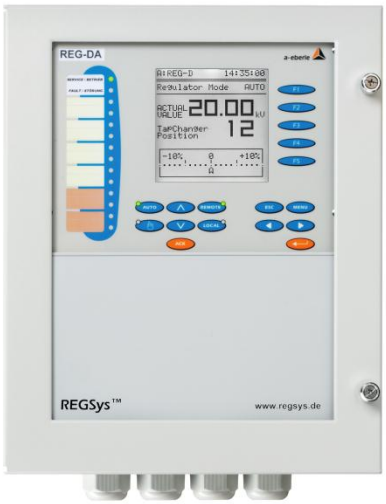
Relay for Voltage Control

Model REG-DA

- **Wall mounting housing**
- **Panel mounting housing**
- **Din-rail mounting**



1. Application

The REG-DA relay for voltage control is used to perform both complex and simple measurement, control and regulation tasks on tap-changing transformers. To achieve these tasks, the REG-DA voltage regulator can be used with an array of add-on components, such as the BIN-D and ANA-D remote I/O modules, and an assortment of communication cards.

Each REG-DA 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.

Voltage regulators 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 six cooling levels can be activated.

As an alternative to direct measurement, the U, I, tap position and cos(φ) value can also be transmitted to the REG-DA via either IEC 61850 or by mA inputs, thereby eliminating the need for CT and VT cabling to the regulator.

The REG-DA regulator can communicate with a SCADA system (see list of characteristics) through all of the common protocols.

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

A number of different communication cards are available for the REG-DA, 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:

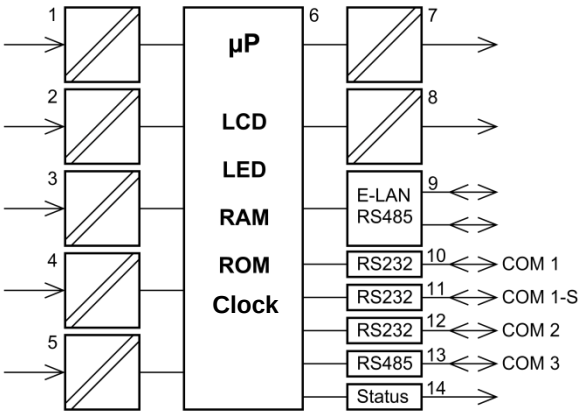
- IEC 61850
- IEC 60870 - 5 - 101 / 103 / 104
- DNP 3.0 via Ethernet
- DNP 3.0
- MODBUS RTU
- Profibus DP
- SPABUS
- LON (on request)

The REG-PED 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.

2. Characteristics of the REG-DA

- Large backlit LCD (128 x 128) with all important information (tap, voltage etc.)
- Measurement functions (U, I, P, Q, S, cos φ, φ, I sin φ, f)
- Recorder function (3-channel line recorder)
- Statistics function (total number of switching operations, switching operations per tap)
- 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
- 14 (26) freely programmable binary inputs
- 9 (21) freely programmable binary outputs
- Freely programmable analogue inputs or outputs (mA)
- PT100 direct input
- Input for tap-potentiometer (200 Ω...20 kΩ 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 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
- ParaGramer function to view and automate the parallel connection of up to ten transformers
- WinREG software (with RegView, WinTM add-ons) to set parameters, program devices, and view and archive data
- REGSim™ simulation software to simulate parallel operations, network and load situations
- UL certification

3. Description

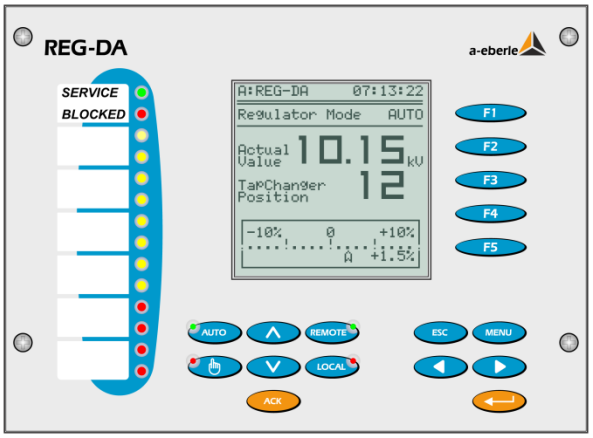


Functions of the REG-DA regulator (all options)

1	three current and two voltage measuring inputs
2	Analogue inputs, PT100 (optional)
3	Binary inputs
4	Input for resistance-coded tap-position indicator (optional)
5	Auxiliary voltage / Power Supply
6	Display and processing unit
7	Analogue outputs
8	Binary outputs
9	ELAN connection (2 x RS485 with repeater function)
10	COM1, RS232
11	COM1-S, RS232 (can be used alternatively to COM1)
12	COM2, RS232
13	COM3, RS485
14	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, catering 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:

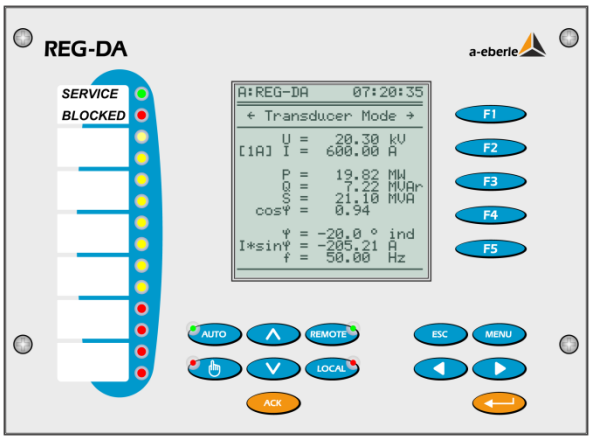
Case	REG-DA – Programme	Conditions
Parallel operation on one or more busbars	ΔI sin φ	Identical transformers, identical or different tap size
	ΔI sin φ (S)	Transformers with different performances, different or equal tap size
	Master/ slave	Identical transformers, same tap size
Free feed in	Δ cos φ	Any transformer, any tap size
Emergency program in the event of a ELAN failure	Δ cos φ	Any transformer, any tap size, for the programs ΔI sin φ and ΔI sin φ (S)

Table 1 *Parallel operated 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 displays	Voltage U_{eff} Current I_{eff} Active power P Reactive power Q Apparent power S cos φ Phase angle φ Reactive current I*sinφ Frequency f Circulating reactive current (see page 2 of the transducer display)

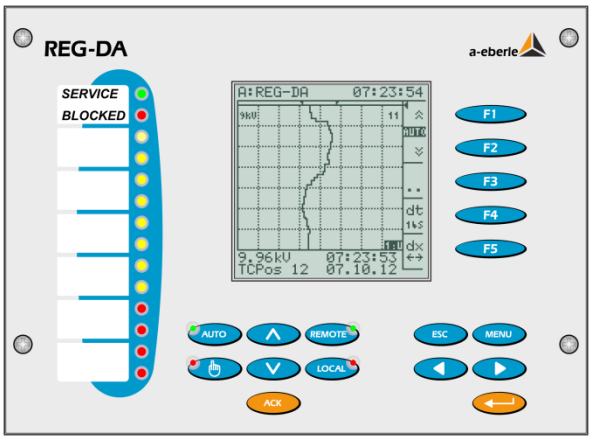
All of the measured and calculated values can be transferred to an analogue output or to SCADA.

3.3 Recorder mode

Up to two selectable analogue values can be continuously recorded and 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)



Time grid dt 14 s, 1, 5, 10, 30, min / Division

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.

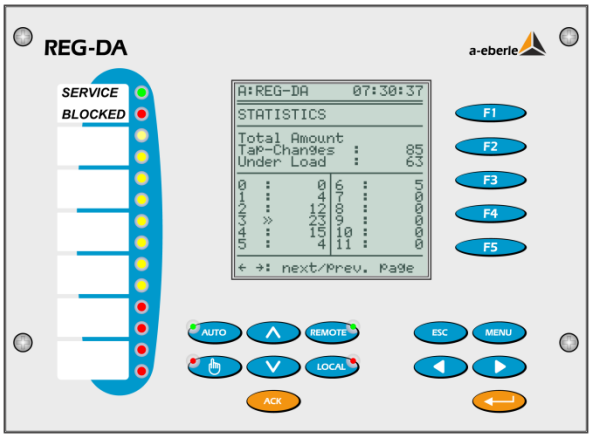
Storage behaviour in the case of an overflow	Overwrite with FIFO (**F**irst **i**n **F**irst **o**ut)
Storage time (voltage plus tap)	< 18.7 days worst case on average > 1 month

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.



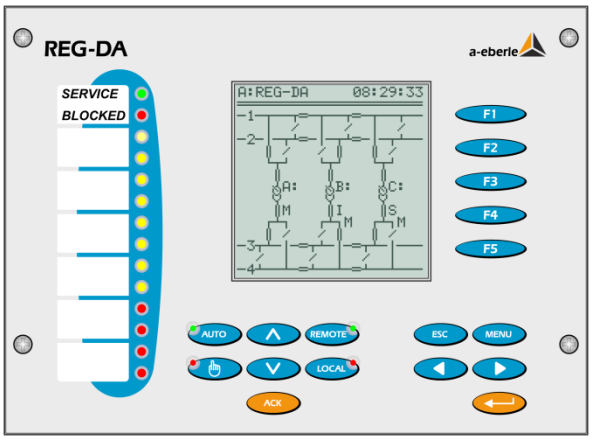
3.5 ParaGramer mode

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.

Paragramer 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'.

3.5 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 transformers loss of life.

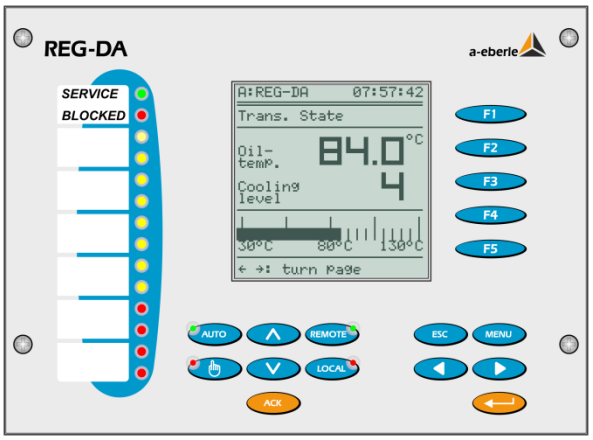
The optional TM+ function evaluates the moisture content of the cellulose and the risk of bubble formation.

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.



4. Technical specifications

Regulations and standards

- IEC 61010-1 / EN 61010-1
- CAN/CSA C22.2 No. 1010.1-92
- IEC 60255-22-1 / EN 60255-22-1
- IEC 61326-1 / EN 61326-1
- IEC 60529 / EN 60529
- IEC 60068-1 / EN 60068-1
- IEC 60688 / EN 60688
- IEC 61000-6-2 / EN 61000-6-2
- IEC 61000-6-4 / EN 61000-6-4
- IEC 61000-6-5 / EN 61000-6-5 (in preparation)

CE

UL Certificate Number 050505 - E242284

Certificate of Compliance

Certificate Number 050505 - E242284
Report Reference E242284, April 7th, 2005
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Underwriters Laboratories Inc.®

Issued to: A EBERLE GMBH & CO KG
AALENER STR 30/32
90441 NUERNBERG GERMANY

This is to certify that representative samples of Voltage Regulator
Model: REG-DA

Have been investigated by Underwriters Laboratories Inc.® in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 61010C-1 - Safety for Process Control Equipment
CSA C22.2 No. 1010.1-92 - Safety of Electrical Equipment for Measurement Control and Laboratory Use; Part 1, General Requirements

Additional Information: ELECTRICAL RATING:
110-240Vac, 50-60Hz, 20VA
110-220VDC, 20W

Only those products bearing the UL Recognized Component Marks for the U.S. and Canada should be considered as being covered by UL's Recognition and Follow-Up Service and meeting the appropriate U.S. and Canadian requirements.
The UL Recognized Component Mark for the U.S. generally consists of the manufacturer's identification and catalog number, model number or other product designation as specified under "Marking" for the particular Recognition as published in the appropriate UL Directory. As a supplementary means of identifying products that have been produced under UL's Component Recognition Program, UL's Recognized Component Mark, , may be used in conjunction with the required Recognized Marks. The Recognized Component Mark is required when specified in the UL Directory preceding the recognition or under "Marking" for the individual recognitions. The UL Recognized Component Mark for Canada consists of the UL Recognized Mark for Canada and the manufacturer's identification and catalog number, model number or other product designation as specified under "Marking" for the particular Recognition as published in the appropriate UL Directory.

Look for the UL Recognized Component Mark on the product

Manfred Müller, Senior Project Engineer
Walter Hofmeir, Senior Project Engineer

AC voltage inputs (U_E)	
Measuring voltage U_E	0 ... 160 V
Shape of the curve	sinusoidal
Frequency range	16....50....60....65 Hz
Internal consumption	≤ U^2 / 100 kΩ
Overload capacity	230 V AC continuous

AC input (I_E)	
Measuring current In	1 A / 5 A software selectable
Shape of the curve	sinusoidal
Frequency range	16....50....60....65 Hz
Control range	0 ... In ... 2.1 In
Internal consumption	≤ 0.5 VA
Overload capacity	10 A continuous 30 A for 10 s 100 A for 1 s 500 A for 5 ms

Analogue inputs (AI)	
Quantity	See order specifications
Input range Y1...Y2	 -20 mA...0...20 mA points Y1 and Y2 are programmable
Control limit	± 1.2 Y2
Voltage drop	≤ 1.5 V
Potential isolation	Optocoupler
Common-mode rejection	> 80 dB
Series-mode rejection	> 60 dB / Decade from 10 Hz
Overload capacity	≤ 50 mA continuous
Error limit	0.5%

The REG-DA is supplied with 1 x mA Analogue Input (e.g. for the tap position indicator) as standard.

The inputs can be continuously short-circuited or open circuited. All inputs are galvanically isolated from all of the other circuits.

Temperature input PT100	
Quantity	one PT100 input at Level III possible two PT100 inputs at Level II possible
Type of connection	Three-wire circuit
Current through sensor	< 8 mA
Potential isolation	Optocoupler
Line compensation	No compensation required
Transmission behaviour	linear

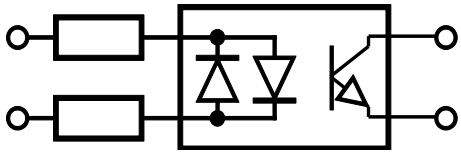
Resistance input (tap change potentiometer)	
Quantity	See order specifications
Connection	Three-wire, convertible to four-wire
Total resistance in the resistor chain	R1: 2 kΩ R3: 20 kΩ
Tap resistance	adjustable R1: 5...100 Ω/tap R3: 50...2000 Ω/tap
Number of taps	≤ 38
Potential isolation	Optocoupler
Current through resistor chain	max. 25 mA

The measuring device has an open circuit monitoring.

Analogue outputs (AO)	
quantity	See order specifications
Output range Y1...Y2	 -20 mA...0...20 mA Y1 and Y2 programmable
Control limit	± 1.2 Y2
Potential isolation	Optocoupler
Load range	0 ≤ R ≤ 8 V / Y2
Alternating component	<0.5% of Y2

The outputs can be continuously short-circuited or open circuited. All outputs are galvanically isolated from all of the other circuits.

Binary inputs (BI)	
Inputs E1 ... E16 (... E22, ... E28)	
Control signals U_{st}	in the AC/DC range 48 V ... 250 V, 10 V ... 50 V, 80 V ... 250 V, 190 V ... 250 V in accordance with characteristic Dx
Shape of the curve, permissible	Rectangular, sinusoidal
48 V...250 V – H - Level – L - Level	 ≥ 48 V < 10 V
10 V...50 V – H - Level – L - Level – Input resistance	 ≥ 10 V < 5 V 6.8 kΩ
80 V ... 250 V – H - Level – L - Level	 ≥ 80 V < 40 V
190 V ... 250 V – H - Level – L - Level	 ≥ 176 V < 88 V
Signal frequency	DC, 40 ... 70 Hz
Input resistance	108 kΩ, except 10...50 V
Potential isolation	Optocoupler; groups of four, each galvanically isolated from each other.
Anti-bounce filter	Software filter, with 50Hz AC input filter



Simplified diagram of a binary input

Binary outputs (BO)	
R 1 ... R13 (... R19, ... R25) max. switching frequency	 ≤ 1 Hz
Potential isolation	Isolated from all internal device potentials
Contact load	AC: 250 V, 5 A (cosφ = 1.0) AC: 250 V, 3 A (cosφ = 0.4) Switching capacity max. 1250 V A DC: 30 V, 5 A resistive DC: 30 V, 3.5 A L/R=7 ms DC: 110 V, 0.5 A resistive DC: 220 V, 0.3 A resistive Switching capacity max. 150 W
Inrush current	250 V AC, 30 V DC 10 A for max. 4 s
Switching operations	≥ $5 \cdot 10^5$ electrical

Display	
LC - Display	128 x 128 graphic display
Back-lighting	LED, automatic switch off after 15 minutes

Indicator elements		
The regulator has 14 light-emitting diodes (LED)		
LED Service	Normal operation	Green
LED Blocked	Faulty operation	Red
LED 1 ... LED 8	Freely programmable	Yellow
LED 9 ... LED 12	Freely programmable	Red

Each LED can be labelled on site.
If the labelling wishes are known at the time of order placement, labelling can be done at the factory.

Analog/Digital Conversion	
Type	12 bit successive-approximation converter
A/D bit resolution	+/- 11 bit
Sampling rate	24 samples per period, e.g. 1.2 kHz at a 50Hz signal *

*The measurement inputs are equipped with an Anti-Aliasing filter.

Device real time clock	
Accuracy	+/- 20 ppm

Limit-value monitoring	
Limit values	programmable
Response times	programmable
Alarm indicators	LEDs are programmable or are programmable on an LCD

Measured quantities (optionally as mA value)	
True RMS voltages	U_{12}, U_{23}, U_{31} (≤ 0.25%)
True RMS current	I_1, I_2 , I_3 (≤ 0.25%)
Active power	P (≤ 0.5%)
Reactive power	Q (≤ 0.5%)
Apparent power	S (≤ 0.5%)
Power factor	cos φ (≤ 0.5%)
Phase angle	φ (≤ 0.5%)
Reactive current	I · sin φ (≤ 1%)
Frequency	f (≤ 0.05%)

Reference conditions	
Reference temperature	23°C ± 1 K
Input quantities	U_E = 0 ... 160 V I_E = 0 ... 1A / 0 ... 5A
Auxiliary voltage	H = Hn ± 1%
Frequency	45 Hz...65 Hz
Shape of the curve	Sinusoidal, form factor 1.1107
Load (only for characteristics E91...E99)	Rn = 5 V / Y2 ± 1%
Other	IEC 60688 - Part 1

Transmission behaviour of the analogue outputs	
Error limit	0.05% / 0.25% / 0.5% / 1% related to Y2 (see 'Measured quantities')
Measurement cycle time	≤ 10 ms

Electrical safety	
Safety class	I
Degree of pollution	2
Measurement category Measurement category	IV/150 V III/300 V

Operating voltages		
50 V	**150 V**	**230 V**
E-LAN, COM1 ... COM3 Analogue in/outputs Inputs 10...50 V	Voltage inputs, current inputs	Auxiliary voltage, binary inputs, relay outputs

Electromagnetic compatibility	
EMC requirements	EN 61326-1 Equipment class A Continuous, unmonitored operation, industrial location and EN 61000-6-2 and 61000-6-4
Interference emissions	
Conducted and radiated emission	EN 61326 Table 3 EN 61000-6-4
Harmonic currents	EN 61000-3-2
Voltage fluctuations and flicker	EN 61000-3-3
Disturbance immunity	EN 61326 Table A1 and EN 61000-6-2
ESD	IEC 61000-6-5 6 kV/8 kV contact/air
Electromagnetic fields	IEC 61000-4-3\80 – 2000 MHz: 10 V/m
Fast transient	IEC 61000-4-4 4 kV/2 kV
Surge voltages	IEC 61000-4-5 4 kV/2 kV
Conducted HF signals	IEC 61000-4-6 150 kHz – 80 MHz: 10 V
Power-frequency magnetic fields	IEC 61000-4-8 100 A/m (50 Hz), continuous 1000 A/m (50 Hz), 1 s
Voltage dips	IEC 61000-4-11 30% / 20 ms, 60% / 1 s
Voltage interruptions	IEC 61000-4-11 100% / 5s
Damped oscillations	IEC 61000-4-12, Class 3, 2.5 kV

Test voltages*	Description	Test voltage / kV	counter circuits
Auxiliary voltage	U_h	2.3	COMs, AI, AO
Auxiliary voltage	U_h	2.3	BI, BO
Measuring voltage	U_e	2.3	COMs, AI, AO
Measuring voltage	U_e	3.3	U_h, BI, BO
Measuring voltage	U_e	2.2	I_e
Measuring current	I_e	2.3	COMs, AI, AO
Measuring current	I_e	3.3	U_h, BI, BO
Interfaces, COMs	COMs	2.3	BI, BO
Analogue outputs	AO	2.3	BI, BO
Analogue outputs	AO	0.5	COMs, AI
Analogue inputs	AI	2.3	BI, BO
Analogue inputs	AI	0.5	COMs, AO
Binary inputs	BI	2.3	BI
Binary inputs	BI	2.3	BO
Binary outputs	BO	2.3	BO

*All test voltages are AC voltages in kV, which may be applied for 1 minute. The COM interfaces are tested against each other with 0.5kV.

Auxiliary Voltage		
Characteristic	**H0**	**H2**
AC	85 … 264 V	–
DC	88 … 280 V	18 … 72 V
AC Power consumption	≤ 35 VA	–
DC Power consumption	≤ 25 W	≤ 25 W
Frequency	45 … 400Hz	–
Microfuse	T1 250 V	T2 250 V

The following applies to all characteristics:
Voltage dips of ≤ 25 ms result neither in data loss nor malfunctions. Fuses are time lag (slow blow) type.

Ambient conditions	
Temperature range Function Transport and storage	 -15°C … +60 °C -25 °C … +65°C
Dry cold	IEC 60068-2-1, - 15 °C / 16 h
Dry heat	IEC 60068-2-2, + 65 °C / 16 h
Humid heat constant	IEC 60068-2-78 + 40°C / 93% / 2 days
Humid heat cyclical	IEC 60068-2-30 12+12 h, 6 cycles +55°C / 93%
Drop and topple	IEC 60068-2-31 100 mm drop height, unpackaged
Vibration	IEC 60255-21-1, Class 1
Shock	IEC 60255-21-2, Class 1
Earthquake resistance	IEC 60255-21-3, Class 1

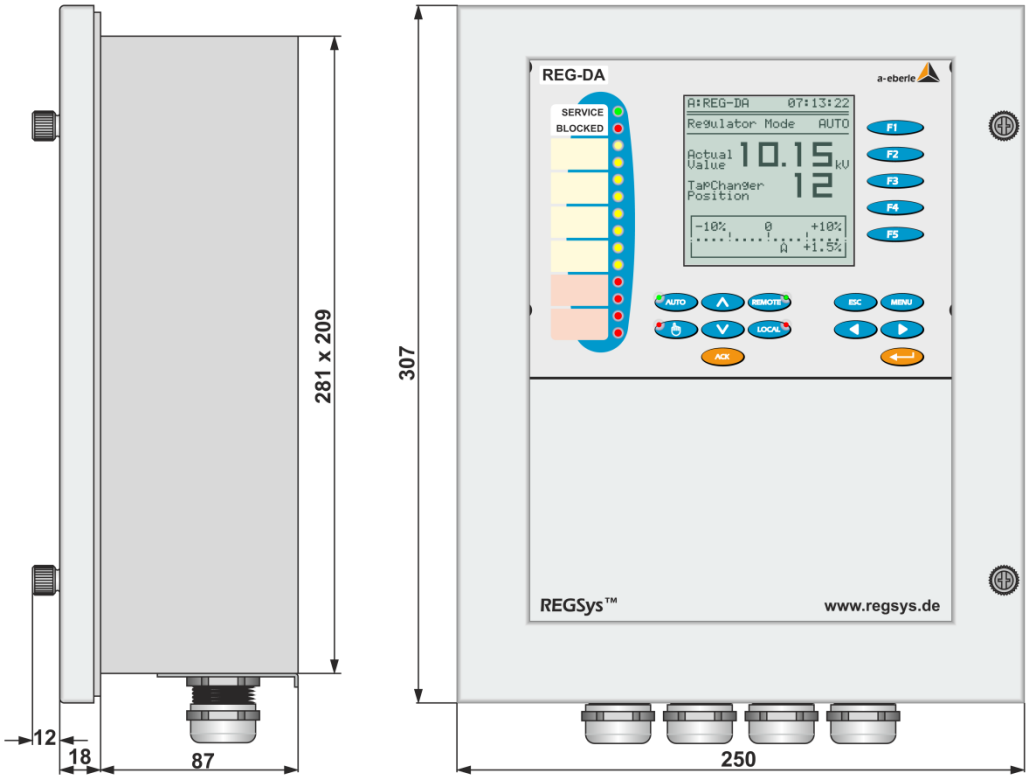
Storage	
Firmware and recorder data Characteristic S2	Flash memory
Device characteristics and calibration data	serial EEPROM with ≥ 1000 k write/read cycles
Other data and recorder data Characteristic S1**	SDRAM, battery-backed (plug-in lithium battery), Backup to flash memory possible

** Devices with feature S2 are equipped with MRAM. The backup battery on these devices is only used to buffer the real time clock.

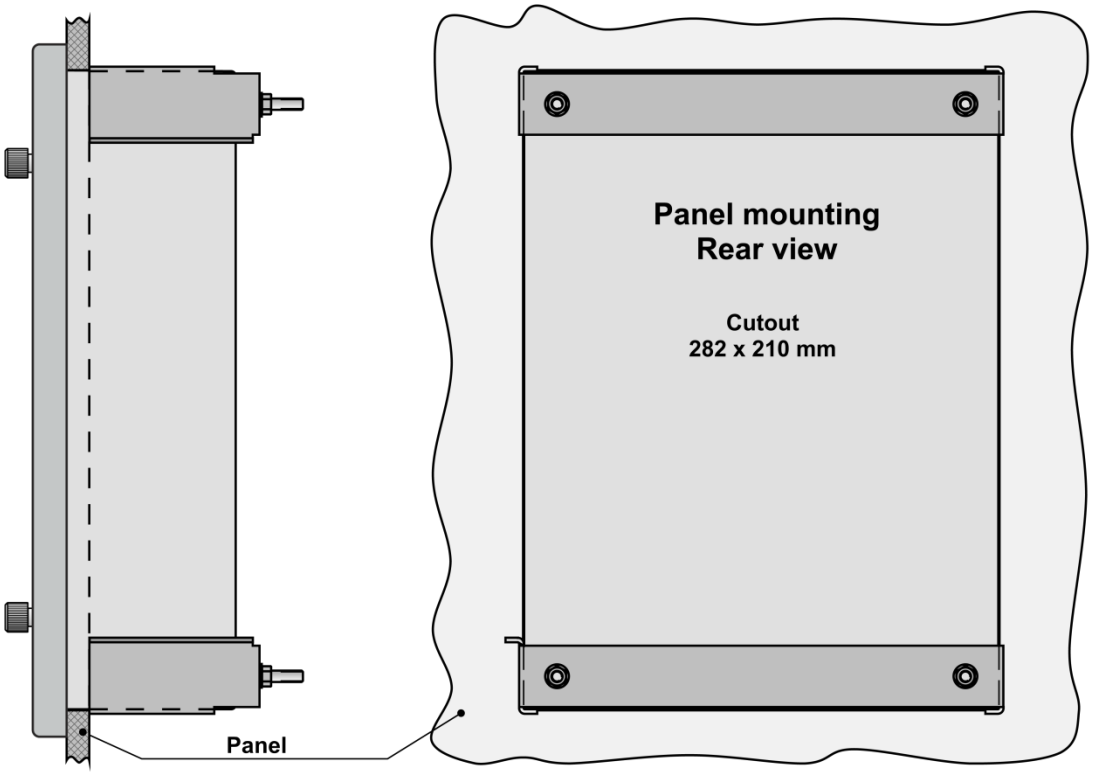
5. Mechanical design

Housing – Height – Width – Total depth – Mounting depth – Weight	Sheet steel, RAL 7035 light-grey 325 mm incl. PG connectors 250 mm 114 mm 87 mm ≤ 6.0 kg
Housing door	with silicate glass
Front panel	Plastic, RAL 7035 grey on aluminium brackets
Control panel cut-out – Height – Width	 282 mm 210 mm
Protection type	IP 54
Protection type with brush sealing	IP 12

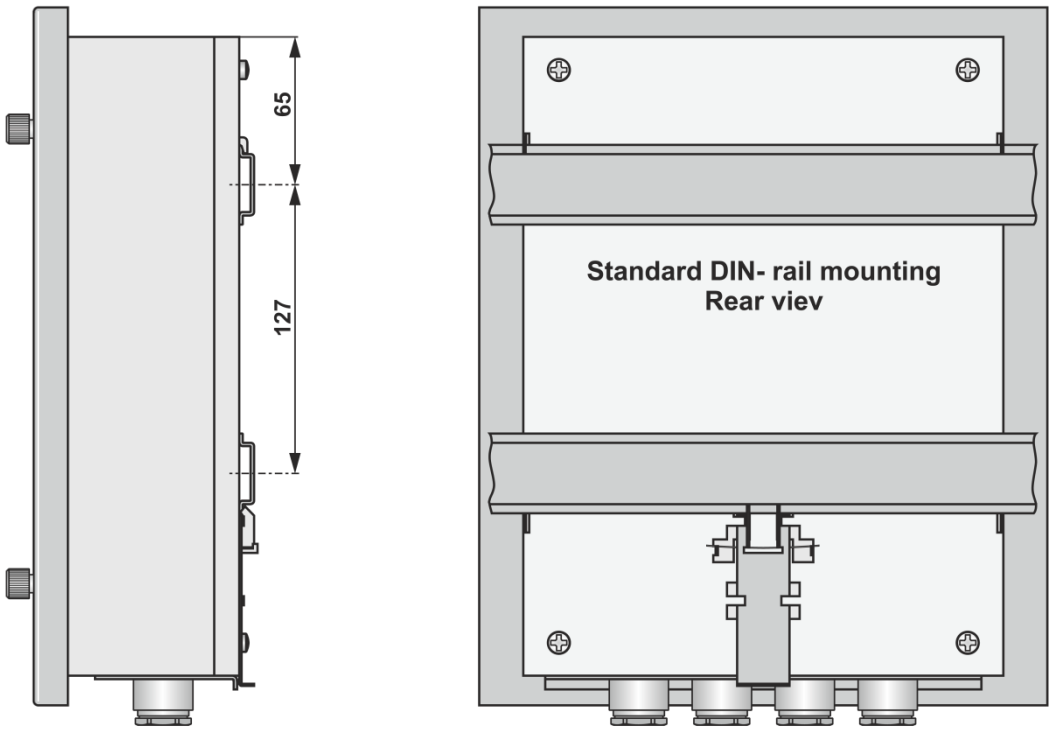
Conductor Cross Section and tightening torque of Terminals				
Level	**Function/ terminal no.**	**cross section / mm²**		**torque**
		stranded	**solid**	**Nm**
I	measurement input 1..10	4	6	0,6
I	BIs, relays, power supply 11…60	2,5	2,5	0,6
II	SCADA interface (without XW90..93+97+98), 87…98	0,5	0,5	---
II	SCADA interface (only XW90..93+97+98) 87…94	2,5	2,5	0,6
II	Extensions C10, C90..99 100…113	2,5	2,5	0,6
III	COMs, analogue IO 61…86/200…209	1,5	1,5	0,25



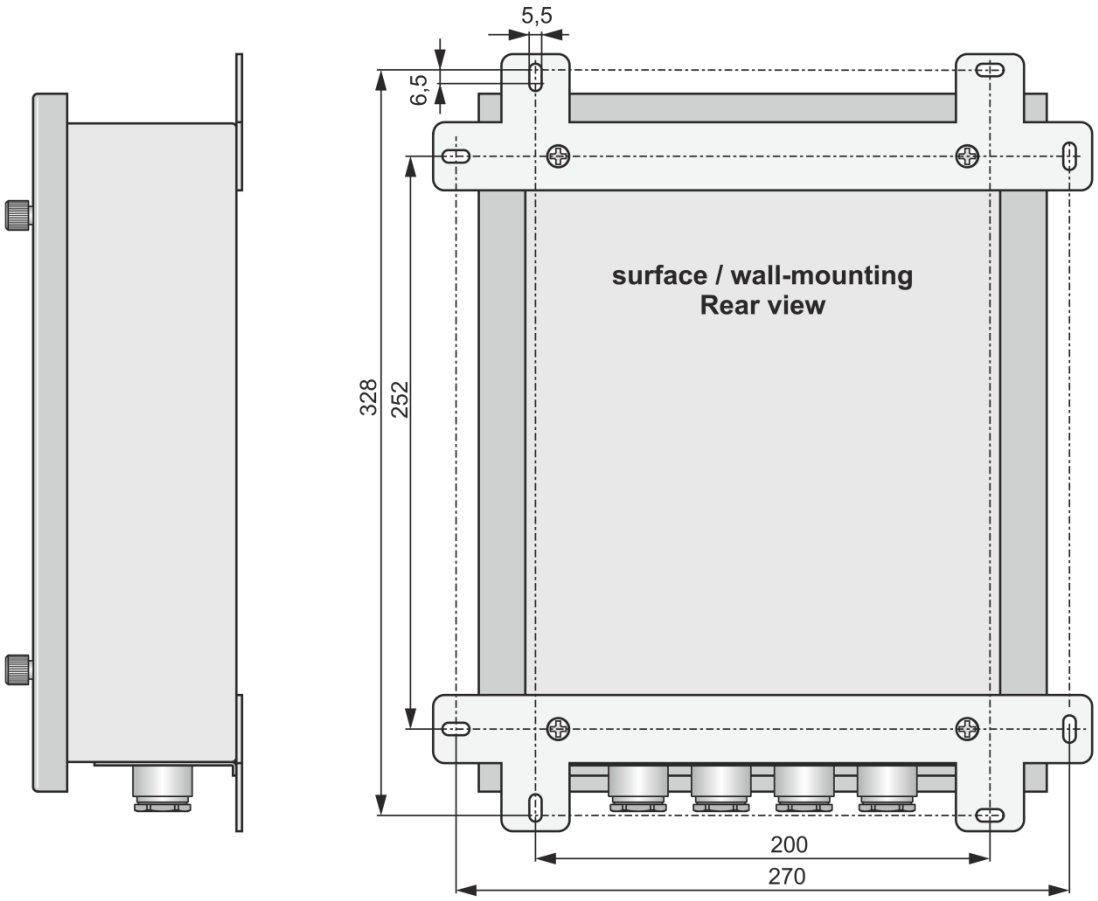
Mechanical dimensions, in mm



Mechanical dimensions, panel mounting



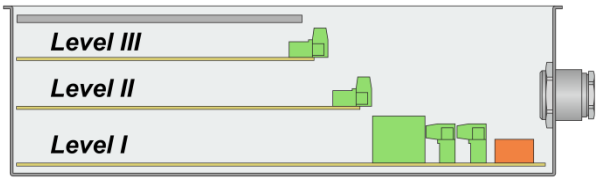
Mechanical dimensions, DIN rail mounting, in mm



Mechanical dimensions, wall mounting, in mm

General information about the connection technology

The regulator has three printed circuit boards or connection levels.



The auxiliary voltage, the VT & CT inputs, as well as the relay outputs, binary inputs etc., are all connected on **Level I**.

The hardware for all SCADA connectivity is on **Level II**.

When working with an Ethernet connection (such as for IEC 61850, IEC 60870-5-104 or DNP 3.0 over Ethernet), the corresponding plug connection is also accessible on Level II (RJ45 and/or ST/LC fibreglass).

Additional binary inputs and outputs, and mA inputs and outputs can also be installed on Level II.

There are two slots available, each of which can be equipped with the following modules:

Module 1 :	6 binary inputs AC/ 48 V...250 V
Module 2 :	6 relay outputs
Module 3 :	2 mA inputs
Module 4 :	2 mA outputs
Module 5 :	PT100 – input
Module 6 :	Standalone monitoring unit PAN-A2 occupies both slots

The connections for the REG-DA COM ports, the E-LANs, additional analogue inputs and outputs, as well as for the PT100 direct input (E91 + E94) or resistance input (E97 + E98) cards, are located on **Level III**.

Fibre optical connection (1 x Ethernet-ST, XW93) at Level II; REG-DA Com ports at Level III

Optical Serial Protocol Interfaces

For fibre optic serial connections up to a baud rate of 19200 (e.g. DNP, IEC 60870-5-101 or 103), ST or FSMA connectors are directly mounted on the flange plate for access without opening the REG-DA door.

Please refer to the list of characteristics for an overview of the available options.

Fibre optical connection (ST-connector, V17, V19)

Fibre optical connection (FSMA-connector, V13, V15)

Optical transmitter

Serial communication up to 19200 baud
(characteristic V13 ... V19)

Product	Wave length	Fibre	Pmin [dBm] 1)	Pmax [dBm] 1)
Fibreglass ST Fibreglass FSMA	λ = 820 nm	50/125 µm NA=0.2	-19.8	-12.8
		62.5/125 µm NA=0.275	-16.0	-9.0
		100/140 µm NA=0.3	-10.5	-3.5
		200 µm HCS NA=0.37	-6.2	+1.8
All-plastic ST	λ = 650 nm	1 mm POF	-7.5	-3.5
		200 µm HCS	-18.0	-8.5
All-plastic FSMA	λ = 650 nm	1 mm POF	-6.2	0.0
		200 µm	-16.9	-8.5

Communication over Ethernet 100 Mbit (100Base Fx)
(characteristics XW92, XW93.x, XW95.x, XW96.1 and XW98)

Product	Wave length	Fibre	Pmin [dBm] 1)	Pmax [dBm] 1)
Fibreglass ST Fibreglass LC	1310 nm	62.5/125 µm NA=0.275	-20	-14

1) TA = 0..70°C, IF = 60 mA, measured after 1 m fibre optic cable

Optical receiver

Serial communication up to 19200 baud
(characteristic V13 ... V19)

Product	Wave length	Fibre	Pmin [dBm] 2)	Pmax [dBm] 2)
Fibreglass ST Fibreglass FSMA	λ = 820 nm	100/140 µm NA=0.3	-24.0	-10.8
All-platic ST	λ = 650 nm	1 mm POF	-20.0	0.0
		200 µm HCS	-22.0	-2.0
All-plastic FSMA	λ = 650 nm	1 mm POF	-21.6	-2.0
		200 µm	-23.0	-3.4

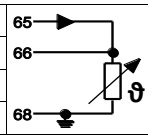
Communication over Ethernet 100 Mbit (100Base Fx)
(characteristics XW92, XW93.x, XW95.x, XW96.1 and XW98)

Product	Wave length	Fibre	Pmin [dBm] 2)	Pmax [dBm] 2)
Fibreglass ST Fibreglass LC	1310 nm	62.5/125 µm NA=0.275	-14	-32

2) TA = 0...70°C, VCC = 5 V±5%, output level LOW (active)

6. Terminal configuration

No.					
		Option	M1*	M2*	M9*
Level I	2 5	Measuring voltage	U1a U1b	U_{L1} U_{L2}	U1a U1b
	8 10	Measuring voltage	-	U_{L3} -	U2a U2b
	1 3	S1 S2	Current input I_1		
	4 6	S1 S2	Current input I_2		
	7 9	S1 S2	Current input I_3		
	21 22	L/(+) L/(-)	U_H = Auxiliary voltage		
Level III	63	mA input	+ A1		
	64	mA input	- A1		
	61	mA input or output	+ A2		
	62	mA input or output	- A2		
	65	mA input or output	+ A3		
	66	mA input or output	- A3		
	67	mA input or output	+ A4		
	68	mA input or output	- A4		
Level I	11	Binary input 1	Freely programmable		
	12	Binary input 2	Freely programmable		
	13	Binary input 3	Freely programmable		
	14	Binary input 4	Freely programmable		
	15	Binary input 1...4	GND		
	16	Binary input 5	AUTO		
	17	Binary input 6	MAN		
	18	Binary input 7	Freely programmable		
	19	Binary input 8	Freely programmable		
	20	Binary input 5...8	GND		
	23	Binary input 9	BCD 1		
	24	Binary input 10	BCD 2		
	25	Binary input 11	BCD 4		
	26	Binary input 12	BCD 8		
	27	Binary input 9...12	GND		
	28	Binary input 13	BCD 10		
	29	Binary input 14	BCD 20		
	30	Binary input 15	BCD sgn.		
	31	Binary input 16	Freely programmable		
	32	Binary input 13...16	GND		
	33 34		Freely programmable	R_5	
	35 36		Freely programmable	R_4	
	37 38		Freely programmable	R_3	
	39 40 41 42		lower	R_2	
	43 44 45 46		higher	R_1	



Level I	47		>I	R_{11}
	48		>U	R_{10}
	49		<U	R_9
	50		Local	R_8
	51		Remote	R_7
	52		TC error**	R_6
	53		GND	R_6...R_{11}
	54		closes in the event of fault	
	55		Life contact (status)	
	56		opens in the event of fault	
	57		MANUAL	
	58		MAN/AUTO	
	59		AUTO	
Level III	69	E-	E-LAN (L)	
	70	E+		
	71	EA-		
	72	EA+		
	200	GND		
	73	E-	E-LAN (R)	
	74	E+		
	75	EA-		
	76	EA+		
	201	GND		
	77	Tx+	COM3 (RS485)	
	78	Tx-		
	79	Rx+		
	80	Rx-		
	81	GND		
	82	TxD	COM2 (RS232)	
	83	RxD		
	84	RTS		
	85	CTS		
	86	GND		
	202	DCF-	DCF 77 ****	
	203	DCF+		
	204	GND		
	205	TxD	COM1 - S	
	206	RxD		
	207	RTS		
	208	CTS		
	209	GND		
Level II***			IEC LON DNP 3.0	SPA Bus Modbus
		Please refer to Terminal Configuration Level II (page 16) for additional fitting options on Level II.		

*__Option M1__ Used for standard applications.
Three-wire networks are generally considered as symmetrical

(I1 = I2 = I3)

__Option M2__ Only used in asymmetrically loaded three-phase systems

(I1 ≠ I2 ≠ I3)

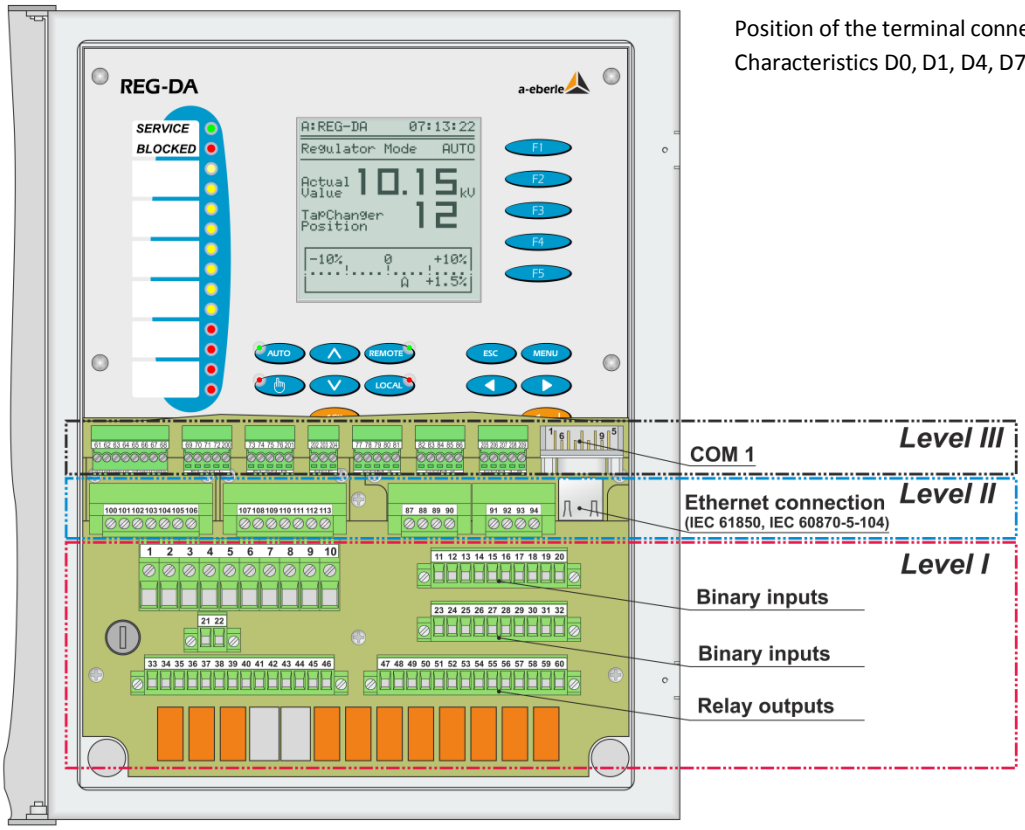
__Option M9__ For triple-wound applications, two galvanically isolated voltage inputs are available for U1 and U2.

** TC = tap changer

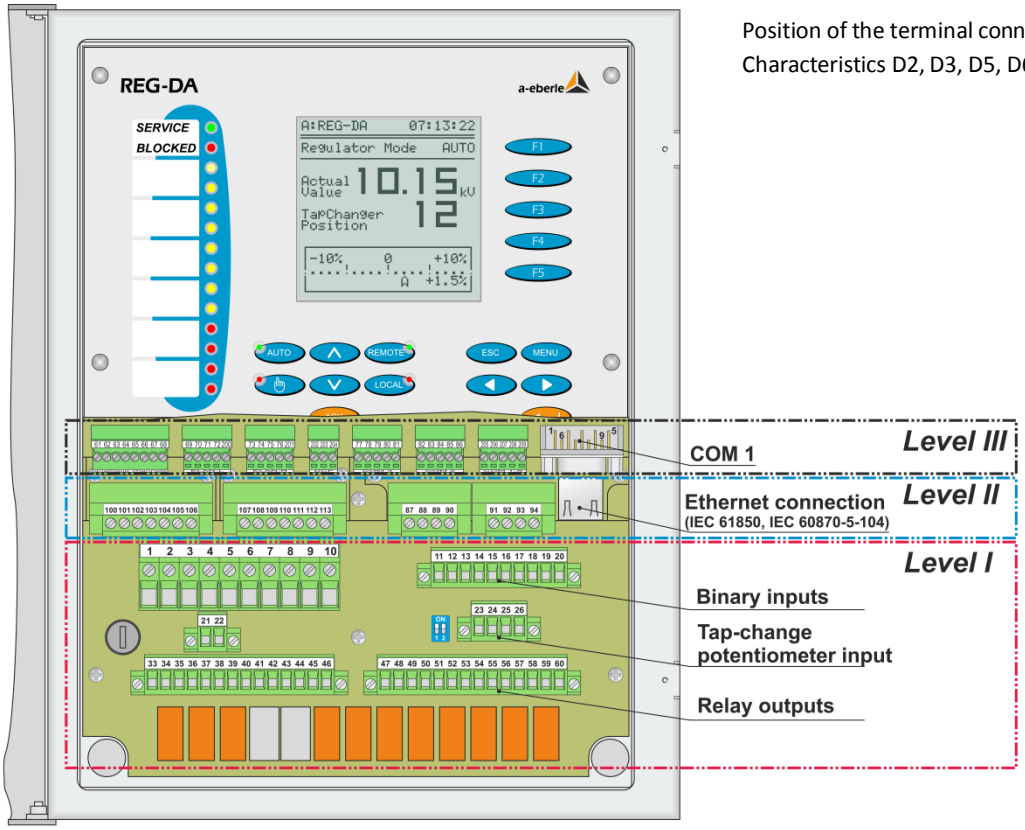
*** Please refer to terminal configuration of the SCADA interface on page 17 for the SCADA interface connections.

**** The DCF77 input is implemented from FW 2.22 onwards.

The allocation of terminals 23 to 32 changes depending on characteristics D0 / D1/ D4 / D7 / D9 and D2 / D3 / D5/ D6 / D8



Position of the terminal connections
Characteristics D0, D1, D4, D7, D9

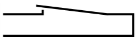
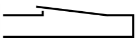
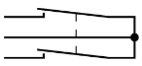


Position of the terminal connections
Characteristics D2, D3, D5, D6, D8

6.1 Terminal Configuration Level II

Characteristics: C10, C90...C99

Characteristic C10 – Standalone monitoring function

	No.			
Module 6	100		lower command interlock	
	101			
	102		raise command interlock	
	103			
	104		Overvoltage >U Root Undervoltage <U	
	105			
	106			
	107		measuring voltage	U1a
	108			U1b
	109		COM 1 COM 2 RS 232	COM1 / RxD
	110			COM1 / TxD
	111			COM1/2/GND
	112			COM2 / RxD
	113			COM2 / TxD

Characteristic C90 – (e.g. 2 x PT100, other combinations are possible)

	No.			
Module 5	100	PT100	Ik+	A10
	101		Ue+	
	102		Ue-	
	103		Ik-	
Module 5	104	PT100	Ik+	A12
	105		Ue+	
	106		Ue-	
	107		Ik-	

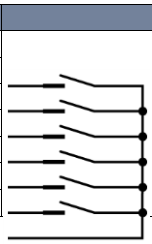
Characteristic C91 – 6 additional binary inputs AC/DC 48 V ... 250 V

	No.		
Module 1	100	Binary input	E17
	101	Binary input	E18
	102	Binary input	E19
	103	Binary input	E20
	104	Binary input	E21
	105	Binary input	E22
	106	GND	E17 ... E22

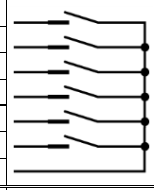
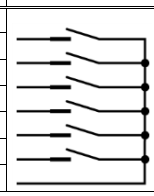
Characteristic C92 – 12 additional binary inputs AC/DC 48 V ... 250 V

	No.		
Module 1	100	Binary input	E17
	101	Binary input	E18
	102	Binary input	E19
	103	Binary input	E20
	104	Binary input	E21
	105	Binary input	E22
	106	GND	E17 ... E22
Module 1	107	Binary input	E23
	108	Binary input	E24
	109	Binary input	E25
	110	Binary input	E26
	111	Binary input	E27
	112	Binary input	E28
	113	GND	E23 ... E28

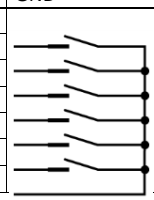
Characteristic C93 – 6 additional relay outputs (NOC)

	No.			
Module 2	100			R12
	101			R13
	102			R14
	103			R15
	104			R16
	105			R17
	106			GND R12 ... R17

Characteristic C94 – 12 additional outputs (NOC)

	No.			
Module 2	100			R12
	101			R13
	102			R14
	103			R15
	104			R16
	105			R17
	106			GND R12 ... R17
Module 2	107			R18
	108			R19
	109			R20
	110			R21
	111			R22
	112			R23
	113			GND R18 ... R23

Characteristic C95– 6 additional binary inputs AC/DC 48 V ... 250 V and 6 additional relay outputs (NOC)

	No.			
Module 1	100	Binary input		E17
	101	Binary input		E18
	102	Binary input		E19
	103	Binary input		E20
	104	Binary input		E21
	105	Binary input		E22
	106	GND		E17 ... E22
Module 2	107			R12
	108			R13
	109			R14
	110			R15
	111			R16
	112			R17
	113			GND R12 ... R17

Characteristic C96 – 2 additional analogue inputs

	No.			
Module 3	100	analogue input	+	A10
	101		-	
	102	analogue input	+	A11
	103		-	

Characteristic C97 – 4 additional analogue inputs

	No.			
Module 3	100	analogue input	+	A10
	101		-	
	102	analogue input	+	A11
	103		-	
Module 3	104	analogue input	+	A12
	105		-	
	106	analogue input	+	A13
	107		-	

Characteristic C98 – 2 additional analogue outputs

	No.			
Module 4	100	analogue output	+	A10
	101		-	
	102	analogue output	+	A11
	103		-	

Characteristic C99 – 4 additional analogue outputs

	No.			
Module 4	100	analogue output	+	A10
	101		-	
	102	analogue output	+	A11
	103		-	
Module 4	104	analogue output	+	A12
	105		-	
	106	analogue output	+	A13
	107		-	

6.2 Terminal Configuration for SCADA interface on Level II

Characteristics: Z10..15, 17..23, 90, 91, 99, XW90...98

Characteristics Z10..15, 17..20, 90, 91–REG-P communication interface

	No.			
COM1 RS485	87	RS485-N (B)		
	88	RS485-P (A)		
COM1 RS232	89	RS232-TxD		
	90	RS232-RxD		
	91	RS232-RTS		
	92	RS232-CTS		
	93	RS232-GND		
PE	94	PE		
COM1 fibre optic	95	Fibre optic In	Fibre optic module	Fibre optic cable
	96	Fibre optic Out		
	97	Fibre optic GND		
	98	Fibre optic VCC		

Characteristics Z22..23–REG-PM communication interface

	No.			
COM1 RS485	92	RS485-P (A)		
	93	RS485-N (B)		
	94	RS485-GND		
COM1 RS232	87	RS232-TxD		
	89	RS232-RxD		
	88	RS232-RTS		
	90	RS232-CTS		
	91	RS232-GND		
COM1 fibre optic	96	Fibre optic In	Fibre optic module	Fibre optic cable
	97	Fibre optic Out		
	95	Fibre optic GND		
	98	Fibre optic VCC		
PARAM (SUB-D)		Parameter Interface		

Characteristic Z21–REG-LON communication interface

	No.			
Fibre optic		Fibre optic cable In	Fibre optic module	Fibre optic cable
		Fibre optic cable Out		
		Fibre optic cable GND		
		Fibre optic cable VCC		

Characteristic Z99–Profibus-DP communication interface

	No.	
PARAM (RJ11)	1	RS232-GND
	2	RS232-GND
	3	RS232-RxD
	4	RS232-TxD
Profibus-DP (SUB-D)	3	B-Line (Rx/Tx +)
	4	RTS
	5	GND BUS
	6	+5 V BUS
	8	A-Line (Rx/Tx -)

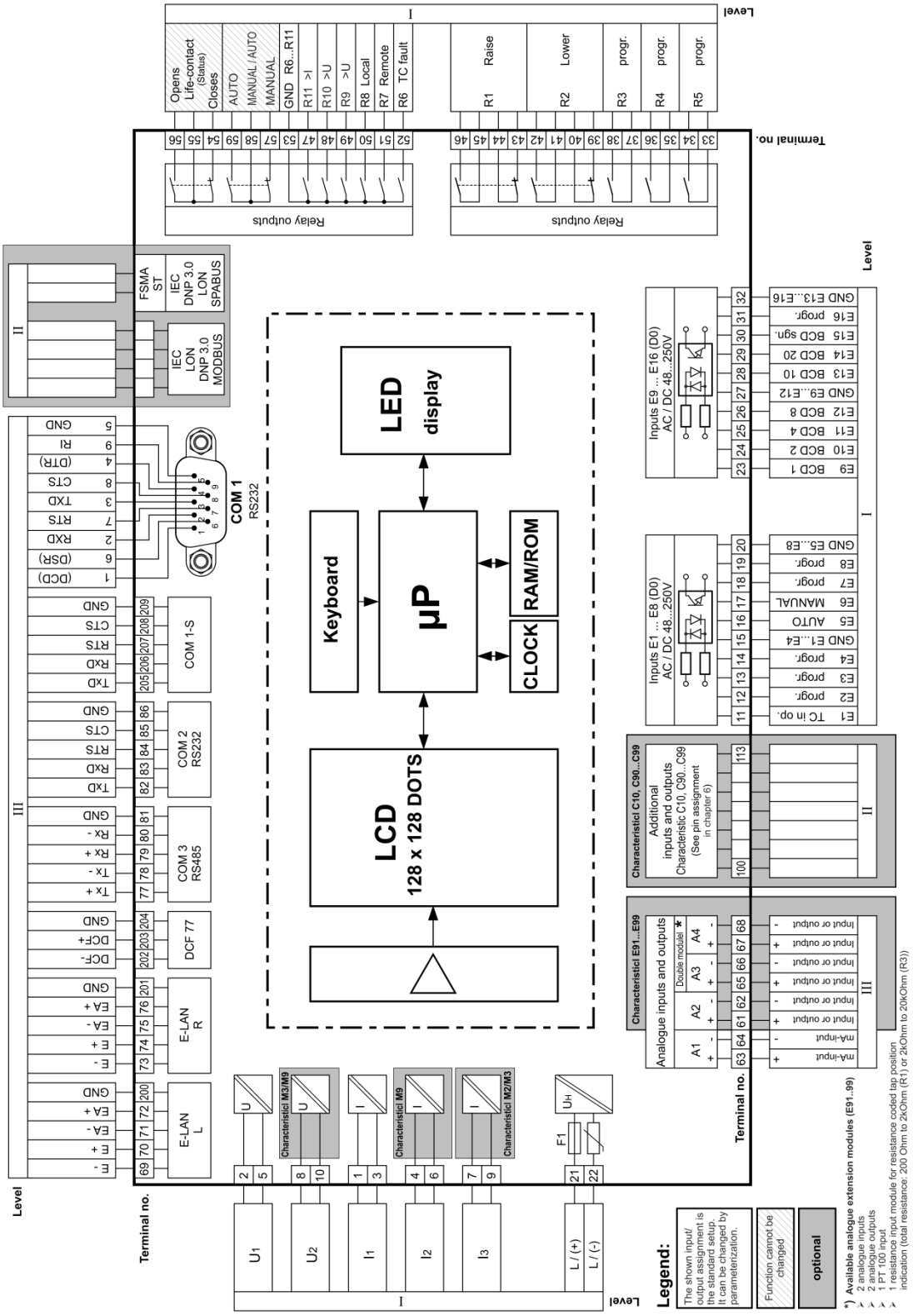
Characteristics XW90..93+97+98–REG-PE communication interf.

	No.			
PARAM1	87	RS232-RxD		
	88	RS232-TxD		
	89	RS232-GND		
	90	RS232-GND-SCR		
PARAM 2	91	RS232-RxD		
	92	RS232-TxD		
	93	RS232-GND		
	94	RS232-GND-SCR		
Ethernet	RJ45 connector		or	Fibre optic cable (ST or LC)

Characteristics XW94..96–REG-PED communication interface

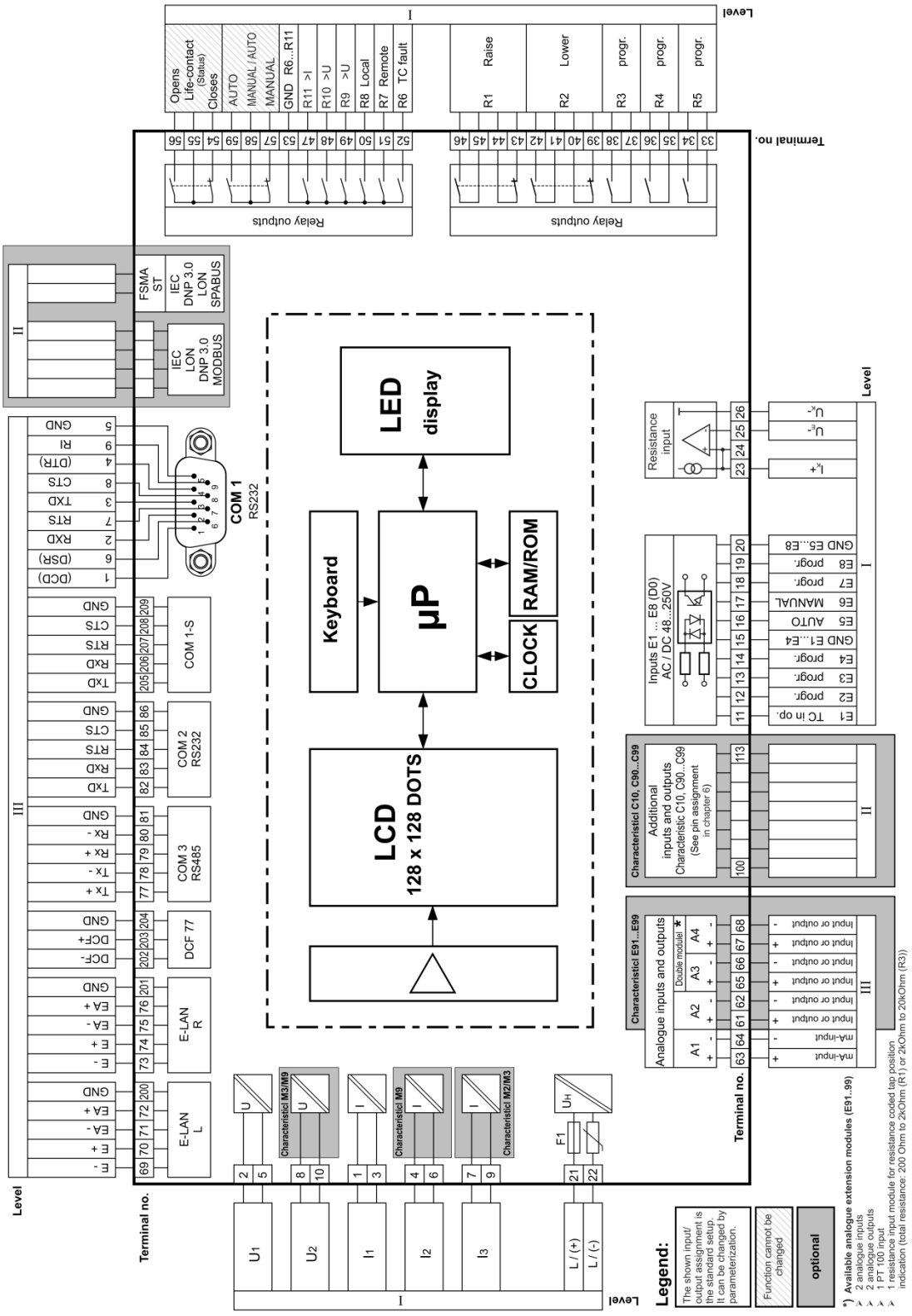
	No.			
COM1	87	RS485-P (A)		
	88	RS232-N (B)		
	89	RS232-TxD		
	90	RS232-RxD		
	91	RS232-RTS		
	92	RS232-CTS		
	93	RS232-GND		
PE	94	PE/Shield		
PARAM	95	PARAM-RxD		
	96	PARAM-TxD		
	97	PARAM-GND		
Ethernet 1	RJ45 connector		or	Fibre optic cable (ST or LC)
Ethernet 2	RJ45 connector		or	Fibre optic cable (ST or LC)

6.3 Block diagram - Characteristics D0, D1, D4, D7, D9

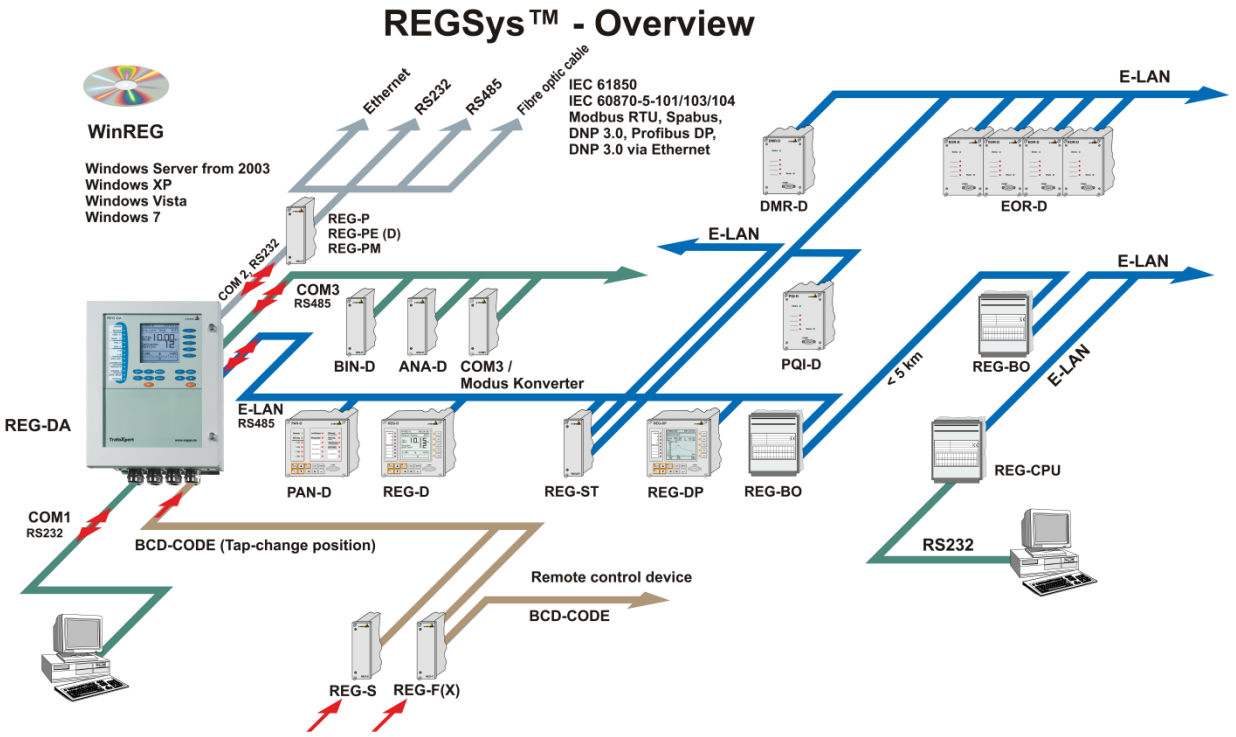


*) The dual module comes as a dual mA input module or a dual mA output module. The position is occupied by a PT100 module if the temperature is to be recorded directly.

6.4 Block diagram - Characteristics D2, D3, D5, D6, D8



*) The dual module comes as a dual mA input module or a dual mA output module. The position is occupied by a PT100 module if the temperature is to be recorded directly.



7. Interfaces and software

Several regulators need to be interconnected in a network when transformers are connected in parallel. The ΔI*sinφ, ΔI*sinφ (S) and Master-Follower parallel programs can only be implemented through the system bus (ELAN). This bus enables each of the members in a group of parallel regulators to communicate with each other easily, without using any additional components.

The regulators do not have to be connected in order to run a parallel program that functions in accordance to the Δcosφ method. It may not be possible to connect the participants due to the long distances between them, for example.

If an interconnection needs to be established over long distances, the ELAN can be redirected through a fibre optic cable or an Ethernet connection.

7.1 Serial interfaces

The REG-DA has 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 is connected, COM1-S is disabled. Devices connected to COM1-S do not have to be physically disconnected. This enables COM1-S to function as an alternative remote parameterisation interface that is only active when parameters are not being set locally. COM1 can also be configured as a USB port (optional).

COM2 is mainly used to connect the regulator to the SCADA system. If a SACDA interface is not installed, COM2 in the terminal compartment can be used to connect a modem, a COM server, a PC or a DCF77 receiver.

Connection Elements

COM1	Sub-D 9-pole male (optionally as mini-USB) at Level III
COM1-S	Terminal connection at Level III
COM2	Terminal connection at Level III
Connection options	PC, modem, PLC, SCADA interface, DCF77 signal
Number of data bits/protocol	Data bits: 8 Parity: even, none
Transmission rate bit/s	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
HANDSHAKE	RTS / CTS, XON / XOFF, delay, none

ELAN (**E**nergy - **L**ocal **A**rea **N**etwork)

Each REG-DA regulator comes with two E-LAN interfaces that are used to connect individual regulators and monitoring units to a voltage regulation system.

E-LAN 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)

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 REG-DA 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 Input (DCF input)

A time synchronisation input enables the time on the REG-DA 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.

7.2 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-DA and archives it on the PC.
REGView is used to view and analyse recorded data directly on the REG-DA or in a data file (collector).
The WinTM module (parameters for the transformer monitoring module) and the WinDM module (parameters for the transformer monitoring device without voltage regulator) complete the software suite.

WinREG runs on the following operating systems:

- Windows XP, Vista, Windows 7
- Windows Server from 2003 onwards

All of the settings can be made either directly on the regulator using the regulator's membrane keyboard, or centrally through WinREG. If the device is to be accessed through a central point, all of the regulators must be connected to each other through the E-LAN.

REG-DA Parameters (selection)

Parameter	Setting range
Permissible voltage deviation	± 0.1 ... 10 %
Time factor	0.1 ... 30
Setpoint value 1..2	60.0 ... 140.0 V
Setpoint value 3..4	60.0 ... 140.0 V or -140 ... 140% for P/Q regulation
Time behaviour	ΔU · t = const REG 5A/E LINEAR CONST
Trend memory	0 ... 60 s
current influence (load-dependent setpoint)	Apparent current Active current Reactive current LDC
Apparent, active, reactive current Increase (I) (pos.) Increase (I) (neg.) Limit (I) (max.) Limit (I) (min.)	 0 ... 400 V/In 0 ... 400 V/In -40 ... 40 V -40 ... 40 V
LDC (Line drop compensation)	R : 0 ... ± 30 Ω X : 0 ... ± 30 Ω
Undervoltage <U	-25% ... +10 %
Overvoltage >U	0 ... 25 %
Overcurrent >I	0 ... 210% (1A / 5A)
Undercurrent >I	0 ... 100 % (1A / 5A)
Inhibit High	65 V ... 150 V
Fast switching forward	0 ... -35 %
Fast switching backward	0 ... 35 %
Inhibit low	-75 % ... 0 %
Switching delay for <U, >U, <I, inhibit high, Fast switching, Inhibit low can be set separately	1 ... 999 s (Fast step-up 2...999 s)
Parallel programs	dI*sin(phi) dI*sin(phi)[S] dcos (phi) Master-slave MSI MSI2
TC in operation - maximum time	3 ... 40 s

7.3 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-DA 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-DA regulator'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.

8. Order specifications

- Only one code of the same capital letter is possible
- When the capital letter is followed by number 9, further details are necessary
- The code can be omitted when the capital letter is followed by zero or one option is marked as standard
- X characteristics such as XE91 cannot be combined with all of the other characteristics. Please read the notes and explanations.

CHARACTERISTIC	CODE
REG-DA relay for voltage control ● with dual ELAN interface COM2, COM3 and **one mA input channel,** for example, to measure the oil temperature or get the tap position via mA signal ● with 16 binary inputs and 12 relay outputs plus a status output, and includes the parameterisation software WinREG to set parameters, program and view all regulator data and connection cables. **Note**: COM2 is only freely accessible when operated without SCADA interface.	REG-DA
Model	
● In-panel mounting or wall mounting (H x W x D) 307 x 250 x 102 mm including flange plate with brush element	B0
● with DIN rail adapter	B1
Serial interface COM1	
● RS232 with SUB-D connector (9-pin male), standard if characteristic I is not specified	I0
● USB	I1
Power supply	
● external AC 85 V ... 110V ... 264 V / DC 88 V ... 220V ... 280V	H0
● external DC 18 V ... 60V ... 72V	H2
Input current (can be changed at a later stage)	
● I_{EN} 1A	F1
● I_{EN} 5A	F2
Voltage and current measurement	
● Three-wire three-phase system with equal load	M1
● Three-wire three-phase system with random load (ARON connection)	M2
● Voltage measurement (high voltage), current and voltage measurement (low voltage)	M3
● other transducer applications (2 x I, 2 x U, e.g. triple-wound)	M9
Recorder function for network quantities incl. REGView evaluation software	
● without	S0
● with max. 3 channels	S1
● with max. 256 channels and 108 MB internal memory and upgraded CPU (better performance for e.g. the PLC functionality)	S2
Transformer monitoring	
● without	T0
● with transformer monitoring in accordance to IEC 60354 and IEC 60076	T1
● additional calculation of the moisture in cellulose and the risk of bubble formation (TM+, Moisture Assessment Module) **Note:** The feature T2 is only available in combination with the features S2 and T1	T2
Parallel operation	
● without firmware for parallel operation	K0
● with firmware for parallel operation	K1
additional analogue inputs and outputs	
● without	E00
● with one PT100 input	E91
● with two mA inputs	E92
● with two mA outputs	E93
● with one PT100 input and one mA output	E94
● with two mA inputs and one mA output	E95

CHARACTERISTIC	CODE
● with three mA outputs	E96
● Tap potentiometer input total resistance 180 Ω ... 2 kΩ, min. 5 Ω/tap	E97
● Tap potentiometer input total resistance 2 kΩ ... 20 kΩ, min. 50 Ω/tap	E98
● other combinations of inputs and outputs	E99
Binary inputs and tap change potentiometer input	
● 16 binary inputs AC/DC 48...250 V (E1...E16)	D0
● 8 binary inputs AC/DC 10..50 V (E1...E8) and 8 units AC/DC 48...250 V (E9...E16)	D1
● 16 binary inputs AC/DC 10...50 V (E1...E16)	D4
● 16 binary inputs AC/DC 190...250 V (E1...E16)	D7
● 16 binary inputs AC/DC 80...250 V (E1...E16)	D9
● 1 tap potentiometer input (total resistance 180 ... 2 kΩ) and 8 binary inputs AC/DC 48...250 V	D2
● 1 tap potentiometer input (total resistance >2 ... 20 kΩ) and 8 binary inputs AC/DC 10...50 V	D3
● 1 tap potentiometer input (total resistance 180 ... 2 kΩ) and 8 binary inputs AC/DC 10...50 V	D5
● 1 tap potentiometer input (total resistance >2 ... 20 kΩ) and 8 binary inputs AC/DC 48...250V	D6
● 1 tap potentiometer input (total resistance >2 ... 20k Ω) and 8 binary inputs AC/DC 80...250 V	D8
Level II: additional inputs and outputs as well as the standalone monitoring function PAN-A2	
● without	C00
● with 6 binary inputs AC/DC 48 V...250 V	C91
● with 12 binary inputs AC/DC 48 V...250 V	C92
● with 6 relay outputs	C93
● with 12 relay outputs	C94
● with 6 binary inputs and 6 relay outputs	C95
● with 2 analogue inputs	C96
● with 4 analogue inputs	C97
● with 2 analogue outputs	C98
● with 4 analogue outputs	C99
● with standalone monitoring function (PAN-A2)	C10
● other combinations 6 inputs, 6 outputs, 2 analogue inputs, 2 analogue outputs or PT100 input	C90
Note for C90: Two slots are usually available on Level II. Each slot can be equipped with 6 binary inputs, 6 binary outputs or with an analogue module.	
COM3 interface	
● RS485 (standard, feature may be omitted)	R1
● RS485 and for remote components fibre optic interface (fibre glass) with ST connector	R2
Note: COM3 is needed for ANA-D, BIN-D and COM3/Modbus converter!	
Integrated SCADA connection in conformity with: IEC61850, IEC 60870- 5-104, DNP 3.0 or MODBUS	
● without (continue with characteristic group 'L')	XW00
● IEC 60850-5-104/RJ 45 (continue with characteristic group 'G')	XW90
● IEC 60850-5-104 with fibre optic connection (continue with characteristic group 'G')	XW92
Note: Please specify the target SCADA system for connections in conformity with IEC 60850-5-104.	
● IEC 61850/RJ 45 (continue with characteristic group 'G')	XW91
● IEC 61850 with fibre optic with ST connection (continue with characteristic group 'G')	XW93
● IEC 61850 with fibre optic with LC connection (continue with characteristic group 'G')	XW93.1
● IEC 61850 with 2 x RJ45 connection (continue with characteristic group 'G')	XW94
● IEC 61850 with 2 x fibre optic with ST connection (continue with characteristic group 'G')	XW95
● IEC 61850 with 2 x fibre optic with LC connection (continue with characteristic group 'G')	XW95.1
● IEC 61850 with 1 x RJ45 and 1 x fibre optic with ST connection (continue with characteristic group 'G')	XW96
● IEC 61850 with 1 x RJ45 and 1 x fibre optic with LC connection (continue with characteristic group 'G')	XW96.1
Note: Please specify the target SCADA system for connections in conformity with IEC 61850.	
● DNP 3.0 over Ethernet with 1 x RJ45 connection (continue with characteristic group 'G')	XW97
● DNP 3.0 over Ethernet with 2 x RJ45 connection (continue with characteristic group 'G')	XW94.1
● DNP 3.0 over Ethernet with 1 x fibre optic with ST connection (continue with characteristic group 'G')	XW98
● DNP 3.0 over Ethernet with 1 x fibre optic with LC connection (continue with characteristic group 'G')	XW98.1
● DNP 3.0 over Ethernet with 2 x fibre optic with ST connection (continue with characteristic group 'G')	XW95.2
● DNP 3.0 over Ethernet with 2 x fibre optic with LC connection (continue with characteristic group 'G')	XW95.3

CHARACTERISTIC	CODE
● DNP 3.0 over Ethernet with 1 x RJ45 and 1 x fibre optic with ST connection (continue with characteristic group 'G') ● DNP 3.0 over Ethernet with 1 x RJ45 and 1 x fibre optic with LC connection (continue with characteristic group 'G') **Note**: Please specify the target SCADA system for connections in conformity with DNP 3.0.	XW96.4 XW96.5
● MODBUS TCP/IP with 2 x RJ45 connection (continue with code "G") ● MODBUS RTU with RS485 (and with 1x RJ45/1x FO) connection (continue with code "G") ● other SCADA protocols on demand	XW94.2 XW96.2 XW99
Integrated SCADA connection in conformity with: IEC 60870- 5-101/ ..-103,...DNP... ● without (continue with characteristic group 'G') ● to connect the REG-DA to a control centre ● to connect several systems to a control centre (REG-D/DA/DP etc.) **Note**: L9 can only be combined with characteristics Z15 to Z19 and Z91.	 L0 L1 L9
Connection type ● Copper – RS232 – RS485 2-wire operation only ● Fibre optic cable with FSMA connection technology – Fibreglass (Wave length 800...900 nm, range 2000 m) – All-plastic (Wave length 620...680 nm, range 50 m) ● Fibre optic cable with ST connection technology – Fibreglass (Wave length 800...900 nm, range 2000 m) – All-plastic (Wave length 620...680 nm, range 50 m)	 V10 V11 V13 V15 V17 V19
Protocol ● IEC60870-5-103 for ABB ● IEC60870-5-103 for Areva ● IEC60870-5-103 for SAT ● IEC60870-5-103 for Siemens (LSA/SAS) ● IEC60870-5-103 for Sprecher Automation ● IEC60870-5-103 for others ● IEC60870-5-101 for ABB ● IEC60870-5-101 for IDS ● IEC60870-5-101 for SAT ● IEC60870-5-101 for Siemens (LSA/SAS) ● IEC60870-5-101 for others ● DNP 3.00 ● LONMark (on request) ● SPABUS ● MODBUS RTU ● Profibus-DP (always with V11!)	 Z10 Z11 Z12 Z13 Z14 Z90 Z15 Z17 Z18 Z19 Z91 Z20 Z21 Z22 Z23 Z99
Operating instructions ● German ● English ● French ● Spanish ● Italian ● Russian ● Portuguese ● Czech ● other	 G1 G2 G3 G4 G5 G6 G7 G8 G9

CHARACTERISTIC	CODE
Display language ● German ● English ● French ● Spanish ● Italian ● Russian ● Portuguese ● Czech ● Dutch ● Polish	 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10
Use of IEC 61850 GOOSE applications	GOOSE
IEC 61850 with bonding in active backup mode	Bonding
DCF simulation over NTP and ELAN extension over Ethernet (CSE) **Note:** Only in combination with XW94.x, XW95.x, XW96.x	DCF/ELAN

REG-DA accessories	ID-No.
Fuses, batteries:	
1 pack microfuses T1 L 250 V, 1 A, for auxiliary voltage range H0	582.1002
1 pack microfuses T2 L 250 V, 2 A, for auxiliary voltage range H2	582.1019
1 lithium battery (pluggable)	570.0003.00
1 lithium battery (solderable)	on request
Connection technique:	
PC connection cable (zero-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 ELAN-FO: RS485/FO (ELAN → FO or FO→ ELAN) FO-connector ST Note: 2 units required per line	111.9030.10
Interface ELAN-FO: RS485/FO (ELAN → FO or FO→ ELAN) FO-connector LC Note: 2 units required per line	111.9030.11
ELAN booster, Uh: DC 20..75 V, DIN rail housing 22.5 mm width, if necessary with power supply adapter H1 111.9030.36	111.9027.02
ELAN router, one outgoing circuit with booster, Uh: DC 20..75 V, DIN rail housing 22.5 mm width, if necessary with power supply adapter H1 111.9030.36	111.9027.03
Time synchronisation:	
Radio clock (DFC 77)	111.9024.01
GPS radio clock NIS time, RS485, Uh: AC 85 V ... 110V ... 264 V / DC 88 V ... 220V ... 280V	111.9024.45
GPS radio clock NIS time, RS485, Uh: DC 18 V ... 60V ... 72V	111.9024.46
GPS radio clock NIS time, RS232, Uh: AC 85 V ... 110V ... 264 V / DC 88 V ... 220V ... 280V	111.9024.47
GPS radio clock NIS time, RS232, Uh: DC 18 V ... 60V ... 72V	111.9024.48
Modems:	
Develo MicroLink 56Ki analogue modem, table top device incl. 230 V AC power supply adapter	111.9030.02
Develo MicroLink 56Ki analogue modem, DIN-rail device incl. 230 V AC power supply adapter	111.9030.03
Industrial analogue modem that can be used as dial-up modem or dedicated line; (Uh: AC 20..260 V/DC 14 V..280 V) with DIN-rail adapter; can be used with the PC and the device!	111.9030.17

REG-DA accessories	ID-No.
Insys industrial analogue modem that can be as a dedicated line; supply voltage DC: 10…60 V, can be used with the PC and the device!	111.9030.20
ISDN modem for DIN-rail mount; Uh: DC 10 … 60 V	111.9030.27
ISDN modem as table top device; incl. 230 V AC mains adapter	111.9030.37
GPRS modem (Insys) for DIN-rail mount; incl. magnet foot antenna and parameterisation software; Uh: DC 10 ..60 V	111.9030.29
Power supply:	
Phoenix power supply adaptor for DIN-hat rail mounting: In: AC 120 V...230 V, DC 90 … 250 V, Out: DC 24 V	111.9005.02
Power supply for DIN-rail mounting: In: AC 80 V...250 V; Out: DC 24 V	111.9030.31
Power supply for DIN-rail mounting: In: DC 18 V...60 V...72 V; Out: DC 24 V	111.9030.32
Power supply for ELAN router or booster: In: AC 100 to 240 V, Out: 24 V/1.3 A	111.9030.36
UPS HighCAP2403-1AC, In: 230 V AC Out: 24 V DC, max. 3 A, 1000 Joule (1 kW), DIN-Rail	111.9030.38
Additional input and output module:	
Analogue input module (2 inputs)	320.0004.00
Analogue output module (2 outputs)	320.0003
Input module for tap-potentiometer total resistance 180 ...2 kΩ, min. 5 Ω/tap	320.0002.01
Input module for tap-potentiometer total resistance 2 ...20 kΩ, min. 50 Ω/tap	320.0002.03
Input module for PT100 in conformity with DIN 43760 in three-wire circuit	320.0005.01
Operating instructions:	
Additional operating instructions for REG-DA (please specify the language)	GX

Add-ons for REG-DA	CODE
Transformer monitoring module - TMM ● Consists of: – Firmware update – User guide and Windows programming user interface for WinREG – Analogue module with two inputs for the temperature transducer – Input for PT100 in a three-wire circuit in conformity with DIN 43760 Additional analogue input, output or PT100 module. See Accessories	**TMM** A1 A2

Software for REG-DA	CODE
REGView as CD-ROM WinREG add-on functions Collector and RegView to archive and view data recorded with REG-D(A) and PAN-D.	**REGView**
REGSim as CD-ROM Simulates the parallel operation of transformers	**REGSim**

General Add-ons	CODE
Profibus DP module incl. RS485 interface and connection cable ● Mountable on DIN-rail (120 x 75 x 27) mm with ext. 24 V power supply adapter	**Profi-DP**
TCP/IP adapter ● 10 Mbit mountable on DIN rail with power supply adapter for Uh AC 230 V ● 100 Mbit	**REG-COM** A01 A90
COM3 converter COM3 to Modbus converter to connect external devices with Modbus interface to the transformer monitoring module. For example, to analyse the gas-in-oil ratio online, directly measure the winding temperature, etc. ● Auxiliary voltage – AC 85…264 V, DC 88 … 280 V, DC 18 … 72 V – DC 18 … 72 V	**COM3-MOD** H1 H2
IRIG-DCF77 converter ● AC 85 V … 110 V …264 V / DC 88 V … 220 V … 280 V ● DC 18 V … 60 V … 72 V ● as wall-mounting housing 20 HP	**IRIG-DCF** H1 H2 B2

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Provided by:

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