

Aluminium electrolytic capacitors Radial High Temperature

165 RHT

FEATURES

- Polarized aluminium electrolytic capacitors, non-solid
- Radial leads, cylindrical aluminium case with pressure relief, insulated with a blue sleeve
- Charge and discharge proof
- Very long useful life: 1500 hours at 125 °C, high stability, high reliability
- Extended temperature range up to 125 °C
- High ripple current capability.

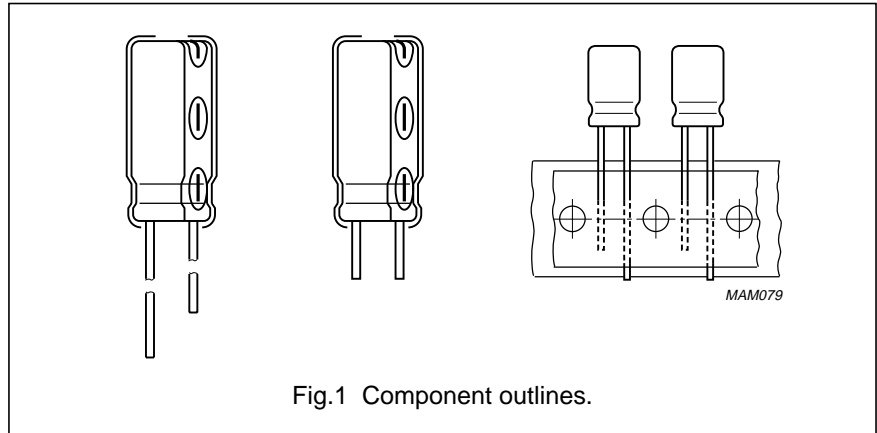
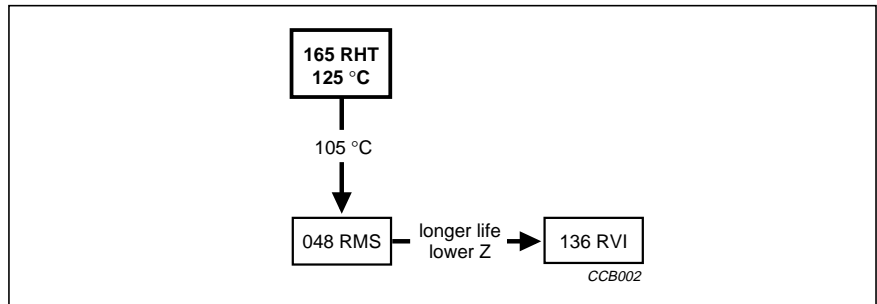


Fig.1 Component outlines.

APPLICATIONS

- EDP, telecommunication, industrial, automotive and military
- Smoothing, filtering, buffering in SMPS
- High ambient temperature environments.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 16 × 35
Rated capacitance range, C_R	22 to 4700 μ F
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	10 to 50 V
Category temperature range	-40 to +125 °C
Endurance test at 125 °C	1 000 hours
Useful life at 125 °C	1 500 hours
Useful life at 40 °C, $1.6 \times I_R$ applied	300 000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 384-4/CECC 30300
Climatic category IEC 68	40/125/56

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Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	35	40	50
22	–	–	–	–	–	10 × 12
47	–	–	–	–	10 × 12	10 × 16
100	–	–	10 × 12	10 × 16	10 × 20	12.5 × 20
220	10 × 12	10 × 16	10 × 20	–	12.5 × 20	16 × 25
470	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	16 × 35
1000	–	12.5 × 25	16 × 31	–	16 × 35	16 × 35
2200	16 × 31	16 × 35	16 × 35	–	–	–
3300	16 × 35	16 × 35	–	–	–	–
4700	16 × 35	–	–	–	–	–

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MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

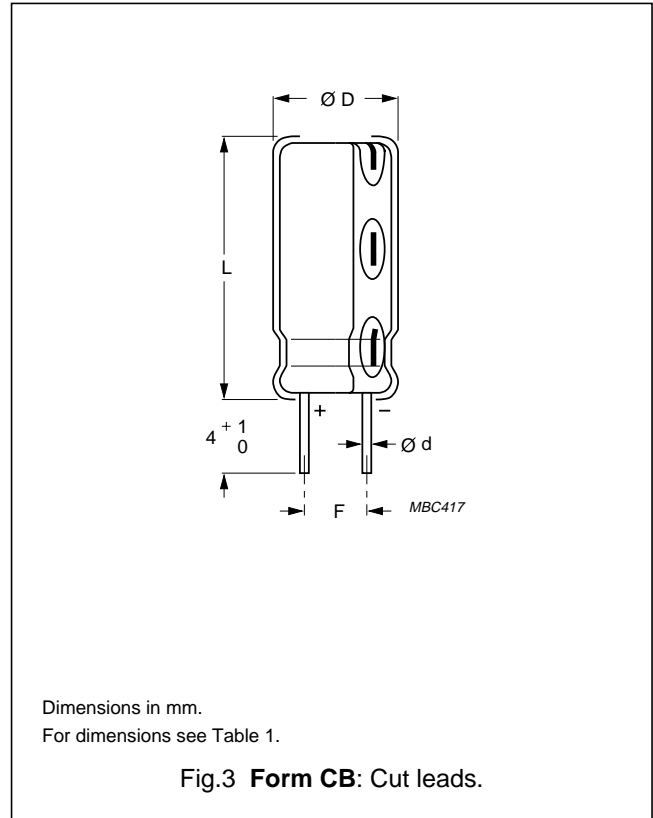
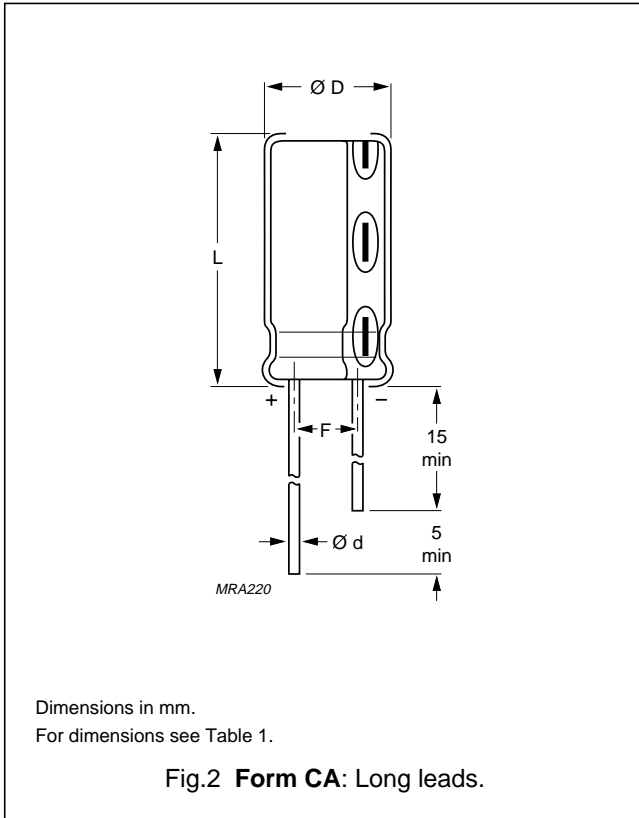


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

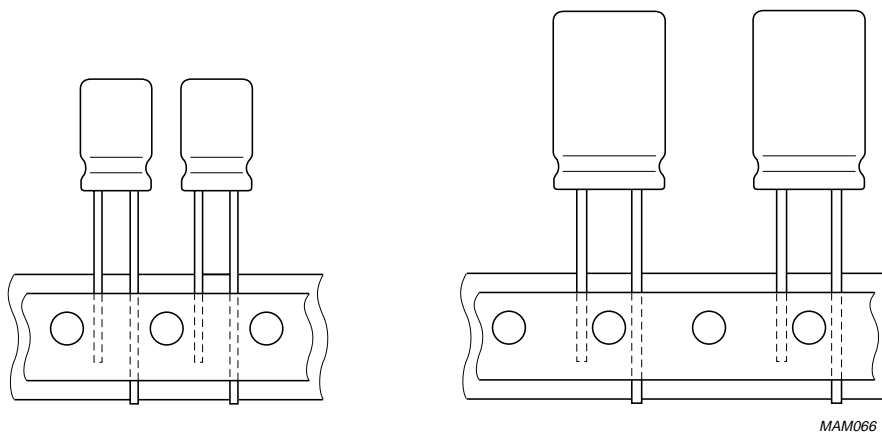
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES PER BOX		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ±0.5	≈1.6	1 000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ±0.5	≈1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ±0.5	≈2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ±0.5	≈4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ±0.5	≈5.0	250	250	500
16 × 25	19	0.8	16.5	27.0	7.5 ±0.5	≈8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ±0.5	≈9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ±0.5	≈11.5	100	100	–

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Taped products



Form TFA:

Case $\varnothing D \times L \leq 16 \times 31\text{mm}$.

Tape dimensions are specified in this handbook, Section "Packaging".

Fig.4 Taped in box (ammopack).

MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 62" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature ($125\text{ }^\circ\text{C}$)
- Group number (165)
- Code indicating factory of origin
- Name of manufacturer, PHILIPS
- Date code, in accordance with "IEC 62"
- Negative terminal identification.

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Ordering example

Electrolytic capacitor 165 series

220 $\mu\text{F}/25\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 10 \times 20\text{ mm}$; Form TFA

Catalogue number: 2222 165 36221.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20\text{ }^{\circ}\text{C}$,
 $P = 86\text{ to }106\text{ kPa}$, $\text{RH} = 45\text{ to }75\%$.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, $125\text{ }^{\circ}\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\text{Tan } \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\text{tan } \delta_{\text{max}}$ and C_R)
Z	max. impedance at 10 kHz or 100 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 125 $^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	FORM TFA
10	220	10 \times 12	14	200	25	7	0.20	1.30	–	0.55	165 54221	165 64221	165 34221
	470	10 \times 20	16	340	50	12	0.20	0.61	–	0.26	165 54471	165 64471	165 34471
	2200	16 \times 31	20	930	220	47	0.24	0.16	0.07	–	165 54222	165 64222	165 34222
	3300	16 \times 35	21	1200	330	69	0.26	0.11	0.05	–	165 54332	165 64332	–
	4700	16 \times 35	21	1400	470	97	0.28	0.09	0.04	–	165 90502	165 90507	–
16	220	10 \times 16	15	240	38	10	0.16	1.00	–	0.43	165 55221	165 65221	165 35221
	470	12.5 \times 20	17	410	78	18	0.16	0.49	–	0.20	165 55471	165 65471	165 35471
	1000	12.5 \times 25	18	650	160	35	0.16	0.23	–	0.10	165 55102	165 65102	165 35102
	2200	16 \times 35	21	1100	360	73	0.20	0.13	0.05	–	165 55222	165 65222	–
	3300	16 \times 35	21	1400	530	110	0.22	0.10	0.04	–	165 90503	165 90508	–
25	100	10 \times 12	14	170	28	8	0.14	2.00	–	0.70	165 56101	165 66101	165 36101
	220	10 \times 20	16	280	58	14	0.14	0.91	–	0.32	165 56221	165 66221	165 36221
	470	12.5 \times 25	18	480	120	27	0.14	0.43	–	0.15	165 56471	165 66471	165 36471
	1000	16 \times 31	20	830	250	53	0.14	0.20	–	0.07	165 56102	165 66102	165 36102
	2200	16 \times 35	21	1200	550	110	0.18	0.12	0.04	–	165 90504	165 90509	–

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U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 125 °C (mA)	I _{L1} 1 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	FORM TFA
35	100	10 × 16	15	200	38	10	0.12	1.70	–	0.65	165 50101	165 60101	165 30101
	470	16 × 25	19	600	170	36	0.12	0.37	–	0.14	165 50471	165 60471	165 30471
40	47	10 × 12	14	130	22	7	0.12	3.70	–	1.30	165 57479	165 67479	165 37479
	100	10 × 20	16	210	43	11	0.12	1.70	–	0.60	165 57101	165 67101	165 37101
	220	12.5 × 20	17	340	91	21	0.12	0.78	–	0.27	165 57221	165 67221	165 37221
	470	16 × 31	20	650	190	41	0.12	0.37	–	0.13	165 57471	165 67471	165 37471
	1000	16 × 35	21	1000	400	83	0.12	0.17	–	0.06	165 57102	165 67102	–
50	22	10 × 12	14	100	14	5	0.10	6.50	–	2.3	165 51229	165 61229	165 31229
	47	10 × 16	15	150	27	8	0.10	3.00	–	1.10	165 51479	165 61479	165 31479
	100	12.5 × 20	17	260	53	13	0.10	1.40	–	0.50	165 51101	165 61101	165 31101
	220	16 × 25	19	450	110	25	0.10	0.65	–	0.23	165 51221	165 61221	165 31221
	470	16 × 35	21	760	240	50	0.10	0.30	–	0.11	165 51471	165 61471	–
	1000	16 × 35	21	1200	500	100	0.10	0.14	–	0.05	165 90506	165 90512	–

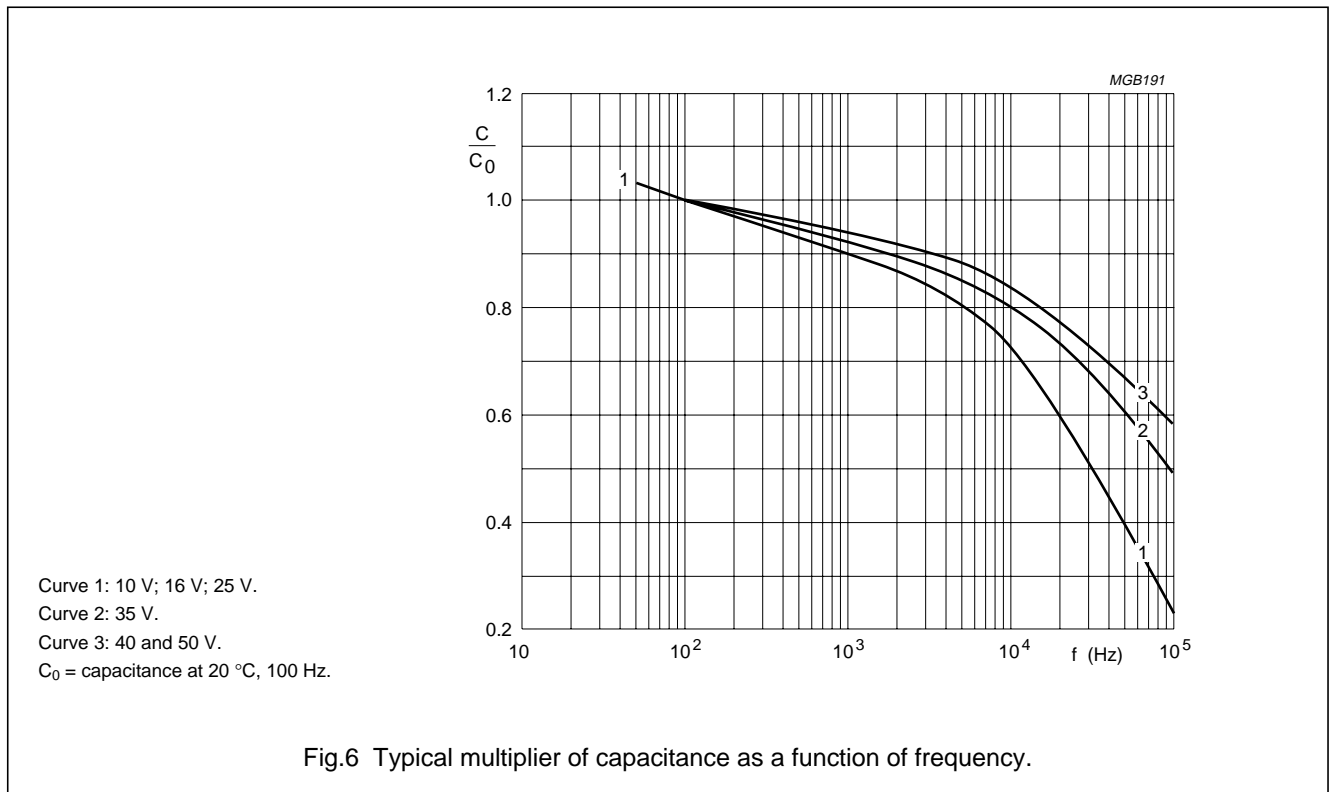
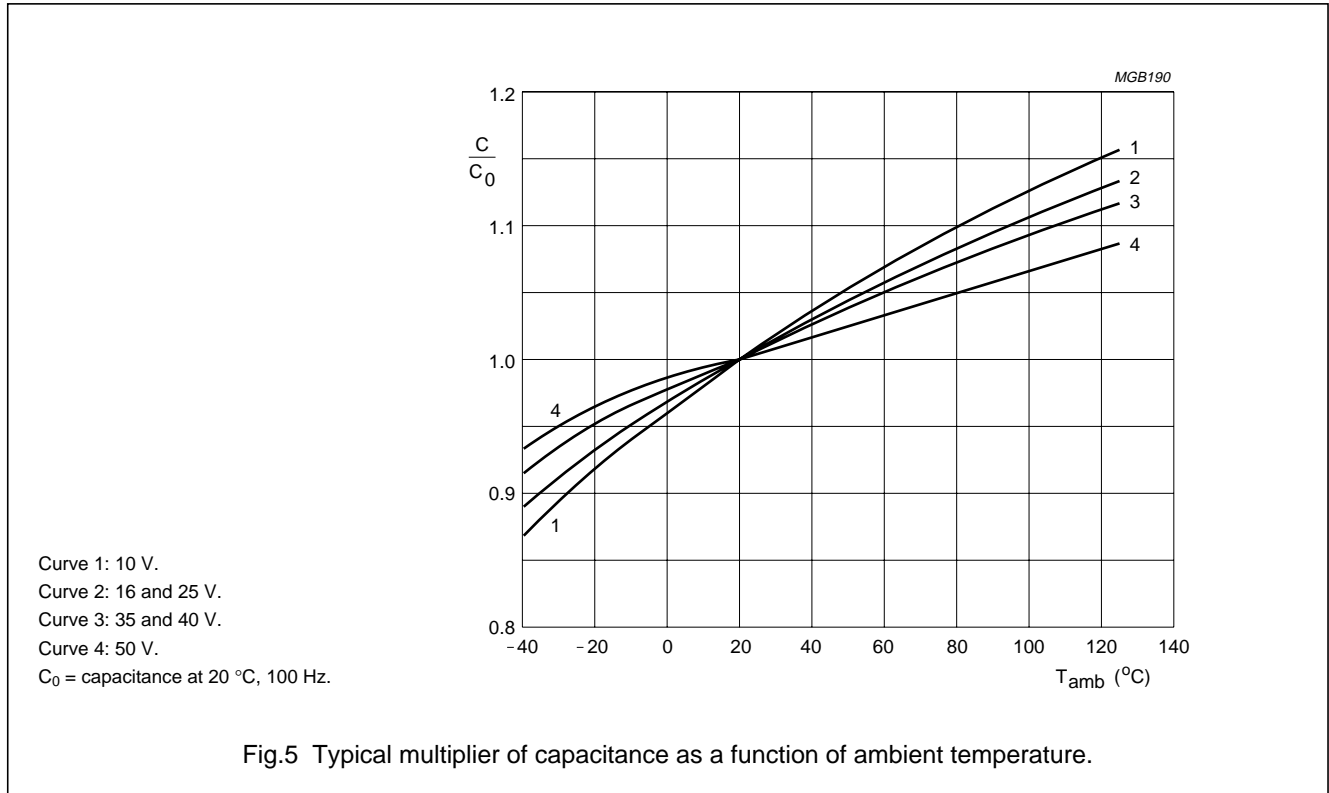
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods		$U_s \leq 1.3 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 1 minute at U _R	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu A$
	after 5 minutes at U _R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu A$
Inductance		
Equivalent series inductance (ESL)	case ∅D = 10 mm	typ. 16 nH
	case ∅D ≥ 12.5 mm	typ. 18 nH

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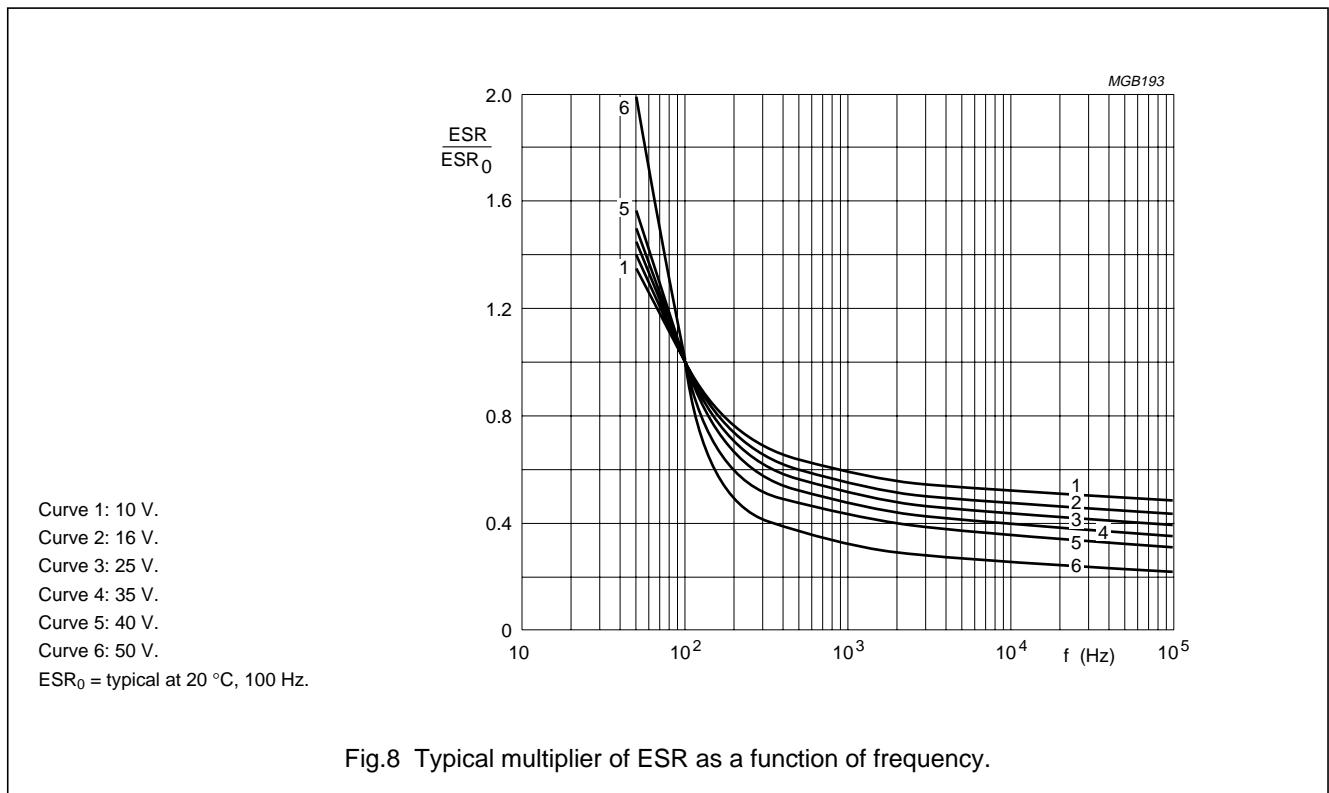
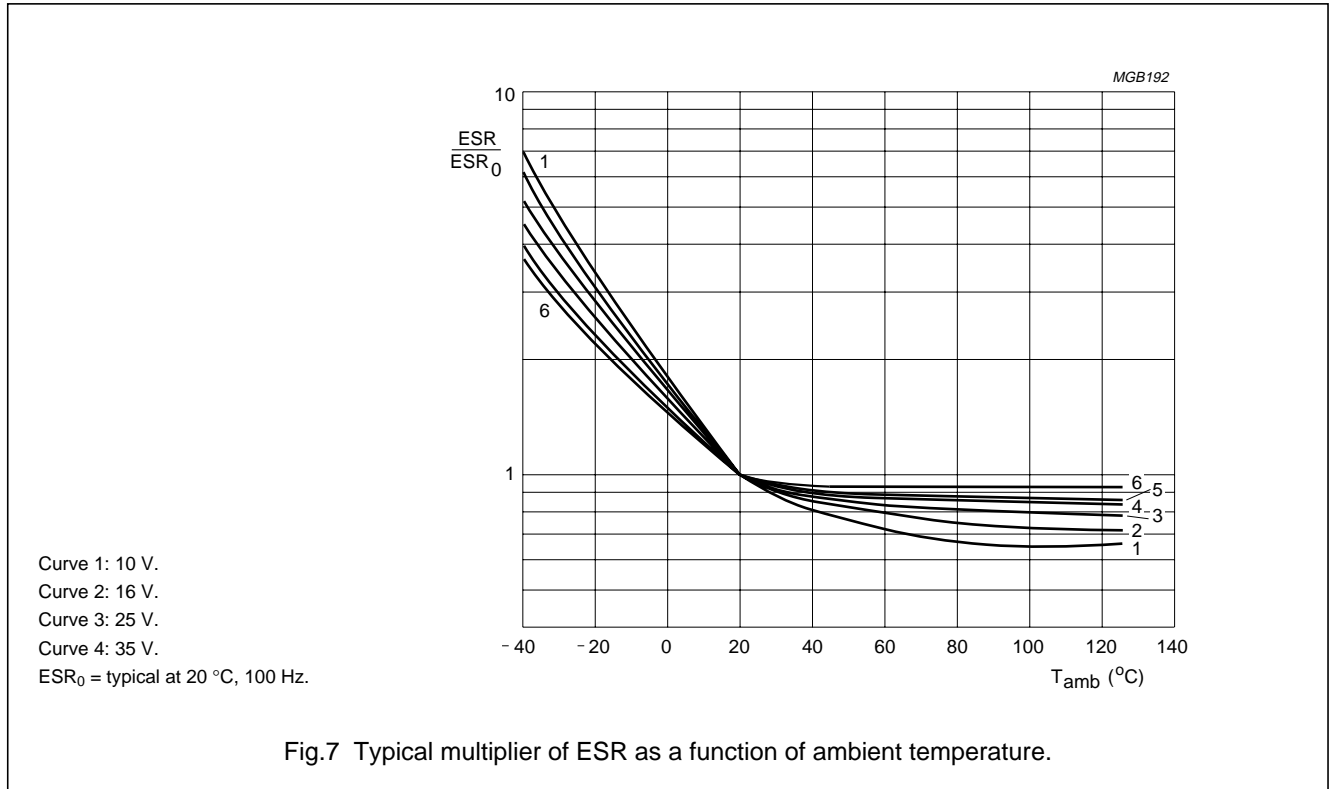
Capacitance (C)



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Equivalent series resistance (ESR)

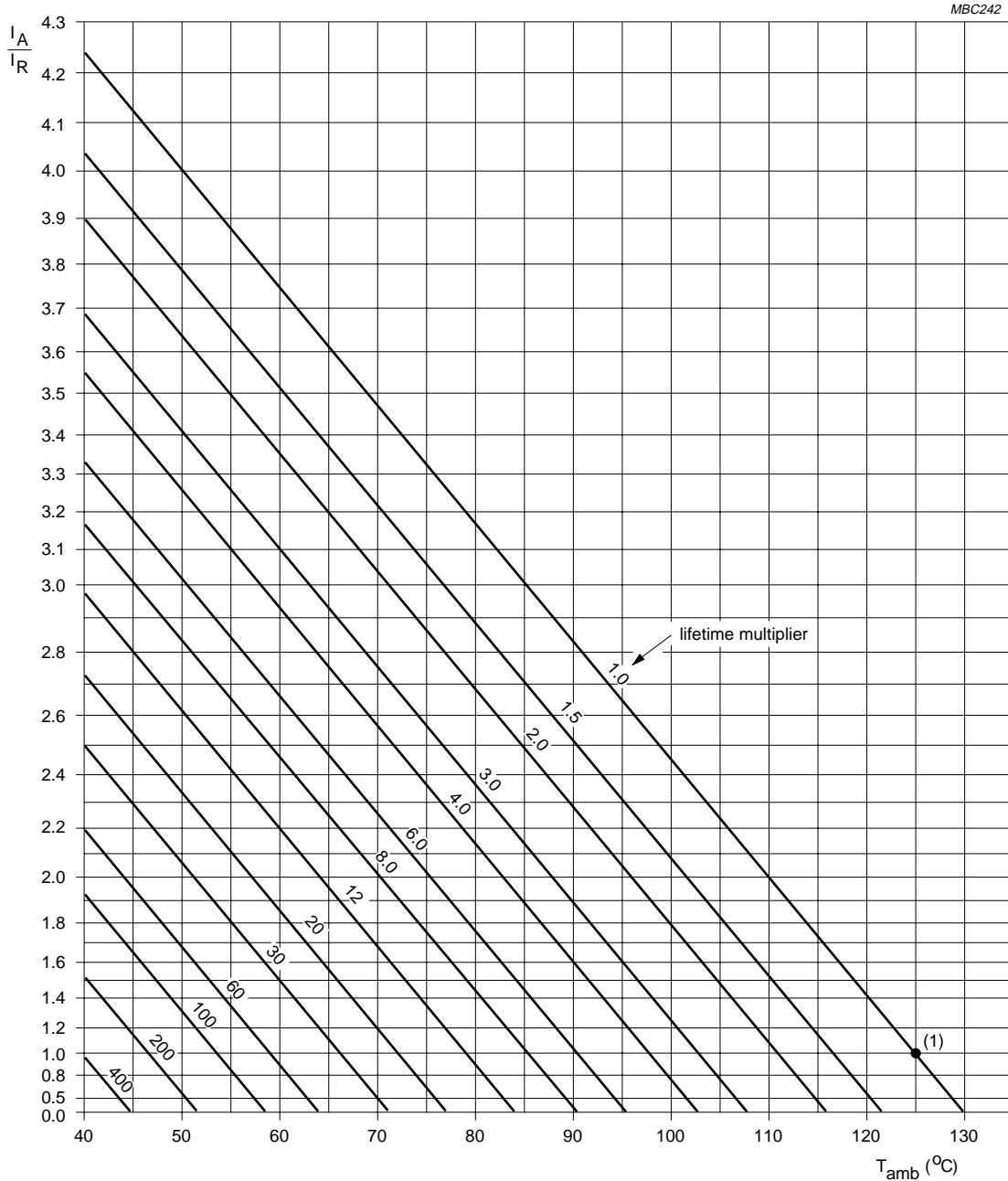


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RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 Hz.
 I_R = rated ripple current at 100 Hz, 125 °C.
 (1) Useful life at 125 °C and I_R applied: 1500 hours.

Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load; see Table 3.

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Table 3 Multiplier of ripple current (I_R/I_{R0}) as a function of frequency; I_{R0} = ripple current at 100 Hz; see Fig.9

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 35$ or 40 V	$U_R = 50$ V
50	0.85	0.80	0.75
100	1.00	1.00	1.00
300	1.20	1.25	1.30
1000	1.30	1.40	1.50
3000	1.35	1.50	1.65
≥ 10000	1.40	1.60	1.80

SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this handbook, Section "Tests and Requirements".

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 384-4/ CECC 30300 subclause 4.13	$T_{amb} = 125$ °C; U_R applied; 1000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 125$ °C; U_R and I_R applied; 1500 hours	$\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life	IEC 384-4/ CECC 30300 subclause 4.17	$T_{amb} = 125$ °C; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

R