

Protecting Capacitors

BELUK

KSR
CAPACITOR PROTECTION

EMM-5
POWER ANALYZER

ADVANCED TECHNOLOGY

BELUK.DE

Parameter	Value	Unit
I1	32.5	A
I2	32.2	A
I3	32.3	A

Parameter	Value	Unit
U1	232.5	V
I1	03.34	A
S1	0779.4	VA

Why is protection of capacitors necessary?

- Life expectancy of capacitors is reduced with rising temperature
- temperature of capacitors depends on ambient temperature and on internal losses
- the current, which is responsible for the internal losses depends on voltage and frequency
- voltage and frequency cannot be influenced directly
- dependent on internal connection of the capacitors, overload conditions are possible due to internal failures. At MV-capacitors overheating and burning of the oil-filling is possible

The protection of capacitor saves the value of your compensation or filter-bank and protects the surrounding against damaging.

How can I protect capacitors?

- normally the capacitor can be protected by switching-off
- monitoring for overcurrent, overvoltage or harmonics of the capacitor can trip switching-off the capacitors.
- Supervision against overvoltage is also protecting against dielectric breakdown
- By supervision of symmetrical currents of MV-capacitors, internal failures can be detected.

What is protecting my LV-compensation panel ?

BLR-CM has an integrated monitoring function for the detection of over- and undervoltage and for detection of harmonic overload. BLR-CM is able to switch-off the capacitors, when these values are out of range.

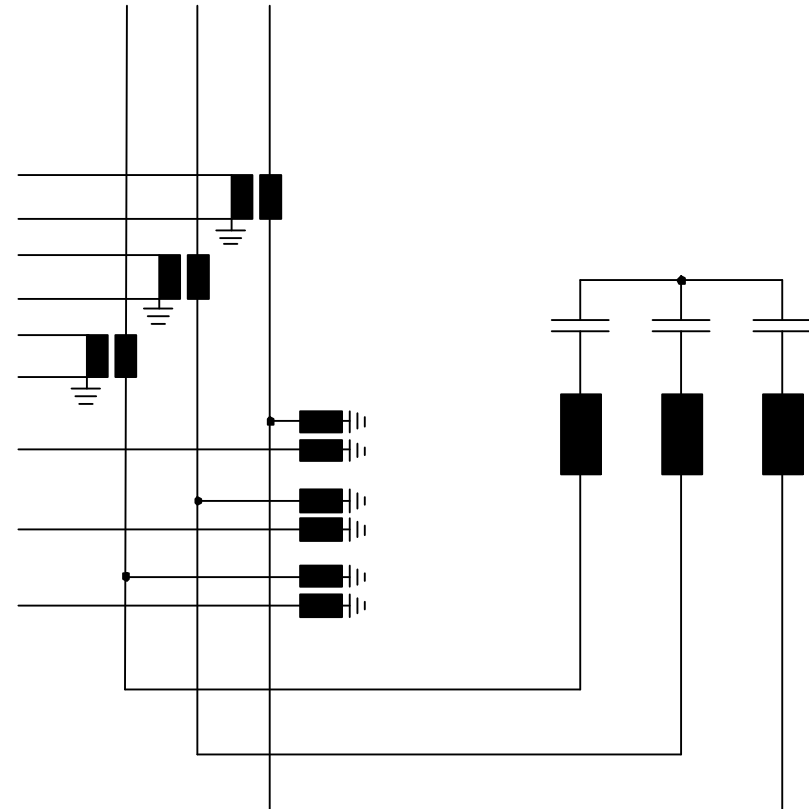
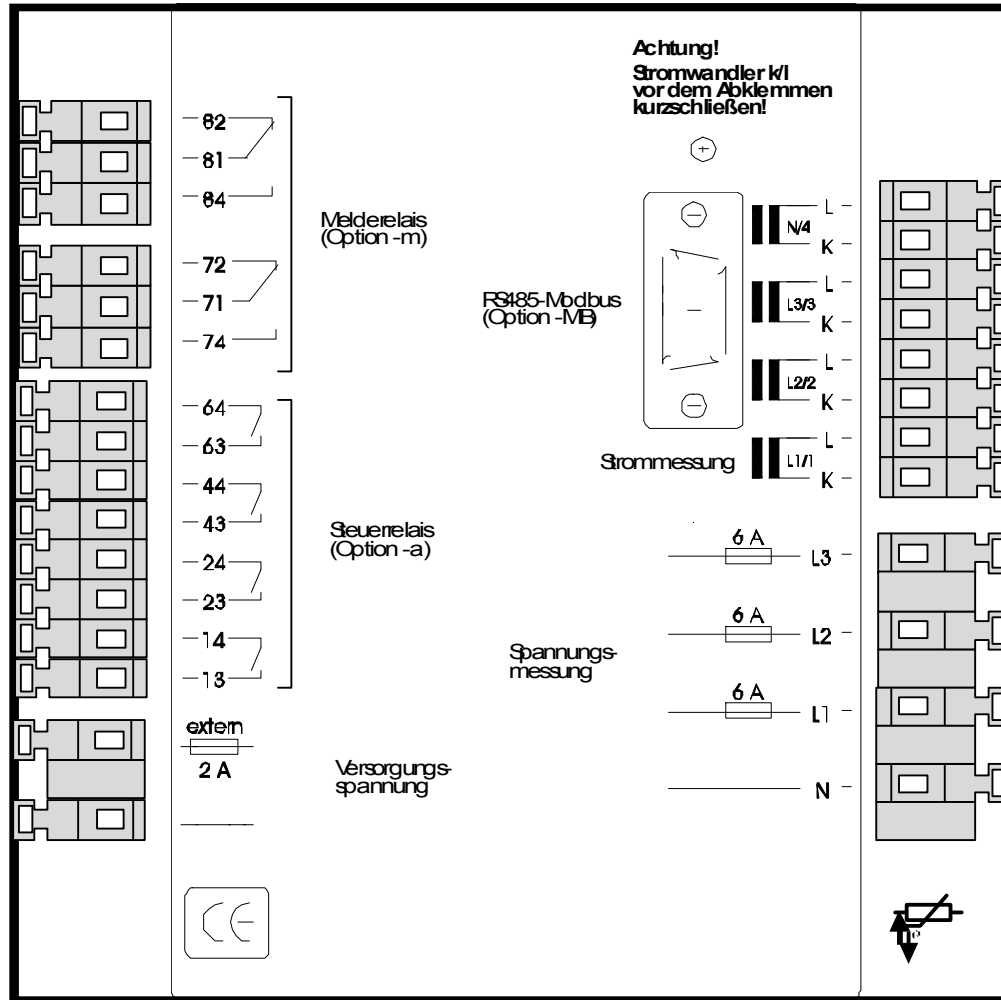
LV-compensation panels can be protected by these functions very well!

What is protecting tuned filter-banks?

- the lowest impedance of tuned filter-banks is at the frequency of the harmonic the filter-bank was harmonised for
- the current in tuned filter-banks is beside the voltage also depended from the concentration of the rated harmonic
- a very strong rated harmonic can overload the filter-bank
- the best protection for the filter-bank is measuring the current
- it's important for this measuring, that the harmonics of the current are not damped
- only a pfc-relay cannot protect a tuned filter against overload!

The necessary device for the protection of tuned filter-banks is KSR!

Example for protection of tuned filter-banks by using KSR



Protection of filter-bank – example for settings

Alarm	Source	Tr.	Limit	T-on	T-off	Output	Reset	Function
1	U L1/N	>	255V	1s	60s	D/1	manual	Trip
2	U L2/N	>	255V	1s	60s	D/1	manual	Trip
3	U L3/N	>	255V	1s	60s	D/1	manual	Trip
4	Ith 1	>	85A	300s	60s	D/1	manual	Trip
5	Ith 2	>	85A	300s	60s	D/1	manual	Trip
6	Ith 3	>	85A	300s	60s	D/1	manual	Trip
7	I 1	>	95A	0,1s	60s	D/1	manual	Trip
8	I 2	>	95A	0,1s	60s	D/1	manual	Trip
9	I 3	>	95A	0,1s	60s	D/1	manual	Trip
10	I 1	>	85A	1s	5s	D/2	auto	Alarm
11	I 2	>	85A	1s	5s	D/2	auto	Alarm
12	I 3	>	85A	1s	5s	D/2	auto	Alarm
...								
...								
32								

Overload of MV-Capacitors

By Internal failures

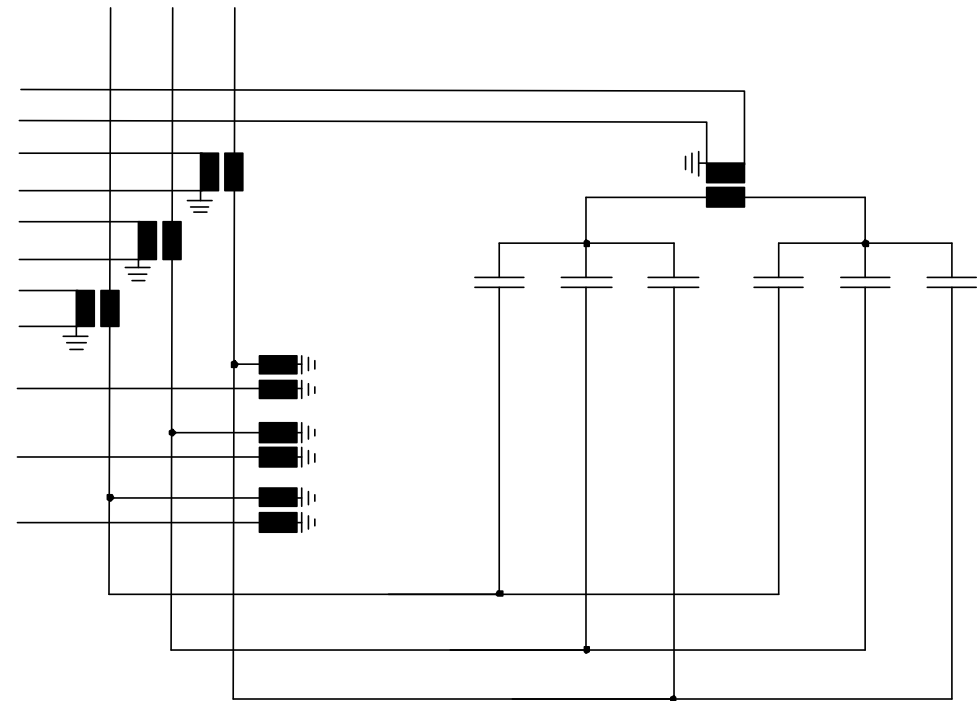
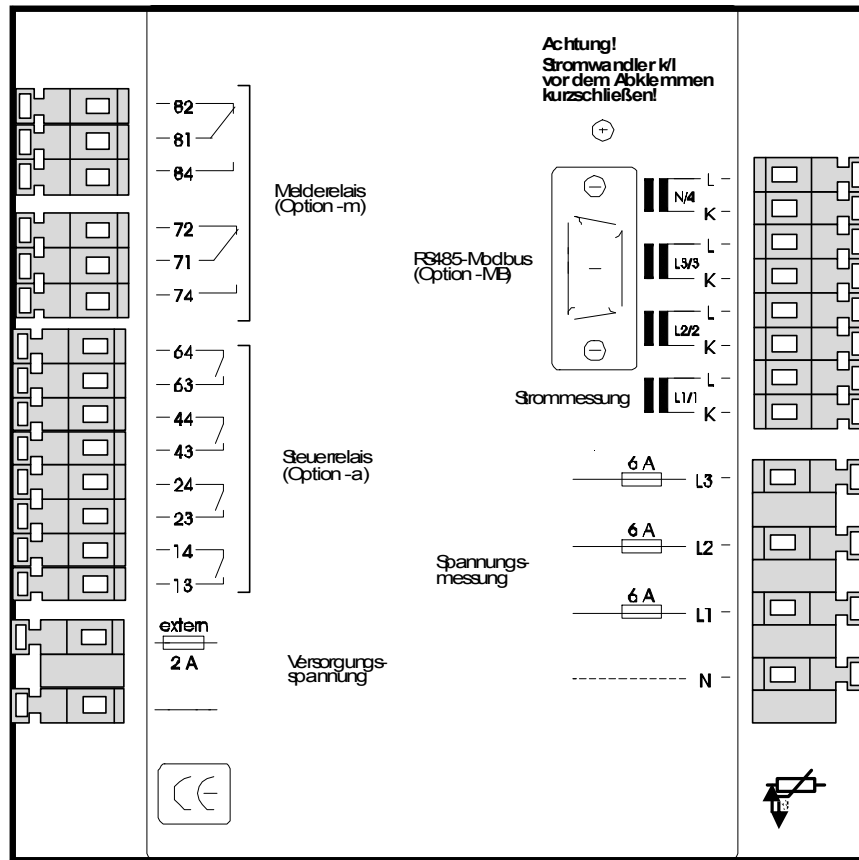
- MV-capacitors are internally built up as a serial and parallel connection of several small capacitors. This is necessary to achieve the necessary voltage level and necessary power.
- the defect of one of these capacitors causes internal overloads
- these overloads are heating-up the capacitor and the oil-filling
- burning or explosion of this oil-filling damages the compensation panel, the building and other things which are near by

External Influence

- Overvoltage, harmonics and high ambient temperature are also overloading the capacitors

Protection of 1 MV-capacitor bank by KSR

overload, overvoltage and out of balance supervision
of 1 MV-capacitor bank with 1 KSR

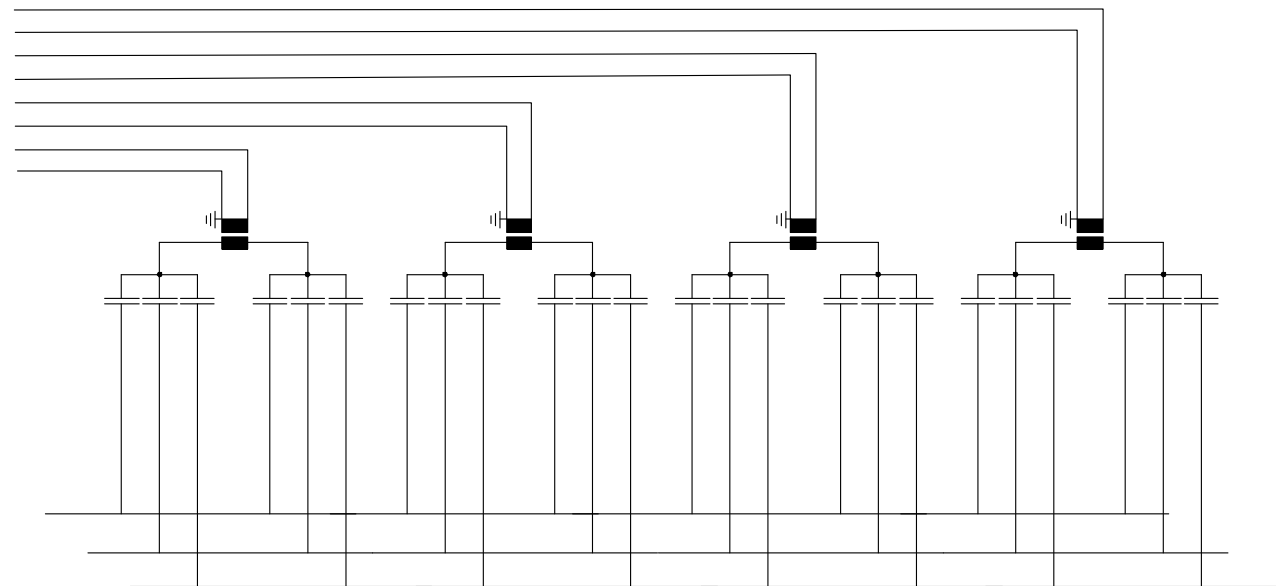
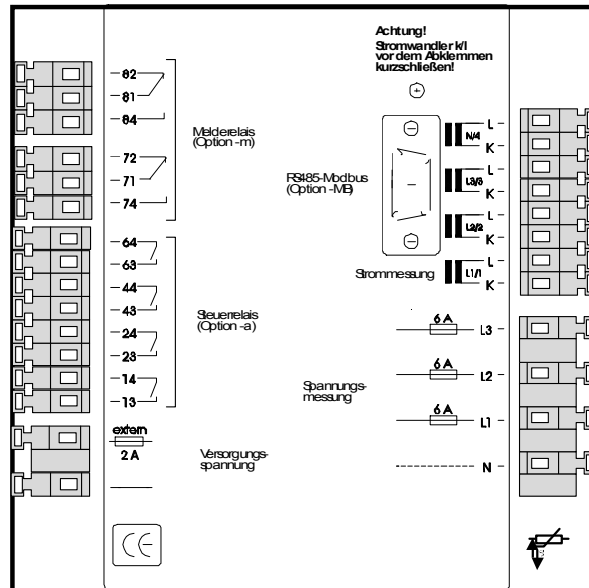


Protection of 1 MV-capacitor bank by KSR – Example

Alarm	Source	Tr.	Limit	T-on	T-off	Out put	Reset	Function
1-3	Ith 1-3	>	100 A	300s	120s	D/1	manual	Trip
4-6	I 1-3	>	120 A	0,1s	120s	D/1	manual	Trip
7-9	I 1-3	>	100 A	5s	5s	D/2	Auto	Alarm
10	If 4	>	3 A	0,1s	120s	D/1	Manual	Trip
11	If 4	>	1,5 A	10s	1s	D/1	Auto	Alarm
12-14	U 1-3	>	12kV	10s	1s	D/2	Auto	Alarm
15-17	U 1-3	>	13kV	1s	120s	D/1	Manual	Trip
18-20	THDU	>	10%	10s	1s	D/2	Auto	Alarm
21-23	U 1-3	<	9kV	10s	1s	D/2	Auto	Alarm
24-26	U 1-3	<	8,5kV	1s	120s	D/1	Manual	Trip
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Protection of 4 MV-capacitor bank by 1 KSR

Out of balance supervision of capacitors banks in double-star with KSR

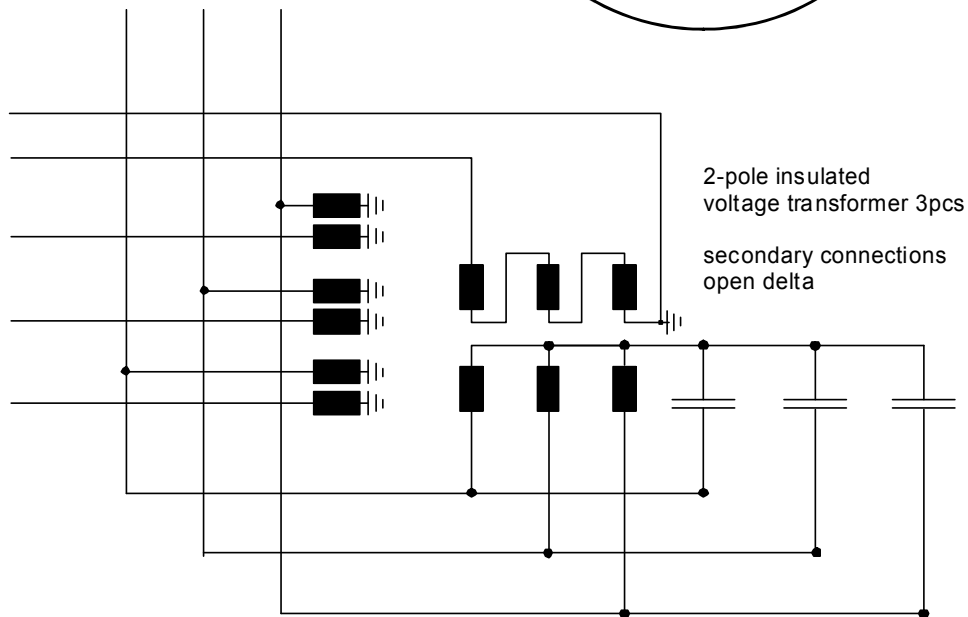
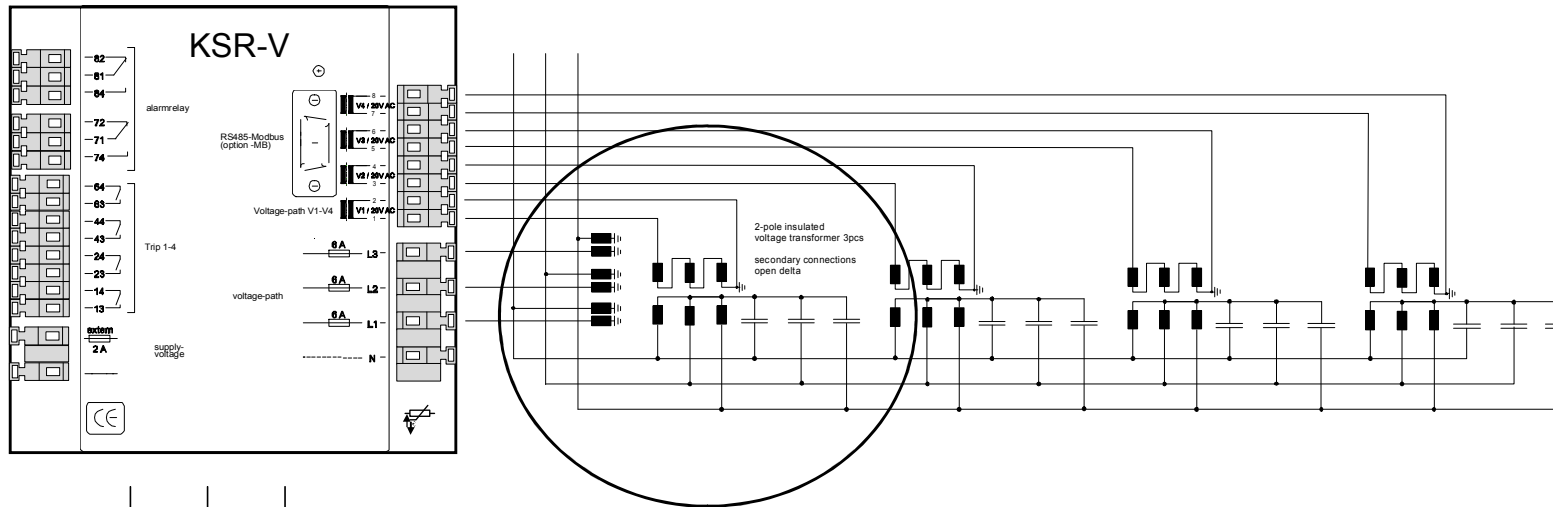


Protection of 4 MV-capacitor bank by 1 KSR – Example

Alarm	Source	Tr.	Limit	T-on	T-off	Output	Reset	Function
1	If 1	>	3 A	0,1s	120s	D/1	manual	Trip
2	If 2	>	3 A	0,1s	120s	D/2	manual	Trip
3	If 3	>	3 A	0,1s	120s	D/4	manual	Trip
4	If 4	>	3 A	0,1s	120s	D/6	manual	Trip
5	If 1	>	1,5 A	10s	5s	D/7	auto	Alarm
6	If 2	>	1,5 A	10s	5s	D/7	auto	Alarm
7	If 3	>	1,5 A	10s	5s	D/7	auto	Alarm
8	If 4	>	1,5 A	10s	5s	D/7	auto	Alarm
...								
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32								

Protection of 4 MV-capacitor bank by KSR-V

Out of balance supervision of capacitor banks by using 3 two-pole insulated VTs



KSR-V with additional
4 voltage measuring channels
0-20V (max. 60V)
instead of current measuring
channels

Protection of 4 MV-capacitor bank by KSR-V

Alarm	Source	Tr.	Limit	T-on	T-off	Output	Reset	Function
1	Vf 1	>	3 V	0,1s	120s	D/1	manual	Trip
2	Vf 2	>	3 V	0,1s	120s	D/2	manual	Trip
3	Vf 3	>	3 V	0,1s	120s	D/4	manual	Trip
4	Vf 4	>	3 V	0,1s	120s	D/6	manual	Trip
5	Vf 1	>	1,5 V	10s	5s	D/7	auto	Alarm
6	vf 2	>	1,5 V	10s	5s	D/7	auto	Alarm
7	Vf 3	>	1,5 V	10s	5s	D/7	auto	Alarm
8	Vf 4	>	1,5 V	10s	5s	D/7	auto	Alarm
9-11	U L1-3	>	12kV	10s	5s	D/7	Auto	Alarm
12-14	U L1-3	>	13kV	1s	120s	D/1/2/4/6	manual	Trip
...								
...								
32								

KSR – measuring values which can give a trigger

Measuring which can be monitored by KSR:

RMS current:

$$I_1 - I_4$$

Fundamental wave current:

$$I_{f1} - I_{f4}$$

Damped current:

$$I_{th1} - I_{th4} \text{ (tau is adjustable)}$$

Voltage Ph-Ph:

$$U_{L1L2} / U_{L2L3} / U_{L3L1}$$

Voltage Ph-N:

$$U_{L1} - U_{L3}$$

THD current:

$$\text{THD } I_1 - \text{THD } I_4$$

THD voltage:

$$\text{THD } U_{L1} - \text{THD } U_{L3}$$

Temperature in cabinet

KSR-V – measuring values which can give a trigger

Measuring which can be monitored by KSR-V:

RMS balance voltage: $V_1 - V_4$

FW balance voltage: $V_{f1} - V_{f4}$

Damped balance voltage: $V_{th1} - V_{th4}$ (tau is adjustable)

Mainsvoltage ph-ph: $U_{L1L2} / U_{L2L3} / U_{L3L1}$

Mainsvoltage ph-N: $V_{L1} - V_{L3}$

THD balance voltage: $THD V_1 - THD V_4$

THD mainsvoltage: $THD U_{L1} - THD U_{L3}$

Temperature in cabinet

KSR / KSR-V – alarming

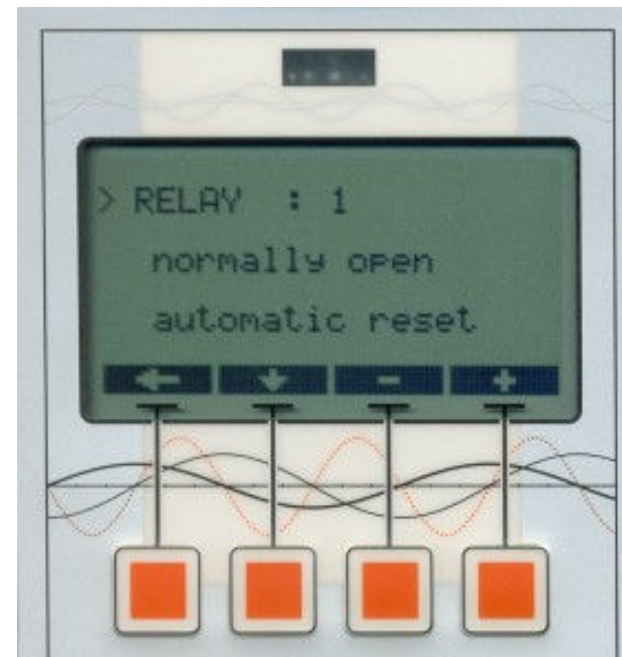
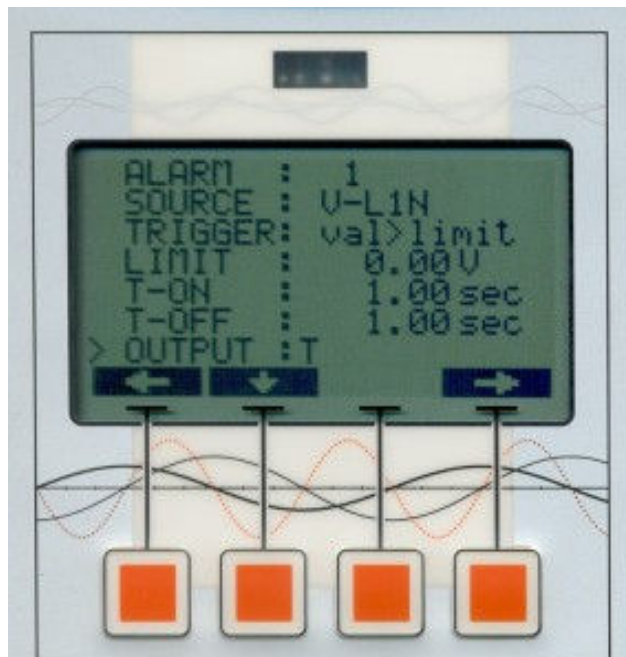
- 32 programmable alarms are available
- each alarm can supervise one triggerable measuring
- each triggerable measuring can be monitored by multiple alarms
- monitoring is possible for exceeding and shortfall
- each alarm can be delayed for activating and dropping in a range of 0,1 sec – 600sec
- the activity of each alarm can be programmed separately
- option –DM allows to store alarms and trips with time-stamp and with information about measuring values
- option –DM is providing a digital input to block alarms and trips

KSR / KSR-V – alarm activities

- 4 relays with voltfree N/O contact
- 2 relays with voltfree C/O contact
- each relay can be programmed for deenergise to trip principle or vice versa
- each relay can be programmed for automatic or manual rest
- the following display messages can be programmed
 - OL ALARM, OL TRIP (overload)
 - OV ALARM, OV TRIP (overvoltage)
 - UV ALARM, UV Trip (undervoltage)
 - UB ALARM, UB Trip (unbalance)
- display message can be programmed for automatic or manual reset

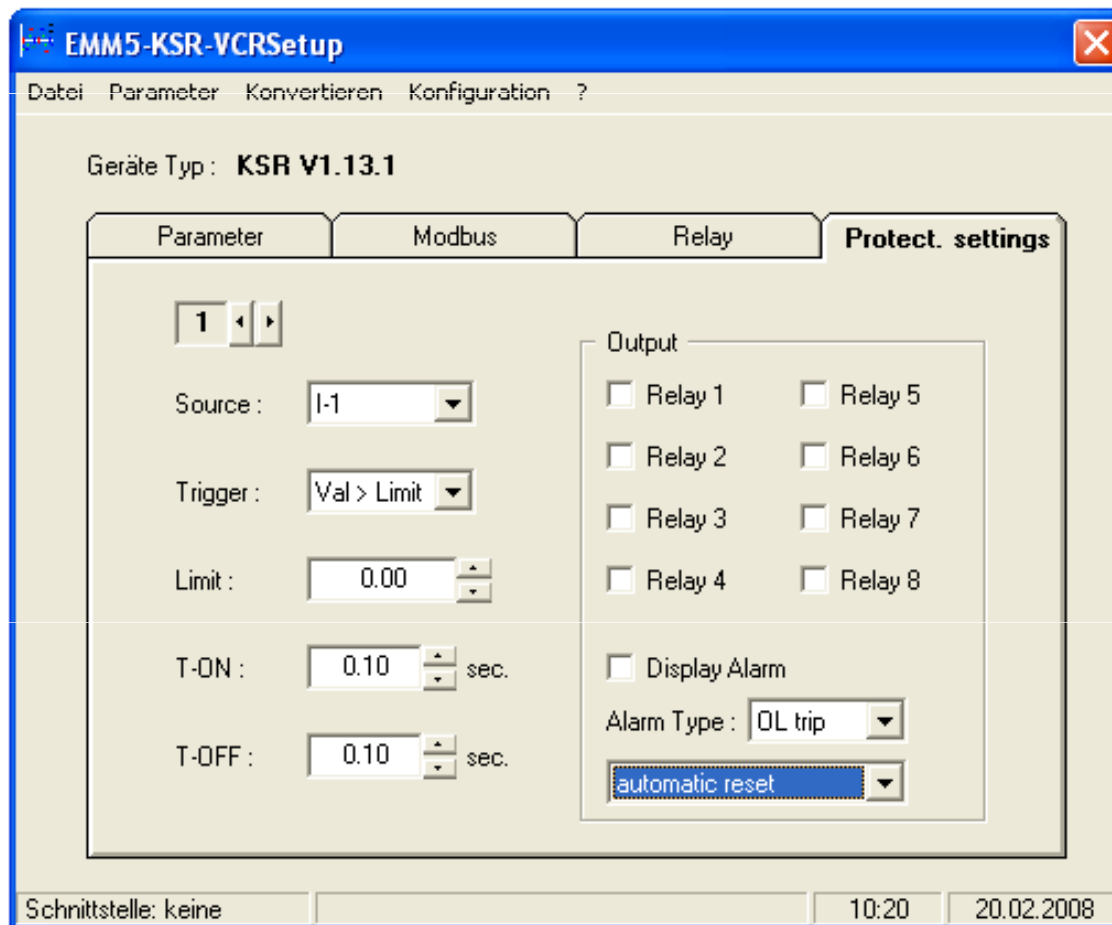
KSR / KSR-V – programming of alarms

programming directly at the device



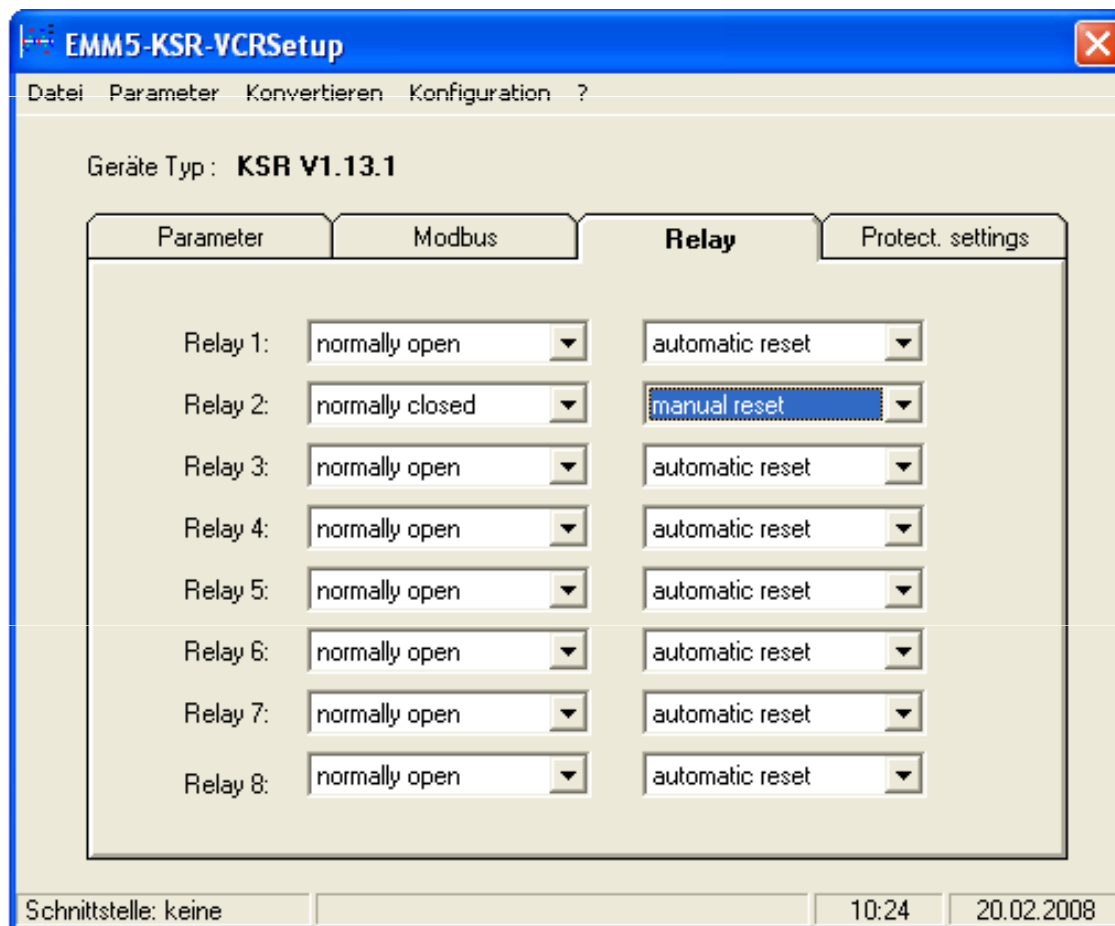
KSR / KSR-V – programming of alarms

Programming by USB-interface and software



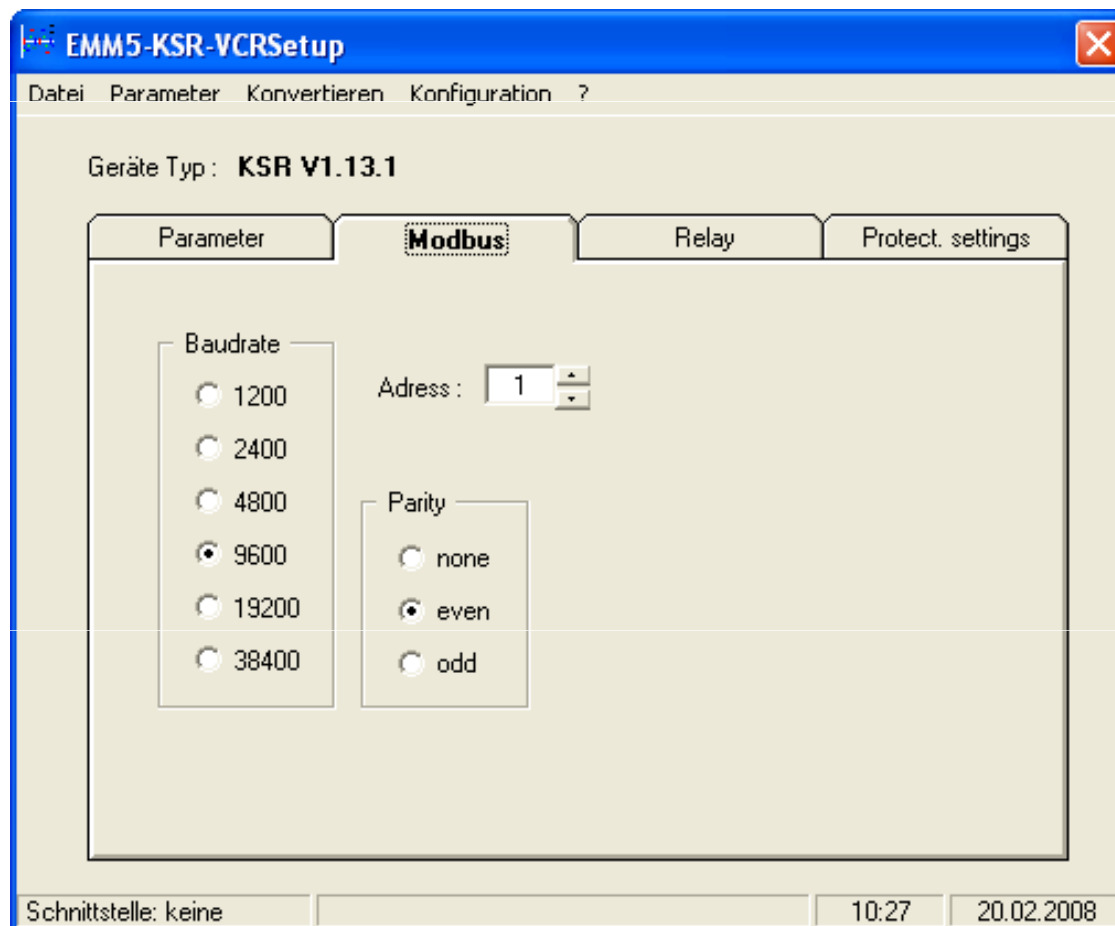
KSR / KSR-V – programming of relays

Programming by USB-interface and software



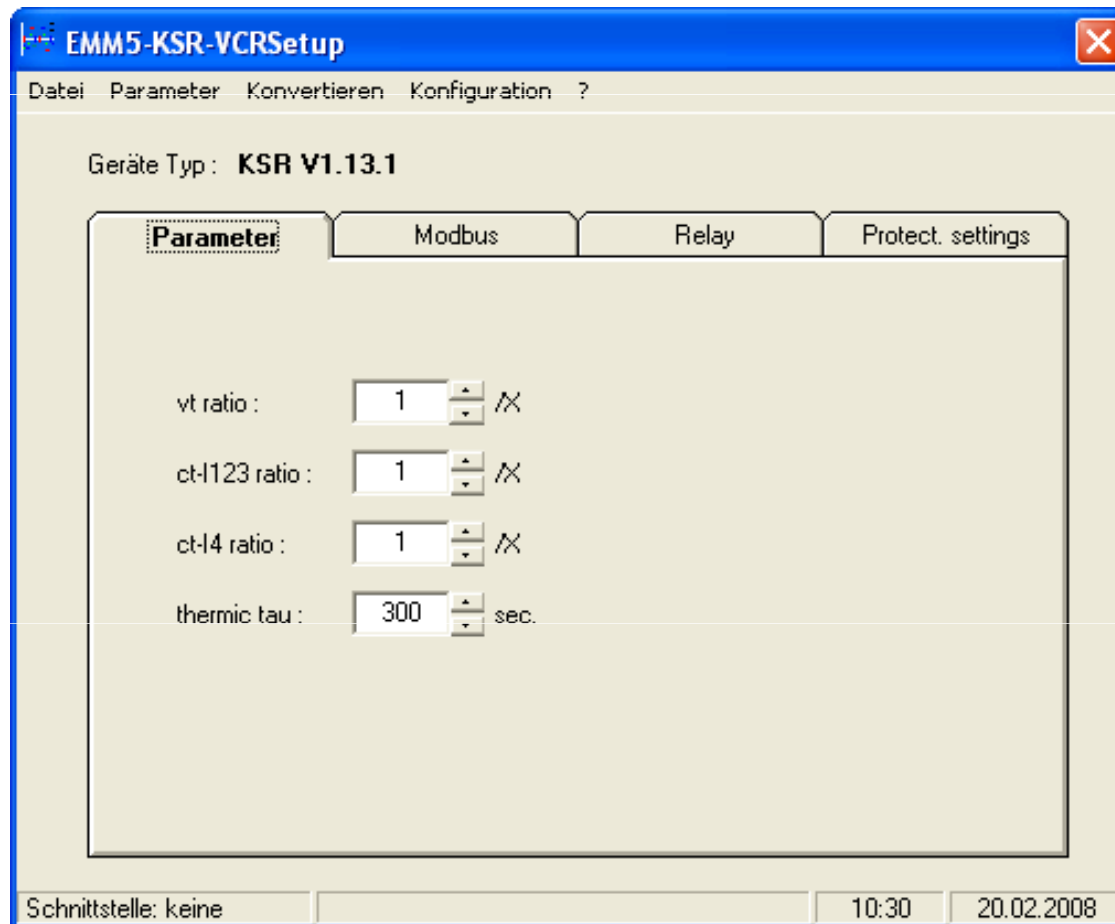
KSR / KSR-V – programming of Modbus parameters

Programming by USB-interface and software



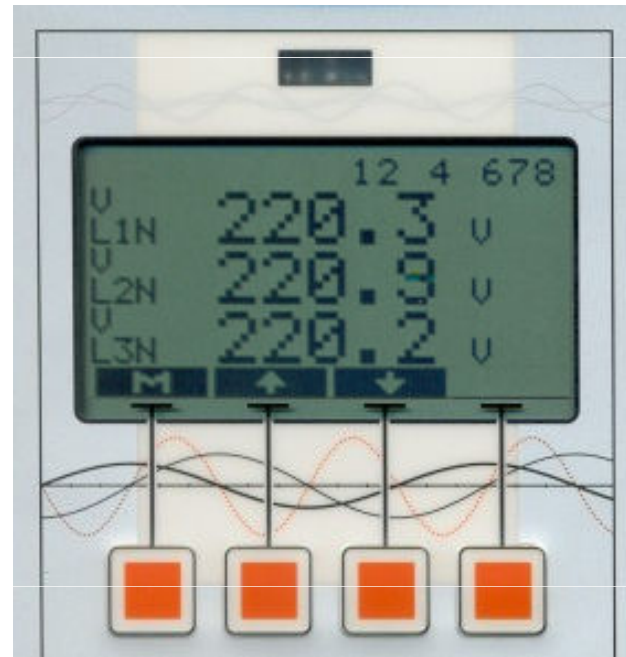
KSR / KSR-V – programming of measuring parameters

Programming by USB-interface and software



KSR / KSR-V – Display of measuring values

display of measuring values and relay status



Remarks for ordering KSR

Description	Type
Capacitor Protecting Relay KSR, supply voltage 230V AC	KSR -am
Capacitor Protecting Relay KSR, supply voltage 115V DC	KSR -am
Options	
Galvanically isolated current paths max. load 200A / 1sec	- E
Interface RS485 protocol Modbus RTU	-MB
Fault recorder, Real-time Clock, programmable blocking of the alarm system via digital input, Interface RS485 protocol Modbus RTU	-DM
Accessories	
Transparent cover with lock IP54	- VT
Wall mounting bracket	3ZWC
Data cable TTL/USB	UMS9
Software to adjust device parameter	

Please inform us, if you are using 5Amp or 1Amp CTs!



Remarks for ordering KSR-V

Description	Type
Capacitor Protecting Relay KSR-V, supply voltage 230V AC	KSR -amv
Capacitor Protecting Relay KSR-V, supply voltage 115V DC	KSR -amv
Options	
Interface RS485 protocol Modbus RTU	- MB
Fault recorder, Real-time Clock, programmable blocking of the alarm system via digital input, Interface RS485 protocol Modbus RTU	-DM
Accessories	
Transparent cover with lock IP54	- VT
Wall mounting bracket	3ZWC
Data cable TTL/USB	UMS9
Software to adjust device parameter	