RIFA

electronic components

capacitors
semiconductors

Contents

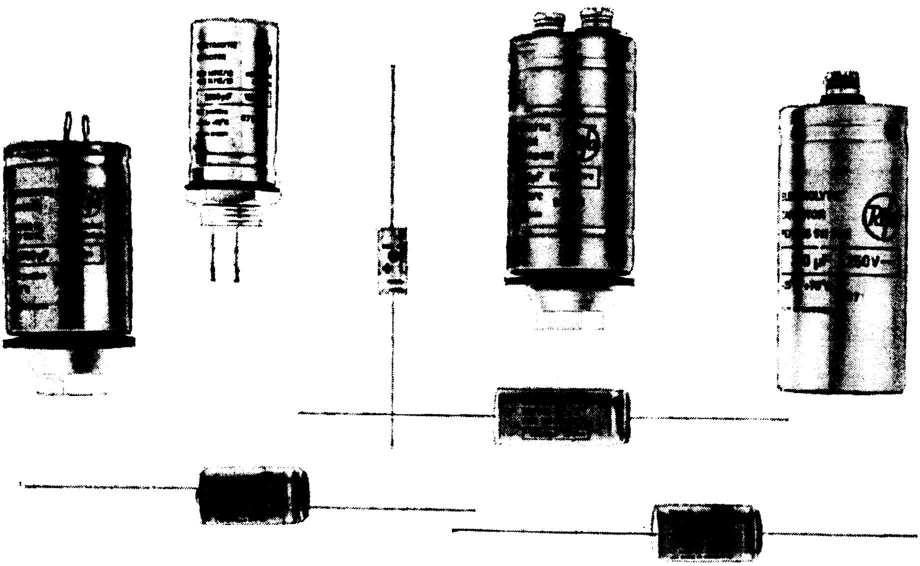
This new edition of the Rifa product catalogue dated 1977 has been designed to incorporate all of Rifa's product program that is of major international interest. It comprises the capacitor program and the standard ranges of the semiconductor program with the exception of the TTL microcircuits. These are described in a separate data book.

The feedback from our customers, with respect to specific information needs, has assisted us in the improvements made, and this we consider to be of immense value. In this catalogue, we have endeavoured to compile a product information guide of practical dimensions, which naturally cannot contain all the available information on a specific product. We would therefore like to bring to your attention that you should contact our local representatives and distributors or alternatively contact Rifa direct if you require more in-depth information oriented to your specific problems.

The index on the following pages offers a simple numerical reference to each product family and specific type. In using the catalogue we recommend that you first familiarise yourself with the characteristics and advantages of each product family, followed by the detailed information on each specific product. The cobination of these should give you sufficient comprehensive information to enable you to apply the product under normal conditions. When ordering the product, it is recommended that both the full part number and the specific characteristics of the product be detailed to avoid any possibility of interpretation error.

We are sure this catalogue will service you well, but it should be appreciated that this is only one element of the Rifa service available to you. It is our objective to give you a service second to none, of which we trust you will be a long term beneficiary.

INTRODUCTION



In air, aluminium (Al) is covered by a very thin oxide. By electro-chemical processing a thicker oxide can be formed and the thickness is proportional to the forming voltage.

The oxide Al_2O_3 has rectifying properties and it has a high insulation resistance for voltages lower than the forming voltage but with the same polarity.

The oxide stands a high electric field strength and it has a high relative dielectric constant. It is therefore well suited as a capacitor dielectric in a **polar** capacitor.

The capacitance C of the electrolytic capacitor is dependent on oxide thickness d, the dielectric constant ε and surface A as given by the normal capacitance formula.

$$C = k \frac{\varepsilon \times A}{d}$$

By etching, the effective surface of the Al-foil can be increased. Foils with 10 to 20 times capacitance increase compared with plain foil are used. General purpose capacitors normally utilize higher etching than long life types.

The negative "electrode" is a liquid electrolyte absorbed in a paper. The paper also acts as a spacer between the positive foil carrying the oxide and another Al-foil — the so called negative foil — acting as a contact medium to the electrolyte. The positive foil, the paper and the negative foil are rolled to a winding. This winding is impregnated with the electrolyte and then encapsulated in an Al-case sealed with an insulating disc or an Al-disc insulated from the case by a rubber insulator.

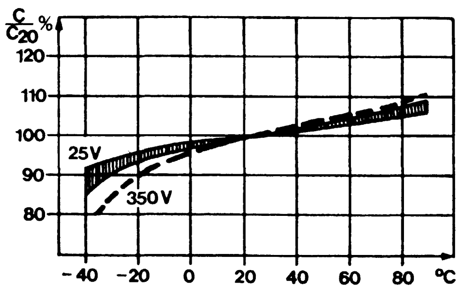
In axial lead capacitors the negative foil is connected to the Al-case and the positive foil is fed through the sealing disc. In can types usually both the positive and the negative connections are feed through the sealing disc. In this case, however, the negative terminal can internally still be connected to the case via axcess of electrolyte. Electrolytic capacitors must therefore be covered with an outer insulation when mounted on a chassis with another potential than the negative terminal of the capacitor.

SPECIFICATIONS

Aluminium electrolytic capacitors are covered in IEC publication 103. This specification divides the capacitors into two quality grades — Grade 1 which is a long life grade and Grade 2 which is a general purpose grade. In Rifa type specifications the IEC Grade and climatic category are stated. Test programmes and test requirements are then to be found in IEC 103 if nothing else is said in the type specifications. General technical data stated below conform in applicable parts with IEC 103.

CAPACITANCE

Capacitance is measured with $\leq$ 0.5 V 100 Hz without DC polarisation if not otherwise is stated in the type specifications. Rated capacitance C_R is marked on the capacitors. The tolerance of the rated capacitance is valid at +20°C. When stated in the type specifications, capacitors with specified DC capacitance can be supplied to special order. The DC capacitance is defined by a time measuring method according to DIN 41 328 if nothing else is agreed.



Examples of dependence of capacitance at 100 Hz v temperature.

RATED VOLTAGE, REVERSE VOLTAGE, SURGE VOLTAGE

Rated voltage U_R is stated in the type specifications and marked on the capacitors. U_R is the highest DC voltage that continuously may be applied to the capacitors within the category temperature range.

When an AC voltage is superimposed on a DC voltage the sum of the DC voltage and the peak of the AC voltage must not exceed U_R.

The maximum reverse voltage — DC or peak AC — is 2 V continuously.

The maximum surge voltage within the category temperature range is

$$1.15 \times U_R \text{ for } U_R \leq 350\text{ V}$$
$$1.1 \times U_R \text{ for } U_R > 350\text{ V}$$

for max 1 minute per 6 minute periods but totally max 5 minutes per hour.

TEMPERATURE RANGE

The temperature range is stated in the type specifications.

The upper temperature limit is the highest ambient temperature to which the capacitors may be continuously exposed in order to operate with intended reliability when connected to rated voltage.

The lower temperature limit is dependent on the increase of 100 Hz impedance as defined in IEC 103.

DISSIPATION FACTOR, EQUIVALENT SERIES RESISTANCE

The dissipation factor $\tan\delta$ is defined as $r_s\, \omega\, C$ at +20°C and 100 Hz

$\tan\delta$ is the tangent for the loss angle δ

$r_s = \frac{\tan\delta}{\omega C}$ is the equivalent series resistance formed by the losses in the capacitor (diel. losses in the oxide, resistance in electrolyte, foils and terminations)

$\omega = 2\pi f$ where f is the measuring frequency 100 Hz

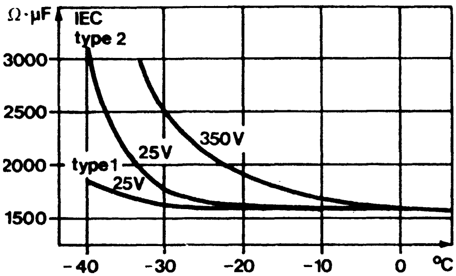
C is the actual capacitance

The max values of $\tan\delta$ are stated in the type specifications. IEC publication 103 states the following max values:

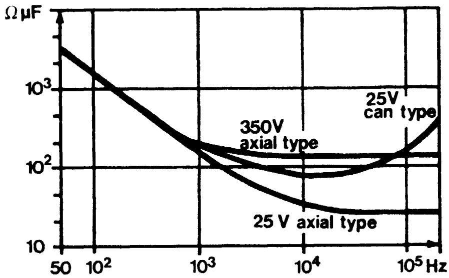
U_R	VDC	4	6.3	10	16	25	40	63	100	160	250	350	450
$\tan\delta$	%	50	50	50	35	35	25	25	20	20	20	20	20

IMPEDANCE

The impedance of an electrolytic capacitor is composed of the capacitive and inductive reactances and the equivalent series resistance. The inductive reactance influences the impedance only at higher frequencies. Examples of impedance curves v frequency and temperature are given below:



Impedance at 100 Hz



Impedance at +20°C

RIPPLE CURRENT

An AC voltage superimposed on the DC voltage across a capacitor will cause a power loss and a self-heating of the capacitor.

For a sinusoidal RMS voltage U or current I of frequency f the power loss in Watts will be

$$P = \frac{U^2}{X} \tan\delta = UI \ \tan\delta = I^2X \ \tan\delta$$

$$X = \frac{1}{2\pi fC}$$

$\tan\delta$ = dissipation factor at frequency f
C = capacitance in Farad

Recommended max RMS ripple currents at 100 Hz and specified ambient temperatures are stated in the type specifications. As $\frac{\tan\delta}{2\pi fC}$ decreases somewhat at increasing frequencies up to approximately 1000 Hz a higher current can be allowed at higher frequencies than 100 Hz for the same self-heating. At lower frequencies lower currents must be applied. Information on this is given in the type specifications.

The peak value of the superimposed AC voltage must not cause a reverse voltage higher than 2 V.

LEAKAGE CURRENT

The leakage current I_l shall be measured at +20°C after 5 minutes at rated voltage. The following max values are valid if nothing else is stated in the data specifications:

	Max. I_l µA for IEC grade IEC Grade 1	IEC Grade 2
$C_R \times U_R \leq 1000$ µF V	$0.01\ C_R \times U_R$	$0.05\ C_R \times U_R$ or 5*)
$C_R \times U_R > 1000$ µF V	$0.006\ C_R \times U_R + 4$	$0.03 C_R \times U_R + 20$

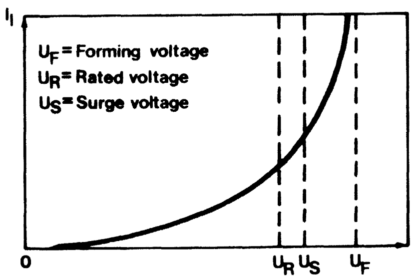
C = rated capacitance in µF
U = rated voltage in V

*) whichever is the greatest

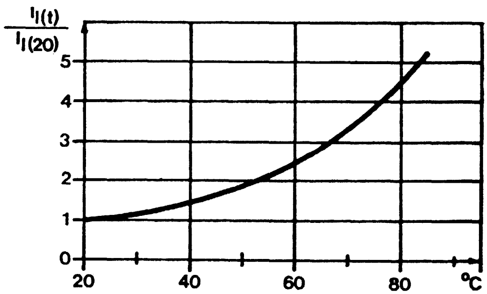
After long term storage the capacitors shall be connected to rated voltage in series with a resistance of 100 Ω for $U_R \leq 100$ VDC and 1000 Ω for $U_R > 100$ VDC for one hour and then disconnected for 12 to 48 hours before measurement.

In continuous operation I_l will decrease to low values. For capacitors with rated voltage ≤ 70 V the leakage current is in the order 10^{-3} to 10^{-4} µA/µF × V at +20°C. Corresponding figures for capacitors with higher rated voltage are 10^{-2} to 10^{-3} µA/µF × V.

Typical curves for leakage current v voltage and temperature is given below.



Leakage current v voltage



Leakage current v temperature

DISCHARGE OPERATION

All Rifa electrolytic capacitors can be short-circuited when charged to rated voltage or charged from a source without internal resistance. Repeated charging-discharging is to be regarded as an AC voltage and the repetition rate must be limited due to the self-heating caused.

Max capacitance change after 10^6 charges-discharges with a time constant of 0.1 s and a repetition rate of one cycle per second is stated in the type specifications.

OUTER INSULATION

Outer plastic insulation and insulated stud mounting versions will withstand a voltage test at +20°C with 1000 VDC for 1 minute between capacitor case and chassis or a metal foil wrapped around the insulation. The insulation resistance at +20°C exceeds 100 MΩ measured after 1 minute at 100 VDC. These results will also be met after a 56 days humidity test at +40°C and 90—95% R.H.

STORAGE

The change of capacitance, impedance and dissipation factor (see also under LEAKAGE CURRENT) after long term storage at room temperature or below will be insignificant and, when put in service, the capacitors will still operate satisfactorily. The life of the capacitors can be regarded to be consumed to a lesser extent compared with service at the same temperature.

Long term storage at elevated temperatures should be avoided.

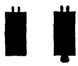
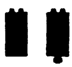
Rifa's electrolytic capacitors can be stored at temperatures down to —55°C.

LIFE EXPECTANCY

The life of electrolytic capacitors in normal electric or electronic equipment is mainly dependent upon ambient temperature and the self-heating caused by AC current, and to a smaller extent by the DC voltage as long as the voltage does not exceed the rated voltage.

The service life of a capacitor is estimated to double with each temperature decrease of 7—10°C. A capacitor with a service life of 2000 h at +85°C can thus be expected to have a life of at least

4000 h at +75°C
8000 h at +65°C
16000 h at +55°C
and so on.

Grade and specification	Cap. range µF	Volt. range VDC	Temp. range °C	Type	Diam. range mm	Type No.	Type spec. page
GENERAL PURPOSE GRADE							
IEC 103 Grade 2	0.47—1000	6.3—100 250—350	—55/+85 —40/+85		6.5—10	**PEG 112**	18
IEC 103 Grade 2	2.2—470	16—63	—40/+85		6.5—13.5	**RR 113**	22
IEC 103 Grade 2	1—10000	6.3—63 100—450	—40/+85 —25/+70		10—25	**PEG 118—119**	26
IEC 103 Grade 2[1]	22—47000	6.3—63 100—450	—40/+85 —25/+85		25—40	**PEH 130—133**	52
IEC 103 Grade 2	22—10000	12—450	—25/+70		25—35	**PEH 140—144**	58
LONG LIFE GRADE							
DIN 41 257	22—4700	10—70	—40/+85		10—20	**PEG 121**	30
BPO D2186	10—3300	10—100	—40/+85		10—20	**PEG 122**	34
IEC 103 Grade 1	10—4700	10—100	—40/+85		10—20	**PEG 123**	38
Telephone grade	10—2200	12—100	—40/+85		10—20	**PEG 124**	42
IEC 103 Grade 1	220—100000	6.3—350	—40/+70[2]		35—75	**PEH 125—129**	46
IEC 103 Grade 1	470—47000	10—100	—40/+85		35—50	**PEH 146—149**	60

[1]) The capacitors meet the specification for grade 1 up to +70°C max. temp.
[2]) Temperature range extended in the voltage range 6.3—70 V to +85°C for grade 2 version.

PEG 112

PEG 112 is a miniaturized electrolytic capacitor type encapsulated in an aluminium can sealed with a rubber disc. All-welded design. Tinned copper wire leads. Plastic insulation is standard.

PEG 112 is mainly intended for filtering, coupling and decoupling in consumer equipment such as radio and TV-sets but is also well suited for industrial equipment if operated at moderate temperatures.

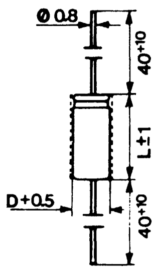
Basic specifications IEC publ. 103 Grade 2, category 55/085/56 (40/085/56 for U_R $>$ 100 VDC)
DIN 41 332 and DIN 41 316 type IIA, class FPF (GPF)

Temperature range —55°C to +85°C (—40°C to +85°C for rated voltage $>$ 100 VDC)

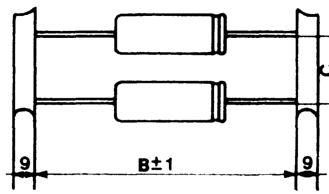
Capacitance tolerance —10 to +50%

General technical data See "Introduction Electrolytic Capacitors"

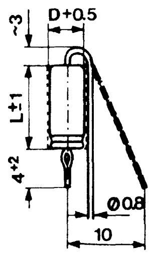
PEG 112, standard version



PEG 112, suffix-T1*) (standard version on tape)



PEG 112, suffix V*)



Dimensions in mm

*) Suffix T1 and suffix V versions can normally be supplied only when ordered in production quantities.

Case code		A	D	E	F	H	K	L	M	N
D	mm	6.5	6.5	8.5	8.5	8.5	8.5	10	10	10
L	mm	16	18	16	18	20	25	21	24	27
B	mm	85	85	85	85	85	90	85	90	95
C	mm	10	10	10	10	10	10	15	15	15
Weight approx.	g	1.4	1.5	2.0	2.2	2.5	3.0	3.4	3.7	4.0
Standard box content	pcs	500	500	500	500	400	250	250	250	250

RIFA

PEG 112

STANDARD UNITS

Cap. μF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current[1]) +40°C 100 Hz I_0 mA	Leakage[2]) current max μA	Order Number[3])
100	6.3	6.5×16 (A)	175	32	PEG 112DA310
220		8.5×16 (E)	300	62	PEG 112DE322
470		8.5×20 (H)	490	109	PEG 112DH347
1000		10 ×24 (M)	890	209	PEG 112DM410
100	10	6.5×18 (D)	210	50	PEG 112ED310
220		8.5×18 (F)	360	86	PEG 112EF322
470		10 ×21 (L)	640	161	PEG 112EL347
47	16	6.5×16 (A)	150	38	PEG 112GA247
100		8.5×16 (E)	255	68	PEG 112GE310
220		8.5×20 (H)	420	126	PEG 112GH322
470		10 ×24 (M)	760	246	PEG 112GM347
100	25	8.5×18 (F)	240	95	PEG 112HF310
220		10 ×21 (L)	500	185	PEG 112HL322
22	40	6.5×16 (A)	120	44	PEG 112KA222
47		8.5×16 (E)	200	76	PEG 112KE247
100		8.5×20 (H)	325	140	PEG 112KH310
220		10 ×24 (M)	600	284	PEG 112KM322
47	50	8.5×18 (F)	235	91	PEG 112LF247
100		8.5×25 (K)	235	170	PEG 112LK310
10	63	6.5×16 (A)	100	32	PEG 112MA210
22		8.5×16 (E)	170	62	PEG 112ME222
47		8.5×20 (H)	275	109	PEG 112MH247
100		10 ×24 (M)	500	209	PEG 112MM310
2.2	100	6.5×16 (A)	50	11	PEG 112PA122
4.7		6.5×16 (A)	70	24	PEG 112PA147
10		8.5×16 (E)	120	50	PEG 112PE210
22		8.5×20 (H)	205	86	PEG 112PH222
47		10 ×27 (N)	365	161	PEG 112PN247
1.0	350	8.5×16 (E)	34	18	PEG 112UE110
2.2		8.5×18 (F)	53	39	PEG 112UF122
4.7		10 ×24 (M)	100	69	PEG 112UM147

[1]) Ripple current at other temperatures and frequencies, see Special technical features.

[2]) Leakage current after 5 minutes at rated voltage and +20°C.

[3]) Add -T1 to the order No. for PEG 112 supplied on tape. Example: PEG 112DA310-T1.
Add V to the order No. for the vertical mounting version. Example: PEG 112DA310V.

SPECIAL TECHNICAL FEATURES

Dissipation factor

Rated voltage VDC	tanδ 100 Hz Max. %
6.3	20
10	20
16	16
25	14
40	10
50	10
63	8
100	7
350	8

Discharge operation: Capacitance change less than 10% after 10^6 charges and discharges.

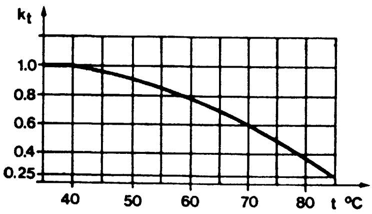
Bump test: The capacitors will withstand a test according to IEC publ. 68-2-29, test Eb, 4000 bumps with 390 m/s² when mounted by their leads only.

Endurance test: The endurance test may be carried out for 1000 h at +85°C and rated voltage.

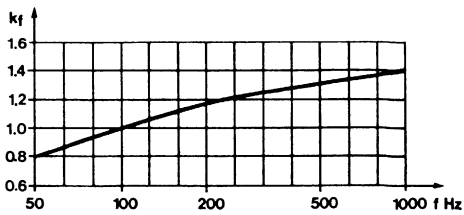
After such a test the capacitance change is less than 25%, the dissipation factor max. 1.5 times the max. value stated above and the leakage current is still below specified limits.

Ripple current multipliers: Tabulated ripple currents I_o refer to 100 Hz and an ambient temperature of +40°C. Ripple currents at other frequencies and temperatures can be calculated from the curves below and the formula

$I = k_f \times k_t \times I_o$



Ripple current multiplier v ambient temperature



Ripple current multiplier v frequency

Notes

RR 113

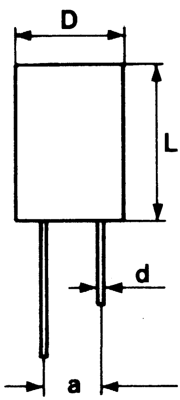
plug-in

RR 113 is a miniaturized single-ended electrolytic capacitor for upright mounting on printed circuit boards. It is mainly intedended for filtering, coupling and decoupling and timing application in consumer equipment, but is also well suited for industrial equipment if operated at moderate temperatures. Tinned copper terminations. Outer plastic insulation is standard.

Bastic specifications IEC 103 grade 2 40/085/56
DIN 41259 type II A, class GPF
DIN 41332

Temperature Range —40°C to +85°C

Capacitance Tolerance —10 to +100% for C ≤ 47 μF
—10 to +50% for C > 47 μF



Dimensions in mm

Case Code		A	B	C	D	E	F	G	H
D	mm	6.5	8.75	10	12.5	12.5	12.5	13.5	13.5
L	mm	12	13	13	13	16.5	20	20	25
d	mm	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0.8
a	mm	2.5	5	5	5	5	5	5	5
Weight approx.	g	0.7	1.1	1.7	2.4	3.0	3.5	3.9	4,5

STANDARD UNITS (16—63 V)

Cap μF	Rated Voltage VDC	Dimension DXL mm	Ripple current 100 Hz 85°C I_o mA	Order Number
100	16	10.0 ×13	200	RR 113GC310
220		12.5 ×16.5	320	RR 113GE322
470		13.5 ×20	480	RR 113GG347
22	25	6.5 ×12	60	RR 113HA222
47		8.75×13	120	RR 113HB247
100		12.5 ×13	200	RR 113HD310
220		12.5 ×20	330	RR 113HF322
470		13.5 ×25	550	RR 113HH347
10	40	6.5 ×12	35	RR 113KA210
22		8.75×13	70	RR 113KB222
47		10.0 ×13	130	RR 113KC247
100		12.5 ×16.5	215	RR 113KE310
2.2	63	6.5 ×12	20	RR 113MA122
4.7		6.5 ×12	35	RR 113MA147
10		8.75×13	45	RR 113MB210

SPECIAL TECHNICAL FEATURES

Dissipation factor

Rated voltage V—	tand δ 100 Hz Max %
16	16
25	14
40	12
63	8

Leakage current

Leakage current in μA at 20°C after 10 minutes at rated voltage.

$I = 0.05\ C \times U_R$ for $CU_R \leq 1\,000$ μFV

$I = 0.03\ C \times U_R + 20$ for $CU_R > 1\,000$ μFV

Endurance test

The endurance test may be carried out for 1 000 h at +85°C and rated voltage.

After such a test the capacitance change is less than 30%, the dissipation factor max 2 times the max value stated above and the leakage current is still below specified limits.

RIPPLE CURRENT MULTIPLIERS

Tabulated ripple current I_0 refer to 100 Hz and an ambient temperature of 85°C. Ripple currents at other temperatures can be estimated by applying ripple current multipliers given below.

Temperature °C	85	65	45	25
Multiplier	1	2	2.5	3

Notes

PEG 118–119

PEG 118—119 are electrolytic capacitors encapsulated in aluminium cans sealed with rubber-faced phenolic discs. Tinned brass wires of rectangular section. Plastic insulation is standard.

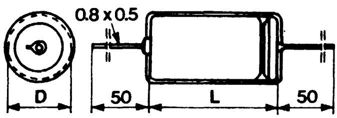
PEG 118—119 is suited for filtering, coupling, decoupling and timing in industrial equipment.

Basic specifications IEC 103 Grade 2, category 40/085/56 (25/070/56 for $U_R \geq 100$ VDC).

Temperature range —40°C to +85°C (—25°C to +70°C for rated voltage ≥ 100 VDC).

Capacitance tolerance —10 to +50%.

General technical data See "Introduction" Electrolytic Capacitors.



Dimensions in mm

Case code		A	B	C	D	E	F	G	J	L	M
D*)	mm	10	10	13	13	13	16	16	20	25	25
L	mm	19	29	19	29	38	29	38	40	40	48
Weight approx.	g	3	4	4	6	8	9	12	18	26	32

*) Add 0.4 mm for plastic insulation.

STANDARD UNITS

Cap. µF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current[1] 100 Hz I_0 mA (k_f)	Leakage[2] current max µA	Impedance 100 kHz, +20°C max. Ω	Order Number
150	16	10×19 (A)	70 (a)	92	0.57	PEG 118GA315
680		13×29 (D)	190 (a)	346	0.13	PEG 118GD368
1000		16×29 (F)	230 (a)	500	0.09	PEG 118GF410
4700		25×48 (M)	650 (d)	2276	0.02[3]	PEG 119GM447
100	25	10×19 (A)	60 (a)	95	0.60	PEG 118HA310
220		10×29 (B)	120 (a)	185	0.27	PEG 118HB322
220		13×19 (C)	100 (a)	185	0.27	PEG 118HC322
470		13×29 (D)	180 (a)	373	0.13	PEG 118HD347
1000		16×38 (G)	310 (a)	770	0.06	PEG 118HG410
2200		20×40 (J)	400 (b)	1670	0.04[3]	PEG 119HJ422
3300		25×40 (L)	560 (b)	2495	0.03[3]	PEG 119HL433
150	40	13×19 (C)	100 (a)	200	0.27	PEG 118KC315
330		13×29 (D)	170 (a)	416	0.12	PEG 118KD333
470		16×29 (F)	210 (a)	584	0.09	PEG 118KF347
1000		20×40 (J)	340 (b)	1220	0.06[3]	PEG 119KJ410
2200		25×40 (L)	560 (b)	2660	0.03[3]	PEG 119KL422
47	63	10×19 (A)	60 (a)	109	0.85	PEG 118MA247
100		10×29 (B)	100 (a)	209	0.40	PEG 118MB310
100		13×19 (C)	80 (a)	209	0.40	PEG 118MC310
220		13×29 (D)	150 (a)	436	0.18	PEG 118MD322
470		16×38 (G)	260 (a)	908	0.09	PEG 118MG347
1000		25×40 (L)	430 (b)	1910	0.05[3]	PEG 119ML410
1500		25×48 (M)	560 (b)	2855	0.05[3]	PEG 119MM415
22	100	10×19 (A)	30 (f)	86	11.0	PEG 118PA222
47		10×29 (B)	50 (f)	161	5.3	PEG 118PB247
47		13×19 (C)	40 (f)	161	5.3	PEG 118PC247
100		13×29 (D)	80 (f)	320	2.5	PEG 118PD310
220		16×38 (G)	130 (f)	680	1.1	PEG 118PG322
470		25×40 (L)	230 (f)	1430	0.53	PEG 119PL347
4.7	160	10×19 (A)	20 (c)	38	21.0	PEG 118QA147
10		13×19 (C)	30 (c)	68	10.0	PEG 118QC210
22		13×29 (D)	50 (c)	126	4.6	PEG 118QD222
47		16×29 (F)	70 (c)	246	2.1	PEG 118QF247
100		20×40 (J)	120 (d)	500	1.0	PEG 119QJ310
2.2	350	10×19 (A)	10 (c)	39	59.0	PEG 118UA122
4.7		13×19 (C)	20 (c)	69	28.0	PEG 118UC147
10		13×29 (D)	30 (c)	125	13.0	PEG 118UD210
22		16×38 (G)	60 (c)	251	5.9	PEG 118UG222
33		20×40 (J)	70 (d)	367	3.9	PEG 119UJ233
68		25×40 (L)	120 (d)	734	1.9	PEG 119UL268
4.7	450	13×29 (D)	20 (c)	83	28.0	PEG 118YD147
10		16×38 (G)	40 (c)	155	13.0	PEG 118YG210
15		20×40 (J)	50 (d)	223	8.7	PEG 119YJ215
33		25×40 (L)	90 (d)	466	3.9	PEG 119YL233

1) See Special technical features.

2) Leakage currents after 5 minutes at rated voltage and +20°C.

3) Impedance at 10 kHz.

SPECIAL TECHNICAL FEATURES

Dissipation factor

Rated voltage VDC	16—25	40—63	≥ 100
tan δ 100 Hz	0.25	0.20	0.20

Discharge operation
Capacitance change less than 10% after 10^6 charges and discharges.

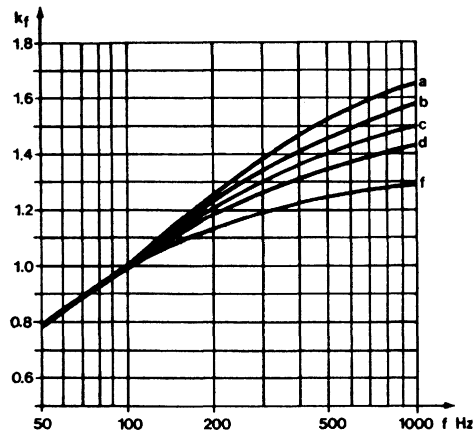
Bump test
The capacitors will withstand a test according to IEC publ. 68-2-29 test Eb, 4000 bumps with 390 m/s².
Diameter ≥ 16 mm must be clamped.
Diameter ≤ 13 mm mounted by their leads.

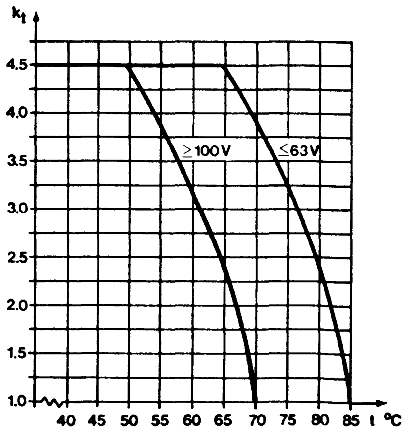
Solderability
The solderability meets the requirements in IEC 68-2-20, test T, solder bath method.

Mounting
The capacitors may be mounted in any position.

Endurance test
The endurance test may be carried out for 1000 h at the upper temperature (+85°C for $U_R \leq 63$ VDC, +70°C for $U_R \geq 100$ VDC) and rated voltage.
After such a test the capacitance change is less than 25%, the dissipation factor less than 1.5×stated initial max. value and the leakage current is still below specified limits.

Ripple current
Tabulated ripple currents I_o refer to 100 Hz and an ambient temperature of +70°C for $U_R \geq 100$ VDC and +85°C for $U_R \leq 63$ VDC. Ripple currents at other frequencies and temperatures can be calculated from the curves below and the formula $I = k_f \times k_t \times I_o$. Applicable curve k_f is given for each article in the table.





Notes

PEG 121

PEG 121 is a long life electrolytic capacitor encapsulated in an aluminium can sealed with a high purity aluminium disc and rubber gasket seal. Tinned copper wire leads. Plastic insulation is standard. The range is designed to meet the DIN specifications for tubular electrolytic capacitors for "erhöhte Anforderungen".

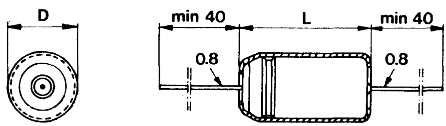
PEG 121 is supplied as 1A- or 1B-capacitors, 1B only for 40—70 VDC. Type 1A is mainly intended for filtering, coupling or decoupling. Type 1B is mainly intended for timing.

Basic specifications DIN 41 257
DIN 41 240, type 1A and 1B
DIN 40 040, class GPF
IEC 103 Grade 1 40/085/56

Temperature range —40°C to +85°C

Capacitance tolerance —10 to +50% type 1A.
0 to +50% type IB. See also under Special technical features.

General technical data See "Introduction" Electrolytic Capacitors.



Case code		A	B	D	F	G	H	J	L
D*)	mm	10	10	13	16	16	20	20	20
L_{max}	mm	20	30	30	30	40	30	40	47
Weight approx	g	3	4	6	9	11	13	20	24
Standard box content	pcs	200	200	200	100	100	100	100	100

*) Add 0.2 mm to D for max. diameter of insulated case.

STANDARD UNITS

Cap. μF	Rated voltage VDC	Dimensions D×L mm (code)	tanδ 100 Hz max. %	Ripple current[3]) at +40°C I_o mA 50 Hz	100 Hz	Impedance 10 kHz +20°C max. Ω	Order Number[1]) for type IA
220		10×20 (A)	25	200	310	1.8	PEG 121DA322
470		10×30[2]) (B)	25	430	580	0.85	PEG 121DB347
1000	6.3	16×30 (F)	25	900	1100	0.40	PEG 121DF410
2200		16×40[2]) (G)	29	1600	1700	0.32[4])	PEG 121DG422
4700		20×40[2]) (J)	33	3000	3200	0.15[4])	PEG 121DJ447
220		10×20[2]) (A)	20	290	410	1.1	PEG 121EA322
470	10	13×30 (D)	20	600	700	0.50	PEG 121ED347
1000		16×30[2]) (F)	20	1200	1300	0.25	PEG 121EF410
2200		20×30[2]) (H)	24	2000	2200	0.23[4])	PEG 121EH422
100		10×20 (A)	16	200	290	1.8	PEG 121GA310
220		10×30[2]) (B)	16	440	490	0.82	PEG 121GB322
470	16	16×30 (F)	16	850	950	0.38	PEG 121GF347
1000		20×30 (H)	16	1400	1500	0.18	PEG 121GH410
2200		20×40[2]) (J)	20	2500	2800	0.16[4])	PEG 121GJ422
47		10×20 (A)	14	140	190	2.8	PEG 121HA247
100		10×20[2]) (A)	14	300	330	1.3	PEG 121HA310
220	25	16×30 (F)	14	550	600	0.59	PEG 121HF322
470		16×30[2]) (F)	14	1000	1100	0.27	PEG 121HF347
1000		20×40[2]) (J)	14	1700	1800	0.13	PEG 121HJ410
47		10×20 (A)	12	200	220	1.9	PEG 121KA247
100		13×30 (D)	12	380	420	0.90	PEG 121KD310
220	40	16×30[2]) (F)	12	650	700	0.41	PEG 121KF322
470		20×30 (H)	12	1100	1200	0.19	PEG 121KH347
1000		20×47 (L)	12	2000	2200	0.09	PEG 121KL410
22		10×20 (A)	8	165	185	2.7	PEG 121NA222
47		10×30[2]) (B)	8	290	320	1.3	PEG 121NB247
100	70	16×30[2]) (F)	8	520	580	0.6	PEG 121NF310
220		20×30 (H)	8	900	1000	0.27	PEG 121NH322
470		20×47[2]) (L)	8	1600	1800	0.13	PEG 121NL347

[1]) Order No. for type IB for example: PEG 121NF310B.

[2]) This dimension which is somewhat smaller than specified in DIN 41 257 will be delivered for some time. All other data are in accordance with DIN 41 240 and DIN 41 257.

[3]) Ripple currents at other temperatures, see Special technical features.

[4]) Max. impedance at 1 kHz.

RIFA

SPECIAL TECHNICAL FEATURES

Capacitance

1A-capacitors are measured with $\leq$ 0.5 V 50 Hz at +20°C.

1B-capacitors are measured with a DC voltage according to DIN 41 328 (time constant method).

Discharge operation

Capacitance change less than 3% after 10^8 charges and discharges.

Ripple current

Tabulated values of ripple current refer to an ambient temperature of +40°C. At higher temperatures the following multipliers shall be applied:

Temp. °C	50	60	70	80	85
Multiplier	0.9	0.8	0.6	0.4	0.25

Vibration and bump test

10—500 Hz, 98 m/s² for 6 hours according to DIN 40 046, Blatt 8. 4000 bumps with 390 m/s², test Eb according to IEC 68-2-29.
Diameter $\geq$ 16 mm must be clamped.
Diameter $\leq$ 13 mounted by their leads.

Solderability

When tested to IEC 68-2-20, test T, solder globule method, the soldering time of the terminals in received condition is less than 1 s.

Life expectancy

The life expectancy exceeds 10 000 h at +85°C and rated voltage.

Reliability

The reliability at +40°C stated below exceeds the requirements in DIN 41 240.

Diameter	Catastrophic failures	Total failures
10 mm	1%/100 000 h	5%/100 000 h
> 10 mm	1%/100 000 h	3%/100 000 h

Catastrophic failures are short circuits or open circuits.

Total failures are the sum of catastrophic failures and degradation failures.

Notes

PEG 122

RIFA

PEG 122 is a long life electrolytic capacitor encapsulated in an aluminium can with a high purity aluminium disc and rubber gasket seal. All-welded design. Tinned copper wire leads. Plastic insulation is standard. An extremely long life and high reliability is achieved by the design, the careful selection of materials and methods for production and control. PEG 122 is well suited for applications where life and reliability is of paramount importance. The range is designed specifically to meet the BPO specification for long life tubular electrolytic capacitors.

PEG 122 can be used for timing, filtering, coupling and decoupling.

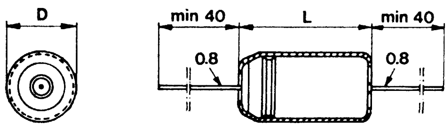
Basic specifications BPO D2186
IEC 103 Grade 1 category 40/085/56

Approval PEG 122 is approved by British Post Office to spec. D2186

Temperature range —40°C to +85°C (+100°C see Special technical features)

Capacitance tolerance Standard —10 to +50%
Special —20 to +20%. Add M to order No.

General technical data See "Introduction" Electrolytic capacitors



Case code		A	B	D	E	F	G	J	L
D*)	mm	10	10	13	13	16	16	20	20
L_{max}	mm	20	30	30	40	30	40	40	46
Weight approx	g	3	4	6	7	9	11	20	24
Standard box content	pcs	200	200	200	200	100	100	100	100

*) Add 0.2 mm to D for max. diameter of insulated case.

STANDARD UNITS

Cap. µF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current¹) +85°C 100 Hz I_o mA	Leakage²) current max. µA	Impedance 100 kHz, +20°C max. Ω	Order Number³)
1000	10	16×30 (F)	430	64	0.15	PEG 122EF410
2200		20×40 (J)	660	136	0.07⁴)	PEG 122EJ422
3300		20×47 (L)	900	202	0.05⁴)	PEG 122EL433
100	16	10×20 (A)	120	14	1.1	PEG 122GA310
150		10×30 (B)	180	18	0.73	PEG 122GB315
220		10×30 (B)	220	25	0.50	PEG 122GB322
470		13×30 (D)	320	49	0.23	PEG 122GD347
1000		16×40 (G)	540	100	0.11	PEG 122GG410
2200		20×47 (L)	780	215	0.96⁴)	PEG 122GL422
47	25	10×20 (A)	100	11	1.3	PEG 122HA247
100		10×30 (B)	170	19	0.60	PEG 122HB310
220		13×30 (D)	260	37	0.27	PEG 122HD322
470		16×30 (F)	390	75	0.13	PEG 122HF347
680		16×40 (G)	520	106	0.09	PEG 122HG368
1000		20×40 (J)	600	154	0.09	PEG 122HJ410
1500		20×47 (L)	840	229	0.07⁴)	PEG 122HL415
22	40	10×20 (A)	80	9	2.0	PEG 122KA222
33		10×20 (A)	100	12	1.4	PEG 122KA233
47		10×30 (B)	130	15	0.96	PEG 122KB247
100		13×30 (D)	190	28	0.45	PEG 122KD310
150		13×30 (D)	300	40	0.20	PEG 122KD315
220		13×40 (E)	320	57	0.20	PEG 122KE322
470		20×40 (J)	470	117	0.13	PEG 122KJ347
680		20×40 (J)	760	167	0.04	PEG 122KJ368
1000		20×47 (L)	780	244	0.06	PEG 122KL410
10	63	10×20 (A)	70	6	4.5	PEG 122MA210
22		10×20 (A)	80	12	2.0	PEG 122MA222
47		10×30 (B)	140	22	0.96	PEG 122MB247
100		13×30 (D)	200	42	0.45	PEG 122MD310
150		16×30 (F)	260	61	0.30	PEG 122MF315
220		16×40 (G)	350	87	0.20	PEG 122MG322
330		20×40 (J)	420	129	0.16	PEG 122MJ333
470		20×47 (L)	550	182	0.12	PEG 122ML347
2.2	100	10×20 (A)	25	2.2	5.8	PEG 122PA122
10		10×20 (A)	50	10	5.0	PEG 122PA210
22		10×30 (B)	80	17	2.3	PEG 122PB222
33		13×30 (D)	100	24	1.5	PEG 122PD233
47		13×40 (E)	140	32	1.1	PEG 122PE247
100		16×40 (G)	200	64	0.50	PEG 122PG310
150		20×40 (J)	380	94	0.27	PEG 122PJ315
220		20×47 (L)	330	136	0.27	PEG 122PL322

¹) Ripple current at other temperatures and frequencies, see Special technical features.
²) Leakage current after 5 minutes at rated voltage and +20°C.
³) Add M to order No. for ±20% capacitance tolerance. Example PEG 122MG322M.
⁴) Max. impedance at 10 kHz.

SPECIAL TECHNICAL FEATURES

Capacitance

Capacitance is measured at +20°C with 1 kHz and a polarizing voltage of 50—75% of rated voltage.

Dissipation factor

Rated voltage VDC	10	16	25	40	63	100
tan δ 1 kHz	1.80	1.50	0.70	0.55	0.50	0.55
100 Hz	0.25	0.20	0.15	0.10	0.10	0.10

The dissipation factor is measured at +20°C with 1 kHz and a polarizing voltage of 50—75% of rated voltage or with 100 Hz without polarizing voltage.

Discharge operation

Capacitance change less than 3% after 10^6 charges and discharges.

Leakage current

$I \leq 0.0002\ CU$

The leakage current shall be measured after 15 minutes with the rated voltage applied.

Prior to the leakage current test the capacitors are preconditioned according to BS 2134 part 1. 1959, para.2.4.1.

Solderability

When tested to IEC 68-2-20, test T, solder globule method, the soldering time of the terminals in received condition is less than 1 s.

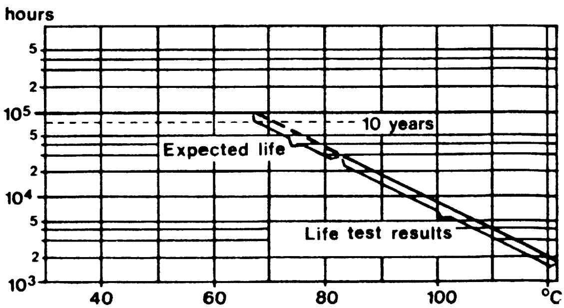
Endurance test

5000 h at +85°C and rated DC voltage or the sum of a DC voltage and a peak AC voltage equal to the rated voltage. The AC voltage shall give the rated ripple current.

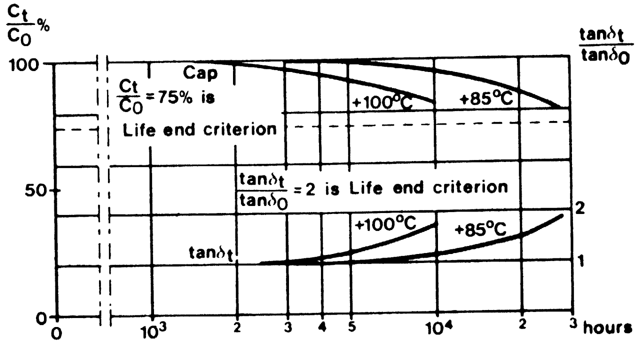
After such a test $\frac{\Delta C}{C} \leq 15\%$, $\frac{\Delta Z}{Z} \leq 1$, $\frac{\Delta \tan\delta}{\tan\delta} < 1$ and the leakage current still below tabulated values.

Life expectancy

> 25 000 h at +85°C and rated voltage or > 10 000 h at +100°C and 75% of rated voltage with less than 3% failures. Estimated to > 40 years at temperatures below 45°C.



Life expectancy vs. temp. at rated voltage.



Typical change of cap. and tanδ at 85°C and 100°C and rated voltage.

Reliability

Laboratory tests indicate that with 60% confidence level the failure rate will be less than 5×10^{-7}/h at +85°C and rated voltage. At +45°C this figure is estimated to be less than 5×10^{-8}/h.

Failure criteria

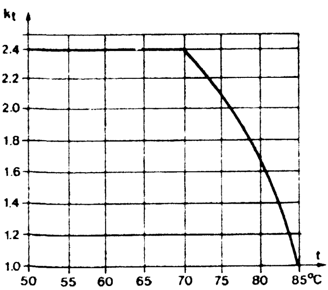
Failure criteria for life expectancy and reliability are

$\frac{\Delta C}{C} > 25\%$ $\tan\delta > 2 \times$ tabulated value

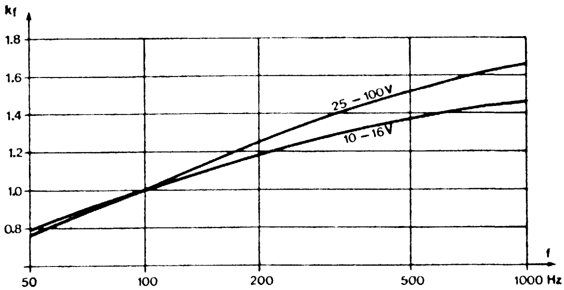
$\frac{\Delta Z}{Z} > 100\%$ or a leakage current higher than specified in the table.

Ripple current multipliers

Tabulated ripple currents I_o refer to 100 Hz and +85°C ambient temperature. Ripple currents at other temperatures and frequencies can be calculated from the curves below and the expression $I = k_f \times k_t \times I_o$



Ripple current multiplier v ambient temperature



Ripple current multiplier v frequency

PEG 123

PEG 123 is a long life electrolytic capacitor encapsulated in an aluminium can with a high purity aluminium disc and rubber gasket seal. Tinned copper wire leads. Plastic insulation is standard.

PEG 123 is designed as an economy range for demanding applications not specifying BPO or telephone grade capacitors. PEG 123 offers the same reliability and performance with a shorter operational life, however exceeding that of the IEC grade 1 specifications.

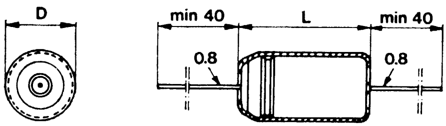
PEG 123 is suitable for timing, filtering, coupling and decoupling.

Basic specifications IEC 103 Grade 1 category 40/085/56
DIN 41 240 type 1A
DIN 40 040 GPF

Temperature range —40°C to +85°C

Capacitance tolerance Standard —10 to +50%

General technical data See "Introduction" Electrolytic capacitors.



Case code	A	B	C	D	E	F	G	H	J	L
D*) mm	10	10	13	13	13	16	16	20	20	20
L_{max} mm	20	30	20	30	40	30	40	30	40	46
Weight approx g	3	4	4	6	7	9	11	13	20	24
Standard box content pcs	200	200	200	200	200	100	100	100	100	100

*) Add 0.4 mm to D for max. diameter of insulated case.

STANDARD UNITS

Cap. µF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current¹) +85°C 100 Hz I_o mA	Leakage²) current max µA	Impedance 100 kHz, +20°C max. Ω	Order Number
470		13×20 (C)	200	22	0.43	PEG 123DC347
1000	6.3	13×30 (D)	340	42	0.20	PEG 123DD410
4700		20×40 (J)	860	182	0.05³)	PEG 123DJ447
220		10×20 (A)	140	17	0.77	PEG 123EA322
470		10×30 (B)	260	32	0.36	PEG 123EB347
1000	10	13×40 (E)	410	64	0.17	PEG 123EE410
2200		16×40 (G)	640	136	0.09³)	PEG 123EG422
2200		20×30 (H)	580	136	0.09³)	PEG 123EH422
4700		20×46 (L)	1040	286	0.04³)	PEG 123EL447
220		13×20 (C)	160	25	0.64	PEG 123GC322
470		13×30 (D)	280	49	0.30	PEG 123GD347
1000	16	16×30 (F)	430	100	0.14	PEG 123GF410
2200		20×40 (J)	700	215	0.08³)	PEG 123GJ422
3300		20×46 (L)	950	321	0.05³)	PEG 123GL433
100		10×20 (A)	130	19	0.85	PEG 123HA310
220		10×30 (B)	230	37	0.39	PEG 123HB322
470	25	13×40 (E)	370	75	0.18	PEG 123HE347
1000		16×40 (G)	560	154	0.09	PEG 123HG410
2200		20×46 (L)	920	334	0.05³)	PEG 123HL422
47		10×20 (A)	100	15	1.40	PEG 123KA247
68		10×20 (A)	130	20	0.96	PEG 123KA268
100		10×30 (B)	170	28	0.65	PEG 123KB310
100		13×20 (C)	150	28	0.65	PEG 123KC310
220	40	13×30 (D)	260	57	0.30	PEG 123KD322
470		16×30 (F)	400	117	0.14	PEG 123KF347
1000		20×40 (J)	640	244	0.08	PEG 123KJ410
1500		20×46 (L)	870	364	0.06³)	PEG 123KL415
10		10×20 (A)	60	10	3.80	PEG 123MA210
22		10×20 (A)	70	12	2.70	PEG 123MA222
47		10×30 (B)	130	22	1.30	PEG 123MB247
47		13×20 (C)	100	22	1.30	PEG 123MC247
100	63	13×30 (D)	170	42	0.60	PEG 123MD310
220		16×30 (F)	280	87	0.27	PEG 123MF322
470		20×30 (H)	400	182	0.15	PEG 123MH347
680		20×40 (J)	530	261	0.10	PEG 123MJ368
10		10×20 (A)	50	10	6.50	PEG 123PA210
22		13×20 (C)	70	17	3.00	PEG 123PC222
47		13×30 (D)	110	32	1.40	PEG 123PD247
100	100	16×30 (F)	170	64	0.65	PEG 123PF310
220		20×40 (J)	290	136	0.34	PEG 123PJ322
330		20×46 (L)	400	202	0.23	PEG 123PL333

¹) Ripple current at other temperatures and frequencies, see Special technical features.

²) Leakage current after 5 minutes at rated voltage and +20°C.

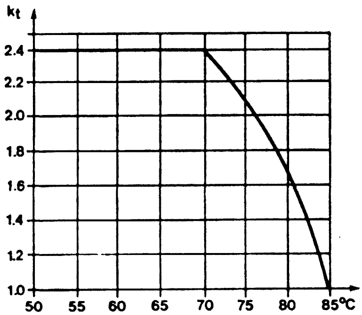
³) Impedance at 10 kHz.

SPECIAL TECHNICAL FEATURES

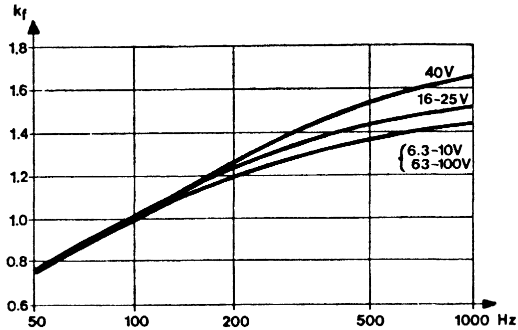
Discharge operation	Capacitance change less than 3% after 10^6 charges and discharges.
Vibration and bump test	10—500 Hz, 98 m/s^2 or 0.75 mm for 6 h according to IEC 68-2-6, test Fc. 4000 bumps with 390 m/s^2 according to IEC 68-2-29, test Eb. Diameter $\geq$ 16 mm must be clamped. Diameter $\leq$ 13 mm mounted by their leads.
Solderability	When tested to IEC 68-2-20, test T, solder globule method, the soldering time of the terminals in received condition is less than 1 s.
Mounting	The capacitors may be mounted in any position.
Endurance test	5000 h at +85°C and rated DC voltage or the sum of a DC voltage and a peak AC voltage equal to the rated voltage. The AC voltage shall give the rated ripple current. After such a test $\frac{\Delta C}{C} \leq 15\%$, $\frac{\Delta Z}{Z} \leq 1$, $\frac{\Delta \tan\delta}{\tan\delta} < 1$ and the leakage current still below tabulated values.
Life expectancy	> 10000 h at +85°C and rated voltage with less than 3% failures.
Reliability	The failure rate at rated voltage is estimated to be less than 10^{-6}/h at +85°C and 10^{-7}/h at +40°C. Failure criteria are: $\frac{\Delta C}{C} > 25\%$, $\frac{\Delta Z}{Z} > 1$, $\frac{\Delta \tan\delta}{\tan\delta} > 1$ or a leakage current exceeding tabulated values.

Ripple current multipliers

Tabulated ripple currents I_o refer to 100 Hz and +85°C ambient temperature. Ripple currents at other temperatures and frequencies can be calculated from the curves below and the formula $I = k_f \times k_t \times I_o$



Ripple current multiplier v ambient temperature



Ripple current multiplier v frequency

PEG 124

PEG 124 is a long life electrolytic capacitor type encapsulated in an aluminium can with a high purity aluminium disc and rubber gasket seal. Tinned copper wire leads. Plastic insulation is standard. An extremely long life and high reliability is achieved by the design, the careful selection of materials and methods for production and quality assurance. PEG 124 is well suited for applications where life and reliability is of paramount importance.

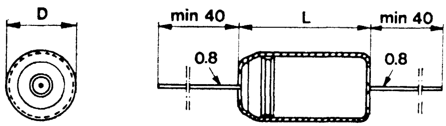
PEG 124 can be used for timing, filtering, coupling and decoupling.

Basic specifications IEC 103 Grade 1, category 40/085/56
DIN 41 240, type 1A and 1B
Electrical and reliability specifications in DIN 41 255 are met.

Temperature range —40°C to +85°C (+100°C. See Special technical features)

Capacitance tolerance Standard —10 to +50%
Special —20 to +20%. Add M to order No.

General technical data See "Introduction" Electrolytic Capacitors.



Case code		A	B	D	E	F	G	J	L
D*)	mm	10	10	13	13	16	16	20	20
L_{max}	mm	20	30	30	40	30	40	40	46
Weight approx	g	3	4	6	7	9	11	20	24
Standard box content	pcs	200	200	200	200	100	100	100	100

*) Add 0.2 mm to D for max. diameter of insulated case.

STANDARD UNITS (12—100 V)

Cap. µF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current[1]) +85°C 100 Hz I_o mA	Leakage[2]) current max. µA	Impedance 100 kHz, +20°C max. Ω	Order Number[3])
1000	12	16×30 (F)	426	76	0.12	PEG 124FF410
2200		20×40 (J)	720	162	0.07[4])	PEG 124FJ422
100	16	10×20 (A)	120	14	1.1	PEG 124GA310
150		10×30 (B)	180	18	0.73	PEG 124GB315
220		10×30 (B)	216	25	0.50	PEG 124GB322
330		13×30 (D)	264	36	0.33	PEG 124GD333
470		13×30 (D)	318	49	0.23	PEG 124GD347
680		13×40 (E)	438	69	0.16	PEG 124GE368
1000		16×40 (G)	540	100	0.11	PEG 124GG410
1500		20×40 (J)	660	148	0.09[4])	PEG 124GJ415
47	25	10×20 (A)	120	11	1.3	PEG 124HA247
100		10×30 (B)	180	19	0.60	PEG 124HB310
220		13×30 (D)	270	37	0.27	PEG 124HD322
330		13×40 (E)	378	54	0.18	PEG 124HE333
470		16×30 (F)	390	75	0.13	PEG 124HF347
680		16×40 (G)	516	106	0.09	PEG 124HG368
1000		20×40 (J)	624	154	0.09	PEG 124HJ410
33	40	10×20 (A)	96	12	1.4	PEG 124KA233
47		10×20 (A)	115	15	1.1	PEG 124KA247
68		10×30 (B)	156	20	0.66	PEG 124KB268
150		13×30 (D)	240	40	0.30	PEG 124KD315
220		13×40 (E)	342	57	0.20	PEG 124KE322
330		16×40 (G)	408	83	0.14	PEG 124KG333
470		20×40 (J)	432	117	0.13	PEG 124KJ347
680		20×40 (J)	564	167	0.09	PEG 124KJ368
10	64	10×20 (A)	51	6	4.5	PEG 124MA210
15		10×20 (A)	60	10	3.0	PEG 124MA215
22		10×20 (A)	78	12	2.0	PEG 124MA222
33		10×30 (B)	114	17	1.4	PEG 124MB233
47		10×30 (B)	138	22	0.95	PEG 124MB247
68		13×30 (D)	162	30	0.66	PEG 124MD268
100		13×30 (D)	204	42	0.45	PEG 124MD310
150		16×30 (F)	258	62	0.30	PEG 124MF315
220		16×40 (G)	348	88	0.21	PEG 124MG322
330		20×40 (J)	420	131	0.17	PEG 124MJ333
470		20×46 (L)	546	184	0.12	PEG 124ML347
4.7	100	10×20 (A)	40	5	10	PEG 124PA147
10		10×30 (B)	48	10	5.0	PEG 124PB210
22		13×30 ((D)	84	17	2.3	PEG 124PD222
47		13×40 (E)	138	32	1.1	PEG 124PE247
100		16×40 (G)	204	64	0.50	PEG 124PG310
220		20×46 (L)	330	136	0.27	PEG 124PL322

[1]) Ripple current at other temperatures and frequencies, see Special technical features.
[2]) Leakage current after 5 minutes at rated voltage and +20°C.
[3]) Add M to the order No. for ± 20% capacitance tolerance. Example: PEG 124MG322M.
[4]) Max. impedance at 10 kHz.

RIFA

SPECIAL TECHNICAL FEATURES

Dissipation factor

Rated voltage VDC	12	16	25	40	64	100
Max. $\tan\delta$ 100 Hz %	18	15	12	10	10	10

Discharge operation
Capacitance change less than 3% after 10^6 charges and discharges.

Vibration and bump test
10—500 Hz, 98 m/s^2, test Fc according to IEC 68-2-6. 4000 bumps with 390 m/s^2, test Eb according to IEC 68-2-29.
Diameter $\geq$ 16 mm must be clamped.
Diameter $\leq$ 13 mm mounted by their leads.

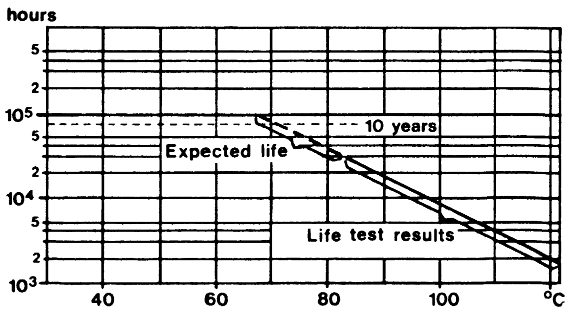
Solderability
When tested to IEC 68-2-20, test T, solder globule method, the soldering time of the terminals in received condition is less than 1 s.

Mounting
The capacitors may be mounted in any position.

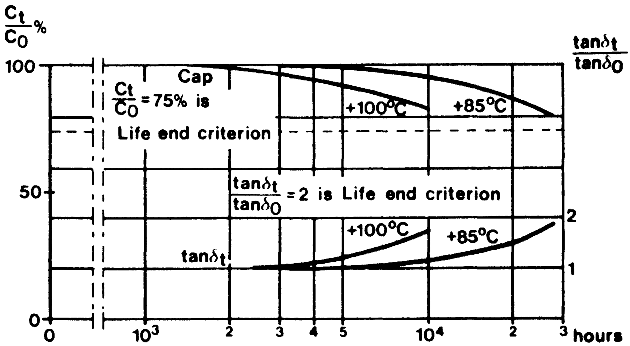
Endurance test
5000 h at +85°C and rated DC voltage or the sum of a DC voltage and a peak AC voltage equal to the rated voltage. The AC voltage shall give the rated ripple current.

After such a test $\frac{\Delta C}{C} \leq 15\%$, $\frac{\Delta Z}{Z} \leq 1$, $\frac{\Delta \tan\delta}{\tan\delta} < 1$ and the leakage current still below tabulated values.

Life expectancy
> 25 000 h at +85°C and rated voltage or > 10 000 h at +100°C and 75% of rated voltage with less than 3% failures. Estimated to > 40 years at temperatures below 45°C.



Life expectancy v temp. at rated voltage.



Typical change of cap and tanδ at +85°C and 100°C and rated voltage.

Reliability

Laboratory tests indicate that with 60% confidence level the failure rate will be less than 5×10^{-7}/h at +85°C and rated voltage. Corresponding figure at +45°C is estimated to be less than 5×10^{-8}/h.

Failure criteria

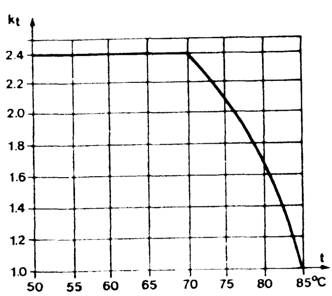
Failure criteria for life expectancy and reliability are

$\frac{\Delta C}{C} > 25\%$ tanδ > 2×tabulated value

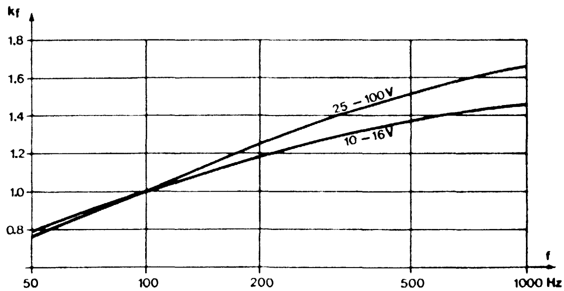
$\frac{\Delta Z}{Z} > 100\%$ or a leakage current higher than specified in the table.

Ripple current multipliers

Tabulated ripple currents I_o refer to 100 Hz and +85°C ambient temperature. Ripple currents at other temperatures and frequencies can be calculated from the curves below and the formula $I = k_f \times k_t \times Io$.



Ripple current multiplier v ambient temperature



Ripple current multiplier v frequency

PEH 125—129

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PEH 125—129 are high capacitance units encapsulated in aluminium cans sealed with a moulded phenolic lid. A vent protects against excess pressure if capacitors are overloaded. Heavy duty screw terminals.

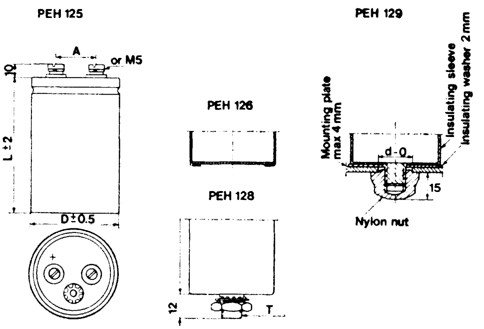
PEH 125—129 offer high reliability and extended life. These types are mainly intended for filtering in power supplies and for providing high current pulses, for example in computers or thyristor inverters.

Basic specifications IEC 103 Grade 1 category 40/070/56
Rated voltage ≤ 70 VDC can be operated up to +85°C as type 2 category 40/085/56
DIN 41 240 IA DIN 40 040 GSF

Temperature range —40°C to +85°C for rated voltage ≤ 70 VDC
—40°C to +70°C for rated voltage > 70 VDC

Capacitance tolerance —10% to +50%

General technical data See "Introduction" Electrolytic capacitors



Dimensions in mm

The hole diameter d mm is important for an exact mounting with a creepage path of 4 mm between mounting plate and capacitor housing.

Case code		N	R	A	B	D	F
D*)	mm	35	35	50,8	50,8	63,5	76,2
L	mm	78	104	78	104	104	104
d	mm	17	17	17	17	21	21
A	mm	15,4	15,4	22	22	29	35
T		M8	M8	M8	M8	M12	M12
Weight approx	g	110	140	190	270	470	660
Standard box content	pcs	80	80	40	40	24	18

*) Add 0,7 mm to D for insulated version.

STANDARD UNITS (10—70 V)

Cap. µF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current[1]) A 100 Hz +65°C	+85°C (I_o)	tanδ 100 Hz max %	Impedance 10 kHz, +20°C max. mΩ	Order Number[2]) stud fixing insulated version
22000	10	35×78 (N)	6.9	1.5	33	17	PEH 129EN522
47000		50.8×78 (A)	12.2	2.6	33	9	PEH 129EA547
100000		63.5×104 (D)	16.0	3.4	58	7	PEH 129ED610
15000	16	35×78 (N)	6.6	1.4	25	17	PEH 129GN515
22000		35×104 (R)	8.7	1.9	27	14	PEH 129GR522
33000		50.8×78 (A)	11.6	2.5	27	9	PEH 129GA533
47000		50.8×104 (B)	14.6	3.1	30	8	PEH 129GB547
68000		63.5×104 (D)	15.7	3.4	40	7	PEH 129GD568
100000		76.2×104 (F)	16.2	3.5	65	8	PEH 129GF610
10000	25	35×78 (N)	6.3	1.4	18	17	PEH 129HN510
15000		35×104 (R)	8.7	1.9	18	14	PEH 129HR515
22000		50.8×78 (A)	11.3	2.4	18	9	PEH 129HA522
33000		50.8×104 (B)	14.4	3.1	22	8	PEH 129HB533
47000		63.5×104 (D)	15.8	3.4	28	7	PEH 129HD547
68000		76.2×104 (F)	15.8	3.4	45	8	PEH 129HF568
6800	40	35×78 (N)	6.2	1.3	13	17	PEH 129KN468
10000		35×104 (R)	8.3	1.8	13	14	PEH 129KR510
15000		50.8×78 (A)	11.1	2.4	13	9	PEH 129KA515
22000		50.8×104 (B)	14.0	3.0	15	8	PEH 129KB522
33000		63.5×104 (D)	15.4	3.3	22	7	PEH 129KD533
47000		76.2×104 (F)	15.4	3.3	33	8	PEH 129KF547
2200	63	35×78 (N)	4.6	1.0	8	17	PEH 129MN422
3300		35×78 (N)	5.3	1.1	8	17	PEH 129MN433
4700		35×104 (R)	7.1	1.5	8	12	PEH 129MR447
6800		50.8×78 (A)	9.5	2.0	8	9	PEH 129MA468
10000		50.8×78 (A)	9.9	2.1	9	9	PEH 129MA510
15000		63.5×104 (D)	14.0	3.0	12	7	PEH 129MD515
22000		76.2×104 (F)	15.0	3.2	17	8	PEH 129MF522
4700	70	50.8×78 (A)	8.0	1.7	8	13	PEH 129NA447
10000		50.8×104 (B)	12.2	2.6	9	8	PEH 129NB510

continued overleaf

[1]) Ripple currents at other temperatures and frequencies, see Special technical features.

[2]) For other versions replace PEH 129 by:
PEH 125 for clip fixing uninsulated version
PEH 126 for clip fixing insulated version
PEH 128 for stud fixing uninsulated version

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STANDARD UNITS (100—350 V)

Cap. μF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current[1] A 100 Hz +50°C	+70°C (I_0)	tanδ 100 Hz max %	Impedance 10 kHz, +20°C max. mΩ	Order Number[2] stud fixing insulated version
1000	100	35×78 (N)	2.9	0.63	13	94	PEH 129PN410
1500		35×104 (R)	4.1	0.87	13	64	PEH 129PR415
2200		50.8×78 (A)	5.3	1.1	13	45	PEH 129PA422
3300		50.8×104 (B)	7.1	1.5	13	31	PEH 129PB433
4700		63.5×104 (D)	8.8	1.9	14	26	PEH 129PD447
8000		76.2×104 (F)	10.9	2.3	16	19	PEH 129PF480
470	160	35×78 (N)	2.4	0.51	10	160	PEH 129QN347
680		35×104 (R)	3.2	0.69	10	120	PEH 129QR368
1000		50.8×78 (A)	4.2	0.90	10	78	PEH 129QA410
1500		50.8×104 (B)	5.7	1.2	10	53	PEH 129QB415
2200		63.5×104 (D)	7.3	1.6	10	38	PEH 129QD422
4000		76.2×104 (F)	9.7	2.1	11	25	PEH 129QF440
330	250	35×78 (N)	1.7	0.36	17	480	PEH 129SN333
470		35×104 (R)	2.4	0.51	17	340	PEH 129SR347
680		50.8×78 (A)	2.9	0.63	17	210	PEH 129SA368
1000		50.8×104 (B)	4.1	0.87	17	160	PEH 129SB410
1500		63.5×104 (D)	5.1	1.1	18	110	PEH 129SD415
2200		76.2×104 (F)	7.0	1.5	17	77	PEH 129SF422
800	300	50.8×104 (B)	3.8	0.81	14	150	PEH 129TB380
2000		76.2×104 (F)	6.9	1.5	14	66	PEH 129TF420
220	350	35×78 (N)	1.5	0.33	12	440	PEH 129UN322
330		35×104 (R)	2.2	0.48	12	290	PEH 129UR333
470		50.8×78 (A)	2.7	0.57	12	210	PEH 129UA347
640		50.8×104 (B)	3.6	0.78	12	150	PEH 129UB364
1000		63.5×104 (D)	4.6	0.99	12	100	PEH 129UD410
1500		76.2×104 (F)	6.3	1.4	12	70	PEH 129UF415

[1]) Ripple currents at other temperatures and frequencies, see Special technical features.

[2]) For other versions replace PEH 129 by:

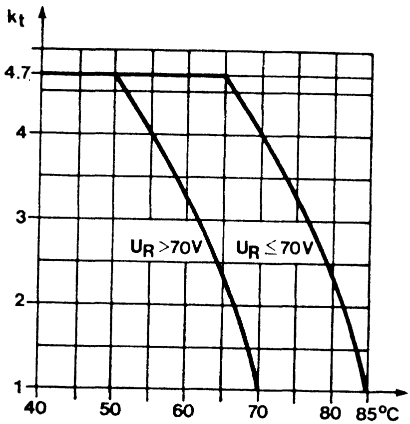
PEH 125 for clip fixing uninsulated version
PEH 126 for clip fixing insulated version
PEH 128 for stud fixing uninsulated version

SPECIAL TECHNICAL FEATURES

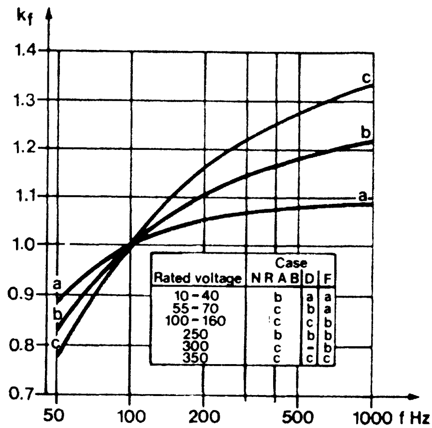
Leakage current	$I \leq (0.006\ CU+4)\ \mu A$ C = rated capacitance in μF U = rated voltage in volts Measured at 20°C after 5 minutes at rated voltage.
Discharge operation	Capacitance change less than 3% after 10^6 charges and discharges.
Vibration and bump test	10—500 Hz, 98 m/s^2 or 0.75 mm for 6 h according to IEC 68-2-6, test Fc. 4000 bumps with 390 m/s^2 according to IEC 68-2-29, test Eb. $\frac{\Delta C}{C} \leq 5\%$. No visible damage. Leakage current and $\tan\delta \leq$ stated limit.
Mounting	The capacitors shall be mounted upright or may be inclined to horizontal position if the vent is in the upper half of the lid. Mounted according to instructions PEH 129 will withstand 1000 VDC for 60 s between capacitor case and chassis.
Endurance test	The endurance test may be carried out for 2000 h at +70°C and rated voltage or the sum of a DC voltage and a peak AC voltage equal to the rated voltage. The AC voltage giving the rated ripple current. After such a test $\frac{\Delta C}{C} \leq 15\%$, $\tan\delta \leq 1.3$ stated limit and leakage current still below stated limit. Capacitors with rated voltage ≤ 70 V may be tested 1000 h at +85°C. Test and requirements otherwise in accordance with above at +70°C.

Ripple current multipliers

Recommended max. ripple current I_o at 100 Hz and +70°C (+85°C for $U_R \leq 70$ VDC) ambient temperature is stated in the table. Ripple currents at other temperatures and frequencies can be calculated from the curves below and the formula $I = k_f \times k_t \times I_o$



Ripple current multiplier v ambient temperature



Ripple current multiplier v frequency

Notes

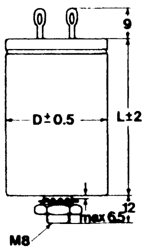
PEH 130–133

The PEH 130—133 series offer single or double section electrolytic capacitors encapsulated in aluminium cans sealed with rubber-faced phenolic laminate discs. Solder tag terminals. These types offer high standards of performance and reliability.

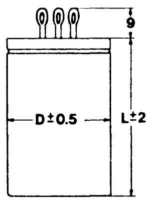
PEH 130—133 are mainly intended for filtering or timing in industrial equipment.

Basic specifications	IEC 103 Grade 1 category 25/070/56 (40/070/56 for $U_R \leq$ 63 VDC) Grade 2 category 25/085/56 (40/085/56 for $U_R \leq$ 63 VDC) DIN 41 240 IA HSF (GSF for $U_R \leq$ 63 VDC)
Temperature range	—25°C to +85°C (—40°C to +85°C for $U_R \leq$ 63 VDC)
Capacitance tolerance	—10% to +50%
General technical data	See "Introduction" Electrolytic capacitors.

PEH 132



PEH 130

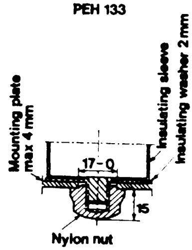


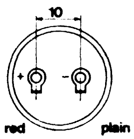
Dimensions in mm

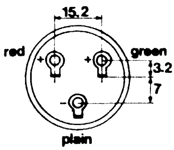
For clip mounting: PEH 130 uninsulated, PEH 131 insulated

For stud mounting: PEH 132 uninsulated, PEH 133 for completely insulated mounting

PEH 133







Red is outer capacitance of double capacitors

The hole diameter 17 mm is important for an exact mounting with a creepage path of 4 mm between mounting plate and capacitor housing.

Case code		B	C	E	L	M	N	S	X
D*)	mm	25	25	30	35	35	35	40	40
L	mm	50	60	50	50	60	72	72	82
Weight approx	g	50	55	65	80	90	100	120	140
Standard box content	pcs	140	140	110	80	80	80	50	50

*) Add 0.7 mm to D for insulated version.

STANDARD UNITS (6.3—100 V)

Cap. µF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current[1] 100 Hz I_0 A	k_f	tan δ 100 Hz max. %	Impedance 10 kHz, +20°C max. mΩ	Order Number[2] stud fixing insulated version
10000	6.3	25×60 (C)	0.71	b	35	23	PEH 133DC510
22000		35×60 (M)	1.2	a	45	19	PEH 133DM522
47000		40×82 (X)	1.5	a	65	13	PEH 133DX547
6800	10	25×50 (B)	0.58	c	35	25	PEH 133EB468
10000		35×50 (L)	0.79	b	35	21	PEH 133EL510
22000		35×72 (N)	1.2	a	40	14	PEH 133EN522
4700	16	25×50 (B)	0.55	c	25	25	PEH 133GB447
10000		35×60 (M)	0.92	b	28	21	PEH 133GM510
15000		35×72 (N)	1.1	a	30	14	PEH 133GN515
22000		40×82 (X)	1.4	a	35	14	PEH 133GX522
2200	25	25×50 (B)	0.45	d	25	40	PEH 133HB422
4700		25×60 (C)	0.69	c	25	19	PEH 133HC447
6800		35×50 (L)	0.77	b	25	24	PEH 133HL468
10000		35×72 (N)	1.1	b	25	16	PEH 133HN510
15000		40×72 (S)	1.2	a	30	16	PEH 133HS515
1000	40	25×50 (B)	0.35	c	20	80	PEH 133KB410
1500		25×50 (B)	0.42	c	20	53	PEH 133KB415
2200		25×60 (C)	0.53	c	20	36	PEH 133KC422
3300		35×50 (L)	0.66	c	20	34	PEH 133KL433
4700		35×60 (M)	0.84	b	20	24	PEH 133KM447
6800		40×72 (S)	1.1	b	20	22	PEH 133KS468
10000		40×82 (X)	1.3	a	20	15	PEH 133KX510
1000	63	25×50 (B)	0.40	d	20	50	PEH 133MB410
1500		25×60 (C)	0.50	d	20	33	PEH 133MC415
2200		35×50 (L)	0.63	c	20	34	PEH 133ML422
3300		35×72 (N)	0.90	c	20	22	PEH 133MN433
4700		40×72 (S)	1.1	b	20	21	PEH 133MS447
470	100	25×50 (B)	0.21	b	20	530	PEH 133PB347
1000		35×50 (L)	0.34	b	25	260	PEH 133PL410
2200		35×72 (N)	0.61	b	30	120	PEH 133PN422
3300		40×72 (S)	0.74	a	30	85	PEH 133PS433

[1]) Ripple current versus temperature and frequency for Grade 1 and Grade 2 requirements, see Special technical features.

[2]) For other versions replace PEH 133 by:

PEH 130 for clip fixing uninsulated version
PEH 131 for clip fixing insulated version
PEH 132 for stud fixing uninsulated version

PEH 130–133

RIFA

STANDARD UNITS (160—450 V)

Cap. µF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current¹) 100 Hz Io A	k_f	tan δ 100 Hz max. %	Impedance 10 kHz, +20°C max. Ω	Order Number²) stud fixing insulated version
220		25×60 (C)	0.20	c	20	0.45	PEH 133QC322
330		35×50 (L)	0.29	c	20	0.32	PEH 133QL333
470	160	35×60 (M)	0.37	c	20	0.22	PEH 133QM347
680		35×72 (N)	0.48	c	20	0.15	PEH 133QN368
1000		40×82 (X)	0.66	c	20	0.11	PEH 133QX410
100		25×50 (B)	0.12	b	20	2.2	PEH 133SB310
150		25×60 (C)	0.16	b	20	1.5	PEH 133SC315
220	250	35×50 (L)	0.22	b	20	1.0	PEH 133SL322
330		35×60 (M)	0.29	b	20	0.67	PEH 133SM333
470		40×72 (S)	0.40	b	20	0.47	PEH 133SS347
47		25×50 (B)	0.09	d	20	2.8	PEH 133UB247
68		25×50 (B)	0.11	d	20	1.9	PEH 133UB268
100	350	30×50 (E)	0.15	d	20	1.3	PEH 133UE310
150		35×50 (L)	0.20	d	20	0.87	PEH 133UL315
220		35×72 (N)	0.29	d	20	0.59	PEH 133UN322
330		40×72 (S)	0.40	c	20	0.39	PEH 133US333
22		25×50 (B)	0.06	d	20	5.9	PEH 133YB222
33		25×50 (B)	0.08	d	20	3.9	PEH 133YB233
47		30×50 (E)	0.11	d	20	2.8	PEH 133YE247
68	450	35×50 (L)	0.14	d	20	1.9	PEH 133YL268
100		35×72 (N)	0.20	d	20	1.3	PEH 133YN310
150		40×72 (S)	0.26	d	20	0.87	PEH 133YS315
100+100	250	35×50 (L)	0.15	b	20	2.2	PEH 133SL906
32+32	350	35×50 (L)	0.10	d	20	4.1	PEH 133UL903
100+100		35×72 (N)	0.20	d	20	1.3	PEH 133UN906
8+8		35×50 (L)	0.04	d	20	16.3	PEH 133YL901
16+16	450	35×50 (L)	0.06	d	20	8.1	PEH 133YL902
32+32		35×50 (L)	0.09	d	20	4.1	PEH 133YL903
50+50		35×72 (N)	0.14	d	20	2.6	PEH 133YN905

¹) Ripple current versus temperature and frequency for Grade 1 and Grade 2 requirements. see Special technical features. Tabulated values are for outer capacitance of double capacitors. Multiply by 0.7 for inner capacitance.

²) For other versions replace PEH 133 by:

PEH 130 for clip fixing uninsulated version
PEH 131 for clip fixing insulated version
PEH 132 for stud fixing uninsulated version

SPECIAL TECHNICAL FEATURES

Leakage current	$I_l \leq 0.006\ C_R\ U_R + 4\ \mu A$ C_R = rated capacitance in μF U_R = rated voltage in volts
Discharge operation	Capacitance change less than 3% after 10^6 charges and discharges.
Vibration and bump test	10—500 Hz, 98 m/s^2 or 0.75 mm for 6 h according to IEC 68-2-6 test Fc. 4000 bumps according to IEC 68-2-29, test Eb. $\frac{\Delta C}{C} \leq 5\%$. No visible damage. Leakage current and $\tan\delta \leq$ stated limits.
Solderability	The solderability meets the requirements in IEC 68-2-20, test, T, solder bath method.
Mounting	The capacitors may be mounted in any position. However, upright mounting is to be preferred.
Endurance test	The capacitors fulfil the requirements in IEC publ. 103 for

Grade 1 after 2000 h at +70°C

$\frac{\Delta C}{C} \leq 15\%$ (10% for $U_R > 160$ V),
$\tan\delta \leq 1.3 \times$ specified limits,
$Z_{10\,kHz} \leq 2 \times$ specified limits,
leakage current $\leq$ specified limits

Grade 2 after 2000 h*) at +85°C

$\frac{\Delta C}{C} \leq 25\%$ (15% for $U_R > 160$ V),
$\tan\delta \leq 1.5 \times$ specified limits,
$Z_{10\,kHz} \leq 3 \times$ specified limits,
leakage current $\leq$ specified limits

During the test the capacitors can be loaded with rated voltage or with an AC voltage, giving the rated ripple current, superimposed on a DC voltage so that the sum of DC plus peak AC voltage equals the rated voltage.

*) IEC publ. 103 specifies only 1000 h.

RIFA

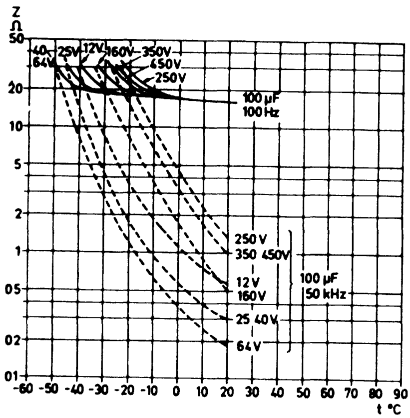
Impedance

Typical values of impedance for 100 μF are given below. Impedance for other capacitances (C) can be calculated from

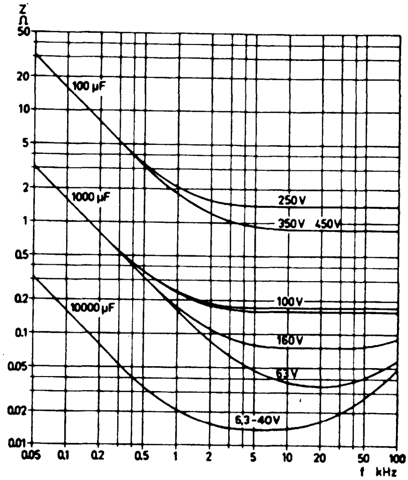
$$Z_C = \frac{Z_{100} \times 100}{C} \text{ ohm}$$

Z_{100} = impedance from diagram.

C = capacitance in μF



Impedance at 100 Hz and at 50 kHz

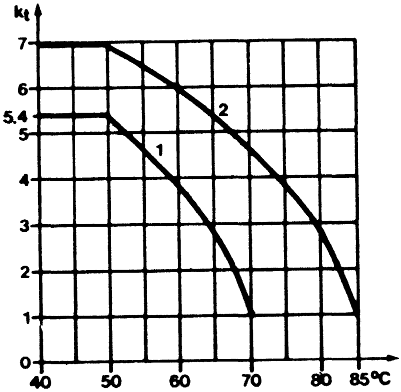


Impedance at +20°C

RIFA

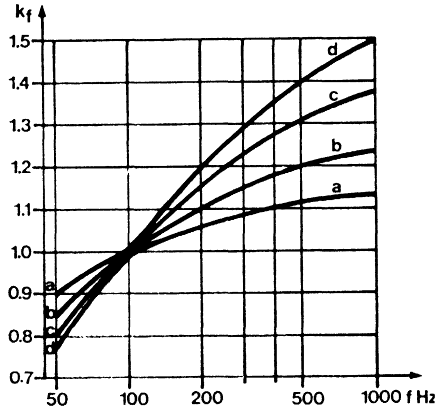
Ripple current multipliers

Tabulated ripple currents I_o refer to 100 Hz and an ambient temperature of +70°C for Grade 1 and +85°C for Grade 2 requirements. Ripple currents at other temperatures and frequencies can be calculated from the curves below and the formula $I = k_f \times k_t \times I_o$. Applicable frequency curve is stated in the table.



1=For Grade 1 requirements
2=For Grade 2 requirements

Ripple current multiplier v ambient temperature



Ripple current multiplier v frequency

PEH 140–144

RIFA

PEH 140—144 are electrolytic capacitors with one or two capacitances encapsulated in an aluminium can sealed with a rubber-faced laminate disc. The aluminium can is provided with a screw socket with solder terminals fed through for wiring under the chassis.

PEH 140—144 are maintenance types.

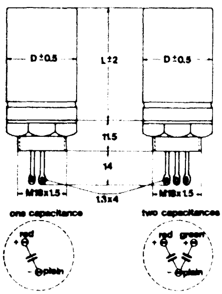
Basic specification IEC 103 type 2 category 25/070/56

Temperature range —25°C to +70°C

Capacitance tolerance —20 to +100% for $U_R \leq 100$ VDC
—20 to + 50% for $U_R > 100$ VDC

Rated voltage range 25 VDC to 450 VDC

PEH 140 uninsulated
PEH 141 outer plastic insulation



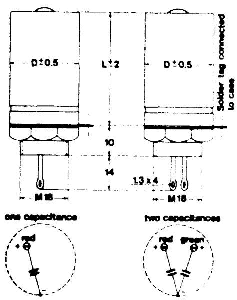
Hole diameter in chassis 18.5-⁰ mm.

Red is outer capacitance at multi-capacitance capacitors.

Dimensions in mm.

PEH 141 has an insulating washer for insulating case from chassis.

PEH 143 uninsulated
PEH 144 outer plastic insulation



Case size v max capacitance[2])

D[1]) mm L mm	25 45	25 52	25 62	30 52	30 62	35 52	35 62	35 74
	Max capacitance in µF							
U_R 25 VDC	1000			2000			5000	
35 VDC	800	1000				2000		
55 VDC	500		1000				2000	
70 VDC	250	500				1000		
100 VDC	500	600	800	900	1200	1300	1500	2200
160 VDC	150	180	240	270	360	390	500	620
250 VDC	82	100	140	160	200	220	270	360
350 VDC	50	60	82	95	120	130	150	220
450 VDC	25	30	40	47	60	62	82	100

[1]) Add 0.7 mm to D for outer plastic insulation.
[2]) The sum of capacitances of multi-capacitance capacitors.

STANDARD UNITS (PEH 140—141)

Cap µF	Rated voltage VDC	Dimension D×L mm (code)	Order Number
1000	25	25×45 (A)	PEH 1411E/29
5000		35×62 (M)	PEH 1411E/221
800	35	25×45 (A)	PEH 1411E/328
1000		25×45 (A)	PEH 1411E/127
2000		30×52 (G)	PEH 1411E/125
500	55	25×45 (A)	PEH 1401E/37
1000		25×62 (C)	PEH 1411E/38
2000		35×62 (M)	PEH 1411E/39
250	70	25×45 (A)	PEH 1401E/248
500		25×52 (B)	PEH 1411E/239
1000		35×52 (L)	PEH 1401E/241
1000		35×52 (L)	PEH 1411E/241
200	100	25×45 (A)	PEH 1411E/46
500		30×62 (H)	PEH 1411E/47
200	350	35×62 (M)	PEH 1411E/173
16	450	25×45 (A)	PEH 1411E/83
32		25×62 (C)	PEH 1411E/84
50+50	300	35×62 (M)	PEH 1412E/406
50+50	350	30×52 (G)	PEH 1412E/175
8+8	450	25×45 (A)	PEH 1412E/86
32+32		35×52 (L)	PEH 1412E/88

STANDARD UNITS (PEH 143—144)

1000	35	25×52 (B)	PEH 1431E/127
500	70	25×52 (B)	PEH 1431E/239
1000		35×52 (L)	PEH 1431E/241
500	160	35×62 (M)	PEH 1431E/251
25+25	300	25×45 (A)	PEH 1432E/408

PEH 146—149

RIFA

PEH 146—149 are long life, high capacitance electrolytic capacitors in cylindrical aluminium cans. Moulded lid with safety vent. Heavy duty screw terminals.

These types have high ripple current ratings and long life at high temperatures. They are intended for filtering or energy storage under severe ambient conditions or for applications where life and reliability is of paramount importance.

Basic specifications IEC 103 grade 1, category 40/085/56
DIN 41 240 type 1A
DIN 40 040 class GPF
Electrical ratings in DIN 41 247 are met.

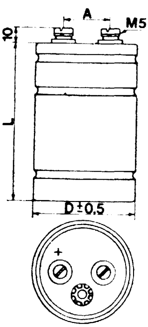
Temperature range —40°C to +85°C

Capacitance tolerance —10 to +50%

General technical data See "Introduction" Electrolytic capacitors

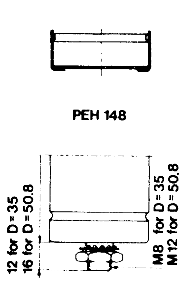
Dimensions in mm

PEH 146

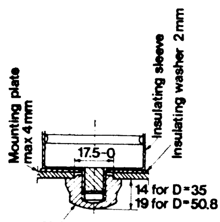


PEH 147

PEH 148



PEH 149



The hole diameter 17.5 mm is important for an exact mounting with a creepage path of 4 mm between mounting plate and capacitor housing.

Case code		A	B	C	D	G	H
D¹)	mm	35	35	35	35	50.8	50.8
L_{max}¹)	mm	54	65	83	115	83	115
A	mm	15.4	15.4	15.4	15.4	22	22
Weight approx	g	90	100	115	150	260	350
Standard box content	pcs	80	80	80	80	40	40

¹) Add 0.8 mm to D and 2 mm to L for insulating sleeve.

RIFA

PEH 146—149

STANDARD UNITS

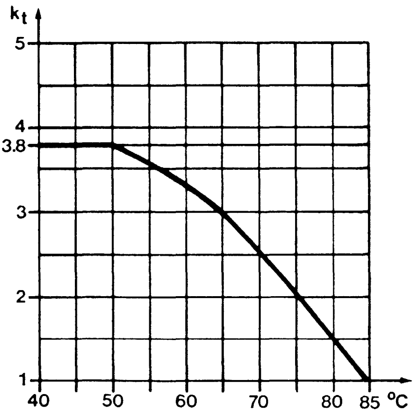
Cap. µF	Rated voltage VDC	Dimension D×L mm (code)	Ripple current[1]) A 100 Hz +50°C	+85°C (I_o)	tanδ 100 Hz, +20°C max %	Impedance 10 kHz, +20°C max. mΩ	Order Number[2]) stud fixing insulated version
10000	10	35×54 (A)	7.1	1.9	30	31	PEH 149EA510
22000		35×83 (C)	12.5	3.3	30	15	PEH 149EC522
47000		50.8×83 (G)	17.9	4.7	40	10	PEH 149EG547
6800	16	35×54 (A)	6.7	1.8	22	31	PEH 149GA468
10000		35×65 (B)	8.7	2.3	22	22	PEH 149GB510
22000		35×115 (D)	16.2	4.3	22	11	PEH 149GD522
33000		50.8×83 (G)	17.4	4.6	30	10	PEH 149GG533
47000		50.8×115 (H)	23.7	6.3	30	7	PEH 149GH547
4700	25	35×54 (A)	6.2	1.7	18	31	PEH 149HA447
6800		35×65 (B)	8.1	2.1	18	22	PEH 149HB468
10000		35×83 (C)	10.6	2.8	18	15	PEH 149HC510
15000		35×115 (D)	15.1	4.0	18	11	PEH 149HD515
22000		50.8×83 (G)	16.5	4.4	22	10	PEH 149HG522
33000		50.8×115 (H)	22.7	6.0	22	7	PEH 149HH533
2200	40	35×54 (A)	5.3	1.4	12	45	PEH 149KA422
3300		35×54 (A)	6.4	1.7	12	31	PEH 149KA433
4700		35×65 (B)	8.1	2.1	12	22	PEH 149KB447
6800		35×83 (C)	10.7	2.8	12	15	PEH 149KC468
10000		35×115 (D)	15.0	4.0	12	11	PEH 149KD510
10000		50.8×83 (G)	15.0	4.0	12	12	PEH 149KG510
15000		50.8×83 (G)	16.2	4.3	15	10	PEH 149KG515
22000		50.8×115 (H)	22.4	5.9	15	7	PEH 149KH522
1000	63	35×54 (A)	4.0	1.1	10	70	PEH 149MA410
1500		35×54 (A)	5.0	1.3	10	49	PEH 149MA415
2200		35×65 (B)	6.4	1.7	10	34	PEH 149MB422
3300		35×83 (C)	8.7	2.3	10	23	PEH 149MC433
4700		35×115 (D)	12.1	3.2	10	16	PEH 149MD447
6800		50.8×83 (G)	14.0	3.7	12	14	PEH 149MG468
10000		50.8×115 (H)	19.2	5.1	12	10	PEH 149MH510
470	100	35×54 (A)	2.5	0.7	12	125	PEH 149PA347
680		35×54 (A)	3.0	0.8	12	89	PEH 149PA368
1000		35×65 (B)	3.9	1.0	12	60	PEH 149PB410
2200		35×115 (D)	7.5	2.0	12	28	PEH 149PD422
2200		50,8×83 (G)	9.0	2.3	12	30	PEH 149PG422
4700		50.8×115 (H)	12.7	3.4	14	15	PEH 149PH447

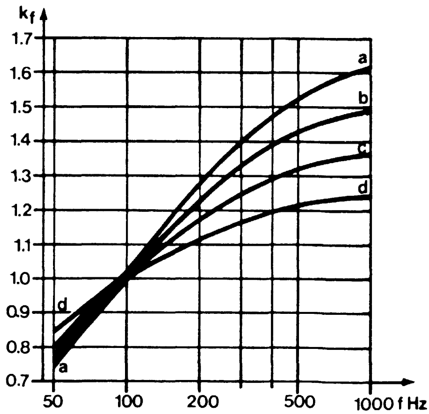
[1]) Ripple current at other temperatures and frequencies, see Special technical features.

[2]) For other versions replace PEH 149 by:
PEH 146 for clip fixing uninsulated version
PEH 147 for clip fixing insulated version
PEH 148 for stud fixing uninsulated version

SPECIAL TECHNICAL FEATURES

Discharge operation	Capacitance change less than 3% after 10^6 charges and discharges.
Terminals	The screws allow for a connector thickness of max 4 mm.
Vibration and bump test	10—500 Hz, 98 m/s^2 or 0.75 mm for 6 h according to IEC 68-2-6, test Fc. 4000 bumps with 390 m/s^2 according to IEC 68-2-29, test Eb. $\frac{\Delta C}{C} \leq 5\%$. No visible damage. Leakage current and $\tan\delta \leq$ stated limit.
Mounting	The capacitors shall be mounted upright or inclined to max horizontal position with the vent in the upper half of the lid.
Endurance test	5000 h at +85°C and rated DC voltage or the sum of a DC and peak AC voltage equal to the rated voltage. The AC voltage shall give the rated ripple current at +85°C. After such a test $\frac{\Delta C}{C} \leq 15\%$, $\tan\delta$ max 1.3×tabulated limits and the leakage current still below specified limits.
Ripple current multipliers	Tabulated ripple currents I_o refer to 100 Hz and +85°C ambient temperature. Ripple current at other temperatures and frequencies can be calculated from the curves below and the formula $I = k_f \times k_t \times I_o$ (+85°C)

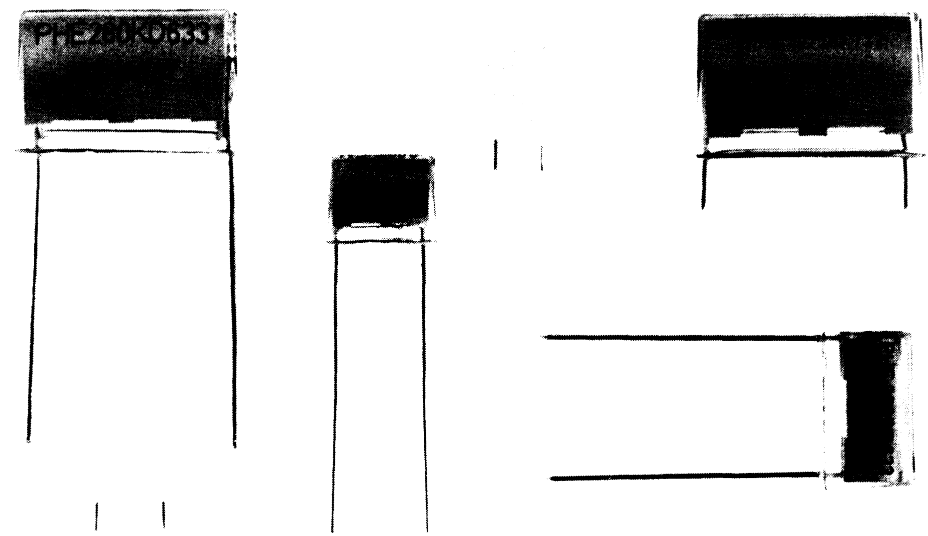




Applicable k_t curves for diameter and rated voltage

Diam. mm	Rated voltage VDC					
	10	16	25	40	63	100
35	c	c	b	b	a	a
50.8	d	d	d	d	c	b

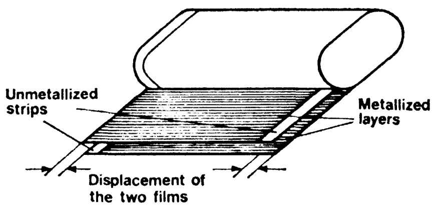
INTRODUCTION



This section covers three various basic designs of metallized film capacitors.

- Metallized Polyester (MKT)
- Metallized Polycarbonate (MKC)
- Metallized Polypropylene (MKP)

The letters in bracket denotes a short form dielectric family designation used in Germany.



In the metallized film capacitor the electrodes have been deposited under vacuum on the plastic film dielectric. The metallized film is wound to a capacitor winding. Contact to the metal layers is obtained by spraying the ends of the winding with a special metal alloy. This method results in a low-inductance capacitor.

SPECIFICATIONS

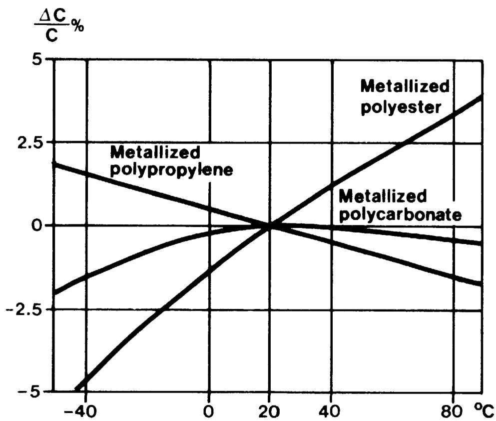
Test methods applied shall be in accordance with IEC publications 384-1 and 68-2.

APPLICATION

These capacitors are mainly intended for electronic equipment with DC or, compared with DC ratings, low AC voltages. When used at non-sinusoidal or pulse voltages the information under "PULSE OPERATION" must be considered.

CAPACITANCE

The capacitance shall be measured with 1 kHz, 20°C. Typical capacitance change with temperature is shown in the figure below.



RATED VOLTAGE, CATEGORY VOLTAGE

Rated voltage is the highest voltage that may be continuously applied to the capacitor up to the rated temperature which is, for all types, +85°C.

Category voltage is the highest voltage that may be continuously applied to the capacitor at the upper category temperature.

TEST VOLTAGE

The test voltage between terminals stated in the type specifications may be applied for 2 s at acceptance tests and for 60 s at type tests. Self-healings are allowed to occur.

CATEGORY TEMPERATURE RANGE

The category temperature range is the range of ambient temperatures for which the component has been designed to operate continuously.

CLIMATIC CATEGORY

The climatic category states the category temperature range and the humidity class. For example 40/100/56 for —40°C to +100°C. 56 states that the steady state humidity test according to IEC 68-2-3, test Ca, shall run for 56 days. The requirements after the test are stated in the type specifications.

PULSE OPERATION

Capacitors loaded with non-sinusoidal voltage pulses with fast rise or decay time (high du/dt) will be exposed to high current pulses. In order not to overload the internal connections, the current must be limited. The current limits for a specific type are dependent on

amplitude and form of the pulse

rated voltage of the capacitor

capacitance

geometrical configuration of the winding

At repeat pulse operation selfheating, ambient temperature and means of cooling would set the load limit.

Pulse current limits are commonly expressed in the form of max. allowed du/dt in volts per microsecond. The figures stated in the type specifications refer to an unlimited number of pulses charging to or decharging from rated voltage U_R. Min. resistance in series to the capacitor is then

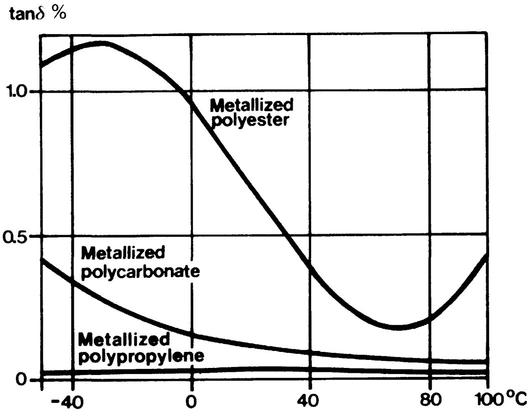
$$R = \frac{U_R}{C \times (du/dt)}$$

U_R = rated voltage of the capacitor
R = min. series resistance in Ω
C = rated capacitance in µF
(du/dt) = max. allowed V/µs

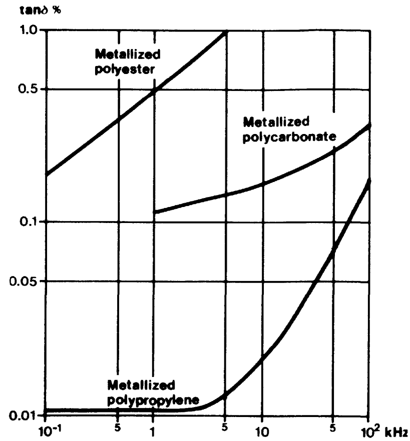
For pulses with an amplitude lower than U_R higher du/dt than stated in the type specifications can be allowed. Please consult Rifa.

DISSIPATION FACTOR

The dissipation factor is dependent on temperature and frequency, and also on the capacitance value. Max. values are stated in the type specifications. Typical curves are shown below.



tanδ at 1 kHz

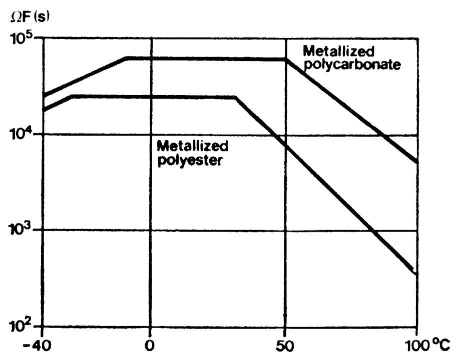


tanδ at +20°C

INSULATION RESISTANCE

Minimum values of the insulation resistance between terminals stated in the type specifications refer to measurements after the voltage has been applied for 1 min ±5 s at +20°C.

The insulation resistance of a capacitor is dependent on voltage, temperature and time elapsed after connection of a voltage. Typical values of product of capacitance and resistance v temperature are given below. These curves refer to stabilized conditions with rated voltage applied.



SELF-HEALING

These capacitors are self-healing in the sense that they have the ability to restore instantaneously the electrical properties after a local break-down in the dielectric. However, to obtain reliable self-healings the capacitor should not be applied to voltage sources where the available power is high and uncontrolled transient voltages can occur. Such a source is for example the mains.

SOLDERING

When mounted on a printed circuit board any normal method of soldering the capacitors may be employed without the need for a heat sink.

These capacitors are resistant to any dissolvent normally employed in flow-soldering techniques.

The solderability of the leads are tested according to IEC 68-2-20 A, test Tb, method IA. The wetting time cleaning shall be less than 1 s.

VIBRATION AND BUMP TEST

When mounted on a printed circuit board the capacitors will withstand vibration 10—2000 Hz or for PHE 425 10—500 Hz, 0.75 mm displacement or 98 m/s^2 according to IEC 68-2-6, test Fc or 4000 bumps with 390 m/s^2 according to IEC 68-2-29, test Eb. $\frac{\Delta C}{C} \leq 0.5\%$.

Notes

Capacitance range	Rated voltage VDC	Category temp. range °C	Applicable spec.	Type No.	Type spec. page
GRADE 1 (Capacitors for high quality requirements)					
Metallized polyester					
0.047—4.7 μF 0.015—2.2 μF 0.01—0.47 μF	100 250 400	—55 to +100	DIN 44 122 IEC 384-2	**PHE 243**	70
0.022—0.10 μF 0.010—0.033 μF 1000—6800 pF	100 250 400	—55 to +100	IEC 384-2	**PHE 353**	82
Metallized polycarbonate					
0.068—6.8 μF 0.022—2.2 μF 0.010—1.0 μF	100 160 400	—55 to +100	DIN 44 116	**PHE 307**	78
10 μF	63	—40 to +85		**PHZ 2039**	90
Metallized polypropylene					
0.035—0.14 μF 0.01—0.035 μF	63 100	—55 to +85		**PHE 425**	86
GRADE 2 (Capacitors for normal quality requirements)					
Metallized polyester					
1000 pF—4.7 μF	100—400	—40 to +100	DIN 44 112	**PHE 280**	74

METALLIZED POLYESTER CAPACITORS

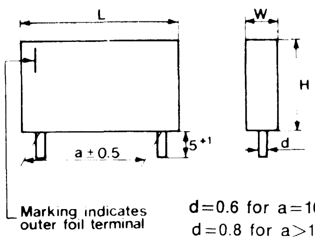
PHE 243

for high quality requirements

PHE 243 has a metallized polyester winding and is vacuum encapsulated in a self-extinguishing epoxy resin. The embedded metal label provides an excellent humidity protection. Reliable operation under pulse conditions is a special feature of this range. The terminal leads are of tinned copper clad steel wires.

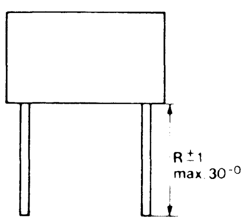
Basic specification	DIN 44 122, DIN 40 040 FMD
Climatic category	55/100/56
Temperature range	
Rated	—55°C to +85°C
Category	—55°C to +100°C
Voltage	
Rated VDC (U_R)	100, 250, 400 VDC
Category VDC (U_c)	$0.7 \times U_R$
Rated VAC	63, 100, 160 VAC up to +85°C and 500 Hz
Test	$1.6 \times U_R$
Capacitance tolerance	Standard ±10%, special ±5%
General technical data	See "Introduction" metallized film capacitors.

Standard version

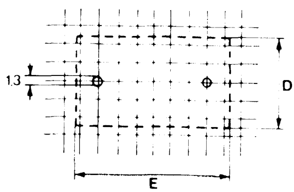


d=0.6 for a=10
d=0.8 for a>10

Special version with lead length differing from standard (code R-)



Space required on mass soldered P.C. board



Dimensions in mm

Ordering

Standard version	State the order No. in the list of standard units.
Special version	Add the special version code to the standard unit order No. Example: PHE 243DA 547J for C_R ±5% PHE 243DA547JR30 for C_R ±5% and lead length 30^{-0} mm.

STANDARD UNITS

Cap. µF	Max. dimensions in mm L	W	H	a	Space requirements in mm D	E	Order Number	Weight approx. g
100 VDC 63 VAC (U_R)								
0.047	13.0	3.9	7.5	10.0	4.4	14.0	PHE 243DA547	0.6
0.068	13.0	3.9	7.5	10.0	4.4	14.0	PHE 243DA568	0.6
0.10	13.0	3.9	7.5	10.0	4.4	14.0	PHE 243DA610	0.6
0.15	13.0	5.1	10.5	10.0	5.6	14.0	PHE 243DA615	1.0
0.22	13.0	5.1	10.5	10.0	5.6	14.0	PHE 243DA622	1.0
0.33	18.0	5.5	10.5	15.0	6.0	19.0	PHE 243DB633	1.5
0.47	18.0	5.5	10.5	15.0	6.0	19.0	PHE 243DB647	1.5
0.68	18.0	7.0	12.0	15.0	7.5	19.0	PHE 243DB668	2.5
1.0	18.0	7.5	13.5	15.0	8.0	19.0	PHE 243DB710	2.5
1.5	26.0	7.0	13.0	22.5	7.5	27.0	PHE 243DD715	3.3
2.2	26.0	8.0	16.5	22.5	8.5	27.0	PHE 243DD722	4.2
3.3	26.0	10.0	19.0	22.5	10.5	27.0	PHE 243DD733	6.7
4.7	31.0	10.5	19.0	27.5	11.0	32.0	PHE 243DF747	7.8
250 VDC 160 VAC (U_R)								
0.015	13.0	3.9	7.5	10.0	4.4	14.0	PHE 243HA515	0.6
0.022	13.0	3.9	7.5	10.0	4.4	14.0	PHE 243HA522	0.6
0.033	13.0	3.9	7.5	10.0	4.4	14.0	PHE 243HA533	0.6
0.047	13.0	4.8	10.5	10.0	5.6	14.0	PHE 243HA547	1.0
0.068	13.0	5.1	10.5	10.0	5.6	14.0	PHE 243HA568	1.0
0.1	18.0	5.5	10.5	15.0	6.0	19.0	PHE 243HB610	1.5
0.15	18.0	5.5	10.5	15.0	6.0	19.0	PHE 243HB615	1.5
0.22	18.0	7.0	12.0	15.0	7.5	19.0	PHE 243HB622	2.5
0.33	18.0	7.5	13.5	15.0	8.0	19.0	PHE 243HB633	2.5
0.47	25.0	6.5	13.5	22.5	7.0	26.5	PHE 243HD647	3.3
0.68	26.0	7.2	15.5	22.5	7.7	27.0	PHE 243HD668	4.1
1.0	26.0	10.0	19.0	22.5	10.5	27.0	PHE 243HD710	6.7
1.5	31.0	10.5	19.0	27.5	11.0	32.0	PHE 243HF715	7.8
2.2	31.0	12.5	20.5	27.5	13.0	32.0	PHE 243HF722	12.0
400 VDC 200 VAC (U_R)								
0.010	13.0	3.9	7.5	10.0	4.4	14.0	PHE 243KA510	0.6
0.015	13.0	4.8	10.5	10.0	5.6	14.0	PHE 243KA515	1.0
0.022	13.0	5.1	10.5	10.0	5.6	14.0	PHE 243KA522	1.0
0.033	13.0	5.1	10.5	10.0	5.6	14.0	PHE 243KA533	1.0
0.047	18.0	5.5	10.5	15.0	6.0	19.0	PHE 243KB547	1.5
0.068	18.0	5.5	10.5	15.0	6.0	19.0	PHE 243KB568	1.5
0.1	18.0	7.0	12.0	15.0	7.5	19.0	PHE 243KB610	2.5
0.15	18.0	9.0	14.5	15.0	9.5	19.0	PHE 243KB615	3.2
0.22	26.0	7.2	15.5	22.5	7.7	27.0	PHE 243KD622	4.1
0.33	26.0	8.0	16.5	22.5	8.5	27.0	PHE 243KD633	4.2
0.47	26.0	10.0	19.0	22.5	10.0	27.0	PHE 243KD647	6.7

SPECIAL TECHNICAL FEATURES

Dissipation factor

$\tan\delta \leq 3\%$ at 100 kHz for C $<$ 0.1 μF
$\tan\delta \leq 1.5\%$ at 10 kHz for C $\leq$ 1.0 μF
$\tan\delta \leq 0.8\%$ at 1 kHz for C $\leq$ 1.0 μF
$\tan\delta \leq 1.0\%$ at 1 kHz for C $>$ 1.0 μF

Insulation resistance

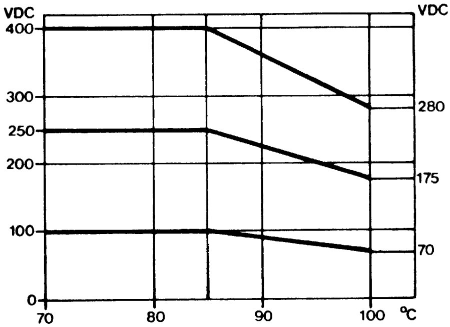
Between terminals

$>$ 30 000 MΩ for C $\leq$ 0.33 μF
$>$ 10 000 ΩF (s) for C $>$ 0.33 μF

Terminals-case

$>$ 30 000 MΩ
Measured at +20°C after 1 minute with 100 VDC.

Voltage derating



Humidity test

After a 56 days test at +40°C and 90 to 95% R.H. the following requirements are met:

Change of capacitance less than 3%.
Absolute change of $\tan\delta$ less than 0.3% at 1 kHz.
Insulation resistance higher than 50% of limits specified above.

Pulse operation

The capacitors meet the DIN 44122 requirements for sample test with 20000 discharges at 10 times the max. du/dt values given in the table.

Rated voltage VDC	Max. du/dt in V/μs for lead spacing in mm 10	15	22.5	27.5
100	6	3	2	1.5
250	10	5	3	2.5
400	14	7	4	—

Marking

Capacitors are marked with code No., rated capacitance, capacitance tolerance, rated voltage, outer electrode terminal, climatic category according to DIN or IEC, manufacturing date, Rifa symbol and DIN 44 122 if in accordance with this specification.

METALLIZED POLYESTER CAPACITORS

PHE 280

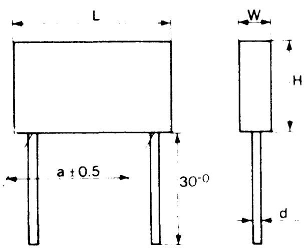
for normal requirements

RIFA

PHE 280 has a metallized polyester winding and is vacuum encapsulated in epoxy resin. The embedded metal label provides an excellent humidity protection. The terminal leads are of tinned copper clad steel.

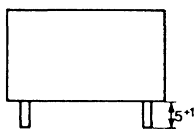
Basic specification	DIN 44 112 Blatt 1 and Blatt 2 DIN 40 040 GMF
Climatic category	40/100/56
Temperature range	
Rated	—40°C to +85°C
Category	—40°C to +100°C
Voltage	
Rated VDC (U_R)	100, 250, 400 VDC
Category VDC (U_c)	$0.85 \times U_R$
Rated VAC	63, 160, 200 VAC up to +85°C and 500 Hz.
Test	$1.6 \times U_R$
Capacitance tolerance	Standard ±10% for C ≥ 0.1 μF ±20% for C < 0.1 μF
General technical data	See "Introduction" metallized film capacitors.

Standard version



d = 0.6 for a ≤ 10.2
d = 0.8 for a ≥ 15.2

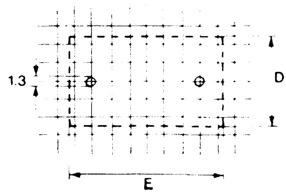
Special version with short leads (code R)



Special tolerance marking

±10% white (code K)
± 5% green (code J)

Space required on mass soldered P.C. board



Dimensions in mm

Ordering

Standard version	State the order No. in the list of standard units.
Special version	Add the special version code to the standard unit order No. Example: PHE 280DK522J for C_R ±5% PHE 280DK522JR5 for C_R ±5% and leads 5^{+1}.

STANDARD UNITS

Cap µF	Max dimensions in mm L	W	H	a*	Space requirements in mm D	E	Order Number	Weight approx. g
100 VDC 63 VAC (U_R)								
0.022	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280DK522	0.5
0.033	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280DK533	0.5
0.047	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280DK547	0.5
0.047	13.0	3.9	7.5	10.2	4.4	14.0	PHE 280DA547	0.6
0.068	10.5	4.0	9.0	7.6	4.4	14.0	PHE 280DK568	0.6
0.068	13.0	3.9	7.5	10.2	4.4	14.0	PHE 280DA568	0.6
0.10	10.5	4.0	9.0	7.6	4.5	11.5	PHE 280DK610	0.6
0.10	13.0	3.9	7.5	10.2	4.4	14.0	PHE 280DA610	0.6
0.15	13.0	5.1	10.5	10.2	4.4	14.0	PHE 280DA615	1.0
0.22	13.0	5.1	10.5	10.2	5.6	14.0	PHE 280DA622	1.0
0.33	18.0	5.5	10.5	15.2	6.0	19.0	PHE 280DB633	1.5
0.47	18.0	5.5	10.5	15.2	6.0	19.0	PHE 280DB647	1.5
0.68	18.0	7.5	13.5	15.2	8.0	19.0	PHE 280DB668	2.5
1.0	18.0	7.5	13.5	15.2	8.0	19.0	PHE 280DB710	2.5
1.5	26.0	7.0	13.0	22.5	7.5	27.0	PHE 280DD715	3.3
2.2	26.0	8.0	16.5	22.5	8.5	27.0	PHE 280DD722	4.2
3.3	26.0	10.0	19.0	22.5	10.5	27.0	PHE 280DD733	6.7
4.7	31.0	10.5	19.0	27.5	11.0	32.0	PHE 280DF747	7.8
250 VDC 160 VAC (U_R)								
0.010	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280HK510	0.6
0.010	13.0	3.9	7.5	10.2	4.4	14.0	PHE 280HA510	0.6
0.015	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280HK515	1.0
0.015	13.0	3.9	7.5	10.2	4.4	14.0	PHE 280HA515	0.6
0.022	13.0	3.9	7.5	10.2	4.4	14.0	PHE 280HA522	0.6
0.033	13.0	3.9	7.5	10.2	4.4	14.0	PHE 280HA533	0.6
0.047	13.0	5.1	10.5	10.2	5.6	14.0	PHE 280HA547	1.0
0.068	13.0	5.1	10.5	10.2	6.0	14.0	PHE 280HA568	1.0
0.10	18.0	5.5	10.5	15.2	6.0	19.0	PHE 280HB610	1.5
0.15	18.0	5.5	10.5	15.2	8.0	19.0	PHE 280HB615	1.5
0.22	18.0	7.5	13.5	15.2	8.0	19.0	PHE 280HB622	2.5
0.33	18.0	7.5	13.5	15.2	8.1	24.5	PHE 280HB633	2.5
0.33	18.0	7.5	13.5	20.3	8.0	26.5	PHE 280HC633	2.5
0.47	23.0	7.6	13.5	20.3	81.	27.0	PHE 280HC647	3.3
*0.47	25.5	6.5	13.5	22.5	7.0	26.5	PHE 280HD647	3.3
0.68	26.0	7.2	15.5	22.5	7.7	27.0	PHE 280HD668	4.1
1.0	26.0	10.0	19.0	22.5	10.5	27.0	PHE 280HD710	6.7
1.5	31.0	10.5	19.0	27.5	11.0	32.0	PHE 280HF715	7.8
2.2	31.0	12.5	20.5	27.5	13.0	32.0	PHE 280HF722	12.0

Lead spacing see page 77.

STANDARD UNITS

Cap µF	Max dimensions in mm L	W	H	a	Space requirements in mm D	E	Order Number	Weight approx. g
400 VDC 200 VAC (U_R)								
0.001	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280KK410	0.5
0.0015	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280KK515	0.5
0.0022	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280KK422	0.5
0.0033	10.5	4.0	6.8	7.6	4.5	11.5	PHE 280KK433	0.5
0.010	13.0	3.9	7.5	10.2	4.4	14.0	PHE 280KA510	0.6
0.015	13.0	5.1	10.5	10.2	5.6	14.0	PHE 280KA515	1.0
0.022	13.0	5.1	10.5	10.2	5.6	14.0	PHE 280KA522	1.0
0.033	13.0	5.1	10.5	10.2	5.6	14.0	PHE 280KA533	1.0
0.047	18.0	5.5	10.5	15.2	6.5	14.0	PHE 280KB547	1.5
0.068	18.0	5.5	10.5	15.2	6.0	19.0	PHE 280KB568	1.5
0.10	18.0	7.5	13.5	15.2	8.0	19.0	PHE 280KB610	2.5
0.15	18.0	9.0	14.5	15.2	9.5	19.0	PHE 280KB615	3.2
0.22	26.0	7.2	15.5	22.5	7.7	27.0	PHE 280KD622	4.1
0.33	26.0	8.0	16.5	22.5	8.5	27.0	PHE 280KD633	4.2
0.47	26.0	10.0	19.0	22.5	10.5	27.0	PHE 280KD647	6.7
0.68	31.0	10.5	19.0	27.5	11.0	31.0	PHE 280KF668	7.8

SPECIAL TECHNICAL FEATURES

Dissipation factor: $\tan\delta \leq 1.0\%$ at 1 kHz

Insulation resistance

Between terminals: $> 30\,000$ MΩ for $C \leq 0.33$ µF
$> 10\,000$ ΩF (s) for $C > 0.33$ µF

Terminals-case: $> 30\,000$ MΩ
Measured at +20°C after 1 minute with 100 VDC

Humidity test: After a 56 days test at +40°C and 90 to 95% R.H. the following requirements are met:
Change of capacitance less than 5%
Absolute change of $\tan\delta$ less than 0.3% at 1 kHz
Insulation resistance higher than 50% of limits specified above.

Voltage derating: DC and AC voltage derating with 1% of the rated voltage per °C for temperatures above +85°C.

Pulse operation

Rated voltage VDC	**Max. du/dt in V/μs for lead spacing in mm**				
	7.6—10.2	15.2	20.3	22.5	27.5
100	10	7	5	4	3
250	20	13	10	9	7
400	30	20	15	13	11

For AC voltages over 200 VAC and for pulse operation with a pulse gradient steeper than the figures above use our MP capacitors PME 261—263.

Marking

Capacitors are marked with code No., rated capacitance, rated voltage, climatic category according to IEC, manufacturing date, Rifa symbol.

Lead spacing

On printed circuits boards with 1.3 mm holes PHE 280 capacitors with 7.6, 10.2 and 15.2 mm lead spacing can be used alternatively to capacitors with 7.5 respectively 10.0 and 15.0 mm terminal lead spacing.

METALLIZED POLYCARBONATE CAPACITORS

PHE 307

for high quality requirements

PHE 307 has a metallized polycarbonate winding and is vacuum encapsulated in a self-extinguishing epoxy resin. The embedded metal label provides an excellent humidity protection. The terminal leads are of tinned copper clad steel wires.

Capacitance stability, low dissipation factor and high insulation resistance characterize these capacitors. They are therefore specially suited for semi-stable medium frequency filters and for timing.

Basic specification DIN 44 116, DIN 40 040 FMD

Climatic category 55/100/56

Temperature range

Rated —55°C to +85°C
Category —55°C to +100°C

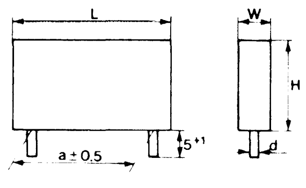
Voltage

Rated VDC (U_R) 100, 160, 400 VDC
Category $0.7 \times U_R$
Test $1.6 \times U_R$

Capacitance tolerance Standard ±10% for C $\geq$ 0.1 μF
±20% for C < 0.1 μF

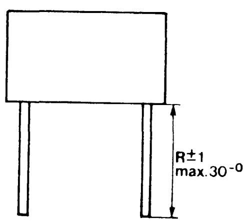
General technical data See "Introduction" metallized film capacitors.

Standard version

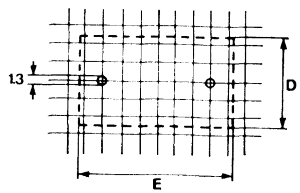


d=0.6 for a=10
d=0.8 for a>10

Special version with lead length differing from standard (code R-)



Space required on mass soldered P.C. board



Dimensions in mm

Ordering

Standard State the order No. in the list of standard units.

Special Add the special version code to the standard unit order No.
Example: PHE 307DA568J for C_R ±5%
PHE 307DA568JR30 for C_R ±5% and leads 30^{-0}.

RIFA

PHE 307

STANDARD UNITS

Cap. μF	Max. dimensions in mm L	W	H	a	Space requirements in mm D	E	Order Number	Weight g
100 VDC/63 VAC								
0.068	13.0	3.9	7.5	10.0	4.4	14.0	PHE 307DA568	0.6
0.10	13.0	3.9	7.5	10.0	4.4	14.0	PHE 307DA610	0.6
0.15	13.0	5.1	10.5	10.0	5.6	14.0	PHE 307DA615	0.9
0.22	13.0	5.1	10.5	10.0	5.6	14.0	PHE 307DA622	0.9
0.33	18.0	5.5	10.5	15.0	6.0	19.0	PHE 307DB633	1.3
0.47	18.0	5.5	10.5	15.0	6.0	19.0	PHE 307DB647	1.3
0.68	18.0	7.0	12.0	15.0	7.5	19.0	PHE 307DB668	2.3
1.0	18.0	7.5	13.5	15.0	8.0	19.0	PHE 307DB710	2.3
1.5	26.0	7.0	13.0	22.5	7.5	27.0	PHE 307DD715	2.9
2.2	26.0	8.0	16.5	22.5	8.5	27.0	PHE 307DD722	3.8
3.3	26.0	10.0	19.0	22.5	10.5	27.0	PHE 307DD733	6.2
4.7	31.0	10.5	19.0	27.5	11.0	32.0	PHE 307DF747	7.1
5.6	31.0	12.5	20.5	27.5	13.0	32.0	PHE 307DF756	9.5
6.8	31.0	12.5	20.5	27.5	13.0	32.0	PHE 307DF768	9.5
160 VDC/100 VAC								
0.022	13.0	3.9	7.5	10.0	4.4	14.0	PHE 307FA522	0.6
0.033	13.0	3.9	7.5	10.0	4.4	14.0	PHE 307FA533	0.6
0.047	13.0	4.8	10.5	10.0	5.3	14.0	PHE 307FA547	0.8
0.068	13.0	5.1	10.5	10.0	5.6	14.0	PHE 307FA568	0.9
0.10	18.0	5.5	10.5	15.0	6.0	19.0	PHE 307FB610	1.3
0.15	18.0	5.5	10.5	15.0	6.0	19.0	PHE 307FB615	1.3
0.22	18.0	7.0	12.0	15.0	7.5	19.0	PHE 307FB622	2.3
0.33	18.0	7.0	12.0	15.0	7.5	19.0	PHE 307FB633	2.3
0.47	25.5	6.5	13.5	22.5	7.0	26.5	PHE 307FD647	3.0
0.68	26.0	7.2	15.5	22.5	7.7	27.0	PHE 307FD668	3.5
1.0	26.0	8.0	16.5	22.5	8.5	27.0	PHE 307FD710	3.8
1.5	30.0	10.5	19.0	27.5	11.0	32.0	PHE 307FF715	7.1
2.2	30.0	12.5	20.5	27.5	13.0	32.0	PHE 307FF722	9.5
400 VDC/200 VAC								
0.010	13.0	3.9	7.5	10.0	4.4	14.0	PHE 307KA510	0.6
0.015	13.0	3.9	7.5	10.0	4.4	14.0	PHE 307KA515	0.6
0.022	13.0	5.1	10.5	10.0	5.6	14.0	PHE 307KA522	0.9
0.033	13.0	5.1	10.5	10.0	5.6	14.0	PHE 307KA533	0.9
0.047	18.0	5.5	10.5	15.0	6.0	19.0	PHE 307KB547	1.3
0.068	18.0	5.5	10.5	15.0	6.0	19.0	PHE 307KB568	1.3
0.10	18.0	7.5	13.5	15.0	8.0	19.0	PHE 307KB610	2.3
0.15	18.0	7.5	13.5	15.0	8.0	19.0	PHE 307KB615	2.3
0.22	26.0	7.2	15.5	22.5	7.7	27.0	PHE 307KD622	3.5
0.33	26.0	8.0	16.5	22.5	8.5	27.0	PHE 307KD633	3.8
0.47	26.0	10.0	19.0	22.5	10.5	27.0	PHE 307KD647	6.2
0.68	30.0	10.5	19.0	27.5	11.0	32.0	PHE 307KF668	7.1
1.0	30.0	12.5	20.5	27.5	13.0	32.0	PHE 307KF710	9.5

PHE 307

RIFA

SPECIAL TECHNICAL FEATURES

Dissipation factor

tanδ $\leq$ 0.3% at 1 kHz for C $\leq$ 10 μF
tanδ $\leq$ 1.0% at 10 kHz for C $\leq$ 1 μF

Insulation resistance

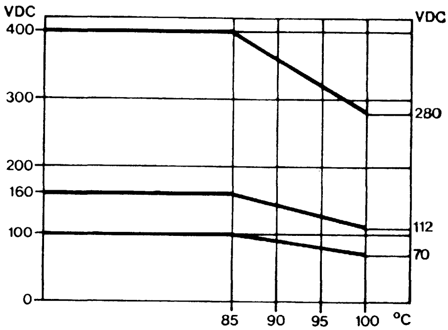
Between terminals

$\geq$ 30 000 MΩ for C $\leq$ 0.33 μF
$\geq$ 10 000 ΩF (s) for C $>$ 0.33 μF

Terminals-case

$\geq$ 30 000 MΩ
Measured at +20°C after 1 minute with 100 VDC.

Voltage derating



Humidity test

After a 56 days test at +40°C and 90—95% R.H. the following requirements are met:

Change of capacitance less than 2%
Absolute change of tanδ less than 0.5% at 1 kHz
Insulation resistance higher than 50% of limits specified above.

Marking

The capacitors are marked with code No., rated capacitance, tolerance, rated voltage, climatic category, manufacturing date, Rifa symbol.

Notes

METALLIZED POLYESTER CAPACITORS

PHE 353

for high quality requirements

RIFA

PHE 353 is a metallized polyester capacitor encapsulated in a selfextinguishing epoxy-filled polypropylene case. Tinned copper clad steel wires. The capacitor is especially designed for decoupling of TTL circuits.

Climatic category 55/100/56

Temperature range

Rated	—55°C to +85°C
Category	—55°C to +100°C

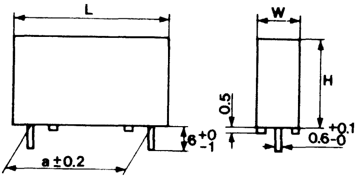
Voltage

Rated VDC (U_R)	100, 250, 400 VDC
Category VDC (U_c)	$0.7 \times U_R$
Rated VAC	63, 160, 200 VAC up to +85°C and 500 Hz
Test	$1.6 \times U_R$

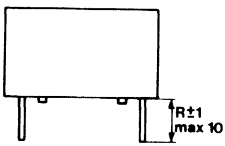
Capacitance tolerance Standard ±20% (code M)
Special ±10% (code K)

General technical data See "Introduction" metallized film capacitors

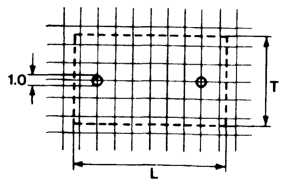
Standard version



Special version
with long leads



Space required on mass
soldered PC boards



Dimensions in mm

Ordering

Standard version: State the order No. in the list of standard units.

Special version: Add the special version code to the standard unit order No.

Example: PHE 353DK522K for C_R ±10%
PHE 353DK522KR10 for C_R ±10% and lead length $10 \, {}^{+1}_{-0}$ mm

RIFA

PHE 353

STANDARD UNITS

Cap.	Max dimensions in mm L	W	H	a*	Order Number	Weight approx. g
100 VDC 63 VAC (U_R)						
0.022 μF	10.5	4.0	8.0	7.6	PHE 353DK522	0.5
0.033 μF	10.5	4.0	8.0	7.6	PHE 353DK533	0.5
0.047 μF	10.5	4.0	8.0	7.6	PHE 353DK547	0.5
0.068 μF	10.5	4.0	10.0	7.6	PHE 353DK568	0.7
0.1 μF	10.5	4.0	10.0	7.6	PHE 353DK610	0.7
250 VDC 160 VAC (U_R)						
0.010 μF	10.5	4.0	8.0	7.6	PHE 353HK510	0.5
0.015 μF	10.5	4.0	8.0	7.6	PHE 353HK515	0.5
0.022 μF	10.5	4.0	10.0	7.6	PHE 353HK522	0.7
0.033 μF	10.5	4.0	10.0	7.6	PHE 353HK533	0.7
400 VDC 200 VAC (U_R)						
1000 pF	10.5	4.0	8.0	7.6	PHE 353KK410	0.5
1500 pF	10.5	4.0	8.0	7.6	PHE 353KK415	0.5
2200 pF	10.5	4.0	8.0	7.6	PHE 353KK422	0.5
3300 pF	10.5	4.0	8.0	7.6	PHE 353KK433	0.5
4700 pF	10.5	4.0	8.0	7.6	PHE 353KK447	0.5
6800 pF	10.5	4.0	8.0	7.6	PHE 353KK468	0.5

* See lead spacing below.

SPECIAL TECHNICAL FEATURES

Dissipation factor
$\tan\delta \leq 3\%$ at 100 kHz
$\tan\delta \leq 1.5\%$ at 10 kHz
$\tan\delta \leq 0.8\%$ at 1 kHz

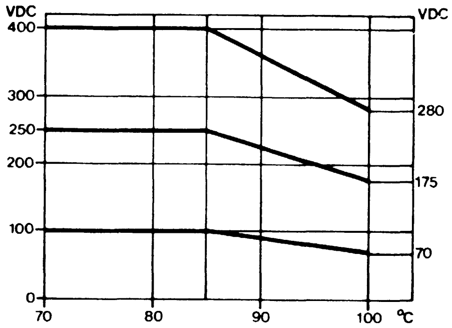
Insulation resistance
Between terminals $> 30\,000$ MΩ
Terminals-case $> 30\,000$ MΩ
Measured at +20°C after 1 minute with 100 VDC

Lead spacing
PHE 353 can without restriction be used in applications specifying 7.5 mm lead spacing

PHE 353

RIFA

Voltage derating



Humidity test

After a 56 days test at +40°C and 90—95% R.H. the following requirements are met:

Change of capacitance less than 3%
Absolute change of tanδ less than 0.3% at 1 kHz
Insulation resistance higher than 50% of limits specified above

Pulse operation

Rated voltage VDC	Max du/dt in V/μs
100	12
250	21
400	25

Marking

Capacitors are marked with code No., rated capacitance, capacitance tolerance, rated voltage, manufacturing date and RIFA symbol.

Notes

METALLIZED POLYPROPYLENE CAPACITORS

PHE 425

modular precision type

PHE 425 is a precision capacitor type with metallized polypropylene dielectric.

PHE 425 is characterized by its outstanding capacitance stability and low losses. The extremely small dimensions are achieved by utilizing ultra-thin metallised polypropylene film. This construction maximizes the ratio capacitance/volume for high stability, low loss capacitors.

Selfextinguishing encapsulation in epoxy-filled polypropylene case. Modular dimensions makes high package density on PC boards possible. Tinned copper clad steel wires. The moulded case incorporates stand-offs facilitating flow soldering on PC-board with through-plated holes.

Configuration and dimensions are identical with those of PFE 225 modular polystyrene capacitor range.

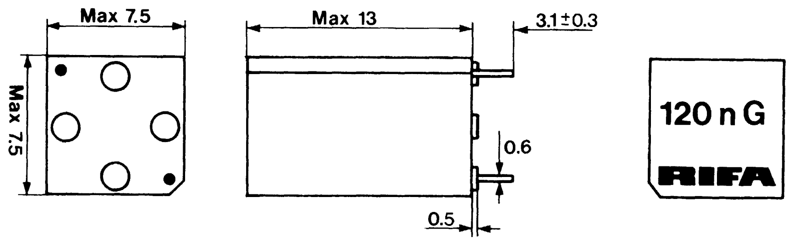
Climatic category 55/085/56

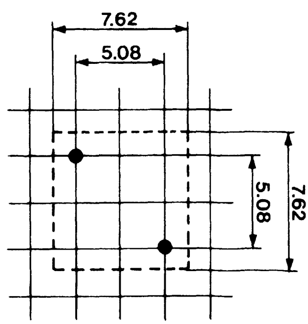
Temperature range —55°C to +85°C

Capacitance tolerance ±2% (code G), ±5% (code J)

General technical data See "Introduction" metallized film capacitors

Special version with lead length 8.0 $^{+2}_{-0}$ mm (code R8)





Dimensions in mm

Space requirements on P.C. board with ≥ 1.0 mm hole diameter

STANDARD UNITS

Capacitance range μF	Rated voltage VDC	VAC	Capacitance tolerance ± %	Order Number	Weight app. g
0.01				PHE 425DB510J	
0.012				PHE 425DB512J	
0.015				PHE 425DB515J	
0.018	**100**	63	5	PHE 425DB518J	1
0.022				PHE 425DB522J	
0.027				PHE 425DB527J	
0.033				PHE 425DB533J	
0.039				PHE 425CB539J	
0.047				PHE 425CB547J	
0.056				PHE 425CB556J	
0.068	**63**	40	5	PHE 425CB568J	1
0.082				PHE 425CB582J	
0.10				PHE 425CB610J	
0.12				PHE 425CB612J	

SPECIAL UNITS

Capacitance range μF	Rated voltage VDC	VAC	Capacitance tolerance ± %	Order Number	Weight app. g
0.01—0.035	**100**	63	2	PHE 425DB....G	1
			5	PHE 425DB....J	
> 0.035—0.14	**63**	40	2	PHE 425CB....G	1
			5	PHE 425CB....J	

On special order any capacitance value within the range stated in the table is available.

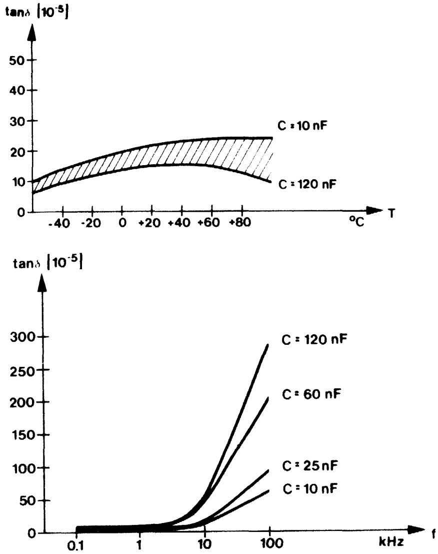
When ordering please state the complete type designation. It should be written as in the following example:

PHE 425	**D**	**B**	**510**	**G**	**R8**
Type	Voltage code	Case code	Capacitance code	Capacitance tolerance code	Code for special lead wire length

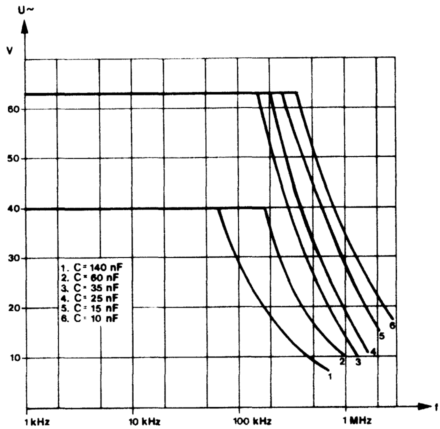
In the type designation the first digit of the capacitance code designates the number of integral digits of the capacitance value in pF. The second and third digits are the first two digits of the capacitance value. Examples: 533 is the code for 33 000 pF and 612 for 120 000 pF.

SPECIAL TECHNICAL FEATURES

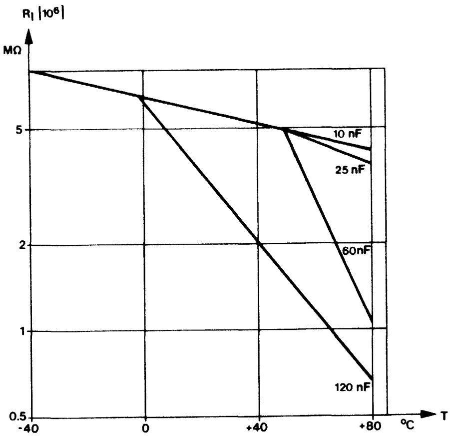
Dissipation factor	$\tan\delta \leq 3\times10^{-4}$ at 1 kHz and 20°C $\tan\delta \leq 20\times10^{-4}$ at 100 kHz and 20°C for $C \leq 35\,000$ pF $\tan\delta \leq 50\times10^{-4}$ at 100 kHz and 20°C for $C > 35\,000$ pF
Insulation resistance	$\geq 200\,000$ MΩ
Self-inductance	≤ 40 nH at 2 mm from capacitor body
Temperature coefficient	$-(250\pm50)\times10^{-6}/°C$
Test voltage	$1.6\times U_R$
Dielectric absorption	$\leq 0.01\%$ according to MIL-C-19978B paragraph 4.6.15. Capacitors shall be charged for one hour at rated DC voltage U_R, then discharged through 5Ω for 10 seconds. The discharge resistor shall then be disconnected and the recovery voltage U_r shall be measured 15 minutes after disconnection. Dielectric absorption is then defined by $\frac{U_r}{U_R}$
Pulse operation	$10\,000 \text{ pF} < C \leq 20\,000$ pF: Max du/dt = 40 V/µs $20\,000 \text{ pF} < C \leq 60\,000$ pF: Max du/dt = 30 V/µs $60\,000 \text{ pF} < C \leq 140\,000$ pF: Max du/dt = 10 V/µs
Harmonic ratio attenuation	≥ 130 dB
Marking	The capacitor is marked with capacitance, capacitance tolerance, rated voltage, manufacturing date, code No. and RIFA symbol.



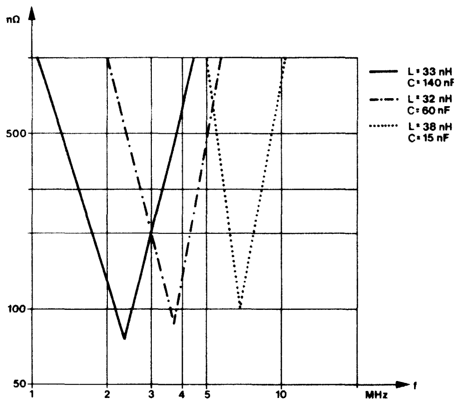
Typical values of tanδ v temperature and requency.



Max. AC voltage v frequency at +25°C.



Insulation resistance v temperature. Typical values.



Resonance diagram. Measurements at 2 mm from the capacitor body. Typical values.

METALLIZED POLYCARBONATE CAPACITORS

PHZ 2039

for high quality requirements

PHZ 2039 has a metallized polycarbonate winding and is vacuum encapsulated in a self-extinguishing epoxy resin. The embedded metal label provides an excellent humidity protection. The terminal leads are of tinned copper clad wires.

Capacitance stability, low dissipation factor and high insulation resistance characterize these capacitors.

Climatic category 40/085/56

Temperature range —40°C to +85°C

Voltage

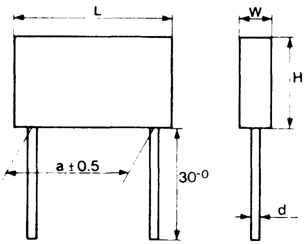
Rated (U_R) 63 VDC

Test 95 VDC

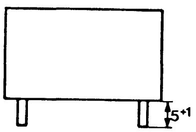
Capacitance tolerance ±10%

General technical data See "Introduction" metallized film capacitors

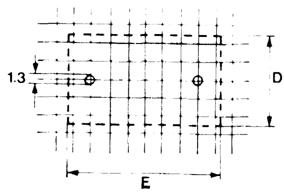
Standard version



Special version with short leads (code R)



Space required on mass soldered P.C. board



Dimensions in mm

Add the special version code to the standard unit order No.
Example: PHZ 2039R5.

RIFA

PHZ 2039

STANDARD UNIT

Cap. μF	Max dimensions in mm L	W	H	a	Space requirements nn mm D	E	Order Number	Weight g
63 VDC/40 VAC								
10	30.0	10.5	19.0	27.5	11.0	31.0	PHZ 2039	7.0

SPECIAL TECHNICAL FEATURES

Dissipation factor: $\tan\delta \leq 0.5\%$ at 1 kHz

Insulation resistance
- Between terminals: $\geq$ 1000 MΩ
- Terminals-case: $\geq$ 30 000 MΩ

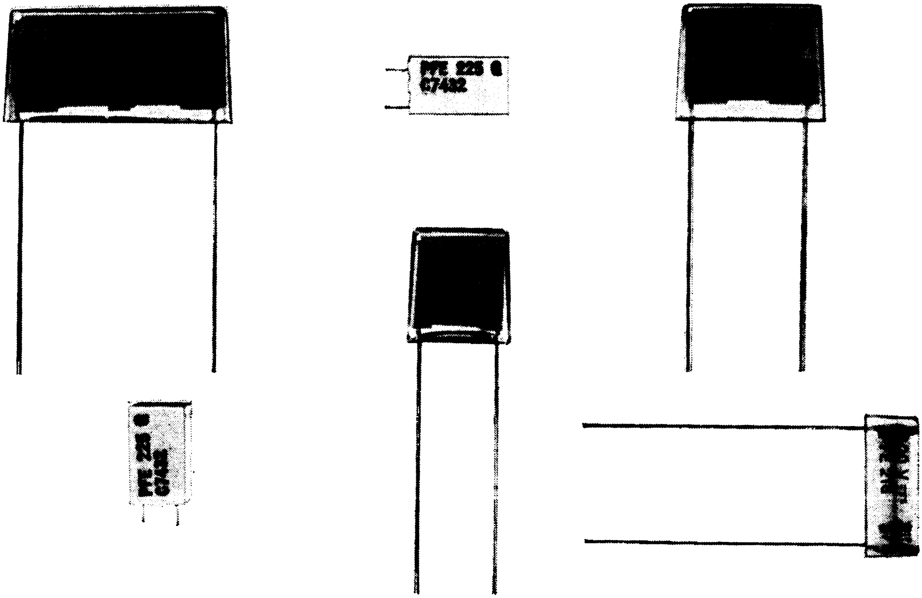
Measured at +20°C after 1 minute

Humidity test: After a 56 days test at +40°C and 90—95% R.H. the following requirements are met:

Change of capacitance less than 2%
Absolute change of tanδ less than 0.5% at 1 kHz
Insulation resistance higher than 50% of limits specified above.

Marking: The capacitors are marked with code No., rated capacitance, rated voltage, temperature ,manufacturing date and RIFA symbol.

INTRODUCTION



Polystyrene film is a plastic material with excellent electrical characteristics. To maintain the good properties in capacitors, careful and well-proven design and manufacture of the capacitors are necessary.

Rifa has manufactured polystyrene capacitors since the material became available in the mid 40's. Consequently the design and production of the capacitors presented in the type specifications are based on many years experience and continuous development work.

The capacitors offer a high long-term capacitance stability. The low and reproducible temperature coefficient makes them ideally suited for use in equipment that has to meet exacting requirements. Also a very low dissipation factor and very high insulation resistance are among the features of these capacitors.

Examples of application ranges for polystyrene capacitors are filters, timing and high-frequency coupling-decoupling.

SPECIFICATION

Polystyrene capacitors are covered in IEC publication 275. This publication is the basic specification for the types presented in this catalogue.

CAPACITANCE

Capacitance is measured at +20°C and at 1 MHz for rated capacitance $C_R \leq 1000$ pF and at 1 kHz for $C_R > 1000$ pF.

RATED VOLTAGE

Rated DC (U_R) and AC voltages are stated in the type specifications and denote the highest DC or RMS AC voltages to which the capacitor may be continuously subjected. When an AC voltage is superimposed on a DC voltage, the resultant peak voltage must not exceed the rated DC voltage U_R.

RATED TEMPERATURE RANGE

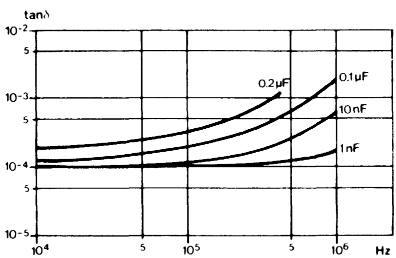
The rated temperature range is stated in the type specifications. It denotes the temperature range within which the capacitor may be connected continuously to rated DC voltage. When the capacitors are subjected to self-heating due to AC load the upper rated temperature denotes the highest surface temperature allowed.

TEST VOLTAGE

2×rated DC voltage for 2 s.

DISSIPATION FACTOR

Max dissipation factor $\tan\delta$ at specified frequencies and +20°C is stated in the type specifications. Typical curves for $\tan\delta$ v frequency are given below. The rise in $\tan\delta$ at high frequencies is mainly dependent on losses in leads and electrodes. The graph shows $\tan\delta$ for capacitors with 2×5 mm lead length outside the capacitor body.



TEMPERATURE CHARACTERISTICS

TC for the capacitance within the rated temperature range is —$(110 \pm 30) \times 10^{-6}/{}^{\circ}C$ for $U_R \geq 100$ VDC and —$(160 \pm 40) \times 10^{-6}/{}^{\circ}C$ for $U_R < 100$ VDC.

INSULATION RESISTANCE

Greater than 500 000 MΩ measured with 100 VDC (10 VDC for $U_R < 100$ VDC) at +20 °C after 1 minute of electrification.

DIELECTRIC ABSORPTION

Less than 0.01%. The capacitor shall be charged for one hour at rated DC voltage U_R, then discharged through a 5Ω resistor for 10 seconds. The discharge resistor shall then be disconnected and the recovery voltage U_r shall be measured 15 minutes after disconnection. Dielectric absorption is defined by $\frac{U_r}{U_R}$

VIBRATION TEST

When mounted on a printed circuit board the capacitors will withstand vibration 10—500 Hz, 0.75 mm displacement or 98 m/s^2 according to IEC 68-2-6, test Fc.

SOLDERABILITY

Wetting time $\leq$ 1 s when subject to test according to IEC publication 68-2-20 (DIN 40 046, Blatt 18, Prüfung Tc).

MOUNTING

For mounting on a printed circuit board, any method of soldering may be employed without the need for a heat sink. For self-supporting assembly of PFE 210 and PFE 216, bending of the terminals does not damage the capacitor.

MARKING

The capacitor is marked with rated capacitance and capacitance tolerance in code, rated DC voltage, type number, period of manufacture and the name of the manufacturer.

Capacitance in IEC code followed by the tolerance code letter is marked according to the following examples:

100 pF ±5% is marked 100 pJ
1100 pF ±2% is marked 1n1G
12300 pF ±1% is marked 12n3F
p = pico and n = nano replace the decimal point.

The code letters for the tolerances which can be supplied are stated in the type specification.

ORDERING

Available capacitance range is stated in the type specifications. Any capacitance within these ranges may be ordered. However, capacitance values selected from the IEC series of values stated below would facilitate manufacture and shipping.

The bold type figures state the IEC E 48 series which is preferred.

100	**127**	**162**	**205**	**261**	**332**	**422**	**536**	**681**	**866**
101	129	164	208	264	336	427	542	690	876
102	130	165	210	267	340	432	549	698	887
104	132	167	213	271	344	437	556	706	898
105	**133**	**169**	**215**	**274**	**348**	**442**	**562**	**715**	**909**
106	135	172	218	277	352	448	569	723	920
107	137	174	221	280	357	453	576	732	931
109	138	176	223	284	361	459	583	741	942
110	**140**	**178**	**226**	**287**	**365**	**464**	**590**	**750**	**953**
111	142	180	229	291	370	470	597	759	965
113	143	182	232	294	374	475	604	768	976
114	145	184	234	298	379	481	612	777	988
115	**147**	**187**	**237**	**301**	**383**	**487**	**619**	**787**	
117	149	189	240	305	388	493	626	796	
118	150	191	243	309	392	499	634	806	
120	152	193	246	312	397	505	642	816	
121	**154**	**196**	**249**	**316**	**402**	**511**	**649**	**825**	
123	156	198	252	320	407	517	657	835	
124	158	200	255	324	412	523	665	845	
126	160	203	258	328	417	530	673	856	

Notes

POLYSTYRENE CAPACITORS

PFE 210

High stability type

RIFA

The PFE 210 polystyrene capacitor has windings with tin foil electrodes. The extended foil design has the terminal leads soldered directly to the tin foils. The epoxy encapsulation with an embedded metal shield provides excellent humidity protection.

The modular dimensions require a minimum of space on the printed circuit board.

Basic specification IEC publication 275, category 40/085/56

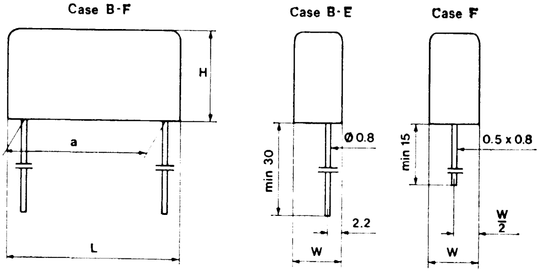
Temperature range —40°C to +85°C

Capacitance tolerance ±0.5% (code D), ±1% (code F), ±2% (code G), ±5% (code J). However, not closer than ±2 pF (code A).

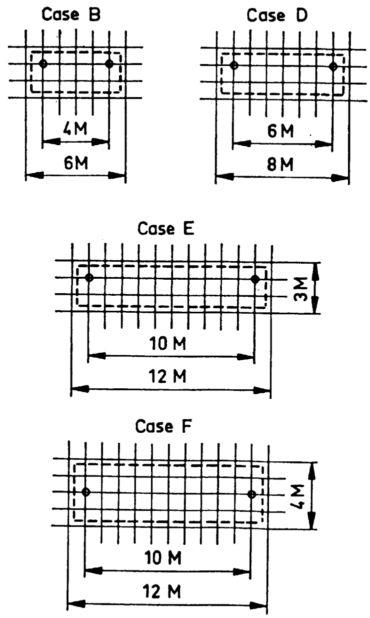
General technical data See "Introduction Polystyrene Capacitors"

Dimensions

Case size	Dimensions in mm				Weight approx.
	L max.	W max.	H max.	a	g
B	14.1	7	15.5	10.2	2.5
D	19.3	7	15.5	15.2	3.5
E	29.3	7	15.5	25.4	5.0
F	29.3	9.5	20.0	25.4	9.0



Space requirements on printed circuit board



1M=0.1"=2.54 mm

Printed circuit board hole diameter 1.3 mm

RIFA

PFE 210

RANGE/CASE SIZES

Capacitance range pF	Case size code	Capacitance tolerance ± %	Order No.
100 VDC 63 VAC			
3,000—10,000	B	0.5 1.0 2.0	PFE 210DB....D PFE 210DB....F PFE 210DB....G
> 10,000—40,000	D	0.5 1.0 2.0	PFE 210DD....D PFE 210DD....F PFE 210DD....G
> 40,000—80,000	E	0.5 1.0 2.0	PFE 210DE....D PFE 210DE....F PFE 210DE....G
> 80,000—170,000	F	0.5 1.0 2.0	PFE 210DF....D PFE 210DF....F PFE 210DF....G
200 VDC 125 VAC			
50—100 400—3,000 200—3,000 100—3,000	B	2 pF 0.5 % 1.0 2.0	PFE 210GB....A PFE 210GB....D PFE 210GB....F PFE 210GB....G
> 3,000—10,000	D	0.5 1.0 2.0	PFE 210GD....D PFE 210GD....F PFE 210GD....G
> 10,000—20,000	E	0.5 1.0 2.0	PFE 210GE....D PFE 210GE....F PFE 210GE....G
> 20,000—40,000	F	0.5 1.0 2.0	PFE 210GF....D PFE 210GF....F PFE 210GF....G

ORDER INFORMATION

When ordering please state the complete order No. It should be written as in the the following example:

PFE 210	**G**	**D**	**462**	**G**
Type	Voltage code	Case code	Capacitance code **(See below)**	Capacitance tolerance code

In the type designation **the first digit** of the capacitance code designates the number of integral digits of the capacitance value in pF. **The second and third (and fourth if necessary) digits are the first two (three) digits** of the capacitance value. Examples: 462 is the code for 6200 pF and 4625 for 6250 pF.

SPECIAL TECHNICAL FEATURES

Dissipation factor	$\tan\delta \leq 10^{-3}$ for $C \leq 1000$ pF at 1 MHz $\tan\delta \leq 2 \times 10^{-4}$ for $C > 1000$ pF at 1 kHz
Self-inductance	The self-inductance is primarily dependent upon lead length. With 10 mm of free lead length the value is approximately 25 nH.
Mechanical solidity	The capacitor is constructed for printed circuit board mounting. It meets vibration tests according to IEC publication 68, test F, severity IV (10-500 Hz, 10 g) or MIL-STD-202, method 204, test condition B and shock test according to MIL-STD-202, method 205, test condition C.
Terminals	Heavily tinned copper leads with 0.8 mm diameter. For case size F tinned brass wires 0.5×0.8 mm.
Humidity resistance	After a test to IEC 68-2 severity 56 (56 days at +40°C and 90—95% R.H.) the I.R. is still above specified limits and the capacitance change does not exceed 0.15%.
Long term instability	The following requirements of max capacitance instability are met by PFE 210 when operated at rated voltage: 1. ±(0.1%+0.3 pF) after at least three years at max +50°C and at an average R.H. of max 70%. 2. ±0.5% for C > 500 pF and ±0.75% or ±0.5 pF (whichever is the greatest) for C ≤ 500 pF after 1000 h at +85°C.
Reliability	The failure rate of PFE 210 is so low that reliability data referring to normal operation cannot be achieved in laboratory tests. However, operational statistics for a total of 12×10^{9} unit-hours have revealed a mean failure rate of less than 10^{-10}/h.

Notes

PFE 216

Low profile precision type

RIFA

The PFE 216 polystyrene capacitor has a winding with tin foil electrodes. The extended foil design has the terminal leads soldered directly to the tin foils. Epoxy encapsulation.

Basic specification IEC publication 275, category 40/085/21

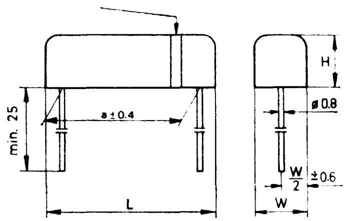
Temperature range —40°C to +85°C

General technical data See "Introduction Polystyrene capacitors".

Capacitance tolerance

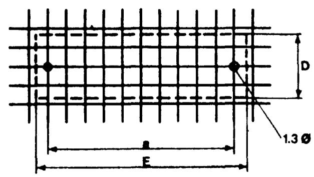
Cap. tolerance ±% (pF)	code	Cap. range pF
1%	F	≥100
2%	G	≥100
2 pF	B	47—200
5 pF	A	47—100

Outer foil, marked in the winding.



Dimensions in mm

Space requirements on printed circuit board



Case size code	Dimensions in mm L	W	H max.	Space requirements in mm D	E	a	Weight g
B	14.5	6	7	6.8	15	10.2	1.3
C	19	7	8	7.8	19.5	15.2	2.0
D	29.5	8.5	10	9.3	30	25.4	2.3
E	29.5	10	12	10.8	30	25.4	5.5
F	29.5	13.5	14.5	14.3	30	25.4	11

RANGE/CASE SIZE

Capacitance range pF	Case size code	Capacitance tolerance ± %	Order No.

100 VDC 63 VAC

> 1,500—8,000	B	1.0 2.0	PFE 216DB. . . .F PFE 216DB. . . .G
> 8,000—33,000	C	1.0 2.0	PFE 216DC. . . .F PFE 216DC. . . .G
> 33,000—100,000	D	1.0 2.0	PFE 216DD. . . .F PFE 216DD. . . .G
> 100,000—150,000	E	1.0 2.0	PFE 216DE. . . .F PFE 216DE. . . .G
> 150,000—250,000	F	1.0 2.0	PFE 216DF. . . .F PFE 216DF. . . .G

200 VDC 125 VAC

> 1,000—1,500	B	1.0 2.0	PFE 216GB. . . .F PFE 216GB. . . .G
> 1,500—8.000	C	1.0 2.0	PFE 216GC. . . .F PFE 216GC. . . .G
> 8,000—50,000	D	1.0 2.0	PFE 216GD. . . .F PFE 216GD. . . .G
> 50,000—70,000	E	1.0 2.0	PFE 216GE. . . .F PFE 216GE. . . .G
> 70,000—100,000	F	1.0 2.0	PFE 216GF. . . .F PFE 216GF. . . .G

Continued overleaf

PFE 216

RIFA

RANGE/CASE SIZE

Capacitance range pF	Case size code	Capacitance tolerance ± % (pF)	Order No.
500 VDC 250 VAC			
47—200	B	2 pF	PFE 216LB....B
47—100		5 pF	PFE 216LB....A
100—1,000		1.0%	PFE 216LB....F
100—1,000		2.0	PFE 216LB....G
> 1,000—5,000	C	1.0	PFE 216LC....F
		2.0	PFE 216LC....G
> 5,000—17,000	D	1.0	PFE 216LD....F
		2.0	PFE 216LD....G
> 17,000—26,000	E	1.0	PFE 216LE....F
		2.0	PFE 216LE....G
> 26,000—55,000	F	1.0	PFE 216LF....F
		2.0	PFE 216LF....G

ORDER INFORMATION

When ordering please state the complete code No. It should be written as in the following example:

PFE 216	**G**	**C**	**462**	**G**
Type	Voltage code	Case code	Capacitance code **(See below)**	Capacitance tolerance code

In the type designation **the first digit** of the capacitance code designates the number of integral digits of the capacitance value in pF. **The second and third (and fourth if necessary) digits are the first two (three) digits** of the capacitance value. Examples: 462 is the code for 6200 pF and 4625 for 6250 pF.

SPECIAL TECHNICAL FEATURES

Dissipation factor	$\tan\delta \leq 2\times10^{-4}$ for $C \leq 0.1$ µF at 1 kHz $\tan\delta \leq 3\times10^{-4}$ for $C > 0.1$ µF at 1 kHz.
Self-inductance	The self-inductance is primarily dependent upon lead length. With 5 mm of free lead length the value is approximately 10 nH.
Mechanical solidity	The capacitor is constructed for printed circuit board mounting. It meets vibration tests according to IEC publication 68, test F, severity IV (10-500 Hz, 10 g)or MIL-STD-202, method 204, test condition B and shock test according to MIL-STD-202, method 205, test condition C.
Terminals	For case sizes B—E heavily tinned copper leads. For case size F heavily tinned copper clad steel wires.
Humidity resistance	After a test to IEC 68, severity 21 (21 days at +40°C and 90—95% R.H.) the capacitance change will be less than ±0.15% and I.R. will still meet values specified above.
Long term instability	The following requirements of max capacitance instability are met by PFE 216 when operated at rated voltage: 1. ±(0.2%+0.4 pF) after at least three years at max +50°C and at an average R.H. of max 70%. 2. ±0.5% for $C > 500$ pF and ±0.75% or ±0.5 pF (whichever is the greatest) for $C \leq 500$ pF after 1000 h at +85°C.
Reliability	The failure rate of PFE 216 is so low that reliability data referring to normal operation cannot be achieved in laboratory tests. However, operational statistics for a total of 12×10^{9} unit-hours have revealed a mean failure rate of less than 10^{-10}/h.

PFE 225

Modular precision type

RIFA

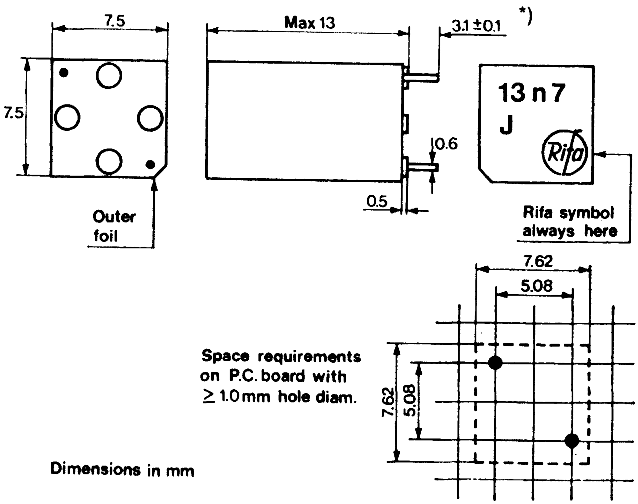
The PFE 225 polystyrene capacitors are designed to be used as filter capacitors together with RM6 ferrite cores.

The capacitor has a winding with extended tin foil electrodes.

Terminal leads are connected to the electrodes in such a way that reliable contact is assured even at very low voltages.

Self-extinguishing epoxy-filled polypropylene case of modular dimensions provides high package density on printed circuit boards. The moulded case incorporates stand-offs facilitating flow soldering on P.C. boards with through-plated holes.

Basic specification	IEC publication 275, category 40/085/56
Temperature range	—40°C to +85°C
Capacitance tolerance	±0.5% (code D), ±1% (code F), ±2% (code G), ±5% (code J). However, not closer than ±1.5 pF (code A).
General technical data	See "Introduction Polystyrene Capacitors" page 93—96.



*) PFE 225 can be supplied with 8^{+2}_{-0} mm lead length. Please add R8 to order number.

CAPACITANCE RANGE AND RATED VOLTAGE

Capacitance range pF	Rated voltage VDC	VAC	Capacitance tolerance ± %	Order No.
47—299			1.5 pF	PFE 225GB....A
300—1,500	200	125	0.5%	PFE 225GB....D
150—1,500			1.0	PFE 225GB....F
75—1,500			2.0	PFE 225GB....G
> 1,500—13,700	100	63	0.5	PFE 225DB....D
			1.0	PFE 225DB....F
			2.0	PFE 225DB....G
> 13,700—18,000	63	40	0.5	PFE 225CB....D
			1.0	PFE 225CB....F
			2.0	PFE 225CB....G

ORDER INFORMATION

When ordering please state the complete order No. It should be written as in the following example:

PFE 225	G	B	462	G	R8
Type	Voltage code	Case code	Capacitance code **(See below)**	Capacitance tolerance code	Code for special wire length

In the type designation **the first digit** of the capacitance code designates the number of integral digits of the capacitance value in pF. **The second and third (and fourth if necessary) digits are the first two (three) digits** of the capacitance value. Examples: 462 is the code for 6200 pF and 4625 for 6250 pF.

SPECIAL TECHNICAL FEATURES

Dissipation factor
Tan$\delta \leq 10^{-3}$ at 1 MHz for C $\leq$ 1000 pF
Tan$\delta \leq 2 \times 10^{-4}$ at 1 kHz for C $>$ 1000 pF

Self-inductance
$\leq$ 12 nH

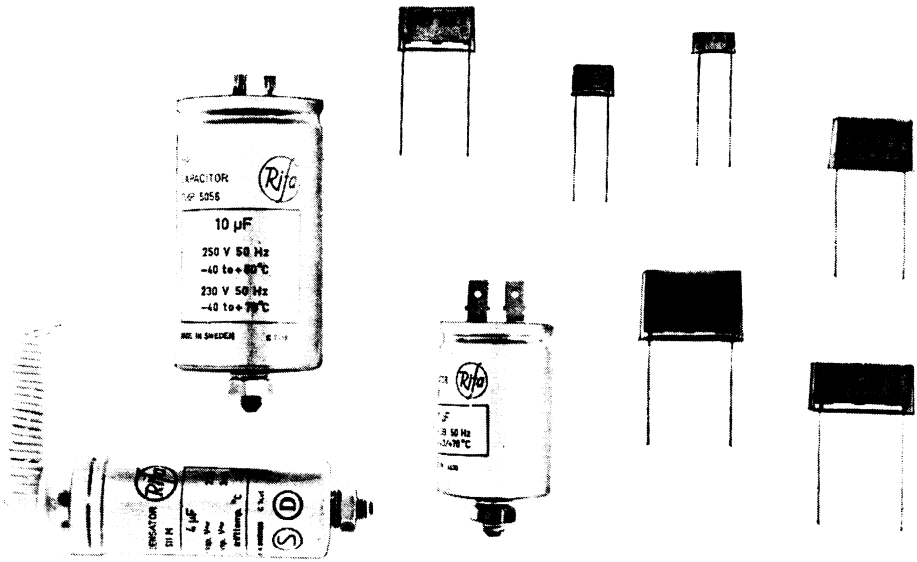
Humidity resistance
After a test according to IEC 68-2-3, test Ca, severity 56, the capacitance change is less than 0.5%+1 pF.

Terminals
Heavily tinned copper clad steel wires with 0.6 mm diameter.

Long term instability
The following requirements of max. capacitance instability are met by PFE 225 when operated at rated voltage:

1. ±(0.2%+0.2 pF) after at least three years at max. +50°C and at an average R.H. of max. 70%.
2. ±0.5% for C > 500 pF and ±0.75% or ±0.5 pF (whichever is the greatest) for C ≤ 500 pF after 1000 h at +85°C.

METALLIZED PAPER CAPACITORS



Throughout this catalogue the expression "MP capacitors" is used to denote capacitors made of vacuum metallized capacitor tissue.

Metallized paper capacitors have for many years formed an important part of Rifa's extensive range of capacitors. The MP capacitors are designed for both AC and DC applications. They are, due to their good self-healing properties, especially suited for AC and other applications where voltage transients may occur. Particularly in such applications the MP capacitors have over a period of many years proven their superiority to other types of dielectric systems. Even the modern plastic dielectrics are lacking a lot of the inherent fabourable properties of metallized paper.

The manufacture of MP capacitors, as of other types, is based on comprehensive tests of materials, experimental production and life tests on finished capacitors at the Rifa laboratories.

The modern MP capacitor is the product of a highly developed vacuum technique involving the condensation of metal in an extremely thin film on capacitor tissue. This layer of metal on paper replaces the conventional metal foil. As a result of its self-healing property referred to below, this dielectric can be subjected to higher stresses than in all other dielectric system capacitors.

The self-healing property of the metallized paper also makes it possible to employ a single paper dielectric. The thin dielectric and the absence of metal foil make the MP capacitor very small in size and weight. It is therefore ideal for use where space is at a premium.

CONSTRUCTION

The capacitor consists of a winding which, for a single layer capacitor, comprises two strips of metallized paper. On the metallized paper a margin is left on one side, and the strips are so arranged, that the metal coating on one strip extends to one edge of the finished winding, and the metal coating on the other strip extends to the other edge.

In capacitors intended for higher voltages one or more layers of paper or polypropylene film are inserted between the metallized papers to reinforce the dielectric.

Connections to the electrodes are made by spraying a layer of metal on the edges of the winding, to which the terminating wires can subsequently be attached by welding or soldering.

The winding is dried and impregnated under high vacuum and assembled in a protecting case. Impregnation materials used are epoxy resin, mineral wax or mineral oil.

During manufacture the capacitor is connected to a DC supply to clear the metal layer around pin-holes and other weak spots in the paper to ensure a high and stable insulation in the capacitor. The clearing voltage is so chosen that only a minimum of self-healing breakdowns occur when the capacitor is operated within specified limits.

SELF-HEALING

If conducting particles or a voltage surge punctures the dielectric, an arc occurs at the point of failure which melts the surrounding metal and isolates the area of the breakdown. Such breakdowns may occur thousands of times in an MP capacitor without appreciably affecting its life or other properties. They do, however, give rise to small electrical pulses which may result in objectionable noise in certain circuits.

If a single-layer capacitor is continuously operated at rated voltage, occasional self-healing breakdowns occur. If the applied voltage is reduced to approximately 0.75 × rated voltage the self-healing breakdowns are virtually eliminated and although the self-healing function is maintained the capacitor behaves as a paper and foil capacitor. By derating the voltage in this way, metallized paper capacitors can be used in circuits where the noise from the self-healing voltage pulses cannot be tolerated. Multi-layer capacitors rated at $\geq$ 400 volts DC show only sporadic self-healing breakdowns at rated voltage.

Type	Terminals	Rated Voltage VDC	VAC	Cap. range µF	Type spec. page

DC APPLICATION CAPACITORS

Type	Terminals	VDC	VAC	Cap. range µF	Type spec. page
miniprint® TYPES					
PME 2602	Radial leads	250	125	0.047—2	118
PME 2614	Radial leads	400	220	0.01 —1	118
PME 2616	Radial leads	630	300	0.001—0.15	118
PME 2631	Radial leads	1000	500	0.001—0.1	118
CAN TYPES					
PMH 510—511	Solder tags	200	75	4—60	122
PMH 512—513	Solder tags	250	125	2—40	122
PMH 520—521	Solder tags	400	200	0.5—32	122
PMH 522—523	Solder tags	500	220	0.5—20	122
PMH 525	Flat tabs	1000	380	0.5—12	126

AC APPLICATION CAPACITORS

Type	Terminals	VDC	VAC	Cap. range µF	Type spec. page
MOTOR RUN CAPACITORS					
PMP 500—501	PVC-insulated leads, insulated cap		250 230	2—20 25	138
PMP 502—503	PVC-insulated leads, aluminium cap		250 230	2—20 25	138
PMP 504—505	Solder tags		250 230	0.5—20 25	138
PMP 508—509M	Flat tabs		250 230	2—20 25	142
DISCHARGE LAMP CAPACITORS					
PMN 511	Solder tags alt. PVC-insulated leads		230	2—16	144
PHN 451*	Terminal block		250	2—25	148
PULSE OPERATION CAPACITORS					
PMP 508—509T	Flat tabs		600	0.5—10	150
PMP 518—519T	Flat tabs		600	0.5—10	152

INTERFERENCE SUPPRESSORS See page 155
RC NETWORKS See page 169

* Metallized Polypropylene Capacitors.

DC APPLICATION CAPACITORS

GENERAL TECHNICAL INFORMATION see pages 111—112.

VOLTAGE RATINGS

The capacitors can be used with rated DC voltage over the whole temperature range. For continuous operation at max. AC ratings the upper temperature has to be limited according to information in the type specifications.

The capacitors can intermittently be used at AC and DC voltages higher than rated. The intermittent voltage depends on ambient temperature and duty cycle. Please consult Rifa.

TEST VOLTAGE

Before shipment every capacitor is tested with a proof voltage as stated in the type specifications. This proof voltage is generally 1.5×rated voltage. During this test occasional self-healing breakdowns are allowed.

Metal cased capacitors are also subject to a proof voltage test between terminals and case. (3000 VDC 3 sec.)

CAPACITANCE TOLERANCE

Unless otherwise stated in the data sheets the capacitance tolerances are as follows:

±20% for $C < 0.01\ \mu F$ ±10% for $C \geq 0.01\ \mu F$

(Other tolerances will be supplied on request.)

SOLDERABILITY

Wetting time ≤ 1 s when tested according to IEC 68-2-20, test T, solder globule method.

BUMP TEST

IEC 68-2-29, Test Eb. The capacitors, properly fixed, will withstand at least 4000 bumps with 390 m/s^2 retardation.

VIBRATION TEST

10—500 Hz, 98 m/s^2 or 0.75 mm for 6h according to IEC 68-2-6, test Fc.

HUMIDITY RESISTANCE

After a test to IEC No. 68.2.3, test Ca, severity 56 (56 days at +40°C and 90% to 95% relative humidity) the insulation resistance is still above specified limits.

INSULATION RESISTANCE

The values given in the catalogue indicate the insulation resistance after one minute of electrification at +20°C with the following voltages: 100 VDC for capacitors rated at 100 to 500 V and 500 VDC for capacitors rated at ≥ 500 V. Insulation resistance is temperature dependent and is approximately halved for each 7°C of temperature increase.

Multi-layer construction provides insulation resistance higher than that of single-layer.

Figure 1 shows typical curves for the insulation resistance v temperature.

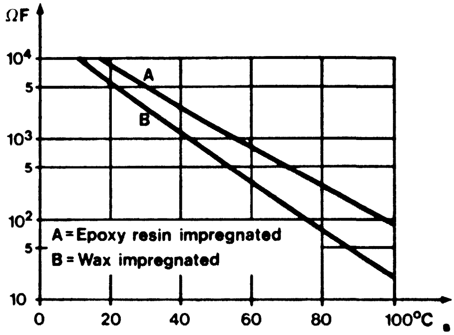


Fig. 1 Insulation resistance v temperature. Typical values.

DISSIPATION FACTOR

The dissipation factor is of interest especially when the capacitor is operated on AC. The dielectric losses cause heating of the capacitor and under unfavourable circumstances it may lead to a destructing break-down. This will not happen if the capacitor is used within specified limits.

The ability to withstand short duration thermal and voltage overload is larger for small capacitors than for large capacitance units.

Dissipation factor figures for AC capacitors are given on page 131.

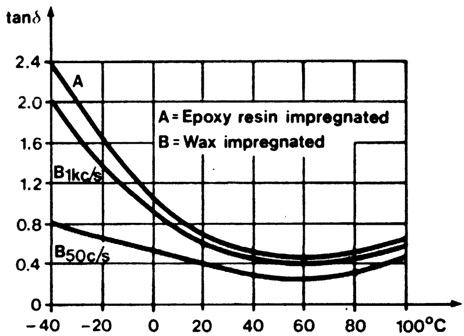


Fig. 2 Dissipation factor v temperature. Typical values.

Figures 2 and 3 show typical curves for the dissipation factor v temperature and frequency respectively.

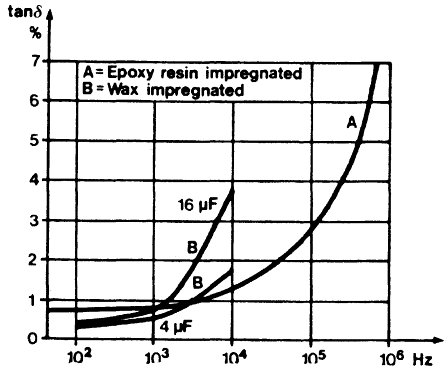


Fig. 3 Dissipation factor v frequency. Typical values.

CAPACITANCE CHANGE

The variation of capacitance v temperature and frequency is dependent on the impregnant used. The variation is shown in figures 4 and 5.

The curves A show the changes for capacitors impregnated with epoxy resin.

The curves B show the changes for wax impregnated capacitors.

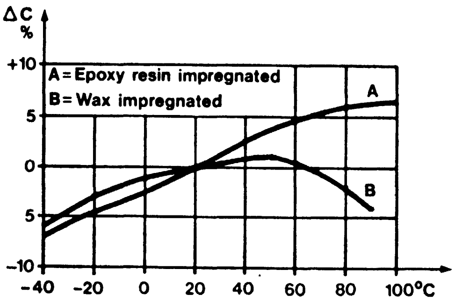


Fig. 4 Capacitance change v temperature. Typical values.

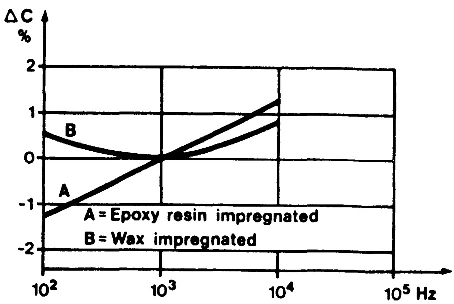


Fig. 5 Capacitance change v frequency. Typical values.

Notes

METALLIZED PAPER CAPACITORS

PME 260–263 miniprint®

epoxy resin encapsulated

RIFA

PME 260—263 are metallized paper capacitors impregnated and encapsulated with epoxy resin. Embedded metal label offers excellent humidity protection. Terminal leads of tinned copper clad steel wires.

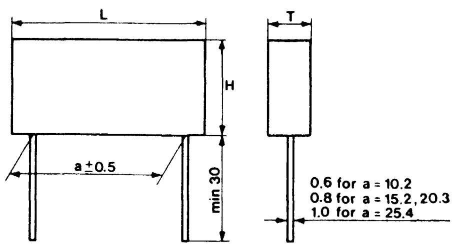
PME 260 are single-layer capacitors.

PME 261—263 are multi-layer capacitors.

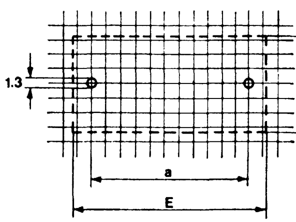
Miniprint MP capacitors are characterized by outstanding ability to withstand high transient voltages and high current pulses (high du/dt). They can be used at DC voltages from zero to rated voltage within the whole temperature range. They are especially well suited for low frequency AC or pulse operation.

Special versions of epoxy impregnated MP capacitors especially designed for radio interference suppression and for contact protection are described in catalogue section "Interference suppressors" and section "RC networks".

	PME 2602	**PME 2614, 2616, 2631**
Basic specification	IEC Publ. 166 Type 2 Category 40/085/56	IEC Publ. 166 Type 1 Category 40/100/56
Temperature range		
DC application	—40 to +85°C	—40 to +100°C
AC application	—40 to +70°C	—40 to +70°C
Rated voltage		
VDC	250 VDC	400—1000 VDC
VAC up to 400 Hz	125 VAC	220—500 VAC
Capacitance tolerance	±10%	±20% for C < 0.01 μF ±10% for C ≥ 0.01 μF
General technical information	See pages 111—116.	



Space requirements



STANDARD UNITS

Cap. µF	Rated voltage VDC	Rated voltage VAC	Dimensions in mm L_{max}	T_{max}	H_{max}	a	Max Space requirements in mm D	E	Order Number	Weight g
0.047			13.5	5.1	10.5	10.2	5.4	14.5	PME 2602/0.047	1.0
0.068			18.5	5.2	10.5	15.2	5.7	19.5	PME 2602/0.068	1.6
0.1			18.5	5.2	10.5	15.2	5.7	19.5	PME 2602/0.1	1.6
0.15			18.5	5.2	10.5	15.2	5.7	19.5	PME 2602/0.15	1.6
0.22			19.0	7.3	13.0	15.2	7.8	20.0	PME 2602/0.22	2.7
	250	125								
0.33			18.5	7.8	13.5	15.2	8.3	19.5	PME 2602/0.33	2.8
0.47			24.0	7.6	14.0	20.3	8.1	25.0	PME 2602/0.47	3.6
0.68			24.0	9.0	15.5	20.3	9.5	25.0	PME 2602/0.68	4.8
1			24.0	11.3	16.5	20.3	11.8	25.0	PME 2602/1	6.1
2			30.5	15.3	22.0	25.4	16.0	31.5	PME 2602/2	14.5
0.01			13.5	3.9	7.5	10.2	4.2	14.5	PME 2614/0.01	0.7
0.015			13.5	5.1	10.5	10.2	5.4	14.5	PME 2614/0.015	1.0
0.022			13.5	5.1	10.5	10.2	5.4	14.5	PME 2614/0.022	1.0
0.033			18.5	5.2	10.5	15.2	5.7	19.5	PME 2614/0.033	1.6
0.047			18.5	5.2	10.5	15.2	5.7	19.5	PME 2614/0.047	1.6
0.068			19.0	7.3	13.0	15.2	7.8	20.0	PME 2614/0.068	2.7
0.1	**400**	220	19.0	7.3	13.0	15.2	7.8	20.0	PME 2614/0.1	2.7
0.15			24.0	7.6	14.0	20.3	8.1	25.0	PME 2614/0.15	3.6
0.22			24.0	7.6	14.0	20.3	8.1	25.0	PME 2614/0.22	3.6
0.33			24.0	11.3	16.5	20.3	11.8	25.0	PME 2614/0.33	6.1
0.47			30.5	10.2	15.5	25.4	10.9	31.5	PME 2614/0.47	7.3
0.68			30.5	15.3	22.0	25.4	16.0	31.5	PME 2614/0.68	14.5
1			30.5	15.3	22.0	25.4	16.0	31.5	PME 2614/1	14.5
0.001			13.5	3.9	7.5	10.2	4.2	14.5	PME 2616/0.001	0.7
0.0015			13.5	3.9	7.5	10.2	4.2	14.5	PME 2616/0.0015	0.7
0.0022			13.5	3.9	7.5	10.2	4.2	14.5	PME 2616/0.0022	0.7
0.0033			13.5	3.9	7.5	10.2	4.2	14.5	PME 2616/0.0033	0.7
0.0047			13.5	3.9	7.5	10.2	4.2	14.5	PME 2616/0.0047	0.7
0.0068			13.5	3.9	7.5	10.2	4.2	14.5	PME 2616/0.0068	0.7
0.01	**630**	300	13.5	5.1	10.5	10.2	5.4	14.5	PME 2616/0.01	1.0
0.015			13.5	5.1	10.5	10.2	5.4	14.5	PME 2616/0.015	1.0
0.022			18.5	5.2	10.5	15.2	5.7	19.5	PME 2616/0.022	1.6
0.033			18.5	5.2	10.5	15.2	5.7	19.5	PME 2616/0.033	1.6
0.047			19.0	7.3	13.0	15.2	7.8	20.0	PME 2616/0.047	2.7
0.068			19.0	7.3	13.0	15.2	7.8	20.0	PME 2616/0.068	2.7
0.1			24.0	7.6	14.0	20.3	8.1	25.0	PME 2616/0.1	3.6
0.15			24.0	9.0	15.5	20.3	9.5	25.0	PME 2616/0.15	4.8

Continued overleaf

PME 260–263 miniprint®

RIFA

STANDARD UNITS

Cap. µF	Rated voltage VDC	VAC	Dimensions in mm L_{max}	T_{max}	H_{max}	a	Max Space requirements in mm D	E	Order Number	Weight g
0.001			13.5	3.9	7.5	10.2	4.2	14.5	PME 2631/0.001	0.7
0.0015			13.5	3.9	7.5	10.2	4.2	14.5	PME 2631/0.0015	0.7
0.0022			13.5	3.9	7.5	10.2	4.2	14.5	PME 2631/0.0022	0.7
0.0033			13.5	3.9	7.5	10.2	4.2	14.5	PME 2631/0.0033	0.7
0.0047			13.5	5.1	10.5	10.2	5.4	14.5	PME 2631/0.0047	1.0
0.0068			13.5	5.1	10.5	10.2	5.4	14.5	PME 2631/0.0068	1.0
0.01	**1000**	500	18.5	5.2	10.5	15.2	5.7	19.5	PME 2631/0.01	1.6
0.015			18.5	5.2	10.5	15.2	5.7	19.5	PME 2631/0.015	1.6
0.022			19.0	7.3	13.0	15.2	7.8	20.0	PME 2631/0.022	2.7
0.033			18.5	7.8	13.5	15.2	8.3	19.5	PME 2631/0.033	2.8
0.047			24.0	7.6	14.0	20.3	8.1	25.0	PME 2631/0.047	3.6
0.068			24.0	9.0	15.5	20.3	9.5	25.0	PME 2631/0.068	4.0
0.1			24.0	11.3	16.5	20.3	11.8	25.0	PME 2631/0.1	6.1

SPECIAL TECHNICAL FEATURES

	PME 2602	PME 2614, 2616, 2631
Dissipation factor	≤ 2‰	≤ 1.5‰
	Measured at 1 kHz and + 20°C	
Insulation resistance		
C ≤ 0.33 µF	≥ 3000 MΩ	≥ 12 000 MΩ
C > 0.33 µF to < 2 µF	≥ 1000 ΩF	≥ 4 000 ΩF
C ≥ 2 µF	≥ 200 MΩ	—

Measured at +20°C after 1 minute with 100 VDC for U_R =250 VDC and 400 VDC and 500 VDC for U_R =630 VDC and 1000 VDC.

Intermittent voltage

	PME 2602	PME 2614, 2616, 2631
VDC up to +85°C	1.5×rated voltage	1.5×rated voltage

VAC: Rated AC voltage may be exceeded. The voltage limitations depend on application and temperature and have to be determined from case to case.

	PME 2602	PME 2614, 2616, 2631
Test voltage	1.5×rated voltage for 1 min.	1.5×rated voltage for 1 min.

Pulse operation

Rated voltage VDC	Max du/dt in V/μs for lead spacing in mm (a) 10.2	15.2	20.3	25.4
250	440	240	190	150
400	660	380	280	220
630	940	550	380	—
1000	1100	660	440	—

Max du/dt refer to an unlimited number of charging/discharging provided that the self-heating does not exceed 4°C.

Bump test

4000 bumps with 390 m/s^2 according to IEC 68-2-29, test Eb.

Terminals

Parallel tinned copper clad steel wires.
Standard length is min. 30 mm.
5.5 ± 0.5 mm can be supplied on request.

PMH 510—523

In aluminium case

The PMH 510—523 series of aluminium can encased and wax impregnated metallized paper capacitors offer a great xariety of small sized, self-healing, reliable capacitors in the range of 0.5 to 60 μF for working voltages up to 500 VDC (220 VAC).

Temperature range	—40°C to +85°C (max. +70°C for AC operation).
Rated voltage	200—500 VDC 75—220 VAC
Capacitance tolerance	±10%. Closer tolerances can be supplied.
General technical information	See pages 111—116.

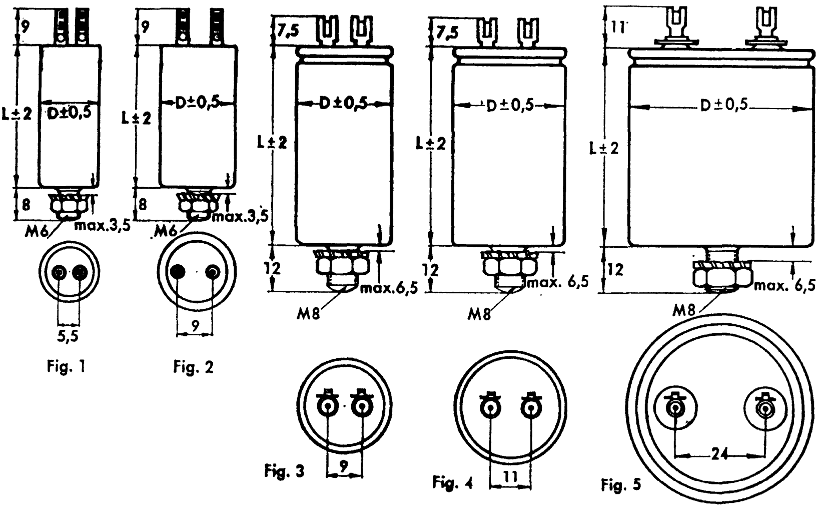


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

STANDARD UNITS

Cap. µF	Rated voltage DC	Rated voltage AC 50—60 Hz	Fig.	Dimensions mm D	Dimensions mm L*)	Order number Stud fixing version	Order number Clip fixing version	Weight g (Stud fixing version)
4			3	25	52	PMH 5112/4	PMH 5102/4	40
6			4	30	52	PMH 5112/6	PMH 5102/6	45
8			4	30	52	PMH 5112/8	PMH 5102/8	55
8			3	25	78	PMH 5112A/8	PMH 5102A/8	55
10			4	30	78	PMH 5112/10	PMH 5102/10	65
16			4	35	78	PMH 5112/16	PMH 5102/16	95
20			4	35	78	PMH 5112/20	PMH 5102/20	120
	200	75						
25			4	35	110	PMH 5112/25	PMH 5102/25	130
25			4	40	78	PMH 5112A/25	PMH 5102A/25	135
32			4	45	78	PMH 5112/32	PMH 5102/32	165
40			4	40	110	PMH 5112/40	PMH 5102/40	215
50			5	50	113	PMH 5132/50	PMH 5122/50	235
60			5	50	113	PMH 5132/60	PMH 5122/60	255
2			3	25	52	PMH 5113/2	PMH 5103/2	35
4			3	25	78	PMH 5113/4	PMH 5103/4	50
6			3	25	78	PMH 5113/6	PMH 5103/6	60
8			4	30	78	PMH 5113/8	PMH 5103/8	70
10			4	30	78	PMH 5113/10	PMH 5103/10	80
12	250	125	4	35	78	PMH 5113/12	PMH 5103/12	95
16			4	40	78	PMH 5113/16	PMH 5103/16	125
20			4	45	78	PMH 5113/20	PMH 5103/20	160
25			4	40	110	PMH 5113/25	PMH 5103/25	175
32			4	45	110	PMH 5113/32	PMH 5103/32	210
40			5	50	113	PMH 5133/40	PMH 5123/40	285

*) For clip fixing version reduce L-measure by 2 mm and weight by 3—12 g.

PMH 520—523 see overleaf.

STANDARD UNITS

Cap. µF	Rated voltage DC	Rated voltage AC 50–60 Hz	Fig.	Dimensions mm D	Dimensions mm L*)	Order number Stud fixing version	Order number Clip fixing version	Weight g (Stud fixing version)
0.5	400	200	1	16	38	PMH 5214/0.5	PMH 5204/0.5	20
1			2	20	38	PMH 5214/1	PMH 5204/1	35
2			3	25	52	PMH 5214/2	PMH 5204/2	40
4			3	25	78	PMH 5214/4	PMH 5204/4	65
4			4	35	52	PMH 5214A/4	PMH 5204A/4	70
5			4	35	52	PMH 5214/5	PMH 5204/5	75
6			4	30	78	PMH 5214/6	PMH 5204/6	85
6			4	40	52	PMH 5214A/6	PMH 5204A/6	90
8			4	35	78	PMH 5214/8	PMH 5204/8	125
10			4	40	78	PMH 5214/10	PMH 5204/10	135
12			4	40	78	PMH 5214/12	PMH 5204/12	160
16			4	40	110	PMH 5214/16	PMH 5204/16	195
16			4	45	78	PMH 5214A/16	PMH 5204A/16	195
20			4	45	110	PMH 5214/20	PMH 5204/20	235
25			4	45	110	PMH 5214/25	PMH 5204/25	285
32			4	45	148	PMH 5214/32	PMH 5204/32	340
0.5	500	220	2	20	38	PMH 5216/0.5	PMH 5206/0.5	25
1			2	20	52	PMH 5216/1	PMH 5206/1	40
1.5			4	30	52	PMH 5216/1.5	PMH 5206/1.5	45
2			4	30	52	PMH 5216/2	PMH 5206/2	50
2			3	25	78	PMH 5216A/2	PMH 5206A/2	50
3			3	25	78	PMH 5216/3	PMH 5206/3	65
4			4	30	78	PMH 5216/4	PMH 5206/4	75
4			4	40	52	PMH 5216A/4	PMH 5206A/4	75
5			4	35	78	PMH 5216/5	PMH 5206/5	90
6			4	35	78	PMH 5216/6	PMH 5206/6	110
7			4	35	78	PMH 5216/7	PMH 5206/7	120
8			4	40	78	PMH 5216/8	PMH 5206/8	130
8			4	35	110	PMH 5216A/8	PMH 5206A/8	135
10			4	45	78	PMH 5216/10	PMH 5206/10	145
12			4	40	110	PMH 5216/12	PMH 5206/12	205
12			4	35	148	PMH 5216A/12	PMH 5206A/12	200
16			4	45	110	PMH 5216/16	PMH 5206/16	250
16			4	40	148	PMH 5216A/16	PMH 5206A/16	260
20			4	45	148	PMH 5216/20	PMH 5206/20	315
20			5	50	113	PMH 5236/20	PMH 5226/20	300

*) For clip fixing version reduce L-measure by 2 mm (except for L=38 mm) and weight by 3—12 g.

SPECIAL TECHNICAL FEATURES

Terminations	Solder tags at one end.
Dissipation factor	Less than 0.006 measured at 50 Hz at +20°C. For C $\leq$ 1.0 μF however, less than 0.01 measured at 1 kHz at +20°C.
Insulation resistance	The insulation resistance between terminals and case exceeds 12 000 MΩ.
For 200 V and 250 V ranges	$\geq$ 200 ΩF measured at +20°C after one minute of electrification with 100 VDC.
For 400 V and 500 V ranges	$\geq$ 1000 ΩF measured at +20°C after one minute of electrification. Measured at 100 VDC for rated voltage 400 VDC; at 500 VDC for rated voltage 500 VDC. The insulation resistance of the 400 V and 500 V ranges of capacitors has a stability comparable with that of foil and paper capacitors.
Capacitance instability	Less than ±3% when stored, or in continuous operation. Self-healing breakdowns do not significantly change the capacitance value.

PMH 525

in aluminium case

RIFA

The PMH 525 series of oil impregnated metallized paper capacitors in aluminium cans are specially designed for operation at 1000 VDC.

The construction offers the valuable inherent self-healing properties of the metallized paper dielectric. Voltage transients of short duration will therefore not damage the capacitor.

Temperature range	—40°C to +85°C
Rated voltage	1000 VDC (380 V 50 Hz at a temperature of +70°C)
Capacitance tolerance	±10%. Closer tolerances can be supplied.
General technical information	See pages 111—116.

Fig. 1

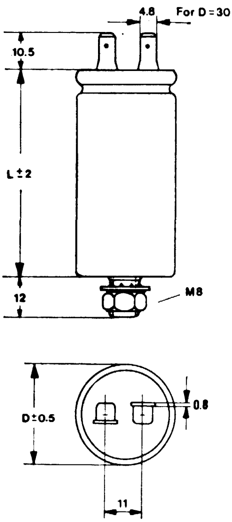
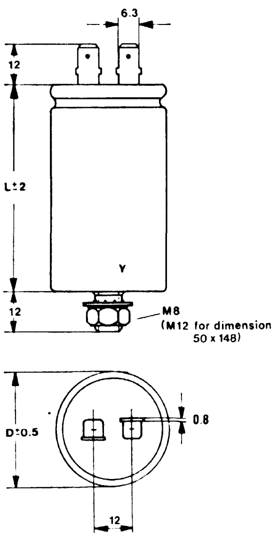


Fig. 2



STANDARD UNITS

Cap. µF	Rated voltage VDC	Fig.	Dimensions in mm D	L	Order number	Weight g
0.5	1000	1	30	40	PMH 525P650	50
1		1	35	52	PMH 525P710	70
2		1	35	78	PMH 525P720	110
3		1	40	78	PMH 525P730	135
4		2	45	78	PMH 525P740	150
5		2	40	110	PMH 525P750	210
6		2	45	110	PMH 525P760	245
7		2	45	110	PMH 525P770	250
8		2	50	110	PMH 525P780	280
10		2	50	148	PMH 525P810	360
12		2	50	148	PMH 525P812	375

SPECIAL TECHNICAL FEATURES

Terminations — Flat tabs according to DIN 46 247. The tabs are lock riveted to prevent turning.

Dissipation factor — tg$\delta \leq$ 1.0% at 1 kHz for C $\leq$ 1 µF
tg$\delta \leq$ 0.7% at 50 Hz for C $>$ 1 µF

Capacitance instability — After 2000 h at +85°C and rated voltage $\leq$ 5%.

Insulation resistance — $\geq$ 1000 ΩF measured at +20°C after one minute of electrification. Measured at 500 V.

The insulation between terminals and case exceeds 12 000 MΩ.

Capacitance change — Max capacitance change in relation to the capacitance at +20°C is $\leq$6%.

MOTOR RUN CAPACITORS AND DISCHARGE LAMP CAPACITORS
PULSE OPERATION CAPACITORS

GENERAL TECHNICAL INFORMATION see pages 111—112.

SPECIAL CAPACITOR DESIGN FEATURES

Standard encapsulation för all AC metallized paper capacitors is an aluminum can with integral stud. Clip fixing versions are available on request. A rubber-faced phenolic disc is used for the sealing of the aluminum can and for the insulation of the terminations.

The capacitors can be used with rated AC voltage up to max. allowed temperature if not otherwise stated in the type specifications. AC ratings refer to RMS value of the sinusoidal voltage at 50 Hz if not otherwise stated.

VOLTAGE RATINGS

If the capacitor is used in AC power circuits at frequences higher than 50 Hz a voltage de-rating is necessary to avoid excessive temperature rise. Fig. 1 and 2 show max. voltage versus frequences.

230 and 250 VAC Capacitors

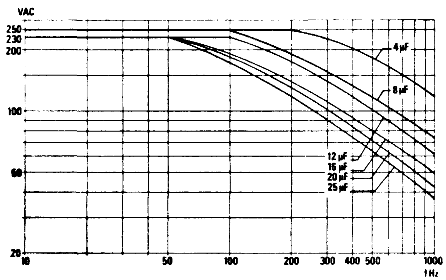


Fig. 1 Voltage ratings v frequency for 230 and 250 VAC capacitors.

600 VAC Capacitors

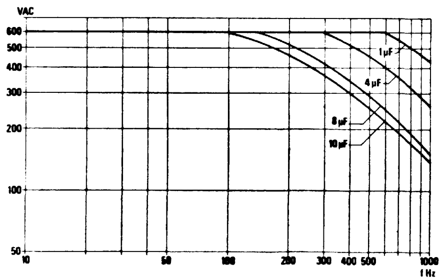


Fig. 2 Voltage ratings v frequency for 600 VAC capacitors.

INTERMITTENT RATING

The capacitor can be used for short periods at voltages higher than rated voltage.

Intermittent rating with 25% in-circuit time is based on a duty cycle of 10 minutes (2.5 minutes switched on and 7.5 minutes switched off).

At voltages above rated voltage the capacitor operates normally but the number of self-healing breakdowns increases and the capacitor life decreases.

If the capacitor is connected to a voltage higher than the intermittent rating the self-healing property of the MP capacitor is jeopardized and a breakdown may result in carbonization of the paper and complete failure of the capacitor.

TEST VOLTAGE

Before shipment every capacitor is tested with a proof voltage.

Between terminals

750 VDC 3 sec for capacitor rated 230 and 250 VAC

2300 VDC 3 sec for capacitor rated 600 VAC.

Between terminals and case

3000 VDC 60 sec.

During this test occasional self-healing breakdowns are allowed.

CAPACITANCE TOLERANCE

Unless otherwise stated in the data specifications the capacitance tolerance are ±10%.

Other tolerances will be supplied on request.

CAPACITANCE INSTABILITY

After 3 years storage: Less than ±3%.

After 10 000 hours at ±70°C and rated voltage: Less than 5%.

Self-healing breakdowns do not significantly change the capacitance value.

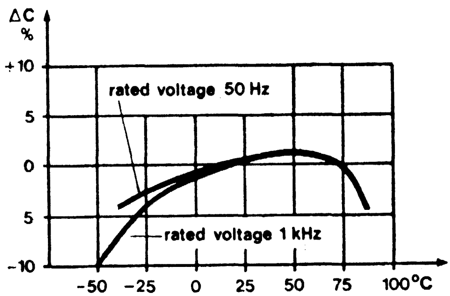


Fig. 3 Capacitance change v temperature for 230 and 250 VAC capacitors.

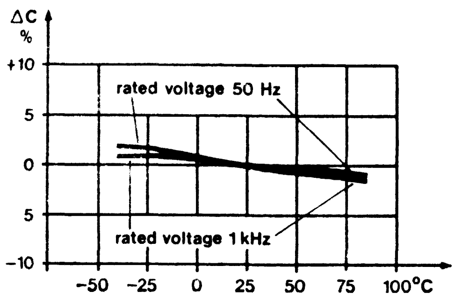


Fig. 4 Capacitance change v temperature for 600 VAC capacitors.

AMBIENT TEMPERATURE

The maximum limit of the temperature range is the highest permissible temperature of the outer surface of the capacitor. In AC operation the temperature rise of the capacitor due to its losses should be given special attention. In critical cases the surface temperature of the capacitor should be checked after the conditions have become stable.

BUMP TEST

IEC 68-2-29, test Eb. The capacitor, properly fixed, will withstand at least 4000 bumps with 390 m/s^2 retardation.

The capacitor, properly fixed, will withstand at least 4000 bumps with 390 m/s^2 retardation.

HUMIDITY RESISTANCE

After a test to IEC No. 68-2, test Ca for 56 days at +40°C and 90% to 95% relative humidity the insulation resistance is still above specified limits.

DISSIPATION FACTOR

The dissipation factor is of interest especially for capacitors designed to operate on AC. The dielectric losses cause heating of the capacitor and, under unfavourable circumstances, may lead to destructive breakdown. This problem, however, is critical only in large capacitance units or under unfavourable temperature conditions.

The normal value of $\tan\delta$ for MP AC capacitors is about 0.005, for mixed dielectric $\tan\delta$ is about 0.002, measured at 50 Hz and max. permitted ambient temperature.

Before shipment every capacitor is tested at +20°C 50 Hz and max. $\tan\delta$ of the loss angle for different voltages is

$\tan\delta \leq 0.6\%$ at 230 and 250 VAC rating
$\tan\delta \leq 0.2\%$ at 600 VAC rating

230 and 250 VAC capacitors

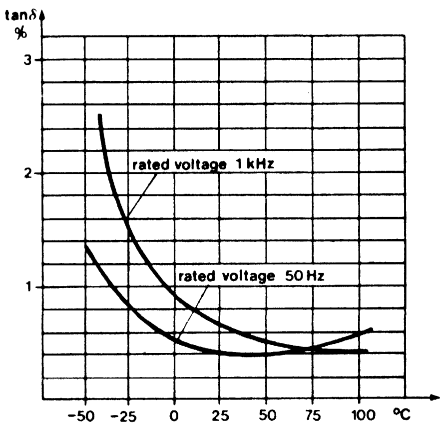


Fig. 5

600 VAC capacitors

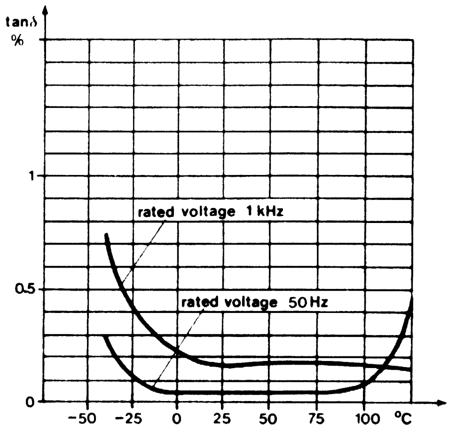


Fig. 6

Fig. 5 and 6 show typical curves for the dissipation factor v temperature.

230 and 250 VAC capacitors

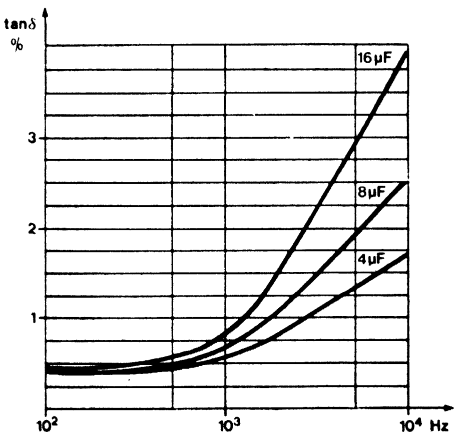


Fig. 7

600 VAC capacitors

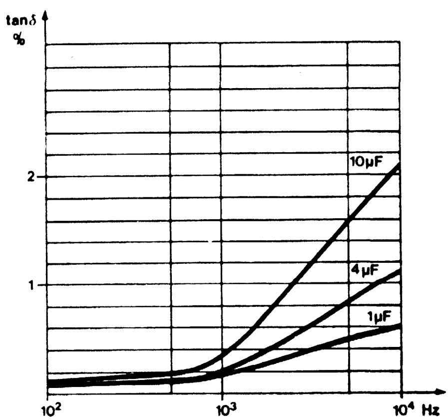


Fig 8

Fig. 7 and 8 show typical curves for the dissipation factor in % v frequency for different capacitances.

INSULATION RESISTANCE

≥ 1000 ohmfarads at +20°C after one minute of electrification between terminals. The insulation resistance between terminals and case exceeds 12 000 megohms.
Insulation resistance is temperature dependent and is approximately halved for each 7°C of temperature increase.

230 and 250 VAC capacitors

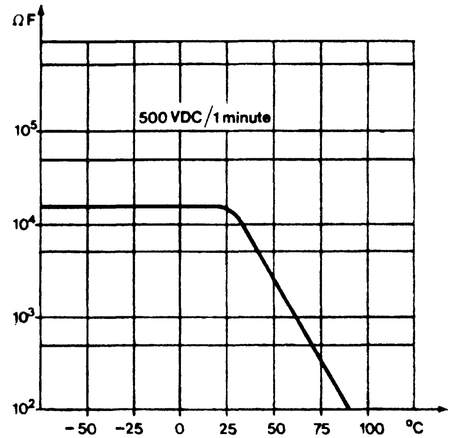


Fig. 9

600 VAC capacitors

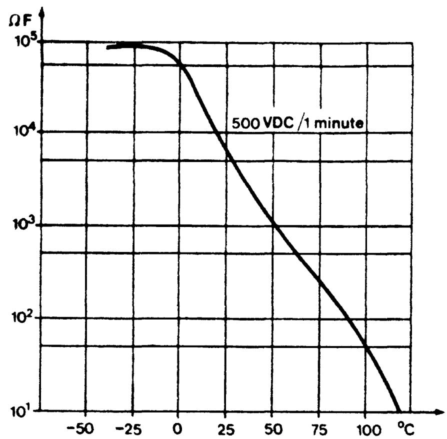


Fig. 10

Fig. 9 and 10 show typical curves for the insulation resistance v temperature.

Insulation resistance is influenced by humidity penetration and the variations due to this are given in the data specifications.

MOTOR APPLICATIONS

Connections and operation of single-phase induction motors.

In single-phase induction motors equipped with a capacitor three methods of operation can in principle be differentiated.

1. The capacitor is used only to produce a start rotating field and is disconnected by for example a centrifugal switch when the motor speeds up. Fig. 1. The motor continues to run on the rotating field which has arisen by means of the combination of the stator winding and the rotating rotor. When the capacitances are high enough the starting torque can reach 200% of the full load torque.

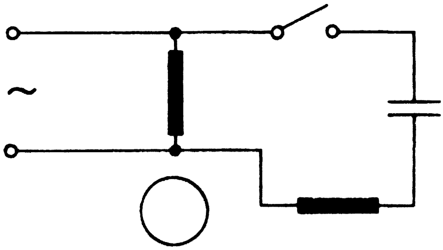


Fig. 1

2. The capacitor remains connected for the whole operational time of the motor. Fig. 2. The capacitance of the operating capacitor must not be too high as the auxiliary winding then becomes continuously overloaded and results in decreased starting torque.

   On the other hand the conditions will be much more favourable when the motor is running. An independent rotating field remains in the stator because of the phase displacement function of the current in the auxiliary winding. As the operative rotating field no longer can be achieved on the longer way via the rotor, the stray losses, which occur when forming this rotating field, are also eliminated. The decrease of the current-heat-losses and iron-losses leads to an improvement of the degree of functioning and smaller dimensions.

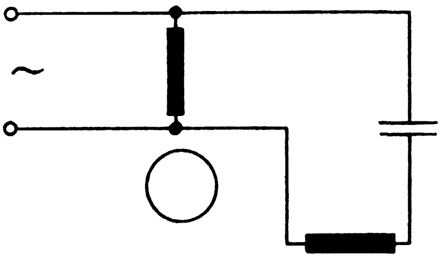


Fig. 2

The single-phase motor with an operational capacitor reaches about 90% of the maximum power of a three-phase motor with the same dimensions.

3. By a combination of the connections according to fig. 3 the capacitor for continuous operation (the dimensioned operational capacitor) and the capacitor for short time operation (the dimensioned start capacitor) are connected parallel. The capacitances for these two capacitors are combined and will give a large starting torque. When the motor is speeded up the start capacitor is disconnected for example by a centrifugal switch. The operational capacitor which is still connected will preserve the rotating field of the stator, give a good degree at function, high power factor and high power in a motor of small dimensions.

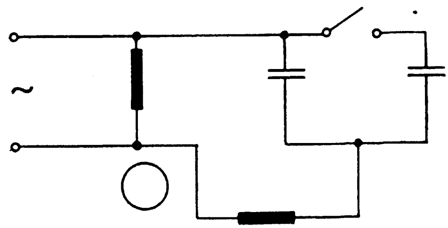


Fig. 3

Operation of three-phase motor on single-phase network.

By means of a motor capacitor it is also possible to operate three-phase motors of normal construction with AC voltage on the single-phase network. It is of course impossible to reach the same start and operating conditions, but in this way the field of application for existing electrical tools and appliances can be considerably expanded. According to fig. 4 and 5, two of the motor terminals are connected to the network and the third is connected via an operational capacitor to one of the network mains.

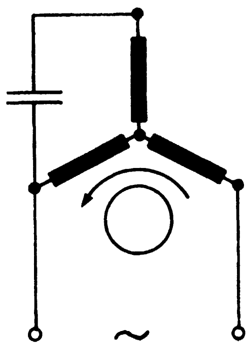


Fig. 4

In order to change the rotation direction, move the capacitor terminal from one network mains to the other. If the motor cannot be started by means of one operation capacitor only, an extra start capacitor must be used, see fig. 6. The start capacitor should be twice as large as the operation capacitor.

A start torque of about 30% of the full load torque can be attained with these connections. The power of the motor is then about 80% of the maximum power at three-phase operation.

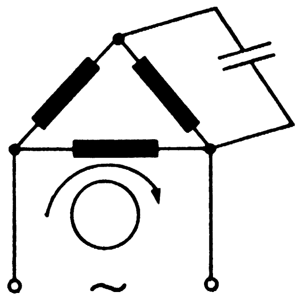


Fig. 5

Selection of capacitor.

As a rule of thumb it can be said that the operation capacitor for single-phase operation of a three-phase motor is about 70 μF/kW or 60μF/HP at 220 V~ mains voltage. The capacitor voltage will then be about 250 V~.

It should be remembered that this is only a general guide and that variations are likely to occur.

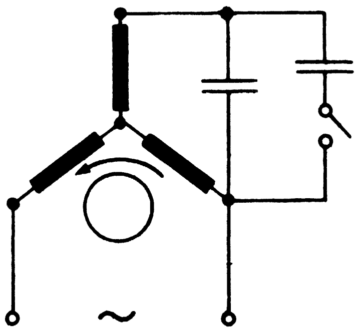


Fig. 6

When selecting a capacitor for a single-phase motor both technical and economical aspects are decisive. Because of the possibility to wind a single-phase motor in many different ways (division of the winding space for main and auxuliary winding, selection of the number of turns of winding and cross sections) it is impossible to give any universal standards for determination of capacity and operating voltage for the motor capacitors which are needed for a certain motor power. Therefore, we refer to the manufacturer's instruction.

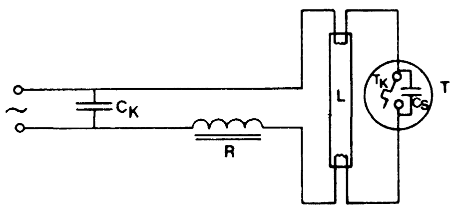
LAMP CAPACITOR APPLICATIONS

Discharge lamps such as fluorescent lamps, high pressure mercury lamps and sodium vapour lamps require, in order to work, a ballast coil or a transformer to limit the current and to assure good ignition function. The total power required of a fluorescent lamp will consist of active and reactive power on account of the magnetic field of the inductor.

The reactive power derives from a phase displacement and an increase in the current resultant on the size of the magnetic field. This means that a high current is produced, and thus a surplus of power. It can be said that the reactive power oscillates between the current source and the lamp, serving no useful purpose. For this reason electricity distributors have to over-dimension their distribution system and normally insist on end-users applying power compensation to their fluorescent lamps. Power compensation can be attained by mounting a capacitor with suitable capacitance in the lamp, thus compensating the reactive power. The capacitor causes phase displacement of the current with the opposite effect. The reactive power can be said to oscillate between the lamp and the capacitor.

Parallel compensation

Normally the electricity distributor demands compensation to cos $\varphi=0.90$ which results in considerable improvement and only an insignificant deviation from the optimum.



C_K = Capacitor for phase compensation

R = Ballast coil

L = Fluorescent lamp

T = Starter

Fig. 1 Parallel compensation for one fluorescent lamp.

Lamp Capacitors Ranges

PMN 511 Metallized Paper Capacitor page 144.

PHN 451 Metallized Polypropylene Capacitor page 148.

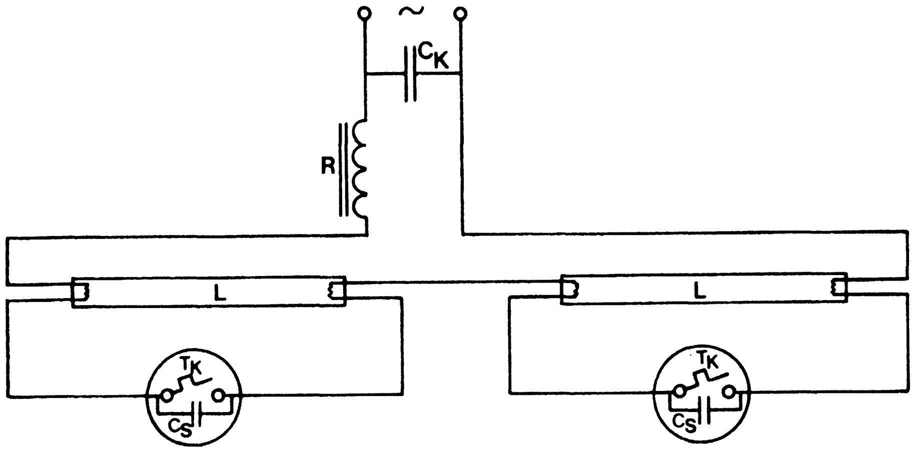


Fig. 2 Parallel compensation for two fluorescent lamps.

For parallel compensation at 220 V 50 Hz to cos $\varphi = 0.90$ the following may be used as guiding values.

Fluorescent lamps		Mercury lamps		Sodium lamps	
Power W	Cap. μF	Power W	Cap. μF	Power W	Cap. μF
1×20	4.5	50	8	45	20
2×20	4	80	8	60	20
1×40	4	125	10	85	20
2×40	8	250	20	140	25
3×40	12	400	25	200	2×20
4×40	16	700	2×20	400	2×25
1×65	7	1000	3×20		
2×65	14				
3×65	20				

METALLIZED PAPER CAPACITORS

PMP 500—505

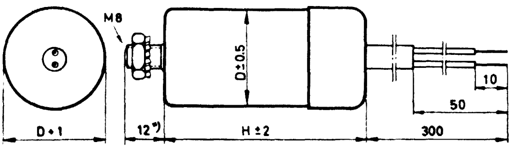
motor capacitors for 230—250 VAC

The PMP 500—505 is a range of metallized paper capacitors intended for start and continuous operation in AC motors. The metallized paper construction gives self-healing properties and high, short duration, transient voltages will therefore not damage the capacitors.

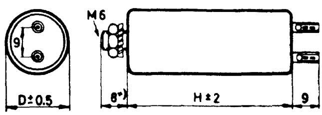
Temperature range	—40°C to +70°C
Rated voltage	230—250 VAC 50 Hz
Capacitance tolerance	±10%
Approvals	VDE 0560 Teil 8/6 67.
General technical information	See pages 128—135.

Stud fixing types	Clip fixing types	Leads and cap
PMP 501	PMP 500	PVC insulated twin-core 0,75 mm² (20/0.061) flexible lead of 300 mm (14″) length and moulded insulating cap.
PMP 503	PMP 502	PVC insulated twin core 0.75 mm² (20/0.061) flexible lead of 300 mm (14″) length and aluminium cap.
PMP 505	PMP 504	Without leads or cap. With solder tags.

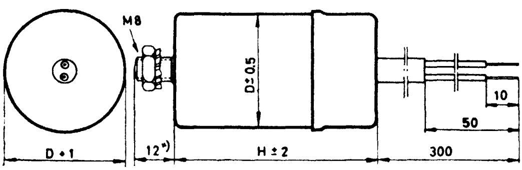
PMP 500-501



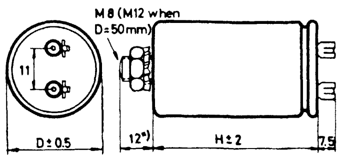
PMP 504-505 D=20mm.



PMP 502-503



PMP 504-505 D>20mm.



*) PMP 500, PMP 502 and PMP 504 are without integrated stud.

Dimensions in mm

STANDARD UNITS

Cap. μF	Rated voltage VAC 50—60 Hz at +60°C	+70°C	Dimensions in mm D	L*)	Order Number Stud fixing version	Clip fixing version	Weight g Stud fixing version	Appro-vals
With 300 mm cable and plastic cap								
2	250	250	30	62	PMP 5016/2	PMP 5006/2	60	VDE
3			35	62	PMP 5016/3	PMP 5006/3	85	VDE
4			30	88	PMP 5016/4	PMP 5006/4	95	VDE
5			35	88	PMP 5016/5	PMP 5006/5	110	VDE
6			35	88	PMP 5016/6	PMP 5006/6	110	
8			40	88	PMP 5016/8	PMP 5006/8	150	VDE
10	250	230	45	88	PMP 5016/10	PMP 5006/10	165	VDE
12			40	120	PMP 5016/12	PMP 5006/12	225	VDE
16			45	120	PMP 5016/16	PMP 5006/16	255	
20			45	158	PMP 5016/20	PMP 5006/20	355	
25	230	—	50	158	PMP 5016/25	PMP 5006/25	380	
With 300 mm cable and aluminium cap								
3	250	250	35	72	PMP 5036/3	PMP 5026/3	90	VDE
4			30	98	PMP 5036/4	PMP 5026/4	100	VDE
5			35	98	PMP 5036/5	PMP 5026/5	115	VDE
8			40	98	PMP 5036/8	PMP 5026/8	155	VDE
10	250	230	45	98	PMP 5036/10	PMP 5026/10	170	VDE
12			40	130	PMP 5036/12	PMP 5026/12	230	VDE

*) For clip fixing version reduce L measure by 1—3 mm and weight by 5 g (approx.).

PMP 504—505 see overleaf.

PMP 500—505

RIFA

Cap. µF	Rated voltage VAC 50—60 Hz at +60°C	+70°C	Dimensions in mm D	L*)	Order Number stud fixing version	clip fixing version	Weight g Stud fixing version	Appro-vals
With solder tag terminals								
0.5	250	250	20	38	PMP 5056/0.5	PMP 5046/0.5	25	
1			20	52	PMP 5056/1	PMP 5046/1	40	
2			30	52	PMP 5056/2	PMP 5046/2	55	VDE
3			35	52	PMP 5056/3	PMP 5046/3	70	VDE
4			30	78	PMP 5056/4	PMP 5046/4	80	VDE
5			35	78	PMP 5056/5	PMP 5046/5	95	VDE
6			35	78	PMP 5056/6	PMP 5046/6	110	VDE
7			35	78	PMP 5056/7	PMP 5046/7	125	VDE
8			40	78	PMP 5056/8	PMP 5046/8	135	VDE
9	250	230	40	110	PMP 5056/9	PMP 5046/9	145	VDE
10			45	78	PMP 5056/10	PMP 5046/10	150	VDE
12			40	110	PMP 5056/12	PMP 5046/12	210	VDE
15			45	110	PMP 5056/15	PMP 5046/15	245	VDE
16	250	230	45	110	PMP 5056/16	PMP 5046/16	250	VDE
20			45	148	PMP 5056/20	PMP 5046/20	350	VDE
25	230	—	50	148	PMP 5056/25	PMP 5046/25	375	VDE

*) For clip fixing version reduce L measure by 2 mm and weight by 3—12 g (approx.).

Motor capacitors with flat tab connectors see PMP 508—509 page 142.

Notes

PMP 508—509

motor capacitors for 250 VAC (360 V intermittent)

The PMP 508 and 509 M series is a range of metallized paper capacitors intended for continuous and intermittent operation in AC motors.

The metallized paper construction gives self-healing properties and high, short duration, transient voltages will therefore not damage the capacitors.

Temperature range	—40°C to +70°C
Capacitance tolerance	±10%
Approvals	SEV. VDE 0560 Teil 8/6.67 (see table).
General technical information	See pages 128—132.
Application notes	See pages 133—135.

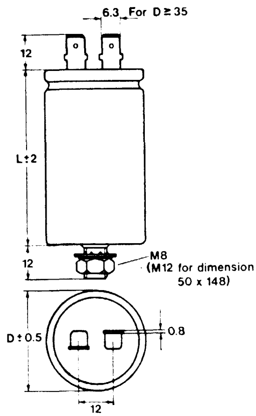


Fig. 1

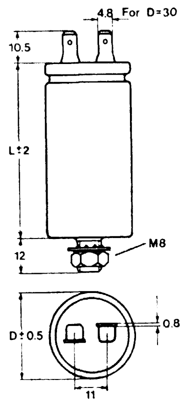


Fig. 2

STANDARD UNITS

For PMP 508—509T 600 VAC see page 150, pulse application capacitors.

Cap. µF	Rated voltage 50—60 Hz —40°C to +70°C Continuous operation	Intermittent operation 25%	Dimensions in mm D	L**)	Order Number stud fixing version (For clip fixing version replace PMP 509 by PMP 508)	Approvals
2	250	360	30	52	PMP 509M720	
3			30	62	PMP 509M730	
3.5			30	78	PMP 509M735	SEV
4			30	78	PMP 509MA740	SEV
4			35	62	PMP 509M740	SEV, VDE
5			35	78	PMP 509M750	SEV, VDE
6			35	78	PMP 509M760	SEV, VDE
8			40	78	PMP 509M780	SEV, VDE
10	230 (250)*	360	45	78	PMP 509M810	SEV, VDE
10			40	110	PMP 509MA810	SEV, VDE
12			40	110	PMP 509M812	SEV, VDE
15			45	110	PMP 509M815	SEV, VDE
16			45	110	PMP 509M816	SEV, VDE
20			50	110	PMP 509M820	SEV, VDE
20			45	148	PMP 509MA820	SEV, VDE
25	230*	360*	50	148	PMP 509M825	VDE

*) Max. temperature +60°C.

**) For clip fixing version reduce L dimension by 2 mm and weight by 3—12 g.

SPECIAL TECHNICAL FEATURES

Terminations — Flat tabs in accordance with DIN 46 247. The tabs are lock riveted to prevent turning.

PMN 511

RIFA

discharge lamp capacitors for 230 VAC

PMN 511 is a metallized paper, mineral wax impregnated capacitor specially designed for power factor compensation in discharge lamp circuits.

Outstanding features are:

- Excellent and reliable inherent stable electrical characteristics ensuring long capacitor life
- High operational reliability even under the worst permissible conditions
- No seepage of hard-wax impregnant in the event of damage to the case
- Inherent self-healing property preventing short-circuiting of the capacitor
- Built-in overload safety device

Temperature range —40°C to +85°C

Rated voltage 230 V 50 Hz

Approvals The capacitor meets the CEE specification No. 12, 1954, edition 1968, for fluorescent lighting capacitors and is tested and approved by approval boards in Denmark, Finland, Norway and Sweden.

General technical information See pages 128—132.

Application notes See pages 136—137.

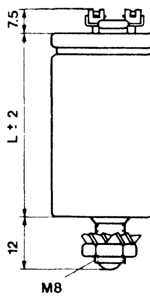


Fig. 1

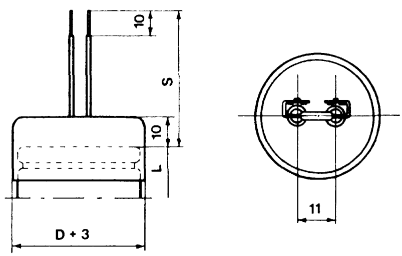


Fig. 2

STANDARD UNITS

Cap. µF ±10%	Rated voltage V 50 Hz	Dimensions in mm D	L	Stud	Order Number[1])	Weight g	Quantity/ Package
2		30	52	M8	PMN 511M720B	50	110
4		30	78	M8	PMN 511M740B	75	110
4.5		30	78	M8	PMN 511M745B	75	110
5		35	78	M8	PMN 511M750B	105	80
6		35	78	M8	PMN 511M760B	115	80
7		35	78	M8	PMN 511M770B	125	80
8		40	78	M8	PMN 511M780B	135	50
8	230	35	110	M8	PMN 511MA780B	140	80
9		40	78	M8	PMN 511M790B	145	50
10		45	78	M8	PMN 511M810B	145	50
10		35	110	M8	PMN 511MA810B	140	80
12		40	110	M8	PMN 511M812B	195	50
12		35	148	M8	PMN 511MA812B	190	40
14		40	110	M8	PMN 511M814B	235	50
16		45	110	M8	PMN 511M816B	245	50

[1]) Add "HS 400" for fig. 2 capacitors.

SPECIAL TECHNICAL FEATURES

Leads and shrouds — Capacitors fitted with plastic shroud and 0.75 mm^2 PVC insulated solid leads are available as standard version. See fig. 2. Add "HS 400" to order number for capacitors with S=400 mm.

Discharge resistor — External discharge resistor is fitted across the terminals.

Safety device — See overleaf.

Mounting — See overleaf.

Metallized Polypropylene Capacitors for 250 VAC Flourenscent Lighting Applications are described on pages 148—149.

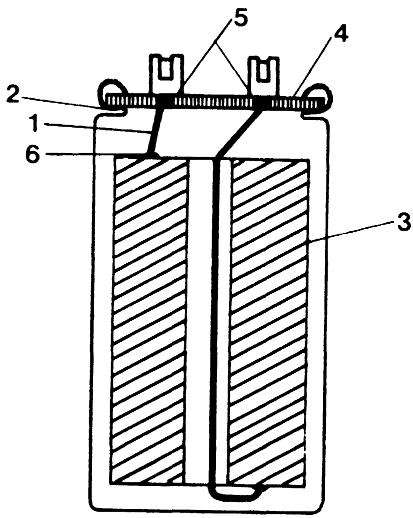
RIFA

Safety device
As protection against overload and consequential damages a safety device is built-in.

In order to ensure proper functioning of the safety device the capacitor should be mounted to allow expansion by 6 mm lengthwise.

The safety device is activated when pressure arises in the capacitor as a result of e.g. overload. The flutes (2) in the can straightens out ripping the terminal leads (1) from the joint with the capacitor winding (6).

The capacitors is thus disconnected from the mains before any leakage or other damage can occur.



1) Lead wire
2) Flute
3) Capacitor winding
4) Cover
5) Terminal
6) Solder with low melting point

Mounting
The capacitor can be mounted in any position without risk of seepage. The simplest method of mounting is to use the integral stud at the bottom of the case. To ensure perfect function of the safety device, mount the capacitor to allow for expansion 6 mm in its longitudial direction. Do not place the capacitor in the vicinity of a ballast coil or other heat-generating component. The life of the capacitor is doubled every time the temperature falls approximately 7°C.

Notes

PHN 451

discharge lamp capacitors for 250 VAC

RIFA

Recent developments have resulted in alternative designs to the metallized paper capacitor for fluorescent lighting applications.

PHN 451 is a metallized polypropylene capacitor with a dry winding encapsulated in hermetically sealed aluminium can.

Outstanding features are:

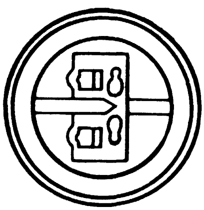
- Excellent and realiable inherent stable electrical characteristics ensuring long capacitor life
- High operational reliability even under the worst permissible conditions
- No seepage of impregnant in the event of damage to the case
- Inherent self-healing property preventing shortcircuiting of the capacitor
- Built-in overload safety device

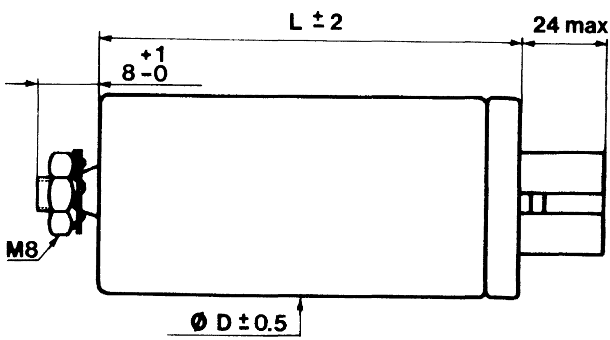
Temperature range —40°C to +85°C

Rated voltage 250 V 50 Hz

Approvals The capacitor meets the CEE specification No. 12, 1954, edition 1968, for fluorescent lighting capacitors and is tested and approved by approval boards in Denmark, Finland, Norway and Sweden, in accordance with SEMKO 21 A-1961.

Application notes See pages 136—137





STANDARD UNITS

Cap. μF ±10%	Rated voltage V 50 Hz	Dimensions in mm D	L	Order Number	Weight g	Quantity/ Package
2	250	30	73	PHN 451MA720	35	110
4		30	73	PHN 451MA740	45	110
4.5		30	73	PHN 451MA745	45	110
5		30	73	PHN 451MA750	50	110
6		35	73	PHN 451MD760	55	80
7		35	73	PHN 451MD770	60	80
8		35	73	PHN 451MD780	65	80
8		30	128	PHN 451MB780	65	40
9		40	73	PHN 451MG790	70	50
10		40	73	PHN 451MG810	70	50
10		30	128	PHN 451MB810	70	40
12		40	73	PHN 451MG812	80	50
12		30	128	PHN 451MB812	80	40
14		35	128	PHN 451ME814	95	50
16		35	128	PHN 451ME816	105	40
18		35	128	PHN 451ME818	115	40
20		40	128	PHN 451MH820	130	25
25		40	128	PHN 451MH825	145	25

SPECIAL TECHNICAL FEATURES

Terminal assembly — The capacitors are fitted with terminal block for snap-in connection of 0.5—1.5 mm^2 solid wire.

Discharge resistor — External discharge resistor is fitted across the terminals in the terminal block.

Safety device — See page 146.

Mounting — See page 146.

Dissipation factor — $\tan\delta \leq 0.1\%$ at 50 Hz, +85°C.

Marking — The capacitor is marked with capacitance, capacitance tolerance, voltage and temperature ratings, code No., manufacturing date, climatic category according to DIN (GPF) approval marks and Rifa symbol.

PMP 508—509

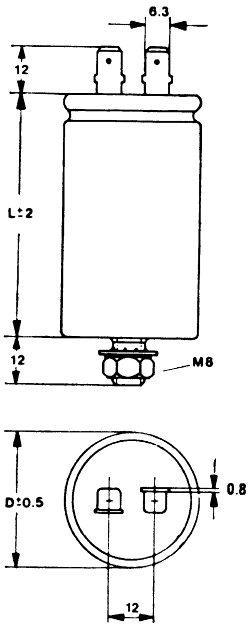
pulse operation capacitors for 600 VAC

RIFA

PMP 508—509T is a range of metallized paper capacitors of the mixed dielectric construction specially made for pulse operation.

Low losses at higher frequencies make the capacitor ideal as a commutator capacitor in many thyristor circuits. For higher current requirements use PMP 518—519. See page 152.

Temperature range	—40°C to +70°C
Rated voltage	600 V 50 Hz up to +70°C
Capacitance tolerance	±10%
General technical information	See pages 128—132.



(M12 for dimension 50×148)

RIFA

PMP 508–509

STANDARD UNITS

Cap. µF	Rated voltage AC RMS 50 Hz	Dimensions in mm D	L*)	Order Number Stud fixing version	Clip fixing version	Weight g
0.5	600	35	40	PMP 509T650	PMP 508T650	55
0.6		35	40	PMP 509T660	PMP 508T660	60
1		35	52	PMP 509T710	PMP 508T710	70
2		35	78	PMP 509T720	PMP 508T720	95
3		40	78	PMP 509T730	PMP 508T730	130
4		45	78	PMP 509T740	PMP 508T740	150
5		50	78	PMP 509T750	PMP 508T750	200
5		45	110	PMP 509TA750	PMP 508TA750	245
6		45	110	PMP 509T760	PMP 508T760	260
8		50	110	PMP 509T780	PMP 508T780	280
10		50	148	PMP 509T810	PMP 508T810	375

*) For clip fixing version reduce L dimension by 2 mm and weight by 3—12 g.

SPECIAL TECHNICAL FEATURES

Rated Voltage — If the capacitor is used in AC power circuits at frequencies higher than 50 Hz a voltage derating is necessary to avoid excess temperature rise.

Terminations — Flat tabs according to DIN 46 247. The tabs are lock riveted to prevent turning.

PMP 518—519

for pulse operation 600 VAC

RIFA

PMP 518—519 is a range of metallized paper capacitors intended for thyristor commutating or as protection capacitors in combination with a resistance in thyristor circuits.

Application class DIN 40040 GSF

Temperature range —40°C to +70°C

Rated voltage 600 V 50 Hz up to +70°C

Capacitance tolerance ±10%

General technical information See pages 128—132.

Dimensions See page 150.

STANDARD UNITS

Cap. µF	Rated voltage AC RMS 50 Hz	Dimensions mm D	L*)	Rifa Code Number Stud fixing version	Clip fixing version	Weight g
0.5		35	40	PMP 519T650	PMP 518T650	55
1		35	50	PMP 519T710	PMP 518T710	70
2		35	76	PMP 519T720	PMP 518T720	95
3		40	76	PMP 519T730	PMP 518T730	130
4	600	45	76	PMP 519T740	PMP 518T740	150
5		50	76	PMP 519T750	PMP 518T750	200
6		45	108	PMP 519T760	PMP 518T760	245
8		50	108	PMP 519T780	PMP 518T780	280
10		50	148	PMP 519T810	PMP 518T810	375

*) Add 2 mm for stud fixing version.

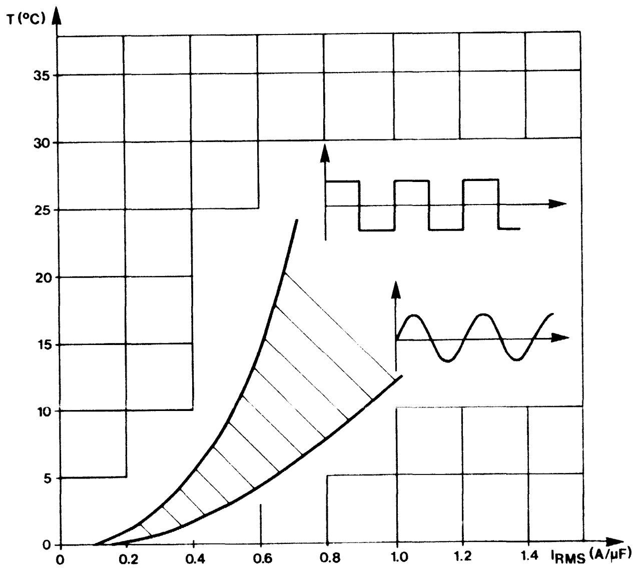
SPECIAL TECHNICAL FEATURES

High frequency applications The PMP 518—519 series has reinforced internal wiring to meet low loss requirements in high frequency applications.

Rated Voltage If the capacitor is used in AC power circuits at frequencies higher than 50 Hz a voltage derating is necessary to avoid excess temperature rise.
See page 128.

Peak voltage	periodic 850 V transient 2300 V
Pulse shape $\left(\frac{du}{dt}\right)$	up to 600 V 70 V/μs

Max surface temperature T of the case at different currents, see figure below.

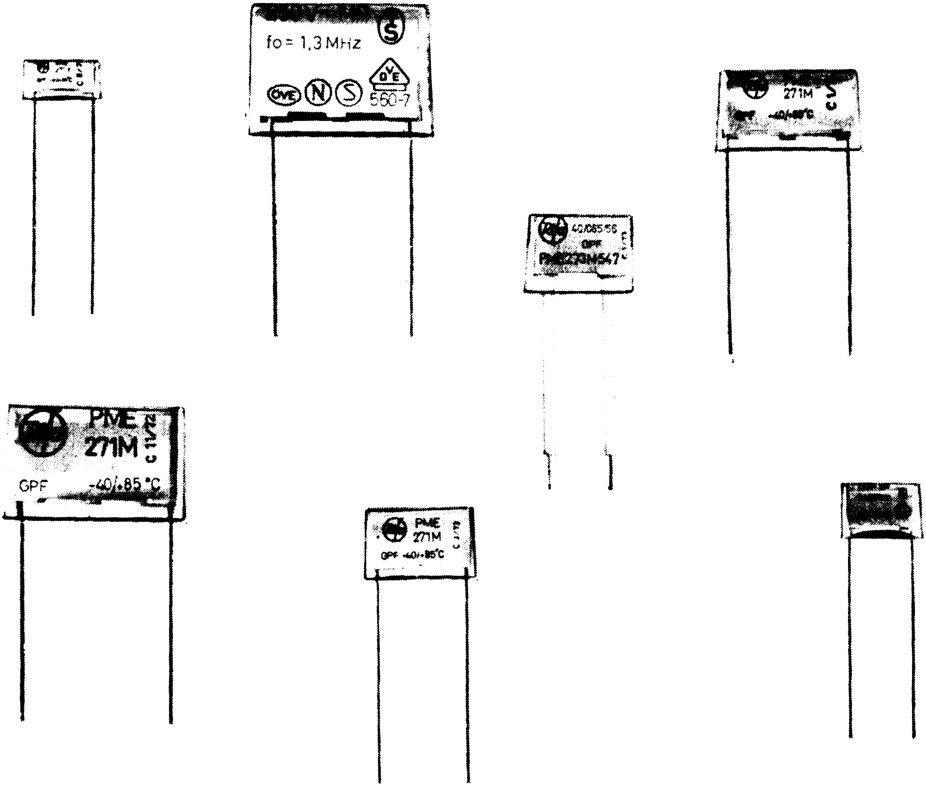


When the ambient temperature exceeds the temperature limit (+70°C) of the case forced cooling must be used.

For operation above recommended data please consult Rifa.

Dissipation factor	tanδ max value 0.2% typical value 0.1%
Terminations	Flat tabs according to DIN 46 247. The tabs are lock riveted to prevent turning.

INTRODUCTION



The Rifa interference suppressors are metallized paper capacitors specially designed for radio interference suppression. The good self-healing properties of the MP capacitor make them outstanding among other types of capacitors as radio interference suppressors on mains voltage. The epoxy impregnation and encapsulation offer excellent electrical robustness, small dimensions and a one-piece solid construction.

GENERATION OF RADIO INTERFERENCE

There are two main sources of radio interference:

- Equipment which because of its construction generates energy of high frequency. High frequency generators for industrial, medical and scientific use, and oscillators in radio and TV sets belong to this type of equipment.

- Equipment in which rapid changes of current give a wide frequency spectrum which causes radio interference. This rapid change may be caused by an electronic device such as a thyristor or a triac, or by an electro-mechanical device such as a switch or a commutator of a motor.

An equipment connected to the mains causes two modes of interference currents to flow in the conductors, see figure 1. One symmetrical current which flows in different directions in the phase and in the neutral conductor. One asymmetrical current which flows in the same direction in the two conductors and back to the equipment via earth. This earth connection may consist of an earth lead or the capacitance between the equipment and its surroundings. The interference on long and medium waves will often increase when a piece of equipment is grounded, because the impedance to the surroundings is short-circuited so that the asymmetrical interference current increases.

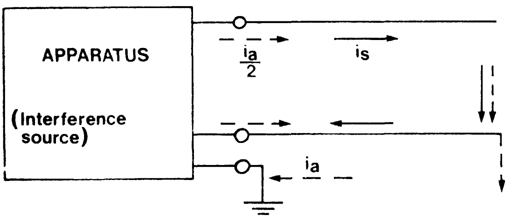


Fig 1. An equipment causes two modes of interference current.

i_a = asymmetrical current
i_s = symmetrical current

The interference frequencies vary depending on the type of equipment as can be seen in figure 2.

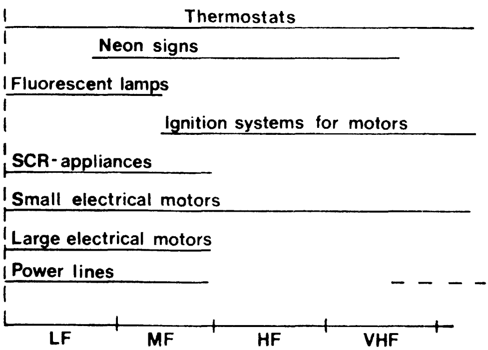


Fig 2. Approximate interference frequencies from different electrical equipment

SUPPRESSION

Interference suppression is carried out in two ways. One way is to decrease the actual generation of interference, the other way is to stop the interference from leaving the appliance. In the latter case suppressors are connected at the mains input of the appliance in such a way as to make either a stop by chokes connected in series with the mains or a short-circuit by capacitors connected between the mains terminals and or between the terminals and the metal body of the appliance. For suppression on long and medium waves capacitors are used in the first place, but if necessary, chokes are added. As a rule both capacitors and chokes are used on VHF. Suppression is also, in some cases, carried out by shielding the appliance.

In appliances which have a switch, a spark suppressor is often connected to the switch in order to decrease the interference generated.

MAXIMUM VALUES OF RADIO INTERFERENCE

In order not to disturb radio reception the outgoing interference from an equipment must be reduced to a tolerable level. Conducted interference is measured on the mains input and radiated interference is measured with a field strength measuring apparatus.

International work on radio interference is carried out by the International Special Committee on Radio Interference, abbreviated CISPR from its French name "Comité International Spécial de Perturbations Radioélectriques".

Limits for radio interference as recommended by the CISPR are:

Frequency range (MHz)	Power (W) ≤ 700	700—1000	1000—2000
0.15—0.5	66 dB	70 dB	76 dB
0.5—5	60 dB	64 dB	70 dB
5—30	66 dB	70 dB	76 dB

Frequency MHz	45	65	90	150	180	220
Limits dB (1 pW) at ≤ 700 W	46	46	47	49	51	52

SAFETY CONSIDERATIONS

The safety problem must be considered. A radio interference capacitor must in many countries be approved by the national safety regulation board either as a radio interference capacitor or as a part of an equipment.

According to IEC the two-terminal suppressor capacitors are subdivided into two groups, X capacitors and Y capacitors (SEV a capacitors and b capacitors). X capacitors are for use only in positions where a failure of the capacitor would not expose anybody to electric shock. Y capacitors are for use in positions where a failure of the capacitor could expose somebody to dangerous electric shock. The two applications are shown in the figure 3.

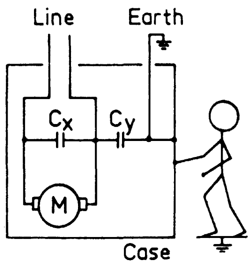


Fig. 3 Positioning of X and Y capacitors

C_x is connected across the supply lines for short-circuiting interference voltages across the line conductors. The capacitor (or failure of it) is not hazardous to a man who touches the case of the motor M and it may therefore be an X capacitor.

C_y is connected from one side of the mains supply to the earth line and to the case for decoupling of asymmetric interference voltages. A breakdown of the capacitor or too high a capacitance is therefore a hazard if the earth line should be open circuit or connected to earth through too high a resistance. The capacitance of Y capacitors must be limited to a certain value depending on the type of equipment in which the capacitor is used (we refer to national Approval Board specifications). The capacitor is dimensioned to minimize the risk of electrical breakdown.

EXAMPLES OF SUPPRESSION

A. Motors

Commutating motors in for example hand tools, sewing machines, vacuum cleaners, mixers etc. generate radio interference from long waves up to VHF. With better commutation less interference is generated. However, it is difficult to achieve good commutation in motors having a variable speed.

In figure 4 different ways of suppressing a motor are shown. It is most important that the suppressing capacitor is placed near the motor so that the terminals of the capacitor can be as short as possible. In most cases it is enough to use capacitors as suppressors but sometimes when a high level of interference is generated at high frequencies, chokes are also needed.

The X capacitor usually has a capacitance of the size 0.1 μF and the Y capacitor a capacitance of the size 2500—5000 pF. The inductance in the high frequency coils is usually 5—10 μH.

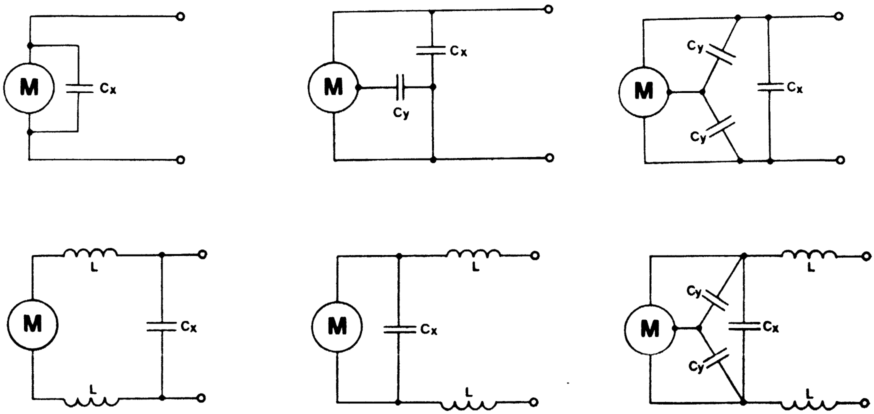


Fig. 4 Different ways of suppressing motors

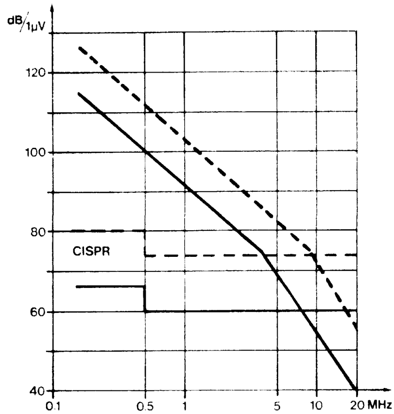
B. Appliances with thyristors and triacs

Thyristors always generate a very high level of interference on long and medium waves. The noise level on long waves can be as high as 1—2 V (the noise from a commutator motor is hardly more than 30 mV).

The thyristor regulator is as a rule a separate unit not built together with the load. The interference will therefore be conducted also along the network to the load. Approx. interference level on both the mains side and the load side of a thyristor regulator with a 100 W resistive load is shown in fig. 5. The limits given by CISPR are also shown.

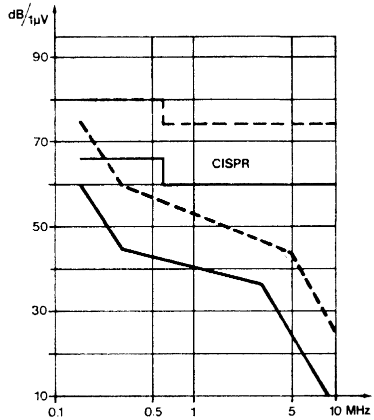
Radio interference suppression of a thyristor regulator is often made with a capacitor and a coil as shown in figure 6 a. The capacitance often is in the order of 0.1 μF and the inductance is of the size 1—4 mH. Approx. interference level from a regulator suppressed with a 0.1 μF capacitor, a 3 mH inducator and with a load of 100 W is shown in figure 6 b. The interference level is below the limits given by CISPR.

The asymmetrical interference depends very much on the mechanical construction of the regulator, for which reason the asymmetrical interference must be taken into consideration when designing the regulator. It is not possible to give any general rules for suppressing the asymmetrical noise, but in general the asymmetrical noise is much lower than the symmetrical and will be suppressed when the symmetrical noise is suppressed.



– – – – – = Load side
———— = Mains side

Fig. 5 Approx. interference levels from thyristor regulator with 100 W resistive load



– – – – – = Load side
———— = Mains side

Fig. 6 b The regulator in fig. 5 suppressed with C = 0.1 μF and L = 3 mH

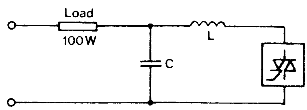


Fig. 6 a Suppression of a thyristor regulator

C. Fluorescent lamps

Fluorescent lamps generate interference on long and medium waves. The interference from many types of lamps is in general not very high. Much more annoying is an additional interference which may suddenly occur, especially when the lamps are growing old. CISPR therefore prescribes a minimum insertion loss in the lamp fitting instead of a maximum allowable interference level.

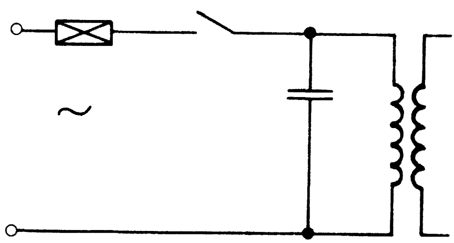
In fluorescent lamps supplied with a phase correcting capacitor, this capacitor serves as a radio interference suppressor. Other fluorescent lamps need a capacitor of 0.05 to 0.1 μF between the branches for interference suppression. High power fluorescent lamps may need capacitors up to 0.5 μF.

D. Mains supply switches

Mains supply switches in consumer electronic equipment such as tape recorders, Hi-Fi amplifiers, and turntables, need capacitive suppression to prevent interference caused by transients at a break and make of the contact fig 7. For such applications the Rifa metallized paper interference suppressor capacitor is the optimal choice. In this catalogue two standard ranges are described. These ranges are tested and approved by several European Approval Boards. (See page 162 and 166.)

For special interference suppression applications with mains supply switches there are special interference capacitor versions available meeting local requirements with regard to voltage ratings and Approval Board specifications. Please consult Rifa.

Fig. 7



PME 271

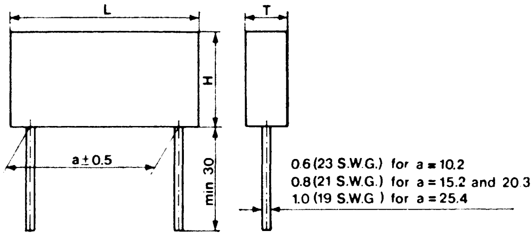
RIFA

PME 271 is a metallized paper capacitor for X and Y applications. Metallized paper is a dielectric superior to metallized synthetic material with regard to pulse operation and self-healing performance. Capacitor element design for low inductance. Impregnated and encapsulated in epoxy resin. Additional humidity protection provided by embedded metal label.

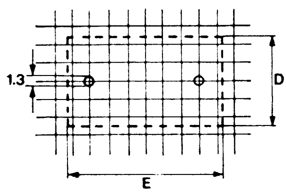
Parallel tinned copper clad steel wires, held to close tolerances on 0.1″ modules. Standard terminal length is minimum 30 mm.

Rated voltage	250 V 50 Hz up to +85°C
IEC category	40/085/56
Temperature range	—40°C to +85°C
Capacitance tolerance	±10% for C > 0.1 μF ±20% for C ≤ 0.1 μF
Approvals	SEMKO, NEMKO, DEMKO, EI, VDE, SEV, ÖVE (see table).

General technical data See page 111.



Space requirements



STANDARD UNITS

Cap.	f_o MHz	Dimensions in mm $L_{max.}$	$T_{max.}$	$H_{max.}$	a	Order Number	Approvals*)
X-CAPACITORS							
1000 pF	41	13.5	3.9	7.5	10.2	PME 271M410	S N D EI VDE SEV ÖVE
1500	35	13.5	3.9	7.5	10.2	PME 271M415	S N D EI VDE SEV ÖVE
2200	29	13.5	3.9	7.5	10.2	PME 271M422	S N D EI VDE SEV ÖVE
3300	24	13.5	3.9	7.5	10.2	PME 271M433	S N D EI VDE SEV ÖVE
4700	20	13.5	5.1	10.5	10.2	PME 271M447	S N D EI VDE SEV ÖVE
6800	17	18.5	5.2	10.5	15.2	PME 271M468	S N D EI VDE SEV ÖVE
0.01 μF	14	18.5	5.2	10.5	15.2	PME 271M510	S N D EI VDE SEV ÖVE
0.015	10	18.5	5.2	10.5	15.2	PME 271M515	S N D EI VDE SEV ÖVE
0.022	8.5	19.0	7.3	13.0	15.2	PME 271M522	S N D EI VDE SEV ÖVE
0.033	6.9	19.0	7.3	13.0	15.2	PME 271M533	S N D EI VDE SEV ÖVE
0.047	5.8	19.0	7.3	13.0	15.2	PME 271M547	S N D EI VDE SEV ÖVE
0.068	4.8	18.5	7.8	13.5	15.2	PME 271M568	S N D EI VDE SEV ÖVE
0.1	3.6	24.0	7.6	14.0	20.3	PME 271M610	S N D EI VDE SEV ÖVE
0.15	3	24.0	9.0	15.5	20.3	PME 271M615	S N D EI VDE SEV ÖVE
0.22	2.5	24.0	11.3	16.5	20.3	PME 271M622	S N D EI VDE SEV ÖVE
0.33	1.8	29.5	12.1	19.5	25.4	PME 271M633	S N D VDE SEV ÖVE
0.47	1.5	30.5	15.3	22.0	25.4	PME 271M647	S N D VDE SEV ÖVE
0.6	1.3	30.5	15.3	22.0	25.4	PME 271M660	S N D VDE SEV ÖVE
Y-CAPACITORS							
1000 pF	41	13.5	3.9	7.5	10.2	PME 271Y410	S N D EI VDE SEV ÖVE
1500	35	13.5	3.9	7.5	10.2	PME 271Y415	S N D EI VDE SEV ÖVE
2200	29	13.5	3.9	7.5	10.2	PME 271Y422	S N D EI VDE SEV ÖVE
3300	24	13.5	3.9	7.5	10.2	PME 271Y433	S N D EI VDE SEV ÖVE
4700**)	20	13.5	5.1	10.3	10.2	PME 271Y447	S N D EI VDE SEV ÖVE
6800	17	18.5	5.2	10.5	15.2	PME 271Y468	S N D EI VDE SEV ÖVE
0.01 μF	14	18.5	5.2	10.5	15.2	PME 271Y510	S N D EI VDE SEV ÖVE
0.015	10	18.5	5.2	10.5	15.2	PME 271Y515	S N D EI VDE SEV ÖVE
0.022	8.5	19.0	7.3	13.0	15.2	PME 271Y522	S N D EI VDE SEV ÖVE

*) S =Sweden (SEN 43 29 01)
N =Norway (NEMKO 132/56)
D =Denmark (DEMKO)
EI =Finland (EI E20-71)
VDE =Germany (VDE 0560/7)
SEV =Switzerland (SEV 1017/1959)
ÖVE =Austria (ÖVE E 2/1962)

**) PME 271Y447 is also approved by SEMKO to SEMKO 101 (IEC 65-1965) as a safety capacitor.

SPECIAL TECHNICAL FEATURES

Resonance frequency
Tabulated self-resonant frequencies f_o refer to 5 mm length of leads.

Suppression

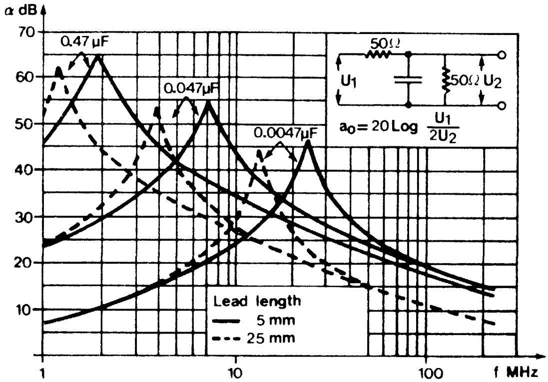


Fig 8. Suppression a_o versus frequency.

The self-inductance of the capacitors is mainly dependent on lead length. For best suppression at high frequencies the length of the leads should therefore be held to a minimum.

Humidity resistance
After a damp heat test to IEC No. 62-2-3, test Ca, severity 56 (56 days at +40°C and 90% to 95% R.H.) the insulation resistance is still above specified limits.

Bump test
IEC 68-2-29, test Eb. The capacitors, properly fixed, will withstand at least 4000 bumps with 390 m/s² retardation.

Vibration test
IEC 68-2-6, test Fc. The capacitors, properly fixed, frequency range 10—500 Hz, amplitude 0.75 mm or 10 g for 6 h.

Marking
Capacitors are marked with type identification, capacitance, rated voltage, temperature range, resonance frequency (fo), approvals, name of manufacturer and date of manufacture.

Mounting
Any normal method of soldering may be employed without the need for a heat sink.
In self-supporting assembly, bending of the terminals does not damage the capacitor.

Notes

PME 273

RIFA

PME 273 is a metallized paper capacitor for X applications. Metallized paper is a dielectric superior to metallized synthetic material with regard to pulse operation and self-healing performance. Capacitor element design for low inductance. Impregnated and encapsulated in non-inflammable epoxy resin. Additional humidity protection provided by embedded metal label. The capacitor will withstand the flame test prescribed by UL (Underwriters Laboratories Inc., USA) for across-the-linecapacitors. (UL 1414 paragraph 4.)

Parallel tinned copper PVC-insulated wires.

Rated voltage 250 V 50 Hz up to +85°C

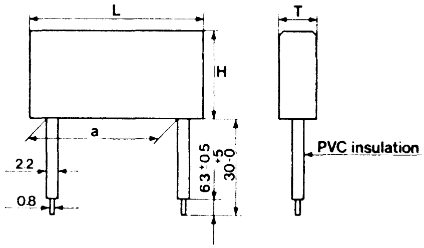
IEC category 40/085/56

Temperature range —40 to +85°C

Capacitance tolerance ± 20%

Approvals SEMKO, NEMKO, DEMKO, Finland, VDE, SEV, ÖVE (see table).

General technical data
See page 111.



Lead length up to 70 mm can be offered on request.

STANDARD UNITS

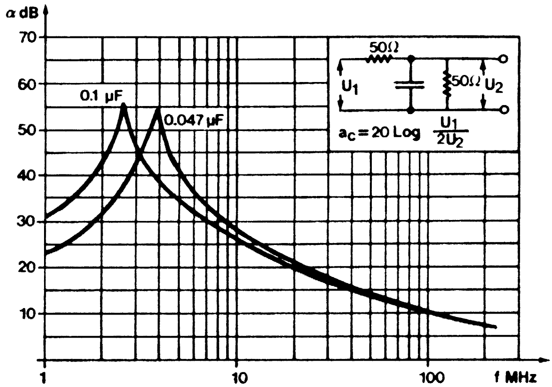
Cap. μF	f_o MHz	Dimensions in mm $L_{max.}$	$T_{max.}$	$H_{max.}$	a	Order Number	Approvals*)
0.01	7.5	19.0	7.3	13.5	10.5	PME 273M510	S N D EI VDE SEV ÖVE
0.015	6.3	19.0	7.3	13.5	10.5	PME 273M515	S N D EI VDE SEV ÖVE
0.022	5.3	18.5	7.8	14.0	10.5	PME 273M522	S N D EI VDE SEV ÖVE
0.033	4.1	18.5	7.8	14.0	10.5	PME 273M533	S N D EI VDE SEV ÖVE
0.047	3.5	18.5	7.8	14.0	10.5	PME 273M547	S N D EI VDE SEV ÖVE
0.068	2.8	24.0	7.6	14.5	16.0	PME 273M568	S N D EI VDE SEV ÖVE
0.1	2.3	24.0	9.0	16.0	16.0	PME 273M610	S N D EI VDE SEV ÖVE
0.1	2.3	24.0	7.6	14.5	16.0	PME 273MB610	S VDE SEV

*) S	=Sweden	(SEN 43 29 01)	VDE	=Germany	(VDE 0560/7)
N	=Norway	(NEMKO 132/56)	SEV	=Switzerland	(SEV 1017/1959)
D	=Denmark	(DEMKO)	ÖVE	=Austria	(ÖVE E 1/1962)
EI	=Finland	(EI E20-71)			

SPECIAL TECHNICAL FEATURES

Resonance frequency — Tabulated self-resonant frequency f_0 refers to 25 mm length of leads.

Suppression



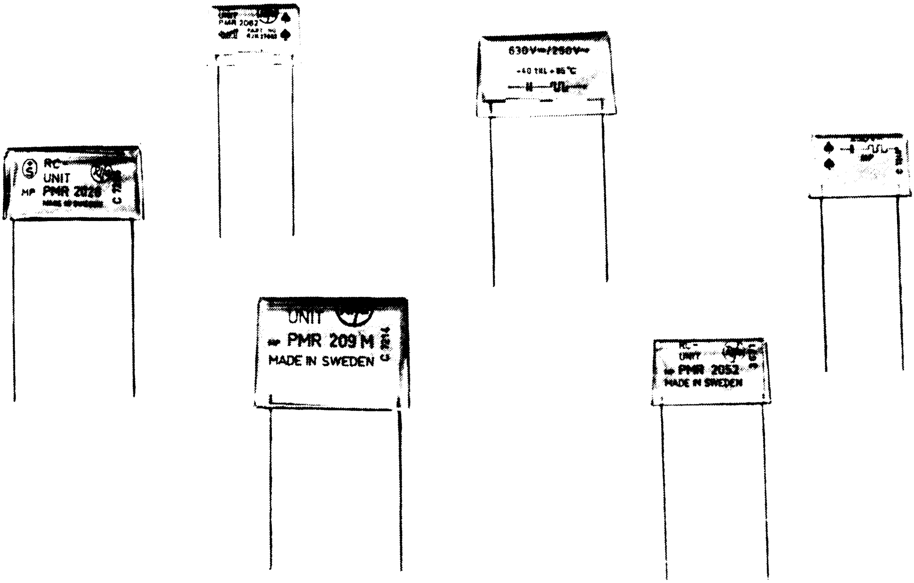
Suppression a_0 versus frequency.

Humidity resistance — After a damp heat test to IEC No. 62-2-3, test Ca, severity 56 (56 days at +40°C and 90% to 95% R.H.) the insulation resistance is still above specified limits.

Marking — Capacitors are marked with type identification, capacitance, rated voltage, temperature range, resonance frequency (fo), approvals, name of manufacturer and date of manufacture.

Mounting — See PME 271 page 164.

INTRODUCTION



The Rifa RC networks are designed for use in DC and AC applications for

- Contact protection
- Interference suppression of contacts
- Transient suppression for protection of low-power thyristors and triacs
- du/dt suppression in thyristor and triac low-power circuits

CONSTRUCTION

Rifa manufactures two types of RC units. One type consists of a metallized paper capacitor element in series with a carbon resistor (PMR 202). The other type consists of a metallized paper capacitor with the resistance in the metal layer utilized as the series resistance to the capacitor (PMR 205—209).

The RC units are encapsulated in epoxy resin with radial leads. The single moulded package makes a neat installation with only two solder joints. The form of the PMR RC unit makes it very suitable for insertion into printed circuit boards. Alternatively the unit may be mounted self-supporting.

SELF-HEALING

If a voltage surge punctures the dielectric, an arc occurs at the point of failure which melts the surrounding metal and insulates the area of the breakdown. Such breakdowns may occur thousands of times without appreciably effecting life or other properties of the RC networks. This self-healing property makes the RC network very resistant to high transient voltages.

WORKING VOLTAGE

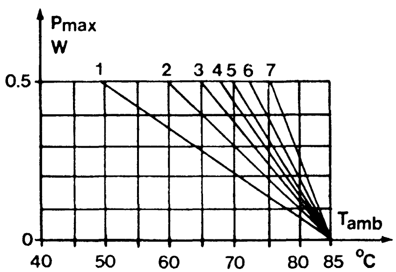
The columns RATED VOLTAGE given in the type specifications indicate the maximum permissible DC and AC voltages for continuous operation within the category temperature range. The columns PEAK PULSE VOLTAGE indicate the maximum permissible pulse voltage.

CATEGORY TEMPERATURE RANGE

—40°C to +85°C.

POWER RATINGS

The average losses may reach 0.5 W provided that a surface temperature of +85°C is not exceeded. The maximum allowable losses v ambient temperature are shown in figure below.



Dimensions (mm) L	T	H	Curve
18.5	5.2	10.5	1
19.0	7.3	13.0	2
18.5	7.8	13.5	2
20.0	8.3	15.0	3
23.5	7.6	13.5	3
24.0	7.6	14.0	3
24.0	9.0	15.5	4
27.5	8.5	15.0	4
23.5	11.3	16.5	5
24.0	11.3	16.5	5
27.5	11.5	16.5	6
27.5	15.5	21.5	7

Figure 1.
Maximum allowable power dissipation v ambient temperature and case size.

MARKING

Units are marked with type identification, capacitance, resistance, rated voltage, temperature range, manufacturer's name, date of manufacture and approvals.

MOUNTING

Any normal method of soldering may be employed without the need for a heat sink. For self-supporting assembly, bending of the terminals does not damage the capacitor.

HUMIDITY RESISTANCE

After a damp heat test according to IEC Publ. 68-2-3, test Ca, severity 56, the insulation resistance is still above specified limits.

SOLDERABILITY

Wetting time $\leq$ 1 s when tested according to IEC 68-2-20, test T, solder globule method.

BUMP TEST

IEC 68-2-29, test Eb. The capacitors, properly fixed, will withstand at least 4000 bumps with 390 m/s^2 retardation.

MINIMUM LIFE EXPECTANCY

Under the worst conditions permissible, the minimum life expectancy is 200 000 000 relay operations.

APPLICATION OF RC UNITS

The use of a capacitor and resistor in series has long been known as a most effective means of increasing the life of contacts. At the same time radio interference suppression is achieved.

RC units are also very suitable as du/dt and transient suppressors on thyristors and triacs in low power applications, for example in dimmers and speed regulators.

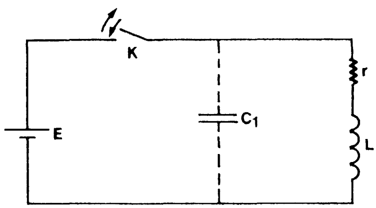
RC UNITS FOR CONTACT PROTECTION AND INTERFERENCE SUPPRESSION

Relay contacts that break and make a current circuit are subjected to electrical erosion resulting from sparking and arcing.

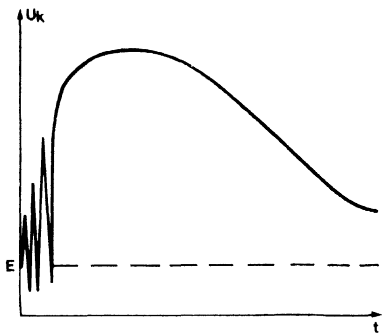
Spark suppressors used are RC units, non-linear resistors, shunt resistors, diodes and gas discharge valves. Amongst these devices the RC network is in most cases the best spark suppressor for the reduction of contact erosion. The advantages are:

- RC networks are non-polar and therefore suitable for AC applications.
- The relay operating time will not be very much affected.
- No current consumption.
- Radio interference suppression is achieved.

When the contact K (see figure 2 a) breaks, the voltage across the contact rapidly grows with the rate of I/C_1(C_1 is the small capacitance of the wiring) resulting in a breakdown of K and a spark discharge of C_1. The discharge stops when the voltage across K has



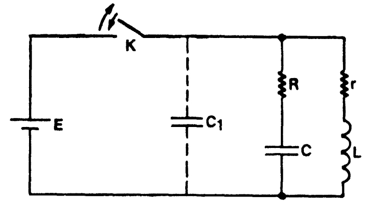
2 a



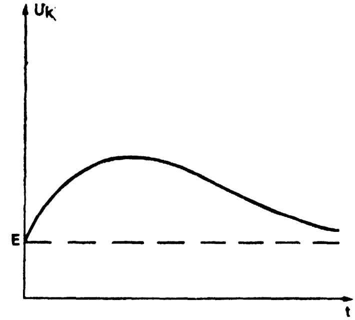
2 b

decreased to about 15 V. C_1 recharges and another breakdown occurs. This series of sparks stops when the contact clearance is long enough to endure the voltage without breakdowns (see figure 2 b).

By coupling a capacitor C over the contact (see figure 3 a) the voltage across the contact will be reduced and the voltage increase du/dt will be limited to I/C instead of I/C_1. As I/C is much less than I/C_1 the voltage increase over the contact will now be low enough to prevent breakdowns (see figure 3 b).



3 a



3 b

In order to limit the current through the contact when it makes the resistor R must be coupled in series with the capacitor.

The values of the capacitor and the resistor depend on the inductance and resistance in the load, the applied voltage and type of contact (i.e. how exactly the contact breaks and makes and its current rating). The protective capacitance must be large enough to prevent the contact voltage from rising to a value greater than the air breakdown value at any instant. This value depends on the contact separation but is never less than 300 volts. With few exceptions, a 0.1 μF capacitor will be large enough to hold the peak voltage to less than 300 volts.

Limiting the voltage rise across the contacts to less than 300 volts peak will not necessarily prevent all breakdowns of the gap. At the very first instant of contact breaking the contact separation is so minute that low-voltage breakdowns of the gap may occur. To minimize this possibility it is the practice to impose the additional requirement that the contact protection capacitor shall limit the rate of voltage rise immediately after the contact breaks to 1 volt per microsecond. This requirement will be met if the ratio I/C is less than unity where I is given in amperes and C is in microfarads. For slow moving contacts even larger capacitors are used.

With sufficient capacitance in the circuit for protection when the contact breaks, a resistor is needed for protection when the contact makes. The network capacitor is charged to the full voltage when the circuit is open. Closing the contacts effectively short-circuits this voltage, so a resistance is connected in series with the network capacitor to limit the current through the contact. The resistor thus reduces erosion as the contact makes, but also tends to increase it as the contact breaks. The sudden diversion of the steady-state current into the protection network on contact breaking immediately produces a voltage across the contacts due to the current flowing through the protection resistance. A compromise value is therefore necessary, and it is general practice to have a resistance that gives the same current through the contact on closure as the steady-state current.

The RC network can be connected across the contact or across the load. If there is a long wiring between the contact and the load, connecting the RC network across the contact is to be preferred.

At the same time as the contact is protected by the RC network, radio interference suppression is achieved as the sparks (which contain a high frequency spectrum) are avoided.

RC UNITS AS DU/DT SUPPRESSORS ON THYRISTORS AND TRIACS

The junctions of any semiconductor exhibit some unavoidable capacitance. A changing voltage impressed on this junction capacitance results in a current, $i = C\ du/dt$. If this current is sufficiently large a regenerative action may occur causing the SCR to switch to the on-state. This regenerative action is similar to that which occurs when a gate current is injected.

High du/dt may occur from other thyristors switching-on or off or be due to reapplied du/dt. Consider the full-wave phase control circuit in figure 4, with an inductive load. When the current reaches zero (the triac commutates), (point A), the supply voltage (which is not zero) must then appear as a forward bias across the triac. The rate-of-change of this voltage is dependent on inductance and capacitance in the load circuit,

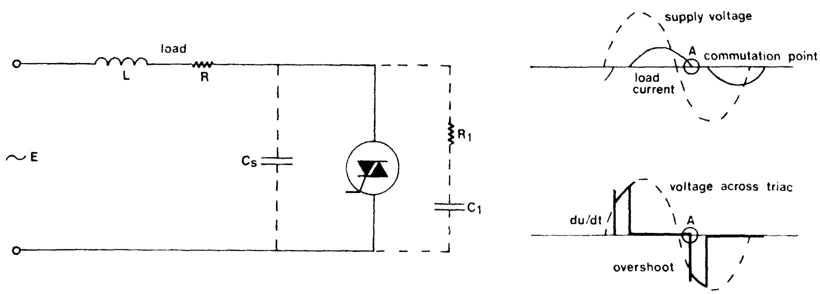


Figure 4

as well as on reverse recovery characteristics of the triac. The application of a series RC circuit in parallel with the triac or with the load, can reduce the du/dt to acceptable limits. The values of R and C are functions of the load, line voltage and triac used. Since circuit impedances for a particular application are not usually well known the values of C and R are often determined by experimental optimisation. For triacs 0.1 μF+100 ohms are often used.

Rifa's RC units PMR 2026 and PMR 209 are well suited as du/dt protectors in low power circuits. As the tolerance of capacitance and resistance is not critical PMR 209 will offer satisfactory operation.

The maximum allowable power dissipation in the RC units is limited to 0.5 W. The calculation of the power dissipated in the RC-units when used as du/dt suppressors can be made as follows:

The energy in the capacitor is

$$E = \frac{1}{2} CU^2$$

where U is the voltage and C the capacitance.

Each time the thyristor goes from off-state to on-state this energy will be dissipated in the resistor. If the thyristor goes to on-state N times per second, the power dissipated in the resistor will be

$$P = \frac{1}{2} CU^2 \times N$$

A triac will be conducting each half-period when using a sinusoidal voltage. If the triac starts to conduct on the top of each half-period of 220 V 50 Hz voltage the power dissipated is

$$P = \frac{1}{2} \times C \times (220 \times V2)^2 \times 2 \times 50 = 5 \times 10^6 \times C$$

This power must not be more than 0.5 W.

$$0.5\ W \geq 5 \times 10^6 \times C$$
$$C \leq 0.1 \times 10^{-6} = 0.1\ \mu F$$

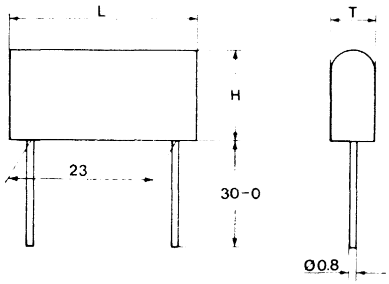
Furthermore, the case temperature must be limited to 85°C. Therefore, the maximum allowable power dissipation must be derated at higher temperatures. For maximum allowable power dissipation versus ambient temperature and case size see POWER RATINGS in the type specification.

PMR 202

RIFA

PMR 202 is a metallized paper capacitor in series with a carbon resistor. The unit is encapsulated in epoxy resin and has tinned copper wire leads.

Temperature range	—40°C to +85°C
IEC category	40/085/56
Approvals	PMR 2026 is approved as radio interference suppressors class a (X) by SEV (SEV 1017/1959, Switzerland) for 630 VDC and 250 VAC.
Capacitance tolerance	±10% for C $\geq$ 0.5 μF ±20% for C $<$ 0.5 μF
Resistance tolerance	±10%



Printed circuit version.
Add A to code number.
Example: PMR 2026A 0.5+22
Lead spacing 22.9±0.5 mm

SPECIAL TECHNICAL FEATURES

Series resistance	The series resistance is defined as $R = \frac{\tan\delta}{\omega C}$ at 100 kHz. The resistance value so defined is very close to the value of the carbon resistor used and for all practical purposes constant up to 1 MHz.
Capacitance	The capacitance is measured at 1 kHz.
Current ratings	The maximum current allowable is limited only by the rated peak pulse voltage and the resistance value.
Power ratings	The average losses may reach 0.5 W provided the surface temperature does not exceed +85°C. For maximum allowable power dissipation v temperature see "Introduction" RC NETWORKS.
Insulation resistance	PMR 2022: $\geq$ 500 ΩF PMR 2026: $\geq$ 12 000 MΩ for C $\leq$ 0.33 μF $\geq$ 4 000 ΩF for C $>$ 0.33 μF Measured with 100 volts DC (500 VDC for PMR 2026) at +20°C after one minute of electrification.

STANDARD UNITS

Cap. µF	Series Resistance Ohms	Rated Voltage (AC for 40-60 Hz)	Peak Pulse Voltage	Max. dimensions mm L	T	H	Weight g	Order Number[2])
0.5	22	200 VDC 125 VAC	300 V	27.5	8.5	15	5	PMR 2022/0.5+22
0.5	33							PMR 2022/0.5+33
0.5	47							PMR 2022/0.5+47
0.5	68							PMR 2022/0.5+68
0.5	82							PMR 2022/0.5+82
0.5	100							PMR 2022/0.5+100
0.5	150							PMR 2022/0.5+150
0.5	220							PMR 2022/0.5+220
0.5	330							PMR 2022/0.5+330
0.5	470							PMR 2022/0.5+470
0.5	680							PMR 2022/0.5+680
1.0	22			27.5	11.5	16.5	7	PMR 2022/1.0+22
1.0	33							PMR 2022/1.0+33
1.0	47							PMR 2022/1.0+47
1.0	68							PMR 2022/1.0+68
1.0	100							PMR 2022/1.0+100
1.0	150							PMR 2022/1.0+150
1.0	220							PMR 2022/1.0+220
0.1	22	630 VDC 250 VAC	900 V	27.5	8.5	15	5	PMR 2026/0.1+22 1)
0.1	33							PMR 2026/0.1+33 1)
0.1	47							PMR 2026/0.1+47 1)
0.1	68							PMR 2026/0.1+68 1)
0.1	100							PMR 2026/0.1+100 1)
0.1	150							PMR 2026/0.1+150 1)
0.1	220							PMR 2026/0.1+220 1)
0.1	330							PMR 2026/0.1+330 1)
0.1	470							PMR 2026/0.1+470 1)
0.25	22			27.5	11.5	16.5	7	PMR 2026/0.25+22 1)
0.25	33							PMR 2026/0.25+33 1)
0.25	47							PMR 2026/0.25+47 1)
0.25	68							PMR 2026/0.25+68 1)
0.25	100							PMR 2026/0.25+100 1)
0.25	150							PMR 2026/0.25+150 1)
0.25	220							PMR 2026/0.25+220 1)
0.25	330							PMR 2026/0.25+330 1)
0.25	470							PMR 2026/0.25+470 1)
0.5	22			27.5	15.5	21.5	14	PMR 2026/0.5+22 1)
0.5	33							PMR 2026/0.5+33 1)
0.5	47							PMR 2026/0.5+47 1)
0.5	68							PMR 2026/0.5+68 1)
0.5	100							PMR 2026/0.5+100 1)
0.5	150							PMR 2026/0.5+150 1)
0.5	220							PMR 2026/0.5+220 1)

[1]) Approved by SEV (SEV 1017/1959) for 630 VDC, 250 VAC.

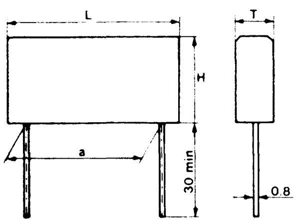
[2]) For printed circuit version add A to code number. Example: PMR 2026A 0.5+33.

PMR 205, PMR 207

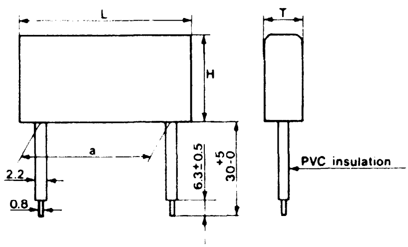
PMR 205 and PMR 207 are epoxy impregnated metallized paper capacitors with the resistance in the metal layer utilized as series resistance to the capacitance.
PMR 205 is encapsulated in an epoxy resin. Tinned copper clad steel leads.
PMR 207 is encapsulated in a self-extinguishing epoxy resin. PVC insulated tinned copper leads.

Temperature range	—40°C to +85°C
IEC category	40/085/56
Capacitance tolerance	±20%
Resistance tolerance	±30%

PMR 205



PMR 207



SPECIAL TECHNICAL FEATURES

Series resistance	The series resistance is defined as $R = \frac{\tan\delta}{\omega C}$ at 1 kHz for RC $\geq$ 50 μs and at 100 kHz for RC $<$ 50 μs.
Capacitance	The capacitance is measured at 1 kHz.
Current ratings	The maximum current allowable is limited only by the rated peak pulse voltage and the resistance value.
Power ratings	The average losses may reach 0.5 W provided the surface temperature does not exceed +85°C. For maximum allowable power dissipation v temperature see "Introduction" RC NETWORKS.
Insulation resistance	$\geq$ 3000 MΩ for C $\leq$ 0.33 μF $\geq$ 1000 ΩF for C $>$ 0.33 μF Measured with 100 VDC and at +20°C after one minute of electrification.

STANDARD UNITS

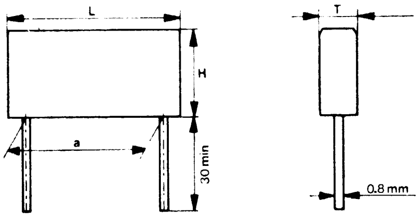
Cap. µF	Series Resistance Ohms	Rated Voltage (AC for 40-60 Hz)	Peak Pulse Voltage	Dimensions mm L Max	T Max	H Max	a ±0.5	Weight g	Order Number
PMR 205									
0.1	33								PMR 2052/0.1+33
0.1	47								PMR 2052/0.1+47
0.1	100			18.5	5.2	10.5	15.2	1.6	PMR 2052/0.1+100
0.1	220								PMR 2052/0.1+220
0.1	330			19.0	7.3	13.0	15.2	2.8	PMR 3052/0.1+330
0.1	470			19.0	7.3	13.0	15.2	2.8	PMR 2052/0.1+470
0.15	68								PMR 2052/0.15+68
0.15	100								PMR 2052/0.15+100
0.22	47								PMR 2052/0.22+47
0.22	100								PMR 2052/0.22+100
0.22	220								PMR 2052/0.22+220
0.22	330								PMR 2052/0.22+330
0.22	470			19.0	7.3	13.0	15.2	2.8	PMR 2052/0.22+470
0.25	200	**250 VDC**	**375 V**						PMR 2052/0.25+200
0.25	350	**125 VAC**							PMR 2052/0.25+350
0.25	600								PMR 2052/0.25+600
0.33	47			18.5	7.8	13.5	15.2	3	PMR 2052/0.33+47
0.47	33								PMR 2052/0.47+33
0.47	47								PMR 2052/0.47+47
0.47	100			24.0	7.6	14.0	20.3	4	PMR 2052/0.47+100
0.47	220								PMR 2052/0.47+220
0.47	270								PMR 2052/0.47+270
0.47	330								PMR 2052/0.47+330
0.47	470			24.0	9.0	14.0	20.3	5	PMR 2052/0.47+470
1.0	47								PMR 2052/1.0+47
1.0	68								PMR 2052/1.0+68
1.0	100			24.0	11.3	16.5	20.3	6	PMR 2052/1.0+100
1.0	220								PMR 2052/1.0+220
1.0	470								PMR 2052/1.0+470
PMR 207									
0.25	200	**250 VDC**							PMR 207HA625+200
0.25	350	**125 VAC**	**375 V**	18.5	7.8	14.0	10	2.9	PMR 207HA625+350
0.25	600								PMR 207HA625+600

PMR 209

PMR 209 is an epoxy impregnated metallized paper capacitor with the resistance in the metal layer utilized as series resistance to the capacitance. The unit is encapsulated in epoxy resin and has tinned copper clad steel leads.

Rated voltage

Continuous	630 VDC 250 VAC 40-60 Hz
Transient peak	Max 1000 V
Temperature range	—40°C to +85°C
IEC category	40/085/56
Approvals	VDE, SEV, NEMKO (see STANDARD UNITS)
Capacitance tolerance	±20%
Resistance tolerance	±30%



SPECIAL TECHNICAL FEATURES

Series resistance	The series resistance is defined as $R = \frac{\tan\delta}{\omega C}$ at 100 kHz.
Capacitance	The capacitance is measured at 1 kHz.
Current ratings	Max. 12 A repetitive. Max. 20 A for occasional transients.
Power ratings	The average losses may reach 0.5 W provided the surface temperature does not exceed +85°C. For maximum allowable power dissipation v temperature see "INTRODUCTION" RC NETWORKS.
Insulation resistance	$\geq$ 3000 MΩ for C $\leq$ 0.33 μF $\geq$ 1000 ΩF for C $>$ 0.33 μF Measured with 500 volts DC and at +20°C after one minute of electrification.

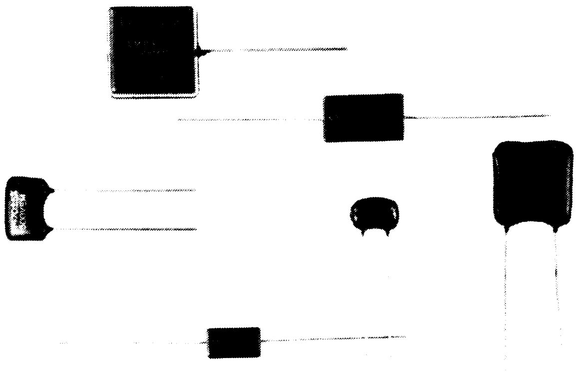
RIFA

STANDARD UNITS

Cap. µF	Series Resistance Ohms	Dimensions in mm L_{max}	T_{max}	H_{max}	a ±0.5	Weight g	Order number	Approvals*) as interference suppressors
0.047	47	19.0	7.3	13.0	15.2	2.7	PMR 209M547+47	SEV
0.047	100	19.0	7.3	13.0	15.2	2.7	PMR 209M547+100	SEV
0.1	47	24.0	7.6	14.0	20.3	3.6	PMR 209M610+47	SEV, VDE
0.1	100	24.0	7.6	14.0	20.3	3.6	PMR 209M610+100	SEV, VDE, N
0.22	47	24.0	11.3	16.5	20.3	6.1	PMR 209M622+47	SEV
0.22	100	24.0	11.3	16.5	20.3	6.1	PMR 209M622+100	SEV
0.47	47	30.5	15.3	22.0	25.4	14.5	PMR 209M647+47	SEV
0.47	100	30.5	15.3	22.0	25.4	14.5	PMR 209M647+100	SEV

*) SEV = Switzerland (SEV 1017.1959) 250 V~/630 V=
VDE = Germany (VDE 0560-7) 250 V~
N = Norway (NEMKO 132/56) 250 V~/630 V=

INTRODUCTION



The Electro Motive Manufacturing Co, who has been a pioneer in developing and manufacturing high quality mica dielectric capacitors "El-menco", is one of the biggest manufacturers of mica capacitors.

Dielectric

Mica is a natural inorganic material being mechanically extremely robust. Electric properties for El-Menco mica capacitors are high insulation resistance and very low dissipation factor even at very high temperatures, good dielectric constant, a low temperature coefficient T.C. and high long term capacitance stability. Normal values for T.C. is 0 to 70 ppm and cap.drift ± (0.05%+0.1 pF).

Electrodes

Silver is applied to the mica sheets with a printing process and then all is heated in an oxidizing atmosphere to obtain a permanent bond.

Section

A number of mica films are stacked together. Contact with the silver electrodes is made either by tin-lead or silver foil strips. This section is then compressed and clinched tightly in the hot tinned lead and clamp assembly to assure positive contact.

Coating

Dipped type. The section is encased with a number of coats of a mineral filled phenolic compound which is then vacuum impregnated with an epoxy resin (W-process).

Molding

Molded type. For protection, the capacitor insert is molded in a mineral filled epoxy compound. The result is a rugged coating which protects the capacitor against shock and vibration and has an outstanding resistance to humidity.

Ordering data

DM15	E	D	101	K	O	4CR
CM15	E	D	101	K	O	—
Style	Charac.	Volt.	Cap.	Tol.	Temp. range	Coating

Style

Two letters and two numbers, where the letters indicate the type, dipped or molded, and the numbers indicate the shape and dimensions.

DM (earlier WDM) = dipped mica
CM = MM = molded mica

"CM" is the military type designation and MM is the normal El-menco commercial type designation.

For molded types Rifa have chosen the CM-designation as standard in stock instead of MM-designation.

Characteristics

Four levels are specified

Letter Designation	Temperature Coefficient	Capacitance Drift
C	±200P/10⁶/°C	±(0.5%+0.1pF)
D	±100P/10⁶/°C	±(0.3%+0.1pF)
E	—20 to +100P/10⁶/°C	±(0.1%+0.1pF)
F	0 to +70P/10⁶/°C	±(0.05%+0.1pF)

In stock Rifa always keep the best available level.

Voltage

Y=50 VDC, A=100 VDC, C=3000 VDC, D=500 VDC

500 V or nearest below is chosen as standard in stock.

Capacitance

The nominal capacitance value is marked on the capacitor. For ordering purposes only a three-digit number is used where the first two digits represent significant figures and the last digit specifies the number of zeros to follow.
Chose European stock values on page 186.

Tolerance

Letter Designation	Capacitance Tolerance*)	Letter Designation	Capacitance Tolerance*)
A	±1pF	H	±3%
D	±0.5pF	J	±5%
E	±1/2%	K	±10%
F	±1%	M	±20%
G	±2%		

*) For capacitance values of 100 pF or less, the minimum standard available tolerance is ±0.5pF.

Temperature range

The temperature letter designates the guaranteed temperature range over which the dipped mica capacitor may be successfully operated.

Letter Designation	Temperature Range
O	—55 to +125°C
P	—55 to +150°C

"O"-range is always standard.

Dipped coating

The dip-type can be coated in several different ways as 1CE, 1CRT, 1CHR, 4CR or 5CR.

The standard dip-type is **4CR,** four coats of phenolic resin and after that vacuum impregnation with epoxy resin. If nothing else is specified the capacitors will be delivered with 4CR.

Marking

All El-Menco capacitors are normally marked with capacitance value, capacitance tolerance in letters or percent numbers and the El-Menco identification.

For more detailed information we refer to pages 188—193 and the El-Menco Capacitors Condensed Catalogue.

Summary of advantages for El-Menco mica capacitors

- Mechanically robust capacitors
- Extremely high stability in temperature cycling and long term operation
- Favourable T.C. and capacitance drift characteristics
- Wide voltage range
- Wide temperature range
- Good availability from **European stock**

STANDARD UNITS

Any capacitance value within the values specified on pages 189 and 193 can be ordered.

A wide selection of standard units has been established as "**European stock types**" as follows.

Style	**Dipped** DM 10, 15, 19 and 30 **Molded** CM 15, 20, 35	
T.C. characteristic	Always the best possible (see page 189 and 193).	
Voltage	500 V (or nearest below)	
Capacitance value	DM10 and 15 $<$ 10 pF : E 12 series DM10, 15 and 19 $>$ 10 pF : E 24 series DM30 $\geq$ 2200 pF, $\leq$ 10 000 pF : E 12 series CM15 and 20 $>$ 10 pF : E 24 series CM35 $\geq$ 3900 pF $\leq$ 10 000 pF : E 12 series	
Tolerance	Dipped (DM) 1% (0.5 pF) and 5% Molded (CM) 2% and 5%	
Temperature range	"0"=—55 to +125°C	
Coating	Dipped (DM) — 4 CR	

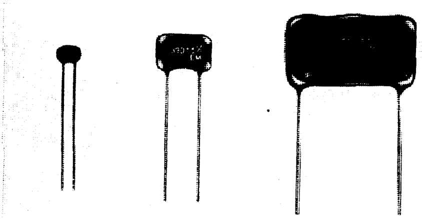
Try first to specify "**European stock types**" because it gives advantage in availability and price.

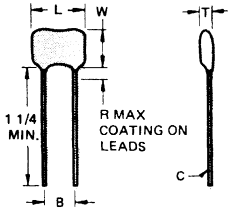
Notes

DIPPED MICA CAPACITORS

El·Menco

CASE STYLES DM5 - DM10 - DM15 - DM16
DM19 - DM20 - DM30 - DM40 - DM42 - DM43





El-Menco dipped mica capacitors are fabricated from the finest India Ruby Muscovite Mica that is available. This particular form exhibits the best characteristics which may be obtained from mica and results in a capacitor with optimum high temperature characteristics and excellent stability.
The dipped mica capacitors are qualified to established reliability specification MIL-C-39001.

Mechanical Characteristics

1. Phenolic coating epoxy impregnated.

LEAD DETAILS							
CASE STYLE	B ±1/32	C ±.001	R MAX.	CASE STYLE	B ±1/32	C ±.001	R MAX.
DM5	.120	.0159	5/64	DM20	7/16	.032	1/8
DM10	9/64	.0159	5/64	DM30	7/16	.040	1/8
DM15	15/64	.025	5/64	DM40	19/32	.040	1/8
DM16	1/2	.025	5/64	DM42	1-1/16	.040	1/8
DM19	11/32	.032	1/8	DM43	1-11/16	.040	1/8

Note: Crimped leads are available for all styles except for DM5.

2. DM5 and DM10 capacitors are marked with the capacitance value, capacitance tolerance letter and the El-Menco identification.
   DM15 thru DM43 capacitors are marked with the capacitance value, capacitance tolerance in percent and the El-Menco identification.

Electrical Characteristics

1. Operating temperature . . . –55°C to +125°C; –55°C to +150°C
2. DC rated voltage . . . . . . 50, 100, 500: as indicated in size charts. Higher voltages are available.
3. Capacitance range. . . . . . 1 pF thru 159,000 pF: see size chart for capacitance range for each case style.
4. Capacitance tolerance. . . . ±1/2%, ±1%, ±2%, ±5%, ±10% and ±20%. Closer tolerances are available. For capacitance values of 100 pF or less, the minimum standard available tolerance is ±0.5 pF.
5. Dielectric withstanding voltage . . . . 200% of rated voltage for 5 seconds.
6. Insulation resistance. . . . . 1000 megohms µF; need not exceed 100000 megohms.
7. Insulation resistance at elevated temperature . . . . See Figure 4
8. Dissipation factor . . . . . See Figures 5 and 6
9. Temperature coefficient . . See Figures 1-3

El-Menco Catalog Number

	DM15	E	D	101	K	0	4CR
Prefix Letter	Style	Characteristic	Voltage	Capacitance	Tolerance	Temperature	Coating

Prefix Letters . . . . Use when the following is required: HR - Debugging M2 - High reliability construction

Style . . . . Shape and dimensions of the capacitor.

Characteristic in PPM/°C . . . . C = ±200 E = –20 to +100; D = ±100 F = 0 to +70

DC Voltage . . . . . Y = 50 A = 100 C = 300; D = 500

Capacitance . . . . . The first two digits represent significant figures and the last digit specifies the number of zeros to follow.

Tolerance . . . . . . F = ±1% G = ±2% J = ±5%; K = ±10% M = ±20% D = 0.5 pF; E = ±1/2%

Temperature . . . . 0 = –55°C to +125°C; P = –55°C to + 150°C

Coating . . . . 4CR - Standard dip for DM10 thru DM43 (need not be specified in type designation)
1CRH* - One heavy phenolic dip epoxy impregnated
1CRT* - One thin phenolic dip epoxy impregnated
1CE* - Epoxy impregnated - no phenolic coating
*Sizes available on request.

CHARACTERISTIC VS CAPACITANCE

CASE STYLE	"C" CAPACITANCE RANGE	"D" AND "E" CAPACITANCE RANGE	"F" CAPACITANCE RANGE
DM5, DM10 DM15, DM16	1 pF THRU 19 pF	20 pF THRU 84 pF	85 pF AND GREATER
DM19, DM20	1 pF THRU 179 pF	180 pF THRU 429 pF	430 pF AND GREATER
DM30, DM40			470 pF AND GREATER
DM42, DM4J			16000 pF AND GREATER

DM5
Standard Dip

CAPACITANCE VALUE IN pF	300 VDC			100 VDC			50 VDC		
	L	W	T	L	W	T	L	W	T
	MAXIMUM			MAXIMUM			MAXIMUM		
1 – 12	270	.190	.110	•	•	•	•	•	•
15	.270	.190	.120	•	•	•	•	•	•
18 – 20	.270	.200	.120	•	•	•	•	•	•
22 – 24	.270	.200	.120	.270	.190	.120	•	•	•
27	.270	.200	.130	.270	.190	.120	•	•	•
30 – 33	.270	.200	.130	270	200	.120	•	•	•
36	.270	.210	.130	.270	.200	.120	•	•	•
39	.270	.210	.130	270	.200	.120	.270	.190	.120
43	.270	.210	.140	.270	.200	.120	.270	.190	.120
47 – 51	.270	.210	.140	.270	.200	.130	270	.190	.120
56	270	220	.150	270	200	130	270	.190	120
62	.270	220	.150	270	.210	.130	.270	.200	.120
68	.270	.220	.150	.270	.210	.140	.270	.200	.120
75 – 82	270	.230	.160	.270	.210	.140	.270	200	.120
91	270	230	.170	270	.210	.140	270	.200	130
100 – 110	.270	240	180	.270	.220	.150	.270	.200	.130
120	.270	.250	.190	.270	.220	.160	.270	.200	.130
130				.270	.230	.160	.270	210	.130
150				.270	.230	.170	.270	.210	.140
160				270	.240	.170	270	210	140
170 – 180				270	.240	.180	.270	.210	.140
200				.270	250	.190	.270	.220	.150
220							270	.220	.150
240							.270	.220	.160
270							270	.230	.160
300							270	.230	.170
330 – 360							270	240	.180
390 – 400							270	.250	190

DM10
4CR

CAPACITANCE VALUE IN pF	500 VDC			300 VDC			100 VDC		
	L	W	T	L	W	T	L	W	T
	MAXIMUM			MAXIMUM			MAXIMUM		
1 – 24	.360	.330	.190	•	•	•	•	•	•
27	.370	.330	.190	•	•	•	•	•	•
30 – 36	.370	.340	.190	•	•	•	•	•	•
39	.370	.340	.190	.370	.340	.190	360	.330	.190
43	.370	.340	.190	.370	.340	.190	.370	.330	.190
47 – 68	.370	.340	.190	.370	.340	.190	.370	.340	.190
75	.370	.340	.200	.370	.340	.190	.370	340	.190
82	370	.350	.200	.370	.340	.190	.370	340	.190
91 – 100	.370	.350	.200	.370	.350	.200	.370	.340	.190
110	380	.350	200	370	.350	.200	.370	340	.190
120	380	.350	200	.370	.350	.200	.370	340	.200
130	380	.360	.200	380	.350	.200	.370	.350	.200
150	.380	.360	.210	.380	.350	.200	.370	.350	.200
160	.380	.360	.210	.380	.360	.200	370	.350	.200
180	390	.370	.210	.380	.360	210	.380	350	.200
200	.390	370	.220	.380	.360	.210	380	350	.200
220	.390	.370	.220	.390	.370	.210	.380	.360	.210
240 – 250	.390	.380	220	.390	.370	.220	.380	.360	.210
270				.390	.380	.220	.380	370	210
300				.390	.380	.220	.390	370	.210
330				.400	390	.230	.390	370	.220
360				.400	.390	.230	390	.380	.220
390 – 400							.390	.380	.220
430 – 470							.400	.390	.230

DM15
4CR

CAPACITANCE VALUE IN pF.	500 VDC			300 VDC			100 VDC		
	L	W	T	L	W	T	L	W	T
	MAXIMUM			MAXIMUM			MAXIMUM		
1 – 62	.450	360	.170	•	•	•	•	•	•
75 – 82	.450	.360	.180	•	•	•	•	•	•
91 – 100	460	.360	.180	•	•	•	•	•	•
110 – 130	460	.370	.180	•	•	•	•	•	•
150 – 180	460	.370	.190	•	•	•	•	•	•
200	460	380	.190	•	•	•	•	•	•
220 – 240	460	.380	.200	•	•	•	•	•	•
270 – 390	470	.390	210	•	•	•	•	•	•
430	.470	.390	.210	460	380	200	•	•	•
470 – 510	470	.400	220	460	.380	.200	•	•	•
560 – 620	.480	.410	230	.460	.380	.200	•	•	•
680	490	.420	.240	.470	.390	.210	•	•	•
750	500	.430	.250	.470	.390	210	•	•	•
820				.470	.390	.210	.470	.390	.210
910				.470	.400	.220	.470	.400	.220
1000				.480	.400	.230	.480	.400	.230
1100				.490	.420	.240	.480	.400	.230
1200				.500	.430	.250	.490	.420	.240
1300 – 1600							.500	.430	.250
							50 VDC		
1800							.480	.400	.230
2000							.490	.420	.240

DM16
4CR

CAPACITANCE VALUE IN pF	500 VDC			300 VDC			100 VDC		
	L	W	T	L	W	T	L	W	T
	MAXIMUM			MAXIMUM			MAXIMUM		
100	.720	.350	.180	•	•	•	•	•	•
110 – 180	.720	.360	.180	•	•	•	•	•	•
200 – 240	.730	.360	.190	•	•	•	•	•	•
270 – 300	.730	.370	.190	•	•	•	•	•	•
330 – 390	.730	.370	.200	•	•	•	•	•	•
430	.730	.380	.200	•	•	•	•	•	•
470 – 510	.740	.380	.210	•	•	•	•	•	•
560	.740	.390	.210	•	•	•	•	•	•
620 – 680	.750	.390	.220	•	•	•	•	•	•
750	.750	.400	.230	•	•	•	•	•	•
820 – 910				.740	.390	.210	•	•	•
1000 – 1100				.750	.390	.220	•	•	•
1200 – 1300				.750	.400	.230	•	•	•
1450				.760	.400	.240	•	•	•
1500							.750	.400	.230
1600 – 1800							.760	.400	.240
2000							.770	.410	.250

**NOTE:* *Where dimensions are not given for a particular capacitance value, use dimensions for next greater voltage rating.*

DM19
4CR

CAPACITANCE VALUE IN pF	500 VDC			300 VDC			100 VDC		
	L	W	T	L	W	T	L	W	T
	MAXIMUM			MAXIMUM			MAXIMUM		
1 – 330	.640	.500	.190	•	•	•	•	•	•
360 – 470	.640	.510	.200	•	•	•	•	•	•
510 – 620	.650	.510	.200	•	•	•	•	•	•
680 – 910	.650	.510	.210	•	•	•	•	•	•
1000 – 1100	.650	.520	.220	•	•	•	•	•	•
1200 – 1300	.660	.520	.220	•	•	•	•	•	•
1500	.660	.520	.230	•	•	•	•	•	•
1600	.660	.530	.230	•	•	•	•	•	•
1800 – 2000	.670	.530	.240	•	•	•	•	•	•
2200	.670	.530	.250	•	•	•	•	•	•
2400	.670	.540	.260	•	•	•	•	•	•
2700	.680	.540	.270	•	•	•	•	•	•
3000	.680	.550	.280	•	•	•	•	•	•
3300	.680	.550	.290	.670	.540	.260	•	•	•
3600	.680	.560	.300	.680	.540	.270	•	•	•
3900	.690	.560	.310	.680	.540	.270	•	•	•
4300	.690	.570	.330	.680	.550	.280	•	•	•
4700	.700	.580	.350	.680	.550	.290	•	•	•
5100	.710	.590	.370	.680	.550	.300	•	•	•
5600				.680	.560	.310	•	•	•
6200				.690	.560	.320	.690	.560	.310
6800				.690	.570	.330	.690	.570	.320
7500							.700	.570	.340
8200							.700	.580	.350

DM20
4CR

CAPACITANCE VALUE IN pF	500 VDC			300 VDC			100 VDC		
	L	W	T	L	W	T	L	W.	T
	MAXIMUM			MAXIMUM			MAXIMUM		
1 – 100	.750	.500	.180	•	•	•	•	•	•
200 – 620	.750	.500	.190	•	•	•	•	•	•
750 – 1200	.750	.510	.200	•	•	•	•	•	•
1300 – 1600	.750	.510	.210	•	•	•	•	•	•
1800 – 2200	.760	.520	.220	•	•	•	•	•	•
2400	.770	.530	.250	•	•	•	•	•	•
2700	.770	.540	.260	•	•	•	•	•	•
3000	.770	.540	.270	•	•	•	•	•	•
3300	.780	.550	.280	•	•	•	•	•	•
3600	.780	.550	.290	•	•	•	•	•	•
3900	.780	.560	.300	•	•	•	•	•	•
4300	.780	.560	.310	.770	.540	.270	•	•	•
4700	.790	.560	.320	.770	.540	.270	•	•	•
5100	.790	.570	.330	.780	.550	.280	•	•	•
5600	.790	.570	.340	.780	.550	.290	•	•	•
6200	.790	.580	.350	.780	.560	.300	.780	.550	.290
6800	.800	.590	.370	.790	.560	.320	.780	.560	.300
7500	.800	.600	.390	.790	.570	.330	.780	.560	.300
8200	.810	.610	.410	.790	.570	.340	.780	.560	.310
9100	.810	.620	.430	.800	.580	.360	.790	.570	.330
10000	.820	.630	.450	.800	.590	.370	.790	.570	.340
11000				.800	.590	.380	.790	.580	.350
12000 – 12300				.810	.600	.400	.800	.580	.360
13000							.800	.590	.380
15000							.810	.600	.400
16000							.810	.610	.410
18000							.820	.620	.440

DM30
4CR

CAPACITANCE VALUE IN pF	500 VDC			300 VDC			100 VDC		
	L	W	T	L	W	T	L	W	T
	MAXIMUM			MAXIMUM			MAXIMUM		
470 – 1000	.760	.840	.230	•	•	•	•	•	•
1100 – 2000	.770	.850	.240	•	•	•	•	•	•
2200 – 2700	.770	.850	.250	•	•	•	•	•	•
3000	.770	.860	.250	•	•	•	•	•	•
3300 – 3900	.770	.860	.260	•	•	•	•	•	•
4300 – 4700	.780	.860	.270	•	•	•	•	•	•
5100	.780	.860	.280	•	•	•	•	•	•
5600 – 6200	.780	.870	.290	•	•	•	•	•	•
6800	.780	.870	.300	•	•	•	•	•	•
7500	.790	.880	.310	.780	.860	.270	•	•	•
8200	.790	.880	.320	.780	.860	.280	•	•	•
9100	.790	.880	.330	.780	.870	.280	•	•	•
10000	.800	.890	.340	.780	.870	.290	•	•	•
11000	.800	.890	.350	.780	.870	.300	•	•	•
12000	.800	.890	.360	.790	.880	.310	•	•	•
13000	.810	.890	.370	.790	.880	.310	•	•	•
15000	.810	.900	.390	.790	.880	.330	•	•	•
16000	.820	.900	.410	.800	.890	.340	•	•	•
18000	.820	.910	.430	.800	.890	.360	•	•	•
20000	.830	.920	.450	.810	.890	.370	•	•	•
22000	.840	.930	.480	.810	.900	.390	.810	.890	.370
24000				.820	.900	.410	.810	.900	.380
27000				.820	.910	.430	.810	.900	.400
30000				.830	.920	.460	.820	.910	.420
33000							.830	.910	.440
36000							.830	.920	.450
39000							.830	.920	.470
40000							.840	.920	.470

NOTE: Where dimensions are not given for a particular capacitance value use dimensions for next greater voltage rating

DM40
4CR

CAPACITANCE VALUE IN pF	500 VDC			300 VDC			100 VDC		
	L	W	T	L	W	T	L	W	T
	MAXIMUM			MAXIMUM			MAXIMUM		
470 – 1100	.940	.670	.210	•	•	•	•	•	•
1200 – 1800	.950	.680	.220	•	•	•	•	•	•
2000 – 2700	.950	.680	.230	•	•	•	•	•	•
3000 – 3300	.960	.690	.240	•	•	•	•	•	•
3600 – 3900	.960	.690	.250	•	•	•	•	•	•
4300 – 4700	.960	.690	.260	•	•	•	•	•	•
5100 – 5600	.970	.700	.270	•	•	•	•	•	•
6200	.970	.700	.280	•	•	•	•	•	•
6800	.970	.710	.290	•	•	•	•	•	•
7500	.980	.710	.300	.970	.700	.270	•	•	•
8200	.980	.710	.310	.970	.700	.280	•	•	•
9100	.980	.720	.320	.970	.710	.290	•	•	•
10000	.990	.720	.330	.980	.710	.300	•	•	•
11000	.990	.730	.340	.980	.710	.310	•	•	•
12000	1.000	.730	.350	.980	.720	.320	•	•	•
13000	1.000	.740	.370	.990	.720	.330	•	•	•
15000	1.010	.750	.390	1.000	.730	.350	•	•	•
16000				1.000	.740	.370	•	•	•
18000				1.010	.750	.390	•	•	•
20000				1.020	.760	.410	•	•	•
22000							1.000	.740	.370
24000							1.010	.750	.380
25000							1.010	.750	.390

FIGURE 1 — TYPICAL TEMPERATURE COEFFICIENT RANGE FOR DM5, DM10 AND DM15

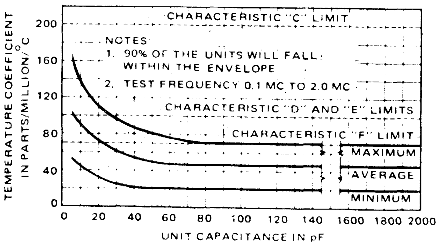
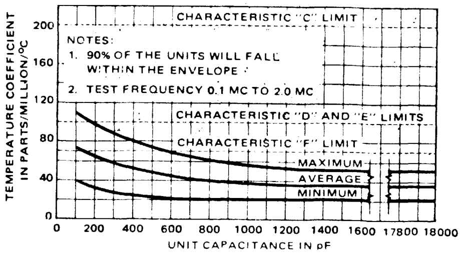


FIGURE 2 — TYPICAL TEMPERATURE COEFFICIENT RANGE FOR DM19 AND DM20



DM42
4CR

CAPACITANCE VALUE IN pF	500 VDC L	500 VDC W	500 VDC T	300 VDC L	300 VDC W	300 VDC T	100 VDC L	100 VDC W	100 VDC T
	MAXIMUM			MAXIMUM			MAXIMUM		
16000	1.410	.870	.280	•	•	•	•	•	•
18000	1.410	.870	.290	•	•	•	•	•	•
20000	1.420	.870	.300	•	•	•	•	•	•
22000	1.420	.880	.310	1.420	.870	.290	•	•	•
24000	1.430	.880	.320	1.420	.870	.300	•	•	•
27000	1.430	.880	.330	1.420	.880	.310	1.410	.870	.280
30000	1.440	.890	.350	1.430	.880	.320	1.410	.870	.290
33000	1.440	.890	.360	1.430	.880	.340	1.420	.870	.300
36000	1.450	.900	.380	1.440	.890	.350	1.420	.880	.310
39000	1.450	.900	.400	1.440	.890	.360	1.430	.880	.320
43000	1.460	.910	.420	1.450	.900	.370	1.430	.880	.330
47000	1.470	.910	.450	1.450	.900	.390	1.430	.890	.340
51000	1.480	.920	.470	1.460	.900	.400	1.440	.890	.360
56000				1.460	.910	.420	1.440	.900	.370
62000				1.470	.920	.450	1.450	.900	.390
68000				1.480	.920	.470	1.460	.900	.410
69000				1.480	.930	.480	1.460	.910	.420
75000							1.470	.910	.440
82000							1.480	.920	.460
91000							1.490	.930	.480
100000							1.500	.940	.490

DM43
4CR

CAPACITANCE VALUE IN pF	500 VDC L	500 VDC W	500 VDC T	300 VDC L	300 VDC W	300 VDC T	100 VDC L	100 VDC W	100 VDC T
	MAXIMUM			MAXIMUM			MAXIMUM		
24000	2.030	.870	.300	•	•	•	•	•	•
27000	2.040	.880	.310	•	•	•	•	•	•
30000	2.040	.880	.320	2.030	.870	.290	•	•	•
33000	2.040	.880	.330	2.030	.870	.290	•	•	•
36000	2.040	.890	.340	2.030	.870	.300	•	•	•
39000	2.050	.890	.350	2.040	.880	.310	2.030	.870	.280
43000	2.050	.890	.360	2.040	.880	.320	2.030	.870	.290
47000	2.050	.900	.370	2.040	.880	.330	2.030	.870	.300
51000	2.060	.900	.380	2.040	.880	.340	2.040	.880	.310
56000	2.060	.900	.400	2.050	.890	.350	2.040	.880	.320
62000	2.070	.910	.420	2.050	.890	.360	2.040	.880	.330
68000	2.070	.910	.440	2.050	.900	.370	2.040	.890	.340
71000	2.070	.910	.450	2.060	.900	.380	2.050	.890	.350
75000				2.060	.900	.380	2.050	.890	.360
82000				2.060	.900	.400	2.060	.900	.380
91000				2.070	.910	.420	2.060	.900	.400
100000				2.070	.910	.440	2.070	.910	.420
110000							2.070	.910	.440
120000							2.080	.920	.460
130000							2.090	.930	.490
140000							2.100	.940	.520
150000							2.110	.950	.530
159000							2.120	.960	.560

**NOTE: Where dimensions are not given for a particular capacitance value, use dimensions for next greater voltage rating.*

FIGURE 3
TYPICAL TEMPERATURE COEFFICIENT RANGE FOR DM30, DM40 AND DM42

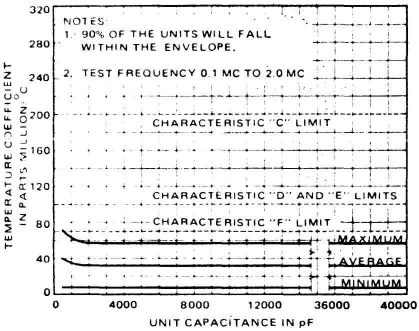


FIGURE 4
INSULATION RESISTANCE VS CAPACITANCE REGULAR PRODUCTION

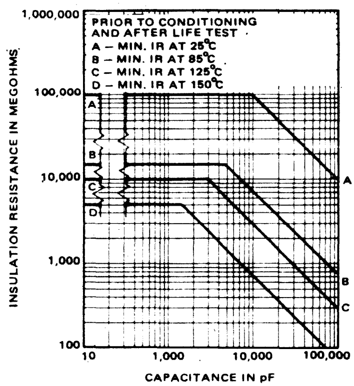


FIGURE 5
MAXIMUM DISSIPATION FACTOR AT 1 MHz

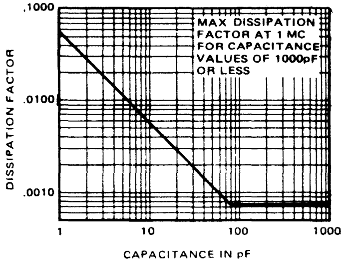
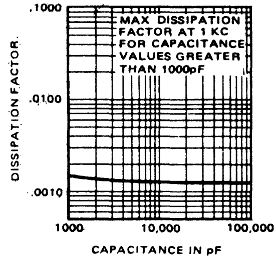


FIGURE 6
MAXIMUM DISSIPATION FACTOR AT 1 KHz

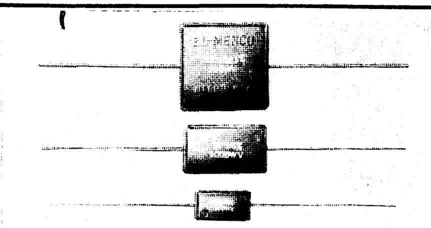


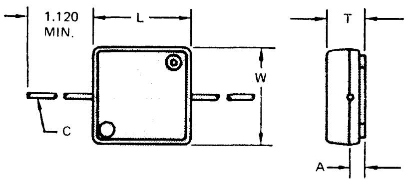
MOLDED MICA CAPACITORS

Case Styles

El-Menco

MM15 - MM19 - MM20 - MM30 - MM35





El-Menco molded mica capacitors are fabricated from the finest India Ruby Muscovite Mica that is available. This particular form exhibits the best characteristics which may be obtained from mica and results in a capacitor with optimum high temperature characteristics and excellent stability.

The molded mica capacitors are qualified to fixed mica specification MIL-C-5.

Electrical Characteristics

1. Operating temperatures ... MM15, MM19, MM20, MM30, MM35 −55°C to +85°C; MM15, MM20, MM30, MM35 −55°C to +125°C, −55°C to +150°C
2. DC rated voltage .... 100, 300, 500. Higher voltage available on request
3. Capacitance range ...... 1pF thru 20000 pF. See chart for capacitance range for each case style.
4. Capacitance tolerance .... ±1/2%, ±1%, ±2%, ±5%, ±10%, ±20%. Closer tolerances are available. For capacitance values of 100 pF or less, the minimum standard available tolerance is ±0.5 pF.
5. Dielectric withstanding voltage .... 200% of rated voltage for 5 seconds.
6. Insulation resistance ..... 1000 megohms μF. Need not exceed 100000 megohms at 25°C.
7. Insulation resistance at elevated temperature..... See Figure 5.
8. Dissipation factor ...... See Figure 6.
9. Temperature coefficient . . . See Figures 1 – 4.

Mechanical Characteristics

1. Case material: Molded with mineral filled epoxy compound.
2. Physical dimensions:

CASE STYLE	L	W	T	A	C
MM15	.520 +.030/−.040	.300 +.010/−.030	*	.060 MIN.	.025 ±.002
MM19	.688 MAX.	.438 MAX.	.219 MAX.	–	.032 ±.002
MM20	.730 ±.060	.440 ±.030	.190 ±.030	.060 MIN.	.032 ±.002
MM30	.800 +.060/−.030	.800 +.060/−.030	.250 +.030/−.020	.080 MIN.	.040 ±.002
MM35	.800 +.060/−.030	.800 +.060/−.030	.310 +.050/−.030	.080 MIN.	.040 ±.002

**1 pF thru 220 pF .190 max., 300 pF and greater 220 max.*

3. All capacitors are normally marked with the nominal capacitance value and tolerance.
4. Lead material: Copper-Clad steel solder, coated.

El-Menco Catalog Number

Prefix	Style	Characteristic	Voltage	Capacitance	Tolerance	Temp.
	MM15	E	D	101	K	0

Prefix Letters .... Use when the following is required: HR = Debugging M2 = High reliability construction

Style .... Shape and dimensions of the capacitor.

Characteristic in PPM/°C .... C = ±200 E = −20 to +100; D = ±100 F = 0 to +70

DC Voltage...... A = 100, C = 300, D = 500

Capacitance ...... The first two digits represent significant figures and the last digit specifies the number of zeros to follow.

Tolerance ...... F = ±1% G = ±2% J = ±5%; K = ±10% M = ±20% E = ±1/2%; D = ±0.5 pF

Temperature ..... N = −55°C to +85°C; O = −55°C to +125°C; P = −55°C to +150°C

ELECTRO MOTIVE CORPORATION, WILLIMANTIC, CONN. 06226 Subsidiary of International Electronics Corporation

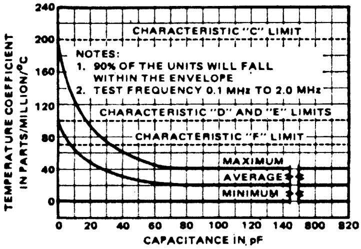
MM=CM (see page 186)

VOLTAGE, CHARACTERISTIC AND CAPACITANCE RANGE BY CASE STYLE

CASE STYLE	DC RATED VOLTAGE			CHARACTERISTIC		
	100	300	500	"C"	"D" & "E"	"F"
MM15	1pF - 820pF	1pF - 620pF	1pF - 510pF	1pF - 19pF	20pF - 31pF	32pF & GREATER
MM19	1pF - 5000pF	1pF - 3600pF	1pF - 2400pF	1pF - 109pF	110pF - 199pF	200pF & GREATER
MM20	1pF - 5100pF	1pF - 4300pF	1pF - 3300pF	1pF - 109pF	110pF - 199pF	200pF & GREATER
MM30	470pF - 15000pF	470pF - 12000pF	470pF - 7500pF	—	—	470pF & GREATER
MM35	3300pF - 20000pF	3300pF - 16000pF	3300pF - 11000pF	—	—	3300pF & GREATER

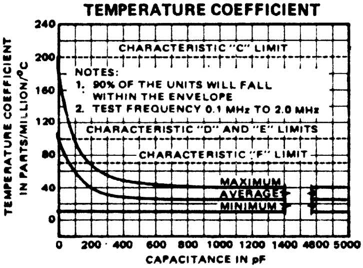
MM15

FIGURE 1
TEMPERATURE COEFFICIENT



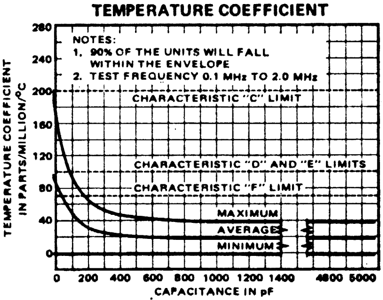
MM19

FIGURE 2
TEMPERATURE COEFFICIENT



MM20

FIGURE 3
TEMPERATURE COEFFICIENT



MM30 & MM35

FIGURE 4
TEMPERATURE COEFFICIENT

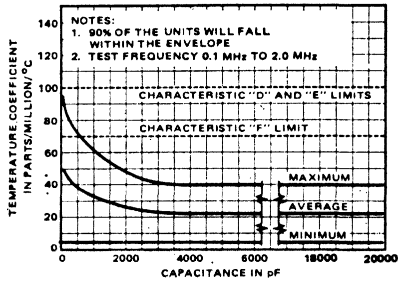


FIGURE 5
INSULATION RESISTANCE VS CAPACITANCE
REGULAR PRODUCTION

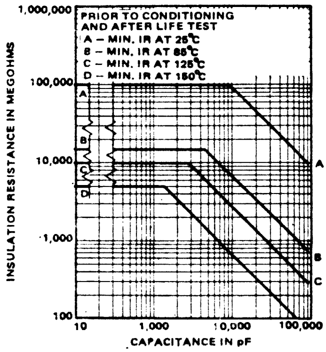
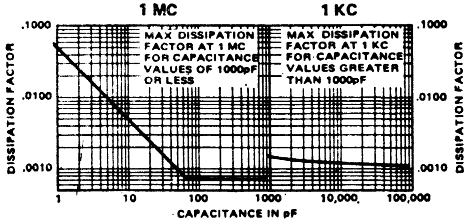
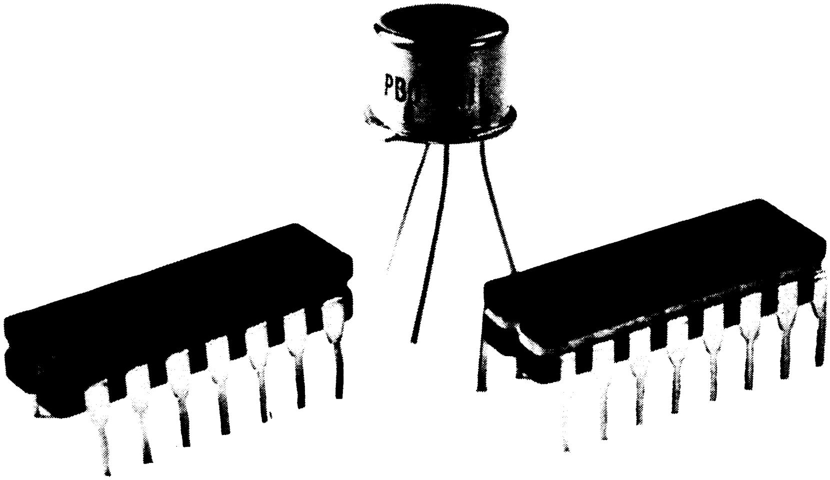


FIGURE 6
MAXIMUM DISSIPATION FACTOR
1 MC 1 KC



INTRODUCTION



Rifa's semiconductor program comprises bipolar monolithics, hybrids, resistor networks and diodes. Apart from the standard product range covered by this catalogue, there is considerable development and production of custom-designed circuits. The whole range has been developed with a view to servicing the tele-communications industry, and this aim has expressed itself in the form of a deliberate investment in the highest quality technology and design.

For ease of reference, the data on each circuit are grouped according to the headings discussed below.

KEY FEATURES

Key Features are the main properties of the component summarized for quick reference.

MAXIMUM RATINGS

Maximum Ratings are limits beyond which the serviceability of the component may be impaired.

ELECTRICAL CHARACTERISTICS

Values cited in the Type column under Electrical Characteristics are given for information only. The maximum and minimum values may be taken as references for acceptance testing.

FUNCTIONAL DESCRIPTION

In Functional Description the internal design of the circuit is described.

TYPICAL APPLICATION

Typical application gives an example of practical circuit connections and the resulting performance.

Notes

GENERAL DESCRIPTION

This one ampere rectifier is axial-leaded and has hermetically sealed glass package. The rectifier has heat-sink construction and the structure is all diffused. The surface is glass passivated and the leads are dip tinned. Weight with leads 0.3 g.

Marking

The rectifier is marked at the cathode side with the colour according to the table below.

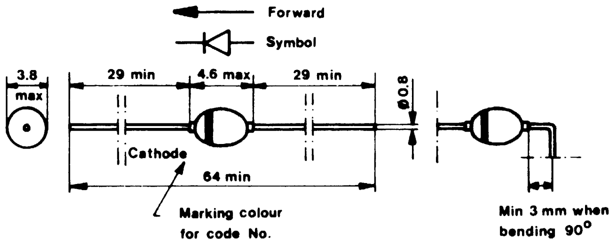
Note At temperatures above +125°C the protective lacquer layer can be discoloured.

Code No.	Marking	Reverse Voltage U_R, U_{RR}	Units
PAB 2192	red	200	V
PAB 2194	yellow	400	V
PAB 2196	blue	600	V
PAB 2198	grey	800	V

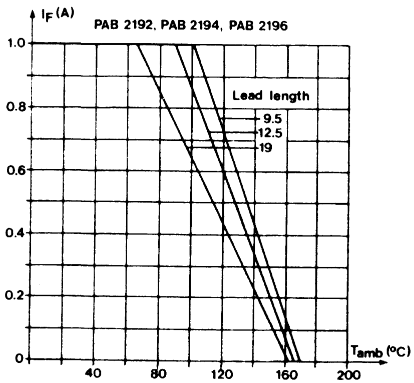
Ordering number

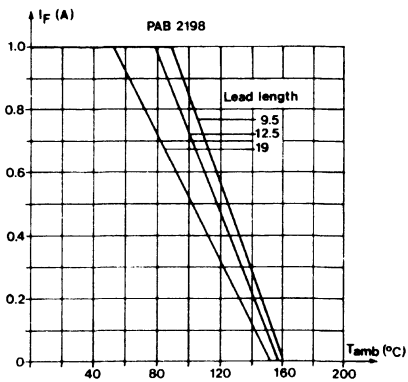
Code No. are according to the table above.

Dimensions



Maximum average forward current at resistive or inductive load as a function of ambient temperature and lead length. The thermal impedance tie-point to ambient is considered to be 40°C/W for each lead.





Maximum ratings

Reverse voltage, DC, U_R and working peak U_{RR} at junction temperature —65°C to +175°C, (+165°C for PAB 2198).

Forward Current, Average at Resistive and Inductive Load (see curves)	T_A=100°C I_F=1 A (T_A=90°C for PAB 2198)
Peak Surge Forward Current, No load T_A=25°C, half sine wave, non repetitive	0.001 s I_F surge 100 A 0.0083 s I_F surge 65 A
Peak Reverse Power Rating, 20 μs half sine wave, non repetitive, at max. T_J	1000 W
Avalanche Voltage	max. 1600 V
I^2t RMS for fusing, 1 to 10 ms	4 A^2s
Storage and Junction Operating Temperature	—65°C to +175°C (+165°C for PAB 2198)
Soldering Temperature (3 mm from body max. 5 sec.)	≤ 290°C

Mounting: Any position

ELECTRICAL CHARACTERISTICS

Forward Voltage drop	at I_F, 1 A	T_J 25°C	U_F max 1 V
Reverse Current	at U_R	T_J 25°C	I_R max 5 μA
		T_J 175°C	max 0.3 mA for PAB 2192
		T_J 175°C	max 0.3 mA for PAB 2194
		T_J 175°C	max 0.2 mA for PAB 2196
		T_J 165°C	max 0.2 mA for PAB 2198
Reverse Recovery Time		T_{RR}=max 6 μs	

EQUIVALENT TYPES

RIFA type No.	Corresponding type No.
PAB 2192	1N 5059
PAB 2194	1N 5060
PAB 2196	1N 5061
PAB 2198	1N 5062

PBA 3008, PBA 3009

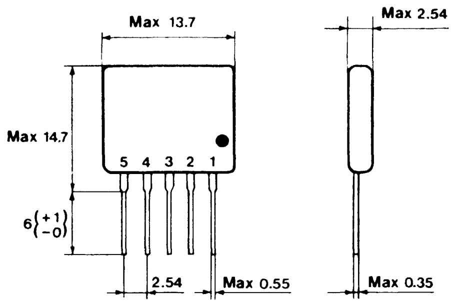
GENERAL DESCRIPTION

The Rifa cermet hybrid circuits PBA 3008 and PBA 3009 are primarily designed for timing control at turn-off and turn-on of relays, lamps, small electromagnetic coils etc. These versatile devices are also suitable for other applications such as driving, filtering and interfacing TTL logic to relay systems. The most characteristic features are high output driving capability and wide timing and voltage ratios. The output sink current is 150 mA and the operating voltage 4.75 — 30 V. The timing circuits operate from 1 ms to several minutes. The circuits are provided with Schmitt-trigger inputs.

Encapsulation

Single-In-Line (SIL) epoxy dip coated.

PHYSICAL DIMENSIONS



Ordering instructions

Rifa Type No.	Function	Encapsulation
PBA 3008	Delayed turn-off	RIPAK D5
PBA 3009	Delayed turn-on	RIPAK D5

PBA 3008, PBA 3009

Maximum ratings

Supply voltage (V_{CC})	30 V
Input voltage pin 2	30 V
Output voltage	30 V
Output current, V_{CC}=max	150 mA
Input current pin 1 (continuous)	50 mA
Storage temperature range	—40°C to +85°C
Operating temperature range	0°C to +70°C
Lead temperature (soldering 10 sec.)	260°C

Power

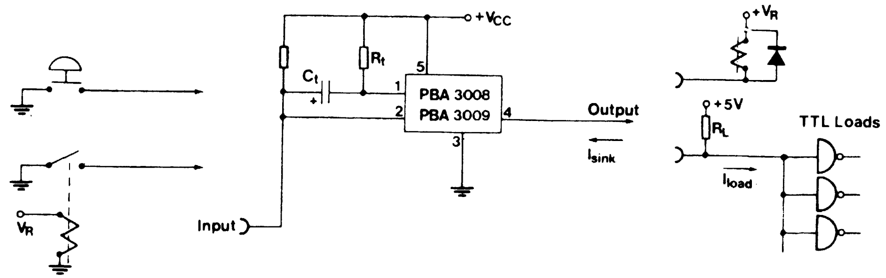
Dissipation at 25°C ambient temperature	P_D=350 mW
Dissipation at 70°C ambient temperature	P_D=190 mW

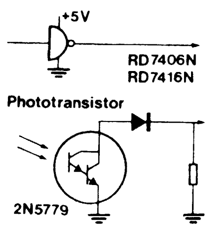
CHARACTERISTICAL DATA T_{amb} 25°C, V_{CC} =12 V, R_a =1 k unless otherwise noted

Symbol	Parameter	Test condition	Min	Typ	Max	Units
V_{out}(sat)	Collector-Emitter Voltage	I_{sink}=150 mA V_{CC}=10—25 V		0.4	0.6	V
V_{in}	Trip Voltage pin 1			1.5		V
V_{in}	Hysteresis pin 1			0.2		V
V_{in}(0)	Input Voltage Low pin 2		0.7			V
I_{in}(0)	Leakage Current pin 1	V_{in}pin 1=—10 V			1	μA
I_{in}(1)	Switching Current pin 1				10	μA
R_t	Timing Resistor		10		2200	kΩ
t_d	Time Delay $t_d = k \cdot R_t \cdot C_t$ (Note)					
k	$\frac{t_d}{R_t \cdot C_t}$ (Note)	V_{CC}=5 V		0.9		
		V_{CC}=12 V		0.8		
		V_{CC}=30 V		0.7		
t_p	Preset time			450		μs/μF

Note Expression valid for moderate time delays ($R_t \geq 50$ kΩ).

Application examples of driving PBA 3008 and PBA 3009 from different sources when driving different loads





Delayed off — PBA 3008: The load is energized as the input goes high. The time-delay (t_d) starts when the input changes to low (0—0.8 V).

Delayed on — PBA 3009: The time-delay (t_d) starts as the input goes low. At the end of the time-delay the output is energized and remains in this state as long as the input is low.

To calculate the volue of R_L use the formula:

$$R_{Lmax} = \frac{V_{CC} - V_{out}(1)}{N \cdot I_{load}}$$

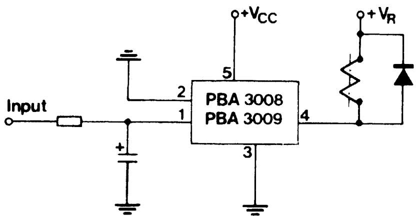
$$R_{Lmin} = \frac{V_{CC} - V_{out}(0)}{I_{sink} - I_{sink} \text{ from TTL loads}}$$

eg. 3 TTL loads will give

$33\Omega < R_L < 20\ k\Omega$

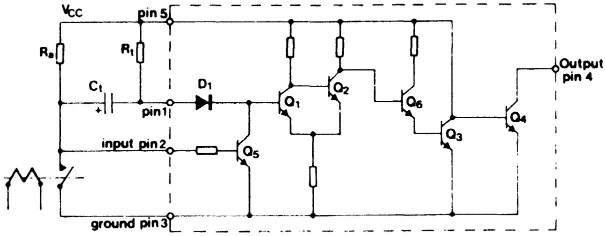
Note: $V_{out}(1)$ min=2.4 V
$V_{out}(0)$ max=0.4 V

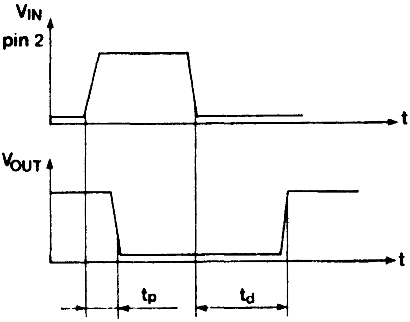
Noise suppressor



The Schmitt-trigger feature can be utilized when using the PBA 3008/ PBA 3009 as a noise suppressor.

Explanation of the circuit diagram, PBA 3008, turn—off delay

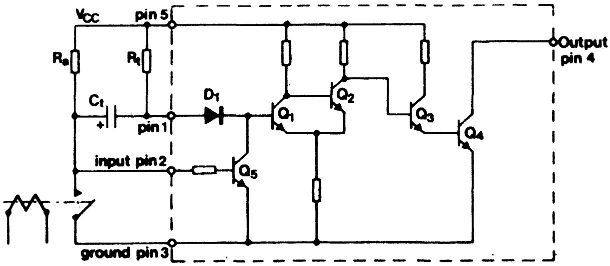


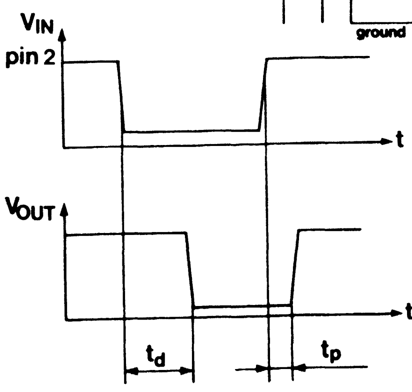


The circuit turns on i.e. the output transistor Q_4 saturates, when the input pin 2 goes high. The preset time, t_p, is dependent upon the charging time of the capacitor C_t via R_a, D_1 and Q_5. At V_{CC}=12 V and R_a=1 k the input voltage, pin 2, is about 11.4 V and the voltage on pin 1 is about 1.5 V.

When the input is grounded the voltage on pin 1 immediately falls to approx. minus 10 V. The capacitor C_t now starts to recharge exponentially with the time constant $T=R_t \cdot C_t$. When the voltage on pin 2 reaches plus 1.5 V Q_1 saturates and the output pin 4 goes high for PBA 3008 and low for PBA 3009.

Explanation of the circuit diagram, PBA 3009, turn—on delay

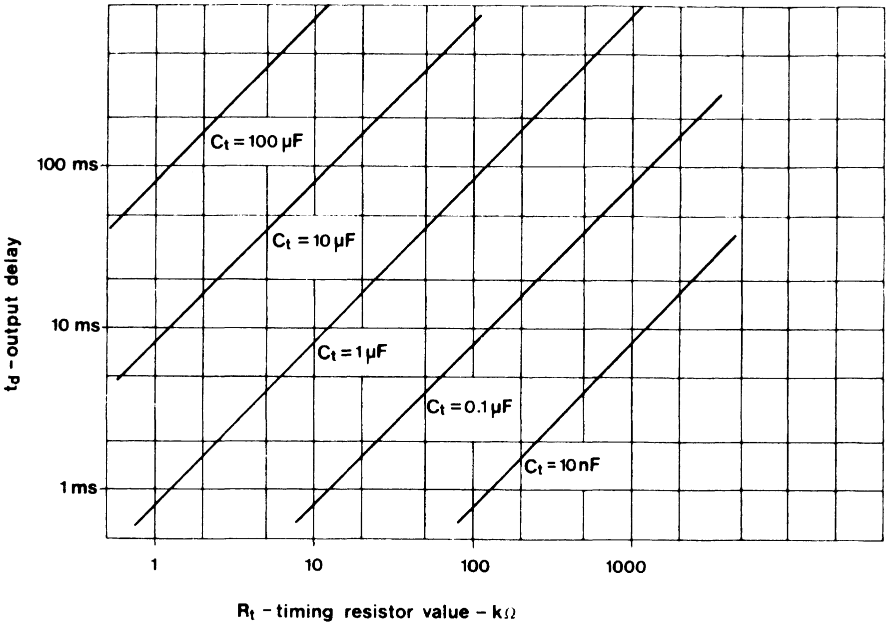




PBA 3009 behaves similar to PBA 3008, but the output function is inverted.

TYPICAL CHARACTERISTICS

Output delay v timing resistor value



RIFA

Notes

PBD 3510, PBD 3511

GENERAL DESCRIPTION

The PBD 3510 and PBD 3511 are monolithic digital integrated circuits especially designed to interface DTL/TTL logic into high current, e.g. relays, electromagnetic valves, solenoids etc. They may also be used to drive resistive loads.

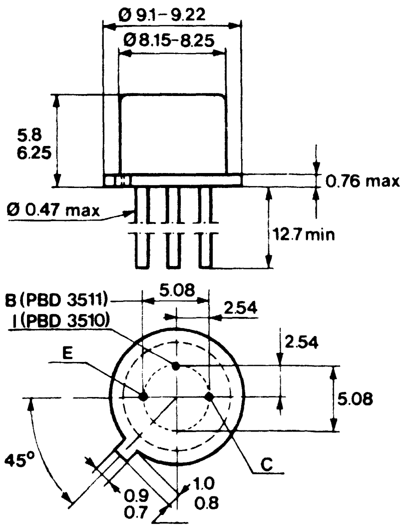
Both of them are manufactured in a high voltage process, giving extremely high breakdown values for the transistors which are integral parts of the circuits.

PBD 3511 is a current-controlled Darlington transistor with two levels on the output; driving or non-driving. The greatest advantage of the circuit is its ability to dissipate the load energy at turn-off. An integrated zenerdiode allows the voltage to rise to approximately 110 V over the output transistor when turning off the load current. This is done very quickly (0.2—0.5 ms). The energy is dissipated without any need for a protecting diode or RC network across the load because the breakdown value of the zenerdiode is at least 30 V lower than the corresponding values for all transistors. This prevents the transistors from going into a breakdown condition. However, at inductive loads, with the current exceeding 125 mA, an external protecting diode is recommended.

PBD 3510 operates in the same way as PBD 3511. The difference between them is that PBD 3510 has a PNP transistor at the input which gives level-shift so that the circuit can drive loads where positive ground is used.

Mechanical data

The collector is connected to the case.
All JEDEC TO-39 dimensions are applicable.
All dimensions in mm unless otherwise specified.



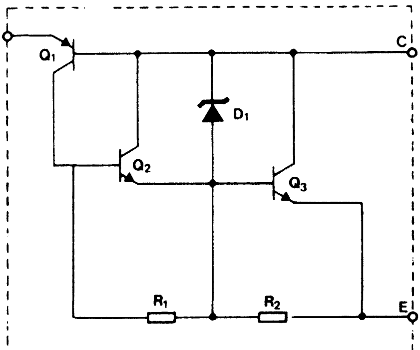
Ordering instructions

Rifa Type No.	Application	Encapsulation
PBD 3510	Load positive grounded	TO-39
PBD 3511	Load negative grounded	TO-39

PBD 3510, PBD 3511

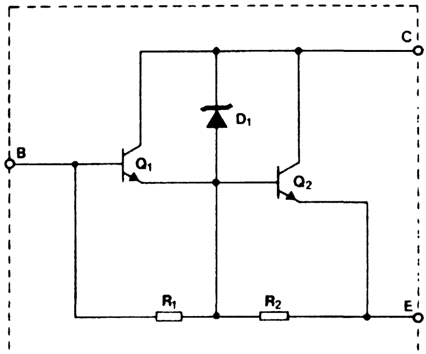
Schematic diagrams

PBD 3510



PBD 3510 Schematic diagram

PBD 3511



PBD 3511 Schematic diagram

Maximum ratings

	PBD 3510	PBD 3511
Voltage and currents		
Relay voltage (V_R)	—85 V	+85 V
Load current (I_C)	300 mA	
Current at inductive load		
without external clamp diode (I_C)	125 mA	
Input current (I_I)	15 mA (typ. 0.9 mA)	
Inductive load without external clamp diode	2 H	
Power		
Dissipation at 25°C case temperature (Note 1) (P_d)	3.8 W	
Dissipation at 25°C case ambient temperature (Note 2) (P_d)	0.7 W	
Temperature		
Storage temperature (T_S)	—55°C to +150°C	
Operating junction temperature (T_J)	+150°C	
Lead temperature (soldering 10 s time limit) (T_L)	+260°C	

Note 1 Derate linearly to 150°C case temperature at the rate of 30.4 mW/°C.
Note 2 Derate linearly to 150°C free air temperature at the rate of 5.6 mW/°C.

PBD 3510, PBD 3511

ELECTRICAL CHARACTERISTICS (25°C ambient temperature unless otherwise noted)

PBD 3510

Symbol	Parameter	Test Condition	Typ	Max	Unit
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_I=1.2$ mA, $I_C=10$ mA	0.8	1.3	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_I=1.4$ mA, $I_C=50$ mA	0.9	1.4	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_I=1.6$ mA, $I_C=250$ mA	1.0	1.5	V
I_{CEO}	Leakage Current	$V_{CE}=70$ V		50	μA
V_{IC}	Input Saturation Voltage	$I_C=100$ mA, $I_I=1$ mA	0.8	1.0	V
V_{IC}	Input Saturation Voltage	$I_C=100$ mA, $I_I=5$ mA	0.9	1.1	V

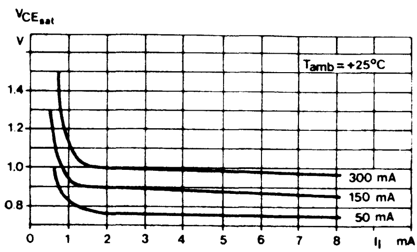
PBD 3511

Symbol	Parameter	Test Condition	Typ	Max	Unit
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_B=0.9$ mA, $I_C=10$ mA	0.8	1.3	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_B=1.1$ mA, $I_C=50$ mA	0.9	1.4	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_B=1.3$ mA, $I_C=250$ mA	1.0	1.5	V
I_{CEO}	Leakage Current	$V_{CE}=70$ V		50	μA
V_{BE}	Input Saturation Voltage	$I_C=100$ mA, $I_B=1$ mA	1.35	1.55	V
V_{BE}	Input Saturation Voltage	$I_C=100$ mA, $I_B=100$ mA	1.4	1.6	V

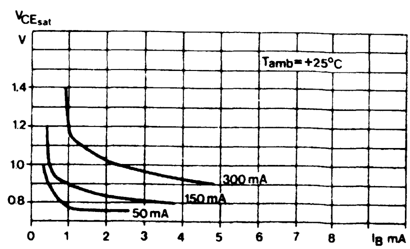
TYPICAL CHARACTERISTICS

Collector-Emitter Saturation Voltage versus Input Current

PBD 3510



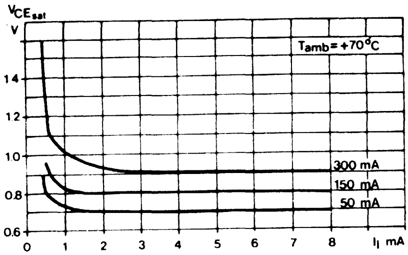
PBD 3511



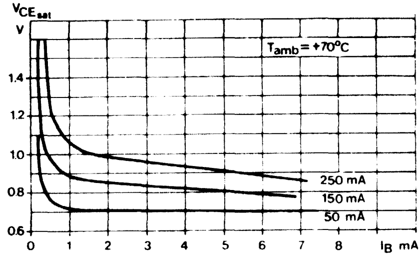
TYPICAL CHARACTERISTICS

Collector—Emitter Saturation Voltage versus Input Current

PBD 3510

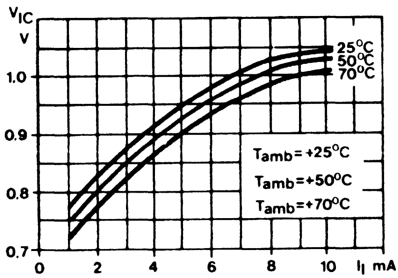


PBD 3511



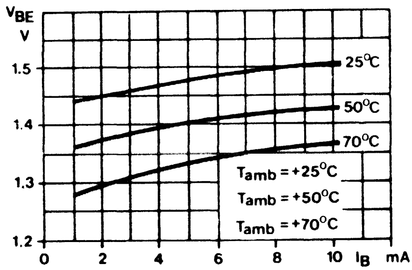
Input-Collector Voltage versus Input Current

PBD 3510 only



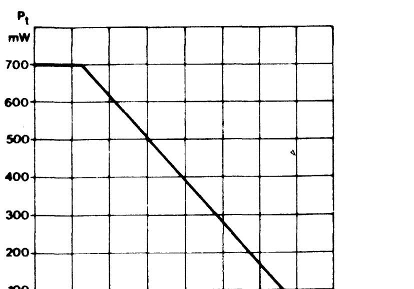
Base-Emitter Voltage versus Base Current

PBD 3511 only



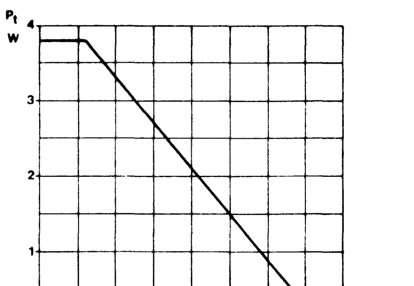
Typical derating curve for the power dissipation versus the ambient temperature

PBD 3510/PBD 3511



Typical derating curve for the power dissipation versus the case temperature

PBD 3510/PBD 3511



PBD 3513

GENERAL DESCRIPTION

RIFA BPD 3513 is a monolithic dual driver circuit. It comprises two independent 12 V drivers on the same chip. The 3 input AND inputs are specially designed to be DTL/TTL compatible, and they can also be fed from relay contacts in 12 V systems.

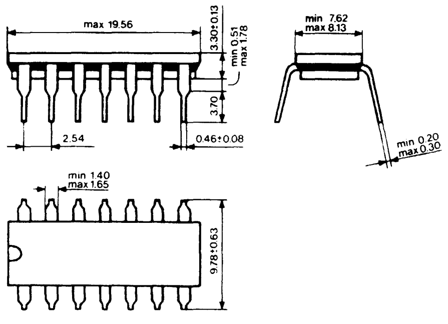
The output current can be chosen according to demand thus avoiding waste of power. Integrated zenerdiodes proctect the outputs against transient voltages. This means that no external protective device (freewheel diods or RC networks) are required.

Key features

- All specifications given for $T_A = 70°C$.
- Excellent driving capability.
  Continuous current sinking capability of 300 mA per stage. Continuous power dissipation capability of 800 mW for the whole package.
- Integrated transient protection on the outputs.
- Inputs directly DTL/TTL compatible.
  Inputs directly compatible to newer CMOS families.
- Expandable Dual 3 AND inputs.
- Output current adjustable according to demand.
- Small dimensions. 14 pin DIL ceramic package.

Mechanical data

14 pin Dual-In-Line (DIL) ceramic package TO-116.



Order information

RIFA Order No.	Function	Encapsulation
PBD 3513	Dual 3 AND Driver	Ceramic DIL 14 pin

Maximum ratings

VOLTAGES AND CURRENTS

Supply voltage, pin 14 V_{CC}	20 V
Input voltage V_{IN}	20 V
Output current continuous $I_{OUT_{cont}}$	300 mA per stage
Output current peak $I_{OUT_{peak}}$	400 mA per stage

POWER

Continuous total power dissipation at T_A 70°C	800 mW

TEMPERATURE RANGE

Operating temperature range	0 to +70°C
Storage temperature range	—55°C to +150°C
Soldering temperature (max 10 s)	+300°C

ELECTRICAL CHARACTERISTICS

(at T_A 0—70°C and V_{CC} 4.75 to 5.25 V unless otherwise specified).

Input characteristics are valid only for inputs A_1, A_2, B_1, B_2 and C_1, C_2. However, these characteristics are applicable to inputs E_1, E_2 too provided small signal diodes (e.g. 1N4148) are used.

Symbol	Parameter	Test condtions	Ref. fig.	Min	Typ	Max	Units
V_{CL}	Input clamping voltage	T_A = +25°C I_{IN} = —12 mA	1.4	—1.5	—1		V
V_{IH}	Logical H input voltage		1.4	2.0			V
V_{IL}	Logical L input voltage		1.4			0.80	V
V_{OH}	Logical H output voltage at switch-off of inductive loads	I_{SINK}=100 μA	1.4	20			V
		I_{SINK}=300 mA			23	25	V
V_{OL}	Logical L output voltage	I_D=4 mA I_{OUT}= 50 mA	1.4		120	400	mV
		I_D=19 mA I_{OUT}=300 mA ($R_{V_{CC}\text{-}D}$=270Ω)			500	700	mV
I_{IH}	Logical H input current	V_{IH}=20 V	1.4			40	μA
I_{IL}	Logical L input current	V_{IL}=0.4 V	1.4	—250	—100		μA
I_{CCH}	Supply current, high outputs	V_{CC}=20 V	1.4		3.4	4.5	mA
I_{CCL}	Supply current, low outputs	V_{CC}=20 V	1.4		42	57	mA
		V_{CC}=5 V			9	12	mA
t_{rise}	Output voltage rise time	$R_{V_{CC}\text{-}D}$=270Ω R_L=40Ω V_{RR}=12 V	1.4			150	ns
t_{fall}	Output voltage fall time	$R_{V_{CC}\text{-}D}$=270Ω R_L=40Ω V_{RR}=12 V	1.4			250	ns
	Propagation delay from input A, B and C or with external diode 1N4148	$R_{V_{CC}\text{-}D}$=270Ω R_L=40Ω V_{RR}=12 V	1.4			500	ns

Functional description

Each section of this driver may be operated individually or in parallel.

Different methods of operation are shown on the next page.

Logic function

When all inputs A, B, C and E are high, the output Y is low and hence the driver will sink current (activate the load).

The inputs A_1, B_1, C_1 are DTL/TTL compatible and the expander E_1 must have a serial input diode (e.g. 1N4148). Newer designs of CMOS are useable for direct drive of PBD 3513.

Electrical function and output current control

The base drive current of the output transistor is limited by means of an integrated 1 kohm resistor between V_{CC} and the collector of transistor Q_2, thus enabling the output transistor to sink maximum 50 mA at $V_{CC}=5$ V.

If 50 mA is insuffcent the base drive current could be increased with an external resistor between V_{CC} and pin D_1. The base drive current must exceed $I_{OUT}/20$ and the saturation voltage on pin D_1 could be estimated at 2 V.

Example:

An output current of 225 mA is required at $V_{CC}=5$ V $\frac{225}{20}=0.011$ A. Internal resistor will supply 3 mA. External resistor value will be $\frac{5-2}{0.011-0.003}$ ohms$=375$ ohms to $V_{CC}=5$ V. Nearest E24 standard value 360 ohms may be used.

At $V_{CC}=12$ V the driver will sink $\frac{10}{1.2}20=165$ mA without continuous drive.

Switch-off transients from inductive loads are handled by the integrated zenerdiode D_7. No external freewheel diodes or RC networks are required across the load provided the load inductance does not exceed 250 mH at 300 mA or 2 H at 100 mA.

All information regarding section 1 is fully applicable to section 2.

Note External resistor must not be supplied to higher voltage than V_{CC}.

Schematic and connection diagrams

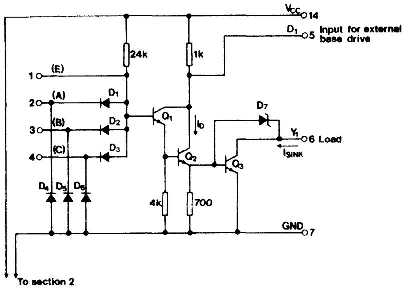


Figure 1

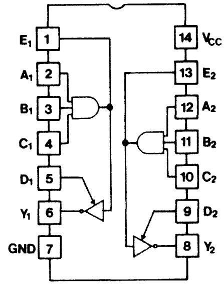


Figure 2

Function table

Inputs[1]				Outputs[1] (load)
A	B	C	E	Y
0	X	X	X	H
X	0	X	X	H
X	X	0	X	H
X	X	X	X	H
H	H	H	H	L

X = Irrelevant

[1]) Each section of the driver operates independently of the other. However, the driver sections may be paralleled in order to increase load capability.

Figure 3

Typical wave form, output voltage and current

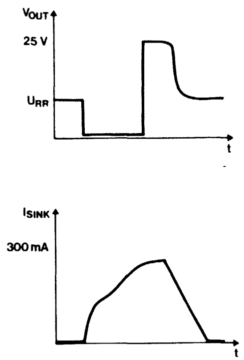
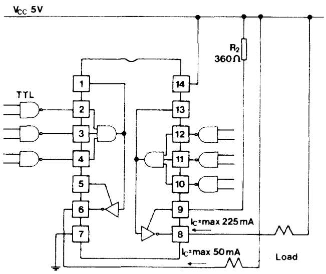
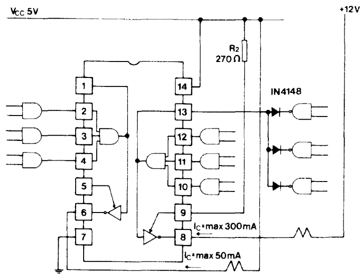


Figure 4



PBD 3513 controlled by TTL gates and driving two separate loads with individual current values. Section two has external base drive supply through resistor R2=360 ohms.

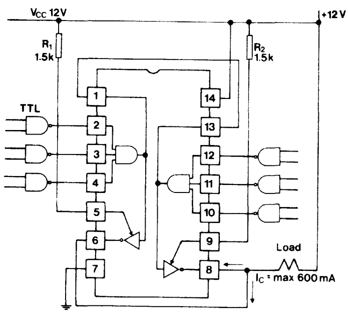
Figure 5



PBD 3513. Section 1 controlled by 3 TTL gates and driving a 50 mA load.

Section 2 controlled by 3+33 (via expander) TTL gates and driving a 300 mA load connected to a separate RV supply. The external base drive supplied through resistor R2=270 ohms.

Figure 6



PBD 3513 operated at 12 V as a 6 input AND 600 mA 12 V driver controlled by TTL gates .The load is driven parallel by sections 1 and 2 and the sections have individual base drive through resistors R1 and R2.

Note Input current at one low input will be twice the specified value.

Figure 7

Notes

PBD 3520

RIFA

GENERAL DESCRIPTION

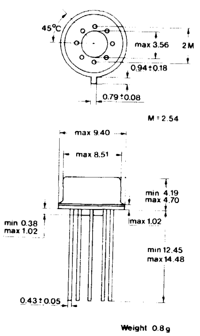
RIFA PBD 3520 is a high voltage monolithic driver circuit with open collector/emitter output in metal TO-99 package. The input is TTL compatible and the circuit is designed for 5 V supply voltage. The output is capable of sinking 150 mA continuously at load voltages down to —56 V. Logical "L" at input activates the output to sink current.

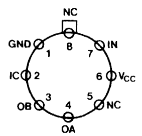
The load can be connected either between ground and the Darlington output transistor or between the Darlington transistor and the negative supply.

Key features

- All specifications given for $T_A = 70°C$
- Open collector/emitter output
- High loading current
- High loading voltage
- Low control current
- Inputs TTL compatible

Mechanical data





NC = Not connected

IC = Internal connection must not be connected externally

All JEDEC TO-99 dimensions are applicable. All dimensions in mm unless otherwise specified.

Order information

RIFA Order No.	Function	Encapsulation
PBD 3520	**Open collector/ emitter output**	**Metall TO-99 package**

Maximum ratings

VOLTAGES AND CURRENTS

Continuous supply voltage V_{CC}	7 V
Input voltage V_{IN}	7 V max —0.5 V min
Output voltage V_{OA}, V_{OB}	1.0 V max —64 V min
Output voltage differential V_{OA}, V_{OB}	65 V
Output current continuous	200 mA

POWER

Dissipation at T_C 25°C	3.8 W
Derate linearly to 150°C case temperature at the rate of 30.4 mW/°C	
Dissipation at T_A 25°C	0.8 W
Derate linearly to 150°C free air temperature at the rate of 6.4 mW/°C.	

TEMPERATURE RANGE

Storage temperature T_s	—55°C to +150°C
Operating junction temperature T_j	+150°C
Lead temperature (soldering 10 s) T_L	260°C

ELECTRICAL CHARACTERISTICS

(Temperature range 0 to 70°C, 4.75 ≤ V_{CC} ≤ 5.25 V, V_{OA} ≤ 0.4 V)

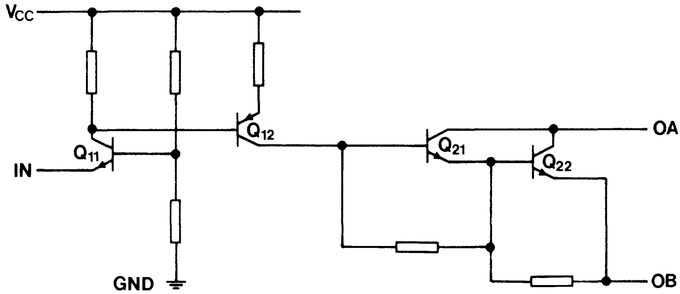
Symbol	Parameter	Test conditions	Min	Typ	Max	Units
V_{IH}	Logical "H" input voltage		2			V
V_{IL}	Logical "L" input voltage				0.80	V
I_{IH}	Logical "H" input current	V_{IN}=2.4 V			40	μA
I_{IL}	Logical "L" input current	V_{IN}=0.4 V	—1.6	—0.8		mA
V_{sat}	Output saturation voltage	V_{IN}=V_{IL}, I_{OA}=150 mA		0.9	1.3	V
-I_{OB}	Output leakage current	V_{IN}=V_{IH}, V_{OA}=0.4 V, V_{OB}=—56 V			30	μA
I_{CC}	Supply current	V_{IN}=2.0 V		0.3	0.8	mA
I_{CC}	Supply current	V_{IN}=0.0 V, V_{OB}=—56 V		2.5	3.5	mA

Functional description

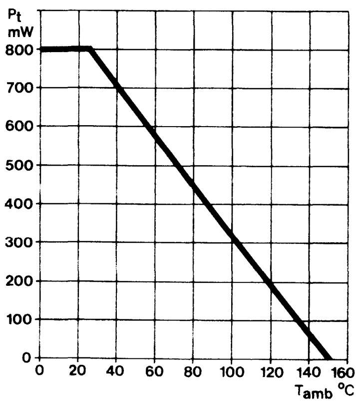
A voltage divider, giving 2.2 V at 5 V supply voltage is connected to the base of transistor Q_{11}. When the input voltage is lower than 1.5 V, Q_{11} starts conducting, thus activing current generatur Q_{12}. This will cause the Darlington output transistor pair Q_{21} and Q_{22} to saturate.

The load can be connected between ground and output A with output B to the negative supply with output A to ground.

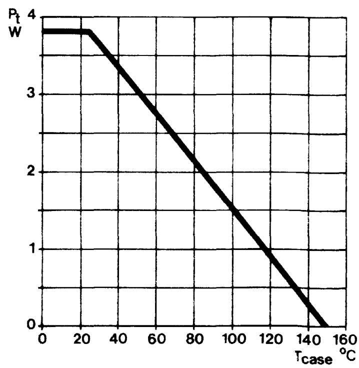
When PBD 3520 drives inductive loads, the switchoff transients must be suppressed by means of an external transient protector (e.g. clamping diode or RC network).



Derating curve for the power dissipation versus the ambient temperature

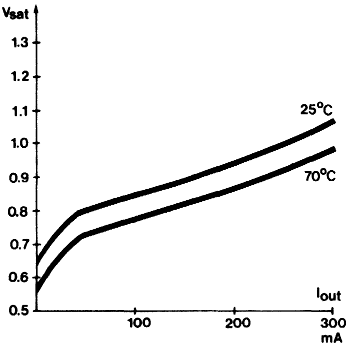


Derating curve for the power dissipation versus the case temperature



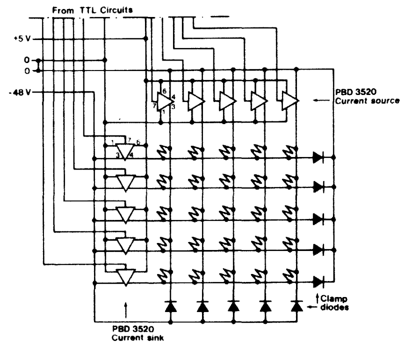
Typical characteristics

Collector-Emitter output saturation voltage versus output current



Typical application

PBD 3520 as an interface between TTL and a relay matrix. The TTL circuits drive PBD 3520 directly. Clamping diodes are needed at switch-off. Note that logic earth may differ from relay earth.



PBD 3523

RIFA

GENERAL DESCRIPTION

RIFA PBD 3523 series monolithic driving circuits are comprised of seven darlington stages per package, capable of sinking 500 mA continuously. Alternatively the total package can dissipate maximum 800 mW continuously. All outputs have integrated suppression diodes to handle transients from inductive loads. The inputs have the following features.

PBD 352301 has no serial input resistors. This driver may be fed direct from a current source. Alternatively an external resistor enables free choice of control voltage.

PBD 352302 has 14 kohms resistors in series with each input in order to limit the input current when driving direct from high voltage sources. (HTL/HHL/LSI, MOS, CMOS, operating with higher V_{CC}, V_{SS}, V_{DD}).

PBD 352303 has 2.5 kohms resistors in series with each input in order to limit the input current when driving direct from medium voltage sources. (CMOS operating at lower V_{DD} or DTL, TTL).

PBD 352304 has a zenerdiode input for increased noise immunity. (Compatible with HTL/HLL/LSI).

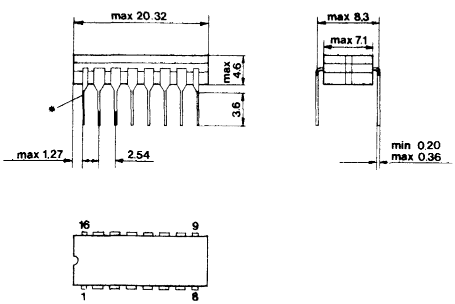
For increased current sinking capability the individual darlington stages of one package may be paralleled.

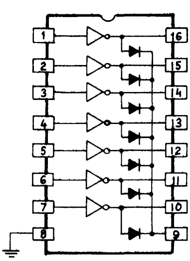
Key features

- Excellent driving capability for lamps, relays, printers, electromagnetic valves, clutches etc. Current sinking capability of 500 mA continuously.
- Integrated suppression diodes on all outputs.
- No free wheel diodes required across inductive loads.
- Low driving current required. Typical 250—300 μA.
- High packing density. Seven darlington stages per package.
- Small dimensions. 16-pin DIL package.

Mechanical data

16-pin dual-in-line (DIL) ceramic package (≈TO-116)





* Circuit board should be drilled to take 0.5 mm diameter pins

Note All dimensions in mm

Plastic packaging will be available in the future.

Maximum ratings

VOLTAGES AND CURRENTS	
Output voltage V_{OUT}	50 V
Input voltage V_{IN}	30 V
Output current I_{OUT} continuous	500 mA
Input current I_{IN} continuous	25 mA
POWER	
Dissipation at T_A 25°C	800 mW
(Note: Derate above 25°C, at the rate of 8 mW/°C, see figure 12)	
Peak power dissipation during 40 ms, duty cycle 15% at T_A 25°C	4 W
TEMPERATURE RANGES	
Storage temperature range	—55°C to +150°C
Operating ambient temperature range	0 to 70°C
Junction temperature T_j	+125°C

ELECTRICAL CHARACTERISTICS (at 25°C T_A unless otherwise noted)

Symbol	Parameter	Test Condition	Ref. fig.	Min	Max	Units
	Input current					
I_{IN}	PBD 352302	V_{IN}=17 V	1		1.3	mA
I_{IN}	PBD 352303	V_{IN}=3,85 V	1		1.3	mA
$V_{OUT(sat)}$	Output saturation voltage	I_{SINK}=350 mA, I_{IN}=500 μA	1		1.6	V
$V_{OUT(sat)}$		I_{SINK}=200 mA, I_{IN}=350 μA	1		1.3	V
I_{CEX}	Output leakage current	V_{OUT}=50 V, V_{IN}=0 V, T_A=70°C, V_{CC}=50 V	1		100	μA
I_{SINK}	Current through output	I_{IN}=50 μA, T_A=70°C	1		500	μA
	Output clamp diode					
V_F	Forward voltage	I_F=350 mA	3		2.0	V
$-I_R$	Leakage current	V_{CC}=50 V, V_{OUT}=1 V	2		50	μA
t_{PHL}	Delay times turn-on	V_{CC}=17 V	4.5		20	μs
t_{PLH}	turn-off	V_{CC}=17 V	4.5		20	μs

Order information

RIFA Order No.	Series input resistor	Encapsulation
PBD 352301 J	**None**	**Ceramic DIL**
PBD 352302 J	**14 kohms**	**Ceramic DIL**
PBD 352303 J	**2.5 kohms**	**Ceramic DIL**
PBD 352304 J	**Zenerdiode**	**Ceramic DIL**

DC and AC tests and waveforms

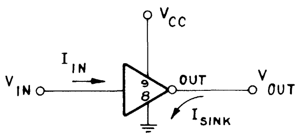


Figure 1

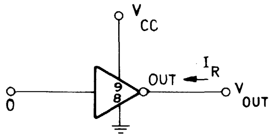


Figure 2

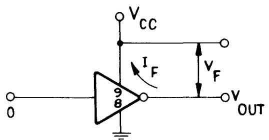


Figure 3

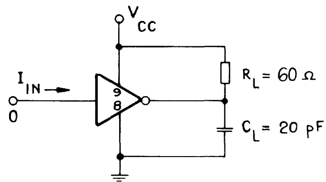


Figure 4

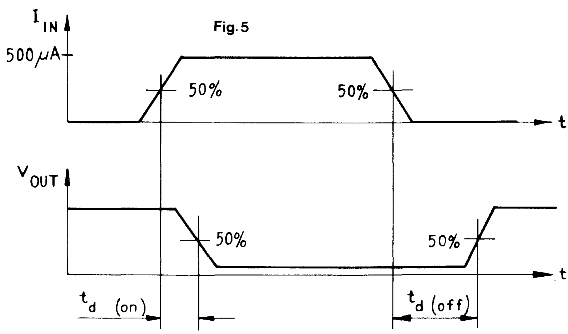


Figure 5

Typical applications

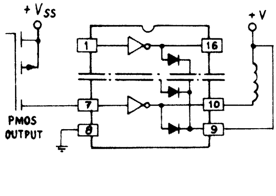


Figure 6

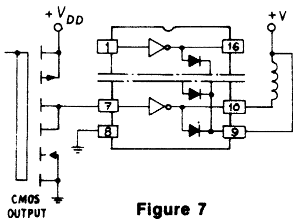


Figure 7

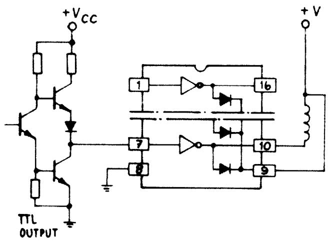
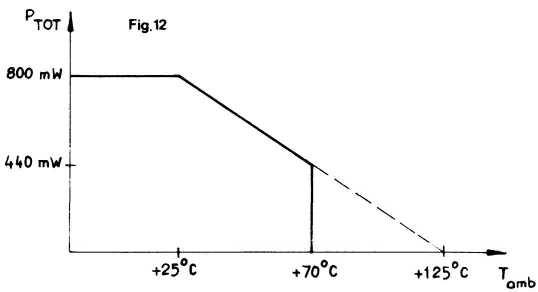


Figure 8

Power dissipating devating curve v ambient temperature



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