

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.

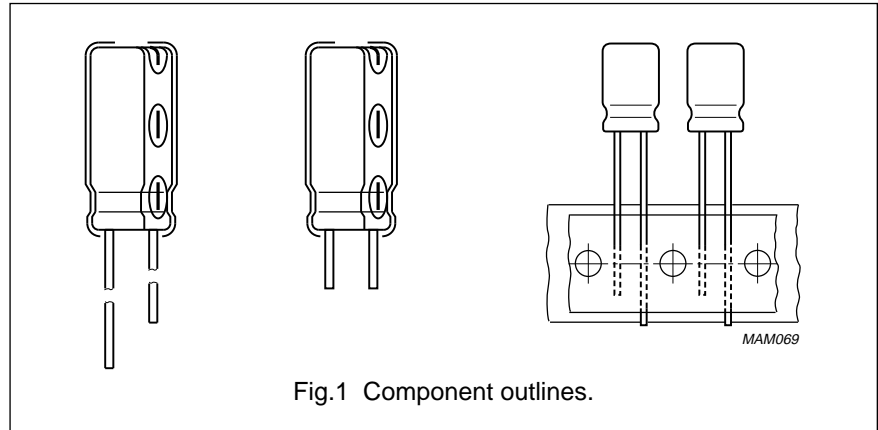
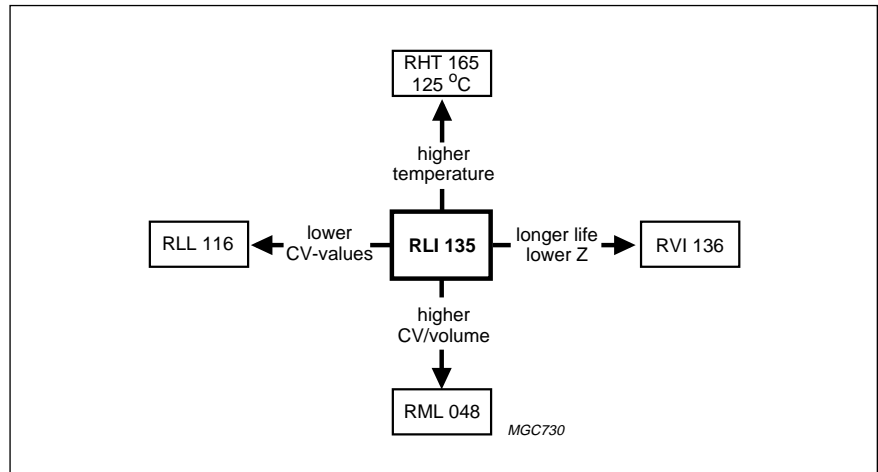


Fig.1 Component outlines.

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)

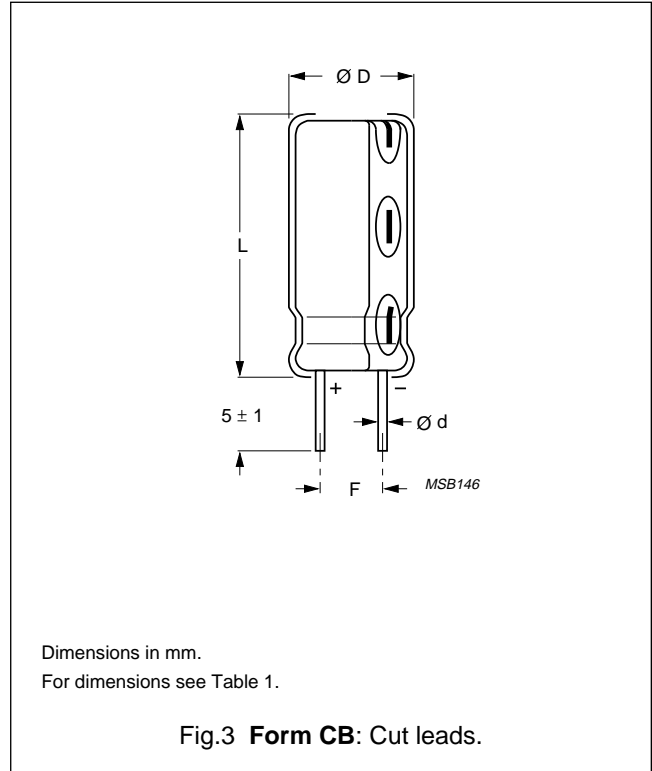
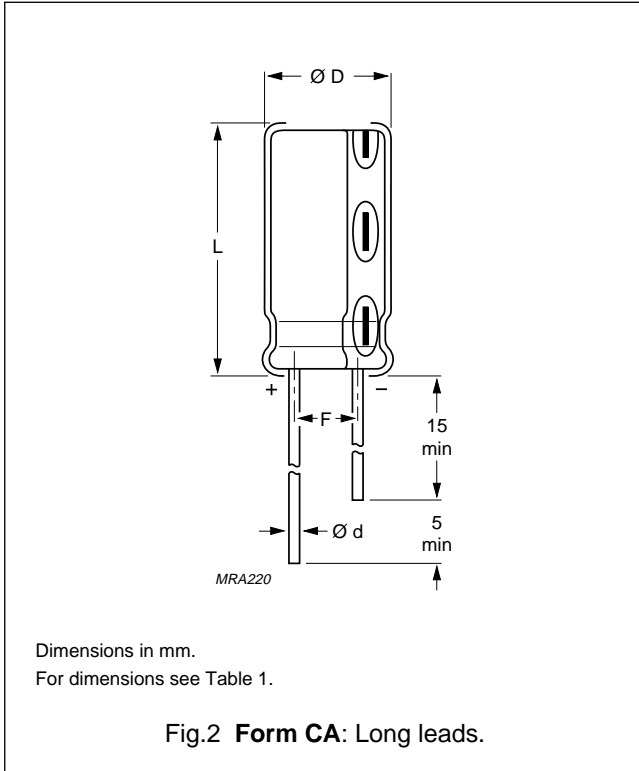
Preferred types in **bold**.

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	–	–	–	–	–	–

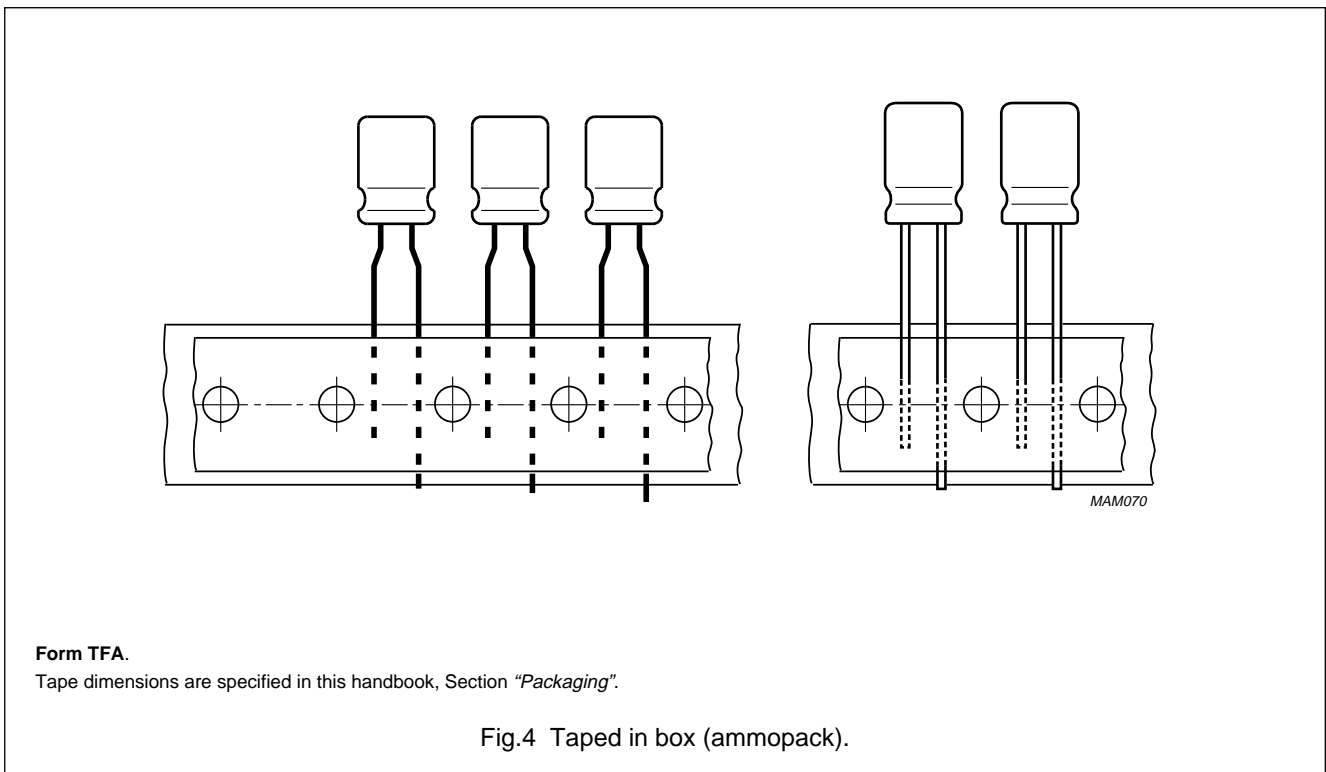
Non-solid Al - electrolytic capacitors
Radial, Low Impedance

RLI 135

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Taped products



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 $\mu\text{F}/16 \text{ V}; \pm 20\%$ Nominal case size: $\varnothing 10 \times 30 \text{ mm}$; Form CB

Catalogue number: 2222 135 65102.

ELECTRICAL DATA AND ORDERING INFORMATION

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

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

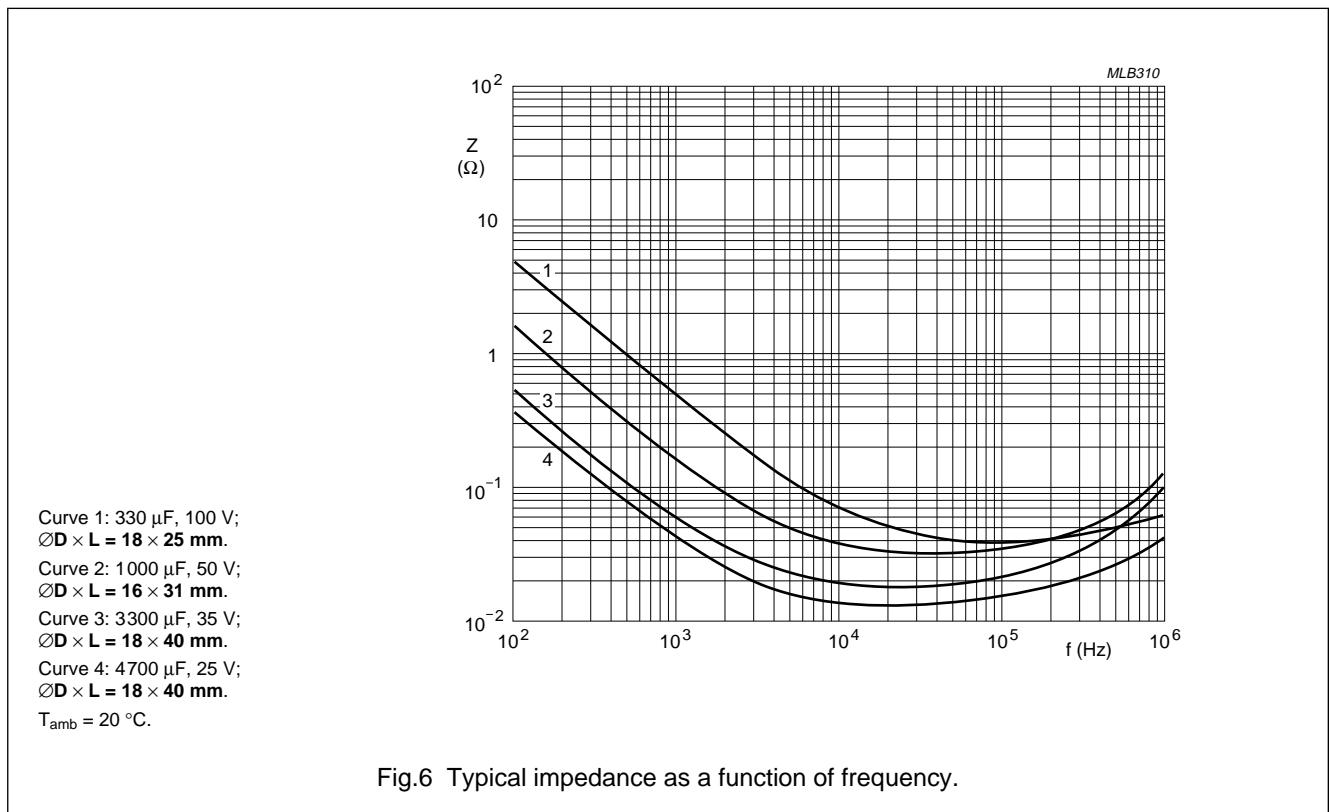
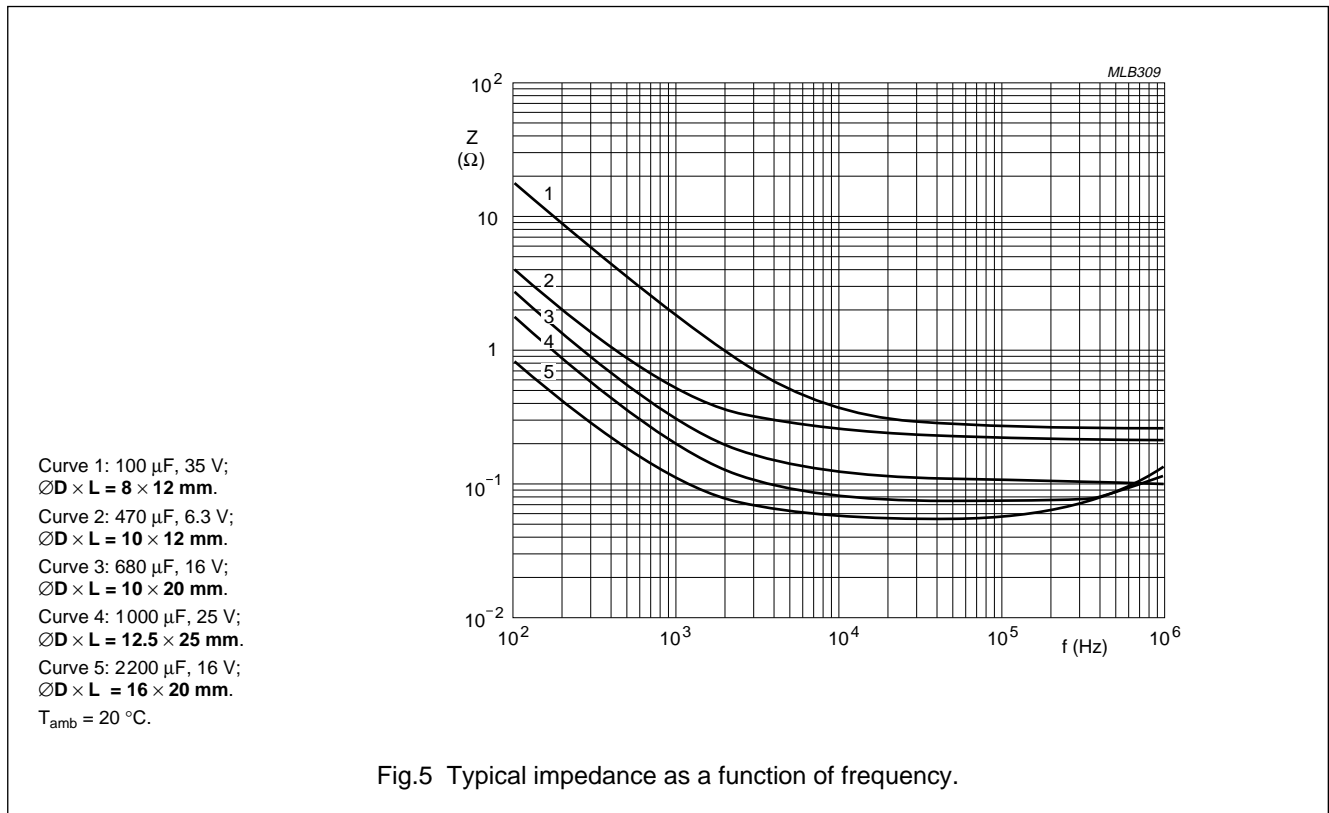
RLI 135

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	$I_{L1} \leq 0.03 C_R \times U_R \mu\text{A}$
	after 2 minutes at U_R	$I_{L2} \leq 0.01 C_R \times U_R \mu\text{A}$
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



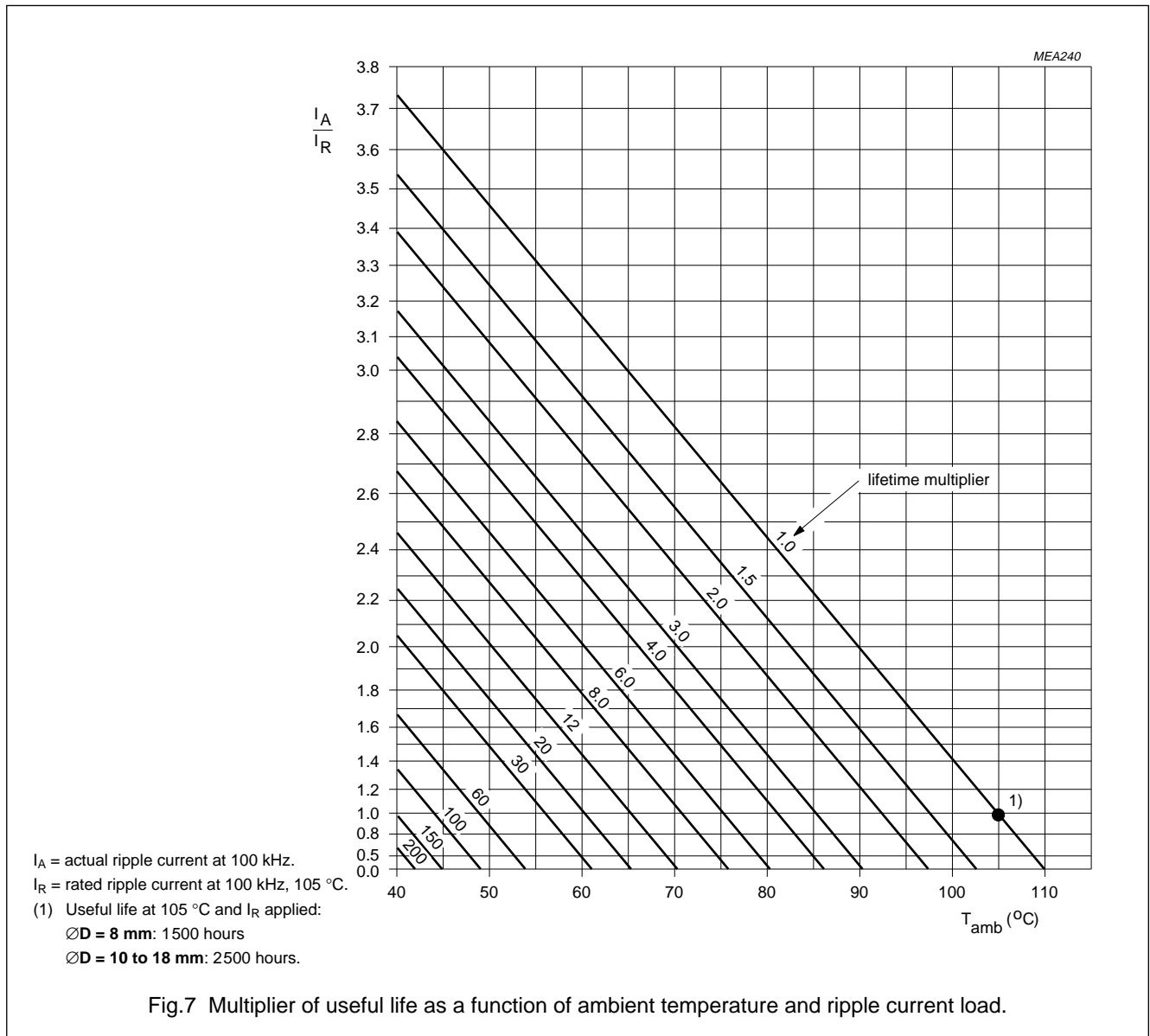
Non-solid Al - electrolytic capacitors
Radial, Low Impedance

RLI 135

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			
	22 μ F	33 to 330 μ F	470 to 1 000 μ F	>1 000 μ F
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 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	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$