Aluminum Capacitors
Radial Miniature Semi-Professional

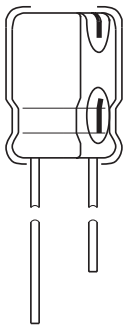
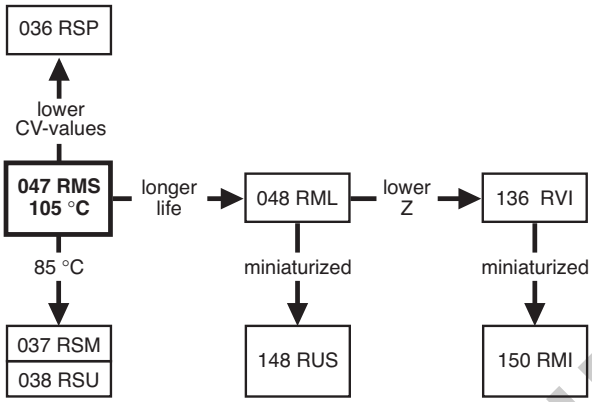


Fig.1 Component outline.



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
- Long useful life: 1500 hours at 105 °C
- Miniaturized, high CV-product per unit volume.

APPLICATIONS

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

MARKING

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

- Rated capacitance value (in µF).
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ±20%).
- Rated voltage (in V).
- Date code, in accordance with IEC 60062.
- Code indicating factory of origin.
- Name of manufacturer.
- Upper category temperature (105 °C).
- Negative terminal identification.
- Series number (047).

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (ØD × L in mm)	10 ×12 to 18 × 35
Rated capacitance range, C_R	100 to 10000 µF
Tolerance on C_R	±20%
Rated voltage range, U_R	16 to 63 V
Category temperature range	–40 to +105 °C
Endurance test at 105 °C	1000 hours
Useful life at 105 °C	1500 hours
Useful life at 40 °C, 1.3 × I_R applied	150000 hours
Shelf life at 0 V, 105 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (ØD x L in mm)

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

DIMENSIONS in millimeters, **AND AVAILABLE FORMS**

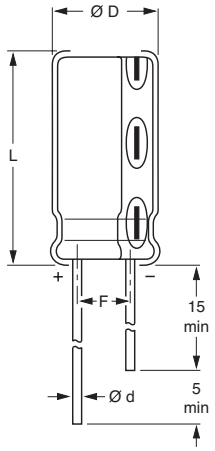


Fig.2 **Form CA**: Long leads.

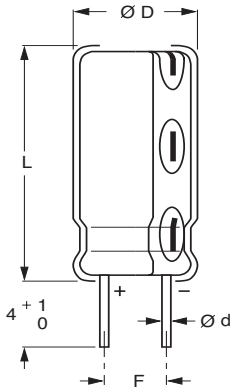


Fig.3 **Form CB**: Cut leads.

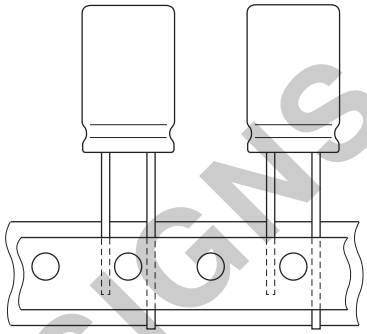


Fig.4 **Form TFA:** Taped in box (ammopack).

Table 1

DIMENSIONS in millimeters, **MASS AND PACKAGING QUANTITIES**									
NOMINAL CASE SIZE ∅D × L	**CASE CODE**	**∅d**	**∅D_{max}**	**L_{max}**	**F**	**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
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	–

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance ±20%
I_R	rated RMS ripple current at 100 Hz, 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
Tan δ	max. dissipation factor at 100 Hz
Z	max. impedance at 10 kHz or 100 kHz

Note

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

ORDERING EXAMPLE

Electrolytic capacitor 047 series

1000 µF/35 V; ±20

Nominal case size: ∅12.5 × 25 mm; Form TFA

Catalog number: 2222 047 30102.

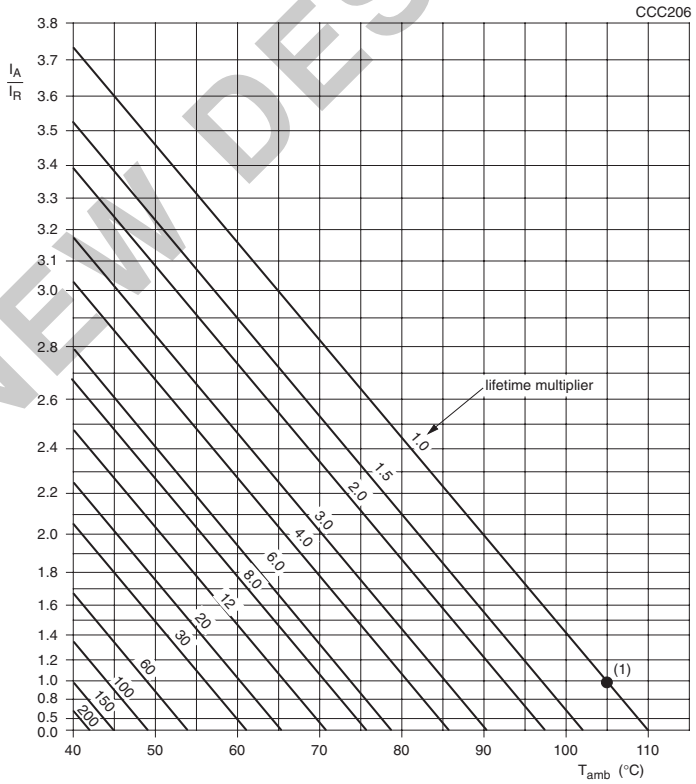
Table 2

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE ∅D × L (mm)	I_R 100 Hz 105 °C (mA)	I_{L1} 1 min (µA)	Tan δ 100 Hz	Z 100 kHz (Ω)	CATALOG NUMBER 2222 047		
							BULK PACKAGING		TAPED
							FORM CA	FORM CB	FORM TFA
16	470	10 × 12	330	78	0.16	0.33	55471	65471	35471
	1000	10 × 20	540	160	0.16	0.17	55102	65102	35102
	2200	12.5 × 25	830	360	0.20	0.10	55222	65222	35222
	3300	16 × 25	1100	530	0.22	0.08	55332	65332	35332
	4700	16 × 31	1300	760	0.24	0.07	55472	65472	35472
	6800	16 × 35	1600	1100	0.28	0.06	55682	65682	–
	10000	18 × 35	1800	1600	0.36	0.05	55103	65103	–
25	470	10 × 16	360	120	0.14	0.25	56471	66471	36471
	1000	12.5 × 20	630	250	0.14	0.13	56102	66102	36102
	2200	16 × 25	990	550	0.18	0.08	56222	66222	36222
	3300	16 × 31	1200	830	0.20	0.07	56332	66332	36332
	4700	18 × 35	1500	1200	0.22	0.05	56472	66472	–
	6800	18 × 35	1700	1700	0.26	0.04	56682	66682	–
35	220	10 × 12	270	80	0.12	0.38	50221	60221	30221
	330	10 × 16	350	120	0.12	0.28	50331	60331	30331
	470	10 × 20	450	170	0.12	0.22	50471	60471	30471
	1000	12.5 × 25	780	350	0.12	0.12	50102	60102	30102
	2200	16 × 31	1200	770	0.16	0.07	50222	60222	30222
	3300	18 × 35	1500	1200	0.18	0.05	50332	60332	–
	4700	18 × 35	1800	1600	0.20	0.04	50472	60472	–
40	330	10 × 20	380	140	0.12	0.26	57331	67331	37331
	2200	16 × 35	1200	880	0.16	0.06	57222	67222	–
	3300	18 × 35	1500	1300	0.18	0.04	57332	67332	–
50	220	10 × 16	310	110	0.10	0.33	51221	61221	31221
	470	12.5 × 20	540	240	0.10	0.17	51471	61471	31471
	1000	16 × 25	940	500	0.10	0.09	51102	61102	31102
	2200	18 × 35	1400	1100	0.14	0.05	51222	61222	–
	3300	18 × 35	1600	1700	0.16	0.04	51332	61332	–
63	100	10 × 12	210	66	0.09	0.65	58101	68101	38101
	220	10 × 20	350	140	0.09	0.32	58221	68221	38221
	330	12.5 × 20	470	210	0.09	0.22	58331	68331	38331
	470	12.5 × 25	620	300	0.09	0.16	58471	68471	38471
	1000	16 × 31	1100	630	0.09	0.08	58102	68102	38102
	2200	18 × 35	1500	1400	0.13	0.04	58222	68222	–

ADDITIONAL ELECTRICAL DATA		
DESCRIPTION	**CONDITIONS**	**VALUE**
Voltage		
Surge voltage		$U_s \leq 1.15\ U_R$
Reverse voltage		$U_{rev} \leq 1$ V
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.0\ 1\ C_R \times U_R + 3\ \mu A$
	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
Resistance		
Equivalent series resistance (ESR)	calculated from tan δ_{max} and C_R (see Table 2)	ESR = tan δ / $2\pi f C_R$

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 Hz.
I_R = rated ripple current at 100 Hz, 105 °C.
(1) Useful life at 105 °C and I_R applied: 1500 hours.

Fig.5 Multiplier of useful life as a function of ambient temperature and ripple current load.

Table 3

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)	**I_R MULTIPLIER**		
	U_R = 16 and 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

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 °C; U_R applied; 1000 hours	ΔC/C: ±15% tan δ ≤ 1.3 × spec. limit Z ≤ 2 × spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 105 °C; U_R and I_R applied; 1500 hours	ΔC/C: ±45% tan δ ≤ 3 × spec. limit Z ≤ 3 × spec. limit I_{L5} ≤ spec. limit no short or open circuit total failure percentage: ≤ 1%
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300, subclause 4.17	T_{amb} = 105 °C; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	ΔC/C: ±15% tan δ ≤ 1.3 × spec. limit Z ≤ 2 × spec. limit I_{L5} ≤ 2 × spec. limit