

| | | | |
|----------|--------|--------|----------|
| Ød ±0.05 | p = 10 | p > 10 | p = 37.5 |
| | 0.6 | 0.8 | 1.0 |

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:
C =50V 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%.

Table 1 (for more detailed information, please refer to page 14)

| 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 Ø 355mm | | 12.70 | 1 | 10.0/15.0 | GY |
| REEL Ø 500mm | | 12.70 | 1 | 10.0/15.0 | CK |
| REEL Ø 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 | | | | 40 |
| | 25 ^{+2/-1} | | | | 50 |

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

**METALLIZED POLYESTER FILM CAPACITOR
D.C. MULTIPURPOSE APPLICATIONS**

Typical applications: 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 10mm**
(Rated Voltage from 50 to 630Vdc)
- **WOUND technology from pitch 10 to 27.5mm**
(Rated Voltage from 63 to 1000Vdc)

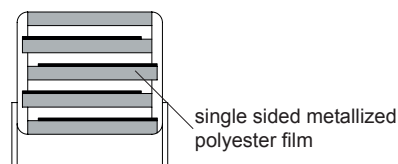
| Pitch (mm) | Box thickness (B) (mm) | Maximum dimensions (mm) | | |
|------------|------------------------|-------------------------|--------|--------|
| | | B max | H max | L max |
| 10.0 | All | B +0.2 | H +0.1 | L +0.2 |
| 15.0 | <7.5 | B +0.2 | H +0.1 | L +0.3 |
| 15.0 | ≥7.5 | B +0.2 | H +0.1 | L +0.5 |
| 22.5 | All | B +0.2 | H +0.1 | L +0.3 |
| 27.5 | All | B +0.2 | H +0.1 | L +0.3 |
| 37.5 | All | B +0.3 | H +0.1 | L +0.3 |

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.
- Marking:** Manufacturer's logo (if requested), capacitance, tolerance, D.C. rated voltage.
- Climatic category:** 55/105/56 IEC 60068-1
- Operating temperature range:** -55 to +105°C
Upper operating temperature of +125°C is allowed for a max.operating time of 1000h.

Related documents: IEC 60384-2

Winding scheme



**METALLIZED POLYESTER FILM CAPACITOR
D.C. MULTIPURPOSE APPLICATIONS**

PRODUCT CODE: R60

STACKED VERSION

| Rated Cap. | 50Vdc/30Vac Std dimensions | | | | Max dv/dt (V/μs) | Max K ₀ (V ² /μs) | Part Number |
|------------|-------------------------------|------|------|------|---------------------|--|----------------|
| | B | H | L | p | | | |
| 1.5 μF | 4.0 | 9.0 | 13.0 | 10.0 | 30 | 3 E3 | R60CF4150--6-- |
| 2.2 μF | 4.0 | 9.0 | 13.0 | 10.0 | 30 | 3 E3 | R60CF4220--6-- |
| 3.3 μF | 5.0 | 11.0 | 13.0 | 10.0 | 30 | 3 E3 | R60CF4330--6-- |
| 4.7 μF | 6.0 | 12.0 | 13.0 | 10.0 | 30 | 3 E3 | R60CF4470--6-- |
| 5.6 μF | 6.0 | 12.0 | 13.0 | 10.0 | 30 | 3 E3 | R60CF4560--6-- |

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

| Rated Cap. | 63Vdc/40Vac Std dimensions | | | | Max dv/dt (V/μs) | Max K ₀ (V ² /μs) | Part Number |
|------------|-------------------------------|------|------|------|---------------------|--|----------------|
| | B | H | L | p | | | |
| 1.0 μF | 4.0 | 9.0 | 13.0 | 10.0 | 50 | 6.3 E3 | R60DF4100--6-- |
| 1.5 μF | 5.0 | 11.0 | 13.0 | 10.0 | 50 | 6.3 E3 | R60DF4150--6-- |
| 2.2 μF | 5.0 | 11.0 | 13.0 | 10.0 | 50 | 6.3 E3 | R60DF4220--6-- |
| 3.3 μF | 6.0 | 12.0 | 13.0 | 10.0 | 50 | 6.3 E3 | R60DF4330--6-- |

| Rated Cap. | 400Vdc/200Vac Std dimensions | | | | Max dv/dt (V/μs) | Max K ₀ (V ² /μs) | Part Number |
|------------|---------------------------------|------|------|------|---------------------|--|----------------|
| | B | H | L | p | | | |
| 0.033 μF | 4.0 | 9.0 | 13.0 | 10.0 | 175 | 140 E3 | R60MF2330--6-- |
| 0.047 μF | 4.0 | 9.0 | 13.0 | 10.0 | 175 | 140 E3 | R60MF2470--6-- |
| 0.068 μF | 4.0 | 9.0 | 13.0 | 10.0 | 175 | 140 E3 | R60MF2680--6-- |
| 0.10 μF | 5.0 | 11.0 | 13.0 | 10.0 | 175 | 140 E3 | R60MF3100--6-- |
| 0.15 μF | 6.0 | 12.0 | 13.0 | 10.0 | 175 | 140 E3 | R60MF3150--6-- |

| Rated Cap. | 100Vdc/63Vac Std dimensions | | | | Max dv/dt (V/μs) | Max K ₀ (V ² /μs) | Part Number |
|------------|--------------------------------|------|------|------|---------------------|--|-----------------|
| | B | H | L | p | | | |
| 0.33 μF | 4.0 | 9.0 | 13.0 | 10.0 | 75 | 15 E3 | R60EF 3330--6-- |
| 0.47 μF | 4.0 | 9.0 | 13.0 | 10.0 | 75 | 15 E3 | R60EF 3470--6-- |
| 0.68 μF | 4.0 | 9.0 | 13.0 | 10.0 | 75 | 15 E3 | R60EF 3680--6-- |
| 1.0 μF | 5.0 | 11.0 | 13.0 | 10.0 | 75 | 15 E3 | R60EF 4100--6-- |
| 1.5 μF | 5.0 | 11.0 | 13.0 | 10.0 | 75 | 15 E3 | R60EF 4150--6-- |

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

| Rated Cap. | 160Vdc/90Vac Std dimensions | | | | Max dv/dt (V/μs) | Max K ₀ (V ² /μs) | Part Number |
|------------|--------------------------------|------|------|------|---------------------|--|-----------------|
| | B | H | L | p | | | |
| 0.22 μF | 4.0 | 9.0 | 13.0 | 10.0 | 100 | 32 E3 | R60GF 3220--6-- |
| 0.33 μF | 4.0 | 9.0 | 13.0 | 10.0 | 100 | 32 E3 | R60GF 3330--6-- |
| 0.47 μF | 5.0 | 11.0 | 13.0 | 10.0 | 100 | 32 E3 | R60GF 3470--6-- |
| 0.68 μF | 6.0 | 12.0 | 13.0 | 10.0 | 100 | 32 E3 | R60GF 3680--6-- |

Mechanical version and packaging (Table1) _____
 Internal use _____
 Tolerance: J (±5%); K (±10%); M (±20%) _____

Mechanical version and packaging (Table1) _____
 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.

*Not suitable for across-the-line applications. Please refer to Interference Suppression Capacitors (page 145).

**METALLIZED POLYESTER FILM CAPACITOR
D.C. MULTIPURPOSE APPLICATIONS**

PRODUCT CODE: **R60**

WOUND VERSION

| Rated Cap. | 1000Vdc/250Vac* Std dimensions | | | | Max dv/dt (V/μs) | Max K ₀ (V ² /μs) | Part Number |
|------------|-----------------------------------|------|------|------|---------------------|--|-----------------|
| | B | H | L | p | | | |
| 1000 pF | 4.0 | 9.0 | 13.0 | 10.0 | 60 | 120 E3 | R60QF 1100--0-- |
| 1500 pF | 4.0 | 9.0 | 13.0 | 10.0 | 60 | 120 E3 | R60QF 1150--0-- |
| 2200 pF | 4.0 | 9.0 | 13.0 | 10.0 | 60 | 120 E3 | R60QF 1220--0-- |
| 3300 pF | 4.0 | 9.0 | 13.0 | 10.0 | 60 | 120 E3 | R60QF 1330--0-- |
| 4700 pF | 5.0 | 11.0 | 13.0 | 10.0 | 60 | 120 E3 | R60QF 1470--0-- |
| 6800 pF | 6.0 | 12.0 | 13.0 | 10.0 | 60 | 120 E3 | R60QF 1680--0-- |
| 0.010 μF | 5.0 | 11.0 | 18.0 | 15.0 | 30 | 60 E3 | R60QI 2100--0-- |
| 0.015 μF | 5.0 | 11.0 | 18.0 | 15.0 | 30 | 60 E3 | R60QI 2150--3-- |
| 0.022 μF | 6.0 | 12.0 | 18.0 | 15.0 | 30 | 60 E3 | R60QI 2220--3-- |
| 0.033 μF | 7.5 | 13.5 | 18.0 | 15.0 | 30 | 60 E3 | R60QI 2330--3-- |
| 0.033 μF | 9.0 | 12.5 | 18.0 | 15.0 | 30 | 60 E3 | R60QI 2330--L-- |
| 0.047 μF | 10.0 | 16.0 | 18.0 | 15.0 | 30 | 60 E3 | R60QI 2470--0-- |
| 0.047 μF | 13.0 | 12.0 | 18.0 | 15.0 | 30 | 60 E3 | R60QI 2470--L-- |
| 0.068 μF | 11.0 | 19.0 | 18.0 | 15.0 | 30 | 60 E3 | R60QI 2680--0-- |
| 0.033 μF | 6.0 | 15.0 | 26.5 | 22.5 | 15 | 30 E3 | R60QN2330--0-- |
| 0.047 μF | 6.0 | 15.0 | 26.5 | 22.5 | 15 | 30 E3 | R60QN2470--0-- |
| 0.068 μF | 7.0 | 16.0 | 26.5 | 22.5 | 15 | 30 E3 | R60QN2680--3-- |
| 0.10 μF | 8.5 | 17.0 | 26.5 | 22.5 | 15 | 30 E3 | R60QN3100--3-- |
| 0.15 μF | 13.0 | 22.0 | 26.5 | 22.5 | 15 | 30 E3 | R60QN3150--0-- |
| 0.15 μF | 9.0 | 17.0 | 32.0 | 27.5 | 12 | 24 E3 | R60QR3150--3-- |
| 0.22 μF | 9.0 | 17.0 | 32.0 | 27.5 | 12 | 24 E3 | R60QR3220--4-- |
| 0.33 μF | 11.0 | 20.0 | 32.0 | 27.5 | 12 | 24 E3 | R60QR3330--4-- |
| 0.47 μF | 13.0 | 22.0 | 32.0 | 27.5 | 12 | 24 E3 | R60QR3470--4-- |
| 0.68 μF | 14.0 | 28.0 | 32.0 | 27.5 | 12 | 24 E3 | R60QR3680--4-- |
| 1.00 μF | 18.0 | 33.0 | 32.0 | 27.5 | 12 | 24 E3 | R60QR4100--4-- |
| 1.50 μF | 22.0 | 37.0 | 32.0 | 27.5 | 12 | 24 E3 | R60QR4150--4-- |
| 0.47 μF | 11.0 | 22.0 | 41.5 | 37.5 | 10 | 20 E3 | R60QW3470--3-- |
| 0.68 μF | 11.0 | 22.0 | 41.5 | 37.5 | 10 | 20 E3 | R60QW3680--4-- |
| 1.00 μF | 13.0 | 24.0 | 41.5 | 37.5 | 10 | 20 E3 | R60QW4100--4-- |
| 1.50 μF | 16.0 | 28.5 | 41.5 | 37.5 | 10 | 20 E3 | R60QW4150--4-- |
| 2.20 μF | 19.0 | 32.0 | 41.5 | 37.5 | 10 | 20 E3 | R60QW4220--3-- |
| 3.30 μF | 24.0 | 44.0 | 41.5 | 37.5 | 10 | 20 E3 | R60QW4330--0-- |
| 4.70 μF | 30.0 | 45.0 | 41.5 | 37.5 | 10 | 20 E3 | R60QW4470--4-- |

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 151).

Mechanical version and packaging (Table1) _____
 Internal use _____
 Tolerance: J (±5%); K (±10%); M (±20%) _____

**METALLIZED POLYESTER FILM CAPACITOR
D.C. MULTIPURPOSE APPLICATIONS**

PRODUCT CODE: R60

ELECTRICAL CHARACTERISTICS**Rated voltage (V_R):** 50Vdc - 63Vdc - 100Vdc - 160Vdc
- 250Vdc - 400Vdc - 630Vdc - 1000Vdc .**Rated temperature (T_R):** +85°C**Temperature derated voltage:**for temperatures between +85°C and +125°C
a decreasing factor of 1.25% per degree °C on the rated
voltage V_R (d.c. and a.c.) has to be applied.**Capacitance range:** 1000pF to 220 μ F**Capacitance values:**

E6 series (IEC 60063 Norm).

Capacitance tolerances (measured at 1 kHz):
 $\pm 5\%$ (J); $\pm 10\%$ (K); $\pm 20\%$ (M).**Total self-inductance (L):** (lead length ~2mm)

| Pitch (mm) | 10 | 15 | 22.5 | 27.5 | 37.5 |
|-----------------|----|----|------|------|------|
| L(nH) \approx | 9 | 10 | 18 | 18 | 22 |

Dissipation factor (DF): $\text{tg}\delta$ 10^{-4} at +25°C $\pm 5^\circ\text{C}$

| kHz | C $\leq 1\mu\text{F}$ | C $> 1\mu\text{F}$ |
|-----|-----------------------|--------------------|
| 1 | ≤ 100 | ≤ 100 |
| 10 | ≤ 150 | |

Insulation resistance:**Test conditions**

Temperature: +25°C $\pm 5^\circ\text{C}$
 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 M Ω for C $\leq 0.33\mu\text{F}$ (50000 M Ω)*
 ≥ 1250 s for C $> 0.33\mu\text{F}$ (5000 s)*

For $V_R > 100$ Vdc
 ≥ 30000 M Ω for C $\leq 0.33\mu\text{F}$ (50000 M Ω)*
 ≥ 10000 s for C $> 0.33\mu\text{F}$ (17000 s)*

*Typical value

Test voltage between terminations:1.6x V_R applied for 2 s at +25°C $\pm 5^\circ\text{C}$ **TEST METHOD AND PERFORMANCE****Damp heat, steady state:****Test conditions**

Temperature: +40°C $\pm 2^\circ\text{C}$
 Relative humidity (RH): 93% $\pm 2\%$
 Test duration: 56 days

Performance

Capacitance change $|\Delta C/C|$: $\leq 5\%$
 DF change ($\Delta \text{tg}\delta$): $\leq 50 \times 10^{-4}$ at 1kHz
 Insulation resistance: $\geq 50\%$ of initial limit.

Endurance:**Test conditions**

Temperature: +105°C $\pm 2^\circ\text{C}$
 Test duration: 2000 h
 Voltage applied: 1.25x V_C

Performance

Capacitance change $|\Delta C/C|$: $\leq 5\%$
 DF change ($\Delta \text{tg}\delta$): $\leq 50 \times 10^{-4}$ at 10kHz for C $\leq 1\mu\text{F}$
 $\leq 30 \times 10^{-4}$ at 1kHz for C $> 1\mu\text{F}$

Insulation resistance: $\geq 50\%$ of initial limit.**Resistance to soldering heat:****Test conditions**

Solder bath temperature: +260°C $\pm 5^\circ\text{C}$
 Dipping time (with heat screen): 10 s ± 1 s

Performance

Capacitance change $|\Delta C/C|$: $\leq 2\%$
 DF change ($\Delta \text{tg}\delta$): $\leq 50 \times 10^{-4}$ at 10kHz for C $\leq 1\mu\text{F}$
 $\leq 30 \times 10^{-4}$ at 1kHz for C $> 1\mu\text{F}$

Insulation resistance: \geq initial limit.**Long term stability** (after two years):**Storage:** standard environmental conditions (see page 12).**Performance**

Capacitance change $|\Delta C/C|$: $\leq 3\%$ for C $\leq 0.1\mu\text{F}$
 $\leq 2\%$ for C $> 0.1\mu\text{F}$

RELIABILITY:

Reference MIL HDB 217

Application conditions:

Temperature: +40°C $\pm 2^\circ\text{C}$
 Voltage: 0.5x V_R
 Failure rate: ≤ 5 FIT
 (1 FIT = 1×10^{-9} failures/componentsxh)

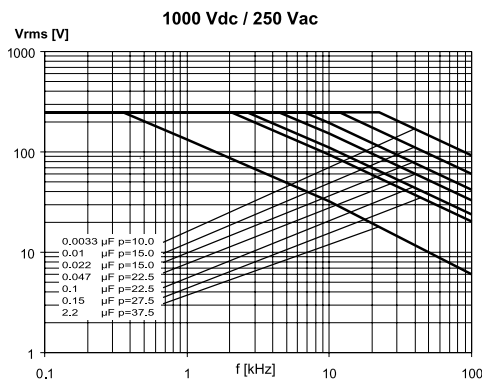
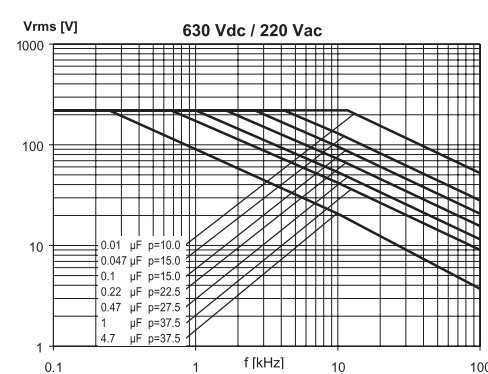
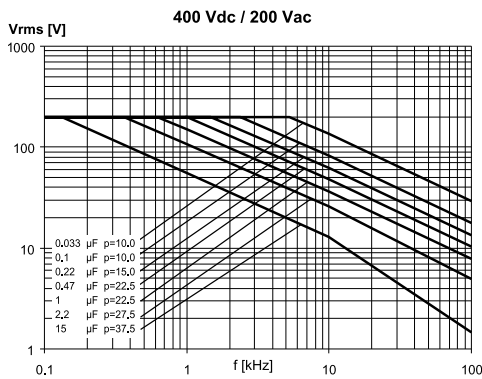
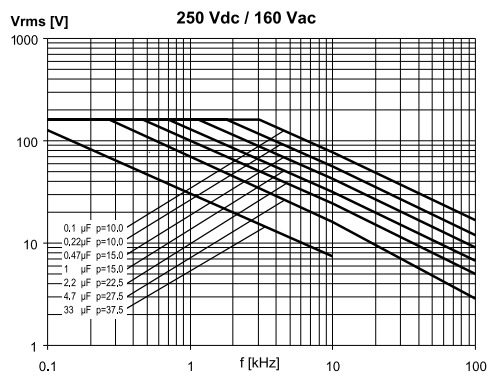
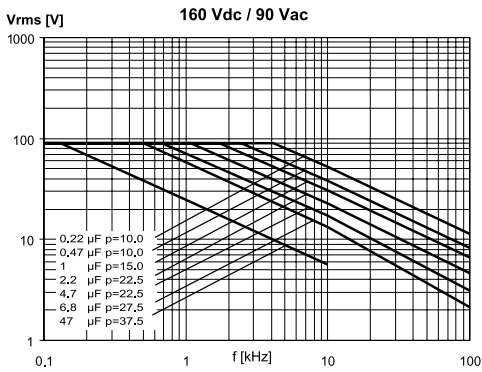
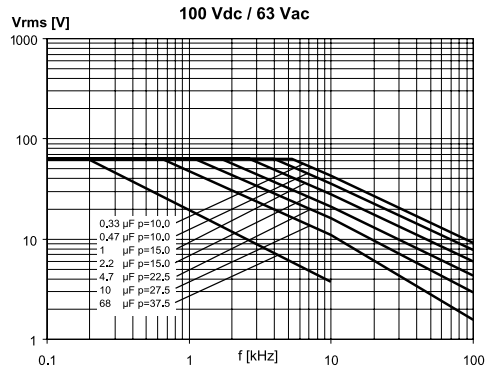
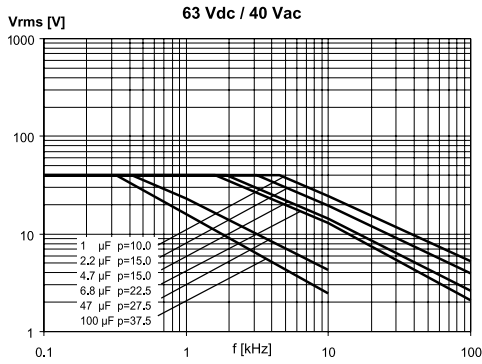
Failure criteria:

Short or open circuit
 Capacitance change $|\Delta C/C|$: $> 10\%$
 DF change ($\Delta \text{tg}\delta$): $> 2 \times$ initial limit.
 Insulation resistance: $< 0.005 \times$ initial limit.

**METALLIZED POLYESTER FILM CAPACITOR
D.C. MULTIPURPOSE APPLICATIONS**

PRODUCT CODE: R60

MAX. VOLTAGE (Vr.m.s.) VERSUS FREQUENCY (sinusoidal wave-form / Th ≤ 40°C)

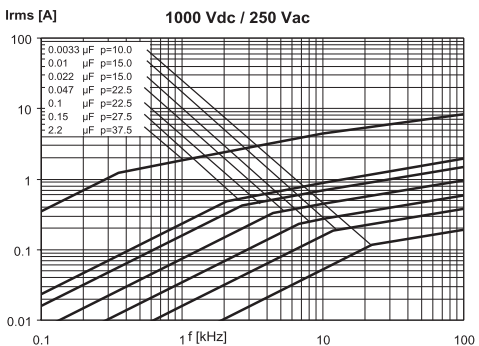
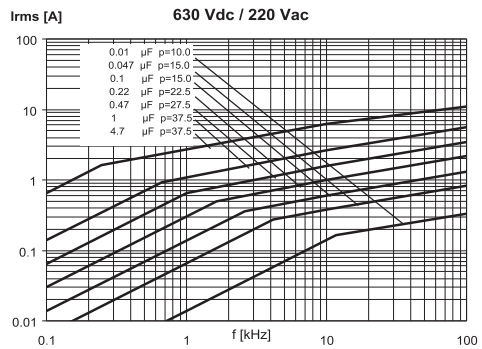
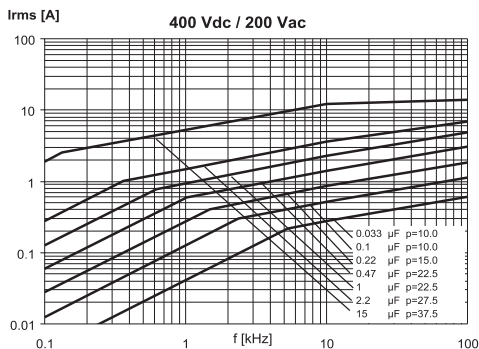
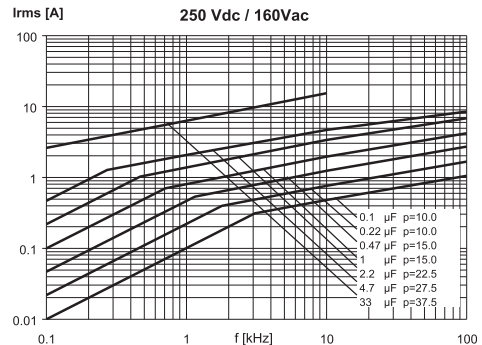
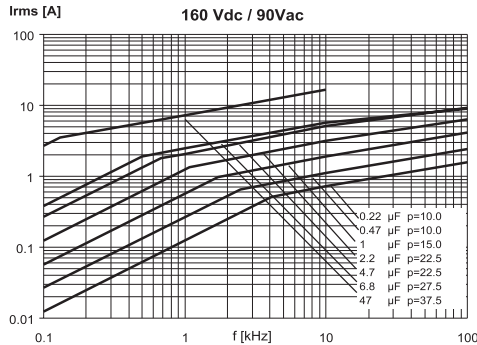
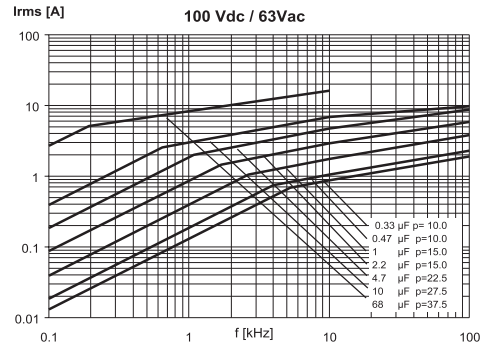
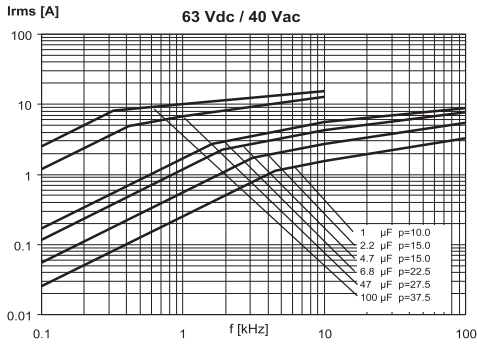


Note: p (pitch) in mm.

METALLIZED POLYESTER FILM CAPACITOR
D.C. MULTIPURPOSE APPLICATIONS

PRODUCT CODE: R60

MAX. CURRENT ($I_{r.m.s.}$) VERSUS FREQUENCY (sinusoidal wave-form / $T_h \leq 40^\circ C$)



Note: p (pitch) in mm.