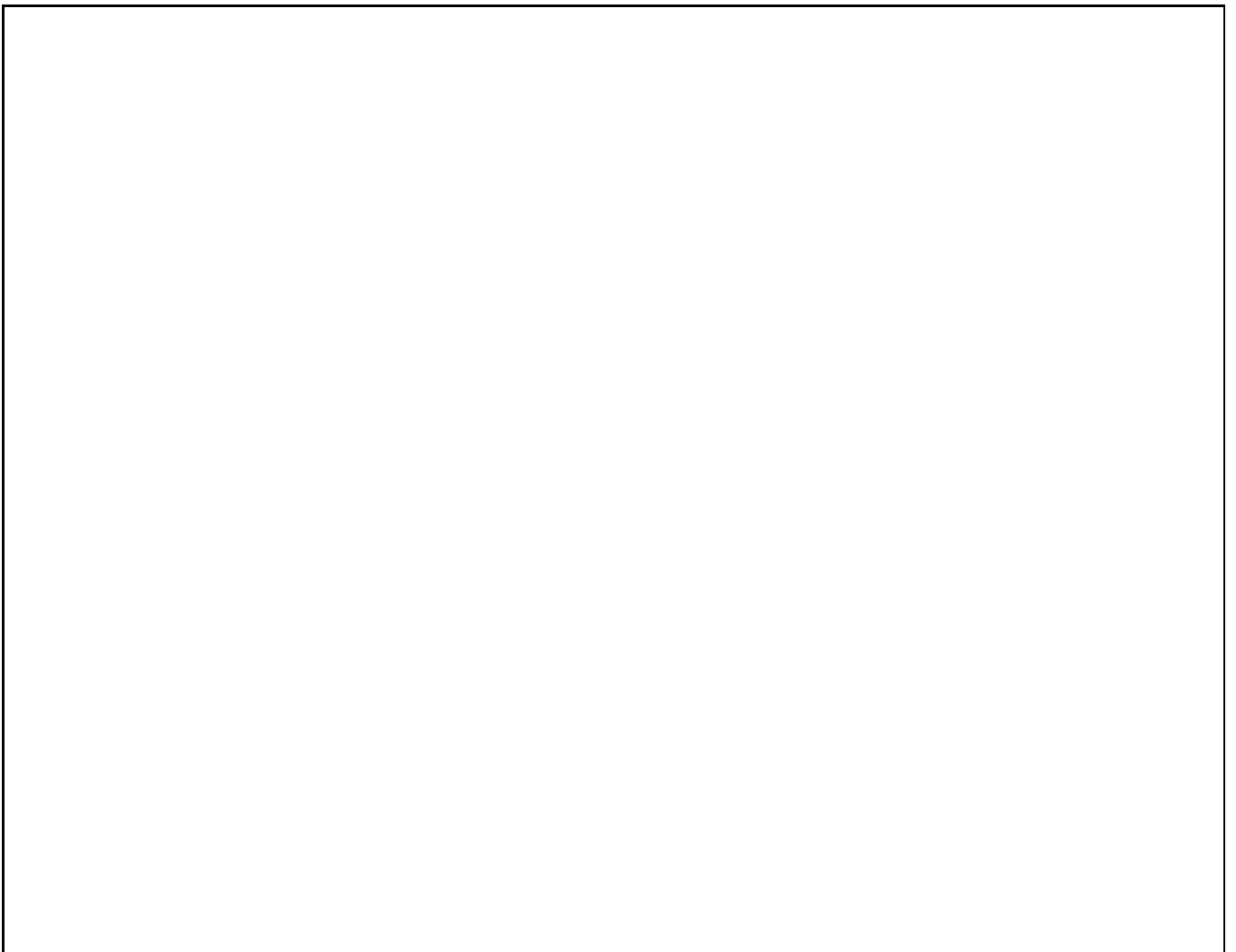


Description and adjustment instructions
"COSIMAT N+" voltage regulator
for DSG and DIG alternators



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1. General

The "COSIMAT N+" is a compact voltage regulator designed to control synchronous alternators both in single and parallel operation.

In single operation, the alternator voltage is held constant irrespective of power, frequency and temperature.

When operated in parallel with the mains or with other alternators, a stable reactive power is produced.

Via its power stage, the "COSIMAT N+" adjusts the excitation current to match the operating conditions.

The main features of the "COSIMAT N+" are:

- Integrated measuring transformers for three-phase measurement of the alternator voltage up to 500 V AC (external conductor voltage).
- Stable reactive power thanks to current-voltage vector measuring system (droop). A load-relieved current transformer is required in alternator phase "V".
- Internal and external alternator voltage set-point adjustment.
- PID control amplifier with large adjustment range.
- Disproportionate drop in desired value when alternator operates at underfrequency.
- Permanent monitoring of the actuator and time limit on the max. possible excitation current.
- Internal protection devices trip whenever a fault occurs, thus separating the excitation field from its energy source.
- Compact construction with interchangeable power stage.
- Fully potted in to protect it from environmental effects.
- Long life thanks to high-quality components.

With the use of additional modules it is possible to intervene in set-point and actual value formation via the "COSIMAT N+" signal inputs:

There are a large number of additional modules available for a wide variety of control applications e.g.

- cos phi regulation of a synchronous alternator or motor
- or
- Limitation of start-up current when connecting up a large asynchronous motor to the alternator
- or
- Cable compensation via load current detection or measured value of the external alternator voltage.

Its additional modules make the "COSIMAT N+" suitable for various applications on test rigs, in power-train technology etc. (see 5.2 Additional modules).

2. Brief summary

2.1 General-arrangement diagram

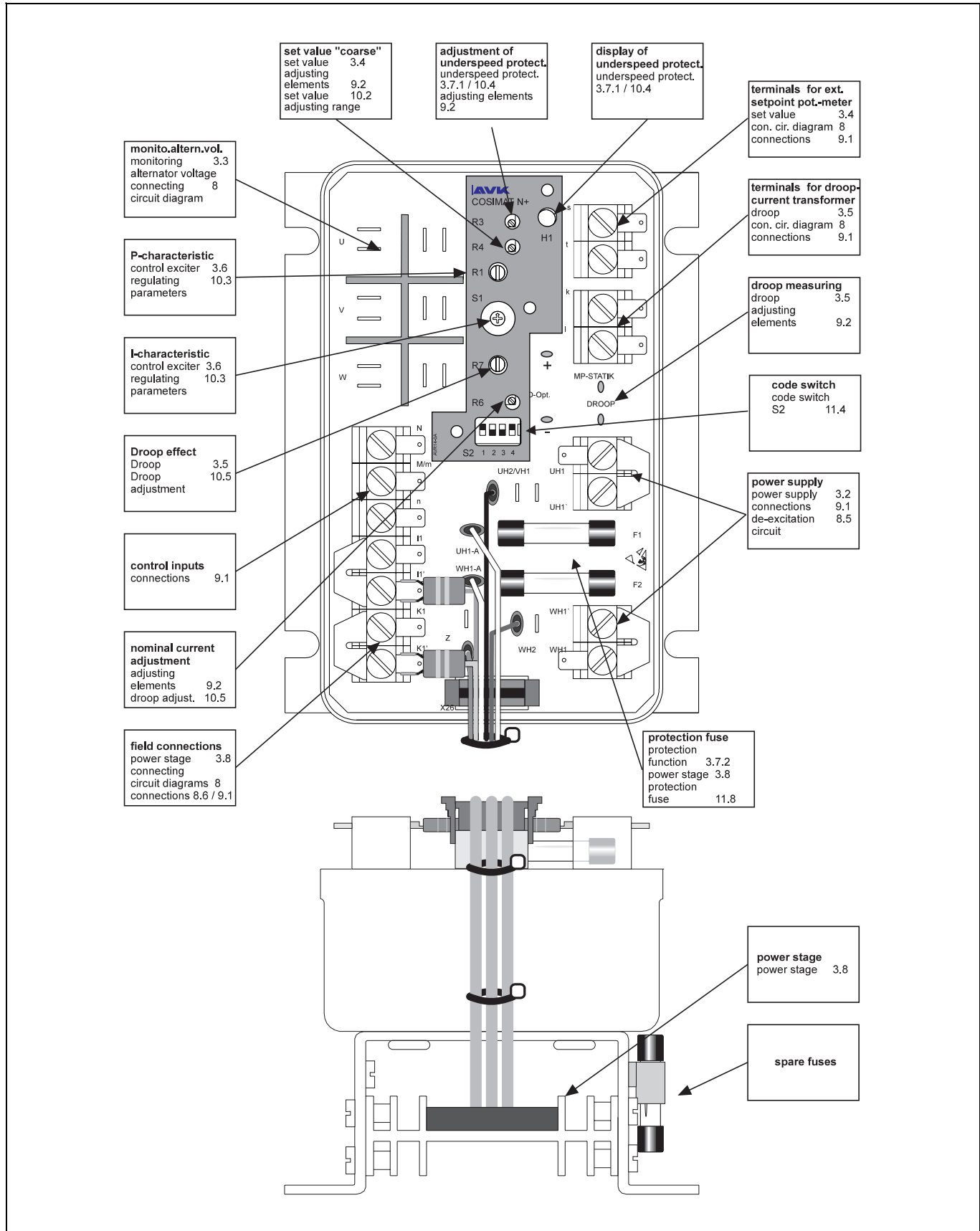


Figure 1 – General-arrangement diagram

2.2 Adjusting elements and their effects

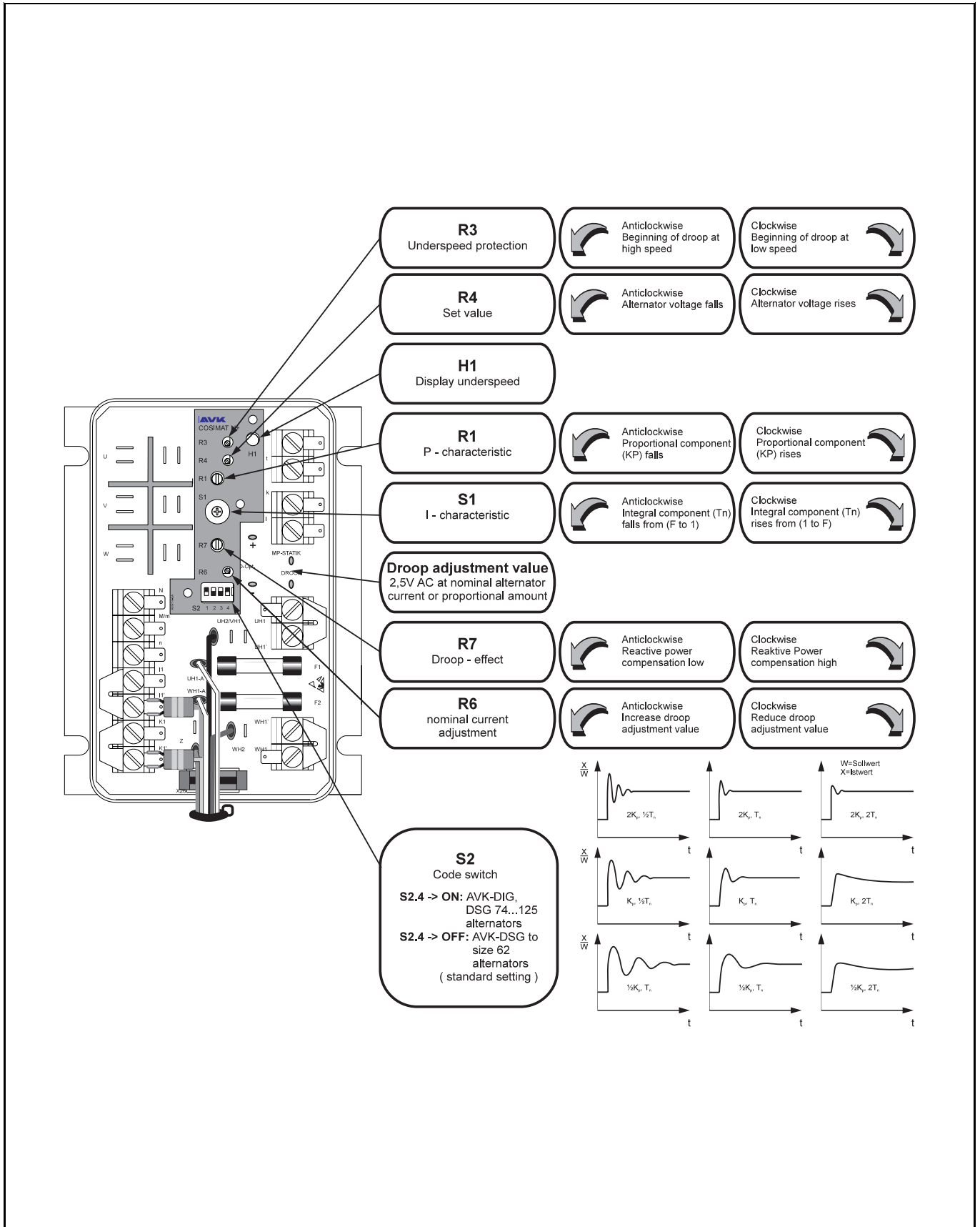


Figure 2 – Adjusting elements

2.3 Start-up

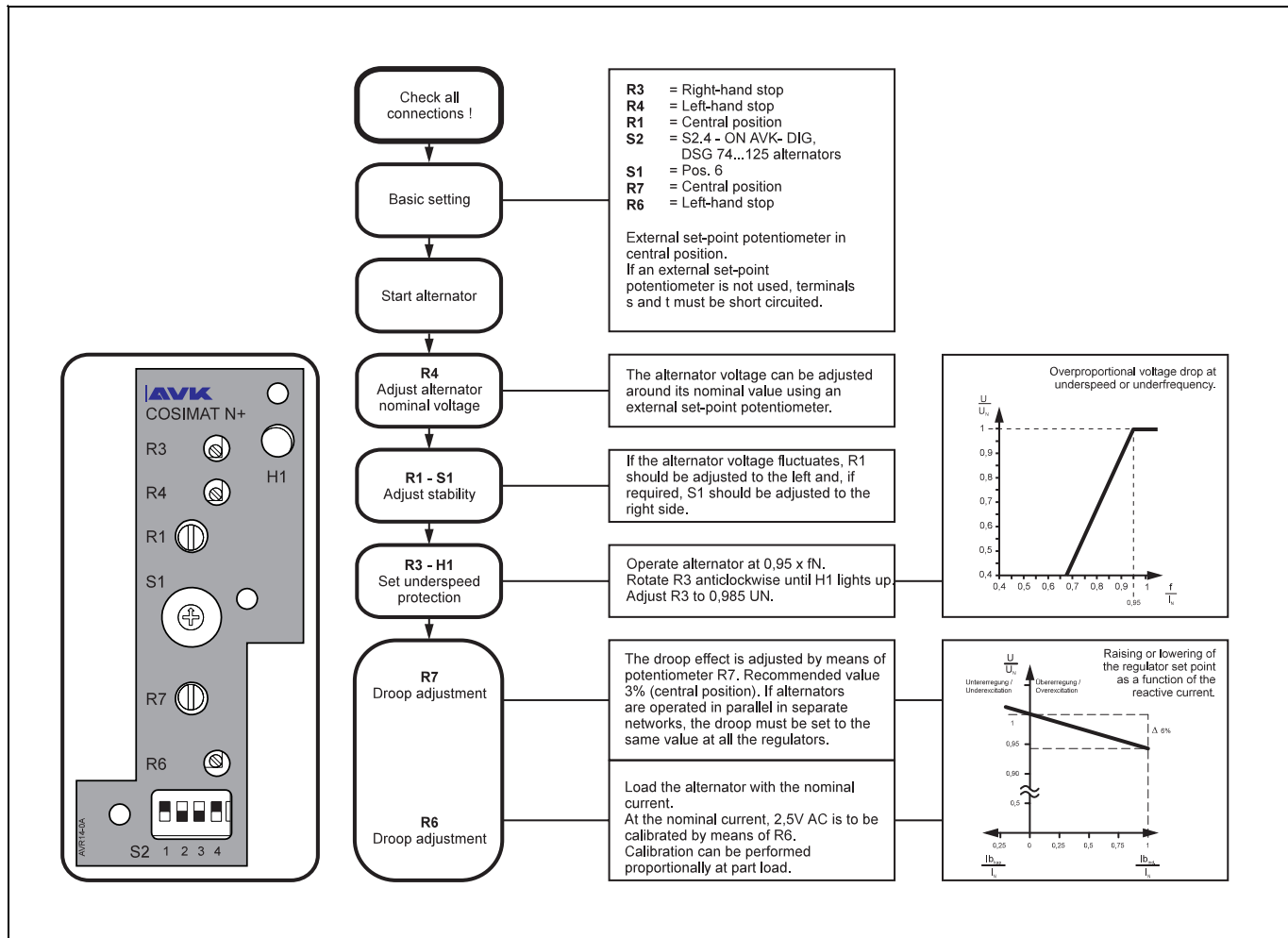


Figure 3 - Start-up

2.4 Optimisation of the regulator

To optimise regulation, it is necessary to connect loads to the alternator.

To allow the trend of the control property following a change in the P or I parameter to be evaluated, the load connected must be reproducible.

The factor with the greatest general significance in achieving an optimum regulating system is an overshoot amplitude x_m which is as small as possible. The essential criterion in the evaluation of the regulating process with respect to time is the settling time t_{aus} .

To follow the trend of the control property, use an oscilloscope to monitor the manipulated variable.

The "COSIMAT N+" regulator allows "free" adjustment of the P and I parameters. The D parameter can be switched over in two stages using code switch S2.4.

It is not necessary to adjust the D parameter in order to optimise the control properties. It is generally determined just once, in accordance with the size of the alternator. In the case of alternators > 1 MVA, switch S2.4 is switched to the ON position.

To decide whether the D parameter should be increased beyond this, it is necessary to take specific measurements of the alternator voltage and at the output of the regulator.

Satisfactory optimisation of the regulator will normally be achieved by the free adjustment of the P and I parameters.

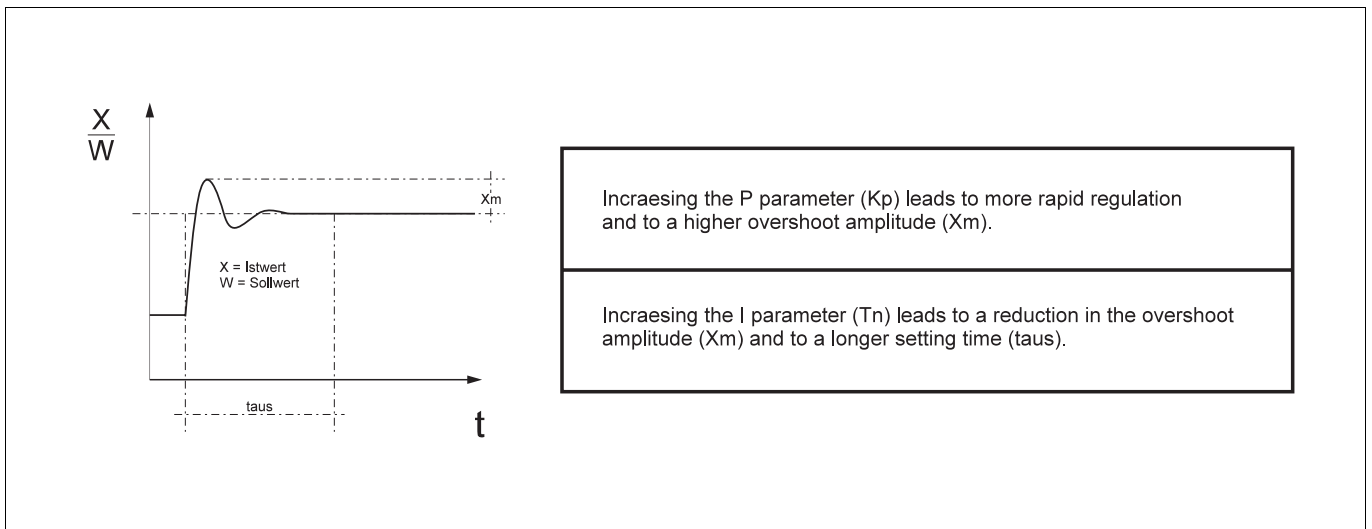


Figure 4 – Characteristic quantities of the regulating system

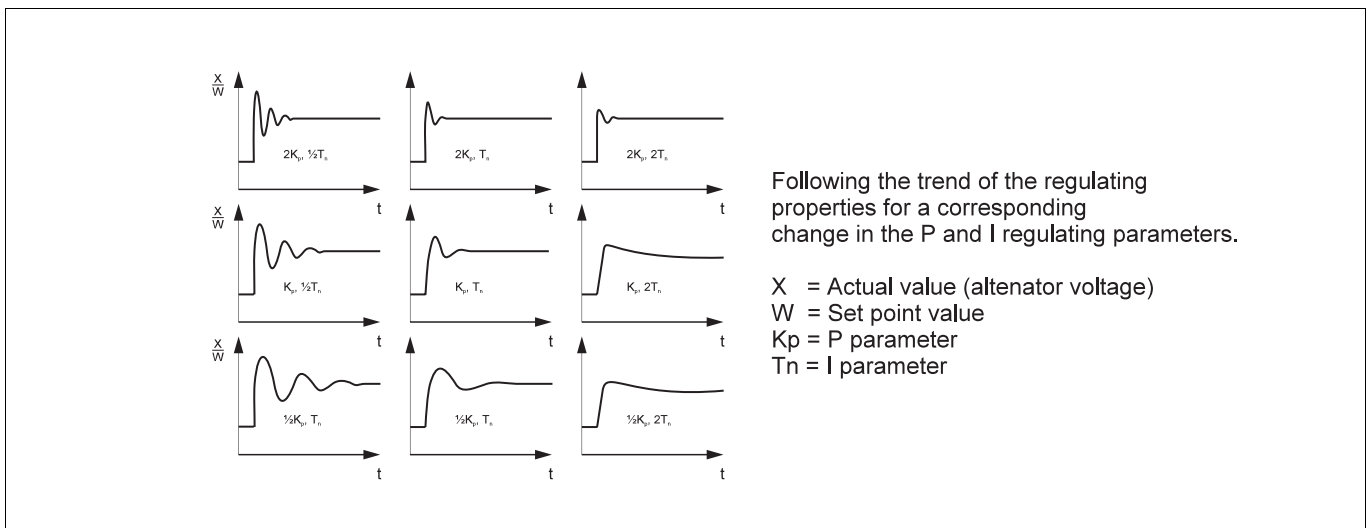


Figure 5 – Trend of the control property

3. Functional description

3.1 Block diagram

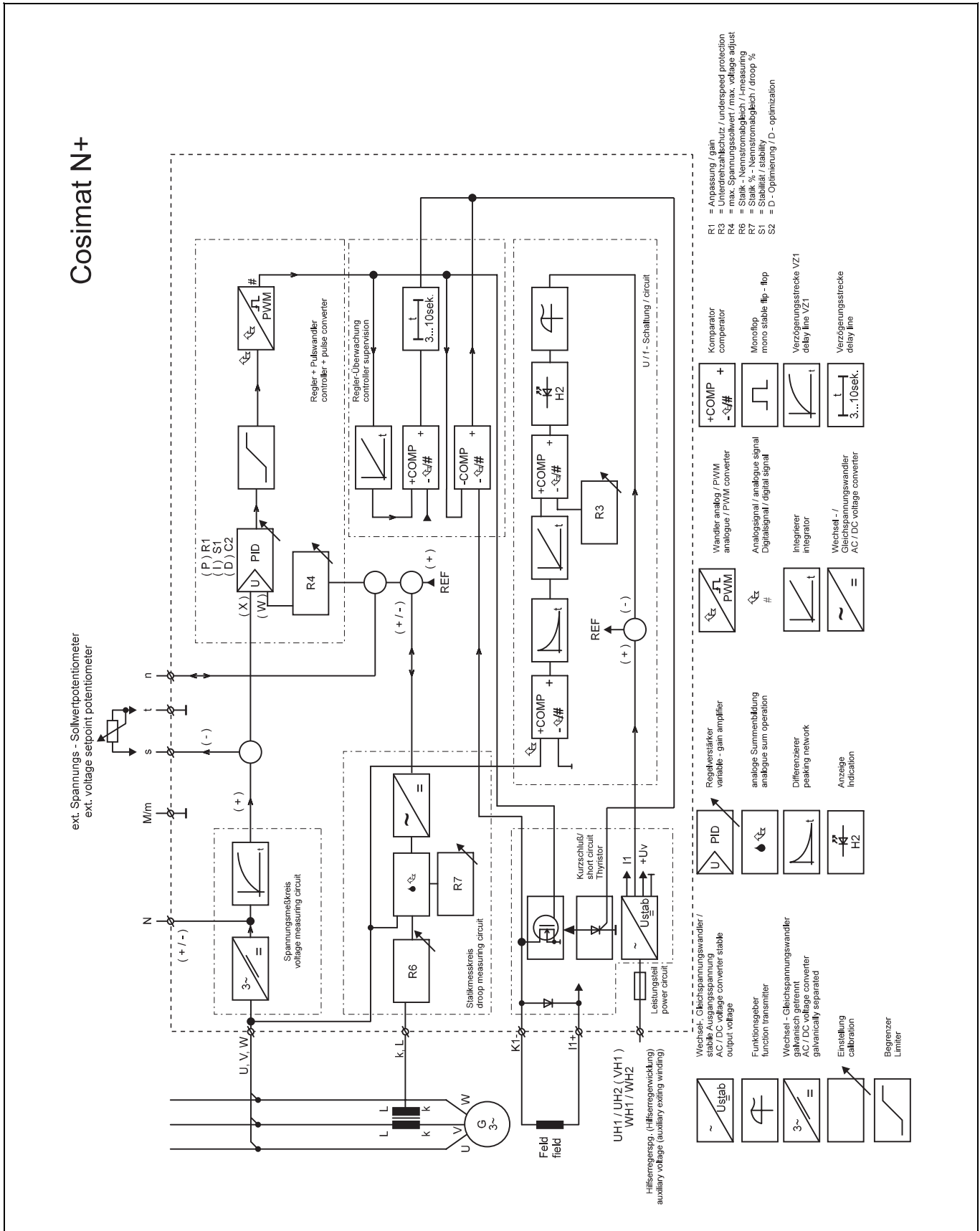


Figure 6 – Block diagram

3.2 Power supply

Power is supplied to the "COSIMAT N+" by means of so-called auxiliary excitation voltages, which are produced in the alternators. The excitation energy and the supply voltage for the "COSIMAT N+" are derived from the auxiliary excitation voltages.

In the case of AvK alternators in Series DSG and DIG with $U_N \leq 11.5$ kV, the "COSIMAT N+" is supplied with power via two single-phase auxiliary windings, which are inserted into the main stator. The windings are designated UH1/UH2 and WH1/WH2.

The voltages UH1 and UH2 are offset by 90° with respect to WH1 and WH2 and are 80 V AC ± 20 % at the nominal voltage of the alternator.

In the case of AvK alternators belonging to Series DIG with $U_N > 11.5$ kV, the "COSIMAT N+" is supplied with power via a two-phase auxiliary exciter machine. The windings are designated UH1, UH2, UH3 and WH1, WH2.

The voltages UH1 and UH2 are offset by 90° with respect to WH1 and WH2 and are 80 V AC ± 20 % at the nominal speed of the machine.

The above-mentioned auxiliary exciter windings UH1 and UH2 and WH1 and WH2 are plugged into the correspondingly designated terminals of the "COSIMAT N+":

Special application

Three-phase auxiliary exciter machine

If a three-phase auxiliary exciter machine is used, the winding terminals are designated UH1-VH1-WH1. The external conductor voltage is 3×75 V AC ± 20 % at the nominal speed of the machine.

Special application

External power supply

The "COSIMAT N+" can also be operated with a constant external voltage. It is generally supplied via a three-phase transformer ($Y_y 0$) with a secondary voltage of 3×75 V AC ± 20 %. The nominal power should be at least 500 VA.

Caution:

If the auxiliary excitation voltage is taken from a constant "external" power source (e.g. the mains), the supply must be switched on only after the alternator has been started. When switching off the alternator, the supply should be switched off before the machine comes to a halt (see 11.10 External power supply).

3.3 Monitoring alternator voltage

The "COSIMAT N+" measures alternator voltages from 90 to 500 V AC (external conductor voltage) within two selectable ranges by means of an internal three-phase measuring transformer.

To measure higher voltages, corresponding voltage transformers must be connected in series.

Signal input N allows intervention into the internal formation of the actual value.

The secondary AC measurement voltage of the measuring transformer is converted into a DC voltage, smoothed, conditioned and output as an actual value to the regulator circuit.

The measured value which is produced corresponds to the arithmetic mean of the rectified three-phase AC measurement voltage.

Three-phase measurement allows for asymmetric loads.

Note:

For non-linear loads (static thyristor converter or rectifier), additional module TF (RC – low-pass filter) is recommended as a measuring adapter. High non-linear loads may require overdimensioning of the alternator.

3.4 Desired value

The desired value for the "COSIMAT N+" is taken from a temperature-compensated reference source.

The signal input "n" allows intervention in the internal formation of the desired value.

The reference voltage reaches the set-point potentiometer R 4 mounted on the front end of the "COSIMAT N+". This potentiometer allows coarse adjustment of the alternator voltage over a wide range (= "approximate" desired value).

In parallel operation of the alternator, the reference voltage is influenced by the droop-measuring system (see 3.5 Droop) and, in the case of underfrequency, by the underspeed protection.

A set-point potentiometer can be connected to the "COSIMAT N+" for external adjustment of the desired value.

This potentiometer is used for fine adjustment of the alternator voltage (= "exact" desired value).

The adjustment range is limited to ± 5 % to ± 10 % around the nominal value, depending on the potentiometer used.

The ES additional module allows the adjustment range of the external set-point potentiometer to be extended from remanence to the nominal voltage.

If the ES module is used on AvK alternators, the regulator system must be provided with an external power supply. This must be decided on a case by case basis, depending on the application and the excitation system used (auxiliary excitation windings or auxiliary excitation machine?)

3.5 Droop

Once an alternator has been connected in parallel, voltage regulation is no longer possible because the system voltage is fixed. The slightest fluctuation in the system voltage would lead to the alternator producing reactive current $> I_N$.

To stabilise the alternator reactive current it is therefore necessary to have a measured variable which is dependent on the reactive current and incorporates the magnitude of the current and the reactive power (inductive or capacitive). This measured variable is introduced at the addition point (comparison point of the desired value and the actual value) of the control amplifier circuit.

This produces a static droop control characteristic, which represents the relationship between:

- the change in the alternator voltage in relation to the nominal voltage and
- the change in the alternator reactive current in relation to the nominal current.

The droop is represented by the slope of the characteristic curve produced i.e. is the quotient of the above ratio.

In the "COSIMAT N+" a linear droop characteristic is generated. The droop effect can be adjusted from 0 to 6 % using the potentiometer R 7.

Example:

In the case of an inductive reactive current of 100 % of the nominal current of the alternator and with the droop set to 6 %, the alternator voltage is reduced by 6 %.

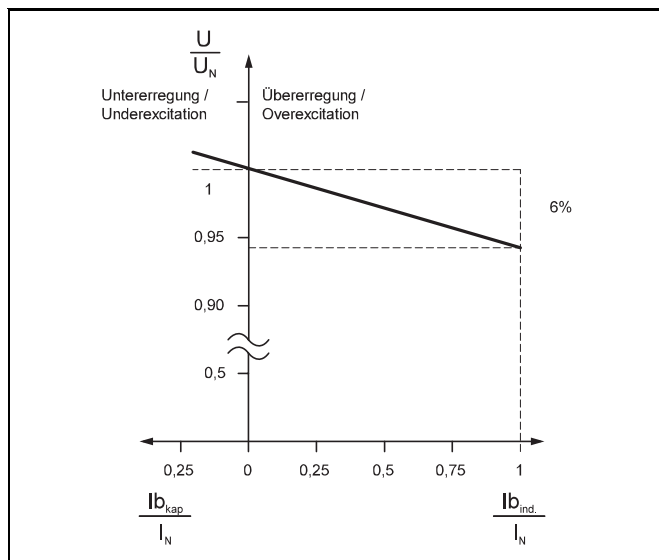


Figure 7 – Droop characteristic

If, when the alternator is connected in parallel, the fixed mains forces it down to a figure which is 6 % lower, the reactive current is inductive and equivalent to 100 % of the nominal alternator current.

In parallel operation, regulation of the synchronous alternator is made possible by the droop sensing signal.

For stand-alone operation, adjustment is performed on the test rig using a reactive load. The droop effect is set to 3 %.

The droop sensing signal in the "COSIMAT N+" influences the desired value and is produced by means of a geometrical addition of the external conductor voltage U-W and a current-dependent voltage signal from the V phase.

In AvK synchronous machines, the corresponding current transformer is located in phase V. The K side of the transformer points towards the alternator's main winding (see Figure 6 – Block diagram).

Internally load-relieved bushing-type transformers are used.

The outlet end of the secondary connections (= potted end of the transformer) is the primary-side K point (= current input).

The wire marked in white is the secondary-side k point.

The secondary connections k and l of the droop current transformer should be plugged into the correspondingly marked terminals of the "COSIMAT N+".

In the case of alternators for parallel and stand-alone operation, the measuring input k – l can be short-circuited by means of a switch for stand-alone operation. This gives better voltage stability (see 8. Diagrams of connections, 11.5 Droop switch).

The droop sensing system of the "COSIMAT N+" is matched to the nominal current of the alternator by means of potentiometer R 6.

Caution:

For the droop sensing system to function correctly, the "COSIMAT N+" requires a clockwise rotating field at its measurement voltage terminals. If the direction of rotation is reversed, measuring leads U and W should be interchanged.

3.6 Control amplifier

The control amplifier of the "COSIMAT N+" has a PID characteristic. The parameter of the I section can be varied in steps from 1 to F using switch S 1. During this process, the integration time constant increases.

Caution:

Switch position 0 is not allowed; never pass through 0.

The parameter of the P section can be varied by means of potentiometer R 1. During this process, the adjustment range shown in Figure 8 should not be exceeded.

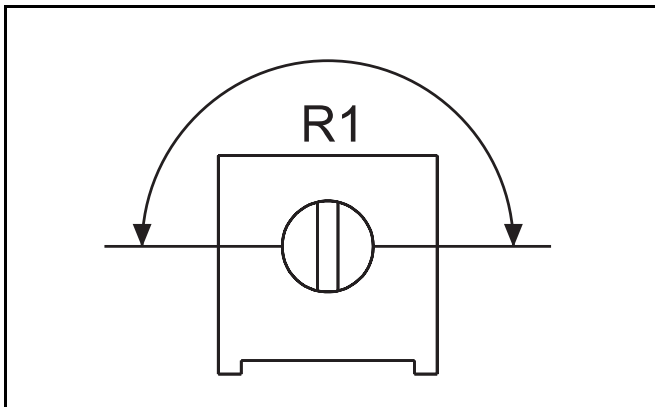


Figure 8 – P adjustment range

Further adjustment in the clockwise direction leads to hunting, while further adjustment in the anticlockwise direction leads to control errors.

The D parameter can be changed by switching code switch S2.4 to the "ON" position. This increases the effect of the D parameter, as required by larger alternators (DIG and DSG 74 ... 125).

The D parameter can furthermore be varied at the "D-Opt." optimisation points. At the specified polarity, a capacitor can additionally be soldered in.

When installing additional D-section capacitors, it is important to note their polarity (electrolyte capacitor) and nominal voltage (= 35 V DC). The maximum recommended value is 150 μ F.

3.7 Additional functions of the "COSIMAT N+"

3.7.1 Underspeed protection

While a drive machine (motor or turbine) is warming up, the alternator is operated at underfrequency. To prevent overexcitation and thermal damage in the exciter system, the "COSIMAT N+" allows frequency-dependent reduction of the regulator's desired value or alternator voltage in accordance with a linear function (see Figure 9 – Underspeed protection).

The point at which the voltage drops is defined by a corresponding frequency value set by means of R3. The reduction for underspeed is indicated by H1. Before delivery, the "U/f

kink point" is set to $0.95 \times f_N$. Above the kink point, voltage regulation is constant.

The voltage reduction is delayed by about 2 seconds to eliminate the effect of transient drops in the speed of the drive machine.

In exceptional circumstances, the underspeed protection function can be deactivated by means of code switch S2.2 (see 9.2 Adjusting elements).

Caution:

For standard applications of the "COSIMAT N+", the underspeed protection function must be active and correctly set. Code switch S2.2 must be in the "ON" position.

The underspeed protection function is active on 50/60 Hz alternators. For other nominal frequencies, the UF module should be used or the alternator should be deexcited when being shut down.

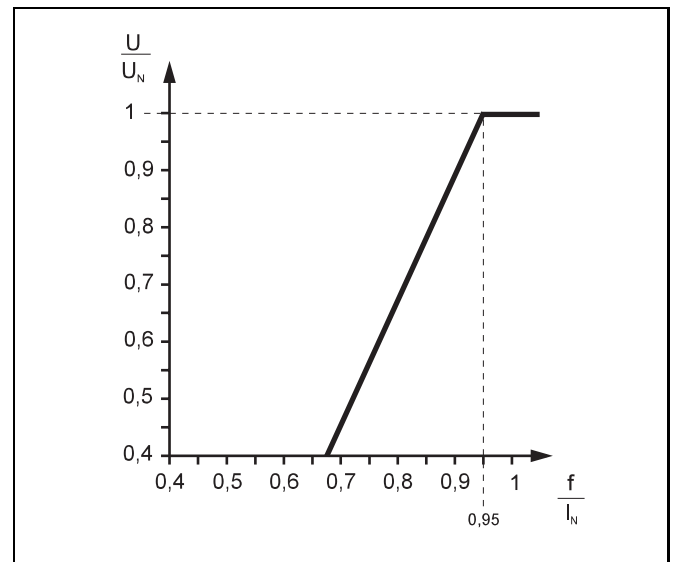


Figure 9 – Underspeed protection

3.7.2 Protective functions

The auxiliary exciter windings (see 3.2 Power supply) have a very high short-circuit capacity. If the actuator is faulty, the high short-circuit power involved may cause severe damage.

To prevent this damage, the "COSIMAT N+" has two protective functions which monitor its actuator and prevent overloading of the exciter system:

Time limitation of the maximum excitation current

When the actuator is fully on, the excitation current reaches a maximum.

If this state is allowed to continue, the exciter system will be damaged.

However, the fully-on state only occurs in the case of compensating processes or short circuits at the main terminals of the alternator.

The monitoring system of the "COSIMAT N+" limits maximum excitation to 8 to 10 seconds.

After this, the protection circuit isolates the exciter field from the source of excitation energy by tripping the protection fuses.

Checking the direction of action of the control amplifier and the actuator

This feature monitors the positioning transistor for short circuits.

Short-circuiting of the positioning transistor leads to maximum excitation. The control amplifier tries to counteract this but has no effect on the faulty actuator. The actuator and the control amplifier act in opposite directions and the fuses trip immediately.

The following circumstances also lead to maximum excitation and can trip the fuses:

- Faulty sensor leads
- Deactivated or incorrectly adjusted underspeed protection function
- Short circuit in the I1 / K1 exciter lead
- Faulty exciter rectifier in the "COSIMAT N+"
- Extreme overloading of the alternator (short circuit) if this has not been switched off after 8 to 10 seconds.

The protection device integrated into the "COSIMAT N+" responds to a large number of defects and faults.

Note:

Additional module ER1 can be used to limit the excitation current when the alternator is operated in parallel.

3.8 Power stage

The power stage of the "COSIMAT N+" provides an excitation current that corresponds to the output signal of the control amplifier.

A MOSFET transistor is used as the actuator, with pulse width modulation, i.e. the turn-on time varies but the switching frequency remains constant.

The excitation energy is taken from the rectified supply voltage, the rectifier circuit being located in the power stage. It allows the rectification of two single-phase or three-phase supply voltages (see 3.2 Power supply).

There is a short-circuit thyristor in the DC circuit. The protective circuit of the "COSIMAT N+" switches this thyristor on if faults occur in the control circuit. The resulting short-circuit current trips the two protection fuses on the front plate of the "COSIMAT N+" and the exciter field is isolated from the source of excitation energy.

Fuse:

10 A super quick-acting
32 mm x 6.3 mm ø
IEC G 144.400

Caution:

Replacement fuses must be of the above type. The power stage may suffer permanent damage if the wrong type of fuse is used.

The power stage is located on a profiled heat sink. It is plugged into the regulator and screwed into the substructure of the "COSIMAT N+".

To ensure adequate cooling for the power semi-conductors in the power stage, you must follow the instructions in Chapter 11.2 Mounting the regulator.

4. Transfer function of the "COSIMAT N+"

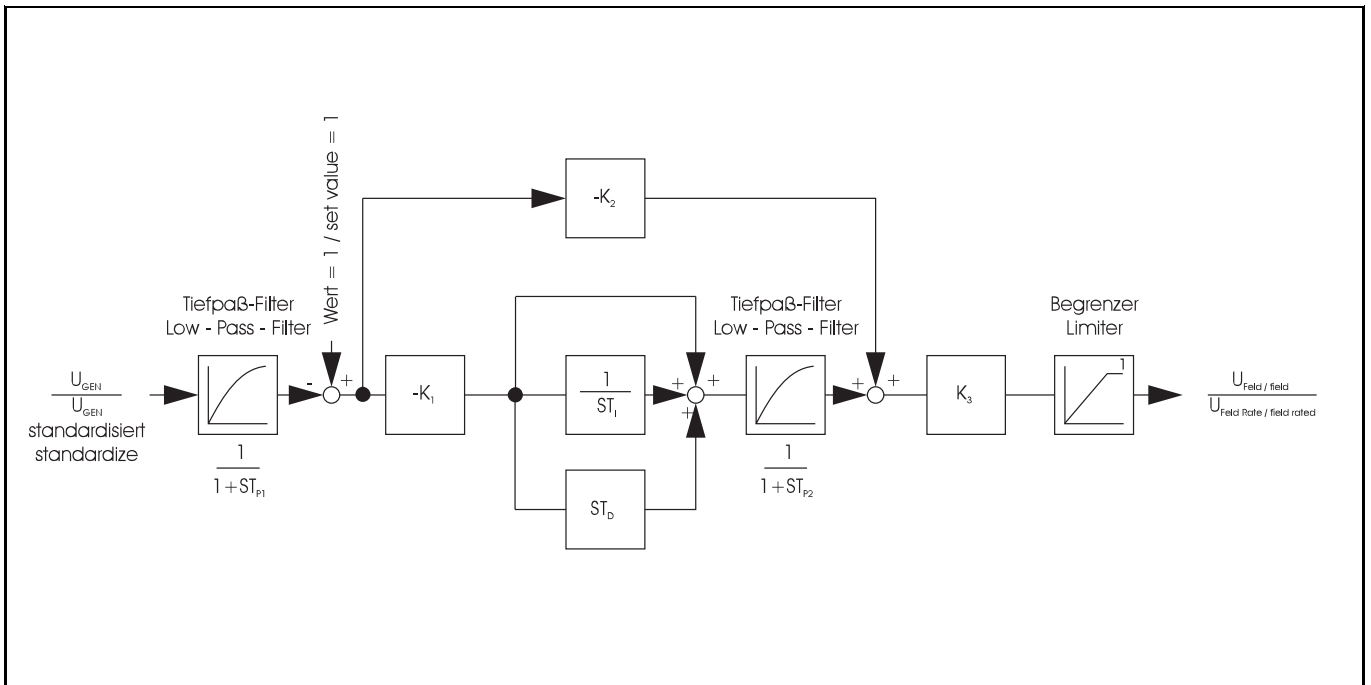


Figure 10 – Equivalent control circuit diagram

There are three ways of influencing the control parameters in the "COSIMAT N+":

Potentiometer R1 (500 k Ω) for changing the P parameter. At the right-hand stop, R1 is 0 Ω .

Switch S1 for changing the I parameter in 15 steps (from 0.22 to 3.85 μ F) each of 0.22 μ F (C1).

Code switch S2.4 for increasing the D parameter from 10.1 μ F (S2.4 = OFF) to 32.1 μ F (S2.4 = ON) (C2).

The individual parameters in the equivalent circuit diagram (see Figure 10 – Equivalent control circuit diagram) can be calculated as follows:

$$\begin{aligned} T1 &= R1 \times C1 \\ T2 &= 6,8 \text{ k}\Omega \times C2 \\ T3 &= 22 \text{ k}\Omega \times C1 \end{aligned}$$

$$T_I = T1 + T2$$

$$T_D = \frac{T1 \times T2}{T1 + T2}$$

$$K1 = 2,56 \frac{T1 + T2}{T3}$$

$$K2 = \frac{716,1 \text{ ms} \times K1}{T_I}$$

$$K3 = \frac{1}{15} = 0,066$$

The time constant of the input low-pass filter is:

$$T_{P1} = 3.62 \text{ ms}$$

The time constant of the output low-pass filter is:

$$T_{P2} = 0.268 \times T2$$

5. Special functions and additional equipment

5.1 Stand-by and emergency manual switchover

Where higher availability is required, there are "stand-by" circuits.

Stand-by circuits contain two "COSIMAT N+" voltage regulators.

The alternator is regulated by one of these regulators (main regulator). If this regulator is defective, it is possible to switch to the second (stand-by) regulator.

Stand-by circuits are available in either manual or automatic form.

Manual stand-by circuit (SB1)

In the event of a malfunction, a changeover switch permits the stand-by regulator to be selected.

The changeover switch switches over all the signals apart from the sensing voltage and supply connections UH2 (VH1) and WH2.

Automatic stand-by circuit (SB2)

The stand-by circuit monitors the main regulator.

Common operating variables with respect to the response of the regulator allow fault detection and switchover to the stand-by regulator.

The stand-by regulator operates in simulated control mode and is likewise monitored.

The switch between the two regulators can take place during the operation of the alternator and can be performed manually, by means of a test function or, in the case of a malfunction, automatically.

5.2 Additional modules

The following list provides a summary of the various additional modules for the "COSIMAT N+".

COS cos phi regulator

FUNCTION: The power factor ($\cos \phi$) is held constant irrespective of fluctuations in system voltage or load changes.

APPLICATION: Parallel operation with fluctuating mains. Limitation of the excitation current by means of ER1 additional module.

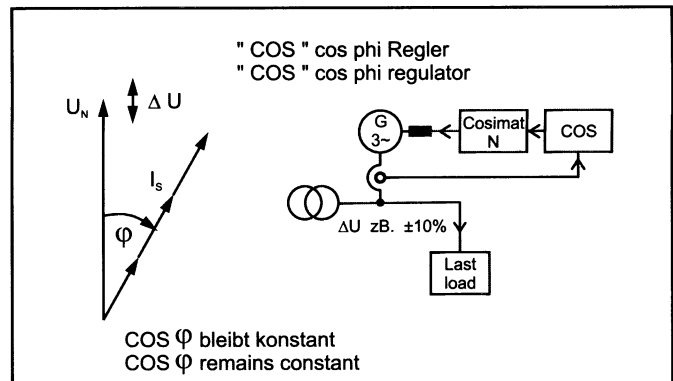


Figure 11 – Additional module COS

QPF Reactive power regulator with single-phase measurement

FUNCTION: The reactive power is held constant irrespective of fluctuations in system voltage or load changes.

APPLICATION: Parallel operation with constant reactive power output.

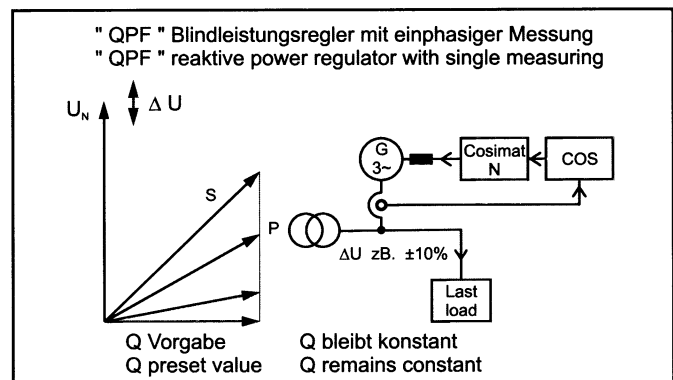


Figure 12 – Additional module QPF A

QPF cos phi trimmer

FUNCTION: The power factor of the regulated alternator is the same as that of the total current or of the currents of the other alternators (depending on current transformer connection).

APPLICATION: Parallel operation with alternators without linear voltage droop.

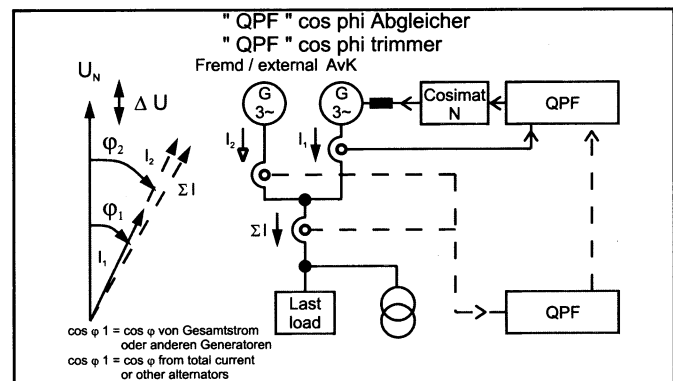


Figure 13 – Additional module QPF B

QPF Reactive power trimmer with single-phase measurement

FUNCTION: The reactive power of the regulated alternator is the same as that of the other alternator.

APPLICATION: Parallel operation with alternators without linear voltage droop.

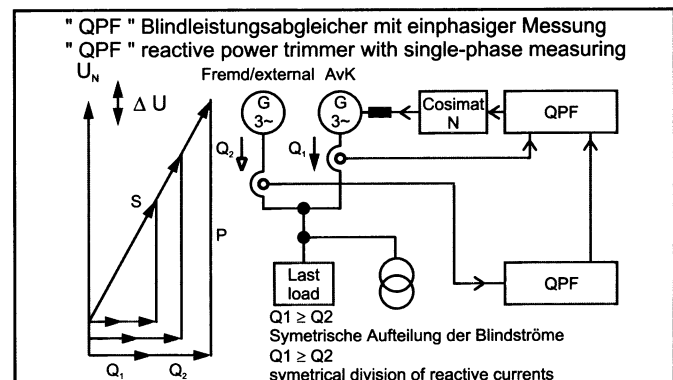


Figure 14 – Additional module QPF C

SB2
Automatic stand-by switchover

(see 5.1 Stand-by and emergency manual switchover)

FUNCTION: Automatic switchover to the stand-by regulator in the event of regulator faults.

APPLICATION: Requirement for higher availability and operating reliability (e.g. on ships).

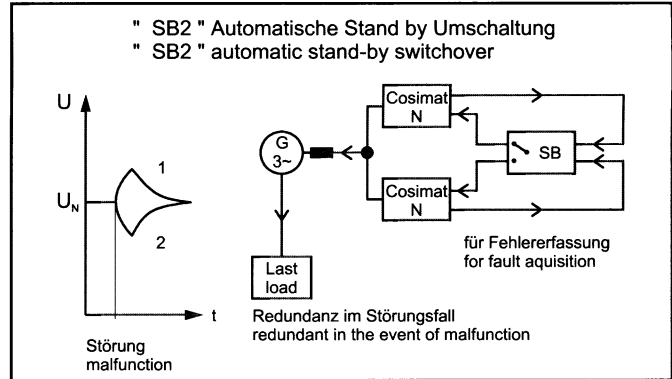


Figure 15 – Additional module SB2

TF/TF1
RC – low-pass filter

(Type TF1-50 for 50/60 Hz)

FUNCTION: Reducing the ripple effect in the voltage sensing signal of the "COSIMAT N+".

APPLICATION: Non-linear alternator loading by rectifier bridges or static converters.

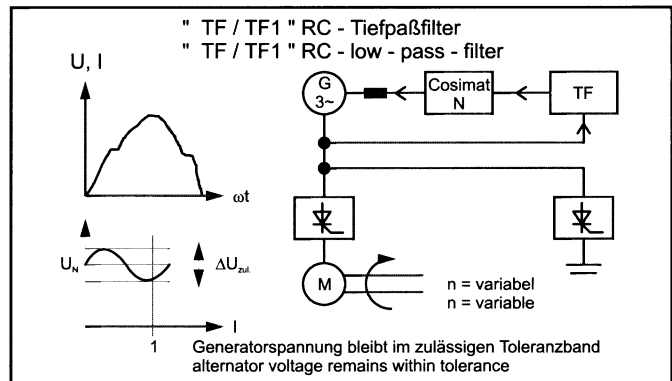


Figure 16 - Additional module TF1

ES
Extended adjustment range

(incl. 10 x potentiometer)

FUNCTION: External adjusting range from remanence to nominal voltage.

APPLICATION: Various test applications in the construction of transformers and electrical machines, run-up of large electric motors (pump motor).

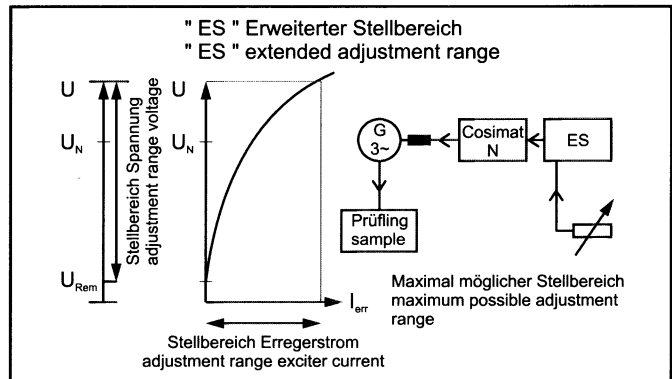


Figure 17 – Additional module ES

UF
U/f characteristic module

FUNCTION: Frequency-dependent regulation of the alternator voltage in accordance with a linear function. Different gradients can be selected.

APPLICATION: Variable-frequency operation of shaft alternators on ships. Reduces the speed dip when there is a jump in the active load.

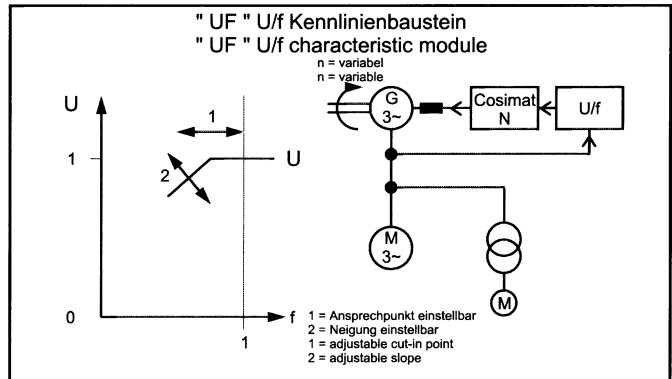


Figure 18 – Additional module UF

UF3
U/f characteristic module with extension

FUNCTION: Frequency-dependent control of the alternator voltage in accordance with freely selectable function. Operation with controlled inner field voltage down to 0 Hz.

APPLICATION: Control of the alternator voltage as a function of any measured variable (using standardised measured-value signal) and freely selectable characteristics. Used for driving asynchronous winding motors and for testing transformers.

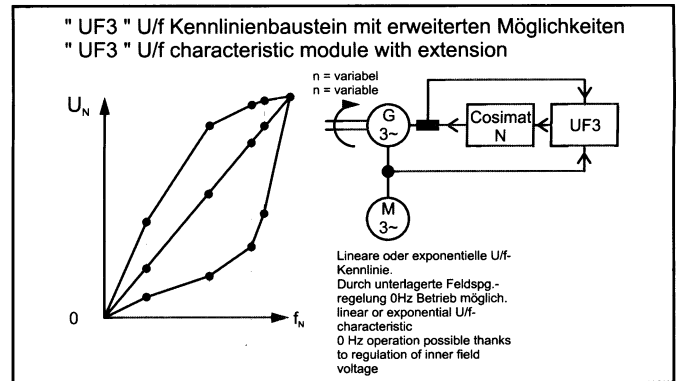


Figure 19 – Additional module UF3

SR2
Current limitation

FUNCTION: Limitation of alternator current to predetermined value.

APPLICATION: Run-up of large electric motors.
 Note: No effect on the switch-on peak in the case of direct switch-on of motors or transformers.

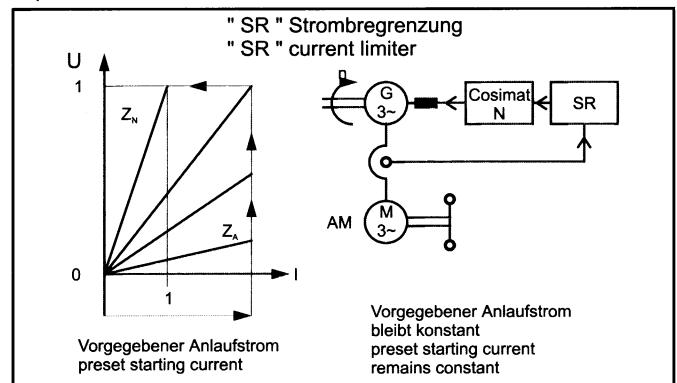


Figure 20 – Additional module SR2

EI
External actual value detection

FUNCTION: Regulation to externally measured voltage. If the measuring lead breaks, it switches over to voltage measurement at the alternator terminal.

APPLICATION: Providing the consumer with highly accurate voltages over long input leads.

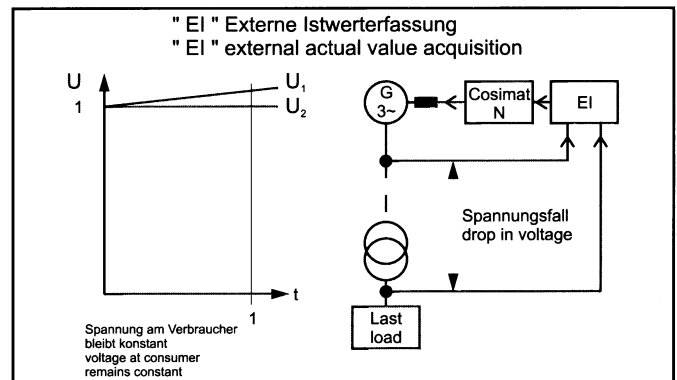


Figure 21 – Additional module EI

UDC2
Detection of DC voltage actual value

FUNCTION: Electrically isolated measurement of a DC voltage actual value.

APPLICATION: Voltage regulation of a synchronous alternator to the rectification value of an output-side bridge-type rectifier.

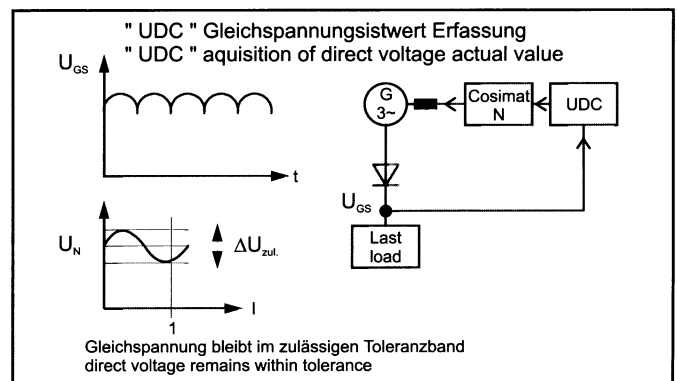


Figure 22 – Additional module UDC2

KP
Cable compensation

FUNCTION: Raising the alternator voltage as a function of the current.

APPLICATION: Compensation of cable voltage losses by way of the load current, specifically when there is no possibility of access to the external measuring point.

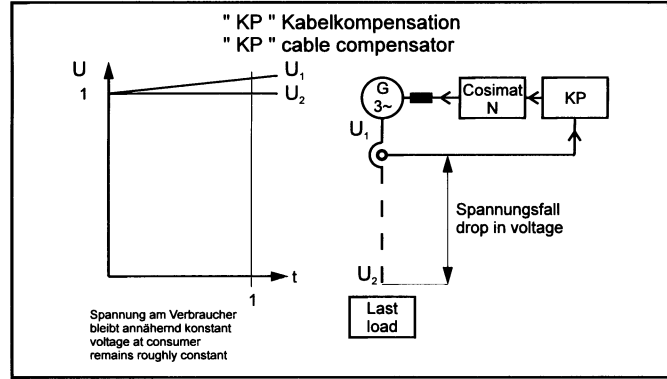


Figure 23 – Additional module KP

ER1
Controlling exciter current limiter

FUNCTION: Secondary regulation of the exciter current to a selected over- and under-excitation value.

APPLICATION: Protects the alternator in cos phi-regulated parallel operation with a "soft" mains when using "COSIMAT N+" and COS module.

When used with QPF, controlling limitation of the exciter current cannot be used. In that case, it would be necessary to employ contact indication in the event of the exciter current limits being over- or undershot.

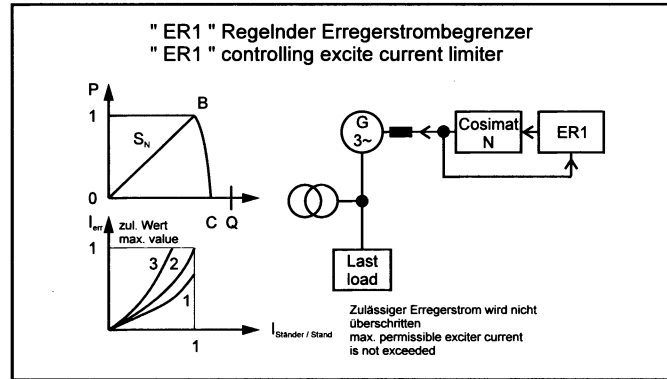


Figure 24 – Additional module ER1

6. Technical data

GENERAL DATA

Type	: fully potted aluminium housing incl. power stage
Maintenance	: maintenance-free
Rated switch-on time	: continuous operation
Installation position	: mount with longitudinal axis vertical at convectional cooling or longitudinal axis in air flow direction at fan cooling
Installation clearance	: 3 cm all round (see 11.2 Mounting the regulator)

MEASURING CIRCUITS

Alternator voltage

Nominal voltage	: 90 ... 250 V AC / 250 ... 500 V AC
Frequency	: 50 ... 400 Hz
Power consumption	: 4 VA / 6 VA

Drop current sensing

(Voltage input)

Voltage at I_N	: 3 ... 7 V AC
Power consumption	: 0.15 ... 0.35 W

AUXILIARY CIRCUITS

Supply voltage	: 2 x single-phase 80 V AC ± 20 % or 1 x three-phase 75 V AC ± 20 %
Power consumption	: depending on excitation requirement
Nominal frequency	: 50 ... 1200 Hz

OUTPUT CIRCUITS

Actuator

Intermediate circuit voltage U_{zk}	: 85 to 130 V DC (dependent on the supply voltage)
Continuous excitation current	: 7 ADC (continuous)
Minimum field resistance R_{fk} Minimum required	: 5Ω (cold)
field time constant τ_{fk}	: 0.06 s
Short circuit exciter current	: 20 ADC for 5 seconds (at $R_{fk} = 5\Omega$ and $U_{zk} = 100$ VDC)
Protective fuse	: 10 A-FF / 250 V – 6.3 x 32

ACCURACY

Control accuracy	: ± 1 % at 0 to 60 °C ± 5 % speed fluctuations and apparent power 0 ... 100 %
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TESTS

Vibration test	: German Lloyd category 2
EMV	: CE-compliant in accordance with EN50081 and EN50082

AMBIENT CONDITIONS

Storage temperature	: - 40 ... + 70 °C
Operating temperature	: -25 ... + 70 °C (Special version "COSIMAT N+T" - 55 ... + 70 °C)

HOUSING, DIMENSIONS, WEIGHT AND INSTALLATION

Height x width x depth	: 121 x 115 x 162.5 mm
Fixing	: 4 M6 bolts, washers and circlips
Weight	: 2 kg

7. Dimensions

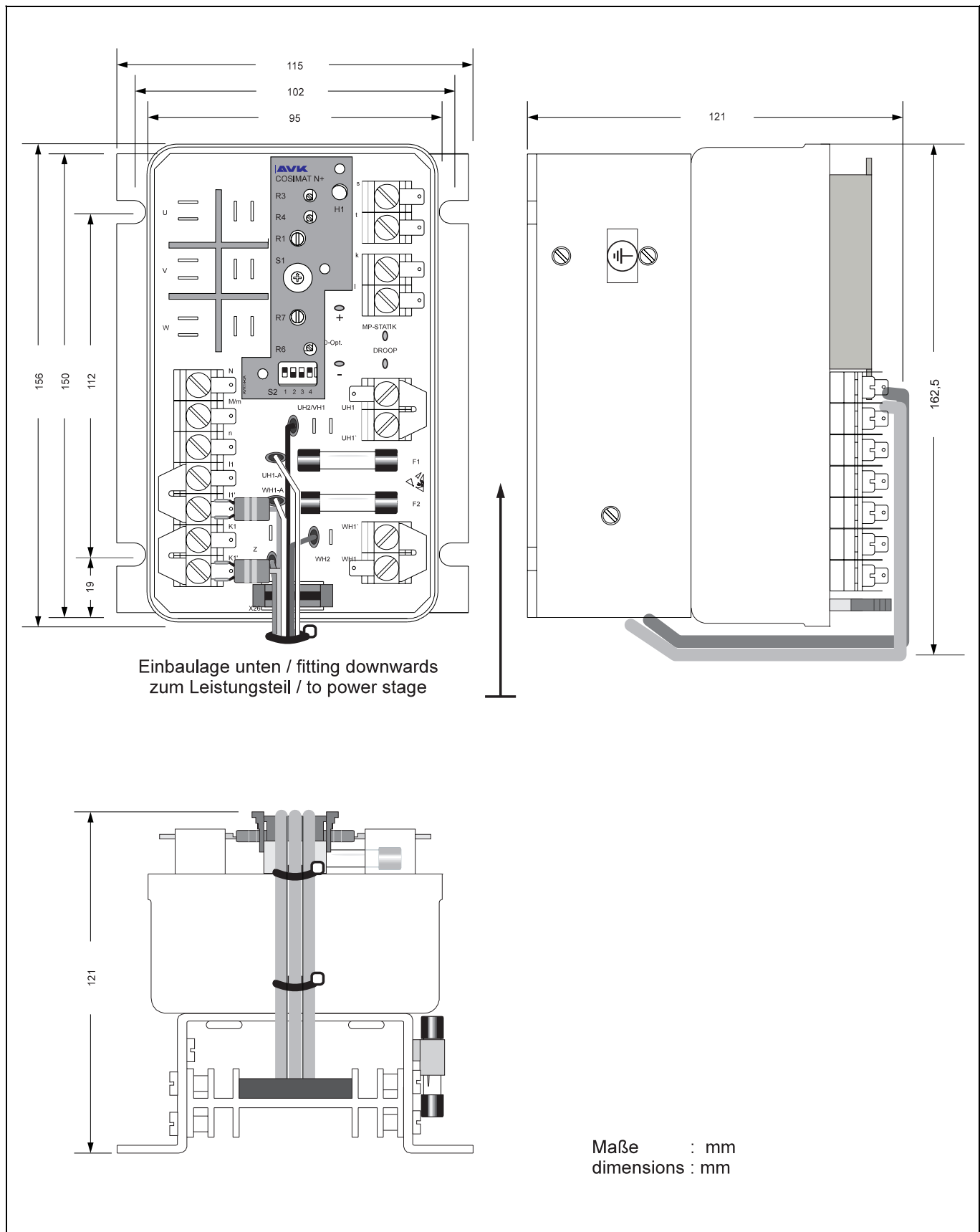


Figure 25 – Dimensions

8. Diagrams of connections

Legend for diagrams of connections

F1	Circuit breakers for G3 Operate only when stationary
G1	Main machine
G2	Exciter/excitation windings
G3	Auxiliary windings/Auxiliary exciter machine
R11/V3	Rotating varistor
T24	Voltage transformer for regulator Must be disconnected if the star point of G1 is open
T32	Voltage transformer for G3 with integrated circuit breaker F1 Operate F1 only when stationary!
V1	Rotating rectifier
X1	Main terminals
X2 – 6	Terminal strip
U1	"COSIMAT N+" voltage regulator
	R3 Underspeed protection
	R4 Internal desired value
	R1 P component
	S1 I component
	R7 Droop adjustment
	R6 Droop transformer matching
R1	Desired value potentiometer alternator voltage ($R = 500\Omega$)
T6	Droop transformer

8.1 Assembly for DSG alternators 52 - 74

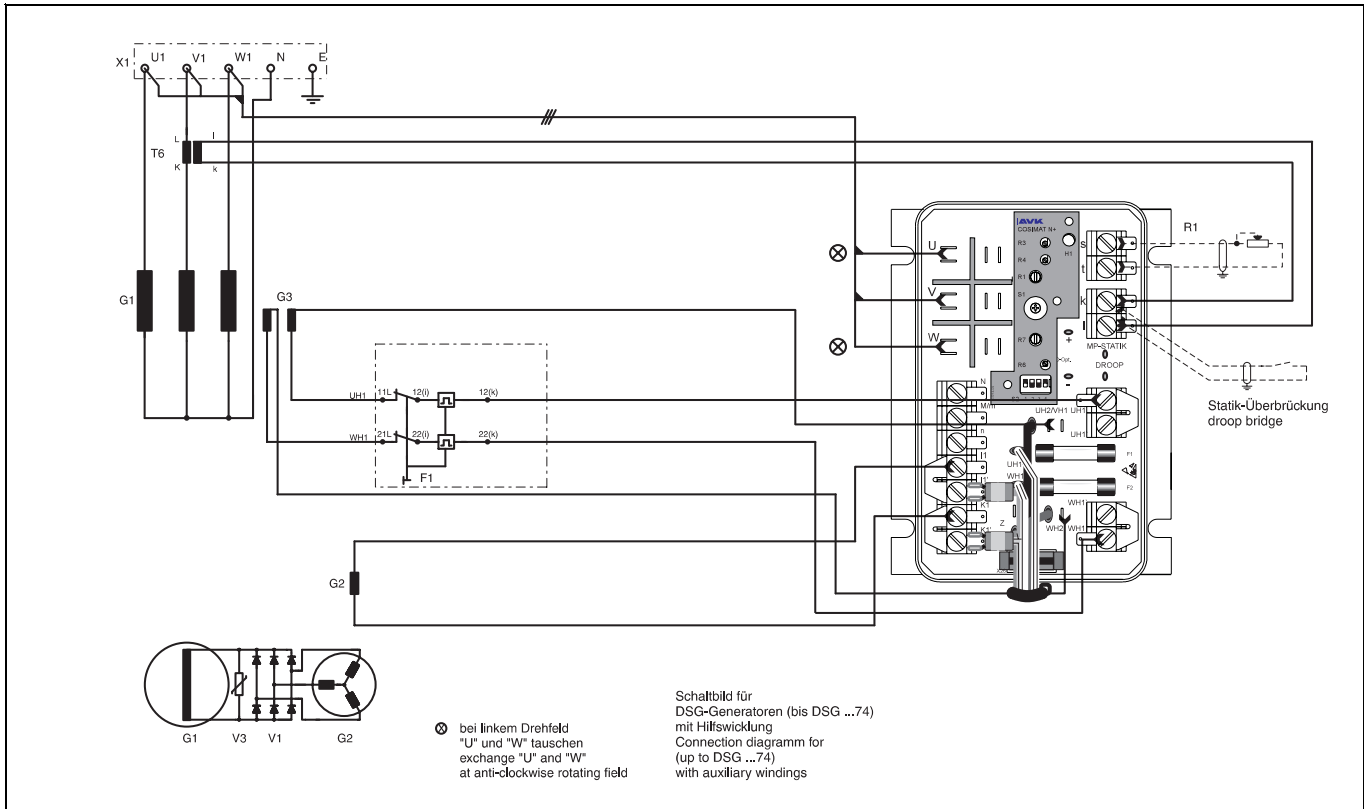


Figure 26 – Internal mounting, DSG alternators 52 – 74

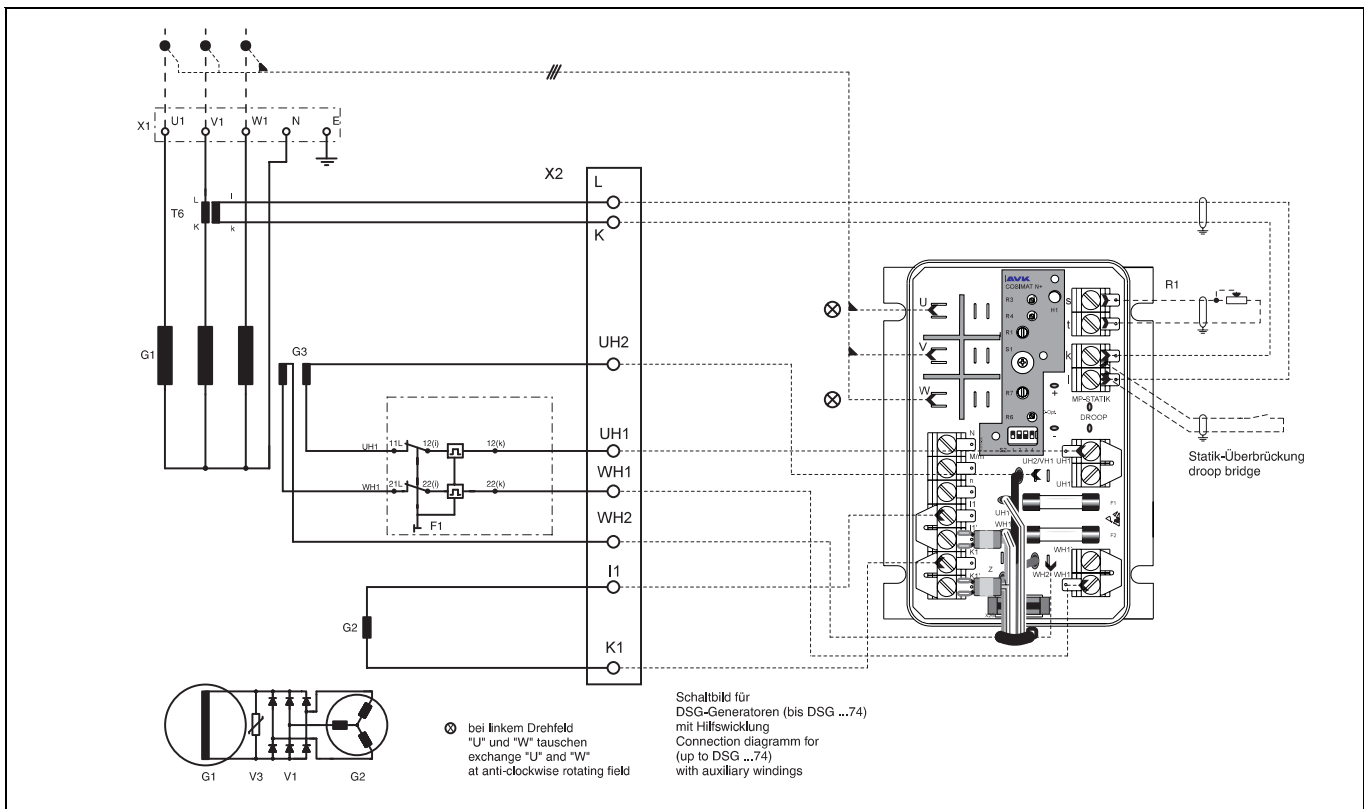


Figure 27 – External mounting, DSG alternators 52 – 74

8.2 Assembly for DSG alternators 86 - 125

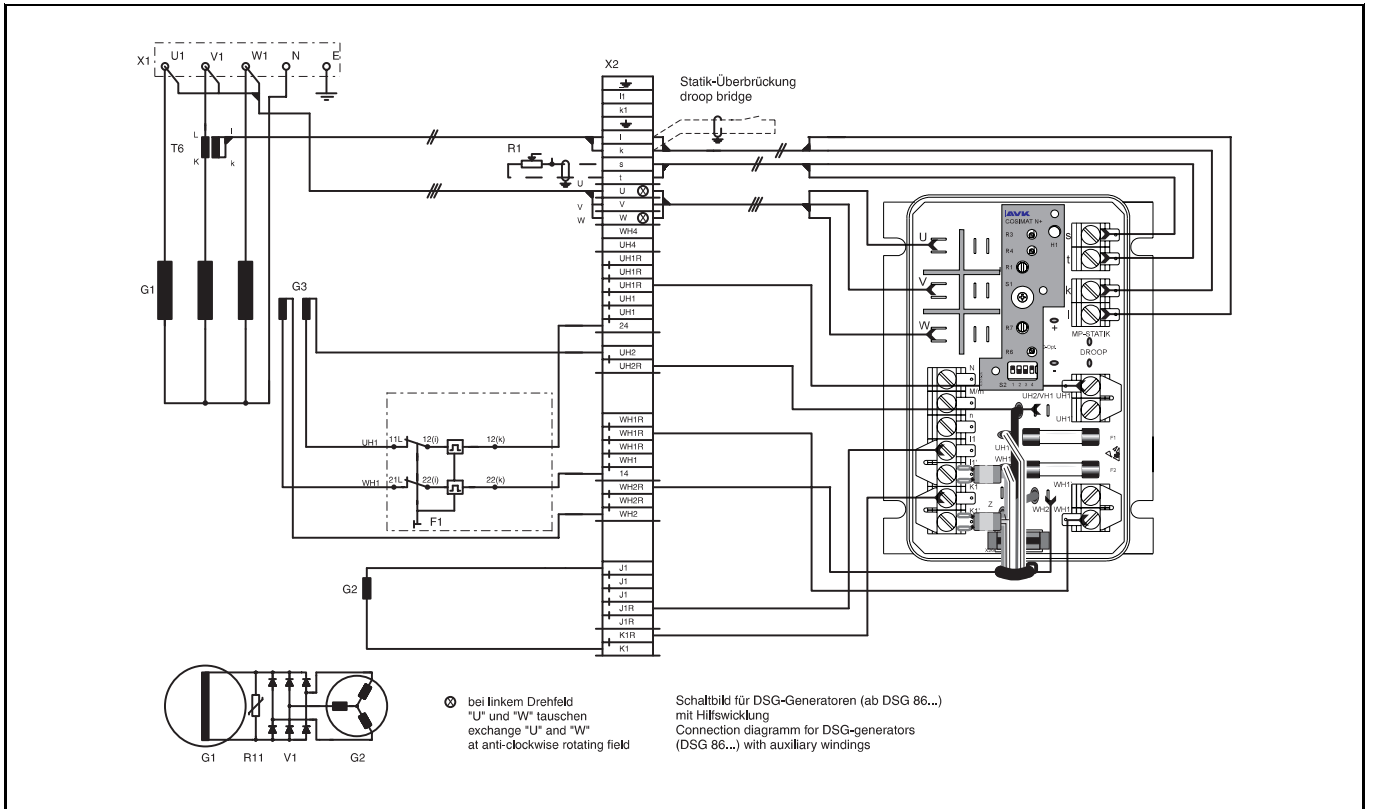


Figure 28 – Internal mounting, DSG alternators 86 - 125

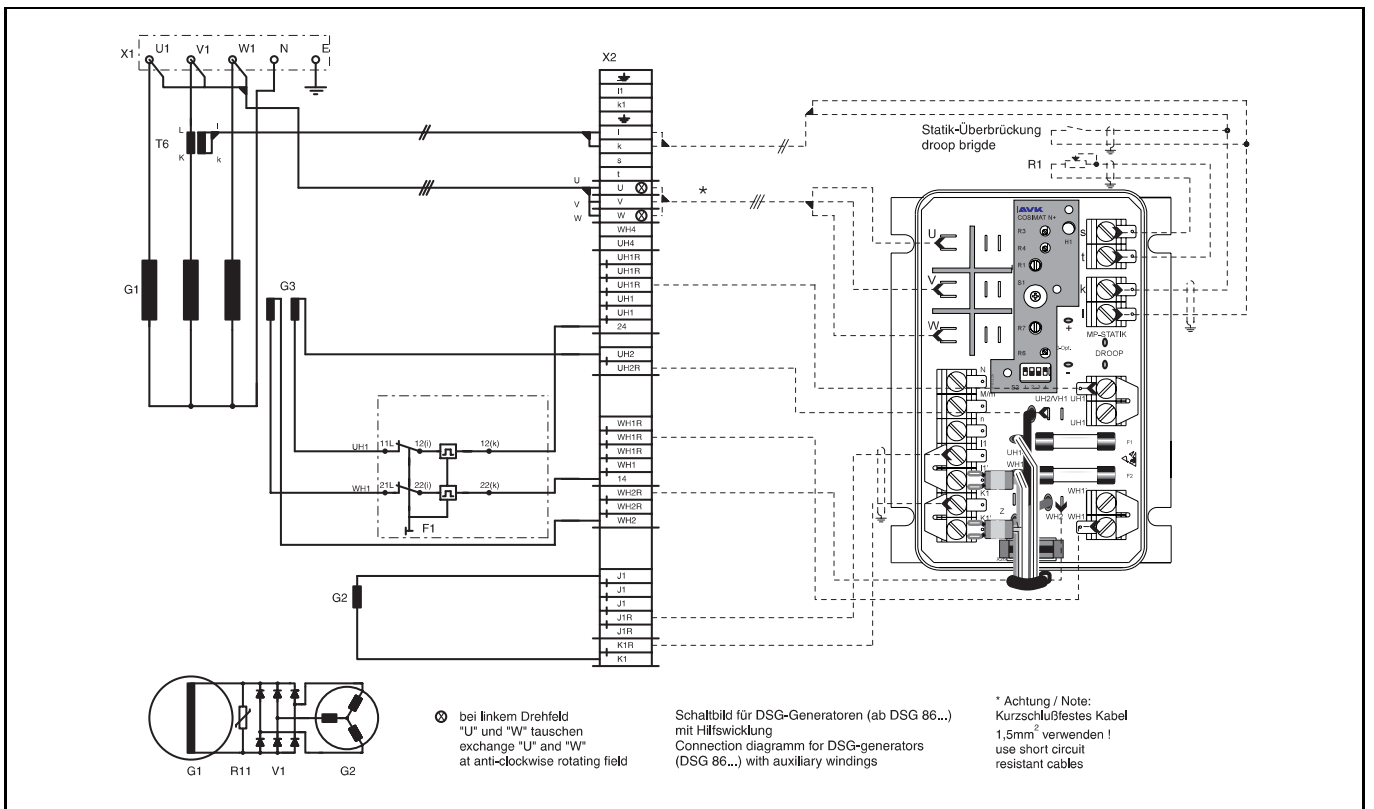


Figure 29 – External mounting, DSG alternators 86 - 125

8.3 Assembly for DIG medium-voltage alternators with $U_N \leq 11.5 \text{ kV}$

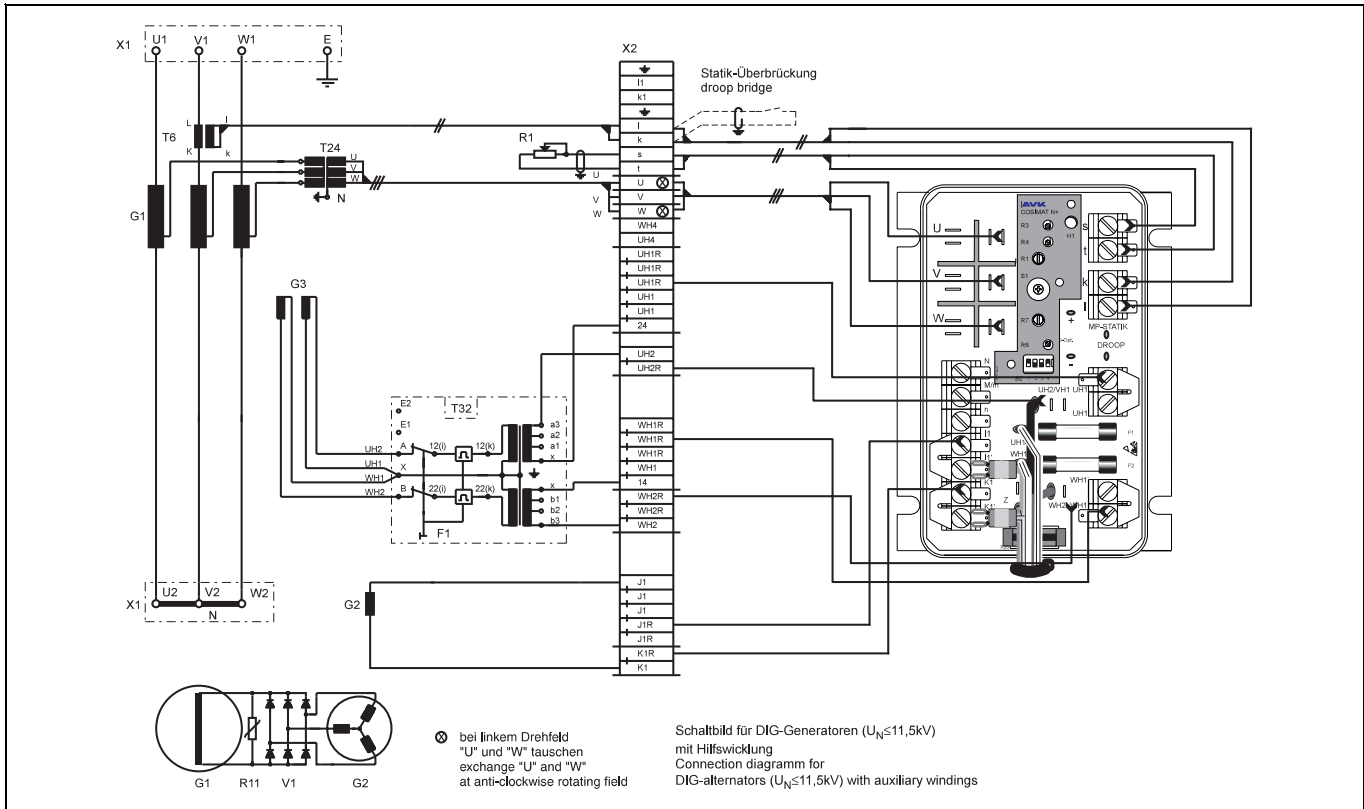


Figure 30 - Internal mounting, DIG medium-voltage alternators with $U_N \leq 11.5 \text{ kV}$

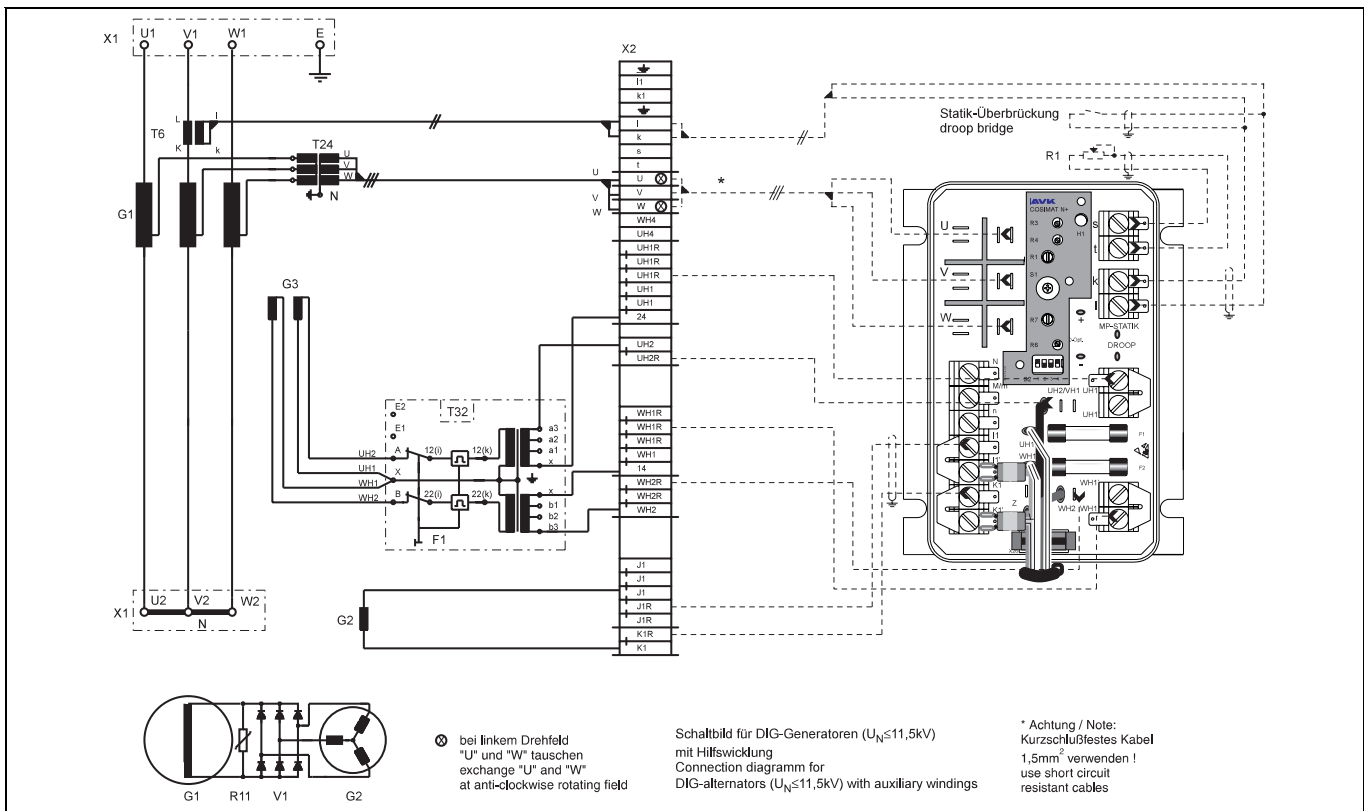


Figure 31 - External mounting, DIG medium-voltage alternators with $U_N \leq 11.5 \text{ kV}$

8.4 Assembly for DIG medium-voltage alternators with $U_N > 11.5 \text{ kV}$

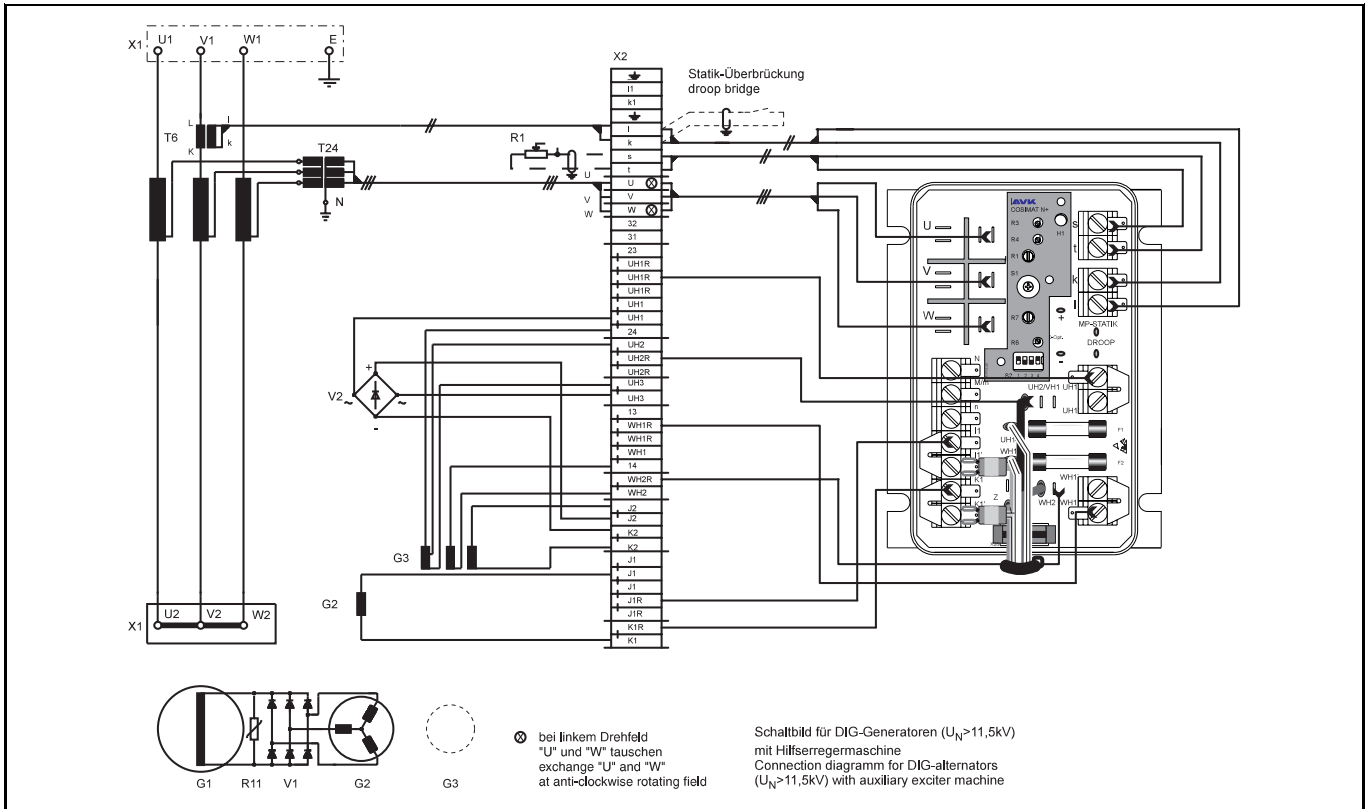


Figure 32 - Internal mounting, DIG medium-voltage alternators with $U_N > 11.5 \text{ kV}$

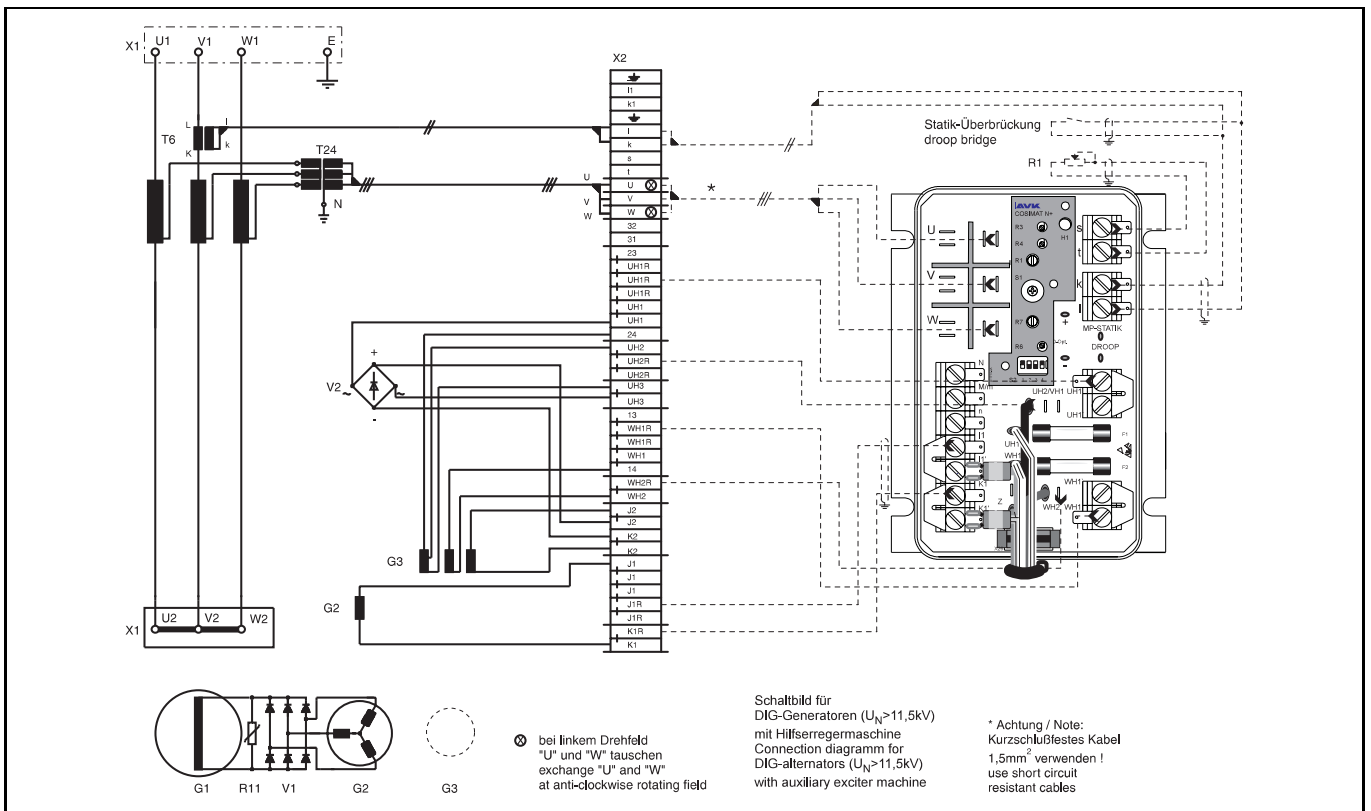


Figure 33 - External mounting, DIG medium-voltage alternators with $U_N > 11.5 \text{ kV}$

8.5 De-excitation circuit on the "COSIMAT N+"

If a de-excitation circuit is fitted, the bridges on the double terminals UH1/UH1' and WH1/WH1' should be removed. Switch contacts should be connected to the double terminals to de-excite the alternator when they open (see Figure 34 – De-excitation circuit). These de-excitation contacts must meet the following specification:

Current carrying capacity: 10 AAC
Voltage carrying capacity: 160 V AC

The switch elements used must have dust-protected contact chambers. Ensure that contact resistance is low – the contacts must be sensitive to low-level signals.

Note:

One of the factors which determines the build-up of excitation is the quality of these contacts.

On AvK alternators (DSG 86 – 125, DIG), connecting terminals for de-excitation are provided in the auxiliary terminal box (see legend of the order-specific circuit diagram).

8.6 Monitoring field current and voltage on the "COSIMAT N+"

The "COSIMAT N+" is provided with double terminals I1/I1' and K1/K1' to allow the exciter field to be connected. Bridge I1/I1' must be removed to allow the field current and voltage to be monitored (see Figure 35 – Field current/field voltage monitoring).

The measuring range for field voltage monitoring is 150 VDC; for field current monitoring it is 10 ADC. Rotary coil or moving-iron instruments are recommended. Under certain conditions, digital instruments may give false readings.

Note:

In the case of AvK alternators (DSG 86 – 125, DIG), there are connecting terminals for monitoring the field current and voltage on terminal strip X2.

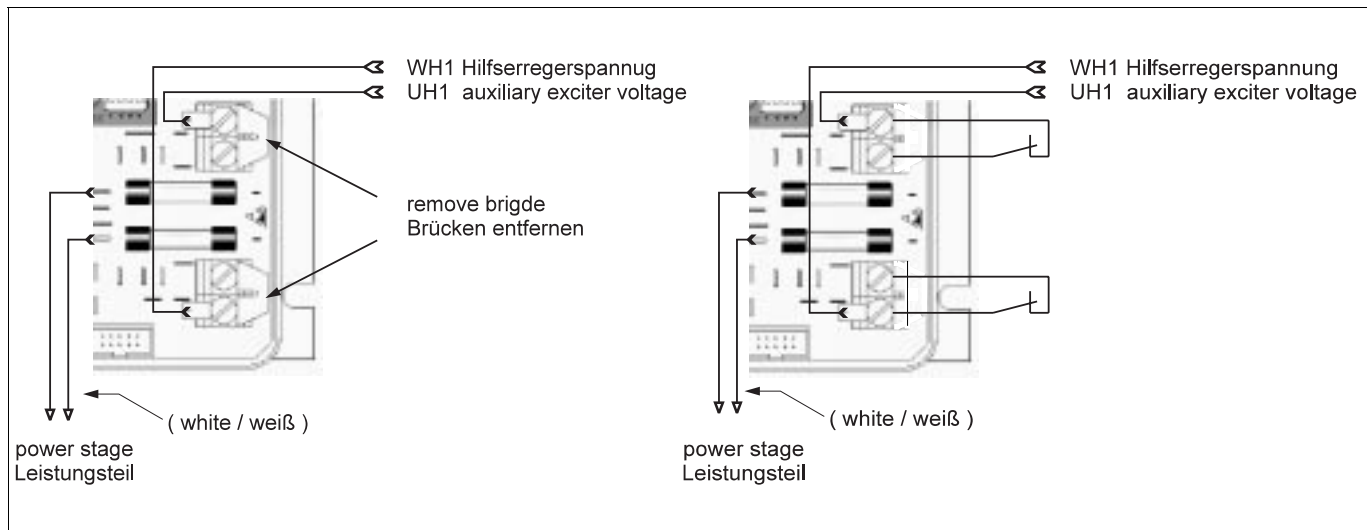


Figure 34 - De-excitation circuit

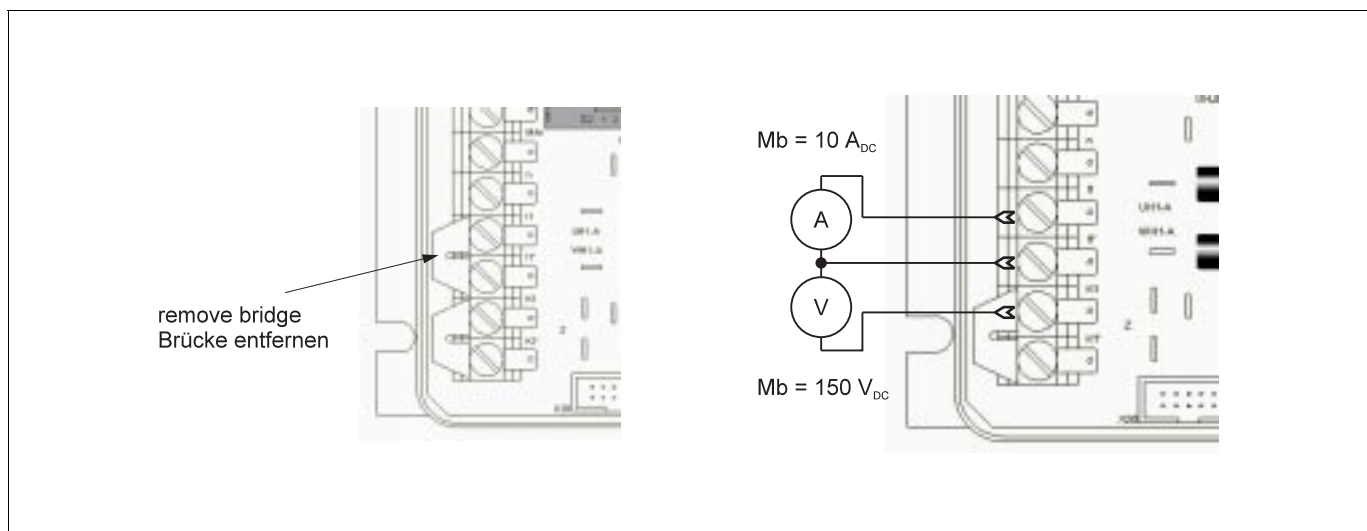


Figure 35 - Field current/field voltage monitoring

9. Connections, adjusting elements and displays

9.1 Connections

Voltage supply:

UH1
UH2 (VH1)
WH1
WH2

4.8 x 0.8 mm flat plugs and/or 2.5 mm²/4mm Ø screw terminals

Supply can be 2 x single-phase (80 V AC ± 20 %) or three-phase (75 V AC ± 20 % external conductor voltage).

2 x single-phase = UH1-UH2, WH1-WH2
three-phase = UH1-VH1-WH1

For de-excitation circuits, the bridges on the double terminals must be removed (see 8.5 De-excitation circuit or order-specific circuit diagram).

Caution:

If there is an external power supply (e.g. from the mains), it must not be switched on until after the alternator has run up. It should be switched off before the machine has come to a halt (see 11.10 External power supply).

Measuring alternator voltage:

U-V-W 250 to 500 V AC
U-V-W 90 to 250 V AC

6.3 x 0.8 mm flat plugs

Caution:

A clockwise rotary field is required. If the alternator rotates anticlockwise, U and W should be interchanged (see 3.5 Droop).

The specified voltage ranges relate to the nominal external conductor voltage of the alternator. For higher voltages, appropriate measuring transducers with a design rating of 10 VA should be connected on the input side (see 3.3 Monitoring alternator voltage).

The applicable voltage range should be taken from the order-specific circuit diagram. For DIG alternators with $U_N > 1$ kV, the range 90 – 250 V AC is generally chosen. Consult AvK **before initial start-up** if required.

Monitoring droop current:

k – I

4.8 x 0.8 mm flat plugs and/or 2.5 mm²/4 mm Ø screw terminals

Caution:

Measuring input k – I is not a current input; standard transformers should be load-relieved accordingly.

The droop current transformer must be installed in the "V" phase of the alternator.

Internally load-relieved droop current transformers are used in AvK alternators.

At the nominal current of the alternator, a voltage of 3 to 7 V AC is required at the terminals k – I (see 3.5 Droop and 6. Technical Data).

Connecting leads to the transformer must be shielded if the regulator is installed externally. Connecting leads to the short-circuit droop switch (see 11.5 Droop switch) should be shielded in all cases. The shield should be earthed at one end on the "COSIMAT N+" (see 8. Diagrams of connections).

Exciter field:

I1 – K1

4.8 x 0.8 mm flat plugs and/or 2.5 mm²/4 mm Ø screw terminals as double terminal.

If the regulator is mounted externally, the I1/K1 field leads to the alternator must be run through a separately shielded cable (LSYCY or LIYCY).

The shield should be earthed at one end on the "COSIMAT N+" (see 8. Diagrams of connections).

External set-point potentiometer

s – t

4.8 x 0.8 mm flat plugs and/or 2.5 mm²/4 mm Ø screw terminals as double terminal.

The value of the set-point potentiometer determines the adjustment range:

250 Ω = about ± 5 %

500 Ω = about ± 10 %

The rated power of the potentiometer must be at least 1 W. A multiple-turn potentiometer must be used (see 3.4 Desired value).

If the regulator or the set-point potentiometer is mounted externally, the set-point lead must be provided with its own separate shield. The shield should be earthed at one end on the "COSIMAT N+". If the regulator is mounted externally and the set-point leads are longer than >10 m, a motor-actuated potentiometer should be used near to the "COSIMAT N+".

Control inputs:

N
M/m
n

4.8 x 0.8 mm flat plugs and/or 2.5 mm²/4 mm Ø screw terminals.

A number of additional modules from the "COSIMAT N+" equipment range can be connected to these control inputs (see 5.2 Additional modules).

Caution:

Only AvK additional modules must be used at the control inputs. 20 mA standard signals must not be used at these inputs.

The inputs have the following functions:

N	Access to the internal actual value circuit
M/m	Reference point for additional equipment
n	Access to the internal desired value circuit

Circuit earth:

-

The circuit earth is likewise used as reference potential for a number of "controlling" additional modules.

This potential is **not** connected when the "COSIMAT N+" is used for stand-alone operation.

Load earth:

Z

The load earth is used for connecting the internal intermediate circuit capacitors.

Additional external capacitors can be connected between the second Z connection tab (MINUS) and terminal I1 (PLUS).

This potential is **not** connected when the "COSIMAT N+" is used for standalone operation.

9.2 Adjusting elements

Underspeed protection

R3

25-gang trim potentiometer

Function:

Adjustment of the frequency-dependent lowering of alternator voltage (see 3.7.1 Underspeed protection).

Direction of action:

Left-hand stop = beginning of reduction at >50/60 Hz.
Right-hand stop = beginning of reduction only after about > 30 Hz.

In special cases, the underspeed protection can be deactivated by means of switch S2.2 (see 9.2 Adjusting elements).

This is necessary when regulating a DC voltage by way of additional module UDC or in some cases when using external UF modules.

Desired value:

R4

25-gang trim potentiometer

Function:

Adjusting the alternator voltage (see 4.3 Desired value, 10.2 Desired value adjustment range).

Direction of action:

Left-hand stop = minimum alternator voltage
Right-hand stop = maximum alternator voltage

Caution:

Before the "COSIMAT N+" is started up, R4 must be turned to the left-hand stop position (see 10. Starting up the "COSIMAT N+"). A regulator which is checked and delivered together with an alternator is already preset.

P component:

R1

1-gang trim potentiometer

Function:

Varying the proportional component of the control characteristic.

Direction of action:

Anticlockwise = small P component
Clockwise = large P component

The recommended adjustment range shown in Fig. 8 – P adjustment range must not be exceeded (see 10.3 Regulating parameters).

I component:**S1****Caution:**

Switch position "0" is not permitted.

16-stage code switch

Function:

Varying the I component in the regulating characteristic (see 10.3 Regulating parameters).

Direction of action:

Left (1 <- F) = small I component
Right (1 -> F) = large I component

Droop:**R7**

1-gang trim potentiometer

Function:

Adjustment of the droop effect.

Direction of action:

Left-hand stop = no droop effect (0 %) parallel operation not possible.
Right-hand stop = droop effect 6 %

If the direction of rotation is reversed, sensing voltage connections U and W must be interchanged.

Droop matching:**R6**

25-gang trim potentiometer

Function:

Matching the various alternator nominal currents and current transformer ratios to the droop monitoring system.

Direction of action:

Left-hand stop = maximum compensation value
Right-hand stop = minimum compensation value

At nominal alternator current, R6 should be used to carry out trimming to 2.5 V AC at the measuring points "MP-STATIK – DROOP". If the alternator load current is less than the nominal current, this may be trimmed to a proportional voltage value.

Code switch:**S2**

4-pole dip switch

Function:

Switch	FUNCTION	ON	OFF
S2.1	none	./.	./.
S2.2	Activation and deactivation of underspeed protection	Active	Not active
S2.3	Reduction of actual value smoothing	Nominal	Reduced
S2.4	Increasing the D-parameter	Increased	Nominal

Required basic setting:

AvK DSG alternators up to size 62:

S2.1 = no function
S2.2 = ON (underspeed protection)
S2.3 = ON (actual value smoothing)
S2.4 = OFF (D parameter)

AvK DIG, DSG 74 – 125 alternators

S2.1 = no function
S2.2 = ON (underspeed protection)
S2.3 = ON (actual value smoothing)
S2.4 = ON (D parameter)

9.3 Displays**Underspeed protection:****H1**

yellow 5 mm Ø LED

H 1 lights up when the desired value or lowering of alternator voltage in the case of underfrequency is active (3.7.1 Under-speed protection)

Caution:

The regulator is set during the testing of the alternator at the factory. See test protocol and order-specific circuit diagram.

10. Starting up the "COSIMAT N+"

10.1 Basic setting and visual check

Before start-up, the following basic settings of the "COSIMAT N+" voltage regulator must be checked:

R3	right-hand stop position
R4	left-hand stop position
R1	central position (in the case of DIG, DSG alternators, 1/4 rotation anticlockwise from the central position)
S1	Pos. 4 (in the case of DIG, DSG alternators Pos. 6, at 600/750 rpm Pos. 9)
S2	S2.1 = no function S2.2 = ON S2.3 = ON S2.4 = OFF (ON in the case of DIG and DSG alternators from size 74)
R7	Central position
R6	Left-hand stop

After basic setting, the following visual checks must be carried out:

- Have the sensing voltage connections (U, V, W 90...250 / 250...500) been correctly selected?
- Do the sensing voltage connections possess a clockwise-rotating field? (If rotation is anticlockwise, interchange U and W).
- Is the supply voltage correctly connected (2 x single-phase UH1/UH2 and WH1/WH2; three-phase UH1, VH1, WH1)?
- Is the excess current circuit breaker in the alternator switched on?
- Is the droop transformer installed in the V phase?
- Is the k – I phase position of the droop current transformer correctly connected? (In the case of external installation, check from the alternator to the regulator).

- Is the field connected with the correct polarity?

10.2 Desired value setting range

Once all the basic settings and visual checks have been carried out, the alternator can be started up.

- Run up alternator to nominal speed.
- Set external set-point potentiometer to the central position.
- Adjust nominal voltage using R4.
- The alternator voltage can be adjusted around its nominal value using the external set-point potentiometer.

10.3 Regulating parameters

- If the basic settings of R1 and S1 (see 10.1 Basic setting and visual check) lead to continuous periodic fluctuations (stability limit), adjust R1 slowly to the left.
- If there is temporarily a tendency towards weakly damped hunting in the event of load surges, adjust S1 one or two positions to the right.

10.4 Underspeed protection

- 50/60 Hz alternators to $0.95 \times f_N$.
- In the case of 50/60 Hz alternators, turn R3 slowly in the anticlockwise direction starting from the right-hand stop position until H1 lights up. Then turn it **slowly** in the clockwise direction until H1 goes out.
- Run the alternator up to nominal speed.

10.5 Droop adjustment

- Load the alternator with nominal current. Measure the AC voltage at the droop sensing points "MP-STATIK-DROOP". Adjust to 2.5 V AC using potentiometer R6.
- For partial loading, the calibration value can be reduced proportionately.
- If a stronger droop effect is required, R7 (percentage droop) should be turned clockwise starting from its central position.

Note:

Where a number of alternators are run in parallel, the droop device must be at the same setting in all the "COSIMAT N+" regulators and be active!

Recommended droop settings:

- 3 % Parallel to the mains (If the mains supply is not stable, the setting may have to be increased).
- 2 % Parallel operation with identical alternators.
- 6 % Parallel operation with different alternators whose regulators do not have a linear droop.
- 1 % Parallel operation with different alternators which also have "COSIMAT N" or "N+" regulators.

11. Important notes

11.1 Protection concept for external mounting of regulator

The following protective measures must be taken if the regulator is installed externally in the switching station:

The sensing line U-V-W is to be laid using short-circuit-proof cable (1.5 mm²) from the alternator terminal strip X2 to the switching station. AvK recommends the installation of a three-phase circuit breaker with a thermal tripping current of approximately 0.5 A. If this circuit breaker is tripped, the alternator must be de-excited and stopped immediately.

If the regulator is installed externally, the connecting leads for the external set-point potentiometer, the droop current transformer, the droop switch and the I1/K1 exciter line are to be provided with separate shielding. The shields must be earthed at one end on the "COSIMAT N+".

Protection concept:

The exciter system should be protected from excessive exciter currents and voltages by a field discharge switch or relay. This switch or relay should be connected as shown in the relevant order-specific circuit diagram. The tripping criteria will be determined by the protection required by the alternator.

Where the alternator is operated in stand-alone mode, an overvoltage protection system must be installed in the switching station. In the case of operation in parallel with the mains or other alternators, an overcurrent protection system is to be added.

DSG/DIG alternators with auxiliary windings:

DSG and DIG alternators with auxiliary windings are fitted with an excess-current circuit breaker F1. This protects the auxiliary windings from excessively high thermal loading e.g. as the result of an external short circuit involving the auxiliary exciter voltage UH1-UH2 or WH1-WH2.

11.2 Mounting the regulator

The "COSIMAT N+" must be mounted with its longitudinal axis vertical in case of convectional cooling to allow the air

to flow freely through its power stage. Note the installation position marking "UNTEN" (= BOTTOM) (connecting leads towards the power stage). At fan cooling, the longitudinal axis of the "COSIMAT N+" has to be in air flow direction. Deviating mounting is only suitable after checking by AvK.

There must be a **3 cm** clearance all the way round between the "COSIMAT N+" and any structural elements that might hinder flow (cable ducts, plates). This rule does not apply to laterally mounted additional modules.

11.3 Excitation build-up

At the nominal speed, the auxiliary excitation windings on DSG and DIG alternators must produce a remanent voltage of at least 10 V AC in order to ensure a satisfactory excitation build-up.

However, problems with excitation build-up may also be caused by dirty de-excitation contacts or a field connection of incorrect polarity.

In the case of alternators which have been stationary for a prolonged period, it may be necessary to introduce an external excitation voltage. To do this, a 4.5 V or 6 V battery is **briefly** connected by its positive terminal to I1 and by its negative terminal to K1 at nominal speed. In the case of two-phase auxiliary excitation machines, the battery should be connected to I2(POSITIVE)/K2(NEGATIVE).

11.4 Code switch S2

For standard applications of the "COSIMAT N+", the following basic settings must be made before start-up at code switch S2 (see 9.2 Adjusting elements):

AvK DSG alternators up to size 62

- S2.1 = no function
- S2.2 = ON (underspeed protection)
- S2.3 = ON (actual value smoothing)
- S2.4 = OFF (D parameter)

AvK DIG and DSG 74 - 125 alternators:

- S2.1 = no function
- S2.2 = ON (underspeed protection)
- S2.3 = ON (actual value smoothing)
- S2.4 = ON (D parameter)

Any differences from these settings must be agreed with the manufacturer beforehand and taken into account in the way the alternator is operated.

11.5 Droop switch

If alternators are to be used for both single and parallel operation, better voltage stability can be achieved in single

operation if the k – I inputs of the "COSIMAT N+" are short-circuited (see 8. Diagrams of connections).

The lead between the droop switch and the regulator must be screened.

The screen must be earthed at one end on the "COSIMAT N+".

Caution:

In parallel operation, the switch must be opened.

11.6 Changing the direction of rotation

To enable the droop sensing system to exercise the correct effect, the "COSIMAT N+" requires a clockwise-rotating field at its measuring voltage connections.

Caution:

If the direction of rotation is reversed, interchange sensing leads U and W.

Note:

The desired direction of rotation should be specified when ordering the alternator. This is important with regard to ventilation.

11.7 Synchronous motors

Synchronous motors operate in a similar way to synchronous alternators in parallel operation. The direction of the active power is rotated through 180° relative to the alternator (see Figure 36 – Operation of the synchronous machine).

Starting from cos phi = 1, this has the following implications for the reactive power:

- Given a rising exciter current (overexcitation), the synchronous machine becomes a source of reactive power.
- Given a falling exciter current (underexcitation), the synchronous machine becomes an acceptor of reactive power.

When used as a generator, the synchronous machine is taken as the reference point; where it is used as a motor, the mains are taken as the reference point.

When used as a generator, the synchronous machine supplies "inductive" reactive power to the mains when overexcited.

When used as a motor, the synchronous machine draws "inductive" reactive power from the mains when underexcited.

The droop system in the "COSIMAT N+" operates with the correct direction of action whether the machine is being operated as a motor or a generator. The direction in which

it is installed in the synchronous machine and the way the droop current transformer is connected to the "COSIMAT N+" remains the same (see 8. Diagrams of connections).

For motor control, a cos phi controller (COS module) is required additionally.

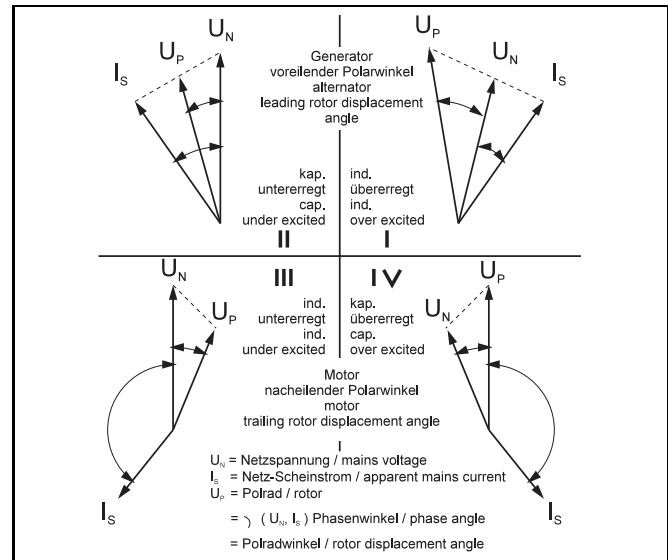


Figure 36 – Modes of operation of a synchronous machine

11.8 Protective fuses

When the protective fuses are tripped, they must be replaced with fuses of the same type.

Fuse type:

10 A super quick-acting IEC G 144.400

Caution:

The power stage may be permanently damaged if slow or medium time-lag fuses with a rating equal to or higher than 10 A are used!

Two spare fuses are mounted on the underside of the "COSIMAT N+" (see 7. Dimensions).

11.9 Drying out the alternator

If, because of inadequate insulation resistance, the alternator has to be dried out at nominal current by the short-circuit method, the "COSIMAT N+" should be disconnected from the supply and exciter field connections.

The alternator is dried out by applying an external source of excitation.

Further information on how to dry out the alternator can be found in the alternator instructions.

11.10 External power supply

If the auxiliary exciter voltage is taken from a different, "external" source (e.g. the mains), the supply must **not** be switched on until the alternator has started up. When shutting down the alternator, the supply must be switched off before the machine comes to a halt.

The switch-on and switch-off point of the supply should be set to $0.95 \times f_N$ using a frequency relay (BF1).

The double terminals at connections UH1 and WH1 can be used to switch the supply on and off (see 8.5 De-excitation circuit).

Caution:

When the alternator is stationary and an auxiliary exciter voltage is applied, the exciter current flowing is at its maximum! The protective circuit of the "COSIMAT N+" will trip the protection fuses on the front plate after about 8 seconds.

11.11 400 Hz alternator/converter

On 400 Hz alternators < 100 kVA (as single machines or converters), switch S2.3 must be set to the "OFF" position.

11.12 Checking the insulation voltage of the electric machine

Before checking the insulation voltage of the electric machine, the following connections of the "COSIMAT N+" must be disconnected:

Measuring voltage	U, V, W
Supply	UH1-UH2, WH1-WH2
Exciter field	I1-K1

The supply and measurement connections of additional regulator components must also be disconnected.

All disconnected or interrupted connections should be isolated in the appropriate manner.

11.13 Exchange/replacement; "COSIMAT N/N3" by "COSIMAT N+"

On AvK alternators of series DSG, DIDBN, DIDBH and DIG, sizes ...74-86-99-114-125, switch S2.4 on the "COSIMAT N+" should be switched to the "ON" position. Switches S2.2 and S2.3 should be switched to the "ON" position. Switch S2.1 should be set to the "OFF" position.

The sequence of terminals WH1 and WH1' has been reversed on the "COSIMAT N+". The connecting cable WH1

must be connected to the correspondingly named connecting terminal of the "COSIMAT N+".

11.14 Malfunctions, causes and remedies

Malfunction	Cause	Remedy
Alternator voltage is too low.	Input speed too low.	Check whether LED H1 on regulator lights up. If so, underspeed protection device has been activated, run up alternator to nominal speed.
	Measuring leads incorrectly connected.	Check measuring-lead connections U, V, W on the regulator. Check whether the nominal voltage of the alternator is within the voltage range indicated on the "COSIMAT N+".
Alternator voltage is too low and cannot be adjusted with the set-point potentiometer.	Set-point potentiometer or its connecting leads are disconnected/interrupted.	Check set-point potentiometer or its connecting leads. Rectify fault.
Alternator voltage is too high.	Broken measuring lead.	Rectify fault.
	Measuring leads incorrectly connected.	Check measuring lead connections U, V, W on the regulator. Check whether the nominal voltage of the alternator is within the voltage range indicated on the "COSIMAT N+".
Alternator voltage is too high and cannot be adjusted with the set-point potentiometer.	Set-point potentiometer or its connecting leads have a short circuit.	Check set-point potentiometer for short circuit. Change potentiometer. Check set-point leads for short circuits. Eliminate short circuit.
Severe voltage dip upon loading.	Input speed falls upon loading.	Check regulator of driving machine.
	Defective protection fuse.	Check protection fuse on the regulator and exchange if necessary.
	Rotating diodes defective.	Check rotating diodes V1 and surge voltage protector V3 and R11 and exchange if necessary.
Alternator does not respond to excitation.	Input speed too low. Less than $0,5 \times n_N$.	Check the speed regulator of the input machine. Check the power transmission to the alternator.
	Exciter protection switch has tripped.	Switch on the protective switch again. If it trips once more, search for the fault and repair it.

Malfunction

Alternator does not respond to excitation.

Cause

Remanence too low.

Remedy

Alternator with auxiliary winding:
Briefly connect positive terminal of 4.5 or 6 V battery to I1 and negative terminal to K1 (at nominal speed).
Alternator with two-phase auxiliary exciter machine:
Briefly connect positive terminal of 4.5 or 6 V battery to I2 and negative terminal to K2 (at nominal speed).

DSG, DIG alternators:
Interruption in the auxiliary exciter windings.

With alternator standing still!
Check windings UH1/UH2 and WH1/WH2 for interruptions using an ohmmeter. Eliminate faults.

DIG alternators ($U_N \leq 11,5\text{kV}$):
Interruption in the auxiliary exciter machine windings.

With alternator standing still!
Check windings WH1/WH2 and UH2/UH1/UH3 for interruptions using an ohmmeter. Eliminate faults.

DSG, DIG alternators:
Interruption in exciter windings I1/K1.

With alternator standing still!
Check windings I1/K1 for interruptions using an ohmmeter. Eliminate faults.

DIG alternators ($U_N > 11,5\text{kV}$):
Interruption in exciter windings I1/K1 and/or I2/K2.

With alternator standing still!
Check windings I1/K1 and I2/K2 for interruptions using an ohmmeter. Eliminate faults.

Fault in regulator.

Check protective fuses and exchange if necessary. Is the regulator receiving excitation release and are the bridges present at the double terminals I1/I1', K1/K1', UH1/UH1' and WH1/WH1'?
Check and eliminate fault.

Fault in the regulator connections.

Check all regulator connections, input and output leads. Eliminate faults.

Regulator defective.

Exchange regulator.

Rotating diodes defective.

Check rotating diodes V1 and voltage surge protector V3 and R11 and exchange if necessary.

Periodic fluctuations in the alternator voltage when operated singly (stability limit)!

Incorrect regulator setting.

Adjust R1 carefully in the anticlockwise direction and turn S1 one or two steps to the right.

Malfunction	Cause	Remedy
Alternator voltage fluctuates at irregular intervals.	Temporary interruption in one of the regulator supply leads.	Check connecting leads to the regulator. Check connections at the terminal board of the alternator. Tighten all contact screws and nuts.
	Mechanical regulator of the driving machine is sticking.	Check speed regulator of the driving machine. Eliminate fault.
Reactive power output too high in parallel operation.	Droop set too low.	Adjust R7 slightly in the clockwise direction on the "COSIMAT N+".
	Transformer connections k/l have been bridged by the droop switch.	Open bridge.
	Phase angle connection (k/l) of the droop current transformer has been wrongly positioned.	Check connecting leads from the alternator to the regulator. Interchange k/l if necessary. The white secondary connection of the droop current transformer is "k".
	Droop switch is not in alternator phase "V".	Install droop transformer in phase "V".
	Measuring voltage connections U, V, W wrongly positioned.	Check the sensing lead. "COSIMAT N+" requires a clockwise-rotating field. Interchange U and W if necessary (in the case of anticlockwise rotation).
Reactive power output too low in parallel operation.	Droop set too high.	Adjust R7 slightly in the anticlockwise direction on the "COSIMAT N+".
	Measuring voltage connections U, V, W wrongly positioned	Check the sensing lead. "COSIMAT N+" requires a clockwise-rotating field. Interchange U and W if necessary (in the case of anticlockwise rotation).
Active load not equally distributed.	This is affected by the driving machine only. The "COSIMAT N+" affects only the reactive power.	Check the drive motor and its regulator.

We reserve the right to make technical changes.

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