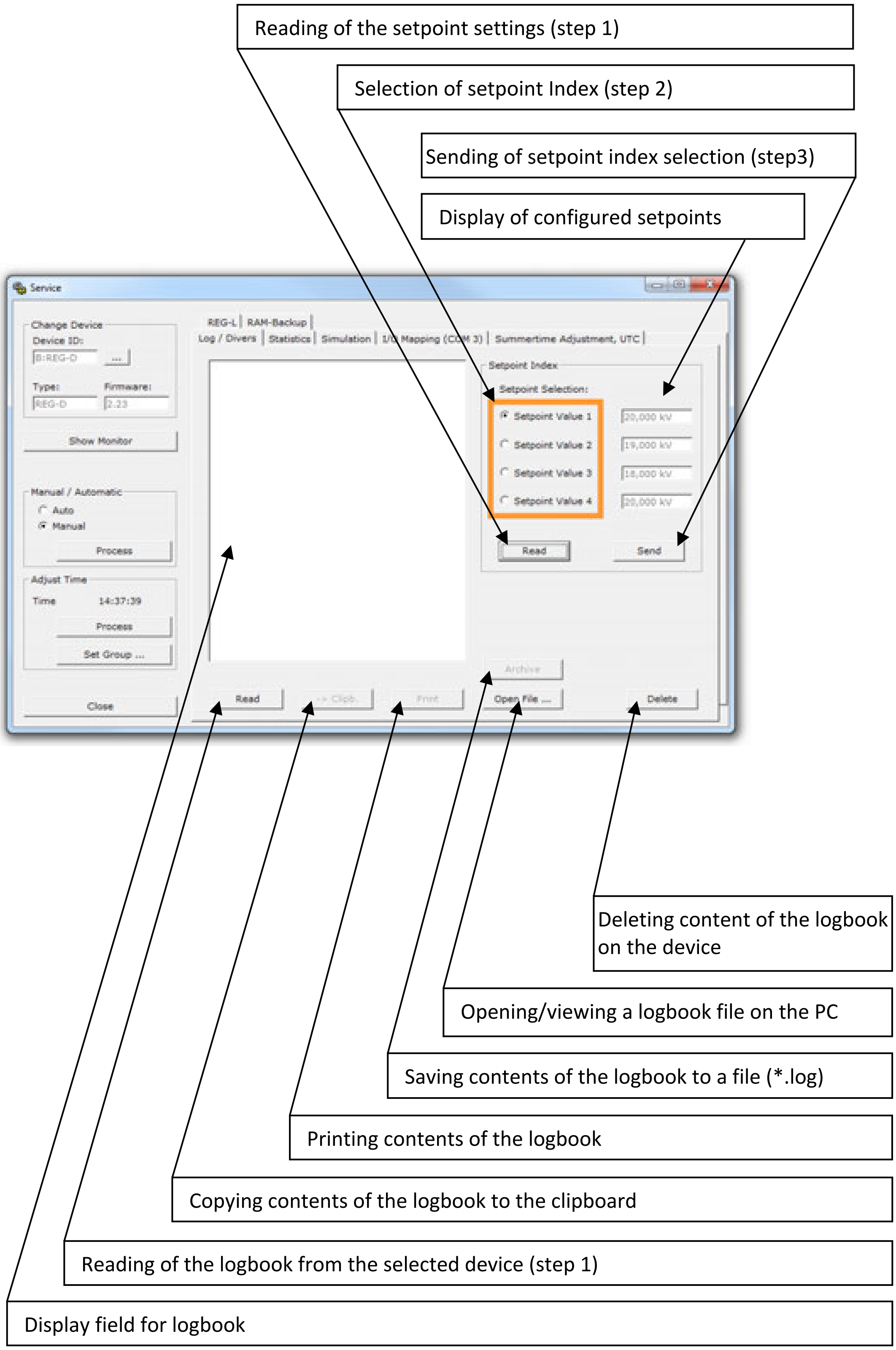
Manual/automatic switching:
Switching MANUAL/AUTOMATIC operating mode

Time setting:
The selected device, or an entire group of devices, is set to the PC time, including date.



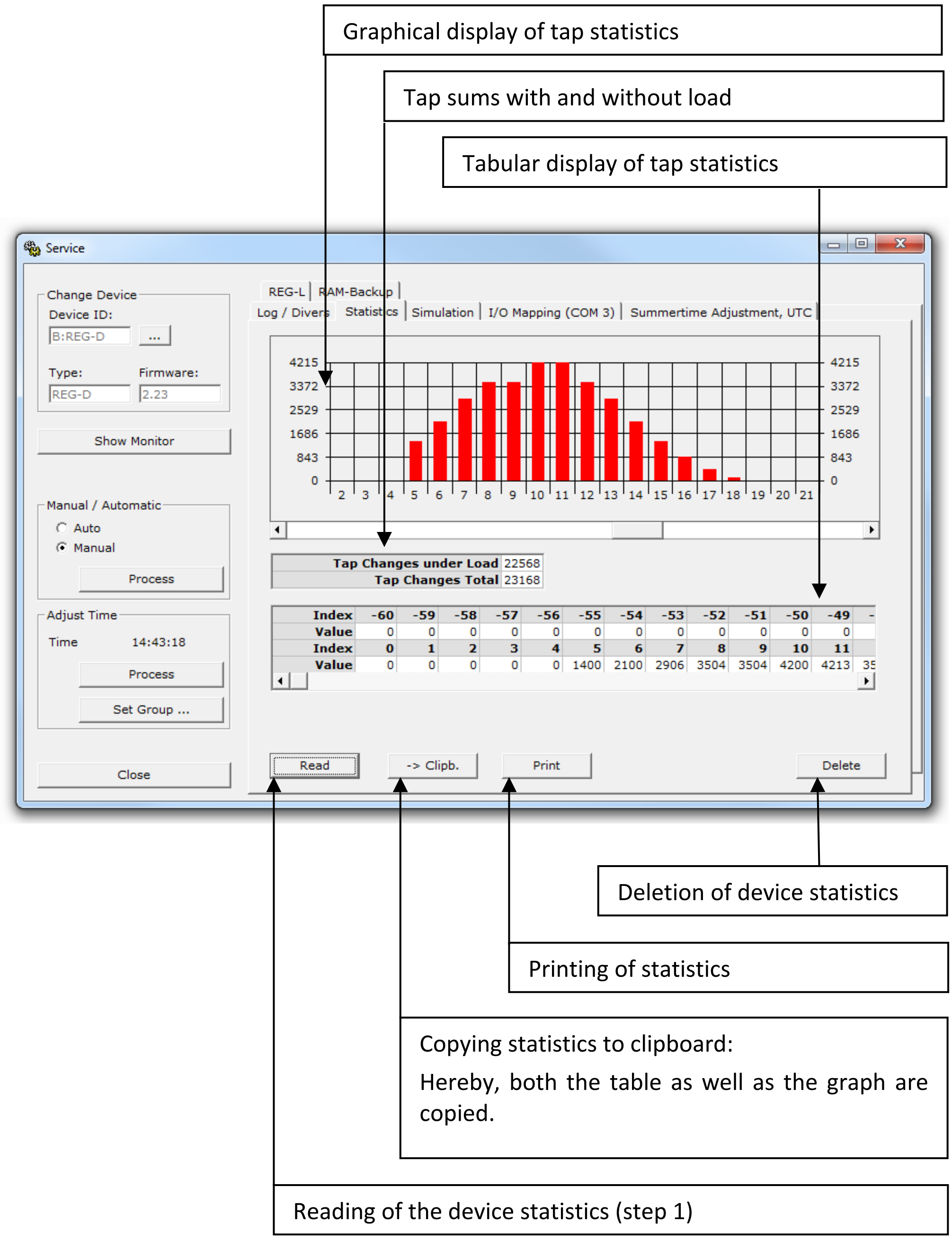
9.7.2 Log/Divers

The logbook of the REG-D™ can be read, archived and deleted via the tab "Log/Divers". Moreover, the setpoint index can be switched here.



9.7.3 Statistics

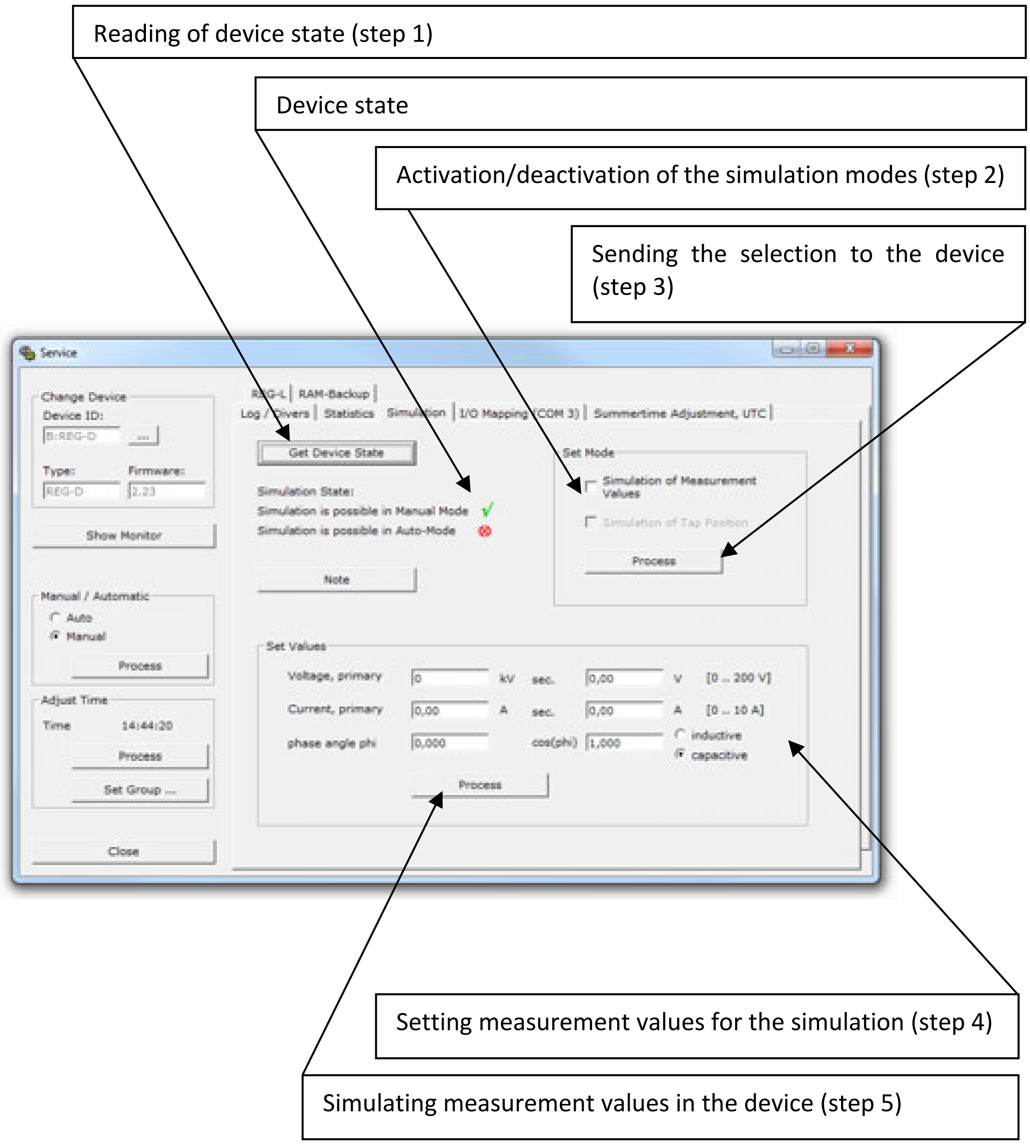
The statistics of REG-D™ can be read out and displayed with the Statistics function of the Service screen.



9.7.4 Simulation

DANGER!	
	Tap commands which are triggered in simulation mode are actually output over the relays. Since measured voltage is not used in simulation mode, this can lead to impermissible changes in the actual voltage at the transformer! ➲ If the transformer the regulator is connected to is in operation, the simulation mode should only be used under extreme caution. Here, tap commands from the regulator to the tap changer must be separated in terms of hardware (e.g. opening of the terminals).

The Simulation tab enables remote control of the REG-D™ simulation mode.



Measurement value monitor

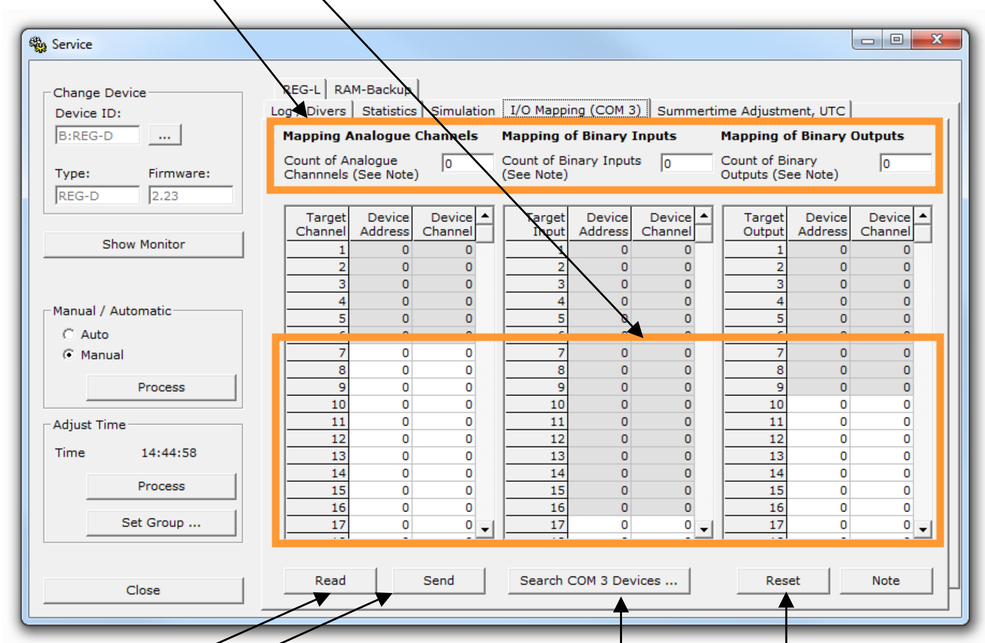
On starting the simulation, the measurement value monitor starts automatically. Here the simulated measurements can be checked.

9.7.5 I/O extnsions (COM3)

In the tab "I/O Mapping (COM3)“ assignment of the BIN-D and ANA-D expansion modules to the inputs and relays of the REG-D™ can be made/changed.

Number of channels including the channels of the device (e.g. REG-D™).
Here, virtual channels can be generated, which can then be assigned values via Modbus, for example.

Manual mapping; mapping information can also be specified manually for each channel (e.g. relays of REG-D™).
Assignment is done by entering the COM3 device address and device channel in the corresponding row.
By selecting multiple channels and pressing the right mouse button, a completion assistant can be used.

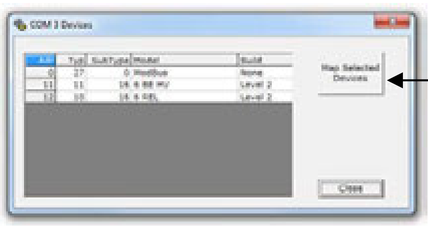


Sending mapping to the device

Reading mapping information from the device (step 1)

Deleting mapping settings; all channels are set to address 0 and device channel 0 (no mapping).

Wizard for the automatic assignment of COM3 devices



Starting automatic assignment

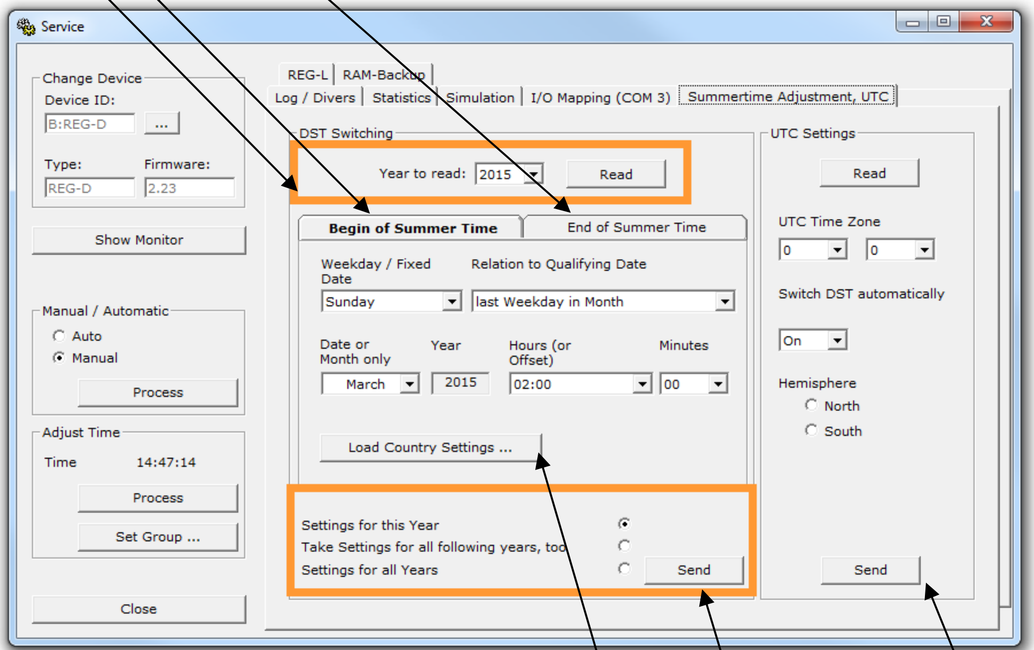
9.7.6 Summertime Adjustment, UTC

The tab "Summertime Adjustment, UTC" allows you to define rules for daylight saving time and the time zone setting. There are templates for certain countries.

Reading the current DST rules for the year xxxx from the device

Define "Start of DST“ as the last Sunday in March, at 2:00 a.m., for example.

Define "End of DST" as the last Sunday in October at 3:00 a.m., for example.



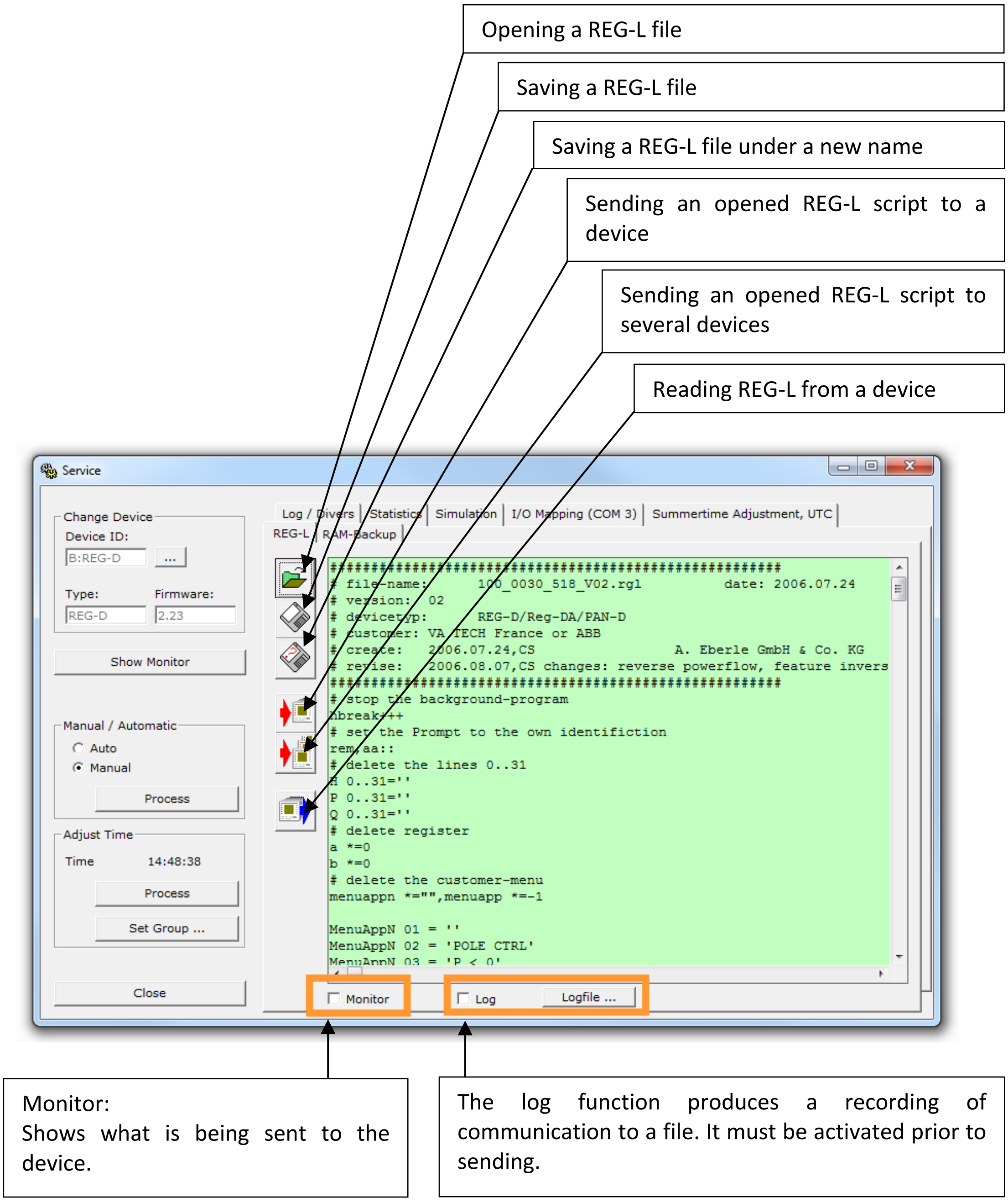
Loading pre-defined rules for specific countries

Sending the rules to the device and defining validity

UTC settings:
Here, the time zone (difference to GMT, e.g. Germany = 1h), use of summer/winter time and hemisphere settings can be made. Before an adjustment is possible, the current settings must be read from the device first. These settings are particularly important when time synchronization is done by means of UTC(GMT) time (e.g. IEC 61850).

9.7.7 REG-L

The "REG-L" tab allows you to open, edit, send, read and save REG-L Files (e.g. H-programs).



Only certain parts (markings, lines, etc.) of the REG-L scripts can be sent via the context menu (right click).

9.7.8 RAM-Backup

The "RAM-Backup" tab allows you to control backup of parameters and the background program in the flash memory. The prerequisite for this is a bootloader version ≥ V2.12 and appropriate hardware. For details on RAM-Backup, see chapter 7.2.6 RAM-Backup, from page 117 onwards.

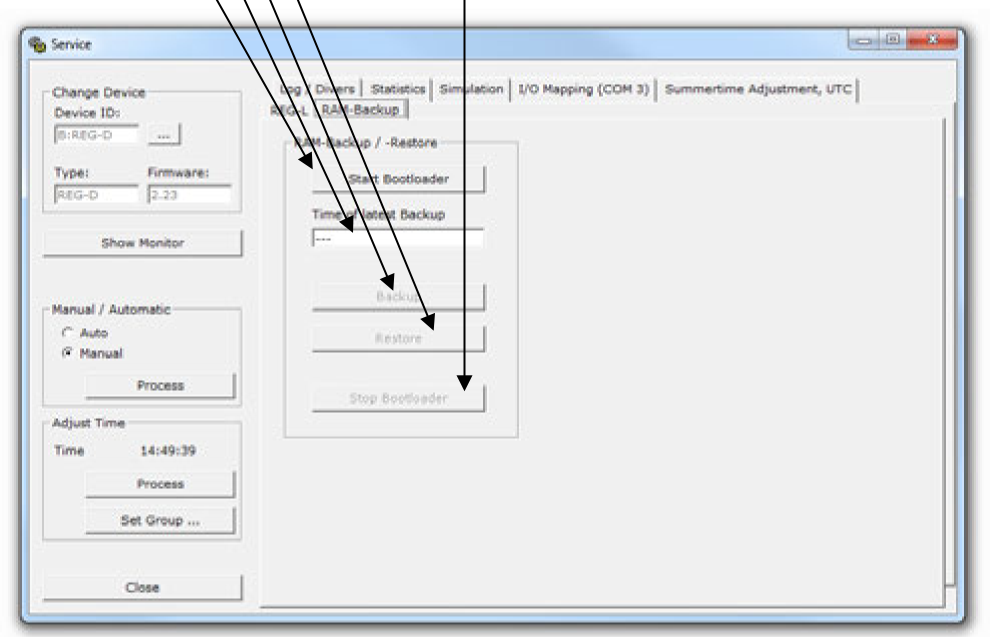
Starting the bootloader. With firmware version <V2.22 or the feature bootload = 0, the bootloader must be started manually (step 1).

Date of the last backup, if a backup is available. An existing backup is not detected until after starting the bootloader.

Backing up in the flash memory (step 2: creating a backup).

Restoring data from a backup. As of firmware version V2.22, when needed, this is run automatically after a power-on reset (step 2: restoration).

Exit the bootloader (step 3).

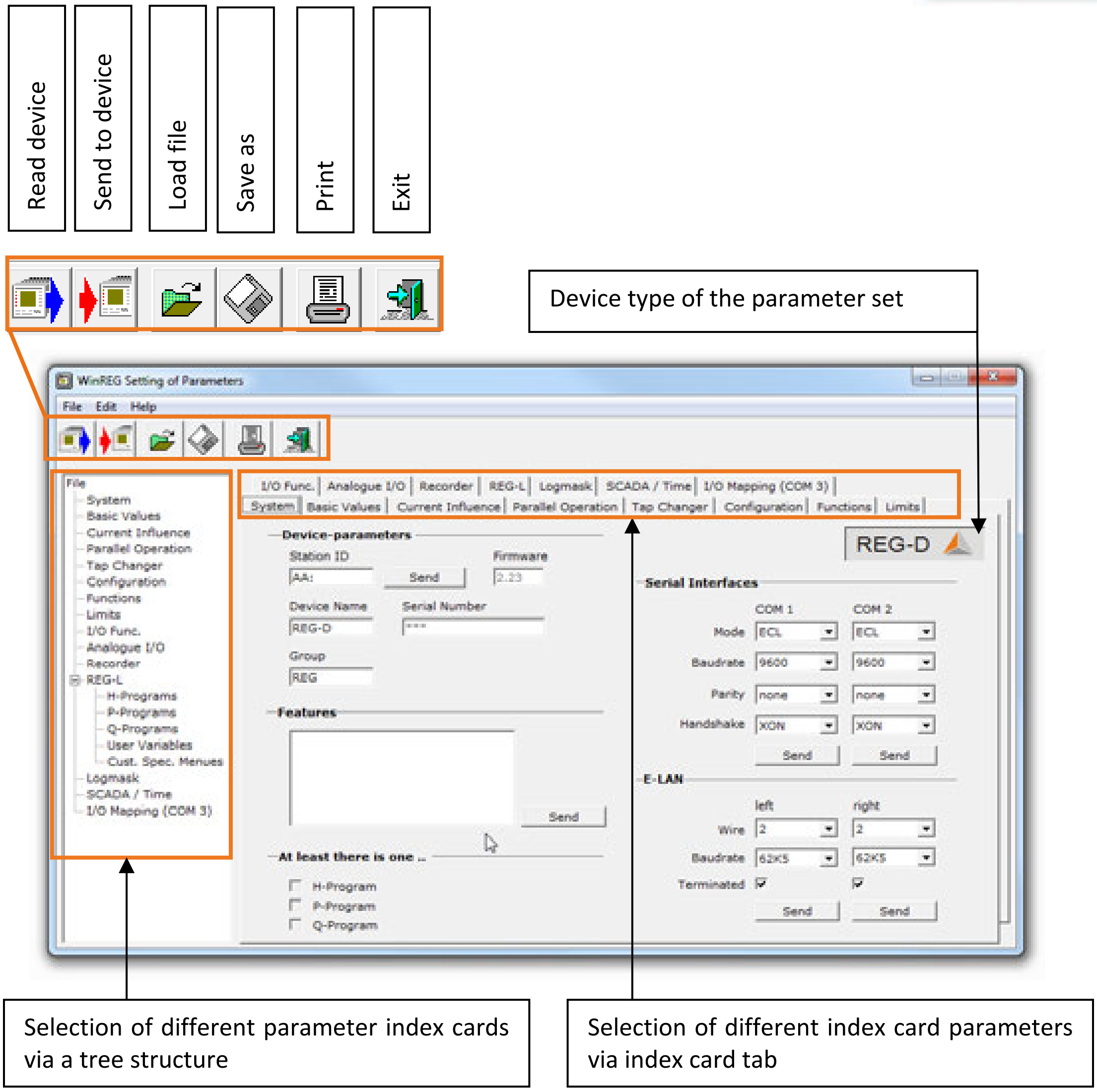


9.8 REGPara

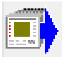
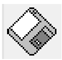
REGPara is used for simple parameter assignment of individual components. Individual parameters can be entered with a concise index card arrangement, stored for future use, or transferred to another regulator. This transfer is also possible via E-LAN.

On starting REGPara, a window appears next to the WinREG configuration for selecting device type. Select the appropriate device, in this case REG-D™, and click OK to load the WinREG configuration interface corresponding to the device.

The WinREG configuration interface is structured as follows:



The following actions are available via the File menu (partly also available as shortcuts in the WinREG configuration interface):

Menu item	Description
Read Device 	Starts reading a device. After starting, a dialog opens for selecting the device to be read.
Send to Device 	Starts sending the current parameter setting to a device. After starting, a dialog opens for selecting the target device. With the action "Send to device" all parameters are sent that do not need to be sent separately. The relevant parameters that need to be sent individually, are provided with a separate Send button. The following parameters must be sent separately: • Identifier • Features • COM interface settings • E-LAN interface settings • DST settings • COM3 mapping • REG-L
Load file 	The dialog "Load parameter file" appears to open existing REGSys™ parameter files (*.prm).
Save as ... 	By clicking on "Save as" an "Additional data" dialog appears first (see also "Edit/Additional data"), where a printout heading and a comment can be entered. With the button "Insert ...", recently used printout headings / comments or templates can be attached. By clicking OK in the "Additional data" dialog, the window "Save parameter file" appears for specifying location and name. By clicking Save, the PRM file is stored as indicated.
Export to XML ...	Export the configuration in xml format (RSEI). The XML file can be read into the management software of the company IPS.
Print 	The Print dialog appears, in which the printer and presentation can be defined. Firstly, font and font size can be set under presentation. Secondly, the order of the parameters can be arranged either as in the configuration of WinREG, i.e., according to the different index cards, or as in the device, i.e., sorted in accordance with setups 1 to 6.
Previous sessions	Up to four of the last opened PRM files can be opened using the shortcut.
Exit 	Exits the software.

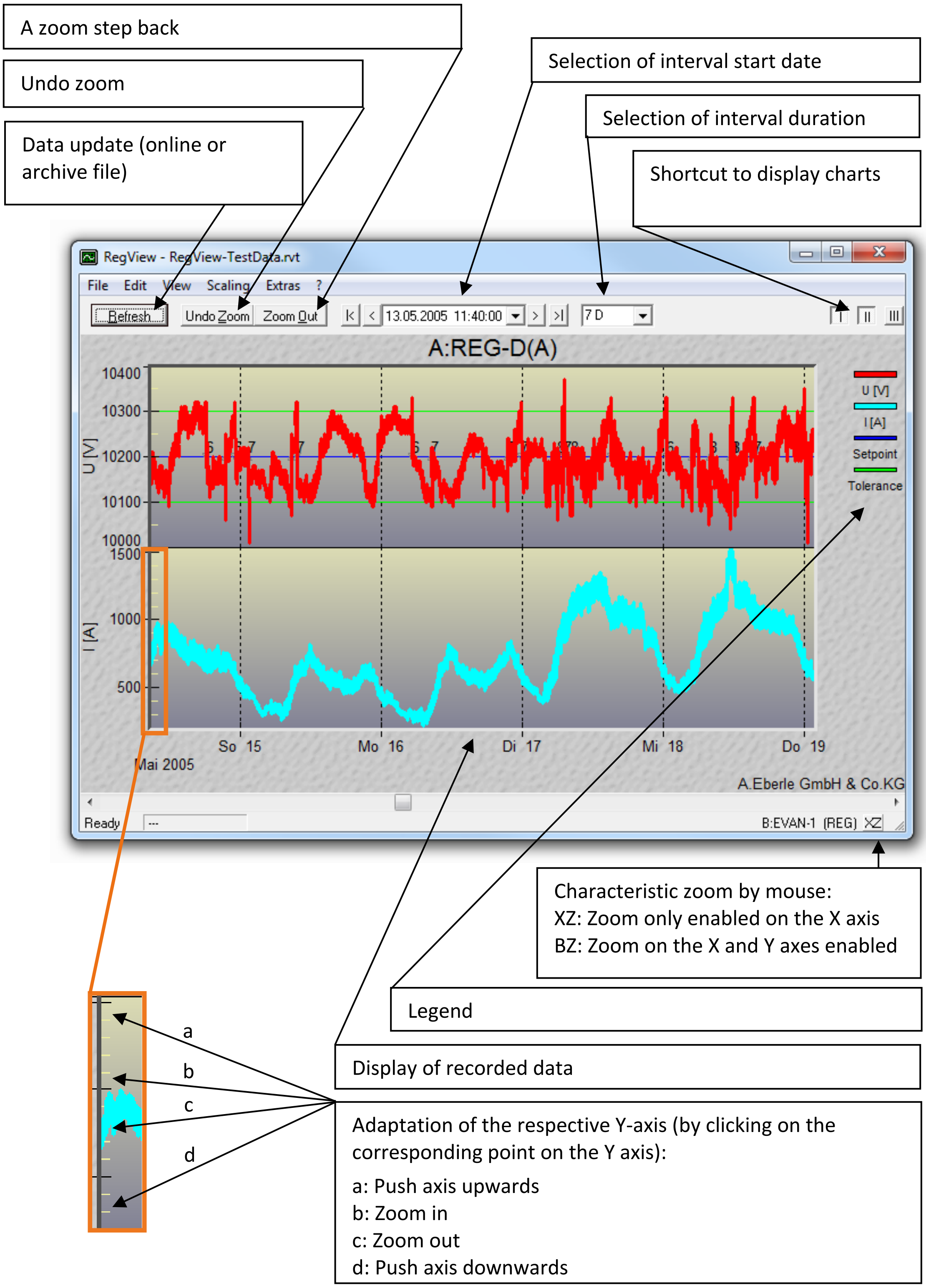
The following actions are also available via the Edit menu:

Menu item	Description
Compare	There are three modes available: The current parameter settings can be compared to a device, or also to an existing parameter file (*.prm). After the comparison, a related dialog appears in which the various parameters are listed with their respective values. H-Programs are not included in the comparison.
Additional Data	Here a printout heading and a comment for the current configuration can be entered. With the button "Insert ...", recently used printout headings / comments or templates can be attached. The "Additional data" dialog also appears the first time you save the current configuration, or with Save as.
Change Device Type	Device type, e.g. REG-D™ or PAN-D, can be changed here. Please note that all previously altered parameters may be irretrievably lost with change of device type. If necessary, save the current parameter settings before starting.
Convert	With the convert function, a set of parameters of a REG-D™ can be converted to a set of parameters of a REG-DA and vice versa. This results in changes, in particular, with regard to the available binary inputs/outputs and analog channels. To transfer a parameter set to a device, the device type of the parameter set must match the type of device.
Configuration	Using all parameters: In some devices (REG-DP(A)) parameters are subdivided into groups. When the function is activated, all parameters are sent, read or compared without prompting. If it is not checked off, for each read, write, or compare action you will receive a request regarding which groups should be used. By default, the parameter is set. Activate feature sending: This function allows you to send the features of the parameter file to a device. By default, the sending of features is not available. The function is password-protected.

REGPara help menu item

Further information about configuration is also available in the configuration help menu item.

9.9 REGView



REGView is used to view and analyse recorder data. These can either be accessed directly on the REG-D™ (online), or via data from an archive file of the Collector.

The following actions are also available in the File menu:

Menu item	Description
Open	Opens the RegView dialog to select the recorder data file.
with Refresh on Update	If you are at the end of a RegView file, a screen refresh is run automatically on updating this file (exception: not in zoom mode, nor with activated measuring bars). The option is enabled by default.
Online	The connected device is read using the refresh button.
Device selection …	If the menu item Online is enabled, the device to be read can be selected here.
Edit Connection List …	Opens the "Edit connections" dialog.
Data-Export	Opens the "Data export" dialog in which recorder data can be extracted.
Chart-Export	Opens the "Chart export" dialog in which the current display of RegView can be exported in various file formats.
Statistics …	Evaluates a specified period for Umax (with time stamp) / Umean / Umin (with time stamp) and tap statistics.
Print	Opens the Print dialog
Previous sessions	Up to five of the last opened REGView files can be opened using the shortcut.
Exit	Exits the software.

The following actions are available in the Edit menu:

Menu item	Description
Copy Chart	Copies the chart to the clipboard.
Copy Readings	Measurements can be applied with a double click on the RegView graph field. The values are shown below the heading. With the menu item, displayed measurements can be copied to the clipboard.
Remove Llast Reading	Remove the last measurement.
Remove All Readings	Remove all measurements.
Modify Last Reading	The time stamp of the last measurement can be adjusted.
Edit Current REGView File	Opens the current RegView recorder data file in the text editor.
Quick Setup …	Opens the "Quick setup" dialog to configure the curve display, the clipboard format and select whether the window size and position, and the skin settings are to be saved at end of program.
Chart Setup …	Under this menu item, the chart can be configured in detail.

The following actions are available via the View menu:

Menu item	Description
Curve Selection	Opens the "Quick setup" dialog
Tile Vertically	By default, this parameter is set active, the recorded channels are shown as individual superimposed graphs. If the parameter is deactivated, the recorded channels are plotted simultaneously in a graph.
Compress from 24h / 14days (DP) on	If the parameter is enabled, with a REG-D™ and a representation of >24h, or with a REG-DP and a representation of >14d, the data is shown compacted in order to optimize computing power. The compression can partially result in display problems. In this case, disable the parameter again.
Interval Start	Interval start time can be set in this menu item.
Interval Period …	A click on this menu item leads to selection of the interval duration on the RegView screen.
Box Zoom	If Box Zoom is enabled, a zoom in the X and Y axis directions can be carried out using the mouse. If Box Zoom is disabled, a zoom can only be carried out in the X axis using the mouse.
Undo Zoom	Zoom out of the interval
Zoom Out	A zoom step back
Zoom range → Full Range or Last Full Range	A zoom step back
Refresh	Reloads the recorder data file or the recorder data of the connected device.

The following actions are available via the Scaling menu:

Menu item	Description
Apply Knu, Kni	If the menu item is selected, recorded secondary data (e.g. on 100V normalized voltage) are multiplied by the regulator Knu for display, to indicate primary values.
U AUTO	Automatic scaling of the voltage graph
U +/-3%	Scaling of the voltage graph to U +/-3%
U +/-5%	Scaling of the voltage graph to U +/-5%
U +/-10%	Scaling of the voltage graph to U +/-10%
U +/-20%	Scaling of the voltage graph to U +/-20%
U Tolerance band	Scaling of the voltage graph to the tolerance band

The following actions are available in the Extras menu:

Menu item	Description
Start Collector	Starts the Collector program.
Edit Device Associations in REGView-LookUp.ini	Under this menu item, an INI file is created to set a title line, subtitle line and footer for all devices collectively and for each device individually.
Path Settings	Here the exact path settings of the recorder data files, etc. can be specified.
Recall Skin Settings	There are several pre-defined skin settings to choose from.
Store Skin Settings	Save current skin settings.

REGView help menu item

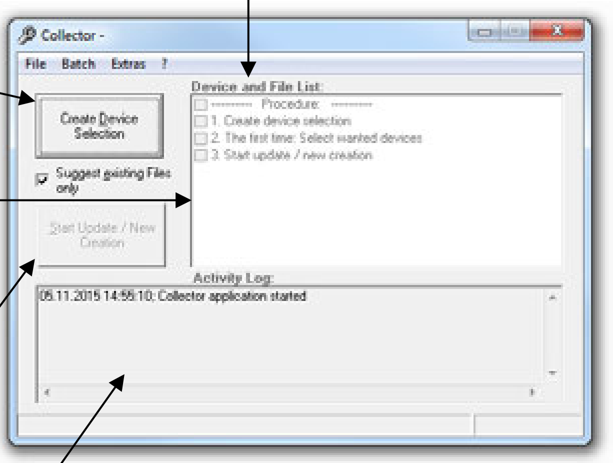
Further information about REGView is also available in the REGView help menu item.

9.10 Collector

The Collector reads the data from the Recorder function of the REG-D™ and archives them on the PC.

Create device selection:
E-LAN is searched for devices with a Recorder function.
(step 1)

Instructions on how to proceed if device selection has not been created.



Select the desired devices:
If "Suggest existing Files only" is selected, already selected Collector files are selected automatically.
(step 2)

Start Update / New Creation:
Starts downloading recorder data and adds them to an existing Collector file of a device, if necessary.
(step 3)

Activity log:
Please wait until recreation or update has been performed for all of the selected devices. (step 4)

Message: "File header does not correspond to actual device data"

The message "File header does not correspond to actual device data" may appear in step 3 of "Update / New Creation" in case of updating an existing Collector file. This message is generated when parameters, such as the voltage transformer factor Knu, have changed since the last update. In this case, it is advisable to create a new Collector file, as otherwise it may lead to incorrect calculation of primary values from the secondary values stored in the Collector file in the RegView software.

The following actions are availablevia the File menu:

Menu item	Description
Create Device Selection	E-LAN is searched for devices with a Recorder function.
Start Update / New Creation:	Starts downloading recorder data and adds them to an existing Collector file of a device, if necessary.
Device Selection + New Creation	E-LAN is searched for devices with a Recorder function. It starts after download of the recorder data.
Select Connection …	Starts the Select Connection dialog.
Close Connection …	Terminates the active connection.
Edit Connection List …	Starts the Edit Connections dialog.
Visualize highlighted File	Starts displaying the selected file in the RegView program part.
Edit highlighted File	Opens the selected file in the Editor.
Update highlighted File	Updates selected file.
Exit	Exits the software.

The following actions are available via the Batch menu:

Menu item	Description
Create/Execute Batch	Opens the "Collector Batch" dialog, in which a batch file can be created and run.
Execute Batch File …	An existing batch file can be selected to be executed.
Edit Batch File …	An existing batch file can be selected to be edited.
Execute Single Batch Command ...	Run batch command directly.
Alarms …	Opens the "Collector - Alarms" dialog, in which different alarms can be defined.
Cancel All Alarms ...	Deletes all alarms defined in the "Collector - Alarms" dialog.
Quick-Access Allocation	Batch files can be assigned to a key combination.
Abort Batch (ESC)	Cancels the currently running batch.

The following actions are available via the Extras menu:

Menu item	Description
Extended File Test ...	Opens a new window with the integrated, self-explanatory recorder file test and repair program.
with Device Time Sync	With this menu item, the time synchronization of the REGSys™ device time built-in as of V1.3.2 can be activated by the PC clock. Time synchronization takes place before updating/rereading.
with Complete File Test	With this menu item the file test built-in from V1.3.2 can be activated and deactivated. The file list will be executed after the update, each file line is checked for correctness (message box in case of error).
Precedure on Header Change	Four selection options: Do not overwrite, overwrite, ask (default), do not overwrite but update
With Additional REG-D(A)/PAN-D Logbook Update Of All Listed Devices	Device logbooks of REG-D™, REG-DA and PAN-D devices can be automatically saved/updated as of REG-D ™, REG-DA and PAN-D firmware V2.11. On the next update, the recorder data are read first and then the logbook data. For unticked devices, no recorder data are read, but the logbook is read.
View Logbook Of Highlighted Device	Opens the logbook of the selected device.
Optional Start Date …	If recorder data are first to be stored as of a certain date, the start date can be set with this menu item. This date is only considered on creating files!
Path Settings	From software version V1.4.0, the file name extension of ".txt" was changed to ".rvt" and already existing files are renamed accordingly on updating. In the "Extras\Path Settings" menu the extension can be manually changed to ".txt".
Log Events	Selection of events to be logged
View Log File	Opens the log file of the Collector.

Collector help menu item

Further information about the Collector is also available in the help menu item of the Collector.

9.11 WinTM/WinDM

The WinTM module (parameters for the transformer monitoring module) and the WinDM module (parameters for the transformer monitoring device without Relay for Voltage Control & Transformer Monitoring) complete the software package. These modules are not part of this user manual.

10. External components

10.1 Additional components REGSys™

In addition to the REG-D™, the voltage regulation system REGSys™ provides a wide range of components for expansion, monitoring, adaptation and a SCADA system connection. These components are presented in this chapter. Please note that each of these devices has its own user manual or datasheet and the details regarding these devices can be found in these sources.

10.1.1 I/O extension modules BIN-D & ANA-D

The interface components BIN-D (binary inputs and outputs) and ANA-D (analog inputs and outputs) serve to expand the inputs and outputs of the REG-D™. The modules are connected to the REG-D™ via the COM3 interface. Further information on physical connection can be found in chapter 7.1.4.7 COM3 interface from page 72 onwards. Use of the additional inputs and outputs by the REG-D™ is described in chapter 8.2.2 Binary inputs, from page 208 onwards and in chapter 8.2.5 Analog inputs and outputs, from page 221 onwards (Analog inputs and outputs).

BIN-D variants

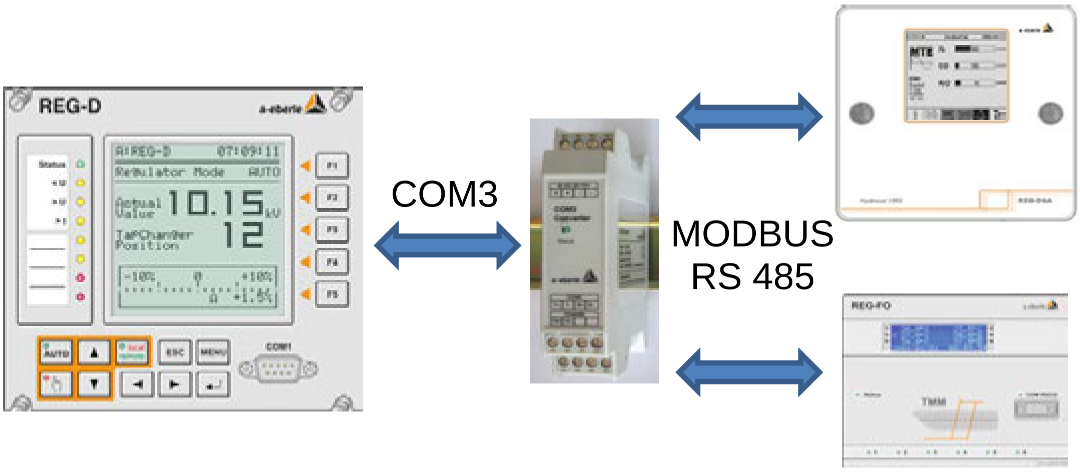
- 16 binary inputs (with or without LEDs)
- 8 relays (with or without LEDs)
- 16 LEDs

ANA-D variants

- 8 analog inputs (optionally also with LEDs)
- 8 analog outputs (optionally also with LEDs)

10.1.2 COM3/MODBUS converter

The COM3/MODBUS converter allows connection of MODBUS RTU compatible devices having RS485 interfaces to the COM3 interface of the REGSys™ devices REG-D™, REG-DA and PAN-D. This allows direct access to all the information made available to the device via MODBUS. This data can be processed and stored in the REG-D™ and passed on to the SCADA system.



Schematic representation of COM3/MODBUS communication.

10.1.3 Monitoring units

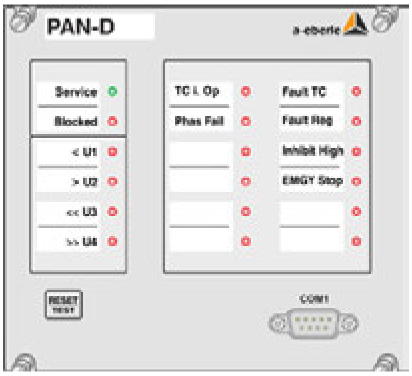
The monitoring units are used to monitor voltage and partly the function of the tap changer and the regulator. They constitute a monitoring unit for the voltage to be regulated that is independent of the Relay for Voltage Control & Transformer Monitoring. If the voltage leaves certain adjustable limits, tap commands are interrupted physically in the corresponding direction and messages are generated.

Moreover, PAN-D provides monitoring functions for the motor drive of the tap changer as well as the Relay for Voltage Control & Transformer Monitoring REG-D™.

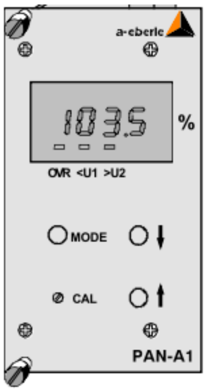
The PAN-D is based on the same platform as the Relay for Voltage Control & Transformer Monitoring REG-D™, and therefore provides the same options as regards configuration, programming and SCADA systems are concerned. Moreover, PAN-D offers the possibility of being configured via the REG-D™.

The PAN-A1 is the simplest of the monitoring modules and provides one-step monitoring of regulation voltage (specific limits for overvoltage and undervoltage). The settings are made locally on the device using keys. No configuration software is necessary.

In addition to the PAN-A1, the PAN-A2 offers two-stage monitoring of the regulation voltage and is configured using the software "PAN-A2 Control".



PAN-D



PAN-A1

PAN-A2

10.1.4 Tap position interfaces

The tap position interfaces have the task of adjusting tap position feedback of the motor drive of the tap changer to the inputs of the REG-D™. The modules partially also provide output of tap positions on potential-free contacts, and a tap position indicator. Depending on the module, this is available as a 19" plug-in module, with wall-mount and panel-mount versions.

Device	Description
REG-F	Implementation of contact row to BCD code, additional output of BCD-code to floating contacts
REG-F BCD	Display of BCD-coded tap position by means of a seven-segment display
REG-FA	Implementation of AWZ-code to BCD code, additional output of BCD-code to floating contacts
REG-FB	Implementation of contact row to BCD code, additional output of tap position as binary code to floating contacts
REG-FD	Passes on the message of the contact row of a tap changer with BCD-code to the voltage regulation system REGSys™. Parallel to this, the signal is available on floating contacts.
REG-FG	Implementation of Gray-code to BCD code, additional output of BCD-code to floating contacts
REG-FI	Implementation of mA-signals to BCD code, additional output of BCD-code to floating contacts
REG-FR	Implementation of resistance value to BCD code, additional output of BCD-code to floating contacts
REG-S	Implementation of contact row to BCD code
REG-SK1	Implementation of contact row to BCD code, compact design, for example, for use in a motor drive

10.1.5 Local/remote switch REG-LR

The local/remote interface REG-LR connects up/down tap signals from multiple sources to the tap changer of the transformer. A selector switch allows up/down input via a remote control device (remote), from the Relay for Voltage Control & Transformer Monitoring REG-D™ (AUTO), or locally (local).

In the "Remote" switch position the up/down control lines are OR-ed with those of the regulator and can influence the tap position of the transformer. In "AUTO" switch position only the signals from the REG-D™ are effective. In the "Local" position, the transformer control is operated with the rotary switch arranged on the front panel.

The up/down signals from the remote or the rotary switch are converted into pulses with adjustable minimum duration. Signals from the regulator are passed on directly.

Relay contacts pass the up/down setting signals and the operating status of the REG-LR (manual/automatic, local/remote, status) to the connected REG-D™ regulator and the reporting device. The REG-LR is available in different versions.

REG-LR with key switch

10.1.6 Miscellaneous

There are other modules that are used to adapt the regulation system to the customer's requirement.

Device	Description
REG-K	The binary interface REG-K extends the hardware resource of the voltage regulation system REGSys™ by raising the nominal insulation voltage of REG-D™ binary inputs and outputs to 250 VAC. The module REG-K is mainly used in older REG-D™ device applications whose binary inputs and outputs are not directly suitable for 250 VAC. In current devices this module is no longer necessary, in general.
REG-M	The module REG-M makes available a possibility of manual intervention in the process, in a selectable manner (with a general switch or key). Applications range from emergency stop keys to manual/automatic and up/down switches.
REG-U/BF	The switching interfaces REG-U and REG-BF expand the hardware resource of the digital voltage regulation system REGSys™. Switches and keys are provided to enable control functions.

10.2 SCADA system

The SCADA system connection of the REG-D™ is implemented via a telecontrol board module. This module can be installed internally or externally, depending on the protocol used, the resulting type of coupling module, and customer request.

Configuration of the telecontrol board module is carried out with the WinConfig software.

For questions regarding the SCADA system please contact the A. Eberle SCADA System Support under +49 (0)911/628108-104 or comms-support@a-eberle.de.

11. Retrofit of analog channels

Check the wiring

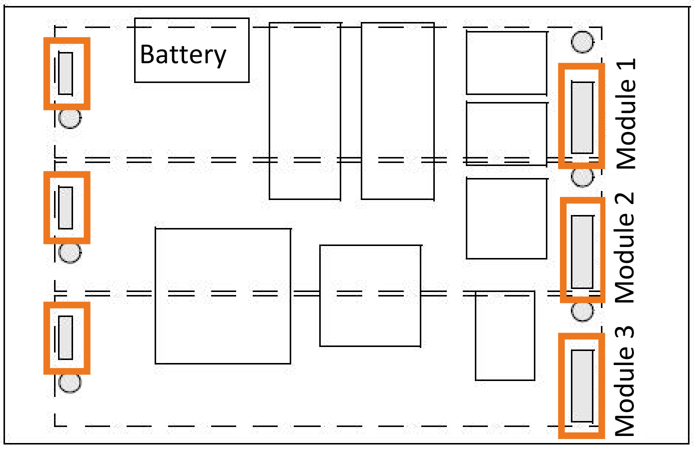
Please check first whether the housing/rack has the wiring for the analog channels. If this is not the case, a rewiring has to be done. It is recommended that this work be carried out at the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101). On the same occasion, retrofitting of the analog channels in the REG-D™ can also take place.

If the housing/rack already has wiring for analog channels, the analog channels can be upgraded based on the following description.

The REG-D™ has a total of three slots for analog modules.

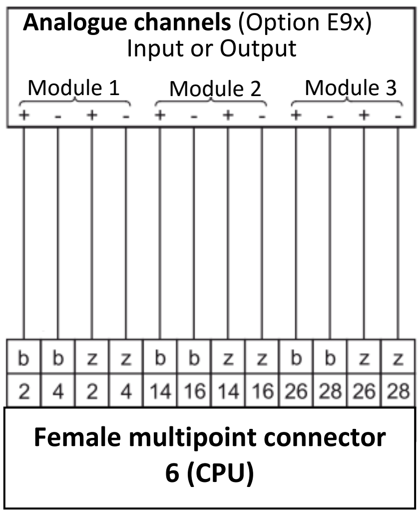
Numbering of the slots is always from top to bottom. That is, the first module (upper), is recognized by the firmware as channel 1 and 2. The middle slot accepts channels 3 and 4, and the lowest slot channels 5 and 6.

Location of analog slots on the REG-CPU processor board:



Front panel

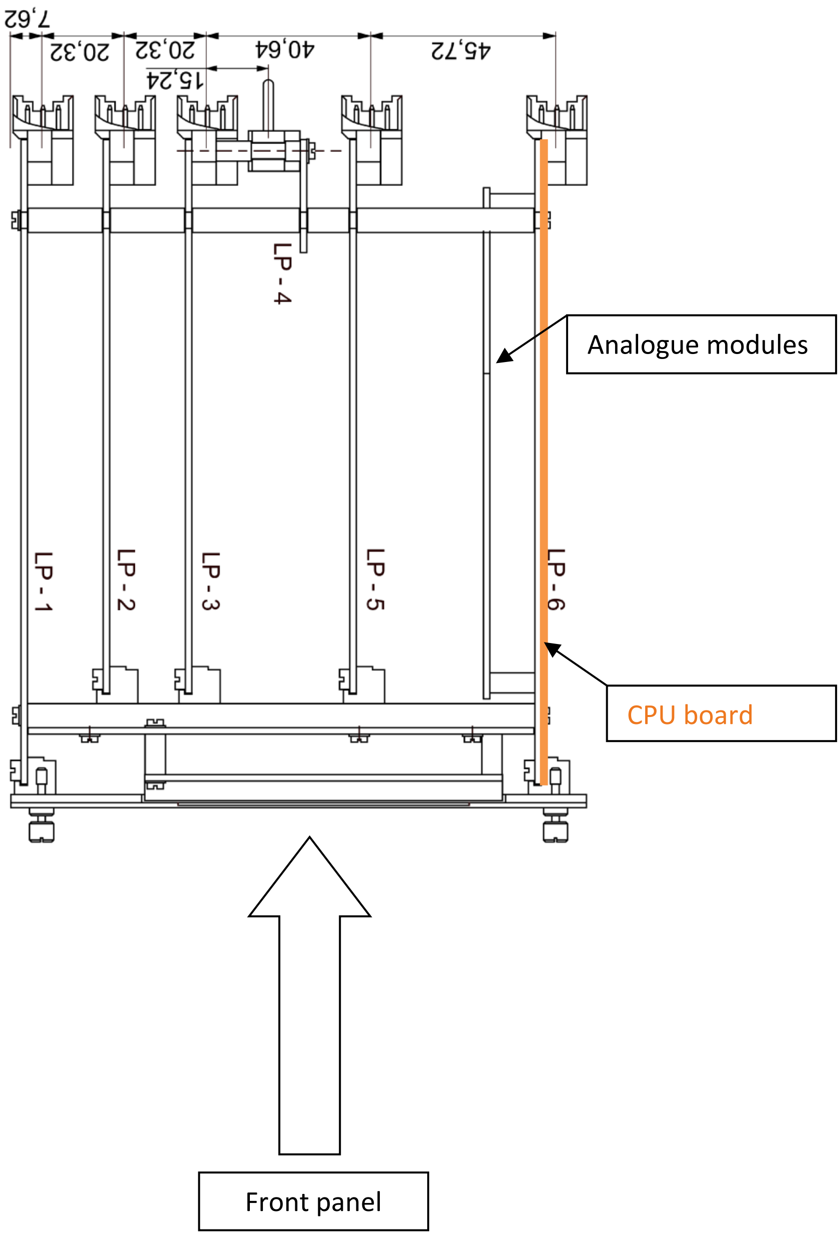
The red rectangles indicate the location of the connector between the CPU and the analog modules.



Module 1.1 - Channel 1
Module 1.2 - Channel 2
Module 2.1 - Channel 3
Module 2.2 - Channel 4
Module 3.1 - Channel 5
Module 3.2 - Channel 6

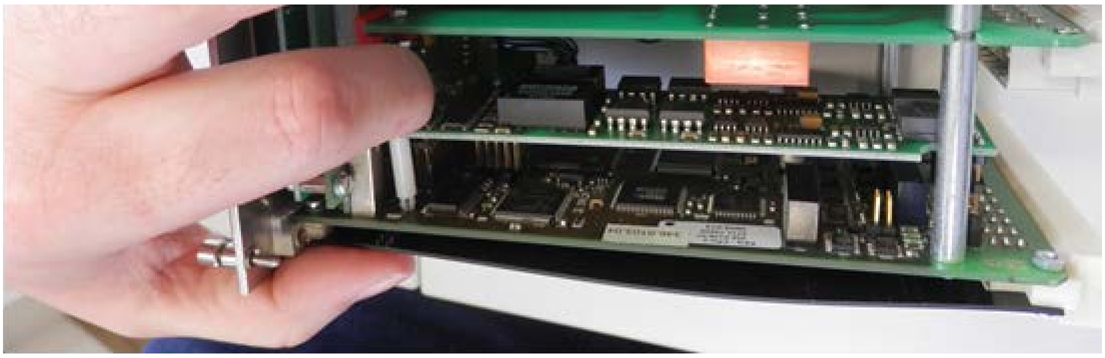
For retrofitting of analog modules it is necessary to remove the REG-D™ from the housing (see chapter 7.1.2.2 REG-D™ , from page 51 onwards). To do so, loosen the four retaining screws and pull the REG-D™ out with aid of the removal tool. Now place the REG-D™ in front of you on a work surface. To ensure correct channel assignment of the analog channels, insert the REG-D™ in the correct direction on the pad. That is, so you can read the indicator plates. The individual printed circuit boards are then placed vertically.

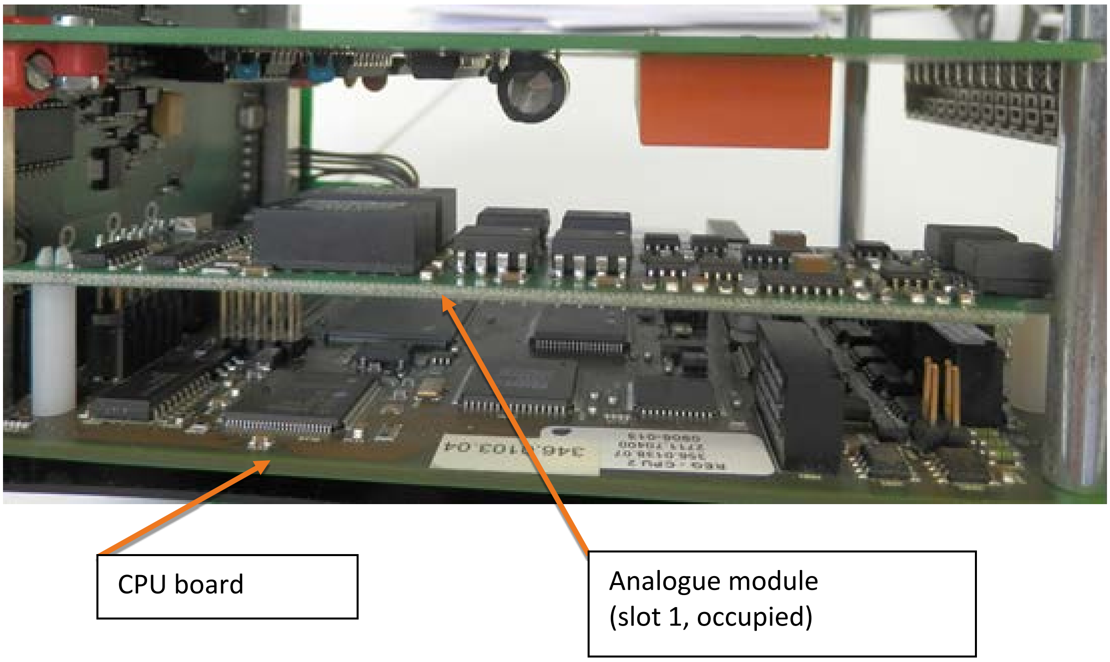
The analog modules are plugged on the CPU board, which is located on the far right as seen from the front over the display.



The analog modules themselves are plugged into the corresponding socket on the CPU board. Please ensure correct placement of all connectors.

In addition to the connectors, the modules are also connected to the CPU board with two pluggable plastic spacers. Please also note correct placement here.





After plugging the analog modules, the REG-D™ can be reinserted into the housing (see chapter 7.1.2.2 REG-D™ , from page 51 onwards).

The analog channels are automatically detected by the firmware after you restart the device, and can then be configured via the menu "Setup -6-\General\Analog..", or the configuration software WinREG.

Please note that the analog channels can only be used directly as of firmware version 2.00. With older firmware versions, a background program is necessary.

For questions regarding this matter, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

12. Maintenance/Cleaning

12.1 Cleaning instructions

Use a soft, slightly damp and lint-free cloth. Make sure no liquid gets in the housing. Do not use window cleaner, household cleaners, sprays, dissolvent, cleaners that contain alcohol, ammonia solutions or abrasive cleaning agents.

If the inside is very dirty due to improper use, it is recommended that the device be returned to the manufacturer. Indeed, if a lot of dust has accumulated on the printed circuit board, this may lead to insulation coordination failure.

Dust is generally hygroscopic and can bridge creepage distances. For this reason, if the device has a housing cover, it is recommended that it be operated with this closed.

NOTICE!	**Do not clean the device with unsuitable products!** This can damage the surface of the device and remove markings ➲ Please follow the cleaning instructions above.

12.2 Fuse replacement

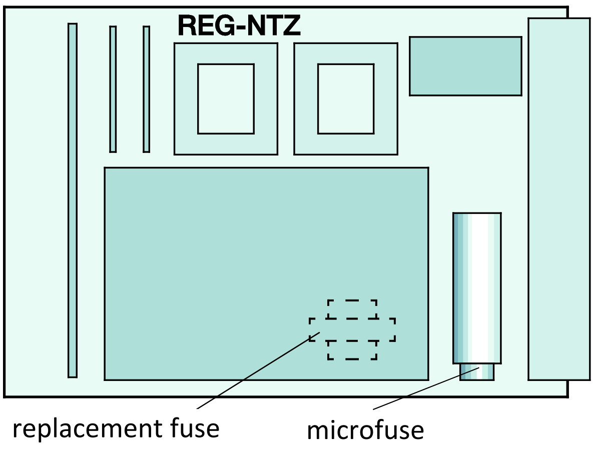
The REG-D™ has a replaceable microfuse (size 20 mm). This is fitted to the printed circuit board 3 (power supply board, REG-NTZ) with an appropriate fuse holder. There is a replacement fuse on the back of printed circuit board 3.

Required fuse

Auxiliary voltage, feature H0/H1: Microfuse T1 L 250 V, 1 A (order No. 582.1002)

Auxiliary voltage, feature H2: Microfuse T2 L 250 V, 2 A (order No. 582.1019)

DANGER!	**Danger of electric shock!**
	Injury or death
	➲ When replacing the fuse, disconnect the device from all power supplies (auxiliary voltage, control voltages).



12.3 Battery replacement

In REG-D™ three variants of buffer batteries are used. Depending on the version and year of manufacture of the device, the batteries are used for different purposes (see case in this chapter). If the device is supplied with auxiliary voltage, the battery is not actively used. The battery serves as a back-up, in the event of auxiliary voltage failure.

In general, the battery voltage is monitored and an alarm (status relay or status/operation LED) or message (output function for weak batteries with firmware version 2.24/3.24 or later (devices with characteristic S2)) is issued if the battery has low remaining capacity. This means that regular replacement of the battery is not necessary. Battery replacement may also be event-based.

The delivery time-frames below are approximate. Due to repairs, for example, old devices can require a new CPU circuit board. Please check the battery type in the device.

Regardless of the type of battery incorporated, in the event of a battery failure, the parameters should be saved as soon as possible, and always before the device is separated from the supply voltage. In devices fitted with MRAM, this is not necessary, but it is possible. Further notes on saving and restoring parameters are to be found in chapter 7.2.6 RAM-Backup, from page 117 onwards, or in the document "Backup and restore parameters of REG-D(A) via Bootloader V02.pdf". Alternatively, parameters can be backed up with the WinREG software (see chapter 9.7 Service, page 305).

⚠ DANGER!	**Danger of electric shock!**
	Injury or death
	➲ When replacing the battery, disconnect the device from all power supplies (auxiliary voltage, control voltages).

To replace the battery, first remove the plastic protective cover on the CPU board. Loosen the four screws and remove the cover. Once the battery has been changed, put the cover back on.

REG-D™ devices with MRAM (devices with the feature S2 from 09/2013, all others from 05/2014)

These devices have a button cell battery to buffer the real-time clock. This means that no data are lost when the battery is removed. The time may have to be adjusted when the new battery is installed.

Required battery:

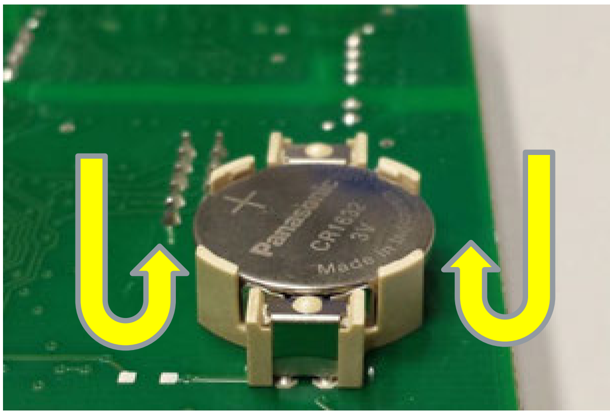
Lithium button cell 3 V Type CR1632 (order no. 570.0005)

Service life:

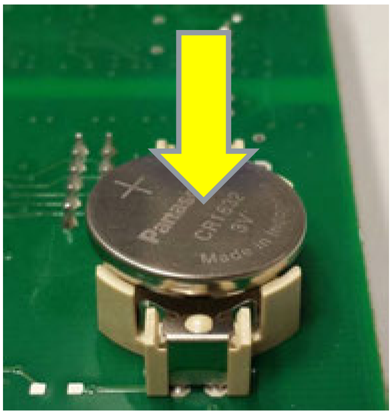
when the REG-D™ is in storage (no auxiliary voltage)	> 6 years
in duty cycle operation > 50%	> 6 years

The battery is installed on the outside of the CPU board in a suitable mount. To replace the battery, remove the existing battery from the mount and insert a new one. If you use tools to remove the battery, be careful not to damage the printed circuit board.

NOTICE!	**Do not use pointed or sharp tools to remove the button cell!** Avoid damage to the CPU circuit board ➲ Remove the button cell with your fingers and not with a tool. ➲ If you have to use a tool, do not use a screwdriver or similar pointed or sharp object.



Remove the button cell



Insert the button cell

REG-D™ devices with SDRAM and plug-in batteries (feature S0 /S1 from 05/2009)

In these devices, the battery acts as a buffer for the SDRAM and the real-time clock. Parameters are lost when the battery is removed. The devices therefore have a dual connection for the buffer battery. This means that the new battery can be connected before the used one is removed.

For safety reasons, it is recommended to make a backup of the parameters for these devices.

Required battery:

Lithium 3V or 3.6V Type CR14250 1/2AA with cable and connector (order no. 570.0003.00)

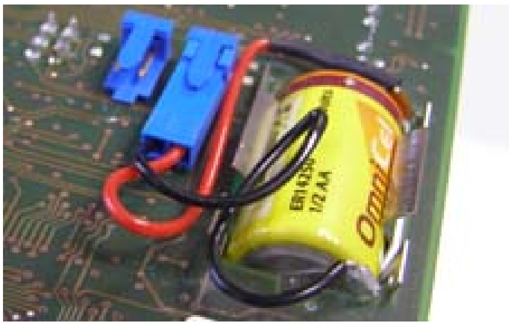
Service life:

when the REG-D™ is in storage (no auxiliary voltage)	> 6 years
in duty cycle operation > 50%	> 10 years

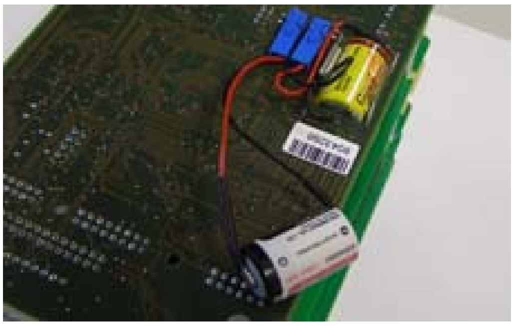
Parameters are lost on removal of the battery!

- Connect the new battery before removing the used one.
- Before replacing the battery, make a backup of the parameters (see chapter 7.2.6 RAM-Backup, from page 117 onwards).

There are two battery connection points on the reverse side of the circuit board. To prevent any loss of parameters in the interim, you can place the replacement battery in the empty connection position. Take out the battery that needs to be replaced and remove carefully from the metal cover. Then you can push the new battery into the metal cover.



Connection positions and metal cover on the outside of the printed circuit board



Parallel arranged batteries

REG-D™ devices with SDRAM and soldering battery (feature S0/S1 before 05/2009 and feature S2 before 09/2013)

In these devices, the battery acts as a buffer for the SDRAM and the real-time clock. Parameters are lost when the battery is removed.

Therefore, before replacing the battery in these devices, a backup of the parameters must be made.

Parameters are lost on removal of the battery!

- ➲ Connect the new battery before removing the used one.
- ➲ Before replacing the battery, make a backup of the parameters (see chapter 7.2.6 RAM-Backup, from page 117 onwards).

Required battery:

Lithium 3V or 3.6V Type CR14250 1/2AA with soldering lugs (order no. 570.0001)

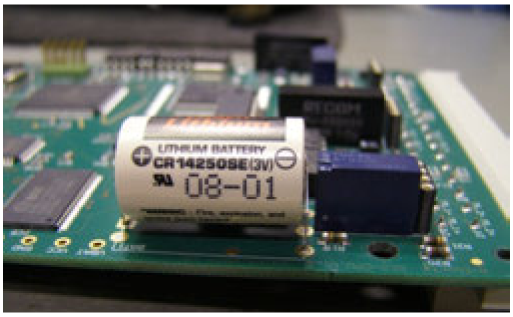
Service life:

when the REG-D™ is in storage (no auxiliary voltage)	> 6 years
in duty cycle operation > 50%	> 10 years

NOTICE!	**Mechanical/thermal damage to the CPU circuit board!** Destruction of the conductor paths and/or the soldering pads ➲ It is recommended to have the battery changed in the factory. ➲ If the battery has to be replaced on-site, this must only be done by trained and qualified personnel, and in compliance with EMC Directives.

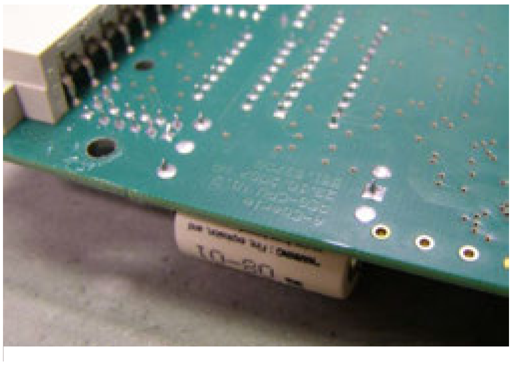
The following describes in detail how to replace a soldered battery with three soldering lugs with a battery with two soldering lugs. When using a soldering iron, it is imperative to comply with general safety rules. Ensure the work is carried out with the utmost care and by trained personnel only.

CPU circuit board with soldering battery – plan view

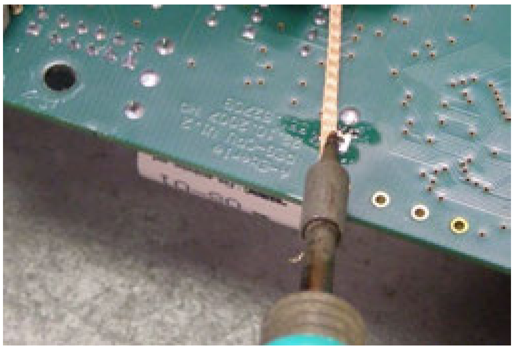


Soldering battery with three soldering lugs

Turn the device so that the three soldering joints are in front of you. Unsolder the three soldering pins on the battery using a soldering iron. We recommend using unsoldering tape to remove the solder from the pins. Often, a little bit of tin solder on the top side of the suction tape helps to suck up the tin solder from the soldering joint. It is not advised to use a unsoldering suction pump as it can damage the soldering pads on the circuit board.

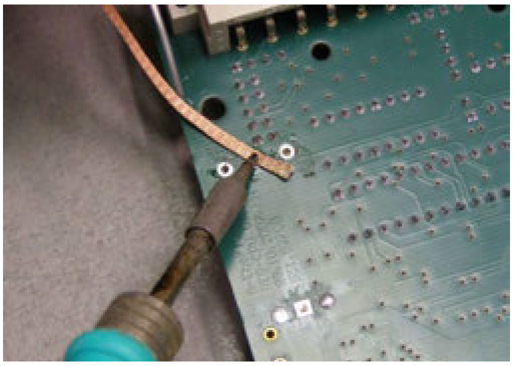


The soldering battery's soldering joints with three soldering lugs

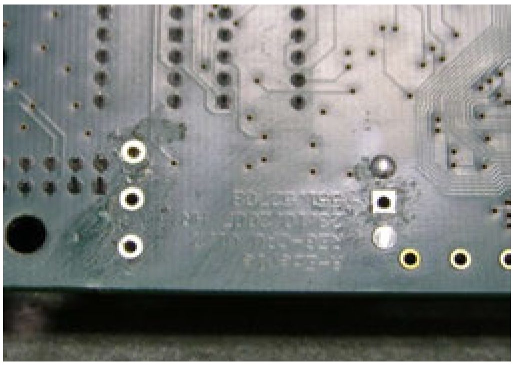


Unsoldering with unsoldering tape

To unsolder a soldered battery with two soldering lugs, the middle soldering point, which is between the two soldering lugs which have already been unsoldered, must be freed from solder. Before inserting the battery with two soldering lugs, the middle of the three soldering pads on both the right and left side must be free of tin solder.

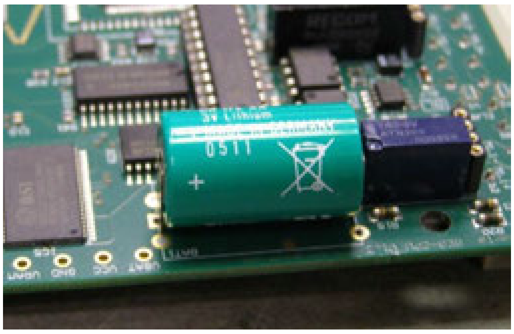


Unsoldering the missing soldering pads for soldering batteries with two soldering lugs

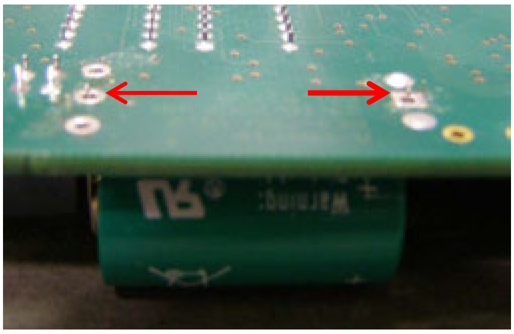


Soldering joints prepared for soldering battery with two soldering lugs

Put the battery with two soldering lugs on the top side, in the central soldering pads, and ensure that the polarity of the battery is correct. On the underside of the CPU circuit board, the soldering pins must stand out from the middle of both soldering pads.

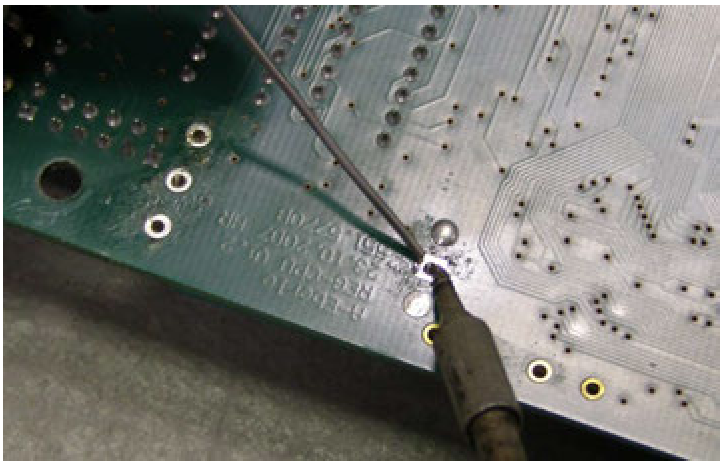


Soldered battery with two soldering lugs – Check the polarity of the battery!



Inserted soldered battery with two soldering lugs

Solder the pins of the batteries again with the circuit board and check that the battery is properly supported. Finally, secure the plastic cover back in place on the CPU circuit board.



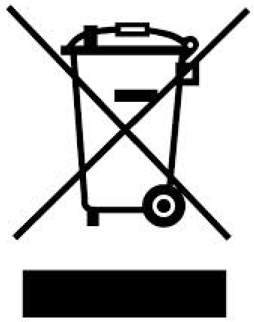
Soldering the soldering battery with two soldering lugs

13. Standards and laws

- IEC 61010-1 / EN 61010-1
- CAN/CSA C22.2 No. 1010.1-92
- IEC 60255-22-1 / EN 60255-22-1
- IEC 61326-1 / EN 61326-1
- IEC 60529 / EN 60529
- IEC 60068-1 / EN 60068-1
- IEC 60688 / EN 60688
- IEC 61000-6-2 / EN 61000-6-2
- IEC 61000-6-4 / EN 61000-6-4
- IEC 61000-6-5 / EN 61000-6-5 (in preparation)

14. Disposal

Disposal note for EU member states



To preserve and protect the environment, prevent pollution, and improve the recycling of raw materials, the European Commission issued a directive according to which manufacturers take back electrical and electronic devices so they can be properly disposed of or recycled.

The devices with this symbol are not allowed to be disposed along with normal solid household within the European Union.

Special note for customers in Germany

The electronic devices manufactured by A. Eberle are intended for commercial use. These devices may not be disposed of at municipal recycling centres for electrical devices, but are taken back by A. Eberle.

If you have question, please contact us by phone or email:

+49(0)911-628 108-0

info@a-eberle.de

If the device is not operated within the European Union, the national waste-disposal regulations in the respective country must be respected.

15. Product warranty

The warranty period is three years starting from the delivery date.

16. Storage

The devices and related spare components must be stored in rooms that are dry and clean.

For storage of the device or its replacement modules, the temperature range -25°C to +65°C applies.

The relative humidity may not result in the creation of condensation or ice.

It is recommended to limit the storage temperature to a range of from -10°C and +55°C to prevent the electrolytic capacitors from ageing prematurely.

It is also recommended to connect the device to the auxiliary voltage every two years to condition the electrolytic capacitors. This should also be done before the device is put in service. In extreme climatic conditions (in the tropics), this also "preheats" the device and prevents condensation.

Before voltage is applied to the device for the first time, it should be left in the operating location for at least two hours to equalise the temperature difference and thus prevent humidity and condensation.

17. Troubleshooting

17.1 General

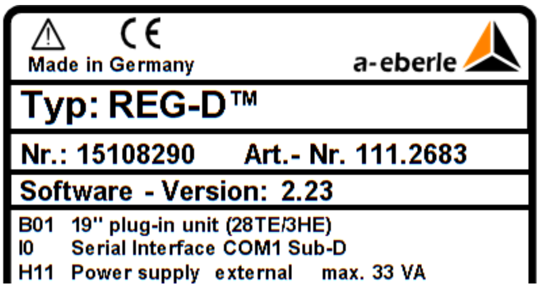
In this chapter frequently occurring problems and their solutions are discussed. For further assistance, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101). The support team often requires the regulator's parameter file in order to analyse a problem; this can be read out with REGPara (part of WinREG). Processes can also be very satisfactorily traced with the help of the logbook, which can be saved with the service (also part of WinREG).

To help us process your request for support as quickly as possible, please send us the parameters and logbook along with it.

⚠ DANGER!	**When troubleshooting electrical installations, you may be exposed to the following hazards:**
	▶ **electric shock**
	▶ **fire**
	▶ **electric arcs, etc.**
	➲ When troubleshooting, observe the relevant safety regulations

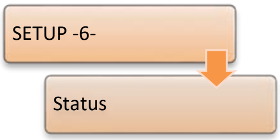
Serial number/design specification?

Where can I find the serial number and design specification for my Relay for Voltage Control & Transformer Monitoring system/ Relay for Voltage Control & Transformer Monitoring?



All the components of Relay for Voltage Control & Transformer Monitoring systems have type labels. "Nr.:" refers to the serial number and "Art-Nr." to the design specification or part number of the Relay for Voltage Control & Transformer Monitoring system/Relay for Voltage Control & Transformer Monitoring.

The status LED of the REG-D™ is off



- This may be the REG-D™ Relay for Voltage Control & Transformer Monitoring's battery warning. In the REG-D™ status menu, the battery status has changed from "OK" to "Error".

  When the warning first appears, the battery voltage is still sufficient to store the parameters of the REG-D™ in the main memory in the event of a supply voltage failure. To prevent losing the parameters, please back them up using the WinREG software, or perform a RAM-Backup using bootloader V2.12 or later, (see also chapter 7.2.6 RAM-Backup, from page 117 onwards).
  It is recommended that the battery be replaced at the A. Eberle head office.
- The Relay for Voltage Control & Transformer Monitoring REG-D™ may have an internal fault (watchdog).
  For questions regarding this matter, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

Must REG-D™ and PAN-D have the same firmware versions?

- Yes, the REG-D™ and PAN-D firmware versions must match one another. For both systems to function properly, the same firmware must be used.

Can I update REG-D™ Relays for Voltage Control & Transformer Monitoring with more recent firmware?

- Yes, firmware upgrades can be installed on all REG-D™ Relays for Voltage Control & Transformer Monitoring. Please refer to the "**Important notes after an upgrade or downgrade of REG-D™ firmware**" in chapter 7.2.1 Update bootloader and firmware, from page 74 onwards.

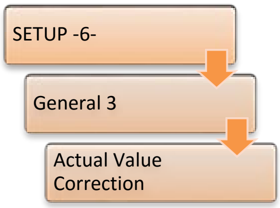
The REG-D™ does not always behave as expected or as described in the operating instructions

- Please check the software features that have been configured for the regulator. For example, the software features "SysCtrl" and "SysCtrl2" can significantly affect its behavior. For more information about the various features, please refer to chapter 8.3 Features (software), from page 230 onwards.
- The behavior of the REG-D™ Relay for Voltage Control & Transformer Monitoring can be modified via customer-specific programming (background programs). Please use the WinREG software to check whether a background program is available on the regulator (REG-L tab in the REGPara program segment). The name of the background program and corresponding design specifications are listed in program line H00. The background program, and a readme file describing its function, are available on the CD supplied.

17.2 Measurement

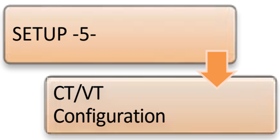
The measured voltages/currents are incorrect

- If there is no measurement voltage or measurement current, please check the wiring for any open disconnect terminals or any short circuit terminals.
- In the case of incorrect measuring voltage or measuring current readings, please check the parameters in the "CT/VT-Configuration" menu. The selected assignment for current and voltage measurement must correspond to the actual voltages and currents connected.



- Even if the transducer is correctly adjusted, impedance on the power supply lines for the measuring voltage or measuring current can lead to variations in the measured quantities recorded. In order to compensate for such variations, the measuring voltages or measuring currents can be proportionally adjusted via the menu item "Actual Value Correction".

The calculated power values are incorrect.

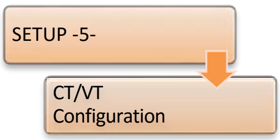


- In the case of incorrect power values, please check the parameters in the "CT/VT-Configuration" menu.

- If a "Left rotary field" is present, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

The sign of the active power does not match the display in a protection device or bay controller.

- Please note the A. Eberle sign definition (see chapter 7.2.3 Parallel operation, page 105)

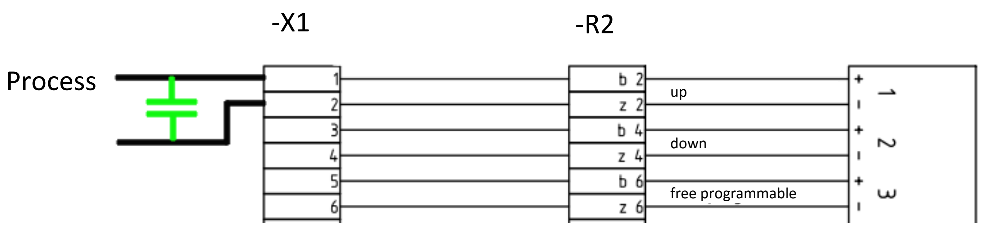


- Check the polarities of the voltage transformer and current transformer, as well as the inversion parameter of the transducer voltage or current on page 2 of the "CT/VT-Configuration" menu. You can access page 2 of the menu with the left or right arrow keys.

17.3 Process signals (e.g. binary signals)

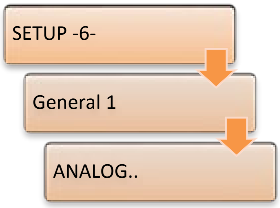
A signal is detected at the REG-D™ binary input, even though there is no wanted signal from the process side.

- This is probably caused by voltage being induced in the binary signal's power supply line. In order to minimise this induced voltage, and thus prevent the binary input from responding as a result, a 220 nF capacitor (630 V, polarity-independent, e.g. film capacitor, not an electrolytic capacitor) can be connected in parallel to the binary input terminals. This measure can be used when the wanted signal is a DC signal.

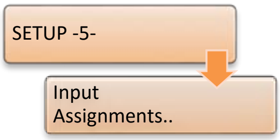


Moreover, input cards with different response thresholds are available for the REG-D™. The highest possible response threshold is recommended. This means that if, for example, an auxiliary voltage of 110 VDC is used, binary inputs with a response threshold of 80 V should be chosen.

The message "Duplicate Assignment" appears in the analog channels menu after allocation of the analog function "70:iTapPos".



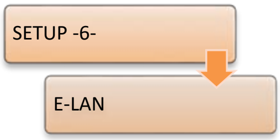
- With new devices, certain binary inputs may already be configured with the input functions for BCD-code by default. If an mA-signal is provided to the regulator for tap-position indication, the analog function "70:iTapPos" must be assigned to the corresponding analog channel. For this, all of the BCD-functions in the "Input assignment" menu must be deleted in order to avoid a duplicate assignment. (Duplicate assignment will also come about if the analog function "70:iTapPos" is simultaneously assigned to two analog channels.)



- If the tap-change position is determined by measuring the resistance, it is also necessary to delete the BCD-functions in the "Input assignment" menu. For details on setting a resistor module see chapter 7.2.2.6 Input/Output signals, from page 99 onwards.

17.4 E-LAN

No communication between two or more devices connected via E-LAN



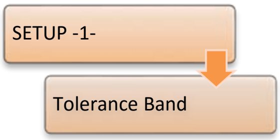
- Please check the communication line for damage and ensure that it is properly connected (no open terminals).
- If the E-LAN communication line has a ring topology, it must be opened at one point, since ring topologies are not supported with E-LAN. For example, the ring can be opened between two physically connected E-LAN interfaces by configuring different baudrates. However, physical separation (disconnect terminals) is preferable.
- If the devices in E-LAN do not have a unique identifier, i.e., several devices have the same ID (e.g. "A:"), communication via E-LAN is not possible. Please also note that PAN-Ds assigned to a REG-D™ are automatically assigned an ID. This is always one higher than the ID of the REG-D™, for example, "B1:" if the code for the associated REG-D™ is "B:".
- Please check the baudrate setting of all involved E-LAN interfaces. The baudrate within a direct E-LAN connection or within an E-LAN bus must always be the same.
- Moreover, the settings for two- or four-wire operation within a direct E-LAN connection or within an E-LAN bus must correspond.
- If a two-wire connection is used, please check the termination resistors of all the E-LAN interfaces. For more information on proper termination, see chapter 7.1.4.6 E-LAN from page 67 onwards.
- If an FOC/RS485 converter is used, four-wire technology must be implemented for the connection.

The PAN-D does not appear in "Setup -6-" of the REG-D™

- Please check the physical E-LAN connection between PAN-D and REG-D™. For a PAN-D to be assigned to an unambiguous REG-D™, the left E-LAN interface of the REG-D™ must always be exclusively connected to the right E-LAN interface of the PAN-D (no bus topology, no other terminals).

17.5 Regulation in general

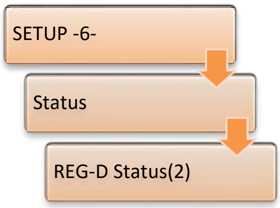
The tap-changer moves back and forth



- If the permissible setpoint deviation is set too low, the tap changer may oscillate, because the tolerance band is completely skipped by a single tap change. Please compare with chapter 7.2.2.4 Regulation (permissible setpoint deviation Xw_Z), from page 93 onwards.

In automatic mode, the tap-changer is off-scale; the voltage is further and further away from the setpoint value.

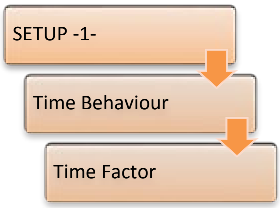
- The wiring of the regulator's up/down relay is reversed. As a result, the tap-change commands are always in the wrong direction.



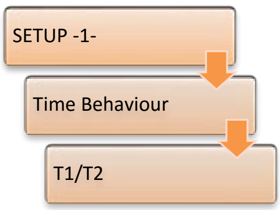
- The "Invers" feature is equal to 2, whereby the software reverses the up/down relays. The wiring must be adjusted to the set feature Invers=2 (see chapter 8.3.13 Feature Invers, from page 268 onwards).

The tap-changer carries out too many tap changes

- The permissible setpoint deviation may be set too low for this particular application. In particular, in the case of regularly high load variations (e.g. steel works), the permissible setpoint deviation can be increased to reduce the number of tap changes. The limit of the permissible setpoint deviation constitutes the tolerable voltage fluctuations for specific applications.

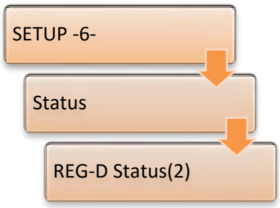


- One of the time programs "Integral", "Fast Integral" or "Linear" is used and the time factor parameter is set too low. Even brief violations of the permissible setpoint deviation result in a switching process.



- The time program "Const" is used and parameters T1/T2 of the "Const" time program are set too low. Even brief violations of the permissible setpoint deviation result in a switching process.

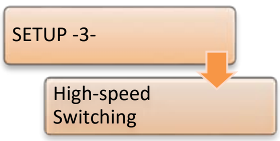
After a higher or lower tap-change in automatic operating mode, the regulator switches to manual mode



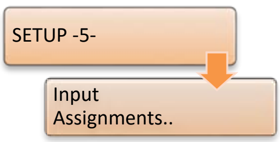
- If the tap position is activated in the REG-D™, after a tap change, the regulator checks whether the new tap matches the expected tap. If this is not the case, a tap-change error is generated, also see chapter 8.2.7.5 Tap change error (TapErr), from page 228 onwards). In connection with a set bit 7 of the software feature "SysCtrl" (see chapter 8.3.20 Feature SYSCTRL, from page 276 onwards), the regulator switches to manual mode. Please also see the Invers feature in this connection (see chapter 8.3.13 Feature Invers, from page 268 onwards).

- If the regulator is in an active parallel program and a parallel error (ParErr, also see chapter 8.2.7.7 Parallel operation error (ParErr), page 229) is generated, the regulator switches into manual mode if bit 6 of the software feature SysCtrl is set (see chapter 8.3.20 Feature SYSCTRL, from page 276 onwards).

In auto mode, high-speed switching is always activated

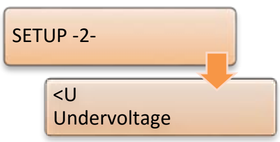


- Please check the set values of the forward and backward high-speed switching parameters. Pay particular attention to the sign for the forward high-speed switching, which should normally be negative. Between forward high-speed switching (e.g. -10%) and backwards high-speed switching (e.g. +10%), there must be a voltage range (percentual) in which high-speed switching is deactivated.



- Please check whether a binary input with the function "25:Quick" is in use and whether this input is active in auto mode. If this input is active, and the regulator in auto mode, it will be forced into high-speed switching mode.

The regulator emits no down tap command in auto mode and the message <U is activated



- The undervoltage threshold is above the current measurement voltage. This can happen, for example, if the limit value for <U was set without a minus sign (e.g. +5% instead of -5%). When the <U limit is reached, down commands are blocked.

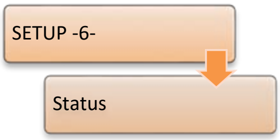
A current program, gradients (except LDC) and limitation have been configured to influence the current-dependent setpoint value. The setpoint value changes, but not in accordance with the current applied.

SETUP -2- → Limitation (I)

- Please check the signs for the minimum and maximum limitation parameters. In particular, the minimum limitation parameter should be given a negative sign.

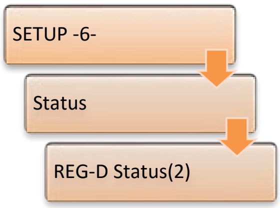
17.6 Parallel operation

Must the REG-D™ have the same firmware version for parallel operation?

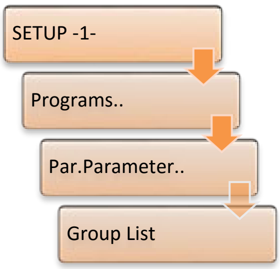


– Yes, several REG-D™ operating in parallel must have the same firmware version in order to ensure proper communication between the devices with regard to the parallel programs.

Group switching of manual/automatic mode is not possible in Master-Follower parallel operation.

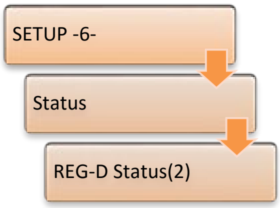


– A set bit 0 of the SysCtrl2 feature ensures that group switching of manual/automatic mode is terminated in master-follower parallel mode. Please check whether the feature bit is set for the appropriate regulator (also see chapter 8.3.21 Feature SYSCTRL2, from page 278 onwards).



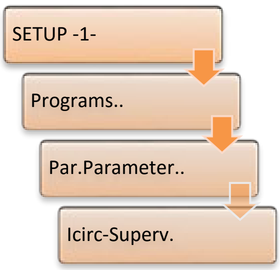
– No group list or an incorrect group list is configured in the slave regulator. In general, the group list must be set the same in **all** of the regulators involved in parallel operation.

In Master-Follower parallel operation, the transformers diverge in follower mode (in the event of a tap difference).



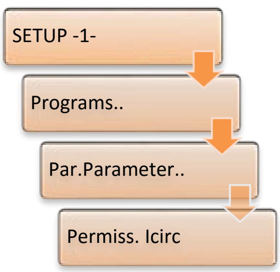
– This is possibly due to transformers behaving inversely but without the "Invers" feature having been set. During normal operation, the master regulates voltage, the slave is adjusted accordingly, and there is no tap-change divergence in the transformers since an up command results in a higher voltage and a down command in a lower voltage. However, if there is a tap difference between master and slave, the slave goes into follower mode and now carries out tap changes according to the tap difference (and not the voltage!). Without the "Invers" feature being set, the follower now always carries out tap changes in the wrong direction, because it assumes that an up command also involves a Up tap change and a down command involves a Down tap change.
Please check if one of the transformers involved is inverted and whether or not the "Invers" feature is set (also see chapter 8.3.13 Feature Invers, page 268). Transformers also diverge when the inverted feature is mistakenly set for a non-inverted transformer.

In Master-Follower parallel operation, ParErr is triggered without a tap difference having occurred.

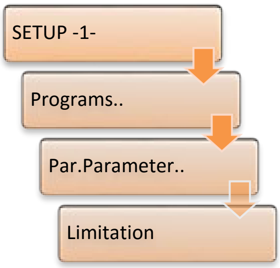


– In addition to the tap difference, the master-follower parallel program monitors circulating reactive current via Icirc-Supervision. If the Icirc limit is exceeded, the parallel error ParErr is generated. (also see chapter 8.2.7.7 Parallel operation error (ParErr), page 229)

The circulating reactive current minimisation programs (dIsin(φ), dIsin(φ)[S], dcos(φ)) do not work (no influence on regulation).

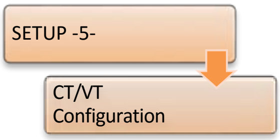


– The default value of the regulation influence for the circulating reactive current minimisation programs dIsin(φ), dIsin(φ)[S] and dcos(φ) is 9999 A. With this default value, the parallel programs have virtually no impact on regulation. Details for determining the parameter Permiss. Icirc can be found in chapter 7.2.3 Parallel operation, from page 105 onwards.



– The limitation parameter of the relevant reactive current minimisation program, whose default setting is 20, is configured to 0. By doing this, the programs dIsin(φ), dIsin(φ)[S] and dcos(φ) have no influence on regulation.

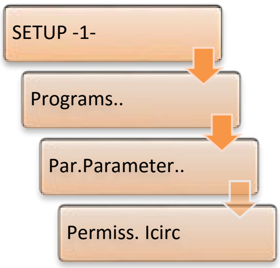
The transformers diverge when a reactive current minimisation program (dIsin(φ), dIsin(φ)[S], dcos(φ)) is used.



– Please check the wiring of the voltage and current detection units (chapter 7.1.4.5 Process, page 66), and the transducer settings (see chapter 7.2.2.2 Taking , page 86), and sign definitions (see chapter 7.2.3 Parallel operation, from page 105 onwards) of the Relay for Voltage Control & Transformer Monitoring REG-D™. A divergence of the transformers in the circulating reactive current minimization programs dIsin(φ), dIsin(φ)[S] and dcos(φ) suggests that the calculation of the circulating reactive current is faulty due to wiring or configuration.

The transformers operating in parallel are tapping back and forth (hunting), yet the permissible setpoint deviation and permissible Icirc parameters are correctly set.

– In the event that the permissible setpoint deviation and the permissible Icirc have been set close to your recommended minimum value, the parameters may nevertheless be set with too narrow a range and thus result in an oscillating tap-change position. The reason for this is that the two permissible Icirc values are interdependent. In this case, it is recommended that the permissible setpoint deviation and permissible Icirc parameters be set with a slightly wider range. (See also the explanatory notes in chapter 8.1.2.1 Permissible setpoint deviation (bandwidth Xw_z), page 127)



17.7 WinREG

There is no communication between WinREG and the connected device.

- The selected COM interface may still be blocked by another program, is unavailable or does not match the COM interface used. All COM interfaces are available, for example, via the Windows 7 operating system under "Control Panel/System/Device Manager".
- No null-modem cable is in use or the cable used is defective. It is recommended that the original A. Eberle null-modem cable be used.
- Check the WinREG and device interface settings. The baudrates, parity and handshakes of these must match.
- In the WinREG connection settings, several interfaces may be defined, and one of these connections will be defined as default. Check that the connection that you are using corresponds to the default connection.
- The connection between the PC and the device may be too slow, whereby the communication timeout (5s default) is activated. The communication timeout can be modified in WinREG's central control program in "Options/Configuration".

It is not possible to communicate via the PQServer

- Please check that "Communication with WinPQ" is activated in "Options/Settings" in WinREG's central control program.
- For a connection to be established, WinPQ's RS232Server must be started (see the tray icon). Since the WinREG cannot start the RS232 server, it is advisable in this operating case to switch the RS232 server of WinPQ to continuous operation. This is done by setting the AUTOCLOSE parameter in PQRS232Server.ini to zero (AUTOCLOSE=0).
- Check whether the registry entry for WinREG has been set in PQManager.

The WinREG 3.9 panel does not start up and instead an error message appears

- If all of the other WinREG 3.9 program modules can connect to the device, yet the WinREG 3.9 panel does not start, Microsoft DotNet Framework 3.5 must be installed. A DotNet Framework 3.5 installation file is included as standard on the WinREG 3.9 CD.

17.8 REGUpdate (update32.exe)

The firmware update aborts and the message "Wrong S-record" appears.

- The PC's native RS232 interface or the USB/RS232 converter does not support hardware handshaking (RTS/CTS). Hardware handshaking is vital to perform a successful update.
- No null-modem cable is in use or the cable used is defective. It is recommended that the original A. Eberle null-modem cable be used.
- The bootloader's firmware version is older than V2.00. Please update the bootloader to version V2.00 or later before updating the firmware.

The firmware update aborts and the message "Wrong version" appears.

- Please use a firmware file with "_p" in the filename.

The firmware update aborts and the message "Bootloader version too low" appears.

- The bootloader's firmware version is V1.05. To pull up this bootloader, a special version of REGUpdate software is required.
  For questions regarding this matter, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).

An error message is displayed when downloading or uploading the H-Program.

- It is recommended that both the regulator's COM1 baudrate and that of the REGUpdate be set to 9600 baud, as higher speeds can lead to transmission problems.

17.9 SCADA system

Internal communication between the REG-D™ and the telecontrol board module is disrupted (the COM2 fault LED (red) is blinking).

- The baudrate of the COM2 interface of the REG-D™ does not correspond to the communication module setting. (Note also the default settings of the various telecontrol cards and protocols, see chapter 7.2.2.8 SCADA system, from page 103 onwards.)
- The REG-D™ identifier does not correspond to the configured device identifier of the telecontrol board module REG-P(E)(D). Enter "AA:" for the device identifier in order to address the device that is directly connected to COM2. In this case, the REG-D™ identifier is irrelevant.
- The telecontrol board module REG-P(ED) uses the P1 method for internal data transfer (only REG-Ps with old SCADA system parameter settings or "Alstom/Areva/Schneider" profile). Please check that the REG-D™ has a background program that supports the P1 method, as a corresponding background program is absolutely necessary for the P1 method.
- The telecontrol board module REG-P(ED) uses the RPS method for internal data transfer. Please check that the REG-D™ firmware version is V2.00 or later, as the RPS method is only supported by REG-D™ firmware versions V2.00 and later.

The REG-P telecontrol board module cannot be loaded or read out via REG-D™.

- The PC's native RS232 interface or the USB/RS232 converter does not support hardware handshaking (RTS/CTS). Hardware handshaking is vital for successful data transfer.
- If the bootloader version of the REG-D™ is lower than V1.14, loading or read out of the REG-P telecontrol board module via REG-D™ cannot take place. Should this be the case, please update the bootloader.
- To load or read out the REG-P telecontrol board module, the REG-D™ and REG-P must be in bootloader mode. After pressing the reset button of an external REG-P, it takes approximately 40s for the REG-P to appear in the serial bootloader. If you use the TK400 external REG-P with an up-to-date serial bootloader, the serial bootloader can be recognised by the alternate flashing of the "RESET/WD" LED and the "S+R" LEDs from "S/R/F 1".
- If you are using a REG-D™ with an internal REG-P (feature XW1), the REG-D™ and REG-P must be simultaneously put into bootloader mode using the following procedure:
  1. Switch off the supply voltage of the REG-D™.
  2. Switch the supply voltage back on, holding down the REG-D™ F1 key at the same time until → the REG-D™ automatically starts up in bootloader mode.
  3. Wait approximately 40s, until the internal REG-P also appears in the serial bootloader, before you begin to load or read out the REG-P.
- If you are using a REG-D™ with an internal REG-P (feature XW1), please ensure that you are using a version of WinConfig that is later than V8.31.

- If the REG-P has been retrofitted, please check that the RTS/CTS lines of the hardware handshake are connected correctly. These are absolutely necessary to load or read out the REG-P telecontrol board module via the REG-D™.
- Some versions of the REG-P telecontrol board module cannot be read out. For further information, please contact telecontrol system support (comms-support@a-eberle.de, +49 (0)911 628108-104).

There is no physical communication with the control system

- Please check the communication line for damage and ensure that it is properly connected (no open terminals).
- Physical communication cannot be established for telecontrol board modules of REG-P with IEC 103, and REG-PM with Modbus or SpaBUS if the internal communication between the REG-D™ and the telecontrol board module is disrupted. In such cases, it is advisable to start by checking that the internal communication is in proper working order.
- The baudrate of the telecontrol board module REG-P(ED) must correspond to the telecontrol board module settings.
- The Ethernet network uses a transfer rate of 10 Mbit/s. However, the telecontrol board module REG-P(ED) supports a transfer rate of 100 Mbit/s.
- Check that the LINK-layer addressing (link or IP address) is set correctly.
- If the IEC 101 protocol is used, please check the following:
  1. Does the length of the link, ASDU and data object addresses of the telecontrol board module REG-P correspond to the control system?
  2. Does the communication mode (balanced or unbalanced) correspond to the control system settings?
  3. Do the settings for the use of the originator address correspond?
- If a serial FOC communication line (not Ethernet) is used, the rest position of the telecontrol board module REG-P(ED) must correspond to the rest position of the control system (TK400 REG-P rest position with "non-inverted" setting -> light on).
- When using an FOC communication line, the fibre optic cables should be cross-connected between the control system and the telecontrol board module, because otherwise there is no receive signal, or there is no activity.
- When using RS485, please check the following:
  1. Is the polarity correct (e.g. double-wire: RX- with TX- and RX+ with TX+)?
  2. Is the RS485 bus terminated correctly at the start and end (120 Ohm termination resistor)?

There is physical communication, but no valid data is available or no data is transferred.

- Please check the internal communication between the REG-D™ and the telecontrol board module REG-P(ED).
- Please check the physical-to-logical device assignment according to IEC 61850 protocol ("Logical device instance" parameter in the Devices folder). This only applies to IEC 61850 for WinCONFIG 9.9 or later (e.g. version 6).
- Check the ASDU address of the telecontrol card in IEC 103/101/104.
- Check the address configuration of the individual data points/objects.

No stable connection can be established when using two control systems according to protocol IEC 61850.

- Please check that both control systems have the same report control block (URCB). It is essential that two different report control blocks are used for control system.

Must the telecontrol board module REG-P(ED) firmware also be upgraded when updating the REG-D™ firmware?

- If the communication standard that has been used between the REG-D™ and REG-P(ED) up to now (RPS or P1 method) remains unchanged, the REG-P(ED) firmware version does not need to be updated. The RPS communication standard has been available since REG-D™ firmware V2.00.

18. Abbreviation list

Abbreviation	Meaning
OFF	OFF
Inhibit low	Triggering, The regulator stops further control operations until the limit value violation is lifted.
AUTO	Automatic
3Winding	Three-winding transformer application
ELAN-Err	E-LAN error (bus error)
ELAN-L	Left E-LAN
ELAN-R	Right E-LAN
up/down	LED indicates up or down tap command
InputErr	Input error Generated at the binary input of setpoint switching (SP1 to SP2), InputErr becomes active if both signals are present at the same time. The regulator keeps the old value and generates InputErr.
TC-Err+	Runtime exceeding of the tap changer as a wiping signal
TC-Err	Runtime exceeding of the tap changer as a continuous signal
TC.i.Op.	TC in operation, Time required for a motor drive, to move from one tap to another
LDC	Line drop compensation
Par-Prog	Activate or activated parallel program
ParErr	ParErr generally stands for a faulty parallel operation (parallel error) and automatically switches parallel-working groups from automatic mode to manual mode. If this behavior is undesirable, a different behavior can be selected via the SysCtrl feature. To do this, please contact the A. Eberle REGSys support team (regsys-support@a-eberle.de, +49(0)911/628108-101).
PhasFail	The function can only be selected in PAN-D and regulators with the M2 feature. PhasFail becomes active when one of the three phases has failed.

Abbreviation	Meaning
TapErr	TapErr is a message that indicates a tap change problem. The designation was derived from the English term "Tap Error“. Unlike ParErr, TapErr acts locally, it is therefore only shown on the regulator where the tap-change error occurred, but with master-follower or MSI mode operation, the parallel working group can be switched to manual mode.
LEVEL	Level-triggered function
PROG	Function triggered by a background program
creepNBD	Creeping Net Breakdown
Quick	High-speed switching, the regulator switches in the tolerance band in the fastest possible time.
Inhibit	Inhibit, the regulator stops further control operations until the limit value violation is lifted.
SP-1	Setpoint 1
SP-2	Setpoint 2
SP-3	Setpoint 3
SP-4	Setpoint 4
SP-decr.	Decrement setpoint via binary input
SP-incr.	Increment setpoint via binary input
SP2Level	Level-controlled changeover to setpoint 2
Trans1	
/Trans1	Transit channel 1, binary input signal can be "passed through" to a freely programmable relay. **Examples:** BE 1 to Trans 1 Rel 3 to Trans 1 → BE 1 = 1 → REL 3 = 1 BE 1 = 0 → REL 3 = 0 BE 1 to Trans 1 Rel 3 to /Trans 1 → BE 1 = 1 → REL 3 = 0 BE 1 = 0 → REL 3 = 1
Trans2	

Abbreviation	Meaning
Trans2	see Trans1 analogously
PG_CB	ParaGramer, undervoltage side, circuit breaker
PG_IS1	ParaGramer, undervoltage side, isolator 1
PG_IS2	ParaGramer, undervoltage side, isolator 2
PG__CP	ParaGramer, undervoltage side, coupling
PG_SC1	ParaGramer, undervoltage side, section 1
PG_SC2	ParaGramer, undervoltage side, section 2
PG_H_CB	ParaGramer, overvoltage side, circuit breaker
PG_H_IS1	ParaGramer, overvoltage side, isolator 1
PG_H_IS2	ParaGramer, overvoltage side, isolator 2
PG_H_CP	ParaGramer, overvoltage side, coupling
PG_H_SC1	ParaGramer,overvoltage side, section 1
PG_H_SC2	ParaGramer,overvoltage side, section 2
BCD1	BCD/BIN code, value 1
BCD2	BCD/BIN code, value 2
BCD4	BCD/BIN code, value 4
BCD8	BCD/BIN code, value 8
BCD10	BCD/BIN code, value 10
BCD20	BCD/BIN code, value 20
BCDminus	BCD/BIN code, "-" sign
BIN16	BIN code, value 16
BIN32	BIN code, value 32
PANmiss	Set when the associated PAN-D is not present.
LR_AH	Local/remote operation with the REG-LR device is activated when the input functions "LR_AH" and "LR_STAT" are used. These inputs are connected to the corresponding outputs of the REG-LR device. So long as the REG-LR device keeps the status line LR_STAT active (1), the AUTOMATIC/MANUAL mode

Abbreviation	Meaning
	of the regulator is determined via the input LR_AH (1:AUTOMATIC, 0:MANUAL). Up/down commands can only arrive from the regulator (with AUTOMATIC mode). As soon as the LR_STAT status of the REG-LR device drops off (0), the regulator assumes the AUTOMATIC/MANUAL mode which was valid 1s prior to the LR_STAT signal fall, and operates as a normal regulator. Special case: "LR_STAT" is not used, i.e., only the input function "LR_AH" is activated. In this case LR_STAT is assumed as being always active.
LR_STAT	If only the input function "LR-STATUS" is used, then the following applies: "LR_STAT" active (1): Remote operation, i.e., MANUAL/AUTOMATIC and up/down only via inputs or REG-L. "LR_STAT" inactive (0): Remote operation, i.e., MANUAL/AUTOMATIC and up/down only via the keyboard.
T60s/1s	Emits a 1s pulse every 60s (relay) or displays it (LED)
COM2ACT	Provides information on the state of the COM2 interface (1: busy, 0: not busy)

19. Symbol list

Symbol	Meaning
> I [%]	Upper current limit (of the transformer)
< I [%]	Lower current limit (of the transformer)
> U [%]	Upper voltage limit (of the transformer)
< U [%]	Lower voltage limit (of the transformer)
ΔI [A]	Difference between any two current values
ΔU [V]	Difference between any two voltage values
AO1 ... AOn	Analog output (mA)
AI1 ... AIn	Analog input (mA)
BA1 ... BAn	Binary output (USt. : 10 V ... 50 V)
E1 ... En	Binary input (USt. : 48 V ... 230 V)
F_t [1]	Time factor for regulator time behavior
I1n [A]	Nominal value for current transformer, primary (of the transformer)
I2n [A]	Nominal value for current transformer, secondary (of the transformer)
Icirc [A]	Circulating current in parallel-connected transformers
Icirc sinφ[A]	Reactive component of the circulating current Icirc
I [A]	Given load current of the transformer
I sinφ = Ib [A]	Reactive part of the load current I (short, reactive current Ib)
Kni [1]	Transformer factor for current transformer
Knu [1]	Transformer factor for voltage transformer
R1 ... Rn	Relay outputs
S [VA]	Apparent power
Sn [VA]	Nominal transformer power
St [%]	Gradient of Uf/I characteristic curve
St_{Nom} [%]	Nominal value for gradient of Uf/I characteristic curve

Symbol	Meaning
tb [s]	Base time; normal value for tb = 30s for Xwb = 1%
t_V [s]	Tap command delay
U1N [kV]	Nominal value voltage transformer, primary
U2N [V]	Nominal value voltage transformer, secondary
Uf [V]	Voltage drop (amount) on the line
$\underline{U}$f [V]	Voltage drop (complex) on the line
U_{act}	Actual voltage value
u_k [%]	Short-circuit voltage of the transformer; fraction of the nominal voltage, which drives the nominal current in the short-circuited secondary winding
U_{Sp}	Setpoint value for voltage
U_T [V]	Transformer voltage (effective value)
U_V [V]	Voltage to user (effective value)
W [V]	Reference value ($X_R + X_K$)
X [V]	Actual control value (of voltage)
X_0	Reference value for limit (setpoint or 100/110 V)
Xd [V, %]	Control difference (negative setpoint deviation: Xd = - Xw)
X_K [V]	Correction value (Uf)
X_R [V]	Setpoint, set on regulator
X_{R100} [V]:	Setpoint, defined as 100%-value
Xw [%] (relative)	Setpoint deviation [(X - W) / W] 100%
Xw [V] (absolute)	Setpoint deviation (X - W)
Xwb [%]	Evaluated relative setpoint deviation; tap commands are activated at Xwb = 1%
Xwz [%]	Permitted setpoint deviation, set on the regulator. Specification in ± n% based on W
Y [1]	Setting value 1 tap
Yh [1]	Setting range for number of tap positions
Z [V]	Disturbance value

20. Index

21. Appendix

On the following pages you will find:

20.1 Technical Data

*) Applies to both the REG-D and the PAN-D

Regulations and standards ***)**

- IEC 61010-1 / EN 61010-1
- CAN/CSA C22.2 No. 1010.1-92
- IEC 60255-22-1 / EN 60255-22-1
- IEC 61326-1 / EN 61326-1
- IEC 60529 / EN 60529
- IEC 60068-1 / EN 60068-1
- IEC 60688 / EN 60688
- IEC 61000-6-2 / EN 61000-6-2
- IEC 61000-6-4 / EN 61000-6-4
- IEC 61000-6-5 / EN 61000-6-5 (in preperation)

AC voltage inputs (U_E) *)	
Measuring voltage U_E	0 ... 160 V software selectable
Shape of the curve	sinusoidal
Frequency range	16....50....60....65 Hz
Internal consumption	$\leq U^2$ / 100 kΩ
Overload capacity	230 V AC continuous

AC input (I_E) *(REG-D™ only)*	
Measuring current In	1 A / 5 A (hardware & software sel-ectable)
Shape of the curve	sinusoidal
Frequency range	16....50....60....65 Hz
Control range	0 ... In ... 2.1 In
Internal consumption	≤ 0.5 VA
Overload capacity	10 A continuous 30 A for 10 s 100 A for 1 s 500 A for 5 ms

Analogue inputs (AI) *)	
Quantity	See order specifications
Input range Y1...Y2	-20 mA...0...20 mA points Y1 and Y2 are pro-grammable
Control limit	± 1.2 Y2
Voltage drop	≤ 1.5 V
Potential isolation	Optocoupler
Common-mode rejec-tion	> 80 dB

Series-mode rejection	> 60 dB / Decade from 10 Hz
Overload capacity	≤ 50 mA continuous
Error limit	0.5%

The inputs can be continuously short-circuited or open circuited. All inputs are galvanically isolated from all of the other circuits.

Analogue outputs (AO) *)	
Quantity	See order specifications
Output range Y1...Y2	-20 mA...0...20 mA points Y1 and Y2 pro-grammable
Control limit	± 1.2 Y2
Potential isolation	Optocoupler
Load range	0 ≤ R ≤ 8 V / Y2
Alternating component	< 0.5% of Y2

The outputs can be continuously short-circuited or o-pen-circuited. All outputs are galvanically isolated from all of the other circuits.

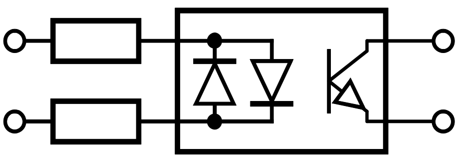
Temperature input PT100 *)	
Quantity	up to three PT100 inputs are possible
Type of connection	Three-wire circuit
Current through sensor	< 8 mA
Potential isolation	Optocoupler
Line compensation	No compensation requi-red
Transmission behaviour	linear

These inputs have open circuit monitoring.

Resistance input (tap position potentiometer)	
Quantity	See order specifications
Connection	Three-wire, convertible to four-wire
Total resistance in the resistor chain	R1: 180 Ω 2 kΩ R3: 2 kΩ 20 kΩ
Resistance per tap	adjustable R1: 1...100 Ω/tap R3: 50...2000 Ω/tap
Number of taps	≤ 38
Potential isolation	Optocoupler
Current through resis-tor chain	max. 25 mA

These inputs have open circuit monitoring.

Binary inputs (BI) *)	
Common	
Shape of the curve, permissible	Rectangular, sinusoidal
Signal frequency	DC, 40 ... 70 Hz
Potential isolation	Optocoupler; all inputs galvanically isolated from each other
Anti-bounce filter	Software filter, with 50Hz AC input filter
Characteristic D1 - Inputs E1 ... E8	
Control signals U_{st}	AC/DC range 48 V ... 250 V
H - Level L - Level	≥ 48 V < 10 V
Input resistance	108 kΩ
Characteristic D1 - Inputs E9 ... E16	
Control signals U_{st}	AC/DC range 10 V ... 50 V
H - Level L - Level	≥ 10 V < 5 V
Input resistance	6.8 kΩ
Characteristic D2 - Inputs E1 ... E16	
Control signals U_{st}	AC/DC range 48 V ... 250 V,
H - Level L - Level	≥ 48 V < 10 V
Input resistance	108 kΩ
Characteristic D3 - Inputs E1 ... E16	
Control signals U_{st}	AC/DC range 10 V ... 50 V
H - Level L - Level	≥ 10 V < 5 V
Input resistance	6.8 kΩ
Characteristic D4 - Inputs E1 ... E16	
Control signals U_{st}	AC/DC range 80 V ... 250 V
H - Level L - Level	≥ 80 V < 40 V
Input resistance	108 kΩ
Characteristic D5 - Inputs E1 ... E16	
Control signals U_{st}	AC/DC range 190 V ... 250 V
H - Level L - Level	≥ 176 V < 88 V
Input resistance	108 kΩ



Simplified diagram of a binary input

Binary outputs (BO) *)	
max. switching frequency	≤ 1 Hz
Potential isolation	Isolated from all internal device potentials
Contact load	AC: 250 V, 5 A (cosφ = 1.0) AC: 250 V, 3 A (cosφ = 0.4) Switching capacity max. 1250 VA DC: 30 V, 5 A resistive DC: 30 V, 3.5 A L/R=7 ms DC: 110 V, 0.5 A resistive DC: 220 V, 0.3 A resistive Switching capacity max. 150 W
Inrush current	250 V AC, 30 V DC 10 A for max. 4 s
Switching operations	≥ $5 \cdot 10^5$ electrical

Analog/Digital Conversion *)	
Type	12 bit successive-approximation converter
A/D bit resolution	+/- 11 bit
Sampling rate	24 samples per period, e.g. 1.2 kHz at a 50Hz signal *

*The measurement inputs are equipped with an Anti-Aliasing filter.

Device real time clock *)	
Accuracy	+/- 20 ppm

Limit value monitoring *)	
Limit values	programmable
Response times	programmable
Alarm indicators	LED programmable

Measured quantities *)	
True RMS voltages	U_{12}, (U_{23}, U_{31}) (≤ 0.25%)
True RMS current	I_1, (I_2 , I_3) (≤ 0.25%)
Active power	P (≤ 0.5%)
Reactive power	Q (≤ 0.5%)
Apparent power	S (≤ 0.5%)
Power factor	cos φ (≤ 0.5%)
Phase angle	φ (≤ 0.5%)
Reactive current	I · sin φ (≤ 1%)
Frequency	f (≤ 0.05%)

Reference conditions *)	
Reference temperature	23°C ± 1 K
Input quantities	U_E = 0 ... 160 V I_E = 0 ... 1A / 0 ... 5A
Frequency	45 Hz...65 Hz
Shape of the curve	Sinusoidal, form factor 1.1107
Load (only for characteristics E91...E900)	R_n = 5 V / Y2 ± 1%
Other	IEC 60688 - Part 1

Electrical safety *)	
Safety class	I
Degree of pollution	2
Measurement category	IV / 150 V III / 300 V

Operating voltages *)		
50 V	**150 V**	**230 V**
E-LAN, COM1 ... COM3, Analogue inputs, Analogue outputs, Inputs 10...50 V	Voltage input, current input	Auxiliary voltage, binary inputs, relay outputs, status

Electromagnetic compatibility *)	
EMC requirements	EN 61326-1 Equipment class A Continuous, unmonitored operation, industrial location and EN 61000-6-2 and 61000-6-4
Interference emissions	
Conducted and radiated emission	EN 61326 Table 3 EN 61000-6-4
Harmonic currents	EN 61000-3-2
Voltage fluctuations and flicker	EN 61000-3-3
Disturbance immunity	EN 61326 Table A1 and EN 61000-6-2
ESD	IEC 61000-6-5 6 kV/8 kV contact/air
Electromagnetic fields	IEC 61000-4-3\80 – 2000 MHz: 10 V/m
Fast transient	IEC 61000-4-4 4 kV/2 kV
Surge voltages	IEC 61000-4-5 4 kV/2 kV
Conducted HF signals	IEC 61000-4-6 150 kHz – 80 MHz: 10 V
Power-frequency magnetic fields	IEC 61000-4-8 100 A/m (50 Hz), continuous 1000 A/m (50 Hz), 1 s
Voltage dips	IEC 61000-4-11 30% / 20 ms, 60% / 1 s
Voltage interruptions	IEC 61000-4-11 100% / 5s
Damped oscillations	IEC 61000-4-12, Class 3, 2.5 kV

Test voltages *)	Description	Test voltage / kV	counter circuit*
Auxiliary voltage	U_h	2.3	COMs, AI, AO
Auxiliary voltage	U_h	2.3	BI, BO
Measuring voltage	U_e	2.3	COMs, AI, AO
Measuring voltage	U_e	3.3	U_h, BI, BO
Measuring voltage	U_e	2.2	I_e
Measuring current	I_e	2.3	COMs, AI, AO
Measuring current	I_e	3.3	U_h, BI, BO
Interfaces, COMs	COMs	2.3	BI, BO
Analogue outputs	AO	2.3	BI, BO
Analogue outputs	AO	0.5	COMs, AI
Analogue inputs	AI	2.3	BI, BO
Analogue inputs	AI	0.5	COMs, AO

Test voltages *)	Description	Test voltage / kV	counter circuit*
Binary inputs	BI	2.3	BI
Binary inputs	BI	2.3	BO
Binary outputs	BO	2.3	BO

* Counter circuits are always at the rack potential.
All test voltages are AC voltages in kV, which may be applied for 1 minute.
The COM interfaces are tested against each other with 0.5 kV.

Auxiliary voltage *)			
Characteristic	**H0**	**H1/H11**	**H2**
AC (internal)	75...185 V	-	-
AC	-	85 ... 264 V	-
DC	-	88 ... 280 V	18 ... 72 V
AC power consumption	≤ 35 VA	≤ 35 VA (H1) ≤ 45 VA (H11)	-
DC power consumption	-	≤ 25 W (H1) ≤ 35 W (H11)	≤ 25 W
Frequency	45 ... 400Hz	45 ... 400Hz	-

The following applies to all characteristics:
Voltage dips of ≤ 25 ms result neither in data loss nor malfunctions. Fuses are time lag (slow blow) type.

Ambient conditions *)	
Temperature range Function (Housing) Function (plug-in module) Transport and storage	 -10 °C ... +50 °C -10 °C ... +60 °C -25 °C ... +65 °C
Dry cold	IEC 60068-2-1, - 10°C / 16 h
Dry heat	IEC 60068-2-2, + 55°C / 16 h
Humid heat constant	IEC 60068-2-78 + 40°C / 93% / 2 days
Humid heat cyclical	IEC 60068-2-30 12+12 h, 6 cycles +55°C / 93%
Drop and topple	IEC 60068-2-31 100 mm drop height, unpackaged
Vibration	IEC 60255-21-1, Class 1
Shock	IEC 60255-21-2, Class 1
Earthquake resistance	IEC 60255-21-3, Class 1

Display (*REG-D™ only*)	
LC - Display	128 x 128 graphic display
Back-lighting	LED, automatic switch off after 15 minutes

Indicator elements (LEDs)		
Color	Quantity	Freely programmable quantity
Green	1 (1)	-- (--)
Yellow	5 (--)	5 (--)
Red	2 (17)	2 (6)

Values in () for PAN-D, Quantity without Manual/Auto and Local/Remote LEDs on the REG-D

Storage *)	
Firmware and recorder data characteristic S2	Flash memory
Device characteristics and calibration data	serial EEPROM with ≥ 1000 k write/read cycles
Other data and recorder data Characteristic S1	MRAM, Backup to flash memory possible

The backup battery on these devices is only used to buffer the real time clock if the aux. power supply is off.

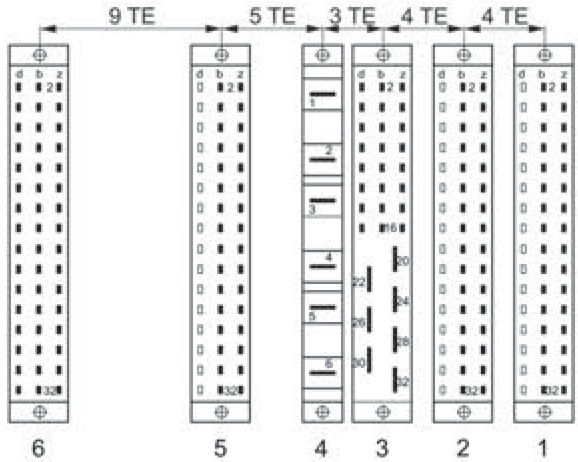
Mechanical design

Plug-in module *)	
Front panel	Plastic, RAL 7035 grey on aluminium brackets
Height	3 U (132.5 mm)
Width	28 HP (142.2 mm)
Printed circuit board	160 mm x 100 mm
Weight	≤ 1.5 kg
Protection type – Plug-in module – Female multi-point connector	 IP 00 IP 00
Mounting	in conformity with DIN 41494 Part 5
Plug-in connector	DIN 41612

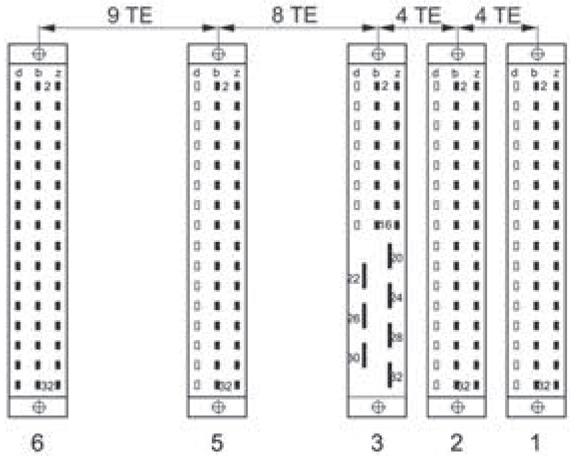
Position of the male or female multipoint connectors

The male multipoint connectors are firmly connected to the device's printed circuit board, meaning that the female multipoint connectors must be mounted in specific positions in the housing or the module rack. A specific position number determines the reference point for the mounting of the guide holders and the connection elements on the back of the module rack/housing.

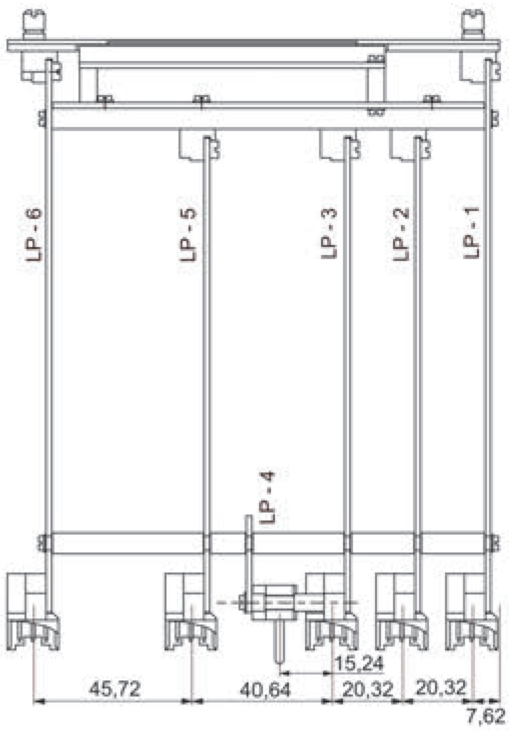
Position numbers						
socket connector	1	2	3	4	5	6
PCB card guide	n	-	-	-	-	n+26
Screws	n	n+4	n+8	n+11	n+16	n+25



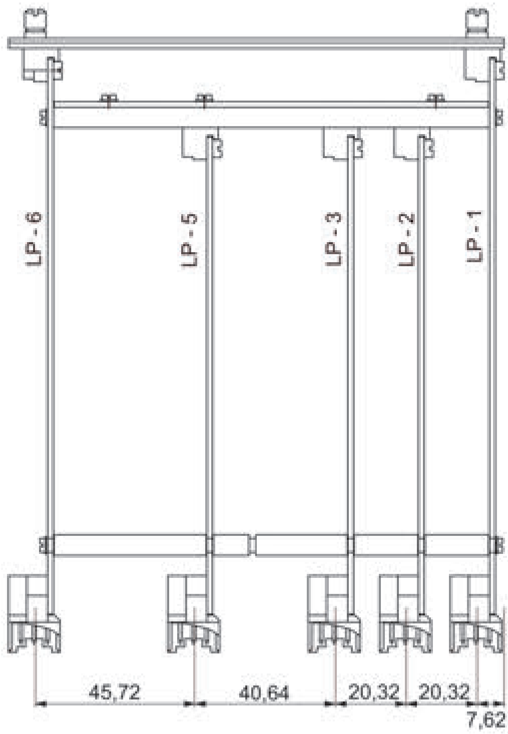
Position of the REG-D™ socket connectors



Position of the PAN-D socket connectors



Position of the REG-D™ blade connectors



Position of the PAN-D blade connectors

Pin assignment of the REG-D™

Socket connector 1; ***(binary outputs)***					
Raise (2 contact pairs) 1 NCC + 1 NOC	R1	Pole Pole	b2 b4	NCC NOC	z2 z4
Lower (2 contact pairs) 1 NCC + 1 NOC	R2	Pole Pole	b8 b10	NCC NOC	Z8 z10
Freely programmable	R3	Pole	b14	NOC	z14
Freely programmable	R4	Pole	b16	NOC	z16
Freely programmable	R5	Pole	b20	NOC	Z20
Manual/Auto (converter)		Pole	b22	Automatic	Z22
	Man		b24		
Status	Pole		b26	NOC/NCC	Z24
Binary outputs (BO) 4 relays freely programmable	GND R6...R9				Z28
	NOC R6		b30	NOC R8	Z30
	NOC R7		b32	NOC R9	Z32

The status contact is either NOC or NCC based on characteristic U. This can be changed at a later stage by soldering a bridge.

Socket connector 2; ***(binary inputs)*** **Characteristic D1**					
Raise	E1	+	b2	-	z2
Lower	E2	+	b4	-	z4
Inhibit	E3	+	b6	-	z6
Fast switching	E4	+	b8	-	z8
Manual/Auto	E5	+	b10	-	z10
Manual	E6	+	b12	-	z12
Freely programmable	E7	+	b14	-	z14
Freely programmable	E8	+	b16	-	z16
BCD 1	E9	+	b24	-	b32
BCD 2	E10	+	b26	-	
BCD 4	E11	+	b28	-	
BCD 8	E12	+	b30	-	
BCD 10	E13	+	z24	-	z32
BCD 20	E14	+	z26	-	
BCD -	E15	+	z28	-	
Freely programmable	E16	+	z30	-	

socket connector 2; ***(binary inputs) Characteristics D2...D5***					
Raise	E1	+	b2	-	z2
Lower	E2	+	b4	-	z4
Inhibit	E3	+	b6	-	z6
Fast switching	E4	+	b8	-	z8
Manual/Auto	E5	+	b10	-	z10
Manual	E6	+	b12	-	z12
Freely programmable	E7	+	b14	-	z14
Freely programmable	E8	+	b16	-	z16
BCD 1	E9	+	b18	-	z18
BCD 2	E10	+	b20	-	z20
BCD 4	E11	+	b22	-	z22
BCD 8	E12	+	b24	-	z24
BCD 10	E13	+	b26	-	z26
BCD 20	E14	+	b28	-	z28
BCD -	E15	+	b30	-	z30
Freely programmable	E16	+	b32	-	z32

All inputs except E5 and E6 are freely programmable. The tables for the socket connector 2 show a sample allocation.

socket connector 3; ***(measuring voltage, auxiliary voltage)***						
DC output (max. 5 W)	+ 5V		d2, b2, z2	GND		d4, b4, z4
Measuring voltage U1	U1a		20	U1b**		22
Measuring voltage U2*	U2a**		26	U2b		24
Auxiliary voltage U_H	L(+)	28	N(-)	30	PE	32

* only available for characteristics M2, M3 and M9

** for characteristic M2 (ARON), pin 26 is internally connected to pin 22. The connection is L1 (pin 20), L2 (pin 22) and L3 (pin 24)..

socket connector 4; **(alternating current input)**				
Measuring current I_{E1}	s1	1	s2	2
Measuring current I_{E2}*	s1	3	s2	4

* only available for characteristics M2 or M9

The current measuring inputs are equipped with special male and female socket connectors that short-circuit the current transformer when they are removed from the device. This means that the device does not have to be short-circuited externally.

Socket connector 4 is numbered from top to bottom (1 to 6). The contact with description 6 is at the top of the male socket connector in the REG-D for design reasons. This means that the male socket connector is numbered 6 to 1 from top to bottom (embossing on the male socket connector).

Socket connector 5; *(binary inputs) Characteristic X25*					
Freely programmable	E17	+	b2	-	z2
Freely programmable	E18	+	b4	-	z4
Freely programmable	E19	+	b6	-	z6
Freely programmable	E20	+	b8	-	z8
Freely programmable	E21	+	b10	-	z10
Freely programmable	E22	+	b12	-	z12
Freely programmable	E23	+	b14	-	z14
Freely programmable	E24	+	b16	-	z16
Freely programmable	E25	+	b24	-	b32
Freely programmable	E26	+	b26	-	
Freely programmable	E27	+	b28	-	
Freely programmable	E28	+	b30	-	
Freely programmable	E29	+	z24	-	z32
Freely programmable	E30	+	z26	-	
Freely programmable	E31	+	z28	-	
Freely programmable	E32	+	z30	-	

Socket connector 5; *(binary inputs) Characteristics X15, 24, 28, 29*					
Freely programmable	E17	+	b2	-	z2
Freely programmable	E18	+	b4	-	z4
Freely programmable	E19	+	b6	-	z6
Freely programmable	E20	+	b8	-	z8
Freely programmable	E21	+	b10	-	z10
Freely programmable	E22	+	b12	-	z12
Freely programmable	E23	+	b14	-	z14
Freely programmable	E24	+	b16	-	z16
Freely programmable	E25	+	b18	-	z18
Freely programmable	E26	+	b20	-	z20
Freely programmable	E27	+	b22	-	z22
Freely programmable	E28	+	b24	-	z24
Freely programmable	E29	+	b26	-	z26
Freely programmable	E30	+	b28	-	z28
Freely programmable	E31	+	b30	-	z30
Freely programmable	E32	+	b32	-	z32

Socket connector 5; (binary outputs) Characteristic X01				
Relay 10 Freely programmable	Pole	b2	NOC	z2
	NCC	b4		
Relay 11 Freely programmable	Pole	b6	NOC	z6
	NCC	b8		
Relay 12 Freely programmable	Pole	b10	NOC	z10
	NCC	b12		

Socket connector 5; (binary outputs) Characteristic X01				
Relay 13 Freely programmable	Pole	b14	NOC	z14
	NCC	b16		
Relay 14 Freely programmable	Pole	b18	NOC	z18
	NCC	b20		
Relay 15 Freely programmable	Pole	b22	NOC	z22
	NCC	b24		
Relay 16 Freely programmable	Pole	b26	NOC	z26
	NCC	b28		
Relay 17 Freely programmable	Pole	b30	NOC	z30
	NCC	b32		

Socket connector 5; *(SCADA interface) Characteristic XW1*					
COM1/RxD	d2	COM1/GND	b2	COM1/TxD	z2
COM1/CTS	d4	COM1/GND	b4	COM1/RTS	z4
COM1/GND Service/RxD*	d6	COM1/GND Service/GND*	b6	COM1/GND Service/TxD*	z6
free Service/CTS*	d8	free Service/GND*	b8	free Service/RTS*	z8
CPU/PE	d10	CPU/PE	b10	CPU/PE	z10
VCC/+5 V DC	d12	VCC/+5 V DC	b12	VCC/+5 V DC	z12
GND/5 V DC	d14	GND/5 V DC	b14	GND/5 V DC	z14
Fibre optic/ Rx	d16	free GND*	b16	Fibre optic/ Tx	z16
free	d18	free	b18	free	z18
RS485/N (B) RS485/P(A)*	d20	free RS485 GND*	b20	RS485/P (A) RTS485/N(B)*	z20
RS485 GND	d22	RS485 GND	b22	RS485 GND	z22
free Modem/RxD*	d24	free Modem/DTR*	b24	free Modem/TxD*	z24
COM2/PE Modem/CTS*	d26	COM2/PE Modem/DSR*	b26	COM2/PE Modem/RTS*	z26
free Modem/GND*	d28	free Modem/RI*	b28	free Modem/DCD*	z28
COM2/RxD	d30	COM2/GND	b30	COM2/TxD	z30
COM2/CTS	d32	COM2/GND	b32	COM2/RTS	z32

* different allocation for Modbus (XZ23) and SpaBus (XZ22)

REG-D/PAN-D CPU and the SCADA interface communicate through the COM2 interface.

Communication with the control system can take place optionally through fibre optic cable, RS485 or RS232 (COM1). The fibre optic cable requires a separate module.
The SCADA connection module for Modbus (XZ23) and Spabus (XZ22) is configured through the service interface. This means that it also has to be wired.

Socket connector 6; *(analogue inputs and outputs; interfaces)*					
free	d2	Analogue channel 1 +	b2	Analogue channel 2 +	z2
DCF GND	d4	Analogue channel 1 -	b4	Analogue channel 2 -	z4
DCF EA+	d6	E-LAN left EA +	b6	E-LAN right EA +	z6
DCF EA-	d8	E-LAN left EA -	b8	E-LAN right EA -	z8
E-LAN left GND	d10	E-LAN left E +	b10	E-LAN right E +	z10
E-LAN right GND	d12	E-LAN left E -	b12	E-LAN right E -	z12
free	d14	Analogue channel 3 +	b14	Analogue channel 4 +	z14
COM1-S TxD	d16	Analogue channel 3 -	b16	Analogue channel 4 -	z16
COM1-S RTS	d18	free	b18	free	z18
COM1-S GND	d20	COM2 TxD	b20	COM2 RTS	z20
COM1-S RxD	d22	COM2 RxD	b22	COM2 CTS	z22
COM1-S CTS	d24	COM2 GND	b24	free	z24
free	d26	Analogue channel 5 +	b26	Analogue channel 6 +	z26
free	d28	Analogue channel 5 -	b28	Analogue channel 6 -	z28
free	d30	COM3 Tx +	b30	COM3 Rx +	z30
COM3 GND	d32	COM3 TX-	b32	COM3 Rx -	z32

Pin assignment of the PAN-D

Socket connector 1; *(binary outputs)*					
Inhibit high	R1	Pole Pole	b2 b4	NOC NOC	z2 z4
EMERGENCY OFF tap-changer motor drive	R2	Pole Pole	b8 b10	NOC NOC	Z8 z10
raise interlock	R3	Pole	b14	NOC	z14
lower interlock	R4	Pole	b16	NOC	z16
Freely programmable	R5	Pole	b20	NOC	Z20
Freely programmable	R6	Pole	b26	NOC	Z24
Status	Pole		b22		
	Failure		b24	Operation	z22

Socket connector 2; *(binary inputs) Characteristic D1*					
TC. in operation	E1	+	b2	-	z2
Freely programmable	E2	+	b4	-	z4
Freely programmable	E3	+	b6	-	z6
Freely programmable	E4	+	b8	-	z8
Freely programmable	E5	+	b10	-	z10
Freely programmable	E6	+	b12	-	z12
Freely programmable	E7	+	b14	-	z14
Freely programmable	E8	+	b16	-	z16
Freely programmable	E9	+	b24	-	b32
Freely programmable	E10	+	b26	-	
Freely programmable	E11	+	b28	-	
Freely programmable	E12	+	b30	-	
Freely programmable	E13	+	z24	-	z32
Freely programmable	E14	+	z26	-	
Freely programmable	E15	+	z28	-	
Freely programmable	E16	+	z30	-	

Socket connector 2; *(binary inputs) Characteristics D2...D5*					
TC. in operation	E1	+	b2	-	z2
Freely programmable	E2	+	b4	-	z4
Freely programmable	E3	+	b6	-	z6
Freely programmable	E4	+	b8	-	z8
Freely programmable	E5	+	b10	-	z10
Freely programmable	E6	+	b12	-	z12
Freely programmable	E7	+	b14	-	z14
Freely programmable	E8	+	b16	-	z16
Freely programmable	E9	+	b18	-	z18
Freely programmable	E10	+	b20	-	z20
Freely programmable	E11	+	b22	-	z22
Freely programmable	E12	+	b24	-	z24
Freely programmable	E13	+	b26	-	z26
Freely programmable	E14	+	b28	-	z28
Freely programmable	E15	+	b30	-	z30
Freely programmable	E16	+	b32	-	z32

All of the PAN-D's binary inputs are freely programmable from firmware version 2.22 onwards. Up to version 2.21, input 1 is allocated to the function TC in Operation. The tables for the socket connector 2 show the standard allocation.

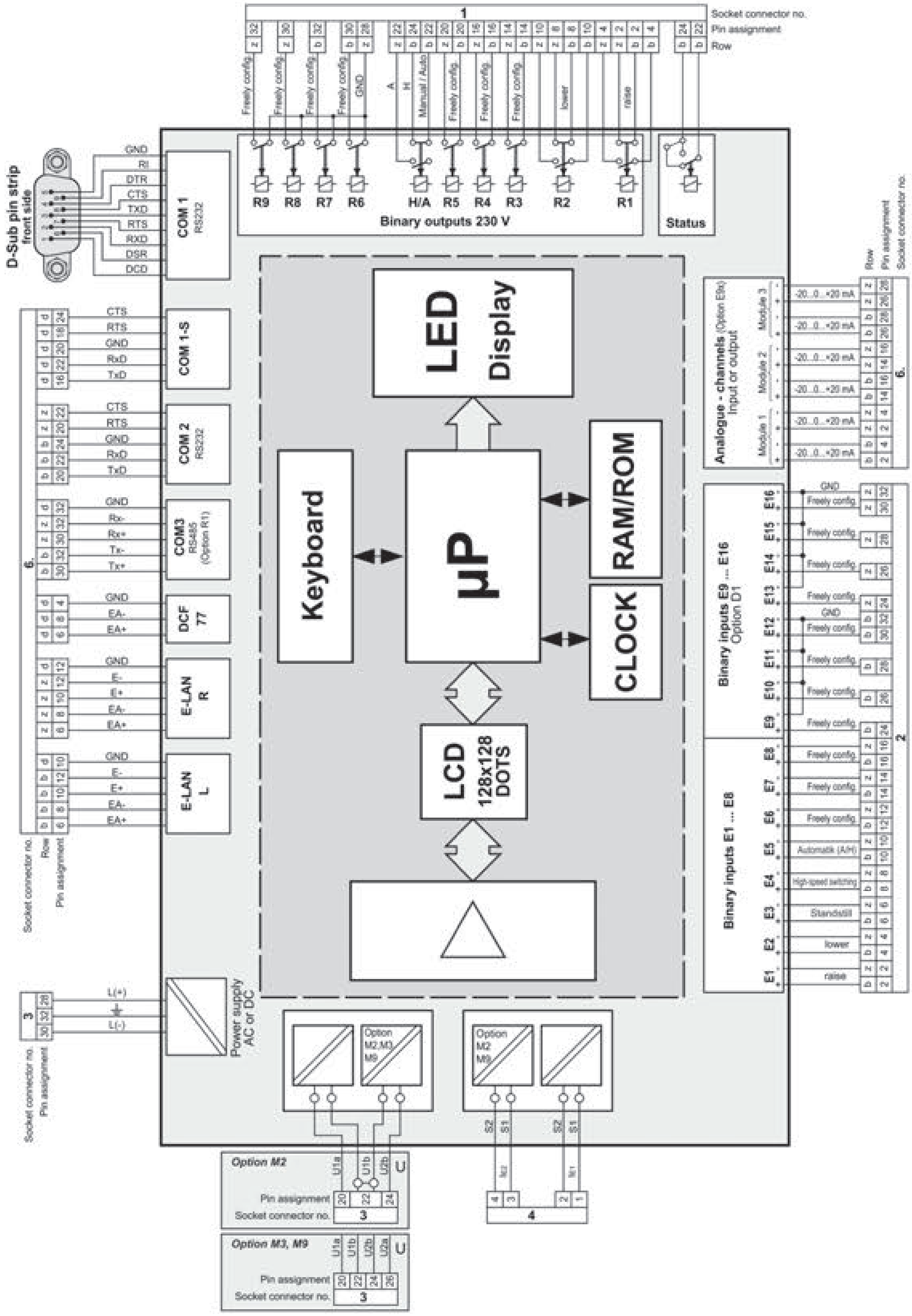
<table>
<tr><th colspan="7">Socket connector 3; (measuring voltage, auxiliary voltage)</th></tr>
<tr><td>DC output (max. 5 W)</td><td colspan="2">+5V</td><td>d2, b2, z2</td><td>GND</td><td colspan="2">d4, b4, z4</td></tr>
<tr><td>Measuring voltage 1</td><td colspan="2">U1a</td><td>20</td><td>U1b**</td><td colspan="2">22</td></tr>
<tr><td>Measuring voltage 2</td><td colspan="2">U2a**</td><td>26</td><td>U2b</td><td colspan="2">24</td></tr>
<tr><td>Auxiliary voltage U_H</td><td>L(+)</td><td>28</td><td>N(-)</td><td>30</td><td>PE</td><td>32</td></tr>
</table>

** for characteristic M1, pin 26 is internally connected to pin 22. The connection is L1 (pin 20), L2 (pin 22) and L3 (pin 24).

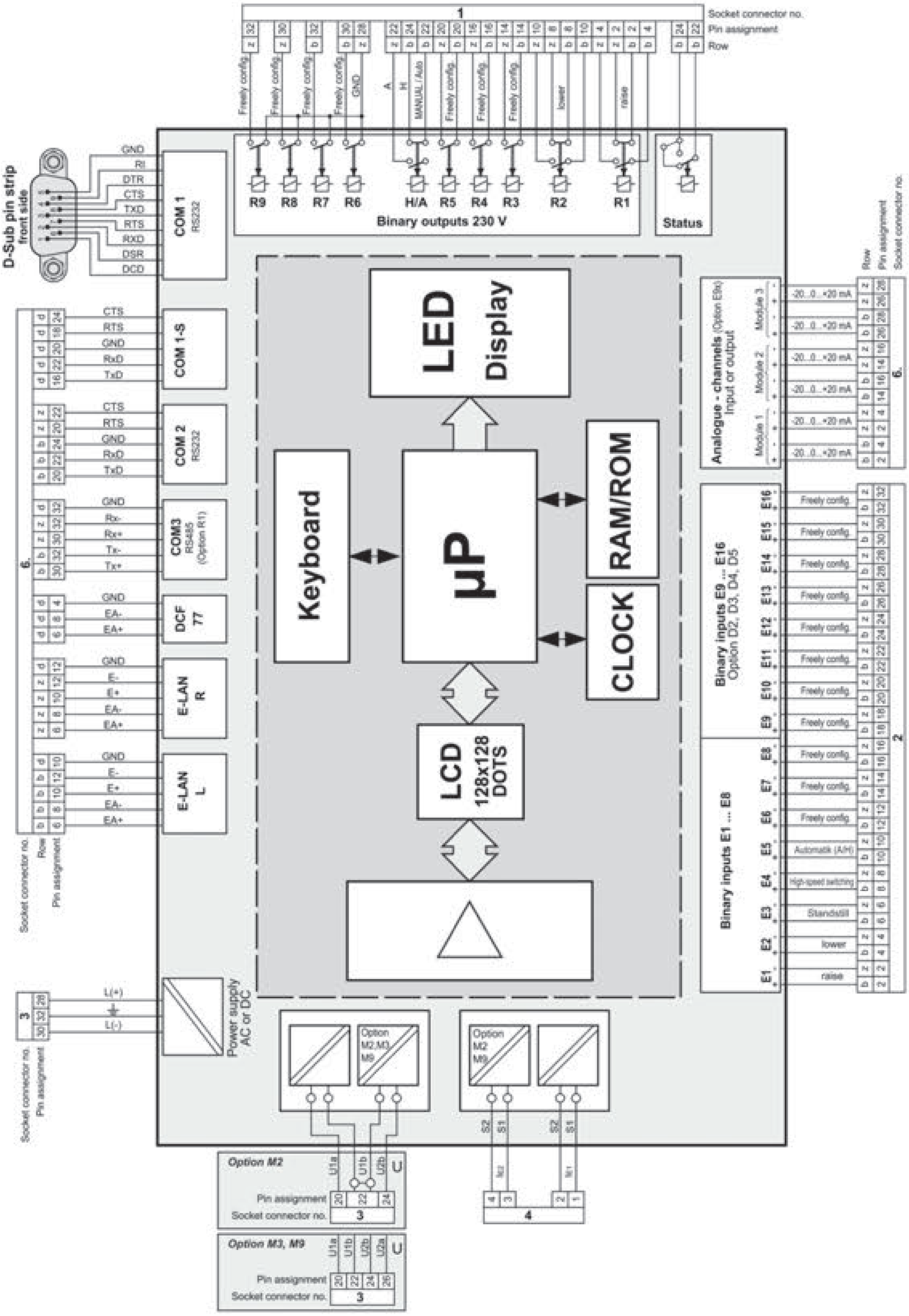
Socket connector 5; *(binary outputs)*				
Tap changer failure	Pole	b2	NOC	z2
	NCC	b4		
Regulator failure	Pole	b6	NOC	z6
	NCC	b8		
<U1	Pole	b10	NOC	z10
	NCC	b12		
>U2	Pole	b14	NOC	z14
	NCC	b16		
«U3	Pole	b18	NOC	z18
	NCC	b20		
»U4	Pole	b22	NOC	z22
	NCC	b24		
Fast circuit switching	Pole	b26	NOC	z26
	NCC	b28		
Freely programmable	Pole	b30	NOC	z30
	NCC	b32		

Socket connector 6; *(analogue inputs and outputs; interfaces)*					
free	d2	Analogue channel 1 +	b2	Analogue channel 2 +	z2
DCF GND	d4	Analogue channel 1 -	b4	Analogue channel 2 -	z4
DCF EA+	d6	E-LAN left EA +	b6	E-LAN right EA +	z6
DCF EA-	d8	E-LAN left EA -	b8	E-LAN right EA -	z8
E-LAN left GND	d10	E-LAN left E +	b10	E-LAN right E +	z10
E-LAN right GND	d12	E-LAN left E -	b12	E-LAN right E -	z12
free	d14	Analogue channel 3 +	b14	Analogue channel 4 +	z14
COM1-S TxD	d16	Analogue channel 3 -	b16	Analogue channel 4 -	z16
COM1-S RTS	d18	free	b18	free	z18
COM1-S GND	d20	COM2 TxD	b20	COM2 RTS	z20
COM1-S RxD	d22	COM2 RxD	b22	COM2 CTS	z22
COM1-S CTS	d24	COM2 GND	b24	free	z24
free	d26	Analogue channel 5 +	b26	Analogue channel 6 +	z26
free	d28	Analogue channel 5 -	b28	Analogue channel 6 -	z28
free	d30	COM3 Tx +	b30	COM3 Rx +	z30
COM3 GND	d32	COM3 Tx -	b32	COM3 Rx -	z32

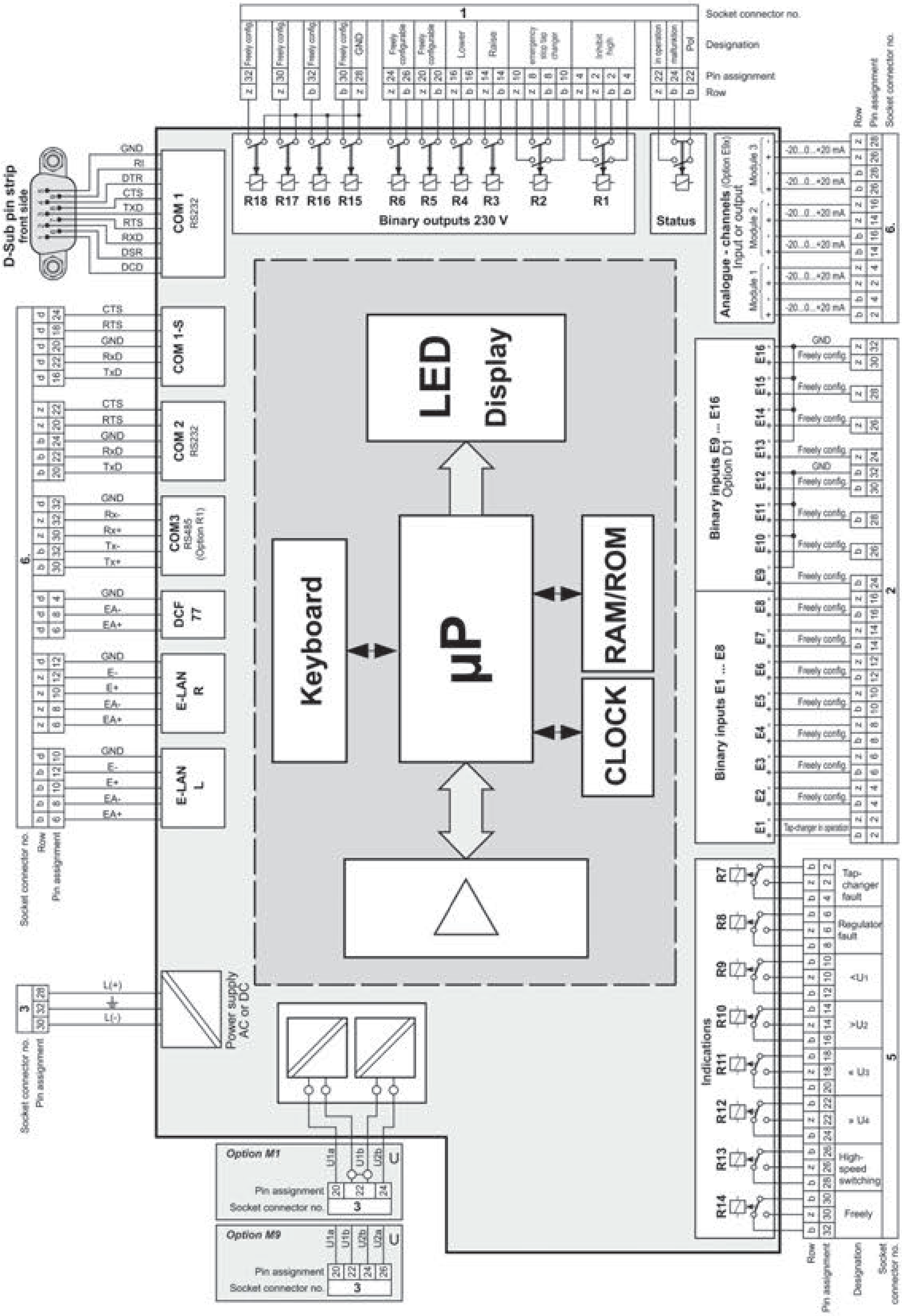
Block diagrams



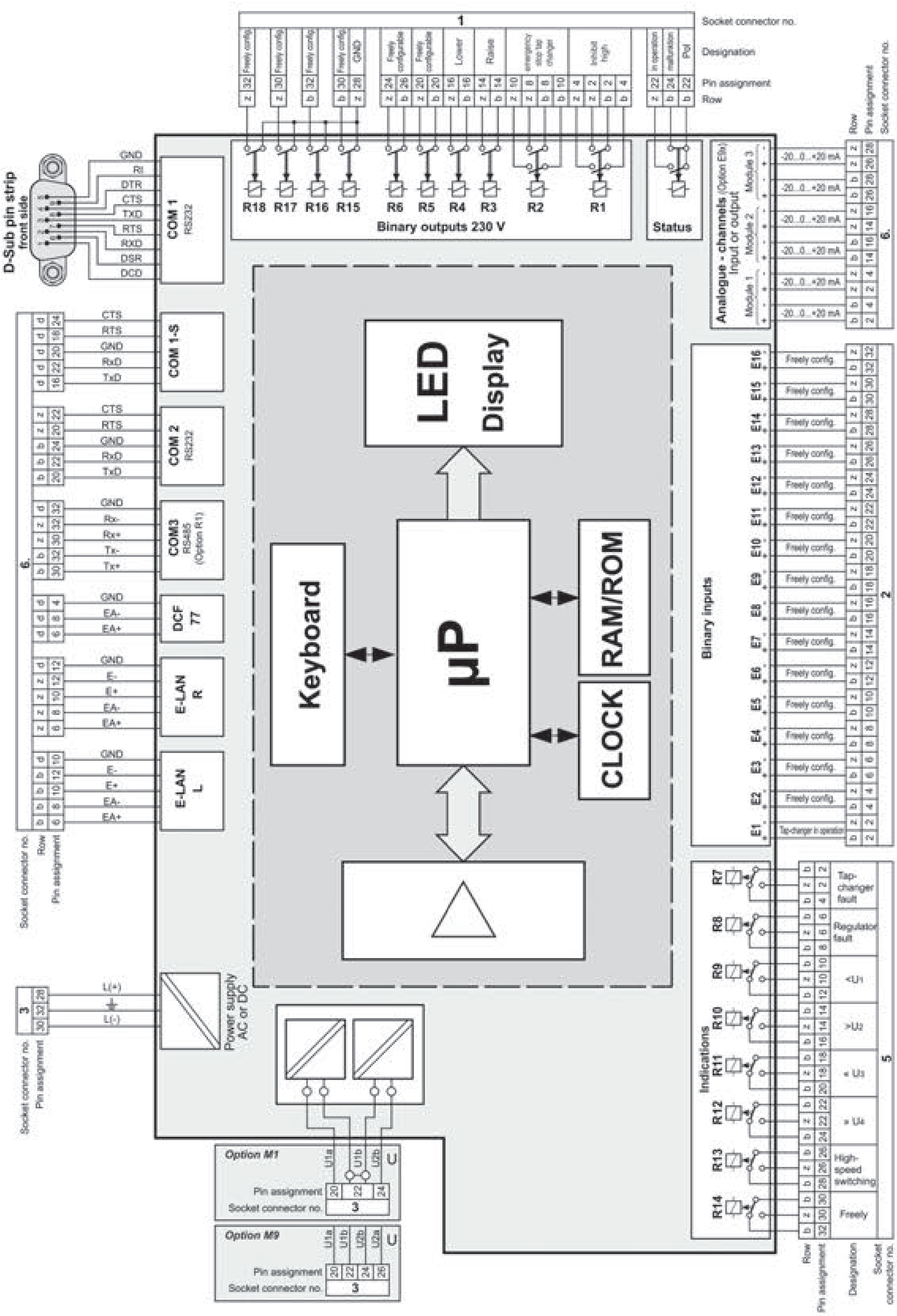
Block diagram REG-D™ Characteristic D1



Block diagram REG-D Characteristic D2 / D3 / D4 / D5



Block diagram PAN-D Characteristic D1



Block diagram PAN –D Characteristic D2 / D3 / D4 / D5

Housing technology

REGSys™ has a very flexible housing technology. A few of the housing configurations are described below. Most of the housings and 19" racks come with customer-specific wiring. The terminal configuration can be taken from the system-specific wiring diagrams. Please contact A. Eberle support if you do not have the diagrams.

19" card racks (CR)

Material	Aluminium
Protection type	IP 20
Weight	≤ 5 kg
Dimensions	see drawings
Width of the MR	84 HP

Connection elements		Number of terminals
Characteristic B92	Screw terminals	max. 200
Characteristic B93	Phoenix pluggable screw terminals	160
Characteristic B95	Phoenix pluggable screw terminals	fixed allocation through backplane*

* the Phoenix pluggable screw terminals in the cover can be used for components without backplane (e.g. PAN-A1, PQI-D). The number of terminals depends on the assembly.

Panel/wall mounting housing

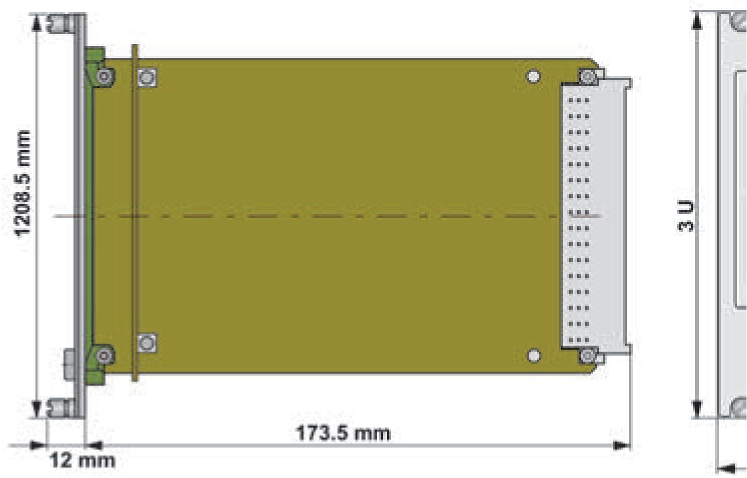
Material	Plastic
Protection type	Front panel IP 65
Weight	≤ 4 kg
Dimensions	see drawings
Housing width	30 or 49 HP

Connection elements		Number of terminals
Characteristic B02 (30 HP, without wiring)	2.8 x 0.8 FASTON 6.3 x 0.8 FASTON	29 * 49 ** 60***
Characteristic B03 (30 HP, compatible with REG-5A and Pantavolt 2)	Phoenix pluggable screw terminals	compatible with REG-5A and Pantavolt 2
Characteristic B03, B05 (30 HP)	Phoenix pluggable screw terminals	29 * 49 ** 60***
Characteristic B06, B07, B91 (49 HP)	Phoenix pluggable screw terminals	60 * 92 ** 92***

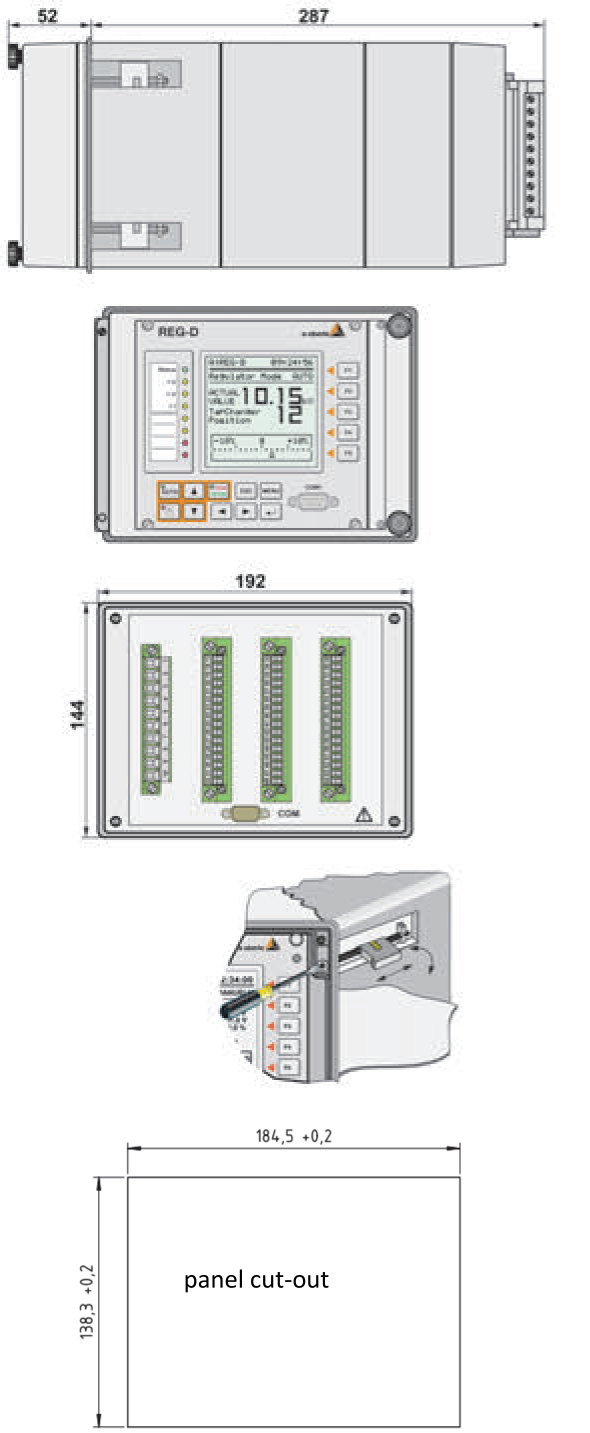
* max. number of terminals for wall mounting with short terminal box
** max. number of terminals for wall mounting with long terminal box
*** max. number of terminals for panel mounting housing

The conductor cross section and the maximum tightening torque of the different terminal types can be found in the next section.

llustrations and dimensions of the modules and housings



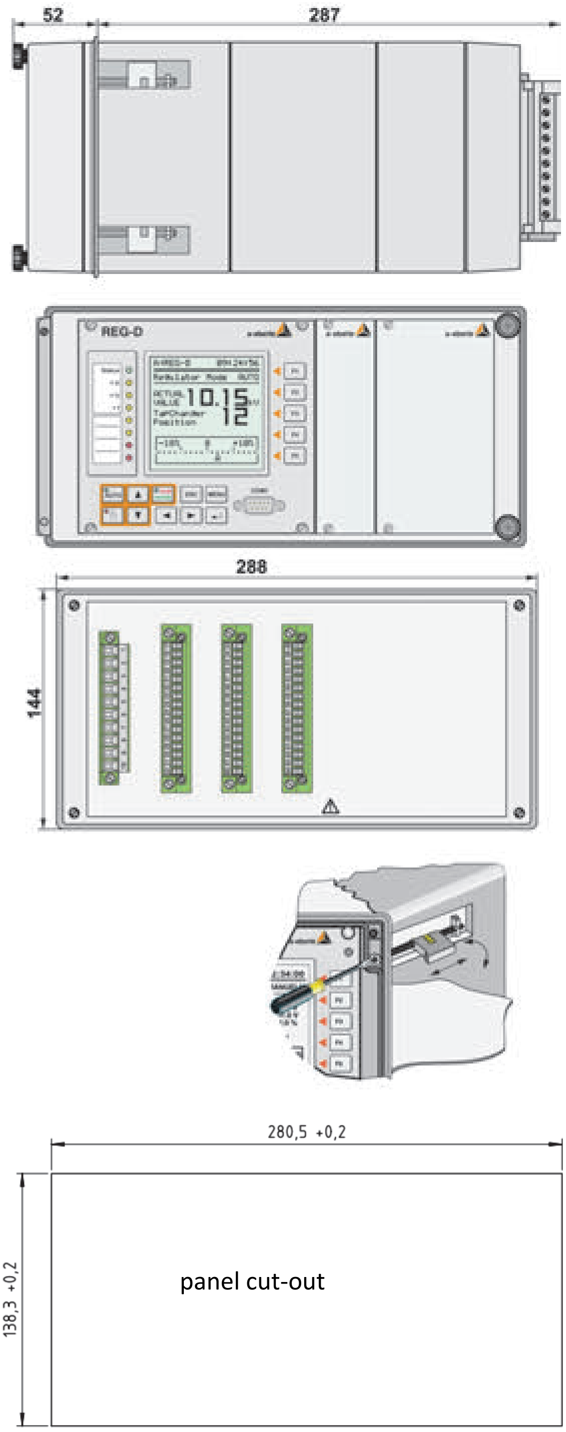
Plug-in module REG-D™/PAN-D 28 HP Characteristic B01



Conductor cross section and torque of the terminals			
connector, pitch, application example	cross section/mm² stranded	solid	torque Nm
10 poles, 7.62 mm, measurements , aux. voltage	4	4	0,6
16 poles, 5 mm, BIs, relays	2,5	2,5	0,6
4/5 poles, 3.81 mm, additional functions, COMs	1,5	1,5	0,25

Panel mounting housing 30 HP - Characteristic B05

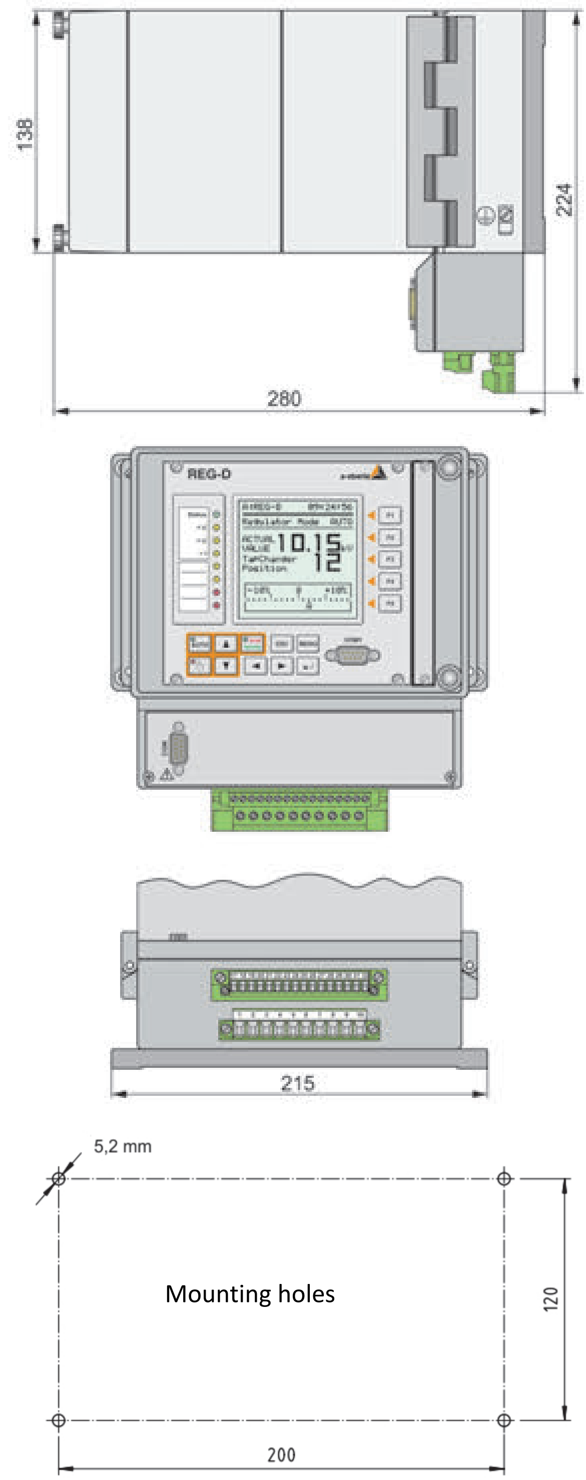
Dimensions in mm



Conductor cross section and torque of the terminals			
connector, pitch, application example	cross section/mm² stranded	solid	torque Nm
10 poles, 7.62 mm, measurements , aux. voltage	4	4	0,6
16 poles, 5 mm, BIs, relays	2,5	2,5	0,6
4/5 poles, 3.81 mm, additional functions, COMs	1,5	1,5	0,25

Panel mounting housing 49 HP - Characteristic B06/B91

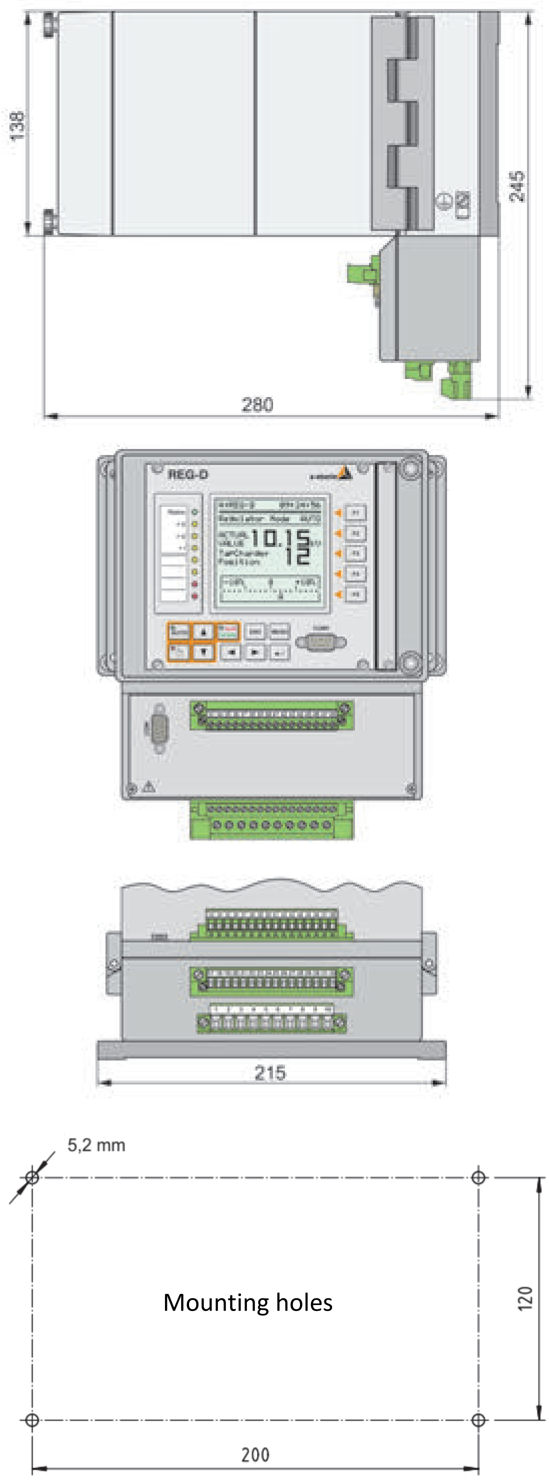
Dimensions in mm



Conductor cross section and torque of the terminals			
connector, pitch, application example	**cross section / mm²**		**torque**
	stranded	**solid**	**Nm**
10 poles, 7.62 mm, measurements , aux. voltage	4	4	0,6
16 poles, 5 mm, BIs, relays	2,5	2,5	0,6
4/5 poles, 3.81 mm, additional functions, COMs	1,5	1,5	0,25

Wall mounting housing 30 HP short terminal box

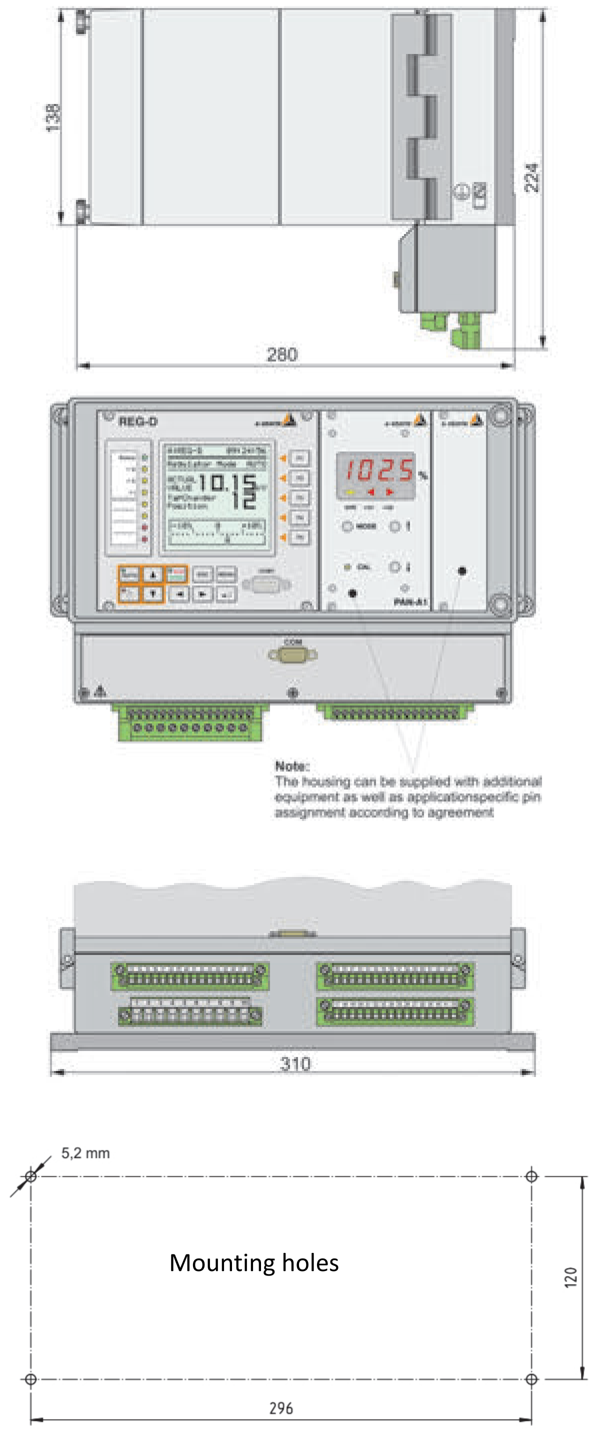
Characteristic B03, Dimensions in mm



Conductor cross section and torque of the terminals			
connector, pitch, application example	**cross section / mm²**		**torque**
	stranded	**solid**	**Nm**
10 poles, 7.62 mm, measurements , aux. voltage	4	4	0,6
16 poles, 5 mm, BIs, relays	2,5	2,5	0,6
4/5 poles, 3.81 mm, additional functions, COMs	1,5	1,5	0,25

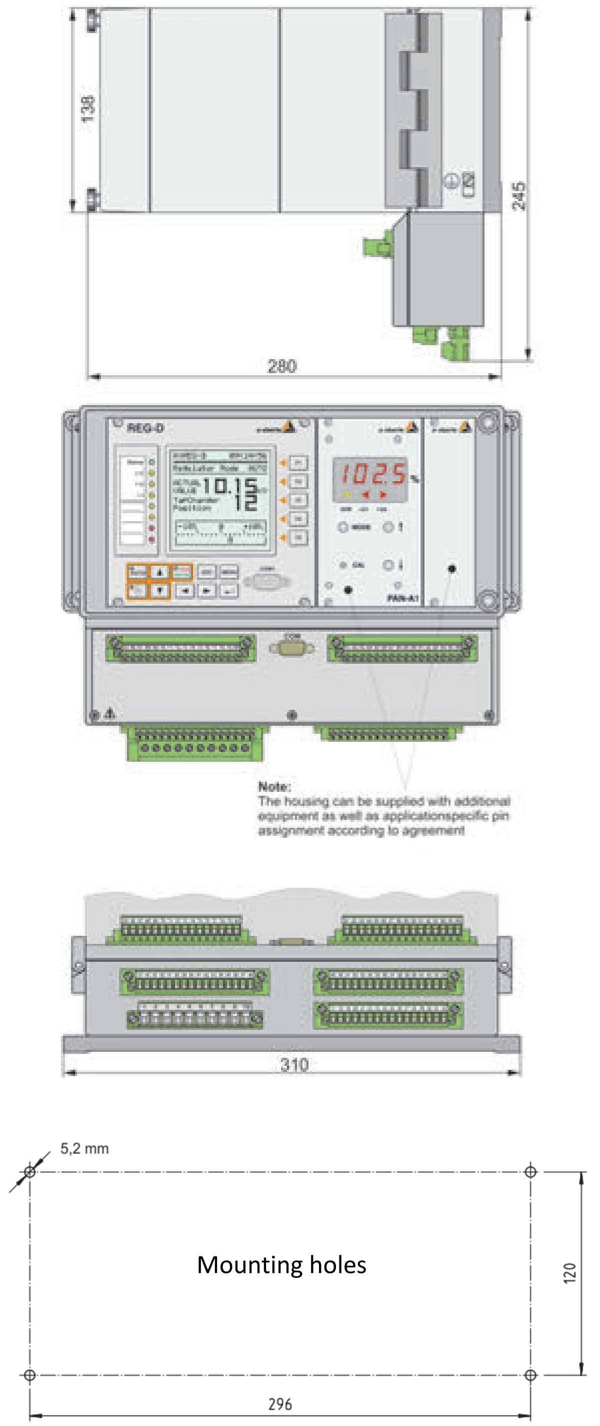
Wall mounting housing 30 HP long terminal box

Characteristic B03, Dimensions in mm



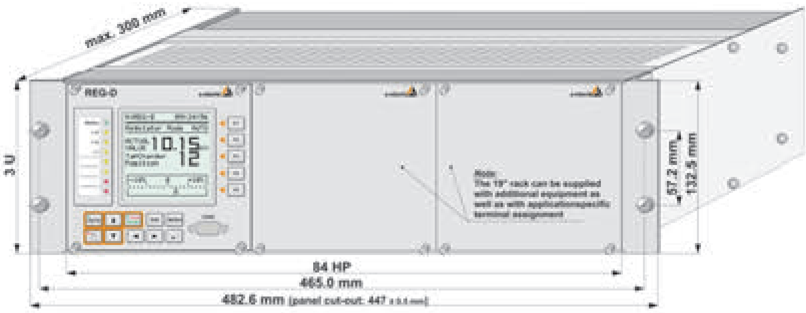
Conductor cross section and torque of the terminals			
connector, pitch, application example	**cross section / mm²**		**torque**
	stranded	**solid**	**Nm**
10 poles, 7.62 mm, measurements , aux. voltage	4	4	0,6
16 poles, 5 mm, BIs, relays	2,5	2,5	0,6
4/5 poles, 3.81 mm, additional functions, COMs	1,5	1,5	0,25

Wall mounting housing 49 HP short terminal box Characteristic B07/B91, Dimensions in mm

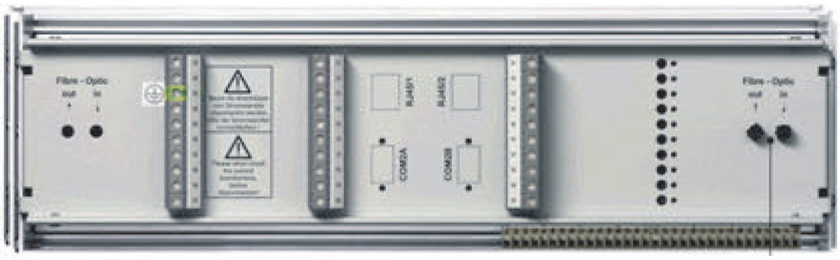


Conductor cross section and torque of the terminals			
connector, pitch, application example	**cross section / mm²**		**torque**
	stranded	**solid**	**Nm**
10 poles, 7.62 mm, measurements , aux. voltage	4	4	0,6
16 poles, 5 mm, BIs, relays	2,5	2,5	0,6
4/5 poles, 3.81 mm, additional functions, COMs	1,5	1,5	0,25

Wall mounting housing 49 HP long terminal box Characteristic B91, Dimensions in mm



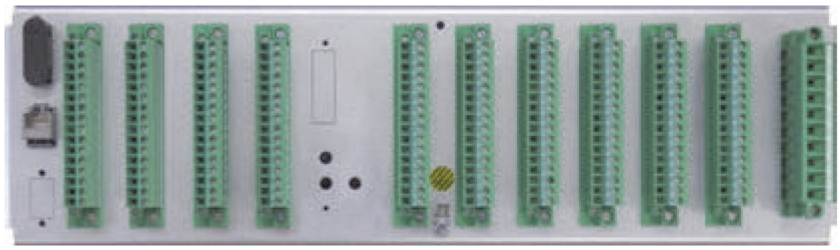
19” card rack 84 HP Front view - Characteristic B92/B93/B95



Fibre optic in-/output with ST or FSMA connector

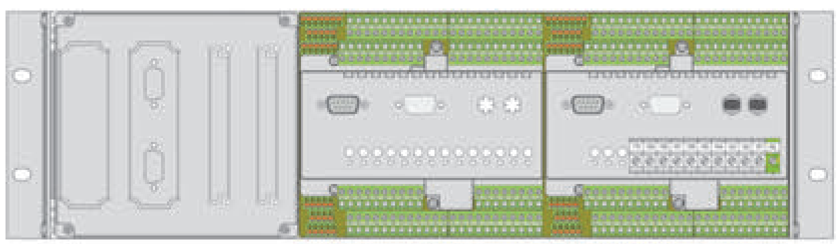
Conductor cross section and torque of the terminals							
terminal type/terminal no.	**cross section / mm²**		**torque**	**terminal type/terminal no.**	**cross section / mm²**		**torque**
	stranded	**solid**	**Nm**		**stranded**	**solid**	**Nm**
screw terminal element, 1…160	1,5	2,5	0,5	Feed-through terminal, 161 … 200	4	6	0,8

19” card rack 84 HP   Rear view with screw terminals - Characteristic B92



Conductor cross section and torque of the terminals							
connector, pitch,	**cross section / mm²**		**torque**	**connector, pitch,**	**cross section / mm²**		**torque**
application example	**stranded**	**solid**	**Nm**	**application example**	**stranded**	**solid**	**Nm**
10 poles, 7.62mm, measurement, aux. volt.	4	4	0,6	16 poles, 5mm, BIs, relays	2,5	2,5	0,6

19” card rack 84 HP with Phoenix pluggable screw terminals   Rear view - Characteristic B93



Conductor cross section and torque of the terminals							
terminal type, pitch, application example	**cross section/mm²**		**torque**	**terminal type, pitch, appl. expl.**	**cross section / mm²**		**torque**
	stranded	**solid**	**Nm**		**stranded**	**solid**	**Nm**
Feed-through terminal, measurement, aux.	4	6	0,8	Pluggable screw terminal, 5mm, binary inputs (BIs), relays	2,5	2,5	0,6
Pluggable spring type terminal, 3.5mm, COMs	1,5	1,5	--				

19” card rack 84 HP with backplane   Rear view - Characteristic B95

Backplane terminal configuration for REG-D (characteristic B95)

The below terminal configuration always applies to one device only (REG-D or PAN-D). If the MR is equipped with several devices, the terminal configuration will be identical for each device, but the terminal configuration numbers (-X1, -X2) will be different for each device.

	Description		No.
U_H	PE		PE
	L(+)		161
	N(-)		162
Voltage	U1a		163
	U1b		164
	U2a		**
	U2b		**
Current	I_{E1} s1		165
	I_{E1} s2		166
	I_{E2} s1		**
	I_{E2} s2		**
Binary inputs	BI 1 (+)		22
	BI 2 (+)		21
	GND BI 1…2 (-)		23
	BI 3 (+)		20
	BI 4 (+)		19
	BI 5 (+)		17
	BI 6 (+)		16
	BI 7 (+)		15
	BI 8 (+)		14
	GND BI 3…8 (-)		18
	BI 9 (+)	Characteristic D1	12
	BI 10 (+)		11
	BI 11 (+)		10
	BI 12 (+)	BI 9 (+)	9
	BI 9…12 (-)	BI 13 (+)	13
	BI 13 (+)	BI 10 (+)	2
	BI 13 (-)	BI 14 (+)	1
	BI 14 (+)	BI 11 (+)	4
	BI 14 (-)	BI 15 (+)	3
	BI 15 (+)	BI 12 (+)	6
	BI 15 (-)	BI 16 (+)	5
	BI 16 (+)	GND BI 9…12 (-)	8
	BI 16 (-)	GND BI 13…16 (-)	7
Binary outputs	Relay 1 (NOC)		66
			65
	Relay 1 (NCC)		64
			63
	Relay 2 (NOC)		70
			69
	Relay 2 (NCC)		68
			67

	Description	No.
	Relay 3 (NOC)	43
		42
	Relay 4 (NOC)	45
		44
	Relay 5 (NOC)	47
		46
	Common Relay 6…9	28
	Relay 6 (NOC)	27
	Relay 7 (NOC)	25
	Relay 8 (NOC)	26
	Relay 9 (NOC)	24
	Manual/Auto common	31
	Manual (NCC)	29
	Auto (NOC)	30
	Status***	49
	Status***	48
E-LAN L	EA+	116
	EA-	115
	E+	114
	E-	113
	GND	117
E-LAN R	EA+	109
	EA-	108
	E+	107
	E-	106
	GND	110
COM1-S	COM1-S	SUB -D
COM2****	COM2 TXD	97
	COM2 RXD	98
	COM2 GND	99
	COM2 RTS	96
	COM2 CTS	95
COM3	COM3 Tx+	89
	COM3 Tx-	88
	COM3 Rx+	86
	COM3 Rx-	87
	COM3 GND	90
Analogue Channels	Analogue Channel 1 (+)	105
	Analogue Channel 1 (-)	104
	Analogue Channel 2 (+)	103
	Analogue Channel 2 (-)	102
	Analogue Channel 3 (+)	101
	Analogue Channel 3 (-)	100
	Analogue Channel 4 (+)	112
	Analogue Channel 4 (-)	111
	Analogue Channel 5 (+)	92
	Analogue Channel 5 (-)	91
	Analogue Channel 6 (+)	94
	Analogue Channel 6 (-)	93

	Description				No.
	X 15, 24, 28, 29	X25	X01	XW1	
Additional BIs, relays, SCADA interface (X01, X15, X24, X25, X28, X29, XW1)	BI 17 (+)	BI 17 (+)	Rel 10 COM		80
	BI 17 (-)	BI 17 (-)	Rel 10 NOC	COM1 TxD	81
	BI 18 (+)	BI 18 (+)	Rel 10 NCC	COM1 GND	82
	BI 18 (-)	BI 18 (-)		COM1 RTS	77
	BI 19 (+)	BI 19 (+)	Rel 11 COM		83
	BI 19 (-)	BI 19 (-)	Rel 11 NOC		84
	BI 20 (+)	BI 20 (+)	Rel 11 NCC		85
	BI 20 (-)	BI 20 (-)			76
	BI 21 (+)	BI 21 (+)	Rel 12 COM		56
	BI 21 (-)	BI 21 (-)	Rel 12 NOC		57
	BI 22(+)	BI 22(+)	Rel 12 NCC		58
	BI 22 (-)	BI 22 (-)			75
	BI 23 (+)	BI 23 (+)	Rel 13 COM		59
	BI 23 (-)	BI 23 (-)	Rel 13 NOC		60
	BI 24 (+)	BI 24 (+)	Rel 13 NCC		61
	BI 24 (-)	BI 24 (-)			74
	BI 25 (+)		Rel 14 COM		73
	BI 25 (-)		Rel 14 NOC		72
	BI 26 (+)		Rel 14 NCC		71
	BI 26 (-)			RS485 P (A)*	41
	BI 27 (+)		Rel 15 COM	RS485 GND	40
	BI 27 (-)		Rel 15 NOC		39
	BI 28 (+)	BI 25 (+)	Rel 15 NCC		38
	BI 28 (-)	BI 29 (+)			55
	BI 29 (+)	BI 26 (+)	Rel 16 COM		37
	BI 29 (-)	BI 30 (+)	Rel 16 NOC		36
	BI 30 (+)	BI 27 (+)	Rel 16 NCC		35
	BI 30 (-)	BI 31 (+)			54

	Description				No.
	BI 31 (+)	BI 28 (+)	Rel 17 COM		34
	BI 31 (-)	BI 32 (+)	Rel 17 NOC		32
	BI 32 (+)	BI 25..28 (-)	Rel 17 NCC		53
	BI 32 (-)	BI 29..32 (-)			33
				COM1 RxD	79
				COM1 CTS	78
				RS485 N (B)*	62

* assignment characteristic XZ22/23: 41 RS485 N(B); 62 RS485 P(A)
** customer-specific wiring for characteristics M2, M3 and M9
*** based on characteristic U, the status contact is either NOC or CC
**** COM2 can only be used without SCADA interface installed

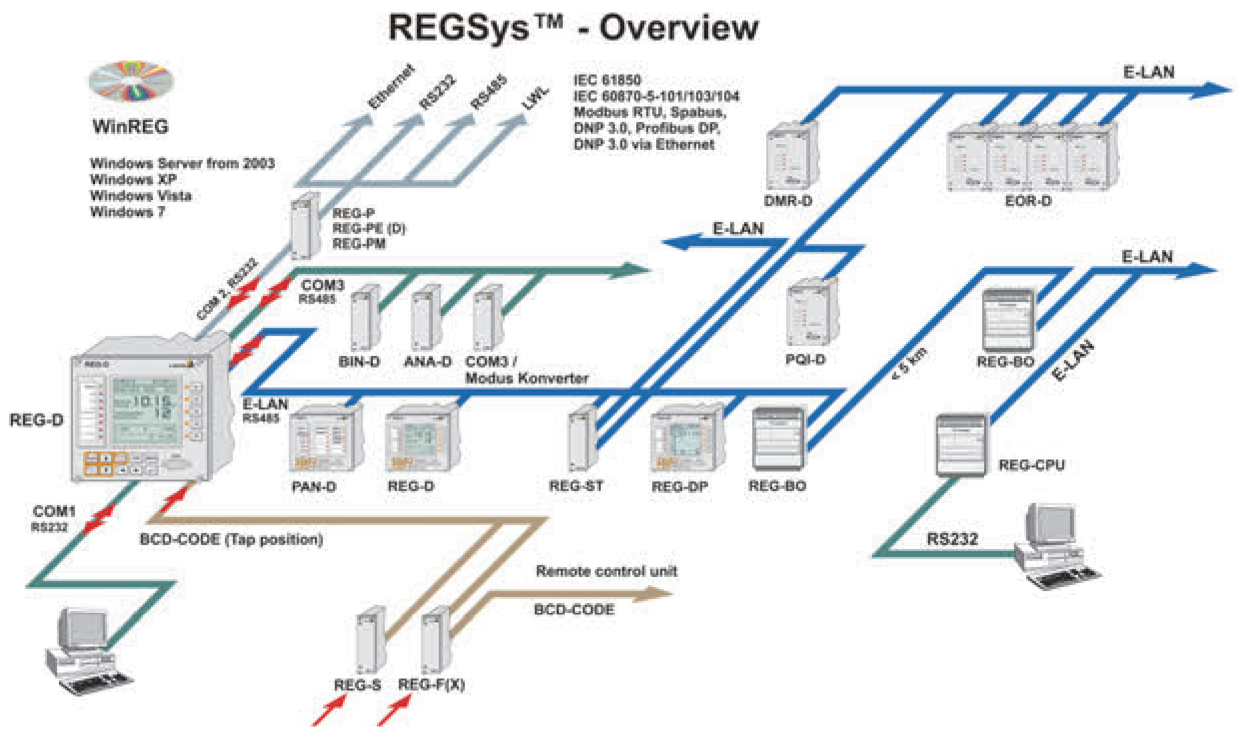
Backplane terminal configuration for PAN-D (characteristic B95)

	Description		No.
U_H	PE		PE
	L(+)		161
	N(-)		162
Voltage	U1a (L1)		163
	U1b (L2)		164
	U2a		*
	U2b (L3)		165*
Binary inputs	BI 1 (+)		22
	BI 2 (+)		21
	GND BI 1…2 (-)		23
	BI 3 (+)		20
	BI 4 (+)		19
	BI 5 (+)		17
	BI 6 (+)		16
	BI 7 (+)		15
	BI 8 (+)		14
	GND BI 3…8 (-)		18
	BI 9 (+)	Characteristic D1	12
	BI 10 (+)		11
	BI 11 (+)		10
	BI 12 (+)	BI 9 (+)	9
	BI 9…12 (-)	BI 13 (+)	13
	BI 13 (+)	BI 10 (+)	2
	BI 13 (-)	BI 14 (+)	1
	BI 14 (+)	BI 11 (+)	4
	BI 14 (-)	BI 15 (+)	3
	BI 15 (+)	BI 12 (+)	6
	BI 15 (-)	BI 16 (+)	5
	BI 16 (+)	GND BI 9…12 (-)	8
	BI 16 (-)	GND BI 13…16 (-)	7

	Description	No.
Binary outputs	Relay 1 (triggered by circuit breaker) NOC	66
		65
	Relay 1 (triggered by circuit breaker) NOC	64
		63
	Relay 2 (Emergency OFF tap changer) NOC	70
		69
	Relay 2 (Emergency OFF tap changer) NOC	68
		67
	Relay 3 (increase interlock) NOC	43
		42
	Relay 4 (decrease interlock) NOC	45
		44
	Relay 5 (freely programmable) NOC	47
		46
	Status common	31
	Status NCC (closes upon failure)	29
	Status NOC (opens upon failure)	30
	Relay 7 (tap changer failure) Common	80
	Relay 7 (tap changer failure) NOC	81
	Relay 7 (tap changer failure) NCC	82
	Relay 8 (regulator failure) Common	83
	Relay 8 (regulator failure) NOC	84
	Relay 8 (regulator failure) NCC	85
	Relay 9 (<U1) Common	56
	Relay 9 (<U1) NOC	57
	Relay 9 (<U1) NCC	58
	Relay 10 (>U2) Common	59
	Relay 10 (>U2) NOC	60
	Relay 10 (>U2) NCC	61
	Relay 11 (<<U3) Common	73
	Relay 11 (<<U3) NOC	72
	Relay 11 (<<U3) NCC	71
	Relay 12 (>>U4) Common	40
	Relay 12 (>>U4) NOC	39
	Relay 12 (>>U4) NCC	38
	Relay 13 (fast circuit switching) Common	37
	Relay 13 (fast circuit switching) NOC	36
	Relay 13 (fast circuit switching) NCC	35
	Relay 14 (freely programmable) Common	34
	Relay 14 (freely programmable) NOC	32
	Relay 14 (freely programmable) NCC	53
	Common Relay 15…18	28
	Relay 15 (NOC)	27
	Relay 16 (NOC)	25
	Relay 17 (NOC)	26
	Relay 18 (NOC)	24
ELAN-L	EA+	116
	EA-	115
	E+	114
	E-	113
	GND	117

	Description	No.
E-LAN R	EA+	109
	EA-	108
	E+	107
	E-	106
	GND	110
COM1-S	COM1-S	SUB-D
COM2**	COM2 TXD	97
	COM2 RXD	98
	COM2 GND	99
	COM2 RTS	96
	COM2 CTS	95
COM3	COM3 Tx+	89
	COM3 Tx-	88
	COM3 Rx+	86
	COM3 Rx-	87
	COM3 GND	90
Analogue Channels	Analogue Channel 1 (+)	105
	Analogue Channel 1 (-)	104
	Analogue Channel 2 (+)	103
	Analogue Channel 2 (-)	102
	Analogue Channel 3 (+)	101
	Analogue Channel 3 (-)	100
	Analogue Channel 4 (+)	112
	Analogue Channel 4 (-)	111
	Analogue Channel 5 (+)	92
	Analogue Channel 5 (-)	91
	Analogue Channel 6 (+)	94
	Analogue Channel 6 (-)	93

* customer-specific wiring for characteristic M9
** COM2 can only be used without SCADA interface installed



Interfaces and software

Several regulators need to be interconnected in a network when transformers are connected in parallel. The ΔI*sinφ, ΔI*sinφ (S) and Master-Follower parallel programs can only be implemented through the system bus (E-LAN). This bus enables each of the members in a group of parallel regulators to communicate with each other easily, without using any additional components.

The regulators do not have to be connected in order to run a parallel program that functions in accordance to the Δcosφ method. It may not be possible to connect the participants due to the long distances between them, for example.

If an interconnection needs to be established over long distances, the E-LAN can be redirected through a fibre optic cable or an Ethernet connection.

Serial interfaces

The REG-DTM and the PAN-D have two RS232 serial interfaces with three connections (COM1, COM1-S, COM2). COM1 is the parameterisation interface, while COM1-S is an alternative connection option for COM1. COM1 has priority, meaning that when COM1 has a connection, COM1-S is switched off. Devices connected to COM1-S do not have to be physically disconnected. This enables COM1-S to function as an alternative remote parameterisation interface that is only active when parameters are not being set locally. COM1 can also be configured as a USB port (optional).

COM2 is mainly used to connect the regulator to the SCADA system. If a SACDA interface is not installed, COM2 in the terminal compartment can be used to connect a modem, a COM server, a PC or a DCF77 receiver.

Connection elements

COM1	Sub-D 9-pole male (optionally as mini USB) at the front of the device
COM1-S (switched off when COM1 is used)	Male multipoint connector (printed circuit board VI) depends on the housing
COM2	Male multipoint connector (printed circuit board VI) depends on the housing
Connection options	PC, modem, PLC, SCADA connection module, DCF77 signal
Number of data bits/protocol	Data bits: 8 Parity: even, none
Transmission rate bit/s	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
HANDSHAKE	RTS / CTS, XON / XOFF, delay, none

ELAN (**E**nergy - **L**ocal **A**rea **N**etwork)

Each REG-D^{TM} regulator comes with two ELAN interfaces that are used to connect individual regulators and monitoring units to a voltage regulation system.

ELAN characteristics

- 255 addressable participants
- Multi-master structure
- Integrated repeater function
- Open ring, bus or point-to-point connection possible
- Transmission rate 15.6 ... 375 kbit/s

COM3 (peripheral interface)

The COM3 is an RS485 or optional fibre optic interface used to connect up to 16 interface modules (BIN-D, ANA-D) in any combination to a REG-D or PAN-D. A COM3/Modbus converter can also be selected, in order to establish direct serial communication with other Modbus devices. This enables the REGSys^{TM} to acquire values such as the winding temperature or the gas-in-oil ratio from other devices and transmit them to the SCADA or record them in Recorder mode.

Time Synchronisation

A time synchronisation input enables the time on the REG-D or PAN-D to be synchronised using a DCF77 signal. This input is designed for an RS485 (5 V) signal and can be wired as a time synchronisation bus to several devices. The termination (terminating resistor) can be switched on and off by using jumpers on the CPU board.

If a DCF signal cannot be received, a GPS clock or controller card that emulates a DCF signal can be used. Time can also be synchronised through SCADA.

Time synchronisation input is not supported until firmware version 2.22.

WinREG parameterisation and configuration software

WinREG is used to parameterise and program the a system. WinREG is modular and consists of the following programs:

PanelView enables you to display an accurate replica of each device and its operating options on your PC screen. All buttons and functions are active from this replica, and multiple devices on the ELAN can be displayed at once.

REGPara enables each of the components to be quickly and easily parameterised. The parameters are set in a straightforward tab structure, and can be saved for later use or transferred to another regulator on the ELAN bus.

The **Terminal** enables direct communication with the system.

The WinREG Terminal is much easier to use than the normal terminal programs and makes programming the system a lot easier.

Service enables the logbook and the tap statistics to be read out of the devices and archived. This is also where the parameters for daylight savings, the allocation of add-on modules, and the remote control of simulation mode are found.

The **Collector** reads the recorded data from the REG-D(A) and archives it on the PC.

REGView is used to view and analyse recorded data directly on the REG-D(A) or in a data file (collector).

The **WinTM** module (parameters for the transformer monitoring module) and the **WinDM** module (parameters for the transformer monitoring device without voltage regulator) complete the software suite.

WinREG runs on the following operating systems:

- Windows XP, Vista, Windows 7
- Windows Server from 2003 onwards

All of the settings can be made either directly on the regulator using the regulator's membrane keyboard, or centrally through WinREG. If the device is to be accessed through a central point, all of the regulators must be connected to each other through the ELAN.

REG-D parameters (selection)

Parameter	Setting range
permissible voltage deviation	± 0.1 ... 10 %
Time factor	0.1 ... 30
Setpoint value 1..2	60.0 ... 140.0 V
Setpoint value 3..4	60.0 ... 140.0 V or -140 ... 140 % for P/Q regulation
Time behaviour	ΔU · t = const REG 5A/E LINEAR CONST
Trend memory	0 ... 60 s
current influence (load-dependent setpoint)	Apparent current Active current Reactive current LDC
Apparent, active, reactive current Increase (I) (pos.) Increase (I) (neg.) Limit (I) (max.) Limit (I) (min.)	0 ... 400 V/In 0 ... 400 V/In -40 ... 40 V -40 ... 40 V
LDC (Line drop compensation)	R : 0 ... ± 30 Ω X : 0 ... ± 30 Ω
Undervoltage <U	-25 % ... +10 %
Overvoltage >U	0 ... 25 %
Overcurrent >I	0 ... 210 % (1A / 5A)
Undercurrent >I	0 ... 100 % (1A / 5A)
Inhibit High	65 V ... 150 V
Fast switching forward	0 ... -35 %
Fast switching backward	0 ... 35 %
Inhibit low	-75 % ... 0 %
Switching delay for <U, >U, <I, Inhibit high, Fast switching, Inhibit low can be set separately	1 ... 999 s (Fast step-up 2...999 s)

Parameter	Setting range
Parallel programs	dI*sin(phi) dI*sin(phi)[S] dcos (phi) Master-Follower MSI MSI2
TC in operation - maximum time*	3 ... 40 s

* when a PAN-D is available, the TC in operation signal is monitored by the PAN-D.

PAN-D parameters (selection)

Parameter	Setting range
Undervoltage <U_1	-25 ... 10 %
Overvoltage >U_2	0 ... 25 %
Undervoltage «U_3	-35 ... 10 %
Overvoltage »U_4	0 ... 35 %
Inhibit high	65 V ... 150 V
Switching delay for <U_1, >U_2, «U3, »U4, Inhibit high (independent setting for each limit)	1 ... 999 s
TC in operation - maximum time	3 ... 40 s

REGSim™ simulation software

REGSim™ was designed to simulate the parallel connection of several transformers in any network and load configuration, and to show the results on a PC.

To ensure that the REG-D™ produces the same results during the simulation as in a live environment, the transformers, the network and the load are accurately recreated mathematically.

The authenticity of the simulation is guaranteed because REGSim™ uses the REG-D™ relay's original algorithm.

All of the settings match those of the real regulator and the simulation is run in real time.

REGSim™ enables parameters to be tested and set before using them in a live environment.

Order specifications

- Only one code of the same capital letter is possible
- When the capital letter is followed by number 9, further details are necessary
- The code can be omitted when the capital letter is followed by zero or one option is marked as standard

CHARACTERISTIC	CODE	
	REG-D™	PAN-D
REG-D™ Relay for Voltage Control & Transformer Monitoring Plug-in module 28 HP, 3 U basic configuration with dual ELAN interface, COM1, COM2, 16 binary inputs, 10 relay outputs and status relays and WinREG parameterisation and programming software incl. connection cable	REG-D™	
PAN-D Monitoring unit Plug-in module 28 HP, 3 U basic configuration with dual ELAN interface, COM1, COM2, 16 binary inputs, 14 relay outputs and status relays		PAN-D
Design		
• 19" plug-in module	B01	B01
• Wall mounting housing (30 HP) - without wiring	B02	B02
• Wall mounting housing (30 HP) - with wiring (terminals are compatible with REG 5A)	B03	-
• Wall mounting housing (30 HP) - with wiring (terminals are compatible with Pantavolt 2)	-	B03
• Panel mounting housing (30 HP) - with wiring	B05	B05
• Panel mounting housing (49 HP) - with wiring	B06	B06
• Wall mounting housing (49 HP) - with wiring	B07	B07
• Wall mounting or Panel mounting housing (30/49 HP) on request	B91	B91
• 19“ card racks with screw terminals on request	B92	B92
• 19“ card racks with Phoenix pluggable screw terminals on request	B93	B93
• 19“ backplane card racks on request	B95	B95
Power supply		
• from the measuring circuit AC 80 V ... <u>110 V</u> ... 185 V	H0	H0
• external AC 85 V ... <u>110 V</u> ... 264 V / DC 88 V ... 220 V ... 280 V	H1	H1
• external AC 85 V ... 110 V ... 264 V / DC 88 V ... 220 V ... 280 V, 20 Watt Note: H11 for REG-PE with fibre optic connection without separate REG-NTZ	H11	-
• external DC 18 V ... <u>60 V</u> ... 72 V	H2	H2
COM1 serial interface in the front panel		
• RS232 with SUB-D connector (9-pin male), standard if characteristic I is not specified	I0	I0
• USB (Mini-USB connector)	I1	I1
Input current (can be changed at a later stage)		
• I_{EN} 1A	F1	-
• I_{EN} 5A	F2	-
Voltage and current measurement		
• Three-wire three-phase system with equal load (1 x voltage, 1 x current)	M1	-
• Three-wire three-phase system, three-phase voltage measurement only	-	M1
• Three-wire three-phase system with unequal load (ARON connection)	M2	-
• U measurement high voltage, U and I measurement low voltage	M3	-
• other transducer applications (2 x I only for REG-D, 2 x U, e.g. three winding transformer)	M9	M9

CHARACTERISTIC	CODE	
	REG-D™	PAN-D
Recorder function for quantities U, I, P, Q, S, PF, tap position incl. REGView visualisation software		
• without	S0	S0
• with max. 3 channels	S1	S1
• with max. 256 channels and 108 MB internal memory and upgraded CPU (better performance for e.g. the PLC functionality)	S2	-
Parallel operation		
• without firmware for parallel operation	K0	-
• with firmware for parallel operation	K1	-
Transformer monitoring		
• without transformer monitoring	TM0	-
• with transformer monitoring in accordance to IEC 60354 and IEC 60076	TM1	-
• additional calculation of the moisture in cellulose and the risk of bubble formation (TM+, Moisture Assessment Module) Note: The feature TM2 is only available in combination with the features S2 and TM1	TM2	
Analogue inputs and outputs		
• without	E00	E00
• with 2 inputs	E91	E91
• with 4 inputs	E92	E92
• with 6 inputs	E93	E93
• with 2 outputs	E94	E94
• with 4 outputs	E95	E95
• with 6 outputs	E96	E96
• with 2 inputs and 2 outputs	E97	E97
• with 2 inputs and 4 outputs	E98	E98
• with 4 inputs and 2 outputs	E99	E99
• PT100 direct input (three-wire circuit)	E901	E901
• any combination on request, 2 analogue inputs and outputs each, PT100 direct input, resistance measurement input (tap position potentiometer)	E900	E900
Note: A total of three modules can be used. This is particularly important when the transformer monitoring module is used!		
Note: **Please specify scaling if known:** Example: Channel 1: -100 ... 0 ... + 100 MW -20 ... 0 . . . + 20 MW Channel 2: 0 ... 80 ... 100 V 4 ... 16 . . 20 mA Channel 3: 1 ... 19 taps 0 ... 20 mA		
Binary inputs (freely programmable)		
• E1...E8: AC/DC 48 ... 250 V, E9 ... E16: AC/DC 10 ... 50 V (can also be used as BCD input)	D1	D1
• E1...E16: AC/DC 48 ... 250 V (can also be used as BCD input)	D2	D2
• E1...E16: AC/DC 10 ... 50 V (can also be used as BCD input)	D3	D3
• E1...E16: AC/DC 80 ... 250 V (can also be used as BCD input)	D4	D4
• E1...E16: AC/DC 190 ... 250 V (can also be used as BCD input)	D5	D5
Additional inputs and outputs (freely programmable), not in combination with XW1		
• without	X00	-
• 8 additional relays (change-over contact)	X01	-
• 16 additional binary inputs E17...E32: AC/DC 48 ... 250V	X15	-
• 16 additional binary inputs E17...E32: AC/DC 10 ... 50V	X24	-
• 16 additional binary inputs E17...E24: AC/DC 48 ... 250 V, E25...E32 AC/DC 10 ... 50V	X25	-
• 16 additional binary inputs E17...E32: AC/DC 190 ... 250 V	X28	-
• 16 additional binary inputs E17...E32: AC/DC 80 ... 250V	X29	-
COM3 interface		
• without	R0	R0
• with RS485	R1	R1
Note: COM3 is needed for ANA-D, BIN-D and COM3/Modbus converter! If a fibre optic connection for the COM3 is needed, please select the according feature of the housing or rack or specify it with additional text on the order		

CHARACTERISTIC	CODE	
	REG-D™	PAN-D
SCADA connection: internal or external		
• without (continue with characteristics group 'Y')	XW0	XW0
• with internal protocol interface (continue with characteristic group 'XL'), **only with characteristic X00**	XW1	XW1
• with external protocol interface: REG-P/-PE/-PED/-PM (continue with characteristic group 'Y')	XW9	XW9
Integrated protocol interface card		
• to connect one REG-D™ to SCADA	XL1	-
• to connect several systems to SCADA	XL9	-
Note: XL9 can only be combined with XZ15...XZ19, XZ91		
Connection type		
• Copper conductors		
– RS232	XV10	-
– RS485 2-wire operation only	XV11	-
Note: XV13 ... XV19 can only be selected with B02...B95. In all other cases, select a suitable fibre optic cable module!		
• Fibre optic cable with FSMA connection technology		
– Fibreglass (Wave length 800...900 nm, range 2000 m)	XV13	-
– All-plastic (Wave length 620...680 nm, range 50 m)	XV15	-
• Fibre optic cable with ST connection technology		
– Fibreglass (Wave length 800...900 nm, range 2000 m)	XV17	-
– All-plastic (Wave length 620...680 nm, range 50 m)	XV19	-
Protocol		
• IEC60870-5-103 for ABB	XZ10	-
• IEC60870-5-103 for Areva	XZ11	-
• IEC60870-5-103 for SAT	XZ12	-
• IEC60870-5-103 for Siemens (LSA/SAS)	XZ13	-
• IEC60870-5-103 for Sprecher Automation	XZ14	-
• IEC60870-5-103 for others	XZ90	-
• IEC60870-5-101 for ABB	XZ15	-
• IEC60870-5-101 for IDS	XZ17	-
• IEC60870-5-101 for SAT	XZ18	-
• IEC60870-5-101 for Siemens (LSA/SAS)	XZ19	-
• IEC60870-5-101 for others	XZ91	-
• DNP 3.00	XZ20	-
• LONMark (ask for availability)	XZ21	-
• SPABUS	XZ22	-
• MODBUS RTU	XZ23	-
Local/Remote control via keyboard (local/remote key)		
• without	Y0	-
• with	Y1	-
Status contact		
• closes in case of malfunction (NC contact)	U0	-
• opens in case of malfunction (NO contact)	U1	-

CHARACTERISTIC	CODE	
	REG-D™	PAN-D
Operating instructions		
German	G1	G1
English	G2	G2
French	G3	G3
Spanish	G4	G4
Italian	G5	G5
Russian	G6	-
Portuguese	G7	-
Czech	G8	-
other on request	G10	-
Display language		
same as the operating manual	A0	-
German	A1	-
English	A2	-
French	A3	-
Spanish	A4	-
Italian	A5	-
Russian	A6	-
Portuguese	A7	-
Czech	A8	-
Dutch	A9	

REG-Sys™ Accessories		ID-No.
Rack design:		
Female multipoint connector 1	(Electrical connector block, model F, wire wrap 32 pins)	582.0197
Female multipoint connector 1	(Electrical connector block, model F, wire wrap 48 pins)	582.0196.01
Female multipoint connector 1	(Electrical connector block, model F, 2.8 FASTON, 32 pins)	582.0213.01
Female multipoint connector 1	(Electrical connector block, model F, 2.8 FASTON, 48 pins)	582.0213
Female multipoint connector 2	(Current input with advanced contacts, 2 pole)	582.0258.10
Female multipoint connector 4	(Current input with advanced contacts, 6 pole)	582.0258.20
Female multipoint connector 3	(Mixed connector model F24 + H7, wire wrap)	582.0215
Female multipoint connector 3	(Mixed connector model F16 + H7, 6.3/2.8 FASTON)	582.0214
Female multipoint connector 3	(Mixed connector model F24 + H7, 6.3/2.8 FASTON)	582.0217
panel plate 28 HP		566.0028
panel plate 18 HP		566.0018
panel plate 14 HP		566.0014
panel plate 10 HP		566.0010
panel plate 8 HP		566.0008
panel plate 7 HP		566.0007
panel plate 6 HP		566.0006
panel plate 5 HP		566.0005
panel plate 4 HP		566.0004
panel plate 2 HP		566.0002

REG-Sys™ Accessories	ID-No.
Fuses, batteries:	
1 pack microfuses T1 L 250 V, 1 A, for auxiliary voltage range H0 and H1	582.1002
1 pack microfuses T2 L 250 V, 2 A, for auxiliary voltage range H2	582.1019
1 lithium battery (pluggable)	570.0003.00
1 lithium battery (solderable)	on request
1 button cell CR1632	on request
Connection technique:	
PC connection cable (null-modem cable)	582.020B
Modem connection cable	582.2040
RS232 10 m extension cable	582.2040.10
USB/RS232 adapter with integrated null-modem cable (FTDI), 1,5m	111.9046.01
Interface E-LAN-FO: RS485/FO (E-LAN → FO or FO→ E-LAN) FO-connector ST Note: 2 units required per line! connection, 2 units needed for each line	111.9030.10
Interface E-LAN-FO: RS485/FO (E-LAN → FO or FO→ E-LAN) FO-connector LC Note: 2 units required per line! connection, 2 units needed for each line	111.9030.11
E-LAN Booster, Uh: DC 20…75V, DIN-rail, 22.5mm; power supply 111.9030.36 if necessary	111.9027.02
E-LAN Router, one output with Booster; Uh: DC20…75V DIN-rail type, 22,5mm; power supply 111.9030.36 if necessary	111.9027.03
Time synchronisation:	
Radio controlled clock (DFC 77)	111.9024.01
GPS radio clock NIS time, RS485, Uh: AC 85 V ... 110V ... 264 V / DC 88 V ... 220V ... 280V	111.9024.45
GPS radio clock NIS time, RS485, Uh: DC 18 V ... 60V ... 72V	111.9024.46
GPS radio clock NIS time, RS232, Uh: AC 85 V ... 110V ... 264 V / DC 88 V ... 220V ... 280V	111.9024.47
GPS radio clock NIS time, RS232, Uh: DC 18 V ... 60V ... 72V	111.9024.48
Modems:	
Develo MicroLink 56Ki analogue modem, tabletop device incl. 230 V AC mains adapter	111.9030.02
Develo MicroLink 56Ki analogue modem, DIN-rail device incl. 230 V AC mains adapter	111.9030.03
Industrial analogue modem that can be used as dial-up modem or dedicated line; (Uh: AC 20..260 V/DC 14 V..280 V) with DIN-rail adapter; can be used with the PC and the device!	111.9030.17
Insys industrial analogue modem that can be as a dedicated line; supply voltage DC: 10…60 V, can be used with the PC and the device!	111.9030.20
ISDN modem for DIN-rail mount; Uh: DC 10 … 60 V	111.9030.27
ISDN modem as tabletop device; incl. 230 V AC power supply adapter	111.9030.37
GPRS modem (Insys) for DIN-rail mount; incl. magnet foot antenna and parameterisation software; Uh: DC 10 ..60 V	111.9030.29
Power supply:	
Phoenix power supply adapter for DIN-rail mounting: In: AC 120 V...230 V, DC 90 … 250 V,	111.9005.02
Power supply for DIN-rail mounting: In: AC 80 V...250 V; Out: DC 24 V	111.9030.31
Power supply for DIN-rail mounting: In: DC 18 V...60 V...72 V; Out: DC 24 V	111.9030.32
Power supply for E-LAN router or booster: In: AC 100 to 240 V, Out: 24 V/1.3 A	111.9030.36
UPS HighCAP2403-1AC, In: 230 V AC Out: 24 V DC, max. 3 A, 1000 Joule (1 kWs), DIN-Rail	111.9030.38
Additional input and output module:	
Analogue input module (2 inputs)	320.0004.00
Analogue output module (2 outputs)	320.0003
Input module for tap-potentiometer total resistance 180 ...2 kΩ, min. 5 Ω/tap	320.0002.01
Input module for tap-potentiometer total resistance 2 ...20 kΩ, min. 50 Ω/tap	320.0002.03

REG-Sys™ Accessories	ID-No.
Input module for PT100 in conformity with DIN 43760 in three-wire connection	320.0005.01
Operating manual:	
Additional operating manual for REG-D™ and PAN-D	GX
Additional operating manual for REG-REG-D™ (please specify the language)	GX

Add-ons for REG-D/PAN-D	ID-No.
Transformer Monitoring Module - TMM (REG-D only)	**TMM**
• Consists of:	
– Firmware update (> 2.x)	
– User guide and parameterisation module WinTM for WinREG	
– Analogue module with two inputs for the temperature transducer	A1
– Input for PT100 in a three-wire circuit in conformity with DIN 43760	A2

Software for REG-D/PAN-D	ID-No.
REGView as CD-ROM WinREG add-on functions Collector and RegView to archive and view data recorded with REG-D(A) and PAN-D.	**REGView**
REGSim as CD-ROM, Simulates the parallel operation of transformers	**REGSim**

General add-ons	ID-No.
Profibus DP module incl. RS485 interface and connection cable	**Profi-DP**
• Model:	
– Mountable on DIN-rail (120 x 75 x 27) mm with ext. 24 V power supply adapter	B0
– Plug-in module: 12 HP/3 U incl. AC 85...264 V mains adapter, DC 88...280 V	B1
– Plug-in module: 12 HP/3 U incl. DC 18...72 V mains adapter	B2
TCP/IP adapter	**REG-COM**
TCP/IP adapter (10 Mbit)	
• Model	
– Mountable on DIN-rail with 230 V AC power supply adapter for U_H	A01
– as plug-in module 8 HP, 3 U with mains adapter: AC 85 V ... 110V ... 264 V / DC 88 V ... 220 V ... 280 V	A02
– as plug-in module 8 HP, 3 U with mains adapter: DC 18 V ... 60V ... 72V	A03
TCP/IP adapter (100 Mbit)	A90
COM3 converter COM3 to Modbus converter to connect external devices with Modbus interface to the transformer monitoring module. For example, to analyse the gas-in-oil ratio online, directly measure the winding temperature, etc.	**COM3-MOD**
• Auxiliary voltage	
– AC 85...264 V, DC 88 ... 280 V, DC 18 ... 72 V	H1
– DC 18 ... 72 V	H2

General add-ons	ID-No.
IRIG-DCF77 – converter	**IRIG-DCF**
• Auxiliary voltage	
– AC 85 … 264 V, DC 88…280 V	H1
– DC 18 … 72 V	H2
• Model	
– Plug-in module 10 HP, 3 U	B1
– Wall-mounting housing 20 HP	B2
• Operating instructions	
– German	G1
– English	G2
Power supply adapter for REG-PE 3 U/6 HP, 15 Watt	**REG-NTZ**
Must always be used when the 19” rack doesn't have a REGSys device or Usync and for module 2 when the 19” rack is not configured with an H11 device and a Usync is not integrated.	
• Auxiliary voltage	
– AC 85…264 V, DC 88 … 280 V	H1
– DC 18 … 72 V	H2

21.2 List of parameters incl. factory settings

The following tables show the parameters of the REG-D™, the ranges and the according factory settings (not the settings after a master reset). The settings on delivery may deviate based on customer or order specific requirements. The settings given in the column Range can vary based on age or variant of the hard- and firmware. In the column Value your current settings or device configuration can be noted. Alternatively, it is possible to print the current settings in WinREG.

Basic values

No.	Parameter	Range	Step size	Default	Value
1	Permissible deviation	± 0,1 ... 10 %	±0,05 %	2,0 %	
2	Setpoint 1	60,0 ... 140,0 V	±0,1 V	100,0 V	
3	Setpoint 2	60,0 ... 140,0 V	±0,1 V	100,0 V	
4	Setpoint 3	60,0 ... 140,0 V oder -140 ... 140 % at P-regulation	±0,1 V	100,0 V or 100%	
5	Setpoint 4	60,0 ... 140,0 V oder -140 ... 140 % at Q-regulation	±0,1 V	100,0 V or 100%	
6	100% value of setpoint 1	60,0 ... 140,0 V	±0,1 V	100,0 V	
7	100% value of setpoint 2	60,0 ... 140,0 V	±0,1 V	100,0 V	
8	100% value of setpoint 3	60,0 ... 140,0 V	±0,1 V	100,0 V	
9	100% value of setpoint 4	60,0 ... 140,0 V	±0,1 V	100,0 V	
10	Time behaviour	ΔU*t = const REG 5A/E LINEAR CONST		ΔU*t = const	
11	Time factor	0,1 ... 30	0,1	1	
12	Time delay T1	1 ... 600s	1 s	1s	
13	Time delay T2	1 ... 600s	1 s	1s	
14	Trend memory	0 ... 60 s	1 s	0 s (OFF)	

Current influence

No.	Parameter	Range	Step size	Default	Value
15	Current influence	Apparent curr. Active current Reactive cur- rent LDC		none	
16	Gradient (I) (pos.)	0 ... 400 V/In	0,1 V/In	0 V/In	
17	Gradient (I) (neg.)	0 ... 400 V/In	0,1 V/In	0 V/In	
18	Limitation(I) (max.)	-40 ... 40 V	0,1 V	0 V	
19	Limitation(I) (min.)	-40 ... 40 V	0,1 V	0 V	
20	LDC resistance R	-30 ... 30 Ω	±0,1 Ω	0 Ω	
21	LDC reactance X	-30 ... 30 Ω	±0,1 Ω	0 Ω	

Parallel operation

No.	Parameter	Range	Default	Value
22	Parallel program	None dIsin(φ) dcos(φ) dIsin(φ)[S] Master-Follower MSI MSI2	None	
23	Parallel program activation	OFF ON LEVEL PULSE	OFF	
24	ParaGramer activation	0 ... 10 Transf.	0	
25	Grouplist member 1	---, A:, A1:, ... , Z4:	---	
26	Grouplist member 2	---, A:, A1:, ... , Z4:	---	
27	Grouplist member 3	---, A:, A1:, ... , Z4:	---	
28	Grouplist member 4	---, A:, A1:, ... , Z4:	---	
29	Grouplist member 5	---, A:, A1:, ... , Z4:	---	
30	Grouplist member 6	---, A:, A1:, ... , Z4:	---	
31	Grouplist member 7	---, A:, A1:, ... , Z4:	---	
32	Grouplist member 8	---, A:, A1:, ... , Z4:	---	
33	Grouplist member 9	---, A:, A1:, ... , Z4:	---	
34	Grouplist member 10	---, A:, A1:, ... , Z4:	---	

No.	Parameter	Range	Default	Value
35	Permissible Icirc	0 … 9999 A	9999 A	
36	Max. tap difference	0 … 6	0, No super-vi-sion	
37	cos (φ) net	0 … 1 ind/cap.	0	
38	Trafo nominal power	10 k … 9999 MVA	10 kVA	
39	Limitation dcos(φ)	0 … 20	20	
40	Manual/Auto comparision on M/F start	MasterPrio HandPrio	MasterPrio	
41	Master-Follower: First ParErr after n*TC in operation time	0 … 15	4	

Limits

No.	Parameter	Range	Step size	Default	Value
42	Inhibit high	65 … 150 V	±0,1 V	125 V	
43	Fast backward swich-ing	0 … 35 %	±0,1 %	10,0 %	
44	Overvoltage	0 … 25 %	±0,1 %	10,0 %	
45	Undervoltage	-25 … 10 %	±0,1 %	-10,0 %	
46	Fast forward switching	-35 … 0 %	±0,1 %	-10,0 %	
47	Inhibit low	- 75 … 0 %	±0,1 %	- 25,0 %	
48	Overcurrent	0 … 210 %	±1 %	100,0 %	
49	Undercurrent	0 … 100 %	±1 %	0,0 %	
50	Threewinding limit >Ub	0 … 25 %	±0,1 %	5,0 %	
51	Delay inhibit high	0 … 999 s	±1 s	0 s	
52	Delay fast backward sw.	0 … 999 s	±1 s	0 s	
53	Delay overvoltage	0 … 999 s	±1 s	0 s	
54	Delay undervoltage	0 … 999 s	±1 s	0 s	
55	Delay fast forward sw.	0 … 999 s	±1 s	2 s	
56	Delay inhibit low	0 … 999 s	±1 s	0 s	
57	Delay over-/undercur-rent	0 … 999 s	±1 s	0 s	

Tapchanger

No.	Parameter	Range	Default	Value
58	Tap position (indication)	OFF ON	OFF	
59	Max. TC in operation time	3 … 40 s	5 s	
60	Tap 0 debounced longer (6s)	OFF ON	ON	
61	Tap limiter	OFF ON	ON	
62	Lower tap limit	- 63 … 63	0	
63	Upper tap limit	- 63 … 63	0	
64	Inverse tapchanger *	No Yes Yes with relay swap	No	

* Parameter selectable only via WinREG

Configuration

No.	Parameter	Range	Step size	Default	Value
65	Latch type (auto/manual latched after reset)	WITH WITHOUT		WITH	
66	Auto/manual switch	E5-A/E6-H E5-PULSE E5+6-PROG		E5-A/E6-H	
67	Current display	OFF ON		OFF	
68	LCD saver	OFF ON		OFF	
69	LCD contrast*	-15 … 15	±1	0	
70	Large display	OFF ON		OFF	
71	Auto locked on ELAN error	OFF ON		OFF	

No.	Parameter	Range	Step size	Default	Value
72	Configuration VT	L1L2 L2L3 L3L1 L1N L2N L3N ARON		L1L2	
73	VT factor 1 (KNU 1)	0.01 … 9000	0.01	1	
74	VT factor 2 (KNU 2)	0.01 … 9000	0.01	1	
75	Polarity VT 1 inverted	NO YES		NO	
76	Polarity VT 2 inverted	NO YES		NO	
77	Actual value correction VT*	-20 … 20 %	±0,1 %	0 %	
78	Configuration CT	L1 L2 L3 ARON OFF		L1	
79	Nominal current	1 / 5 A		Order code F	
80	CT factor 1 (KNI 1)	0.01 … 90000	0.01	1	
81	CT factor 2 (KNI 2)	0.01 … 90000	0.01	1	
82	Polarity CT 1 inverted	NO YES		YES	
83	Polarity CT 2 inverted	NO YES		NO	
84	Actual value correction CT*	-20 … 20 %	±0,1 %	0 %	

* Parameter can be set only at the REG-D™ itself, not in WinREG.

Functions

No.	Parameter	Range	Default	Value
85	Creeping net breakdown	OFF PRIM SEC	OFF	
86	Lock Time	Hand 1 min 3 min 5 min 10 min 15 min 20 min	15 min	
87	Time slice	15 … 120s, in 15 s Schritten	30 s	
88	Number of changes	2 … 6	2	
89	Limit base	Setpoint Un=100V Un=110V	Setpoint	
90	R/L relay: ON time	0.5 … 6 s	2,0 s	
91	Setpoint adjustment with <> keys	OFF 0.1 % 0.2 % 0.5 % 1.0 % 1.5 % 2.0 % PROG SPIndex	OFF	
92	Setpoint adjustment with bi-nary inputs	0.1 % 0.2 % 0.5 % 1.0 % 1.5 % 2.0 %	1.0 %	
93	Block if <I or >I	OFF >I+<I >I <I	OFF	
94	Block highspeed switching	OFF ON	OFF	

No.	Parameter	Range	Default	Value
95	Language	German English Spanish Italian French Dutch Czech Russian Polish Portuguese	Order code A	
96	Rolling Screens after *	0 … 10 min	0 (off)	
97	Time for Rolling Screens *	3 … 15 s	5 s	

* Parameter can be set only at the REG-D™ itself, not in WinREG.

System

No.	Parameter	Range	Default	Value
98	Station ID (Address in E-LAN)	A:, A1:, … , Z4:	A:	
99	Name	8 Characters	REG-D	
100	Group*	8 Characters	REG	
101	COM1 Mode	ECL ECLADR PROFI ELAN-L ELAN-R DCF77	ECL	
102	COM1 Baudrate	1200 2400 4800 9600 19200 38400 57600 115200 230400 (S2) 460800 (S2) 921600 (S2)	115200	
103	COM1 Parity	NONE (--) EVEN	NONE	

No.	Parameter	Range	Default	Value
104	Handshake COM1	NONE (--) XON/XOFF RTS/CTS DELAY	RTS/CTS	
105	COM2 Mode	OFF ECL ECL+HP ECLADR PROFI ELAN-L ELAN-R DCF77	ECL	
106	COM2 Baudrate	1200 2400 4800 9600 19200 38400 57600 115200 230400 (S2) 460800 (S2) 921600 (S2)	9600, or dependent on the con-nected telecontrol card	
107	COM2 Parität	NONE (--) EVEN	None, or dependent on the con-nected telecontrol card	
108	COM2 Handshake	NONE (--) XON/XOFF RTS/CTS DELAY	XON/XOFF, or dependent on the con-nected telecontrol card	
109	ELAN left Mode	2- wire 4- wire	2-wire	
110	ELAN left Baudrate	15K6 31K2 62K5	62K5	

No.	Parameter	Range	Default	Value
		125K 375K		
111	ELAN left termination	ON OFF	ON	
112	ELAN right Mode	2- wire 4- wire	2-wire	
113	ELAN right Baudrate	15K6 31K2 62K5 125K 375K	62K5	
114	ELAN right termination	ON OFF	ON	

* Parameter selectable only via WinREG
(S2) only available with order code S2

Binary in-/outputs

No.	In-/Output	Range	Default		Value	
			Function	Inverted	Function	Invert.
115	Binary input 1	Input functions	up	No		
116	Binary input 2		down	No		
117	Binary input 3		Inh.Low	No		
118	Binary input 4		Quick	No		
119	Binary input 5		[AUTO]	No		
120	Binary input 6		[MANUAL]	No		
121	Binary input 7		OFF	No		
122	Binary input 8		OFF	No		
123	Binary input 9		OFF	No		
124	Binary input 10		OFF	No		
125	Binary input 11		OFF	No		
126	Binary input 12		OFF	No		
127	Binary input 13		OFF	No		
128	Binary input 14		OFF	No		
129	Binary input 15		OFF	No		
130	Binary input 16		OFF	No		
131	Binary input 17		OFF	No		

No.	In-/Output	Range	Default		Value	
			Function	Inverted	Function	Invert.
132	Binary input 18		OFF	No		
133	Binary input 19		OFF	No		
134	Binary input 20		OFF	No		
135	Binary input 21		OFF	No		
136	Binary input 22		OFF	No		
137	Binary input 23		OFF	No		
138	Binary input 24		OFF	No		
139	Binary input 25		OFF	No		
140	Binary input 26		OFF	No		
141	Binary input 27		OFF	No		
142	Binary input 28		OFF	No		
143	Binary input 29		OFF	No		
144	Binary input 30		OFF	No		
145	Binary input 31		OFF	No		
146	Binary input 32		OFF	No		
147	Binary output 1	Relay functions	up	No		
148	Binary output 2		down	No		
149	Binary output 3		OFF	No		
150	Binary output 4		OFF	No		
151	Binary output 5		OFF	No		
152	Binary output 6		OFF	No		
153	Binary output 7		OFF	No		
154	Binary output 8		OFF	No		
155	Binary output 9		OFF	No		
156	LED 1	LED functions	OFF	No		
157	LED 2		OFF	No		
158	LED 3		OFF	No		
159	LED 4		OFF	No		
160	LED 5		<U	No		
161	LED 6		>U	No		
162	LED 7		>I	No		

Analog channels

No.	Parameter	Range	Default	Value		
				Channel 1	Channel 2	Channel 3
				Channel 4	Channel 5	Channel 6
163	Analogue function	Analogue functions see chapter 8.2.5	ANA			
164	Scaling (para-meter selection)	ALL Fac+Off P0P2 P0P1P2 ModBus	P0P2			
165	Limitation at	None High Low High+Low	None			
166	Resolution	100 … 10000	2000			
167	Datapoint 0 X-Value (ModBus-Ad-dress if parameter se-lection = ModBus)	-10^{12} … 10^{12}	0			
168	Datapoint 0 Y-Value (standardised)	- 2 … 2	0			
169	Datapoint 1 X-Value (ModBus-func-tion if parameter se-lection= ModBus)	-10^{12} … 10^{12}	20			
170	Datapoint 1 Y-Value (standardised)	- 2 … 2	1			

No.	Parameter	Range	Default	Value		
				Channel 1	Channel 2	Channel 3
				Channel 4	Channel 5	Channel 6
171	Datapoint 2 X-Value (ModBus-register address if parameter selection = ModBus)	-10^{12} … 10^{12}	20			
172	Setpoint 2 Y-Value (standardised)	- 2 … 2	1			
173	Analogue-Unit	8 characters	Depends on function			
174	Decimal places	0 … 10	2			

SCADA/Time

No.	Parameter	Range	Default	Value
175	IP address	0.0.0.0 … 255.255.255.255	0.0.0.0	
176	Subnetmask	0.0.0.0 … 255.255.255.255	0.0.0.0	
177	Gateway	0.0.0.0 … 255.255.255.255	0.0.0.0	
178	Daylight saving time settings (summertime rules)	See manual	Settings for CET	
179	UTC timezone	- 13,75 … 13.75 h	0 h*	
180	Automatic DST switch	OFF ON	ON	

* setting depends on the country of delivery (deliveries for Germany -> 1h)

Logbook

No.	Parameter	Range	Default	Value
181	Relay events*	Logbook events see manual	all OFF	
182	Input events*		all OFF	
183	LED events*		all OFF	
184	System events*		all ON	

* Parameter selectable only via WinREG

E/A Extensions (COM3), Assignment of ANA-Ds and BIN-Ds

No.	Parameter	Range	Default	Value
185	Number of analogue channels	0, 7 … 32*	0 6 default channels	
186	Number of entries	0, 17 … 64*	0 32 default inputs	
187	Number of relays	0, 10 … 64*	0 11 default relays	
188	Assignment of analogue channels**	0.00 … 15.08	0.00	
189	Assignment of inputs**	0.00 … 15.16	0.00	
190	Assignment of relays**	0.00 … 15.08	0.00	

* with order code S2: analogue channels 0, 7 … 64, binary inputs 0, 7 … 64, relays 0, 7 … 64
** Value = „Address of ANA/BIN-D.Channel on ANA/BIN-D“; E.g. The binary input 1 of a BIN-D with address 0 shall be assigned to binary input 17. The assignment will be: Channel 17 of the binary inputs = 0.01

Recorder (order code S1)

No.	Parameter	Range	Default	Value
191	Number of channels	Ch 1 Ch 1+2 Ch 1+2+3	Ch 1	
192	Assignment of channel 1	See manual	U	
193	Assignment of channel 2		I	
194	Assignment of channel 3		PHI	
195	Absolute deviation channel 1	0 … 10^{12}	0	
196	Absolute deviation channel 2	0 … 10^{12}	0	
197	Absolute deviation channel 3	0 … 10^{12}	0	
198	Step size channel 1	0.001 0.01 0.1 1 10 100 1000	0.1, can vary with the selected measurand	
199	Step size channel 2	0.001 0.01 0.1 1 10 100 1000	0.1, can vary with the selected measurand	
200	Step size channel 3	0.001 0.01 0.1 1 10 100 1000	0.1, can vary with the selected measurand	
201	Scan width	1 … 60 s	1 s	
202	Dual display	OFF ON	OFF	
203	MMU display	OFF ON	OFF	
204	Grid display	OFF ON	ON	

No.	Parameter	Range	Default	Value
205	Dt Scroll	1 Pixel 1-Div. 3-Div. 5-Div. 1min 1h 24h	1 Pixel	
206	Time resolution dt	14 s 1 Min 2 Min 5 Min 10 Min	14 s	

Software Features

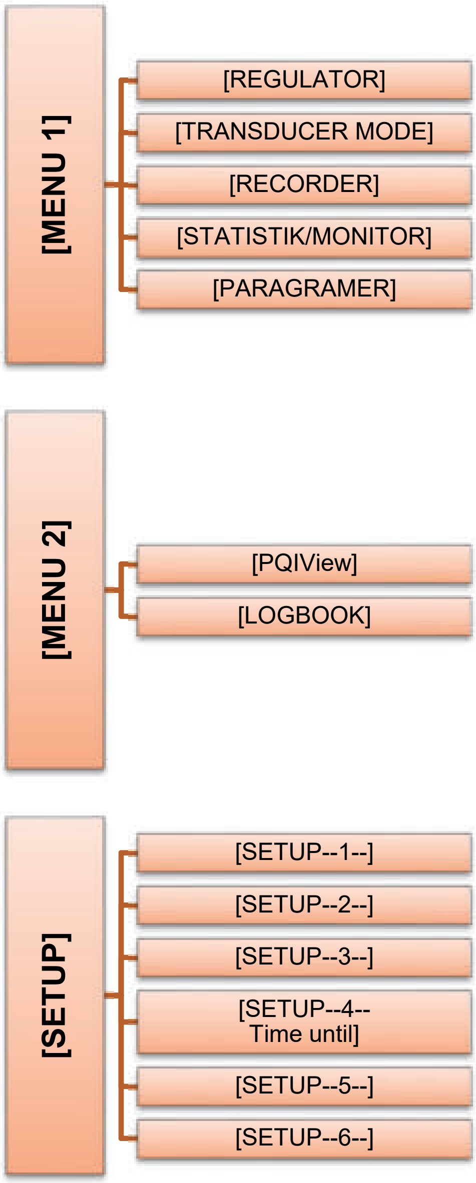
No.	Feature	Range	Default	Value
207	991101	0; 1	0	
208	3winding	0 … 63	Order code M9 + 3win-ding	
209	4Setpoints (nur bis FW 1.99)	0; 1	Order code	
210	Adapt	0; 1	0	
211	BBN4.4.3	0; 1	0	
212	Bootload	0; 1	0	
213	COM2FIX	0 … 255	Depends on SCADA card	
214	Crosslink	0; 1; 2; 3	0	
215	DELTAI	0; 1	0	
216	EMHAGEN	0; 1	0	
217	EnBW	0; 1; 2; 3	0	
218	ESB	0; 1	0	
219	HVLVControl	0; 1	0	
220	Invers	0; 1; 2	0	
221	LEW	0; 1	0	
222	LocalRemote	0; 1; 2	Order code Y	
223	M2	0; 1; 2	Order code M	
224	MISWAP	0 … 255	0	

No.	Feature	Range	Default	Value
225	NLK	0; 1	0	
226	ParaGramer	0; 1	Order code K + ParaGramer	
227	PG_SCHEME_1	0; 1	0	
228	PQCtrl	0; 1	0	
229	PrimCtrl	0; 1	0	
230	Qsigned	0; 1	0	
231	Recorder	0; 1	Order code S	
232	Ringlink	0; 1; 2; 3	0	
233	SimMode	0; 1; 2	1	
234	SR192	0; 1; 2	0	
235	SYSCTRL	0 … 255	64	
236	SYSCTRL2	0 … 255	0	
237	TM	0; 1	Order code TM	
238	ULC	0; 1	0	
239	VEW	0; 1	0	

Background program and UDM (UserDefineableMenu)

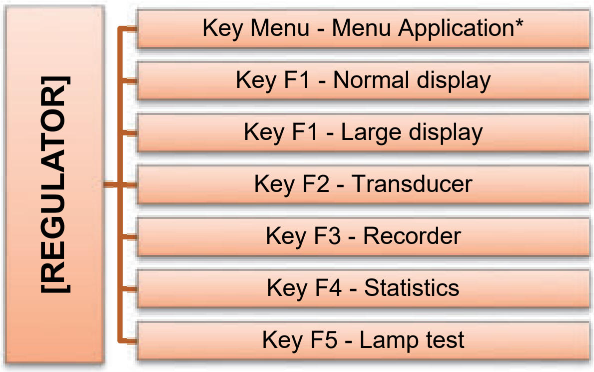
No.	Resource	used program
240	Background program	.rgl
241	UDM (only with order code S2)	.udm

21.3 Menu structure of the REG-D™



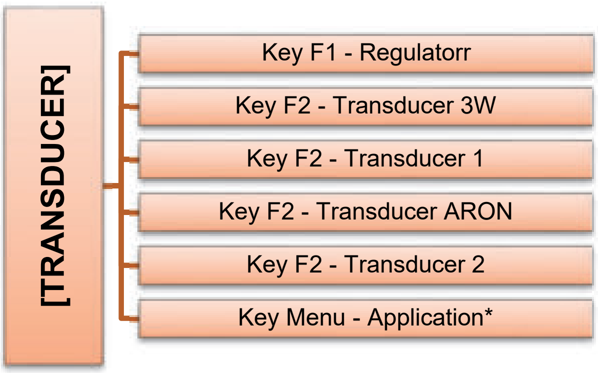
21.3.1 Menu 1

21.3.1.1 Regulator



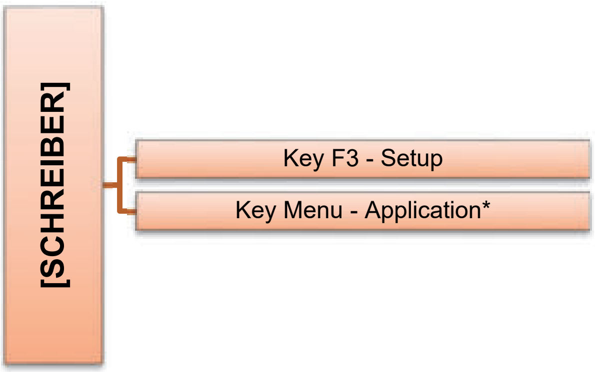
* if available

21.3.1.2 Transducer



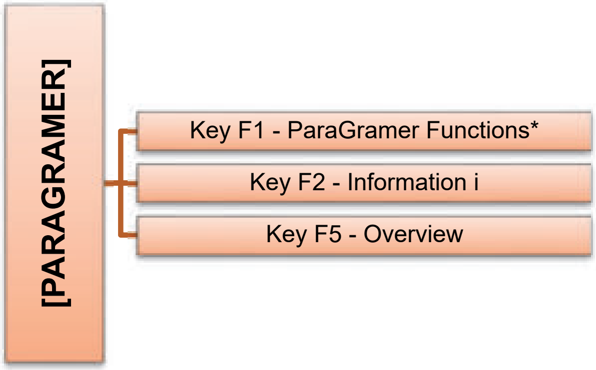
* if available

21.3.1.3 Recorder



* if available

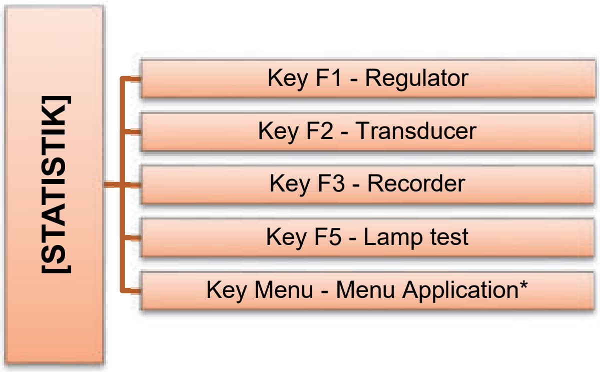
21.3.1.4 ParaGramer



* e.g. MSI-selection i

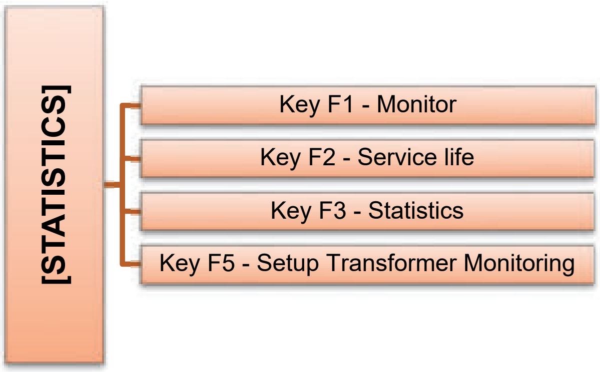
21.3.1.5 Statistik / Monitor

without Transformator Monitoring (Code TM = 0)



* if available

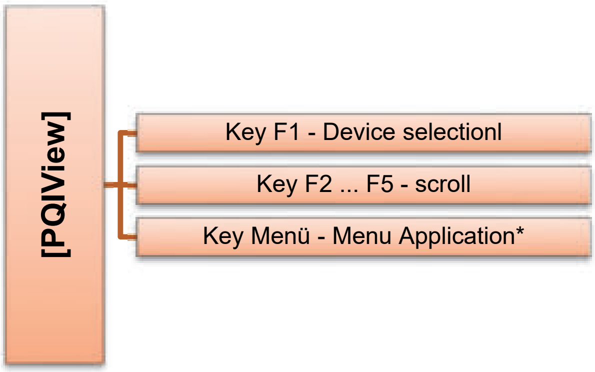
with Transformator Monitoring (Code TM = 1)



* if available

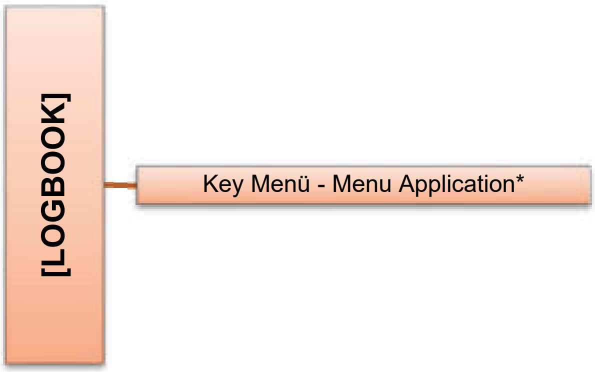
21.3.2 Menu 2

21.3.2.1 PQIView



* if available

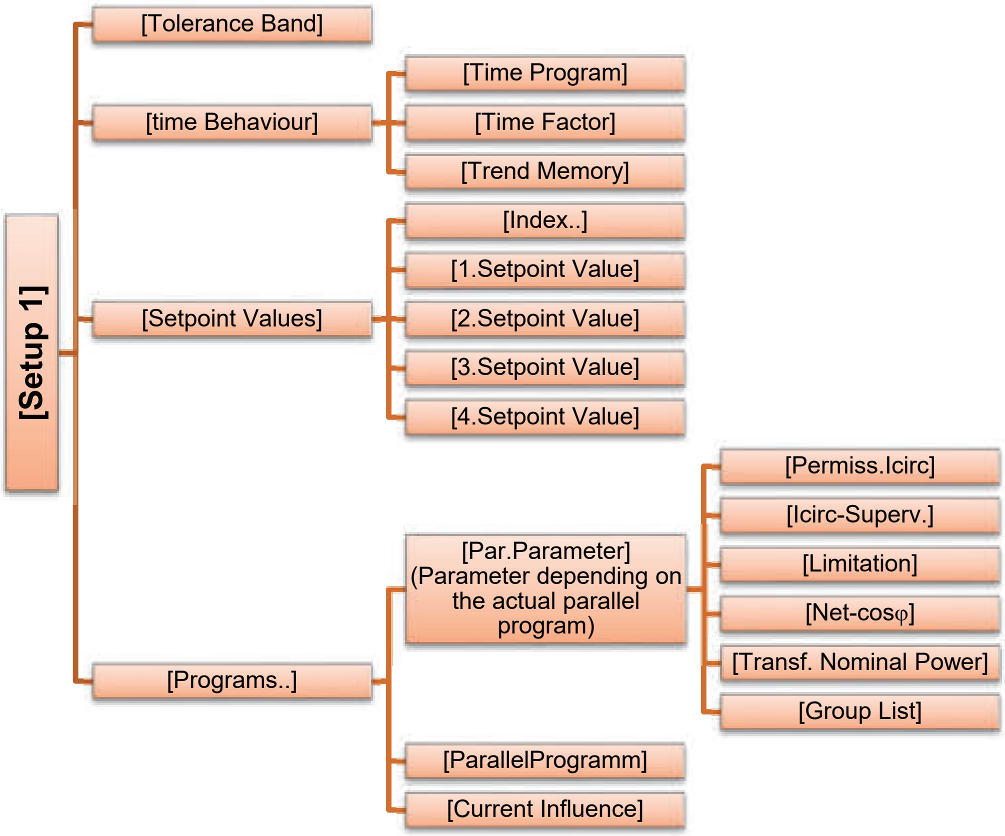
21.3.2.2 Logbuch



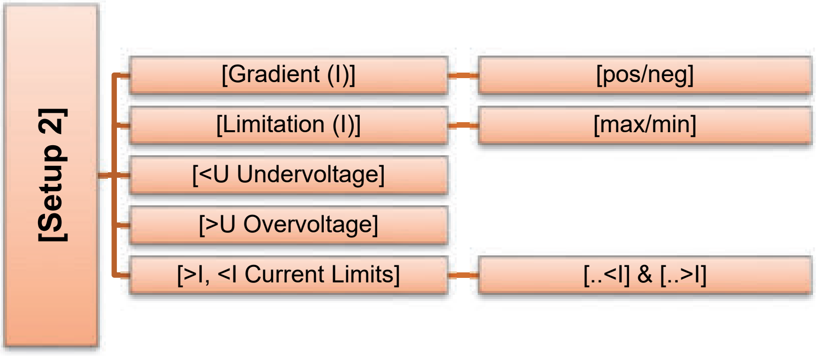
* if available

21.3.3 Setup

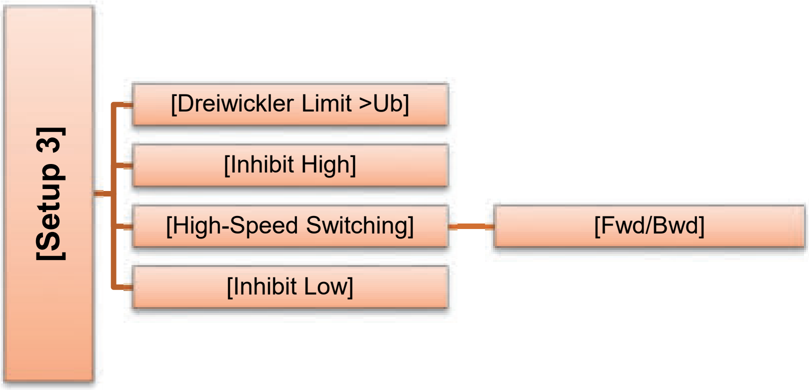
21.3.3.1 Setup 1



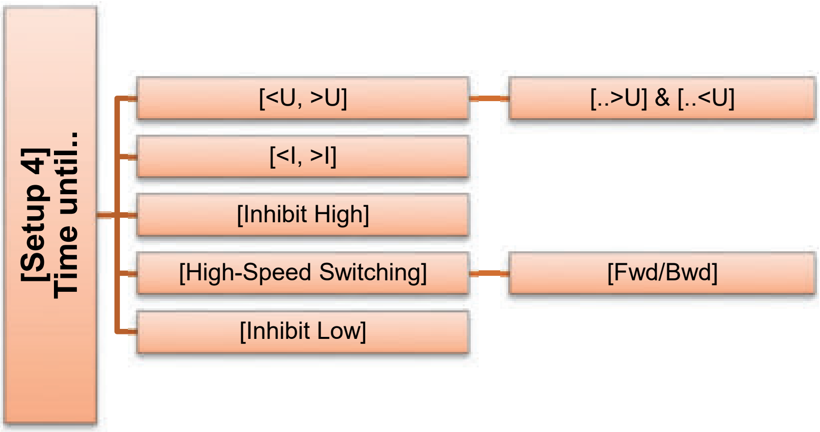
21.3.3.2 Setup 2



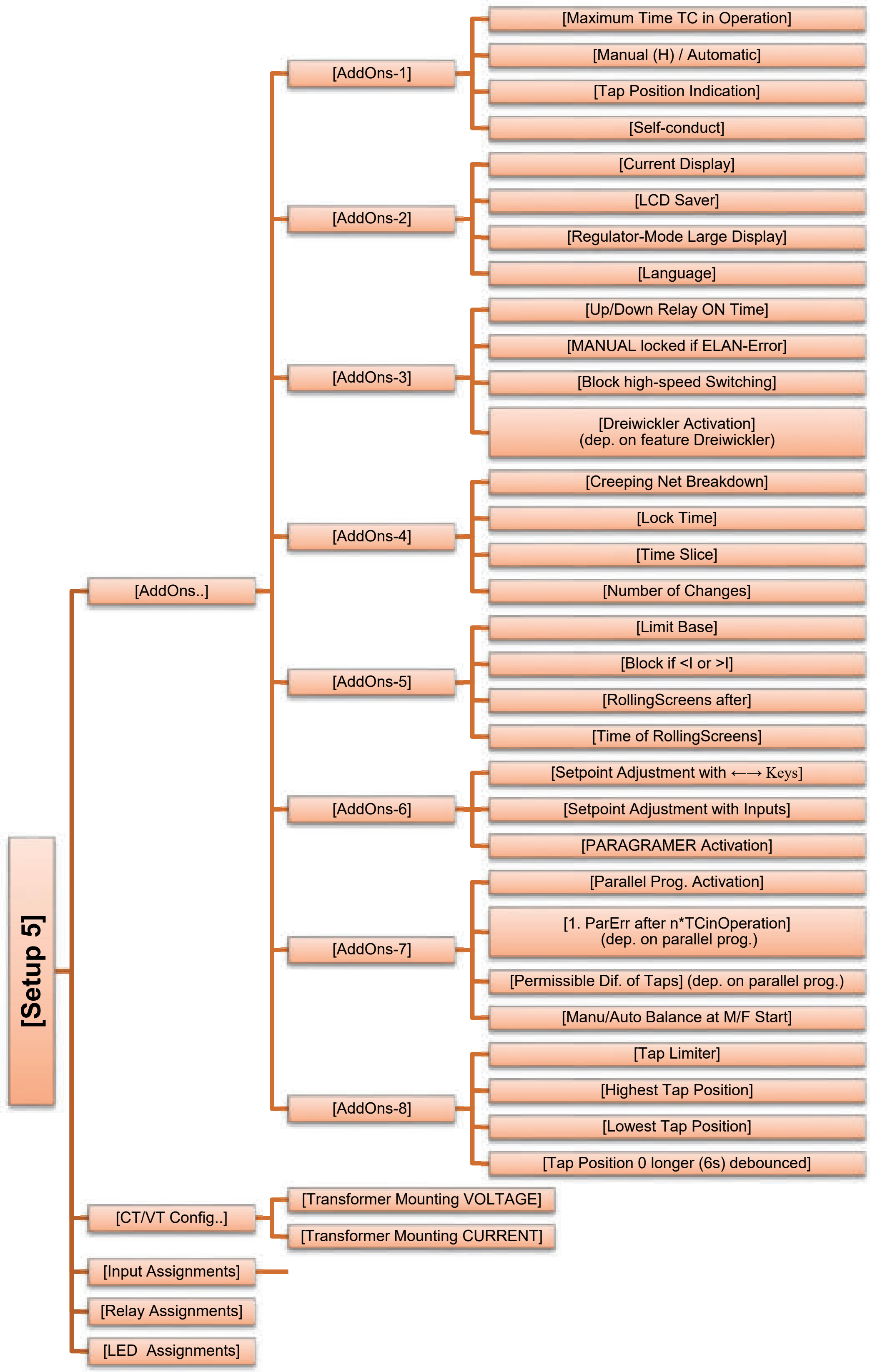
21.3.3.3 Setup 3



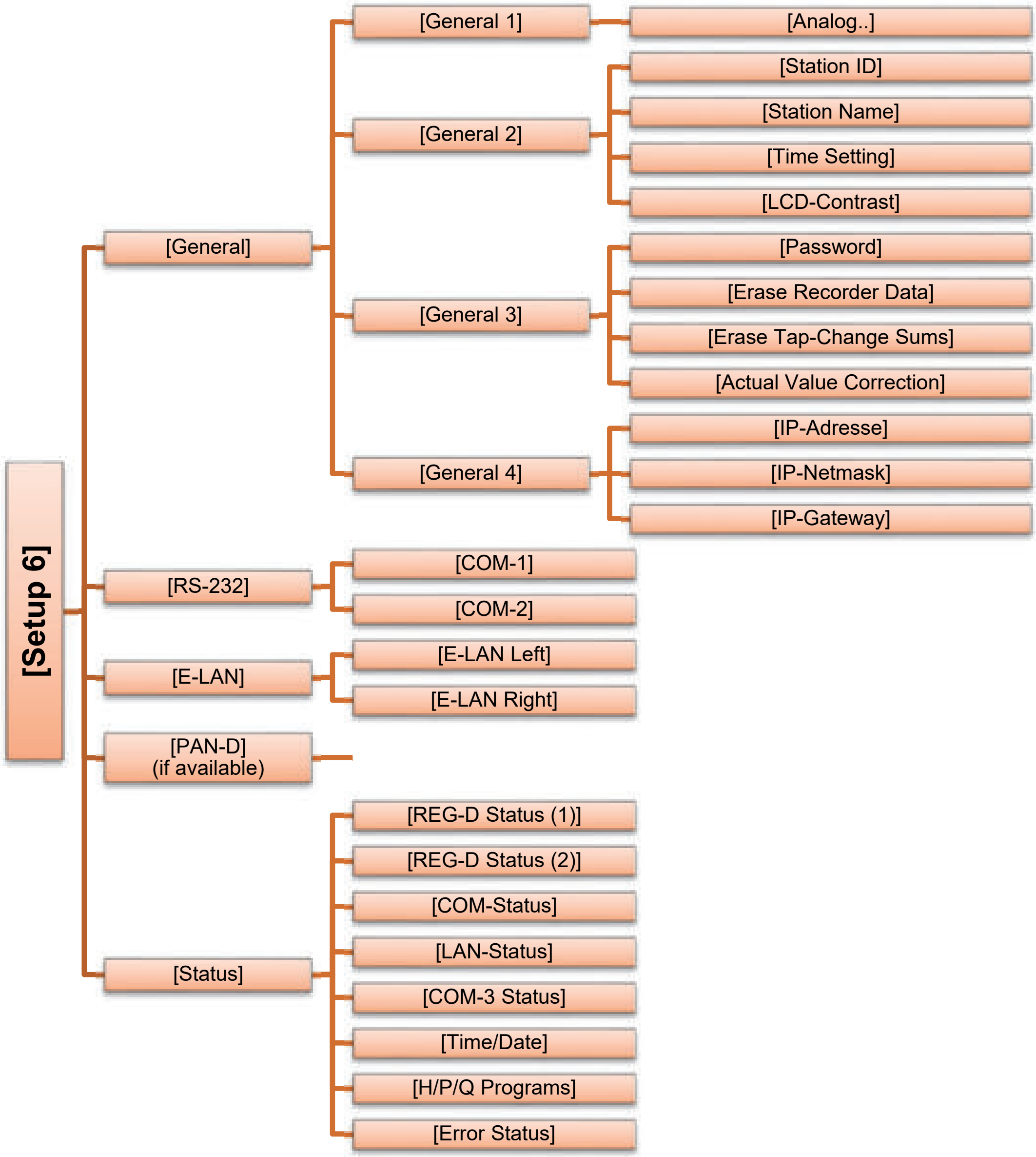
21.3.3.4 Setup 4



21.3.3.5 Setup 5



21.3.3.6 Setup 6



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