

# Aluminium electrolytic capacitors

## Radial, Very Low Impedance

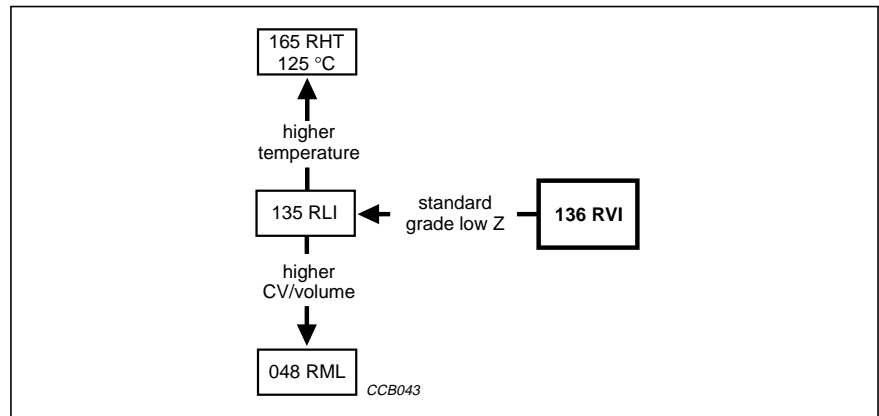
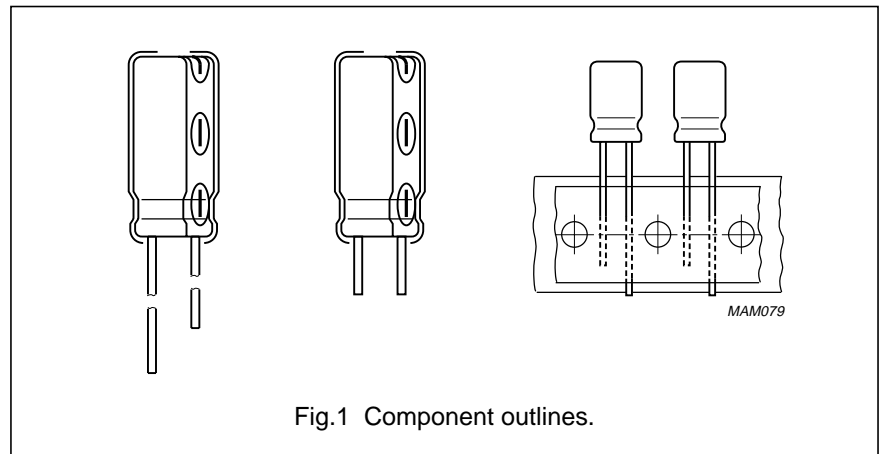
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### FEATURES

- Polarized aluminium electrolytic capacitors, non-solid
- Radial leads, cylindrical aluminium case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Very long useful life: 4000 to 10000 hours at 105 °C, very high reliability
- Very low impedance or ESR respectively, which is significantly lower than the RLI 135 series
- Excellent ripple current capability.

### APPLICATIONS

- Power supplies (SMPS, DC/DC converters) for general industrial, EDP, audio-video, automotive and telecommunications
- Smoothing, filtering, buffering.



### QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ( $\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, $C_R$	22 to 10000 $\mu F$
Tolerance on $C_R$	$\pm 20\%$
Rated voltage range, $C_R$	10 to 100 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C	3000 to 5000 hours (dependent on case size)
Useful life at 105 °C	4000 to 10000 hours (dependent on case size)
Useful life at 40 °C, $1.8 \times I_R$ applied	200000 to 500000 hours (dependent on case size)
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 384-4/CECC 30300
Climatic category IEC 68	55/105/56

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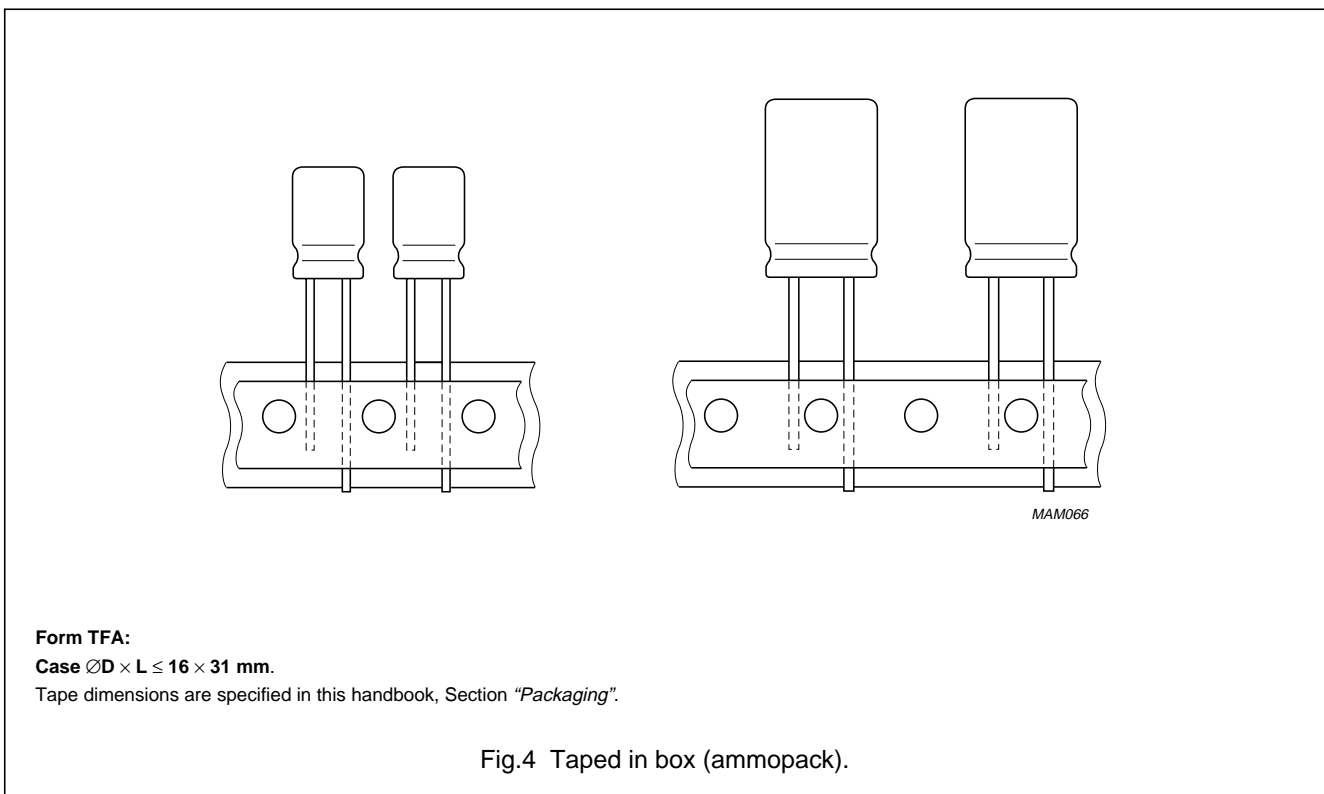
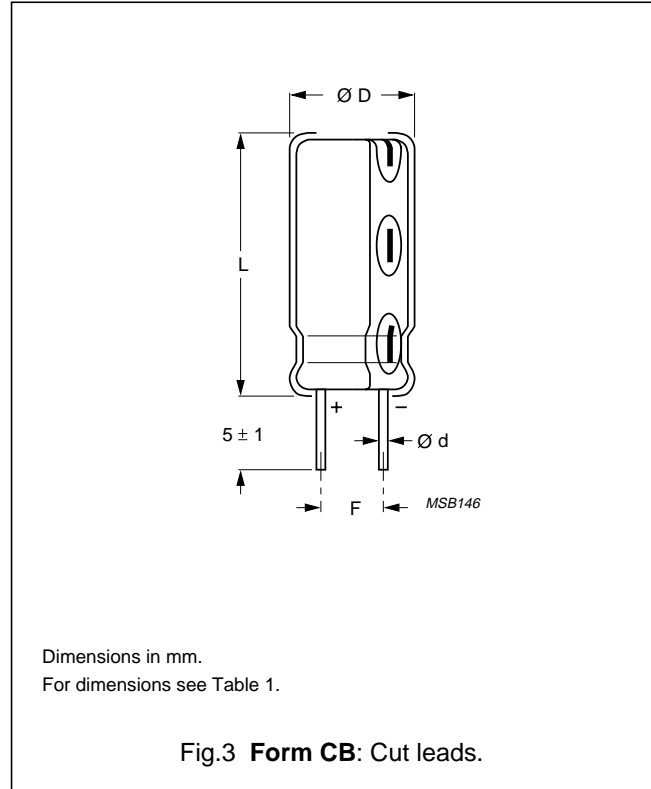
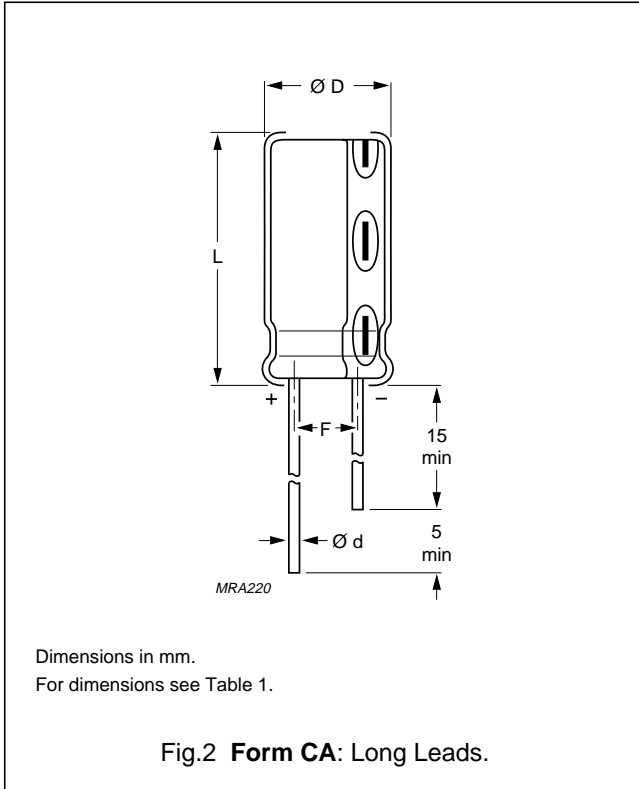
**Selection chart for  $C_R$ ,  $U_R$  and relevant nominal case sizes ( $\varnothing D_{nom} \times L_{nom}$  in mm). Preferred types in bold.**

$C_R$ ( $\mu F$ )	$U_R$ (V)						
	10	16	25	35	50	63	100
22	–	–	–	–	–	–	10 × 12
33	–	–	–	–	–	–	10 × 12
47	–	–	–	–	–	<b>10 × 12</b>	<b>10 × 16</b>
56	–	–	–	–	–	10 × 12	–
68	–	–	–	–	–	10 × 16	10 × 20
82	–	–	–	–	10 × 12	–	–
100	–	–	–	–	<b>10 × 12</b>	<b>10 × 16</b>	<b>12.5 × 20</b>
120	–	–	–	10 × 12	10 × 16	10 × 20	–
	–	–	–	–	–	12.5 × 16	–
150	–	–	–	10 × 12	10 × 20	10 × 25	16 × 20
180	–	–	10 × 12	–	10 × 20	10 × 30	–
	–	–	–	–	12.5 × 16	–	–
220	–	–	10 × 12	<b>10 × 16</b>	10 × 25	<b>12.5 × 20</b>	<b>16 × 25</b>
270	–	10 × 12	–	–	–	12.5 × 25	–
330	–	10 × 12	10 × 16	10 × 20	10 × 30	16 × 20	16 × 31
	–	–	–	12.5 × 16	12.5 × 20	–	–
390	10 × 12	–	–	10 × 25	–	12.5 × 31	–
470	10 × 12	<b>10 × 16</b>	<b>10 × 20</b>	12.5 × 20	<b>12.5 × 25</b>	<b>16 × 25</b>	<b>16 × 35</b>
	–	–	12.5 × 16	–	–	–	18 × 31
560	–	–	10 × 25	10 × 30	12.5 × 31	–	–
	–	–	–	12.5 × 20	–	–	–
680	10 × 16	10 × 20	–	12.5 × 25	16 × 20	16 × 31	18 × 35
	–	12.5 × 16	–	–	–	18 × 25	–
820	–	10 × 25	10 × 30	–	16 × 25	16 × 35	–
	–	–	12.5 × 20	–	–	–	–
1000	<b>10 × 20</b>	12.5 × 20	<b>12.5 × 25</b>	12.5 × 31	<b>16 × 31</b>	18 × 31	–
	12.5 × 16	–	–	<b>16 × 20</b>	18 × 20	–	–
1200	10 × 25	10 × 30	–	16 × 25	16 × 35	–	–
	–	12.5 × 20	–	–	–	–	–
1500	10 × 30	12.5 × 25	12.5 × 31	16 × 25	18 × 31	18 × 35	–
	12.5 × 20	–	16 × 20	–	–	–	–
1800	12.5 × 20	–	16 × 25	16 × 31	–	–	–
2200	<b>12.5 × 25</b>	12.5 × 31	16 × 31	<b>16 × 35</b>	18 × 35	–	–
	–	<b>16 × 20</b>	18 × 20	18 × 31	–	–	–
2700	12.5 × 31	16 × 25	16 × 31	–	–	–	–
	16 × 20	16 × 25	<b>16 × 35</b>	18 × 35	–	–	–
3300	–	–	18 × 31	–	–	–	–
	16 × 25	16 × 31	–	–	–	–	–
4700	16 × 31	<b>16 × 35</b>	18 × 35	–	–	–	–
	–	18 × 31	–	–	–	–	–
5600	16 × 31	–	–	–	–	–	–
	18 × 25	–	–	–	–	–	–
6800	16 × 35	18 × 35	–	–	–	–	–
	18 × 31	–	–	–	–	–	–
10000	18 × 35	–	–	–	–	–	–

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MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



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**Table 1** Physical dimensions mass and packaging quantities; see Figs 2, 3 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{\max}$ (mm)	$L_{\max}$ (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							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
10 × 25	16L	0.6	10.5	27.0	5.0 ±0.5	≈3.0	1000	1500	800
10 × 30	16LL	0.6	10.5	32.0	5.0 ±0.5	≈3.5	1000	750	–
12.5 × 16	17a	0.6	13.0	17.5	5.0 ±0.5	≈2.7	1000	1500	500
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
12.5 × 31	18L	0.6	13.0	33.5	5.0 ±0.5	≈5.5	1000	750	–
16 × 20	19a	0.8	16.5	22.0	7.5 ±0.5	≈6.0	250	250	250
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	≈11.0	100	100	–
18 × 20	1820	0.8	18.5	22.0	7.5 ±0.5	≈8.0	100	100	–
18 × 25	1825	0.8	18.5	27.0	7.5 ±0.5	≈10.0	100	100	–
18 × 31	1831	0.8	18.5	33.5	7.5 ±0.5	≈12.5	100	100	–
18 × 35	22	0.8	18.5	37.5	7.5 ±0.5	≈14.5	100	100	–

**MARKING**

The capacitors are marked with the following information:

- Rated capacitance (in  $\mu\text{F}$ )
- Tolerance on rated capacitance, code letter in accordance with "IEC 62" (M for  $\pm 20\%$ )
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (136)
- 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 136 series

1000  $\mu\text{F}/25\text{ V}$ ;  $\pm 20\%$ Nominal case size:  $\varnothing 12.5 \times 25\text{ mm}$ ; Form TFA

Catalogue number: 2222 136 36102.

## 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 kHz, $105\text{ }^\circ\text{C}$
$I_{L2}$	max. leakage current after 2 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 100 kHz and $+20$ or $-10\text{ }^\circ\text{C}$

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

$U_R$ (V)	$C_R$ 100 Hz ( $\mu\text{F}$ )	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$I_R$ 100 kHz 105 $^\circ\text{C}$ (mA)	$I_{L2}$ 2 min ( $\mu\text{A}$ )	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (m $\Omega$ )	Z 100 kHz $+20\text{ }^\circ\text{C}$ (m $\Omega$ )	Z 100 kHz $-10\text{ }^\circ\text{C}$ (m $\Omega$ )	CATALOGUE NUMBER 2222 ... ..		
										BULK PACKAGING		TAPED
										FORM CA	FORM CB	FORM TFA
10	390	10 $\times$ 12	14	630	39	0.19	780	120	240	136 54391	136 64391	136 34391
	470	10 $\times$ 12	14	630	47	0.19	640	120	240	136 54471	136 64471	136 34471
	680	10 $\times$ 16	15	830	68	0.19	450	84	170	136 54681	136 64681	136 34681
	<b>1000</b>	<b>10 <math>\times</math> 20</b>	<b>16</b>	1000	100	0.19	300	62	130	136 54102	<b>136 64102</b>	<b>136 34102</b>
	1000	12.5 $\times$ 16	17a	940	100	0.19	300	76	160	136 94105	136 94106	136 94103
	1200	10 $\times$ 25	16L	1300	120	0.19	250	52	110	136 54122	136 64122	136 34122
	1500	10 $\times$ 30	16LL	1400	150	0.19	200	44	88	136 94155	136 94156	–
	1500	12.5 $\times$ 20	17	1300	150	0.19	200	46	92	136 54152	136 64152	136 34152
	1800	12.5 $\times$ 20	17	1340	180	0.19	170	46	92	136 54182	136 64182	136 34182
	<b>2200</b>	<b>12.5 <math>\times</math> 25</b>	<b>18</b>	1700	220	0.21	150	34	68	136 54222	<b>136 64222</b>	<b>136 34222</b>
	2700	12.5 $\times$ 31	18L	2000	270	0.21	120	30	60	136 54272	136 64272	–
	3300	16 $\times$ 20	19a	1600	330	0.23	110	38	76	136 54332	136 64332	136 34332
	3900	16 $\times$ 25	19	2100	390	0.23	94	28	56	136 54392	136 64392	136 34392
	4700	16 $\times$ 31	20	2400	470	0.25	85	25	50	136 54472	136 64472	136 34472
	5600	16 $\times$ 31	20	2400	560	0.27	77	25	50	136 54562	136 64562	136 34562
	5600	18 $\times$ 25	1825	2270	560	0.27	77	25	50	136 94565	136 94566	–

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U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I <sub>R</sub> 100 kHz 105 °C (mA)	I <sub>L2</sub> 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (mΩ)	Z 100 kHz +20 °C (mΩ)	Z 100 kHz -10 °C (mΩ)	CATALOGUE NUMBER 2222 ... ..		
										BULK PACKAGING		TAPED
										FORM CA	FORM CB	FORM TFA
10	6800	16 × 35	21	2600	680	0.29	68	22	44	136 54682	136 64682	–
	6800	18 × 31	1831	2760	680	0.29	68	23	46	136 94685	136 94686	–
	10000	18 × 35	22	3 180	1000	0.31	49	21	42	136 54103	136 64103	–
16	270	10 × 12	14	630	43	0.16	940	120	240	136 55271	136 65271	136 35271
	330	10 × 12	14	630	53	0.16	770	120	240	136 55331	136 65331	136 35331
	<b>470</b>	<b>10 × 16</b>	<b>15</b>	830	75	0.16	540	84	170	136 55471	<b>136 65471</b>	<b>136 35471</b>
	680	10 × 20	16	1000	110	0.16	380	62	130	136 55681	136 65681	136 35681
	680	12.5 × 16	17a	940	110	0.16	380	76	160	136 95685	136 95686	136 95683
	820	10 × 25	16L	1300	130	0.16	310	52	110	136 55821	136 65821	136 35821
	1000	12.5 × 20	17	1300	160	0.16	260	48	96	136 55102	136 65102	136 35102
	1200	10 × 30	16LL	1400	190	0.16	210	44	88	136 95125	136 95126	–
	1200	12.5 × 20	17	1300	190	0.16	210	46	92	136 55122	136 65122	136 35122
	1500	12.5 × 25	18	1700	240	0.16	170	34	68	136 55152	136 65152	136 35152
	2200	12.5 × 31	18L	2000	350	0.18	130	30	60	136 95225	136 95226	–
	<b>2200</b>	<b>16 × 20</b>	<b>19a</b>	1600	350	0.18	130	38	76	136 55222	<b>136 65222</b>	<b>136 35222</b>
	2700	16 × 25	19	2100	430	0.18	110	28	56	136 55272	136 65272	136 35272
	3300	16 × 25	19	2100	530	0.20	97	28	56	136 55332	136 65332	136 35332
	3900	16 × 31	20	2400	620	0.20	82	25	50	136 55392	136 65392	136 35392
	<b>4700</b>	<b>16 × 35</b>	<b>21</b>	2600	750	0.22	75	22	44	136 55472	<b>136 65472</b>	–
4700	18 × 31	1831	2560	750	0.22	75	23	46	136 95475	136 95476	–	
6800	18 × 35	22	3000	1090	0.24	56	21	42	136 55682	136 65682	–	

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U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I <sub>R</sub> 100 kHz 105 °C (mA)	I <sub>L2</sub> 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (mΩ)	Z 100 kHz +20 °C (mΩ)	Z 100 kHz -10 °C (mΩ)	CATALOGUE NUMBER 2222 ... ..		
										BULK PACKAGING		TAPED
										FORM CA	FORM CB	FORM TFA
25	180	10 × 12	14	630	45	0.14	1200	120	240	136 56181	136 66181	136 36181
	220	10 × 12	14	630	55	0.14	1000	120	240	136 56221	136 66221	136 36221
	330	10 × 16	15	830	83	0.14	680	84	170	136 56331	136 66331	136 36331
	<b>470</b>	<b>10 × 20</b>	<b>16</b>	1000	120	0.14	470	62	130	136 56471	<b>136 66471</b>	<b>136 36471</b>
	470	12.5 × 16	17a	940	120	0.14	470	76	160	136 96475	136 96476	136 96473
	560	10 × 25	16L	1300	140	0.14	400	52	110	136 56561	136 66561	136 36561
	820	10 × 30	16LL	1400	210	0.14	270	44	88	136 96825	136 96826	-
	820	12.5 × 20	17	1300	210	0.14	270	46	92	136 56821	136 66821	136 36821
	<b>1000</b>	<b>12.5 × 25</b>	<b>18</b>	1700	250	0.14	220	34	68	136 56102	<b>136 66102</b>	<b>136 36102</b>
	1500	12.5 × 31	18L	2000	380	0.14	150	30	60	136 96155	136 96156	-
	1500	16 × 20	19a	1700	380	0.14	150	38	76	136 56152	136 66152	136 36152
	1800	16 × 25	19	2100	450	0.14	120	28	56	136 56182	136 66182	136 36182
	2200	16 × 31	20	2400	550	0.16	120	25	50	136 56222	136 66222	136 36222
	2200	18 × 20	1820	1680	550	0.16	116	28	56	136 96225	136 96226	-
	2700	16 × 31	20	2400	680	0.16	94	25	50	136 56272	136 66272	136 36272
	<b>3300</b>	<b>16 × 35</b>	<b>21</b>	2600	830	0.18	87	22	44	136 56332	<b>136 66332</b>	-
	3300	18 × 31	1831	2490	830	0.18	87	27	54	136 96335	136 96336	-
4700	18 × 35	22	3000	1180	0.20	68	21	42	136 56472	136 66472	-	
35	120	10 × 12	14	630	42	0.12	1600	120	240	136 50121	136 60121	136 30121
	150	10 × 12	14	630	53	0.12	1300	120	240	136 50151	136 60151	136 30151
	<b>220</b>	<b>10 × 16</b>	<b>15</b>	830	77	0.12	870	84	170	136 50221	<b>136 60221</b>	<b>136 30221</b>
	330	10 × 20	16	1000	120	0.12	580	62	130	136 50331	136 60331	136 30331
	330	12.5 × 16	17a	940	120	0.12	580	76	160	136 90335	136 90336	136 90333
	390	10 × 25	16L	1300	140	0.12	490	52	110	136 50391	136 60391	136 30391
	470	12.5 × 20	17	1300	170	0.12	410	48	96	136 50471	136 60471	136 30471
	560	10 × 30	16LL	1400	200	0.12	340	44	88	136 90565	136 90566	-
	560	12.5 × 20	17	1300	200	0.12	340	46	92	136 50561	136 60561	136 30561
	680	12.5 × 25	18	1700	240	0.12	280	34	68	136 50681	136 60681	136 30681
	1000	12.5 × 31	18L	2000	350	0.12	190	30	60	136 90105	136 90106	-

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										BULK PACKAGING		TAPED
										FORM CA	FORM CB	FORM TFA
35	<b>1000</b>	<b>16 × 20</b>	<b>19a</b>	1700	350	0.12	190	38	76	136 50102	<b>136 60102</b>	<b>136 30102</b>
	1200	16 × 25	19	2100	420	0.12	160	28	56	136 50122	136 60122	136 30122
	1500	16 × 25	19	2100	530	0.12	130	28	56	136 50152	136 60152	136 30152
	1800	16 × 31	20	2400	630	0.12	110	25	50	136 50182	136 60182	136 30182
	<b>2200</b>	<b>16 × 35</b>	<b>21</b>	2600	770	0.14	100	22	44	136 50222	<b>136 60222</b>	-
	2200	18 × 31	1831	2320	770	0.14	101	27	54	136 90225	136 90226	-
	3300	18 × 35	22	2890	1160	0.16	77	21	42	136 50332	136 60332	-
50	82	10 × 12	14	480	41	0.10	1900	200	400	136 51829	136 61829	136 31829
	<b>100</b>	<b>10 × 12</b>	<b>14</b>	480	50	0.10	1600	200	400	136 51101	<b>136 61101</b>	<b>136 31101</b>
	120	10 × 16	15	760	60	0.10	1300	100	200	136 51121	136 61121	136 31121
	150	10 × 20	16	850	75	0.10	1100	90	180	136 51151	136 61151	136 31151
	180	10 × 20	16	950	90	0.10	880	75	150	136 51181	136 61181	136 31181
	180	12.5 × 16	17a	780	90	0.10	880	110	120	136 91185	136 91186	136 91183
	220	10 × 25	16L	1200	110	0.10	720	63	130	136 51221	136 61221	136 31221
	330	10 × 30	16LL	1300	170	0.10	480	54	110	136 91335	136 91336	-
	330	12.5 × 20	17	1200	170	0.10	480	59	120	136 51331	136 61331	136 31331
	<b>470</b>	<b>12.5 × 25</b>	<b>18</b>	1500	240	0.10	340	44	88	136 51471	<b>136 61471</b>	<b>136 31471</b>
	560	12.5 × 31	18L	1700	280	0.10	280	39	78	136 51561	136 61561	-
	680	16 × 20	19a	1400	340	0.10	230	50	100	136 51681	136 61681	136 31681
	820	16 × 25	19	1900	410	0.10	190	34	68	136 51821	136 61821	136 31821
	<b>1000</b>	<b>16 × 31</b>	<b>20</b>	2200	500	0.10	160	30	60	136 51102	<b>136 61102</b>	<b>136 31102</b>
	1000	18 × 20	1820	1510	500	0.10	159	41	82	136 91105	136 91106	-
	1200	16 × 35	21	2300	600	0.10	130	27	54	136 51122	136 61122	-
	1500	18 × 31	1831	2200	750	0.10	106	31	62	136 51152	136 61152	-
	2200	18 × 35	22	2650	1100	0.12	87	27	54	136 51222	136 61222	-



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U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I <sub>R</sub> 100 kHz 105 °C (mA)	I <sub>L2</sub> 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (mΩ)	Z 100 kHz +20 °C (mΩ)	Z 100 kHz -10 °C (mΩ)	CATALOGUE NUMBER 2222 ... ..		
										BULK PACKAGING		TAPED
										FORM CA	FORM CB	FORM TFA
63	<b>47</b>	<b>10 × 12</b>	<b>14</b>	380	30	0.10	3400	300	750	136 58479	<b>136 68479</b>	<b>136 38479</b>
	56	10 × 12	14	420	35	0.10	2800	270	680	136 58569	136 68569	136 38569
	68	10 × 16	15	520	43	0.10	2300	210	530	136 58689	136 68689	136 38689
	<b>100</b>	<b>10 × 16</b>	<b>15</b>	580	63	0.10	1600	190	480	136 58101	<b>136 68101</b>	<b>136 38101</b>
	120	10 × 20	16	650	76	0.10	1300	160	400	136 58121	136 68121	136 38121
	120	12.5 × 16	17a	610	76	0.10	1300	180	450	136 98125	136 98126	136 98123
	150	10 × 25	16L	780	95	0.10	1100	130	330	136 58151	136 68151	136 38151
	180	10 × 30	16LL	960	110	0.10	880	100	250	136 58181	136 68181	-
	<b>220</b>	<b>12.5 × 20</b>	<b>17</b>	870	140	0.10	720	110	280	136 58221	<b>136 68221</b>	<b>136 38221</b>
	270	12.5 × 25	18	1200	170	0.10	590	74	190	136 58271	136 68271	136 38271
	330	16 × 20	19a	1100	210	0.10	480	85	220	136 58331	136 68331	136 38331
	390	12.5 × 31	18L	1300	250	0.10	410	68	170	136 58391	136 68391	-
	<b>470</b>	<b>16 × 25</b>	<b>19</b>	1500	300	0.10	340	55	140	136 58471	<b>136 68471</b>	<b>136 38471</b>
	680	16 × 31	20	1700	430	0.10	230	46	120	136 58681	136 68681	136 38681
	680	18 × 25	1825	1470	430	0.10	234	54	108	136 98685	136 98686	-
	820	16 × 35	21	1900	520	0.10	190	40	100	136 58821	136 68821	-
	1000	18 × 31	1831	1950	630	0.10	159	39	78	136 58102	136 68102	-
	1500	18 × 35	22	2350	950	0.10	106	33	66	136 58152	136 68152	-
100	22	10 × 12	14	300	22	0.07	5100	450	2300	136 59229	136 69229	136 39229
	33	10 × 12	14	320	33	0.07	3400	390	2000	136 59339	136 69339	136 39339
	<b>47</b>	<b>10 × 16</b>	<b>15</b>	450	47	0.07	2400	320	1600	136 59479	<b>136 69479</b>	<b>136 39479</b>
	68	10 × 20	16	520	68	0.07	1600	240	1200	136 59689	136 69689	136 39689
	<b>100</b>	<b>12.5 × 20</b>	<b>17</b>	800	100	0.07	1100	150	750	136 59101	<b>136 69101</b>	<b>136 39101</b>
	150	16 × 20	19a	1000	150	0.07	740	110	550	136 59151	136 69151	136 39151
	<b>220</b>	<b>16 × 25</b>	<b>19</b>	1300	220	0.07	510	81	400	136 59221	<b>136 69221</b>	<b>136 39221</b>
	330	16 × 31	20	1600	330	0.07	340	58	290	136 59331	136 69331	136 39331
	470	16 × 35	21	1800	470	0.07	240	45	230	136 59471	136 69471	-
	470	18 × 31	1831	1800	470	0.07	240	45	230	136 99475	136 99476	-
680	18 × 35	22	2000	680	0.07	160	39	200	136 59681	136 69681	-	

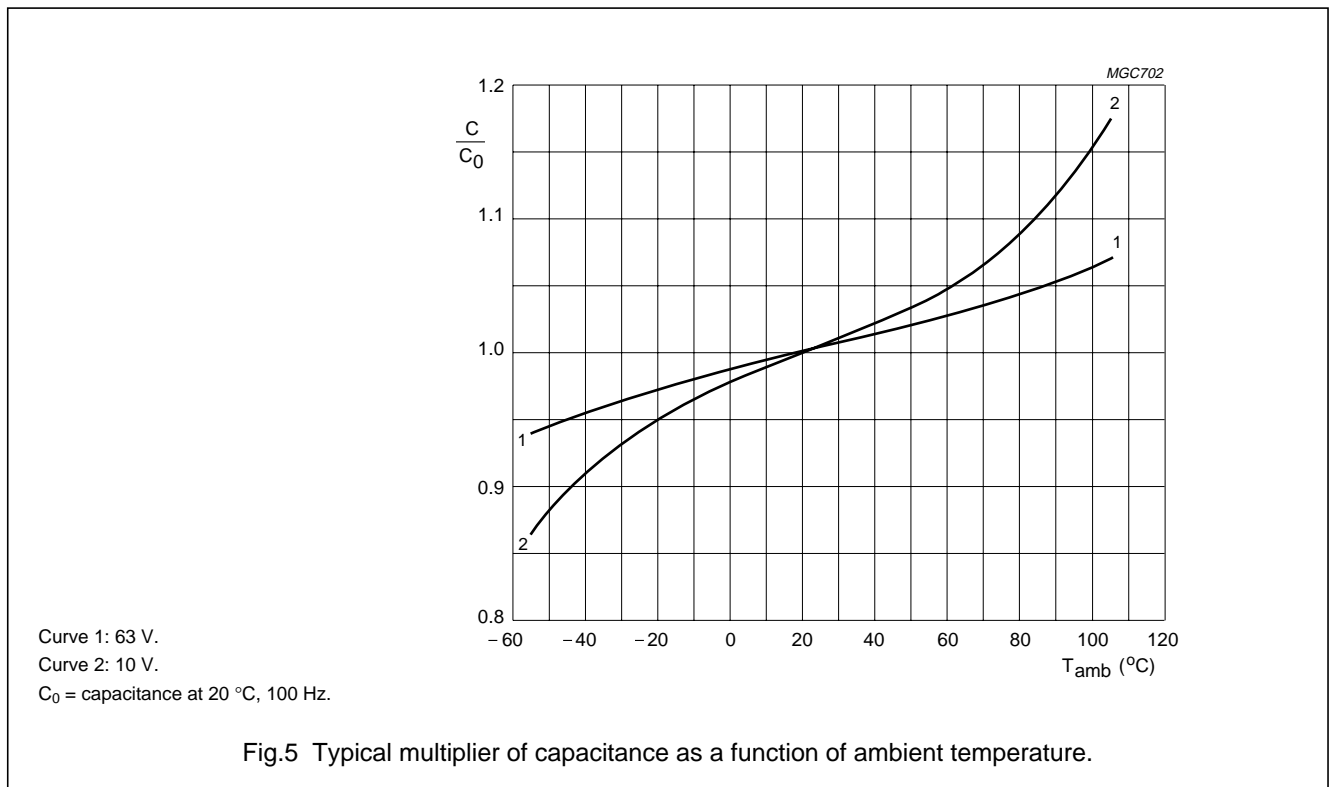
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Additional electrical data

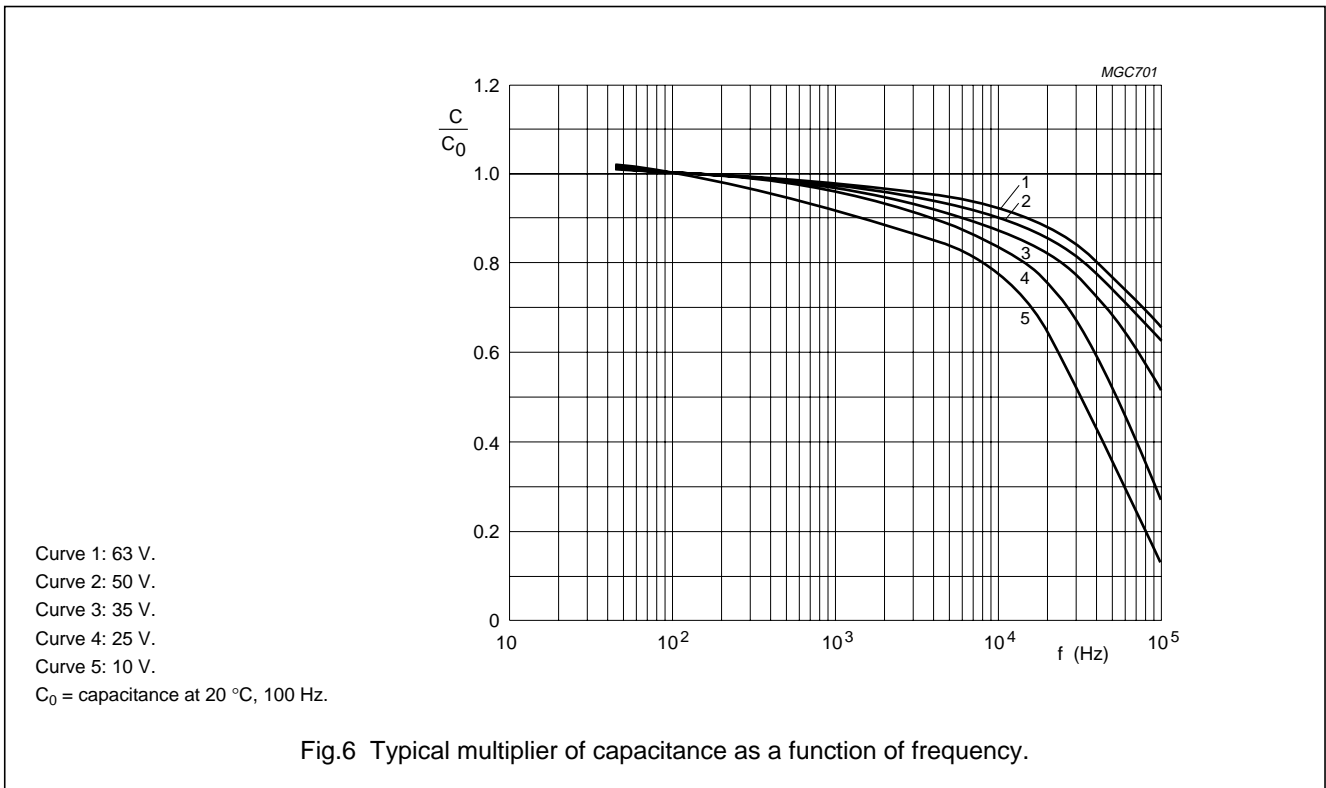
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage for short periods		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
<b>Current</b>		
Leakage current	after 2 minutes at $U_R$	$I_{L2} \leq 0.01C_R \times U_R$ or $3 \mu\text{A}$ , whichever is greater
<b>Inductance</b>		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

Capacitance (C)

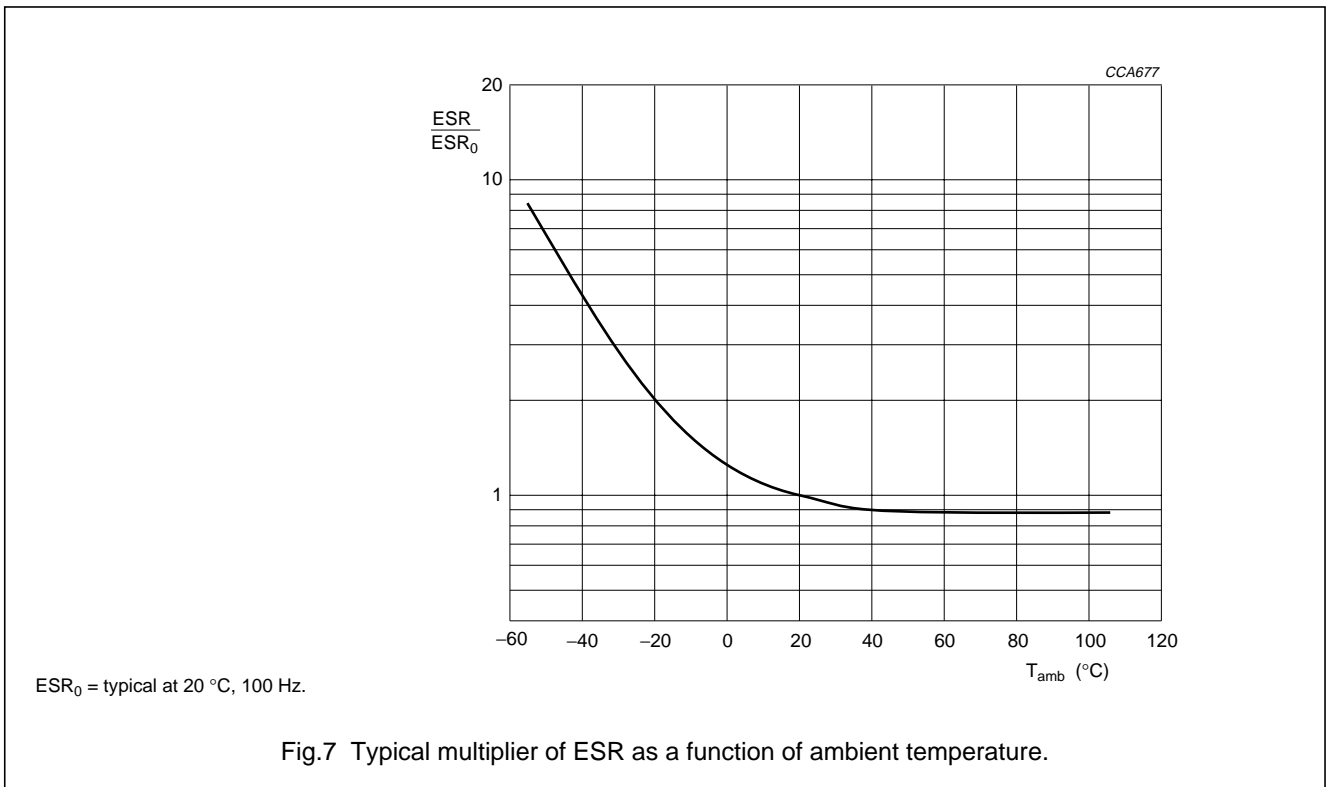


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Equivalent series resistance (ESR)



R

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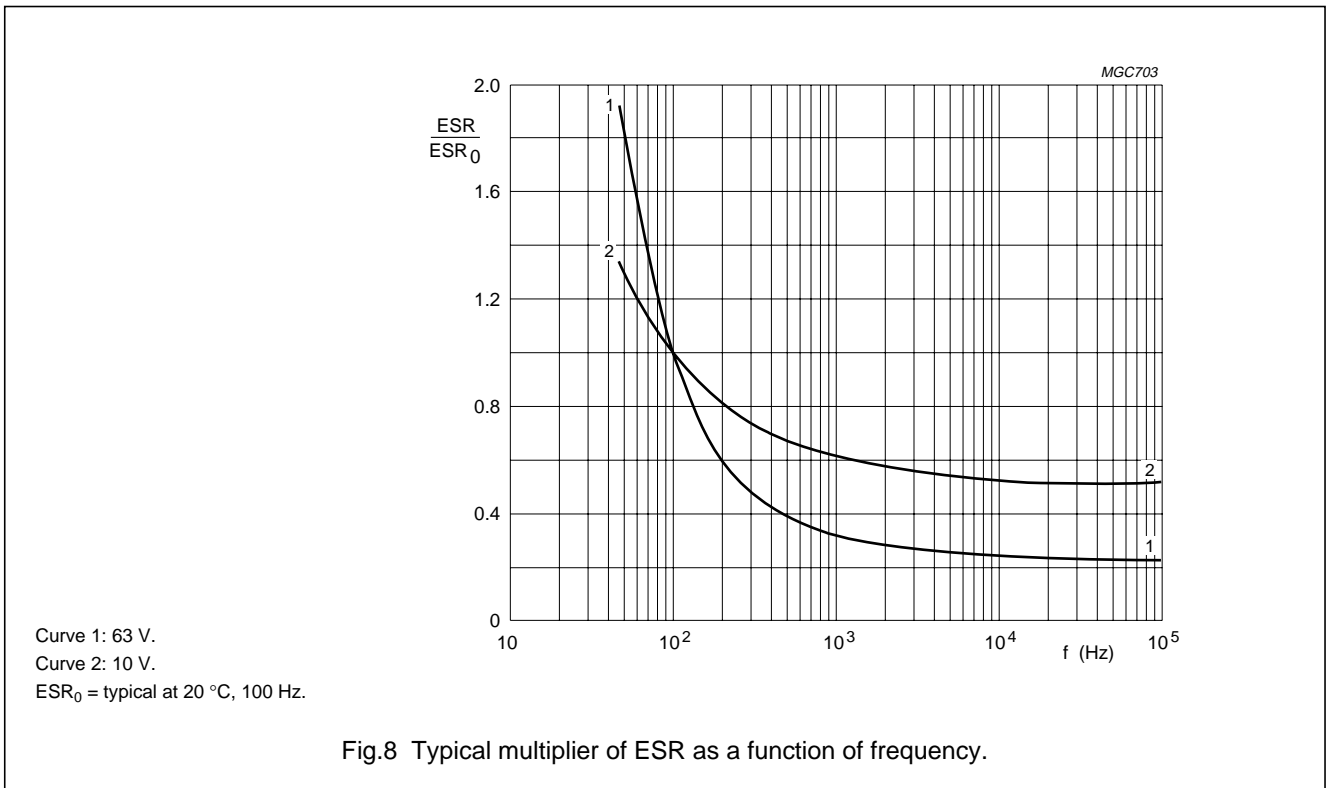


Fig.8 Typical multiplier of ESR as a function of frequency.

Impedance (Z)

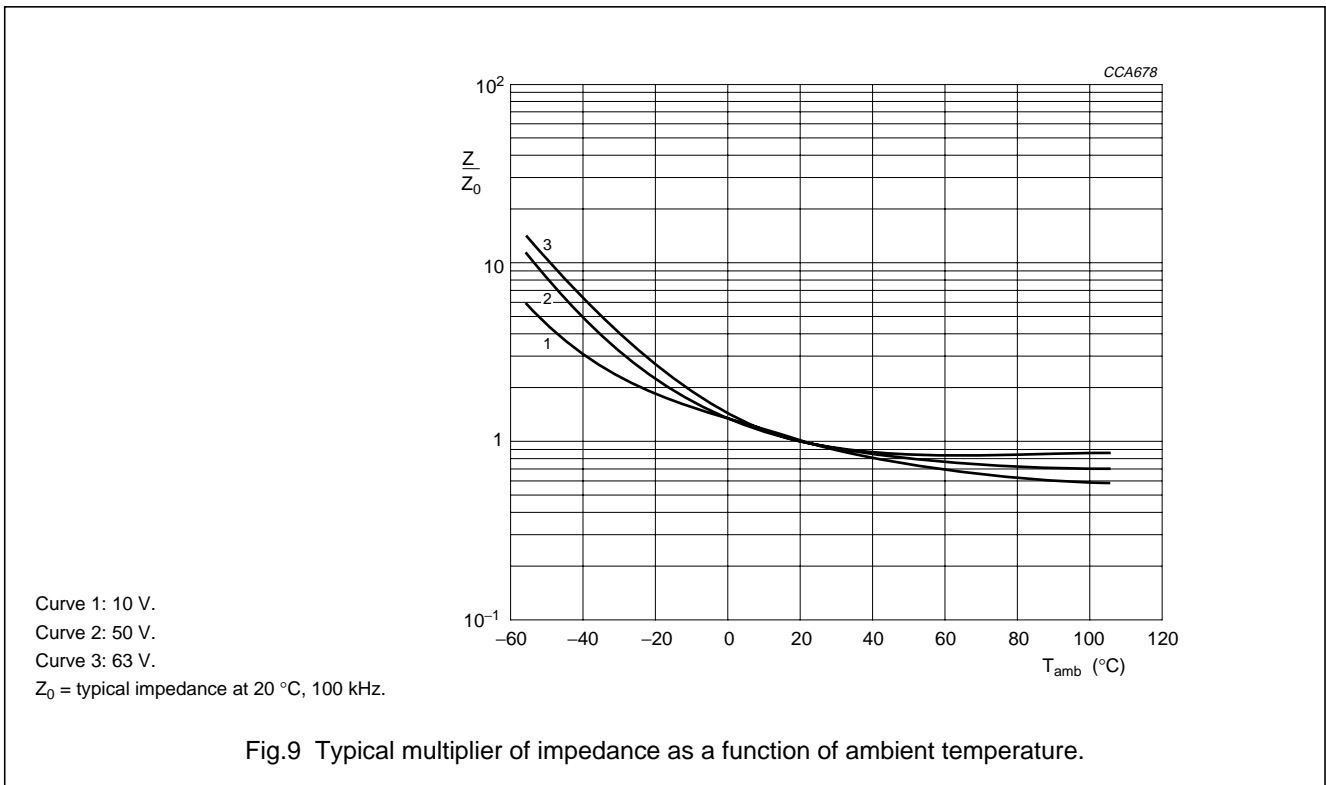


Fig.9 Typical multiplier of impedance as a function of ambient temperature.

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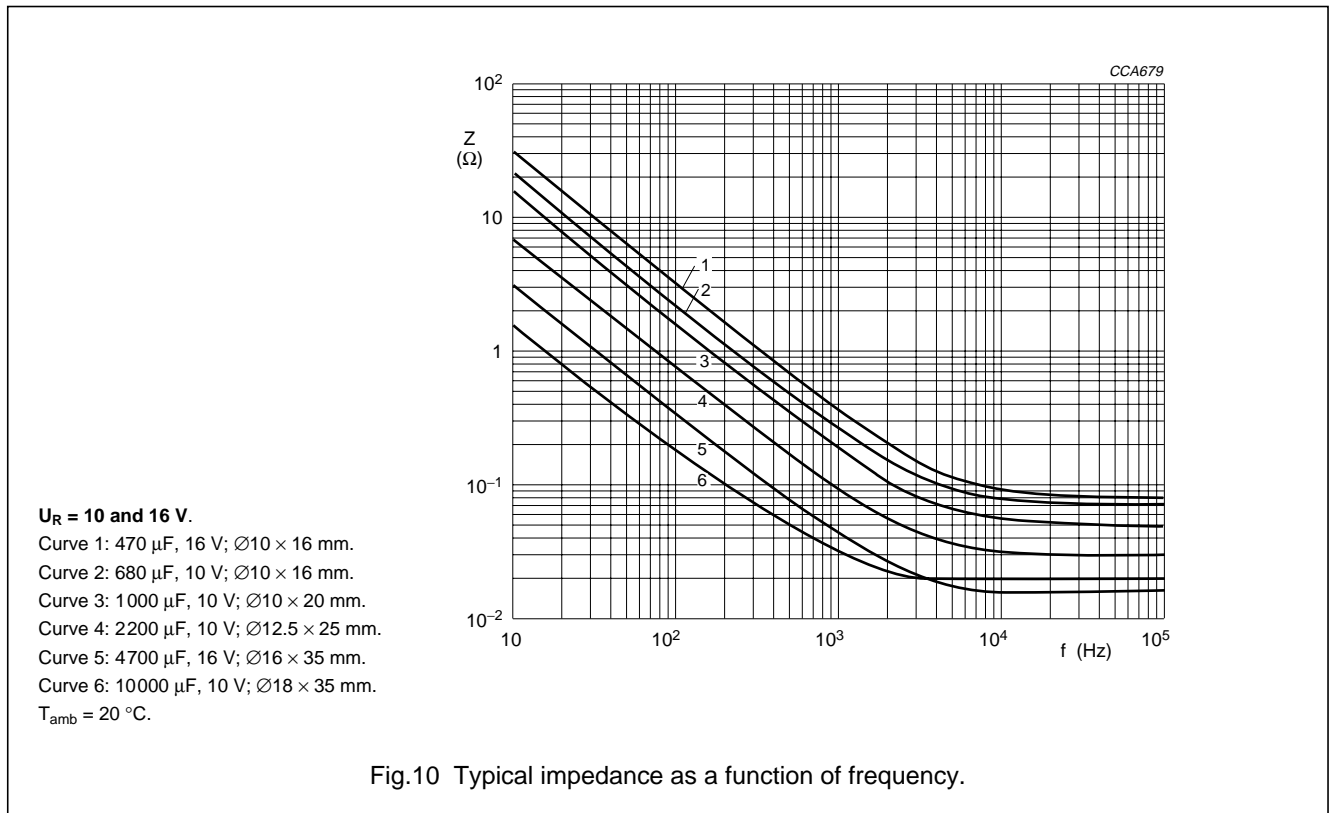


Fig.10 Typical impedance as a function of frequency.

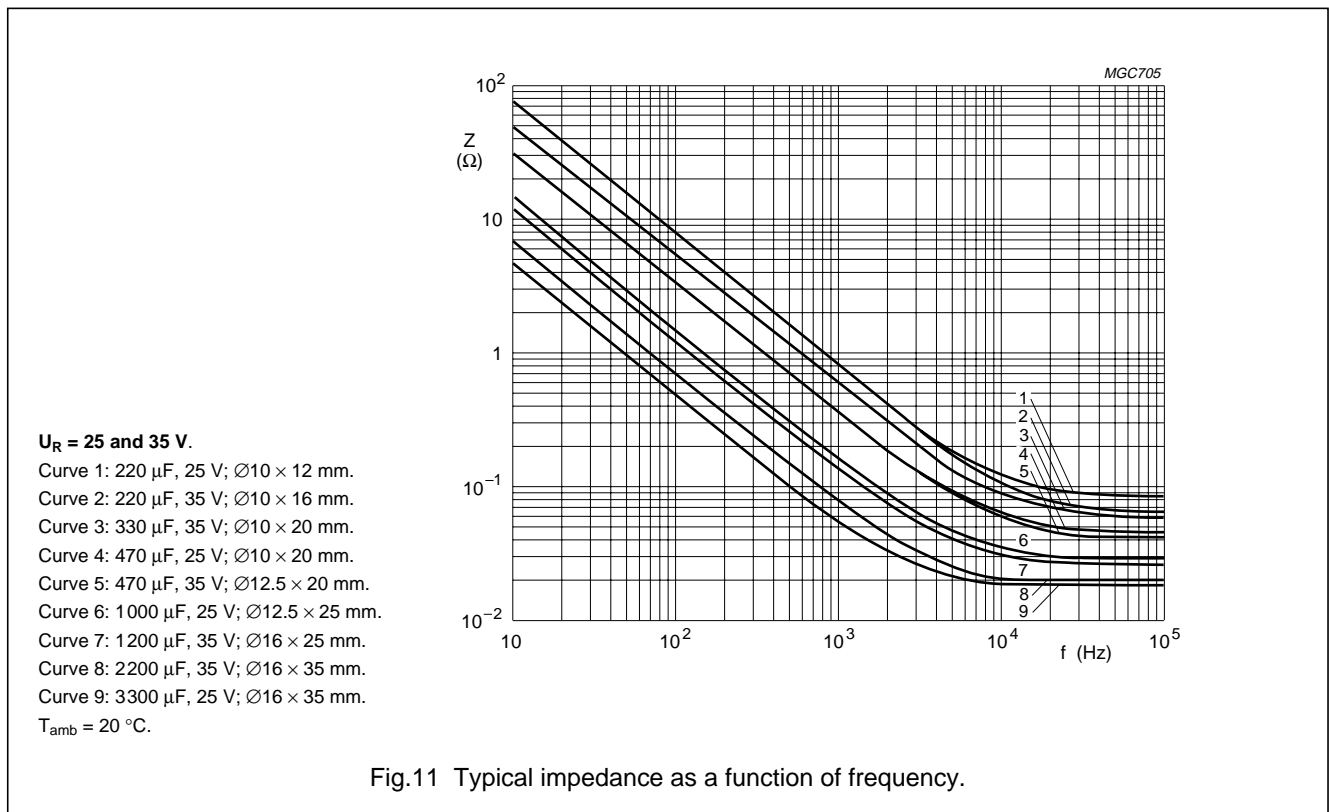
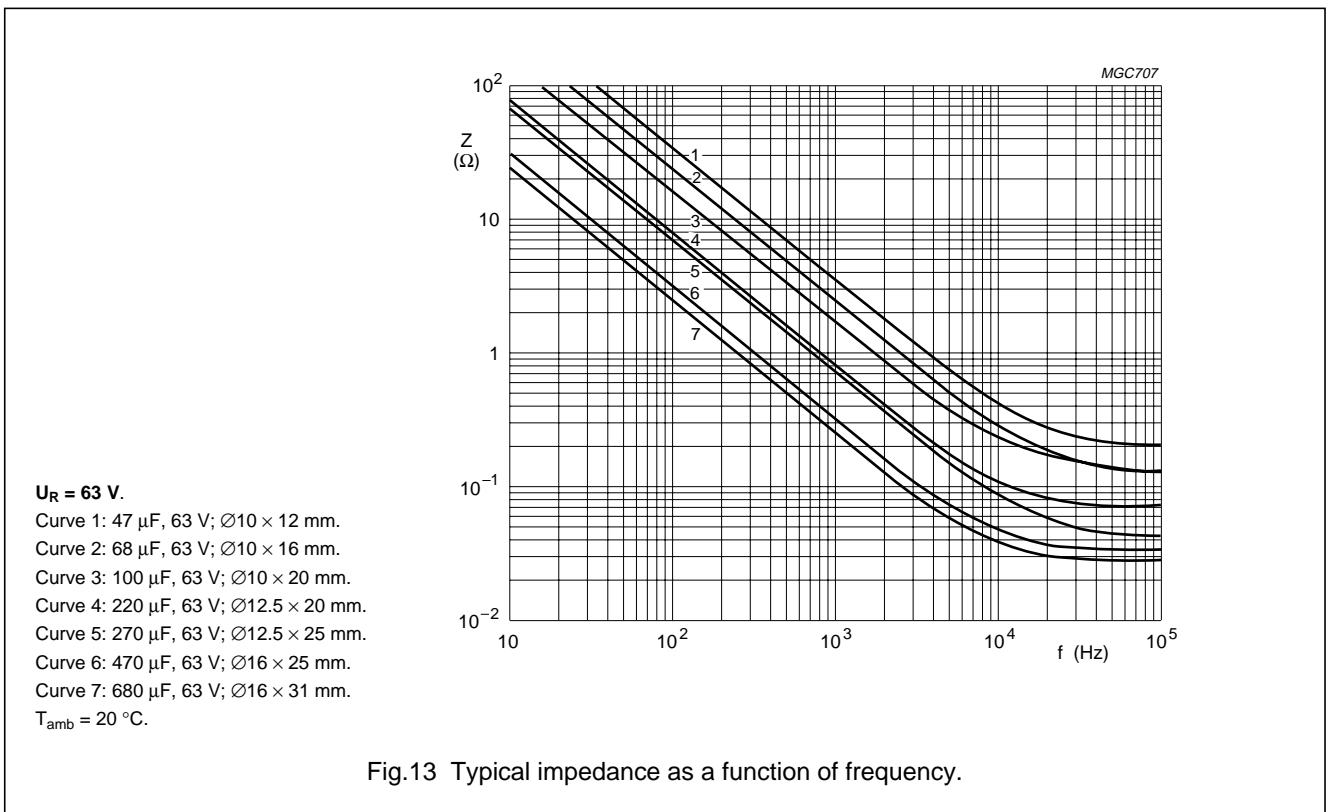
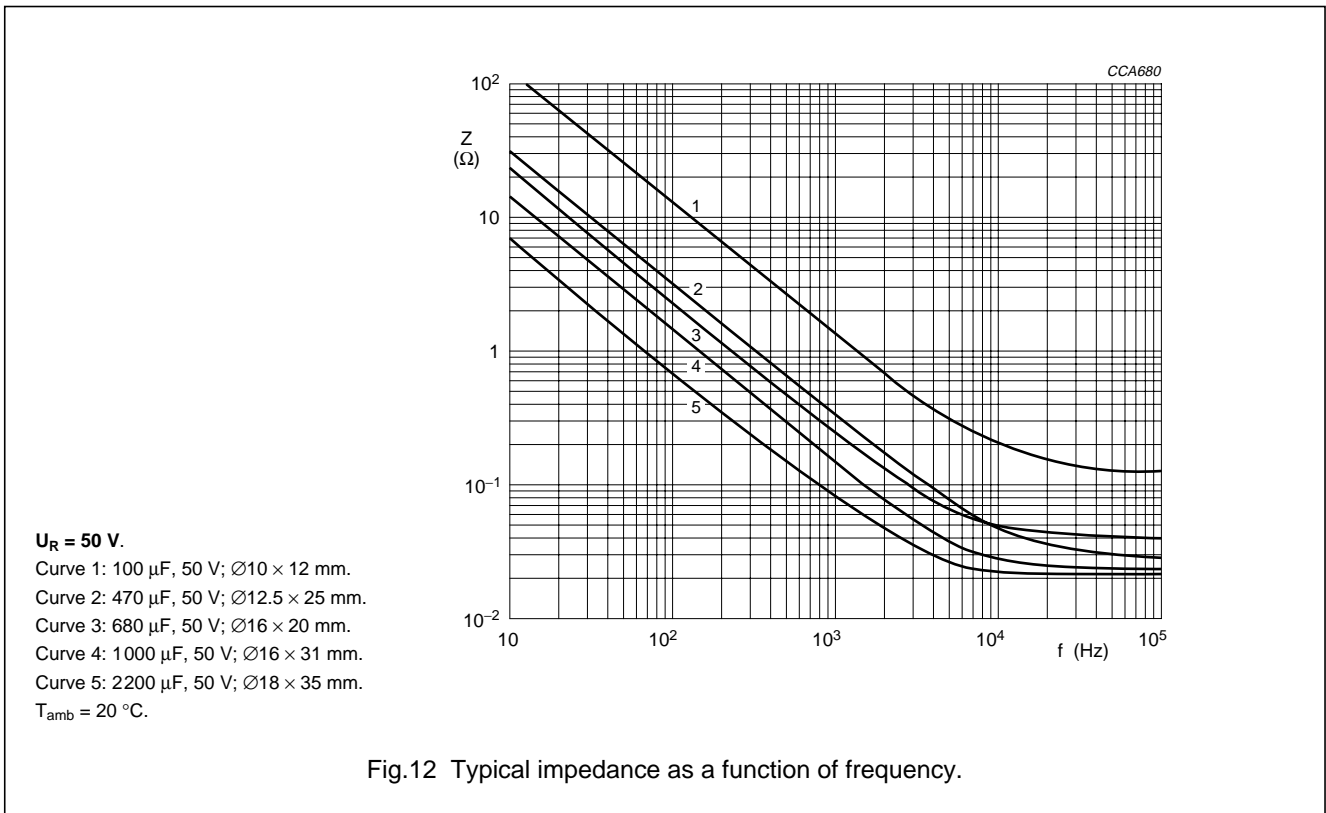


Fig.11 Typical impedance as a function of frequency.

R

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### RIPPLE CURRENT AND USEFUL LIFE

**Table 3** Multiplier of ripple current ( $I_R/I_{R0}$ ) as a function of frequency;  $I_{R0}$  = ripple current at 100 kHz

FREQUENCY (Hz)	$I_R$ MULTIPLIER							
	$U_R = 10\text{ V}$		$U_R = 16\text{ and }25\text{ V}$		$U_R = 35\text{ and }50\text{ V}$		$U_R = 63\text{ and }100\text{ V}$	
	$\varnothing \leq 12.5$	$\varnothing \geq 16$	$\varnothing \leq 12.5$	$\varnothing \geq 16$	$\varnothing \leq 12.5$	$\varnothing \geq 16$	$\varnothing \leq 12.5$	$\varnothing \geq 16$
100	0.7	0.83	0.63	0.69	0.5	0.6	0.35	0.5
300	0.8	0.9	0.72	0.79	0.61	0.71	0.51	0.64
1000	0.88	0.95	0.8	0.87	0.72	0.8	0.66	0.74
3000	0.92	0.98	0.88	0.92	0.81	0.88	0.76	0.83
10000	0.96	0.99	0.92	0.96	0.88	0.93	0.85	0.9
30000	0.99	1.0	0.98	0.99	0.94	0.96	0.92	0.95
100000	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

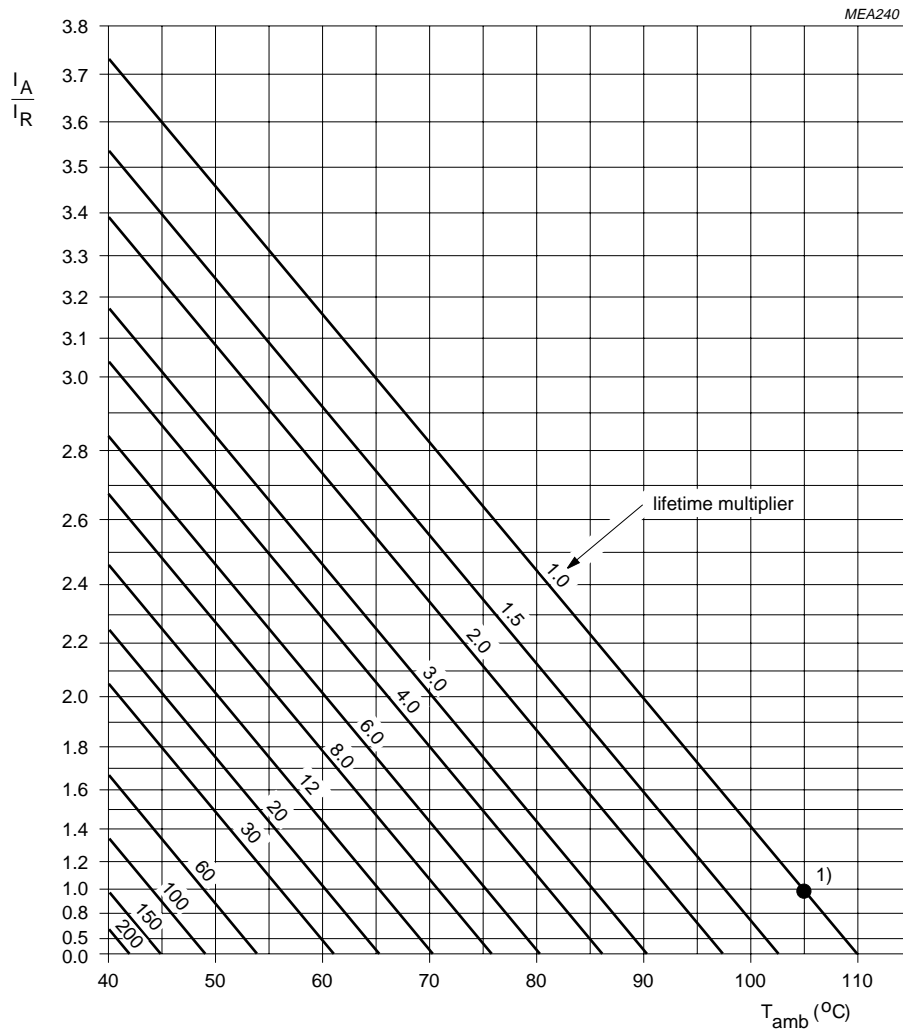
**Table 4** Endurance test duration and useful life as a function of case size; see Fig.14

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	ENDURANCE TEST at 105 °C (hours)	USEFUL LIFE at 105 °C (hours)
10 × 12	14	3000	4000
10 × 16	15	3000	6000
10 × 20	16	3000	6000
10 × 25	16L	5000	7000
10 × 30	16LL	5000	7000
12.5 × 16	17a	3000	5000
12.5 × 20	17	3000	7000
12.5 × 25	18	5000	8000
12.5 × 31	18L	5000	8000
16 × 20	19a	3000	7000
16 × 25	19	5000	10000
16 × 31	20	5000	10000
16 × 35	21	5000	10000
18 × 20	1820	3000	7000
18 × 25	1825	5000	10000
18 × 31	1831	5000	10000
18 × 35	22	5000	10000

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$I_A$  = actual ripple current at 100 kHz.  
 $I_R$  = rated ripple current at 100 kHz, 105 °C.  
 (1) Useful life at 105 °C and  $I_R$  applied; see Table 4.

Fig.14 Multiplier of useful life as a function of ambient temperature and ripple current load.



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### SPECIFIC TESTS AND REQUIREMENTS

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

**Table 5** Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 384-4/ CECC 30300 subclause 4.13	$T_{amb} = 105\text{ °C}$ ; $U_R$ applied; for test duration see Table 4	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$ ; $U_R$ and $I_R$ applied; for test duration see Table 4	$\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 384-4/ CECC 30300 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	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$

R