# METALLIZED POLYETHYLENETEREPHTHALATE FILM CAPACITORS

MKT axial moulded type

- Supplied in boxes

## QUICK REFERENCE DATA

| | |
|---|---|
| Rated capacitance range (E12-series) | 0,0082 to 6,8 $\mu$F |
| Tolerance on rated capacitance | ± 20%, ± 10%, ± 5% |
| Rated voltage $U_R$ (d.c.) | 100 V, 250 V, 400 V |
| Climatic category | 55/100/56 |
| Rated temperature | 85 °C |
| Tangent of loss angle at 10 kHz | $100 \times 10^{-4}$ |
| Related specification | IEC 384-2 |
| Performance grade | general purpose |

## STYLE

Style 2222 341; see Tables 1 to 3.

## APPLICATION

In electronic circuits for blocking and coupling, bypass and energy reservoir applications.

## DESCRIPTION

The capacitors consist of a low-inductance wound cell of metallized polyethyleneterephthalate (PETP) film. The cell is moulded in yellow flame retardent polypropylene. The axial leads are of solder-coated wire. One end of the capacitor is provided with two stand-off ridges to allow removal of solder flux etc., when cleaning the printed-wiring board.

## GENERAL DATA

Dimensions in mm

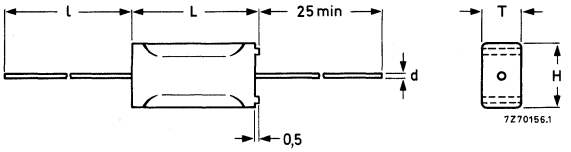



Fig. 1.

**Table 1** $-U_R$ (d.c.) = 100 V; max. a.c. voltage = 63 V; Fig. 1

| rated capacitance μF | $T_{max}$ | $H_{max}$ | $L_{max}$ | d | ℓ min | mass g | catalogue number 2222 341 ..... | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | tol. ± 20% | tol. ± 10% | tol. ± 5% |
| 0,082 | 5,1 | 8,8 | 14,6 | 0,8 | 40 | 1,0 | 26823 | 27823 | 25823 |
| 0,10 | | | | | | | 26104 | 27104 | 25104 |
| 0,12 | | | | | | | 26124 | 27124 | 25124 |
| 0,15 | | | | | | | 26154 | 27154 | 25154 |
| 0,18 | | | | | | 1,1 | 26184 | 27184 | 25184 |
| 0,22 | | | | | | 1,4 | 26224 | 27224 | 25224 |
| 0,27 | 5,7 | 9,5 | 14,6 | | | | 26274 | 27274 | 25274 |
| 0,33 | 6,6 | 10,4 | 18,1 | | | 1,7 | 26334 | 27334 | 25334 |
| 0,39 | | | | | | | 26394 | 27394 | 25394 |
| 0,47 | | | | | | 2,0 | 26474 | 27474 | 25474 |
| 0,56 | 7,9 | 11,5 | 18,1 | | | | 26564 | 27564 | 25564 |
| 0,68 | 7,8 | 11,6 | 23,5 | | | 2,5 | 26684 | 27684 | 25684 |
| 0,82 | | | | | | | 26824 | 27824 | 25824 |
| 1,0 | 9,2 | 12,9 | 23,5 | | | 3,2 | 26105 | 27105 | 25105 |
| 1,2 | | | | | | | 26125 | 27125 | 25125 |
| 1,5 | 10,8 | 14,5 | 23,5 | | | 4,0 | 26155 | 27155 | 25155 |
| 1,8 | | | | | | | 26185 | 27185 | 25185 |
| 2,2 | 10,7 | 14,6 | 31 | 1 | 50 | 5,5 | 26225 | 27225 | 25225 |
| 2,7 | | | | | | | 26275 | 27275 | 25275 |
| 3,3 | 12,5 | 19,5 | 31 | | | 8,0 | 26335 | 27335 | 25335 |
| 3,9 | | | | | | | 26395 | 27395 | 25395 |
| 4,7 | | | | | | | 26475 | 27475 | 25475 |
| 5,6 | 15,4 | 22,1 | 31 | | | 10,5 | 26565 | 27565 | 25565 |
| 6,8 | | | | | | | 26685 | 27685 | 25685 |

**Table 2** $U_R$ (d.c.) = 250 V; max. a.c. voltage = 160 V; Fig. 1

| rated capacitance μF | $T_{max}$ | $H_{max}$ | $L_{max}$ | d | ℓ min | mass g | catalogue number 2222 341 . . . . . | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | tol. ± 20% | tol. ± 10% | tol. ± 5% |
| 0,039 | 5,1 | 8,8 | 14,6 | 0,8 | 40 | 1,0 | 88393 | 89393 | 87393 |
| 0,047 | | | | | | | 88473 | 89473 | 87473 |
| 0,056 | | | | | | | 88563 | 89563 | 87563 |
| 0,068 | | | | | | | 88683 | 89683 | 87683 |
| 0,082 | 5,7 | 9,5 | 14,6 | | | 1,1 | 88823 | 89823 | 87823 |
| 0,10 | | | | | | | 88104 | 89104 | 87104 |
| 0,12 | 6,6 | 10,4 | 18,1 | | | 1,7 | 88124 | 89124 | 87124 |
| 0,15 | | | | | | | 88154 | 89154 | 87154 |
| 0,18 | | | | | | | 88184 | 89184 | 87184 |
| 0,22 | | | | | | | 88224 | 89224 | 87224 |
| 0,27 | 7,8 | 11,6 | 23,5 | | | 2,5 | 88274 | 89274 | 87274 |
| 0,33 | | | | | | | 88334 | 89334 | 87334 |
| 0,39 | | | | | | | 88394 | 89394 | 87394 |
| 0,47 | | | | | | | 88474 | 89474 | 87474 |
| 0,56 | 9,2 | 12,9 | 23,5 | | | 3,2 | 88564 | 89564 | 87564 |
| 0,68 | | | | | | | 88684 | 89684 | 87684 |
| 0,82 | 10,7 | 14,6 | 31 | 1 | 50 | 5,5 | 88824 | 89824 | 87824 |
| 1,0 | | | | | | | 88105 | 89105 | 87105 |
| 1,2 | | | | | | | 88125 | 89125 | 87125 |
| 1,5 | 12,5 | 19,5 | 31 | | | 8,0 | 88155 | 89155 | 87155 |
| 1,8 | | | | | | | 88185 | 89185 | 87185 |
| 2,2 | | | | | | | 88225 | 89225 | 87225 |

**Table 3**-$U_R$ (d.c.) = 400 V; max. a.c. voltage = 220 V; Fig. 1

| rated capacitance μF | $T_{max}$ | $H_{max}$ | $L_{max}$ | d | ℓ min | mass g | catalogue number 2222 341 ..... | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | tol. ± 20% | tol. ± 10% | tol. ± 5% |
| 0,0082 | 5,1 | 8,8 | 14,6 | 0,8 | 40 | 1,0 | 54822 | 55822 | 53822 |
| 0,010 | | | | | | | 54103 | 55103 | 53103 |
| 0,012 | | | | | | | 54123 | 55123 | 53123 |
| 0,015 | | | | | | | 54153 | 55153 | 53153 |
| 0,018 | | | | | | | 54183 | 55183 | 53183 |
| 0,022 | | | | | | | 54223 | 55223 | 53223 |
| 0,027 | | | | | | | 54273 | 55273 | 53273 |
| 0,033 | | | | | | | 54333 | 55333 | 53333 |
| 0,039 | 7 | 10,6 | 14,6 | | | 1,4 | 54393 | 55393 | 53393 |
| 0,047 | | | | | | | 54473 | 55473 | 53473 |
| 0,056 | 6,6 | 10,4 | 18,1 | | | 1,7 | 54563 | 55563 | 53563 |
| 0,068 | | | | | | | 54683 | 55683 | 53683 |
| 0,082 | 7,9 | 11,5 | 18,1 | | | 2,0 | 54823 | 55823 | 53823 |
| 0,10 | | | | | | | 54104 | 55104 | 53104 |
| 0,12 | 7,8 | 11,6 | 23,5 | | | 2,5 | 54124 | 55124 | 53124 |
| 0,15 | | | | | | | 54154 | 55154 | 53154 |
| 0,18 | 9,2 | 12,9 | 23,5 | | | 3,2 | 54184 | 55184 | 53184 |
| 0,22 | | | | | | | 54224 | 55224 | 53224 |
| 0,27 | 10,8 | 14,5 | 23,5 | | | 4,0 | 54274 | 55274 | 53274 |
| 0,33 | | | | | | | 54334 | 55334 | 53334 |
| 0,39 | 10,7 | 14,6 | 31 | 1 | 50 | 5,5 | 54394 | 55394 | 53394 |
| 0,47 | | | | | | | 54474 | 55474 | 53474 |
| 0,56 | 12,5 | 19,5 | 31 | | | 8,0 | 54564 | 55564 | 53564 |
| 0,68 | | | | | | | 54684 | 55684 | 53684 |
| 0,82 | 15,4 | 22,1 | 31 | | | 10,5 | 54824 | 55824 | 53824 |
| 1,0 | | | | | | | 54105 | 55105 | 53105 |

### Marking

a. Rated capacitance
b. Rated voltage
c. Tolerance on rated capacitance
d. Category voltage
e. Year and month of manufacture
f. Manufacturer's name
g. Climatic category
h. Manufacturer's type designation

The marking is impressed on one side with a, b, c, e and h as follows:

1st line : rated capacitance in pF or $\mu$F, tolerance and rated d.c. voltage;

2nd line: 5th, 6th and 7th digits of the catalogue number, code for dielectric material (MKT) and production date code (according to IEC 62, clause 5).

The marking on the other side is impressed with f as follows:

1st line : manufacturer's name;

2nd line: code for factory of origin.

The package containing the capacitors is marked with a to h.

### Mounting

The capacitors are for horizontal or vertical mounting on printed-wiring boards and for point to point wiring.

**Ratings and characteristics**

Unless otherwise specified all electrical values apply to an ambient free air temperature of 23 ± 1 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 50 ± 2%.

**Capacitance**

| | |
|---|---|
| Rated capacitance range at 1 kHz | see Tables 1 to 3 |
| Tolerance on rated capacitance | see Tables 1 to 3 |

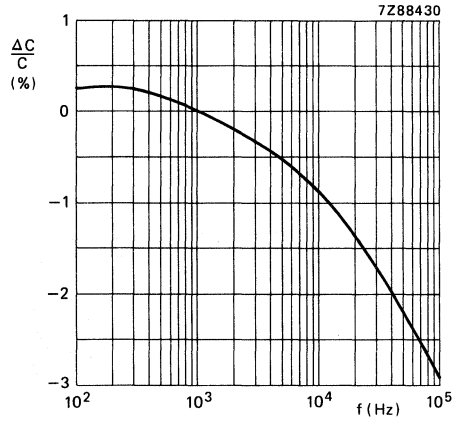



Fig. 2 Capacitance as a function of frequency; typical curve.

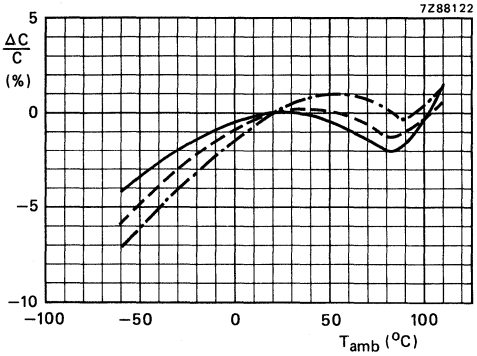



Fig. 3 Capacitance as a function of ambient free air temperature; typical curves.
——— for all capacitance values, measured at 1 kHz, 1 V.
– – – – for capacitance values ⩽ 1 μF, measured at 10 kHz, 1 V.
– · – · – for capacitance values ⩽ 0,1 μF, measured at 100 kHz, 0,3 V.

**Voltage**

| | |
|---|---|
| Rated voltage $U_R$ (d.c.) | See Tables 1 to 3 |
| Category voltage $U_C$ | 0,8 x $U_R$ (d.c.) |
| Maximum a.c. voltage (r.m.s. value), at 50 to 60 Hz | See Tables 1 to 3 |
| Test voltage | |
| between terminations | 1,6 x $U_R$ (d.c.) |
| between interconnected terminations and case | 2 x $U_R$ (d.c.); min. 200 V |

**Temperature**

| | |
|---|---|
| Climatic category | 55/100/56 |
| Rated temperature | 85 °C |
| Storage temperature range | −55 to + 100 °C |

Notes

- The sum of the d.c. voltage and the peak value of the superimposed a.c. voltage must be $\leqslant U_R$ (d.c.).
- For waveforms other than sinusoidal the maximum permissible dissipation must not be exceeded.

**Maximum pulse load**

| rated voltage V | maximum pulse load (V/μs) | | | |
|---|---|---|---|---|
| | L = 14,5 mm | L = 18 mm | L = 23,5 mm | L = 31 mm |
| 100 | 24 | 10 | 6 | 3,5 |
| 250 | 35 | 14 | 9 | 5 |
| 400 | 55 | 22 | 14 | 8 |

The maximum pulse load values in the table are valid for pulse voltages equal to the rated voltage.

For lower pulse voltages the given values may be multiplied by $U_R$/applied voltage.

Note

If the pulse load requirement is satisfied, a check must be made to ascertain that the maximum dissipation is not exceeded.

**Tangent of loss angle**

| capacitance | tangent of loss angle | | |
|---|---|---|---|
| | 1 kHz | 10 kHz | 100 kHz |
| $C_R \leqslant 0{,}1\ \mu F$ | $\leqslant 75 \times 10^{-4}$ | $\leqslant 130 \times 10^{-4}$ | $\leqslant 250 \times 10^{-4}$ |
| $0{,}1\ \mu F < C_R \leqslant 1\ \mu F$ | $\leqslant 75 \times 10^{-4}$ | $\leqslant 130 \times 10^{-4}$ | |
| $C_R > 1\ \mu F$ | $\leqslant 75 \times 10^{-4}$ | $\leqslant 150 \times 10^{-4}$ | |

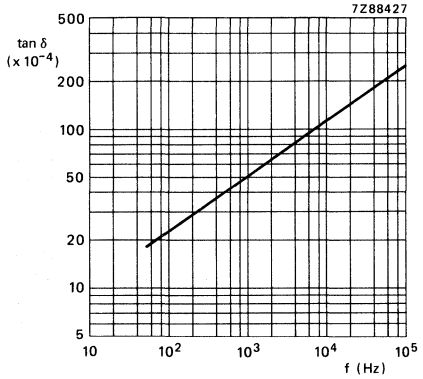



Fig. 4 Tan $\delta$ as a function of frequency, typical curve.

**Insulation resistance**

The insulation resistance is measured after a voltage of 100 ± 15 V has been applied for 1 min ± 5 s, at $T_{amb}$ = 20 °C.

| | |
|---|---|
| R between terminations, for $C_R \leqslant 0{,}33\ \mu F$ | |
| 100 V version | $> 15\,000$ MΩ |
| 250 V and 400 V versions | $> 30\,000$ MΩ |
| RC between terminations, for $C_R > 0{,}33\ \mu F$ | |
| 100 V version | $> 5\,000$ s |
| 250 V and 400 V versions | $> 10\,000$ s |
| R between interconnected terminations and case (foil method) | $> 30\,000$ MΩ |

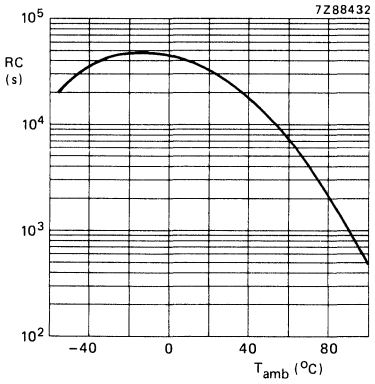



Fig. 5 RC-product as a function of ambient free air temperature; typical curve.

**Maximum dissipation**

Notes

In applications where voltages higher than 50 V are applied, it is recommended that the power in the capacitor be limited to 2,5 VA in case of capacitor failure.

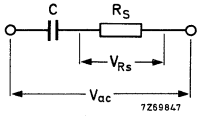
If the requirement for the maximum dissipation is satisfied, a check must be made to ascertain that the maximum pulse load is not exceeded.

The maximum a.c. voltage has been specified for 50 to 60 Hz and at 23 °C. This voltage value must also never be exceeded at other frequencies. This permissible a.c. voltage may further be limited by the following requirements:

1. The power dissipation must not exceed the specified limit $P_{max}$.
2. The steepness of the a.c. voltage must not exceed the specified limit.

The power dissipated by a capacitor is a function of the voltage across the series resistance ($R_S$) or of the current through the series resistance and is expressed by

$$P = \frac{V_{R_S}^2}{R_S} = I^2 R_S \qquad (1)$$




$$V_{R_S}^2 = \frac{R_S^2}{R_S^2 + 1/\omega^2 C^2} V_{ac}^2 \qquad (2a)$$

Because for these capacitors $\tan \delta = R_S \omega C = < 0{,}1$, the formula (2a) can be simplified to

$$V_{R_S}^2 = \frac{R_S^2}{1/\omega^2 C^2} V_{ac}^2 = R_S^2 \omega^2 C^2 V_{ac}^2 \qquad (2b)$$

Thus $P = R_S \omega^2 C^2 V_{ac}^2$ (3a)

or $P = (R_S C)\, C\omega^2 V_{ac}^2$ (3b)

The term $R_sC$ can be found from Fig. 6, C (in farads), $\omega = 2\pi f$ and $V_{ac}$ are assumed to be known.

The maximum permissible value of power dissipation ($P_{max}$), which depends on the dimensions of the capacitor and on the ambient free air temperature, can be read from Fig. 7.

Thus, when the actual power has been calculated with equation (3b), Fig. 7 gives the minimum size of capacitor which can dissipate this power.

**Example** of using Figs 6 and 7

A capacitor of 1 $\mu$F should be used at an a.c. voltage of 130 V, a frequency of 1 kHz and an ambient free air temperature of 50 °C.

The RsC-product is 7,1 x $10^{-7}$ $\Omega$F (from Fig. 6), so that the power to be dissipated is

$$P = (RsC)\, C\omega^2 Vac^2$$
$$= 7{,}1 \cdot 10^{-7} \times 1 \cdot 10^{-6} \times (2\pi)^2 \times 10^6 \times 130^2$$
$$= 472 \text{ mW}$$

For a rated voltage of 130 Vac a capacitor of the 250 V range is required at least.

Capacitor 1 $\mu$F/160 Vac is satisfactory because of its dimensions 10,7 mm x 14,6 mm x 31 mm and its dissipated power of 595 mW at 50 °C.

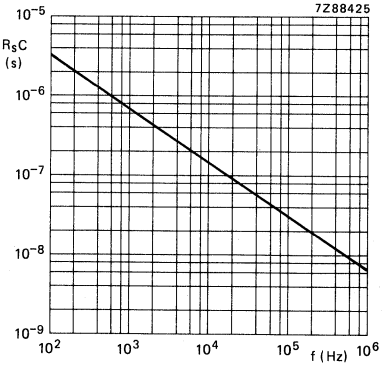



Fig. 6 Maximum product of series resistance and capacitance as a function of frequency.

| curve | dimensions (mm) | | |
|---|---|---|---|
| | $T_{max}$ | $H_{max}$ | $L_{max}$ |
| 1 | 5,1 | 8,8 | 14,6 |
| 2 | 5,7 | 9,5 | 14,6 |
| 3 | 7 | 10,6 | 14,6 |
| 4 | 6,6 | 10,4 | 18,1 |
| 5 | 7,9 | 11,5 | 18,1 |
| 6 | 7,8 | 11,6 | 23,5 |
| 7 | 9,2 | 12,9 | 23,5 |
| 8 | 10,8 | 14,5 | 23,5 |
| 9 | 10,7 | 14,6 | 31 |
| 10 | 12,5 | 19,5 | 31 |
| 11 | 15,4 | 22,1 | 31 |

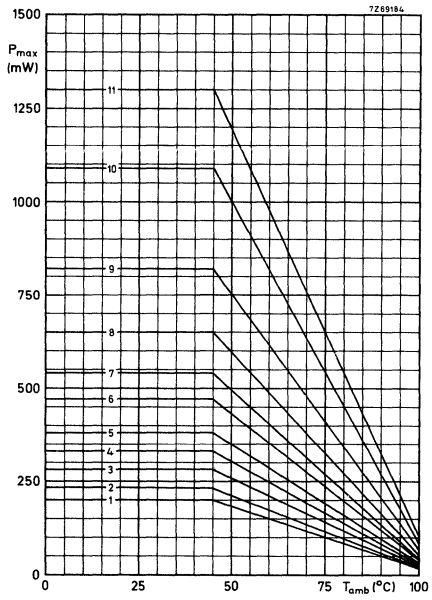



Fig. 7 Maximum dissipation as a function of ambient free air temperature.

## ORDERING INFORMATION

Order the capacitors by quoting the 12-digit catalogue number as shown in Tables 1 to 3.

## PACKING

The capacitors are packed in boxes of 250 (for $H_{max} \leqslant 11{,}6$ mm) and 200 (for $H_{max} > 11{,}6$ mm).