

# Relay for OLTC Control & Transformer Monitoring

## REGSys™ (REG-D, PAN-D)

- ▶ Wall-mounting housing
- ▶ Panel-mounting housing
- ▶ Plug-in module



## 1. Application

The REGSys™ relay for OLTC Control & Transformer Monitoring is used to perform both complex and simple measurement, control and regulation tasks on tap-changing transformers. To achieve these tasks, the REG-D™ relay can be used with an array of add-on components, such as the PAN-D and PAN-A monitoring and supervisory modules, the BIN-D and ANA-D remote I/O modules, and an assortment of communication cards.

Each REG-D™ has Transducer and Statistical modes, as well as optional multi-channel Recorder, Transformer Monitoring Module (TMM) and ParaGramer.

Transducer Mode displays all of the relevant measured variables of the voltage network, while Statistical Mode provides a clear overview of the various switching operations of the tap changer.

Relays operating in parallel are connected via a fibre optic or copper ELAN bus, which enables the automatic sharing of relevant data. ParaGramer then detects which transformers have been switched into a parallel control scheme and displays this information via a single-line diagram.

The powerful TMM functions enable the continuous monitoring of various conditions within the transformer and tap changer. Information such as hot-spot temperature (IEC 60354 or IEC 60076) and transformer loss-of-life are calculated, and if necessary up to 6 cooling levels can be activated.

As an alternative to direct measurement, the U, I, tap position and  $\cos(\varphi)$  value can also be transmitted to the REG-DA via SCADA client function (IEC 61850, IEC 60870-5-104), IEC61850-9-2 Sampled Values, IEC61850 GOOSE or by mA inputs, thereby eliminating the need for CT and VT cabling to the regulator.

The PAN-D relay is used to independently monitor the control voltage and to supervise signals from the relay to the tap changer.

The PAN-D relay generates a range of indications that make it easy to operate the transformer. For example, the voltage limits <U1, >U2, <<U3, >>U4, the tap changer in operation signal, and indications like 'Regulator fault' and 'Tap changer fault' are indicated via LED and relay contact.

Freely programmable inputs and outputs enable the implementation of application specific tasks.

A number of different communication cards are available for the REGSys™, with connections that range from copper RS232 to fibre optic Ethernet.

A variety of protocols are available to communicate with a SCADA system or RTU:

- IEC 61850
- IEC 60870 - 5 - 101 / 103 / 104
- DNP 3.0 via Ethernet
- DNP 3.0
- Profibus DP
- MODBUS RTU
- SPABUS
- LON (on request)

The REG-PED<sup>SV</sup> is capable of most of these protocols and may be switched between them and configured using the free WinConfig software. WinConfig is specifically designed to provide a similar configuration interface for all of the protocols, thereby reducing engineering time.

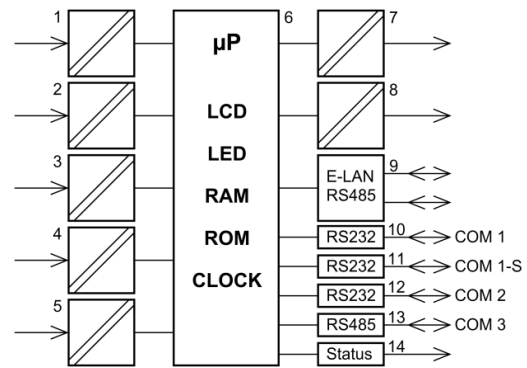
The communication interfaces of the REG-D™ and PAN-D are equipped with cyber security features including role based access control (RBAC) with remote user authentication via e.g. the Radius protocol.

## 2. Characteristics of the REGSys™\*

- Cyber security with role based access control (RBAC) and remote authentication via e.g. Radius
- Large backlit LCD (128 x 128)
- Measurement functions (U, I, P, Q, S,  $\cos \varphi$ ,  $\varphi$ ,  $I \cdot \sin(\varphi)$ ,  $f$ )
- Recorder function (characteristic S2) with up to 256 recording channels and 108 MB internal memory (REG-D only)
- A three-channel line recorder function (characteristic S1) is also available for the PAN-D (with indication on REG-D's LCD)
- Statistics function (total number of switching operations, switching operations per tap, switching operations under load)
- Event recorder (logbook)
- Transformer monitoring functions to calculate the hot-spot temperature and lifetime consumption and to control the fans and oil pumps. In addition the moisture content in cellulose and the risk of bubble formation is evaluated
- ParaGramer function to view and automate the parallel connection of up to ten transformers
- 14 (16) freely programmable binary inputs
- 9 freely programmable binary outputs
- Freely programmable analogue mA in- or outputs
- PT100 direct input
- Direct input for tap position potentiometer (200  $\Omega$ ...20 k $\Omega$  total resistance)
- Regulation of three winding transformers
- Regulation of phase shifting transformers
- Regulation of transformer banks
- Control of capacitor banks
- Limit-value monitoring for all measured quantities
- 4 freely programmable and selectable setpoint values
- Dynamic adjustment of the setpoint values based on the load (Z-compensation, LDC)
- Programmable rated U and I values
- Open programmability enables implementation of PLC functions (background program)
- Peripheral bus (COM3) for additional interface modules (ANA-D, BIN-D, Modbus converter)
- Ability to enter externally measured quantities (gas-in-oil ratio, winding temperature, etc.) by communicating directly with the measuring devices through Modbus
- All of the measurements (including external measurements) and events can be transferred to SCADA
- Software to set parameters, program devices, view and archive data

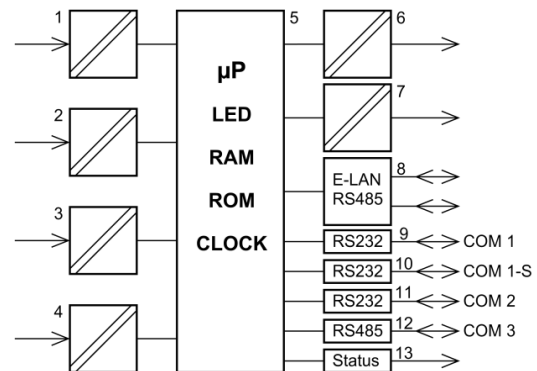
\*Characteristics may be available in REG-D™ or PAN-D or in both

## 3. Description



### Functions of the REG-D™ relay

- 1 two current and two voltage measurement inputs
- 2 Analogue mA inputs, PT100 (optional)
- 3 Binary inputs
- 4 Input for resistance coded tap position (optional)
- 5 Power supply
- 6 Display and processing unit
- 7 Analogue outputs (optional)
- 8 Binary outputs
- 9 E-LAN connection (2 x RS485 with repeater function)
- 10 COM1, RS232
- 11 COM1-S, RS232 (can be used alternatively to COM1, on devices with characteristic S2 the COM1-S can be switched into COM4)
- 12 COM2, RS232 (on devices with characteristic S2 the COM2 can be split into COM2 and COM5)
- 13 COM3, RS485 (optional)
- 14 Status contact (life contact)

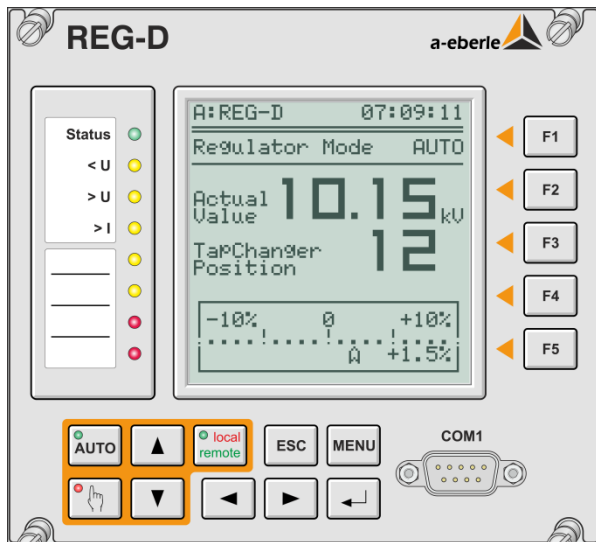


### Functions of the PAN-D monitoring unit

- 1 Voltage measurement input
- 2 Binary inputs
- 3 Analogue mA inputs, PT100 (optional)
- 4 Power supply
- 5 Display and processing unit
- 6 Binary outputs
- 7 Analogue outputs (optional)
- 8 E-LAN connection (2 x RS485 with repeater)
- 9 COM1, RS232
- 10 COM1-S, RS232 (can be used alternatively to COM1)
- 11 COM2, RS232
- 12 COM3, RS485 (optional)
- 13 Status contact (life contact)

### 3.1 Regulator mode

The actual value and a fixed or load-dependent setpoint value are continually compared in the regulator, which then determines the correct commands for the transformer's tap changer. The regulator's parameters can be fine-tuned to the dynamic time behaviour of the grid voltage to obtain high control performance for a low number of switching operations.



#### Connecting transformers in parallel

Each regulator is capable of operating in parallel with up to 9 other regulators, without the need for additional components.

A number of different parallel control schemes are available, fitting for transformers that operate in parallel on a single busbar, as well as those that are feeding the same grid from different substations.

Parallel control schemes are listed in Table 1 below:

| Case                                      | REG-D™ program              | Conditions  |
|---|-----------------------------|---|
| Parallel operation on one or more busbars | $\Delta I \sin \varphi$     | Identical transformers, identical or different tap steps                    |
|   | $\Delta I \sin \varphi (S)$ | Transformers with different nominal power, identical or different tap steps |
|   | Master-Follower             | Identical transformers, identical tap steps                                 |

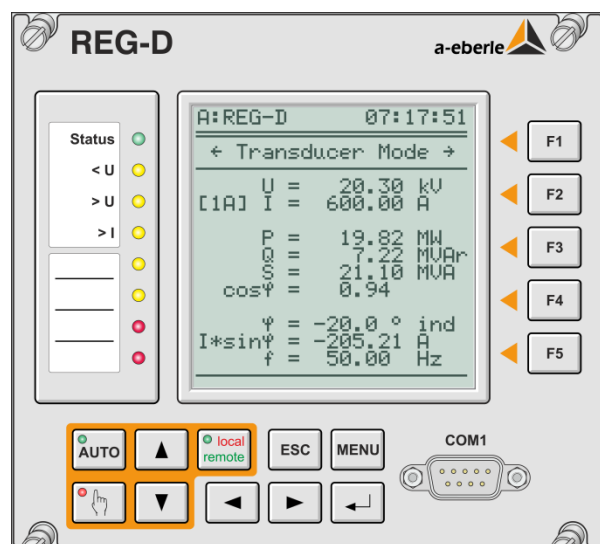
| Case  | REG-D™ program        | Conditions   |
|---|-----------------------|--|
| free feed in                                      | $\Delta \cos \varphi$ | Any transformer, any tap size  |
| Emergency program in the event of an ELAN failure | $\Delta \cos \varphi$ | Any transformer, any tap size;<br>for the programs $\Delta I \sin \varphi$ and $\Delta I \sin \varphi (S)$ |

Table 1 Parallel operation of transformers

### 3.2 Transducer mode

The values of all relevant variables of a three-wire, three-phase system with balanced or unbalanced load are calculated from the measured CT & VT inputs.

All of the measured and calculated values can then be viewed on the LCD display, or transferred by analogue signal and SCADA connection.



Measured quantities on the display

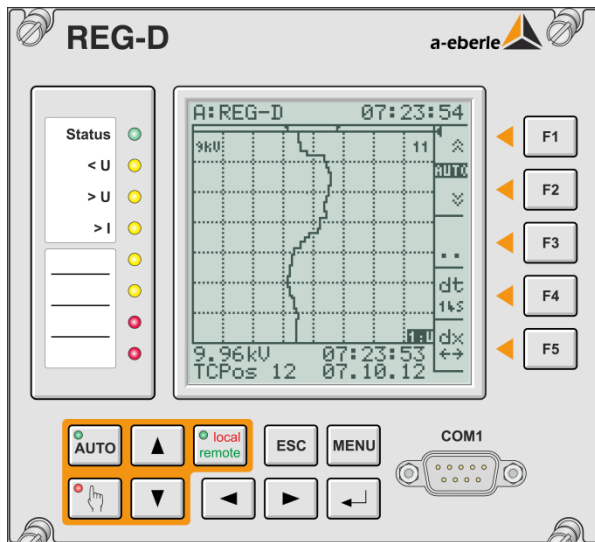
- Voltage  $U_{eff}$
- Current  $I_{eff}$
- Active power  $P$
- Reactive power  $Q$
- Apparent power  $S$
- $\cos \varphi$
- Phase angle  $\varphi$
- Reactive current  $I * \sin \varphi$
- Frequency  $f$
- Circulating reactive current (see page 2 of the transducer display)

### 3.3 Recorder mode

Up to three selectable analogue values can be continuously recorded. Up to two of them can be displayed as a line chart with an adjustable time grid. The tap position\*, setpoint value\*, tolerance band, and Manual/Auto state, as well as the time and date are recorded in addition to these measured quantities. This enables the voltage and the time-correlated tap position to be viewed at any time, for example. The average storage time for voltage and tap position (1 channel) is approximately six weeks.

The stored values can also be retrieved and displayed by the WinREG Control software, using the REGView module.

(\*requires the voltage to be recorded on channel 1)



Regardless of the selected time grid (feed rate) of the display, all of the measurements are stored at a standard rate of 1 data point per second. Each data point then represents the arithmetic mean of 10 measurements that were generated at 100 ms intervals.

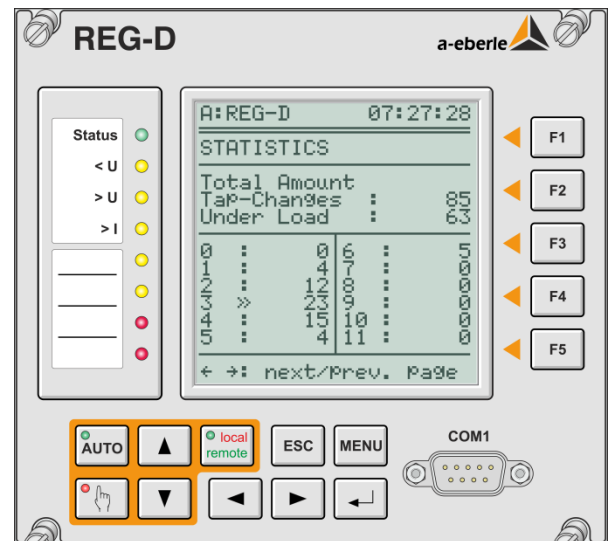
|  |   |
|--|---|
| Storage behaviour in the case of an overflow | Overwrite with FIFO (First in First out)    |
| Storage time (voltage plus tap)              | < 18.7 days worst case on average > 1 month |

### 3.4 Statistics mode

The Statistics mode records all of the tap changer's switching operations. Separate logs are stored for switching operations under load and without load.

This information can be used to analyse how many taps were made in a certain timeframe, as well as how often a particular tap was selected. This information is then used to fine-tune the regulator's settings.

The stored values can also be retrieved and displayed by the WinREG Control software, using the Service module.



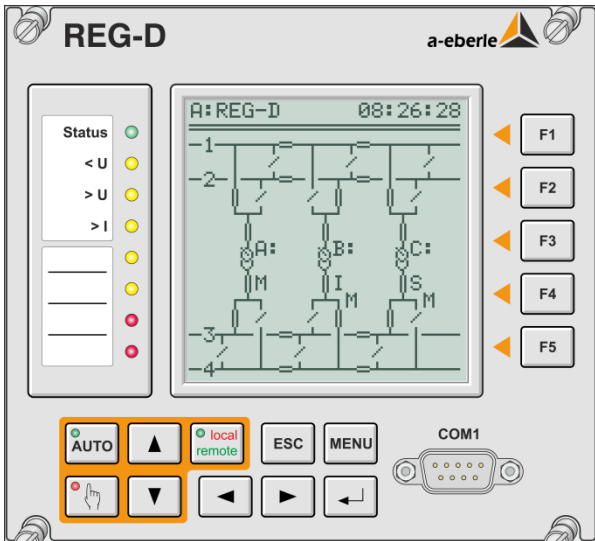
### 3.5 ParaGramer mode

ParaGramer is an efficient tool that automatically detects which transformers have been switched into a parallel control scheme, and displays this information via a single-line diagram.

The artificial word ParaGramer is a combination of the terms **parallel** and single-line **diagram**.

Paragrammer can monitor the positions of circuit breakers, isolators, bus ties and bus couplings. Based on the status of these inputs and of the regulators in the parallel scheme, the system automatically determines optimum tap positions for all of the transformers.

Multiple busbars are configurable on both the HV and LV sides of the transformers.



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

### 3.6 Transformer monitoring module TMM

The Transformer Monitoring module collects and calculates information about the condition of the transformer and tap changer.

The hot-spot temperature is calculated in accordance with IEC 60354 and IEC 60076, and is used to determine the transformer's loss of life.

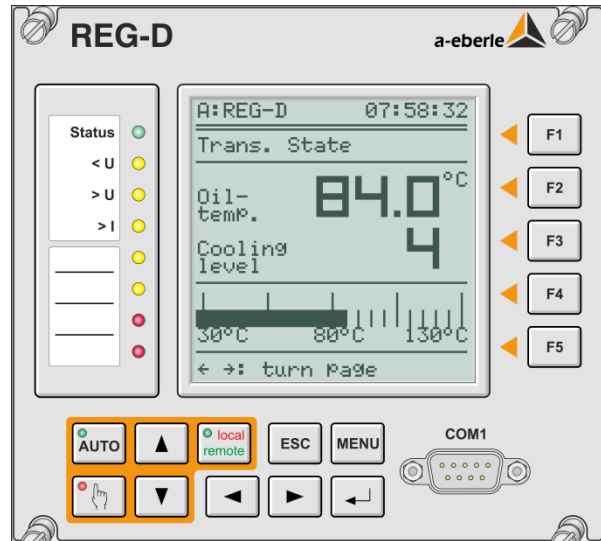
The optional TM+ function evaluates the moisture content of the cellulose and the risk of bubble formation.

Up to 6 groups of fans and 2 oil pumps can be controlled to regulate the temperature of the transformer. The operating times of the fans and pumps are stored for maintenance purposes.

Oil temperature is measured either directly as a PT100 input or via a mA transducer, and also be recorded using the Recorder mode.

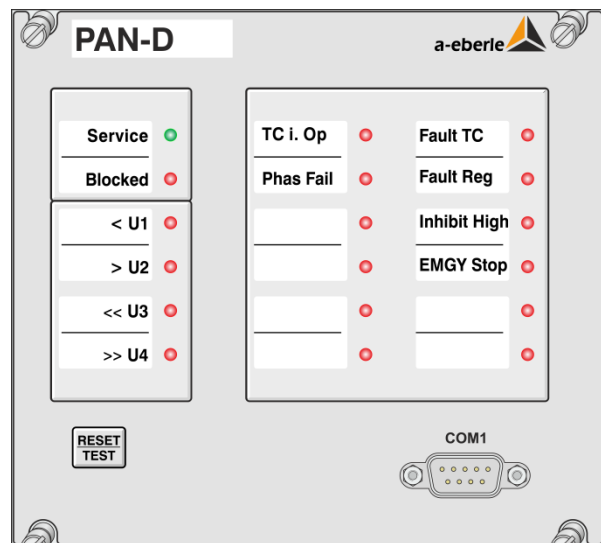
A total of three analogue input slots are available in the REG-D™, allowing the monitoring of several temperatures, oil levels, gas levels, and so on.

Please refer to characteristic group 'E' in the Order specifications for a list of the combination options.



### 3.7 PAN-D Monitoring unit

The PAN-D monitoring unit is normally assigned to a REG-D™ and is connected via the E-LAN bus. When used in stand-alone mode, the PAN-D unit is used without bus connection and is thus a fully autonomous add-on monitoring unit.



The parameters for the PAN-D monitoring unit are set either directly through the unit's interface or by using the keyboard and display of the regulator.

## 4. Technical specifications

\*) Applies to both the REG-D™ and the PAN-D

### Regulations and standards \*)

- IEC 61010-1 / EN 61010-1
- IEC 61010-2-030 / EN 61010-2-030
- 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

The time mentioned at the isolation test voltage is applied during the routine test. For type testing the voltage is applied for the duration in accordance to the standard (e.g. 60s).

| AC voltage inputs (U <sub>E</sub> ) *) |  |
|--|--|
| Nominal input voltage U <sub>n</sub>   | 100 VAC                                |
| Input voltage range                    | 0 ... 160 VAC                          |
| Rated voltage                          | 230 VAC                                |
| Frequency range                        | 16... <u>50</u> ... <u>60</u> ...65 Hz |
| Crest factor @ U <sub>r</sub>          | ≤ 2                                    |
| Input resistance                       | 100...102kΩ                            |
| Internal consumption                   | ≤ 0.01mW/V <sup>2</sup>                |
| Bandwidth                              | 420Hz                                  |
| ADC                                    | 12 Bit, 24 samples/cycle               |
| Over voltage category                  | 300V CAT II / 150V CAT III             |
| Isolation                              | reinforced *                           |
| Isolation test voltage                 | 2.3kVAC, 5s                            |

\*The voltage measurement inputs can be interconnected with a 100kΩ resistor.

| AC current input (I <sub>E</sub> ) only for REG-D™ |  |
|--|--|
| Nominal input current I <sub>n</sub>               | 1A / 5A, selectable                    |
| Measurement range                                  | 0 ... 2.1·I <sub>n</sub>               |
| Rated current                                      | 10 A                                   |
| Over load capacity                                 | 100 A für 1s                           |
| Frequency range                                    | 16... <u>50</u> ... <u>60</u> ...65 Hz |
| Crest factor @ I <sub>n</sub>                      | ≤ 3                                    |
| Internal consump. @ 5A                             | ≤ 0,5 VA                               |
| Bandwidth  | 420Hz                                  |
| ADC  | 12 Bit, 24 samples/cycle               |
| Over voltage category                              | 300V CAT II / 150V CAT III             |

| AC current input (I <sub>E</sub> ) only for REG-D™ |                         |
|--|-------------------------|
| Isolation  | reinforced, per channel |
| Isolation test voltage                             | 2.3kVAC, 5s             |

| Measured quantities *) |  |
|------------------------|--|
| True RMS voltages      | U <sub>12</sub> , (U <sub>23</sub> , U <sub>31</sub> ) (≤ 0.25%) |
| True RMS current       | I <sub>1</sub> , (I <sub>2</sub> , I <sub>3</sub> ) (≤ 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%)  |

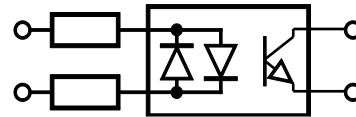
| Reference conditions *)                    |  |
|--|--|
| Reference temperature                      | 23°C ± 1 K   |
| Input quantities                           | U <sub>E</sub> = 0 ... 160 V<br>I <sub>E</sub> = 0 ... 1A / 0 ... 5A |
| Frequency                                  | 45 Hz...65 Hz  |
| Shape of the curve                         | Sinusoidal, form factor 1.1107                                       |
| Load (only for characteristics E91...E900) | R <sub>n</sub> = 5 V / Y2 ± 1%                                       |
| Other                                      | IEC 60688 - Part 1   |

| Ambient conditions *)     |  |
|---------------------------|--|
| <b>Temperature range</b>  |  |
| Function (Housing)        | -10 °C ... +50 °C                                  |
| Function (plug-in module) | -10 °C ... +60 °C                                  |
| Transport and storage     | -25 °C ... +65 °C                                  |
| Dry cold                  | IEC 60068-2-1,<br>- 10°C / 16 h                    |
| Dry heat                  | IEC 60068-2-2,<br>+ 55°C / 16 h                    |
| Humid heat constant       | IEC 60068-2-78<br>+ 40°C / 93% / 2 days            |
| Humid heat cyclical       | IEC 60068-2-30<br>12+12 h, 6 cycles<br>+55°C / 93% |
| Drop and topple           | IEC 60068-2-31<br>100 mm drop height,<br>unpacked  |
| Vibration                 | IEC 60255-21-1,<br>Class 1                         |
| Shock                     | IEC 60255-21-2,<br>Class 1                         |
| Earthquake resistance     | IEC 60255-21-3,<br>Class 1                         |



| Binary inputs (BI) *)   |                               |
|---|-------------------------------|
| <b>General</b>  |                               |
| Signal frequency  | 0 ... 70Hz                    |
| AC debouncing   | 40 ... 70Hz                   |
| Form factor   | ≤ 1.16                        |
| <b>Binary input type HV (High voltage)</b>  |                               |
| Input voltage   | ≤ 250V (r.m.s.)               |
| Input resistance  | 107...116kΩ                   |
| Over voltage category   | 300V CAT II                   |
| Isolation between input groups  | basic isolation <sup>a)</sup> |
| Isolation against touchable parts   | reinforced                    |
| Isolation test voltage  | 2.3kVAC, 5s                   |
| <b>Binary input type LV (Low voltage)</b>   |                               |
| Input voltage   | ≤ 50V (r.m.s.)                |
| Input resistance  | 6.5...8.1kΩ                   |
| <b>Characteristic D1 – Binary inputs 1 ... 8, isolated</b><br><b>Characteristic X25 – Binary inputs 17...24, isolated</b>     |                               |
| Input type  | HV                            |
| H – Level   | ≥ 48 V                        |
| L - Level   | < 10 V                        |
| <b>Characteristic D1 – Binary input groups 9...12,13...16</b><br><b>Characteristic X25 – B. input groups 25...28, 29...32</b> |                               |
| Input type  | LV                            |
| H – Level   | ≥ 10 V                        |
| L - Level   | < 5 V                         |
| <b>Characteristic D2 – Binary inputs 1 ... 16, isolated</b><br><b>Characteristic X15 – Binary inputs 17 ... 32, isolated</b>  |                               |
| Input type  | HV                            |
| H – Level   | ≥ 48 V                        |
| L - Level   | < 10 V                        |
| <b>Characteristic D3 - Binary inputs 1 ... 16, isolated</b><br><b>Characteristic X24 - Binary inputs 17 ... 32, isolated</b>  |                               |
| Input type  | LV                            |
| H – Level   | ≥ 10 V                        |
| L - Level   | < 5 V                         |
| <b>Characteristic D4 - Binary inputs 1 ... 16, isolated</b><br><b>Characteristic X29 - Binary inputs 17 ... 32, isolated</b>  |                               |
| Input type  | HV                            |
| H – Level   | ≥ 80 V                        |
| L - Level   | < 40 V                        |
| <b>Characteristic D5 - Binary inputs 1 ... 16, isolated</b><br><b>Characteristic X28 - Binary inputs 17 ... 32, isolated</b>  |                               |
| Input type  | HV                            |
| H – Level   | ≥ 176 V                       |
| L - Level   | < 88 V                        |

a) In the case of DC voltage, the sum of the operating voltages of adjacent binary input groups must not exceed 300V!



Simplified diagram of a binary input

| Binary outputs (BO) *)                     |   |
|--|---|
| max. switching frequency                   | ≤ 1 Hz  |
| Contact load                               | AC: 250 V, 5 A (cosφ = 1.0)<br>AC: 250 V, 3 A (cosφ = 0.4)<br>Switching capacity max. 1250 VA<br>DC: 30 V, 5 A resistive<br>DC: 30 V, 3.5 A L/R=7 ms<br>DC: 110 V, 0.5 A resistive<br>DC: 220 V, 0.3 A resistive<br>Switching capacity max. 150 W |
| Inrush current                             | 250 V AC, 30 V DC<br>10 A for max. 4 s  |
| Switching operations                       | ≥ 5·10 <sup>5</sup> electrical  |
| Over voltage category                      | 300V CAT II   |
| Isolation between outputs or output groups | Basic isolation <sup>b) c)</sup>  |
| Isolation against touchable parts          | reinforced  |
| Isolation test voltage                     | 2.3kVAC, 5s   |

b) In case of DC voltage, the sum of the working voltages of adjacent outputs or output groups must not exceed 300V!

c) If an output or an output group is connected to a dangerous active circuit, the neighboring outputs or output groups must not be connected with SELV circuits or other touchable parts!

| Auxiliary voltage *)   |             |                               |             |
|------------------------|-------------|-------------------------------|-------------|
| Characteristic         | H0          | H1/H11                        | H2          |
| AC (internal)          | 75...185 V  | -                             | -           |
| AC                     |             |                               |             |
| Nom. voltage range     | -           | 100 ... 240 V                 | -           |
| Total voltage range    | -           | 90 ... 264 V                  | -           |
| DC Nom. volt. range    | -           | 100 ... 300 V                 | 20 ... 70 V |
| AC power consumption   | ≤ 35 VA     | ≤ 35 VA (H1)<br>≤ 45 VA (H11) | -           |
| DC power consumption   | -           | ≤ 25 W (H1)<br>≤ 35 W (H11)   | ≤ 25 W      |
| Frequency              | 50/60 Hz    | 50/60 Hz                      | DC          |
| Microfuse              | T1 250 V    | T1 250 V                      | T2 250 V    |
| Over voltage category  | 300V CAT II | 300V CAT II                   | 150V CAT II |
| Isolation              | reinforced  | reinforced                    | reinforced  |
| Isolation test voltage | 2.3kVAC, 5s | 2.3kVAC, 5s                   | 1.4kVAC, 5s |

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.

We take care of it.

| Electrical safety *) |                                |
|----------------------|--------------------------------|
| Safety class         | I                              |
| Degree of pollution  | 2                              |
| Standards            | IEC 61010-1<br>IEC 61010-2-030 |

| Electromagnetic compatibility *) |  |
|----------------------------------|--|
| <b>EMC requirements</b>          | EN 61326-1<br>Equipment class A<br>Continuous, unmonitored operation, industrial location and EN 61000-6-2 and 61000-6-4 |
| <b>Interference emissions</b>    |  |
| Conducted and radiated emission  | EN 61326 Table 3<br>EN 61000-6-4   |
| Harmonic currents                | EN 61000-3-2   |
| Voltage fluctuations and flicker | EN 61000-3-3   |
| <b>Disturbance immunity</b>      | EN 61326 Table A1 and EN 61000-6-2   |
| ESD                              | IEC 61000-6-2<br>8 kV/16 kV contact/air  |
| Electromagnetic fields           | IEC 61000-4-3<br>80 – 2700 MHz: 10 V/m   |
| Fast transient                   | IEC 61000-4-4 2 kV/1 kV  |
| Surge voltages                   | IEC 61000-4-5 4 kV/2 kV  |
| Conducted HF signals             | IEC 61000-4-6<br>150 kHz – 80 MHz: 10 V <sub>rms</sub>   |
| Power-frequency magnetic fields  | IEC 61000-4-8<br>100 A/m (50 Hz), continuous<br>1000 A/m (50 Hz), 3 s  |
| Voltage dips                     | IEC 61000-4-11<br>30% / 20 ms, 60% / 1 s   |
| Voltage interruptions            | IEC 61000-4-11<br>100% / 5s  |
| Damped oscillations              | IEC 61000-4-12,<br>Class 3, 2.5 kV   |

| Analogue inputs (AI) *) |   |
|-------------------------|---|
| Quantity                | See order specifications                                |
| Input range Y1...Y2     | -20 mA...0...20 mA<br>points Y1 and Y2 are programmable |
| Control limit           | ± 1.2 Y2  |
| Voltage drop            | ≤ 1.5 V   |
| Isolation               | functional, per channel                                 |
| Common-mode rejection   | > 80 dB   |

|                              |                             |
|------------------------------|-----------------------------|
| <i>Series-mode rejection</i> | > 60 dB / Decade from 10 Hz |
| <i>Overload capacity</i>     | ≤ 50 mA continuous          |
| <i>Error limit</i>           | 0.5%                        |

| Analogue outputs (AO) *) |   |
|--------------------------|---|
| Quantity                 | See order specifications                            |
| Output range Y1...Y2     | -20 mA...0...20 mA<br>points Y1 and Y2 programmable |
| Control limit            | ± 1.2 Y2  |
| Potential isolation      | Functional, per channel                             |
| Load range               | 0 ≤ R ≤ 8 V / Y2                                    |
| Alternating component    | < 0.5% of Y2  |

| Temperature input PT100 *) |                                       |
|----------------------------|---------------------------------------|
| Quantity                   | up to three PT100 inputs are possible |
| Type of connection         | Three-wire circuit                    |
| Current through sensor     | < 8 mA                                |
| Isolation                  | functional                            |
| Line compensation          | No compensation required              |
| Transmission behaviour     | linear                                |

| Resistance input (tap position potentiometer) |   |                |
|---|---|----------------|
| Characteristic                                | R1  | R3             |
| Quantity                                      | See order specifications                        |                |
| Connection                                    | Three-wire / Four-wire with open wire detection |                |
| Total resistance in the resistor chain        | 180 Ω ... 2 kΩ                                  | 2 kΩ ... 20 kΩ |
| Resistance per tap                            | 5...100 Ω                                       | 50 Ω ... 2 kΩ  |
| Number of taps                                | ≤ 38  |                |
| Isolation                                     | functional                                      |                |
| Current through resistor chain                | ≤ 25 mA   | ≤ 2.5 mA       |



| Communication interfaces |           |          |            |
|--------------------------|-----------|----------|------------|
| Name                     | Standard  | Wires    | Isolation  |
| COM1                     | RS232     | 4, GND   | -          |
| COM1-S                   | RS232     | 4, GND   | functional |
| COM2                     | RS232     | 4, GND   | functional |
| COM3                     | RS422     | 4, GND   | functional |
| E-LAN-L                  | RS485/422 | 2/4, GND | functional |
| E-LAN-R                  | RS485/422 | 2/4, GND | functional |
| DCF77                    | RS485     | 2, GND   | functional |

| Device real time clock *) |   |
|---------------------------|---|
| Accuracy                  | +/- 20 ppm<br>0 ... 10 ppm with Charact. S2 |
| Backup battery            | Lithium button cell 3V, Type CR1632         |

| Limit value monitoring *) |                  |
|---------------------------|------------------|
| Limit values              | programmable     |
| Response times            | programmable     |
| Alarm indicators          | LED programmable |

| 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

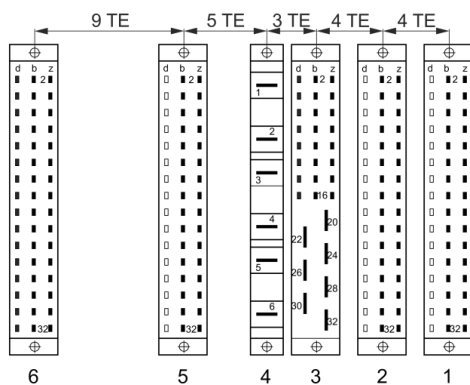
| Storage *)                                     |   |
|--|---|
| Firmware and recorder data characteristic S2   | Flash memory                                  |
| Device characteristics and calibration data    | serial EEPROM with ≥ 1000 k write/read cycles |
| Other data and recorder data Characteristic S1 | MRAM,<br>Backup to flash memory possible      |

## 5. 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              | IP 00  |
| — Female multipoint connector | IP 00  |
| Mounting                      | in conformity with DIN 41494 Part 5          |
| Plug-in connector             | DIN 41612                                    |

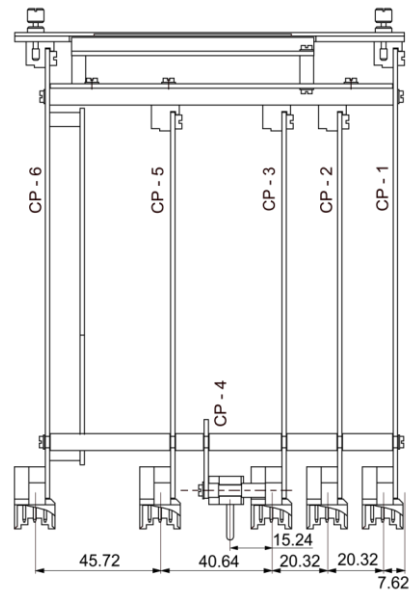
### 5.1 Position of the male or female multipoint connectors

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.

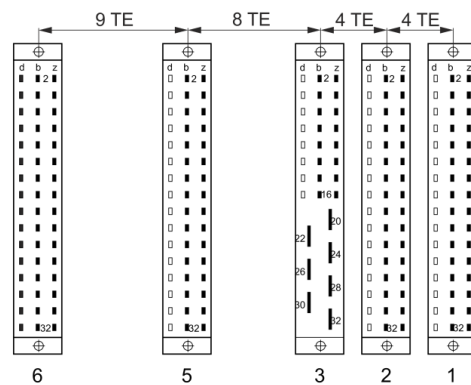


Position of the REG-D™ socket connectors

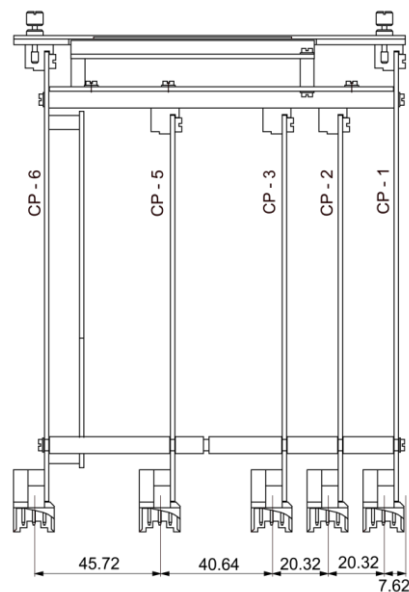
| Position numbers |   |     |     |      |      |      |
|------------------|---|-----|-----|------|------|------|
| socket connector | 1 | 2   | 3   | 4    | 5    | 6    |
| PCB card guide   | n | -   | -   | -    | -    | n+26 |
| Screws           | n | n+4 | n+8 | n+11 | n+16 | n+25 |



Position of the REG-D™ blade connectors



Position of the PAN-D socket connectors



Position of the PAN-D blade connectors

## 5.2 Pin assignment of the REG-D™

| Socket connector 1; (binary outputs)                   |             |        |           |            |           |
|--|-------------|--------|-----------|------------|-----------|
| Raise (2 contact pairs)<br>1 NCC + 1 NOC               | R1          | Pole   | b2<br>b4  | NCC<br>NOC | z2<br>z4  |
| Lower (2 contact pairs)<br>1 NCC + 1 NOC               | R2          | Pole   | b8<br>b10 | NCC<br>NOC | Z8<br>z10 |
| Freely programmable                                    | R3          | Pole   | b14       | NOC        | z14       |
| Freely programmable                                    | R4          | Pole   | b16       | NOC        | z16       |
| Freely programmable                                    | R5          | Pole   | b20       | NOC        | Z20       |
| Manual/Auto<br>(converter)                             |             | Pole   | b22       | Automatic  | Z22       |
|  |             | Man    | b24       |            |           |
| Status   |             | Pole   | b26       | NOC/NCC    | Z24       |
| Binary outputs (BO)<br>4 relays<br>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 | - | z32 |
| BCD 8   | E12 | + | b30 | - |     |
| BCD 10  | E13 | + | z24 | - |     |
| 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 <sub>H</sub>                           | 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 <sub>e1</sub>               | s1 | 1 | s2 | 2 |
| Measuring current I <sub>e2</sub> *             | 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  | Pole | b2  | NOC | z2  |
| Freely programmable                                     | NCC  | b4  |     |     |
| Relay 11  | Pole | b6  | NOC | z6  |
| Freely programmable                                     | NCC  | b8  |     |     |
| Relay 12  | Pole | b10 | NOC | z10 |
| Freely programmable                                     | NCC  | b12 |     |     |

| Socket connector 5; (binary outputs) Characteristic X01 |      |     |     |     |
|---|------|-----|-----|-----|
| Relay 13  | Pole | b14 | NOC | z14 |
| Freely programmable                                     | NCC  | b16 |     |     |
| Relay 14  | Pole | b18 | NOC | z18 |
| Freely programmable                                     | NCC  | b20 |     |     |
| Relay 15  | Pole | b22 | NOC | z22 |
| Freely programmable                                     | NCC  | b24 |     |     |
| Relay 16  | Pole | b26 | NOC | z26 |
| Freely programmable                                     | NCC  | b28 |     |     |
| Relay 17  | Pole | b30 | NOC | z30 |
| Freely programmable                                     | 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/PE  | d6  | COM1/PE     | b6  | COM1/PE        | z6  |
| free   | d8  | free        | b8  | free           | 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        | b16 | Fibre optic/Tx | z16 |
| free   | d18 | free        | b18 | free           | z18 |
| RS485/P (A)  | d20 | free        | b20 | RS485/N (B)    | z20 |
| RS485 PE   | d22 | RS485 PE    | b22 | RS485 PE       | z22 |
| COM3/TxD   | d24 | COM3/RxD    | b24 | COM3/RTS       | z24 |
| COM2/PE  | d26 | COM2/PE     | b26 | COM2/PE        | z26 |
| free   | d28 | free        | b28 | COM3/CTS       | z28 |
| COM2/RxD   | d30 | COM2/GND    | b30 | COM2/TxD       | z30 |
| COM2/CTS   | d32 | COM2/GND    | b32 | COM2/RTS       | z32 |



REG-D/PAN-D CPU and the SCADA interface communicate through the COM2 interface.

Communication with the SCADA system can take place optionally through fibre optic cable, RS485 or RS232 (COM1). The fibre optic cable requires a separate module.

| 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/4* TxD   | d16 | Analogue channel 3 - | b16 | Analogue channel 4 - | z16 |
| COM1-S/4* RTS   | d18 | free                 | b18 | free                 | z18 |
| COM1-S/4* GND   | d20 | COM2 TxD             | b20 | COM2 RTS COM5 TxD**  | z20 |
| COM1-S/4* RxD   | d22 | COM2 RxD             | b22 | COM2 CTS COM5 RxD**  | z22 |
| COM1-S/4* CTS   | d24 | COM2 GND COM5 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 |

\*COM 4 is only available on devices with feature S2 since 09/2014

\*\*COM 5 is only available on devices with feature S2 since 09/2014 and firmware version  $\geq 3.29$  and ESCC2 version  $\geq 10$

### 5.3 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 | - | z32 |
| Freely programmable                                   | E13 | + | z24 | - |     |
| 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.

We take care of it.

| Socket connector 3; (measuring voltage, auxiliary voltage) |       |            |       |            |       |
|--|-------|------------|-------|------------|-------|
| DC output (max. 5 W)                                       | +5V   | d2, b2, z2 | GND   | d4, b4, z4 |       |
| Measuring voltage 1  | U1a   | 20         | U1b** | 22         |       |
| Measuring voltage 2  | U2a** | 26         | U2b   | 24         |       |
| Auxiliary voltage U <sub>H</sub>                           | L(+)  | 28         | N(-)  | 30         | PE 32 |

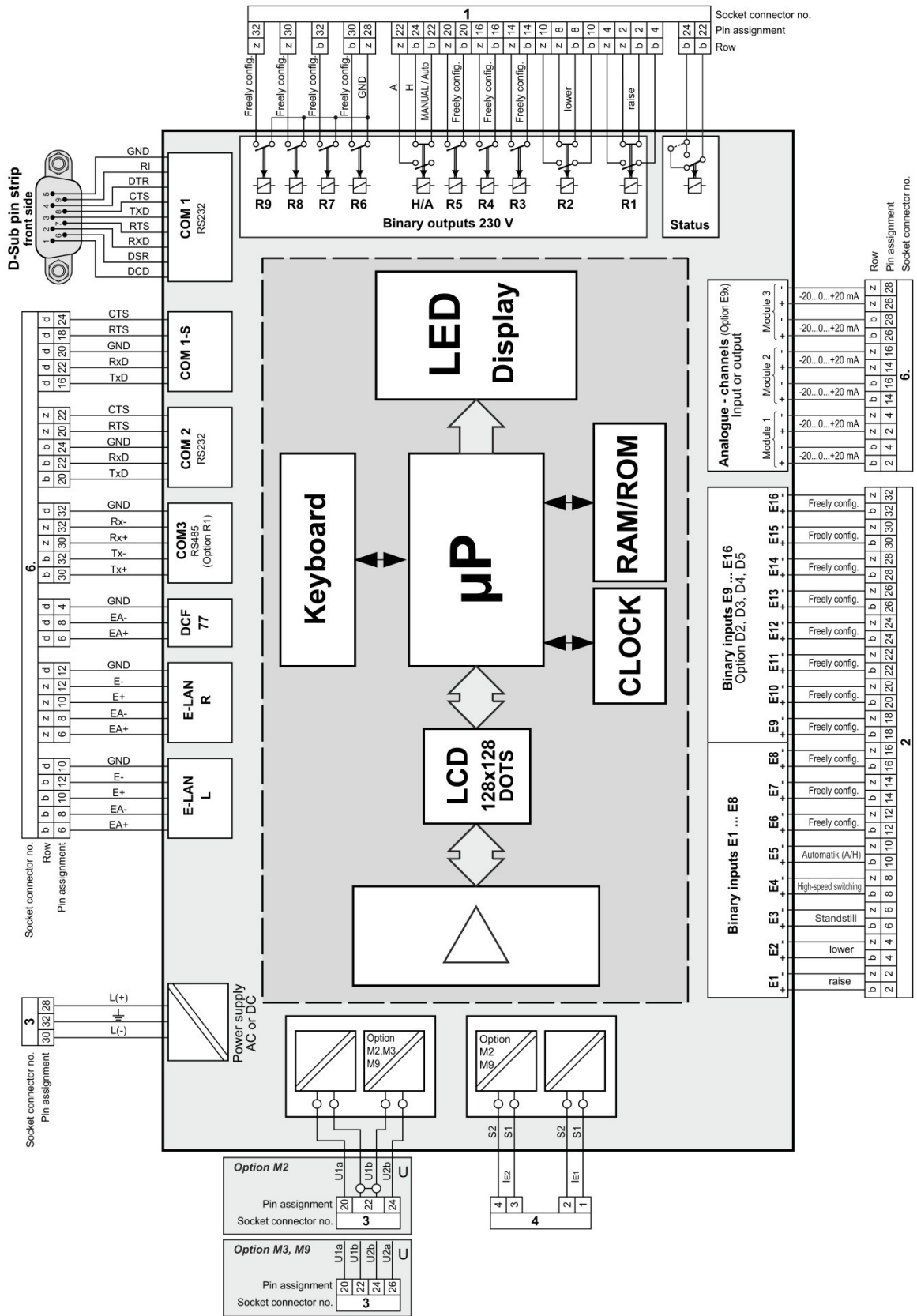
\*\* for characteristic M1, pin 26 is internally connected to pin 22. The connection is L1 (pin 20), L2 (pin 22) and L3 (pin 24).

| 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 |

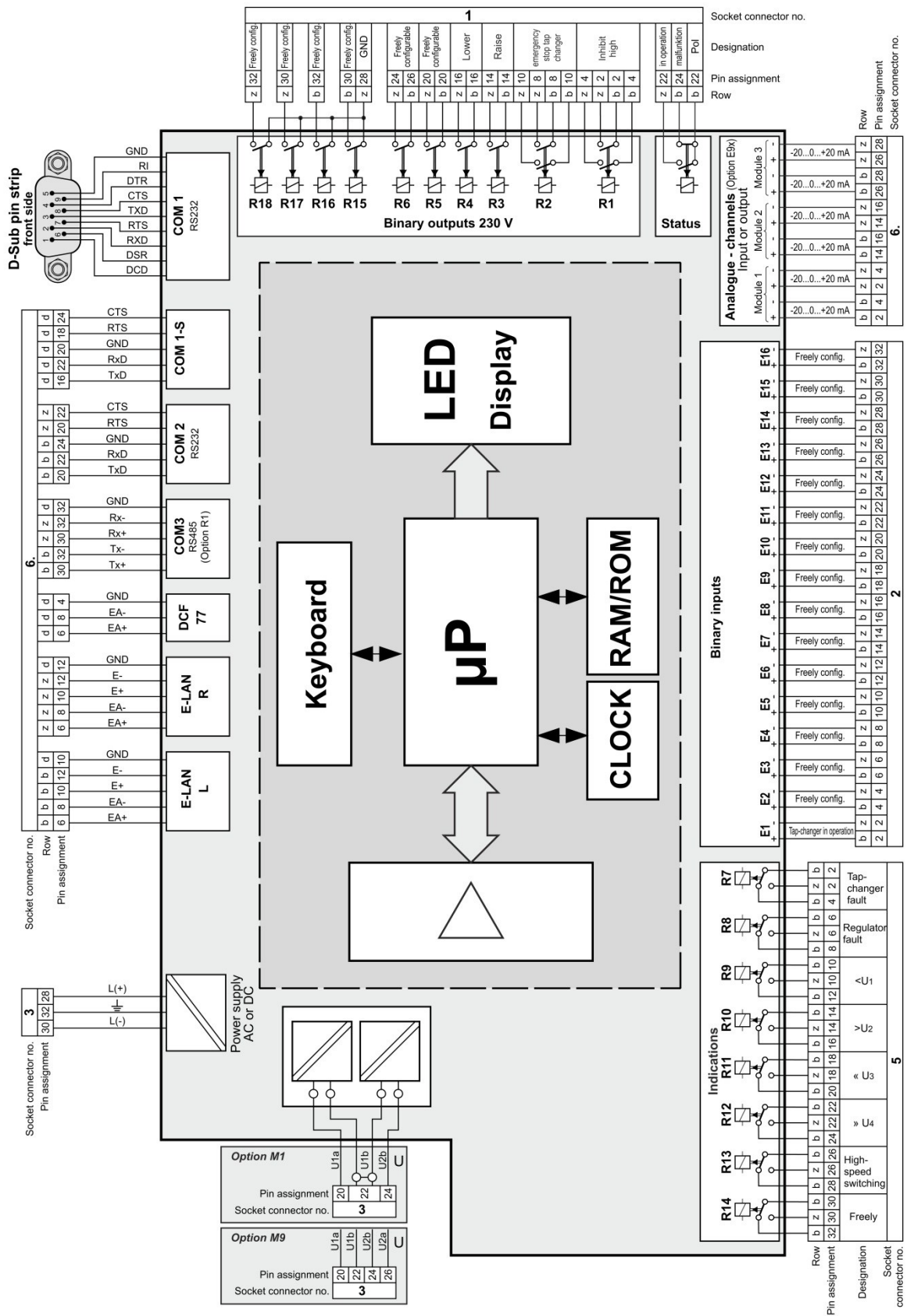






Block diagram REG-D™ Characteristic D2 / D3 / D4 / D5





Block diagram PAN –D Characteristic D2 / D3 / D4 / D5

## 7. 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.

### 7.1 19" card racks (19" rack)

|                        |              |
|------------------------|--------------|
| Material               | Aluminium    |
| Protection type        | IP 20        |
| Weight                 | ≤ 5 kg       |
| Dimensions             | see drawings |
| Width of the card rack | 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.

### 7.2 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 |
|----------------------------------|-----------------------------------|---------------------|
| Charact. B30 (30HP WMH short TB) | Phoenix pluggable screw terminals | 26                  |
| Charact. B31 (30HP WMH long TB)  | Phoenix pluggable screw terminals | 42                  |
| Charact. B32 (30HP PMH)          | Phoenix pluggable screw terminals | 58                  |
| Charact. B33 (30HP PMH)          | Cooper Bussmann screw terminals   | 68                  |
| Charact. B40 (49HP WMH short TB) | Phoenix pluggable screw terminals | 58                  |
| Charact. B41 (49HP WMH long TB)  | Phoenix pluggable screw terminals | 90                  |
| Charact. B42 (49HP PMH)          | Phoenix pluggable screw terminals | 90                  |
| Charact. B43 (49HP PMH)          | Cooper Bussmann screw terminals   | 88                  |

WMH: Wall mounting housing

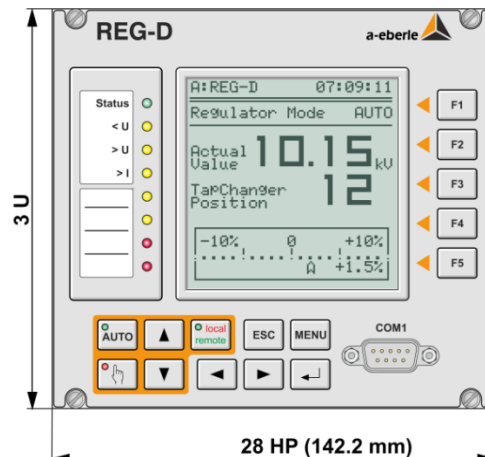
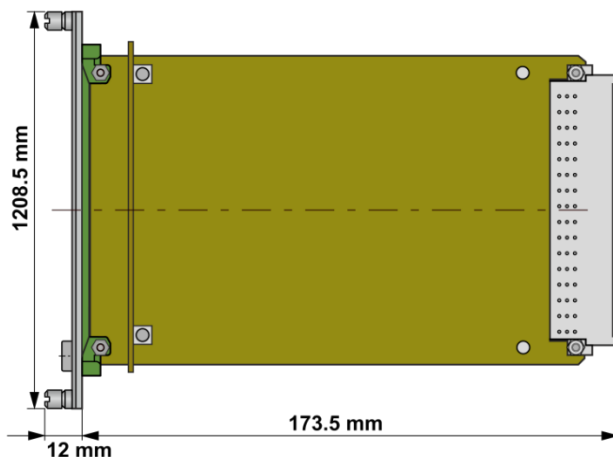
PMH: Panel mounting housing

short TB: short terminal box, long TB: long terminal box

\* No. of terminals with standard wiring. Depending on the configuration it's possible that the real no. of terminals is different.

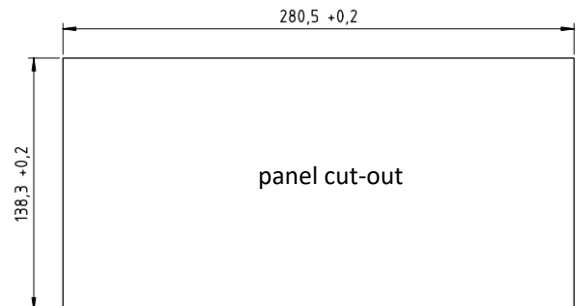
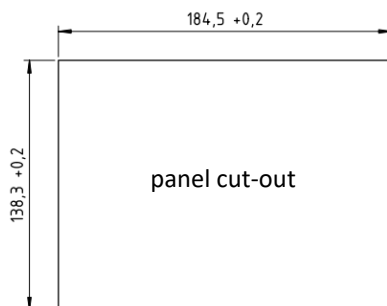
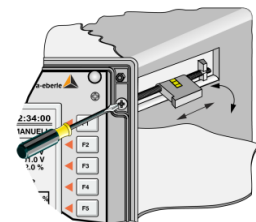
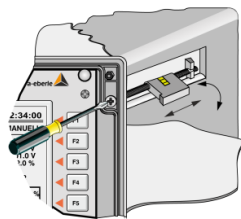
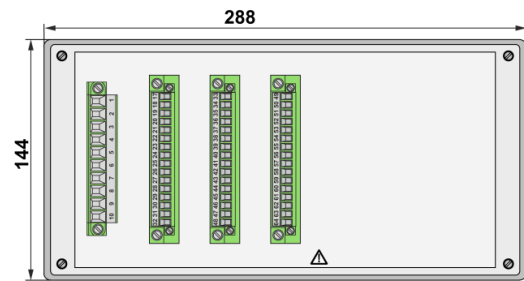
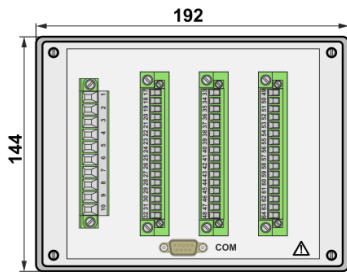
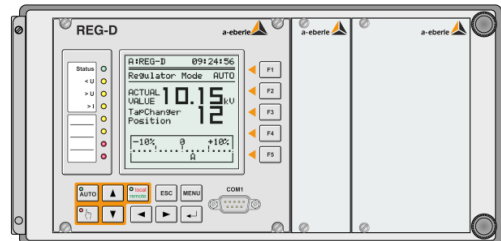
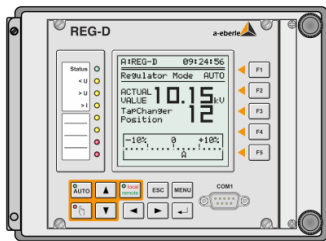
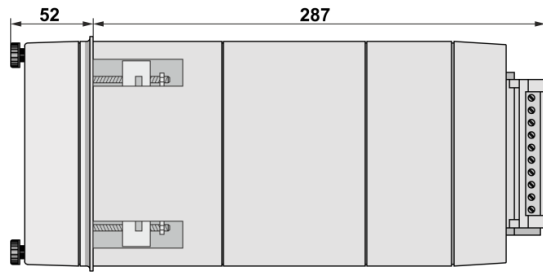
The conductor cross section and the maximum tightening torque of the different terminal types can be found in section 7.3.

### 7.3 Illustrations and dimensions of the modules and housings



Plug-in module REG-D™/PAN-D 28 HP Characteristic B01

We take care of it.



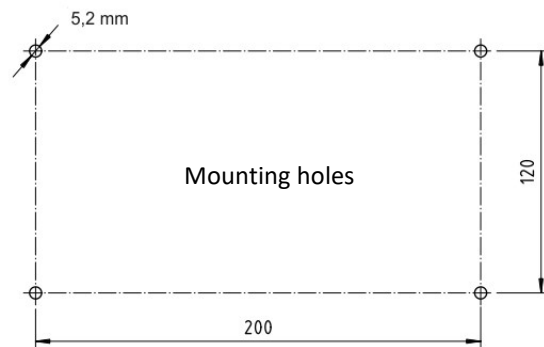
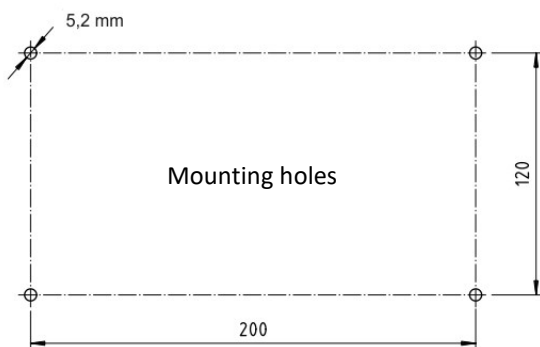
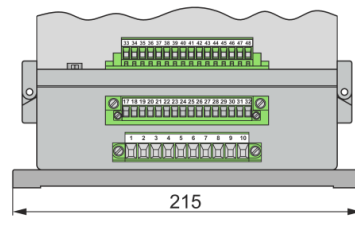
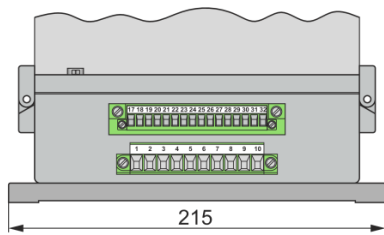
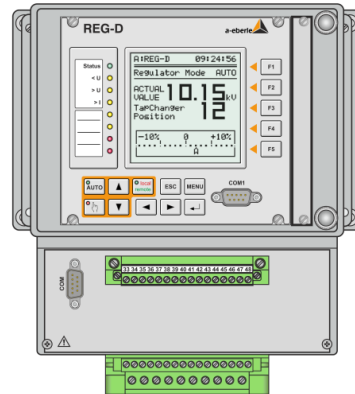
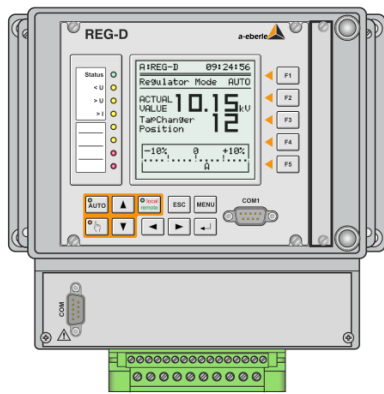
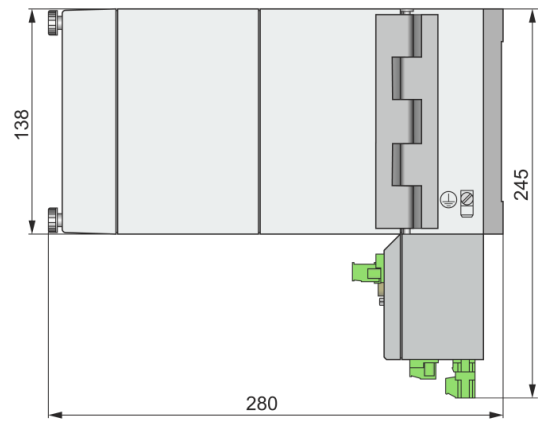
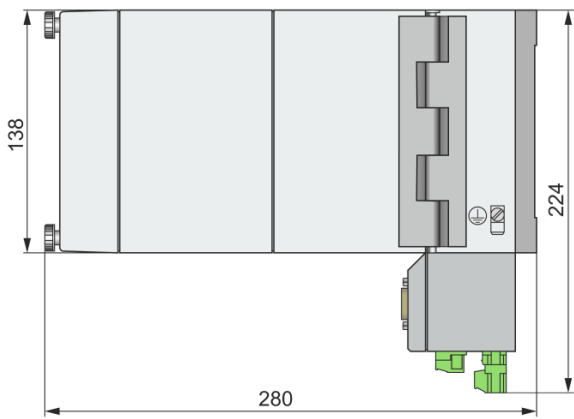
| Conductor cross section and torque of the terminals |                                 |       |           |
|---|---------------------------------|-------|-----------|
| connector, pitch, application example               | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                        | solid |           |
| 10 poles, 7.62 mm, measurements, aux. voltage       | 4                               | 4     | 0,6       |
| 16 poles, 5 mm, Bls, relays                         | 2,5                             | 2,5   | 0,6       |
| 4/5 poles, 3.81 mm, additional functions, COMs      | 1,5                             | 1,5   | 0,25      |

| Conductor cross section and torque of the terminals |                                 |       |           |
|---|---------------------------------|-------|-----------|
| connector, pitch, application example               | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                        | solid |           |
| 10 poles, 7.62 mm, measurements, aux. voltage       | 4                               | 4     | 0,6       |
| 16 poles, 5 mm, Bls, 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 B32  
Dimensions in mm

Panel mounting housing 49 HP - Characteristic B42  
Dimensions in mm





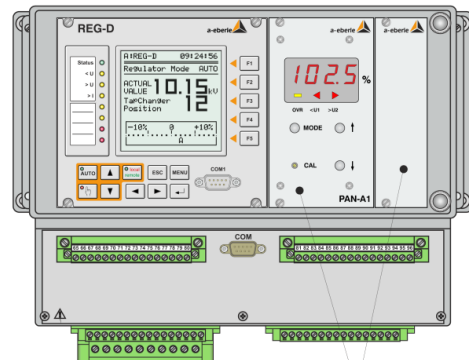
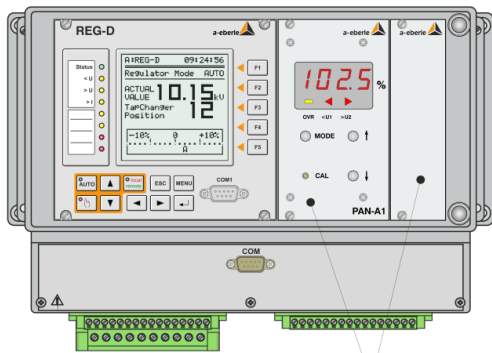
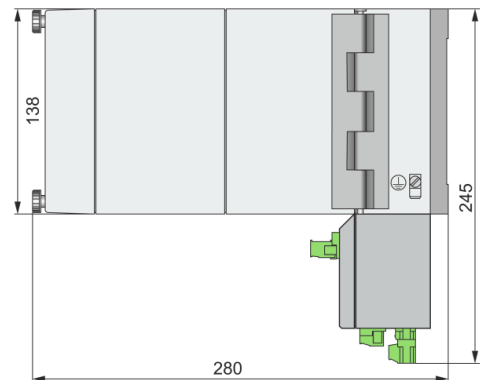
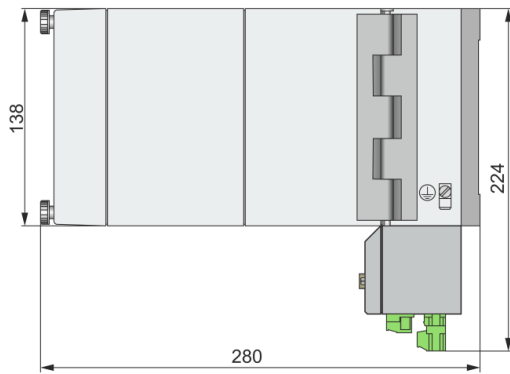
| Conductor cross section and torque of the terminals |                                 |       |           |
|---|---------------------------------|-------|-----------|
| connector, pitch, application example               | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                        | solid |           |
| 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      |

| Conductor cross section and torque of the terminals |                                 |       |           |
|---|---------------------------------|-------|-----------|
| connector, pitch, application example               | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                        | solid |           |
| 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 B30, Dimensions in mm

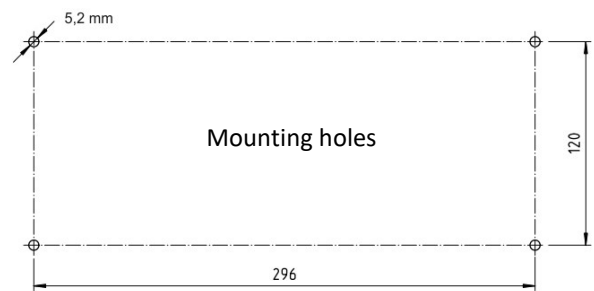
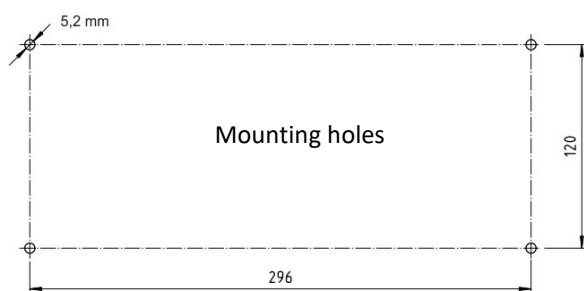
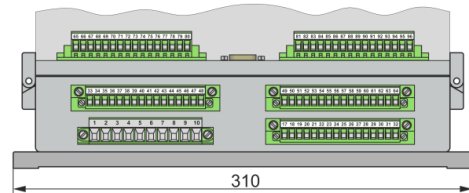
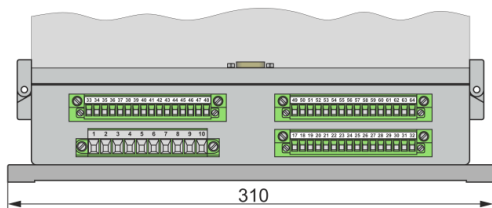
Wall mounting housing 30 HP long terminal box  
Characteristic B31, Dimensions in mm

We take care of it.



Note:  
The housing can be supplied with additional equipment as well as applicationspecific pin assignment according to agreement

Note:  
The housing can be supplied with additional equipment as well as applicationspecific pin assignment according to agreement

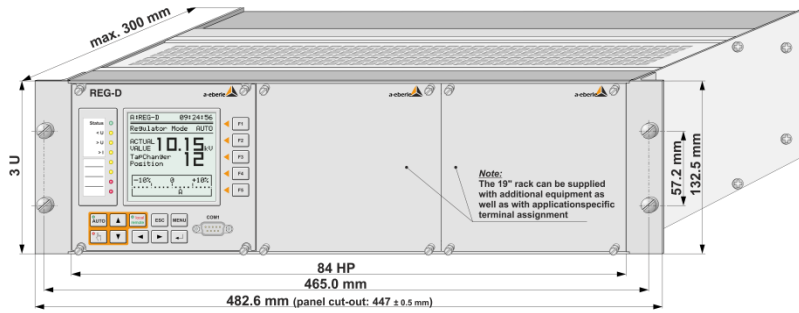


| Conductor cross section and torque of the terminals |                                 |       |           |
|---|---------------------------------|-------|-----------|
| connector, pitch, application example               | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                        | solid |           |
| 10 poles, 7.62 mm, measurements , aux. voltage      | 4                               | 4     | 0,6       |
| 16 poles, 5 mm, Bls, relays                         | 2,5                             | 2,5   | 0,6       |
| 4/5 poles, 3.81 mm, additional functions, COMs      | 1,5                             | 1,5   | 0,25      |

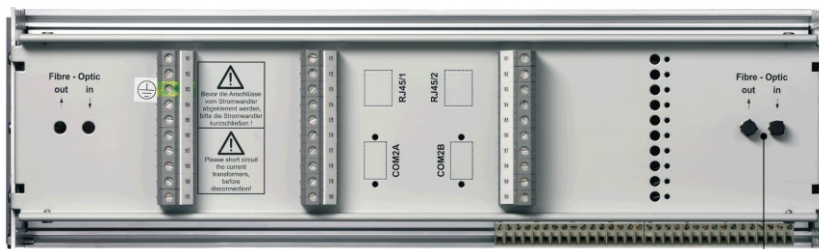
| Conductor cross section and torque of the terminals |                                 |       |           |
|---|---------------------------------|-------|-----------|
| connector, pitch, application example               | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                        | solid |           |
| 10 poles, 7.62 mm, measurements , aux. voltage      | 4                               | 4     | 0,6       |
| 16 poles, 5 mm, Bls, 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 B40, Dimensions in mm

Wall mounting housing 49 HP long terminal box  
Characteristic B41, Dimensions in mm



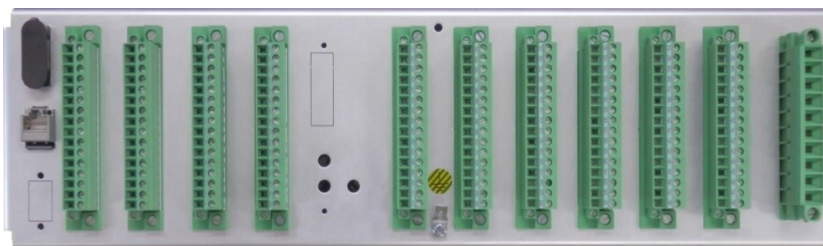
19" card rack 84 HP Front view - Characteristic B92/B93/B95



Fibre optic in-/output with ST or FSMA connector

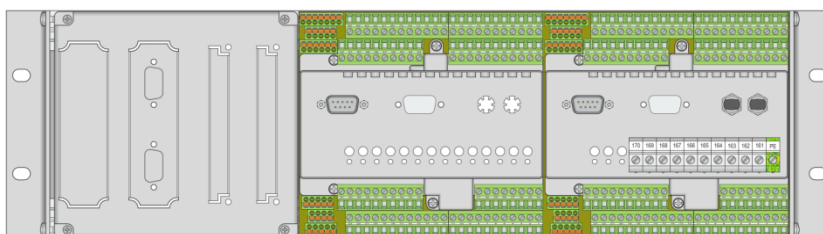
| Conductor cross section and torque of the terminals |                                 |       |           |                                    |                                 |       |           |
|---|---------------------------------|-------|-----------|------------------------------------|---------------------------------|-------|-----------|
| terminal type/terminal no.                          | cross section / mm <sup>2</sup> |       | torque Nm | terminal type/terminal no.         | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                        | solid |           |                                    | stranded                        | solid |           |
| 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, application example               | cross section / mm <sup>2</sup> |       | torque Nm | connector, pitch, application example | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                        | solid |           |                                       | stranded                        | solid |           |
| 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/mm <sup>2</sup> |       | torque Nm | terminal type, pitch, appl. expl.                          | cross section / mm <sup>2</sup> |       | torque Nm |
|   | stranded                      | solid |           |  | stranded                        | solid |           |
| 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

## 7.4 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 <sub>H</sub> | PE                 | PE                |    |
|                | L(+)               | 161               |    |
|                | N(-)               | 162               |    |
| Voltage        | U1a                | 163               |    |
|                | U1b                | 164               |    |
|                | U2a                | **                |    |
|                | U2b                | **                |    |
| Current        | I <sub>E1</sub> S1 | 165               |    |
|                | I <sub>E1</sub> S2 | 166               |    |
|                | I <sub>E2</sub> S1 | **                |    |
|                | I <sub>E2</sub> 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                |    |
|                |                    | 68                |    |
|                |                    |                   |    |

|                        | Description            | No.   |
|------------------------|------------------------|-------|
|                        | Relay 2 (NCC)          | 67    |
|                        | 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/4               | COM1-S / COM 4         | 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                     |       |

|   | Description             |            |            |              | No. |
|---|-------------------------|------------|------------|--------------|-----|
|   | Analogue Channel 6 (-)  |            |            |              | 93  |
| Additional BIs, relays, SCADA interface (X01, X15, X24, X25, X28, X29, XW1) | <b>X 15, 24, 28, 29</b> | <b>X25</b> | <b>X01</b> | <b>XW1</b>   |     |
|   | 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  |

\*\* customer-specific wiring for characteristics M2, M3 and M9  
 \*\*\* based on characteristic U, the status contact is either NOC or NCC  
 \*\*\*\* COM2 can only be used without SCADA interface installed

## 7.5 Backplane terminal configuration for PAN-D (characteristic B95)

|                | Description      |                    | No.               |    |
|----------------|------------------|--------------------|-------------------|----|
| U <sub>H</sub> | 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  |    |

|         |     |     |
|---------|-----|-----|
| E-LAN L | EA+ | 116 |
|         | EA- | 115 |
|         | E+  | 114 |
|         | E-  | 113 |
|         | GND | 117 |

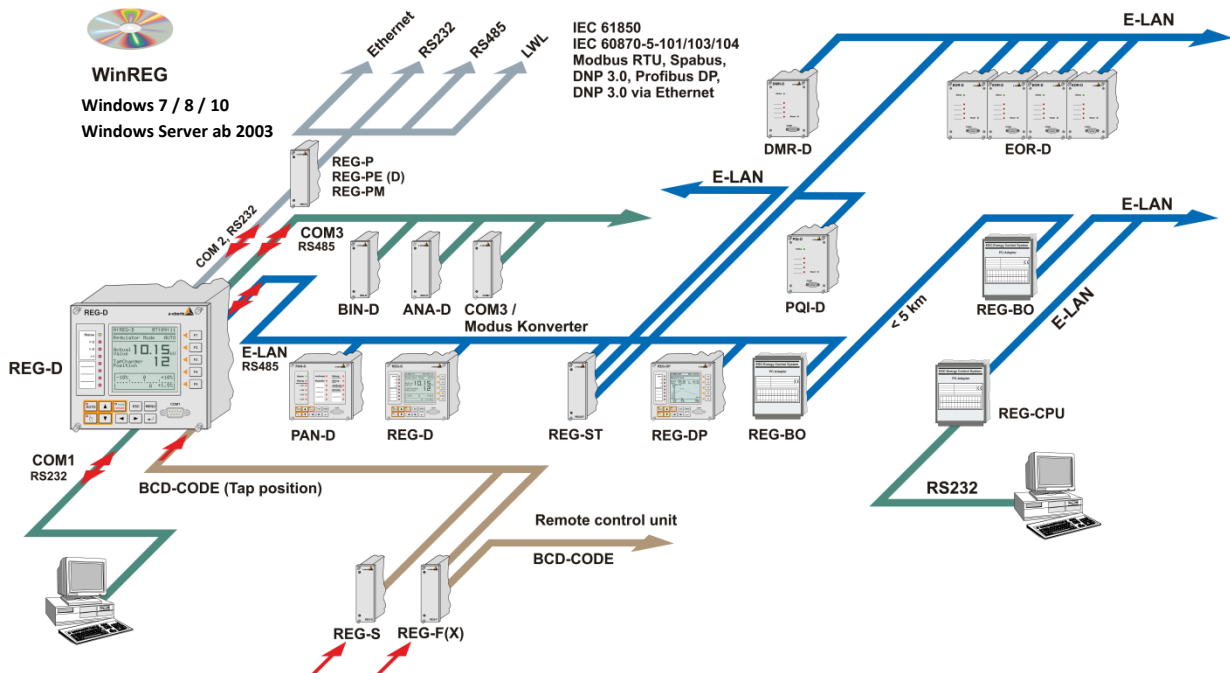
|                   |                        | Description | No. |
|-------------------|------------------------|-------------|-----|
| E-LAN R           | EA+                    |             | 109 |
|                   | EA-                    |             | 108 |
|                   | E+                     |             | 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



## REGSys™ - Overview



## 8. Interfaces and software

Several regulators need to be interconnected in a network when transformers are connected in parallel. The  $\Delta I \cdot \sin \varphi$ ,  $\Delta I \cdot \sin \varphi (S)$  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  $\Delta \cos \varphi$  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.

### 8.1 Serial interfaces

The REG-D™ 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. On devices with characteristic S2 it's possible to switch the COM1-S interface into a permanently working COM interface

(COM4). COM1 can also be configured as a USB port (optional).

COM2 is mainly used to connect the regulator to the SCADA system. If a SCADA 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 / COM 4<br>(COM1-S is switched off when COM1 is used) | Male multipoint connector (printed circuit board VI) depends on the housing |
| COM2 / COM5  | 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<br>Parity: even, none  |

We take care of it.

---

|                            |   |
|----------------------------|---|
| Transmission rate<br>bit/s | 1200, 2400, 4800, 9600,<br>19200, 38400, 57600,<br>115200, 230400*, 460800*,<br>921600* |
| HANDSHAKE                  | RTS / CTS, XON / XOFF, delay,<br>none   |

\* Only available on REG-D™ with characteristic S2 on COM1 and COM2

### ELAN (Energy - Local Area Network)

Each REG-D™ 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™ 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.

## 8.2 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 7 / 8 / 10
- 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 %<br>± 0.1 ... 100 % for P/Q regulation                          |
| Time factor   | 0.1 ... 30  |
| Setpoint value 1..2   | 60.0 ... 140.0 V  |
| Setpoint value 3..4   | 60.0 ... 140.0 V or<br>-500 ... 500 % for P/Q regulation                      |
| Time behaviour  | $\Delta U \cdot t = \text{const}$<br>REG 5A/E<br>LINEAR<br>CONST              |
| Trend memory  | 0 ... 60 s  |
| Current influence (load-dependent setpoint)   | Apparent current<br>Active current<br>Reactive current<br>LDC                 |
| Apparent, active, reactive current  |   |
| Increase (I) (pos.)   | 0 ... 400 V/In  |
| Increase (I) (neg.)   | 0 ... 400 V/In  |
| Limit (I) (max.)  | -40 ... 40 V  |
| Limit (I) (min.)  | -40 ... 40 V  |
| LDC (Line drop compensation)  | R : 0 ... ± 100 Ω<br>X : 0 ... ± 100 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<br>(Fast step-up 2...999 s)                                       |
| Parallel programs   | dI*sin(phi)<br>dI*sin(phi)[S]<br>dCos (phi)<br>Master-Follower<br>MSI<br>MSI2 |
| TC in operation - maximum time*   | 3 ... 40 s  |

### PAN-D parameters (selection)

| Parameter   | Setting range  |
|---|----------------|
| Undervoltage <U <sub>1</sub>  | -25 ... 10 %   |
| Overvoltage >U <sub>2</sub>   | 0 ... 25 %     |
| Undervoltage «U <sub>3</sub>  | -35 ... 10 %   |
| Overvoltage »U <sub>4</sub>   | 0 ... 35 %     |
| Inhibit high  | 65 V ... 150 V |
| Switching delay for <U <sub>1</sub> , >U <sub>2</sub> , «U <sub>3</sub> , »U <sub>4</sub> , Inhibit high (independent setting for each limit) | 1 ... 999 s    |
| 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.

## 8.3 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.

## 9. Order specifications

- Only one code of the same capital letter is possible
- When the capital letter is followed by number 9, further details may be necessary
- The code can be omitted when the capital letter is followed by zero or one option is marked as standard

| CHARACTERISTIC  | CODE   |  |
|---|--------|--|
|   | Design |  |
| <b>30 HP housing</b>  |        |  |
| Wall mounting housing with short terminal box (30HP) with Phoenix pluggable screw terminals | B30    |  |
| Wall mounting housing with long terminal box (30HP) with Phoenix pluggable screw terminals  | B31    |  |
| Panel mounting housing (30HP) with Phoenix pluggable screw terminals                        | B32    |  |
| Panel mounting housing (30HP) special design with Cooper Bussmann screw terminals           | B33    |  |
| <b>49 HP housing</b>  |        |  |
| Wall mounting housing with short terminal box (49HP) with Phoenix pluggable screw terminals | B40    |  |
| Wall mounting housing with long terminal box (49HP) with Phoenix pluggable screw terminals  | B41    |  |
| Panel mounting housing (49HP) with Phoenix pluggable screw terminals                        | B42    |  |
| Panel mounting housing (49HP) special design with Cooper Bussmann screw terminals           | B43    |  |
| <b>19" card racks (84HP)</b>  |        |  |
| 19" card rack (84HP) with wire-wrap wiring and screw terminals                              | B92    |  |
| 19" card rack (84HP) with Phoenix pluggable screw terminals                                 | B93    |  |
| 19" card rack (84HP) with backplane   | B95    |  |

| CHARACTERISTIC   | CODE   |       |
|--|--------|-------|
|  | REG-D™ | PAN-D |
| <b>REG-D™ Relay for Voltage Control &amp; Transformer Monitoring</b>   | REG-D™ |       |
| Plug-in module 28 HP, 3 U<br>basic configuration with dual ELAN interface, COM1, COM2,<br>16 binary inputs, 10 relay outputs and status relays and parameterisation and<br>programming software incl. connection cable |        |       |
| <b>PAN-D Monitoring unit</b>   |        | PAN-D |
| Plug-in module 28 HP, 3 U<br>basic configuration with dual ELAN interface, COM1, COM2,<br>16 binary inputs, 14 relay outputs and status relays   |        |       |
| <b>Design</b>  |        |       |
| ● Plug-in unit   | B01    | B01   |
| <b>Power supply</b>  |        |       |
| ● from the measuring circuit AC 80 V ... <u>110 V</u> ... 185 V  | H0     | H0    |
| ● external AC 100 V ... <u>110 V</u> ... 240 V / DC 100 V ... 220 V ... 300 V  | H1     | H1    |
| ● external AC 100 V ... 110 V ... 240 V / DC 100 V ... 220 V ... 300 V, 20 Watt  | H11    | -     |
| ● external DC 20 V ... <u>60 V</u> ... 70 V  | H2     | H2    |
| <b>Note:</b><br>H0/H1 for REG-P(E) with FO please use a REG-NTZ.<br>H11 is meant for REG-P(E) with FO but without REG-NTZ.<br>H2 for REG-P(E) with FO please use a REG-NTZ.  |        |       |

| CHARACTERISTIC  | CODE                                   |                                 |
|---|--|---------------------------------|
|   | REG-D™                                 | PAN-D                           |
| <b>COM1 serial interface in the front panel</b> <ul style="list-style-type: none"> <li>● RS232 with SUB-D connector (9-pin male), standard if characteristic I is not specified</li> <li>● USB (Mini-USB connector)</li> </ul>  | I0<br>I1                               | I0<br>I1                        |
| <b>Input current (can be changed at a later stage)</b> <ul style="list-style-type: none"> <li>● I<sub>EN</sub> 1A</li> <li>● I<sub>EN</sub> 5A</li> </ul>   | F1<br>F2                               | -<br>-                          |
| <b>Voltage and current measurement</b> <ul style="list-style-type: none"> <li>● Three-wire three-phase system with balanced load (1 x voltage, 1 x current)</li> <li>● Three-wire three-phase system, three-phase voltage measurement only</li> <li>● Three-wire three-phase system with unbalanced load (ARON connection)</li> <li>● U measurement high voltage, U and I measurement low voltage side</li> <li>● other application with 2 x CT's and 2 x VT's; Feature for three winding transformers always active (deactivation possible)</li> </ul>   | M1<br>-<br>M2<br>M3<br>M9              | -<br>M1<br>-<br>-<br>M9         |
| <b>Recorder function for quantities U, I, P, Q, S, PF, tap position incl. REGView visualisation software</b> <ul style="list-style-type: none"> <li>● without</li> <li>● with max. 3 channels</li> <li>● with max. 256 channels (4 x 64) and 108 MB internal memory and upgraded CPU, including S1</li> </ul> <p><b>Note:</b> If Sampled Values (IEC 61850-9-2LE) are used the feature S2 is mandatory!</p>   | S0<br>S1<br>S2                         | S0<br>S1<br>-                   |
| <b>Parallel operation</b> <ul style="list-style-type: none"> <li>● Parallel operation: without</li> <li>● Parallel operation: with (incl. ParaGramer)</li> <li>● Feature K1 and additional HVLVControl</li> <li>● Feature K1 and additional Crosslink</li> <li>● Feature K1 and additional Crosslink &amp; HVLV</li> <li>● Feature K1 and additional Ringlink</li> <li>● Feature K1 and additional Ringlink &amp; HVLVControl</li> </ul>  | K0<br>K1<br>K2<br>K3<br>K4<br>K5<br>K6 | -<br>-<br>-<br>-<br>-<br>-<br>- |
| <b>PQCtrl – Feature for regulating active or reactive power</b> <ul style="list-style-type: none"> <li>● PQCtrl: without</li> <li>● PQCtrl: with</li> </ul>   | P0<br>P1                               | -<br>-                          |
| <b>Transformer monitoring according to IEC 60354 or IEC 60076</b> <ul style="list-style-type: none"> <li>● Transformer monitoring according to IEC 60354 or IEC 60076: without</li> <li>● Transformer monitoring according to IEC 60354 or IEC 60076: with</li> <li>● Transformer monitoring according to IEC 60354 or IEC 60076: with extended function: moisture in paper/oil, bubbling temperature (TM1 incl.)</li> </ul> <p><b>Note:</b> TM2 only possible with S2. Please choose from the feature group "E" an additional mA input module or select a PT-100 module for temperature measurement.</p> | TM0<br>TM1<br>TM2                      | -<br>-<br>-                     |

| Analogue in- and outputs  |   |                |                |
|---|---|----------------|----------------|
| <ul style="list-style-type: none"> <li>● without</li> <li>● 2 x mA-inputs</li> <li>● 4 x mA-inputs</li> <li>● 6 x mA-inputs</li> <li>● 2 x mA-outputs</li> <li>● 4 x mA-outputs</li> <li>● 6 x mA-outputs</li> <li>● 2 x mA-inputs and 2 x mA-outputs</li> <li>● 2 x mA-inputs and 4 x mA-outputs</li> <li>● <u>4 x mA-inputs and 2 x mA-outputs</u></li> </ul>   | <p><b>Note:</b><br/> <b>Please specify scaling if known:</b><br/>                     Example:<br/>                     Channel 1: -100 ... 0 ... + 100 mV<br/>                                       -20 ... 0 ... + 20 mA<br/>                     Channel 2: 0 ... 80 ... 100 V<br/>                                       4 ... 16 ... 20 mA<br/>                     Channel 3: 1 ... 19 taps<br/>                                       0 ... 20 mA</p> | E00            | E00            |
|   |   | E91            | E91            |
|   | E92   | E92            |                |
|   | E93   | E93            |                |
|   | E94   | E94            |                |
|   | E95   | E95            |                |
|   | E96   | E96            |                |
|   | E97   | E97            |                |
|   | E98   | E98            |                |
|   | <u>E99</u>  | <u>E99</u>     |                |
| <ul style="list-style-type: none"> <li>● 1 x PT100 input (three-wire connection) (slot 1)</li> <li>● 1 x PT100 input (three-wire connection) (slot 2)</li> <li>● 1 x PT100 input (three-wire connection) (slot 3)</li> <li>● 2 x mA-inputs and 1 resistor module R1 (180Ω...2kΩ, min. 5Ω / step)</li> <li>● 1 x PT 100 input and 1 x resistor module R1 (180Ω...2kΩ, min. 5Ω / step)</li> <li>● 2 x mA-outputs and 1 x resistor module R1 (180Ω...2kΩ, min. 5Ω / step)</li> <li>● 1 x resistor module R1 (180Ω...2kΩ, min. 5Ω / step) (slot 2)</li> <li>● 2 x mA-inputs and 1 x PT 100 input</li> <li>● 1 x PT 100 input and 1 x resistor module R3 (2kΩ...20kΩ, min. 50Ω / step)</li> <li>● <u>3 x PT100 inputs</u></li> </ul> |   | E901           | E901           |
|   |   | E902           | E902           |
|   |   | E903           | E903           |
|   |   | E900.1         | -              |
|   |   | E900.2         | -              |
|   |   | E900.3         | -              |
|   |   | E900.4         | -              |
|   |   | E900.5         | E900.5         |
|   |   | E900.6         | -              |
|   |   | <u>E900.7</u>  | <u>E900.7</u>  |
|   |   | E900.9         | -              |
|   |   | E900.10        | E900.10        |
|   |   | E900.11        | E900.11        |
|   |   | E900.12        | -              |
|   |   | E900.13        | -              |
|   |   | E900.14        | -              |
|   |   | E900.15        | -              |
|   |   | E900.16        | E900.16        |
|   |   | E900.17        | -              |
|   |   | <u>E900.18</u> | -              |
|   |   | E900.19        | -              |
|   |   | E900.20        | E900.20        |
|   |   | E900.21        | -              |
|   |   | E900.22        | E900.22        |
|   |   | E900.23        | -              |
|   |   | E900.24        | -              |
|   |   | E900.25        | E900.25        |
|   |   | E900.26        | -              |
|   |   | E900.27        | E900.27        |
|   |   | <u>E900.28</u> | -              |
|   |   | E900.29        | E900.29        |
|   |   | E900.30        | -              |
|   |   | E900.31        | -              |
|   |   | E900.32        | -              |
|   |   | E900.33        | -              |
|   |   | E900.34        | E900.34        |
|   |   | E900.35        | E900.35        |
|   |   | E900.36        | -              |
|   |   | E900.37        | -              |
|   |   | <u>E900.38</u> | <u>E900.38</u> |
|   |   | E900.39        | E900.39        |
|   |   | E900.40        | E900.40        |



| CHARACTERISTIC  | CODE  |                                    |
|---|---|------------------------------------|
|   | REG-D™  | PAN-D                              |
| <ul style="list-style-type: none"> <li>any combination on request, 2 analogue inputs and outputs each, PT100 direct input, resistance measurement input (tap position potentiometer)</li> </ul> <p><b>Note:</b> A total of three modules can be used.<br/>This is particularly important when the transformer monitoring module is used!<br/>The underlined entries are just marked because of the readability, it's not any kind of preselection!</p>  | E900  | E900                               |
| <p><b>Binary inputs (freely programmable)</b></p> <ul style="list-style-type: none"> <li>8 x AC/DC 48...250V (BI1...BI8) and 8 x AC/DC 10...50V (BI9...BI16)</li> <li>7 x AC/DC 48 ... 250V (BI2...BI8) and 9 x AC/DC 10 ... 50V (BI1, BI9...BI16)</li> <li>16 x AC/DC 48...250 V (BI1...BI16)</li> <li>16 x AC/DC 10...50V (BI1...BI16)</li> <li>16 x AC/DC 80...250V (BI1...BI16)</li> <li>16 x AC/DC 190...250V (BI1...BI16)</li> </ul>  | D1<br>-<br>D2<br>D3<br>D4<br>D5               | D1<br>D1.1<br>D2<br>D3<br>D4<br>D5 |
| <p><b>Additional inputs and outputs (freely programmable), not in combination with XW1</b></p> <ul style="list-style-type: none"> <li>without</li> <li>8 relays (changeover contacts) (BO10...BO17)</li> <li>16 x AC/DC 48...250V (BI17...BI32)</li> <li>16 x AC/DC 10...50V (BI17...BI32)</li> <li>8 x AC/DC 48...250V (BI17...BI24), 8 x AC/DC 10..50V (BI25...BI32)"</li> <li>16 x AC/DC 190...250V (BI17...BI32)</li> <li>16 x AC/DC 80...250V (BI17...BI32)</li> </ul>   | X00<br>X01<br>X15<br>X24<br>X25<br>X28<br>X29 | -<br>-<br>-<br>-<br>-<br>-<br>-    |
| <p><b>COM3 interface</b></p> <ul style="list-style-type: none"> <li>without</li> <li>with RS485</li> </ul> <p><b>Note:</b> COM3 is needed for ANA-D, BIN-D and COM3/Modbus converter!<br/>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</p>  | R0<br>R1                                      | R0<br>R1                           |
| <p><b>SCADA connection: internal or external</b></p> <ul style="list-style-type: none"> <li>without (continue with characteristics group 'Y')</li> <li>with internal protocol interface (continue with characteristic group 'XL'), <b>only with characteristic X00</b></li> <li>with external protocol interface: REG-P/-PE/-PED<sup>SV</sup> (continue with characteristic group 'Y')</li> </ul>   | XW0<br>XW1<br>XW9                             | XW0<br>XW1<br>XW9                  |
| <p><b>Integrated protocol interface card</b></p> <ul style="list-style-type: none"> <li>to connect one REG-D™ to SCADA</li> <li>to connect several systems to SCADA</li> </ul> <p><b>Note:</b> XL9 can only be combined with XZ01, XZ15...XZ19, XZ91</p>  | XL1<br>XL9                                    | -<br>-                             |
| <p><b>Connection type</b></p> <ul style="list-style-type: none"> <li>Copper conductors <ul style="list-style-type: none"> <li>RS232</li> <li>RS485 2-wire operation only</li> </ul> </li> <li>Fibre optic cable with FSMA connection technology <ul style="list-style-type: none"> <li>Fibreglass (Wave length 800...900 nm, range 2000 m)</li> <li>All-plastic (Wave length 620...680 nm, range 50 m)</li> </ul> </li> <li>Fibre optic cable with ST connection technology <ul style="list-style-type: none"> <li>Fibreglass (Wave length 800...900 nm, range 2000 m)</li> </ul> </li> </ul> | XV10<br>XV11<br>XV13<br>XV15<br>XV17          | -<br>-<br>-<br>-<br>-              |



| REGSys™ Accessories  | ID-No.      |
|--|-------------|
| <b>Rack design:</b>  |             |
| Female multipoint connector 1 (Electrical connector block, model F, wire wrap)   | 582.0197    |
| 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    |
| <b>Fuses, batteries:</b>   |             |
| 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)   | 570.0001    |
| 1 button cell CR1632   | 570.0005    |
| <b>Connection technique:</b>   |             |
| Connection adapter set from fibre optic connector LC to ST including 1m fibre  | 111.9048.99 |
| 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, Fiber optics: multi-mode, max. transmission distance: 2.5 km, FO-connector: ST (E-LAN → FO or FO → E-LAN)<br>Note: 2 units required per line! connection, 2 units needed for each line | 111.9030.10 |
| Interface E-LAN-FO: RS485/FO, Fiber optics: single-mode, max. transmission distance: 15 km, FO-connector: SC (E-LAN → FO or FO → E-LAN)<br>Note: 2 units required per line! connection, 2 units needed for each line | 111.9030.11 |
| <b>Time synchronisation:</b>   |             |
| Radio controlled clock (DCF 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 |
| <b>Modems:</b>   |             |
| INSYS EBW-L100, Router 4G / LTE  | 111.9049.04 |
| Antenna for router   | 111.9049.01 |

| REGSys™ Accessories  | ID-No.         |
|--|----------------|
| INSYS External antenna (magnetic base antenna)   | 111.9030.68    |
| INSYS extension cable f. ext. antenna  | 111.9030.68.01 |
| SHDSL Ethernet modem, (Westermo DDW-120) for establishing a TCP / IP connection via 2 – wire, 10..60V DC, DIN rail | 111.9030.16    |
| <b>Power supply:</b>   |                |
| Power supply Phoenix for DIN rail mounting: In: AC 120 ... 230 V, DC 90 ... 250 V, Out: 24 V/1.3 A                 | 111.9030.36    |
| <b>Additional input and output module:</b>   |                |
| 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    |
| Input module for PT100 in conformity with DIN 43760 in three-wire connection                                       | 320.0005.01    |
| <b>Operating manual:</b>   |                |
| Additional operating manual for REG-D™ and PAN-D   | GX             |
| Additional operating manual for REG-D™ (please specify the language)   | GX             |

| Add-ons for REG-D™   | ID-No.                                |
|--|---------------------------------------|
| <b>Transformer Monitoring Module - TMM (REG-D™ only)</b>   |                                       |
| <ul style="list-style-type: none"> <li>● Consists of: <ul style="list-style-type: none"> <li>Firmware update</li> <li>User guide and parameterisation software for Windows</li> </ul> </li> <li>— Analogue module with two inputs for the temperature transducer</li> <li>— Input for PT100 in a three-wire connection in conformity with DIN 43760</li> </ul> | <p><b>TMM</b></p> <p>A1</p> <p>A2</p> |

| Software for REG-D/PAN-D   | ID-No.         |
|--|----------------|
| <b>REGView</b> as CD-ROM   | <b>REGView</b> |
| WinREG add-on functions Collector and RegView to archive and view data recorded with REG-D(A) and PAN-D. |                |
| <b>REGSim</b> as CD-ROM, Simulates the parallel operation of transformers                                | <b>REGSim</b>  |

| General add-ons   | ID-No.                          |
|---|---------------------------------|
| <b>Profibus DP module</b> incl. RS485 interface and connection cable  |                                 |
| Design  | <b>Profi-DP</b>                 |
| <ul style="list-style-type: none"> <li>● Mountable on DIN-rail (120 x 75 x 27) mm, ext. 24 V power supply adapter necessary</li> <li>● Plug-in module: 12 HP/3 U incl. AC 100...240 V, DC 100 ... 300V power adapter</li> <li>● Plug-in module: 12 HP/3 U incl. DC 20...70 V power adapter</li> </ul> | <p>B0</p> <p>B01</p> <p>B02</p> |
| <b>TCP/IP adapter (COMServer)</b>   |                                 |
| REG-COM Com-Server - Adapter Seriell to TCP/IP - 100 Mbit (8 HP / 3 U)  | <b>REG-COM</b>                  |
| Plug in unit with power supply: AC 100V ... 110V ... 240V / DC 24V ... 220V ... 240V  | 111.9037.24                     |
| Com-Server DIN rail power supply 24V/15W  | 111.9037.12                     |
| Com-Server 100BT, LC, 24 Volt AC/DC   | 111.9037.20                     |
| Com-Server 100BT, 3-way,12-24 Volt AC/DC  | 111.9037.08                     |

| General add-ons   | ID-No.  |
|---|---|
| <p><b>COM3 converter</b><br/>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. Auxiliary voltage DC 20 ... 70 V</p>  | <p><b>COM3-MOD</b></p>                                      |
| <p><b>IRIG-DCF77 – converter</b></p> <p>IRIG - DCF77-Converter as plug in unit (10HP / 3U)<br/>Power supply: AC 100V ... 110V ... 240V / DC 100V ... 220V ... 300V</p>  | <p><b>IRIG-DCF</b></p> <p>111.9024.21</p>                   |
| <p><b>Power supply adapter for REG-PE 3 U/6 HP, 15 Watt</b><br/>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.</p> <p>REG-NTZ Power supply for REG-PE (3U / 6HP) - 15 Watt<br/>Voltage: AC 100V ... 110V ... 240V / DC 100V ... 220V ... 300V</p> <p>REG-NTZ Power supply for REG-PE (3U / 6HP) - 15 Watt<br/>Voltage: DC 20V ... 60V ... 70V</p> | <p><b>REG-NTZ</b></p> <p>111.9005.10</p> <p>111.9005.11</p> |







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