BA1 - Voltage balance relay

Application

Supervision of voltage unbalance in three-phase systems, phase failure, phase sequence and undervoltage.

Function

Relay *BA1* measures amplitude and angle of three phase voltages. The angle of the phasors determine the phase sequence. Unbalance and phase loss are detected by the measurement of amplitude and angle. The undervoltage trip setting is 70 % of Un fixed. ΔU characterizes the difference of the lowest to the highest phase-to-phase voltage related to nominal voltage. The underfrequency element trips if the frequency falls below 45 Hz.

Technical data

rated voltage Un:	110 V, 230 V, 400 V AC
frequency range:	45 - 66 Hz
hysteresis:	2% Un
power consumption:	3 VA (4 VA BA1-400)
thermal load carrying capacity:	continuously 1,3 x Un
returning time:	600 ms
minimum operating time:	650 ms

Output relays:

max. breaking capacity	
ohmic:	250 V AC/120 W DC
inductive:	500 V AC/75 W DC
rated current:	5 A
making current (16ms):	20 A

System data:

regulations:	VDE 0435 Teil 303
temperature range at storage and operation:	- 25°C bis + 70°C

Mechanical stress:

shock:	class 1 acc. to DIN IEC 255-21-2
vibration:	class 1 acc. to DIN IEC 255-21-1

degree of protection:	IP 40 at closed front cover
weight:	approx. 0,5 kg
mounting position:	any

CE

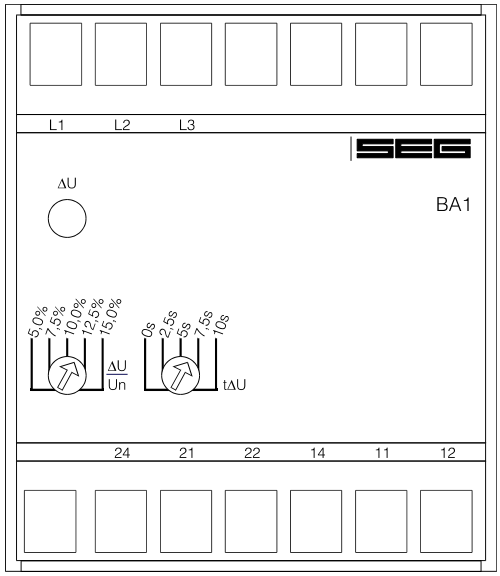


Fig. 1: Front plate

The unit *BA1* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022 same as all units of the *BASIC LINE*.
The front plate of the unit is protected with a sealable transparent cover (IP40).
Please remove the transparent cover with a screw driver to adjust the relay.

LED

LED ΔU is used to indicate operation without fault with steady light. This LED indicates pickup of the relay by flashing. At tripping or underfrequency the LED ΔU extinguishes.

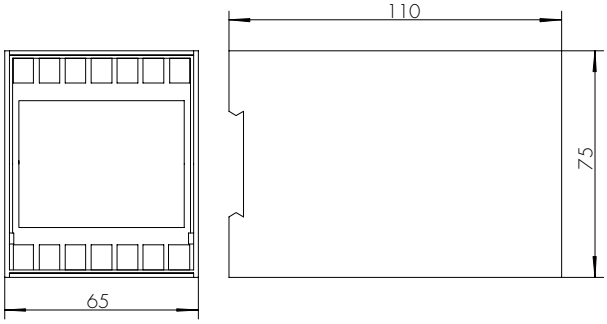


Fig. 2: Dimensional drawing of BA1

Auxiliary voltage supply

The unit *BA1* needs no separate auxiliary voltage supply. The supply voltage can be formed directly from the measuring quantity.

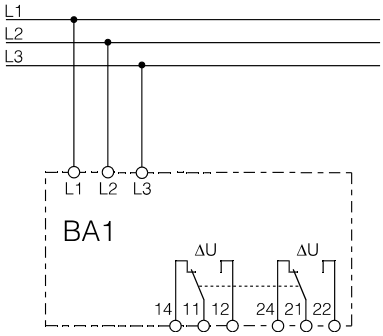
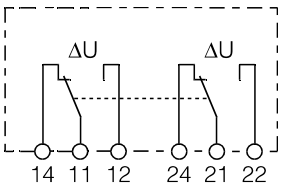
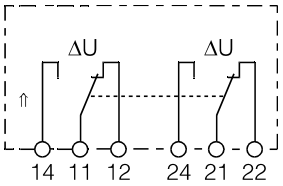


Fig. 3: Connection diagram



Unit dead, wrong phase sequence, underfrequency or tripped



Operation without a fault

Fig. 4: Contact positions

Connection terminals

The connection up to a maximum of 2 x 2,5 mm² cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Setting ranges

ΔU:	5 - 15 % Un
tΔU:	0 - 10 s

Order key:

quantity			
☐	***BA1***	-	☐
	110 V AC		110
	230 V AC		230
	400 V AC		400

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BF1 - Frequency relay

Application
Under- and overfrequency supervision of single or three-phase systems.

Function
The unit *BF1* is equipped with an independent over- (f>) and underfrequency supervision (f<) with seperate adjustable pickup values and trip delays. The measured frequency is continuously compared with the set reference values.
For frequency supervision the cycle duration is evaluated and so measuring is virtually independent on harmonics. To avoid tripping during normal operation due to interference voltages, a fixed measuring repetition is used.

Technical data
rated voltage Un:	110 V, 230 V, 400 V AC
frequency range at	
50 Hz rated frequency:	46 - 54 Hz
60 Hz rated frequency:	55,2 - 64,8 Hz
hysteresis:	0,5% of nominal frequency
power consumption:	3,7 VA
thermal load carrying capacity:	continuously 1,3 x Un
returning time:	250 ms
minimum operating time:	250 ms

Output relays:
max. breaking capacity	
ohmic:	250 V AC/120 W DC
inductive:	500 V AC/75 W DC
rated current:	5 A
making current:	20 A

System data:
regulations:	VDE 0435 part 303
temperature range at	
storage and operation:	- 25°C bis + 70°C

Mechanical stress:
shock:	class 1 acc. to DIN IEC 255-21-2
vibration:	class 1 acc. to DIN IEC 255-21-1

degree of protection:	IP 40 at closed front cover
weight:	approx. 0,5 kg
mounting position:	any

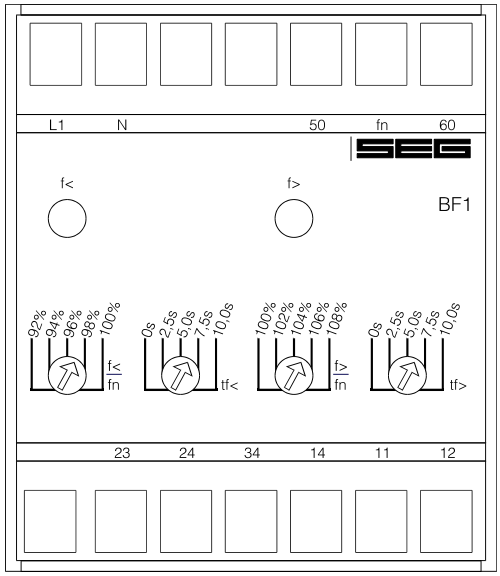

Fig. 1: Front plate

The unit *BF1* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022 same as all units of the *BASIC LINE*.
The front plate of the unit is protected with a sealable transparent cover (IP40).
Please remove the transparent cover with a screw driver to adjust the relay.

LEDs
LED f< is used to indicate operation without fault with steady light. LEDs f> and f< indicate pickup of the relay by flashing. At underfrequency tripping LED f< extinguishes. LED f> indicates tripping at overfrequency (steady light).

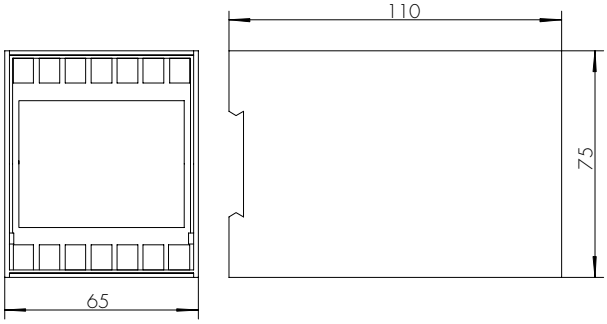

*Fig. 2: Dimensional drawing of **BF1***

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Auxiliary voltage supply

The unit ***BF1*** needs no separate auxiliary voltage supply. The supply voltage can be formed directly from the measuring quantity.

3 wire system 100 or 110 V

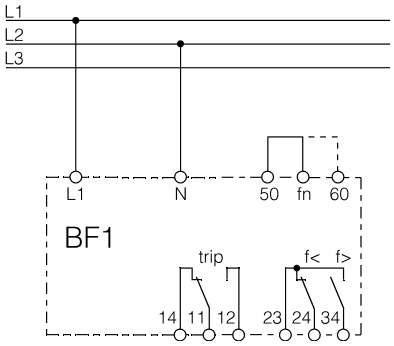

Fig. 3: Connection diagram BF1-110

4 wire system 400/230 V

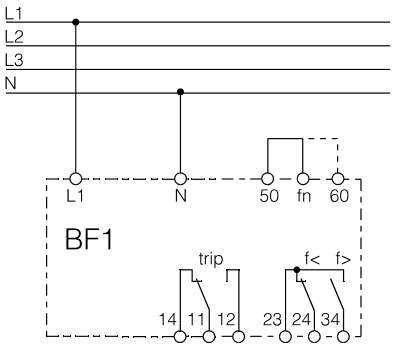

Fig. 4: Connection diagram BF1-230

3 wire system 400 V

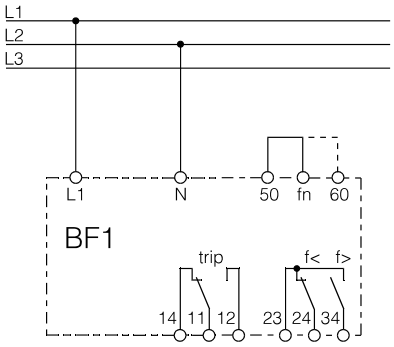

Fig. 5: Connection diagram BF1-400

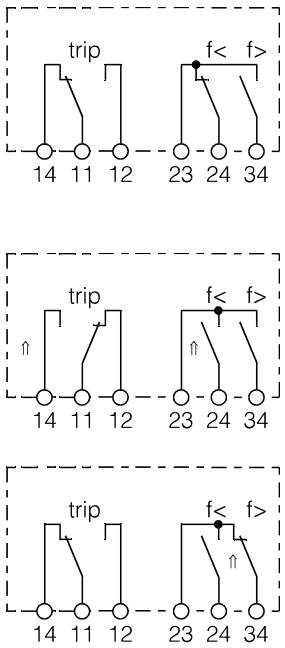

Fig. 6: Contact positions

Connection terminals

The connection up to a maximum of 2 x 2,5 mm² cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Setting ranges

f<:	92 - 100 %·fn
tf<:	0 - 10 s
f>:	100 - 108 %·fn
tf>:	0 - 10 s

Order key

quantity	***BF1***	-	
	110 V AC		110
	230 V AC		230
	400 V AC		400

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BI1 - Time overcurrent relay

Application

- selective over- and undercurrent protection relay for electr. machines, lines and networks
- load dependent connection and disconnection of consumers and electric power generators in load shedding schemes

Function

The unit *BI1* is equipped with an independent over- (I>) and undercurrent supervision (I<) with separate adjustable pickup values and trip delays. The measured current is continuously compared with the set reference values.
If the current exceeds or drops below the set value the relay trips after the time delay has elapsed.
Undercurrent supervision can be deactivated by turning potentiometer I</In to 0 %.

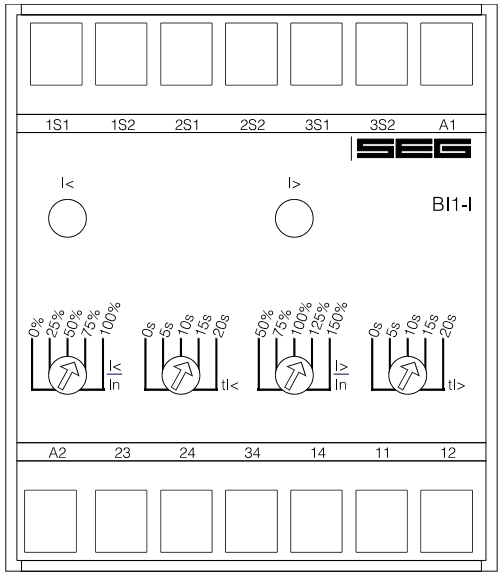


Fig. 1: Front plate

Technical data

rated voltage Un:	24 V DC or 230 V AC ±20%
power consumption:	3,3 W
dropout to pickup ratio:	>97 %
Thermal load carrying capacity:	continnuously 4 x In
returning time:	400 ms
minimum operating time:	400 ms
Rated frequency:	50/60 Hz

Output relays:

max. breaking capacity	
ohmic:	250 V AC/120 W DC
inductive:	500 V AC/75 W DC
rated current:	5 A
making current:	20 A

System data:

regulations:	VDE 0435 part 303
temperature range at storage and operation:	- 25°C bis + 70°C

Mechanical stress:

shock:	class 1 acc. to DIN IEC 255-21-2
vibration:	class 1 acc. to DIN IEC 255-21-1

degree of protection:	IP 40 at closed front cover
weight:	approx. 0,5 kg
mounting position:	any

CE

The unit *BI1* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022 same as all units of the *BASIC LINE*.
The front plate of the unit is protected with a sealable transparent cover (IP40).
Please remove the transparent cover with a screw driver to adjust the relay.

LEDs

LED I< is used to indicate operation without fault with steady light. LEDs I> and I< indicate pickup of the relay by flashing. At undercurrent tripping LED I< extinguishes. LED I> indicates tripping at overcurrent (steady light).

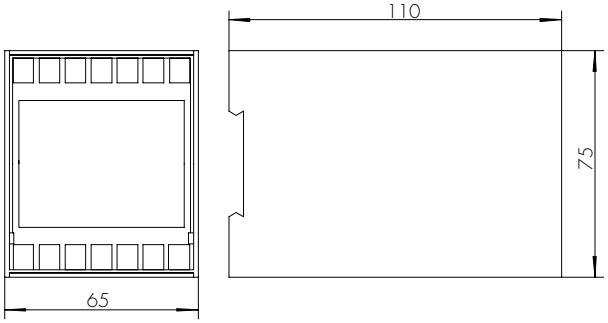


Fig. 2: Dimensional drawing of BI1

Auxiliary voltage supply

The unit ***BI1*** needs a separate auxiliary voltage supply. The auxiliary voltage should be 24 V DC or 230 V AC (refer to order key !).
Hint !
The correct polarity of connection terminals has to be observed:
A1 = L+
A2 = L-

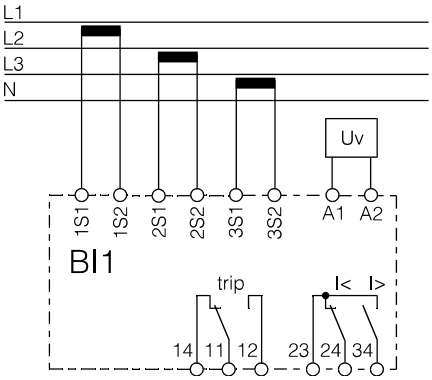
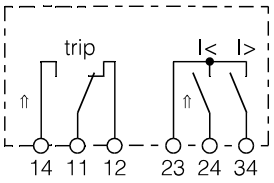
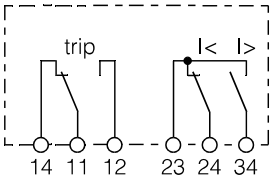


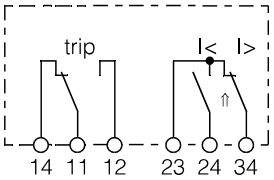
Fig.3: Connection diagram



Operation without a fault



Unit dead or undercurrent



Overcurrent

Fig. 4: Contact positions

Connection terminals

The connection up to a maximum of 2 x 2,5 mm² cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Setting ranges

I<:	0 - 100 %·In
tI<:	0 - 20 s
I>:	50 - 150 %·In
tI>:	0 - 20 s

Order key

Time overcurrent relay	***BI1-***		
auxiliary voltage	24 V DC	**24**	
	230 V AC	**230**	
rated current	1 A		**1**
	5 A		**5**

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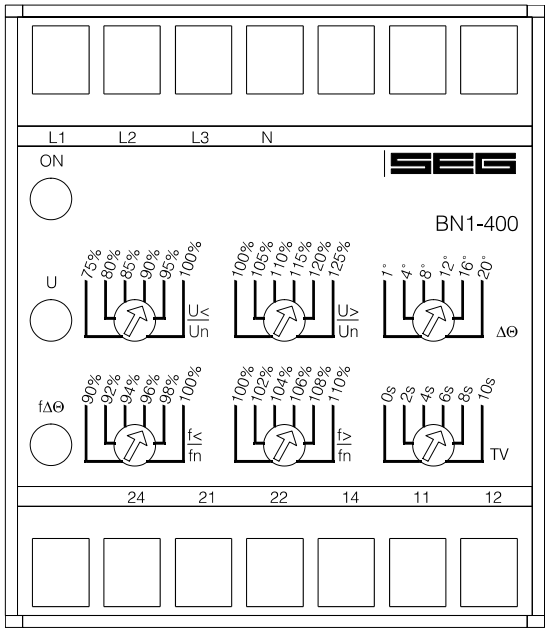
SEG

BN1-400 - Mains decoupling relay



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Contents

1 Applications and features

Unit *BN1-400* of the *BASIC LINE* is an universal mains decoupling device to monitor the phase-to-neutral voltages and contains the protective functions required of VDEW and most other utilities for the mains parallel operation of power stations:

- over- and undervoltage protection
- over- and underfrequency protection
- fast decoupling of the generator in case of mains failure
- Phase sequence supervision

When compared to conventional devices an exceptional price/performance ratio is achieved by integration of the three protective functions in one device.

When compared to the conventional protection equipment all relays of the *BASIC LINE* reflect the superiority of digital protection techniques with the following features:

- High measuring accuracy by digital data processing
- Fault indication via LEDs
- Very fine graded wide setting ranges
- RMS measurement
- Extremely short respone time
- Compact design by SMD-technology

2 Design

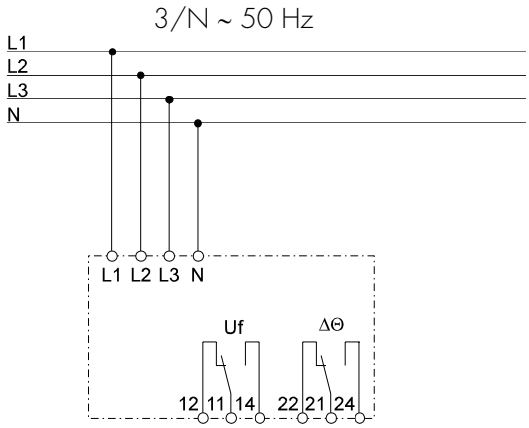


Figure 2.1: Connection four-wire system

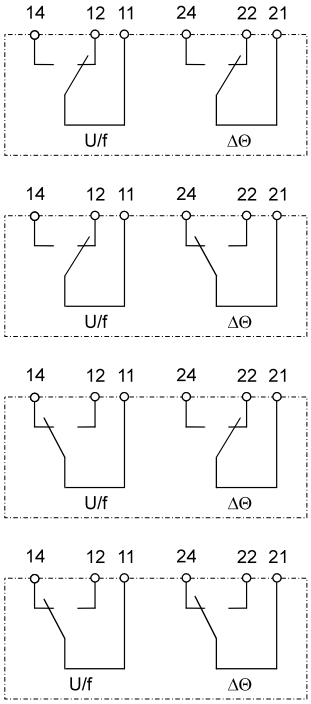
Analog inputs

The analog input signals of the voltages are connected to the protection device via terminals L1 - L3 and N.

Supply

Unit *BN1-400* will be supplied directly from the measuring quantity itself (L1 and L3).
The supply range is ±25% of U_N = 400 V (phase-to-phase voltage).

Contact positions



unit dead

phase sequence fault or under-/overvoltage in at least one phase or f>/f<; **ΔΘ** without fault

vector surge tripping; U>/U</f>/f</ phase sequence supervision without fault

operation without fault

Figure 2.2: Contact positions of the output relays

3 Function

3.1 Voltage supervision

The *BN1-400* has an independent under- and overvoltage supervision of the phase-to-neutral voltage. During 3-phase measuring the voltage is permanently compared with the set reference values.
For overvoltage supervision always the highest value is evaluated, for undervoltage supervision always the lowest value.
Tripping at undervoltage is indicated by flashing LED U, whereas at overvoltage LED U is steady lit.

3.2 Frequency supervision

For frequency supervision the cycle time is evaluated and so measuring is virtually independent on harmonic influences. To avoid tripping during normal operation due to voltages transients and phase transients - a fixed measuring repetition is used.
Supervision of the frequency is 3-phase. Each of the phases is individually monitored. Pickup or tripping only after the set reference value in at least one phase is exceeded or not reached.
Tripping at underfrequency f< is indicated by flashing of the LED f$\Delta\Theta$. At overfrequency LED f$\Delta\Theta$ lights up permanently.

3.3 The vector surge supervision

The vector surge supervision protects synchronous generators in mains parallel operation due to very fast decoupling in case of mains failure. Very dangerous are mains auto reclosing for synchronous generators. The mains voltage returning after 300 ms can hit the generator in asynchronous mode. The same very fast decoupling is also necessary in case of transients mains failures. Generally there are two different applications:

a) Only mains parallel operation no single operation. In this application the vector surge supervision protects the generator by tripping the generator circuit breaker in case of mains failure.

b) Mains parallel operation and single operation. For this application the vector surge supervision trips the mains circuit breaker. Here it is insured that the gen.-set is not blocked when it is required as the emergency set.

A very fast decoupling in case of mains failures for synchronous generators is known as very difficult. Voltage supervision units can not be used because the synchronous alternator as well as the consumer impedance support the decreasing voltage.
The voltage reaches the threshold of voltage supervision unit because of this reason after a couple of 100 msec., and therefore a safe detection of auto reclosing in the mains is not possible with single-voltage supervision units.

Also frequency relays can not be used, because even a fully overloaded generator decreases the speed after 100 msec. Current protection relays detects the fault, by existing short circuit currents. Power sensing relays can also detects but can not avoid the decreasing change of power to short circuit power. A problem is also the failure tripping of this kind of devices when to suddenly loading the generator. Without any mentioned limitation, the *BN1-400* described detect mains failures within 70 ms, because it was specially designed for such kind of applications, where the kind of fault requires a very fast decoupling from the mains.

The total tripping time lies still under 170 ms even, when the circuit breaker time and the relay time is added. Requirement for a tripping of the generator mains monitor is a change of power of more than 15-20 % nominal power. Slow changes of the system frequency for example controlling of the governor does not trip the relay.

Short circuits in the mains can also trip the relay, because a vector surge higher than the pre-set threshold can be detected. The value of the vector surge is dependent on the short circuit distance to the generator. This function offers the advantage for the utility that the mains short circuit capacity and therefore the energy feeding the short circuit is limited.

Measuring principle of vector surge

When a synchronous alternator is loaded, the rotor displacement angle is build between the terminal voltage (mains voltage U1) and the synchronous electromotive force (Up). Therefore a voltage is difference ΔU is built between Up and U1 (Figure 3.1).

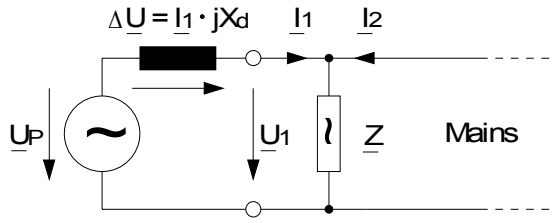


Figure 3.1: Equivalent curcuit at synchronous generator in parallel with the mains

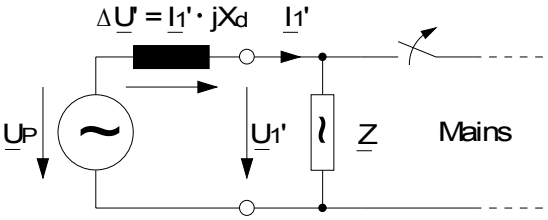


Figure 3.3: Equivalent curcuit at mains failure

In case of mains failure or auto reclosing the generator suddenly feeds a very high consumer load. The rotor displacement angle is decreased repeatedly and the voltage vector U1 change its direction U1' (Figure 3.3 and Figure 3.4).

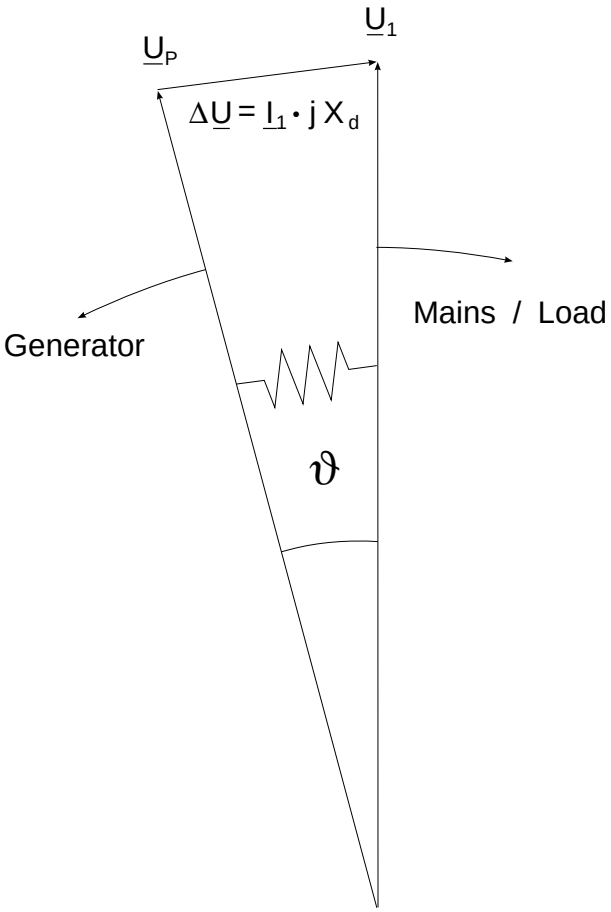


Figure 3.2: Voltage vectors at mains parallel operation

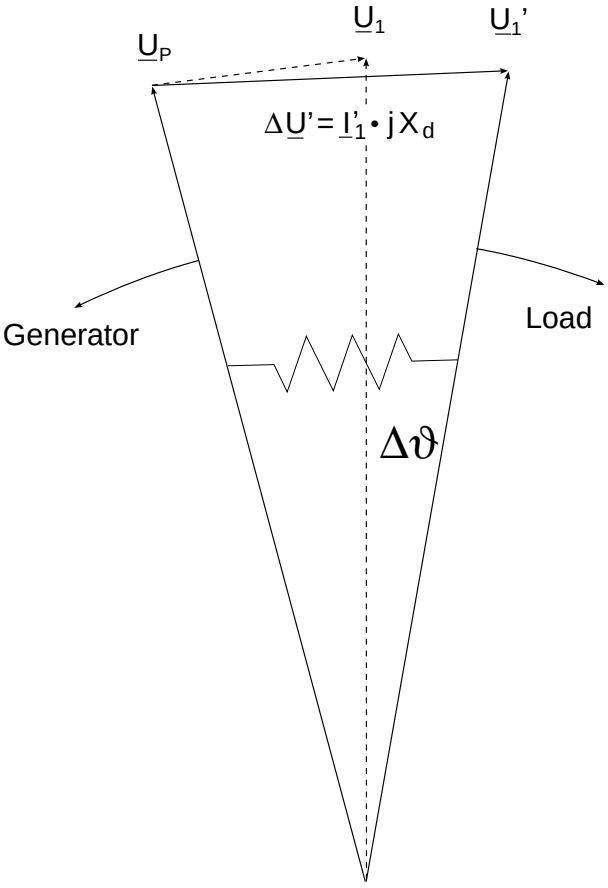


Figure 3.4: Voltage vectors at mains failure

The rotor displacement angle ϑ between stator and rotor is depending of the mechanical moving torque of the generator shaft. The mechanical shaft power is balanced with the electrical feeded mains power, and therefore the synchronous speed keeps constant (Figure 3.2).

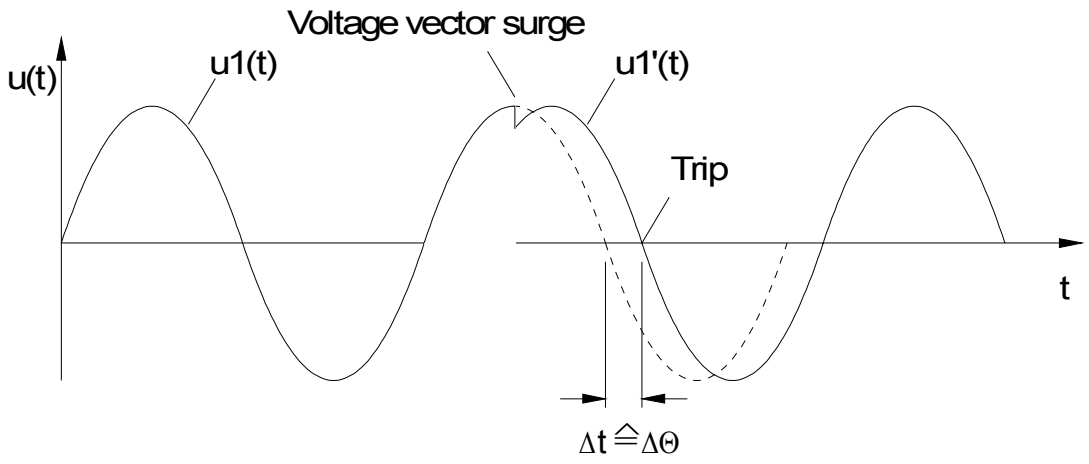


Figure 3.5: Voltage vector shift

As shown in the time diagram the voltage jumps to an other value and the phase position change. This procedure is named phase or vector surge.

The *BN1-400* measures the cycle duration. A new measuring is started at each voltage zero passage. The measured cycle duration is internally compared with a quartz stable reference time and from this the deviation of the cycle duration of the voltage signal is ascertained. In case of a vector surge as shown in fig. 3.5, the zero passage occurs either earlier or later. The established deviation of the cycle duration is in compliance with the vector surge angle.
If the vector surge angle exceeds the set value, the relay trips immediately. $\Delta\Theta$ can be set in the range from 1° - 20°.

Tripping logic for vector surge measurement:

The vector surge function of the *BN1-400* supervises vector surges in all three phases at the same time.

Application hint

Although the vector surge relay guarantees very fast and reliable detection of mains failures under nearly all operational conditions of mains parallel running alternators, the following borderline cases have to be considered accordingly:

a) None or only insignificant change of power flow at the utility connection point during mains failures.
This can occure during peak lopping operation or in CHP stations (Combined Heat and Power) where the power flow between power station and the public grid may be very low. For detection of a vector surge at parallel running alternators, the load change must be at least 15 - 20 % of the rated power. If the active load at the utility connection point is regulated to a minimal value and a high resistance mains failure occurs, then there are no vector surge or power and frequency changes and the mains failure is not detected.

This can only happen if the public grid is disconnected near the power station and so the alternators are not additionally loaded by any consumers. At distant mains failures the synchronous alternators are abruptly loaded by remaining consumers which leads directly to a vector surge and so mains failure detection is guaranteed.

If such a situation occurs the following has to be taken into account:

In case of an undetected mains failure, i.e. with the mains coupling C.B. in operation, the vector surge relay reacts upon the first load change causing a vector surge and isolates the mains C.B.

For detecting high resistance mains failures a zero sequence relay with an adjustable time delay can be used. A time delay is needed to allow regulating actions where the current may reach "zero" at the utility connection point. At high resistance mains failures, the mains coupling C.B. is tripped by the zero sequence relay after the time delay.
To prevent asynchronous switching on, an automatic restart by the public grid should be not possible during this time delay.

As a further measure the load regulation at the utility connection point should be such that an active energy of 5 % of the alternator rated power is always flowing.

b) Short circuit type loading of the alternators at distant mains failures

At any distant mains failure, the remaining consumers cause sudden short circuit type loading of the power station alternators. The vector surge relay detects the mains failure in about 70 ms and switches off the mains coupling C.B. The total switch off time is about 150 - 170 ms. If the alternators are provided with an extremely fast short circuit protection e.g. able to detect di/dt, the alternators might be switched off unselectively by the alternator C.B., which is not desireable because the power supply for the station is endangered and later on synchronized changeover to the mains is only possible after manual reset of the overcurrent protection.

To avoid such a situation, the alternator C.B.s must have a delayed short circuit protection. The delay time must be long enough so that mains disconnection by the vector surge relay is guaranteed.

4 Operation and settings

All operating elements needed for setting parameters are located on the front plate of unit *BN1-400* as well as all display elements.
Because of this all adjustments of the unit can be made or changed without disconnecting the unit from the DIN-rail.

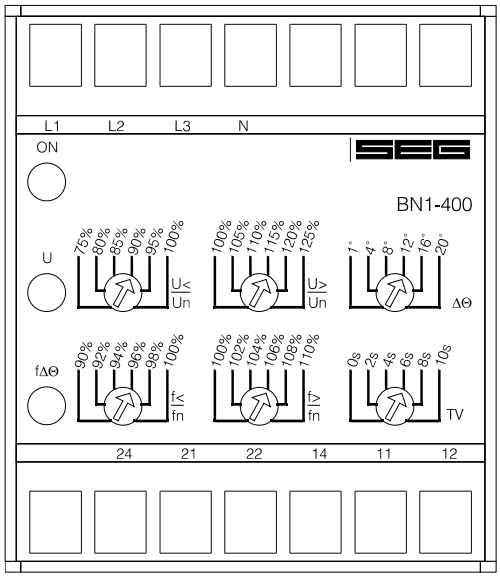


Figure 4.1: Front plate

For adjustment of the unit the transparent cover has to be opened as illustrated. Do not use force! The transparent cover has two inserts for labels.

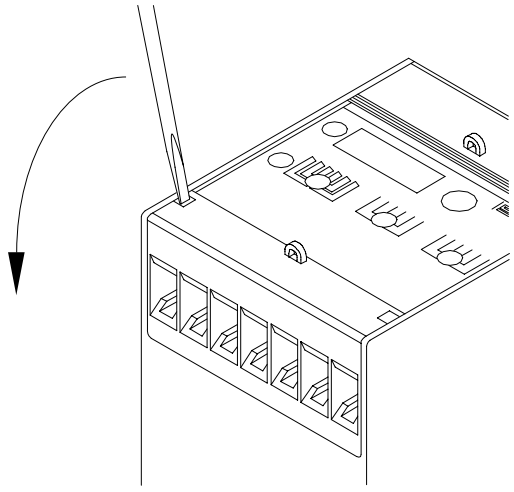


Figure 4.2: How to open the tranparent cover

LEDs

LED "ON" is used for display of the readiness for operation and besides this it flashes when the phase sequence is wrong (see cap. 4.1). LED U indicates undervoltage by flashing, at overvoltage the LED is lit steady. Flashing of the LED f$\Delta\Theta$ indicates tripping because of underfrequency, at overfrequency the LED is steady lit. A short flash of the LED f$\Delta\Theta$ indicates vector surge tripping.

Internal self supervision (watchdog)

To increase the operating safety a software watchdog is installed which checks over the internal hard- and software.

4.1 Setting of protection functions

Rated voltage

The rated voltage (phase-to-phase voltage) is 400 V AC. The voltage supervision takes place in the phase-to-neutral voltages (internal star point).

Phase sequence supervision

Flashing LED "ON" indicates wrong phase sequence and the U/f relays will be tripped, steady lit LED "ON" indicates correct phase sequence.

Undervoltage supervision U<

The tripping value at undervoltage is continuously adjustable in the range from 75 - 100 % Un (hysteresis 3 %) with the aid of potentiometer U</Un.

Overvoltage supervision U>

The tripping value at overvoltage is adjustable in the range from 100 - 125 % Un (hysteresis 3 %) with the aid of potentio-meter U>/Un.

Underfrequency supervision f<

The tripping value at underfrequency is adjustable in the range from 90 - 100 % fn (hysteresis 0,25 % fn) with the aid of potentiometer f</fn.

Overfrequency supervision f>

The tripping value at overfrequency is adjustable in the range from 100 - 110 % with the aid of potentiometer f>/fn (hysteresis 0,25 % fn).

Vector surge tripping $\Delta\Theta$

The pickup value for vector surge tripping is continuously adjustable in the range from 1 to 20°.

Blocking time

To prevent wrong trippings caused by oscillations after the synchronizing procedure, vector surge tripping is blocked after applying the measuring voltage for time tv.
The time delay tv can be set in the range from 0 to 10 s (t_{Umin} = 0.1 s).

Note !
If the measuring voltage drops below 70 % Un the blocking time will be reset. If the measuring voltage exceeds 70 % Un the blocking time will be started again.
Phase loss of L1/L3 or decreasing the supply range will be result in dead condition (L1-L3 measuring voltage = supply voltage).
Phase loss L2 or decreasing below 70 % Un results in blocking of the frequency protection and vector surge tripping.

5 Relay case and technical data

5.1 Relay case

Unit *BN1-400* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022, same as all units of the *PROFESSIONAL LINE*.

The front plate of the unit is protected with a sealable transparent cover (IP40).

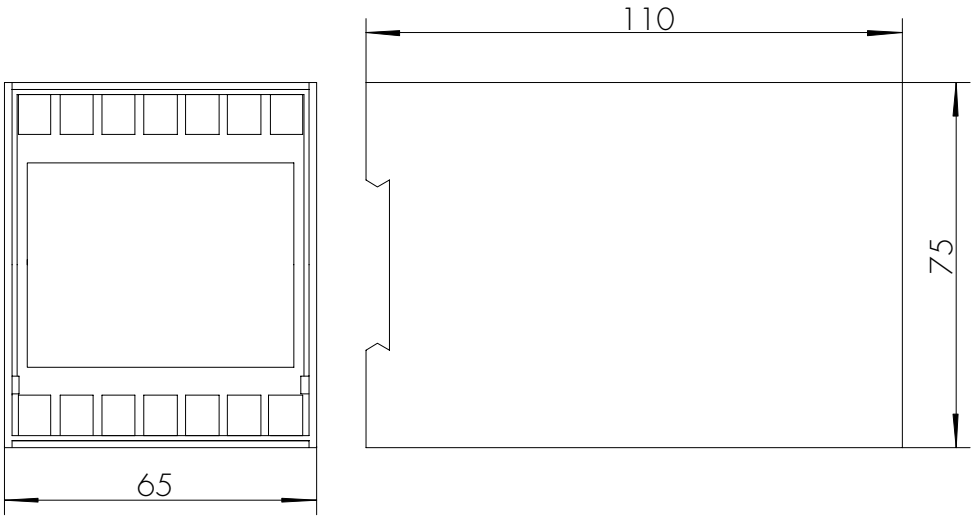


Figure 5.1: Dimensional drawings

Connection terminals

The connection of up to a maximum of 2 x 2.5 mm^2 cross-section conductors is possible. For this the transparent cover of the unit has to be removed (see para. 4).

5.2 Technical data

Measuring input circuits

Rated voltage Un:	400 V/AC (phase-to-phase voltage)
Rated frequency fn:	50 Hz
Rated frequency range:	45 - 55 Hz
Power consumption in voltage circuit:	for L2 1 VA/per phase at Un for L1/L3 3 VA at (measuring and supply)
Thermal capacity of the voltage circuit:	continuously 500 V/AC (phase-to-phase voltage) 288 V AC (phase-to neutral voltage

Common data

Dropout to pickup ratio:	depending on the adjusted hysteresis
Resetting time from pickup:	<50 ms
Returning time from trip:	500 ms
Minimum initializiation time after supply voltage has applied:	150 ms
Minimum response time when supply voltage is available:	50 ms for U and f / 70 ms for vector surge
Time lag error class index E:	± 20 ms

Output relay

Number of relays:	2
Contacts:	1 changeover contact for each trip relay
Maximum breaking capacity:	ohmic 1250 VA/AC resp. 120 W/DC inductive 500 VA/AC resp. 75 W/DC
Max. rated voltage:	250 V AC 220 V DC ohmic load Imax. = 0,2 A inductive load Imax. = 0,1 A at L/R ≤ 50 ms 24 V DC inductive load Imax. = 5 A
Minimum load:	1 W / 1 VA at Umin ≥ 10 V
Maximum rated current:	5 A
Making current (16 ms):	20 A
Contact life span:	10^5 hysteresis at max. breaking capacity
Contact material :	AgCd0

System data

Design standard:	VDE 0435 T303; IEC 0801part 1-4, VDE 0160; IEC 255-4; BS 142
Temperature range at storage and operation:	-25° C to +70° C
Constant climate class F acc. to DIN 40040 and DIN IEC 68, T.2-3:	more than 56 days at 40°C and 95% relative humidity
High voltage test acc. to VDE 0435, part 303	
Voltage test:	2.5 kV (eff.) / 50 Hz; 1 min
Surge voltage test:	5 kV; 1.2 /50 µs, 0.5 J
High frequency test:	2.5 kV / 1 MHz
Electrostatic discharge (ESD) acc. to IEC 0801, part 2:	8 kV
Radiated electromagnetic field acc. to IEC 0801, part 3:	10 V/m
Electrical fast transient (burst) acc. to IEC 0801, part 4:	4 kV/2.5 kHz, 15 ms
Radio interference suppression test acc. to DIN 57871 and VDE 0871:	limit value class A

Repeat accuracy: for U 0.5 %; for f 0.10 %; at vector surge 0.2°

Basic time delay accuracy: 0.5 % or ±25 ms

Accuracy of the specific rated values: for U: Un = 400 V 1 % (phase-to-neutral)
for f: 0.15 %
at vector surge: ± 0.4°

Temperature effect: 0.02 % per K for voltage measuring
0.002 % pro K for frequency measuring

Frequency effect: for voltage measuring: 45 - 55 Hz no tolerance
for vector surge: 0.2° for the whole frequency range

Mechanical test
Shock: class 1 acc. to DIN IEC 255-21-2
Vibration: class 1 acc. to DIN IEC 255-21-1

Degree of protection
Front panel: IP40 at closed front cover
Weight: approx. 0.9 kg
Mounting position: any
Relay case material: self-extinguishing

Parameter	Setting range	Graduation
U<	75 - 100 % Un	continuously variable
U>	100 - 125 %	continuously variable
f<	90 - 100 % fn	continuously variable
f>	100 - 110 % fn	continuously variable
ΔΘ	1 - 20° el.	continuously variable
Switching hysteresis for U> and U<	3 % fixed	
Switching hysteresis for f> und f<	0.25 % fixed	
tv	0 - 10 s	continuously variable

Table 5.1: Setting ranges and graduation

Technical data subject to change without notice!

Setting-list *BN1-400*

Project: _____ SEG job.-no.: _____

Function group: = _____ Location: + _____ Relay code: - _____

Relay functions: _____ Date: _____

Setting of parameters

Function		Unit	Default settings	Actual settings
U<	Undervoltage	% Un	75	
U>	Overvoltage	% Un	100	
f<	Underfrequency	% fn	90	
f>	Overfrequency	% fn	100	
t_v	Blocking time	s	0,1	
$\Delta\Theta$	Vector surge tripping	°	1	

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BU1-AC - AC-voltage relay

Application
Over- and undervoltage supervision of 1- and 3-phase systems.

Function
Unit *BU1-AC* is equipped with an independent over- (U>) and undervoltage supervision (U<) with separate adjustable pickup values and common trip delay (t) and hysteresis (DIFF). The voltages are compared with the set reference values.
For three-phase overvoltage supervision the highest voltage in each phase is evaluated, for undervoltage supervision the lowest in each phase.
Pickup of supervision circuit U> or U< is indicated by flashing of the corresponding LED.
At U< - tripping LED U< extinguishes, at U> - tripping. LED U> is steady lit.
At voltages < 60 % Un no trip delay takes place.

Technical data
rated voltage Un:	110 V, 230 V, 400 V AC
rated frequency range:	45 - 66 Hz
power consumption in voltage circuit:	3.5 VA
thermal load carrying capacity of the voltage circuit:	constant 1.3 x Un
dropout to pickup ratio:	dependent on the set hysteresis
dropout time:	300 ms
minimum operating delay:	300 ms

Output relay
maximum breaking capacity:	ohmic 250 V AC/120 W DC inductive 500 V AC/75 W DC
rated current:	5 A
making current:	20 A

System data
regulations:	VDE 0435, part 303
temperature range at storage and operation:	- 25°C to 70°C
mechanical stress	
shock:	class 1 acc. to DIN IEC 255-21-2
vibration:	class 1 acc. to DIN IEC 255-21-1
degree of protection unit front:	IP 40 at closed front cover
weight:	approx. 0.5 kg
mounting position:	any

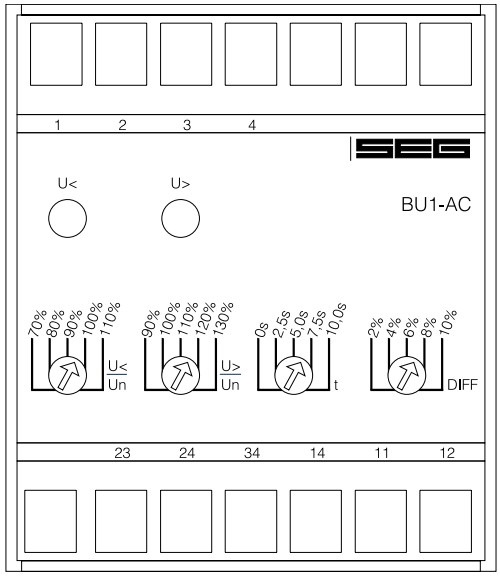

Fig. 1: Front plate

Unit *BU1-AC* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022 same as all units of the *BASIC LINE*.
The front panel of the unit is protected with a sealable transparent cover (IP40).
Please remove the transparent cover at the appropriate openings with a screw driver to adjust the relay.

LEDs
LED U< is used to indicate trouble free operation with steady light. LEDs U> and U< indicate pickup of the relay by flashing. At undervoltage tripping LED U< extinguishes. LED U> indicates tripping at overvoltage (steady light).

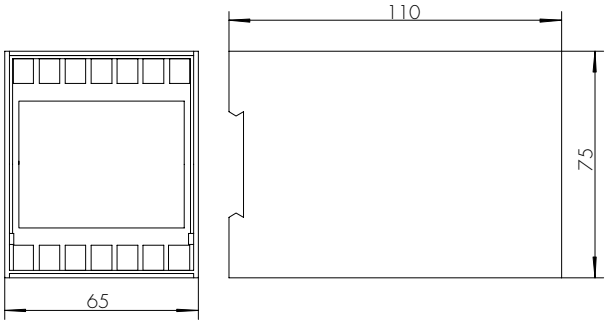

Fig. 2: Dimensional drawing BU1-AC

Auxiliary voltage supply

Unit *BU1-AC* needs no separate auxiliary voltage supply. The supply voltage can be formed directly from the measuring quantity.

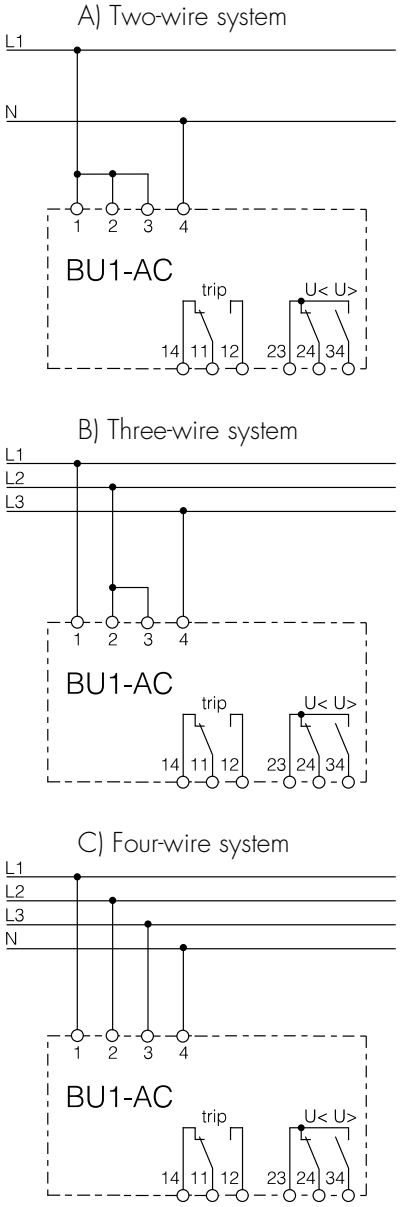

Fig. 3: Connection diagrams

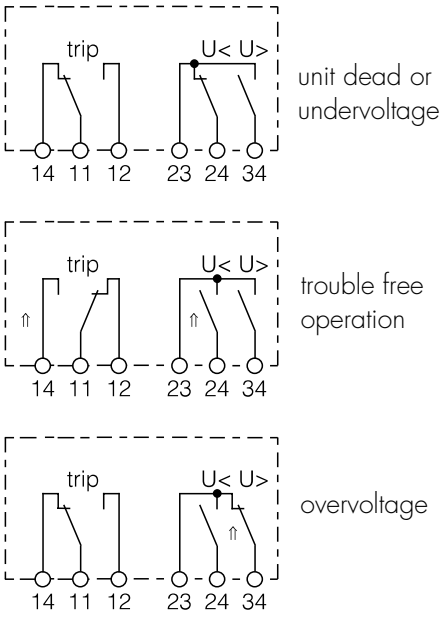

Fig. 4: Contact positions

Connecting terminals

The connection up to a maximum of 2 x 2.5 s mm^2 cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Setting ranges

U<:	0.7 - 1.1 · Un
U>:	0.9 - 1.3 · Un
t:	0 - 10 s
DIFF:	2 - 10 %
fn:	45 - 66 Hz

Order key

quantity

	BU1-AC-	
Rated voltage 110 V		**110**
Rated voltage 230 V		**230**
Rated voltage 400 V		**400**

The rated voltage of the unit is determined and defined by the voltage that was measured between terminals 1 and 4, 2 and 4, 3 and 4.

System	Relay type	Connection diagram
3-phase 110 V	BU1-110	B
3-phase 400 V	BU1-400	B
3-phase 400/230 V with N	BU1-230	C or A (A for single-phase measuring)
3-phase 690/400 V with N	BU1-400	A (only single-phase measuring possible)

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BU1-DC2 - DC Voltage Relay

Application
Supervision of DC voltages

Function
Unit *BU1-DC2* is equipped with an over- (U>) and undervoltage supervision (U<) with separate adjustable pick-up values and common trip delay (t) and hysteresis (DIFF).
The DC voltage measured is constantly compared with the set reference values. Any voltage signal, which exceeds the set reference value for overvoltage, or falls below the set reference value for undervoltage, will cause the respective relay to trip after elaps of the time delay.
Pick-up of the supervision circuit, either U> or U<, is displayed by the corresponding flashing LED.
At undervoltage tripping LED U< extinguishes.
At U>-tripping LED U> is steady lit.

Technical data

rated voltage Un:	12 V or 24 V
Power consumption:	3 W
dropout to pickup ratio:	dependent on the set hysteresis
dropout time:	300 ms
Minimum operating delay:	300 ms

Output relay

max. breaking capacity:	ohmic 250 V AC/120 V DC inductive 500 V AC/ 75 W DC
rated current:	5 A
making current:	20 A

System Data

regulations:	VDE 0435 part 303
temperature range at storage and operation:	-25°C to 70°C
mechanical stress:	
shock:	class 1 acc. to DIN IEC 255-21-2
vibration:	class 1 acc. to DIN IEC 255-21-1
degree of protection unit front:	IP 40 at closed front cover
weight:	approx. 0.3 kg
mounting position:	any

CE

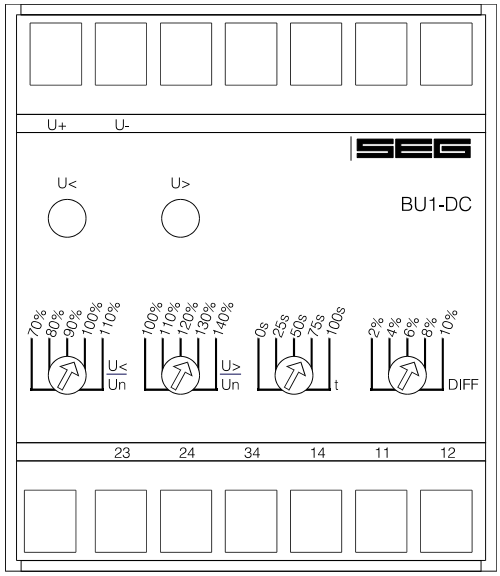

Fig. 1: Front plate

Unit *BU1-DC2* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022, same as all units of the BASIC LINE.
The front plate of the unit is protected with a sealable transparent cover (IP40).
Please remove the tranparent cover at the appropriate openings with a screw driver to adjust the relay.

LEDs
LED U< is used to indicate trouble free operation with steady light. LEDs U> and U< indicate pickup of the relay by flashing.
At undervoltage tripping LED U< extinguishes.
LED U> indicates tripping at overvoltage (steady light).

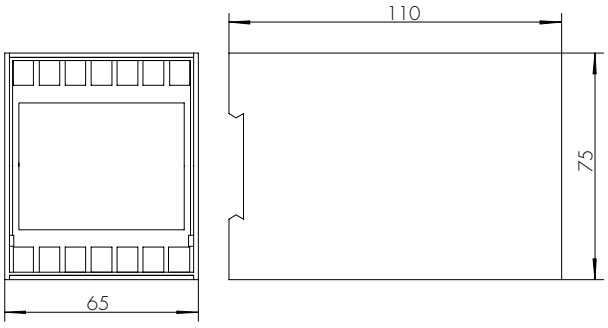

Fig. 2: Dimensional drawing BU1-DC2

Auxiliary voltage supply

Unit *BU1-DC2* needs no separate auxiliary voltage supply. The supply voltage can be formed directly from the measuring quantity.

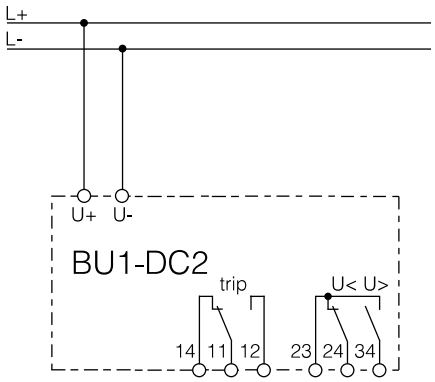

Fig. 3: Connection diagram

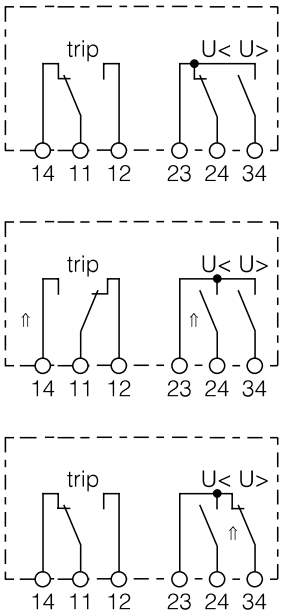

Fig. 4: Contact positions

Connecting terminals

The connection up to a maximum of 2 x 2.5 s mm^2 cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Setting ranges

U<:	0.7 - 1.1 · Un
U>:	1.0 - 1.4 · Un
t:	0 - 100 s
DIFF:	2 - 10 %

Order key

quantity

	BU1-DC2-	
Rated voltage 12 V		**12**
Rated voltage 24 V		**24**

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BUA1 - Voltage and voltage balance relay

Application

Supervision of voltage unbalance in three-phase systems, phase failure, phase sequence and under-/overvoltage.

Function

The relay *BUA1* measures amplitude and angle of three phase voltages. The angle of the phasors determine the phase sequence. Unbalance and phase loss are detected by the measurement of amplitude and angle.
ΔU characterizes the difference of the lowest to the highest phase-to-phase voltage related to nominal voltage. The underfrequency element trips if the frequency falls below 45 Hz.

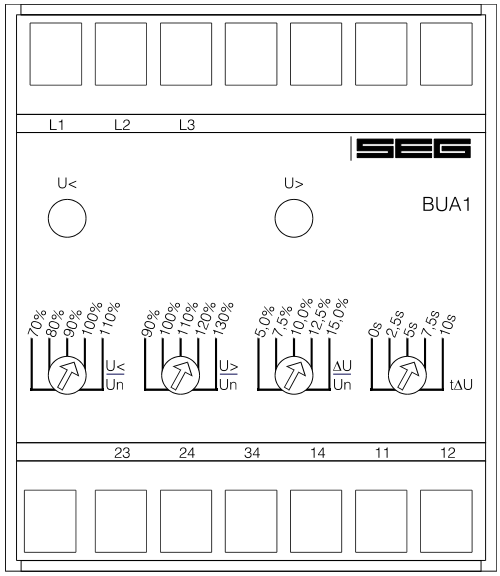


Fig. 1: Front plate

Technical data

rated voltage Un:	110 V, 230 V, 400 V AC
frequency range:	45 - 66 Hz
hysteresis:	2% Un
power consumption:	4 VA
thermal load carrying capacity:	continuously 1,3 x Un
returning time:	600 ms
minimum operating time:	650 ms

Output relays:

max. breaking capacity	
ohmic:	250 V AC/120 W DC
inductive:	500 V AC/75 W DC
rated current:	5 A
making current (16ms):	20 A

System data:

regulations:	VDE 0435 Teil 303
temperature range at storage and operation:	- 25°C bis + 70°C

Mechanical stress:

shock:	class 1 acc. to DIN IEC 255-21-2
vibration:	class 1 acc. to DIN IEC 255-21-1

degree of protection:	IP 40 at closed front cover
weight:	approx. 0,5 kg
mounting position:	any

CE

The unit *BUA1* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022 same as all units of the *BASIC LINE*.
The front plate of the unit is protected with a sealable transparent cover (IP40).
Please remove the transparent cover with a screw driver to adjust the relay.

LED

LED U< is used to indicate operation without fault with steady light. The LED U> indicates overvoltage tripping with steady light. At undervoltage, ΔU or underfrequency tripping the LED U< extinguishes.

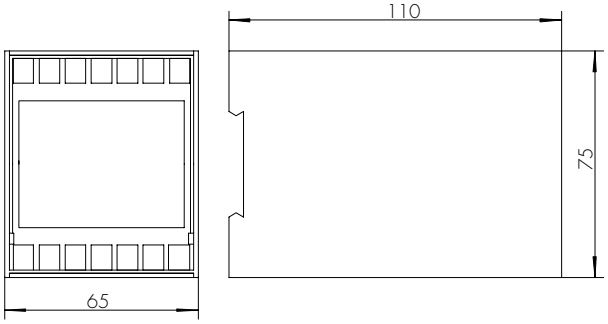


Fig. 2: Dimensional drawing of BUA1

Auxiliary voltage supply

The unit ***BUA1*** needs no separate auxiliary voltage supply. The supply voltage can be formed directly from the measuring quantity.

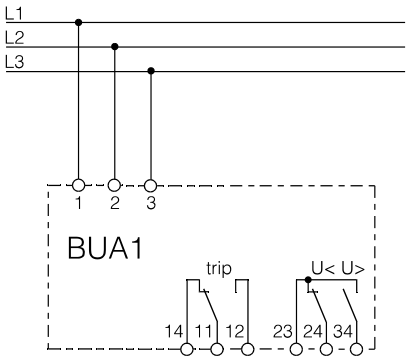
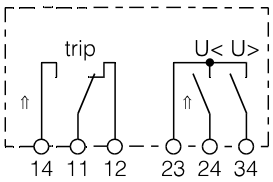
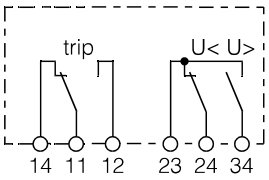


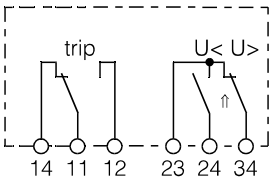
Fig. 3: Connection diagram



Operation without a fault



Unit dead, undervoltage wrong phase sequence, or underfrequency



Overvoltage

Fig. 4: Contact positions

Connection terminals

The connection up to a maximum of 2 x 2,5 mm² cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Setting ranges

ΔU:	5 - 15 % Un
tΔU:	0 - 10 s
U<:	70 - 110 % Un
U>:	90 - 130 % Un

Order key:

quantity			
☐	***BUA1***	-	☐
	110 V AC		110
	230 V AC		230
	400 V AC		400

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BV1 - Phase sequence relay

Application
Supervision of phase loss, phase sequence and undervoltage in three-phase systems.

Function
Relay *BV1* measures amplitude and angle of three phase voltages. The angle of the phasors determine the phase sequence. Unbalance and phase loss are detected by the measurement of amplitude and angle. The undervoltage trip setting is 70 % of Un fixed. The underfrequency element trips if the frequency falls below 45 Hz.

Technical data

rated voltage Un:	110 V, 230 V, 400 V AC
frequency range:	45 - 66 Hz
hysteresis:	2% Un
power consumption:	3 VA (4 VA BA1-400)
thermal load carrying capacity:	continuously 1,3 x Un
returning time:	700 ms
minimum operating time:	700 ms

Output relays:

max. breaking capacity	
ohmic:	250 V AC/120 W DC
inductive:	500 V AC/75 W DC
rated current:	5 A
making current (16ms):	20 A

System data:

regulations:	VDE 0435 Teil 303
temperature range at storage and operation:	- 25°C bis + 70°C

Mechanical stress:

shock:	class 1 acc. to DIN IEC 255-21-2
vibration:	class 1 acc. to DIN IEC 255-21-1

degree of protection:	IP 40 at closed front cover
weight:	approx. 0,5 kg
mounting position:	any

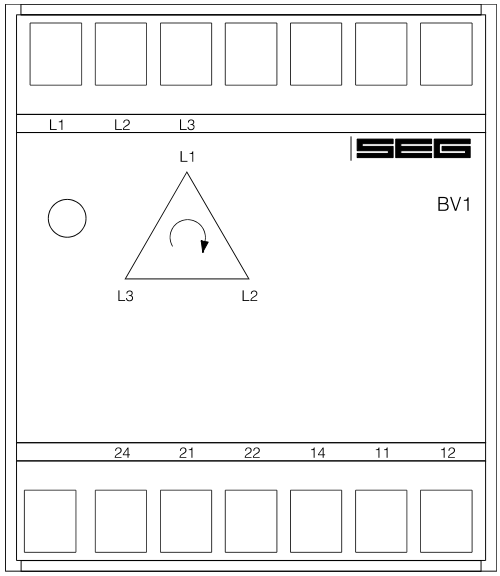


Fig. 1: Front plate

The unit *BV1* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022 same as all units of the *BASIC LINE*.
The front plate of the unit is protected with a sealable transparent cover (IP40).
Please remove the transparent cover with a screw driver to adjust the relay.

LED
LED is used to indicate operation without fault with steady light. At tripping or underfrequency the LED extinguishes.

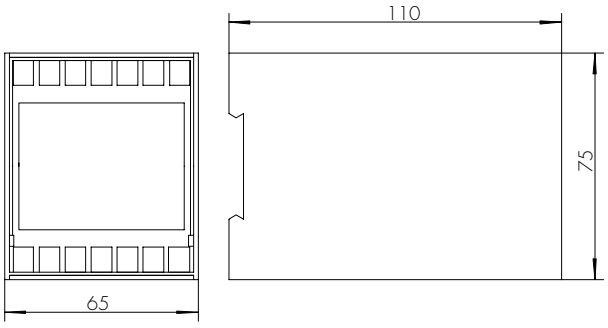


*Fig. 2: Dimensional drawing of **BV1***

CE

Auxiliary voltage supply

The unit ***BV1*** needs no separate auxiliary voltage supply. The supply voltage can be formed directly from the measuring quantity.

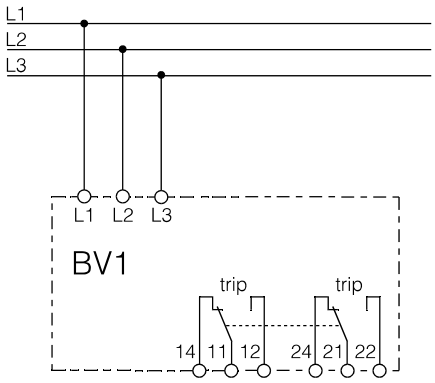
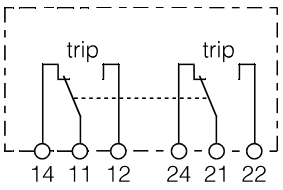
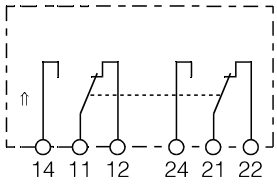


Fig. 3: Connection diagram



Unit dead, wrong phase sequence or tripped



Operation without a fault

Fig. 4: Contact positions

Connection terminals

The connection up to a maximum of 2 x 2,5 mm² cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Order key:

quantity			
	BV1	-	
	110 V AC		110
	230 V AC		230
	400 V AC		400

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BZ1-G - Speed relay

Application
Speed supervision of gensets

Function
Via the output frequency of the generator, the *BZ1* detects the speed of the genset to be supervised. The relay is provided with three independently adjustable elements for ignition speed, under- and overspeed. The rated frequency can be changed from 50 Hz (left stop) to 60 Hz (right stop) by means of potentiometer CAL. At output CAL-A2 a current of 0 - 20 mA in proportion to the speed is available for indication of speed.

Technical data
Auxiliary voltage

Terminals (A1 - A2):	12 V DC, 24 V DC ±40 %
Gen. rated frequency:	50/60 Hz, 4 - 500 V AC
Hysteresis:	2 % of fn
Power consumption:	4 VA
Therm. load carrying capacity:	continuous 1.4 x Un
Returning time:	<450 ms
Minimum operating time:	<650 ms
Output current CAL:	0 - 20 mA DC, Ri ≤ 100 Ω, 100 % fn = 15 mA

Output relays:
Max. breaking capacity

Ohmic:	1250 VA AC/150 W DC
Inductive:	500 VA AC/75 W DC
Rated current:	5 A
Making current (16ms):	20 A

System data:

Regulations:	VDE 0435 part 303
Temperature range at Storage and operation:	- 25°C to + 70°C

Mechanical stress:

Shock:	class 1 acc. to DIN IEC 255-21-2
Vibration:	class 1 acc. to DIN IEC 255-21-1

Degree of protection:	IP 40 at closed front cover
Weight:	approx. 0.3 kg
Mounting position:	any

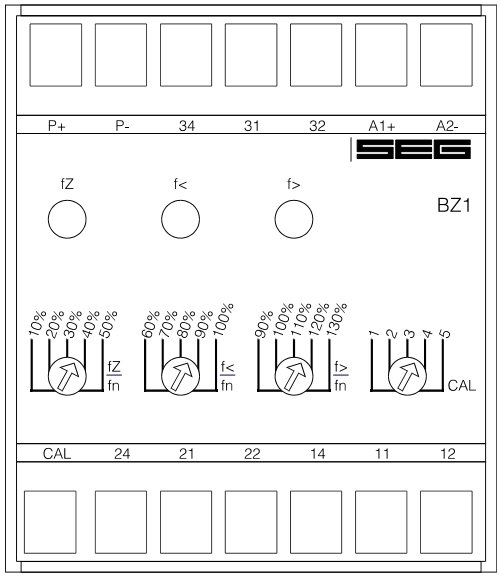


Fig. 1: Front plate

The unit *BZ1* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022 same as all units of the *BASIC LINE*.
The front plate of the unit is protected with a sealable transparent cover (IP40).
Please remove the transparent cover with a screw driver to adjust the relay.

LEDs
The LED fZ lights up at ignition speed. The LED f< extinguishes at underspeed. During operation without fault LEDs fZ and f< light up. The LED f> lights up at overspeed.

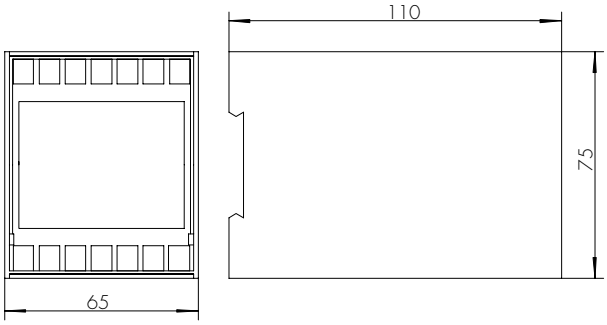


*Fig. 2: Dimensional drawing of **BZ1***

CE

Auxiliary voltage supply

The unit ***BZ1*** needs a separate auxiliary voltage supply. The supply voltage will be connected to terminals A1 - A2.

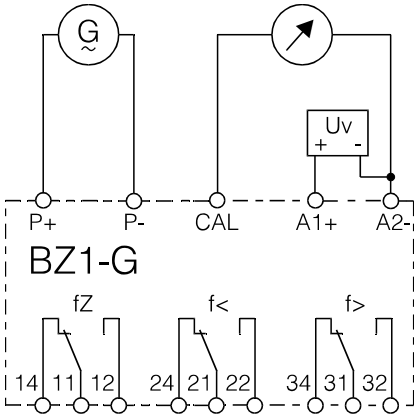
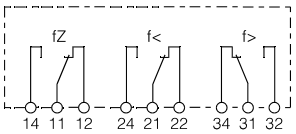
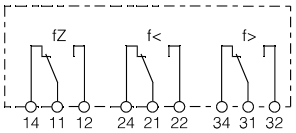


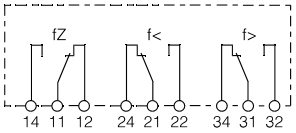
Fig. 3: Connection terminals



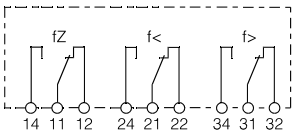
Operation without fault



Unit dead or ignition speed not achieved



Underspeed



Overspeed

Fig. 4: Contact positions

Connection terminals

The connection up to a maximum of 2 x 2,5 mm² cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Setting ranges

fZ:	10 - 50 % fn
f<:	60 - 100 % fn
f>:	90 - 130 % fn
fn (CAL):	50/60 Hz

Order key

quantity			
	BZ1-G	**-**	
Aux. voltage	12 V DC		**12**
	24 V DC		**24**

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BZ1-P - Speed relay

Application
Speed supervision of gensets

Function
Via the connected pickup, the *BZ1* detects the speed of the genset to be supervised. The relay is provided with three independently adjustable elements for ignition speed, under- and overspeed. At nominal speed of the machine the pickup frequency can be calibrated to 100 % fn by means of potentiometer CAL. At output CAL-A2 a current of 0 - 20 mA in proportion to the speed is available for indication of speed.

Technical data
Auxiliary voltage
Terminals (A1 - A2): 12 V DC, 24 V DC ±40 %
Rated pickup-frequency: 1-10 kHz; U_p = 4 Vss - 90 Vss
Hysteresis: 2 % of fn
Power consumption: 4 VA
Therm. load carrying capacity: continuous 1,4 x Un
Returning time: <500 ms
Minimum operating time: <500 ms
Output current CAL: 0 - 20 mA DC, Ri ≤ 100 Ω, 100 % fn = 15 mA

Output relays:
Max. breaking capacity
Ohmic: 1250 VA AC/150 W DC
Inductive: 500 VA AC/75 W DC
Rated current: 5 A
Making current (16ms): 20 A

System data:
Regulations: VDE 0435 Teil 303
Temperature range at
Storage and operation: - 25°C bis + 70°C

Mechanical stress:
Shock: class 1 acc. to DIN IEC 255-21-2
Vibration: class 1 acc. to DIN IEC 255-21-1

Degree of protection: IP 40 at closed front cover
Weight: approx. 0.3 kg
Mounting position: any

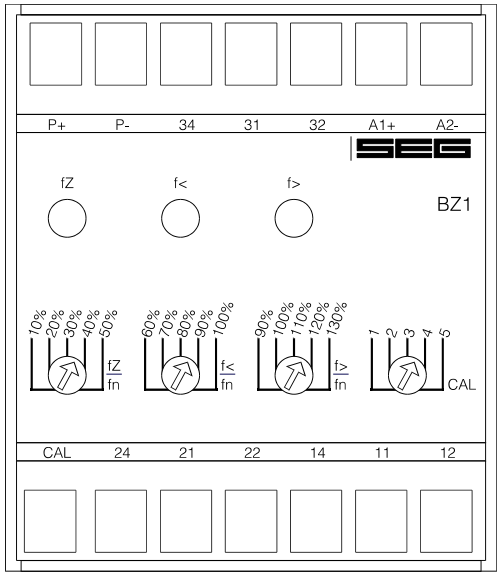

Fig. 1: Front plate

The unit *BZ1* is designed to be fastened onto a DIN-rail acc. to DIN EN 50022 same as all units of the *BASIC LINE*.
The front plate of the unit is protected with a sealable transparent cover (IP40).
Please remove the transparent cover with a screw driver to adjust the relay.

LEDs
The LED fZ lights up at ignition speed. During operation without fault LEDs fZ and f< light up. The LED f> lights up at overspeed. The LED f< extinguishes at underspeed.

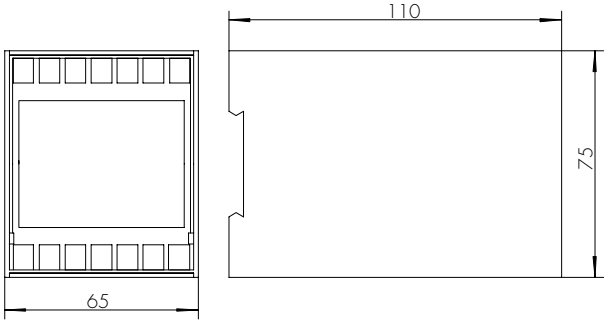

*Fig. 2: Dimensional drawing of **BZ1***

Auxiliary voltage supply

The unit *BZ1* needs a separate auxiliary voltage supply. The supply voltage will be connected to terminals A1 - A2.

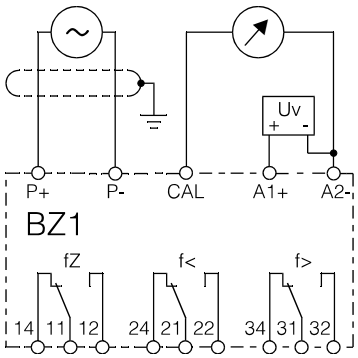

Fig. 3: Connection terminals

Note:

For connection of the pickup a two-wire screened cable is used, the screen of which is earthed at the pickup side.

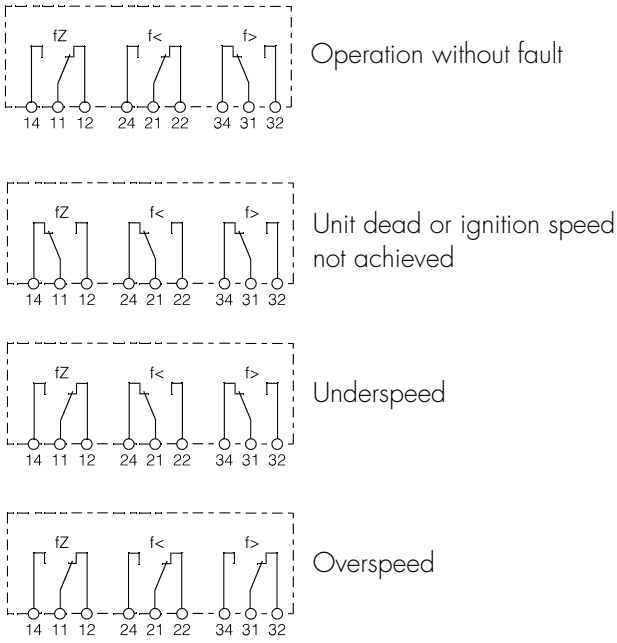

Fig. 4: Contact positions

Connection terminals

The connection up to a maximum of 2 x 2,5 mm² cross-section conductors is possible. For this procedure the transparent cover of the unit has to be removed.

Setting ranges

fZ:	10 - 50 % fn
f<:	60 - 100 % fn
f>:	90 - 130 % fn
fn (CAL):	1 - 10 kHz

Order key

quantity			
	BZ1-P	**-**	
Aux. voltage	12 V DC		**12**
	24 V DC		**24**

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