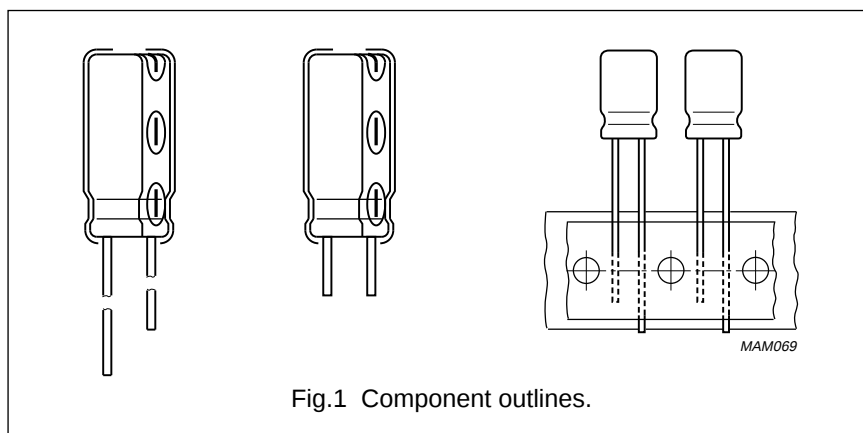


Non-solid Al - electrolytic capacitors

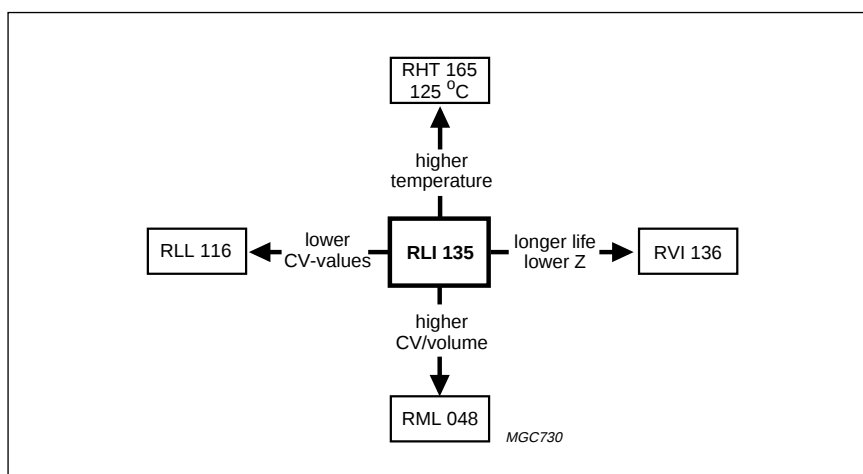
Radial, Low Impedance

RLI 135**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
- Long useful life:
1500 to 2500 hours at 105 °C
- Low ESR, low impedance, high ripple current capability.

**APPLICATIONS**

- General industrial, EDP, telecommunication and audio-video
- Smoothing, filtering, buffering in SMPS and DC/DC converters.

**QUICK REFERENCE DATA**

DESCRIPTION	VALUE	
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	8 × 12 to 8 × 20	10 × 12 to 18 × 40
Rated capacitance range, C_R	22 to 10000 μF	
Tolerance on C_R	±20%	
Rated voltage range, U_R	6.3 to 100 V	
Category temperature range	−55 to +105 °C	
Endurance test at 105 °C	1000 hours	2000 hours
Useful life at 105 °C	1500 hours	2500 hours
Useful life at 40 °C, $1.3 \times I_R$ applied	150000 hours	250000 hours
Shelf life at 0 V, 105 °C	1000 hours	1000 hours
Based on sectional specification	IEC 384-4/CECC 30300	
Climatic category IEC 68 (DIN 40040)	55/105/56 (FMF)	

Non-solid Al - electrolytic capacitors

Radial, Low Impedance

RLI 135

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

Preferred types in **bold**.

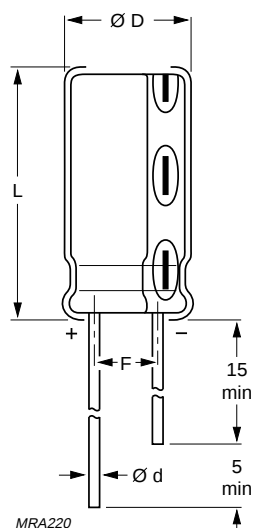
C_R (μF)	U_R (V)							
	6.3	10	16	25	35	50	63	100
22	–	–	–	–	–	–	–	8 × 12
47	–	–	–	–	–	–	8 × 12	–
100	–	–	–	–	8 × 12	10 × 16	–	12.5 × 20
220	–	–	8 × 12	8 × 15	8 × 20	10 × 25	12.5 × 20	16 × 25
330	–	–	8 × 15	–	10 × 20	12.5 × 20	–	16 × 31
	–	–	–	–	–	–	–	18 × 25
470	10 × 12	8 × 15	8 × 20	10 × 20	10 × 30	12.5 × 25	16 × 25	16 × 40
	–	–	–	–	–	18 × 15	–	–
680	10 × 16	–	10 × 20	–	12.5 × 25	–	16 × 31	18 × 40
1000	–	12.5 × 16	10 × 30	12.5 × 25	12.5 × 31	16 × 31	16 × 40	–
	–	–	–	–	16 × 20	–	–	–
1500	–	10 × 30	12.5 × 25	12.5 × 31	12.5 × 40	16 × 40	–	–
2200	12.5 × 20	12.5 × 25	12.5 × 31	12.5 × 40	16 × 35	18 × 40	–	–
	–	18 × 15	16 × 20	18 × 20	18 × 31	–	–	–
3300	–	12.5 × 35	–	16 × 35	18 × 40	–	–	–
	–	16 × 20	–	18 × 31	–	–	–	–
4700	–	16 × 31	16 × 35	18 × 40	–	–	–	–
	–	18 × 25	18 × 31	–	–	–	–	–
6800	16 × 31	16 × 35	18 × 35	–	–	–	–	–
10000	18 × 31	18 × 40	–	–	–	–	–	–

Non-solid Al - electrolytic capacitors

Radial, Low Impedance

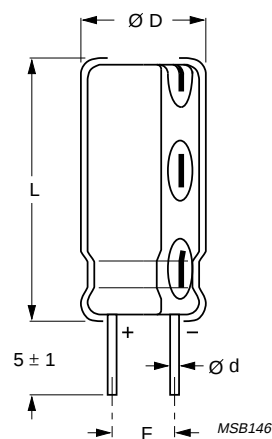
RLI 135

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.
For dimensions see Table 1.

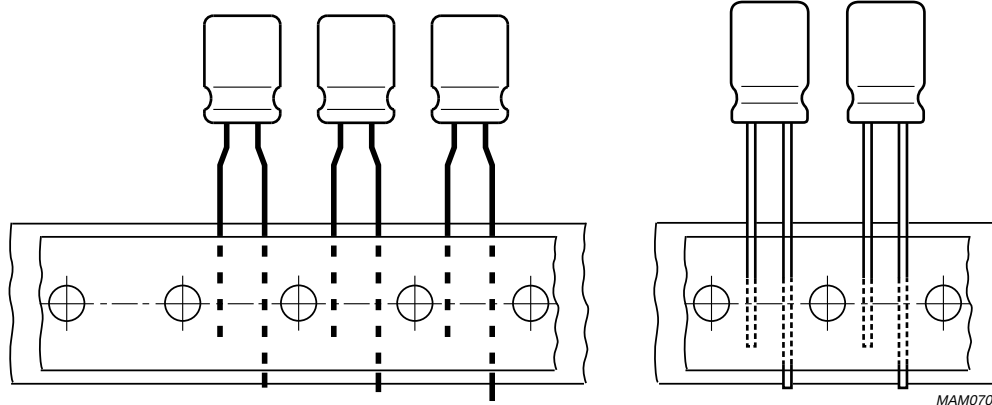
Fig.2 Form CA: Long leads.



Dimensions in mm.
For dimensions see Table 1.

Fig.3 Form CB: Cut leads.

Taped products



Form TFA.

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

Fig.4 Taped in box (ammopack).

Non-solid Al - electrolytic capacitors

Radial, Low Impedance

RLI 135

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

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
8 × 12	13	0.6	8.5	13	3.5 ± 0.5	≈ 1.1	1000	2000	1000
8 × 15	13L	0.6	8.5	16	3.5 ± 0.5	≈ 1.3	1000	2000	1000
8 × 20	13LL	0.6	8.5	21	3.5 ± 0.5	≈ 1.5	1000	1000	1000
10 × 12	14	0.6	10.5	13.5	5 ± 0.5	≈ 1.6	2000	1500	800
10 × 16	15	0.6	10.5	17.5	5 ± 0.5	≈ 1.9	2000	1500	800
10 × 20	16	0.6	10.5	22	5 ± 0.5	≈ 2.2	2000	1500	800
10 × 25	16L	0.6	10.5	27	5 ± 0.5	≈ 3.0	1000	1500	800
10 × 30	16LL	0.6	10.5	32	5 ± 0.5	≈ 3.5	1000	750	–
12.5 × 16	17a	0.6	13	17.5	5 ± 0.5	≈ 2.7	1000	1500	500
12.5 × 20	17	0.6	13	22	5 ± 0.5	≈ 4.0	1000	1500	500
12.5 × 25	18	0.6	13	27	5 ± 0.5	≈ 5.0	1000	1500	500
12.5 × 31	18L	0.6	13	33.5	5 ± 0.5	≈ 5.5	1000	750	–
12.5 × 35	18LL	0.6	13	37.5	5 ± 0.5	≈ 6.0	500	750	–
12.5 × 40	1240	0.6	13	42	5 ± 0.5	≈ 7.5	500	750	–
16 × 20	19a	0.8	16.5	23.5	7.5 ± 0.5	≈ 6.0	500	500	250
16 × 25	19	0.8	16.5	27	7.5 ± 0.5	≈ 8.0	500	500	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	500	500	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11	500	500	–
16 × 40	21L	0.8	16.5	42	7.5 ± 0.5	≈ 13	250	500	–
18 × 15	1815	0.8	18.5	17	7.5 ± 0.5	≈ 6.0	500	500	–
18 × 20	1820	0.8	18.5	23.5	7.5 ± 0.5	≈ 8.0	500	500	–
18 × 25	1825	0.8	18.5	27.5	7.5 ± 0.5	≈ 10	500	500	–
18 × 31	22a	0.8	18.5	33.5	7.5 ± 0.5	≈ 12.5	250	500	–
18 × 35	22	0.8	18.5	37.5	7.5 ± 0.5	≈ 14.5	250	500	–
18 × 40	23	0.8	18.5	42	7.5 ± 0.5	≈ 16	250	500	–

MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 62"
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (135)
- Name of manufacturer (PHILIPS)
- Date code, in accordance with "IEC 62"
- Code indicating factory of origin
- Negative terminal identification.

Non-solid Al - electrolytic capacitors Radial, Low Impedance

RLI 135

Ordering example

Electrolytic capacitor RLI 135

1000 µF/16 V; ±20%

Nominal case size: Ø10 × 30 mm; Form CB

Catalogue number: 2222 135 65102.

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 120 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 120 Hz, 105 °C
I_{RH}	rated RMS ripple current at 100 kHz, 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L2}	max. leakage current after 2 minutes at U_R
$\tan \delta$	max. dissipation factor at 120 Hz
ESR	equivalent series resistance at 120 Hz (calculated from $\tan \delta_{max}$ and C_R)
Z	max. impedance at 100 kHz and 20 or -10 °C

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

U_R (V)	C_R 120 Hz (µF)	NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	I_R 120 Hz 105 °C (mA)	I_{RH} 100 kHz 105 °C (mA)	I_{L1} 1 min (µA)	I_{L2} 2 min (µA)	$\tan \delta$ 120 Hz	ESR 120 Hz (Ω)	Z 100 kHz 20 °C (Ω)	Z 100 kHz -10 °C (Ω)	CATALOGUE NUMBER 2222		
												BULK PACKAGING		TAPED
												LONG LEADS FORM CA	CUT LEADS FORM CB	FORM TFA
6.3	470	10 × 12	14	410	510	89	30	0.22	0.62	0.28	0.73	135 53471	135 63471	135 33471
	680	10 × 16	15	510	640	129	43	0.22	0.43	0.22	0.57	135 53681	135 63681	135 33681
	2200	12.5 × 20	17	1000	1100	416	140	0.24	0.14	0.089	0.23	135 53222	135 63222	135 33222
	6800	16 × 31	20	1600	1800	1290	430	0.32	0.062	0.055	0.14	135 53682	135 63682	135 33682
	10000	18 × 31	22a	1800	2000	1890	630	0.40	0.053	0.047	0.12	135 53103	135 63103	–
10	470	8 × 15	13L	400	500	141	47	0.19	0.54	0.24	0.62	135 54471	135 84471	135 34471
	1000	12.5 × 16	17a	780	970	300	100	0.19	0.25	0.12	0.31	135 54102	135 64102	135 34102
	1500	10 × 30	16LL	1000	1200	450	150	0.19	0.17	0.093	0.24	135 54152	135 64152	–
	2200	12.5 × 25	18	1200	1300	660	220	0.21	0.13	0.073	0.19	135 54222	135 64222	135 34222
	2200	18 × 15	1815	1200	1300	660	220	0.21	0.13	0.080	0.21	135 90001	135 90002	–
	3300	12.5 × 35	18LL	1600	1800	990	330	0.23	0.092	0.052	0.14	135 54332	135 64332	–
	3300	16 × 20	19a	1200	1400	990	330	0.23	0.092	0.075	0.20	135 90025	135 90026	135 90042
	4700	16 × 31	20	1600	1800	1410	470	0.25	0.071	0.054	0.14	135 54472	135 64472	135 34472

Non-solid Al - electrolytic capacitors

Radial, Low Impedance

RLI 135

U _R (V)	C _R 120 Hz (μF)	NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	I _R 120 Hz 105 °C (mA)	I _{RH} 100 kHz 105 °C (mA)	I _{L1} 1 min (μA)	I _{L2} 2 min (μA)	Tan δ 120 Hz	ESR 120 Hz (Ω)	Z 100 kHz 20 °C (Ω)	Z 100 kHz -10 °C (Ω)	CATALOGUE NUMBER 2222		
												BULK PACKAGING		TAPED
												LONG LEADS FORM CA	CUT LEADS FORM CB	FORM TFA
10	4700	18 × 25	1825	1700	1800	1410	470	0.25	0.071	0.053	0.14	135 90003	135 90004	–
	6800	16 × 35	21	1800	2000	2040	680	0.29	0.057	0.046	0.12	135 54682	135 64682	–
	10000	18 × 40	23	2200	2500	3000	1000	0.37	0.049	0.037	0.096	135 54103	135 64103	–
16	220	8 × 12	13	220	400	106	35	0.16	0.96	0.33	0.86	135 55221	135 85221	135 35221
	330	8 × 15	13L	350	500	158	53	0.16	0.64	0.23	0.60	135 55331	135 85331	135 35331
	470	8 × 20	13LL	520	650	226	75	0.16	0.45	0.18	0.47	135 55471	135 85471	135 35471
	680	10 × 20	16	690	860	326	110	0.16	0.31	0.14	0.36	135 55681	135 65681	135 35681
	1000	10 × 30	16LL	920	1200	480	160	0.16	0.21	0.091	0.24	135 55102	135 65102	–
	1500	12.5 × 25	18	1200	1300	720	240	0.16	0.14	0.072	0.19	135 55152	135 65152	135 35152
	2200	12.5 × 31	18L	1400	1500	1060	350	0.18	0.11	0.063	0.16	135 55222	135 65222	–
	2200	16 × 20	19a	1200	1400	1060	350	0.18	0.11	0.073	0.19	135 90007	135 90008	135 90043
	4700	16 × 35	21	1800	2000	2260	750	0.22	0.062	0.046	0.12	135 55472	135 65472	–
	4700	18 × 31	22a	1800	2000	2260	750	0.22	0.062	0.046	0.12	135 90009	135 90011	–
	6800	18 × 35	22	2000	2200	3260	1100	0.26	0.051	0.040	0.10	135 55682	135 65682	–
25	220	8 × 15	13L	350	500	165	55	0.14	0.84	0.23	0.60	135 56221	135 86221	135 36221
	470	10 × 20	16	690	860	353	120	0.14	0.40	0.14	0.36	135 56471	135 66471	135 36471
	1000	12.5 × 25	18	1100	1300	750	250	0.14	0.19	0.071	0.18	135 56102	135 66102	135 36102
	1500	12.5 × 31	18L	1400	1500	1125	380	0.14	0.12	0.062	0.16	135 56152	135 66152	–
	2200	12.5 × 40	1240	1800	2000	1650	550	0.16	0.10	0.044	0.11	135 56222	135 66222	–
	2200	18 × 20	1820	1400	1600	1650	550	0.16	0.10	0.060	0.16	135 90012	135 90013	–
	3300	16 × 35	21	1800	2000	2475	830	0.18	0.072	0.045	0.12	135 56332	135 66332	–
	3300	18 × 31	22a	1800	2000	2475	830	0.18	0.072	0.045	0.12	135 90014	135 90015	–
	4700	18 × 40	23	2200	2500	3525	1200	0.20	0.056	0.036	0.94	135 56472	135 66472	–
35	100	8 × 12	13	280	400	105	35	0.12	1.59	0.32	0.83	135 50101	135 80101	135 30101
	220	8 × 20	13LL	460	650	231	77	0.12	0.72	0.18	0.47	135 50221	135 80221	135 30221
	330	10 × 20	16	610	860	347	120	0.12	0.48	0.13	0.34	135 50331	135 60331	135 30331
	470	10 × 30	16LL	920	1200	490	160	0.12	0.34	0.089	0.23	135 50471	135 60471	–

Non-solid Al - electrolytic capacitors

Radial, Low Impedance

RLI 135

U _R (V)	C _R 120 Hz (μF)	NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	I _R 120 Hz 105 °C (mA)	I _{RH} 100 kHz 105 °C (mA)	I _{L1} 1 min (μA)	I _{L2} 2 min (μA)	Tan δ 120 Hz	ESR 120 Hz (Ω)	Z 100 kHz 20 °C (Ω)	Z 100 kHz -10 °C (Ω)	CATALOGUE NUMBER 2222		
												BULK PACKAGING		TAPED
												LONG LEADS FORM CA	CUT LEADS FORM CB	FORM TFA
35	680	12.5 × 25	18	1100	1300	714	240	0.12	0.23	0.070	0.18	135 50681	135 60681	135 30681
	1000	12.5 × 31	18L	1400	1500	1050	350	0.12	0.16	0.061	0.16	135 50102	135 60102	—
	1000	16 × 20	19a	1100	1370	1050	350	0.12	0.16	0.071	0.18	135 90016	135 90017	135 90044
	1500	12.5 × 40	1240	1800	2000	1575	530	0.12	0.11	0.043	0.11	135 50152	135 60152	—
	2200	16 × 35	21	1800	2000	2310	770	0.14	0.084	0.044	0.11	135 50222	135 60222	—
	2200	18 × 31	22a	1800	2000	2310	770	0.14	0.084	0.044	0.11	135 90018	135 90019	—
	3300	18 × 40	23	2200	2500	3465	1200	0.16	0.064	0.035	0.091	135 50332	135 60332	—
50	100	10 × 16	15	450	640	150	50	0.10	1.33	0.20	0.52	135 51101	135 61101	135 31101
	220	10 × 25	16L	730	1000	330	110	0.10	0.60	0.11	0.29	135 51221	135 61221	135 31221
	330	12.5 × 20	17	790	1100	495	170	0.10	0.40	0.081	0.22	135 51331	135 61331	135 31331
	470	12.5 × 25	18	1100	1300	705	240	0.10	0.28	0.068	0.19	135 51471	135 61471	135 31471
	470	18 × 15	1815	1000	1300	705	240	0.10	0.28	0.074	0.19	135 90021	135 90022	—
	1000	16 × 31	20	1500	1800	1500	500	0.10	0.13	0.050	0.13	135 51102	135 61102	135 31102
	1500	16 × 40	21L	2100	2300	2250	750	0.10	0.088	0.035	0.091	135 51152	135 61152	—
	2200	18 × 40	23	2200	2500	3300	1100	0.12	0.072	0.034	0.091	135 51222	135 61222	—
63	47	8 × 12	13	220	300	89	30	0.08	2.26	0.56	1.5	135 58479	135 88479	135 38479
	220	12.5 × 20	17	630	890	416	140	0.08	0.48	0.16	0.42	135 58221	135 68221	135 38221
	470	16 × 25	19	1200	1400	888	300	0.08	0.23	0.091	0.25	135 58471	135 68471	135 38471
	680	16 × 31	20	1400	1800	1285	430	0.08	0.16	0.065	0.18	135 58681	135 68681	135 38681
	1000	16 × 40	21L	1800	2200	1890	630	0.08	0.11	0.049	0.13	135 58102	135 68102	—
100	22	8 × 12	13	120	310	66	22	0.07	4.22	0.53	1.4	135 59229	135 89229	135 39229
	100	12.5 × 20	17	630	890	300	100	0.07	0.93	0.15	0.40	135 59101	135 69101	135 39101
	220	16 × 25	19	1000	1400	660	220	0.07	0.42	0.086	0.23	135 59221	135 69221	—
	330	16 × 31	20	1300	1800	990	330	0.07	0.28	0.062	0.17	135 59331	135 69331	—
	330	18 × 25	1825	1200	1700	990	330	0.07	0.28	0.074	0.20	135 90023	135 90024	—
	470	16 × 40	21L	1800	2200	1410	470	0.07	0.20	0.047	0.13	135 59471	135 69471	—
	680	18 × 40	23	1900	2400	2040	680	0.07	0.14	0.043	0.12	135 59681	135 69681	—

Non-solid Al - electrolytic capacitors

Radial, Low Impedance

RLI 135

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods		$U_S \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.03 C_R \times U_R \text{ } \mu\text{A}$
	after 2 minutes at U_R	$I_{L2} \leq 0.01 C_R \times U_R \text{ } \mu\text{A}$
Capacitance (C)		
Ratio of capacitance at 120 Hz	$U_R = 6.3 \text{ V}$	$C_{-55^\circ\text{C}}/C_{20^\circ\text{C}} \geq 0.7$
	$U_R = 10 \text{ to } 100 \text{ V}$	$C_{-55^\circ\text{C}}/C_{20^\circ\text{C}} \geq 0.8$
Impedance (Z)		
Ratio of impedance at 120 Hz		$Z_{-55^\circ\text{C}}/Z_{20^\circ\text{C}} \leq 3$

Non-solid Al - electrolytic capacitors

Radial, Low Impedance

RLI 135

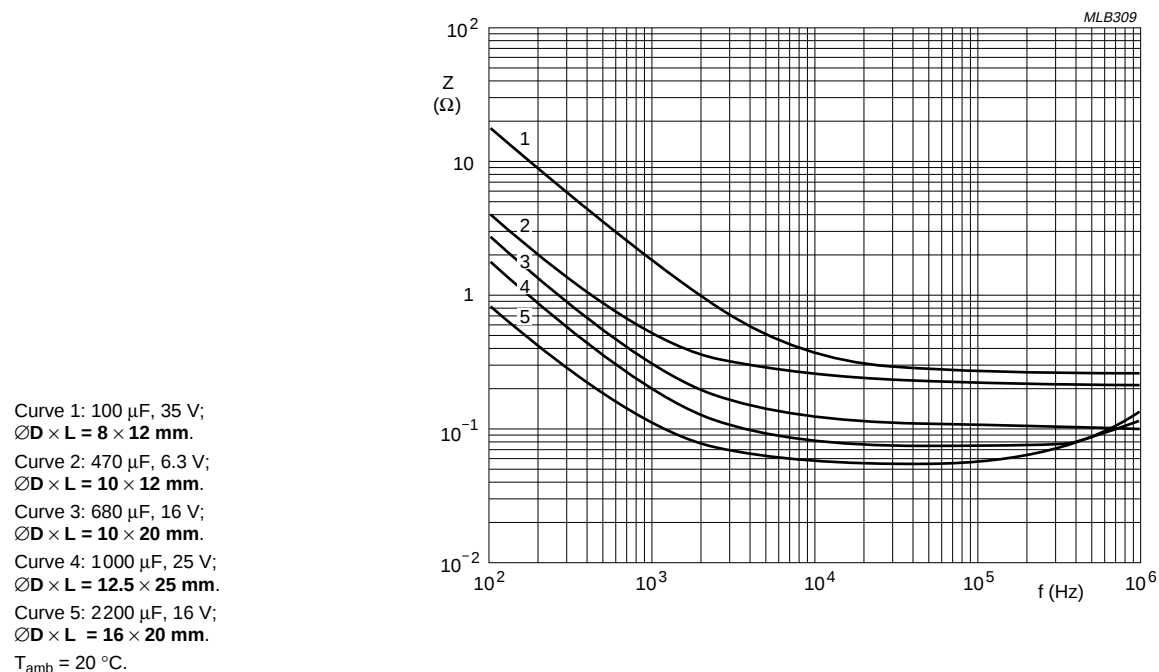


Fig.5 Typical impedance as a function of frequency.

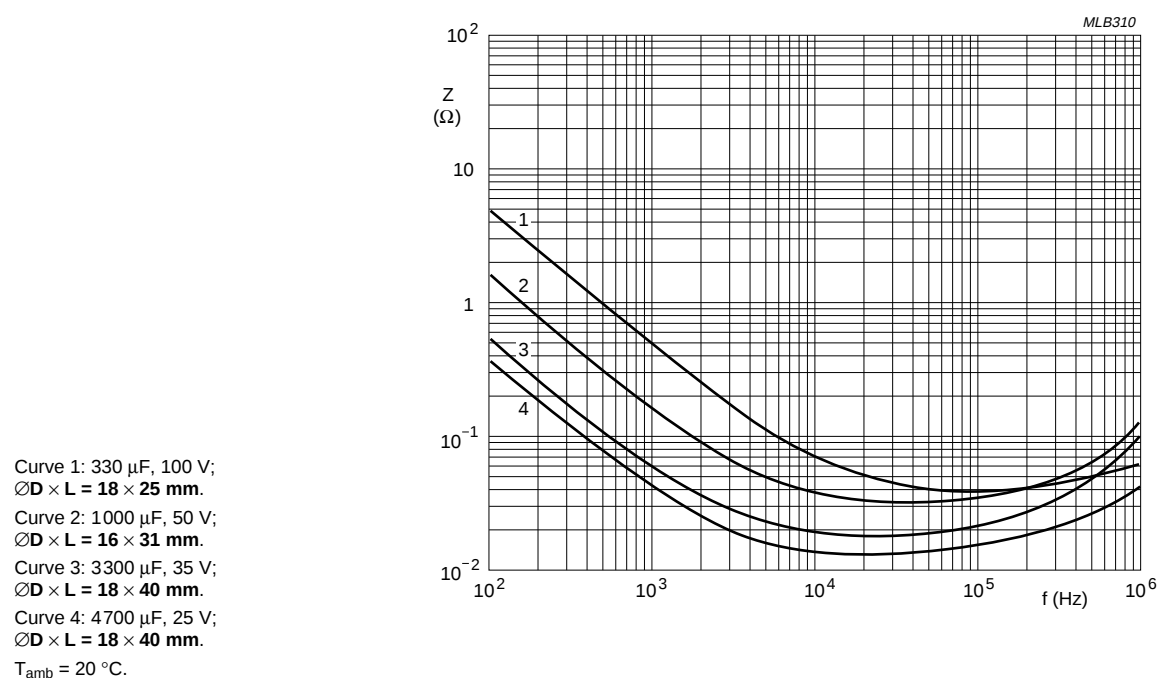


Fig.6 Typical impedance as a function of frequency.

Non-solid Al - electrolytic capacitors

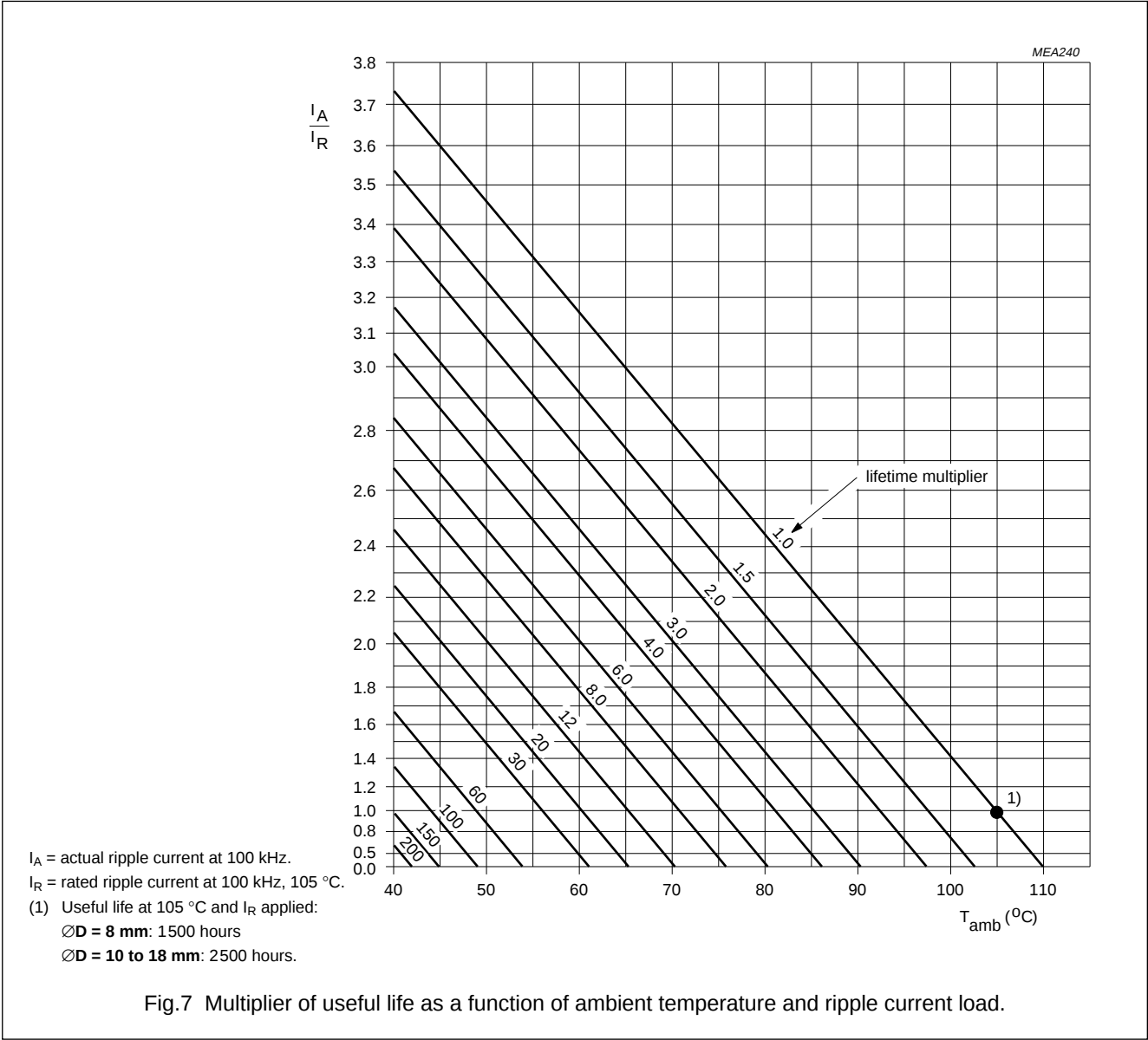
Radial, Low Impedance

RLI 135

RIPPLE CURRENT AND USEFUL LIFE

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

FREQUENCY (Hz)	I _R MULTIPLIER			
	22 μF	33 to 330 μF	470 to 1 000 μF	>1 000 μF
50	0.4	0.6	0.65	0.8
120	0.5	0.7	0.8	0.9
300	0.6	0.8	0.9	0.95
1 000	0.8	0.9	0.98	0.98
10 000	0.9	0.95	1.0	1.0
100 000	1.0	1.0	1.0	1.0



Non-solid Al - electrolytic capacitors

Radial, Low Impedance

RLI 135

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	$T_{amb} = 105\text{ °C}$; U_R applied; $\varnothing D = 8\text{ mm}$: 1000 hours $\varnothing D = 10\text{ to }18\text{ mm}$: 2000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; $\varnothing D = 8\text{ mm}$: 1500 hours $\varnothing D = 10\text{ to }18\text{ mm}$: 2500 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 384-4/ CECC 30 300, 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	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$