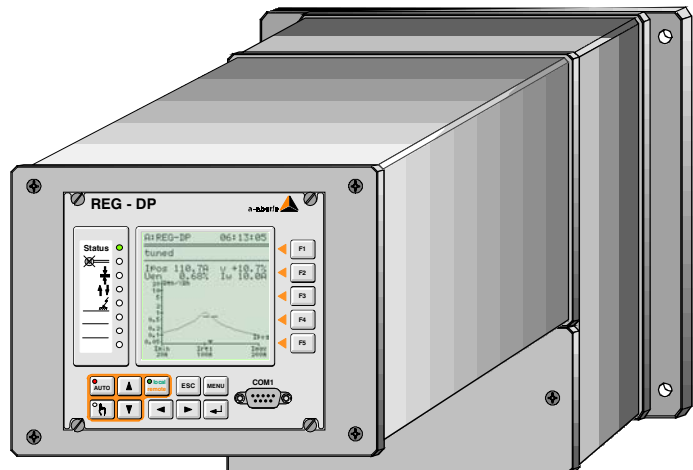


Regulator for Petersen - Coils

REG-DP

- * as wall-mounting version
- * as modular version
- * as 19" mounting rack version



Application

In medium- and high voltage networks, the free programmable regulator REG-DP is used for the automatic control of Petersen-coils (P-coils), which are continuously adjustable on load. Furthermore, the controller can solve a lot of control-, measuring- and recording tasks all around the Petersen-coil.

Control methods

As a standard feature, the regulator offers different methods for the automatic control of a Petersen-coil. Depending on the requirements, the REG-DP can control either to a percentage or absolute detuning-current or a given zero-sequence-voltage. It is remarkable, that during a ground-fault, the Petersen-coil can be corrected by the detuning and adjusted to the resonance point. Furthermore, there are different methods available for the control of several Petersen-coils in the same network.

Resistor control

Included as an independent functional unit there is a resistor-control for the "increase of the residual ohmic current", which can be freely parameterised and which contains even a thermal model.

Recording of the Zero-Sequence-Voltage

An integrated electronic "recorder" continuously stores the time history of the zero-sequence-voltage and the coil-position. The chart-time lines can be shown and evaluated either on the display of the controller or on a PC. This integrated "net spy" enables to record and monitor long-term alterations of the zero-sequence voltage. The parameterisation-software WinREG can be used to evaluate and archive the recorded data.

Connection to the SCADA system and REGSys

The controller REG-DP is part of the control system REGSys and therefore it can be easily connected to the voltage regulator REG-D or to the multi-transducer MMU-D. An essential attribute of REGSys is, that all components, which are connected by the system-bus E-LAN, can be parameterised or connected to the supervisory control and data acquisition system (SCADA) over only one interface. For this reason, the measured values and parameters of all connected de-

vices are available to the SCADA system and can be read out or modified there. Gateways according IEC 60870-5-103 (VDEW) and IEC 60870-5-101 (balanced or unbalanced mode) are available.

Multimaster-System-Architecture

If several devices are connected via the system-bus E-LAN, each bus-node can be parameterised or read-out via interface (COM1, COM 2) of any other node by using a PC. In addition, several PC's can access on different bus-nodes simultaneously.

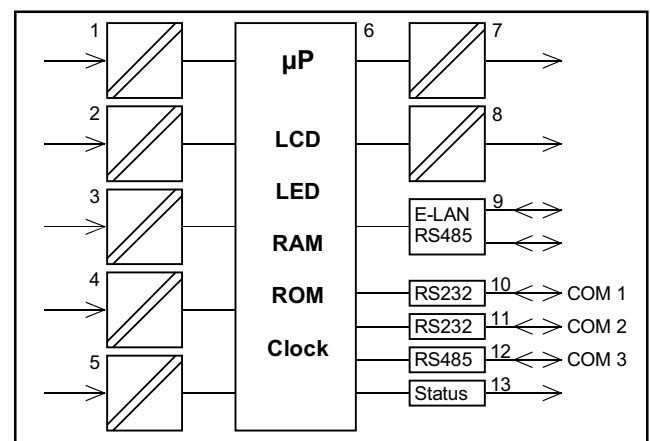
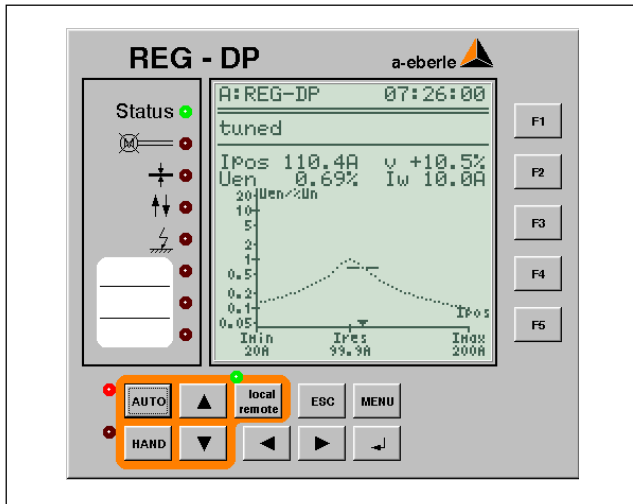


fig. 1: functions of the regulator REG-DP

- 1 voltage transformer (zero-sequence-voltage)
- 2 Petersen-coil position indicator (potentiometer)
- 3 current-transformer (e.g. current through the P-coil)
- 4 binary inputs
- 5 power supply
- 6 display- and processing unit
- 7 binary outputs
- 8 analogue outputs
- 9 E-LAN connection (2 x RS485 with repeater)
- 10 COM 1, RS232
- 11 COM 2, RS232 (optional)
- 12 COM 3, RS485 (optional)
- 13 status-relay

Regulator Mode



Control of the detuning

A change in the switching condition of the network is recognised because of the change of the zero-sequence-voltage. Considering adjustable restrictions, the controller guides the P-coil to the pre-set detuning.

On the display, beside the status of the controller, the following data are shown:

- actual coil position
- actual zero-sequence-voltage
- actual detuning
- residual resistive current of the net over the fault point
- resonance curve and their parameters

The monitoring of the switching-condition is made by evaluating the zero-sequence-voltage in the complex plain.

Voltage control

The controller continuously compares the actual value and a specified value of the zero-sequence-voltage. The manipulating variable for the tuning of the Petersen-coil is derived from this comparison.

Adjusting the P-coil during the ground-fault

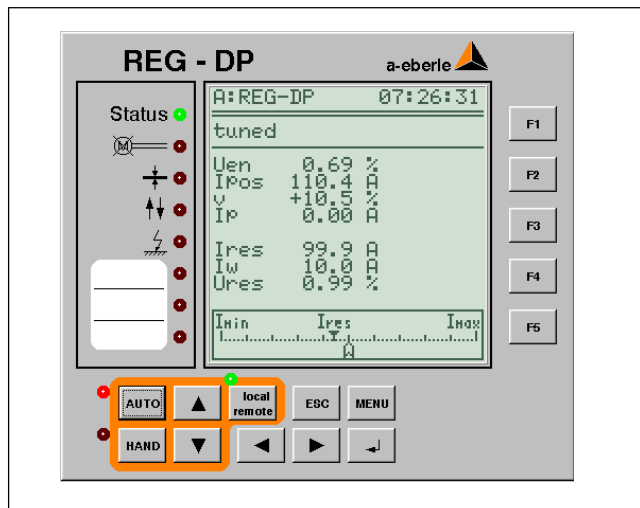
The controller can be parameterised in a way, that the coil-position is corrected by the compensation value during a ground-fault. Additional corrections can be activated via the binary inputs.

Methods for Petersen-coils, working in parallel

To control P-coils, which are connected in parallel, several methods are offered. If the controllers e.g. are connected over the E-LAN, the actual position value of the second coil can be considered as fixed coil. It is even possible to adjust the "fixed coil", if the regulating range of the "master controller" is not sufficient.

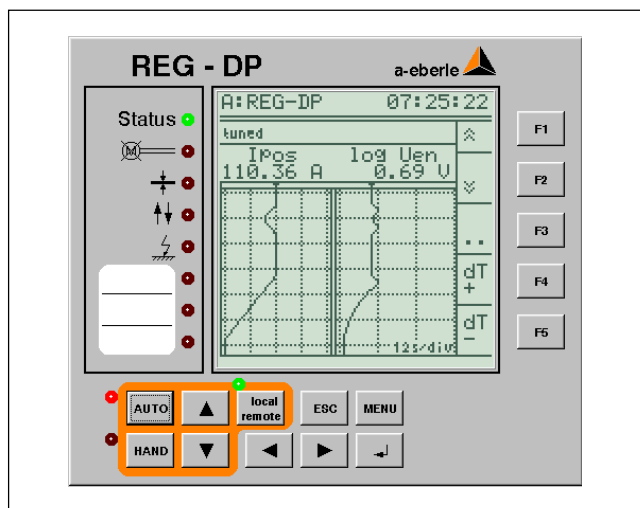
Special requirements of the 110kV-network

Additional parameters of the high-voltage distribution network can be considered, e.g. a maximum permanent zero-sequence-voltage.



Recorder Mode

The time history of the zero-sequence voltage V_0 is presented on the display as a line diagram. The time base (rate of feed) for the display can be adjusted. The recorded data and the assigned time can be retrieved to the display via function keys or to a PC.

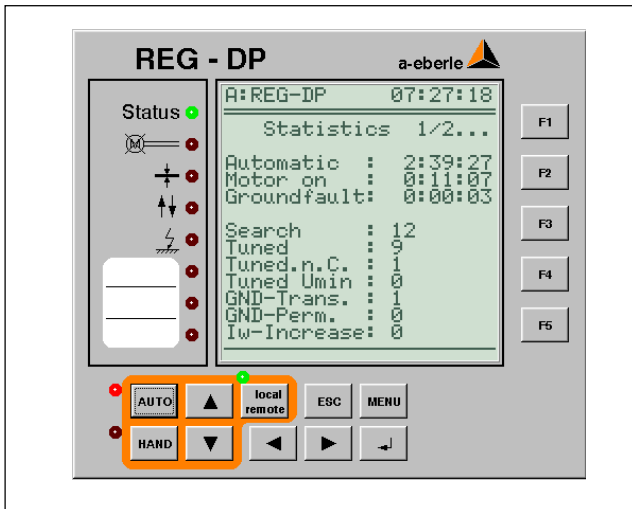


In addition, substantial events are recorded (with date and hour) in an "event recorder" and can be retrieved via a PC.

Statistics Mode

In the statistics mode the most important total-timers and counters are shown. Using these data it can be checked how many tunings occurred in a given period resp. how many have been completed successfully. Furthermore, it can be seen for how many tuning operations the adjusting range of the P-coil was not sufficient.

The statistics mode even records the number of the ground-faults, which occurred and the number of the "increase of the residual ohmic current".

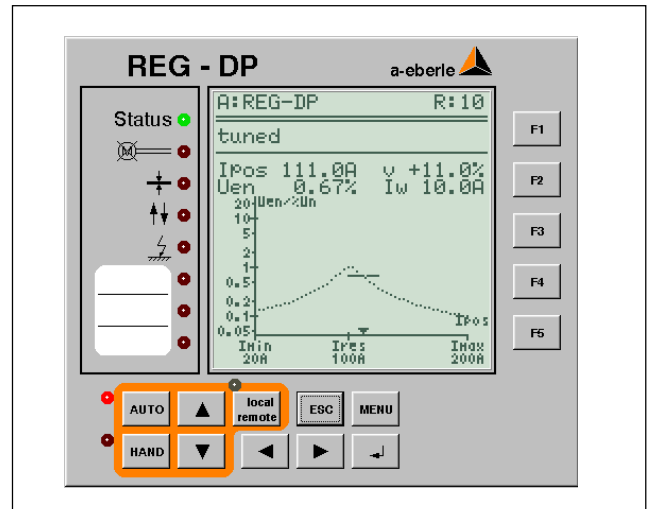


Resistor control

The independent and free programmable resistor control makes it possible to connect a resistor for the “increase of the residual ohmic current “ in the case of a ground fault automatically. To supervise the load of the resistor, a “thermal model” is used, which considers the actual zero-sequence-voltage during the connection. At overtemperature the switch in of the resistor is blocked. The display shows the possible remaining resistor connections until the temperature limit is reached.

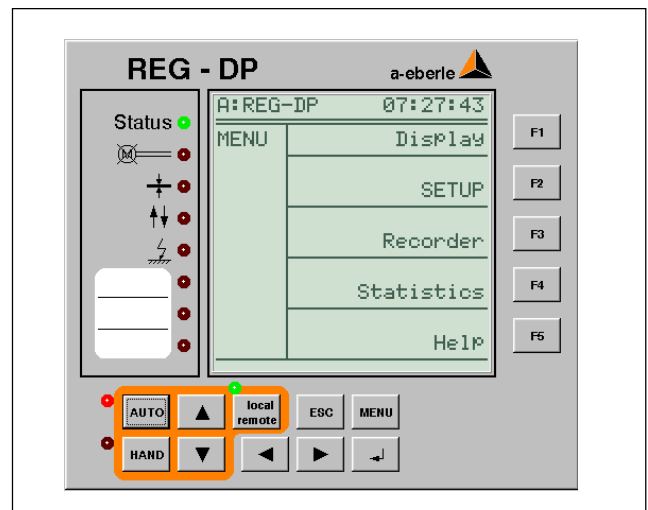
The repeated connection by transient ground faults can be avoided.

The manual release of the resistor connection can be done via a binary input as well as via SCADA



Parametrization

The assignment of the parameters of the controller is menu-driven and very simple .



The setting into operation of the controller and the adjustment to the Petersen-coil (e.g. linearization of the coil-position) is largely automated. The reactions of the process are permanent monitored and checked according to their plausibility. Errors are analysed and shown in the status line. An additional-menu offers more detailed information and tips for the trouble-shooting.

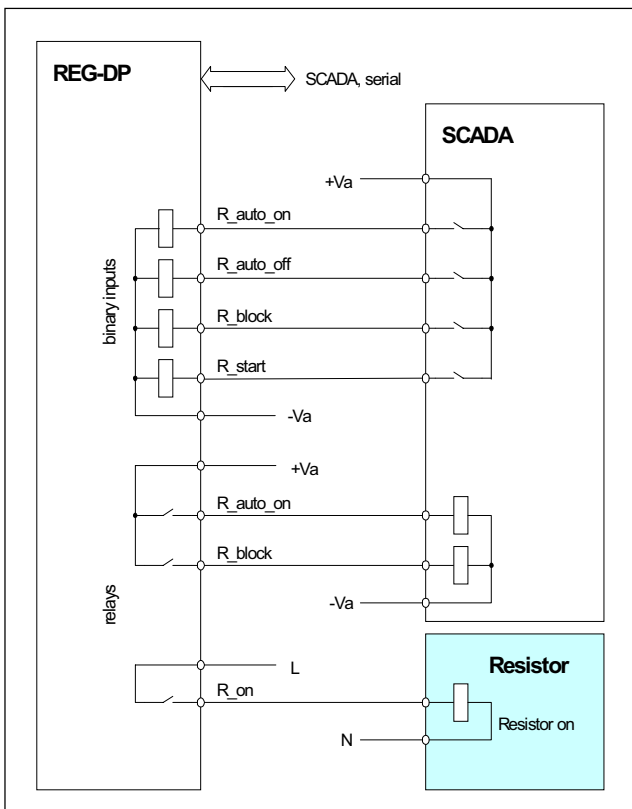
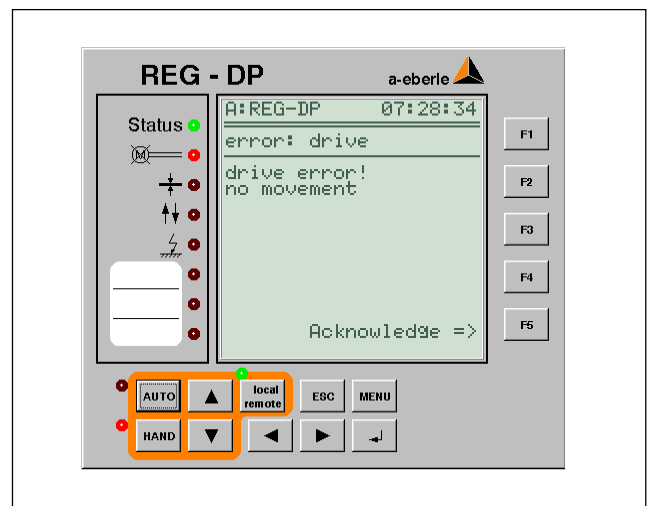


fig. 2 Example for application of the resistor control



Technical Characteristics

Applied Rules and Standards

IEC 1010 / EN61010 (VDE 0411)
 CAN / CSA - C 22.2 No. 1010.1 - 92
 VDE 0110
 IEC 255-4
 EN 55011 : 1991
 EN 50082 - 2 : 1995
 IEC 688 -1
 IEC 529
 EN 50178 / VDE 0160 / 11.94 (draft)
 VDE0106 TEIL 100
 DIN 40050



AC Voltage Inputs (V_o and V_{12})

zero sequence voltage V_o 0,1V ... 120V
 wave form sinus
 frequency range 45...50...60...65 Hz
 power dissipation $\leq V^2 / 20 \text{ k}\Omega$
 overload capability 1,2 * 120V

AC Current Inputs (I_p and I_2)

current range 1 A / 5 A
 (selectable via
 hardware and software)
 wave form sinus
 frequency range 45...50...60...65 Hz
 power dissipation $\leq 0,5 \text{ VA}$
 overload capability 10 A permanent
 60 I_{rated} for 1 s
 30 I_{rated} for 10 s
 500 A for 5 ms

Coil Position Indication (Ipos)

measuring sensor potentiometer R_{pot} or
 mA - source
 rated value for R_{pot} 0,15 ... 3 k Ω
 measuring voltage about 5 VDC

 selectable range for 1, 5, 10, 20 mA
 mA - source
 burden voltage at rated about 5 VDC
 current of the mA-source

Error message at interruption or short-circuit of the sensor resp. if the voltage of the slider is outside the range.

20 mA - Analog Outputs

number of channels refer to order details
 output range -20 mA...0...20 mA,
 (Y1... Y2) Y1 and Y2
 programmable
 isolation optocoupler
 load impedance $0 \leq R \leq 8 \text{ V} / Y2$
 ripple content $< 0,5 \% \text{ of } Y2$

The outputs can also operate either shortend or opened permanently. The output clamps are galvanically isolated from all other circuits.

Binary Inputs

inputs E1 ... E16

rated input voltage AC/DC 48 V...230 V
 wave form, permissible rectangular, sinus
 H – level $> 35 \text{ V}$
 L – level $< 25 \text{ V}$
 signal frequency f_s $\text{DC} \leq f_s \leq 60 \text{ Hz}$
 input impedance $\geq 47 \text{ k}\Omega$
 isolation optocoupler; all inputs are
 galvanically isolated from
 each other

Relays (REL 1-11)

relay R1 ... R11, incl. status

max. switching frequency $\leq 1 \text{ Hz}$
 isolation isolated from all
 internal potentials
 contact load AC 250 V, 5 A ($\cos\phi = 1,0$)
 AC 250 V, 3 A ($\cos\phi = 0,4$)
 DC 220 V, 55 W(L/R=0ms)
 DC 100 V, 55 W(L/R=0ms)
 DC 60 V, 60 W(L/R=0ms)
 DC 30 V, 150 W(L/R=0ms)
 $> 10^5$ electrical

 number of make-break
 operations relay output selectable by
 status-relay jumper as NO or NC

Reference Conditions

reference-temperature 23°C $\pm 1 \text{ K}$
 input quantities $V = 0 \dots 120 \text{ V}$
 $I = 0 \dots 1 \text{ A} / 0 \dots 5 \text{ A}$
 auxiliary voltage $H = H_n \pm 1 \%$
 frequency 50 Hz...60 Hz
 wave form sinus, form factor 1,1107
 burden for analog outputs $R_n = 4 \text{ V} / Y2 \pm 1 \%$
 others IEC 688 - Teil 1

Electrical Safety

protection class I
 pollution grade 2
 overvoltage category II, III

III	II
input circuits of the current and voltage transformers	control circuits, analog inputs, analog outputs, power supply, ELAN, COM's

rated isolation level

50 V	230 V
E-LAN, COM1...COM3, analog inputs, analog outputs	voltage inputs, current inputs, power supply, binary inputs (E1 ... E16), relay outputs (R1 ... R11), incl. status-relay

Test voltage: V_{rms} in kV; 1 minute duration

	Bgtr.	Va	COM's	REL	BI	AI	AO	V_x	I_x	R
rack	-	1,35	0,35	1,35	1,35	0,35	0,35	1,35	1,35	0,35
Va	1,35	-	2,3	2,3	2,3	2,3	2,3	3,25	3,25	2,3
COM's	0,35	2,3	-	2,3	2,3	0,35	0,35	2,3	2,3	0,35
REL	1,35	2,3	2,3	-	2,2	2,3	2,3	3,25	3,25	2,3
BI	1,35	2,3	2,3	2,2	-	2,3	2,3	3,25	3,25	2,3
AI	0,35	2,3	0,35	2,3	2,3	-	0,49	2,3	2,3	0,49
AO	0,35	2,3	0,35	2,3	2,3	0,49	-	2,3	2,3	0,49
V_x	1,35	3,25	2,3	3,25	3,25	2,3	2,3	-	2,2	1,35
I_x	1,35	3,25	2,3	3,25	3,25	2,3	2,3	2,2	-	1,35
R	0,35	2,3	0,35	2,3	2,3	0,49	0,49	1,35	1,35	-

interfaces COM's, ELAN 0,35 kV against each other

- rack mounting rack
- Va auxiliary voltage
- COM's interfaces (COM1, COM2, COM3, E-LAN)
- BI binary input E1...E16
- REL relays R1...R10, status
- AI analog inputs
- AO analog outputs
- V_x input voltage
- I_x input current
- R potentiometer

Electromagnetic Compatibility

The device complies with the EMC requirements EN 55011: 1991, EN 50082-2: 1995

Emitted interference

according to EN 55011
limit class A, group 1

Immunity to interference

Electrostatic Discharge (ESD)
according to EN 61000-4-2
air discharge 8 kV,
contact discharge 4 kV

Electromagnetic Fields according to ENV 50140, EN 50204
80 MHz...1000 MHz 10 V / m
radio frequency range 10 V / m
900 MHz ± 5 MHz 10 V / m (pulsmodulation)

Fast Transients (Bursts) according to EN61000-4-4
power supply AC 230 V, 2 kV
data lines 2 kV

Conducted Disturbances according to ENV 50141
0,15 MHz...80 MHz $V_{rms} = 10 V$
radio frequency range $V_{rms} = 3 V$

Magnetic Fields according to EN 61000-4-8
50 Hz-fields 30 A / m

Environmental

Temperature range
operating (rack) -10 °C...+50 °C
operating (plug-in module) -10 °C...+60 °C
transport and storage -25 °C...+65 °C

Power Supply

code	H1	H2
AC	85...264V	20...60V
DC	88...280V	18...72V
power dissipation	≤ 15 VA	≤ 15 VA
frequency	50 Hz / 60 Hz	-
fine-wire fuse	T2 250V	T2 250V

Applicable for all codes:
Voltage dips ≤ 80 ms do neither lead to data losses nor to malfunctions.

Display

LC - Display 128 x 128 dots
illumination on / off is programmable

Data Storage

controller parameter serial EEPROM with
≥ 1 million write/read
cycles
RAM - data laser sealed Li - battery

**Mechanical
Plug-in group**

front panel plastic-sheet on alu,
RAL 7035 gray
height 3 U (132,5 mm)
width 28 T (142,2 mm)
printed board 160 mm x 100 mm
mass ≤ 1,5 kg
protection class IP 00
plug-in group IP 00
connector block IP 00
mounting according to DIN 41494 / 5

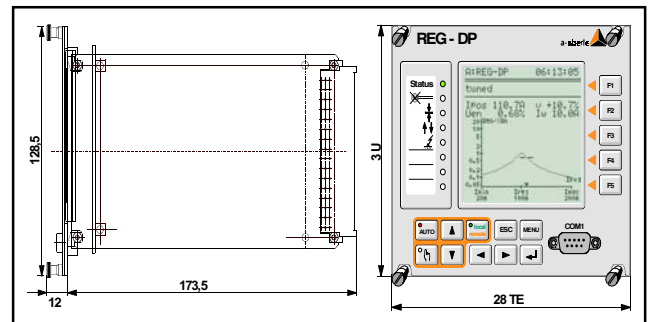


fig. 3 dimensions of the REG-DP

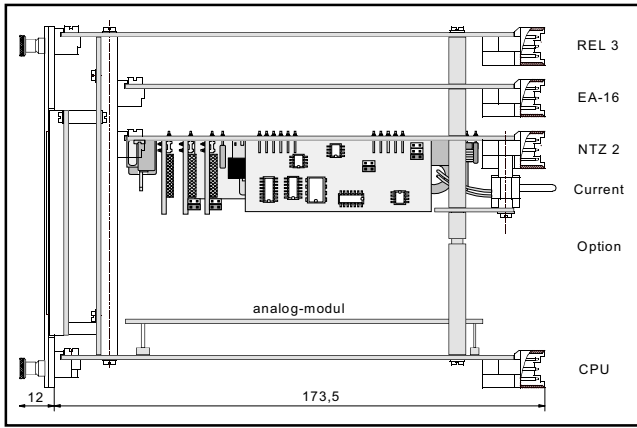


fig. 4 position of the male-connectors REG-DP

female connector 2; (Binary Inputs E)					
end switch high	E1	+	b2	z2	-
end switch low	E2	+	b4	z4	-
programmable	E3	+	b6	z6	-
programmable	E4	+	b8	z8	-
AUTO (Impuls)	E5	+	b10	z10	-
MANUAL (Impuls)	E6	+	b12	z12	-
motor higher	E7	+	b14	z14	-
motor lower	E8	+	b16	z16	-
programmable	E9	+	b18	z18	-
programmable	E10	+	b20	z20	-
programmable	E11	+	b22	z22	-
programmable	E12	+	b24	z24	-
programmable	E13	+	b26	z26	-
programmable	E14	+	b28	z28	-
programmable	E15	+	b30	z30	-
programmable	E16	+	b32	z32	-

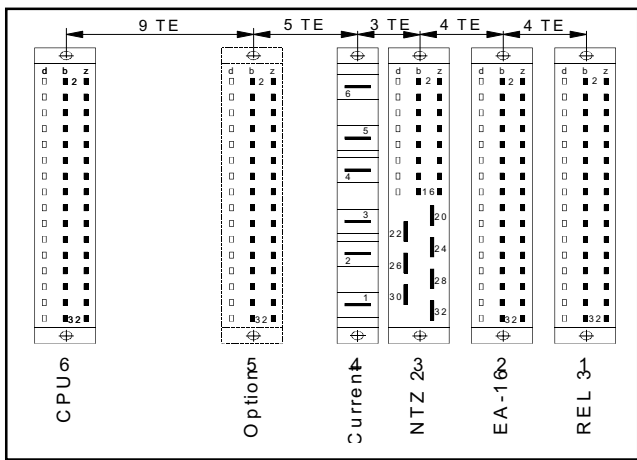


fig. 5 position of the female-connectors of the REG-DP

female connector 3; (Ipos, Vo, V12 and auxiliary voltage)			
pot+	Ipos	pot+	z8
slider		Vs	b8
pot-		pot-	d8
zero-sequence-voltage	Vo	e	20
		n	22
reference-voltage	V12	L1	24
		L2	26
auxiliary voltage (AC / DC)	Va	L(+)	28
		N(-)	30
		PE	32

Mounting in the 19 " rack

The rack has 84 TE with 84 place numbers 'n'. Each place number is the reference point for the mounting of the guide rails and the connector-block on the rear-side of the rack.

place numbers

female connector	1	2	3	4	5	6
guide rails	n	-	-	-	-	n+26
screws	n	n+4	n+8	n+11	n+16	n+25

Contact Assignment for REG-DP plug-in modul

female connector 1; (REL)					
higher (2 contact pairs) 1 NC + 1 NO	R1	root	b2	z2	NC
		root	b4	z4	NO
		--	b6	z6	--
lower (2 contact pairs) 1 NC + 1 NO	R2	root	b6	z6	NC
		root	b10	z10	NO
		--	b12	z12	--
programmable	R3	root	b14	z14	NO
programmable	R4	root	b16	z16	NO
		--	b18	z18	--
programmable	R5	root	b20	z20	NO
manual / auto	R6	root	b22	z22	NO
		NC	b24		
status				z24	NO
		root	b26	z26	--
programmable relays	R7	--	b28	z28	root R7...R10
	...	NO R7	b30	z30	NO R9
	R10	NO R8	b32	z30	NOR10

female connector 4; (current inputs I1 und I2)			
current I1(AC) (e.g. coil-current)	I1	k	6
		l	5
current I2 (AC)	I2	k	4
		l	3

female connector 6; (analog IO ; interfaces)				
20 mA analog-module (Vo, coil position)	Vo +	b2	z2	Ipos +
	Vo -	b4	z4	Ipos -
E-LAN	left EA +	b6	z6	right EA+
	left EA -	b8	z8	right EA-
	left E +	b10	z10	right E+
	left E -	b12	z12	right E-
20 mA analog-module	I1 +	b14	z14	2.2 +
	I1 -	b16	z16	2.2 -
COM 2 (RS232)	TxD	b20	z20	RTS
	RxD	b22	z22	CTS
	GND	b24	z24	+12V
20 mA analog-module	3.1 +	b26	z26	3.2 +
	3.1 -	b28	z28	3.2 -
COM 3 (RS485)	Tx +	b30	z30	Rx+
	Tx -	b32	z32	Rx-

Wall-mounting case

material polykarbonat (UL 94 V-0)
 degree of protection case: IP 65
 mass $\leq 1,5$ kg
 dimensions see fig. 5

connection elements screw clamps
 cross section of the connecting cable $\leq 4,0$ mm² single core
 $\leq 2 \times 2,5$ mm² fine-wire

Panel-mounting case

material polykarbonat (UL 94 V-0)
 degree of protection case: IP 65
 mass $\leq 1,5$ kg
 dimensions see fig. 6

connection elements screw clamps
 cross section of the connecting cable $\leq 4,0$ mm² single core
 $\leq 2 \times 2,5$ mm² fine-wire

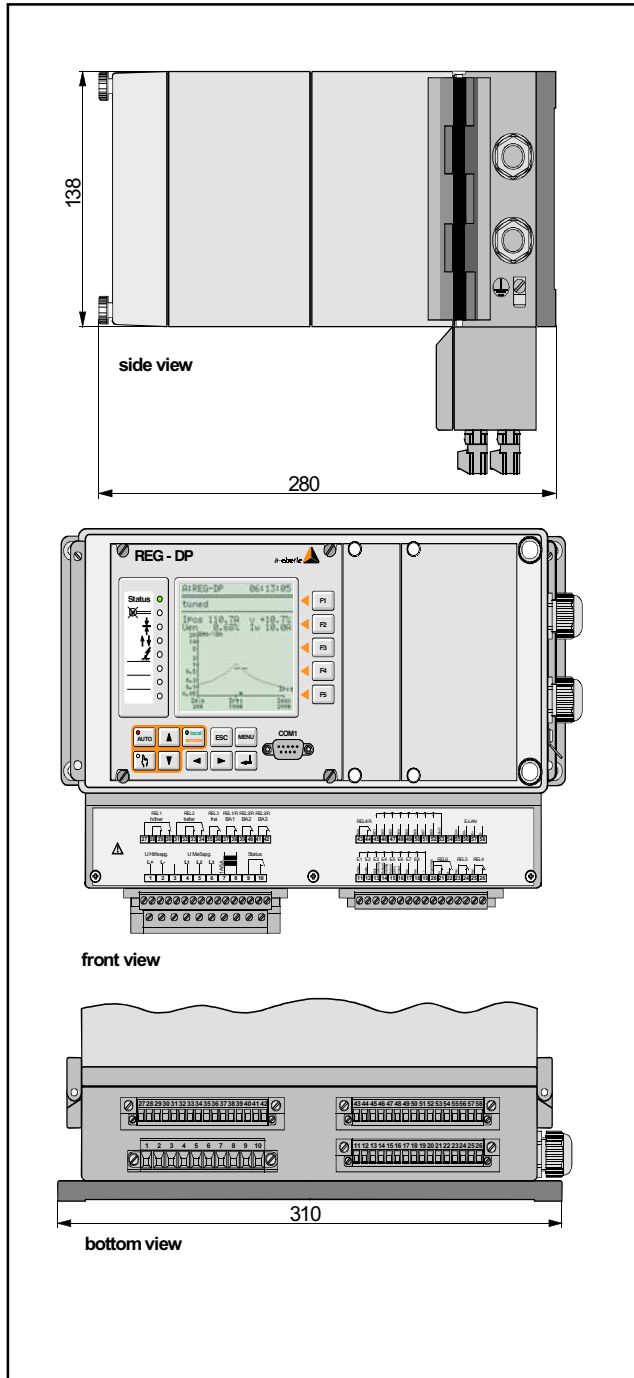


fig. 5 dimensions of REG-DP (code B02)

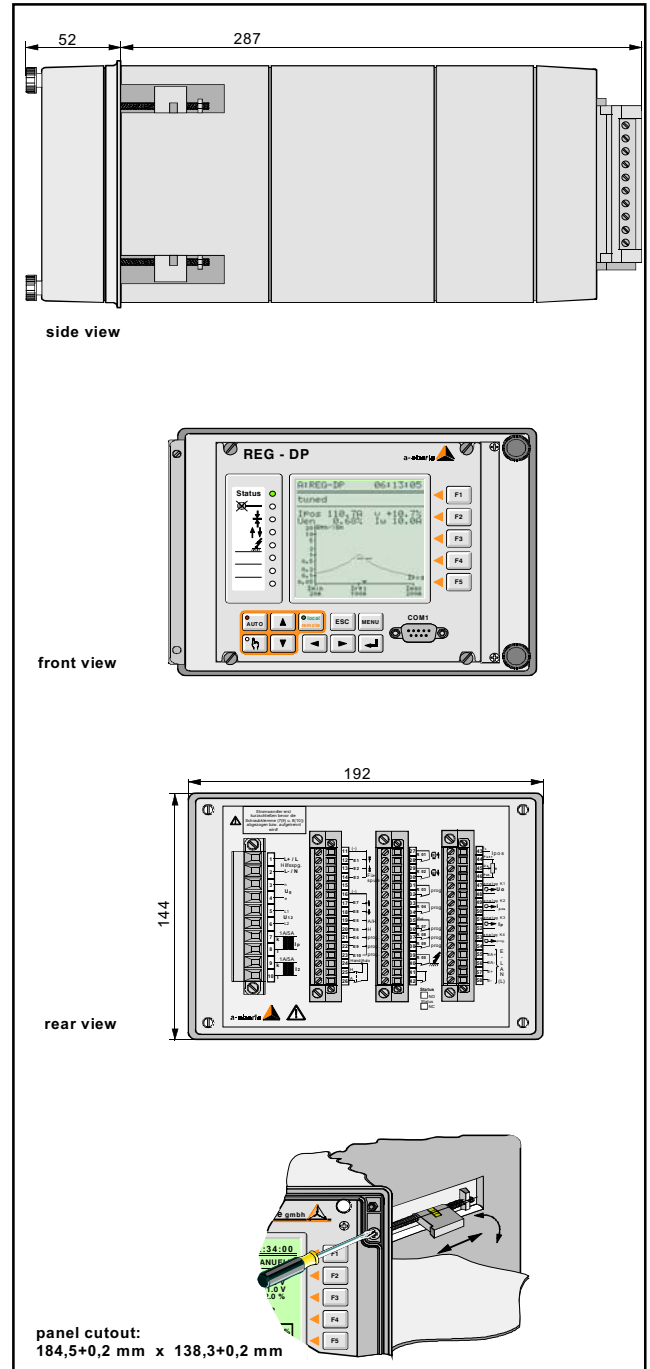


fig. 6 dimensions of REG-DP (code B03)

Interfaces

Interfaces RS232

The controller REG-DP includes two serial interfaces RS 232 (COM1, COM2); the access to COM 1 is on the front panel, access to COM 2 can be reached via the rear-mounted connector block. COM 2 is used for the connection of the control system to the higher ranking SCADA. Even customised protocols can be realised via COM 2.

Connection elements

COM 1 male connector, Sub-Min-D on the panel, pin assignment equivalent to a PC

COM 2 connector block (printed board 6)

possible connections PC, terminal, modem, PLC
 standard protocol 8 bit, parity off
 transfer rate bit / s 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115000

Interfaces RS485

Used for the **E-LAN**
 Double interface RS485 with repeater function

E-LAN (Energie- Local Area Network) characteristics

- 255 nodes adressable
- multimaster-struktur
- integrated repeater function
- open ring, bus or combination of bus and ring
- protocol based on SDLC/HDLC-frames
- transfer rate 62,5 kbit / s resp. 125 kbit / s
- telegram length 10... 30 Bytes
- average throughput approx. 100 telegrams / s

COM3

for the connection of ≤ 15 interface components (ANA-D, BIN-D) in any combination with the regulator REG-DP.

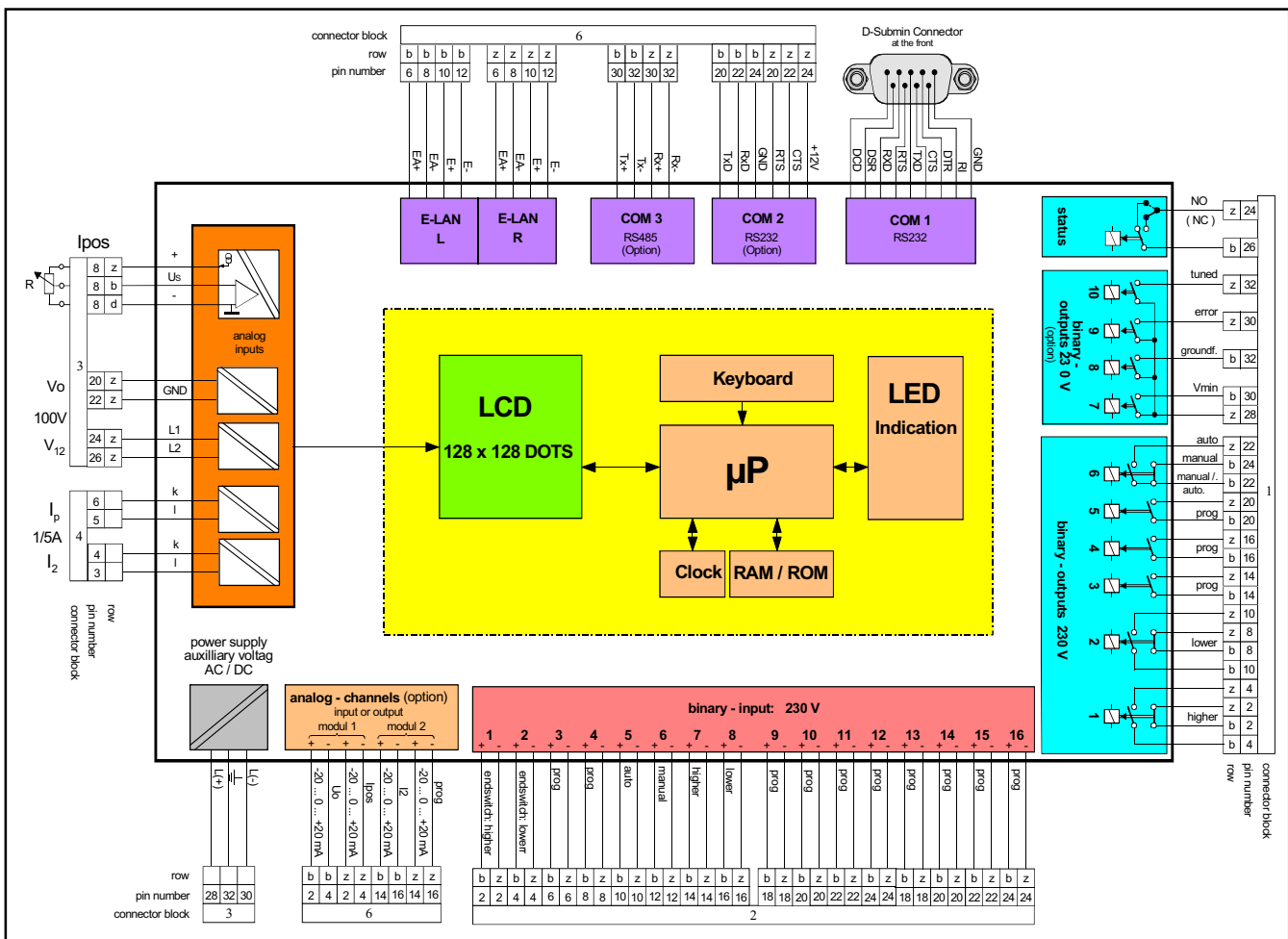
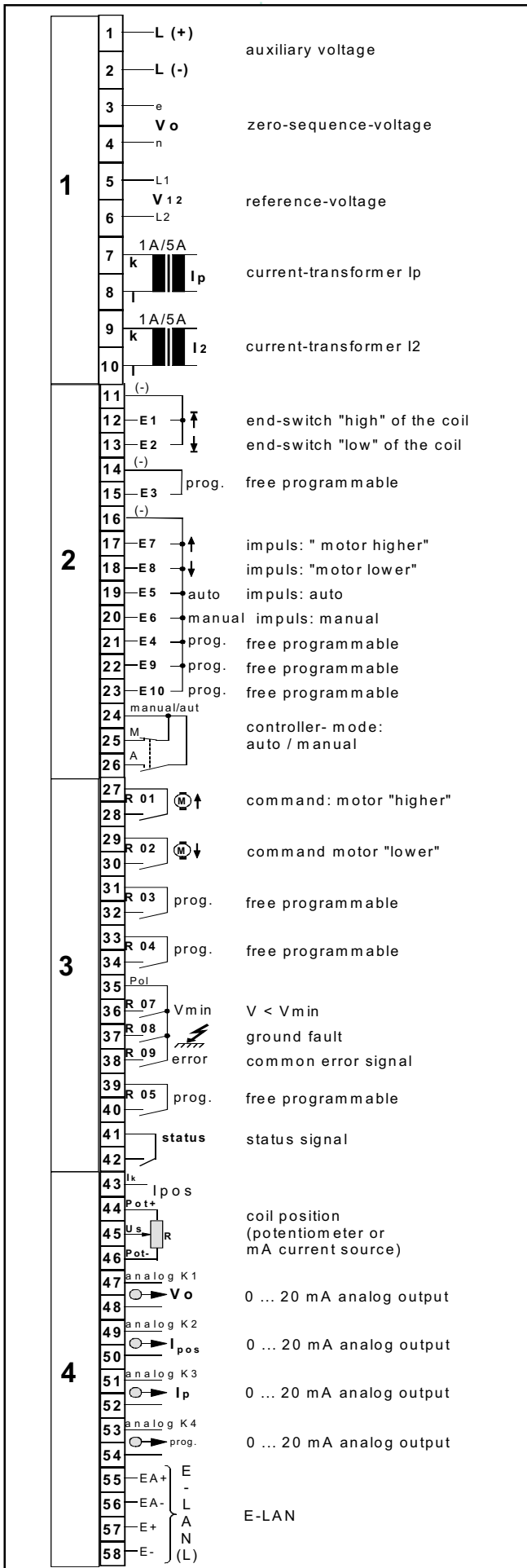


Bild 9 Blockschaltbild des REG-DP mit Kontaktbelegung (Merkmal B01)



REG-DP

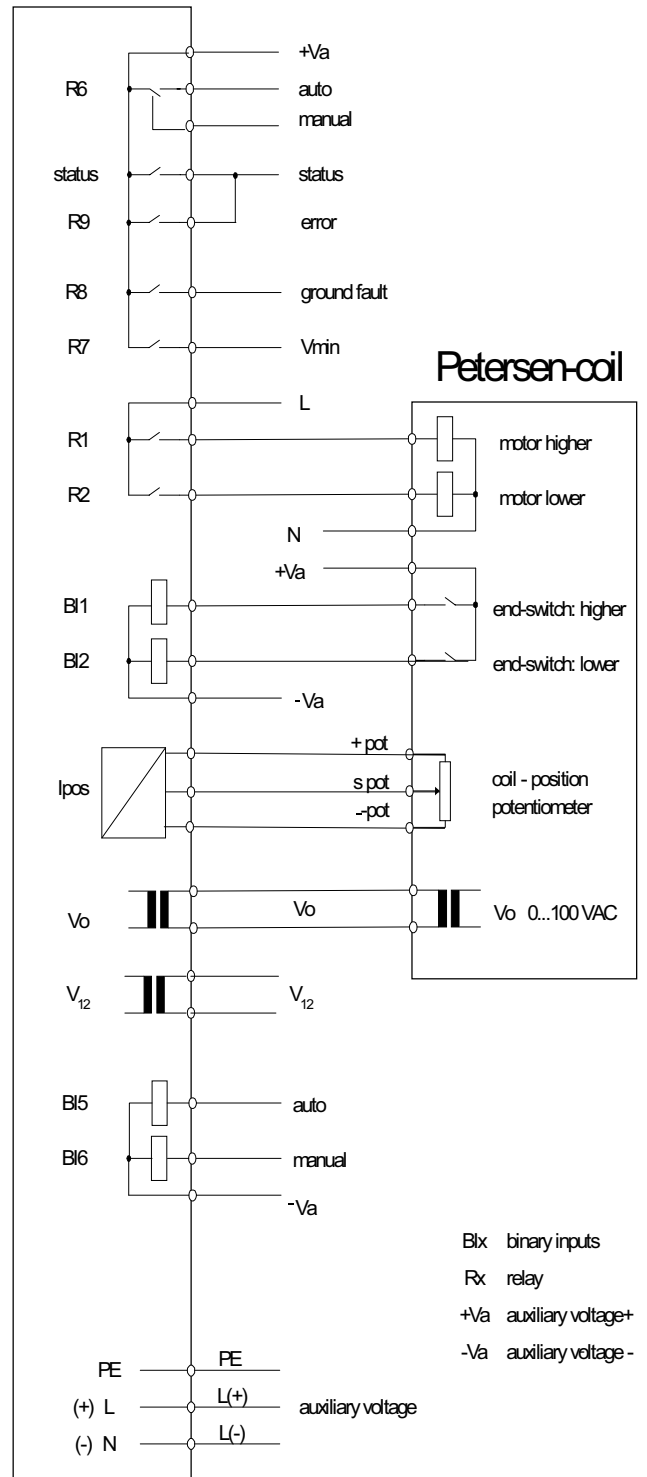


fig. 7 example for the connection of the Petersen-coil to the REG-DP

Standard terminal-assignment for code B02 and B03

The Parameterisation- and Configuration Software WinREG-DP

The PC Software WinREG is used to parameterise and program the control system. WinREG offers three different modes.

In the **panel-mode** up to 6 controllers can be displayed simultaneously and controlled via mouse. All settings, which can be executed directly on the controller via the keyboard, can be carried out centrally with WinREG under the condition that all controllers are connected via E-LAN.

Using the **parameter mode**, each component can be parameterised easily. Each parameter can be put in clearly arranged card files, stored on disk for further use or transferred to other bus-nodes. Especially for the simultaneous operation of voltage controller, P-coil controller and other REGSys-components in one system, this mode offers an easy handling at highest transparency.

The **terminal-mode** offers the straight communication with the system. Compared with well-known terminal programs, the WinREG-terminal is much more comfortable and makes the programming of the system much easier.

WinREG runs under Windows 95, Windows 98 or Windows NT.

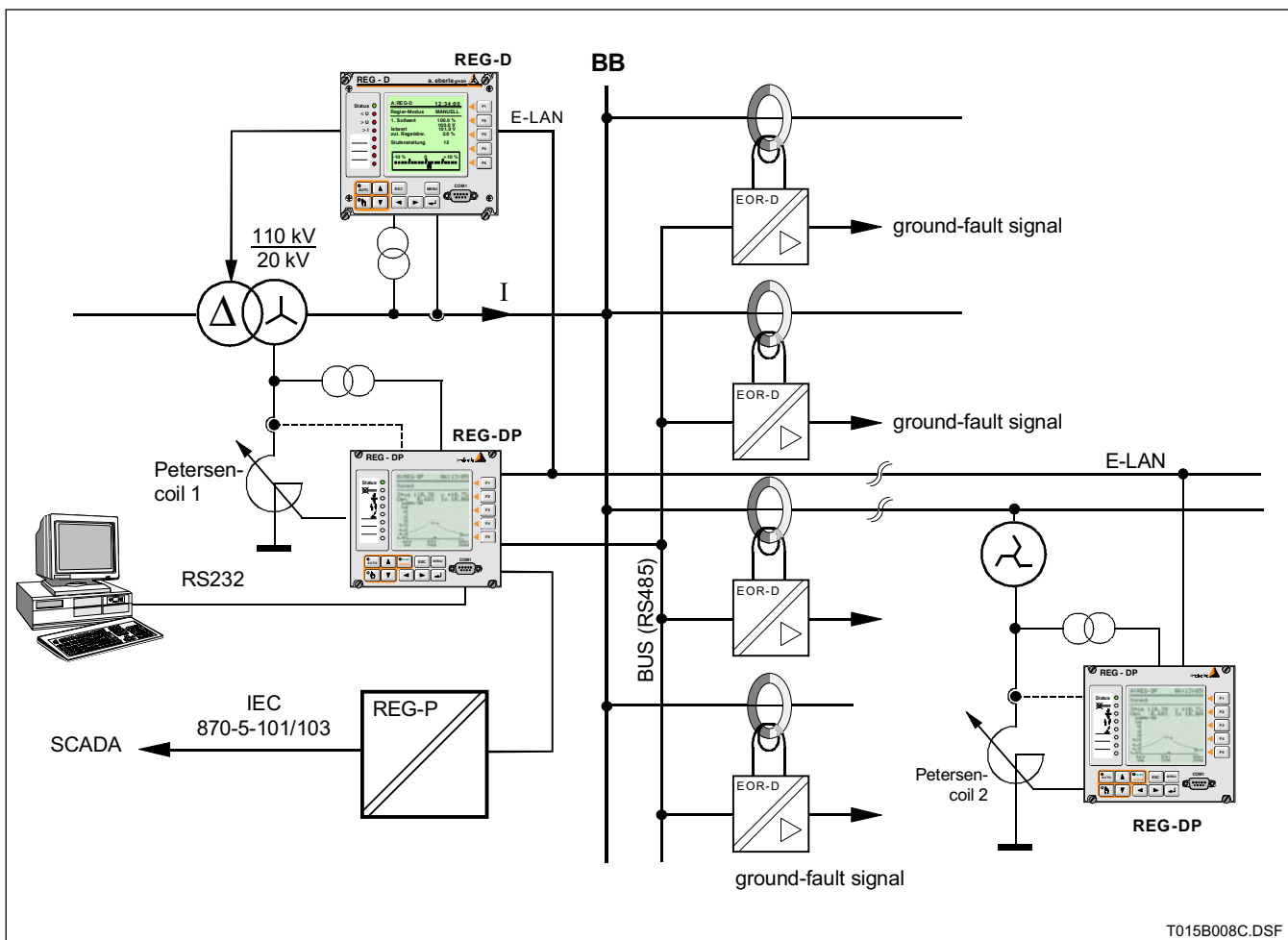


fig. 8 automation - island

Order details

Please note:

- Only one code of the same capital letter is possible
- When the capital letter is followed by a number 9, further details are necessary
- The code can be omitted when the capital letter is followed by zero

characteristics	Code			
regulator REG-DP for Petersen coils with resistor control, long-time recording and log book, standard version, plug-in module 28 TE, 3 HE	REG-DP			
design: plug-in version 28 TE, 3 HE wall mounting case (49 TE) with wiring panel mounting (30 TE) with wiring wall mounting / panel mounting case (30/49 TE) - with wiring upon arrangement 19 " rack with wiring upon arrangement	B01 B02 B03 B91 B92			
power supply external AC 85 V...230 V...264 V / DC 88 V...220 V...280 V external DC 18 V...60 V...72 V	H1 H2			
long-term recording of Vo with 1 MB RAM)	S0			
analogue outputs please indicate measuring range i.e. scaling output 1: zero-sequence voltage V_0 output 2:: position of Petersen coil I_{pos} output 3: coil-current I_p output 4: programable I_2	without with E00 E90			
interface RS232 (COM 2) without with	P0 P1			
interface RS485 (COM 3) without with	R0 R1			
status output closes in case of malfunction opens in case of malfunction	U0 U1			
language on display same language as in the operating manual German English upon agreement (Czech,Swedish, Finish, French, Hungarian, Italian)	A0 A1 A2 A91			
operating manual German English upon agreement (Czech,Swedish, Finish, French, Hungarian, Italian)	G1 G2 G91			

software and accessories	code			
additional operating manual				
KNOSPE resistor control				
several controllers in the same network				
protocol interface card (10TE/3HE) for the connection of the regulator REG-DP SCADA systems according to IEC protocols 60870-5-101 or 60870-5-103, cable for parameterization and software download	REG-P			
design of the REG-P 19" plug in module wall-mounting case with wiring	B01 B02			
optical fibre connection of the REG-P without with 1 link with 2 links with 3 links	A0 A1 A2 A3			
type of connection without glass fibre (wavelength 800...900nm, max. distance 500m) glass fibre (wavelength 800...900nm, max. distance 2000m) plastic fibre (wavelength 620...680nm, max. distance 10m) plastic fibre (wavelength 620...680nm, max. distance 50m) cooper (RS232 with reversable level) copper (RS232, max.32 nodes, 2 wire operation only)	V0 V1 V2 V3 V4 V5 V6			

characteristics	Code			
WinREG-DP without modem link (Windows 95,98 and NT) for the parameterization, visualisation and storage of REG-DP data 3 1/2" floppy disk CD ROM	D0 D1			
WinREG-DP with modem link (Windows 95,98 and NT) for the parameterization, visualisation and storage of REG-DP data 3 1/2" floppy disk CD ROM	D0 D1			
WinREG-DP without modem link single licence 3 1/2" floppy disk	D0			
WinREG-DP with modem link single licence 3 1/2" floppy disk	D0			
WinREG-DP without modem link multiple licence 2nd ... 5th licence 3 1/2" floppy disk CD ROM 6th ... nth licence 3 1/2" floppy disk CD ROM	D0 D1 D0 D1			
WinREG-DP with modem link multiple licence 2nd ... 5th licence 3 1/2" floppy disk CD ROM 6th ... nth licence 3 1/2" floppy disk CD ROM	D0 D1 D0 D1			
WinREG-DP without modem link update 3 1/2" floppy disk CD ROM	D0 D1			
WinREG-DP with modem link update 3 1/2" floppy disk CD ROM	D0 D1			
WinREG-DP update for WinREG (Voltage Regulator REG-D) update 3 1/2" floppy disk CD ROM	D0 D1			
female connector 1 (acc. DIN41612 Type F) for fast-on connection				
female connector 1 (acc. DIN41612 Type F) for wire-wrap connection				
female connector 2 (for currents with leading contacts)				
female connector 3 (acc. DIN41612 Type MH: F24+H7) for fast-on connection				
female connector 3 (acc. DIN41612 Type MH: F24+H7) for wire-wrap connection				
panel plate 7 TE				
panel plate 8 TE				
panel plate 14 TE				
panel plate 28 TE				
cable for PC connection				
cable for printer connection				
cable for modem connection				
set of fuses T2 L 250 V				
coupler for optical fiber link				
radio controlled clock				
modem				
analog input modul (2 inputs)				
analog output modul (2 outputs)				
E-LAN triple star coupler with booster				
E-LAN PC adapter with booster				
E-LAN PC adapter as triple star coupler with booster				
E-LAN booster (wide aerea network)				