

# Discharge Resistors and Cable Cross Section

By Michael Kopp

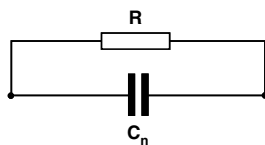
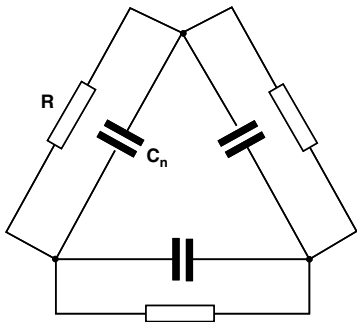
## DISCHARGE RESISTORS

ESTAprop and ESTAdry MKP-type capacitors will be provided, complete with discharge resistors. After the capacitor is disconnected from the supply source, discharge resistors are required for discharging each unit within 3 min to 75 V or less from initial nominal peak voltage (according to the IEC-standard 60831-1 + 2). Discharge resistors have to be connected directly to the capacitors. There shall be no switch, fuse cut-out, or any other isolating device between the capacitor unit and the discharge resistors.

Annotation: Our capacitors are discharged to 50 V or less within 1 min to also comply with the UL standard 810.

### MAXIMUM RESISTOR VALUE

$$R \leq \frac{60 \text{ s}}{C_n \times I_n \left( \frac{U_n \times \sqrt{2}}{50 \text{ V}} \right)}$$



#### Note

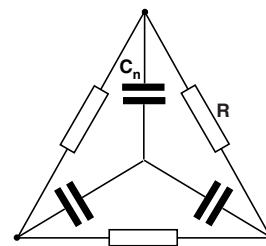
- Attention: terminals have to be short-circuited before handling

## MINIMUM REQUIRED POWER RATING OF THE RESISTORS (W)

$$P = \frac{U^2}{R}$$

### MAXIMUM RESISTOR VALUE

$$R \leq \frac{60 \text{ s}}{1/3 \times C_n \times I_n \left( \frac{U_n \times \sqrt{2}}{50 \text{ V}} \right)}$$



**Example:** PhMKP 400.3.25  
(Delta Connection)

$$C_n = 165.8 \mu\text{F}$$

$$\Rightarrow R \leq \frac{60 \text{ s}}{165.8 \times 10^{-6} \text{ F} \times I_n \left( \frac{400 \text{ V} \times \sqrt{2}}{50 \text{ V}} \right)}$$

$$R \leq 149.1 \text{ k}\Omega$$

(a thick film discharge resistor with 145 kΩ is used)



## Discharge Resistors and Cable Cross Section

### CROSS SECTION OF CONNECTING CABLE BETWEEN MAIN SUPPLY AND CAPACITOR BANK, FUSE RATING

The cross section for the connecting cable and fuse rating has to be selected in accordance with the standard VDE 0100 part 523. The values mentioned below are guideline values valid for operation under normal conditions and at an ambient temperature of 40 °C. Higher values shall be selected if conditions differ from normal (e.g. high harmonic distortion or higher ambient temperature).

OUTPUT kvar	RATED VOLTAGE 230 V, 50 Hz			RATED VOLTAGE 400 V, 50 Hz			VOLTAGE 415 V, 50 Hz		
	RATED CURRENT A	FUSE A	CABLE mm <sup>2</sup>	RATED CURRENT A	FUSE A	CABLE mm <sup>2</sup>	RATED CURRENT A	FUSE A	CABLE mm <sup>2</sup>
2.5	6.3	16	2.5	3.6	10	1.5	3.5	10	1.5
5.0	12.6	25	4	7.2	20	2.5	7.0	20	2.5
6.67	16.7	35	6	9.6	20	2.5	9.3	20	2.5
7.5	19	35	6	10.80	20	2.5	10.4	20	2.5
8.33	21	35	6	12	20	2.5	11.6	20	2.5
10.0	25	50	10	14.4	25	4	13.9	25	4
12.5	31	63	16	18	35	6	17.4	35	6
15.0	38	63	16	21.7	35	6	20.9	35	6
16.7	42	80	25	24.1	50	10	23.2	50	10
20.0	50	100	35	28.9	50	10	27.8	50	10
25.0	63	125	50	36.1	63	16	34.8	63	16
30.0	75	125	50	43.3	80	25	41.7	80	25
33.3	84	160	70	48.1	80	25	46.3	80	25
40.0	100	160	95	57.7	100	35	55.6	100	35
50.0	125	250	120	72.2	125	50	69.6	125	50
60.0	-	-	-	86.6	160	70	83.5	160	70
66.7	-	-	-	96.3	160	70	92.8	160	70
70.0	-	-	-	101	160	70	97	160	70
75.0	-	-	-	108	160	70	104	160	70
83.3	-	-	-	120	200	95	116	200	95
100.0	-	-	-	144	250	120	139	250	120

### CAPACITOR BANK INTERNAL WIRING

The internal wiring of capacitor banks can be normally done with a lower cross section. Various parameters such as the cabinet's inside temperature, quality of cable, maximum cable isolation temperature, single or multicore cable, and temperature rating have to be taken into consideration for selection of the appropriate value.

The contrary requirement for limiting the inrush current and reduction of cable losses is another important aspect in this matter if no inrush current limiting devices are used.

APPLICATION NOTE