

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

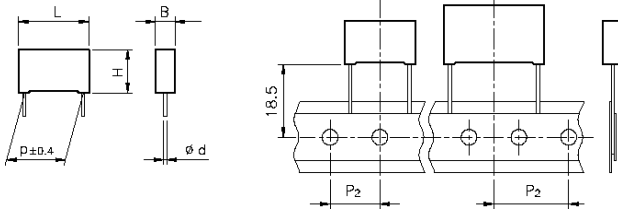
NOTE: Special version, in compliance with DIN 44122 is available upon request.

Construction:

- **STACKED technology for pitch 10 mm**
(Rated Voltage from 63 to 630Vdc)
- **WOUND technology from pitch 10 to 27.5mm**
(Rated Voltage from 63 to 1000Vdc)

Loose

Taped



∅ 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
W = 37.5mm

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, thermosetting 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

For stacked technology an upper operating temperature of +125°C is allowed for a max. operating time of 1000h.

Related documents: IEC 60384-2

Winding scheme

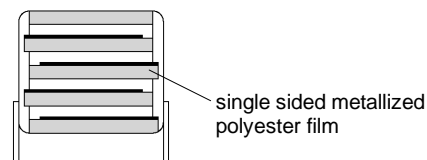


Table 1 (for more detailed information, please refer to page 16)

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 ∅ 355mm		12.70	1	10.0/15.0	GY
REEL ∅ 500mm		12.70	1	10.0/15.0	CK
REEL ∅ 500mm		19.05	2	22.5/27.5	CK
Loose, short leads	4 +2				AA
Loose, long leads (p=10mm)	17 +1/-2				Z3
Loose, long leads (p ≥ 15mm)	30 +5 25 +2/-1				40 50

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

NEW

STACKED VERSION

Rated Cap.	63Vdc/40Vac					Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p				
1.0μF	4.0	9.0	13.0	10.0	50	6.3 E3	R60DF 4100--6--	
1.5μF	5.0	11.0	13.0	10.0	50	6.3 E3	R60DF 4150--6--	
2.2μF	5.0	11.0	13.0	10.0	50	6.3 E3	R60DF 4220--6--	
3.3μF	6.0	12.0	13.0	10.0	50	6.3 E3	R60DF 4330--6--	

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	75	15 E3	R60EF 3330--6--	
0.47μF	4.0	9.0	13.0	10.0	75	15 E3	R60EF 3470--6--	
0.68μF	4.0	9.0	13.0	10.0	75	15 E3	R60EF 3680--6--	
1μF	5.0	11.0	13.0	10.0	75	15 E3	R60EF 4100--6--	
1.5μF	5.0	11.0	13.0	10.0	75	15 E3	R60EF 4150--6--	

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	100	32 E3	R60GF 3220--6--	
0.33μF	4.0	9.0	13.0	10.0	100	32 E3	R60GF 3330--6--	
0.47μF	5.0	11.0	13.0	10.0	100	32 E3	R60GF 3470--6--	
0.68μF	6.0	12.0	13.0	10.0	100	32 E3	R60GF 3680--6--	

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

Rated Cap.	250Vdc/160Vac					Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p				
0.10μF	4.0	9.0	13.0	10.0	150	75 E3	R60IF 3100--6--	
0.15μF	4.0	9.0	13.0	10.0	150	75 E3	R60IF 3150--6--	
0.22μF	5.0	11.0	13.0	10.0	150	75 E3	R60IF 3220--6--	
0.33μF	5.0	11.0	13.0	10.0	150	75 E3	R60IF 3330--6--	
0.47μF	6.0	12.0	13.0	10.0	150	75 E3	R60IF 3470--6--	

Rated Cap.	400Vdc/200Vac					Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p				
0.033μF	4.0	9.0	13.0	10.0	175	140 E3	R60MF 2330--6--	
0.047μF	4.0	9.0	13.0	10.0	175	140 E3	R60MF 2470--6--	
0.068μF	4.0	9.0	13.0	10.0	175	140 E3	R60MF 2680--6--	
0.10μF	5.0	11.0	13.0	10.0	175	140 E3	R60MF 3100--6--	
0.15μF	6.0	12.0	13.0	10.0	175	140 E3	R60MF 3150--6--	

Rated Cap.	630Vdc/220*Vac					Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p				
1000pF	4.0	9.0	13.0	10.0	200	250 E3		
1500pF	4.0	9.0	13.0	10.0	200	250 E3		
2200pF	4.0	9.0	13.0	10.0	200	250 E3		
3300pF	4.0	9.0	13.0	10.0	200	250 E3		
4700pF	4.0	9.0	13.0	10.0	200	250 E3		
6800pF	4.0	9.0	13.0	10.0	200	250 E3		
0.010μF	4.0	9.0	13.0	10.0	200	250 E3	R60PF 2100--6--	
0.015μF	4.0	9.0	13.0	10.0	200	250 E3	R60PF 2150--6--	
0.022μF	4.0	9.0	13.0	10.0	200	250 E3	R60PF 2220--6--	
0.033μF	5.0	11.0	13.0	10.0	200	250 E3	R60PF 2330--6--	
0.047μF	5.0	11.0	13.0	10.0	200	250 E3	R60PF 2470--6--	

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

In Progress

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.

*Not suitable for across-the-line applications. Please refer to Interference Suppression Capacitors (page 109).

WOUND VERSION

Rated Cap.	400Vdc/200Vac				Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p			
0.015μF	4.0	9.0	13.0	10.0	30.0	24.0 E3	R60MF2150--3--
0.022μF	4.0	9.0	13.0	10.0	30.0	24.0 E3	R60MF2220--3--
0.033μF	4.0	9.0	13.0	10.0	30.0	24.0 E3	R60MF2330--3--
0.047μF	4.0	9.0	13.0	10.0	30.0	24.0 E3	R60MF2470--3--
0.068μF	5.0	11.0	13.0	10.0	30.0	24.0 E3	R60MF2680--3--
0.10μF	6.0	12.0	13.0	10.0	30.0	24.0 E3	R60MF3100--3--
0.047μF	5.0	11.0	18.0	15.0	20.0	16.0 E3	R60MI2470--3--
0.068μF	5.0	11.0	18.0	15.0	20.0	16.0 E3	R60MI2680--3--
0.10μF	5.0	11.0	18.0	15.0	20.0	16.0 E3	R60MI3100--3--
0.15μF	5.0	11.0	18.0	15.0	20.0	16.0 E3	R60MI3150--3--
0.22μF	6.0	12.0	18.0	15.0	20.0	16.0 E3	R60MI3220--3--
0.33μF	7.5	13.5	18.0	15.0	20.0	16.0 E3	R60MI3330--3--
0.33μF	9.0	12.5	18.0	15.0	20.0	16.0 E3	R60MI3330--L--
0.47μF	8.5	14.5	18.0	15.0	20.0	16.0 E3	R60MI3470--3--
0.47μF	13.0	12.0	18.0	15.0	20.0	16.0 E3	R60MI3470--L--
0.68μF	11.0	19.0	18.0	15.0	20.0	16.0 E3	R60MI3680--3--
0.22μF	6.0	15.0	26.5	22.5	10.0	8.0 E3	R60MN3220--3--
0.33μF	6.0	15.0	26.5	22.5	10.0	8.0 E3	R60MN3330--3--
0.47μF	6.0	15.0	26.5	22.5	10.0	8.0 E3	R60MN3470--3--
0.68μF	7.0	16.0	26.5	22.5	10.0	8.0 E3	R60MN3680--3--
1.0μF	10.0	18.5	26.5	22.5	10.0	8.0 E3	R60MN4100--3--
1.5μF	11.0	20.0	26.5	22.5	10.0	8.0 E3	R60MN4150--3--
0.68μF	9.0	17.0	32.0	27.5	8.5	3.4 E3	R60MR3680--3--
1.0μF	9.0	17.0	32.0	27.5	8.5	3.4 E3	R60MR4100--3--
1.5μF	10.0	20.0	32.0	27.5	8.5	3.4 E3	R60MR4150--3--
2.2μF	13.0	22.0	32.0	27.5	8.5	3.4 E3	R60MR4220--3--
3.3μF	14.0	28.0	32.0	27.5	8.5	3.4 E3	R60MR4330--3--
4.7μF	18.0	33.0	32.0	27.5	8.5	3.4 E3	R60MR4470--3--
6.8μF	22.0	37.0	32.0	27.5	8.5	3.4 E3	R60MR4680--3--
3.3μF	11.0	22.0	41.5	37.5	6.0	2.4 E3	R60MW4330--3--
4.7μF	13.0	24.0	41.5	37.5	6.0	2.4 E3	R60MW4470--3--
6.8μF	16.0	28.5	41.5	37.5	6.0	2.4 E3	R60MW4680--3--
10.0μF	19.0	32.0	41.5	37.5	6.0	2.4 E3	R60MW5100--3--
15.0μF	24.0	44.0	41.5	37.5	6.0	2.4 E3	R60MW5150--3--

Rated Cap.	1000Vdc/250Vac*				Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p			
1000pF	4.0	9.0	13.0	10.0	60	120 E3	R60QF1100--0--
1500pF	4.0	9.0	13.0	10.0	60	120 E3	R60QF1150--0--
2200pF	4.0	9.0	13.0	10.0	60	120 E3	R60QF1220--0--
3300pF	4.0	9.0	13.0	10.0	60	120 E3	R60QF1330--0--
4700pF	5.0	11.0	13.0	10.0	60	120 E3	R60QF1470--0--
6800pF	6.0	12.0	13.0	10.0	60	120 E3	R60QF1680--0--
0.010μF	5.0	11.0	18.0	15.0	30	60 E3	R60QI2100--0--
0.015μF	5.0	11.0	18.0	15.0	30	60 E3	R60QI2150--3--
0.022μF	6.0	12.0	18.0	15.0	30	60 E3	R60QI2220--3--
0.033μF	7.5	13.5	18.0	15.0	30	60 E3	R60QI2330--3--
0.033μF	9.0	12.5	18.0	15.0	30	60 E3	R60QI2330--L--
0.047μF	10.0	16.0	18.0	15.0	30	60 E3	R60QI2470--0--
0.047μF	13.0	12.0	18.0	15.0	30	60 E3	R60QI2470--L--
0.068μF	11.0	19.0	18.0	15.0	30	60 E3	R60QI2680--0--
0.033μF	6.0	15.0	26.5	22.5	15	30 E3	R60QN2330--0--
0.047μF	6.0	15.0	26.5	22.5	15	30 E3	R60QN2470--0--
0.068μF	7.0	16.0	26.5	22.5	15	30 E3	R60QN2680--3--
0.10μF	8.5	17.0	26.5	22.5	15	30 E3	R60QN3100--3--
0.15μF	13.0	22.0	26.5	22.5	15	30 E3	R60QN3150--0--
0.15μF	9.0	17.0	32.0	27.5	12	24 E3	R60QR3150--3--
0.22μF	11.0	20.0	32.0	27.5	12	24 E3	R60QR3220--3--
0.33μF	13.0	22.0	32.0	27.5	12	24 E3	R60QR3330--3--
0.47μF	14.0	28.0	32.0	27.5	12	24 E3	R60QR3470--3--
0.68μF	18.0	33.0	32.0	27.5	12	24 E3	R60QR3680--3--
1.0μF	22.0	37.0	32.0	27.5	12	24 E3	R60QR4100--3--
0.47μF	11.0	22.0	41.5	37.5	10	20 E3	R60QW3470--3--
0.68μF	13.0	24.0	41.5	37.5	10	20 E3	R60QW3680--3--
1.0μF	16.0	28.5	41.5	37.5	10	20 E3	R60QW4100--3--
1.5μF	20.0	40.0	41.5	37.5	10	20 E3	R60QW4150--3--
2.2μF	24.0	44.0	41.5	37.5	10	20 E3	R60QW4220--3--

Mechanical version and packaging (Table 1)

Internal use

Tolerance: J (± 5%); K (± 10%); M (± 20%)

Rated Cap.	630Vdc/220*Vac				Max dv/dt (V/μs)	Max K ₀ (V ² /μs)	Part Number
	B	H	L	p			
4700pF	4.0	9.0	13.0	10.0	40	50 E3	R60PF1470--3--
6800pF	4.0	9.0	13.0	10.0	40	50 E3	R60PF1680--3--
0.010μF	4.0	9.0	13.0	10.0	40	50 E3	R60PF2100--3--
0.015μF	4.0	9.0	13.0	10.0	40	50 E3	R60PF2150--3--
0.022μF	5.0	11.0	13.0	10.0	40	50 E3	R60PF2220--3--
0.033μF	6.0	12.0	13.0	10.0	40	50 E3	R60PF2330--3--
0.047μF	6.0	12.0	13.0	10.0	40	50 E3	R60PF2470--3--
0.033μF	5.0	11.0	18.0	15.0	25	31 E3	R60PI2330--3--
0.047μF	5.0	11.0	18.0	15.0	25	31 E3	R60PI2470--3--
0.068μF	6.0	12.0	18.0	15.0	25	31 E3	R60PI2680--3--
0.10μF	7.5	13.5	18.0	15.0	25	31 E3	R60PI3100--3--
0.15μF	8.5	14.5	18.0	15.0	25	31 E3	R60PI3150--3--
0.10μF	6.0	15.0	26.5	22.5	12	15 E3	R60PN3100--3--
0.15μF	6.0	15.0	26.5	22.5	12	15 E3	R60PN3150--3--
0.22μF	7.0	16.0	26.5	22.5	12	15 E3	R60PN3220--3--
0.33μF	10.0	18.5	26.5	22.5	12	15 E3	R60PN3330--3--
0.33μF	9.0	17.0	32.0	27.5	10	12 E3	R60PR3330--3--
0.47μF	11.0	20.0	32.0	27.5	10	12 E3	R60PR3470--3--
0.68μF	13.0	22.0	32.0	27.5	10	12 E3	R60PR3680--3--
1.0μF	14.0	28.0	32.0	27.5	10	12 E3	R60PR4100--4--
1.5μF	18.0	33.0	32.0	27.5	10	12 E3	R60PR4150--3--
2.2μF	22.0	37.0	32.0	27.5	10	12 E3	R60PR4220--3--
1.0μF	11.0	22.0	41.5	37.5	8	9.6 E3	R60PW4100--3--
1.5μF	13.0	24.0	41.5	37.5	8	9.6 E3	R60PW4150--3--
2.2μF	16.0	28.5	41.5	37.5	8	9.6 E3	R60PW4220--3--
3.3μF	20.0	40.0	41.5	37.5	8	9.6 E3	R60PW4330--3--
4.7μF	24.0	44.0	41.5	37.5	8	9.6 E3	R60PW4470--3--

Mechanical version and packaging (Table 1)

Internal use

Tolerance: J (± 5%); K (± 10%); M (± 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 109).

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 the upper operating temperature (+105°C for wound technology and +125°C for stacked technology) a decreasing factor of 1.25% per degree °C on the rated voltage V_R has to be applied.

Capacitance range: 1000pF to 100µF

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	37.5
L(nH) ≈	9	10	18	18	22

Dissipation factor (DF):

tgδ × 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 ≥ 100 Vdc

Performance

For V_R ≤ 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 |ΔC/C|: ≤ 5%

DF change (Δtgδ): ≤ 50 × 10⁻⁴ at 1kHz

Insulation resistance: ≥ 50% of initial limit.

Endurance:

Test conditions

Temperature: +100°C ± 2°C

Test duration: 2000 h

Voltage applied: 1.25 × V_C

Performance

Capacitance change |ΔC/C|: ≤ 5%

DF change (Δtgδ): ≤ 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 |ΔC/C|: ≤ 2%

DF change (Δtgδ): ≤ 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 11).

Performance

Capacitance change |ΔC/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:

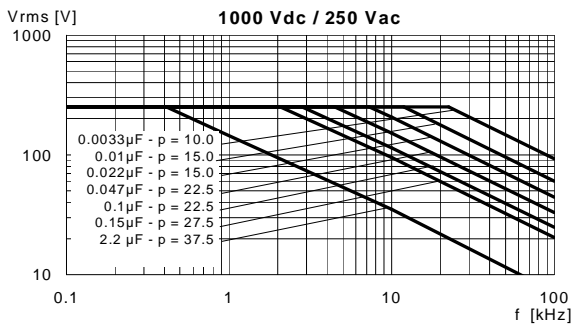
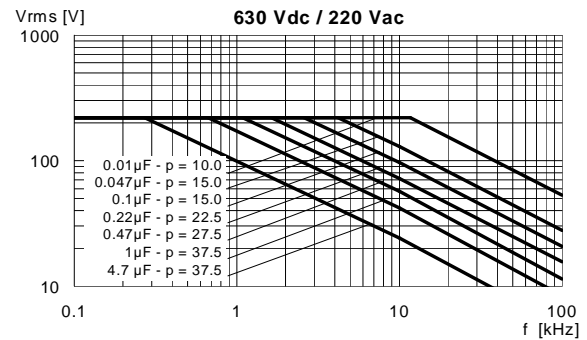
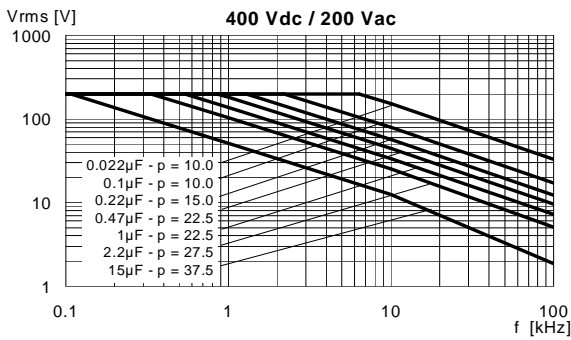
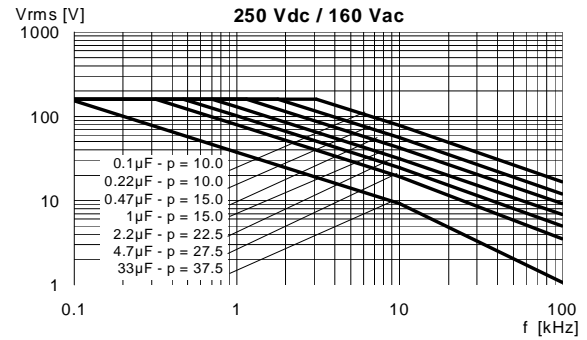
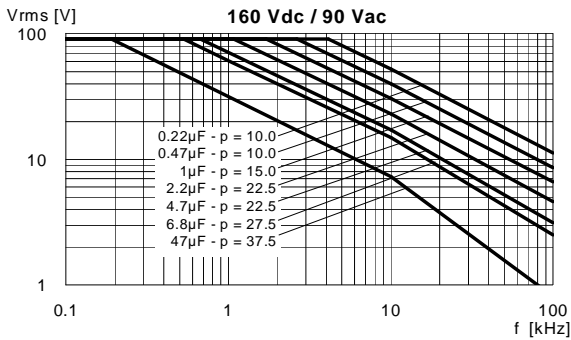
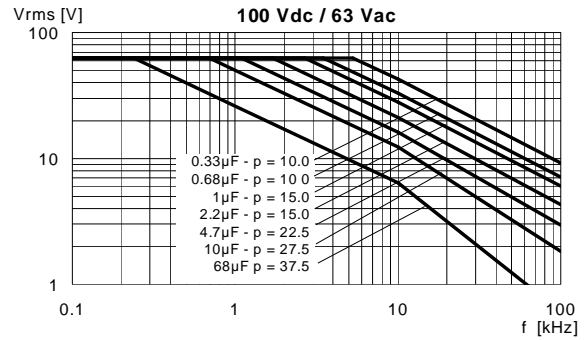
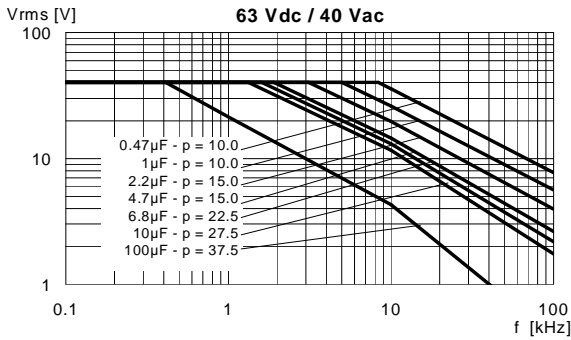
Short or open circuit

Capacitance change |ΔC/C|: > 10%

DF change (Δtgδ): > 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: ρ (pitch) in mm.