REGSys

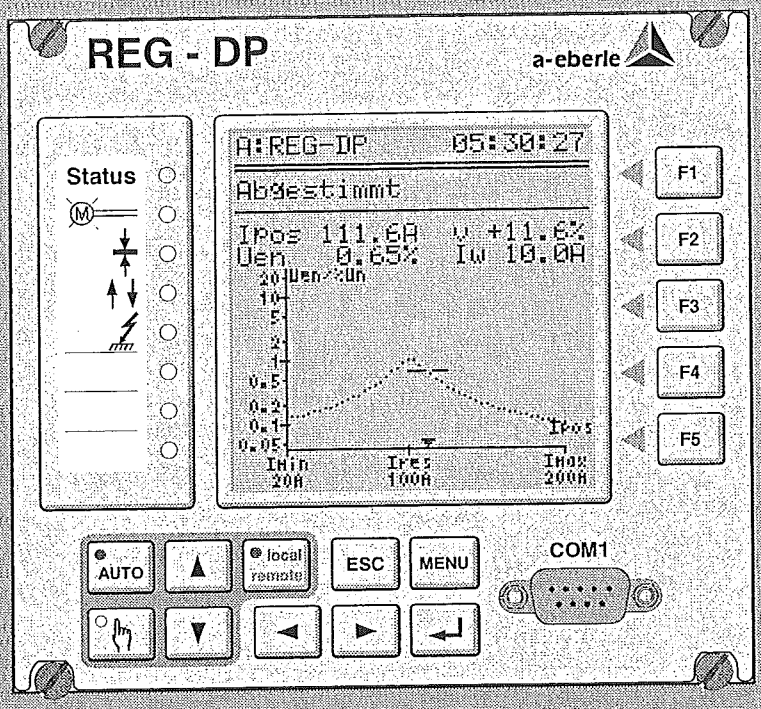
Operating Manual

Issue: 07.01.2002
Version: 2.1.02

Petersen - Coils

Regulator
REG - DP

delivered
Software - Version:



Operating manual

Version 07.01.2002

Edited by:

a.eberle gmbh

Aalener Straße 30/32
D-90441 Nürnberg

Tel.: 0911 / 62 81 08 - 0
Fax: 0911 / 66 66 64

e-mail: info@a-eberle.de
Internet: www.a-eberle.de

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Mapping list

1 Warnings and Notes

The P-coil regulator REG- DP is exclusively designed for installations and equipment of the electrical engineering in which only trained experts are permitted to do all required works. Experts are persons who are familiar with the installation, mounting, putting into operation and the operation of products of this kind. Furthermore experts have qualifications which comply with their field of work.

The P-coil regulator REG-DP has been built and tested in accordance with all important electrical safety regulations and left the factory in perfect condition. To maintain this condition and to ensure safe operation, the following instructions and warnings in this Operating Manual must be observed.

- The P-coil regulator REG-DP has been built in compliance with IEC 10110 / EN61010 (DIN VDE 0411), accuracy class I and checked on this norm before delivery.

- The P-coil regulator REG-DP must not be operated with but with a connected non-fused earthed conductor. This condition is complied with the connection to an auxiliary voltage line system with a non-fused earthed conductor (European net). Should the auxiliary voltage line system have no non-fused earthed conductor, an additional connection from the earth-conducting terminal to the earth must be made.

- The upper limit of the admissible auxiliary voltage U_{AUX} must not be exceeded neither permanently nor for a short while.

- Before changing the fuse separate the P-coil regulator REG - DP completely from the auxiliary voltage U_{AUX}. Any use of orr fuses than those being of the indicated type and current intensity is prohibited.

- A P-coil regulator REG - DP, which shows a visible damage or a clear malfunction must not be used and has to be secured against unintentional on-switching.

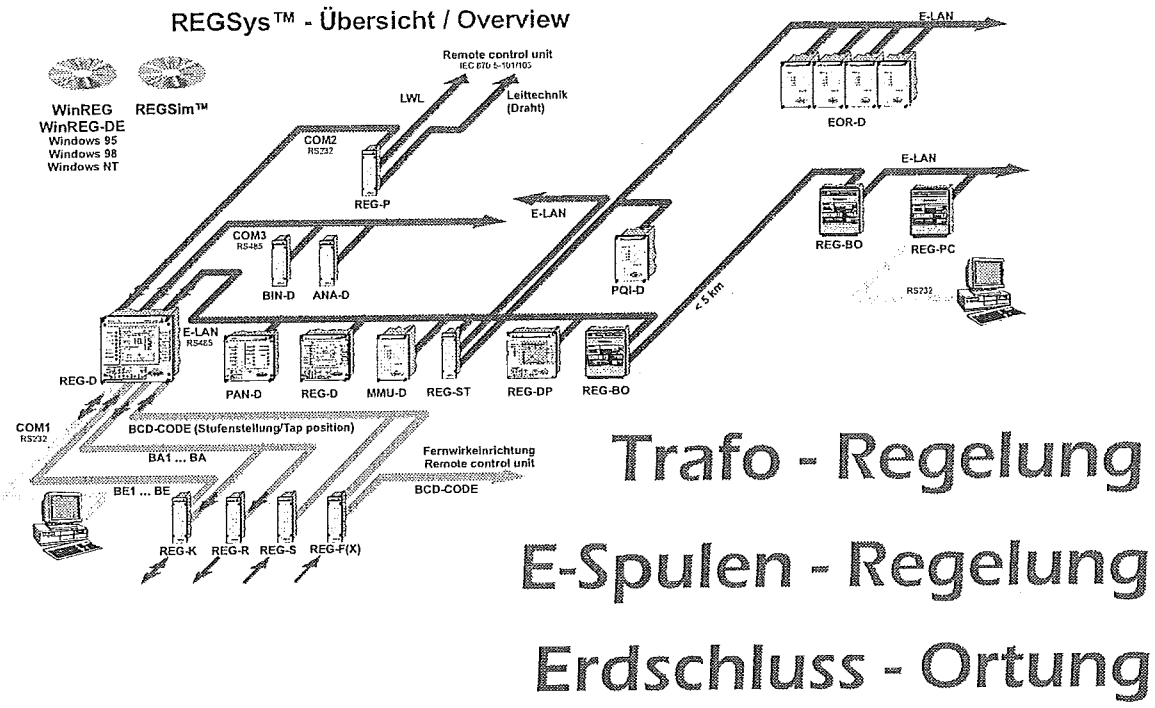
- Adjustments, maintenance and repair works which are made when the lines of P-coil regulator REG - DP are laid bare may only be made by authorized experts.

2 Delivery contents

1 Piece	P-coil regulator REG - DP
1 Piece	Operation manual in German, English or another language

3 Application

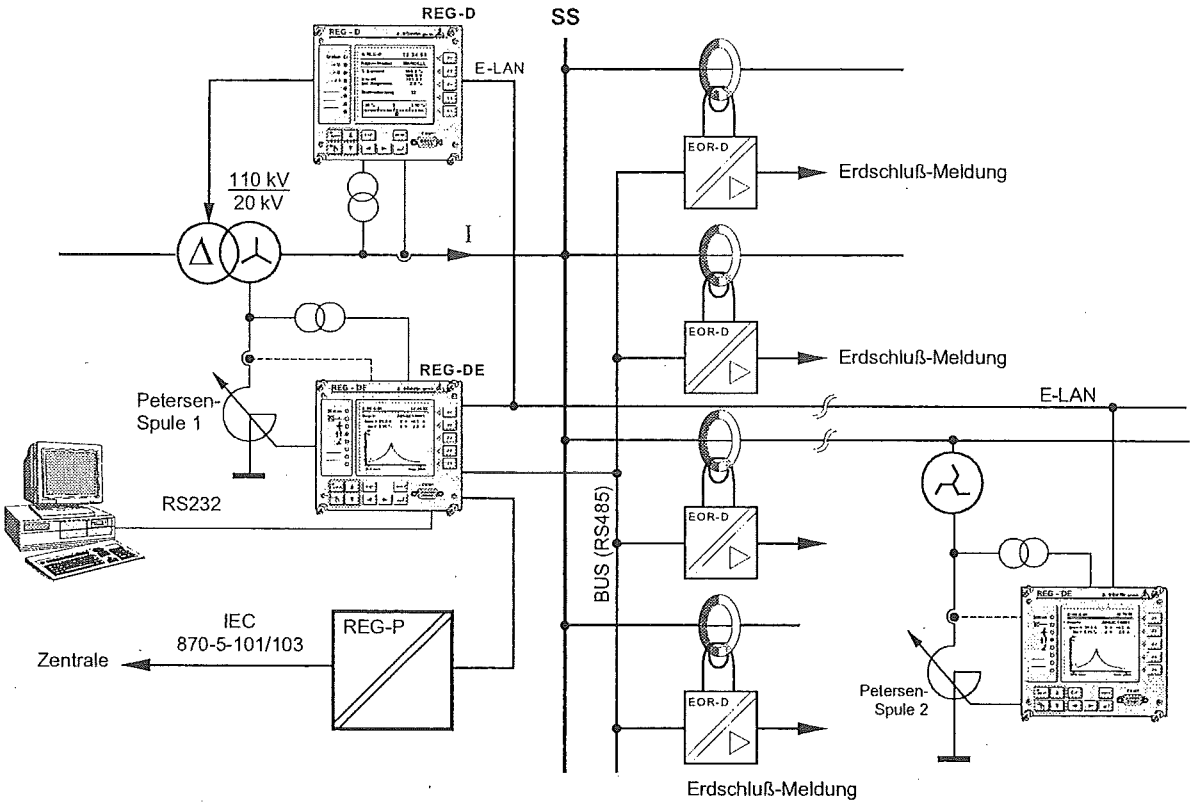
The P-coil regulator REG-DP is a component of the Measuring, Control, Regulation and Registration system REGSys™.



map 3.1: REGSys™

The P-coil regulator is used for the regulation of Petersen-Coils in medium and high-voltage systems. (Orr descriptions for the Petersen Coil: P-Coils, Earth fault-neutralizer, arc suppression coil, arc neutralization coil, E-Coils). By means of the P-coil regulator, a tuning of the P-Coils may be made already in the sound network. This tuning is made in a way that the currents which might override the fault location in case of an earth fault are as low as possible.

In a system structure by bus based on the RS485A, a P-coil regulator may be operated together with a voltage regulator REG-D, a supervisory unit PAN-D, an earth fault locating system EOR-Sys, a multi - transducer MMU-D, or the Power-Quality-Interface PQI-D.



Map 3.2: Principle of the automation island

All measuring values and binary inputs and outputs are defined as data objects, the access of which is possible from any device in this network, provided that the device address is indicated. By means of the backgroand programming, even complex control tasks may be resolved easily.

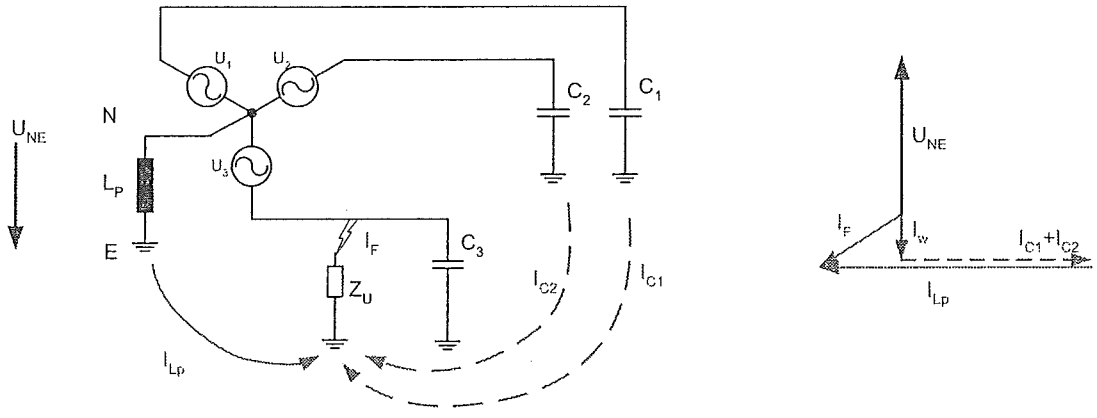
The module REG-P, which is available either as internal or external unit, permits a serial link to a higher-levelled control and instrumentation technology.

Furthermore, it is possible to solve all measuring, control and registrating tasks aroand the P-Coils through the free programmability of the regulator.

4 The Regulation

4.1 Principle of the earth-fault neutralizer

The earth-fault neutralizer is based on the principle, that the P-Coil is set in a way that the capacitive current overriding the fault location is being compensated by an inductive current of the same quantity. Thus, in case of an ideal compensation, only a little ohmic residual ohmic current is overriding the fault location.

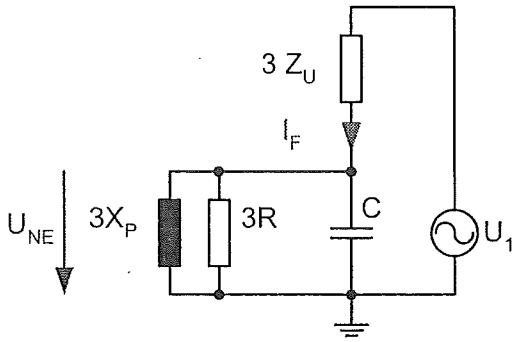


Map 4.1: Principle of the earth-fault neutralizer

L_P	Inductivity of the P-Coils (Petersen Coil)
C_1, C_2, C_3	Capacities of the single conductors to the earth
N	Neutral point of the transformers
E	Earth
U_1, U_2, U_3	Phase-to-neutral voltages
U_{NE}	Offset voltage
I_{C1}, I_{C2}	Capacitive currents of the two sound phases
I_{LP}	Inductive current through the earth-fault coil (compensation current)
I_W	Active component of the fault current
I_F	Current over the fault location

4.2 A closer look onto the zero phase-sequence system

When using the "Symmetric components", the following simple equivalent circuit diagram (system analyzer) may be given for the Zero phase-sequence system:



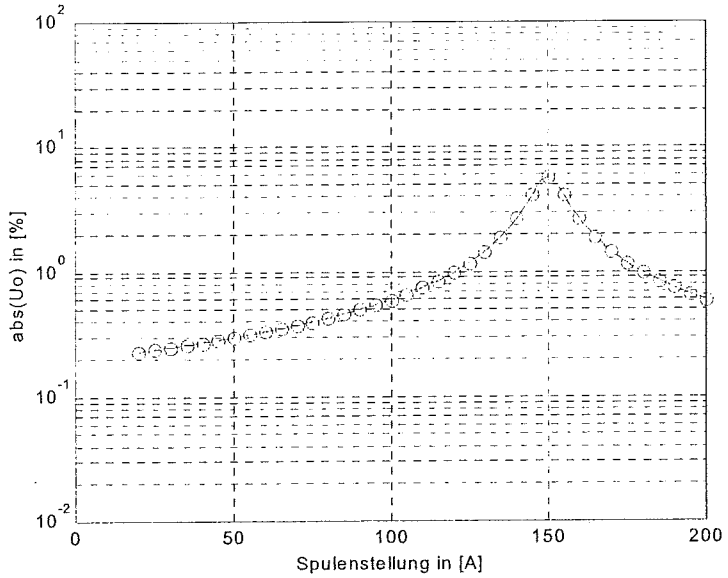
Map 4.2: One- phase equivalent circuit of the Zero phase-sequence system (system analyzer)

U_1	Phase-to-neutral voltage = interlinked voltage / √3
Z_U	Unbalance impedance of the system; mainly caused by the capacitive unbalance ΔC against earth
C	Medium equivalent capacity of the three conductors against earth
X_P	Inductivity of the Petersen Coil
R	Ohmic losses in the system

This simplified equivalent circuit applies as well for the case of an earth-fault, as also for the sound system operation.

In the **sound system operation,** Z_U is essentially determined by the capacitive unbalance of the single conductors against earth. In the usual systems, the conductor-earth capacities are approximately equal so that the unbalance ΔC is very tiny. This, however, means that the unbalance impedance Zu = 1/ ωΔC becomes very big. Taking a look at the voltage divithe shown in *map 4.2*, the user recognizes that the offset voltage U_{NE} in the resonance point (The reactive components of X_P and X_C = 1/ωC offset each orr) becomes very low.

In the resonance point through the Petersen coil there is a reactive current of the same quantity as of the equivalent conductor capacity against earth, but with reversed signs. As soon as the Petersen coil is being changed, an inductive or capacitive reactive resistance will be effective parallely to the active resistance. By this parallel-switching, the impedance in the lower part of the voltage divithe becomes lower and thus, the measurable voltage U_{NE} becomes lower as well. Therefore, the user gets the following process, depending on the coil position for the offset voltage:

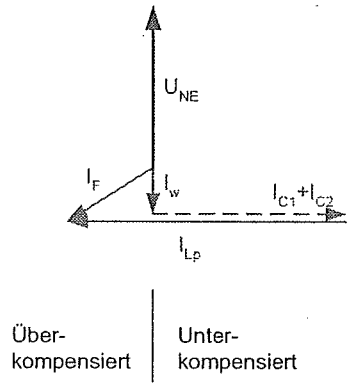


Map 4.3: Offset voltage U_{NE} depending on the coil position (resonance wave)

In the **case of an earth fault,** the unbalance Z_U mainly is determined through the transition resistance of the fault location resp. through the resistance of the 'burning' arc.
This unbalance Z_U may be in the range of some Ohm (dead earth-fault) up to some kOhm (high-ohmic earth fault).

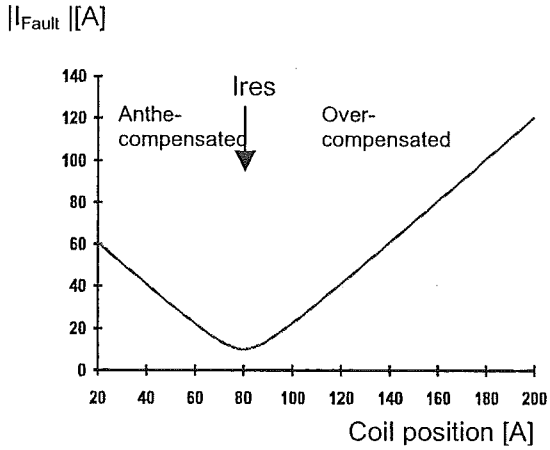
In case of a **dead earth fault,** the unbalance impedance Z_U becomes very low. Thus, the offset voltage U_{NE} becomes more or less independent from the setting of the P-Coil roughly equalling the feeding voltage E_1. The current I_F overriding the fault location is composed of the active current over the resistance R and of the resulting reactive current over the two reactive resistances. In the resonance point, both reactive currents are of the same quantity but opposite, so that there is no reactive current overriding the fault location in this case. Depending on the setting of the P-Coil, there is, additionally to the active current, an inductive reactive current in the case of an overcompensation and a capacitive reactive current in the case of an anthecompensation. The active current I_W and the resulting reactive current add each orr geometrically to the fault current I_F over the fault location (see *Map 4.4*) .

In the following map, the pointer display in the complex level for a overcompensated coil setting is shown. It is easy to recognize that in this case there is an inductive current over the fault location in addition to the active current.



Map 4.4: Pointer display of the fault current for a P-Coil setting

If only the "sum of the current" over the fault location depending on the set coil position is regarded, the waveform shown in *Map 4.5* is resulting. This depiction often is defined as "V-Wave".



Map 4.5: Sum of the fault current depending on the P-Coil setting (V-Wave)

The quantity of the reactive current over the fault location, e.g. the detuning v may be calculated either as "absolute value" or as "relative value". The following equations are describing both of these ways of calculation:

Detuning in [A]: $$v[A] = Ipos[A] - Ires[A] \qquad (4.1)$$

Detuning in [%]: $$v[\%] = \frac{Ipos[A] - Ires[A]}{Ires[A]} * 100 \qquad (4.2)$$

In both equations, **positive** values define an "overcompensation" and **negative** values an anthe-compensation. A value of **zero** corresponds to a tuning to resonance.

Example:

Resonance current of the system : Ires = 150 A
(this corresponds to the capacitive current over C in case of a dead earth fault):

Present setting of the P-Coils: Ipos = 160 A

The ***absolute detuning*** thus is calculated to:

$v = 160 - 150 = +10A$ (=> 10A overcompensation)

and the ***relative detuning*** is calculated as follows:

$$v = \frac{160 - 150}{150} * 100 = 6{,}66\%$$

Advantages of the input of an absolute detuning:

The regulator sets the reactive current overriding the fault location in a way that it is always equal. The reactive current is equal for small and for big systems. Furthermore, no fix coils (resp. firm coils) installd in the same quenching district have to be consitheed. The result is a clear statement on how big the expected reactive current over the fault location will be as soon as the regulator has successfully finished the tuning procedure and the earth fault has been made.

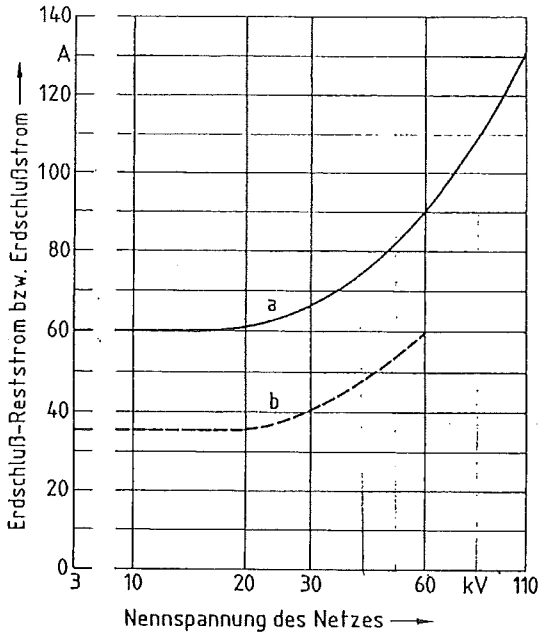
When indicating the values for the detuning in per cent, the reactive current becomes *dependant* on the system size (Ires). In this case, there must be the consitheation of a fixcoil which possibly is located in the system. Defining the present values of the fixcoil(s), resp. which and how many fixcoils are momentarily active in the system, mostly is very difficult to detect. It is even more difficult to steadily re-set the regulator to this present sum value of the fixcoils.

In case of a detuning in per cent, the expected reactive current I_V in [A] over the fault location is calculated according to the following formula:

$$I_v = \frac{(I_{res} + I_{fix}) * v}{100} \qquad (4.3)$$

Iv	Detuning current (Reactive current) in [A]
Ires	Current through the settable P-Coils in the resonance point. Ires corresponds to the capacitive current of the system when earth fault
Ifix	Current of an additionnally switched fixcoil in the system
v	Detuning in [%]

With a compensation in per cent, very big systems are endangered that the recommended value for the neutralization limit acc. to VDE 228 Part 2 may be exceeded (bis 20 kV: 60A, when 110kV approx. 120 A).



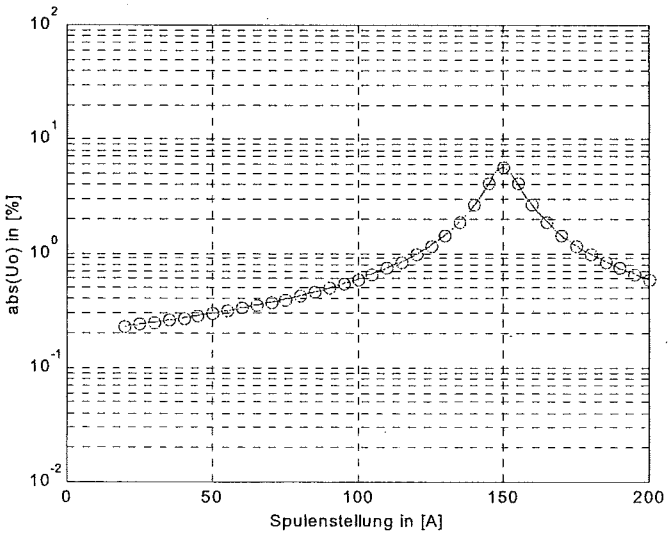
Map 4.6: Neutralization limits according to VDE228, Part 2

Wave a: Neutralization limit for earth fault-residual ohmic current for systems with earth fault-compensation. This wave also applies for cable systems up to 20 kV nominal voltage with small open line component even with isolated neutral point.
Wave b: systems with isolated neutral point.

The expected contact voltage in the case of an earth fault should be taken into consitheation according to the DIN VDE 0101 as a further criteria for selecting the compensation.

4.3 Principle of the regulation

The regulation of the Petersen coil is made during the sound system status through the evaluation of the resonance wave.



Map 4.7: Resonance wave

As already mentioned above, the single-poly equivalent circuit diagram applies as well for the sound system status, as also for the earth-faulted system status.

A switching in the system corresponds to a change of the conductor capacity against earth. Through this change, the complex voltage divithe and thus the corresponding measurable offset voltage are changed as already described above. This is mainly a shift of the resonance wave to the left (switching-off the conductor capacities) or to the right (additional switching of conductor capacities). In most cases, this is also linked with a change of the capacitive unbalance ΔC. The switching of the system changes the offset voltage. This change is used for the recognition of a switching operation in the system and is the beginning of a tuning process.

Since the regulator does not know immediately if the system was enlargened or made smallr, the search for the resonance maximum in direction of a neutral position defined by the menu will be started. This neutral position itself has been defined in a way that the P-coil will be set to this value, in case of the regulator being unable for some reason to make a successful tuning. This neutral position is used to be selected to describe the most usual switching status of the system. Thus, it is most probable to find the resonance maximum with a search into this direction.

After a little setting of the Petersen-Coil by approx. 1,5 % of the maximum setting range, the grathent will be checked. If an incrementing offset voltage is recognized, then, the P-coil will be set by at least 5 % of the setting range. If no increase in the offset voltage is recognized, the search direction will be reversed.

During this setting, as well the offset voltage U_{NE} as also the corresponding coil position Ipos are measured and saved. By means of a "Non-linear Least Square Procedure", the regulator tries to lay a resonance wave over these measuring points. The estimated evaluation will be improved by each additional measuring point. The evaluation will measure best if the resonance point has been overridden at least once.

As soon as the regulator has accepted the resonance point, the requested final position will be calculated according to the requested over- or anthecompensation and to the kind of compensation (absolute or in per cent). Then, the regulator directly goes to the final position.

After having reached the final position, the offset voltage and the coil position will be measured. By means of the measured coil position, a requested-offset voltage is measured from the estimated wave. This requested-offset voltage is compared to the measured one. If this offset voltage is within the trigger treshold, the tuning procedure will be regarded as successful and finished. The presently measured offset voltage now is used as the new reference value for the recognition of new switching operations. If the measured offset voltage is beyond the trigger treshold, it will be assumed that a switching operation has been made during the regulation and a new tuning procedure will be started immediately.

The resonance wave may be described completely by three parameters:

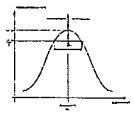
Ires	Capacitive current of the system.
Ures	Offset voltage U_{NE} in the resonance point
Iw	Active current Iw through R when dead earth fault

Resulting from this, the attenuation d of the system may be calculated:

$$d = \frac{Iw}{Ires}$$

By means of these three parameters, the single-poly equivalent circuit diagram of the Zero phase-sequence system may be calculated corresponding to *Map 4.2* .

The attenuation d is a measuring quantity for the grathent of the resonance wave. Waves with a big attenuation are flat and essentially caused by big losses in the system. Flat waves are therefore mainly in open line systems. Contrarily, waves with a small attenuation are mostly used in cable systems.



Map 4.8: Parameter to the description of the resonance wave

The measuring of the active current may approximately effect according to the equivalent circuit diagram as follows:

At first, the P-Coil is tuned to resonance. Then the Petersen Coil is set until the offset voltage U_{NE} sinks to the value $1/\sqrt{2}$. The sum of the difference of Ires to the present coil position corresponds to the active current I_W.

$$\left|I_w\right| = \left|I_{res} - I_{ist\_0.7Ures}\right| \qquad (4.4)$$

The reason may quite easily be shown by means of the single-poly equivalent circuit diagram. In case of resonance, the reactive resistance in the lower part of the voltage divithe is $X = X_C - X_{LP} = 0$. Only the active component R is efficient. If, due to the detuning, there is a parallel-switching between this resistance and a reactive resistance of the same quantity, the sum of the current I_W will, due to the resistance, be approximately the same as the sum of the reactive current through the sum-reactive resistance X. The resulting sum of the impedance of the parallel-switching of R and X has been decremented to the value $R/\sqrt{2}$. Therefore, the offset voltage U_{NE} also decreases to the value $Ures/\sqrt{2}$.

5 Technical Characteristics

5.1 Electrical Data

5.1.1 Rules and regulations

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 (z.Zt. Entwurf)
VDE0106 TEIL 100
DIN 40050

5.1.2 Alternating voltage input (U_{NE} and U_{12})

Offset voltage U_{NE}	0,1V ... 120V
Synchronisation U_{sync}	0,1V ... 230V
Wave form	Sinus
Frequency range	45....50....60....65 Hz
Power consumption	$\leq U_{nenn}^2$ / 20 kΩ
Overloadability	U_{nenn} *1,2

5.1.3 Alternating current input (I_1 and I_2)

Current range	1 A / 5 A (hardware- and software selectable)
Wave form	Sine
Frequency range	45....50....60....65 Hz
Power consumption	≤ 0,5 VA
Overloadability	10 A permanent 60 I_{nenn} for 1 s 30 I_{nenn} for 10 s 500 A for 5 ms

5.1.4 Position message (Ipos)

Measuring sensor	Potentio meter
Nominal values Rn of the Potentio meter	REG-DP: 150 Ω bis 3 kΩ (REG-DE: 0,2 kΩ, 0,5 kΩ, 1 kΩ, 3 kΩ)
Measuring voltage	ca. 5 VDC
Current source over jumper selectable (R_{ein} of the regulator)	1 mA (3 kOhm) 5 mA (600 Ohm) 10 mA (300 Ohm) 20 mA (150 Ohm)

Error message when interruption or short-circuit breaking of the sensor resp. when the voltage of the wiper outranges the measuring range.

5.1.5 20 mA – Analog outputs

Number	see order features
Output range (Y1...0...Y2)	-20 mA...0...20 mA, Y1 and Y2 are free programmable
potential separation	Optocoupler
Load range	$0 \leq R \leq 8$ V / Y2
Alternating part	< 0,5 % of Y2
Ripple	0,5 % referred to Y2

The output may either be permanently short-circuited or operated with openly.
The output connections are galvanically separated from all other circuits

5.1.6 Binary inputs

Inputs E1 ... E16

Input voltage	AC/DC 48 V...230 V
Wave form, admissible	Rectangular, Sine
H – Level	> 35 V
L – Level	< 25 V
Signal frequency fs	$DC \leq fs \leq 60$ Hz
Input resistance	≥ 47 kΩ
potential separation	Optocoupler; all inputs separated against each other separated

5.1.7 Relay outputs

Relay R1 ... R11, incl. Status

max. switching frequency	≤ 1 Hz
potential separation	Separeted from all device-intern potentials
Contact load	AC 250V,5A($\cos\varphi = 1{,}0$)
	AC 250 V, 3 A ($\cos\varphi = 0{,}4$)
	DC 220 V, 55 W (L/R = 0 ms)
	DC 110 V, 55 W (L/R = 0 ms)
	DC 60 V, 55 W (L/R = 0 ms)
	DC 30 V, 150 W (L/R = 0 ms)
Number of switches	$> 10^5$ electrical
Statusrelay	Relay as open or close (selectable by solder jumper)

5.1.8 Reference conditions

Ambient temperature	23°C ± 1 K
Inputs quantities	1 V, 5 V, 20 V, 100V
Auxiliary voltage	H = Hn ± 1 %
Frequency	50 Hz...60 Hz
Wave form	Sine, Form factor 1,1107
Load for analog output	Rn = 4 V / Y2 ± 1 %
Others	IEC 688 - part 1

5.1.9 Electrical safety

Protection class	I
Pollution level	2
Overvoltage category	II, III

III	II
Input circuits of the current and voltage transformer power supply	Control circuits(DC), Analog inputs, Analog outputs, ELAN's, COM's

Nominal insulation voltages

50V	230V
E-LAN, COM1 - COM3, Analog outputs	Voltage inputs, Current inputs, Power supply, Binary inputs (E1 ... E16), Relay outputs (R1 ...R11) incl. Status relay

5.1.10 Electromagnetical compability

This instrument corresponds to the requirements of the interference emission and the interference immunity according to test basics EN 55011: 1991, EN 50082-2: 1995

Interference emissions
according to EN 55011
Limit value class A Group 1

Interference immunity
Electrostatical discharges
according to EN 61000-4-2

Air discharge	8 kV
Contact discharge	4 kV

Electromagnetical Fields
according to ENV 50140, ENV 50204

80 MHz...1000 MHz	10 V / m
Radio frequency range	10 V / m
900 MHz ± 5 MHz	10 V / m
	puls moduled

Fast transient interference quantities (Bursts)
according to EN61000-4-4

Supply voltage	AC 230 V, 2 kV
Data lines	2 kV

Line-guided interference quantities
according to EN 50141

0,15 MHz...80 MHz	Ueff = 10 V
Radio frequency range	Ueff = 3 V

Magnetic fields according to EN 61000-4-8

50 Hz-Fields	30 A / m

Resistance to climatic changes

temperature range

Function (housing)	-10 °C...+50 °C
Function (Plug-in group)	-10 °C...+60 °C

Transport and storage -25 °C...+65 °C

5.1.11 Power supply

Feature	H1	H2
AC	85 ... 264 V	
DC	88 ... 280 V	18 .. 72 V
Power consumption	≤ 15 VA	≤15 VA
Frequency	50 Hz / 60 Hz	
Fuse	T2 250V	T2 250V

For all features applies:
Voltage breakdowns of ≤ 80 ms do not lead neither to a data loss nor to malfunctions.

5.1.12 Indication, Status

Indication, Display
LC - Display 128 x 128 with graphics capabilities

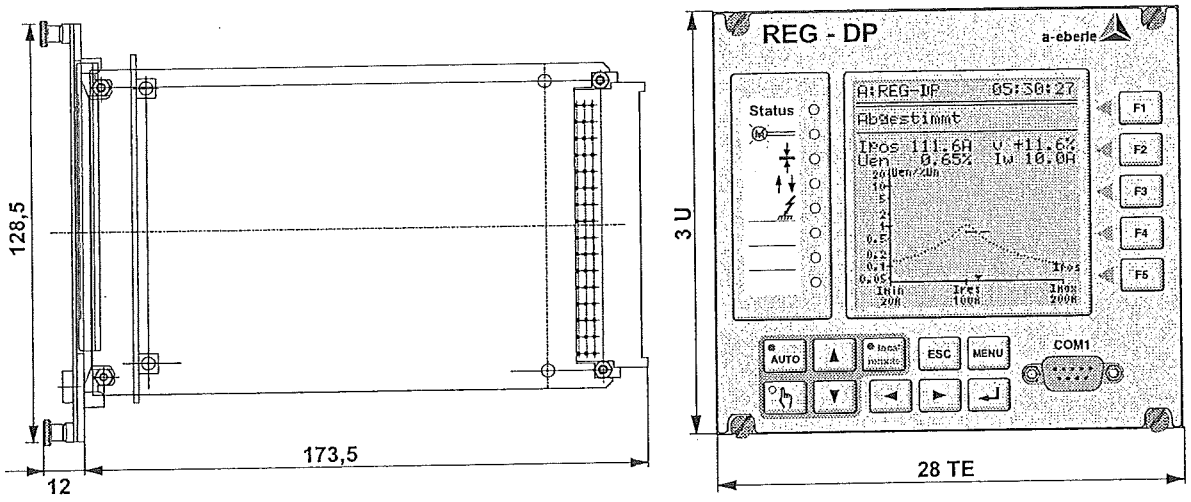
Function supervision (Status)
In each regulator, the battery, the marginal run of the processor (Watchdog) and the operation voltage are controlled.

Status indication LED - green

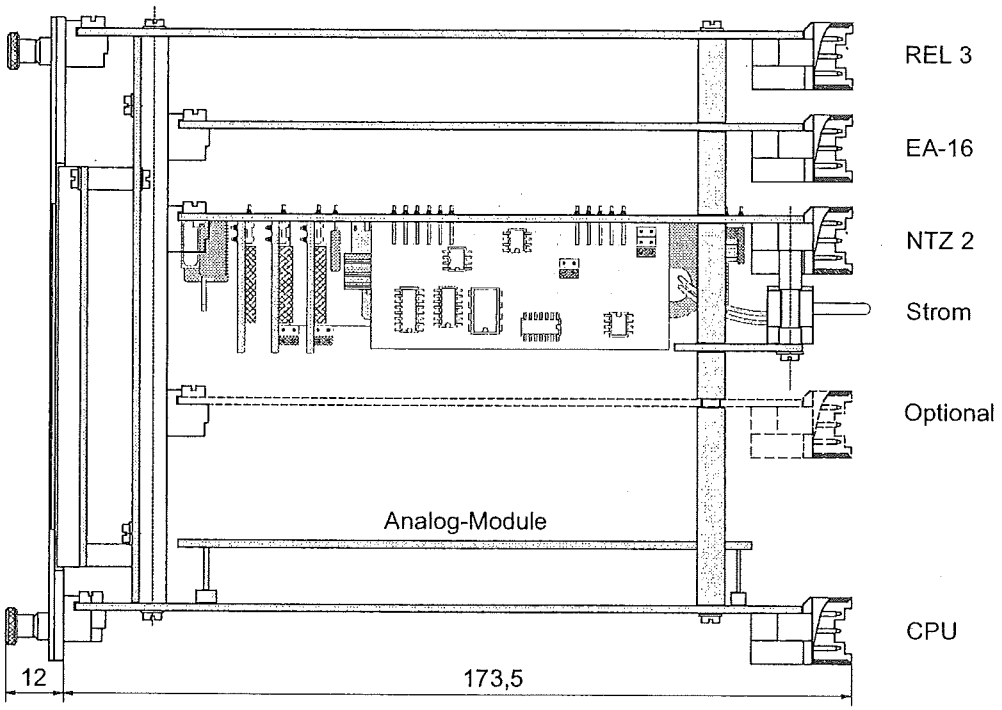
5.2 Mechanical Structure

5.2.1 Plug-in group

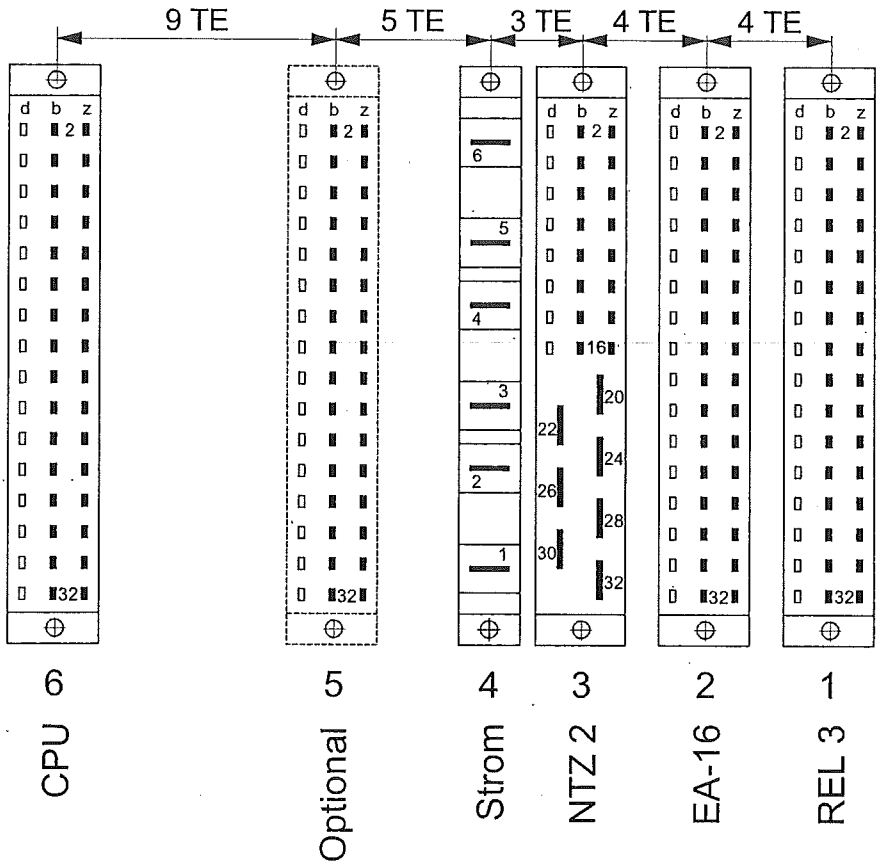
Front plate	Plastic foil on Alu-carrier, RAL 7035 lightgrey
Height	3 U (128,5 mm)
Width	28 TE (142,2 mm)
Weight	≤1,5 kg
Protection class	
Plug-in group	IP 00
Terminal block	IP 00
Mounting acc. to	according to DIN 41494 Teil 5
Connector	DIN 41612



Map 5.1: *Dimensions*



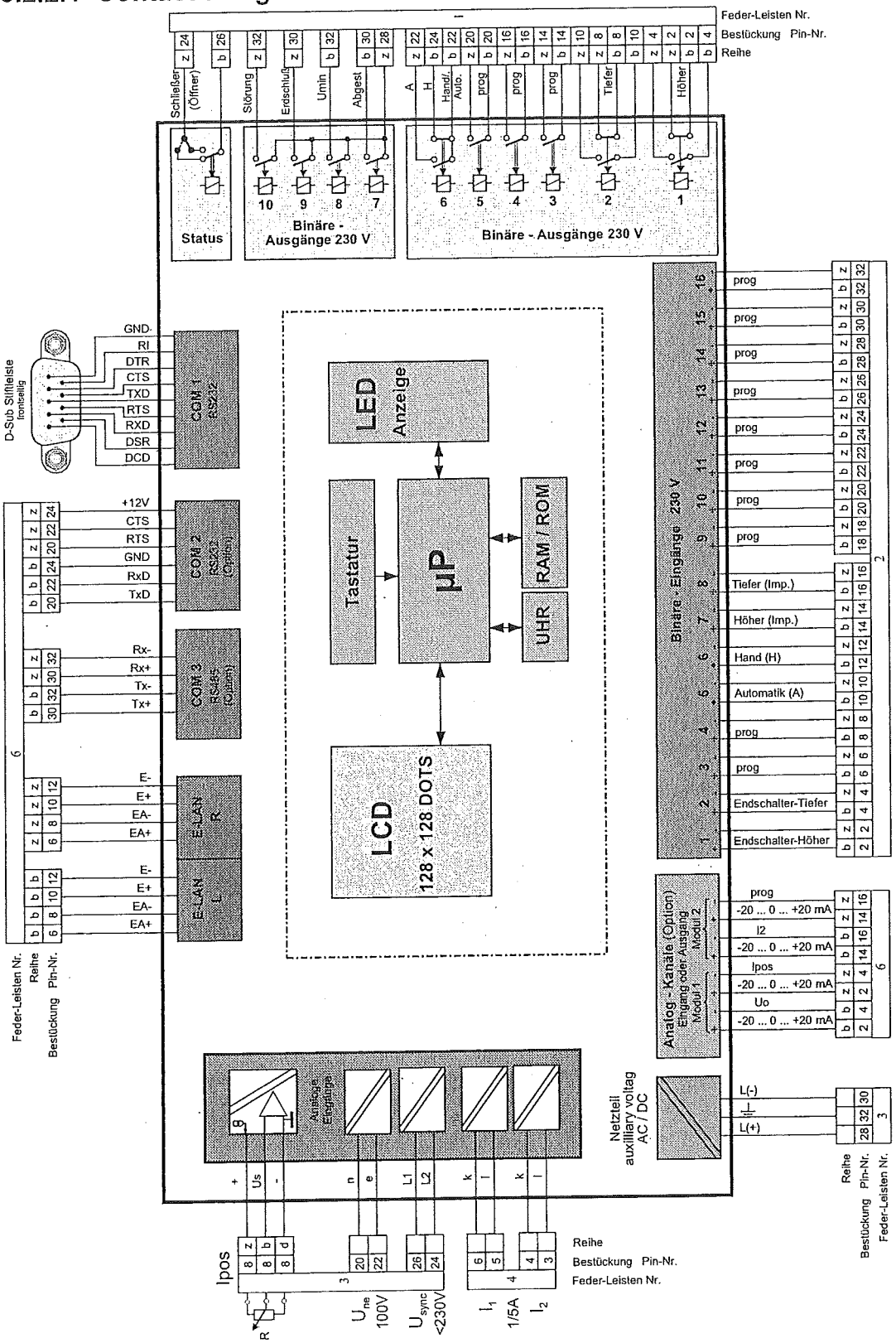
Map 5.2: Location of the circuit boards and plug connectors (View from above)



Map 5.3: Position of the terminal blocks (View from the rear)

5.2.2 Contact assignment of the Plug-in group

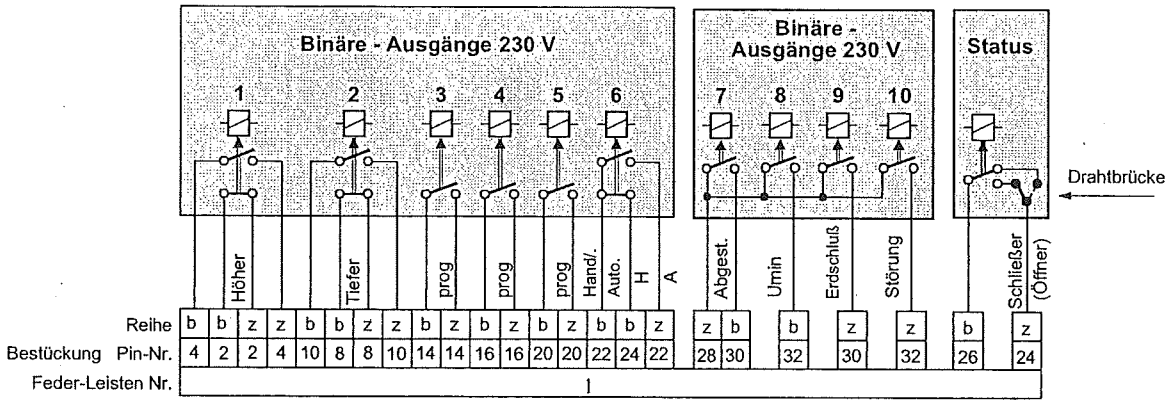
5.2.2.1 Contact assignment of the terminal blocks



Map 5.4: Contact assignment of the terminal blocks

5.2.2.2 Terminal block 1: Binary outputs REL

Funktion	Bez.	Belegung	Pin	Pin	Belegung
Höher (2 Kontaktpaare)	R1	Pol	b2	z2	Öffner
1 Öffner und 1 Schließer		Pol	b4	z4	Schließer
		--	b6	z6	--
Tiefer (2 Kontaktpaare)	R2	Pol	b8	z8	Öffner
1 Öffner und 1 Schließer		Pol	b10	z10	Schließer
		--	b12	z12	--
frei programmierbar	R3	Pol	b14	z14	Schließer
frei programmierbar	R4	Pol	b16	z16	Schließer
		--	b18	z18	--
frei programmierbar	R5	Pol	b20	z20	Schließer
HAND / AUTO	R6	Pol	b22	z22	Schließer
		Öffner	b24		
Status	Status			z24	Schließer
		Pol	b26	z26	--
frei programmierbare		--	b28	z28	Pol R7...R10
Ausgänge	R7/R9	Schließer R7	b30	z30	Schließer R9
	R8/R10	Schließer R8	b32	z32	Schließer R10



Map 5.5: Terminal block 1: Binary outputs R

The regulators are delivered with the above mentioned parameterization. The relays however are, up to the Status relay, free parameterizable through the software.

R1 ... R10: Status	Potential free relay contacts
loadability:	AC 250 V, 5A, cosφ = 1

Caution:

The binary output "Status" may be used either as „open" or as „close" by a corresponing order of a wire jumper. The position of the wire jumper is shown in map 5.6. ***The not used function (wire jumper) must disappear.***

In "sound status" of the regulator, the status-relay is excited, e.g. picked up. By means of the wire jumpers shown in *Map 5.6*, there will be the possibility to select if the contact will be opened or closed in case of a fault.

Status-Relay with function Open: In case of a fault, the contact is opened.
The relay-coil will not be excited if there is a disturbance. Via the wire jumper, the operating contact of the status relay will be chosen.

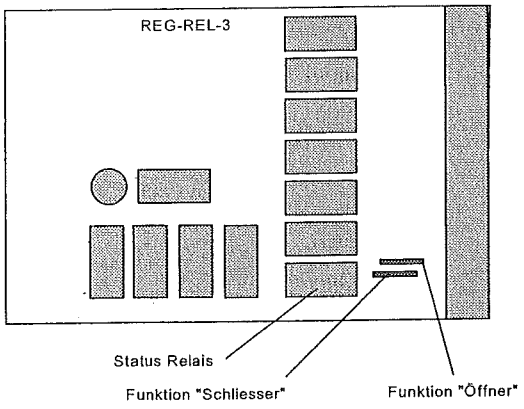
Note:
The message of the following faults will thus be sent also to the control and instrumentation technology:
- withdrawn plug-in module
- failure of the auxiliary voltage at the regulator
- regulator intern default

=> remove wire jumper for function Close, wire jumper for function Open remains.

Status-Relay with function Close: In case of a fault, the contact is closed.
The relay-coil will not be excited if there is a disturbance. Via the wire jumper, the resting contact of the status relay will be chosen.

Note:
No error message will be sent if plug-in module is withdrawn.

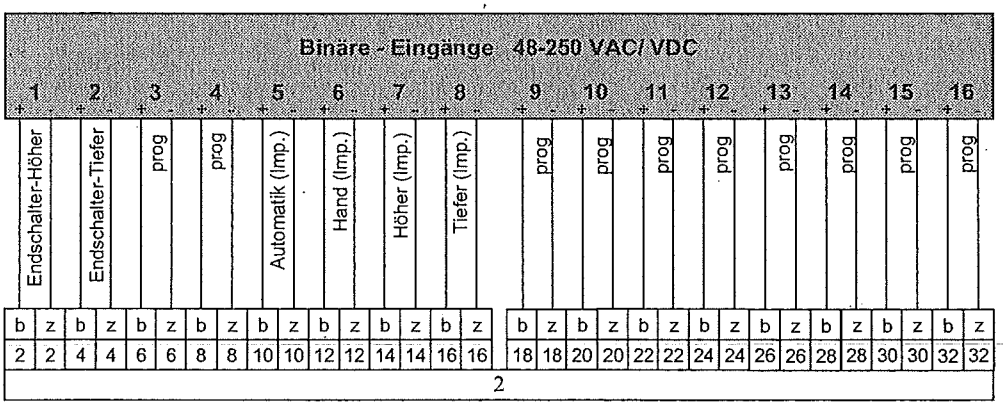
=> remove wire jumper for function Open, wire jumper for function Close remains.



Map 5.6: Position of the wire jumper on circuit board 1

5.2.2.3 Terminal block 2: Binary inputs E

Funktion	Bez.	Belegung	Pin	Pin	Belegung
Endschalter Höher	E1	+	b2	z2	-
Endschalter Tiefer	E2	+	b4	z4	-
frei programmierbar	E3	+	b6	z6	-
frei programmierbar	E4	+	b8	z8	-
AUTO (Impuls)	E5	+	b10	z10	-
HAND (Impuls)	E6	+	b12	z12	-
Motor Höher (Imp.)	E7	+	b14	z14	-
Motor Tiefer (Imp.)	E8	+	b16	z16	-
frei programmierbar	E9	+	b18	z18	-
frei programmierbar	E10	+	b20	z20	-
frei programmierbar	E11	+	b22	z22	-
frei programmierbar	E12	+	b24	z24	-
frei programmierbar	E13	+	b26	z26	-
frei programmierbar	E14	+	b28	z28	-
frei programmierbar	E15	+	b30	z30	-
frei programmierbar	E16	+	b32	z32	-

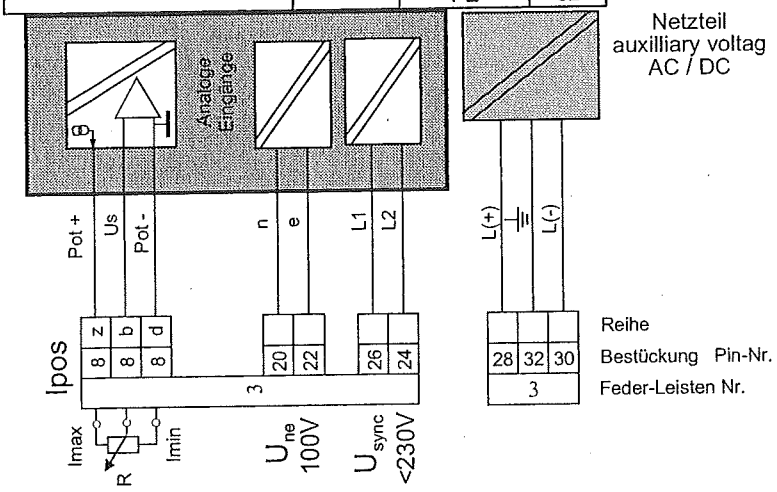


Map 5.7: Terminal block 2: Binary inputs E

Note:
All inputs E1 ... E16 are not available but in the 19" mounting frame.When using the 49 TE- wide wall-mounting rack (B02) resp. the 30 TE- wide panel-monting rack (B03), not all inputs are available which is due to the limited number of connection terminals.

5.2.2.4 Terminal block 3: Ipos , U_{en}, U_{Sync} and Auxiliary voltage

Funktion	Bez.	Belegung	Pin
Pot+ (Imax)	I_{pos}	Pot+	z8
Schleifer		Us	b8
Pot - (Imin)		Pot-	d8
Verlagerungsspannung	U_{ne}	n	20
		e	22
Referenzspannung	U_{Sync}	L1	24
		L2	26
Hilfsspannung	U_H	L (+)	28
(AC / DC)		L (-)	30
		PE	32

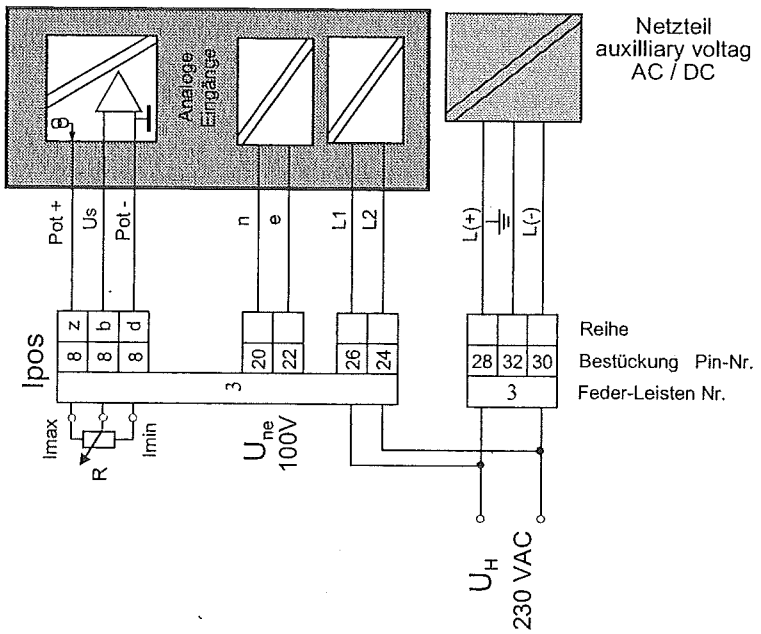


Map 5.8: Terminal block 3: Offset voltage Uen and Auxiliary voltage

The offset voltage Uen may be used up to a rating value of 110 V.

The synchronization voltage Usync is used as reference voltage to measure the phase angle as well for the offset voltage Uen as also for the currents I_1 and I_2. The quantities are used in some calculation procedures for the regulation. As synchronization voltage, there may serve for example the interlinked voltage U_{12}. Other voltages may also be used, however, they must at least be system synchrone and they must not be influenced by a one-poly earth fault. The input for the synchronization is made for a nominal voltage of a maximum of 230V AC; a voltage of 50 VAC, however, is already sufficient. The voltage is internally transformed into a rectangular signal, so that no special requirements will have to be fulfilled, apart from the demanded minimum value and the synchronity with 50 Hz voltage. An intern PLL-Switching (phase-locked loop) is synchronized by this synchronization voltage and interruptions of the synchronization voltage in the range of seconds have no effects, as for instance switching of the EB-Transformer to another busbar.

To reset the Petersen-coil, the Petersen-coil regulator mostly requires an auxiliary voltage of 230 V in the motor-drive box. If this voltage is missing, the regulator may not set the Petersen-coil. Thus, a supply of the regulator with this auxiliary voltage is normally sufficient. The data and parameters of the regulator are put in a buffer stock and do not get lost. This offers the possibility to use the auxiliary voltage as synchronization voltage. This is very favourable in case of an operation with several busbars because there will always be a synchronization voltage, independently from the switching status.

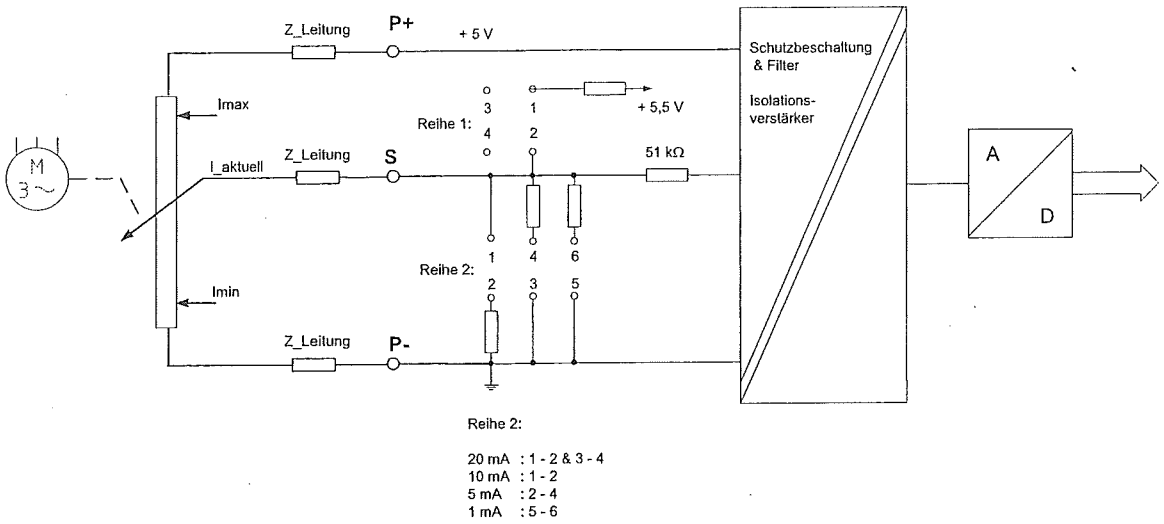


Map 5.9: Wiring proposal for Usync with the auxiliary voltage of 230 VAC

Caution:

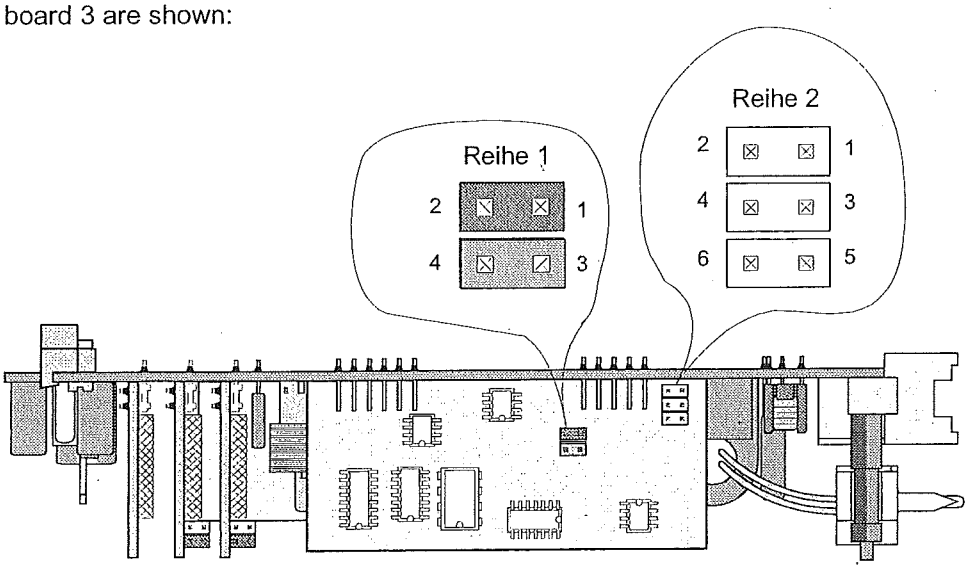
The wiring of the synchronization input with 230 VAC requires a suitable hardware version.
Necessary indication in the status-display of the regulator (key sequence: <Menu>,<F2>,<F5>,<F1>,<F5>):
Measuring-HW: NTZ2 /230V

The coil position of the Petersen-coil is measured by the voltage divider ratio of the potentio meter. The resistance-range of the potentio meter (terminal Pot+ / Pot-) may be in a range of 150 Ohm up to 3 kOhm. The linearization of the function coil position – inductivity effects with the putting into operation.



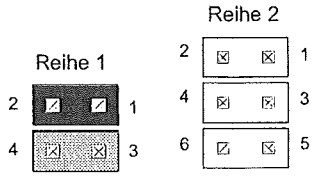
Map 5.10: Principal construction of the analog input for the coil position

In the following map, the corresponding positions of the jumpers on the subprint of the circuit board 3 are shown:

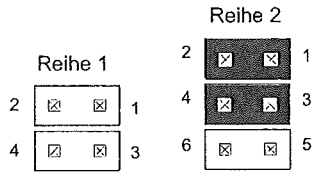


Map 5.11: Position of the jumpers for the coil position
Note:
In row 1, the position 3-4 is an empty position and may serve as carrier for reserve jumpers and will possibly be equipped (on the following maps: orange resp.lightgrey jumper).

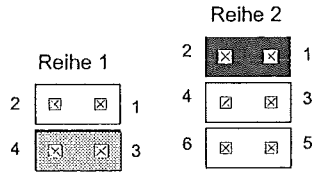
Potentiometer (180 Ohm .... 3 kOhm)



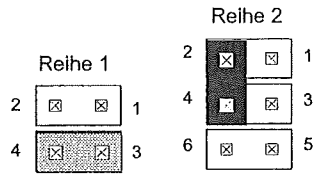
Stromquelle 20 mA



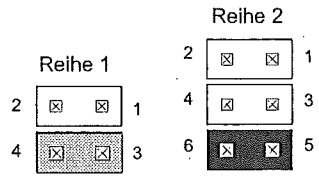
Stromquelle 10 mA



Stromquelle 5 mA

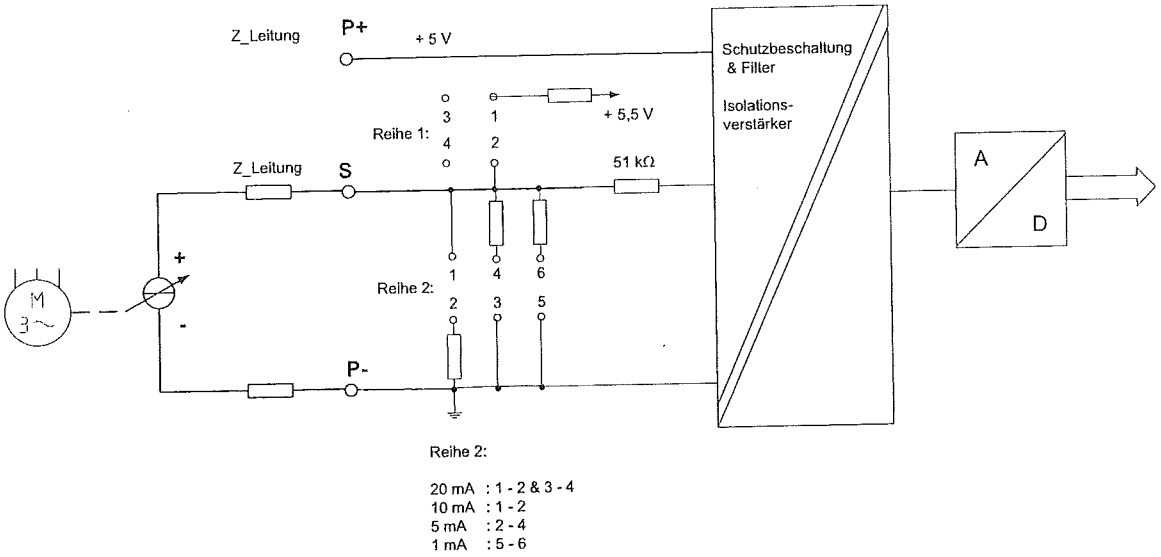


Stromquelle 1 mA

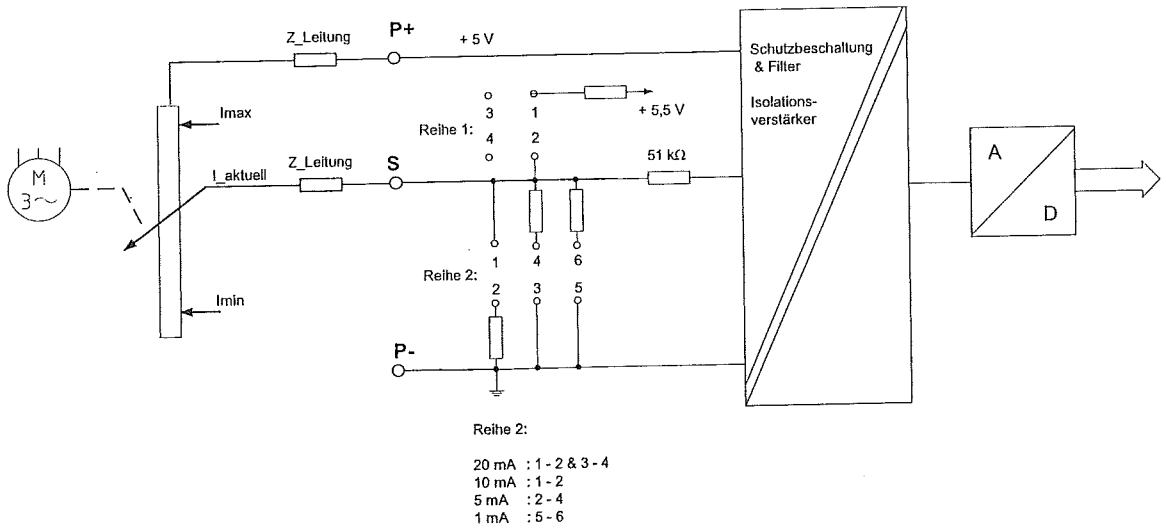


Map 5.12: Equipment of the jumpers depending on the input function

Note:
The usual delivery status of the jumpers for the position message is made by means of a potentio meter.



Map 5.13: Coil position by controlled current source



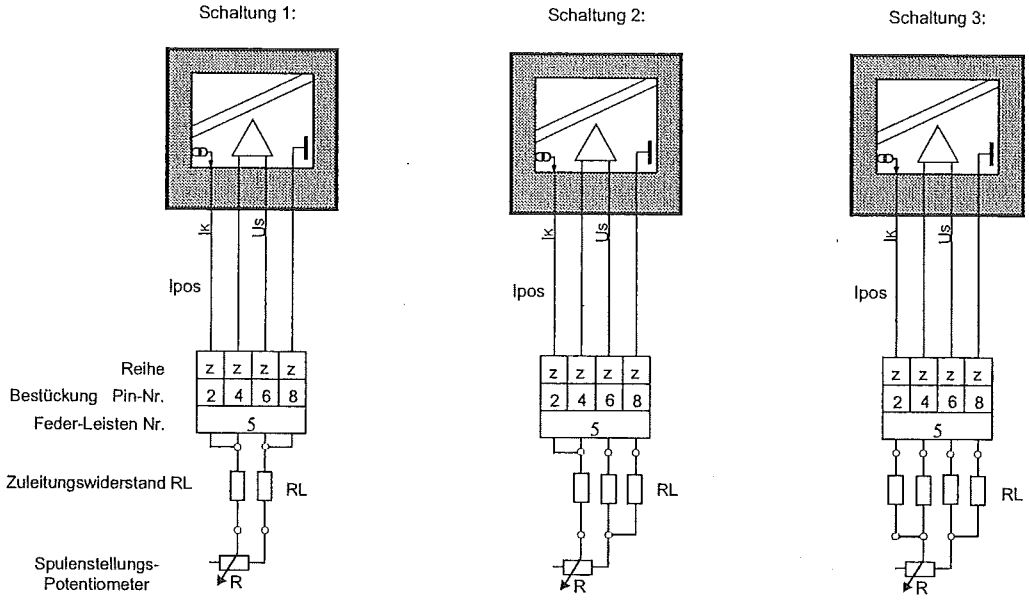
Map 5.14: Potentiometer of the coil position in two-line wiring

If the potentio meter of the coil position is not available but in two-line-link, the switching shown in *Map 5.14* may be used. In this case, the jumper 1-2 of row 1 must not be equipped. According to the maximum resistance value of the potentio meter, a jumper in row 2 must be set, considering the chart below and *Map 5.12*

Resistance range of the Potentio meter	**Equivalent current source mA**
0 ... 225 Ohm	20
0 ... 450 Ohm	10
0 ... 900 Ohm	5
0 ... 4500 Ohm	1

5.2.2.5 Terminal block 5: Coil position (only with REG-DE)

Function	Name	Assignment	Pin
Current source	Ipos	Ik	z2
Sensor +		Us +	z4
Sensor -		Us -	z6
Weight		GND	z8



Map 5.15: Terminal block 5: coil position Ipos

The current source is set to the external resistance by the software.
The maximum voltage of the current source is < 5V DC.

Depending on the available links to the E-Coil, one of the shown possibilities may be used.

Switching 1: (2 Phases measuring)
The line resistances from the regulator to the E-Coil are not compensated.
Setting at the regulator: **3-Phases**

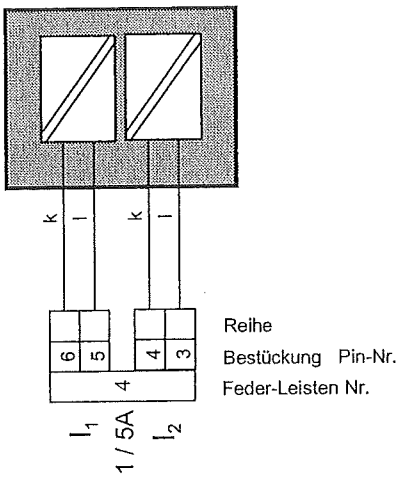
Switching 2: (3 Phases measuring)
Line resistances of the same quantity are compensated.
Setting at the regulator: **3-Phases**

Switching 3: (4 Phases measuring)
There is a complete compensation even from different feeder resistances from the regulator to the E-Coil.
Setting at the regulator: **4-Phases**

Note:
Since relatively big wire cross sections are usually used from the regulator up to the E-Coil and the resistance of the potentio meter is > 200 Ohm, Switching 1 is recommended.

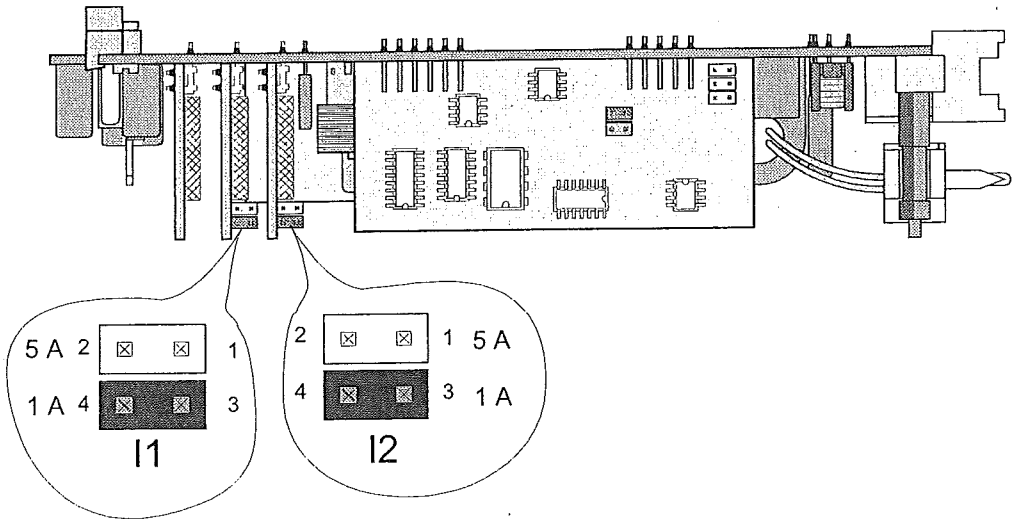
5.2.2.6 Terminal block 4: Current inputs, f.e. by the P-coil

Funktion	Bez.	Belegung	Pin
Spulenstrom (AC)	I_1	k	6
		l	5
Strom (AC)	I_2	k	4
		l	3



Map 5.16: Terminal block 4: Current I1 (f.e. Ip) and I2

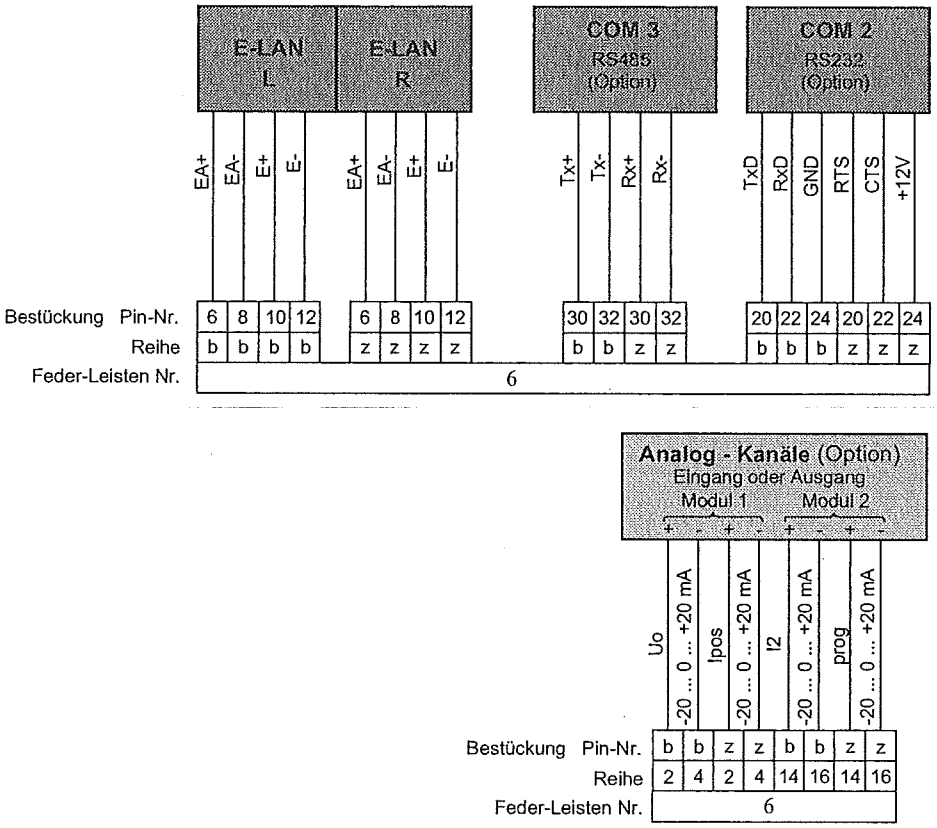
Note:
Before changing the current ranges, the jumpers on the circuit board of terminal block 3 must be re-plugged to the required range.



Map 5.17: Position of the jumpers for the current inputs I1 and I2

5.2.2.7 Terminal block 6: 20 mA Inputs / Outputs; COM1- 3

Funktion	Belegung	Pin	Pin	Belegung
20 mA Ausgabe (Modul 1) Verlagerungsspannung (1.1) Spulenstellung (1.2)	Uo+	b2	z2	Ipos +
	Uo-	b4	z4	Ipos -
E-LAN	links EA+	b6	z6	rechts EA +
	links EA -	b8	z8	rechts EA -
	links E +	b10	z10	rechts E +
	links E -	b12	z12	rechts E -
20 mA Ausgabe (Modul 2) Spulenstrom (2.1) frei (2.2)	Ip +	b14	z14	frei +
	Ip -	b16	z16	frei -
		b18	z18	
COM 2 (RS232)	TxD	b20	z20	RTS
	RxD	b22	z22	CTS
	GND	b24	z24	+12V
20 mA Ausgabe (Modul 3) Option frei (3.1) frei (3.2)	3.1 +	b26	z26	3.2 +
	3.1 -	b28	z28	3.2 -
COM3 (RS 485)	Tx +	b30	z30	Rx +
	Tx -	b32	z32	Rx -



Map 5.18: Terminal block 6: 20 mA Inputs / Outputs; COM1-3

Analog Input / Output-Channels

Two analog channels are available for each pluggable module. As a rule, the regulator is delivered with two modules which offers four analog output channels. From part of the factory, three channels are already plugged in with U_{en}, Ipos and Ip. However, their configuration may be changed at any time when they are put into operation.

The analog channels may be freely configurated by the menu or by means of WinREG-DP. This permits the realization of , for example, Knick-characteristics, characteristics for the range 4-20 mA, logarithmical or user specific characteristics.For details see chapter 8.2.4.5 Analog Inputs/Outputs

The current source works on a load up to a maximum voltage of ± 8V.

Interface COM 2 (optional)

The serial interface COM 2 and serves to couple a regulating system to a higher-levelled leading equipment. By means of this interface, there may be contacted for example the **REG-P** module which serves to link the REGSys using the IEC870-5-101 / 103 record.

Interface COM 3 (RS485) (optional)

By means of this interface, there may be additional switches in any required sequence, so that the inputs and outputs may be multiplied up to 15 interface components (BIN-D, ANA-D).

E - LAN (Energy - Local Area systemwork)

The E-LAN serves to linke a maximum of 255 E-LAN-participants (REG-DP, REG-D, MMU-D, PAN-D). All participants may intercommunicate but may also be center-controlled. (For selection and details please refer to the operating manual of WinREG-DP).

Features of the E-LAN

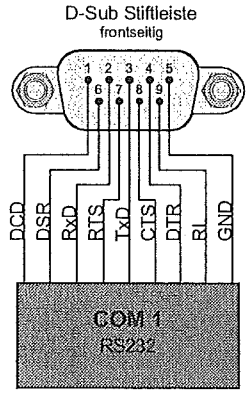
255 subscribers may be addressed
multimaster-structure
repeater function integrated
open ring, bus or combination of bus and ring
record based on SDLC/HDLC-frames
transmission rate 62,5 kbit/s resp. 115 kbit/s
telegramme length 10 ... 30 Byte
average throughput about 100 Telegramme/s

Configuration see "E - LAN (Energy - Local Area systemwork)" on page 147.

5.2.2.8 Serial Interface COM1

Function	Pin
DCD	1
Rx	2
Tx	3
DTR	4
GND	5
DSR	6
RTS	7
CTS	8
RI	9

The serial interface COM 1 is at the front of the regulator and serves to couple PC, Terminal or Modem

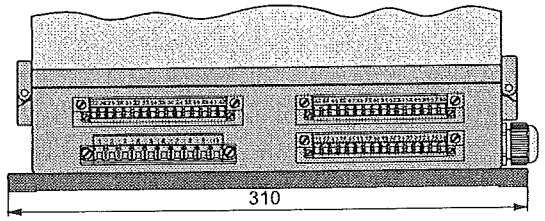


Map 5.19: Serial Interface COM1

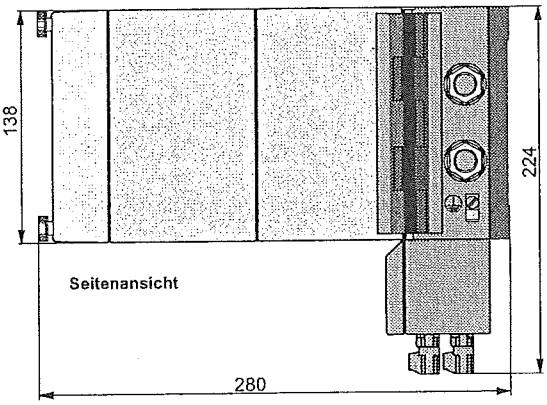
5.2.3 Wall-mounting rack 49TE

(TE ⇔ Rack-units: 1TE = 5,08 mm)

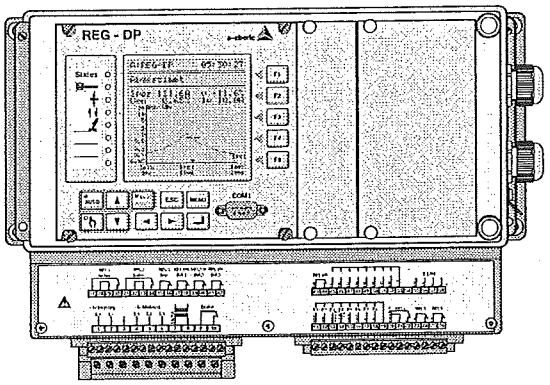
Material	Polycarbonate (UL 94 V-0)
Protection class	housing IP 65
Weight	≤ 1,5 kg
Dimensions	see below
connecting elements	screw terminals
cross section of the connecting lines	≤ 4,0 mm² one-wire stranded ≤ 2 x 2,5 mm² fine-wire stranded



Ansicht von unten



Seitenansicht



Frontansicht

Map 5.20: Wall-mounting rack 49TE

Caution

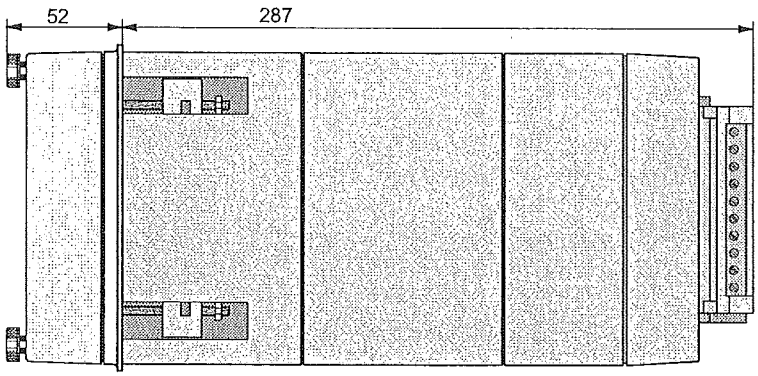
Wall-mounting rack must be grounded!
The corresponding connection is at the side of the regulator.

The earthing of the regulator is made by the screwed connectors of the front plate. The earthing will only be totally effective if the front plate is screwed-in.

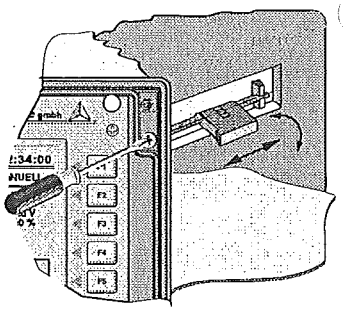
5.2.4 Panel-mounting rack 30TE

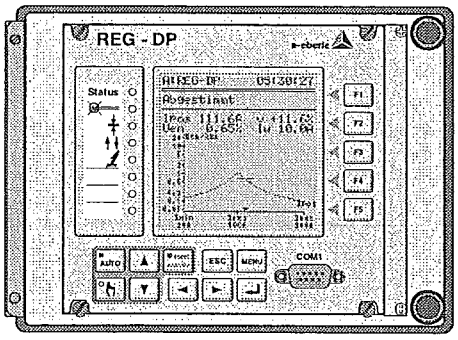
(TE ⇔ Rack-units: 1TE = 5,08 mm)

Material	Polycarbonate (UL 94 V-0)
Protection class	housing IP 65
Weight	≤ 1,5 kg
Dimensions	see map below
connecting elements	screw terminals
cross section the connecting lines	≤ 4,0 mm² one-wire stranded ≤ 2 x 2,5 mm² fine-wire stranded

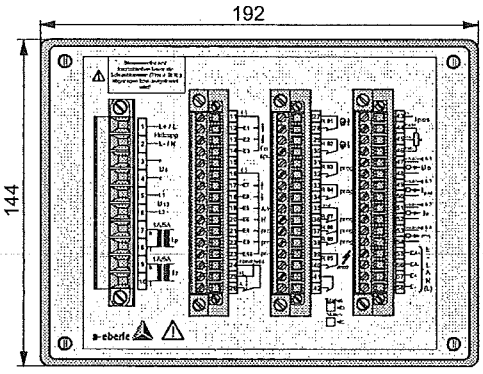


Seitenansicht





Frontansicht



Rückansicht

Schalttafelausschnitt:
184,5+0,2 mm x 138,3+0,2 mm

Map 5.21: Panel-mounting rack (30TE)

Caution

Panel-mounting rack must be grounded!
The corresponding connection is at the rear of the regulator.

The earthing of the regulator is made by the screwed connectors of the front plate. The earthing will only be totally effective if the front plate is screwed-in.

5.2.5 19 Inch Plug-in group rack

Caution

Plug-in group rack must be grounded!

The earthing of the regulator is made by the screwed connectors of the front plate. The earthing will only be totally effective if the front plate is screwed-in.

Caution

Plug-in group rack must be grounded !
The earthing of the regulator is made by the screwed connectors of the front plate. The earthing will only be totally effective if the front plate is screwed-in.

Each plug-in group rack is provided with space for 84 units and thus for 84 place numbers "n". Each single place number is the point of reference for the mounting of the aligning plugs and the connection elements at the rear of the rack.

Terminal block	1	2	3	4	5	6
Screws	n	n+4	n+8	N+11	n+16	n+25
Aligning plugs	n	-	-	-	-	n+26

5.2.5.1 Plug-in group rack with Phoenix-terminals

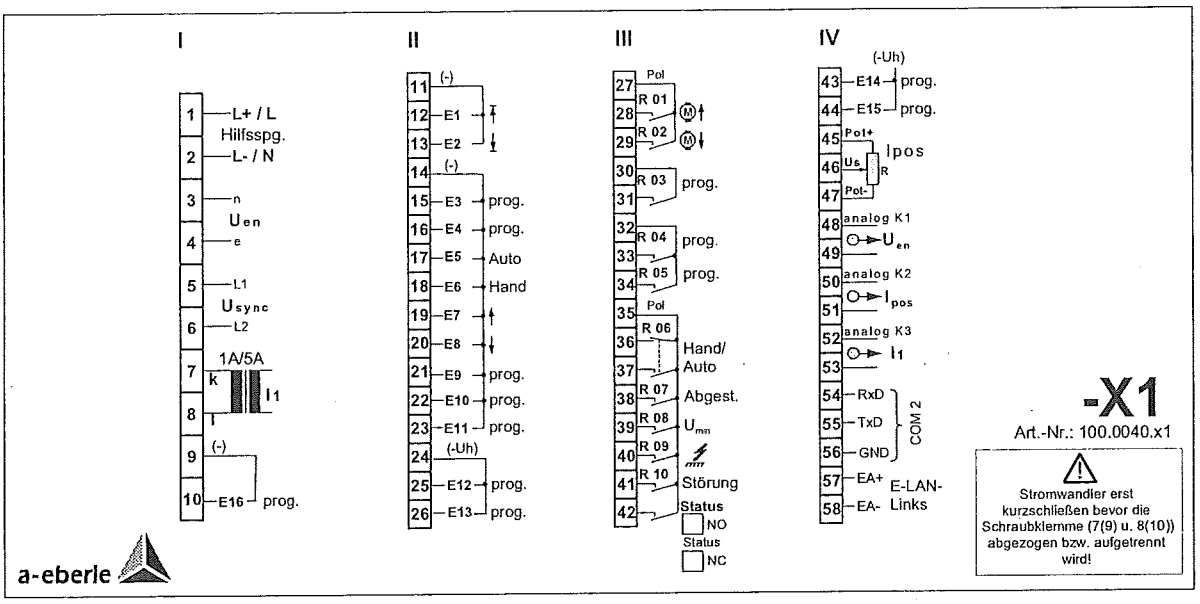
Map 5.22: Example for 19" Plug-in group rack with Phönix terminals

5.2.5.2 Plug-in group rack with screw terminals

Map 5.23: Example for 19" Plug-in group rack with screw terminals

5.2.6 Standard assignment for Phoenix-terminals

(Typ 30TE, 49TE and Plug-in group rack with Phoenix-terminals)

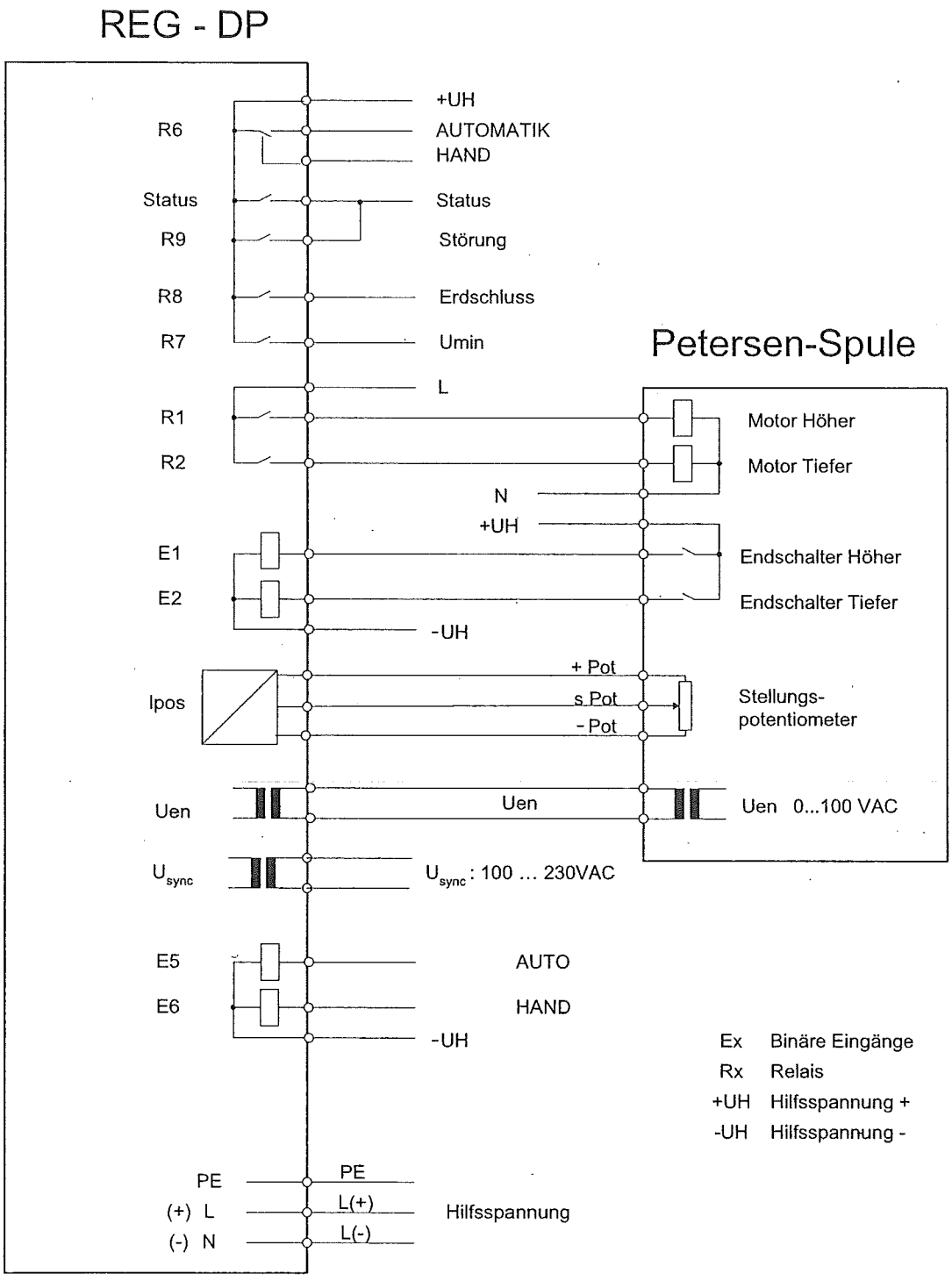


Map 5.24: Standard – terminal assignment for wall- and panel-mounting rack

Note:
In case of wall- and panel-mounting rack, not all possible links have been brought out of the regulator (e.g.: the second E-LAN) . An assignment according to user-specific requirements is possible.

5.2.7 Example for the link of the REG-DP to a P-Coil

In the following map,as well the links which are at least required between the regulator and the P-. Coil are shown as also the usual links between the regulator and the control room.

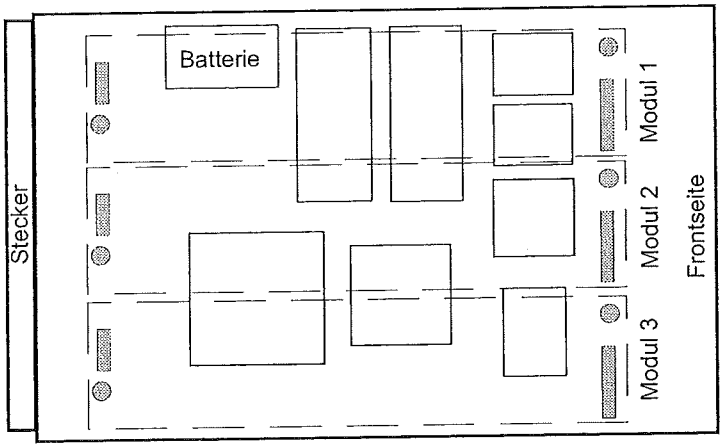


Map 5.25: Example for the connection of the REG-DP to a P-coil

5.3 Upgrading of analog inputs resp. outputs

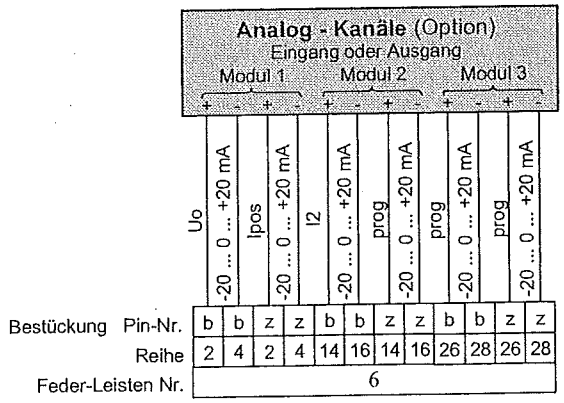
How to proceed:

- Remove front plate from the REG-DP
  (untighten 4x slot screws and pull off flat ribbon cable)
- Remove CPU-Platine REG-CPU
  (loosen 2x screws and 2x retaining ring, then carefully remove CPU-Platine)
- Equip CPU-Platine REG-CPU with analog modules and plug onto the regulator again
  (consider 2x plug-in connection)



Map 5.26: Slots for analog-double modules

After the analog-double modules have been inserted, the modules are automatically recognized by the regulator and are operated with accordingly.



Map 5.27: Pin assignment of the analog-double modules

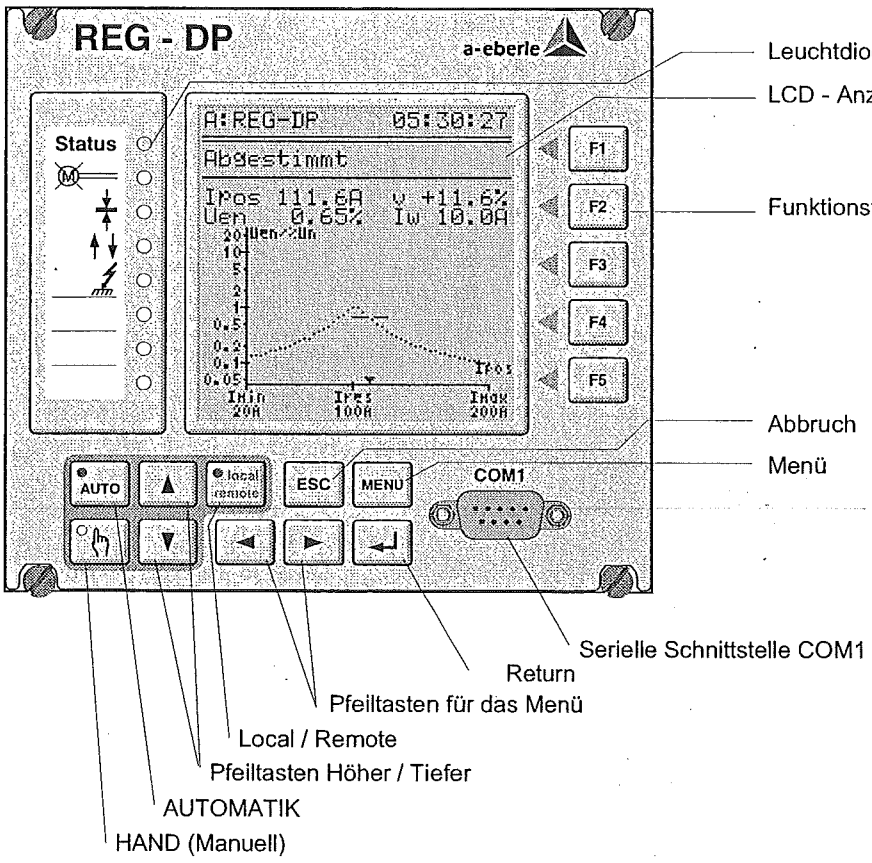
For this, the following channel assignment applies:

Module	Channel
1.1	1
1.2	2
2.1	3
2.2	4
3.1	5
3.2	6

- Plug-in CPU-Platine REG-CPU and front plate with flat ribbon cable again and screw them
- Parameterize the analog modules by the regulator-menu, by means of WinREG-DP or by means of REG-L commands. See also chapiter " 8.2.4.5 Analog Inputs/Outputs"

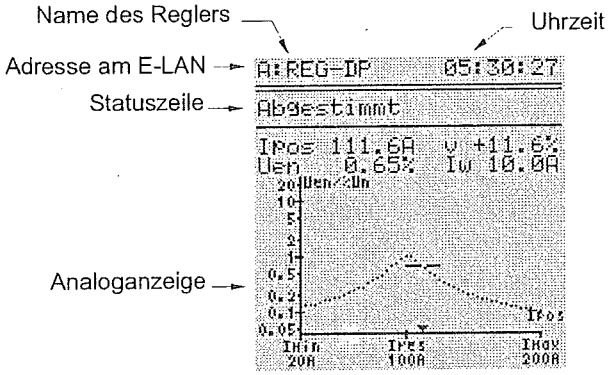
6 Operation

6.1 Indication and operation elements



Map 6.1: indication and operation elements

6.1.1 Indication and operation elements



Map 6.2: LCD - indication im regulator mode

Analog-indication in the resonance-wave display	**Definition**
Imin	Final position "Lower"
▼	Ipos, the present coil position.
Imax	Final position "Higher"
Ires	Resonsance point from the last calculation.
- -	Present value the Offset voltage Uen

Analog-indication in the detail- and large-scale indication	**Definition**
Imin	Final position "Lower"
⍓	Present coil position.
⍓	Present coil position, Uen has left the tolerance range.
Imax	Final position "Higher"
Ires	Resonsance point resulting from the last calculation.

Light-emitting diodes		
Status	green	Status of the regulator.
Ⓜ resp. Interference	red	Sum - Interference message. In the status line, a small message box will appear. Details may be polled by MENU><F5>
	red	Final switch "Higher" or Final switch "Lower " has been reached.
	red	Setting command "Higher" or "Lower" is edited. (Running message)
	red	Earth fault.

LED 6	red	free programmable.
LED 7	red	free programmable.
LED 8	red	free programmable.

6.1.2 Function keys

Functions keys (F1...F5)
To select the several indication modes and to parameterize the P-coil regulator REG-DP.

Operation mode AUTO
for automatical regulation under consideration of the set parameters.

Operation mode HAND
To parameterize the REG-DP and to manually control the P-coil.

Operation mode Local / Remote

In the Operation mode "Remote", the following keys are blocked:
<HAND>
<AUTO>
<Higher>
<Lower>
The keys for the menu continue to be available here as well. It is also possible to navigate in the menu, and to regard and change the setting values.

ESC (Abort)

Short pressing of the key:
In the menu leads to a return to the above menu level

Long pressing of the key:
Return to the previously active indication mode (standard display, large-scale display or resonance wave)

Manual control of the P-coil
In the operation mode "HAND", the arrow keys "Higher" and "Lower" are used to control the P-coil drive.

Note:
The keys will only be active, if the regulator is switched to operation mode "HAND".

MENU and arrow keys <⇒> and <⇐ >
The key menu is used to switch to the different operation modes (indication, recorder, statistics and Interferences-help) and to switch to the "SETUP" for parameterization.
In the "SETUP", the horizontal arrow keys <⇒> and <⇐ > are taken to turn the pages between the single menu pages. Alternatively, there also is function key <F1> to turn the pages.

ENTER
To confirm a changed parameter in the "SETUP" menu points.

Repeat function
If a key is pressed down for quite some time, the function of the key will at first be repeated every second. After approx. 10s, the repeat frequency will be increased.

6.1.3 Plug connection at the front

Serial Interface COM1
To link the P-coil regulator to external devices as for example Laptop or Modem.

6.2 Operation principle

The operation of the P-coil regulator REG - DP is made completely menu-guided.

Should regulation parameters be set or changed, the following operation principle applies:

Switching of the operation mode AUTO / HAND

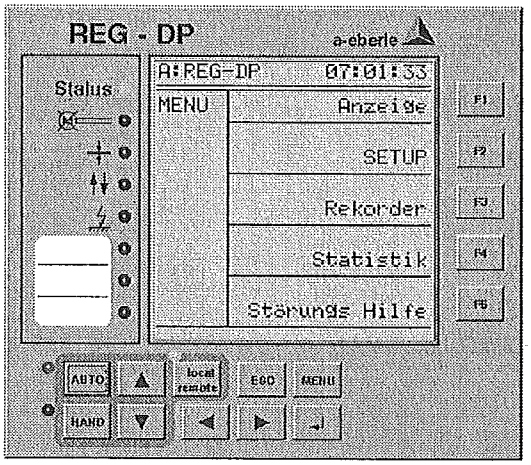
- <HAND> Operation mode is changed to hand operation
- <AUTO> Operation mode is changed to automatical operation

Switching of the operation mode local / remote

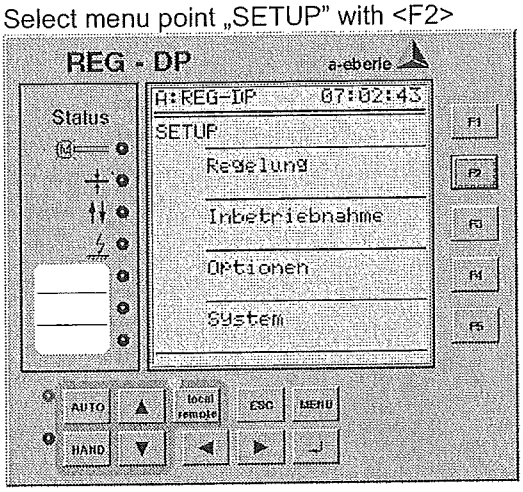
- With every striking of key <local / remote> there will be a change to the other operation status. (Note: The change is also possible by the menu)

Switching to operation mode menu and parameterization

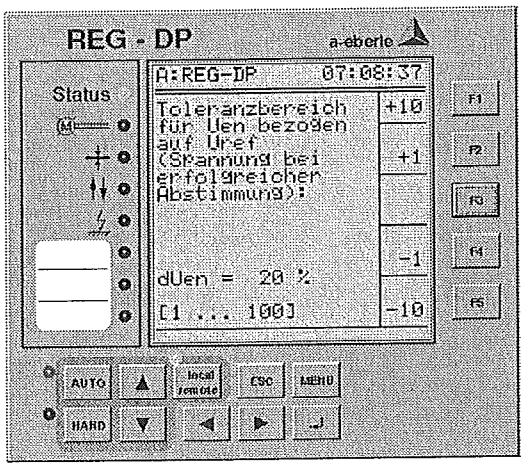
- Key <MENU> lists all possible operation modes



➢ Select menu point „SETUP" with <F2>



➢ Turn pages through the keys <F1> to <F5> and the horizontal arrow keys until the required parameter is reached.



➢ Set the value of the parameter by means of the function keys.
<F1> increments the value in big steps
<F2> increments the value in small steps
<F4> decrements the value in small steps
<F5> decrements the value in big steps

➢ By the horizontal arrow keys < ⇐ > and < ⇒ > **the value of the range counter** may be **changed in the right column.** Therefore it is possible to navigate very quickly even with very big number ranges.

➢ <F3> resp. <F5> are occupied by special functions in some "SETUP"- menus.

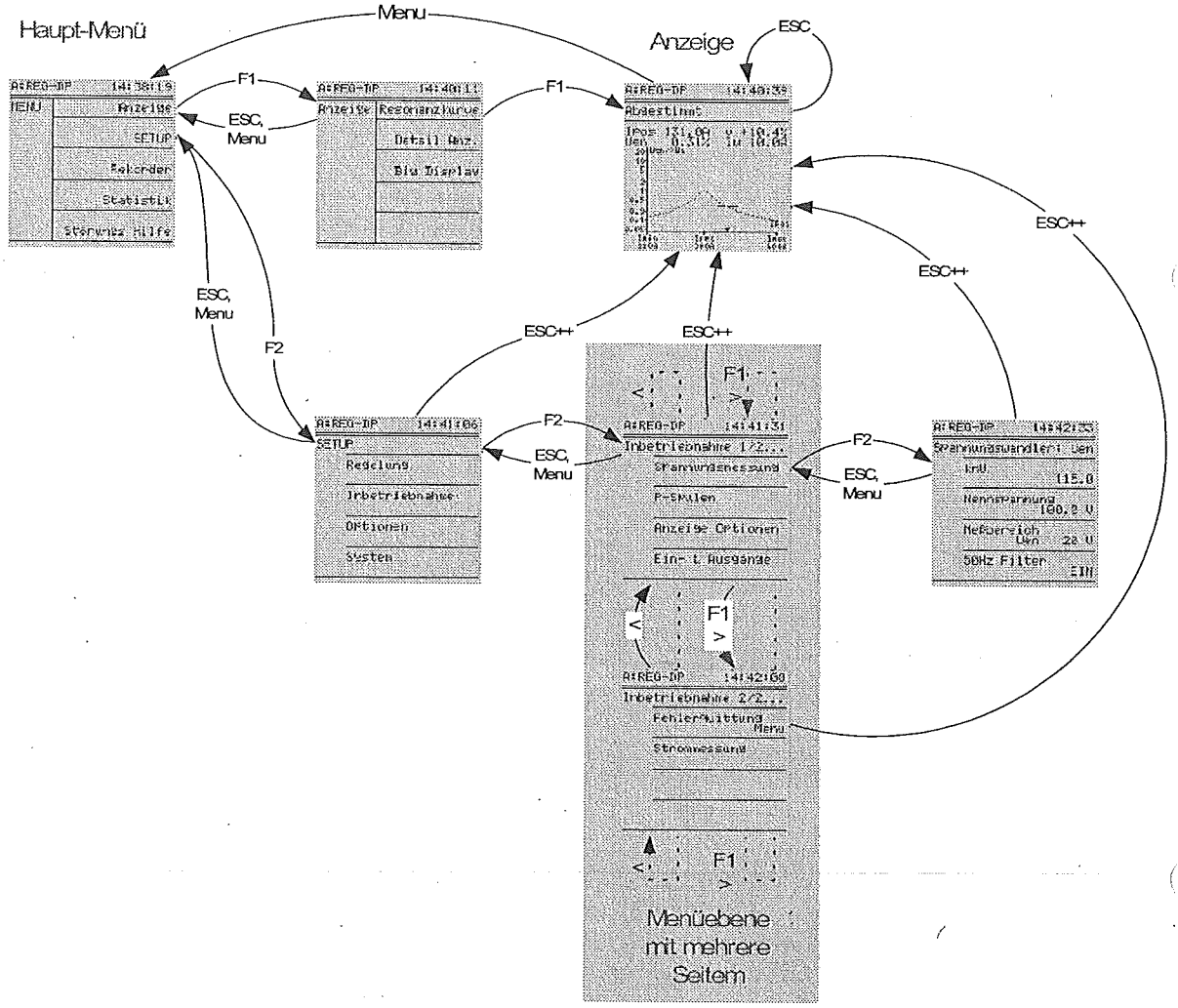
➢ If the insertion of a value is finished, the changed value will have to be confirmed by key <ENTER>. Then, the regulator will switch back to the nearest higher level.

➢ Leaving the setting menu without changing the value: **short** striking of <ESC > (abort)

➢ Leaving the parameterization and return to the initial indication mode:
long pressing of key <ESC> (ESC++)

- If the menu is indicated, a regulation may be made in the background, provided that the regulator has been in the operation mode "AUTO".
- In the operation mode "AUTO", the keys "Higher" and "Lower" are locked.

In the following map, the principle of the navigation between the single menu-levels and its effects are shown.



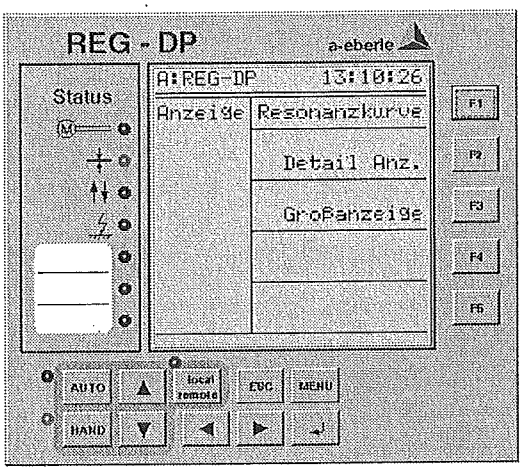
Map 6.3: principle of the navigation between the single menu-levels

Legend:

<	... key arrow at the left
>	... key arrow at the right
F1	... key F1
F2	... key F2
ESC	... key ESC
ESC++	... key ESC, pressed down for longer than approx. 3 sec
Menu	... key Menu

6.3 Selection of the indication mode

6.3.1 Indication mode indication

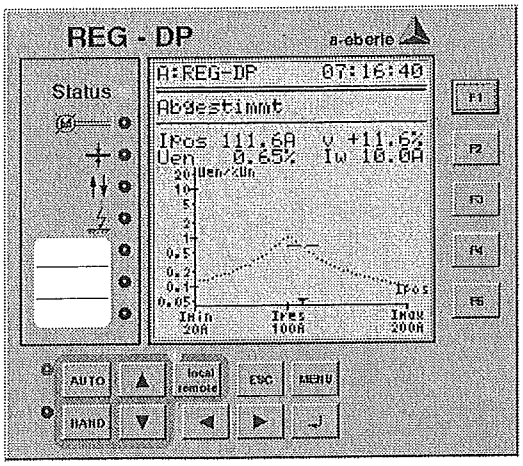


This selection menu may be reached by striking keys **<MENU> <F1>**

On this screen, the single indication modes of the regulator may be selected:

Turn pages between the kinds of displays:
Apart from the menu, also key **<F1>** permits the changing between the indication-modes.

6.3.1.1 <F1> Resonance wave:



Here the following is displayed

- the regulator status,
- the measuring values Uen and Ipos,
- the calculated detuning v and the active current Iw
- the graphic indication of the resonance wave

1. Line:

A:	**Adress of the regulator at the E-LAN - Bus**
REG-DP	Name of the regulator
07:16:40	Clock-time

2. Line:
In this line, the present regulator-status and the present searching delay are shown.

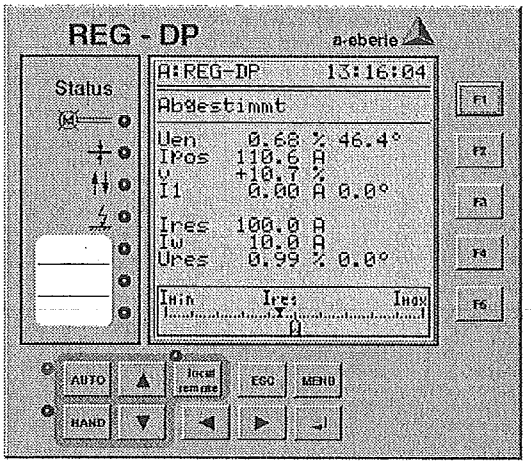
From the 3. Line on, the following values are indicated:

Parameter	Description
Uen	Presently measured offset voltage Uen in [%] referred to 100V, as secondary voltage of the voltage transformer or as primary voltage in [kV]
Ipos	By the potentio meter presently measured and linearized coil position in [A] or [%]. In case of the activation of a fixcoil, this one will not be considered in the indication.
V	Present detuning of the current referred to point of resonance measured resp. calculated in the last searching procedure
Iw	Calculated active part of the current in [A] via the fault location in the case of a low-resistant earth fault.

The upper and lower final positions of the P-coil are additionnally indicated as sum message by means of a red LED. The movement of the P-coil as running message is also displayed by means of a red LED.

Change of the indication options
<F2> Switching to the display of the offset voltage Uen (%, V, kV)
<F3> Switching to the display of kvd and Iw

6.3.1.2 <F2> Detail indication:



Here is the display
- of the regulator status,
- of the measuring value of the offset voltage Uen acc. to amount and angle,
- of the present coil position Ipos,
- of the calculated detuning v,
- of the measured current of the input transformer I1 according to amount and angle and
- of the calculated wave parameters: Ires, Iw and Ures

1. Line:

A:	**Adress of the regulator at the E-LAN - Bus**
REG-DP	Name of the regulator
07:13:37	Clock-time

2. Line:
In this line, the present regulator-status and the present search delay are shown.

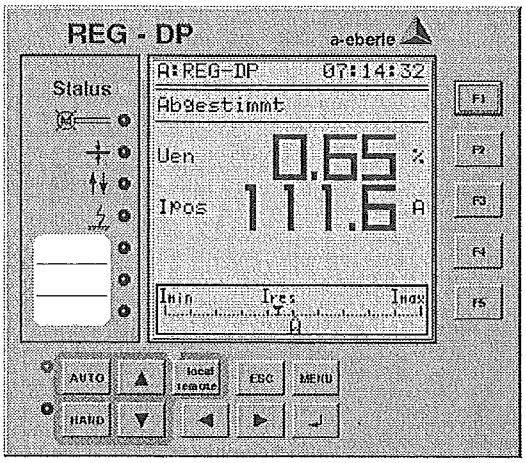
From the 3. Line on, the following values are indicated:

Parameter	Description
Uen	Presently measured offset voltage Uen in [%] referred to 100V, as secondary voltage of the voltage transformer in [V] or as primary voltage in [kV].
Ipos	By the potentio meter presently measured and linearized coil position in [A] or [%]. In case of the activation of a fixcoil, this one will not be considered in the indication.
v	Present detuning of the current referred to point of resonance measured resp. calculated in the last searching procedure
I_1	Measured current of the current transformer 1 e.g..: actually measured current through the Petersen-coil in [A] by the current transformer
Ires	Last measured resp. calculated coil position in [A] of which the maximum of the offset voltage (Ures) has been found.
Iw	Calculated active part of the current in [A] via the fault location in the case of a low-resistant earth fault.
Ures	Measured or calculated offset voltage Uen in the point of resonance (Ipos => Ires)
Alternatively to Ires, Iw, Ures:	
Ires	Last measured resp. calculated coil position in [A] of which the maximum of the offset voltage (Ures) has been found.
d	Operating loss of the system in [A] or [%]. When indication in [%] an activated Fixcoil is considered
k	Calculated unsymmetry of the system

The upper and lower final positions of the P-coil are additionnally indicated as sum message by means of a red LED. The movement of the P-coil as running message is also displayed by means of a red LED.

Change of the indication options
<F2> Switching to the display of the offset voltage Uen (%, V, kV)
<F3> Switching to the display of the calculated system parameter (k,v,d resp. Iw,v,Ures)

6.3.1.3 <F3> Large-scale display:



Here the display shows

- the regulator status,
- the measuring values Uen and Ipos,
- the graphic indication of the present coil position Ipos and
- the graphic indication of the last measured point of resonance Ires

1. Line:

A:	**Adress of the regulator at the E-LAN - Bus**
REG-DP	Name of the regulator
07:14:32	Clock-time

2. Line:
In this line, the present regulator-status and the present search delay are indicated.

From the 3. Line on, the following values are shown in large-scale format:

Parameter	Description
Uen	Presently measured offset voltage Uen in [%] referred to 100V, as secondary voltage of the voltage transformer or as primary voltage in [kV]
Ipos	By the potentio meter presently measured and linearized coil position in [A] or [%]. In case of the activation of a Fixcoil, this one will not be considered in the indication.
alternatively:	
Uen	Presently measured offset voltage Uen in [%] referred to 100V, as secondary voltage of the voltage transformer or as primary voltage in [kV]
V	Present detuning of the current referred to the point of resonance measured resp. calculated in the last searching procedure
v (SP)	Set setpoint value - Detuning of the current

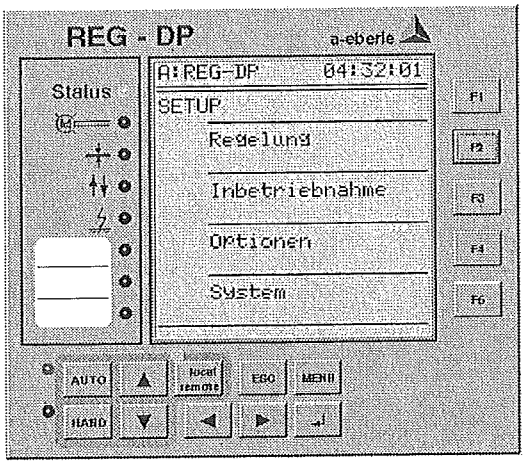
Change of the indication options

<F2> Switching to the display of the offset voltage Uen (%, V, kV)
<F3> Switching to the display of the calculated system parameter (v, v(SP) resp. Ipos)

Graphic display of the coil position.

In the graphic display of the coil position, the present coil position is shown in the changing range of Imin up to Imax of the P-coil. The measured resp. calculated point of resonance Ires is marked with a downwards arrow..

6.3.2 Indication mode: Setup



By this menu point, the parameterization up to the following groups may be reached:

F2: Regulation
- F2: Standard Parameter
- F3: Earth fault
- F4: Umax
- F5: Umin

- F2: R - Control
- F3: Parallel - Regulation

F3: Putting into operation
- F2: Voltage measuring
- F3: P-coil
- F4: Indication Options
- F5: Input & Outputs

- F2: Fault acknowledgement
- F3: Current measuring

F4: Options
- F2: Local/Remote
- F3: Loc/Rem Release
- F4: Loc/Rem Function

- F2: Simulation
- F3: system model

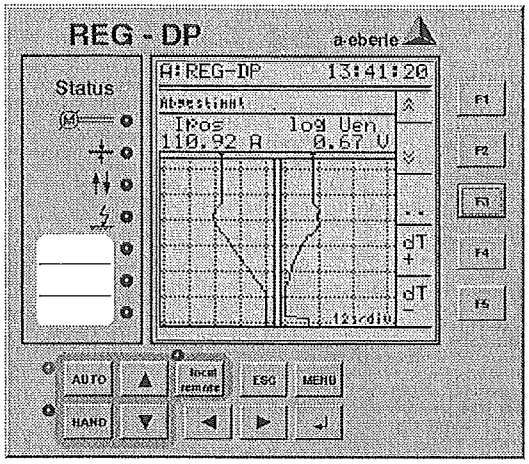
F5: System
- F2: language
- F3: COM & E-LAN
- F4: Station identification

F5: Station name

F2: LCD saver
F3: Date & Clock-time
F4: Password
F5: Status

6.3.3 Operation mode Recorder

6.3.3.1 Indication des recorders



On the display, the temporal characteristic of the coil position Ipos and of the offset voltage Uen is shown as line diagram. At the left, the linearized coil position Ipos is displayed in [A] and at the right the offset voltage Uen is monitored in [V] logarithmically in a range of three decades which corresponds to the range of 0.1 V ... 100 V.

In the grid chart, the present values are on top of the grid. These present values are marked downwards through small arrows. In order to permit a better reading of the values, the measuring values are also displayed digitally.

By the digital indication for Ipos and Uen, the present status of the regulator is displayed. Thus, it is possible to recognize, even in the operation mode "recorder", the status in which the regulator is presently operating.

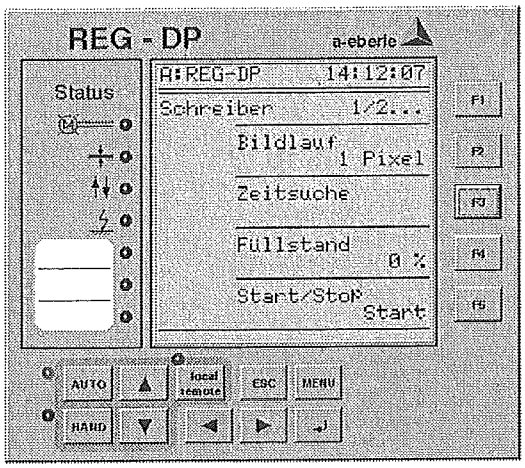
The present forward speeds are shown in the bottom corner at the right of the screen and they are selectable by means of the keys **<F4>** and **<F5>** in the following steps:

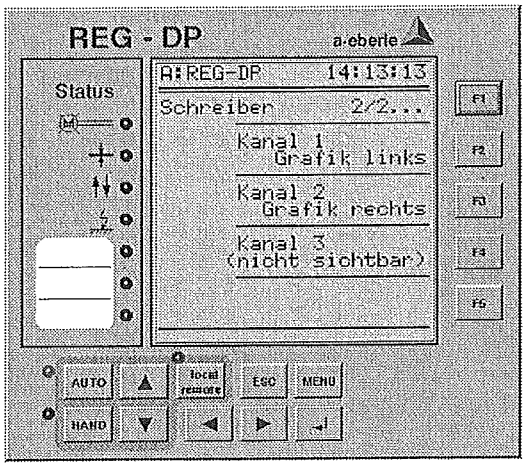
- 12s / Div,
- 1 min / Div
- 5 min / Div
- 10 min / Div

Keys **<F1>** and **<F2>** will switch to mode **"Hitstory"** and the memory may be polled for the requested events according to the given arrow directions.

By striking key <F3> there will be a switch to a submenu in which additional parameters may be set for den recorder.

6.3.3.2 Setting possibilities for the recorder



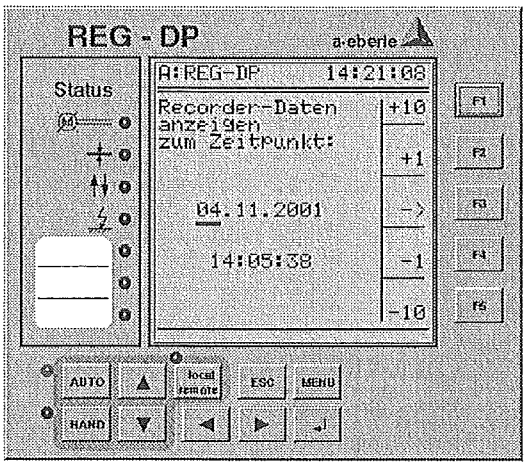


Screen Scroll:

By this parameter, the different feedrates for the keys <F1:⩝> and <F2: ⩛> may be set for the search in the Hitstory- buffer. The following *step sizes per key strike* are selectable:

- 1 Pixel
- 1 Div
- 3 Div
- 5 Div
- 1 min
- 1 h

Time search:

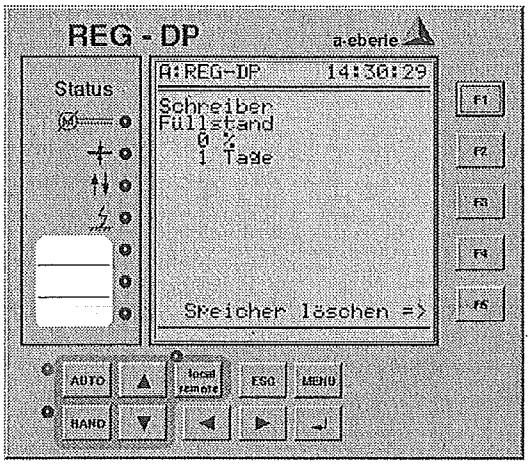


To enable a faster search im Hitstory – buffer, here it is possible to directly insert the date and clock-time of the instant to be examined. The instant corresponds to the position of the pen.

Selection of the values to be changed by means of key <F3> or by means of the arrow- keys < ⇐ > and < ⇒ >. Via keys <F1>, <F2> resp. <F4>, <F5> the required value may be set.

< ESC> aborts the insertion whereas the value is taken over by <ENTER>

Filling level:



The present filling level of the recorder is shown here in % resp. in days.

Registering procedure of the recorder:
Each second is checked, if the measuring channels to be recorded have changed by a defined treshold value. If the treshold value is exceeded in positive or negative direction, a complete set of data is stored in the recorder. By this measurement, a very comprimized recording is effected.

The memory itself is made as a ring memory, e.g. as soon as the buffer is full, the oldest data are overwritten.The tresholds are set in a way that three channels may be stored over a period of approx. one week, provided that there are the usual changes in the system.

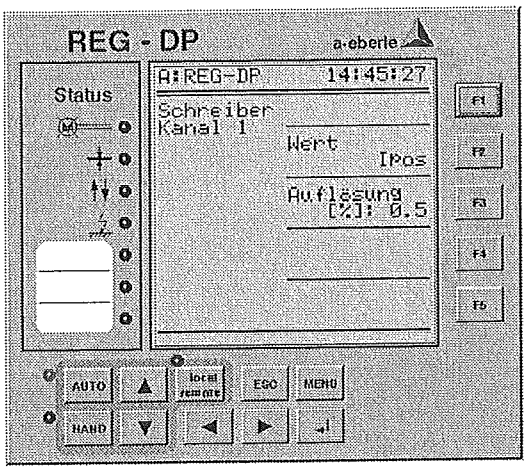
By means of key <F5> the memory may be deleted.

Start / Stop:

Key <F5> stops the recording resp. restarts it.
By means of this key, the recording may be frozen so that, for example, the data are transmitted to a PC much later.

Channel 1 , Graphic at the left:

The assignment and the treshold values of the measuring values to be recorded, are freely selectable:



Assignment of the measuring value to the left-hand recording channel in the graphic. The left channel is displayed linear!

Measuring value	Description
Not used	No recording is made
Uen	Amount of the Offset voltage Uen in [V] (primary values)
Uen_Phi	Angle ofthe Offset voltage Uen, referred to Usync - 30°
I1	Amount of the current input I1 in [A][(primary values)
I1_Phi	Angle of the current I1, referred to Usync - 30°
I2	Amount of the current input I2 in [A][(primary values)
I2_Phi	Angle of the current I2, referred to Usync - 30°
Ipos	coil position in[A], linerarized and recalculated to the coil data
Usync	Amount of the synchronization voltage.

Key <F3> may set the treshold value for the trigger-off of a new recording. After the recording, the present value is taken as new reference value for the recording.

Channel 2 , Graphic at the right:

The right-hand channel is stored logarithmically and also displayed logarithmically. This recording is preferred for the offset voltage Uen, because the interesting part is shown clearly even if the offset voltage is very low.

Channel 3 , (invisible):

In this channel, an additional information may be stored, e.g. the angle information of the offset voltage Uen.

Caution:

If the assignment of a recording channel is changed, all data stored in the recorder will be deleted.

6.3.4 Statistics

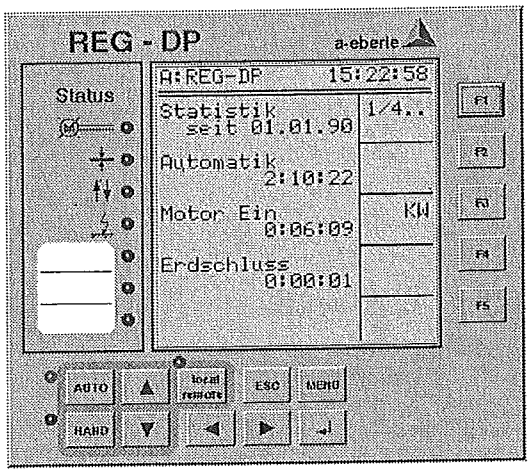
6.3.4.1 Indication of the statistics

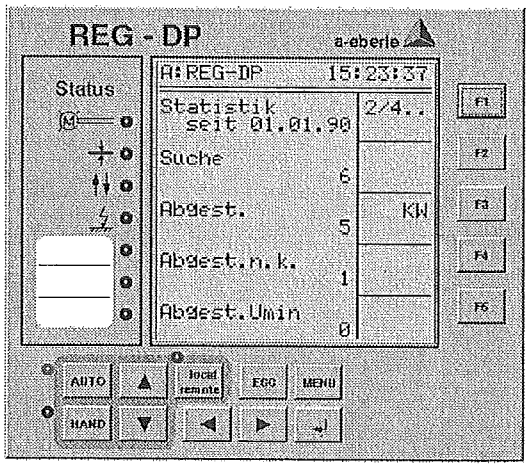
The statistics is displayed as sum statistics (sum) or as statistics divided in calendar weeks (KW). Key <F3> permits the change between the single display kinds. A turn of the page may be made by key <F1> resp. by the arrow keys <> and <> .

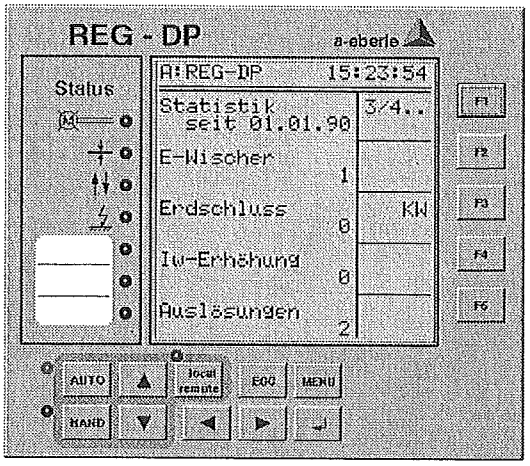
The following data are recorded in the statistics:

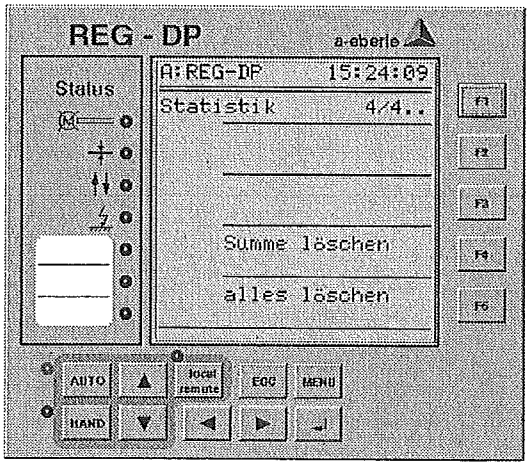
Parameter	Description
Automation	Sum time of the operation mode Automation: overshoot when 100 000 h Automatical change of the edit to days: d
Motor On	Sum time of the change commands "Higher" and "Lower" Also the input Mot_Lauf of the P-Coil is considered.
Earth fault duration	Sum time of the earth faults including transient earth fault
Search	Number of the started search procedures
Tuned	Number of the successful tunings
Tuned n.k.	Number of the unsuccessful tunings
Tuned Umin	Number of the reached position Umin
Transient earth fault	Number of the transient earth fault (Earth fault lower than the set transient earth fault time)
earth faults	Number of the permanent-earth faults (without transient earth fault)
Iw - increments	Number of the residual ohmic current trigger-offs (Number of the R_on)
Trigger-offs	Number of the Trigger-offs (Leaving the Tolerance range)

6.3.4.2 Sum statistics:



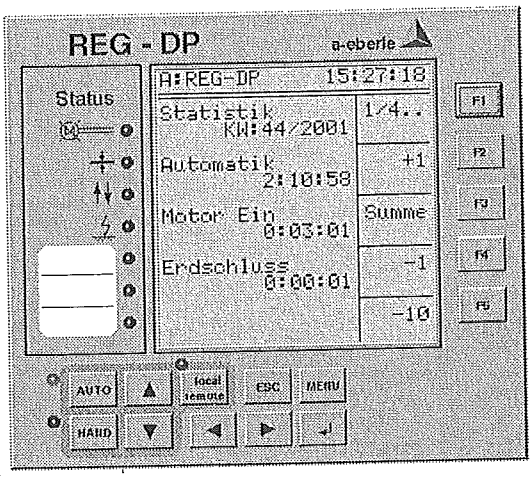






In the last map, the recorded data of the statistics may be deleted.

6.3.4.3 Statistics per calender week:



In the above map, the statistics-data of the calendar week KW44 are shown.

The selection of the calendar week is made by means of the keys <F2>, <F4> and <F5>.

The data may also be read out directly by means of a terminals using the following REG-L commands and they may be transmitted to other programmes as, for instance, Excel or Work, with Cut-and-Paste:

```
EspCounter <aufz> [<KW>] [=0] aktuelle Statistiker-Zählerstände
                              <aufz>: 1:SuchAnzahl,2:Abgestimmt, 3:AbgestNK,
                              4:AbgestUmin, 5:ErdschlussWischer, 6:Erdschluss,
                              7:WattRestStrom, 8:Auslösungen
                              ohne <KW>:  liest/setzt die Summen-Zähler
                              mit <KW>=1..53: liest/setzt die KW-Zähler
                              Zuweisungen: nur mit Extension '*' möglich;
                                           zuweisbarer Bereich:0...1e9;
                                           Nachkommastellen werden ignoriert

EspStatist [<KW>] [<KW2>] liefert Tabelle aller Zählerstände
                          ohne Parameter: liefert Summenzählerstände
                          mit <KW>: liefert die Zählerstände der KW
                          mit <KW> und <KW2>: liefert die Stände von KW bis KW2
```

6.3.4.4 Example for statistics

sum statistics:

<A>espstatist

Statistik

	Auto	MotorEin	Erdschl	Suche	Abgest	AbgestNK	AbgeUmin	ErdschlW	Erdschl	Iw-Erhöh	Auslösg
Summe	2:21:57	0:06:09	0:00:01	6	5	1	0	1	0	0	2

seit 01.01.90

statistics von KW 42 bis KW 44

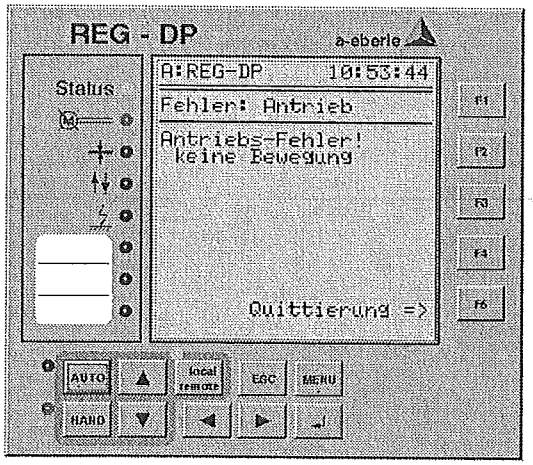
espstatist 42 44

Statistik

	Auto	MotorEin	Erdschl	Suche	Abgest	AbgestNK	AbgeUmin	ErdschlW	Erdschl	Iw-Erhöh	Auslösg
KW42/2001	0:00:00	0:00:00	0:00:00	0	0	0	0	0	0	0	0
KW43/2001	0:00:00	0:00:00	0:00:00	0	0	0	0	0	0	0	0
KW44/2001	2:26:33	0:03:01	0:00:01	6	5	1	0	1	0	0	2

Summe	2:26:33	0:03:01	0:00:01	6	5	1	0	1	0	0	2

6.3.5 Indication mode Interference help

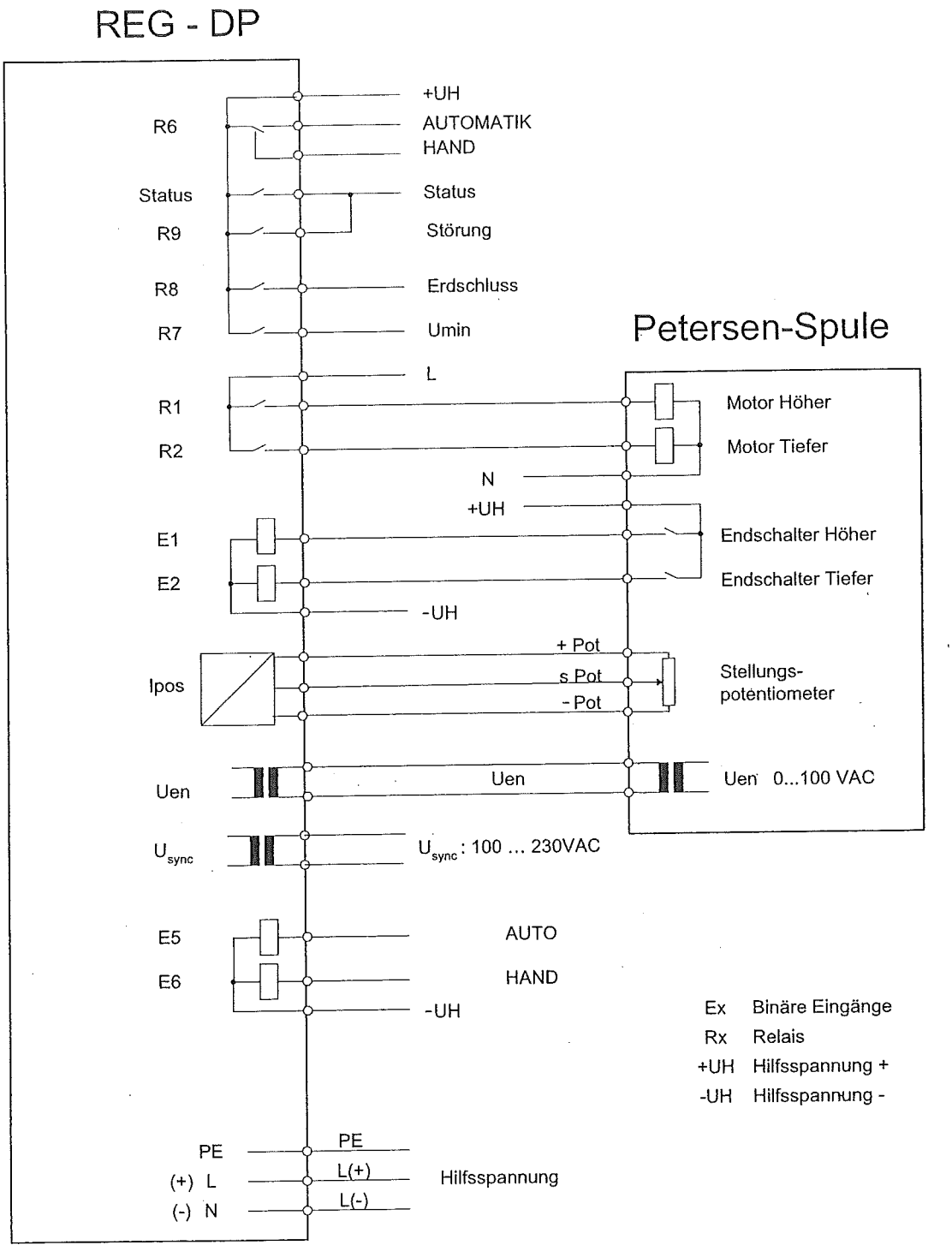


As soon as an error occurs, a message will appear in the status line. By the indication mode Interference help (**<MENU><F5>**) detailed information may be read out. The error message may be acknowledged by means of key **<F5>**.

Note:
Only the last error is indicated.

7 Putting into operation

In this section, the basic way of procedure is described when the REG-DP is put into opeation which is done by means of a typical configuration of a deleted system.



Map 7.1: Regulator with Petersen-Coil

Note

The structure of the following sections and the menu-structure of ***"Putting into operation"*** *into the regulator has been made in a way that a complete putting into operation of the regulator may be made if the single points are worked through* ***from the top to the bottom.***

7.1 Hardware - Wiring

The wirings which are listed in the following points are, if necessary, to be executed resp. to be checked:

- Auxiliary voltage. Please consider the admissible range of the auxiliary voltages of the regulator (See label)

- Final switches messages from the P-Coil to the regulator
  (Auxiliary voltage for the final switch to be considered)
  (Also consider the type of the final switch: open / close)

  - Final switch Higher (Input E1)
  - Final switch Lower (Input E2)

- Change commands from the regulator to the P-Coil
  (Auxiliary voltage for the motor contacter to be considered)

  - Motor Higher (direction Imax: Relay R1)
  - Motor Lower (direction Imin: Relay R2)

- Connecting of the potentio meter in the required way of switching. There possibly is the need for changes at the wiring on the potentio meter at the coil. (Details see chapiter: 8.2.3 P-coil)

  Note:
  Check the direction of the coil change: If the current (coil position) is incrementing, the voltage divider ratio will also have to be increased.

- Wiring to the control room / supervisory remote control

  Note:
  As a rule, here another auxiliary voltage is used than with the message and control signals to the P-coil. It may be necessary to set intermediate relays.

  - messages regulator => control room
    - Status
    - Diverse regulator messages

  - commands control room => regulator
    - Change of switching Hand / Auto
    - Higher / Lower, if wired by means of the regulator.

  - Measuring value transmission regulator => control room
    The following values may be transmitted
    - Uen Offset voltage
    - Ipos coil position in [A]
    - I1 real current through the P-coils

The scaling of the analog-output is either made by REG-L commands or by the parameterization software WinREG-DP (See chapiter 11 WinREG-DP).

7.2 Putting into operation without medium-voltage system

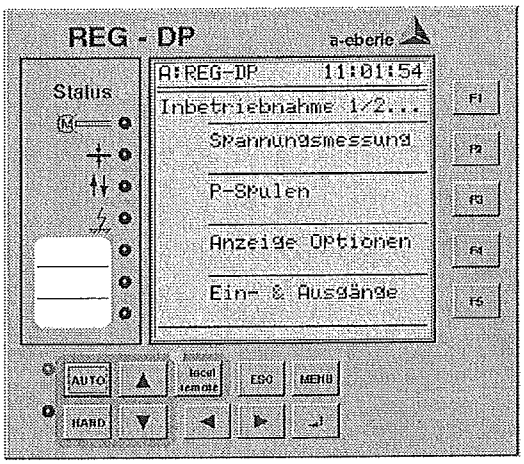
The following points may be made without switching the P-coil to the system.

After the turning-on, the regulator is in the HAND - operation and the regulator-parameters are loaded with "Factory setting".

In the following steps, the P-coil regulator is adpted to the data of the P-coil.
The putting into operation menu is reached by striking the following keys:

<MENU><F2><F3>

Thus, the following screen pages are available for the input of the parameters:



The points marked with ☑ in the following chart are to be checked with the first putting into operation and be adapted, if necessary. It is provided that the wiring for the message of the final switches (E1, E2) from the P-coil to the regulator as well as the wiring of the setting commande from the regulator to the P-coil (R1, R2) has already been made during the following putting into operation.

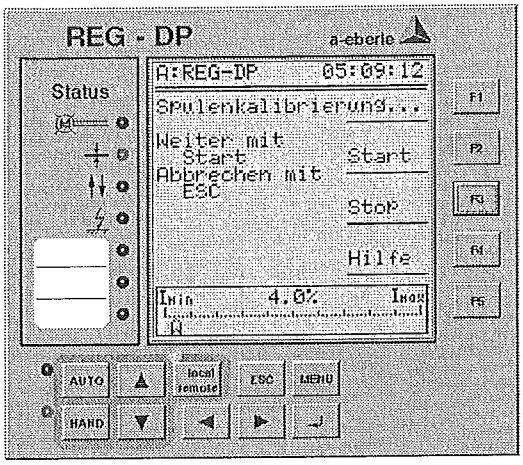
	Menu point ***Putting into operation 1/2***	Factory setting	Note
	F2: Voltage measuring		
☑	F2: knU	115.0	Transmission ratio of the voltage transformer for a 20kV system knU = 11550[V] /100[V] = 115
☑	F3: nominal voltage Uen	100 V	Nominal voltage of the transformer to measure the offset voltage in V
	F4: measuring range Uen	*20 V*	*Measuring range for high-resolution measuring of Uen (only when **REG-DE-I** is required)*
	F5: 50Hz Filter	*EIN*	*50 Hz Filter for Uen (only when **REG-DE-I** is required)*
	F3: P-coil ***F2: data of the P-coil*** ***data P-coil 1/2...***		
☑	F2: Imin:	20 A	Lower limit value of the P-coil acc. to label
☑	F3: Imax:	200 A	Upper limit value of the P-coil according to label
	F4: coil position connection	*Pot*	*Type of the position messager in the P-coil and of the applicable link technology (only with **REG-DE-I**)*
	F5: coil position R-value	*1 kOhm*	*Maximum value of the position messager (only with **REG-DE-I**)*
	data P-coil 2/2...		
☑	F2: Final switch:	Close	Type of the final switch in the P-coil
☑	F3: Soft-Final switch active	Off	Activation of current limitations through the final switches settable by software
☑	F4: Soft-Final switch Imin	0 A	Software Final switch near to Imin
☑	F5: Soft-Final switch Imax	9999 A	Software Final switch near to Imax
☑	***F3: coil - calibration***		Automatical adaptation of the position messager to the inputs of the regulator
☑	***F4: coil - linearization***		Semi-automatical linearization of the coil characteristic
	F5: Fixcoil	0 A	Sum of the fixcoils in the deleting range

By the start of the automatical coil calibration with <F2> the following data of the P-coil are measured by the regulator.

- Assignment coil position to the final switches "Higher" and "Lower"
- Running time of the P-coil for the changing of the P-coil over the complete range
- coil-play
- Overshoot of the P-coil
- Check of the moving direction of the P-coil on change of commands
- Recognition of wiring errors within the range of the position messagers

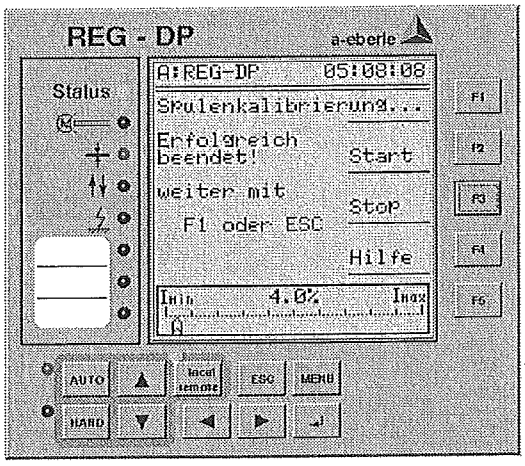
Note:
When error messages see chapiter 8.2.1 Interface to the Petersen coil

coil- calibration :

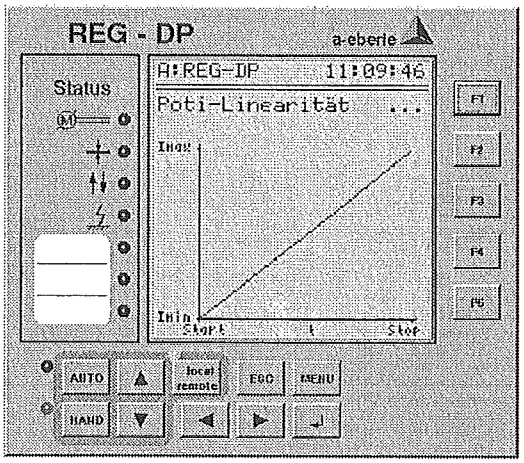


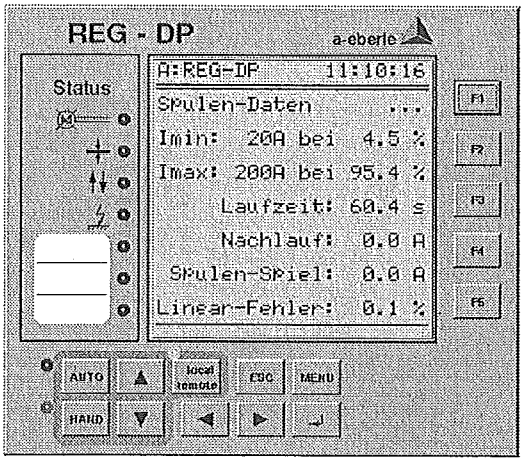
With the coil calibration, there is at first a search for the final switch "Lower". Then, the P-coil is changed into the final switch "Higher". After having done this, the coil-play and the coil-overshoot in the middle of the changing range is measured. In preparation for the following coil linearization, the P-Coil is simultaneously set to the lower final position.

The successful coil calibration is shown on the screen as follows:



The results of the calibration may be read on the following pages of the menu "coil calibration", which may be switched to by means of key <F1>.





If the non-linearity of the potentio meter-characteristic is too big (> 2%), please check the wiring. When 2 phases are used, the non-linearity may be big. For details please see chapiter "8.2.1 Interface to the Petersen coil" resp. "5.2.2.4 Terminal block 3: Ipos , U_{en}, U_{Sync} and Auxiliary voltage"

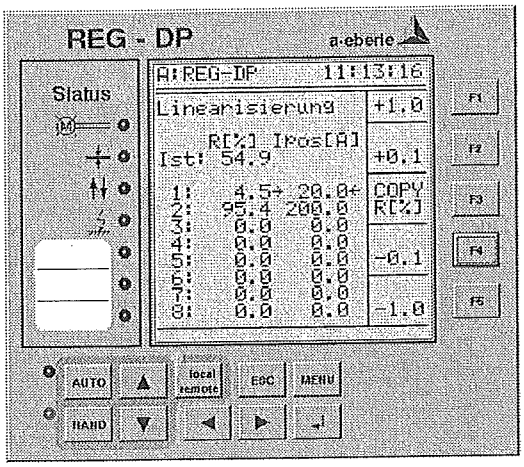
Final switch not wired:

If the final switches from the P-Coil to the regulator are not wired, it will be necessary to indicate this when selecting the used final switches. The type of the final switches is to be set to "None".

In this case, the coil calibration will thus not effect before the selection of the final switch. The regulator will recognize the final positions by supervising the position message of the potentio meter. If no change of the Petersen-coil is made into the selected direction for quite some time, then this will not be interpreted as interference when indication "No final switch" but as final switch in the present moving direction. The coil-linearization then will be made as the selection of a final switch.

F4:coil - linearisation

By the coil calibration, only the two final switches are assigned to. If the scaling on the mechanical indication of the P-coil is non-linear ist, so please also make a linearization for the regulator.



The following procedure is recommended for the linearisation:

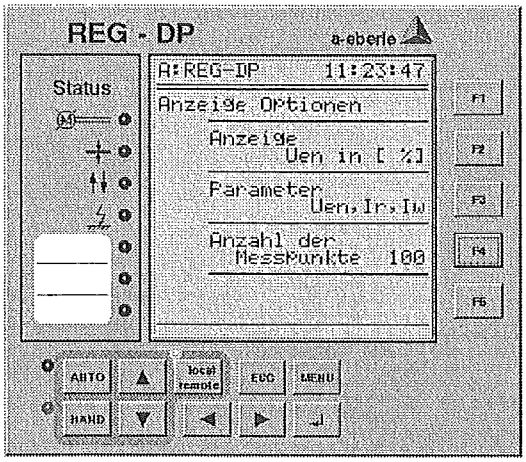
- Manual change of the P-coil in the lower final position
- Selection of 8 support points; please use more supporting plates in the lower range of the P-coils because here the non-linearity in this range usually is bigger.
  There should be only supporting plates which are characterized at the E- Coil on the mechanical indication. The approach of these supporting plates should not be else than from the bottom to the top so that possibly present mechanical plays will have no effects.

1. Change the P-coil to the next selected support point
2. By the arrow key < ⇒ > select the next line
3. By <F3> take over the ohmic value of the P-coil
4. Correct the indicated value of the current in [A] to the value of the P-coils set locally

- Repeat the last 4 steps until all 8 values are set or until Imax has been reached.

Indication - Options

For the adaptation of the screen-indication, the following menu points are available:



	Menu point ***Putting into operation 1/2***	Factory-setting	Note
	F4: Indication Options		
	F2: indication Uen in	%	Display of the offset voltage on the screen. Selection possibilities: % ... Uen referred to the nominal value V ... Secondary side of the voltage transform. kV ... Primary side of the voltage transformer
	F3: Parameter	Uen, Ir, Iw	Display of the calculated parameters of the resonance wave Selection possibilities: Uen, Ires, Iw k, v, d
	F4: Current indication incl. Slavepos.	Yes	In the Master-Slave operation, the current display for Ipos and Ires is made including the present coil position of the slave

If only the standard functions of the regulator are required, the following menu points may be missed out:

	Menu point ***Putting into operation 1/2***	Factory-setting	Note
	F5: Input & Outputs		
	F2: Binary inputs		Detail see chapiter: 8.2.4.2
	F3: Relay outputs		Detail see chapiter: 8.2.4.3
	F4: LED's		Detail see chapiter: 8.2.4.4
	F5: Analog Input/Outputs		Detail see chapiter: 8.2.4.5
	F2: Delays		Detail see chapiter: 8.2.4.6

	Menu point ***Putting into operation 2/2***	Factory-setting	Note
	F2: Fault acknowledgement	menu	Details see chapiter: 8.2.5
	F3: Current measuring		Details see chapiter: 8.2.6
	F2: Current nominal value I1	1A	
	F3: knI1	1,00	
	F4: Current nominal value I2	1A	
	F5: knI2	1,00	

Essentially, now there is a lack of no more than the parameters for the regulation behaviour. It is best to completely check the menu points for the regulation (<MENU><F2><F2>) and to set the required parameter.

In the following, please find a **reduced** summary of the recommended setting values (list of details see chapiter: 11.6.2 Parameter print-out acc. to regulator menu):

F2: Regulation

Regulation 1/2...
F2: Standard Param.

Standard-Param. 1/4..

F2: tolerance range	[%]
F3: Uen-Tolerance :	20.0 %
F4: Delay of the search by:	10.0 s (should be incremented to 180s)
F5: Delay of the forcing search:	10.0 s

Standard-Param. 2/4..

F2: Setpoint detuning in	[%]
F3: Setpoint detuning	+10.0 %
F4: positioning Tolerance[%]:	1.0
F5: minimum setting dIpos[%]:	5.0

Standard-Param. 3/4..

F2: Override resonance maximum:	YES
F3: Pulling of Uref [min]:	5.0
F4: Uen angle measuring	ON

Standard-Param. 4/4..

F2: Search cycles max.	10
F3: Motor running time max [min]	45
F4: Rest pos. Search	Last tuning position
F5: Rest pos. Search [A]	50.0

F3: Earth fault

Earth fault 1/2...

F2: Uerd-Treshold	30.0
F3: Transient earth fault[s]:	7.0
F4: Uerd-message delay [s]:	5.0
F5: Self-conduct with Uerd:	OFF

Earth fault 2/2...

F2: Correction Ipos	OFF
F3: Correction Chart	
F2: dIc_1 [A] =	0.0
F3: dIc_2 [A] =	0.0
F4: dIc_3 [A] =	0.0
F5: dIc_4 [A] =	0.0

F4: Umax

F2: Umax-Treshold [%]	30.0

F5: Umin

Uen < Umin 1/2...

F2: Umin-Treshold [%]	0.2
F3: final position	last tuning position
F4: Message Uen<Umin for [min]:	15.0

F5: new search for [min]: 60

Uen < Umin 2/2...
F2: dUen-limitation in Umin[%]: 30.0
F3: Self-conduct when Umin: OFF

Regulation 2/2...
F2: R - Control

R-Control 1/3...
F2: Resistance control OFF
F3: ON delay [s]: 1.0
F4: R-ON time [s]: 1.0
F5: Self-conduct: Off

R-Control 2/3...
F2: R-ON time maximum[s]: 10.0
F3: R-temperature maximum [°]: 200.0
F4: R-Cooling time [min]: 60

R-Control 3/3...
F4: Repeat delay [s]: 1.0
F5: Repeat cycles: 0

F3: Parallel - Regulation

Parallel-Regulation 1/2 ...
F2: Parallel-Prog OFF
F3: Parallel-Prog active: OFF
F4: Slave identifier ---
F5: Pulling of slave No

Parallel-Regulation 2/2 ...
F2: Slaveposition when Umin: Stop

In the menu for the putting into operation, the inputs, relays and the LEDs may be assigned to the corresponding regulator functions. In addition to that, the following parameters may also be set there.

Putting into operation 1/2...
F5: Inputs&Outputs 2/2
F2: Delays
F2: Minimum hold time Relay[s]: 0.0
F3: Prolong. of impulse Mot-H/T [s]: 4.0
F4: Message delay Alarm [s]: 0.0
F5: Message delay Interference [s]: 0.0

Putting into operation 2/2...
F1: Fault acknowledgement Menu /H/A

F3: Current measuring
F2: Current nominal value I1 1 A
F3: knI1 100
F4: Current nominal value I2 1 A
F5: knI2 100

Options 1/2

F2: Local / Remote	Local
F3: Loc/Rem Release:	locked
F4: Loc/Rem Function	Off

Options 2/2

F2: Simulation	OFF

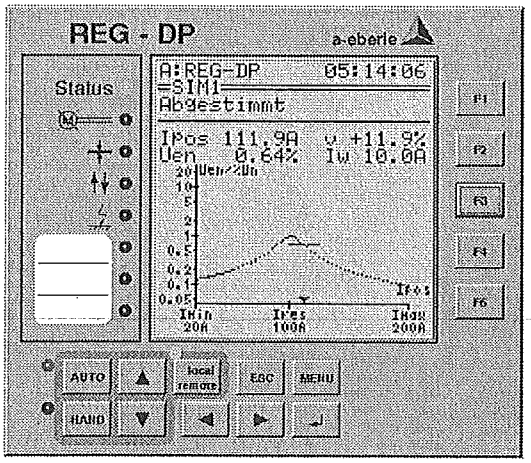
The system parameters like language, COM1, COM2, ELAN, password, status, date, clock-time may be found in menu point "System".

7.3 Putting into operation with medium-voltage system

The described steps for the putting into operation could be made without having had to link the P-coil to the medium-voltage system.

By the start-up of the medium-voltage system, the regulator may measure the offset voltage Uen. If the regulator is switched from HAND to AUTO, it will start a search run and make a tuning.

Note:
Please consider that the regulator is not switched to the simulation mode. In this case, an offset voltage would be simulated. In the simulation mode, the changing commands are not edited to the real P-coil. In the following map, the marks for the simulation mode is shown on top of the status line:



7.4 Check of the digital information regulator <=> supervisory remote control

After the successful tuning, the remaining links to the supervisory remote control may be parameterized and tested.

If the link is made to the control and instrumentation technology by the serial interface (e.g.: IEC 870-5-101 / 103), then the answers to the general questions may be found in the operation manual of the REG-P resp. on the Homepage www.a-eberle.de . For detailed questions, please refer to out project department under +49-(0)911-628108-78 resp. –86.

- Check of the messages regulator => control room
  - Status
  - regulator Hand
  - regulator Automation

- Check of the commands control room => regulator

  - Switching from Auto => Hand
  - Switching from Hand => Auto
  - Change of the P-coil: Higher
  - Change of the P-coil: Lower

- Check of the other messages regulator => control room

7.5 Check of the analog Information regulator => supervisory remote control

- Scaling and assignment of the analog outputs see chapiter 8.2.4.5

7.6 Operation with Fixcoil

On the regulator, the "Actual-position" (Ipos) and the point of resonance "Ires" are always indicated, including the Fixcoil.

For the regulator, a preparameterized Fixcoil is activated by a binary input. The input may be chosen according to the user's requirement (See chapiter "8.2.4.2 Binary Inputs")

The activation of the Fixcoil may be messaged through the regulator by means of a LED or a relay (See chapiter "8.2.4 Inputs & Outputs")

Depending from the selection of the screen indication, there are the following possibilities:

1) indication on the screen, if the detuning is selected in [A]:

v_IST [A] = Ipos [A] - Ires [A]

d[A]

with

Ipos	Present coil position including Fixcoil in [A]
Ires	Coil position of the resonance maximum including fixcoil in [A]
v	Present detuning referred to the last found point of resonance Ires. The indication is made in [A]
d	Operating loss of the system in [A]

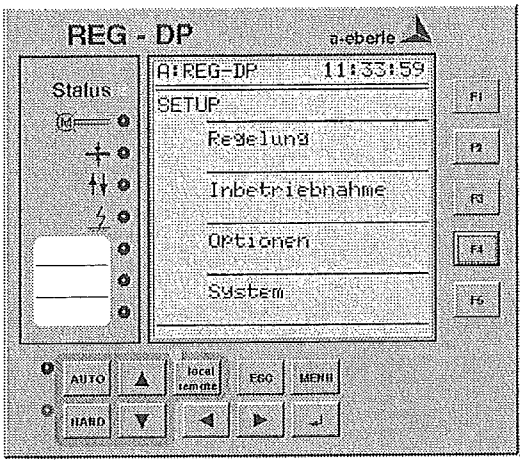
2) Indication on the screen if the detuning is selected in [%]:

v_IST [%] = 100 * (Ipos / Ires -1)

d [%] = 100 * d[A] / Ires

Ipos	Present coil position including fixcoil in [A]
Ires	Coil position of the resonance maximum including fixcoil in [A]
v	Present detuning referred to the last found point of resonance Ires. The indication effects in [%]
d	Operating loss of the system in [%]

8 SETUP



The following submenus may be reached by the Setup:

F2: Regulation
- F2: Standard Parameter
- F3: Earth fault
- F4: Umax
- F5: Umin

- F2: R - Control
- F3: Parallel-Regulation

F3: Putting into operation
- F2: Voltage measuring
- F3: P-coils
- F4: indication Options
- F5: Inputs & Outputs

- F2: Fault acknowledgement
- F3: Current measuring

F4: Options
- F2: Local / Remote
- F3: Loc / Rem Release
- F4: Loc / Rem Function

- F2: Simulation
- F3: system model

F5: System
- F2: language
- F3: COM & E-LAN
- F4: Station identification
- F5: Station name

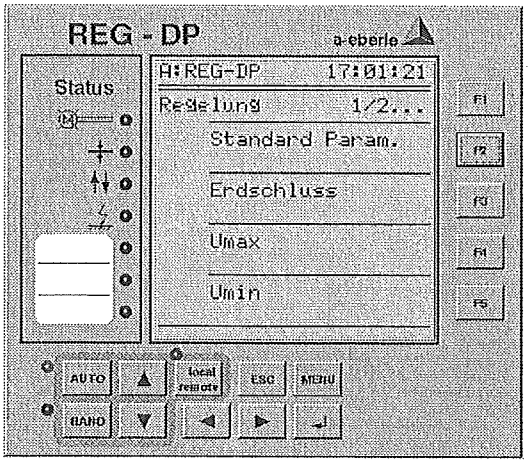
- F2: LCD saver
- F3: Date & Clock-time
- F4: Password
- F5: Status

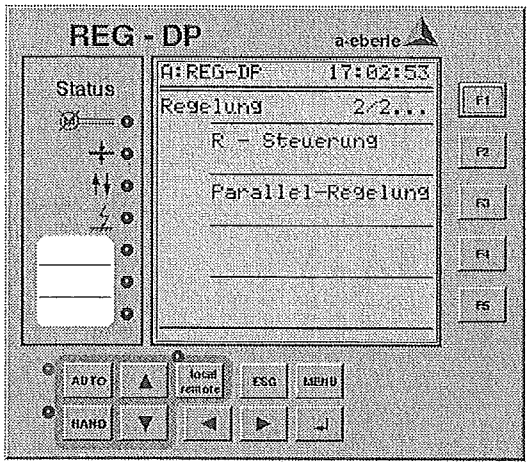
8.1 Regulation

In the menu point Regulation, the following subgroups are settable

F2: Regulation
F2: Standard Parameter
F3: Earth fault
F4: Umax
F5: Umin

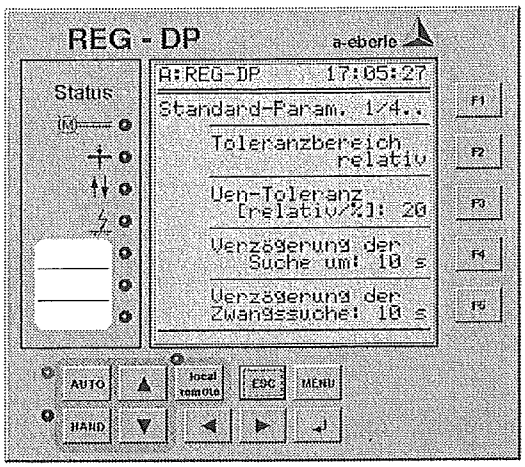
F2: R - Control
F3: Parallel-Regulation

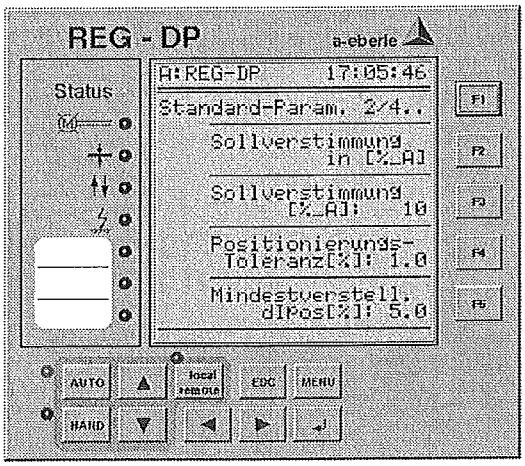


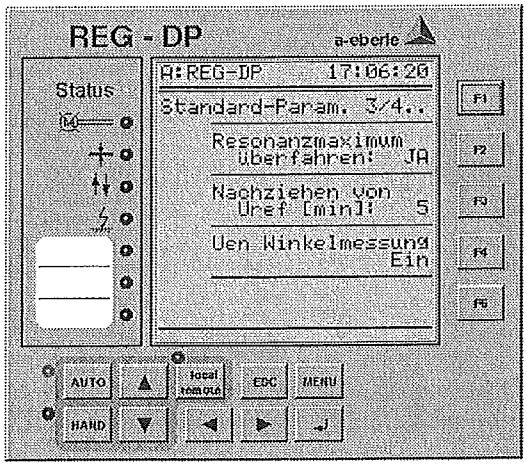


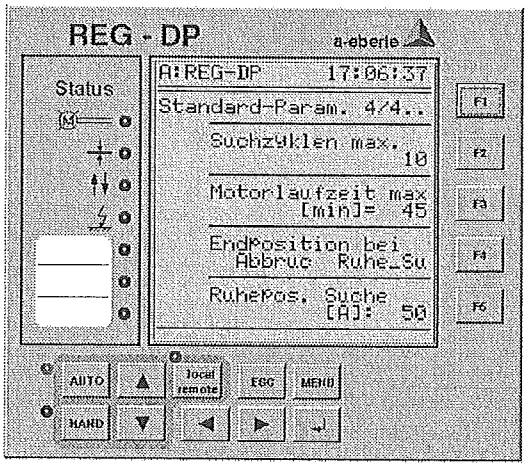
8.1.1 Standard Parameter

For the parameterization the Regulation, the following menu displays are available:









Explanation of the single parameters:

After a successful tuning process of the Petersen Coil, the present offset voltage Uen is taken as new reference value U_{ref}. From this time on, the offset voltage is steadily being supervised. From regarding the change of offset voltage, a switching action will be recognized. If the offset voltage leaves the defined tolerance range during the complete trigger-off time, a new tuning process will be started.

8.1.1.1 Tolerance range

Kind of the tolerance range :

Parameter	Description
relative	The indicated tolerance range is refered to the reference voltage Uref
absolute	The indicated tolerance range is independent from the reference voltage. Values in per cent are referred to the nominal voltage.

8.1.1.2 Uen – Tolerance range

Value of the tolerance range:

Parameter	Description
relative / %	Tolerance range for Uen referred to Uref (Voltage when successful tuning):
absolute	Tolerance range for Uen (absolute):

standard setting: 20%

Example:

A value of 20 % means that a search procedure will be started if offset voltage is outside the tolerance range from (Uref * 0.8) to (Uref * 1,2) during the complete time of the set search delay.

If there is only an amount measuring of the offset voltage, so the angle changes of the offset voltage will not be recognized.

However, if the measuring of the offset voltage is made to amount and angle, the "change of the angle" will also be evaluated. For the angle measuring, some system-synchrone reference voltage is required, which is also there during the earth fault. It is recommandable to use an interlinked voltage U_{12}. Since a change of the Petersen-Coil usually requires an auxiliary voltage of 230 VAC this one may also be used. The advantage compared to the use of the interlinked voltage U_{12} is that a necessary changeover is no longer required in a several busbar-operation.

In the following map, the tolerance range is shown in the complex level.

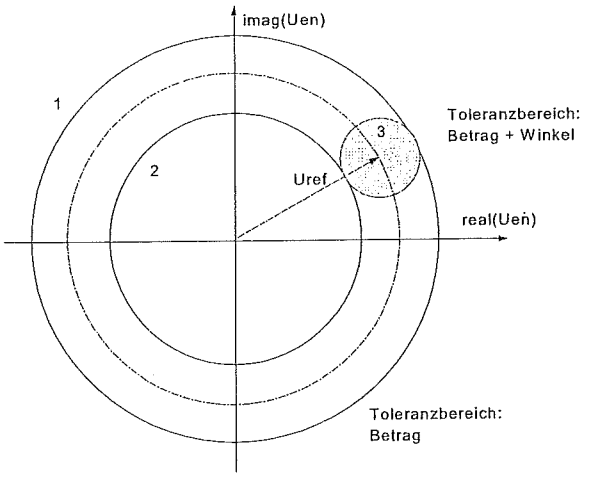


Abb. 8.1: Tolerance range for the start of the tuning

Evaluation of the amount of the Offset voltage: A searching procedure will be started if the offset voltage is either outside the biggest circle (1) or within the smallest circle (2) after the changeovers of the system during the complete time delay.

Evaluation of the amount and of the angle of the Offset voltage: A searching procedure will be started if the offset voltage is outside the circumference (3) after the changeovers of the system during the complete delay time.

It is evident that essentially more changeovers are recognized in the system by rating the amount and angle.

8.1.1.3 Delay of the Search by x s

During this set time, the offset voltage has to be outside of the tolerance band so that a search will be started. If the offset voltage returns into the tolerance band before the set time has run out, the counter will be set to its maximum previously set time. During the delay time, the remaining time to the start of the search is being displayed in the status line.

Note:
The usual setting value is within a range of 2 to 3 minutes (120 .. 180s) , so that the changeovers of the system may be finished before a new search procedure will be started.
The factory setting is set to 10s in order to permit the reduction of waiting times when putting into operation.

standard setting: 180s

8.1.1.4 Delay of the forcing search: x s

A shortened reaction may be set by changes to which **no former history** of the system status must be taken into consideration, as it is for instance when switching from Hand to Automation locally or by the control and instrumentation technology.

standard setting: 10s

8.1.1.5 Setpoint detuning in %

By means of this parameter please select **how** the detuning is measured

Parameter	Description
%	The value of per cent refers to the resonance current Ires. (Caution: In big systems, the neutralization limit may possibly be exceeded)
A	The detuning always effects by the same amount independently from Ires.
V	The detuning is set in a way that the indicated offset voltage will be reached.

8.1.1.6 Setpoint detuning

In this menu point the quantity of the detuning is set.

Positive values define an overcompensation
(The E-Coil delivers more current than the capacities of the system in case of an earth fault => Overcompensation)
Negative values define an undercompensation.
A value of **zero** means a tuning to resonance.

standard setting: +10A

8.1.1.7 Positioning tolerance

With this parameter, the tolerance is set when the P-coil is being positioned. The value in per cent is referred to Imax of the P-Coil. A proposal for the positioning accuracy is measured by the regulator during the putting into operation through the measuring of the coilplay and of the overshoot.

Note
If the coil-play or the overshoot are too big, it will be possible to avoid oscillations by enlarging this value.

standard setting: 1%

8.1.1.8 Minimum change dIpos

For the evaluation of the resonance wave, a minimum change of the P-Coil is required in order to have enough support points for the calculation.

standard setting: 5%

8.1.1.9 Overriding the resonance maximum

The most exact parameters of the resonance wave may be measured by overriding the point of resonance. If the point of resonance is not overridden, it will only be possible to estimate the value of the resonance currence through the 2P-procedure. On the contrary, if the point of resonance is overridden, even the active current and the voltage in the point of resonance of the system will be measured by the considerably more exact 3P-procedure.

Parameter	Description
YES	resonance maximum must be overriden
NO	resonance maximum does not have to be overriden

8.1.1.10 Pulling of Uref in [min]

Changeovers in the system are always relatively fast and will thus be finished within some minutes. Nevertheless, changes through weather and feedover of load current changes are mostly very slow. The number of search procedures may be reduced if the tolerance range is being pulled for the slow changes. If the offset voltage does not leave the tolerance field within the set time, the present offset voltage will be taken as reference voltage at the end of this supervised time period. The quantity of the tolerance range will not be changed.

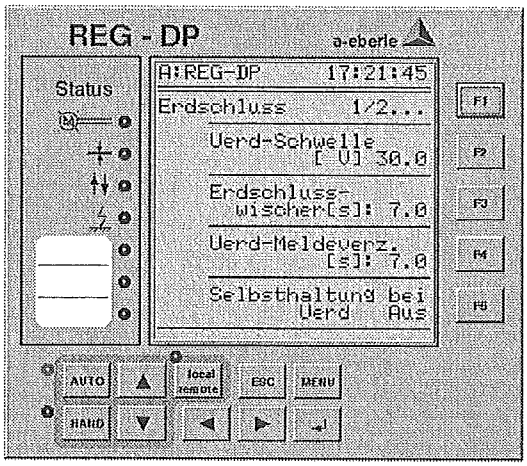
If a value of 0 is inserted, this function will be deactivated.

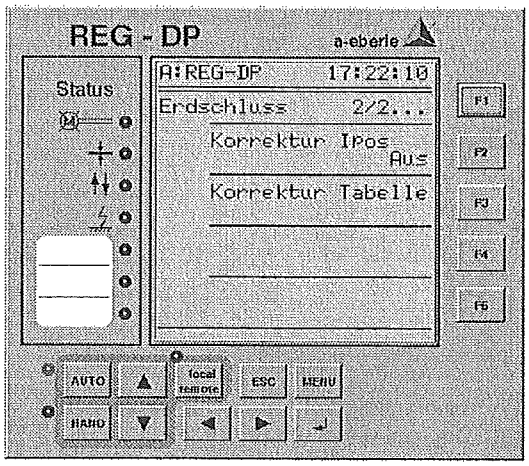
standard setting: 5 min

8.1.1.11 Uen - Angle measuring

Parameter	Description
YES	If the hardware permits it and if the synchronization voltage is connected, there will be an angle measuring. This will essentially have effects on the tolerance range and of the number of recognized switching actions.
NO	The angle measuring is suppressed. There is only the amount of the offset voltage available as tolerance range.

8.1.2 Earth fault



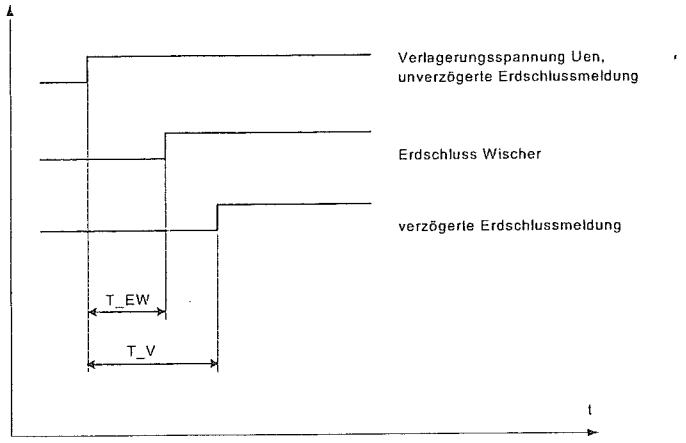


8.1.2.1 Behaviour when Earth fault

An earth fault is recognized, when the amount of the offset voltage Uen is bigger than the set treshold value Uerd. In the following map, the time behaviour of the regulator is shown.

There are two kinds of messages through the earth fault:

- The **undelayed** earth fault message
  This message is edited immediately after having recognized the earth fault.
- The **delayed** earth fault message.
  This message is not edited before the set delay time. Furthermore, the earth fault must be during the whole delay time.



T_{EW}	Transient earth fault-time
T_V	Delay time for the earth fault message

Abb. 8.2: Time behaviour of the earth fault

The settable "transient earth fault time" has no influence but on the behaviour of the regulator. Referred to the duration of the earth fault, the following cases may be determined:

- $t_{erd} < T_{EW}$
  If the regulator was tuned when the earth fault occured and provided that the offset voltage returns to its initial value within "transient earth fault time" , it will be assumed that the P-coil has deleted the arc successfully. This is presumably made without changing the P-coils and without switching-off of the phase sections. It will thus not be necessary to readjust the P-coil.

- $t_{erd} > T_{EW}$
  If the earth fault is longer than the set transient earth fault time, it will be most likely that it had been necessary to make switch-offs of phases in order to eliminate the earth fault. To be sure that the P-coil is set onto the correct value, a search run will be started even if the offset voltage has returned to its initial value.

If the regulator has been on the search for a new point of resonance when the earth fault occured, the search procedure will immediately be aborted. After having finished the earth fault, a new search procedure will be started even if the earth fault time is less than the set transient earth fault time T_{EW}.

8.1.2.2 Uerd - Treshold [V]

If the amount of the offset voltage exceeds this set treshold, the regulator will recognize an earth fault. The behaviour of the regulator will be influenced by the following parameters. A possibly running search procedure will be aborted at any rate.

The unit of the voltage depends on the set display of the voltage in the resonance display (%, V, kV)

standard setting: 30 [%]

8.1.2.3 Transient earth fault [s]

Description as above mentioned

standard setting: T_{EW} = 7s

8.1.2.4 Uerd-Message delay [s]

Description as above mentioned

standard setting: T_V = 7s

8.1.2.5 Self-conduct when Uerd

As described above, the regulator will automatically start a new tuning procedure after having finished an earth fault after the set delay time. This may be suppressed by the self-conduct. If the self-conduct is activated, the regulator will switch to operation mode HAND after the transient earth fault time and will have to be switched back to Automation either manually or by the control and instrumentation technology.

This is made to prevent a change of the Peterson Coil in the case of a longer search for the earth fault and its possible necessary changeovers resp. switching-offs.

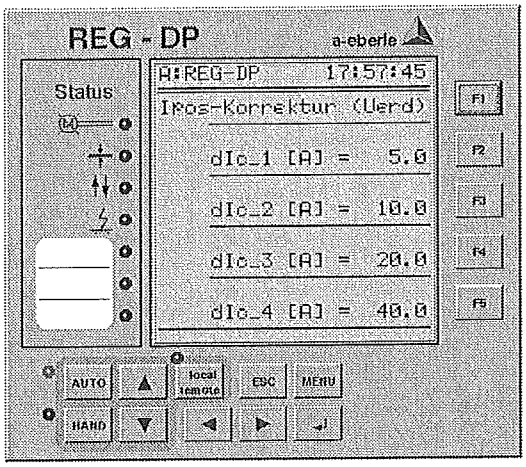
standard setting: OFF

8.1.2.6 Readjusting the P-coil during the earth fault.

To continue to minimize the current over the fault location, the resonance regulator REG-DP may change the P-coil in the case of an earth fault. In the following chart, please find a selection list for the behaviour of the regulator:

Parameter	Description
OFF	In the case of an earth fault, there is no readjustment of the the coil position.
Ires	Readjust to the point of resonance. After the transient earth fault time has run out, the P-coil is set to the last calculated point of resonance.
KorrTab	Readjust by a defined value After the transient earth fault time has run out, the P-coil is readjusted by a defined value. The measuring of the correction value is described below.
Ires+ KorrTab	Combination of the two upper points. Change will be made to the point of resonance plus current correction.

The correction chart may be inserted by the following menu:



If the system is operated with in a way that no phase switching-offs are made for the search for faults, there will be the possibility to work with selection "Ires". In this case, the P-coils will be set to the calculated point of resonance.

However, if there switching-offs resp. changeovers to other systems in order to limit the earth fault, then, there will be the necessity to correct the present coil position by these switched-off resp. changed-over amount.

In the menu there are four current values available for the correction during the earth fault. The set values, however, are not activated but by the digital input. The change value results from the sums of the set values, e.g. there are 16 possibilities through the four inputs. The correction values are referred to the P-coil and are inserted in [A]. Positive values mean that the P-coils are enlargened by the set value in the case of an earth fault.

If this option is activated, the switching status of the binary input during the last search of the point of resonance will be considered. A change of the binary inputs will be recognized even during the earth fault and the Petersen-coil will be readjusted according to the requirements. In sound operation, a new tuning procedure will be started in any case as soon as there is a change of the binary input.

Example 3.1:

Set values in the menu:
line 1: - 80 A
line 2: - 40 A

Selection of the readjustment: Ikorr

Present values of the regulator:
Ires = 200 A
Ipos = 220 A (10 % overcompensation)

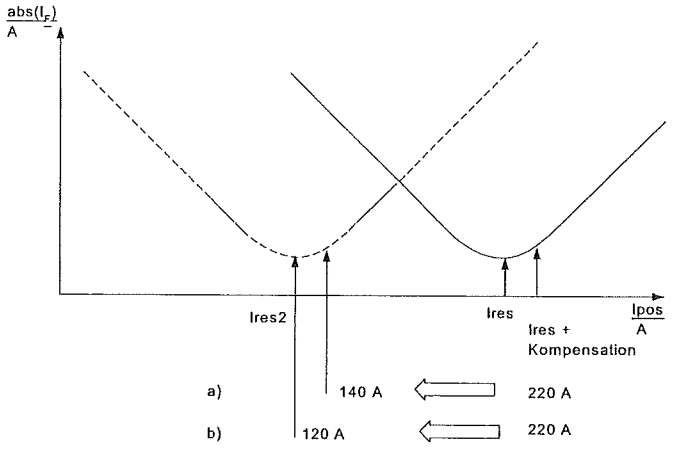


Abb. 8.3: Current over the fault location

When line 1 with a capacitive current of 80 A is being switched off (map 3.2 case a) as fault limitation in case of an earth fault, this will be messaged to the regulator by a digital input. The switch-off corresponds to a shift of the fault current wave to the left.
The regulator reacts with a correction of the present coil position by –80 A. The P-coils are set to a value of 220A - 80 A = 140 A.
If, in addition to that, line 2 is also switched off, there will be a further correction by -40 A to 100 A.

Example 3.2:

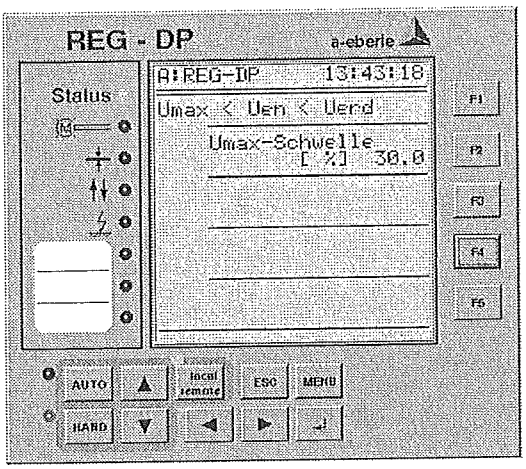
Set values in the menu:
line 1: - 80 A
line 2: - 40 A

Selection of the readjustment: Ires + Ikorr

Present values of the regulator:
Ires = 200 A
Ipos = 220 A (10 % overcompensation)

In case of an earth fault, the P-coil is firstly set to Ires. If, in the fault limitation, line 1 with a capacitive current of 80 A is being switched off, this will be messaged to the regulator by a digital input. The regulator reacts with an additional correction of the present coil position by -80 A. The P-coils are set to a value of 220A -20A-80 A = 120 A (case b). If, in addition to that, line 2 is also switched off, there will be a further correction by -40 A to 80 A.

8.1.3 Umax



This parameter describes the upper voltage range up to which a tuning may be made.

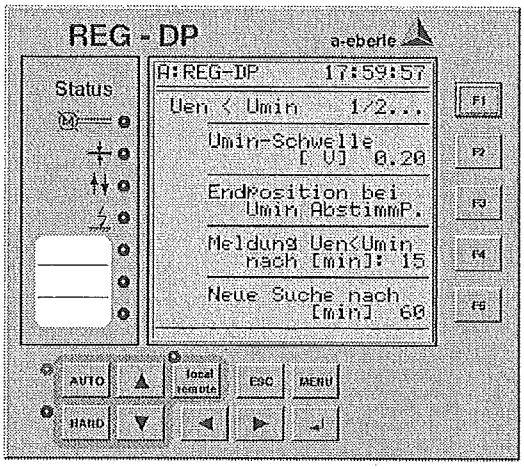
If the regulator reaches this limit value during the search, so the search will be aborted. The message Uen > Umax will be edited.

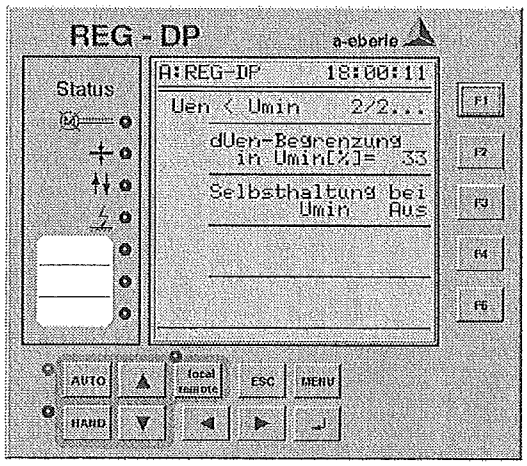
If, by a switching action, a status is reached in the system that the offset voltage lies in the range Umax < Uen < Uerd, the regulator will try to find a point which is lower than resp. equal to Umax. To do this, the search procedure is started in the direction of the rest position. If an increment of the offset voltage is recognized, the search direction will be reversed. The change is made as long as the offset voltage undershoots the limit value.

indication: "Umax"
output function: "Uen > Umax"

standard setting: 30% resp. identical to Uerd

8.1.4 Umin





8.1.4.1 Umin - Treshold

Voltages lower than this limit value are taken as "noise". If, in the process of triggering-off, the offset voltage is lower than this voltage, the complete range of changing of the P-coils will be searched for an offset voltage Uen > Umin.

standard setting: 0.2%

8.1.4.2 Final position when Umin

For the calculation and rating of the resonance wave it is demanded that at least one measuring point must be bigger than this set treshold Umin. If no valid rating is possible, the P-coils will be changed into a waiting position. This waiting position may be:

- rest position or the
- last point of tuning
  (point of resonance including the set compensation of the last calculation)

standard setting: point of tuning

A new search procedure will be started if
- the offset voltage Uen leaves the tolerance band or
- a cyclical check of the point of resonance is set at the regulator.

8.1.4.3 Delay of the message Umin

By the parameter T_Umin, the delay of the message for Umin is set. If no search run is started during this time T_Umin, the message "Uen < Umin" will be activated.

The most frequent cause is that the transformer resp. the P-Coil is set out of function for a short time during the changeovers of the system. If the P-coil is not switched to the system again after the changeovers, there will be no sufficient offset voltage available for the regulation and the regulator will send this message.

standard setting: 15 min

8.1.4.4 New search for [min]

If the offset voltage Uen remains lower than the treshold value of Umin during the complete set time, there will be an automatical search for the point of resonance after the run-out of this time.

In symmetrical cable systems and with a big detuning, it may happen that a switching action has only a small effect on the change of the voltage. Through this automatical search, however, it is made sure that a possibly not recognized switching action will be tuned correctly at least after the set time.

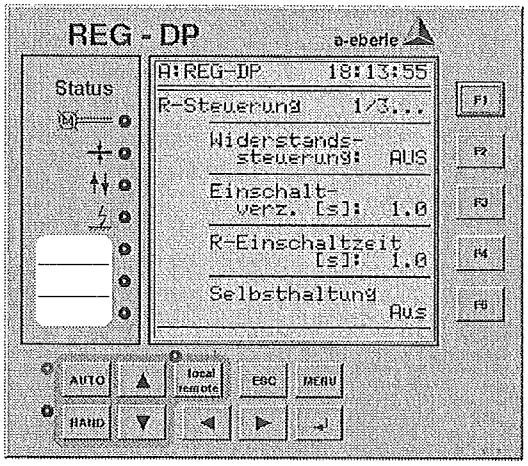
standard setting: 60 min

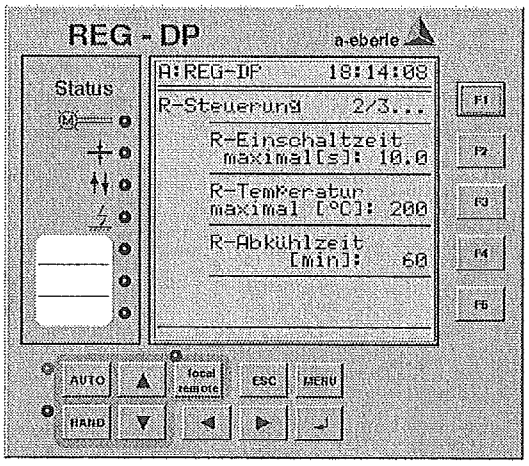
8.1.4.5 Limitation of dUen when Umin

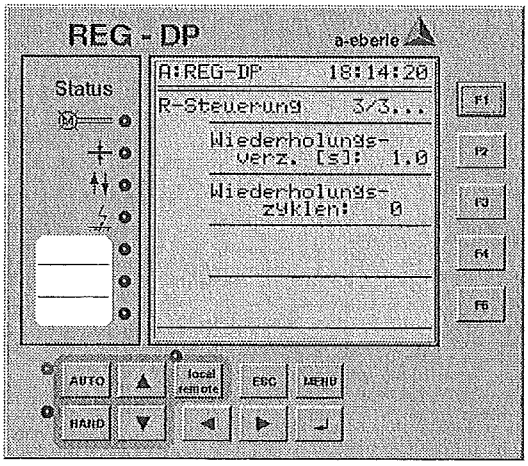
Since the offset voltage is superimposed by "noise" in case of very low voltages, a limitation of the trigger-off treshold will be made when there are low offset voltages. This means that, in case a standard parameterization for low offset voltage, the treshold for the start of a search procedure will at least be 33% of Umin.

standard setting: 33%

8.1.5 R - Control







8.1.5.1 In general

The resistance control to increment the residual ohmic current in the case of an earth fault protects the resistance from a thermical overload. The through-rating power in the resistance is reconstructed by a **thermical replica**.

The resistance control is a **parallel** implemented independent control function to the P-coil regulation and is **not** influenced by a changeover of the P-coil regulator between Hand/ Automation or by an interference condition in the regulating circle of the P-coil regulator.

8.1.5.2 Description of the functions

The offset voltage Uen measured by the regulator is permanently supervised. If the offset voltage overshoots the set "Earth fault - Voltage" Uerd in the case of an earth fault, a cycle for the residual ohmic current increase will be started, provided that the resistance control is activated. The resistance is linked after a settable time delay (T_R_vz1) as long as there is the set ON time (T_R_on). The transient earth fault time T_EW has only influence on the behaviour of the regulator for the P-Coil and has no influence on the temporal run of the resistance control.

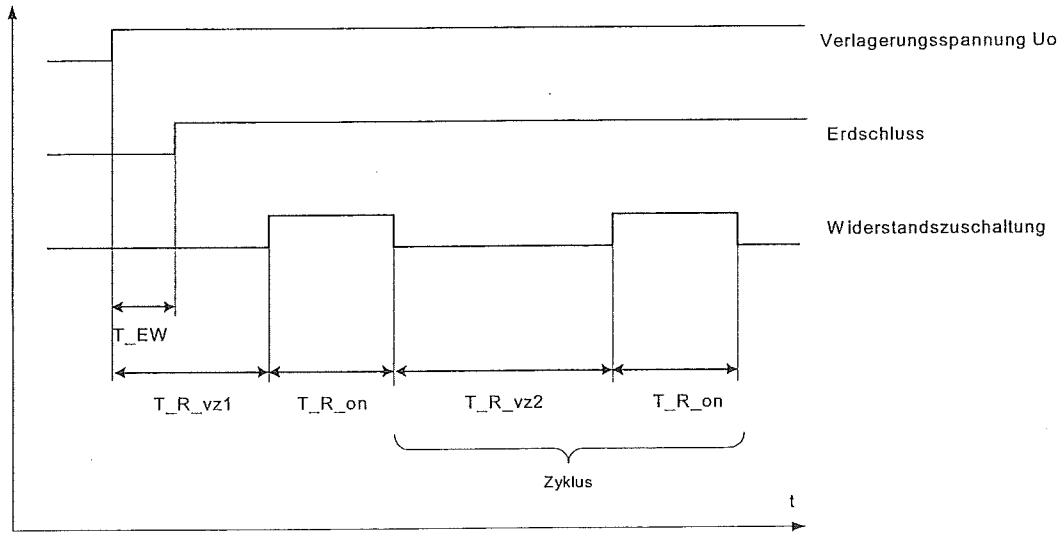


Abb. 8.4: Temporal run of the resistance control

The link of the resistance may additionnaly be triggered off by a binary input or by the serial coupling to the control and instrumentation technology. By supervising the resistance temperature rise by means of a thermical model, it will be checked before switching of the resistance if the limit temperature of the resistance is exceeded. If there is the danger that this limit temperature will be exceeded, then, the switching of the resistance will be blocked. The switching will only be possible again if the resistance has been cooled down enough to be under the limit temperature during the ON time. This thermical overheating of the resistance will be sent as message.

When the switching of the resistance is triggered off manually by a binary input or by the link of the serial control and instrumentation technology, the switching is not made before the run-out of T_R_vz1. In a manual trigger-off, the switching is made, even if there is no earth fault.

Automatical repeat cycle:

By the parameter T_N_cycle, the number of the repeats of the 2. ON-switching cycle consisting of the times T_R_vz2 and T_R_on may be set. If a value here is set bigger than zero, there will be the trigger-off of further switchings of the resistance after the first one which is auomatically triggered of by the increment of the residual ohmic current caused by the earth fault.

The new switching of the resistance will also be checked for these cycles by means of the "thermical replica".

The number of the repeats of the cycle consisting of T_R_vz2 and T_R_on depends on the parameter T_N_cyle.

Self-conduct:

If the self-conduct is active, a new start-up of the resistance will be avoided after the first automatical residual ohmic current increment after the begin of the earth fault.The resistance automation will go to blocking.

A manual trigger-off of the residual ohmic current increment by a binary input or by the serial coupling is possible at any time. However, the resistance automation supervises the temperature of the resistance by a thermical replica.

Through the self-conduct it may be prevented that it may come to a permanently repeating start-up of the resistance in the case of high-ohmic earth faults resp. in the case of re-igniting earth faults.

The resistance automation may be made "ready"again by a binary input or by the serial coupling. The turning off and on of the resistance automation may also make the resistance automation "ready".

If the self-blocking is set to **AUTO**, so there will be, after cooling time of the resistance T_R_cold, an automatical "ready" making of the resistance automation for the next earth fault.

Setting parameter:

Title	Range	Factory-setting	Description
R-Control	**OFF** ON	OFF	Switching status of the resistance automation
T_EW	0,1s ...	5s	Transient earth fault - time, delay time between the entering and the message of the earth fault
T_R_vz1	0,1s...20s	1s	ON-switching - delay time after recognition of the earth fault
T_R_on	0,1s...20s	1s	ON time of the resistance
Self-conduct	**OFF** On Auto		Self-blocking after the first residual ohmic current increment
T_R_on_max	5s...200s	10s	Maximum ON time of the resistance
T_R_Temp		200	Final temperature of the resistance after T_R_on_max provided that there is an ambient temperature of 40 °C
T_R_cold	60min ... 600min	120min	Cooling time of the resistance down to the temperature of 40°C (T_R_cold = 3 * cool-down time constant)
T_R_vz2	0,1s ... 100s	1s	ON-switching - delay time 2, Repeat delay after the last resistance start-up.
N_cycle		0	Number of the repeats of the start-up cycle consisting of T_R_on and T_R_vz2(0: no automatical repeat)

Binary input functions:

Title	Description
R_auto_on	resistance control on: An impulse switches the resistance control on
R_auto_off	resistance control off: An impulse switches the resistance control off
R_auto_onoff	The On-switching status of the resistance control changes by every impulse on this input line
R_block	Blocking the resistance control.
R_block_T	Coincidental blocking of the resistance control and of the regulator e.g. by overtemperature of the P-coil (Buchholz relay)
R_start	Manual start of the resistance control. (The increasing edge of this signal is evaluated.)
R_ready	Cancelling the self-blocking

Relay Output functions:

Title	Description
R_auto	resistance control active
R_ready	resistance control is "ready"
R_T_on_max	Resistance is too hot (triggered off by the internal thermical replica)
R_on	Turn-on of the resistance
R_block	Sum message of the blocking of the resistance control. The resistance is either blocked by the thermical replica or by a binary input resp. by the control and instrumentation technology.

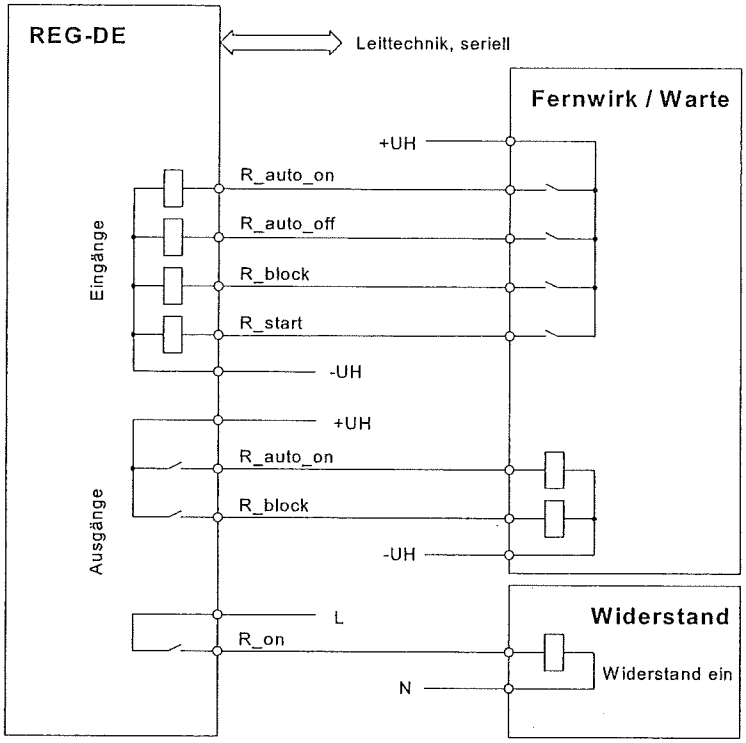


Abb. 8.5: Example for the protective circuit of the resistance control

The resistance control will be released by one of the following events:

- activation by the menu of the regulator
- Impulse by the binary input function E_R_auto_on
- First impulse by the binary input function E_R_auto_onoff
- Switch-on - command by the control and instrumentation technology

The resistance control will be switched off by one of the following events:

- deactivation by the menu of the regulator
- Impulse by the binary input function E_R_auto_off
- Second impulse by the binary input function E_R_auto_onoff
- Switch-off - command by the control and instrumentation technology

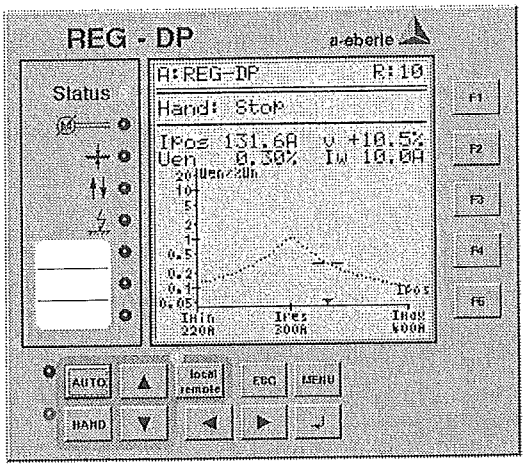
In case of an activated resistance control, a start-up of the resistance would be avoided if the limit temperature during the following ON time had been outranged. The thermical model does not only consider the switching-on and cool-down times but also the offset voltage available during the ON time. This means that the resistance may be linked more often with higher-ohmic earth faults for which the offset voltage is lower. With activated resistance control, the regulator display monitors the remaining number of the admissible resistance start-ups in the upper right-hand corner of the display for the case of a dead earth fault.

On request, as well the remaining ON time as also the present temperature of the thermical replica may be edited by an analog output or transmitted to the control and instrumentation technology by the serial link.

If the resistance control is activated, an automatical trigger-off of the resistance start-up will be made as soon as the offset voltage is outranged although regulator itself is on mode "HAND".

Indication:

The status of the resistance automation is shown in the upper right-hand corner of the LCD-display:



The following indications are possible:

Indication	Description
R:10	Resistance control active and 10 residual ohmic current increments are possible for full offset voltage
*R:10	The residual ohmic current increment is about to be made. During the complete connection time T_R_on a star is shown.
R:0	The resistance is too hot. A new connection is not possible before the remaining residual ohmic current increments have taken at least a value of 1. The message that the resistance has reached its limit temperature will additionnally be sent by a relay.
[R:10]	The resistance automation is blocked

8.1.6 Parallel - Regulation

The Parallel - Regulation permits the recognition if there is a link by the E_LAN to the second regulator or not. If both regulators are installed in the same transformating station, a link via the E_LAN will be possible and the regulators may interchange the information directly.

If the regulators are installed far from each other, a communication by the E_LAN is mostly not possible. Nonetheless, both regulators will see the same offset voltage Uen, as soon as they are switched together in an neutralization field.

8.1.6.1 Master-Slave Operation mode

In the easiest form of a Master-Slave operation, a regulator will be blocked, as soon as the coupling of the two regulators is recognized. The present coil position of the slaves will be transmitted to the master by the E-LAN and, if required, considered for the calculation of the compensation. For the calculation of the setpoint position of the Petersen-coil, even possibly switched fixcoils as well at the master as also at the slave are taken into consideration.

The setpoint detuning in a per centual compensation v[%] is calculated as follows:

$$I\_soll = v / 100 * ((\ Ipos\ + I\_fix\ )_{Master} + (\ Ipos + I\_fix)_{\ Slave}\ )$$

In the Master-Slave operation, the Master recognizes as well the present coil position as also the possible changing range of the slave. If the Master recognizes during its tuning process that it may not reach the required final position but that this would be possible if the slave was changed so this will be made if it is permitted by the parameterization.

The following parameters are available for the parallel-regulation:

Title	Range	Factory-setting	Description
Parallel - Prog	OFF; Master/Slave; without comm.	OFF	Type of the used Parallel regulation
Parallel - Prog. active	OFF ON coupling	OFF	Kind of the activation of the Parallel - Programms
Slave identifier	A: ... Z4	--	Identifier of the slave.
Pulling of slave	NO YES	NO	Is the Slave to be changed by the Master.
SlavePosition when Umin	Stop rest_Su tuning pos	Stop	Position of the Slave if the offset voltage is Uen < Umin.

Depending from the set parameter, the parallel regulation with communication by the E-LAN is activated by a binary input. This coupling information (coupling) may also be sent serially to the regulator by means of the control and instrumentation technology (Precondition: control and instrumentation technology link by REG-P).

If two regulators are declared as Master at the same time, the regulator with the higher identifier will be the Master.

The Master recognizes the parallel operation, shows this on its display and sends an information to the Slave that it has to a Slave now. The Slave receives the information cyclical that it is a slave

during the parallel operation. If this information fails, the regulator will be an autonomous regulator again.

The Slave shows its "Slave-status" in its status line. The Slave may only be set into this status if it was set to automation before.

The Slave delivers its present coil position including a possibly activated fixcoil to the Master by the E_LAN.

The activation as Slave will even be made if this regulator is set on HAND. However, in this case, the Master must not pull the Slave even if this option is activated. The operation mode HAND is given priority.

If the Slave is corrected by the Master, there will be an indication on the Slave that it is being positioned by the Master: "Slave is being positioned"

Finishing of the coupling

Master:
The regulator leaves the status "Master" and starts the search procedure after the long delay time (Finishing is recognized as switching action in the system).

Slave to AUTO:
Slave leaves its blocking status and starts its search procedure after long delay time (Finishing is recognized as switching action in the system).

Slave to HAND:
The indication "Slave" is deleted on the screen. The regulator changes into the status "HAND".

8.1.6.2 Possible scenes for the Master Slave- operation:

8.1.6.2.1 Sound system :

- Master recognizes the busbar-coupling by the binary input
- Master sends the information cyclically to the Slave that it is the Master now.
- The Master takes over the coil position of the Slave and of the fixcoil values for the calculation of the setpoint position. The coil position of the Slave is sent cyclically to the Master.
- After the run-out of the search delay a tuning test of the Master will begin

- If the setpoint position lies within the changing range of the Master, the Master will get into the status "**Tuned**".

- If the setpoint position lies outside the changing range of the Master, the necessary difference will be calculated so that the future setpoint position will be approx. 10% within the changing range of the Master. This coil difference is demanded by the Slave.
- The demand is only made if the pulling of the Slave is released in the Master.
- If the Slave is present and the function "Pulling of slave" is activated, the Slave will try to deliver this required coil-difference. The Master will get the following information from the Slave:
  - Slave is about to be "pulled"
  - Final position reached
  - Final switch reached
  - Error when positioning

- As soon as the Slave has reached its final position or the final switch, the Master will begin with a new tuning process (Delay: forcing search).
- If the setpoint position lies within the changing range of the Master, the Master will get into the status "**Tuned**".
- If the setpoint position lies outside the changing range of the Master, the Master will get into the status "**Tuned,not compensated**".

8.1.6.2.2 Sound system but Ures < Umin:

- Master / Slave Regulation essentially effects like in the sound system.
- Slave position when Umin: Off
  Master once searchs the complete changing range. If it does not find an offset voltage over Umin, the Master will drive to the rest position or to the last point of tuning (Selection Parameter in the menu). The Slave is not being changed.

- Slave position when Umin: rest position
  - Master once searchs the complete changing range. If it does not find an offset voltage over Umin, the Master will, at first, remain in the final switch.
  - The Slave is regulated in its rest position
  - If Slave is positioned successfully, the Master will once again try to find an offset voltage bigger than Umin, e.g. the complete coil range will be driven through once again.
  - If the Master finds an offset voltage bigger than Umin during the search and may drive to the compensated value, the Master will get to the status "Tuned".
  - If the Master finds an offset voltage bigger than Umin during the search and if the compensated value is outside this range, the difference amount will be demanded by the Slave (if permitted).
  - If the search of the Masters is not successful, the Master will be positioned to its rest position resp. to the last point of tuning (Selection Parameter in the menu of the Master). The regulator changes to the status "Tuned Umin".

- Slave position when Umin: last point of tuning before Slave - operation
  The regulation is made as above but instead of the rest position the last point of tuning before the Slave-operation is used.

The number of searching procedures is supervised. If the regulator does not reach the status "Tuned", "Tuned not compensated" or "Tuned Umin" within the permitted searching procedure, an interference message will be produced..

8.1.6.2.3 Sound system but Ures > Umax:

Master changes to the regulation "Umax"

8.1.6.2.4 Earth fault

- Slave is blocked
- Only the Master is readjusted according to the setting in the menu:
  - Off
  - Ires
  - Chart
  - Ires + Chart

8.1.6.3 Parall - Regulation without communication by E-LAN

In this regulation, special data may no longer be interchanged by a communication system. In order to reach a stable regulation even for several regulators in a system sector, some marginal conditions must be adhered to:

The following parameters must be **equal** for all regulators present in the same neutralization field:

- Absolute compensation
- The same value of the compensation in [A]
- Option Parallel-Regulation without communication activated by E-LAN.

Principle of the procedure:

This procedure may be compared to the talk behaviour of humans in a small group. If there is an event, so that some in a group would have to say something one person would be a little bit faster and begin to speak. As soon as the others realize that someone has taken the word, they would wait politely until the first person has finished to speak. If there was still something to say, the next person would speak. The others would then recognize again that someone speaks and would again wait for reasons of politeness until this person has finished to speak. If no one has anything more to say, they would wait until the next event happened to be.

This simple procedure is rebuilt in the regulators but the common media now is the offset voltage Uen. If the offset voltage is changing slowly, this will be leading to the assumption that another regulator is making a tuning procedure.

In order to avoid that the reaction speed of the regulator to a switching position becomes different, the trigger-off time is linked to a random number. This means that a random number in the range between zero and the coil running time will be added to the menu time set in the menu.

Before the regulator begins its search run, the offset voltage recorded within the last 20 seconds is checked if this offset voltage has not left the tolerance band during these 20 seconds. The present offset voltage is used as reference value for the tolerance band. If this is not done, there will be assumed that the other regulators have finished their tuning procedures.

If the offset voltage is outside the tolerance field, but now referred to the last tuning process, a new searching procedure will be started.

This procedure is no restricted to two regulators. The time until the tuning of the complete system increments with the number of parallel switched regulators.

In this procedure it may also not be made sure that each regulator takes over a defined part of the compensation. The neutralization condition is only fulfilled for the complete system. Should the strategy exist that the first measurement in case of an earth fault is to divide the big system in smaller parts, then, this procedure should not be used there.

8.2 Putting into operation

In the menu point Putting into operation, all characteristics in the link of the regulator to the process are defined.

F3: Putting into operation
F2: Voltage measuring
F3: P-coils
F4: indication Options
F5: Inputs & Outputs

F2: Fault acknowledgement
F3: Current measuring

8.2.1 Interface to the Petersen coil

When putting into operation, a semi-automatical adaptation of the regulator to the P-coil is made. For the calibration procedure, at least the following parameters of the P-coil are required for the insertion:

Title	Description
Imin	Neutralization current in the lower final position of the P-coils
Imax	Neutralization current in the upper final position of the P-coils
E_Type	Type of the final switches (open, close, None)
E1	Nominal value of the P-coil voltage in the case of an earth fault.
Uen_nenn	Nominal value of the offset voltage in the case of a dead earth fault at the secondary side of the voltage transformer integrated in the P-coil

In the following block diagram please find the assignment of the position message and the final switches:

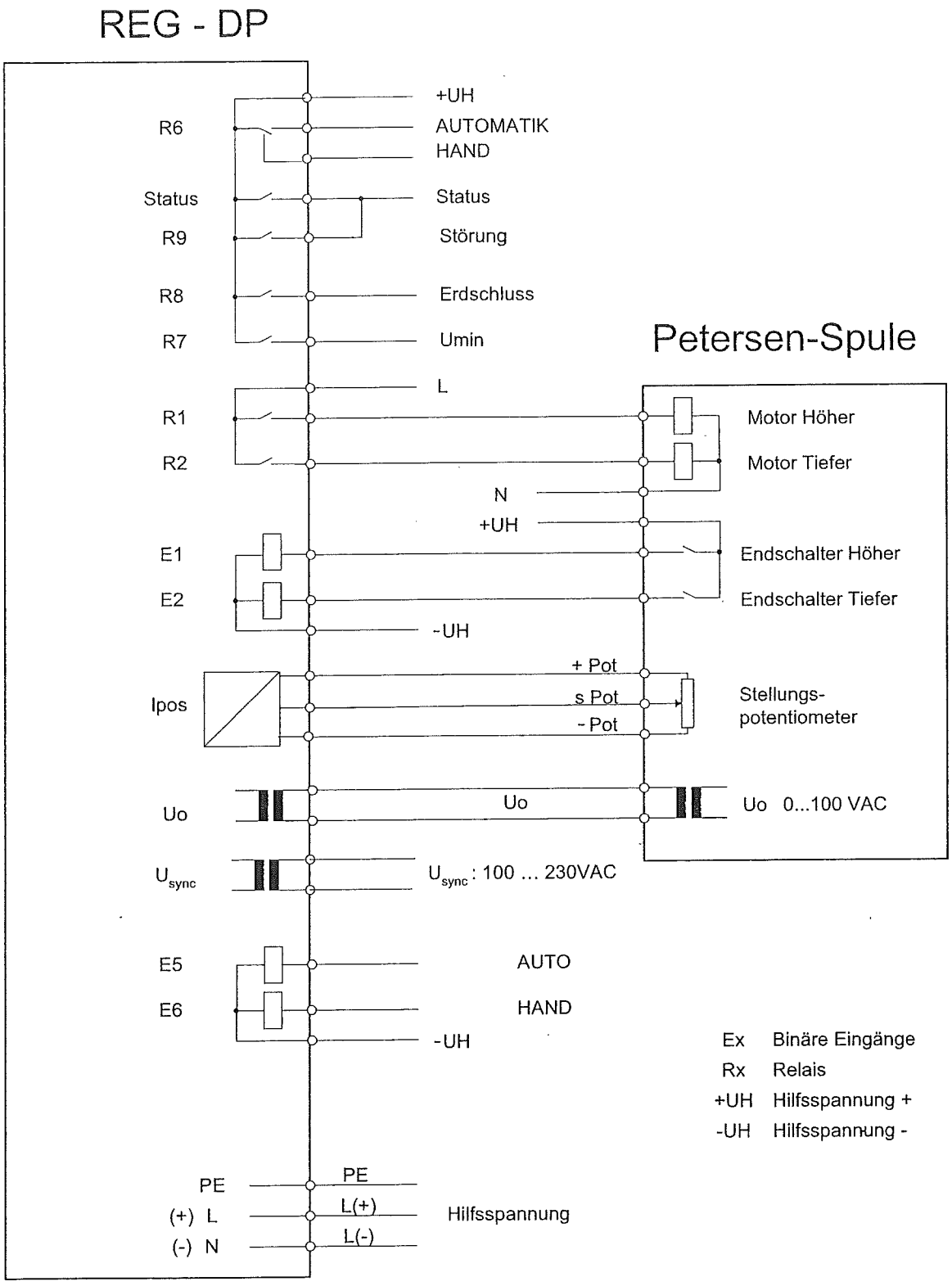


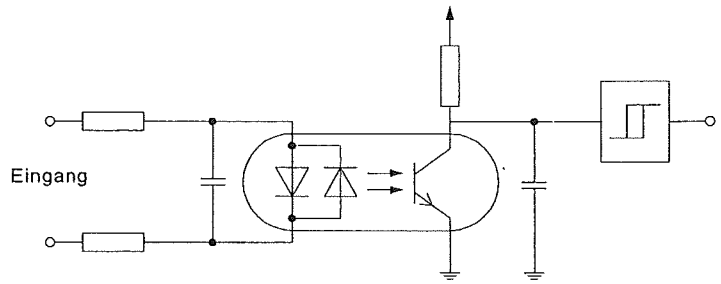
Abb. 8.6: Coil position and Final switch assignment

When putting into operation a check is made of the following points by the regulator:

- Phase failure from regulator to locator of the P-coil (Potentiometer)
- Correct sequence of the wiring of the potentio meter (Pot+, Pot s, Pot-)
- Control of the direction of the coil movement in connection with the final switching messages
- The assignment of the final switches to the upper / lower voltage divider ratio of the coil position display
- Selection of the final switch types (There may for example not be both final switches on at the same time)

Binary inputs:

The "Binary Inputs" for the final position messages consist of optocouplers which are suitable as well for alternating voltages as also for direct voltage geeignet sind. There are high-ohmic resistances to be switched before these optocouplers so that the on-switching treshold is approx. 35 VAC.



map. 8.7: principle switching of the binary input

The right type of final switch of the Petersen coil must be given for the functioning of the regulation and for the plausibility control.

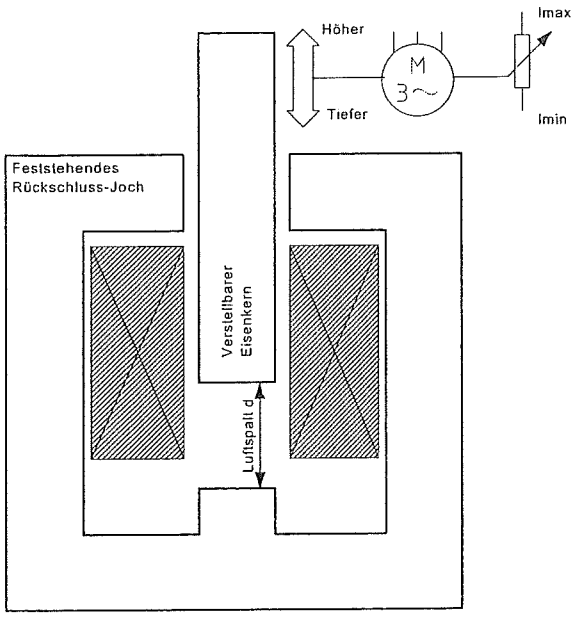
Note:
When using long open lines, interferences may deliver very high voltage values. In particular, the lines to the E-Coil should be controlled in reference to 50 Hz - interferences.
Possible measurements when interferences are too high:

- *parallel switching of condensators to the input: the additional capacity reduces the effects of the interferences by the better voltage divider ratio*
- *attenuation of the input by an additional resistance*
- *setting of interrelays with a higher response treshold*

The binary inputs of the "Final switch Higher" and "Final switch Lower" are already delivered with a condensator (1µF) from the factory.

coil position:

The potentio meter is coupled with the drive of the P-coil by a gearing. Therefore, the divider ratio of the potentio meter corresponds to the air gap d in the iron circle of the P-coil.In a linear coil, the inductivity would be reversed proportional to this air gap. The real flowing current through the P-coil, if the P-coil is connected to the nominal voltage, is again reversed proportional to the inductivity. This, however, means that the current through the P-coil on the primary side when nominal voltage is proportional to the length of the air gap d in the P-coil. This is one of the reasons why the P-coil is gauged in [A].



Map 8.8: *principle structure of a Petersen Coil*

In the reality, however, the flowing of the P-coil current through the P-coil when nominal voltage is not completely proportional to the length of the air gap resp. to the potentio meter status due to non-linear couplings of the magnetic fields. This may be seen on the non-linear distribution of the mechanical current display. This mechanical indication is adapted to the P-coils by a real measuring at a P-coil, which is made directly in the factory. The regulator, however, can only measure at the potentio meter. An adaptation to the non-linear connection of the P-coil to the gauged coil current of the mechanical indication is usually made when the combination regulator / P-coils is being put into operation.

In the following map the principle input switching to detect the coil position is shown:

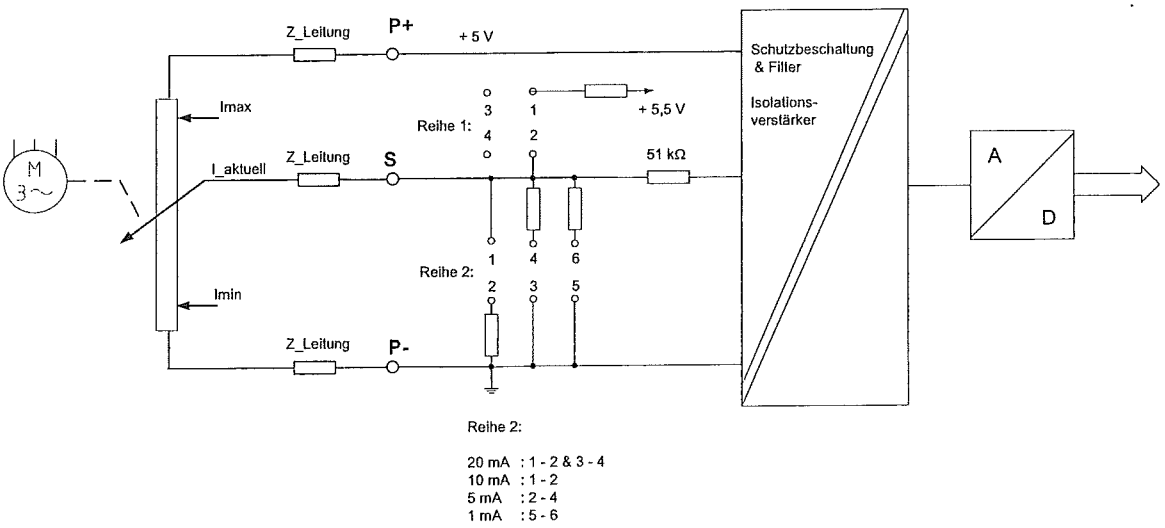


Abb. 8.9: *principle structure of the analog input to the determination of the coil position*

Potentio meter:

A voltage of approx. 5 V is given from the regulator to measure the coil position. In the regulator, a current limitation and protective resistors have been mounted into the terminal for the case of a short circuit of the terminal blocks. Thus, a short circuit between the three phases Pot+ , wiper and Pot- during the putting into operation is not dangerous. The input to measure the voltage at the wiper (Us) is very high-resistant.

By the jumper 1-2 of the row 1 there is the feeding of a voltage, which permits the recognition of a phase failure at the wiper.

For the measuring, the phase resistances from the regulator to the potentio meter of the P-coil are added. These may be in the range of some Ohm if the P-coil is placed some 100 m away from the regulator.d

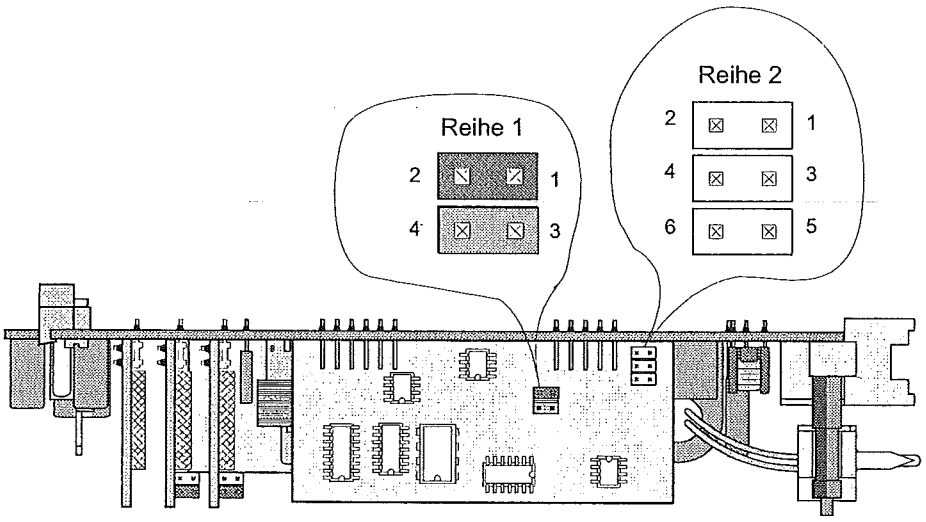
Due to the making process of the P-coil it is usual to use only part of the changing range from the mounted potentio meter. This means that from a 200 Ohm potentio meter only, for example, the part range of 20 Ohm up to 150 Ohm is covered by the P-coils. This assignment may differ even with P-coils of the same type of construction which is due to production tolerances.

Current source 0...1mA to 0...20 mA

In these sensor-switches an additional displacement of potentio meter status to a load-independant current is made already in the motor junction box of the P-coil. In some transducer, as well the offset may be freely programmed as also the reinforcement of the transducer. In some devices, even a linearization of the characteristic is possible with little work.

Position and Function of the jumpers on the Subprint

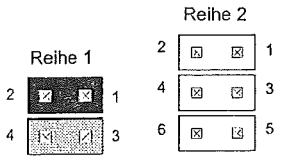
In the following map the corresponding positions of the jumpers on the Subprint of circuit board 3 are shown:



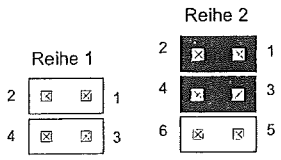
Map 8.2: Position of the jumpers for the coil position

Note:
In the row 1 the position 3-4 is an empty position and may serve as carrier for reserve-jumpers and is possibly be equipped (on the following maps: orange jumper).

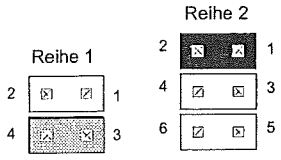
Potentiometer (180 Ohm .... 3 kOhm)



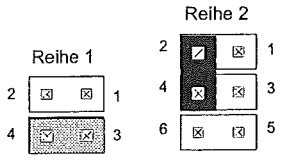
Stromquelle 20 mA



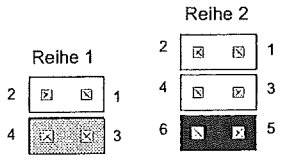
Stromquelle 10 mA



Stromquelle 5 mA

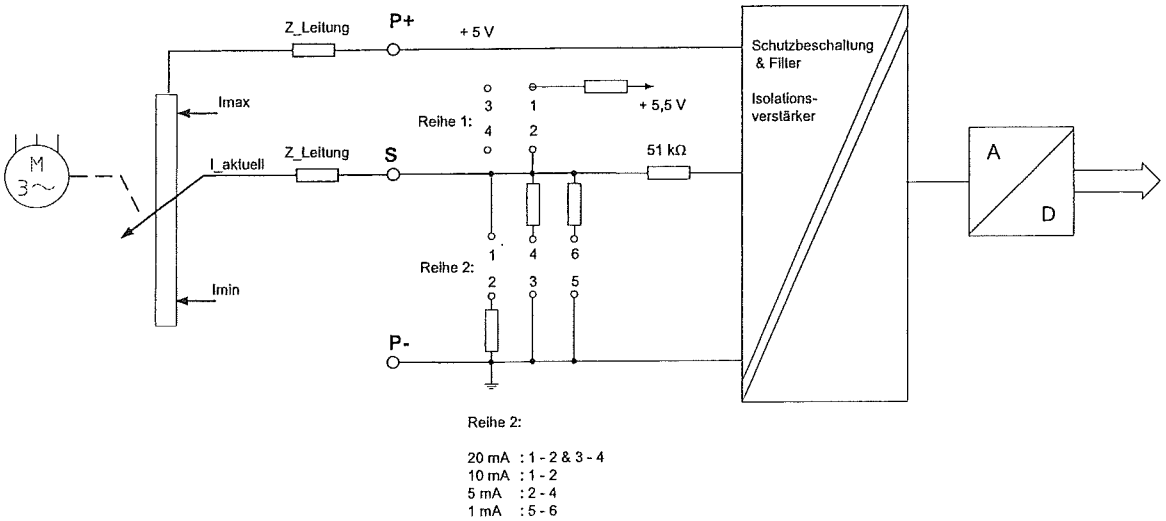


Stromquelle 1 mA



Map 8.3: Plug-in of the jumpers depends on the input function

Note:
The usual delivery status of the jumpers for the position message is made by means of a potentio meter.



Map 8.4: Potentio meter in two-phase - wiring

If the potentio meter of the coil position is only available in two-phase connection, the switching shown in *Map 5.14* may be used. In this case the jumper 1-2 of the row 1 does not have to be equipped. Corresponding to the maximum resistance value of the potentio meter there must be the setting of a jumper in the row 2 considering the chart below and *Map 5.12*.

Resistance range of the Potentio meter	**Equivalent current source mA**
0 ... 225 Ohm	20
0 ... 450 Ohm	10
0 ... 900 Ohm	5
0 ... 4500 Ohm	1

Putting into operation:

Some functions have been implemented in the regulator to simplify the putting into operation. The following steps are taken with the putting into operation:

- Changing of the P-coil into the lower final position.
  In the lower final position, the assignment of the present potentio meter position effects to the given minimum coil current Imin by the regulator. The lower final position itself is given by the "Final Switch Lower" recognized by the digital inputs. If the option "No final switches" is selected, the final switch will be recognized if there has been no return message of a coil changing for a longer period of time. In this case, no error message will be produced but the assignment Imin will be brought to the momentarily measured coil position.

If the P-coil has already been in the lower final position at the beginning of the coil calibration, the P-coil will at first be set into the direction of the upper final position for 5 s before the search run will start. Then the search procedure of the lower final position will begin as described.

- Changing of the P-coil into the upper final position
  Analog to the lower setting, the assignment of the potentio meter position to the given minimum coil current Imax effects in the upper final settings. Here, too, the upper position is recognized by the message "Final switch Higher" resp. by selection of the option "No Final switches" by the potentio meter if there has been no return message of a coil changing for a longer period of time.
- Changing of the P-coil into the middle of the changing range
- Measuring of the "coil-overshoot" and of the coil play by evaluating the behaviour of the P-coil onto the direction reversal of the coil changing.

The following points are especially supervised with putting into operation through the regulator:

Signals	Action	Error description
ET=1 & EH=1		Wrong type of final switch has been selected
dIpos = 0	Mot ⇑ resp. Mot ⇓	There is no message back from the coil position after a changing command. Possible causes are: - Changing command is not edited by the regulator - Coil does not react on changing command - Motor protecting switch fallen - Contacter in the P-coil wrongly wired - Contacter in the P-coil deficient - Coupling Motor - Potentiometer not ok - Potentiometer in the P-coil connected incorrectly - Error in the wiring potentiometer - regulator
dIpos = -	Mot ⇑	The change of the P-coil is made in the wrong direction
dIpos = +	Mot ⇓	The change of the P-coil is made in the wrong direction
dIpos = 0 ET = 0 Ipos = Imin	Mot ⇓	The P-coil is already in "Final switch Lower". The motor junction box in the P-coil has already reacted. The message of the second final switch for den regulator is not messaged by the P-coil. => Check final switch assignments.
dIpos = 0 EH = 0 Ipos = Imax	Mot ⇑	Error behaviour as above in "Final switch Higher".
Us > Upot+		Phase failure at the wiper
Ipos strongly non-linear		Connection at the potentiometer mixed - Pot+ ⇔Pot s - Pot - ⇔Pot s This error may not always be recognized immediately because, during a coil changing, a change of the divider ratio is recognized. This is due to the protective resistances and phase resistances. (See *map 8.8: principle structure of a Petersen Coil*)
Ipos unsteady		Gaps in the potentiometer, for instance the sliding contact lifts up in certain positions
Ipos in steps		Too rough grading of the potentio meter, for example wire potentio meter with only 13 windings
Ipos Hysteresis		Coil play The core of the P-coil is changed but the corresponding movement is not edited by the potentiometer ausgegeben wird. This is caused by a mechanical play between the movement of the core and the movement of the potentio meter.
Ipos with interferences		Interferences on the digital input of the final switching messages

The following images result from the errors described above

Assumption:
Pot+: (R+) + R_{line+} = 10 Ohm
Pot-: (R-) + R_{line-} = 10 Ohm
Pot: 200 Ohm (Total resistance of the potentio meter in the P-coil)

The range at the potentiometer is used from the P-coil between 10% and 80%.

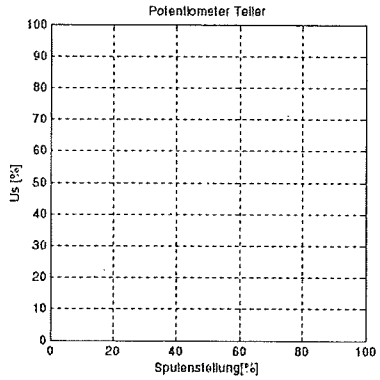


Abb. 8.10: *Wiring okay*

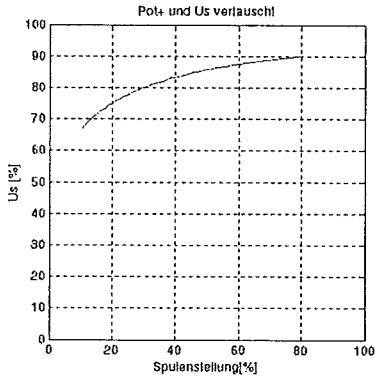


Abb. 8.11: *wiper and Pot+ mixed*

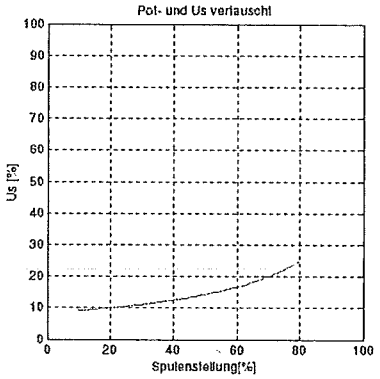


Abb. 8.12: *wiper and Pot- mixed*

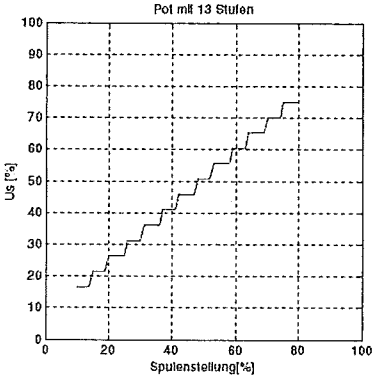
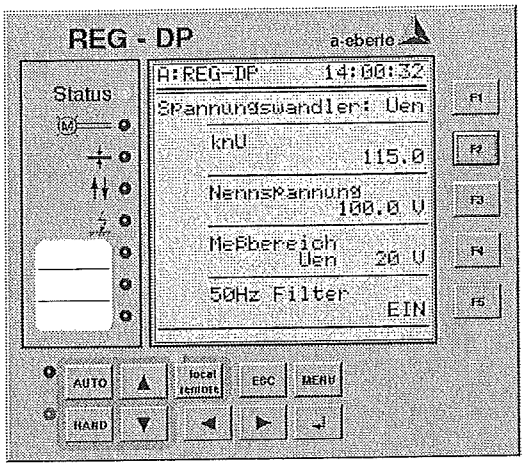


Abb. 8.13: *Potentio meter with 13 steps*

8.2.2 Voltage measuring



Setting the transmission ratio knU

knU corresponds to the conversion rate to the primary voltage of the offset voltage

$$knu = \frac{U_{Nenn}[V]}{100[V]} \qquad (8.5)$$

Example:

For a 20 kV system : $knu = \frac{20[kV]}{\sqrt{3}} * \frac{1}{100[V]} = \frac{11550[V]}{100[V]} = 115$

standard setting: 115 (for 20 kV system)

nominal voltage
The indicated nominal voltage corresponds to the nominal voltage of the voltage transformer to measure the offset voltage on the secondary side. The values of 100 V and 110 V are usual.

standard setting: 100 V

measuring range Uen (Only with REG-DE Version 1)

For the version REG-DE I the following ranges may be selected:

1 V
5 V
20 V
100 V

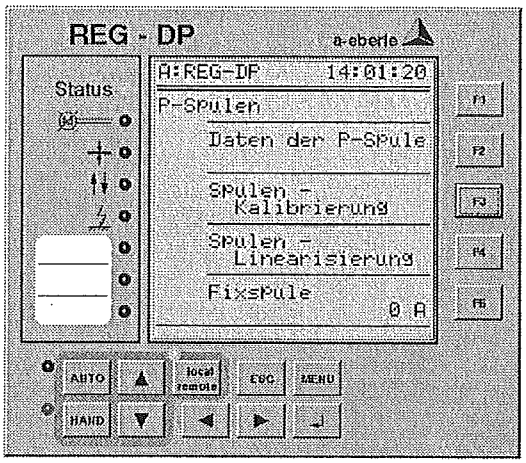
Filter 50 Hz (Only with REG-DE Version 1)

For the regulation only the 50 Hz component of the offset voltage Uen may be used. In the zero system there are also harmonic voltages included which may lead to an incorrect tuning. To eliminate resp. reduce these harmonic voltages considerably, the 50 Hz Filter is activated. In the REG-DP II Hardware the filter is always switched on.

Selection possibilities:

ON	Das 50 Hz Bandfilter is activated.
OFF	Das 50 Hz Bandfilter is turned off.

8.2.3 P-coil



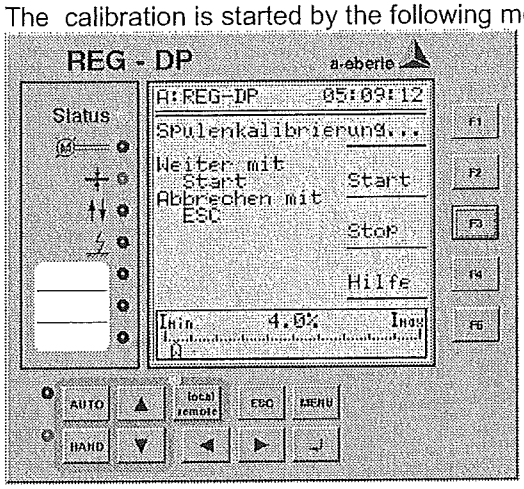
8.2.3.1 Data of the P-coil

In this menu the following values may be set:

Title	Factory-setting	Description
Imin		Neutralization current in the lower final position of the P-coil
Imax		Neutralization current in the upper final position of the P-coil
Ipos: connection		Only with REG-DE I: Selection of the connection version: Pot, 0..20 mA , 3phases, 4phases
Ipos: R-value		**Only with REG-DE I:** Resistance value of the locator as for example 1 kOhm
Final switch	close	Type of the final switch (open, close, None)
Soft-Final switch active	Off	If the final switches simulated by the software are active, the searching resp. positioning range of the Petersen Coil will be limited to these values. Will not be active before the coil calibration.
Soft-Final switch Imin	0 A	"Final switch Lower" simulated by software
Soft-Final switch Imax	999 A	"Final switch Higher" simulated by software

8.2.3.2 Coil calibration

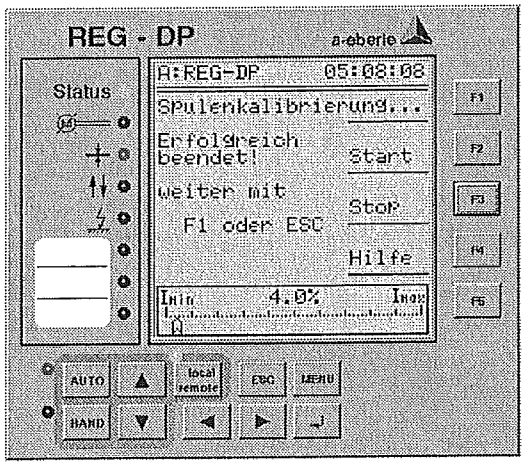
In this menu the calibration procedures which have been described very clearly above are executed.
The calibration is started by the following menu display.



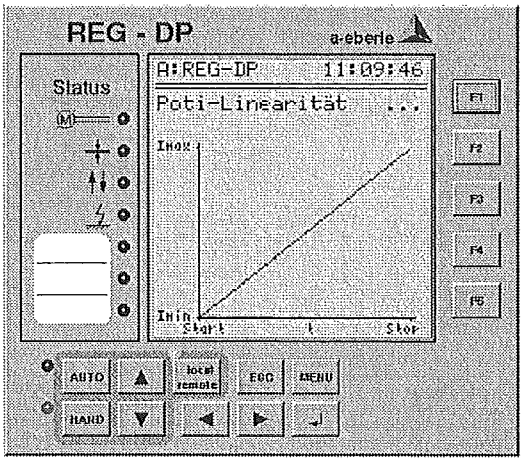
In the coil calibration there is primarily searched for the Final switch "Lower". Then the P-coil is set in den Final switch "Higher". After that, the coil-play and the coil-overshoot in the middle of the changing range is measured. The P-coil is immediately changed to the lower final position in preparation for the following coil-linearization.

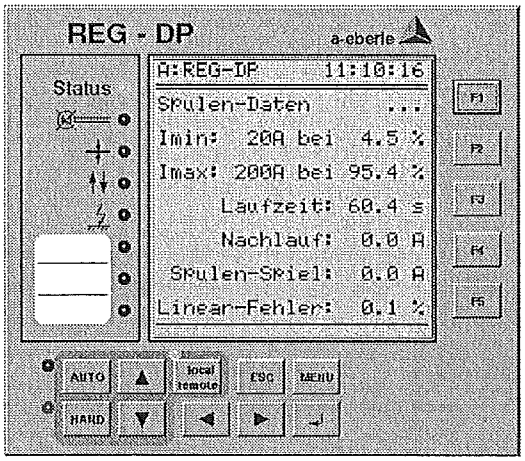
The measured coil-overshoot and the **coil-play** are taken into consideration during the regulation.

The successful coil calibration is shown on the screen as follows



The results of the calibration are to be read on the following pages which may be turned by <F1>.

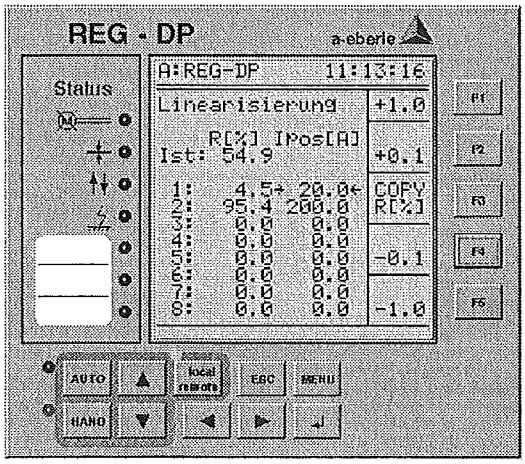




If the non-linearity of the potentiometer-characteristic is too big (> 2%) the wiring will have to be checked. For details see chapiter "8.2.1 Interface to the Petersen coil"

With the coil calibration only the two final switches are assigned. If the scaling on the mechanical indication of the P-coil was non-linear, so there should also be a linearisation for the regulator.

8.2.3.3 Linearization of the coil



For the linearization the following procedure is recommended:

- Manual change of the P-coil to the lower final position
- Selection of 8 support points, please use here in the lower range of the P-coil more supporting plates because the non-linearity in this range usually is bigger.

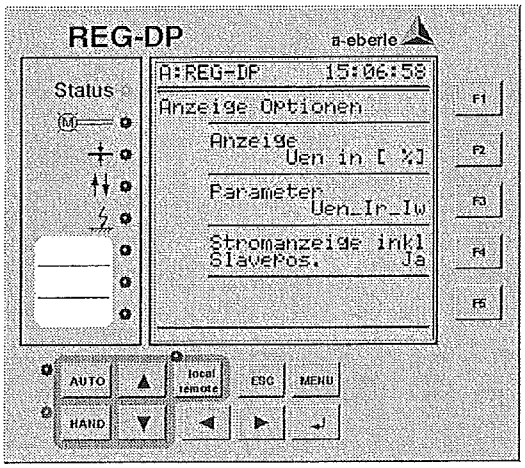
  Please do only select supporting plates which are marked on the P-coil on the mechanical indication. The approach to these supporting plates should always be from the bottom to the top so that mechanical plays will have no effects.

5. Change the P-coil to the next selected support point
6. By arrow key < ⇒ > select next line
7. By <F3> take over the ohm value of the P-coil
8. Rectify the indicated value of the current in [A] to the locally set value of the P-coil

- Repeat the last 4 steps until all 8 values are set or Imax is reached.

8.2.3.4 Indication Options

For the adaptation of the screen-indication the following menu points are available:

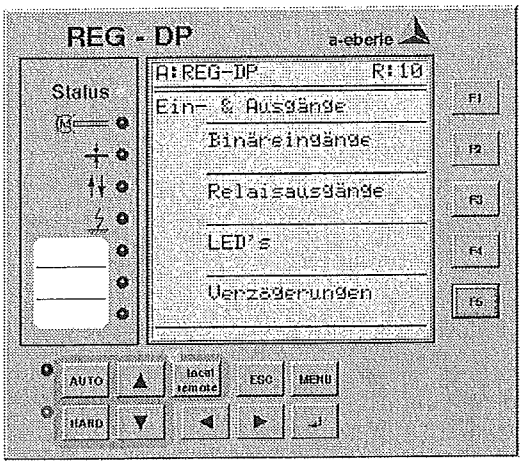


Menu point	Factory-setting	Note
indication Options		
F2: indication Uen in	%	Display of the offset voltage on the screen. Selection possibilities: % ... Uen referred to the nominal value V ... Secondary side of the voltage transformer kV ... Primary side of the voltage transformer
F3: Parameter	Uen, Ir, Iw	Display of the calculated parameters of the resonance wave Selection possibilities: Uen, Ires, Iw k, v, d
F4: current display incl. Slavepos.	Yes	Selection, if, in Master-Slave operation, the present coil position of the Slave is to be added and shown as sum to the present position of the Master.

8.2.3.5 Fixcoil

Sum of the Fixcoils in the neutralization range.
For the calculation the fixcoil will only be used if these ones are activated by the binary input or by the serial control and instrumentation technology link. Another possibility of activation is offered by the background programme in connection with the Parallel-Regulation programmes.

8.2.4 Inputs & Outputs



8.2.4.1 Binary Inputs and Outputs

The binary Inputs and Outputs of the regulator may directly be configured by the menu of the regulator. In the following map the principle coupling of binary inputs and outputs to the regulator process is shown:

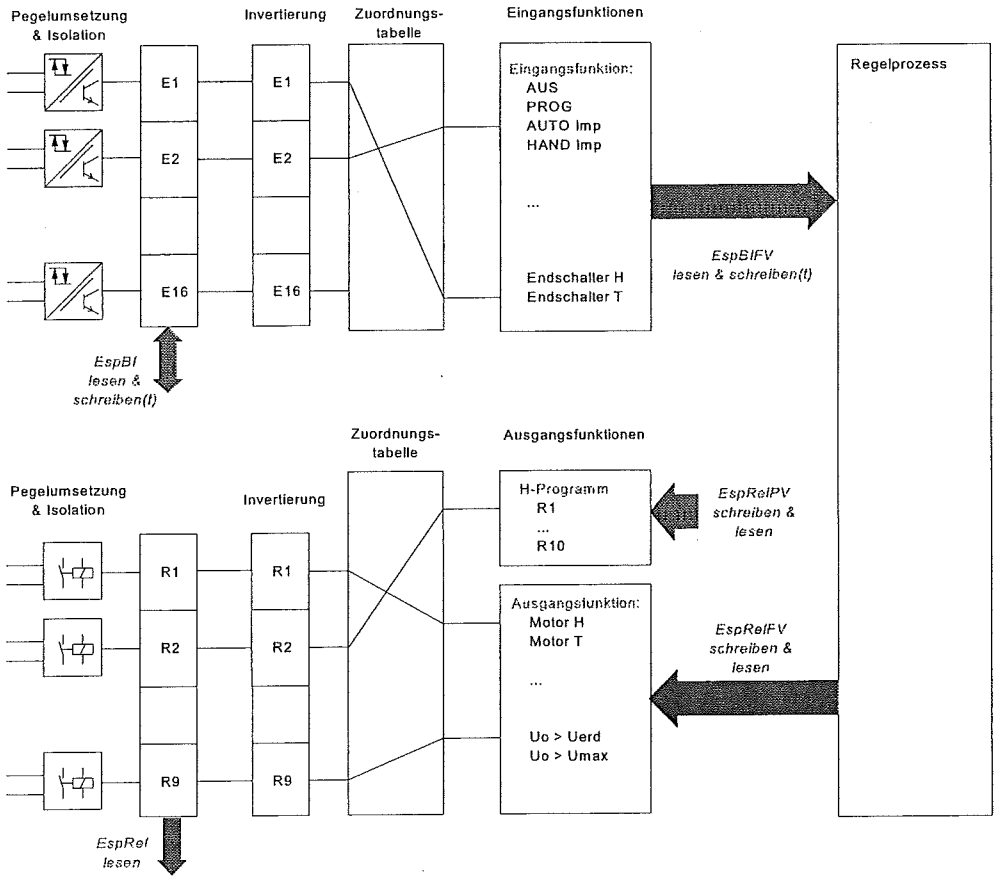


Abb. 8.14: *block diagram binary Inputs and Outputs*

8.2.4.2 Binary inputs

Equivalent circuit

In the following map the principle structure of the binary inputs is shown.

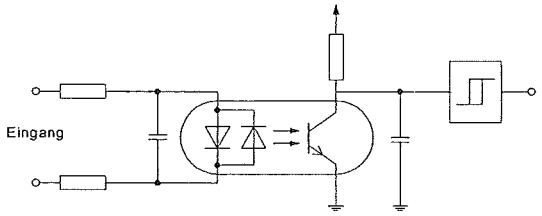


Abb. 8.15: *Simplified input switching*

From Abb. 8.15 it is possible to see that the inputs are suitable as well for AC as also for DC. The switching is made in a way that the contact treshold lies at approx. 30 VAC.

For some input functions, **impulses** which are placed at the input are evaluated. From these impulses only the **incrementing edge** is used in the regulator. The impulse must have a length of **at least 500 ms** in order to be safely recognized. Joint with background programmes the necessary time may possibly be longer.

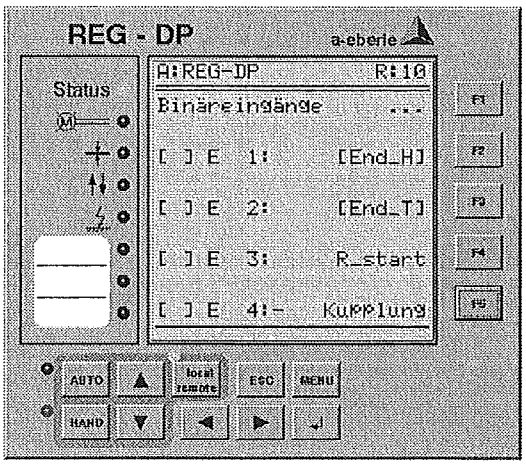
Note:
With long open lines, interferences may deliver very high voltage values. Especially the lines to the E-Coil should be controlled referred to 50 Hz - interferences.
Possible measurements if too high interferences:

- *parallel switching of condensators to the input: The additional capacity reduces the effects of the interferences through the better voltage divider ratio*
- *attenuation of the input with an additional resistance*
- *Placing of interrelays with a higher contact treshold*

The binary inputs of the "Final switch Higher" and "Final switch Lower" are already switched by a condensator (1µF) from the factory.

Configuration of the inputs

Please see menu display of the inputs 1 to 4 as example for the configuration possibilities of the digital inputs directly by the menu of the regulator



Function key <F1> switches to the other inputs E5 to E16.

In the first paragraph, the electrical level is shown in the square bracket and the following maps are possible:

```
[ ]... 0 (Uon < Utreshold)
[x]... 1 (Uon > Utreshold)
```

In the second paragraph, the names of the physical inputs are displayed (E1 to E4)

Immediately after the colon, the activated inverting for each corresponding input function is indicated by a "Minus" (see input E4).

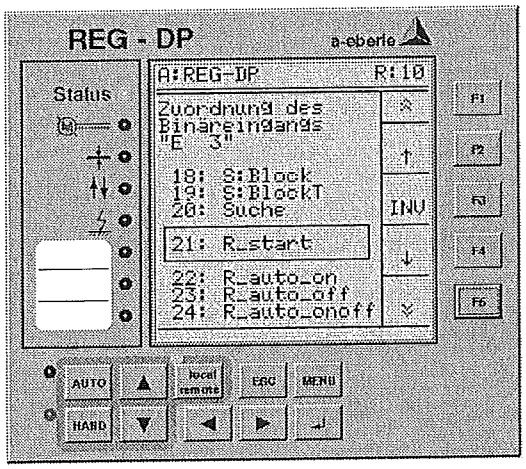
In the last paragraph, the assignment of the physical input to the logical input function of the regulation process is monitored. In the given example, the input E1 is linked to the input function "End_H" (Final switch Higher) of the regulation process. This means that the regulator will realize it by the digital input E1, if the "Final switch Higher" is used.

Should the assignment be **in square brackets**, so this assignment is set by the factory and cannot be configurated by the user.

It is easy to learn from *map. 8.16: principle switching of the binary input* that several physical inputs may be laid to one input function. The single inputs are switched together in the regulator, considering the inverting by an "OR – link".

Selection of the Assignment

Please press the function key of the corresponding input to change the assignment chart resp. the inverting. The following map shows the corresponding selection menu for the input E3



The selected input function, e.g. in this case the No. 21 for the manual start of the resistance control is indicated in a frame. By the selection keys <F2> and <F4> selection may be made of the input function above resp. below whereas each one of the keys <F1> and <F5> turns one page. The key Return takes over the setting übernommen and changes back to the input selection menu

By striking key <F3> (INVers) there may be the inverting of the signal.

Background Programming:

For the very mighty background programming, the following functions are available:

- The recognized electrical level may be read by command EspBI
- The command EspBI enables the background programme in the writing access to overwrite the recognized electrical value for 60 s. Thus, there is the possibility to give an input signal to the regulator by the background programme.
- The measured input function may be read from the background programme by the command EspBIFV (**B**inary **I**nput **F**unction **V**alue).
  Here also is the possibility to overwrite this value for 60 s by the background programme.
- As well the inverting as also the assignment chart may be read by the background programming. The released assignments may also be changed by the background programme.

There may be the assignment of the following input functions to the physical inputs:

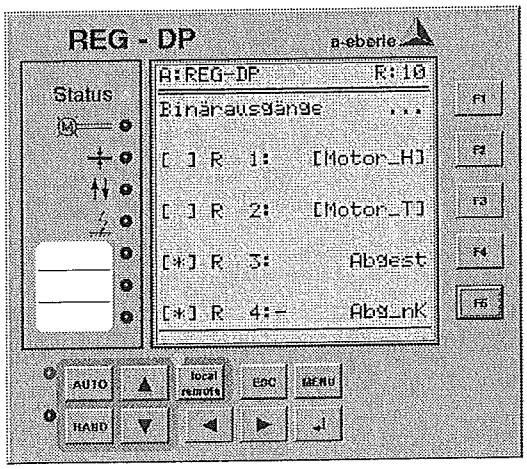
Nr.	Name	Function
0	OFF	The input is not assigned to an input function. The signals are practically sent to nowhere.
1	PROG	The input is only assigned to the background programme. The Standard regulation process is not used by this input
2	Motor_H	control and instrumentation technology to regulator: The P-coil should be set in the direction of „Higher"
3	Motor_T	control and instrumentation technology to regulator: The P-coil should be set in the direction of „Lower"
4	Imp_Mot_H	control and instrumentation technology-Impuls to regulator: The P-coil should be set in the direction of „Higher". The incrementing edge of the input signal is rated and be prolonged by a value which is settable by the menu.
5	Imp_Mot_T	control and instrumentation technology-Impulse to regulator: The P-coil is to be changed in the direction of „Lower".The incrementing edge of the input signal is rated and be prolonged by a value which is settable by the menu.
6	Mot_Lauf	P-coil to regulator: The running message is transmitted for the statistics. Therefore also motor running times are measured which are not caused by the regulator, as for instance by a local changing of the P-coil.
7	End_H	P-coil to regulator: **„Final position Higher"** has been reached
8	End_T	P-coil to regulator: **„Final position Lower"** has been reached
9	E:Hand	P-coil to regulator: P-coil was set to HAND locally. The regulator may not make a changing of the P-coil
10	E:Error	P-coil to regulator: P-coil has recognized an error
11	Imp:L	Supervisory remote impulse to regulator: regulator is to switch to operation mode **„Local"**
12	Imp:F	Supervisory remote impulse to regulator: regulator is to switch to operation mode **„Remote"**
13	Imp:L/F	Supervisory remote impulse to regulator: regulator is to change to operation mode **„Local / Remote"**
14	Stat:F	A statical signal induces the regulator to remote operation.
15	Imp:AUTO	Supervisory remote impulse to regulator: regulator is to switch to operation mode **„AUTO"**
16	Imp:HAND	Supervisory remote impulse to regulator: regulator is to switch to operation mode **„HAND"** . Furthermore, this switching serves to acknowledge error conditions
17	Imp:A/H	Supervisory remote impulse to regulator: regulator is to switch to operation mode **„AUTO / HAND"**.

18	S:Block	Statical signal to regulator: Blocking of the regulator. After having finished the blocking, a search run will be triggered off.
19	S:BlockT	Statical signal to regulator: Blocking of the regulator through overtemperature of the P-coil. After having finished the blocking, a search run will be triggered off
20	Search	The incrementing edge of the signal **triggers off a search run.**
21	R_start	The incrementing edge of the signal triggers off a start-up of the resistance for the **residual ohmic current increment**. (Details see chapiter "8.1.5 R - Control")
22	R_auto_on	Supervisory remote impulse to regulator: activation of the resistance automation
23	R_auto_off	Supervisory remote impulse to regulator: deactivation of the resistance control
24	R_auto_onoff	Supervisory remote impulse to regulator: Switching between activation / deactivation of the resistance control
25	R_block	Blocking of the resistor connection by an external signal, e.g. by an external temperature control of the resistance
26	SE_ system	reserved
27	SE_ein	reserved
28	Slave	Statical signal to regulator: regulator is switched to Slave-operation
29	coupling	Statical signal to regulator: The busbar has been linked by a bus-tie or by a bus coupling. The Parallel-Regulation is activated
30	Fixcoil	Statical signal to regulator: a fixcoil is connected. This has mainly effects on the calculation of the relative compensation
31	Acknowl.	Acknowledgement of the interference message
32	Erd_Korr1	Statical signal to the regulator: In the case of an earth fault, the P-coil is rectified by one set value.
33	Erd_Korr 2	
34	Erd_Korr 3	
35	Erd_Korr 4	
36	R_ready	Self-conduct of the resistance automation is being finished. The resistance automation is made "ready" for the next earth fault

8.2.4.3 Binary outputs

Configuration of the outputs

The menu map for the outputs 1 to 4 is an example for the configurating possibilities of the digital outputs directly by the menu of the regulator



Function key <F1> switches to the other relay outputs R5 bis R10.

In the first paragraph, the edited status of the relay (or more accurately: the status of the relay excitation winding) is shown in the square bracket and the following maps are possible:

```
[ ]... 0 Relay not started up)
[x]... 1 Relay started up
```

In the second paragraph, the names of the physical outputs are displayed (R1 bis R10)

Immediately after the colon, the activated inverting for each corresponding output function is indicated by a "Minus" (see output R4).

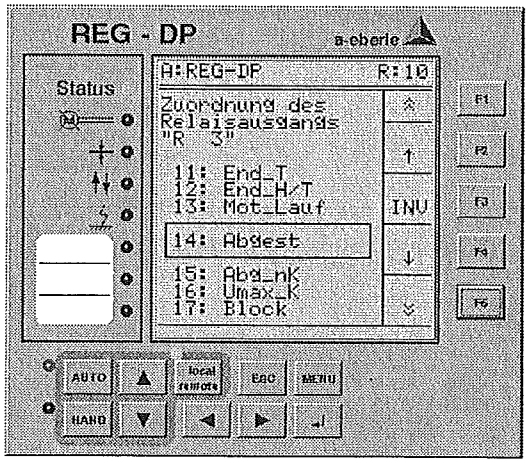
In the last paragraph, the assignment of the physical output to the logical output function of the regulation process is monitored. In the given example, the output R1 is linked to the output function "Motor_H" (Motor Higher) of the regulation process. This means that the regulator may regulate the P-coil in the direction of "higher current" by this output.

Should the assignment be **in square brackets**, so this assignment is set by the factory and cannot be configurated by the user.

Please learn from *Abb. 8.14: block diagram binary Inputs and Outputs* that several physical outputs may be laid to one output function. This corresponds to a **contact multiplication**. The single outputs are switched together in the regulator, considering the inverting by an "OR – link".

Selection of the Assignment

Please press the function key of the corresponding output to change the assignment chart resp. the inverting. The following map shows the corresponding selection menu for the output R3



The selected output function, e.g. in this case the No. 14 for the message that the regulator is in the status tuned is indicated in a frame. By the selection keys <F2> and <F4> selection may be made of the input function above resp. below whereas each one of the keys <F1> and <F5> turns one page. The key Return takes over the setting übernommen and changes back to the relay selection menu

Background Programming:

For the background programming, the following functions are avilable:
The edited relay status may be read by the command EspBI

- The regulation process may set the output function EspRelFV (**Relay Function V**alue). The background programme has only reading access to this output function EspRelFV
- The background programme has reading and writing access to the output function EspRelPV (**Relay P**rogramm **V**alue)
- By the „Inverting" the output functions may be slightly inverted in the assignment chart. However, please consider that this is only a logical inverting which is only applicable as long as the instrument is connected to the auxiliary voltage.
- As well the inverting as also the assignment chart may be read by the background programming. The released assignments may also be changed by the background programme.

There may be the assignment of the following output functions of the regulation process to the physical outputs

No.	Name	Function
0	OFF	Relay is not assigned. A „0" or a „1" is edited depending on the inverting.
1	PROG	The relay is assigned to the background programming
2	Motor_H	Command to the P-coil: change in the direction of **„Higher"**
3	Motor_T	Command to the P-coil: change in the direction of **„Lower"**
4	Status	Message of the regulator status
5	AUTO	Message: The regulator is in the Operation mode AUTO
6	Uen>Uerd	Message: The offset voltage is bigger than the set earth fault-treshold
7	Uen>Uerd_vz	Message delayed: The offset voltage is bigger than the set earth fault-treshold
8	Uen>Umax	Message: The offset voltage is bigger than the set maximum offset voltage
9	Uen< Umin	Message: The regulator has controlled the complete changing range and has not found an offset voltage bigger than the set minimum offset voltage. The message is only edited after the set delay time for Umin.
10	End_H	Message: The regulator has recognized the final position **„Higher"**
11	End_T	Message: The regulator has recognized the final position **„Lower"**
12	End_H/T	Message: The regulator has recognized the final position **„Higher" OR„Lower"**. It is the OR –link of the two previous messages
13	Mot_Lauf	Message: The regulator has recognized a change of the P-coil. The signal is an OR link to the setting commands „Motor Higher", „Motor Lower" and to the input „Mot_Lauf"
14	Abgest	Message **Tuned**: The search procedure has been finished successfully. The required compensation value has been set successfully.
15	Abg_nK	Message **Tuned not compensated**: The regulator has set the coil to the best possible value, taking the frame conditions into consideration. The required compensation value, however, could not be reached because, for example, this value lies outside the changing range of the P-coil
16	Umax_K	reserved
17	Block	Message: The regulator is in the operation mode AUTO but blocked by an event

18	Rest pos.1	Message: The regulator has reached the rest position 1. This rest position is depending on the parameterization of the function, see also: - Umin - Abort of the search
19	Rest pos.2	reserved
20	Remote	Message: The regulator has been switched to remote. At the regulator, the keys for „Motor Higher", „Motor Lower", „HAND" and „AUTO" are blocked by the software. A physical separation of the signals from the P-coil will not be made. An operation of the menu and selection of the different indication modes is continuously possible
21	Fixcoil	Message: The fixcoil is considered for the calculation of the compensation
22	coupling	Message: parallel operation of P-coils
23	R_auto_on	Message: resistance automation is activated
24	R_block	Message: resistance automation is active but blocked
25	R_on	Command: Resistor to the residual ohmic current increment is started-up
26	R_T>>	Message: Resistor is too hot
27	SE	reserved
28	SIM	Internal simulation is activated.
29	Alarm	**Alarm-Message**: The regulator has problems with the measuring of Uen: - SearchTime run out (45 min) - SearchNumber exceeded
30	Alarm vz	**Alarm-Message delayed**.
31	AlarmInt	Alarm - Message Internal
32	E:Direct	Error-Message: P-coil drives in the wrong direction
33	E:Move	Error-Message: No change of the P-coil was recognized within the set time on the commands „Motor Higher" resp. „Motor Lower"
34	Interference	Interference message: Sum message for recognized interferences: - Motor error o No movement on changing command o Wrong direction - Potentiometer error o Linebreak - Both final switches are recognized at the same time - Positioning error - Interference message of the P-Coil
35	Interference vz	Interference message delayed: delayed sum interference message
36	Stör_Sum	**Bus- Interference message** SumInterf = Interference + Alarm + Status Alarm: - SearchTime run out (45 min) - SearchNumber exceeded Interference: - Motor error o No movement on changing command o Wrong direction - Potentiometer error o linebreak - Both final switches are recognized at the same time - Positions- error - Interference message of the P-Coil Status: - All internal errors as for example o RAM o ELAN

		o Battery o ...
37	>n_Search	Message: After **n Search cycles** no successful tuning of the P-coil could be made.
38	>T_MotOn	Message: The set **Motor Running time** was exceeded
39	Pot_???	Message: Error recognized at the measuring of the coil position, for example linebreak
40	Uen_??	Message. Error recognized at the measuring of the offset voltage, for example value > 120 % the set nominal voltage
41	E:HAND	Message: Pass-through of the Input message "E-Hand"
42	E:ERROR	Message: Pass-through of the Input message "E-Error"
43	ELAN L	Message: Error recognized at the E-LAN L
44	ELAN R	Message: Error recognized at the E-LAN R
45	ELAN Error	Message: Sum message for errors at the E-LAN
46	U12<<	Reference voltage is very low
47	R_ready	Resistance control is ready. As soon as the next earth fault occurs, there will be an increment of the residual ohmic current
48	SuchVerz	Set if the regulator is in search delay, e.g. the offset voltage is outside the tolerance range and the regulator has not yet begun with the search. Is also set during the delay of the forcing search.
49	ParaProg	Will be set, if the Parallel-regulation is released and also is activated, for example by the coupling switch.
50	Local	The regulator is switched to Local
51	Remote	The regulator is switched to Remote
52	Uerd Pos	The P-Coil is being positioned during the earth fault
53	Search	Set during the searching procedure: Start until (Tuned v Abg. nK v Abgest. Umin) The message is set back to: Uerd, Blocking, Hand, Umax

8.2.4.4 LED - Outputs

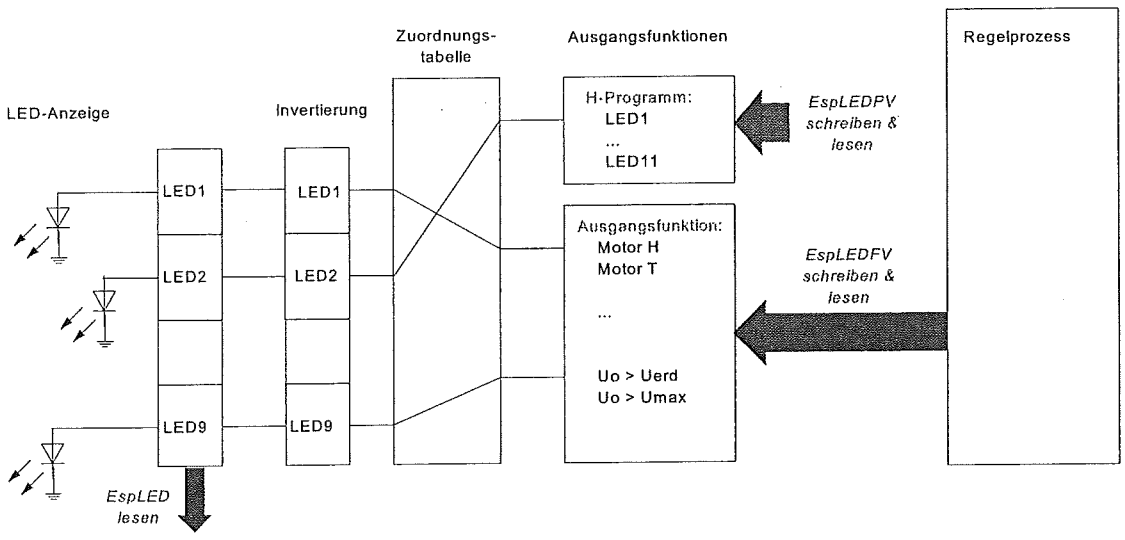
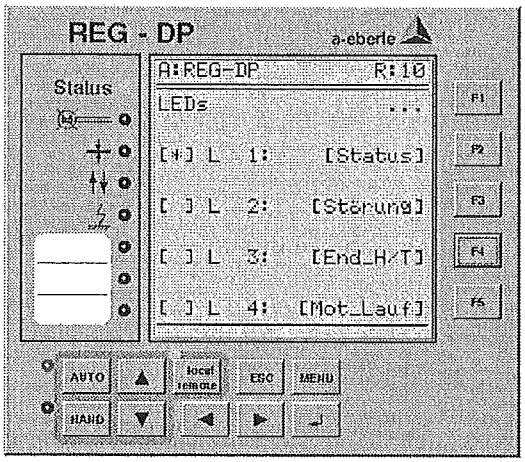


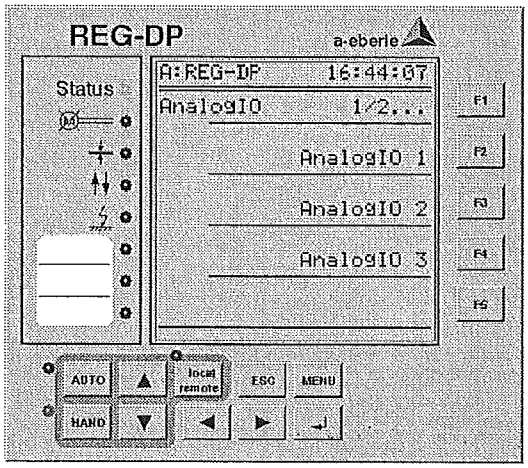
Abb. 8.17: *block diagram LED Functionen*

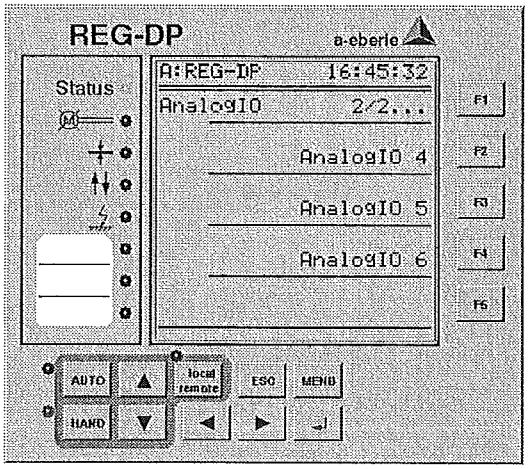
The assignment of the LEDs to the output functions is made completely analog to the assignment of the relays. There are even the same output functions available.

In the following map the assignment for the first four LEDs is shown



8.2.4.5 Analog Inputs/Outputs





There may be the installation of up to six **free programmable Analog - Outputs** for the range of -20mA ... 0 ... +20 mA in the regulator.

In the following map, the functional block map for the parameterization of the analog outputs is shown.

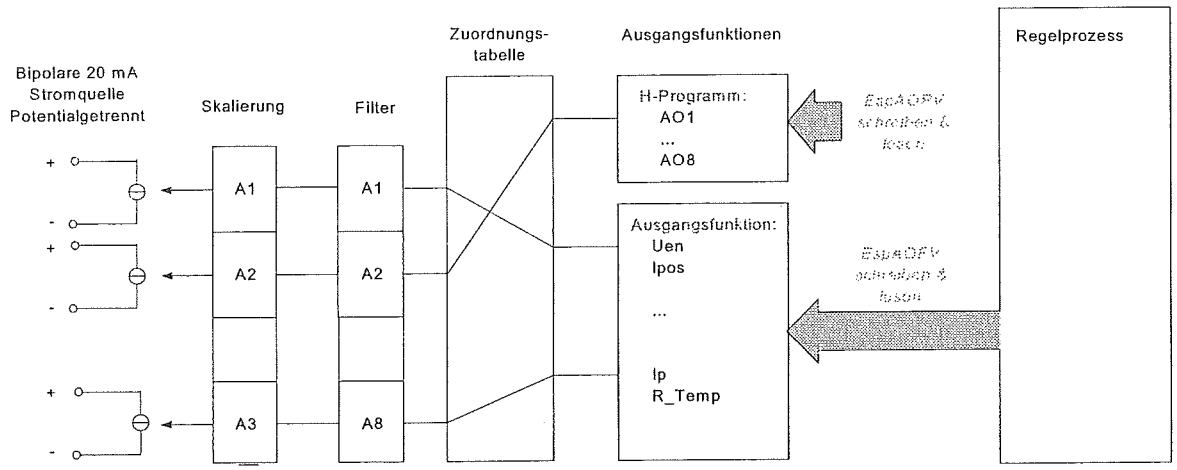


Abb. 8.18: block diagram of the analog outputs

By the assignment chart, the following quantities measured in the regulating process may be edited to the physical outputs:

Nr.	Name	Function
0	OFF	The analog output is not used
1	Prog	The analog output is assigned to the background programme
2	Une	The offset voltage Une is edited
3	I1	The measured value of the current transformer 1 is edited
4	I2	The measured value of the current transformer 1 is edited
5	Rproz	The measured value of the coil position is edited (voltage divider ratio of the position measuring, without linearization)
6	Ipos	The linerarized coil position of the changing range is edited in per cent. (Imax corresponds to 100%, 0A corresponds to 0%)
7	RTemp	The temperature of the resistance, measured by the thermical replica, is edited.

For each channel, the kind of the transmission characteristic may be defined by three points so that as well a linear characteristic as also a bend characteristic may be produced.

Please consider that, in case of using REG-L language, the counting for the channels and for the support points begins with 0 and not with 1.

When the coil position is edited, the coil position measured by the linearization chart is used. Thus, there is the same coil position in the control room as at the coil itself.

Example for a linear characteristic:
The range of the offset voltage Uen from 0 to 100 V is to be shown on the range from 4 to 20 mA and be edited by channel 1:

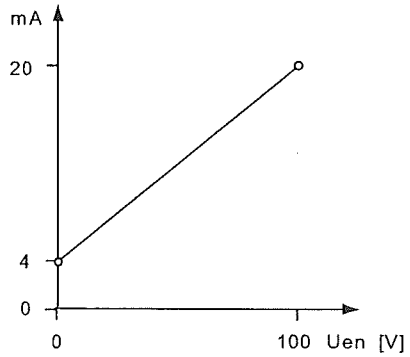


Abb. 8.19: Linear transmission characteristic

Parameterization by menu:

Menu-point	Value	Function
Type	Output	A mA – Output module is used.
Nominal value	20 mA	Maximum value which the module may deliver pysically. The standard moduls deliver 20 mA
Input function	Une	(At present no difference between Input and Output, input see next point)
Output function	Une	Assignment of the required "analog measuring value" for the edit (see chart above)
Filter time	0	reserved
point 1x	0 V	0 V corresponding to the smallest value of Uen of 0V on the x-axis
point 1y	20 %	4mA on the y-axis correspond to 20% of 20mA
point 2x	100 V	100 V corresponding to the maximum value of Uen on the x-axis
point 2y	100 %	20 mA on the y-axis correspond to **100 %**
point 3x	0	
point 4x	0	

When parameterization is made by REG-L, the following commands are necessary:

command	Function
ESPAIOType 0 2	channel 1 (0) as Output (2)
ESPAOFu 0 = 2	From the function chart, the voltage Uen (2) is assigned to channel 1 (0)
ESPAScalX 0 0 = 0	The minimum value of the voltage (0V) has to be given (channel 0, support point 0 = 0 V)
ESPAScalY 0 0 = 0.2	The normed value referred to 20 mA must be inserted: 4mA/20mA = 0.2 (channel 0, support point 0 = 0.2)
ESPAScalX 0 1 = 100	The maximum value of the voltage (100V has to be given (channel 0, support point 1 = 100 V)
ESPAScalY 0 1 = 1	The normed value referred to 20 mA must be inserted: 20mA/20mA = 1 (channel 0, support point 1 = 1)

Example for a bend-characteristic (zoom-in):
The display is to larger indicate the range of the voltage of 0 to 10V. Therefore the range of 0 to 10 V is shown on the range of 0 to 8 mA. The range of 10 V to 100 V is monitored on the remaining range of 8 to 10 mA . The edit is to be made by channel 2.

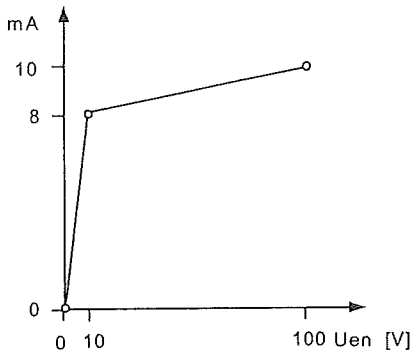


Abb. 8.20: Bend-characteristic (zomm-in)

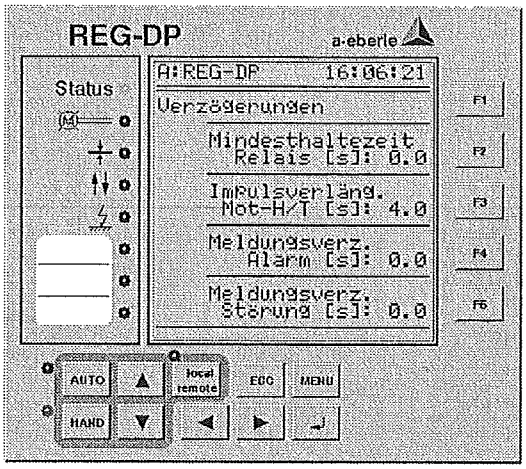
Parameterization by menu:

Menu-point	Value	Function
Typ	Output	A mA – Output module is used.
Nominal value	20 mA	Maximum value which the module may deliver physically. The standard modules deliver 20 mA
Input function	Une	(at present no difference between Input and Output, insertion see next point)
Output function	Une	Assignment of the required "analog measuring value" for the edit (see chart above)
Filter time	0	Reserved
point 1x	0 V	0 V corresponding to the smallest value of Uen of 0V on the x-axis
point 1y	0 %	0 mA on the y-axis correspond to 0% of 20mA
point 2x	10 V	10 V corresponding to the bend point on the x-axis
point 2y	40 %	8 mA on the y-axis correspond to **40 %** of 20 mA
point 3x	100 V	100 V correspond to the maximum value of Uen on the x-axis
point 3y	50 %	10 mA on the y-axis correspond to **50 %** of 20mA

When parameterization is made by REG-L, the following commands are necessary:

Command	Function
ESPAIOType 0 2	channel 1 as output
ESPAOFu 0 = 2	From the function chart, the voltage Uen is assigned to channel 1
ESPAScalX 0 0 = 0	The minimum value of the voltage (0V) has to be given (channel 0, support point 0 = 0 V)
ESPAScalY 0 0 = 0.2	The normed value referred to 20 mA must be inserted: 4mA/20mA = 0.2 (channel 0, support point 0 = 0.2)
ESPAScalX 0 1 = 10	The medium support point of the Voltage (10V) has to be given (channel 0, support point 1 = 10 V)
ESPAScalY 0 1 = 0.4	The normed value referred to 20 mA must be inserted: 8mA/20mA = 0.4 (channel 0, support point 1 = 0.4)
ESPAScalX 0 2 = 100	The maximum value of the voltage (100V) has to be given (channel 0, support point 2 = 100V)
ESPAScalY 0 2 = 0.5	The normed value referred to 20 mA must be inserted: 10mA/20mA = 0.5 (channel 0, support point 2 = 0.5)

8.2.4.6 Delays



Minimum hold time of the relay
The minimum hold time of the relay may be set here. Therefore it may be made sure that even short signals are recognized and transmitted by the supervisory remote control.

standard setting: 0 s

Impulse prolongation Motor Higher / Lower
The incrementing edge of the input signal to the regulator which is necessary to change the P-coil is prolonged here by the set value. Therefore, it is not necessary to remotely control the position and to react very fast.

For a P-coil with a running time of 200s and a changing range from 20 to 220 A, an impulse time of 2s seconds would correspond to a positioning possibility of 1%.

standard setting: 4 s

Message delay Alarm
The edit of the messages Alarm are delayed by the set time.

Standard setting: 0 s

Message delay Interference
The edit of messages interferences are delayed by the set time.

Standard setting: 0 s

8.2.5 Fault acknowledgement

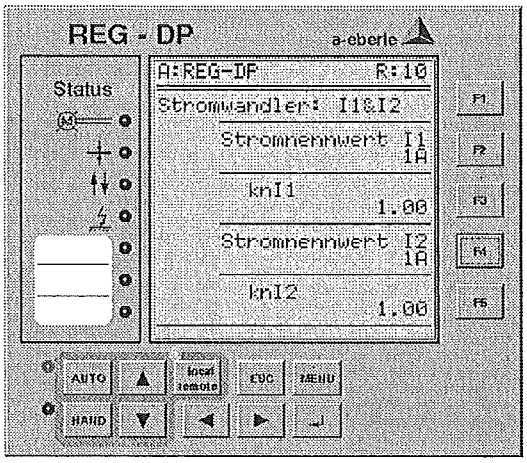
Apart from the acknowledgement by a **binary Input (input function 31),** the following versions made be selected:

Method	Description
Menu	The error may be acknowledged locally only by the menu "Interferences- help" and by the key <F5>.
Menu / Hand	The interference may additionnally be acknowledged by the key HAND without having to get to the menu. Disadvantage: the detailed help text to the interference analysis is not indicated.
Menu / Hand / Auto	The interference may now also be acknowledged by the key AUTO.

The last two versions are of course identically applicable also for the binary Inputs to the change-over HAND / AUTOMATION.

8.2.6 Current measuring

There are two current channels available in the regulator to measure Amount and Angle.



Selection possibilities:

1 A
5 A

Note:
Consider Jumper on the Hardware!

$$kni = \frac{I_{Prim}[A]}{Isek[A]} \qquad (8.6)$$

knI corresponds to the conversion rate to the primary current and depends on the set Input current (1A or 5A)

In the following map, the corresponding positions of the jumpers are shown on circuit board 3:

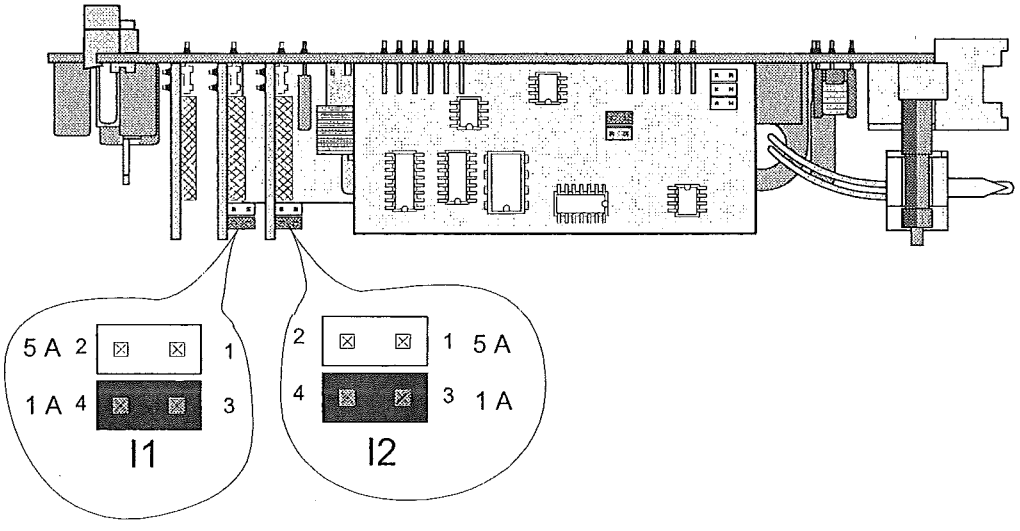


Abb. 8.21: jumpers for the selection of the nominal range of the current input

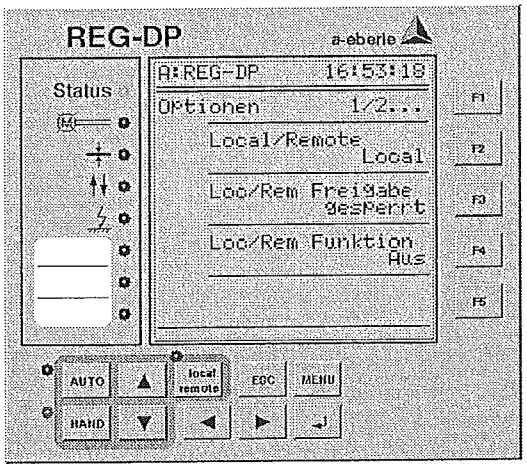
8.3 Options

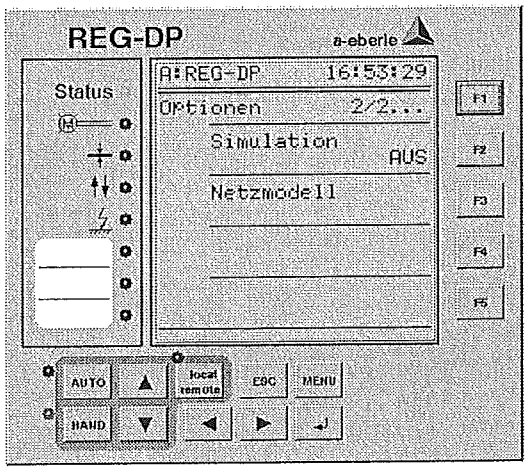
Menu point Options offers the possibility to parameterize additional functions.

F4: Options

F2: Local / Remote
F3: Loc / Rem Release
F4: Loc / Rem Function

F2: Simulation
F3: system model





8.3.1 Local / Remote

The regulator may be switched between local and remote operation by the key Local / Remote.

Operation Local:

All **orange marked keys** may be operated locally. The control and instrumentation technology has no access but a reading access by the serial coupling.

The operation of the menu is without restrictions

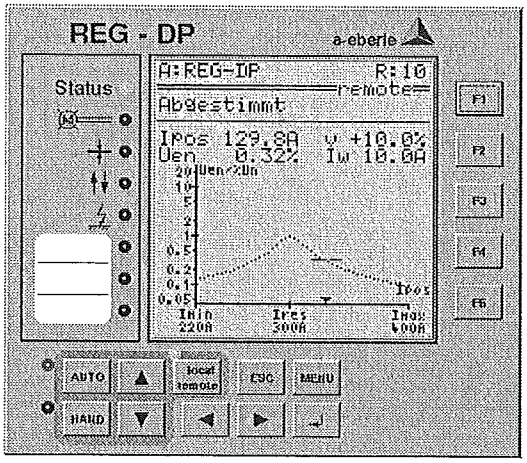
Operation Remote:

All **orange marked keys** except for the switching Local / Remote are locked. Therefore an erroneous change between the operation modes AUTO / HAND is impossible. A switching AUTO / HAND may only effect remotely. This also applies for the keys to change the coil position: "Motor Higher" and "Motor Lower"

The operation of the menu is without restrictions

For devices without key Remote /Local the switching effects in the above menu.

The switching status is additionnally shown at the right side above the status display.



Parameter	Setting values	Description
Local / Remote	**Local** Remote	Local: All commands remotely by the binary inputs are locked Remote: The keys <AUTO>, <HAND>, <Higher> and <Lower> are locked.
Loc / Rem Release	**locked** permitted	Access permission **only** for the switching Local / Remote remotely, even when the regulator is on Local.
Loc / Rem Function	**Off** On	If the Local / Remote Function is turned off the local operation and the remote operation have the same permissions. In the Off- status, both LEDs at the front side are turned off.

8.3.2 Simulation

8.3.2.1 Principle of the system simulation in the REG-DP

In order to test the essential parts of the regulation procedure, a system simulation with a changeable P-coil and different system switching status has been implemented into the REG-DP. If this simulation is activated, the following input signals are superseded by the data simulated in the regulator:

- offset voltage Uen as function of the coil position
- coil position Ipos
- Final switch Higher
- Final switch Lower

The simulation is a process which is completey seperated from the regulation and it does not influence the system during regulator operation.

8.3.2.2 Activation of the Simulation

For the simulation of the regulation behaviour, a simulation mode may be started in the regulator. For the simulation of the system with a P-coil, the following simplified diagram is applied to:

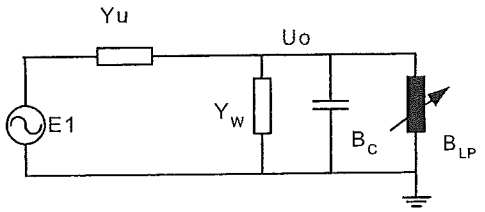


Abb. 8.1: Simplified system for the simulation

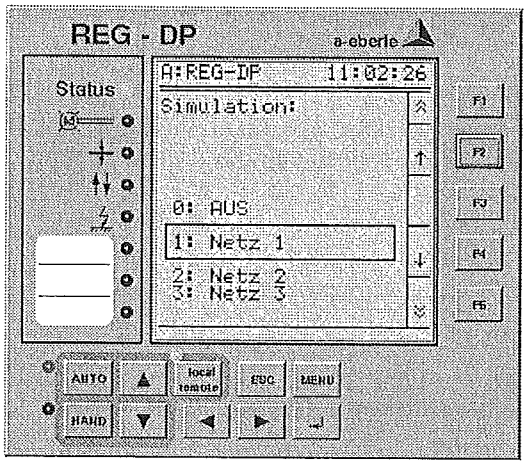
The conductivity components for this simplified system may also be calculated, for the defined voltage E1, on currents. Thus, the result is a considerably more detailed description of the system by the following parameters:

Parameter	Description
Ires	The coil position in which the zero system of the system is tuned to resonance. In this case, the offset voltage is biggest in the sound system. The current through the P-coil corresponds to the capacitive current of the system in this case.
Iu	The unsymmetry current Iu corresponds to the current over earth when solid earthing.
Iw	The active current Iw flows parallel to the resonance circle. This current would flow over the error position, if there was a dead earth fault.
Phi	Phase shift of the replacement voltage source in the range of -180 ... + 180° referred to the real axis.

The offset voltage Uen in the point of resonance is calculated as follows:

$$Ures = 100\% \frac{Iu}{Iw + Iu} \qquad (8.1)$$

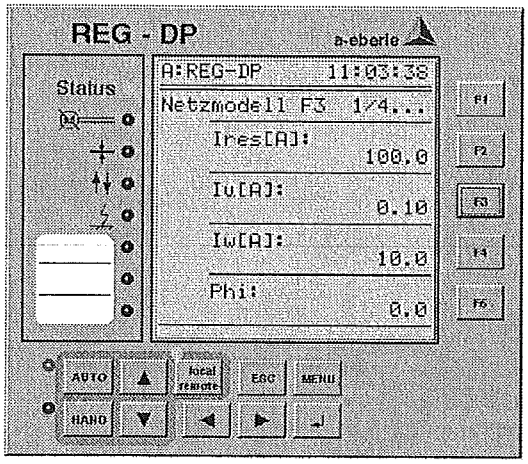
By means of the following menu, there may be, on the one hand, the simulation **activated** and on the other hand, selection may be made between three aleady given systems.



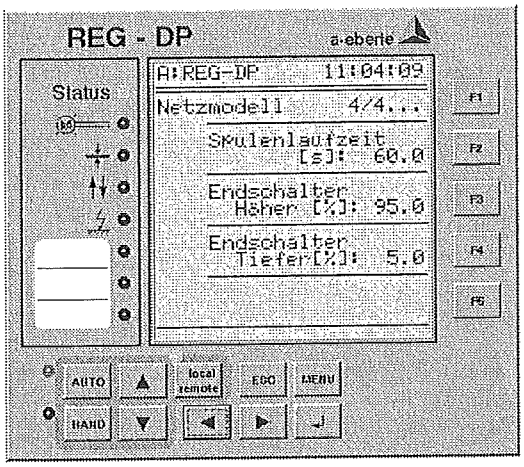
The activation of the simulation may be recognized by the fact that on all screens the double line is interrupted and the active simulation status is characterized by the following procedure:

```
SIM1E
|  ||
|  |Earth fault
|   system  1
SIMulation
```

As above mentioned, the parameters of the three systems in the regulator may be changed by the menu. In the following map, the menu for the system 1 is shown as example.



In the last map from the series "system models" there may be data given for the simulated P-coil:



Parameter	Factory setting	Description
Coil running time	60s	Changing time of the P-coils from the lower final position "Final switch Lower" up to the upper final position "Final switch Higher".
Final switch Higher	95%	The "Final switch Higher" is recognized from a potentio meter position of > 95%.
Final switch Lower	5%	The " Final switch Lower" is recognized from a potentio meter position of < 5%.

8.3.2.3 Key assignment during the simulation

As soon as the simulation is activated, the function keys F3 to F5 are used to switch between the single systems. In addition to that, an earth fault may be simulated by function key F2. The earth fault is valid for the correspondingly selected system. The assignment of the keys is as follows:

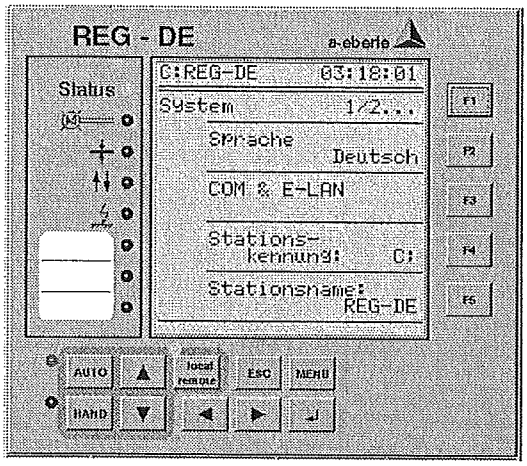
F2 Earth fault on / off
F3 system model F3
F4 system model F4
F5 system model F5

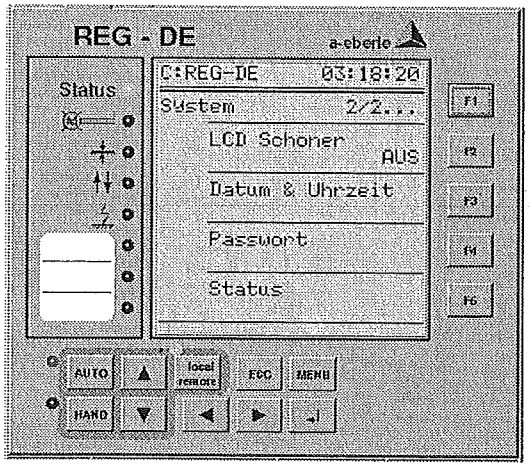
The functions which are normally on these keys, which are essentially the changing between the different indication modes, are deactivated during the simulation.

8.4 System

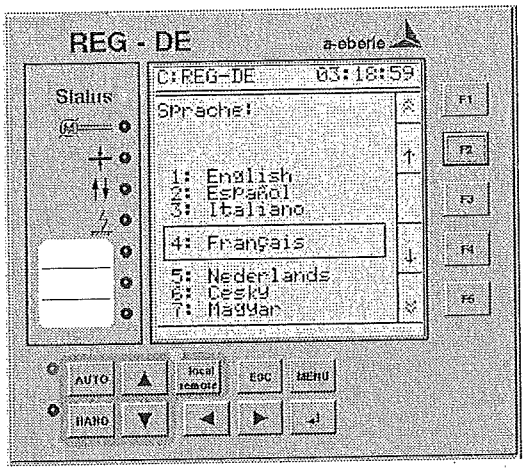
F5: System
F2: language
F3: COM & E-LAN
F4: Station identification
F5: Station name

F2: LCD saver
F3: date & Clock-time
F4: Password
F5: Status



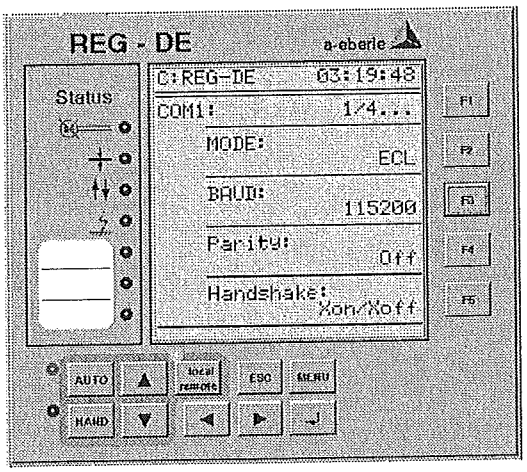


8.4.1 Language



8.4.2 COM & ELAN

8.4.2.1 COM1 and COM2



Key <F1> permits the changing between the two free configurable serial interfaces COM1 and COM2. In the left-hand part of the screen, the presently active interface is displayed.

Mode ECL <F2>

Selection possibilities:

MODE ECL	Standard telegramme of the regulator REG-DP
MODE DCF77	Telegramme for the time synchronization is being processed with. A DCF 77 receiver may serially be linked to the interface.

Baudrate <F3>

Selection possibilities:

1200
2400
4800
9600
19200
38400
57600
76800
115200

Parity <F4>

Selection possibilities:

even
none

Handshake <F5>

Selection possibilities:

RTS / CTS
Xon / Xoff
none

8.4.2.2 E-LAN

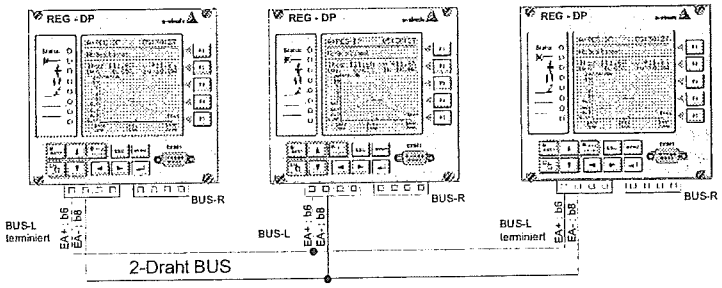


Abb. 8.1: *Link with E-LAN: 2-wire BUS*

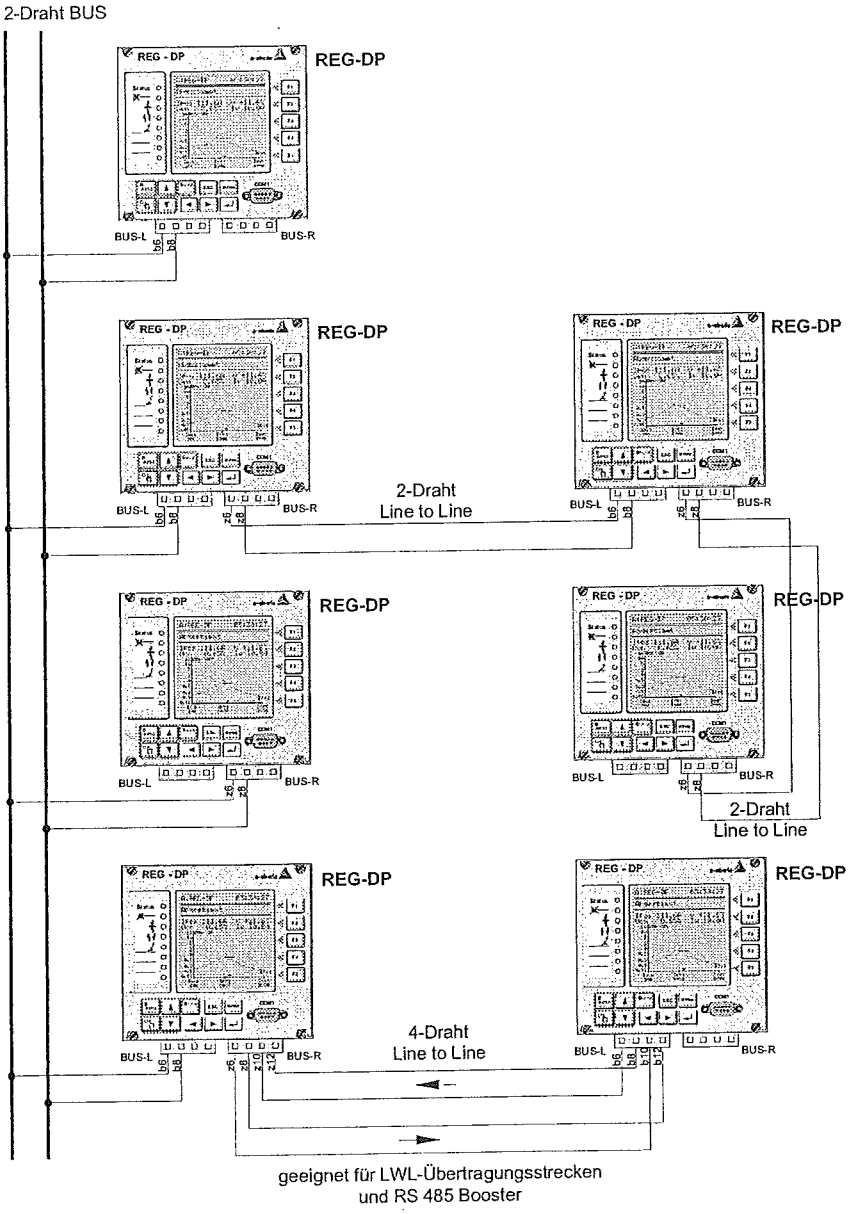
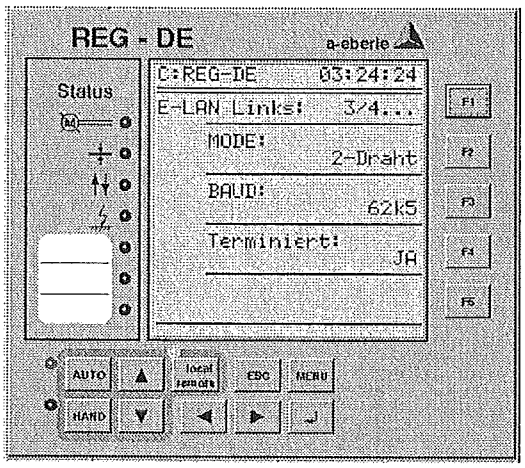


Abb. 8.2: Possible link with ELAN



Each regulator offers two complete E-LAN-Interfaces.

E-LAN LEFT defines the settings for Bus – left-hand
(Terminal block 6, terminals b6, b8, b10 and b12 see page 22).

E-LAN RIGHT defines the settings for Bus – right-hand
(Terminal block 6, terminals z6, z8, z10 and z12 see page 22).

Each one of these interfaces may work as well with a 2-wire-phase as also with the 4-wire-transmisssion technics (RS485).

Terminal block 6				
BUS-L Terminal	BUS-R Terminal	Function	2-wire	4-wire
b6	z6	EA+	"Input +" and "Output +"	"Output +"
b8	z8	EA -	"Input -" and "Output -"	"Output -"
b10	z10	E+	No function	"Input +"
b12	z12	E -	No function	"Input -"

The usual operation is with a 2-wire-phase because only this permits a bus configuration with several participants on the same bus line. To do this, please switch on the integrated final resistors at the **first** and at the **last** participant on the bus line (Selection: **"in finish**").

Due to appearing reflections at the corresponding phase end, it is impossible to get a proper functioning of the bus without final resistor.

For long transmission distances >1000m or in the case of a booster (amplifier to increase the signal level for very long transmission distances), there must be an operation with 4-wire- transmisssion technics. The necessary final resistors are automatically activated (Selection **"in finish"** is no longer needed).

Baudrate <F1>

Selection possibilities:

62k5
125k

Note:
The transmission speed for the ELAN-L and the ELAN-R may be selected differently.

MODE <F2> and <F4>

Selection possibilities:

2-wire
4-wire

Note:
The operation mode for the ELAN-L and the ELAN-R may be selected differently.

Termination <F3> and <F5>

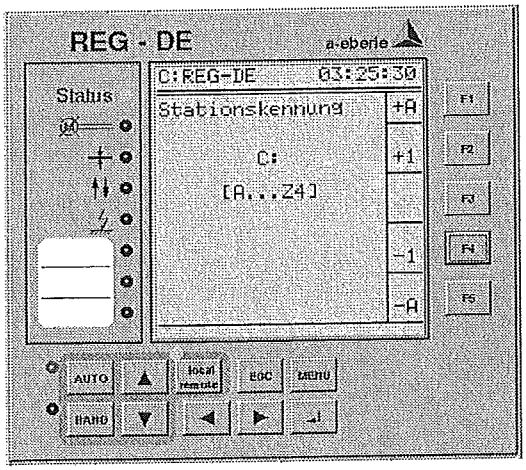
Selection possibilities:

Finish to be ended
Finish open

Note:

The operation mode for the ELAN-L and the ELAN-R may be selected differently.

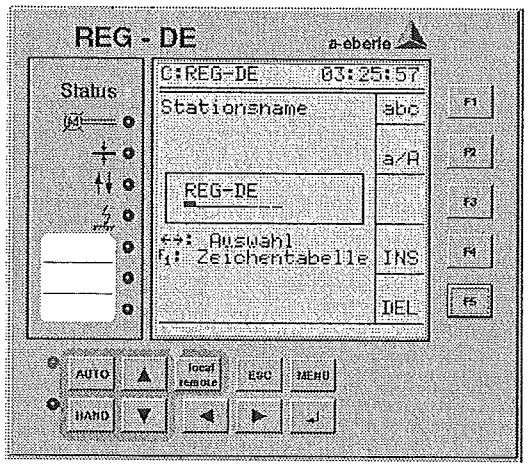
8.4.3 Station identification



Note:

Devices operated at the bus (E-LAN)have to be marked with different adresses (A ... Z4) so that they may be addressed clearly.

8.4.4 Station name



The name of the regulator may be changed.
Maximum length of the name: 8 signs

8.4.5 LCD saver

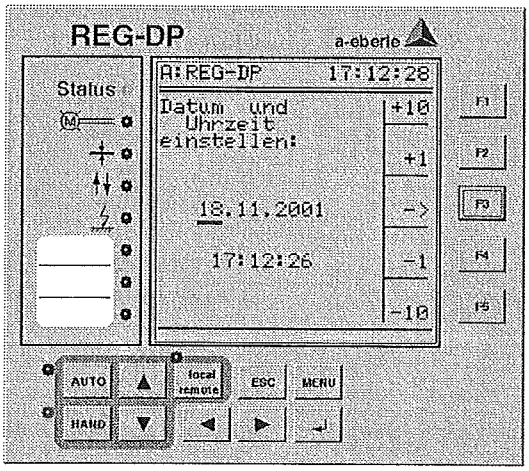
The background illumination is switched off after approx. 15 min if no key has been pressed down. To save the LCD display the text and graphics are also deleted after approx. 1h.
To turn it on again, please strike any key.

Caution:
The first pressing down of a key is rated even with dark screen. To switch to a light screen only, please use key <ESC>.

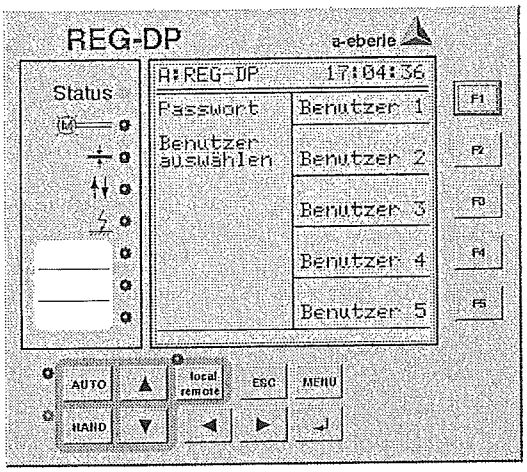
Selection possibilities:

ON	Switching off of the text and the graphics after approx.one hour
OFF	Text and graphics are not switched off

8.4.6 Date & Clock-time

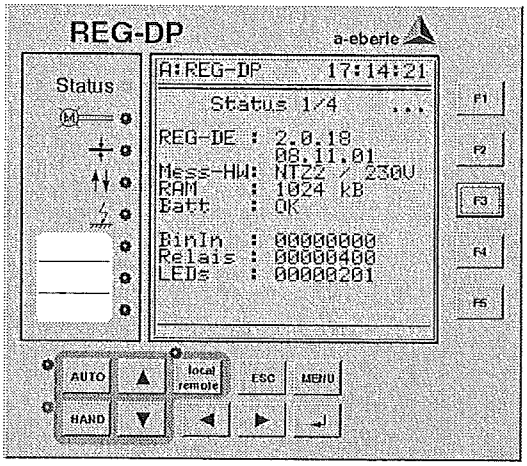


8.4.7 Password



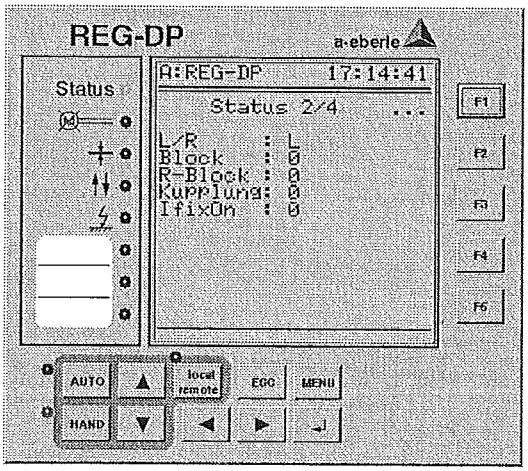
8.4.8 Status

In the mode Status some information is shown in a very comprimized form. This menu is applied for a fast rating of the system and for the putting into operation for some tests.



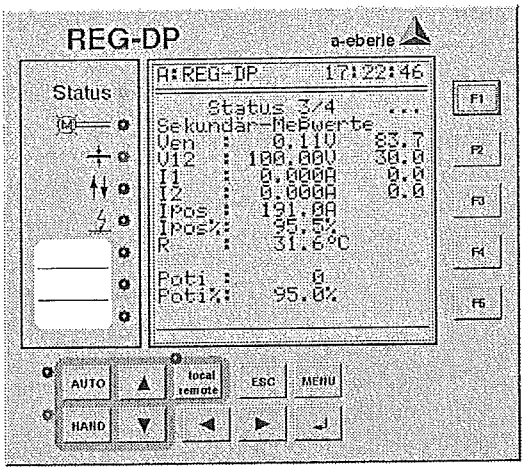
The Status-Map 1/4 shows the following values:

- Software Version with date
- Hardware Version of the measuring card
  ERLP ... without angle measuring
  NTZ2 ... with angle measuring and measuring range up to 120 VAC for Usync
  NTZ2 / 230 V ... with angle measuring and measuring range up to 230 VAC for Usync
- quantity of the installed memory
- Status of the battery
- Present level to the physical input as HEX-number
- Present edit to the relay as HEX-number
- present indication of the LEDs as HEX-number



The Status Map 2/4 shows the following internal registers

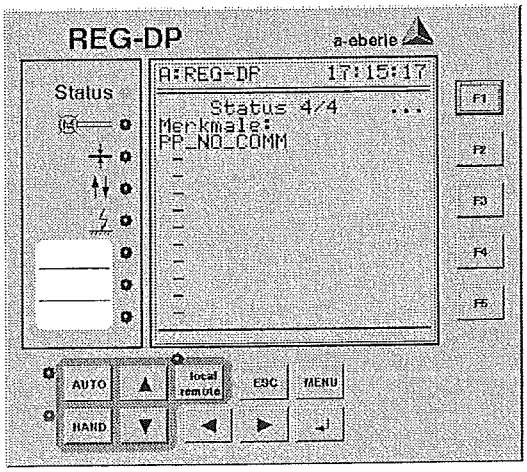
- Status of the Local / Remote switching status
- Status of the regulation status: Blocking
- Status of the resistance control: R-Blocking
- Input function: coupling
- Activation status of the fixcoil



The Status Map 3/4 shows the following analog measuring values and all measuring values are referred to the regulator inputs. The values for **knI resp. knU are not considered.**

- Uen offset voltage (0...100V) (Amount and Angle)
- U12 The reference voltage is fixed to 100V
- I1 Current through the first current transformer (Ip), Amount and Angle
- I2 Current through the second current transformer (I2), Amount and Angle
- Ipos coil position in [A], after the linearization
- Ipos% coil position in [%] referred to Imax
- R temperature of the thermical equivalent (resistance automation)

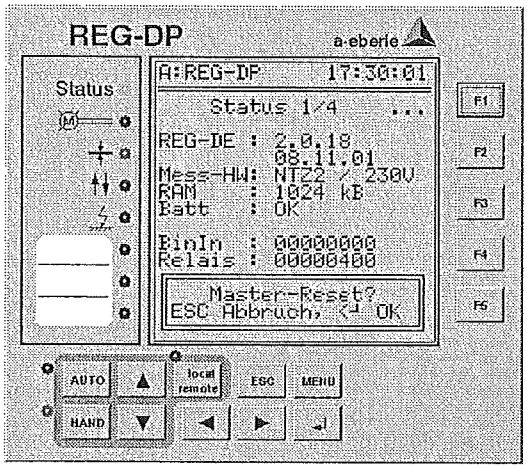
- Poti voltage divider measured
- Poti% voltage divider measured, referred to 5V



The Status map 4/4 lists the activated features.

Moreoever, there may be the trigger-off of a Master-Reset in this Status-menu:

Master -Reset:

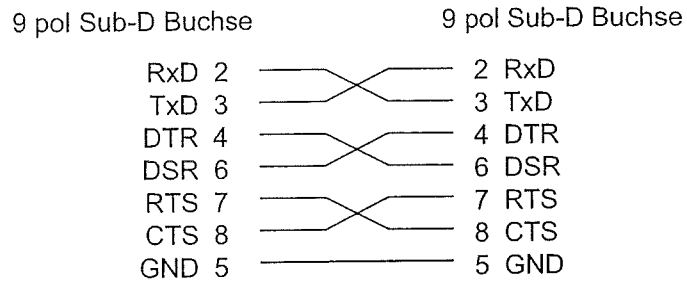


In the case of a Master-Reset, all parameters are set back to the factory setting.
The Master-Reset may be triggered off by pressing key <F2> in one of the Status maps.

9 Update of the operation software

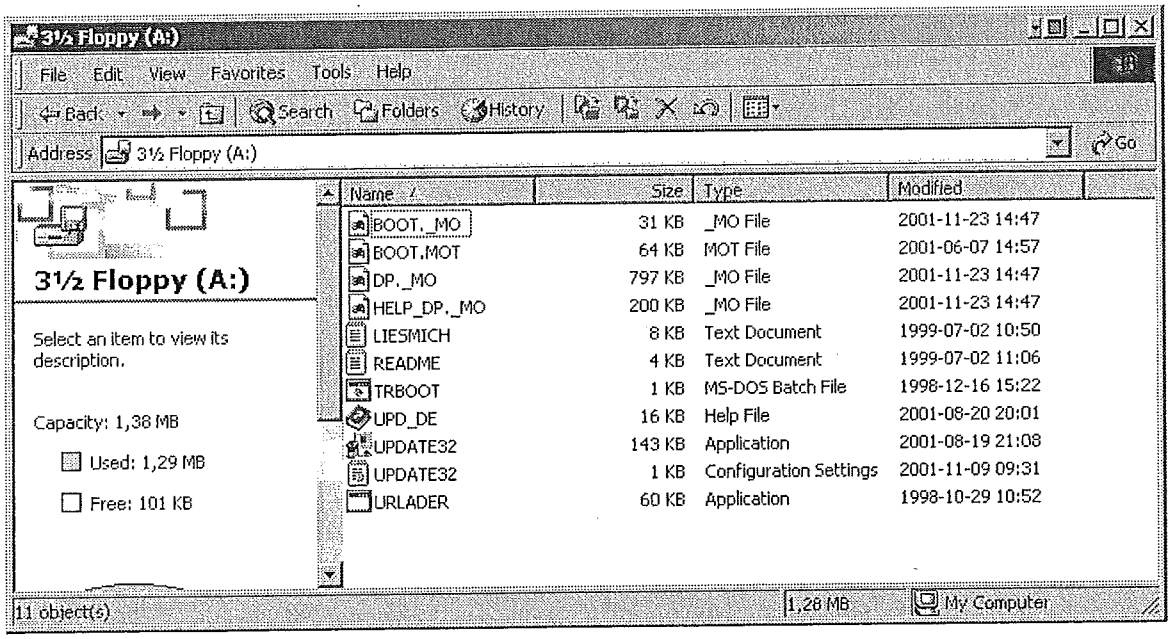
For an update of the operation software, a zero-modem cable is required. Due to the high baudrate a hardware-handshake is required. This is why the RTS / CTS - lines must be linked crosswise.

Zero-modem cable:



9.1 Operation system Windows 95/98, NT and Win2000

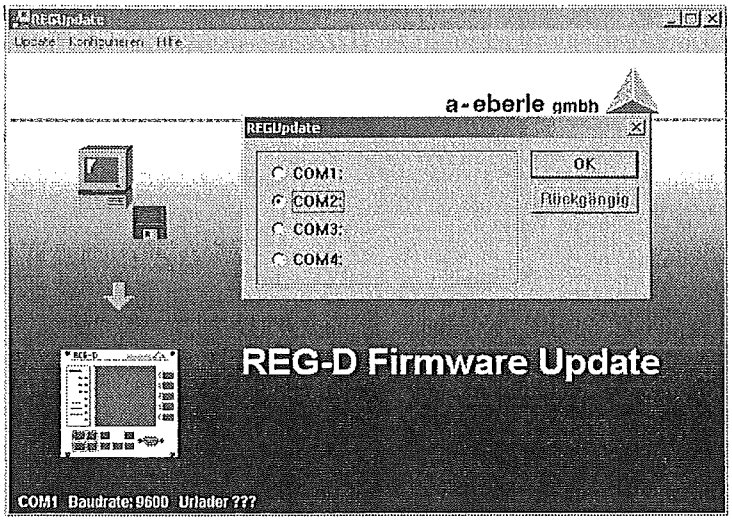
The following files are present on the installation disk resp. in the installation index:



File	Description
Update32	Windows programme for the transfer of the firmware into the regulator
DP._MO	Firmware of the regulator (comprimized)
HELPDP._MO	Help file of the regulator contains the description of the REG-L commands (comprimized)

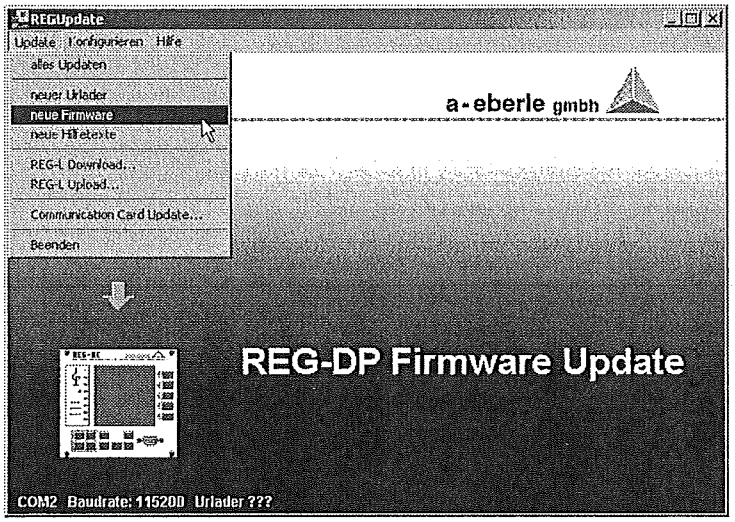
The following steps are to be made at the PC resp. Laptop:

- Start of the programme Update32

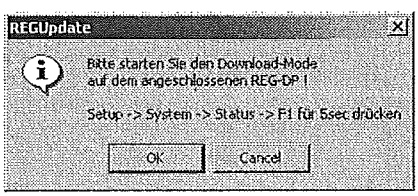


- Selection of the interface used **at the PC**.
  After having confirmed by key OK, the interface of the PC is initialized to 115kBaud and RTS/CTS - Handshake. The Interface must not be blocked by another programme. (for example communication software for mobile phones ...)

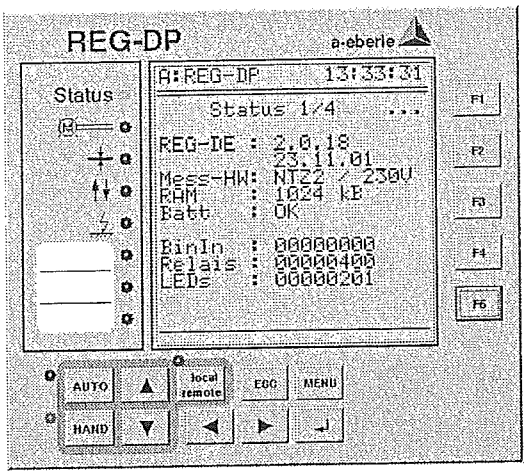
- Selection: Update\ new firmware



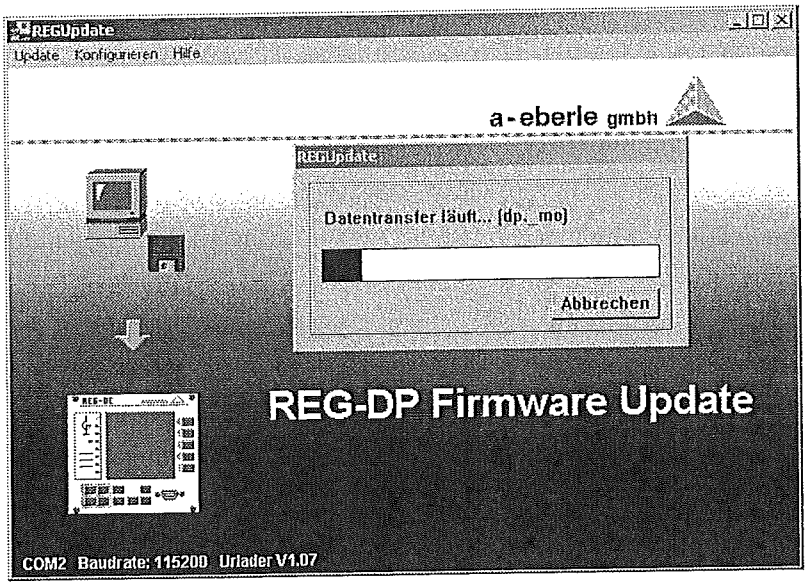
- The Windows-Software demands the corresponding setting at the REG-DP:



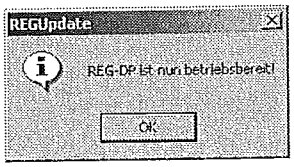
➢ The regulator REG-DP must show the following map



➢ After having confirmed the setting at the PC, the download is made using the file dp._mo from the present index.



➢ The successful transfer is messaged by



and the regulator boots with the new software.
In the case of another message there is an interference and the download will have to be repeated.

Note:
For further questions please refer to the following adress by e-mail: info@a-eberle.de or by phone to the hotline: 0911-628108-86 resp. -78

- The above procedure is to be repeated for the help-Texts.
- Please consider that the background programmes may possibly have to be loaded newly also.

9.2 Menu Functions of the Update32-Programme

9.2.1 Update

Here all functions are listed which refer to the download of new software. Please choose between the following possibilities:

Update all:

The complete firmware is brought up-to-date, e.g. the primeload and and the help texts, which are stored in the meter.

new primeload:
The boot programme of the meter is brought up-to-date

new firmware:
The firmware of the meter is brought up-to-date

new help texts:
The help texts of the meter are brought up-to-date

REG-L download:
A REG-L background- or foreground programme may be transmitted from the PC to the regulator.

REG-L upload:
The REG-L background- or foreground programme may be transmitted from the regulator to the PC.

Communication Card Update:
Optionally, the REGSys meters are equipped with an additional card in order to permit the communication with control and instrumentation technological equipments.
With this menu point there may be made an update of the additional card.

End:
Finishes the programme.

9.2.2 Configurate

ComPort:

Here please select the used interface (COM1 to COM4). The interface has to be physically present and must not be used by another device.

Baudrate:

In this dialog, the baudrate may be set and the standard value is 115200 Baud.

Under Windows 3.xx, however, high baudrates (> 57600 Baud) are not supported. The download programme uses a standard value of 57600 Baud in this case. Then, the selection point <115200 Baud> appears in grey and may not be selected.
After the change of the baudrate, the regulator has to be set accordingly by key <F4> .

Language:

Here, the language of the Download programme is selected. At present, the languages English, German and Spanish are available.

10 Maintenance and Current consumption

10.1 Change of fuse

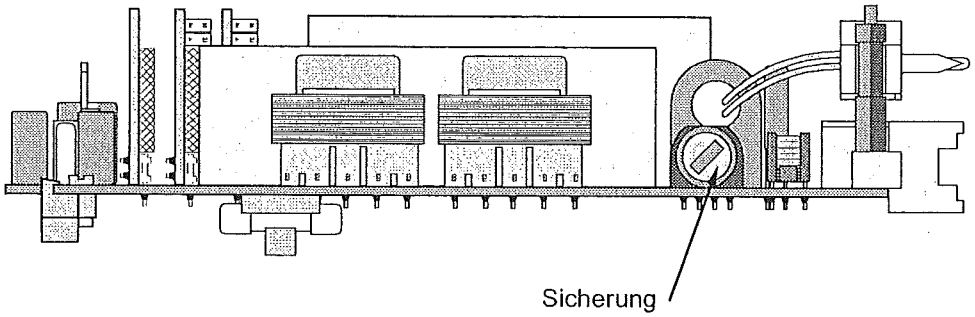
Caution!

Before changing the fuse, the E-coil regulator REG -DE must be separated from the voltage supply!

Required fuse:

Fine-wire fuse T (Träge) 250 V, 2 A

Please find the fuse-holder on the lower sideof circuit board 3 (LP-REG-NTZ2)



Map 10.1: change of fuse on circuit board 3

10.2 Change of batteries

Caution!

Before changing the fuse, do not forget to separate the E-coil regulator REG -DE from the voltage supply!

Required battery:

Lithium 3 V with soldering tags type VARTA AA-6127

Battery life:

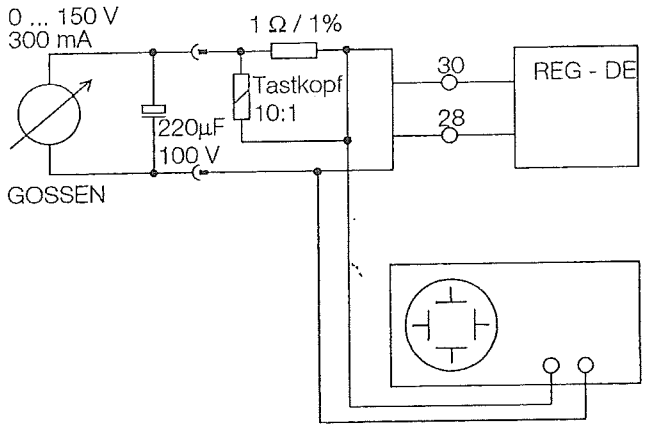
In storage > 6 years

In operation if on-switching duration > 50%, the battery life is > 10 years

We recommend to let the battery change be made in the factory

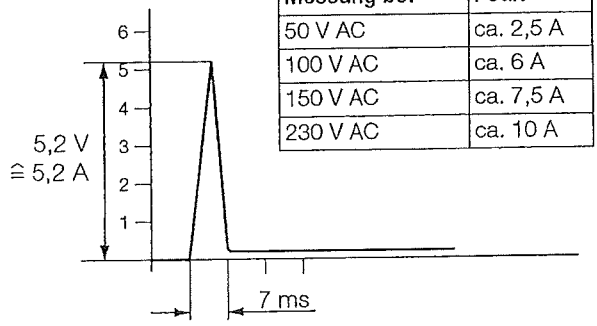
10.3 Current consumption of the REG-DP

Meßschaltung (100 V DC)



Meßergebnisse

Einschalt-Spike bei 100 V DC



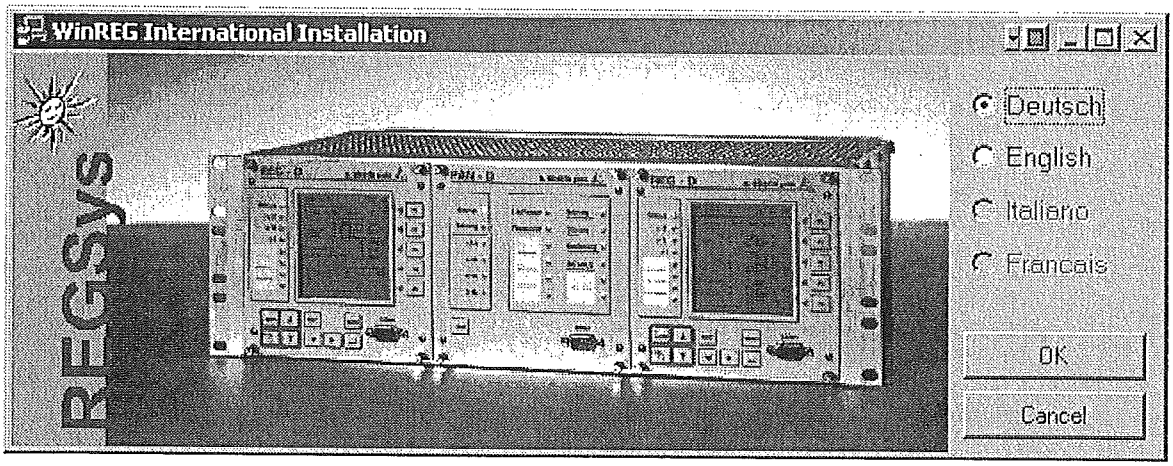
Messung bei	Peak
50 V AC	ca. 2,5 A
100 V AC	ca. 6 A
150 V AC	ca. 7,5 A
230 V AC	ca. 10 A

The measuring results should deliver hints to the selection of the fuses.

11 WinREG-DP

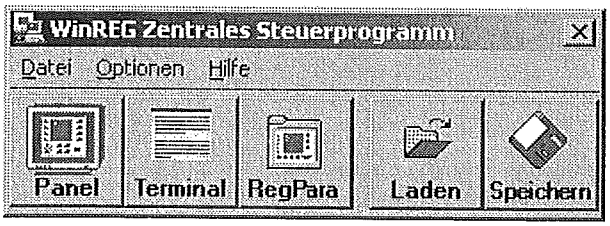
11.1 Installation

The installation programme is started automatically with the putting in of the CD. Alternatively, the Setup.exe in the Root-index of the CD may be started.



For the following installation, we suggest as a standard index path C:\Programme\WinREG3. If another path is to be used, please change it accordingly during the installation.

After the installation, a central control program is at your disposal

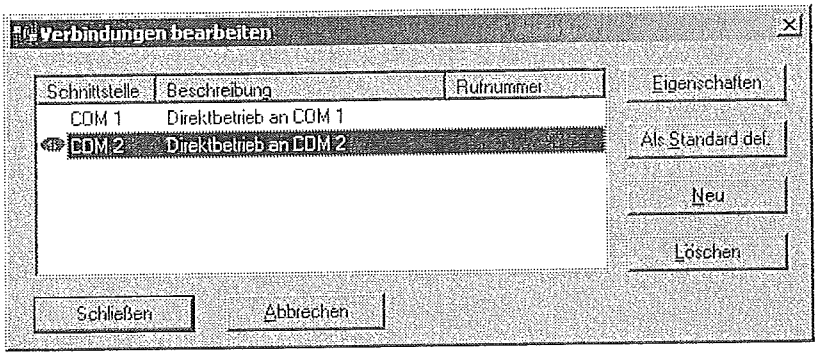


For the communication with the regulator, please select the used serial interface at the PC under menu "Option" and set the parameters at the regulator accordingly.

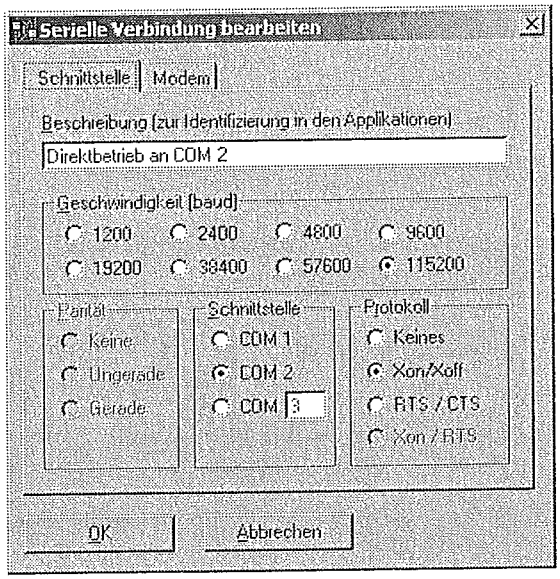
The regulator itself is set to 9600 baud from the factory. It is recommended to set the serial interface COM1 at the regulator in the menu: SETUP\ System\COM & E-LAN\COM1 to

Mode: ECL
BAUD: 115000
Parity: Off
Handshake: RTS/CTS

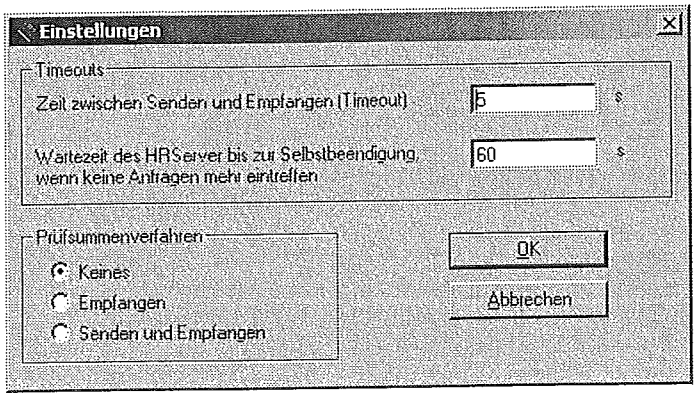
At the PC there will be the corresponding preparation, as for example the COM2 in the menu: Options\Verbindung



By submenu: Features

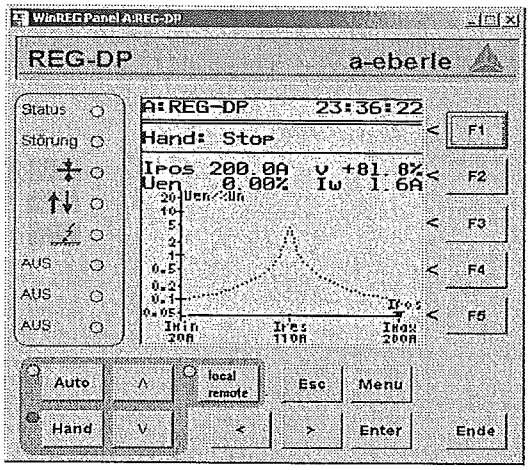


In order to operate several panels and thus several regulators **at the same time** by one serial interface, a special interface for the serial interface has been developped. After having finished the programme, this program remains active in the background and blocks the other programmes to get free access to the serial interface. This operation programme titled "HR-Server" may either be ended by the task-manager directly or resp. the waiting time to the automatical ending of the server may be set in menu: Options\settings. The factory setting is 60s, e.g. 60s after all communication programmes via the serial interface are finished, the serial interface will be released again for other programmes.



After the configuration of the serial interface the following programmes are available:

11.2 Panel



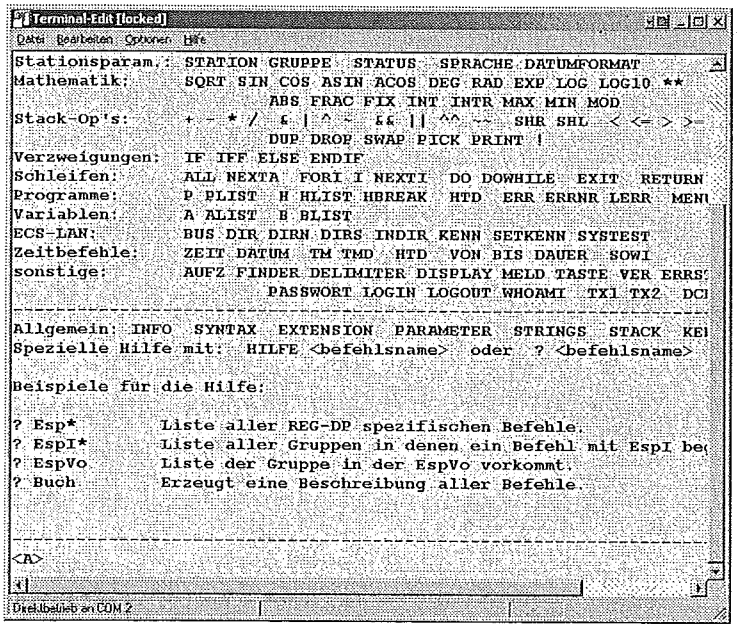
In this operation mode, the control surface of the regulator is simulated. There are the same functions available as may be made locally by the keyboard of the regulator.

Thus there is the possibility to operate and to parameterize the regulator remotely by a modem link.

If several regulators are linked by the E-LAN bus, several panels may be opened and operated with by one serial interface.

11.3 Terminal

By means of the terminal programme, the programming of the regulator may effect by the REG-L commands:



Moreover the following menus resp. functions are available
File
- Link
- Writing in File
- End

Edit
- Cut-out
- Copy
- Insert
- Go to end

Options
- Colours
  - Background
  - Foreground
- Fonts
- Translate (Converting the vowels for the indication under Windows)
- Lock-Mode
- Settings

11.4 Load

Load the Desktop File

11.5 Save

Save the Desktop File

11.6 RegPara

The RegPara is the central function around the regulator parameters with the following tasks:

- read parameters out of the regulator
- read parameters without coil data out of the regulator (present coil data in the memory are not overwritten)

- save parameters in a file
- read parameters from a file

- transmit parameters completely into the regulator
- transmit parameters without coil data into the regulator

- compare parameters in the memory of the PC to the parameters in the regulator and produce a difference list.
- compare parameters in the memory of the PC to the parameters in the file and produce a difference list.

The following menu structure is available:

File

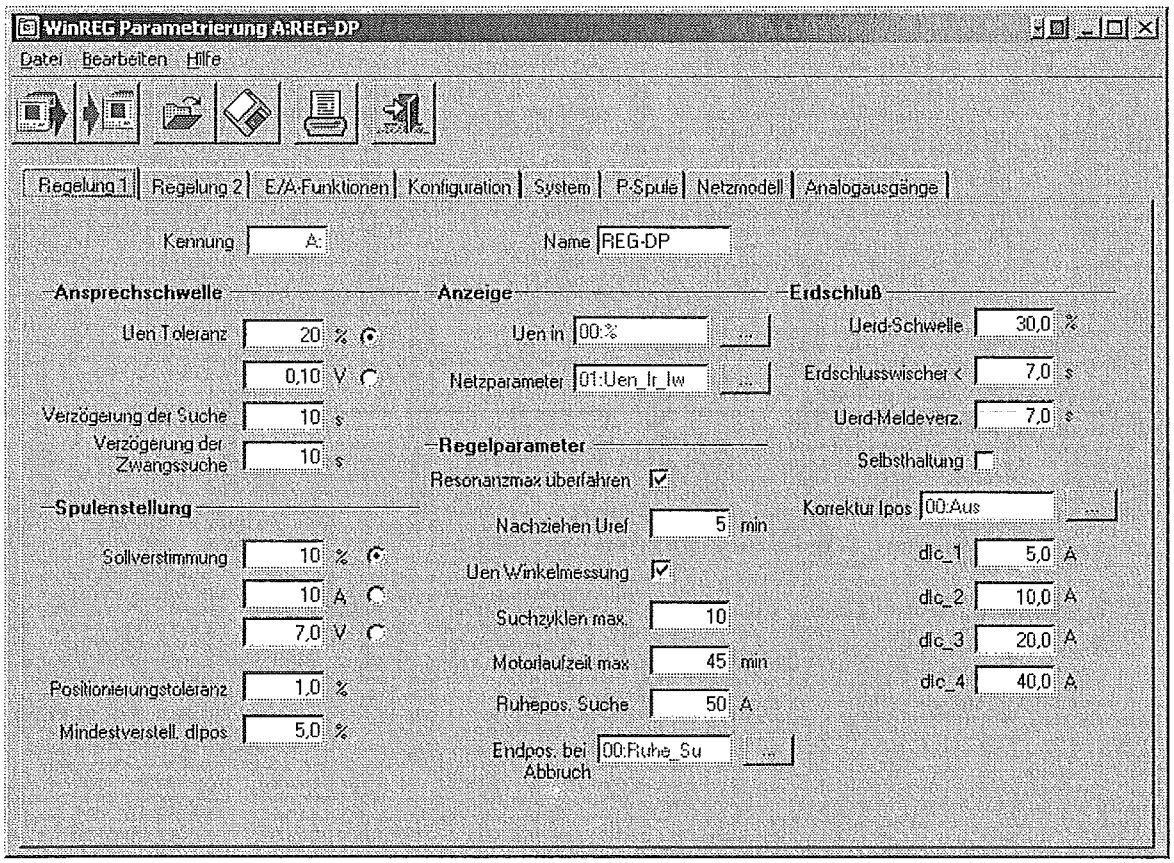
- Read in meter
- Send to meter
- Load file
- Save as
- Print
- End

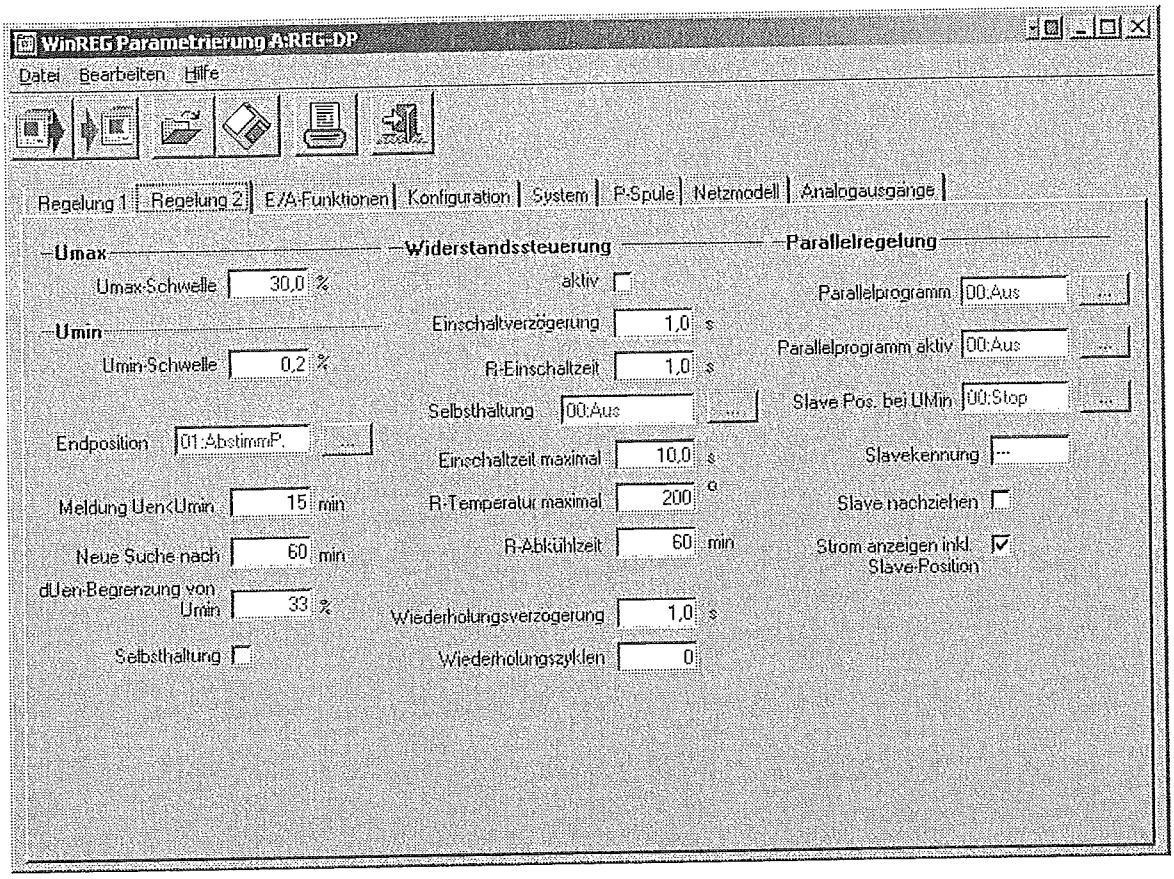
Edit

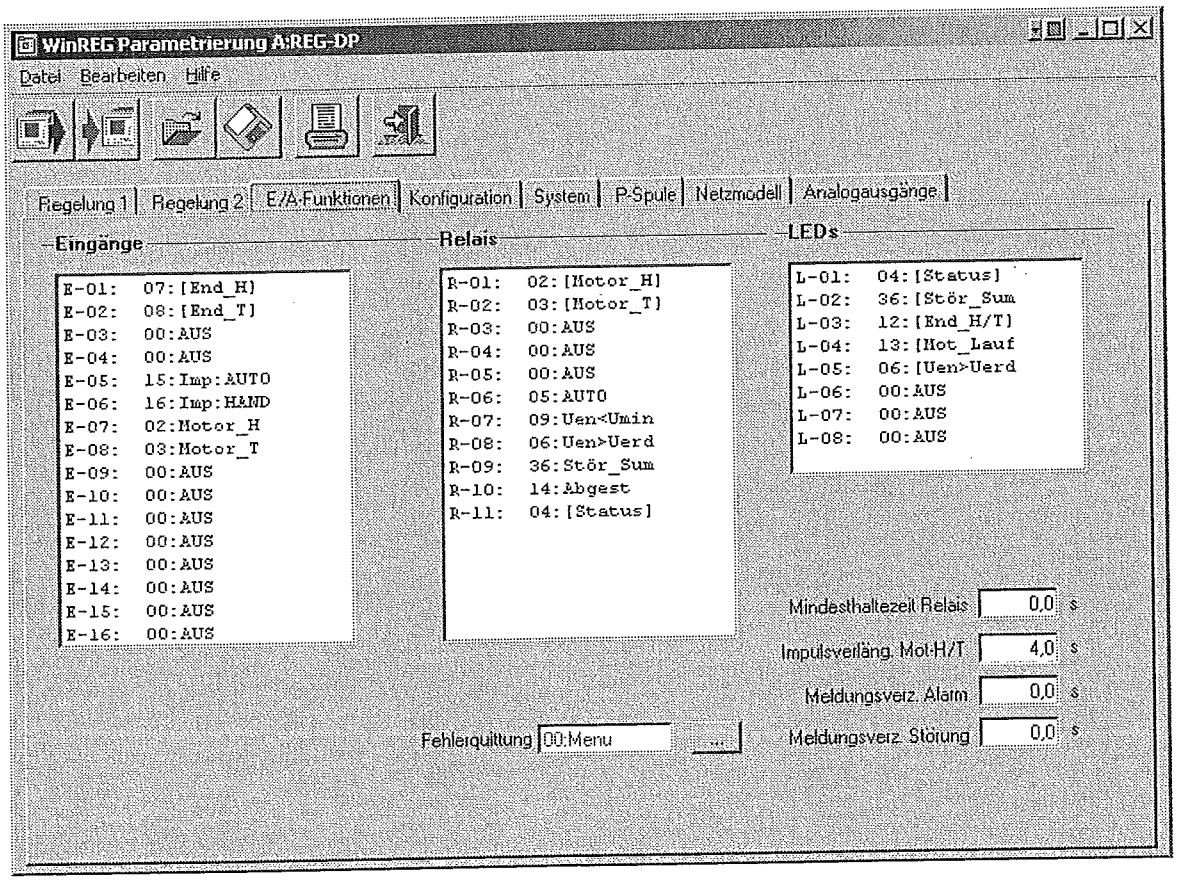
- Compare
- Additional data
- Online-actions
- Change type of meter
- Convert
- Settings

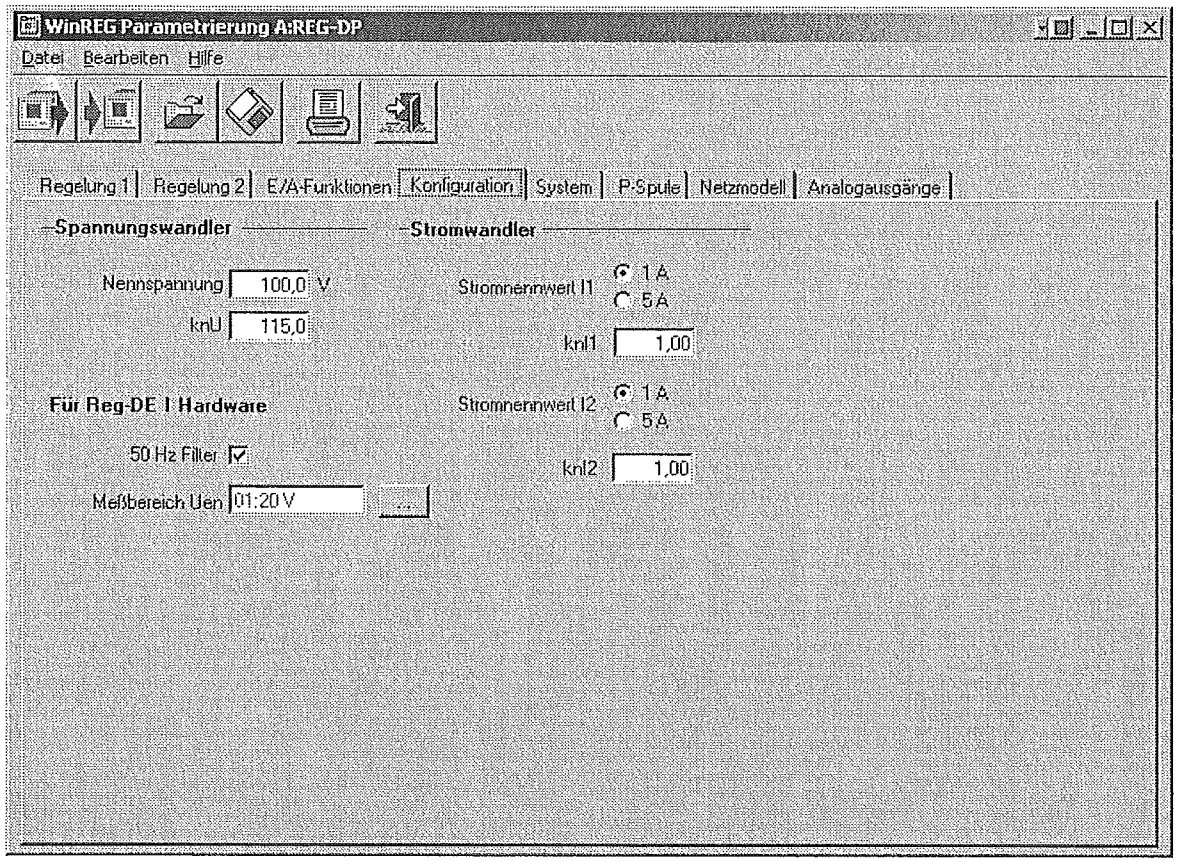
11.6.1 Cards

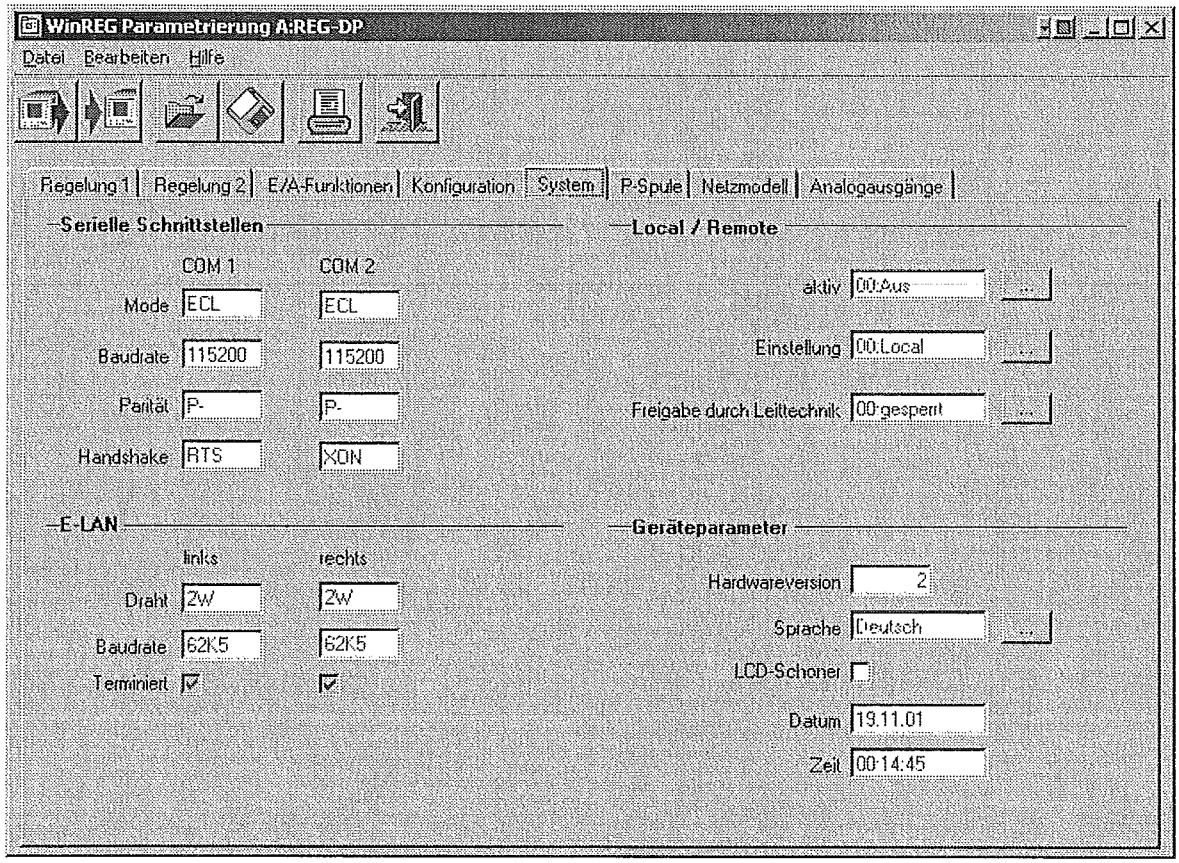
The following maps are an overview of the single "Cards" of the REG-DP.

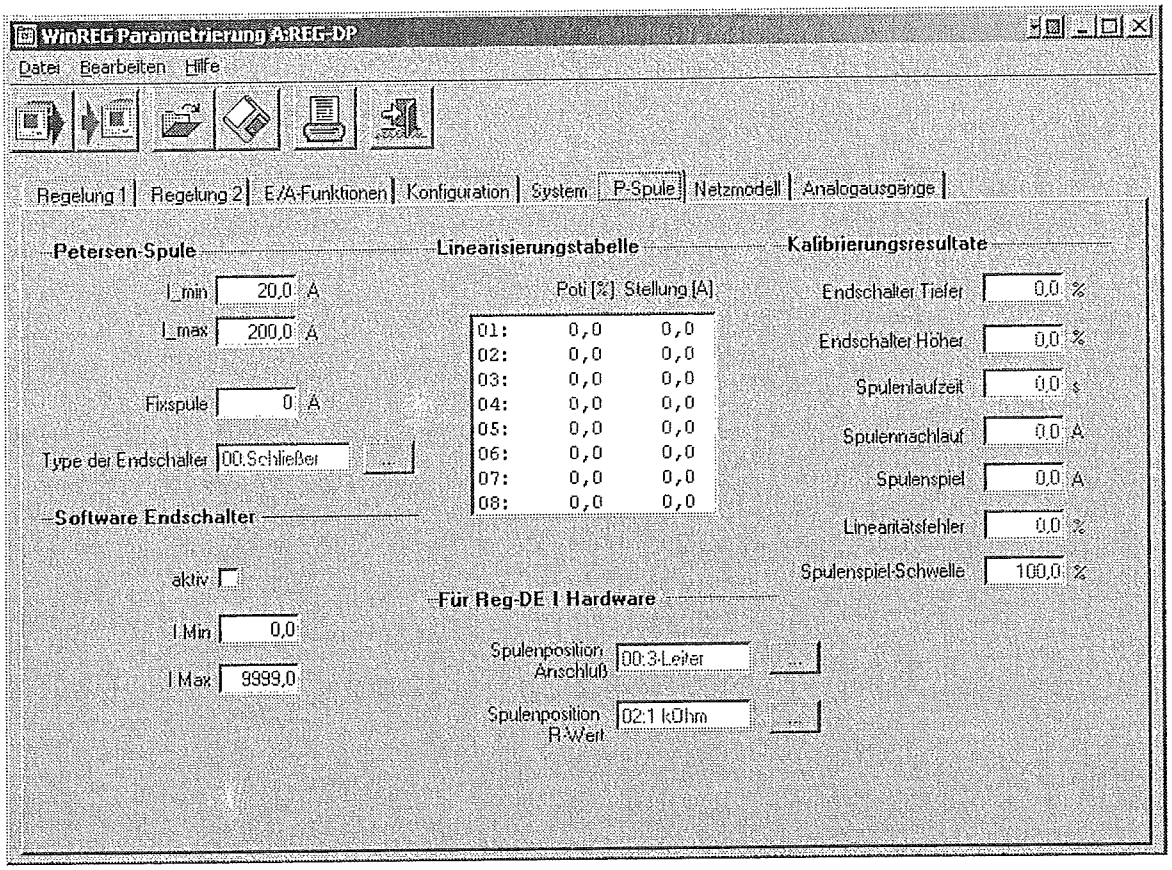


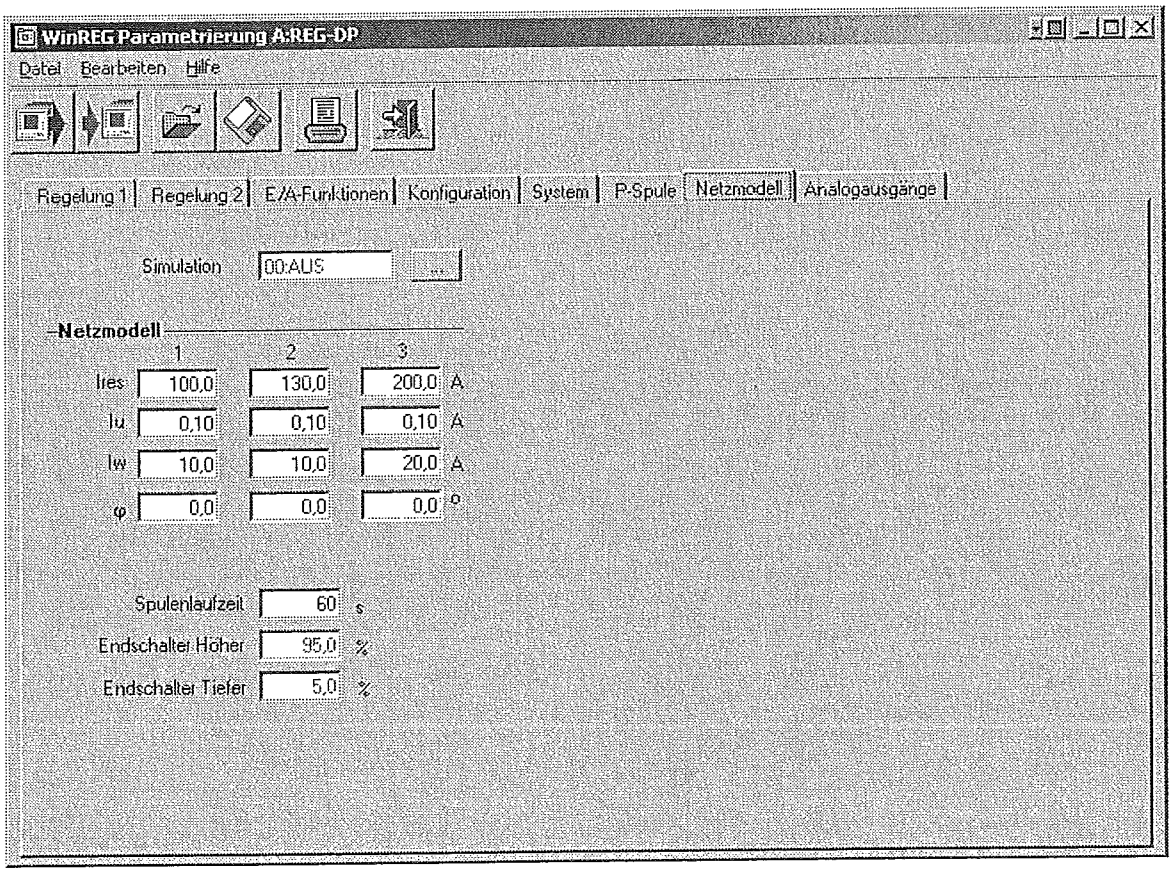

WinREG Parametrierung A:REG-DP
Datei Bearbeiten Hilfe
Regelung 1 Regelung 2 E/A-Funktionen Konfiguration System P-Spule Netzmodell Analogausgänge
Umax
Umax-Schwelle 30,0 %
Umin
Umin-Schwelle 0,2 %
Endposition 01:AbstimmP.
Meldung Uen<Umin 15 min
Neue Suche nach 60 min
dUen-Begrenzung von Umin 33 %
Selbsthaltung
Widerstandssteuerung
aktiv
Einschaltverzögerung 1,0 s
R-Einschaltzeit 1,0 s
Selbsthaltung 00:Aus
Einschaltzeit maximal 10,0 s
R-Temperatur maximal 200 °
R-Abkühlzeit 60 min
Wiederholungsverzögerung 1,0 s
Wiederholungszyklen 0
Parallelregelung
Parallelprogramm 00:Aus
Parallelprogramm aktiv 00:Aus
Slave Pos. bei UMin 00:Stop
Slavekennung ---
Slave nachziehen
Strom anzeigen inkl. Slave-Position

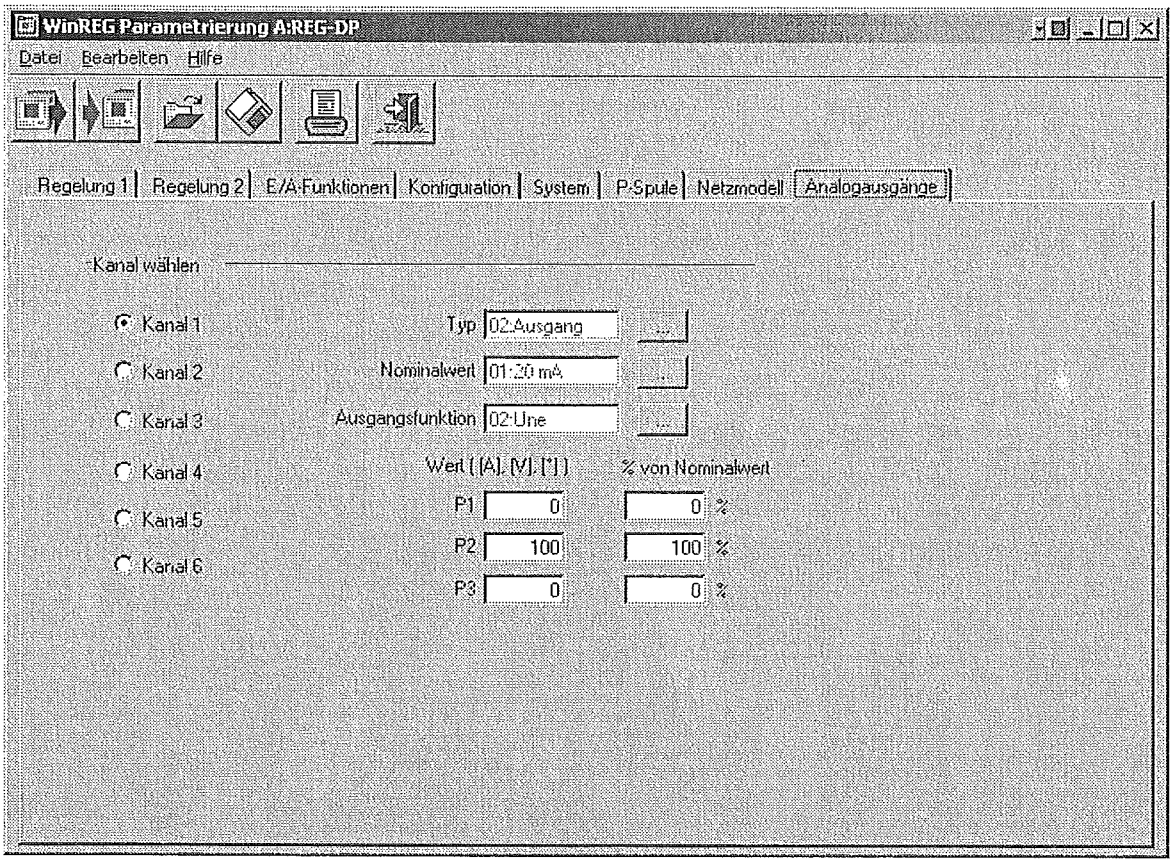

WinREG Parametrierung A:REG-DP
Datei Bearbeiten Hilfe
Regelung 1 Regelung 2 E/A-Funktionen Konfiguration System P-Spule Netzmodell Analogausgänge
Eingänge
E-01: 07:[End_H]
E-02: 08:[End_T]
E-03: 00:AUS
E-04: 00:AUS
E-05: 15:Imp:AUTO
E-06: 16:Imp:HAND
E-07: 02:Motor_H
E-08: 03:Motor_T
E-09: 00:AUS
E-10: 00:AUS
E-11: 00:AUS
E-12: 00:AUS
E-13: 00:AUS
E-14: 00:AUS
E-15: 00:AUS
E-16: 00:AUS
Relais
R-01: 02:[Motor_H]
R-02: 03:[Motor_T]
R-03: 00:AUS
R-04: 00:AUS
R-05: 00:AUS
R-06: 05:AUTO
R-07: 09:Uen<Umin
R-08: 06:Uen>Uerd
R-09: 36:Stör_Sum
R-10: 14:Abgest
R-11: 04:[Status]
LEDs
L-01: 04:[Status]
L-02: 36:Stör_Sum
L-03: 12:[End_H/T]
L-04: 13:[Mot_Lauf
L-05: 06:[Uen>Uerd
L-06: 00:AUS
L-07: 00:AUS
L-08: 00:AUS
Mindesthaltezeit Relais 0,0 s
Impulsverläng. Mot-H/T 4,0 s
Meldungsverz. Alarm 0,0 s
Meldungsverz. Störung 0,0 s
Fehlerquittung 00:Menu


WinREG Parametrierung A:REG-DP
Datei Bearbeiten Hilfe
Regelung 1 Regelung 2 E/A-Funktionen Konfiguration System P-Spule Netzmodell Analogausgänge
Spannungswandler
Nennspannung 100,0 V
knU 115,0
Für Reg-DE I Hardware
50 Hz Filter
Meßbereich Uen 01:20 V
Stromwandler
Stromnennwert I1 1 A 5 A
knI1 1,00
Stromnennwert I2 1 A 5 A
knI2 1,00


WinREG Parametrierung A:REG-DP
Datei Bearbeiten Hilfe
Regelung 1 Regelung 2 E/A-Funktionen Konfiguration System P-Spule Netzmodell Analogausgänge
Serielle Schnittstellen
COM 1 COM 2
Mode ECL ECL
Baudrate 115200 115200
Parität P- P-
Handshake RTS XON
E-LAN
links rechts
Draht 2W 2W
Baudrate 62K5 62K5
Terminiert
Local / Remote
aktiv 00:Aus
Einstellung 00:Local
Freigabe durch Leittechnik 00:gesperrt
Geräteparameter
Hardwareversion 2
Sprache Deutsch
LCD-Schoner
Datum 19.11.01
Zeit 00:14:45


WinREG Parametrierung A:REG-DP
Datei Bearbeiten Hilfe
Regelung 1 | Regelung 2 | E/A-Funktionen | Konfiguration | System | P-Spule | Netzmodell | Analogausgänge
Petersen-Spule
I_min 20,0 A
I_max 200,0 A
Fixspule 0 A
Type der Endschalter 00:Schließer
Software Endschalter
aktiv
I Min 0,0
I Max 9999,0
Linearisierungstabelle
Poti [%] Stellung [A]
01: 0,0 0,0
02: 0,0 0,0
03: 0,0 0,0
04: 0,0 0,0
05: 0,0 0,0
06: 0,0 0,0
07: 0,0 0,0
08: 0,0 0,0
Kalibrierungsresultate
Endschalter Tiefer 0,0 %
Endschalter Höher 0,0 %
Spulenlaufzeit 0,0 s
Spulennachlauf 0,0 A
Spulenspiel 0,0 A
Linearitätsfehler 0,0 %
Spulenspiel-Schwelle 100,0 %
Für Reg-DE I Hardware
Spulenposition Anschluß 00:3-Leiter
Spulenposition R-Wert 02:1 kOhm


WinREG Parametrierung A:REG-DP
Datei Bearbeiten Hilfe
Regelung 1 | Regelung 2 | E/A-Funktionen | Konfiguration | System | P-Spule | Netzmodell | Analogausgänge
Simulation 00:AUS
Netzmodell
1 2 3
Ires 100,0 130,0 200,0 A
Iu 0,10 0,10 0,10 A
Iw 10,0 10,0 20,0 A
φ 0,0 0,0 0,0 °
Spulenlaufzeit 60 s
Endschalter Höher 95,0 %
Endschalter Tiefer 5,0 %



The setting parameters may be printed out assortedly. The following options are available as selection criteria:

- sequence corresponding to the menu of the regulator
- sequence corresponding to the cards

11.6.2 Parameter print-out sorted according to menu of the regulator

REG-DP

Kommentar: UW-Standard
Quelle: Standard_REG-DP.prm; Firmware: 2.0.18
Speicherdatum: 18. Nov. 01; Speicherzeit: 22:21:14
Ausdruck vom 18. Nov. 01, 10:40

Regelung - Standardparameter

Toleranzbereich	00:relativ
Uen Toleranz [%]	20
Uen Toleranz [A]	0,10
Verzögerung der Suche [s]	10
Verzögerung der Zwangssuche [s]	10
Sollverstimmung	00:% von Ire
Sollverstimmung [%]	10
Sollverstimmung [A]	10
Sollverstimmung [V]	7,0
Positionierungstoleranz [%]	1,0
Mindestverstell. dIpos [A]	5,0
Resonanzmax überfahren	01:JA
Nachziehen Uref [min]	5
Uen Winkelmessung	01:Ein
Suchzyklen max.	10
Motorlaufzeit max [min]	45
Endposition bei Abbruch	00:Ruhe_Su
Ruhepos. Suche [A]	50

Regelung - Erdschluss

Uerd-Schwelle [%]	30,0
Erdschlusswischer < [s]	7,0
Uerd-Meldeverz. [s]	7,0
Selbsthaltung	00:Aus
Korrektur Ipos	00:Aus
dIc_1 [A]	5,0
dIc_2 [A]	10,0
dIc_3 [A]	20,0
dIc_4 [A]	40,0

Regelung - U

Umax-Schwelle [%]	30,0
Umin-Schwelle [%]	0,2
Endposition	01:AbstimmP.
Meldung Uen<Umin nach [min]	15
Neue Suche nach [min]	60
dUen-Begrenzung von Umin [%]	33
Widerstandssteuerung aktiv	00:AUS
Einschaltverzögerung [s]	1,0
R-Einschaltzeit [s]	1,0
Widerstandssteuerung, Selbsthaltung	00:Aus
Einschaltzeit maximal [s]	10,0
R-Temperatur maximal [o]	200
R-Abkühlzeit [min]	60
Wiederholungsverzögerung [s]	1,0
Wiederholungszyklen	0
Parallelprogramm	00:Aus
Parallelprogramm: aktiv	00:Aus
Slavekennung	---
Slave nachziehen	00:Nein
Parallelprogramm: Slave Pos. bei Umin	00:Stop

Inbetriebnahme

knU	115,0
Nennspannung [V]	100,0
Messbereich Uen	01:20 V
50 Hz Filter	01:EIN
Imin [A]	20,0
Imax [A]	200,0
Spulenposition Anschluss	00:3-Leiter
Spulenposition R-Wert	02:1 kOhm
Software-Endschalter: aktiv	00:Aus
Type der Endschalter	00:Schließer
Software-Endschalter: I Min [A]	0,0
Software-Endschalter: I Max [A]	9999,0

Seite 2:

Schaltabstand zur gemessenen Endschalterpos.[%]	1,0
Fixspule [A]	0
Uen in	00:%
Netzparameter	01:Uen_Ir_Iw
Strom anzeigen inkl. Slave-Position	01:Ja
Eingänge E 1	07:[End_H]
Eingänge E 2	08:[End_T]
Eingänge E 3	00:AUS
Eingänge E 4	00:AUS
Eingänge E 5	15:Imp:AUTO
Eingänge E 6	16:Imp:HAND
Eingänge E 7	02:Motor_H
Eingänge E 8	03:Motor_T
Eingänge E 9	00:AUS
Eingänge E 10	00:AUS
Eingänge E 11	00:AUS
Eingänge E 12	00:AUS
Eingänge E 13	00:AUS
Eingänge E 14	00:AUS
Eingänge E 15	00:AUS
Eingänge E 16	00:AUS
Relais 1	02:[Motor_H]
Relais 2	03:[Motor_T]
Relais 3	00:AUS
Relais 4	00:AUS
Relais 5	00:AUS
Relais 6	05:AUTO
Relais 7	09:Uen<Umin
Relais 8	06:Uen>Uerd
Relais 9	36:Stör_Sum
Relais 10	14:Abgest
Relais 11	04:[Status]
LEDs 1	04:[Status]
LEDs 2	36:[Stör_Sum
LEDs 3	12:[End_H/T]
LEDs 4	13:[Mot_Lauf
LEDs 5	06:[Uen>Uerd
LEDs 6	00:AUS
LEDs 7	00:AUS
LEDs 8	00:AUS
Mindesthaltezeit Relais [s]	0,0
Impulsverläng. Mot-H/T [s]	4,0
Meldungsverz. Alarm [s]	0,0
Meldungsverz. Störung [s]	0,0
Fehlerquittung	00:Menu
Stromnennwert I1	00:1A
knI1	1,00
Stromnennwert I2	00:1A
knI2	1,00

Fixspule	00:AUS
Querkupplung	00:AUS
Linearisierungstabelle R 1 [%]	0,0
Linearisierungstabelle R 2 [%]	0,0
Linearisierungstabelle R 3 [%]	0,0
Linearisierungstabelle R 4 [%]	0,0
Linearisierungstabelle R 5 [%]	0,0
Linearisierungstabelle R 6 [%]	0,0
Linearisierungstabelle R 7 [%]	0,0
Linearisierungstabelle R 8 [%]	0,0
Linearisierungstabelle Stellung 1 [A]	0,0
Linearisierungstabelle Stellung 2 [A]	0,0
Linearisierungstabelle Stellung 3 [A]	0,0
Linearisierungstabelle Stellung 4 [A]	0,0
Linearisierungstabelle Stellung 5 [A]	0,0
Linearisierungstabelle Stellung 6 [A]	0,0
Linearisierungstabelle Stellung 7 [A]	0,0
Linearisierungstabelle Stellung 8 [A]	0,0

Analogausgänge

Kanaltyp 1	02:Ausgang
Nominalwert 1	01:20 mA
Ausgangsfunktion 1	02:Une

Seite 3:

Eingangsfunktion 1	02:Une
Filter-Zeitkonstante 1 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 1	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 1	100,0
Punkt X3 (Einheit: Siehe Nominalwert) 1	0,0
Punkt Y1, normiert 1 [%]	0,000
Punkt Y2, normiert 1 [%]	100,000
Punkt Y3, normiert 1 [%]	0,000
Kanaltyp 2	02:Ausgang
Nominalwert 2	01:20 mA
Ausgangsfunktion 2	06:Ipos
Eingangsfunktion 2	06:Ipos
Filter-Zeitkonstante 2 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 2	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 2	400,0
Punkt X3 (Einheit: Siehe Nominalwert) 2	0,0
Punkt Y1, normiert 2 [%]	0,000
Punkt Y2, normiert 2 [%]	100,000
Punkt Y3, normiert 2 [%]	0,000
Kanaltyp 3	02:Ausgang
Nominalwert 3	01:20 mA
Ausgangsfunktion 3	03:I1
Eingangsfunktion 3	03:I1
Filter-Zeitkonstante 3 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 3	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 3	1,0
Punkt X3 (Einheit: Siehe Nominalwert) 3	0,0
Punkt Y1, normiert 3 [%]	0,000
Punkt Y2, normiert 3 [%]	100,000
Punkt Y3, normiert 3 [%]	0,000
Kanaltyp 4	02:Ausgang
Nominalwert 4	01:20 mA
Ausgangsfunktion 4	00:Aus
Eingangsfunktion 4	00:Aus
Filter-Zeitkonstante 4 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 4	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 4	0,0
Punkt X3 (Einheit: Siehe Nominalwert) 4	0,0
Punkt Y1, normiert 4 [%]	0,000

Punkt Y2, normiert 4 [%]	0,000
Punkt Y3, normiert 4 [%]	0,000
Kanaltyp 5	00:AUS
Nominalwert 5	00:AUS
Ausgangsfunktion 5	00:AUS
Eingangsfunktion 5	00:AUS
Filter-Zeitkonstante 5 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 5	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 5	0,0
Punkt X3 (Einheit: Siehe Nominalwert) 5	0,0
Punkt Y1, normiert 5 [%]	0,000
Punkt Y2, normiert 5 [%]	0,000
Punkt Y3, normiert 5 [%]	0,000
Kanaltyp 6	00:AUS
Nominalwert 6	00:AUS
Ausgangsfunktion 6	00:AUS
Eingangsfunktion 6	00:AUS
Filter-Zeitkonstante 6 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 6	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 6	0,0
Punkt X3 (Einheit: Siehe Nominalwert) 6	0,0
Punkt Y1, normiert 6 [%]	0,000
Punkt Y2, normiert 6 [%]	0,000
Punkt Y3, normiert 6 [%]	0,000
Endschalter Tiefer [%]	0,0
Endschalter Höher [%]	0,0
Spulenlaufzeit [s]	0,0
Spulennachlauf [A]	0,0
Spulenspiel [A]	0,0
Spulenspiel-Schwelle [%]	100,0
Linearitätsfehler [%]	0,0
Estimate1	0,5
Estimate2	0,6

Seite 4:

Ruhepos 2 [A]	100

Optionen

Local / Remote Einstellung	00:Local
L / R Freigabe durch Leittechnik	00:gesperrt
Local / Remote aktiv	00:Aus
Simulation	00:AUS
Ires 1 [A]	100,0
Iu 1 [A]	0,10
Iw 1 [A]	10,0
phi 1 [°]	0,0
Ires 2 [A]	130,0
Iu 2 [A]	0,10
Iw 2 [A]	10,0
phi 2 [°]	0,0
Ires 3 [A]	200,0
Iu 3 [A]	0,10
Iw 3 [A]	20,0
phi 3 [°]	0,0
Spulenlaufzeit [s]	60
Endschalter Höher	95,0
Endschalter Tiefer [%]	5,0

System

Sprache	Deutsch
COM 1 Mode	ECL
COM 1 Baudrate	115200
COM 1 Parität	P-
COM 1 Handshake	RTS

COM 2 Mode	ECL
COM 2 Baudrate	115200
COM 2 Parität	P-
COM 2 Handshake	XON
ELAN links Draht	2W
ELAN links Baudrate	62K5
ELAN links Terminiert	Ja
ELAN rechts Mode	2W
ELAN rechts Baudrate	62K5
ELAN rechts Terminiert	Ja
Kennung	A:
Name	REG-DP
LCD-Schoner	00:AUS
Datum	19.11.01
Zeit	00:14:45
Hardwareversion	2

11.6.3 Parameter print-out sorted according to index cards:

REG-DP
Kommentar: UW-Standard
Quelle: Standard_REG-DP.prm; Firmware: 2.0.18
Speicherdatum: 18. Nov. 01; Speicherzeit: 22:21:14
Ausdruck vom 18. Nov. 01, 10:25

Regelung 1

Kennung	A:
Name	REG-DP
Toleranzbereich	00:relativ
Uen Toleranz [%]	20
Uen Toleranz [A]	0,10
Verzögerung der Suche [s]	10
Verzögerung der Zwangssuche [s]	10
Sollverstimmung	00:% von Ire
Sollverstimmung [%]	10
Sollverstimmung [A]	10
Sollverstimmung [V]	7,0
Positionierungstoleranz [%]	1,0
Mindestverstell. dIpos [A]	5,0
Uen in	00:%
Netzparameter	01:Uen_Ir_Iw
Resonanzmax überfahren	01:JA
Nachziehen Uref [min]	5
Uen Winkelmessung	01:Ein
Suchzyklen max.	10
Motorlaufzeit max [min]	45
Ruhepos. Suche [A]	50
Endposition bei Abbruch	00:Ruhe_Su
Uerd-Schwelle [%]	30,0
Erdschlusswischer < [s]	7,0
Uerd-Meldeverz. [s]	7,0
Selbsthaltung	00:Aus
Korrektur Ipos	00:Aus
dIc_1 [A]	5,0
dIc_2 [A]	10,0
dIc_3 [A]	20,0
dIc_4 [A]	40,0

Regelung 2

Umax-Schwelle [%]	30,0
Umin-Schwelle [%]	0,2
Endposition	01:AbstimmP.
Meldung Uen<Umin nach [min]	15
Neue Suche nach [min]	60
dUen-Begrenzung von Umin [%]	33
Selbsthaltung	00:Aus
Widerstandssteuerung aktiv	00:AUS
Einschaltverzögerung [s]	1,0
R-Einschaltzeit [s]	1,0
Widerstandssteuerung, Selbsthaltung	00:Aus
Einschaltzeit maximal [s]	10,0
R-Temperatur maximal [o]	200
R-Abkühlzeit [min]	60
Wiederholungsverzögerung [s]	1,0
Wiederholungszyklen	0
Parallelprogramm	00:Aus
Parallelprogramm: aktiv	00:Aus
Parallelprogramm: Slave Pos. bei UMin	00:Stop
Slavekennung	---
Slave nachziehen	00:Nein

Strom anzeigen inkl. Slave-Position	01:Ja
E/A-Funktionen	
Eingänge E 1	07:[End_H]
Eingänge E 2	08:[End_T]
Eingänge E 3	00:AUS
Eingänge E 4	00:AUS
Eingänge E 5	15:Imp:AUTO
Eingänge E 6	16:Imp:HAND
Eingänge E 7	02:Motor_H
Eingänge E 8	03:Motor_T

Seite 2:

Eingänge E 9	00:AUS
Eingänge E 10	00:AUS
Eingänge E 11	00:AUS
Eingänge E 12	00:AUS
Eingänge E 13	00:AUS
Eingänge E 14	00:AUS
Eingänge E 15	00:AUS
Eingänge E 16	00:AUS
Relais 1	02:[Motor_H]
Relais 2	03:[Motor_T]
Relais 3	00:AUS
Relais 4	00:AUS
Relais 5	00:AUS
Relais 6	05:AUTO
Relais 7	09:Uen<Umin
Relais 8	06:Uen>Uerd
Relais 9	36:Stör_Sum
Relais 10	14:Abgest
Relais 11	04:[Status]
LEDs 1	04:[Status]
LEDs 2	36:[Stör_Sum
LEDs 3	12:[End_H/T]
LEDs 4	13:[Mot_Lauf
LEDs 5	06:[Uen>Uerd
LEDs 6	00:AUS
LEDs 7	00:AUS
LEDs 8	00:AUS
Fehlerquittung	00:Menu
Mindesthaltezeit Relais [s]	0,0
Impulsverläng. Mot-H/T [s]	4,0
Meldungsverz. Alarm [s]	0,0
Meldungsverz. Störung [s]	0,0
Konfiguration	
Nennspannung [V]	100,0
knU	115,0
50 Hz Filter	01:EIN
Messbereich Uen	01:20 V
Stromnennwert I1	00:1A
knI1	1,00
Stromnennwert I2	00:1A
knI2	1,00
System	
COM 1 Mode	ECL
COM 1 Baudrate	115200
COM 1 Parität	P-
COM 1 Handshake	RTS
COM 2 Mode	ECL
COM 2 Baudrate	115200
COM 2 Parität	P-

COM 2 Handshake	XON
ELAN links Draht	2W
ELAN links Baudrate	62K5
ELAN links Terminiert	Ja
ELAN rechts Mode	2W
ELAN rechts Baudrate	62K5
ELAN rechts Terminiert	Ja
Local / Remote aktiv	00:Aus
Local / Remote Einstellung	00:Local
L / R Freigabe durch Leittechnik	00:gesperrt
Hardwareversion	2
Sprache	Deutsch
LCD-Schoner	00:AUS
Datum	19.11.01
Zeit	00:14:45

P-Spule

Imin [A]	20,0
Imax [A]	200,0
Fixspule [A]	0
Software-Endschalter: aktiv	00:Aus

Seite 3:

Type der Endschalter	00:Schließer
Software-Endschalter: I Min [A]	0,0
Software-Endschalter: I Max [A]	9999,0
Schaltabstand zur gemessenen Endschalterpos.[%]	1,0
Linearisierungstabelle R 1 [%]	0,0
Linearisierungstabelle R 2 [%]	0,0
Linearisierungstabelle R 3 [%]	0,0
Linearisierungstabelle R 4 [%]	0,0
Linearisierungstabelle R 5 [%]	0,0
Linearisierungstabelle R 6 [%]	0,0
Linearisierungstabelle R 7 [%]	0,0
Linearisierungstabelle R 8 [%]	0,0
Linearisierungstabelle Stellung 1 [A]	0,0
Linearisierungstabelle Stellung 2 [A]	0,0
Linearisierungstabelle Stellung 3 [A]	0,0
Linearisierungstabelle Stellung 4 [A]	0,0
Linearisierungstabelle Stellung 5 [A]	0,0
Linearisierungstabelle Stellung 6 [A]	0,0
Linearisierungstabelle Stellung 7 [A]	0,0
Linearisierungstabelle Stellung 8 [A]	0,0
Spulenposition Anschluss	00:3-Leiter
Spulenposition R-Wert	02:1 kOhm
Endschalter Tiefer [%]	0,0
Endschalter Höher [%]	0,0
Spulenlaufzeit [s]	0,0
Spulennachlauf [A]	0,0
Spulenspiel [A]	0,0
Linearitätsfehler [%]	0,0
Spulenspiel-Schwelle [%]	100,0
Netzmodell	
Simulation	00:AUS
Ires 1 [A]	100,0
Iu 1 [A]	0,10
Iw 1 [A]	10,0
phi 1 [°]	0,0
Ires 2 [A]	130,0
Iu 2 [A]	0,10
Iw 2 [A]	10,0
phi 2 [°]	0,0
Ires 3 [A]	200,0
Iu 3 [A]	0,10

Iw 3 [A]	20,0
phi 3 [°]	0,0
Spulenlaufzeit [s]	60
Endschalter Höher	95,0
Endschalter Tiefer [%]	5,0
Analogausgänge	
Kanaltyp 1	02:Ausgang
Nominalwert 1	01:20 mA
Ausgangsfunktion 1	02:Une
Eingangsfunktion 1	02:Une
Filter-Zeitkonstante 1 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 1	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 1	100,0
Punkt X3 (Einheit: Siehe Nominalwert) 1	0,0
Punkt Y1, normiert 1 [%]	0,000
Punkt Y2, normiert 1 [%]	100,000
Punkt Y3, normiert 1 [%]	0,000
Kanaltyp 2	02:Ausgang
Nominalwert 2	01:20 mA
Ausgangsfunktion 2	06:Ipos
Eingangsfunktion 2	06:Ipos
Filter-Zeitkonstante 2 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 2	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 2	400,0
Punkt X3 (Einheit: Siehe Nominalwert) 2	0,0
Punkt Y1, normiert 2 [%]	0,000
Punkt Y2, normiert 2 [%]	100,000
Punkt Y3, normiert 2 [%]	0,000
Kanaltyp 3	02:Ausgang

Seite 4:

Nominalwert 3	01:20 mA
Ausgangsfunktion 3	03:I1
Eingangsfunktion 3	03:I1
Filter-Zeitkonstante 3 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 3	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 3	1,0
Punkt X3 (Einheit: Siehe Nominalwert) 3	0,0
Punkt Y1, normiert 3 [%]	0,000
Punkt Y2, normiert 3 [%]	100,000
Punkt Y3, normiert 3 [%]	0,000
Kanaltyp 4	02:Ausgang
Nominalwert 4	01:20 mA
Ausgangsfunktion 4	00:Aus
Eingangsfunktion 4	00:Aus
Filter-Zeitkonstante 4 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 4	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 4	0,0
Punkt X3 (Einheit: Siehe Nominalwert) 4	0,0
Punkt Y1, normiert 4 [%]	0,000
Punkt Y2, normiert 4 [%]	0,000
Punkt Y3, normiert 4 [%]	0,000
Kanaltyp 5	00:AUS
Nominalwert 5	00:AUS
Ausgangsfunktion 5	00:AUS
Eingangsfunktion 5	00:AUS
Filter-Zeitkonstante 5 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 5	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 5	0,0
Punkt X3 (Einheit: Siehe Nominalwert) 5	0,0
Punkt Y1, normiert 5 [%]	0,000
Punkt Y2, normiert 5 [%]	0,000
Punkt Y3, normiert 5 [%]	0,000

Kanaltyp 6	00:AUS
Nominalwert 6	00:AUS
Ausgangsfunktion 6	00:AUS
Eingangsfunktion 6	00:AUS
Filter-Zeitkonstante 6 [s]	0
Punkt X1 (Einheit: Siehe Nominalwert) 6	0,0
Punkt X2 (Einheit: Siehe Nominalwert) 6	0,0
Punkt X3 (Einheit: Siehe Nominalwert) 6	0,0
Punkt Y1, normiert 6 [%]	0,000
Punkt Y2, normiert 6 [%]	0,000
Punkt Y3, normiert 6 [%]	0,000

Interne Parameter

Estimate1	0,5
Estimate2	0,6
Querkupplung	00:AUS
Fixspule	00:AUS
Ruhepos 2 [A]	

12 Background - programming REG-L

12.1 The programming language REG-L

The programming language REG-L (REG-Language) has been especially developped for the requirements of the voltage regulation system REGSys with the aim to offer a simple line-orientated dialogue language. Meanwhile, the REG-L has been enlargened by commands for the P-coil regulator REG-DP.

The language leans on the programming languages Forth and BASIC which had been developed for a fast close-to-the-machine control. Forth permits a simple summary of command series to new commands. Forth uses the "Reversed Polnish Notation" (UPN) which is well-known from the scientific HP-calculators.

The programming of the regulator may be made by any ASCII - terminal. The programme lines are edited as text in the regulator and stored by <Return> when all is typed in.

The programme lines are read from the interpreter in the regulator and worked through cyclically in the "background".

In the following please find extracts of the available commands in the REG-DP. This list may also be polled by the help text in the terminal mode. (After the Prompt, which includes the regulator address, an <A> in our example, please insert a ? and a <Return>)

12.2 List of the REG-L / ECL-Interpreter-commands

```
A>?
-------------------------------------------------------------------------------
Verzeichnis der REG-L/ECL-Interpreter-Befehle:
------------------------------------------------ REG-DP: Version 2.0.18
Messdaten:       Esp...
Schreiber:      RecSCAN RecSTOP RecCLEAR
Analogwerte:    ANA ANAMIN ANAMAX ANAFAKTOR ANAOFFSET ANAMODE
Stationsparam.: STATION GRUPPE  STATUS  SPRACHE DATUMFORMAT
Mathematik:     SQRT SIN COS ASIN ACOS DEG RAD EXP LOG LOG10 **
                       ABS FRAC FIX INT INTR MAX MIN MOD
Stack-Op's:     + - * /  & | ^ ~  && || ^^ ~~  SHR SHL  < <= > >= == !=
                       DUP DROP SWAP PICK PRINT !
Verzweigungen:  IF IFF ELSE ENDIF
Schleifen:      ALL NEXTA  FORI I NEXTI  DO DOWHILE  EXIT  RETURN  PAUSE
Programme:      P PLIST  H HLIST HBREAK  HTD  ERR ERRNR LERR  MENUAPP  REM
Variablen:      A ALIST  B BLIST
ECS-LAN:        BUS DIR DIRN DIRS INDIR KENN SETKENN SYSTEST
Zeitbefehle:    ZEIT DATUM  TM TMD  HTD  VON BIS DAUER  SOWI
sonstige:       AUFZ FINDER DELIMITER DISPLAY MELD TASTE VER ERRSTAT ERRKAN
                       PASSWORT LOGIN LOGOUT WHOAMI  TX1 TX2  DCF
-------------------------------------------------------------------------------
Allgemein: INFO  SYNTAX  EXTENSION  PARAMETER  STRINGS  STACK  KENNUNG  RS232
Spezielle Hilfe mit:  HILFE <Befehlsname>  oder  ? <Befehlsname>

Beispiele für die Hilfe:

? Esp*        Liste aller REG-DP spezifischen Befehle.
? EspI*       Liste aller Gruppen in denen ein Befehl mit EspI beginnt.
? EspVo       Liste der Gruppe in der EspVo vorkommt.
? Buch        Erzeugt eine Beschreibung aller Befehle.

-------------------------------------------------------------------------------
```

12.3 REG-DP specific commands

```
<A>? ESP*

--------------------------------------------------------------------------------
REG-DP spezifische Befehle
==================================
Diese Befehlsgruppe beginnt stets mit ESP...
Allgemeine Form:  ESPxxxxxxxxx [<aufzählung>] [= <wert>]
Ausgabe:          Ja (außer bei Ext. '-' oder entsprechendem Hinweis)
Stack (Lesen):     - >>> <rückgabewert>
Stack (Schreiben): - >>> -
Ext.:- + % # . & $
modifzierende Ext.:     * _    (bei entsprechendem Hinweis)

- Die Befehlsausgabe ist rückschreibbar (sofern der entsprechende Befehl eine
  Zuweisung erlaubt). Ausnahme: Numerische Parameter beim Lesen mit der
  Extension *: sie liefern die Bereichsgrenzen als String in der Form
  [<min>,<max>] und legen den eingestellten Wert auf den Stack. Beim Schreiben
  in der *-Form wird bei Überschreitung der Bereichsgrenzen der nächstliegende
  Grenzwert eingestellt, statt die Meldung <<Argumentbereich überschritten>>
  zu bringen.
- Unterstützt der Befehl eine <aufzählung>, so ist der <rückgabewert> stets
  die Summe aus allen Rückgabewerten der <aufzählung>.

Befehlsliste:

  Momentanwerte:
  ---------------
EspVo, EspVoPhi, EspV12, EspIo, EspIoPhi, EspI2, EspI2Phi, EspIpos, EspIposR,
EspTimer, EspCounter

  Betriebsmoden:
  ---------------
EspAuto, EspMotUp, EspMotUpI, EspMotDown, EspMotDownI, EspMotGoto,EspLRActive,
EspEnableLR, EspRemote, EspLocal, EspBlock, EspSearch, EspGoIHome, EspEFault,
EspIFixOn, EspBusBar, ESPErrAckM, ESPErrAck, EspPState

  Berechnete Netzgrößen:
  ----------------------
EspUres, EspUresPhi, EspIres, EspIu, EspIw, EspUref, EspUrefPhi

  Anzeige-Optionen:
  -----------------
EspLcdVo, EspLcdPar, EspLcdVoCnt, EspLCDSaver, Language, EspAddSlPos

  Standardparameter:
  ------------------
ESPdVoType, ESPdVoRel, ESPdVoAbs, EspTSearch, EspTuneType, EspTuneAP,
EspTuneAA, EspTuneVV, EspMaxDPos, SPdIpMin, EspVresPass, EspTFollow,
EspUseAngle, EspSrchCnt, EspTMotMax, EspIhome, EspIhome2

  Erdschlußparameter:
  -------------------
EspVEarth, EspTEFSpike, EspTDVearth, EspEFCorrMod, EspEFCorr, EspEFToMan

  Umax-Parameter:
  ---------------
EspVMax

  Umin-Parameter:
  ---------------
EspVMin, EspVminPos, EspTDVmin, EspSrchT, EspVMinMin, EspVminToMan

  Signalverzögerungen:
  --------------------
EspTOnRel, EspTOnPuls, EspTDAlarm, EspTDError
```

```
  Widerstandssteuerung:
  ---------------------
EspRBlock, EspRStart, EspRTemp,
EspRActive, EspRTon, EspRTonMax, EspRTcold, EspRTdelay1, EspRTdelay2,
EspRNcycle, EspRTempMax

  Parallelregelung:
  ---------------------
EspParaProg, EspParaProgA, EspParaGr, EspSlaveMove, EspSlUminPos,

  Binäre Ein/Ausgänge:
  --------------------
EspBIFu, EspBIInv, EspRelFu, EspRelInv, EspLedFu, EspLedInv, EspRelFVOvr,
EspBI, EspBI32, EspBITC, EspRel, EspRel32, EspLed, EspLed32, EspBIFV,
EspBIFV32, EspRelFV, EspRelFV32, EspLedFV, EspRelPV, EspLedPV

  Analoge Ein/Ausgänge:
  ---------------------
EspAIOType, EspAIOnom, EspAIFu, EspAOFu, EspAIOFIL, EspAScalX, EspAScalY,
EspAIFV, EspAOFV, EspAOPV

  Spannungsmessung:
  -----------------
EspHardware, EspKnVo, EspVoRated, EspVoRange, EspVo50Hz

  Daten der Petersen-Spule:
  -------------------------
EspIMin, EspIMax, EspRType, EspRValue, EspIFix, EspLinR, EspLinI,
EspSwitchL, EspSwitchH, EspTMotLH, EspMotDly, EspMotHyst, EspMHystThr, EspRError,
EspEndAvail, EspSoftEnd, EspSoftEndH,  EspSoftEndL

  Strommessung:
  -------------
EspI1Rated, EspKnI1, EspI2Rated, EspKnI2

  Spulen-Daten:
  -------------
EspCalOpen, EspCalU0, EspCalU2, EspCalI01, EspCalI05, EspCalI21, EspCalI25
EspCalRU, EspCalRO, EspCalState

  Simulation:
  -----------
EspSimul, EspNet1Ires, EspNet1Iu, EspNet1Iw, EspNet1Phi, EspNet2Ires, EspNet2Iu
EspNet2Iw, EspNet2Phi, EspNet3Ires, EspNet3Iu, EspNet3Iw, EspNet3Phi,
EspNetMotLH, EspNetEndH, EspNetEndL, EspNetHyst, EspEst1, EspEst2
```

```
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Momentan-Werte lesen
-------------------------------------------------------------------------------

EspVo       Momentanwert der Verlagerungsspannung (sekundär)
EspVoPhi    Winkel der Verlagerungsspannung in ° bezogen auf U12

EspV12      [=<wert>] Momentanwert der Vergleichsspannung U12 (sekundär)

EspIpos     linearisierte Spulenposition in A
EspIposR    Messwert der Spulenposition in % vom Meßbereich des Widerstandes
            Nennwert des Widerstandes entspricht 100% bzw. beim Potentiometer
            der oberen Endstellung.

EspIo       [=<wert>] Momentanwert des gemessenen Petersen-Spulenstroms (sek.)
EspIoPhi    [=<wert>] Winkel des gemessenen P-Spulenstroms in ° bezogen auf U12

EspI2       [=<wert>] Momentanwert des 2. Stromeingangs (sekundär)
EspI2Phi    [=<wert>] Winkel des 2. Stromeingangs in ° bezogen auf U12

EspTimer <aufz> [<KW>] [= <wert>] aktuelle Statistiker-Zeiten lesen/setzen in [s]
                           <aufz>: 1:Auto-Betrieb, 2:MotorLaufzeit, 3:Erdschlusszeit
                           ohne <KW>:  liest/setzt die Summen-Zeiten
                           mit <KW>=1..53: liest/setzt die KW-Zeiten
                           Zuweisungen: nur mit Extension '*' möglich;
                                        zuweisbarer Bereich: 0...1e9;
                                        Nachkommastellen werden ignoriert
EspCounter <aufz> [<KW>] [=0] aktuelle Statistiker-Zählerstände
                             <aufz>: 1:SuchAnzahl,2:Abgestimmt, 3:AbgestNK,
                             4:AbgestUmin, 5:ErdschlussWischer, 6:Erdschluss,
                             7:WattRestStrom, 8:Auslösungen
                             ohne <KW>:  liest/setzt die Summen-Zähler
                             mit <KW>=1..53: liest/setzt die KW-Zähler
                             Zuweisungen: nur mit Extension '*' möglich;
                                          zuweisbarer Bereich:0...1e9;
                                          Nachkommastellen werden ignoriert
EspStatist [<KW>] [<KW2>] liefert Tabelle aller Zählerstände
                          ohne Parameter: liefert Summenzählerstände
                          mit <KW>: liefert die Zählerstände der KW
                          mit <KW> und <KW2>: liefert die Stände von KW bis KW2

            Soweit die Werte zuweisbar sind, wird der zugewiesene Wert bei
            eingeschalteter Simulation zurückgeliefert.


-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Betriebsmodes  lesen/ändern
-------------------------------------------------------------------------------

EspAuto      [=<wert>] 1: Automatikbetrieb
                       0: Handbtrieb
EspMotUp     [=<wert>] Motor höher für <wert> Sek.; Lesen liefert die Restzeit;
                       =0 stoppt den Motor
EspMotUpI    [=1]      Motor höher für im Menü parametriert Impulszeit;
                       Lesen liefert die Restzeit
EspMotDown   [=<wert>] Motor tiefer für <wert> Sek.; Lesen liefert die Restzeit
                       =0 stoppt den Motor
EspMotDownI  [=1]      Motor tiefer für im Menü parametrierte Impulszeit;
                       Lesen liefert Restzeit
EspMotGoto   [=wert]   Zuweisung: gewünschte Position der Spule [A] im Handbetrieb (ohne
Fixspule)
                       Lesen: liefert =1, wenn Position erreicht; sonst 0

EspLRActive  [=<wert>] 1: Local-/Remotebetrieb ist aktiv
                       0: Local-/Remotebetrieb ist nicht aktiv
                          (Bedienung ist nicht eingeschränkt)
EspEnableLR  [=<wert>] 1: Umschaltung Local/Remote über Reg-L erlaubt
                       0: Umschaltung Local/Remote über Reg-L gesperrt
                       Zuweisung nur in der *-Form möglich
```

```
EspRemote    [=<wert>] 1: Remotebetrieb
                       0: Localbetrieb
                       Zuweisung nur möglich, falls erlaubt(EspEnableLR)
EspLocal     [=<wert>] 1: Localbetrieb,
                       0: Remotebetrieb
                       Wie EspRemote, nur invertiert
EspBlock     [=<wert>] 1: Regler blockiert; wirkt nur im Automatikbetrieb!
                       0: Regler nicht blockiert


EspSearch    =1        Zwangssuche auslösen (nur im Auto-Betrieb)
EspGoIHome2  =1        Position IHome2 anfahren


EspEFault    [=<wert>] 1: Erdschluß liegt an,
                       0: kein Erdschluß
                       Zuweisung wirkt sich nur auf die Simulation aus

EspIFixOn    [=<wert>] 1: Fixspule ist eingeschaltet,
                       0: Fixspule ist ausgeschaltet
                       Wertzuweisung erfolgt über EspIFix !

EspBusBar    [=<wert>] 1: Querkupplung ist eingeschaltet,
                       0: Querkupplung ist ausgescaltet

ESPErrAckMod [=<wert>] Fehlerquittierung erfolgt über
                        0: nur über Menü "Störungshilfe"
                        1: Menü oder "Hand" (Taste, BE, REG-L, Leittechnik)
                        2: Menü oder "Hand" oder "Auto" (Taste, BE, REG-L, LT)
ESPErrAck    =1         Fehler über Reg-L quittieren

EspPState               liefert den internen Zustand des Regelalgorithmus

Die Kommandos EspAuto,EspMot.., EspBlock,EspSearch,EspGoIHome2,EspIFixOn und EspBusBar
wirken nicht im Localbetrieb; in der *-Form immer.


-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
  Netzgrößen:
-------------------------------------------------------------------------------

Sie können nur gelesen werden. Falls der betreffende Wert (noch) nicht
ermittelt werden konnte, wird 0 geliefert.

EspUres      Verlagerungsspannung im Resonanzpunkt in V
EspUresPhi   Winkel der Unsymmetriespannung bezogen auf U12
EspIres      Resonanzpunkt (Spulenposition, ohne Fixspule)
EspIu        Unsymmetriestrom
EspIw        Wattreststrom
EspUref      Referenzspannung für Auslösung im Abstimmpunkt
EspUrefPhi   Referenzwinkel bezogen auf U12 für Auslösung im Abstimmpunkt


-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
  Widerstandssteuerung
-------------------------------------------------------------------------------

EspRBlock    [=<wert>] 1: Widerstandssteuerung blockiert,
                       0: frei
EspRStart    =1        Wattreststromerhöhungs-Zyklus starten
EspRTemp               Liefert die geschätzte Widerstandstemperatur

Die Kommandos EspRBlock und EspRStart
wirken nicht im Localbetrieb; in der *-Form immer.
```

```
------------------------------------------------------------------------------
------------------------------------------------------------------------------
  Anzeige
------------------------------------------------------------------------------

EspLcdVo     [=<wert>] Anzeige der Verlagerungsspannung
                       0: % von Unenn,
                       1: V (sekundär),
                       2: kV (primär)
EspLcdPar    [=<wert>] Anzeige der Netzparameter
                       0: k,v,d
                       1: Uen,Ir,Iw
EspLcdVoCnt  [=<wert>] Anzeige der letzten n Meßwerte in der Resonanzkurve
                       0: aus,
                       1: n=10,
                       2: n=100
EspLCDSaver  [=<wert>] LCD-Schoner: Löschen der Anzeige nach 60min
                       0: aus,
                       1: ein
Language     [=<wert>] Anzeigesprache
                       1: Deutsch,
                       2: English,
                       7: Cesky

EspAddSlPos  [=<wert>] im Master/Slave-Parallelbetrieb: die Slave-Position
                       zu den angezeigten Werten Ipos, Ires und Resonanzkurve
                       addieren
                       0: nein
                       1: ja


------------------------------------------------------------------------------
------------------------------------------------------------------------------
Parameter  lesen/schreiben
------------------------------------------------------------------------------


------------------------------------------------------------------------------
------------------------------------------------------------------------------
   Standardparameter
------------------------------------------------------------------------------

ESPdVoType   [=<wert>] Art der Berechnung der Auslöseschwellen um den Abstimmpunkt;
                       0: relativ zum Abstimmwert,
                       1: absolut
ESPdVoRel    [=<wert>] Wert der relativen Auslöseschwellen in % vom Abstimmwert
ESPdVoAbs    [=<wert>] Wert der absoluten Auslöseschwellen in % von Unenn
EspTSearch   [=<wert>] Verzögerung der autom. Suche nach Überschreiten der
                       Auslöseschwelle in s
EspTSearchF  [=<wert>] Verzögerung der autom. Suche nach Hand/Auto-Wechsel
                       oder EspSearch("Zwangssuche") in s
EspTuneType  [=<wert>] Art des Bezuges der Sollverstimmung;
                       0: relativ zu Ires
                       1: absolut in Verstellung (A)
                       2: absolut in Spannungsdiff. zu Ures
EspTuneAP    [=<wert>] Wert der Sollverstimmung in % von Ires (>0 überkompensiert)
EspTuneAA    [=<wert>] Wert der Sollverstimmung in A (>0 überkompensiert)
EspTuneVV    [=<wert>] Wert der Sollverstimmung als absolute Spannung in % von Unenn

EspMaxDPos   [=<wert>] Positioniertoleranz der P-Spule in % von Imax
ESPdIpMin    [=<wert>] Mindestweg bei Suche in % von Imax für eine gültige
                       Schätzung

EspVresPass  [=<wert>] Bei der Suche muss das Resonanzmax. überfahren werden;
                       0: nein,
                       1: ja
EspTFollow   [=<wert>] Zeit für Nachziehen des Toleranzbandes in Minuten
EspUseAngle  [=<wert>] Winkelmessung verwenden, falls möglich;
                       0: nein,
                       1: ja

EspSrchCnt   [=<wert>] Anzahl Suchzyklen bis zur Aufgabe
EspTMotMax   [=<wert>] max. erlaubte Motorlaufzeit in Minuten
```

```
EspIhome     [=<wert>] Homeposition bei erfolgloser Suche in [A]
                       ( Ruhepos1 )
EspIhome2    [=<wert>] Homeposition für Kommando EspGoIhome2 in A
                       ( Ruhepos2 )

-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
   Erdschlussparameter
-------------------------------------------------------------------------------

EspVEarth     [=<wert>] U-Grenzwert für Erdschlusserkennung in % von Unenn
EspTEFSpike   [=<wert>] Erdschluss - Wischerzeit in s
EspTDVearth   [=<wert>] Verzögerung der Erdschlussmeldung in s
ESPEFCorrMod [=<wert>] Positionskorrektur bei Erdschluss;
                        0: keine, bleibt im aktuellen Abstimmpunkt
                        1: auf Ires
                        2: Abstimmpunkt + Korrekturwerte aus der Tabelle
                        3: auf Ires + Korrekturwerte aus der Tabelle
ESPEFCorr <aufz>[=<wert>] Korrekturwerte für Erdschlußposition in A
                       die Werte können einzeln per Binäreingang aktiviert
                       werden
EspEFToMan    [=<wert>] Selbsthaltung nach Erdschluss (wechselt in den Handbetrieb)
                       0: nein
                       1: ja

-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
  Umax-Parameter
-------------------------------------------------------------------------------

EspVMax     [=<wert>]   Bis zu diesem Maximalwert von Uen in % von Unenn
                        erfolgt ein Regelvorgang

-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
  Umin-Parameter
-------------------------------------------------------------------------------

EspVMin     [=<wert>] Mindestwert für Ures-Erkennung in % von Unenn
EspVminPos  [=<wert>] Position bei erfolgloser Suche wegen Ures<Umin;
                      0: Homeposition
                      1: letzter Abstimmpunkt
EspTDVmin   [=<wert>] Verzögerung der Meldung Ures<Umin in min
EspSrchT    [=<wert>] Wartezeit für neuen Suche nach Ures<Umin in min
EspVMinMin  [=<wert>] Auslöseschwelle bei Ures<Umin in % von Umin
EspVminToMan [=<wert>] Selbsthaltung bei Umin (wechselt in den Handbetrieb)
                      0: nein
                      1: ja


-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
  Signalverzögerungen
-------------------------------------------------------------------------------

EspTOnRel   [=<wert>] Mindest-Haltezeit der Melderelais zur Warte in s
                      ( nicht für Befehlsrichtung zur P-Spule)
EspTOnPuls  [=<wert>] Motorlaufzeit für EspMotUpI/EspMotDownI in s
EspTDAlarm  [=<wert>] Verzögerung der Meldung "Alarm" in s
EspTDError  [=<wert>] Verzögerung der Meldung "Störung" in s
```

Widerstandssteuerung

```
EspRActive   [=<wert>] Hauptschalter für Widerstandssteuerung;
                       0: aus,
                       1: ein
EspRTempMax  [=<wert>] Maximal zulässige Widerstandstemperatur nach EspRTonMax
EspRTonMax   [=<wert>] Maximale Einschaltzeit des Widerstands in s
EspRTcold    [=<wert>] Abkühlzeit des Widerstands von RTempMax auf 40°C in min
                       ( entsricht 3x Zeitkonstante )
EspRTon      [=<wert>] Einschaltzeit des Widerstandes für einen einzelnen
                       Impuls in s
EspRTdelay1  [=<wert>] Verzögerung vom Erdschlußeintritt bzw. manueller
                       Auslösung bis zum 1. Impuls in s
EspRTdelay2  [=<wert>] Verzögerung zwischen den einzelnen Impulsen in s
EspRNcycle   [=<wert>] Anzahl der zusätzlichen Impulse pro Auslösung
EspRAutoBlk  [=<wert>] Selbstblockierung nach Auslösung durch Erdschluß:
                         0: aus
                         1: ein, Quittierung nur manuell möglich
                         2: auto, Selbstblockierung erlischt nach RTcold
```

Das thermische Abbild arbeitet nach folgenden Regeln:
Aufheizung: linear, die Temperatur steigt in RTonMax von 40°C auf RTempMax
Abkühlung: exponentiell mit Zeitkonstante RTcold/3, die Ausgleichstemperatur ist so gewählt, daß der Widerstand in RTcold von RTempMax auf 40°C abkühlt.

Parallelregelung

```
EspParaProg   [=<wert>] Auswahl der Parallelbetriebs-Art
                        00:Aus
                        01:Master/Slave
EspParaProgA  [=<wert>] Aktivieren des Parallelbetriebs
                        00:Aus
                        01:Ein
                        02:SSKupplung (mit binärer Eingangsfunktion 29:Kupplung)
EspParaGr     [=<KennungsNummer>] Kennung des Parallelregel-Partners
                                  Infos zu <KennungsNummer> bei KENN
EspSlaveMove  [=<wert>] Master/Slave-Betrieb: das Nachziehen(Positionieren) vom
                        Slave erlauben
                        00:Nein
                        01:Ja
EspSlUminPos  [=<wert>] Master/Slave-Betrieb: Positionieren vom Slave bei Umin
                        00:Stop        (kein Positionieren)
                        01:Ruhe_Su     (Positionieren auf IRuhe)
                        02:AbstimmP.   (Positionieren auf letztgültigen Abstimmpunkt)
```

Binäre Ein/Ausgänge

Der Einfachheit halber ist im Folgenden immer von "dem" Ein- oder Ausgang die Rede, obwohl eine Adressierung über <aufz> vorliegt. Wie für alle Aufzählungen gilt: beim Lesen werden alle Einzelwerte gelistet und die Summe auf den Stack gelegt, bei Zuweisungen werden alle adressierten Werte gesetzt.

binäre Eingänge:

Alle Eingänge und Eingangsfunktionen können mit "EspBI", "EspBIFV zugewiesen werden: Der Wert wird für 60s überschrieben. Zuweisung eines beliebigen Wertes mit Extension "*" hebt den Override sofort wieder auf.

```
EspBIFu  <aufz>[=<wert>] Funktion des Eingangs
ListBIFu                 Liste der möglichen Eingangsfunktionen
EspBIInv <aufz>[=<wert>] Inversschaltung des Eingangs;
                         0: normal,
                         1: invertiert
                         Die Eingangsinvertierung wirkt zwischen Eingang und
                         Eingangs-Funktion, wird also bei EspBiFV sichtbar,
                         bei EspBI nicht
EspBI    <aufz>[=<wert>] Zustand des Eingangs; Achtung bei Zuweisung !!!
                         0: kein Signal,
                         1: Signal
EspBI32                  Zustand aller Eingänge: Bit 0 entspricht Eingang 1 etc.
EspBITC  <aufz>[=<wert>] Anzahl der 0/1-Flanken am Eingang seit dem letzten Aufruf;
                         die *-Form setzt den Zähler nicht zurück, es wird also
                         tatsächlich die Anzahl seit dem letzten Aufruf ohne * geliefert.
EspBITCT <aufz>[=<wert>] Anzahl der 0/1-Flanken am Eingang seit dem letzten
                         Reset. Dieser Befehl ist nützlich, falls mehrere
                         Instanzen die Flanken des gleichen Eingangs auswerten wollen.
EspBIFV  <aufz>[=<wert>] Zustand der Eingangsfunktion; alle nicht mit
                         Eingängen verknüpften Eingangsfunktionen liefern
                         immer 0; alle mit mehreren Eingängen verknüpften
                         Eingangsfunktionen liefern die verODERung der Eingänge
EspBIFV32 <aufz>         Zustand aller Eingangsfunktionen in Gruppen zu 32 Bit:
                         Bit0 entspricht Eingangsfunktionen 0:AUS etc.


  Relais:
  ---------------
EspRelFu  <aufz>[=<wert>] Relais-Funktion
ListRelFu                 Liste der möglichen Binär-Ausgangsfunktionen
EspRelInv <aufz>[=<wert>] Relais-Inversschaltung
                          Die Relaisinvertierung wirkt zwischen Ausgangsfunktion
                          und Ausgang, wird also bei EspRel sichtbar, bei EspRelFV nicht
EspRel    <aufz>          Zustand des Relaisausgangs.
EspRel32                  Zustand aller Relaisausgänge: Bit 0 entspr. Relais 1 etc.

EspRelFV  <aufz>[=<wert>] Zustand der Ausgangsfunktionen; eine Zuweisung ist nur möglich,
                          wenn vorher "EspRelFVOvr =1" gesetzt wurde (siehe dort)
EspRelFV32 <aufz>         Zustand aller Ausgangsfunktionen in Gruppen zu 32 Bit:
                          Bit0 entspricht Ausgangsfunktionen 0:AUS etc.
EspRelPV  <aufz>[=<wert>] Zustand der Ausgangsfunktion "Prog", mit <aufz>
                          wird hier das Relais adressiert


  LED's:
  ---------------
EspLEDFu  <aufz>[=<wert>] LED-Funktion
ListLEDFu                 Liste der möglichen Ausgangsfunktionen (identisch zu ListRelFu)
EspLEDInv <aufz>[=<wert>] LED-Inversschaltung (vgl. EspRelInv)
EspLED    <aufz>          Zustand der LED.
EspLED32                  Zustand aller LEDs: Bit 0 entspricht LED 1 etc.
EspLEDFV  <aufz>          Zustand der Ausgangsfunktionen; wie EspRelFV
EspLEDPV  <aufz>[=<wert>] Zustand der Ausgangsfunktion "Prog", mit <aufz>
                          wird hier die LED adressiert

  Testfunktionen:
  ---------------

EspRelFVOvr [=<wert>] Override der Ausgangsfunktionen; !!!! Nur für Testzwecke !!!!:
                      0: Normalbetrieb, Ausgangsfunktionen werden vom Regler bedient
                      1: Ausgangsfunktionen vom Regler abgekoppelt und stattdessen
                      zuweisbar für max. 10 min
            ACHTUNG: die zugewiesenen Werte werden über Relais/LEDs ausgegeben!
                      Fehlbedienung kann u.U. zu Schäden in der Anlage führen!
```

Analoge Ein/Ausgänge

Der Einfachheit halber ist im Folgenden immer von "dem" Ein- oder Ausgang die Rede, obwohl eine Adressierung über <aufz> vorliegt. Wie für alle Aufzählungen gilt: beim Lesen werden alle Einzelwerte gelistet und die Summe auf den Stack gelegt, bei Zuweisungen werden alle adressierten Werte gesetzt.

```
ESPAIOType  <aufz> Typ des Analogkanals;
                   0: nicht bestückt,
                   1: Eingang,
                   2: Ausgang
ESPAIONOM   <aufz> Installierter Nennwert des Analogkanals;
                   0: unbekannt/nicht bestückt,
                   1: 20 mA
                   2: 10 mA
                   3: 5 mA
                   4: 2.5 mA
                   5: 10 V
ESPAIFu     <aufz>[=<wert>] Eingangsfunktion des AnalogEingangs
ESPAOFu     <aufz>[=<wert>] Ausgangsfunktion des AnalogAusgangs
ESPAIOFIL   <aufz>[=<wert>] Filter-Zeitkonstante des Analogkanals in s
ESPAScalX   <aufz><index>[=<wert>] X-Komponente der Stützstellen für die
                                   geknickte Kennlinie, <index>=0/1/2
ESPAScalY   <aufz><index>[=<wert>] Y-Komponente der Stützstellen für die
                                   geknickte Kennlinie, <index>=0/1/2

EspAIFV     <aufz> Wert der Analog-Eingangsfunktion
EspAOFV     <aufz> Wert der Analog-Ausgangsfunktion
EspAOPV     <aufz>[=<wert>] Wert der Analog-Ausgangsfunktion "Prog"; mit <aufz>
                            wird hier der Analogkanal adressiert
```

Spannungsmessung

```
EspHardware Mess-Hardware: 0: unbekannt
                           1: LPER (Reg-DE)
                           2: NTZ2 (Reg-DP)
EspKnVo     [=<wert>] Wandlerübersetzung für Verlagerungsspannung
EspVoRated  [=<wert>] Nennspannung der Verlagerungsspannung (sek.)
EspVoRange  [=<wert>] Meßbereich für U0-Messung (nur LPER);
                      0: 100 V
                      1: 20 V
                      2: 5 V
                      3: 1 V
                      bei höheren Spannungen als angegebne wird automatisch auf
                      100V umgeschaltet. Die NTZ2-Hardware arbeitet von
                      vorneherein mit höherer Auflösung und ohne
                      Meßbereichsumschaltung.
EspVo50Hz   [=<wert>] 50Hz-Filter (nur LPER);
                      0: Aus,
                      1: Ein
```

Daten der Petersen-Spule

```
EspIMin     [=<wert>] Nennstrom der Petersenspule in der Endstellung "Tiefer"
EspIMax     [=<wert>] Nennstrom der Petersenspule in der Endstellung "Höher"
EspRType    [=<wert>] Art der Widerstandsmessung für Spulenposition;
                      0: 3-Leiter (nur LPER, siehe EspHardware)
                      1: 4-Leiter (nur LPER)
                      2: Potentiometer (nur NTZ2)
```

```
EspRValue    [=<wert>] Meßbereich für Widerstandsmessung (nur LPER);
                       0: 200 Ohm
                       1: 500 Ohm
                       2: 1000 Ohm
                       3: 3000 Ohm

  Spulenlinearisierung mit 8 Stützstellen:
  ----------------------------------------

EspLinR      <aufz>[=<wert>] Spulenposition in % vom R- bzw. Poti-Meßbereich
EspLinI      <aufz>[=<wert>] zugehöriger Nennstrom in A

EspSwitchL   [=<wert>] Spulenposition am unteren Endschalter
EspSwitchH   [=<wert>] Spulenposition am oberen Endschalter
                        jeweils in % vom R- bzw. Poti-Meßbereich

  Ergebnisse aus Spulenkalibrierung:
  ----------------------------------

EspTMotLH    [=<wert>] Motorlaufzeit vom unteren bis zum oberen Endschalter in s
EspMotDly    [=<wert>] Spulennachlauf in A
EspMotHyst   [=<wert>] Spulenspiel in A
EspMHystThr  [=<wert>] Schwelle für Spulenspiel in A, ab der auf ein
                       alternatives Positionierverfahren umgeschaltet wird
EspRError    [=<wert>] Maximaler Linearitätsfehler der R- bzw. Poti-Messung
                       in % vom Meßbereich

  Fixspule:
  ---------

EspIFix      [=<wert>] Nennstrom der Fixspule


  Endschalter:
  ------------
EspEndAvail  [=<wert>] Endschalter-Typ
                       0: Schließer
                       1: Öffner
                       2: nicht angeschlossen

EspSoftEnd   [=<wert>] aktivieren der Software-Endschalter
                       0: nein
                       1: ja
EspSoftEndH  [=<wert>] Position oberer Software-Endschalter in A
EspSoftEndL  [=<wert>] Position unterer Software-Endschalter in A


-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
  Strommessung
-------------------------------------------------------------------------------

EspI1Rated   [=<wert>] Nenneingangsstrom des Stromwandlers 1 des Reglers ( Ip );
                       0: 1 A,
                       1: 5 A
EspKnI1      [=<wert>] Wandlerübersetzung für Strom 1
EspI2Rated   [=<wert>] Nenneingangsstrom des Stromwandlers 2 des Reglers;
                       0: 1 A,
                       1: 5 A
EspKnI2      [=<wert>] Wandlerübersetzung für Strom 2


-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
  Simulation
-------------------------------------------------------------------------------

EspSimul     [=<wert>] Hauptschalter für Simulation:
                       0: Aus,
                       1: Netz-Modell 1
                       2: Netz-Modell 2
                       3: Netz-Modell 3
```

```
EspNet1Ires [=<wert>] Modell 1: Resonanzpunkt in A
EspNet1Iu   [=<wert>] Modell 1: Unsymmetriestrom in A
EspNet1Iw   [=<wert>] Modell 1: Wirkanteil in A
EspNet1Phi  [=<wert>] Modell 1: Winkel Ures gegen U1n

EspNet2Ires [=<wert>] Modell 2: Resonanzpunkt in A
EspNet2Iu   [=<wert>] Modell 2: Unsymmetriestrom in A
EspNet2Iw   [=<wert>] Modell 2: Wirkanteil in A
EspNet2Phi  [=<wert>] Modell 2: Winkel Ures gegen U1n

EspNet3Ires [=<wert>] Modell 3: Resonanzpunkt in A
EspNet3Iu   [=<wert>] Modell 3: Unsymmetriestrom in A
EspNet3Iw   [=<wert>] Modell 3: Wirkanteil in A
EspNet3Phi  [=<wert>] Modell 3: Winkel Ures gegen U1n

  Simulation der Petersen Spule:
  ------------------------------

EspNetMotLH [=<wert>] simulierte Motorlaufzeit vom unteren bis zum oberen
                      Endschalter in s
EspNetEndH  [=<wert>] simulierter Endschalter "Höher" in % vom R-Meßbereich
EspNetEndL  [=<wert>] simulierter Endschalter "Tiefer" in % vom R-Meßbereich
EspNetHyst  [=<wert>] simuliertes Spulenspiel in % vom R-Meßbereich
EspEst1     [=<wert>] interner Parameter für Netzberechnung
EspEst2     [=<wert>] interner Parameter für Netzberechnung
```

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13 Control and instrumentation technology

13.1 In general

All comes/goes-messages are due to make the general poll.

For the free messages of the pass-through function, a decision will be made in the communication plug-in group or in the REG-DP if it is a comes/goes-Message or a transient message. In case of the setting of a comes/goes-Message, this message is due to be go through the general poll.

The measuring value telegramme must always include all (at present 7) measuring values. If a measuring value is not available for the transmission, so this measuring value will be transmitted with the value 7FFFh (corresponds to a failure identification).

Advantage: The measuring values always have the same address for all configurations.

Since the measuring values are not due to make the general poll, they will have to be transmitted in the case of a general poll.

13.2 Communication behaviour

Approach message

The E-coil regler REG-DP presents itself to the Master as UMZ-protection.

Time delay when general poll

When sending a general poll command, there will be a delay before the general poll is being responded to totally. In this moment, the communication plug-in group demands the present values from the regulator. There will not be the transmission of the last values sent for the general poll but the present values from the regulator.

13.3 Data points of the command direction

Description	IEC-Telegramme (values in DEZ) DATA Fkt-Typ Inf-Nr DB1 DB2 -UNIT	ILS-Telegramme (values in HEX) DT DN2 DN3 DB1 DB2	Scaling (values decimal) value = carried-over value
Hand / Automation-operation	232 160 16 02 00 Auto 232 160 16 01 00 Hand	E8 A0 10 02 00 Auto E8 A0 10 01 00 Hand	
Motor run direction I_{max} (always 2 = On)	232 160 17 02 00	E8 A0 11 02 00	
Motor run direction I_{min} (always 2 = On)	232 160 18 02 00	E8 A0 12 02 00	
Remote / Local Switching	232 160 19 02 00 Remote 232 160 19 01 00 Ort	E8 A0 13 02 00 Remote E8 A0 13 01 00 Ort	
free	232 160 20 02 00 on 232 160 20 01 00 Off	E8 A0 14 02 00 on E8 A0 14 01 00 Off	
Residual ohmic current blocking	232 160 21 02 00 on 232 160 21 01 00 Off	E8 A0 15 02 00 on E8 A0 15 01 00 Off	
Res. Ohm. Current start (always 2 = On)	232 160 22 02 00	E8 A0 16 02 00	
Regulator in Home-Position 2 (always 2 = On)	232 160 23 02 00	E8 A0 17 02 00	
Search (always 2 = on) Fixed E-Coil is on SS-coupling Position in A	232 160 24 02 00 20 160 31 02 00 on 20 160 31 02 01 Off 20 160 32 02 00 on 20 160 31 02 01 Off 144 176 58 00 00	E8 A0 18 02 00	 0...2047 (16bit value)

13.4 Data points of the message direction

Description	IEC-Telegramme (values in DEZ) DATA Fkt-Typ Inf-Nr DB1 DB2 -UNIT	ILS-Telegramme (values in hex) DT DN2 DN3 DB1 DB2	Scaling (values dezimal) value = carried-over value
position in %	09 160 144 00 00	04 A0 90 00 00	100,0 = 1000
position in A	09 161 144 00 00	04 A1 90 00 00	100,0 = 1000
Offset voltage in mV (Amount)	09 162 144 00 00	04 A2 90 00 00	100,0 = 1000
Offset voltage (Angle)	09 163 144 00 00	04 A3 90 00 00	-180,0° - +180,0° = * 100
Current through E-Coil (Amount)	09 164 144 00 00	04 A4 90 00 00	100,0 = 1000
Current through E-Coil (Angle)	09 165 144 00 00	04 A5 90 00 00	-180,0° - +180,0° = * 100
Resistance temperature	09 166 144 00 00	04 A6 90 00 00	-40,0°C - +50,0°C = * 100
Hand / Automation-operation	01 160 16 02 00 Auto 01 160 16 01 00 Hand	0D A0 10 02 00 Auto 0D A0 10 01 00 Hand	
Motor run direction I_{max}	01 160 17 02 00 comes 01 160 17 01 00 goes	0D A0 11 02 00 comes 0D A0 11 01 00 goes	
Motor run direction I_{min}	01 160 18 02 00 comes 01 160 18 01 00 goes	0D A0 12 02 00 comes 0D A0 12 01 00 goes	
Remote- / Local-Switching	01 160 19 02 00 Rem. 01 160 19 01 00 Local	0D A0 13 02 00 Remote 0D A0 13 01 00 Local	
regulator in b*locking*	01 160 20 02 00 comes 01 160 20 01 00 goes	0D A0 14 02 00 comes 0D A0 14 01 00 goes	
Residual ohmic current blocking	01 160 21 02 00 comes 01 160 21 01 00 goes	0D A0 15 02 00 comes 0D A0 15 01 00 goes	
Res. Ohm. current *on*	01 160 22 02 00 comes 01 160 22 01 00 goes	0D A0 16 02 00 comes 0D A0 16 01 00 goes	
Res.ohm.current Automation active	01 160 23 02 00 Yes 01 160 23 01 00 No	0D A0 17 02 00 Yes 0D A0 17 01 00 No	
regulator in Interferences-Position (j/n)	01 160 30 02 00 Yes	0D A0 1E 02 00 Yes	

Description	IEC-Telegramme (values in DEZ) DATA Fkt-Typ Inf-Nr DB1 DB2 -UNIT	ILS-Telegramme (values in hex) DT DN2 DN3 DB1 DB2	Scaling (values dezimal) value = carried-over value
	01 160 30 01 00 No	0D A0 1E 01 00 No	
Fix E-Coil is on	01 160 31 02 00 comes 01 160 31 01 00 goes	0D A0 1F 02 00 comes 0D A0 1F 01 00 goes	
coupling is on	01 160 32 02 00 comes 01 160 32 01 00 goes	0D A0 20 02 00 comes 0D A0 20 01 00 goes	
Final switch I_{max} (E2)	01 160 33 02 00 comes 01 160 33 01 00 goes	0D A0 21 02 00 comes 0D A0 21 01 00 goes	
Final switch I_{min} (E1)	01 160 34 02 00 comes 01 160 34 01 00 goes	0D A0 22 02 00 comes 0D A0 22 01 00 goes	
Number of the search cycles exceeded	01 160 35 02 00 comes 01 160 35 01 00 goes	0D A0 23 02 00 comes 0D A0 23 01 00 goes	
regulator tuned, not compensated	01 160 36 02 00 comes 01 160 36 01 00 goes	0D A0 24 02 00 comes 0D A0 24 01 00 goes	
regulator ist tuned	01 160 37 02 00 comes 01 160 37 01 00 goes	0D A0 25 02 00 comes 0D A0 25 01 00 goes	
$U_0 > U_{erd}$	01 160 38 02 00 comes 01 160 38 01 00 goes	0D A0 26 02 00 comes 0D A0 26 01 00 goes	
$U_0 > U_{max}$	01 160 39 02 00 comes 01 160 39 01 00 goes	0D A0 27 02 00 comes 0D A0 27 01 00 goes	
$U_0 < U_{min}$	01 160 40 02 00 comes 01 160 40 01 00 goes	0D A0 28 02 00 comes 0D A0 28 01 00 goes	
U_{12} too small (reference phase)	01 160 41 02 00 comes 01 160 41 01 00 goes	0D A0 29 02 00 comes 0D A0 29 01 00 goes	
$I_{pos} > I_{max}$	01 160 42 02 00 comes 01 160 42 01 00 goes	0D A0 2A 02 00 comes 0D A0 2A 01 00 goes	
Direction error	01 160 43 02 00 comes 01 160 43 01 00 goes	0D A0 2B 02 00 comes 0D A0 2B 01 00 goes	
Drive error	01 160 44 02 00 comes 01 160 44 01 00 goes	0D A0 2C 02 00 comes 0D A0 2C 01 00 goes	
Potentiometer cable breakdown	01 160 45 02 00 comes 01 160 45 01 00 goes	0D A0 2D 02 00 comes 0D A0 2D 01 00 goes	
Running time supervision	01 160 48 02 00 comes 01 160 48 01 00 goes	0D A0 30 02 00 comes 0D A0 30 01 00 goes	
Free message 01 (Pass-through function)	01 160 60 02 00 comes 01 160 60 01 00 goes	0D A0 3C 02 00 comes 0D A0 3C 01 00 goes	
Free message 02 (Pass-through function)	01 160 61 02 00 comes 01 160 61 01 00 goes	0D A0 3D 02 00 comes 0D A0 3D 01 00 goes	
Free message 03 (Pass-through function)	01 160 62 02 00 comes 01 160 62 01 00 goes	0D A0 3E 02 00 comes 0D A0 3E 01 00 goes	
Free message 04 (Pass-through function)	01 160 63 02 00 comes 01 160 63 01 00 goes	0D A0 3F 02 00 comes 0D A0 3F 01 00 goes	
Free message 05 (Pass-through function)	01 160 64 02 00 comes 01 160 64 01 00 goes	0D A0 40 02 00 comes 0D A0 40 01 00 goes	
Free message 06 (Pass-through function)	01 160 65 02 00 comes 01 160 65 01 00 goes	0D A0 41 02 00 comes 0D A0 41 01 00 goes	
Free message 07 (Pass-through function)	01 160 66 02 00 comes 01 160 66 01 00 goes	0D A0 42 02 00 comes 0D A0 42 01 00 goes	
Free message 08 (Pass-through function)	01 160 67 02 00 comes 01 160 67 01 00 goes	0D A0 43 02 00 comes 0D A0 43 01 00 goes	
Free message 09 (Pass-through function)	01 160 68 02 00 comes 01 160 68 01 00 goes	0D A0 44 02 00 comes 0D A0 44 01 00 goes	
Free message 10 (Pass-through function)	01 160 69 02 00 comes 01 160 69 01 00 goes	0D A0 45 02 00 comes 0D A0 45 01 00 goes	
Free message 11 (Pass-through function)	01 160 70 02 00 comes 01 160 70 01 00 goes	0D A0 46 02 00 comes 0D A0 46 01 00 goes	

Description	IEC-Telegramme (values in DEZ) DATA Fkt-Typ Inf-Nr DB1 DB2 -UNIT	ILS-Telegramme (values in hex) DT DN2 DN3 DB1 DB2	Scaling (values dezimal) value = carried-over value
Free message 12 (Pass-through function)	01 160 71 02 00 comes 01 160 71 01 00 goes	0D A0 47 02 00 comes 0D A0 47 01 00 goes	
Warning coll.message	01 160 46 02 00 comes 01 160 46 01 00 goes	0D A0 2E 02 00 comes 0D A0 2E 01 00 goes	
Interferences coll..message	01 160 47 02 00 comes 01 160 47 01 00 goes	0D A0 2F 02 00 comes 0D A0 2F 01 00 goes	

14 Definition of the abbreviations and icons

Abbreviation	Definition
OFF	OFF
AUTO	Automation
HAND	HAND, resp. Manual
EndsH	Final switch "Higher"
EndsT	Final switch "Lower"
Ends H/T	Final switches "Higher" or "Lower"
Higher	Changing command to the E-coil in the direction of "Higher" (Imax)
Lower	Changing command to the E-coil in the direction of "Lower" (Imin)
PROG	Function is triggered off by background programme
Uen	Offset voltage
Uerd	Earth fault - Voltage
Umax	Maximum offset voltage up to which is regulated
Umin	Minimum offset voltage. Values below are regarded as interferences
Uo_akt	present offset voltage
Ufmax	upper limit of the tolerance band determined by "F"
Ufmin	lower limit of the tolerance band determined by "F"
Ires	current in the point of resonance. Corresponds to the complete capacitive current of the system
Ifix	neutralization current of a parallel Fixcoil
Isoll	setting the E-Coil in the tuned status
Ipos	present coil **pos**ition (setting of the E-Coil)
Ip	real measured current through the E-Coil
k	Unsymmetry of the system
v	Detuning (see chapiter "4.3 Principle of the regulation")
d	operating loss (see chapiter "4.3 Principle of the regulation")
E1 ... E16	Binary inputs (48V ... 320 V)
kni	Transmission ratio of the primary current transformer
knu	Transmission ratio of the primary voltage transformer
R1 ... R11	Relay outputs
Uh	Auxiliary voltage (supply voltage)of the regulator

15 Index