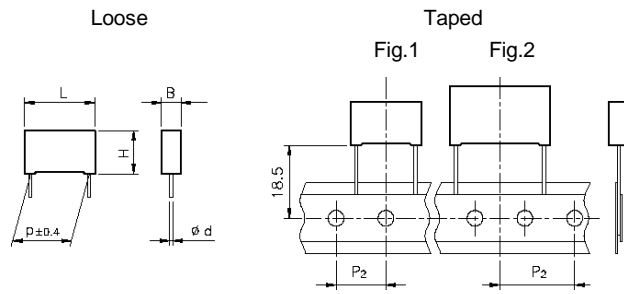


METALLIZED POLYESTER FILM CAPACITOR MULTIPURPOSE APPLICATIONS

Typical application: blocking, coupling, decoupling, by-passing, interference suppression in low voltage applications (i.e.:AUTOMOTIVE)

PRODUCT CODE: R60

NOTE: Special version, in compliance with DIN 44122, is available upon request.



φ d ± 0.05	p = 10	p > 10
	0.6	0.8

All dimensions are in mm.

PRODUCT CODE SYSTEM

The part number, comprising 14 digits, is formed as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
R	6	0										-	

Digit 1 to 3 Series code.

Digit 4 d.c. rated voltage:

D = 63V E = 100V G = 160V I = 250V
M = 400V P = 630V Q = 1000V

Digit 5 Pitch:

F=10mm; I=15mm; N=22.5mm; R=27.5mm

Digit 6 to 9 Digits 7 - 8 - 9 indicate the first three digits of Capacitance value and the 6th digit indicates the number of zeros that must be added to obtain the Rated Capacitance in pF.

Digit 10 to 11 Mechanical version and/or packaging (table 1)

Digit 12 Identifies the dimensions and electrical characteristics.

Digit 13 Internal use

Digit 14 Capacitance tolerance:
J=5%; K=10%; M=20%

GENERAL TECHNICAL DATA

Dielectric: polyester film (polyethylene terephthalate).

Plates: aluminium layer deposited by evaporation under vacuum.

Winding: non-inductive type.

Leads: tinned wire.

Protection: plastic case, epoxy resin filled.
Box material is solvent resistant and flame retardant according to UL94 V0.

Marking: Manufacturer's logo, capacitance, tolerance, D.C. rated voltage.

Climatic category: 55/100/56 IEC 60068-1

Operating temperature range: -55 to +105°C

Related documents: IEC 60384-2; CECC 30400

Winding scheme

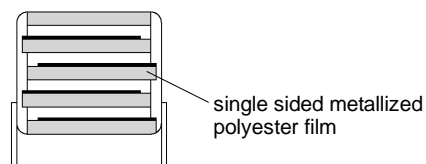


Table 1 (for more detailed information, please refer to page 15).

Standard packaging style	Lead length (mm)	Taping style			Ordering code (Digit 10 to 11)
		P ₂ (mm)	Fig. (No.)	Pitch (mm)	
AMMO-PACK		12.70	1	10.0/15.0	DQ
AMMO-PACK		19.05	2	22.5	DQ
REEL φ 355mm		12.70	1	10.0/15.0	GY
REEL φ 500mm		12.70	1	10.0/15.0	CK
REEL φ 500mm		19.05	2	22.5/27.5	CK
Loose, short leads	4 +2				AA
Loose, long leads	30 +5				50

Note: Ammo-pack is the preferred packaging for taped version.

Rated Cap.	63Vdc/40Vac				Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p			
0.47μF	4.0	9.0	13.0	10.0	6.0	0.75 E3	R60DF 3470--3--
0.68μF	4.0	9.0	13.0	10.0	6.0	0.75 E3	R60DF 3680--3--
1.0μF	5.0	11.0	13.0	10.0	6.0	0.75 E3	R60DF 4100--3--
1.5μF	6.0	12.0	13.0	10.0	6.0	0.75 E3	R60DF 4150--3--
0.68μF	5.0	11.0	18.0	15.0	2.5	0.32 E3	R60DI 3680--3--
1.0μF	5.0	11.0	18.0	15.0	2.5	0.32 E3	R60DI 4100--3--
1.5μF	5.0	11.0	18.0	15.0	2.5	0.32 E3	R60DI 4150--3--
2.2μF	6.0	12.0	18.0	15.0	2.5	0.32 E3	R60DI 4220--3--
3.3μF	7.5	13.5	18.0	15.0	2.5	0.32 E3	R60DI 4330--3--
4.7μF	8.5	14.5	18.0	15.0	2.5	0.32 E3	R60DI 4470--3--
6.8μF	10.0	16.0	18.0	15.0	2.5	0.32 E3	R60DI 4680--3--
3.3μF	6.0	15.0	26.5	22.5	1.5	0.19 E3	R60DN4330--3--
4.7μF	7.0	16.0	26.5	22.5	1.5	0.19 E3	R60DN4470--3--
6.8μF	7.0	16.0	26.5	22.5	1.5	0.19 E3	R60DN4680--3--
10.0μF	8.5	17.0	26.5	22.5	1.5	0.19 E3	R60DN5100--3--
10.0μF	9.0	17.0	32.0	27.5	1.0	0.13 E3	R60DR5100--3--
15.0μF	11.0	20.0	32.0	27.5	1.0	0.13 E3	R60DR5150--3--
22.0μF	13.0	22.0	32.0	27.5	1.0	0.13 E3	R60DR5220--3--

Rated Cap.	100Vdc/63Vac				Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p			
0.33μF	4.0	9.0	13.0	10.0	9.0	1.8 E3	R60EF 3330--3--
0.47μF	5.0	11.0	13.0	10.0	9.0	1.8 E3	R60EF 3470--3--
0.68μF	6.0	12.0	13.0	10.0	9.0	1.8 E3	R60EF 3680--3--
0.33μF	5.0	11.0	18.0	15.0	3.0	0.6 E3	R60EI 3330--3--
0.47μF	5.0	11.0	18.0	15.0	3.0	0.6 E3	R60EI 3470--3--
0.68μF	5.0	11.0	18.0	15.0	3.0	0.6 E3	R60EI 3680--3--
1.0μF	5.0	11.0	18.0	15.0	3.0	0.6 E3	R60EI 4100--3--
1.5μF	7.5	13.5	18.0	15.0	3.0	0.6 E3	R60EI 4150--3--
2.2μF	8.5	14.5	18.0	15.0	3.0	0.6 E3	R60EI 4220--3--
3.3μF	10.0	16.0	18.0	15.0	3.0	0.6 E3	R60EI 4330--3--
1.5μF	6.0	15.0	26.5	22.5	2.0	0.4 E3	R60EN4150--3--
2.2μF	6.0	15.0	26.5	22.5	2.0	0.4 E3	R60EN4220--3--
3.3μF	7.0	16.0	26.5	22.5	2.0	0.4 E3	R60EN4330--3--
4.7μF	8.5	17.0	26.5	22.5	2.0	0.4 E3	R60EN4470--3--
6.8μF	10.0	18.5	26.5	22.5	2.0	0.4 E3	R60EN4680--3--
4.7μF	9.0	17.0	32.0	27.5	1.5	0.3 E3	R60ER4470--3--
6.8μF	9.0	17.0	32.0	27.5	1.5	0.3 E3	R60ER4680--3--
10μF	11.0	20.0	32.0	27.5	1.5	0.3 E3	R60ER5100--3--

Mechanical version and packaging (Table 1) _____
 Internal use _____
 Tolerance: J (± 5%); K (± 10%); M (± 20%) _____

Rated Cap.	160Vdc/90Vac				Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p			
0.22μF	4.0	9.0	13.0	10.0	15.0	4.80 E3	R60GF 3220--3--
0.33μF	5.0	11.0	13.0	10.0	15.0	4.80 E3	R60GF 3330--3--
0.47μF	6.0	12.0	13.0	10.0	15.0	4.80 E3	R60GF 3470--3--
0.33μF	5.0	11.0	18.0	15.0	9.0	2.90 E3	R60GI 3330--3--
0.47μF	5.0	11.0	18.0	15.0	9.0	2.90 E3	R60GI 3470--3--
0.68μF	5.0	11.0	18.0	15.0	9.0	2.90 E3	R60GI 3680--3--
1.0μF	7.5	13.5	18.0	15.0	9.0	2.90 E3	R60GI 4100--3--
1.5μF	8.5	14.5	18.0	15.0	9.0	2.90 E3	R60GI 4150--3--
2.2μF	10.0	16.0	18.0	15.0	9.0	2.90 E3	R60GI 4220--3--
1.5μF	6.0	15.0	26.5	22.5	5.5	1.70 E3	R60GN4150--3--
2.2μF	7.0	16.0	26.5	22.5	5.5	1.70 E3	R60GN4220--3--
3.3μF	8.5	17.0	26.5	22.5	5.5	1.70 E3	R60GN4330--3--
4.7μF	11.0	20.0	26.5	22.5	5.5	1.70 E3	R60GN4470--3--
3.3μF	9.0	17.0	32.0	27.5	3.0	0.96 E3	R60GR4330--3--
4.7μF	9.0	17.0	32.0	27.5	3.0	0.96 E3	R60GR4470--3--
6.8μF	11.0	20.0	32.0	27.5	3.0	0.96 E3	R60GR4680--3--

Rated Cap.	250Vdc/160Vac				Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p			
0.068μF	4.0	9.0	13.0	10.0	20	10.0 E3	R60IF 2680--3--
0.10μF	4.0	9.0	13.0	10.0	20	10.0 E3	R60IF 3100--3--
0.15μF	4.0	9.0	13.0	10.0	20	10.0 E3	R60IF 3150--3--
0.22μF	5.0	11.0	13.0	10.0	20	10.0 E3	R60IF 3220--3--
0.33μF	6.0	12.0	13.0	10.0	20	10.0 E3	R60IF 3330--3--
0.10μF	5.0	11.0	18.0	15.0	12	6.0 E3	R60II 3100--3--
0.15μF	5.0	11.0	18.0	15.0	12	6.0 E3	R60II 3150--3--
0.22μF	5.0	11.0	18.0	15.0	12	6.0 E3	R60II 3220--3--
0.33μF	5.0	11.0	18.0	15.0	12	6.0 E3	R60II 3330--3--
0.47μF	6.0	12.0	18.0	15.0	12	6.0 E3	R60II 3470--3--
0.68μF	7.5	13.5	18.0	15.0	12	6.0 E3	R60II 3680--3--
1.0μF	8.5	14.5	18.0	15.0	12	6.0 E3	R60II 4100--3--
1.5μF	10.0	16.0	18.0	15.0	12	6.0 E3	R60II 4150--3--
0.47μF	6.0	15.0	26.5	22.5	8	4.0 E3	R60IN 3470--3--
0.68μF	6.0	15.0	26.5	22.5	8	4.0 E3	R60IN 3680--3--
1.0μF	6.0	15.0	26.5	22.5	8	4.0 E3	R60IN 4100--3--
1.5μF	7.0	16.0	26.5	22.5	8	4.0 E3	R60IN 4150--3--
2.2μF	10.0	18.5	26.5	22.5	8	4.0 E3	R60IN 4220--3--
3.3μF	11.0	20.0	26.5	22.5	8	4.0 E3	R60IN 4330--3--
1.5μF	9.0	17.0	32.0	27.5	5	2.5 E3	R60IR 4150--3--
2.2μF	9.0	17.0	32.0	27.5	5	2.5 E3	R60IR 4220--3--
3.3μF	11.0	20.0	32.0	27.5	5	2.5 E3	R60IR 4330--3--
4.7μF	13.0	22.0	32.0	27.5	5	2.5 E3	R60IR 4470--3--

Mechanical version and packaging (Table 1) _____
 Internal use _____
 Tolerance: J (± 5%); K (± 10%); M (± 20%) _____

All dimensions are in mm.

Note: If the working voltage (V) is lower than the rated voltage (V_R), the capacitor may work at higher dv/dt. In this case the maximum value allowed is obtained multiplying the above value (see table dv/dt) with the ratio V_R/V. The pulse characteristic K₀ depends on the voltage wave-form and in any case it cannot overcome the value given in the above table.

Rated Cap.	400Vdc/200Vac				Max dv/dt (V/ μ s)	Max K ₀ (V ² / μ s)	Part Number
	B	H	L	p			
0.015 μ F	4.0	9.0	13.0	10.0	30.0	24.0 E3	R60MF2150--3--
0.022 μ F	4.0	9.0	13.0	10.0	30.0	24.0 E3	R60MF2220--3--
0.033 μ F	4.0	9.0	13.0	10.0	30.0	24.0 E3	R60MF2330--3--
0.047 μ F	4.0	9.0	13.0	10.0	30.0	24.0 E3	R60MF2470--3--
0.068 μ F	5.0	11.0	13.0	10.0	30.0	24.0 E3	R60MF2680--3--
0.10 μ F	6.0	12.0	13.0	10.0	30.0	24.0 E3	R60MF3100--3--
0.047 μ F	5.0	11.0	18.0	15.0	20.0	16.0 E3	R60MI 2470--3--
0.068 μ F	5.0	11.0	18.0	15.0	20.0	16.0 E3	R60MI 2680--3--
0.10 μ F	5.0	11.0	18.0	15.0	20.0	16.0 E3	R60MI 3100--3--
0.15 μ F	5.0	11.0	18.0	15.0	20.0	16.0 E3	R60MI 3150--3--
0.22 μ F	6.0	12.0	18.0	15.0	20.0	16.0 E3	R60MI 3220--3--
0.33 μ F	7.5	13.5	18.0	15.0	20.0	16.0 E3	R60MI 3330--3--
0.47 μ F	8.5	14.5	18.0	15.0	20.0	16.0 E3	R60MI 3470--3--
0.22 μ F	6.0	15.0	26.5	22.5	10.0	8.0 E3	R60MN3220--3--
0.33 μ F	6.0	15.0	26.5	22.5	10.0	8.0 E3	R60MN3330--3--
0.47 μ F	6.0	15.0	26.5	22.5	10.0	8.0 E3	R60MN3470--3--
0.68 μ F	7.0	16.0	26.5	22.5	10.0	8.0 E3	R60MN3680--3--
1.0 μ F	10.0	18.5	26.5	22.5	10.0	8.0 E3	R60MN4100--3--
1.5 μ F	11.0	20.0	26.5	22.5	10.0	8.0 E3	R60MN4150--3--
0.68 μ F	9.0	17.0	32.0	27.5	8.5	3.4 E3	R60MR3680--3--
1.0 μ F	9.0	17.0	32.0	27.5	8.5	3.4 E3	R60MR4100--3--
1.5 μ F	10.0	20.0	32.0	27.5	8.5	3.4 E3	R60MR4150--3--
2.2 μ F	13.0	22.0	32.0	27.5	8.5	3.4 E3	R60MR4220--3--

Rated Cap.	1000Vdc/250Vac*				Max dv/dt (V/ μ s)	Max K ₀ (V ² / μ s)	Part Number
	B	H	L	p			
1000pF	4.0	9.0	13.0	10.0	60	120 E3	R60QF 1100--0--
1500pF	4.0	9.0	13.0	10.0	60	120 E3	R60QF 1150--0--
2200pF	4.0	9.0	13.0	10.0	60	120 E3	R60QF 1220--0--
3300pF	4.0	9.0	13.0	10.0	60	120 E3	R60QF 1330--0--
4700pF	5.0	11.0	13.0	10.0	60	120 E3	R60QF 1470--0--
6800pF	6.0	12.0	13.0	10.0	60	120 E3	R60QF 1680--0--
0.010 μ F	5.0	11.0	18.0	15.0	30	60 E3	R60QI 2100--0--
0.015 μ F	6.0	12.0	18.0	15.0	30	60 E3	R60QI 2150--0--
0.022 μ F	7.5	13.5	18.0	15.0	30	60 E3	R60QI 2220--0--
0.033 μ F	8.5	14.5	18.0	15.0	30	60 E3	R60QI 2330--0--
0.047 μ F	10.0	16.0	18.0	15.0	30	60 E3	R60QI 2470--0--
0.033 μ F	6.0	15.0	26.5	22.5	15	30 E3	R60QN2330--0--
0.047 μ F	6.0	15.0	26.5	22.5	15	30 E3	R60QN2470--0--
0.068 μ F	8.5	17.0	26.5	22.5	15	30 E3	R60QN2680--0--
0.10 μ F	10.0	18.5	26.5	22.5	15	30 E3	R60QN3100--0--
0.15 μ F	11.0	20.0	32.0	27.5	12	24 E3	R60QR3150--0--
0.22 μ F	13.0	22.0	32.0	27.5	12	24 E3	R60QR3220--0--

Mechanical version and packaging (Table 1)

Internal use

Tolerance: J ($\pm 5\%$); K ($\pm 10\%$); M ($\pm 20\%$)

Rated Cap.	630Vdc/220*Vac				Max dv/dt (V/ μ s)	Max K ₀ (V ² / μ s)	Part Number
	B	H	L	p			
4700pF	4.0	9.0	13.0	10.0	40	50 E3	R60PF 1470--3--
6800pF	4.0	9.0	13.0	10.0	40	50 E3	R60PF 1680--3--
0.010 μ F	4.0	9.0	13.0	10.0	40	50 E3	R60PF 2100--3--
0.015 μ F	4.0	9.0	13.0	10.0	40	50 E3	R60PF 2150--3--
0.022 μ F	5.0	11.0	13.0	10.0	40	50 E3	R60PF 2220--3--
0.033 μ F	6.0	12.0	13.0	10.0	40	50 E3	R60PF 2330--3--
0.047 μ F	6.0	12.0	13.0	10.0	40	50 E3	R60PF 2470--3--
0.033 μ F	5.0	11.0	18.0	15.0	25	31 E3	R60PI 2330--3--
0.047 μ F	5.0	11.0	18.0	15.0	25	31 E3	R60PI 2470--3--
0.068 μ F	6.0	12.0	18.0	15.0	25	31 E3	R60PI 2680--3--
0.10 μ F	7.5	13.5	18.0	15.0	25	31 E3	R60PI 3100--3--
0.15 μ F	8.5	14.5	18.0	15.0	25	31 E3	R60PI 3150--3--
0.10 μ F	6.0	15.0	26.5	22.5	12	15 E3	R60PN3100--3--
0.15 μ F	6.0	15.0	26.5	22.5	12	15 E3	R60PN3150--3--
0.22 μ F	7.0	16.0	26.5	22.5	12	15 E3	R60PN3220--3--
0.33 μ F	10.0	18.5	26.5	22.5	12	15 E3	R60PN3330--3--
0.33 μ F	9.0	17.0	32.0	27.5	10	12 E3	R60PR3330--3--
0.47 μ F	11.0	20.0	32.0	27.5	10	12 E3	R60PR3470--3--
0.68 μ F	13.0	22.0	32.0	27.5	10	12 E3	R60PR3680--3--

Mechanical version and packaging (Table 1)

Internal use

Tolerance: J ($\pm 5\%$); K ($\pm 10\%$); M ($\pm 20\%$)

All dimensions are in mm

Note 1: If the working voltage (V) is lower than the rated voltage (V_R), the capacitor may work at higher dv/dt. In this case the maximum value allowed is obtained multiplying the above value (see table dv/dt) with the ratio V_R/V.
The pulse characteristic K₀ depends on the voltage wave-form and in any case it cannot overcome the value given in the above table.

Note 2: Rated voltages higher than 1000Vdc are available upon request

* Not suitable for across-the-line applications. Please refer to Interference Suppression Capacitors (page 105).

ELECTRICAL CHARACTERISTICS

Rated voltage (V_R): 63 Vdc-100 Vdc- 160 Vdc-250 Vdc
400 Vdc-630 Vdc-1000 Vdc.

Rated temperature (T_R): +85°C

Temperature derated voltage:

for temperatures between +85°C and +105°C a decreasing factor of 1.25% per degree °C on the rated voltage V_R has to be applied.

Capacitance range: 1000pF to 22µF

Capacitance values:

E6 series (IEC 60063 Norm).

Capacitance tolerances (measured at 1 kHz):

± 5% (J); ± 10% (K); ± 20% (M).

Total self-inductance (L): (lead length ~2mm)

Pitch (mm)	10	15	22.5	27.5
L(nH) ≈	9	10	18	18

Dissipation factor (DF):

$tg\delta \times 10^{-4}$ at +25°C ± 5°C

kHz	C ≤ 1µF	C > 1µF
1	≤ 100	≤ 100
10	≤ 150	

Insulation resistance:

Test conditions

Temperature: +25°C ± 5°C

Voltage charge time: 1 min

Voltage charge: 50 Vdc for $V_R < 100$ Vdc
100 Vdc for $V_R \geq 100$ Vdc

Performance

For $V_R \leq 100$ Vdc

≥ 3750 MΩ for C ≤ 0.33µF (50000 MΩ)*

≥ 1250 s for C > 0.33µF (5000 s)*

For $V_R > 100$ Vdc

≥ 30000 MΩ for C ≤ 0.33µF (50000 MΩ)*

≥ 10000 s for C > 0.33µF (17000 s)*

*Typical value

Test voltage between terminations:

1.6 × V_R applied for 2 s at +25°C ± 5°C

TEST METHOD AND PERFORMANCE

Damp heat, steady state:

Test conditions

Temperature: +40°C ± 2°C

Relative humidity (RH): 93% ± 2%

Test duration: 56 days

Performance

Capacitance change $|\Delta C/C|$: ≤ 5%

DF change ($\Delta tg\delta$): ≤ 50 × 10⁻⁴ at 1kHz

Insulation resistance: ≥ 50% of initial limit.

Endurance:

Test conditions

Temperature: +85°C ± 2°C

Test duration: 2000 h

Voltage applied: 1.25 × V_R

Performance

Capacitance change $|\Delta C/C|$: ≤ 5%

DF change ($\Delta tg\delta$): ≤ 50 × 10⁻⁴ at 10kHz for C ≤ 1µF

≤ 30 × 10⁻⁴ at 1kHz for C > 1µF

Insulation resistance: ≥ 50% of initial limit.

Resistance to soldering heat:

Test conditions

Solder bath temperature: +260°C ± 5°C

Dipping time (with heat screen): 10 s ± 1 s

Performance

Capacitance change $|\Delta C/C|$: ≤ 2%

DF change ($\Delta tg\delta$): ≤ 50 × 10⁻⁴ at 10kHz for C ≤ 1µF

≤ 30 × 10⁻⁴ at 1kHz for C > 1µF

Insulation resistance: ≥ initial limit.

Long term stability (after two years):

Storage: standard environmental conditions (see page 10).

Performance

Capacitance change $|\Delta C/C|$: ≤ 3% for C ≤ 0.1µF

≤ 2% for C > 0.1µF

RELIABILITY:

Reference MIL HDB 217

Application conditions:

Temperature: +40°C ± 2°C

Voltage: 0.5 × V_R

Failure rate: ≤ 5 FIT

(1 FIT = 1 × 10⁻⁹ failures/components × h)

Failure criteria:

(according to DIN 44122)

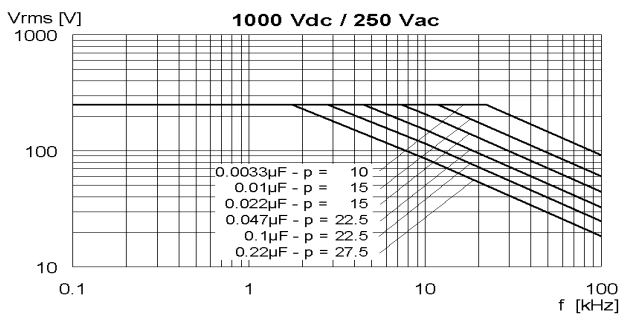
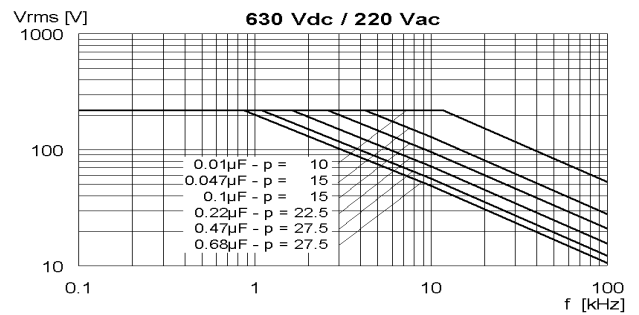
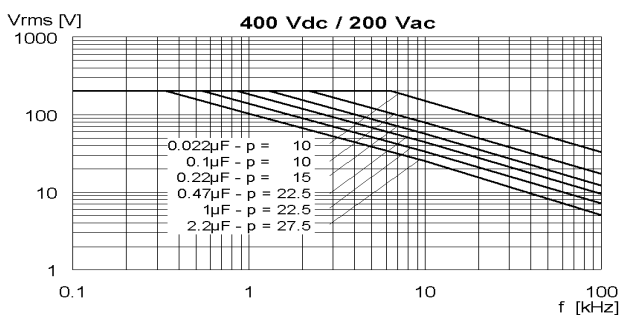
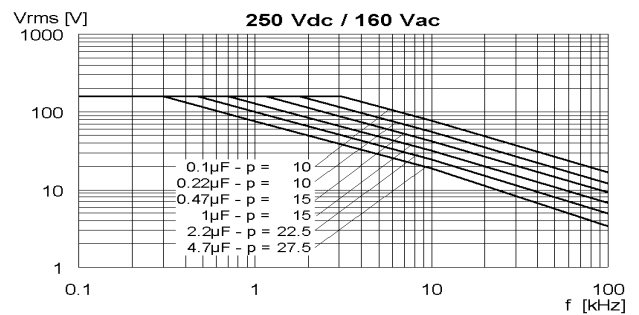
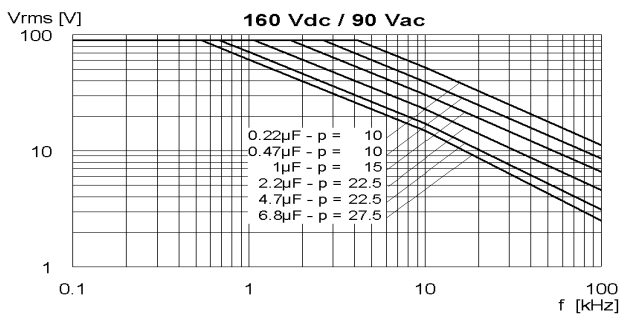
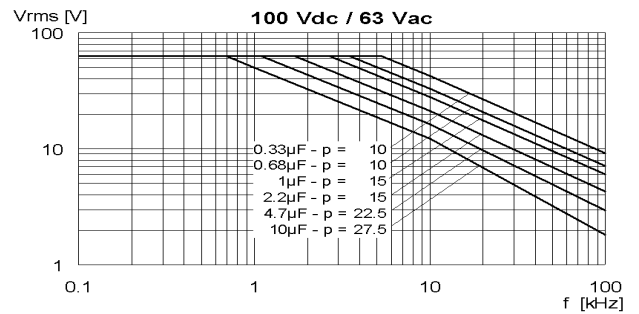
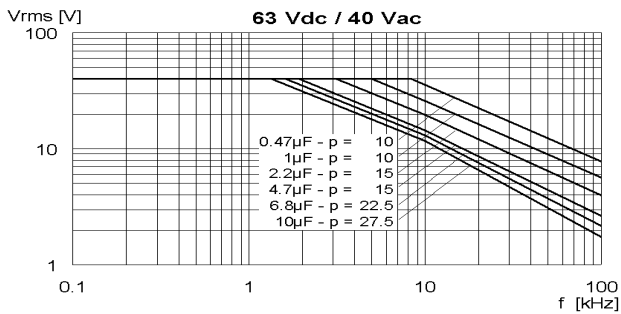
Short or open circuit

Capacitance change $|\Delta C/C|$: > 10%

DF change ($\Delta tg\delta$): > 2 × initial limit.

Insulation resistance: < 0.005 × initial limit.

MAX. VOLTAGE (Vr.m.s.) VERSUS FREQUENCY (sinusoidal wave-form / $T_h \leq 40^\circ\text{C}$)



Note: p (pitch) in mm.