

DATA SHEET

O48 RML
Aluminum electrolytic capacitors
Radial Miniature Long-Life

Product specification
Supersedes data of January 1998
File under BCcomponents, BC01

2000 Jan 18

Aluminum electrolytic capacitors Radial Miniature Long-Life

O48 RML

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume
- Very long useful life: 3000 to 4000 hours at 105 °C, high reliability.

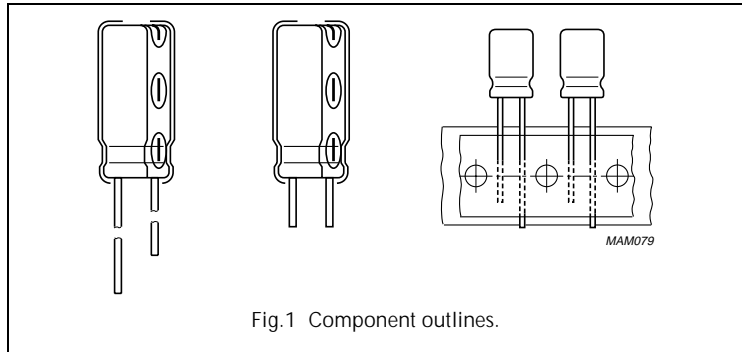
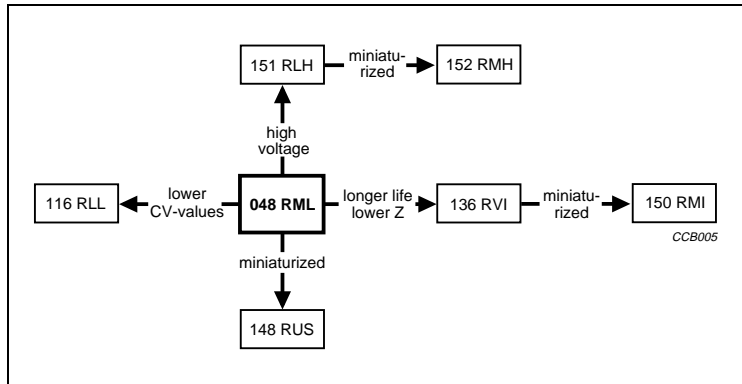


Fig.1 Component outlines.

APPLICATIONS

- EDP, telecommunication, industrial, automotive and audio-video
- Smoothing, filtering, buffering in SMPS, timing
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	100 to 10000 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	6.3 to 63 V
Category temperature range	-40 to +105 °C
Endurance test at 105 °C	2000 hours
Useful life at 105 °C: case $\varnothing D = 10$ and 12.5 mm case $\varnothing D = 16$ and 18 mm	3000 hours 4000 hours
Useful life at 40 °C, $1.6 \times I_R$ applied: case $\varnothing D = 10$ and 12.5 mm case $\varnothing D = 16$ and 18 mm	200000 hours 260000 hours
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

Aluminum electrolytic capacitors

Radial Miniature Long-Life

O48 RML

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)							
	6.3	10	16	25	35	40	50	63
100 ⁽¹⁾	–	–	–	–	–	–	–	10 × 12
220	–	–	–	–	10 × 12	–	10 × 16	10 × 20
330	–	–	–	–	–	–	–	12.5 × 20
470	–	–	10 × 12	10 × 16	10 × 20	–	12.5 × 20	12.5 × 25
1000	–	10 × 16	10 × 20	12.5 × 20	12.5 × 25	–	16 × 25	16 × 31
2200	–	12.5 × 20	12.5 × 25	16 × 25	16 × 31	16 × 35	18 × 35	18 × 35
3300	–	12.5 × 25	16 × 25	16 × 31	18 × 35	18 × 35	18 × 35	–
4700	–	16 × 25	16 × 31	18 × 35	18 × 35	–	–	–
6800	16 × 25	16 × 31	16 × 35	–	–	–	–	–
10000	16 × 35	18 × 35	18 × 35	–	–	–	–	–

Note

1. For lower CV-values see data sheet "116 RLL".

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

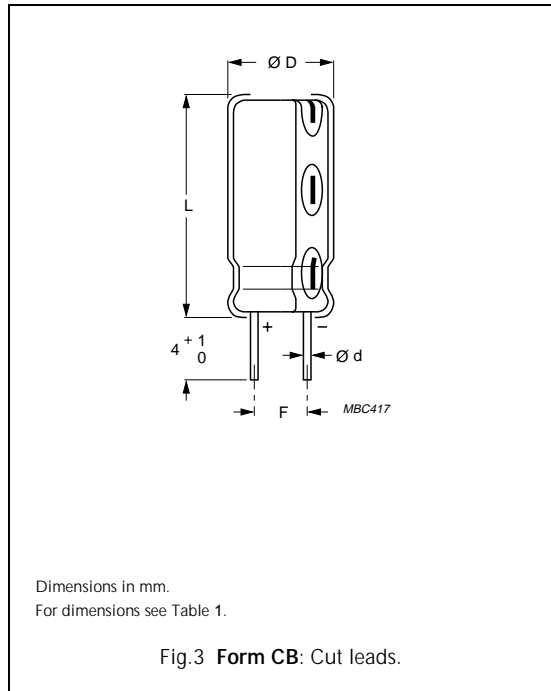
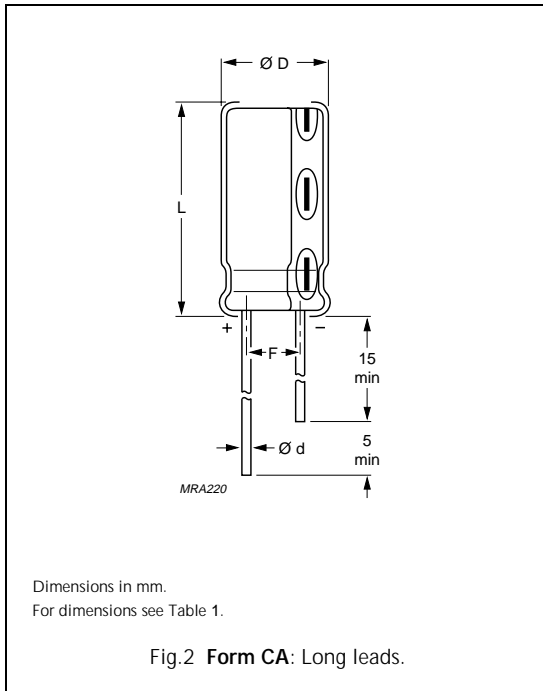


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

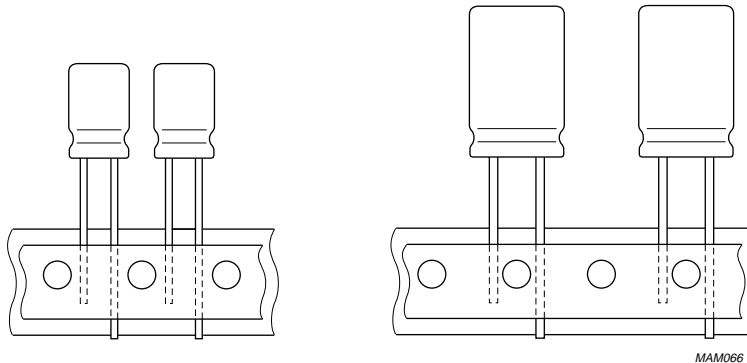
NOMINAL CASE SIZE ØD × L (mm)	CASEC ODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES PER BOX		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ±0.5	≈1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ±0.5	≈1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ±0.5	≈2.2	500	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	–
18 × 35	22	0.8	18.5	37.5	7.5 ±0.5	≈14.5	100	100	–

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

Taped products



Form TFA

Case $\varnothing D \times L \leq 16 \times 31$ 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 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (048)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

ELECTRICAL DATA AND ORDERING INFORMATION

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

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\tan \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\tan \delta_{max}$ and C_R)
Z	max. impedance at 10 kHz or 100 kHz

Ordering example

Electrolytic capacitor 048 series

2200 $\mu\text{F}/16\text{ V}$; $\pm 20\%$

Nominal case size: $\varnothing 12.5 \times 25\text{ mm}$; Form TFA

Catalogue number: 2222 048 35222.

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 105 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	Z 100 kHz (m Ω)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	FORM TFA
6.3	6800	16 × 25	19	1350	430	89	0.32	75	60	56	048 53682	048 63682	048 33682
	10000	16 × 35	21	1700	630	130	0.40	64	46	42	048 53103	048 63103	–
10	1000	10 × 16	15	470	100	23	0.19	300	220	180	048 54102	048 64102	048 34102
	2200	12.5 × 20	17	800	220	47	0.21	150	110	90	048 54222	048 64222	048 34222
	3300	12.5 × 25	18	1000	330	69	0.23	110	76	68	048 54332	048 64332	048 34332
	4700	16 × 25	19	1270	470	97	0.25	85	61	56	048 54472	048 64472	048 34472
	6800	16 × 31	20	1550	680	140	0.29	68	49	45	048 54682	048 64682	048 34682
	10000	18 × 35	22	1870	1000	200	0.37	59	40	36	048 54103	048 64103	–
16	470	10 × 12	14	360	78	18	0.16	540	340	250	048 55471	048 65471	048 35471
	1000	10 × 20	16	600	160	35	0.16	250	160	140	048 55102	048 65102	048 35102
	2200	12.5 × 25	18	1000	360	73	0.18	130	82	70	048 55222	048 65222	048 35222
	3300	16 × 25	19	1220	530	110	0.20	100	61	56	048 55332	048 65332	048 35332
	4700	16 × 31	20	1500	760	150	0.22	75	49	45	048 55472	048 65472	048 35472
	6800	16 × 35	21	1690	1100	220	0.26	61	46	42	048 55682	048 65682	–
	10000	18 × 35	22	1980	1600	320	0.34	54	38	34	048 55103	048 65103	–

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{L1} 1 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (mΩ)	Z 10 kHz (mΩ)	Z 100 kHz (mΩ)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	FORM TFA
25	470	10 × 16	15	440	120	27	0.14	470	240	180	048 56471	048 66471	048 36471
	1000	12.5 × 20	17	720	250	53	0.14	220	120	100	048 56102	048 66102	048 36102
	2200	16 × 25	19	1120	550	110	0.16	120	63	56	048 56222	048 66222	048 36222
	3300	16 × 31	20	1450	830	170	0.18	87	50	45	048 56332	048 66332	048 36332
	4700	18 × 35	22	1720	1200	240	0.20	68	40	36	048 56472	048 66472	–
35	220	10 × 12	14	310	80	18	0.12	870	360	280	048 50221	048 60221	048 30221
	470	10 × 20	16	500	170	36	0.12	410	170	150	048 50471	048 60471	048 30471
	1000	12.5 × 25	18	900	350	73	0.12	190	90	75	048 50102	048 60102	048 30102
	2200	16 × 31	20	1340	770	160	0.14	100	52	45	048 50222	048 60222	048 30222
	3300	18 × 35	22	1600	1200	230	0.16	77	42	36	048 50332	048 60332	–
	4700	18 × 35	22	1950	1600	330	0.18	61	40	34	048 50472	048 60472	–
40	2200	16 × 35	21	1500	880	180	0.13	94	48	45	048 57222	048 67222	–
	3300	18 × 35	22	1600	1300	270	0.15	72	40	36	048 57332	048 67332	–
50	220	10 × 16	15	340	110	25	0.10	720	300	250	048 51221	048 61221	048 31221
	470	12.5 × 20	17	620	240	50	0.10	340	130	110	048 51471	048 61471	048 31471
	1000	16 × 25	19	1030	500	100	0.10	160	70	60	048 51102	048 61102	048 31102
	2200	18 × 35	22	1500	1100	220	0.12	87	50	50	048 51222	048 61222	–
	3300	18 × 35	22	1900	1700	330	0.14	68	40	40	048 51332	048 61332	–
63	100	10 × 12	14	240	66	16	0.09	1400	550	310	048 58101	048 68101	048 38101
	220	10 × 20	16	400	140	31	0.09	650	250	200	048 58221	048 68221	048 38221
	330	12.5 × 20	17	550	210	45	0.09	430	170	120	048 58331	048 68331	048 38331
	470	12.5 × 25	18	700	300	62	0.09	300	110	80	048 58471	048 68471	048 38471
	1000	16 × 31	20	1150	630	130	0.09	140	55	49	048 58102	048 68102	048 38102
	2200	18 × 35	22	1600	1400	280	0.11	80	45	45	048 58222	048 68222	–

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

Additional electrical data

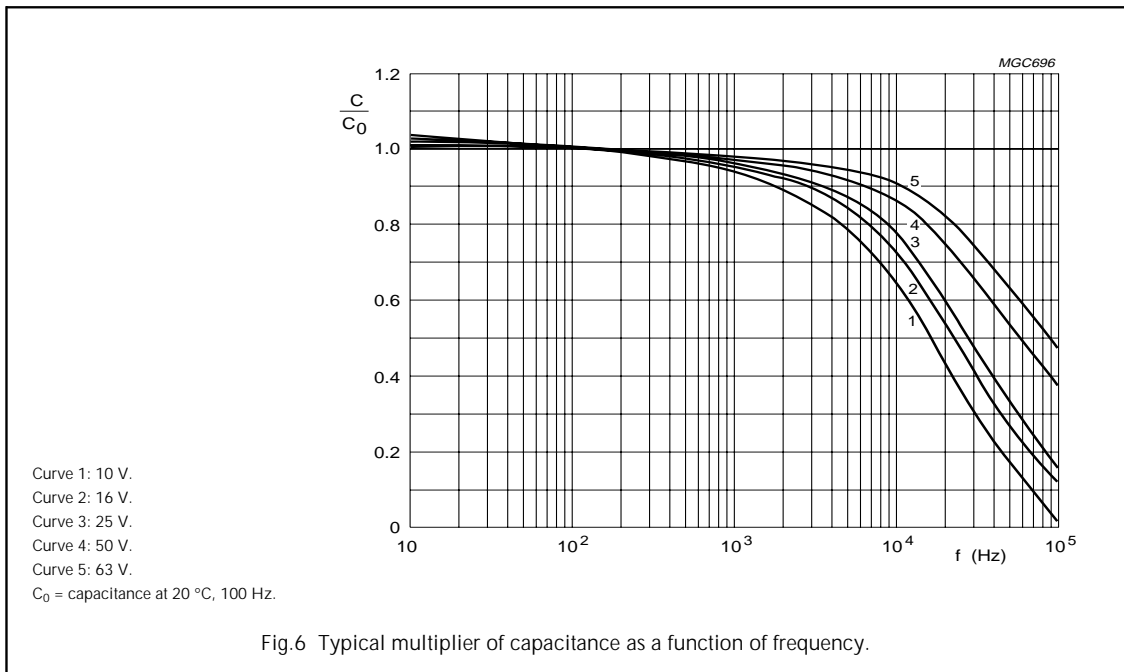
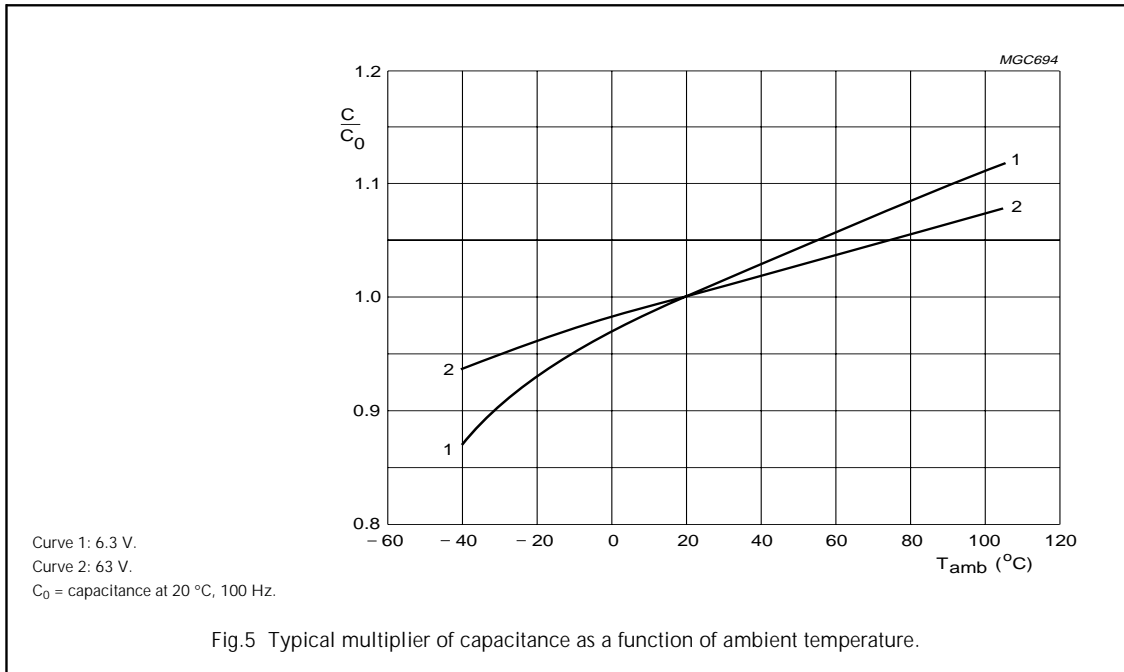
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

Capacitance (C)

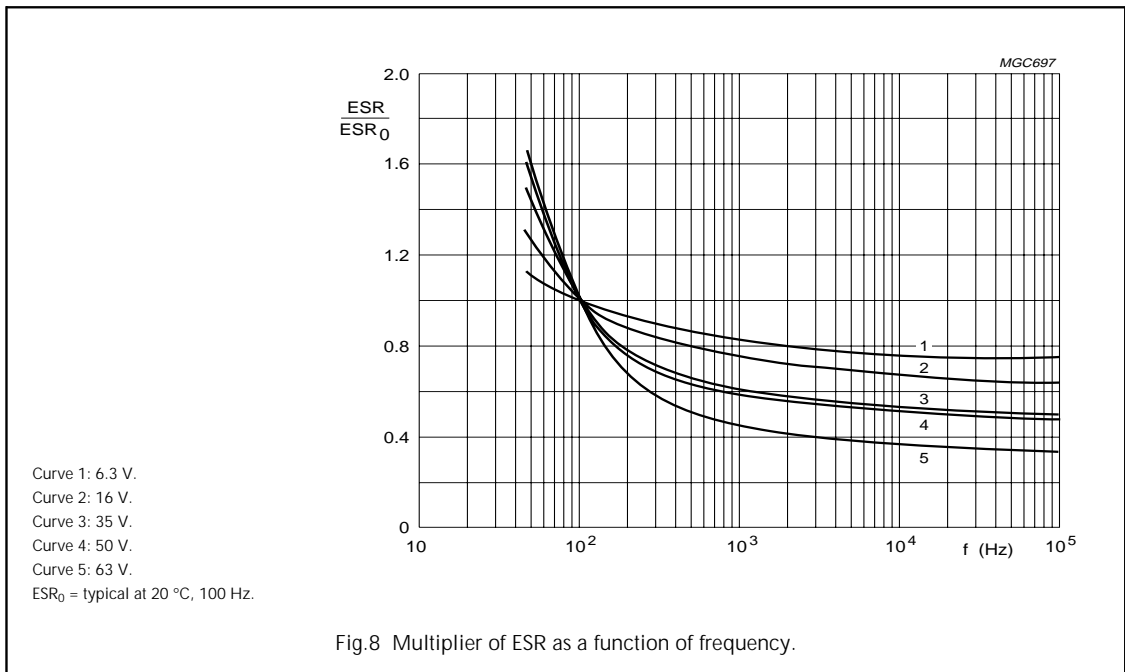
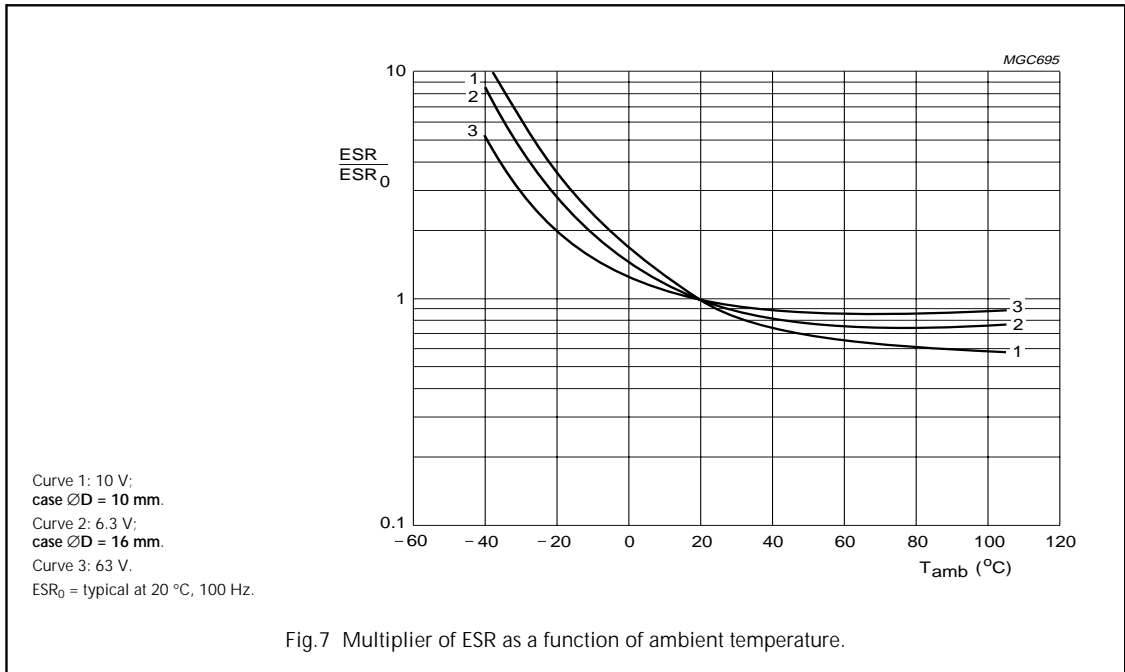


Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

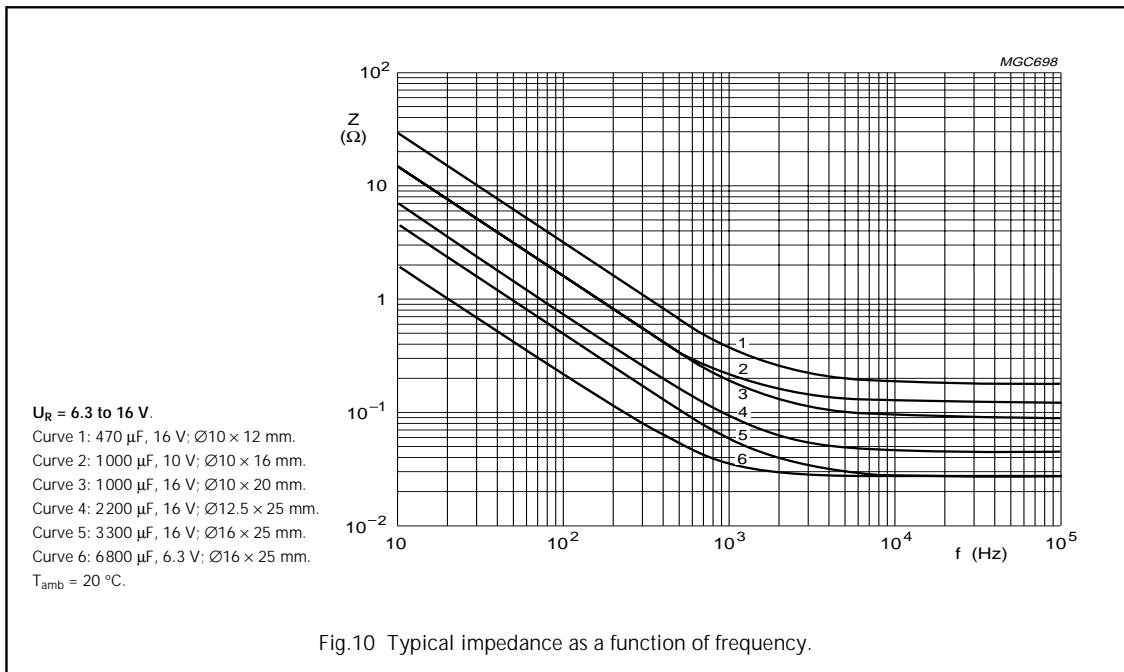
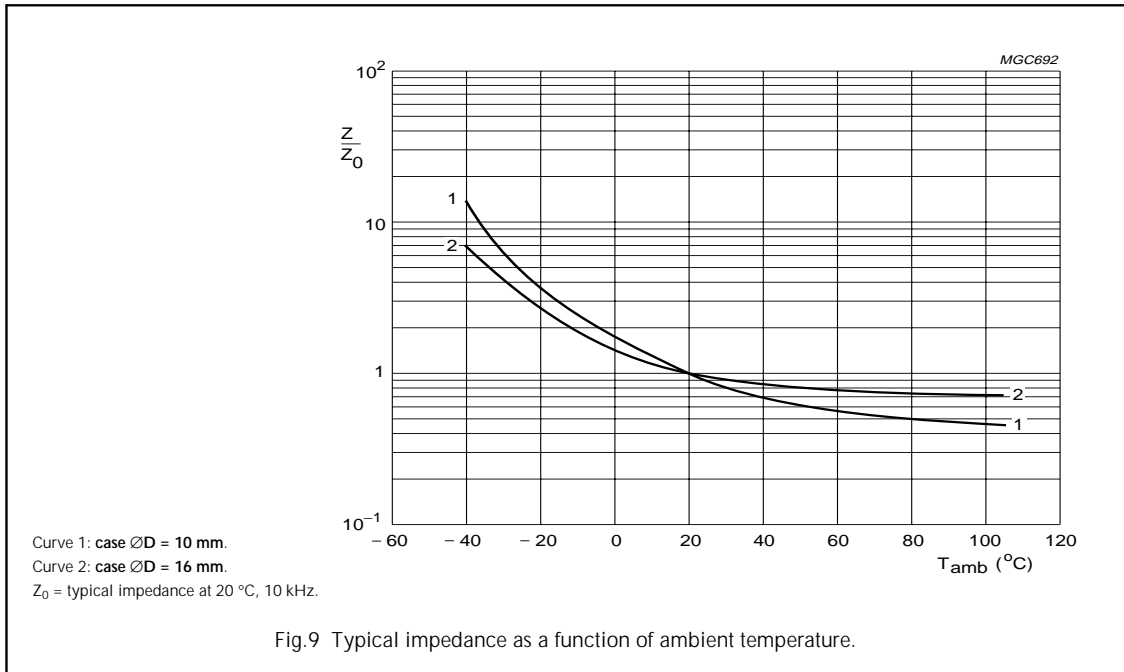
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors Radial Miniature Long-Life

048 RML

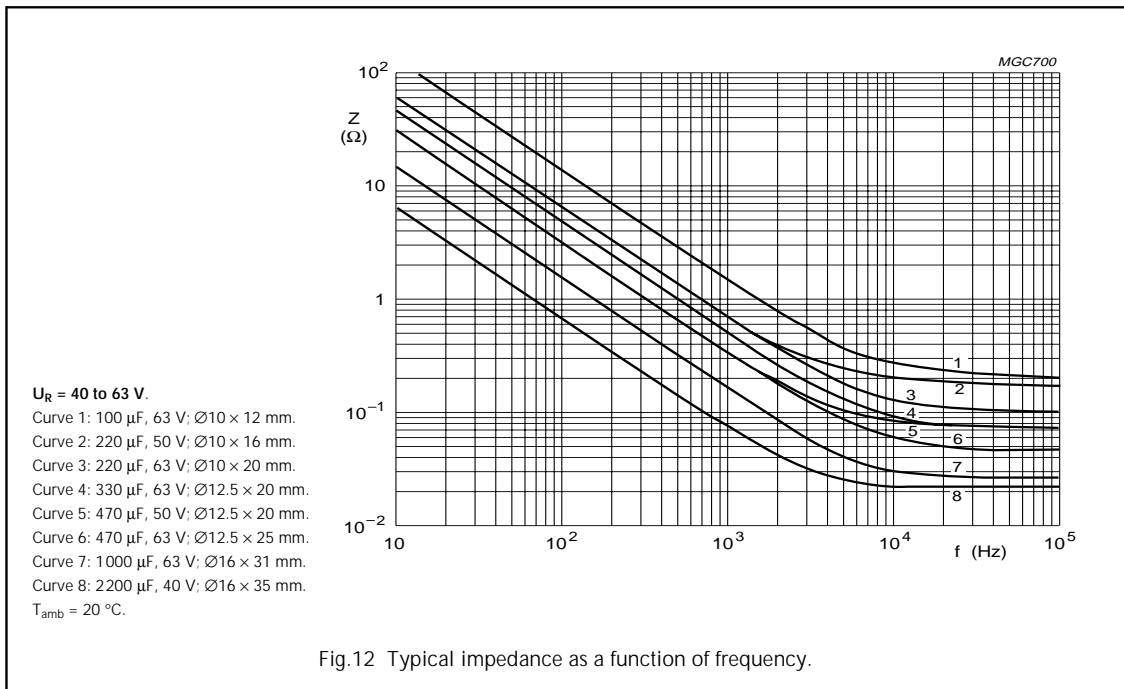
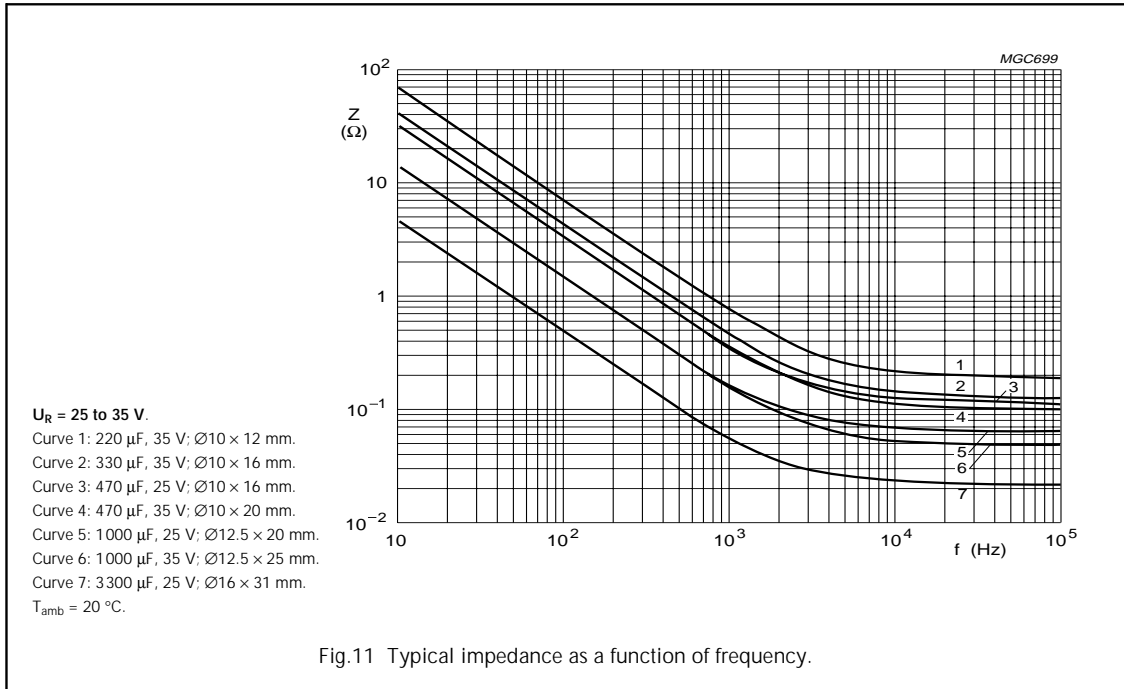
Impedance (Z)



Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML



Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 6.3$ to 25 V	$U_R = 35$ and 40 V	$U_R = 50$ and 63 V
50	0.95	0.85	0.80
100	1.00	1.00	1.00
300	1.07	1.20	1.25
1000	1.12	1.30	1.40
3000	1.15	1.35	1.50
≥ 10000	1.20	1.40	1.60

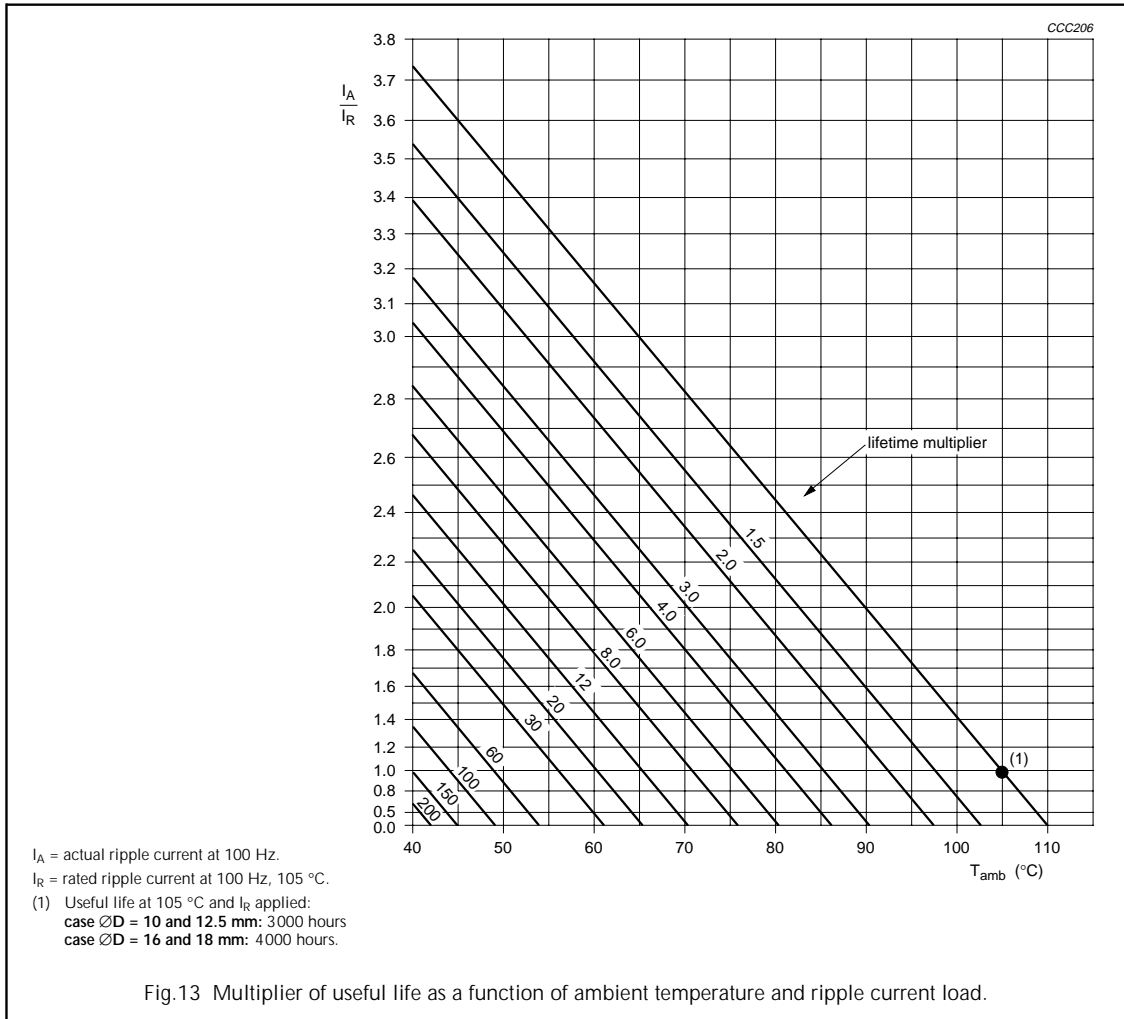


Fig.13 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

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 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ °C}$; U_R applied; 2000 hours	$U_R = 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; case $\varnothing D = 10$ and 12.5 mm : 3000 hours; case $\varnothing D = 16$ and 18 mm : 4000 hours	$U_R = 6.3\text{ V}$; $\Delta C/C$: +45/-50% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ °C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$U_R = 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$