Aluminum Capacitors
Radial Miniature, High Voltage

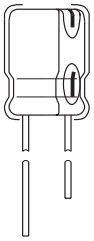
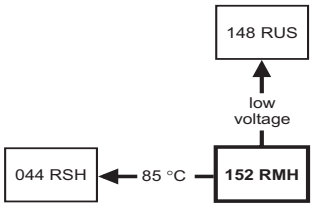


Fig.1 Component outline.



FEATURES

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

APPLICATIONS

- High-reliability and professional applications
- Lighting, monitors, consumer electronics, general industrial
- Filtering of high voltages in power supplies.

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 (152).

QUICK REFERENCE DATA	
DESCRIPTION	**VALUE**
Nominal case sizes (∅D × L in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	2.2 to 220 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	200 to 450 V
Category temperature range	–40 to +105 °C
Endurance test at 105 °C	2000 hours
Useful life at 105 °C: case ∅D = 10 and 12.5 mm case ∅D = 16 and 18 mm	 3000 hours 4000 hours
Useful life at 40 °C, 1.6 × I_R applied: case ∅D = 10 and 12.5 mm case ∅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

SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (∅D × L in mm)

C_R (μF)	U_R (V)			
	200	**250**	**400**	**450**
2.2	–	–	10 × 12	10 × 16
4.7	–	–	10 × 16	10 × 20
	–	–	10 × 12	-
6.8	–	–	10 × 16	12.5 × 20
10	10 × 12	10 × 16	10 × 20	12.5 × 20
22	10 × 16	12.5 × 20	12.5 × 25	16 × 25
	–	–	16 × 20	18 × 20
33	10 × 20	12.5 × 20	16 × 20	16 × 35
	–	–	–	18 × 25
47	12.5 × 20	12.5 × 25	16 × 25	18 × 35
	–	16 × 20	–	–
68	12.5 × 25	–	16 × 35	–
100	16 × 20	16 × 25	18 × 35	–
220	16 × 35	–	–	–

DIMENSIONS in millimeters, **AVAILABLE FORMS**

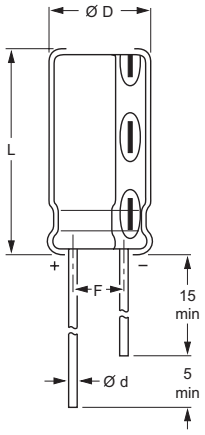


Fig.2 **Form CA**: Long leads.

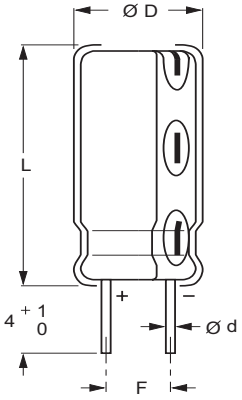


Fig.3 **Form CB**: Cut leads.

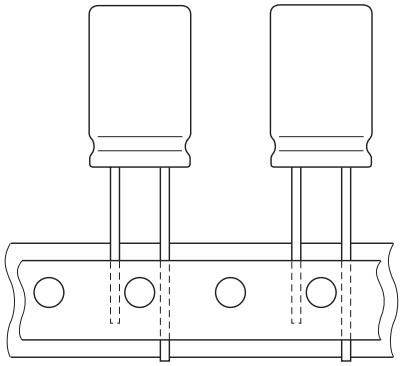


Fig.4 **Form TFA:** Taped in box (ammopack).

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 × 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 × 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 × 35	22	0.8	18.5	37.5	7.5 ±0.5	≈14.5	100	100	–

Note

1. Detailed tape dimensions see section ‘PACKAGING’.

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

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 152 series

4.7 µF/400 V; ±20%

Nominal case size: ∅10 × 16 mm; Form TFA

Catalog number: 2222 152 36478.

Table 2

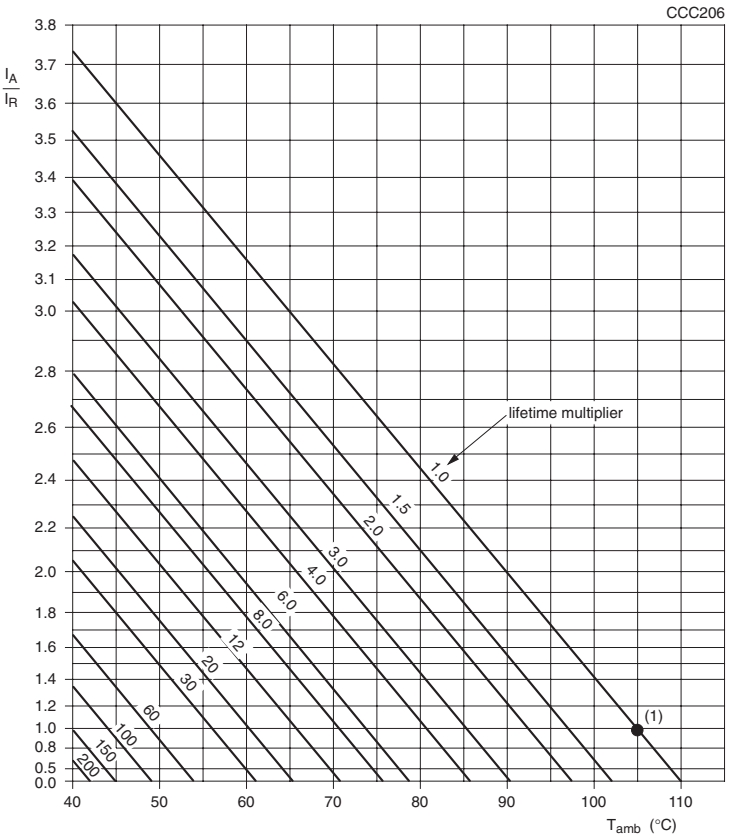
ELECTRICAL DATA AND ORDERING INFORMATION									
U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE ∅D × L (mm)	I_R 100 Hz 105 °C (mA)	I_{L1} 1 min (µA)	Tan δ 100 Hz	Z 10 kHz (Ω)	CATALOG NUMBER 2222 152		
							BULK PACKAGING		TAPED
							FORM CA	FORM CB	FORM TFA
200	10	10 × 12	85	130	0.12	6.3	52109	62109	32109
	22	10 × 16	120	202	0.12	3.2	52229	62229	32229
	33	10 × 20	150	268	0.12	2.3	52339	62339	32339
	47	12.5 × 20	240	352	0.12	0.9	52479	62479	32479
	68	12.5 × 25	310	478	0.12	0.6	52689	62689	32689
	100	16 × 20	340	670	0.12	0.4	52101	62101	32101
	220	16 × 35	630	1390	0.12	0.2	52221	62221	–
250	10	10 × 16	105	145	0.12	6.3	53109	63109	33109
	22	12.5 × 20	180	235	0.12	2.3	53229	63229	33229
	33	12.5 × 20	180	318	0.12	1.5	53339	63339	33339
	47	12.5 × 25	310	423	0.12	0.9	53479	63479	33479
	47	16 × 20	310	423	0.12	0.9	93475	93476	93473
	100	16 × 25	340	820	0.12	0.4	53101	63101	33101
400	2.2	10 × 12	44	96	0.15	28.0	56228	66228	36228
	4.7	10 × 12	48	127	0.15	24.0	96475	96476	96473
	4.7	10 × 16	48	126	0.15	18.0	56478	66478	36478
	6.8	10 × 16	65	152	0.15	12.0	56688	66688	36688
	10	10 × 20	80	190	0.15	9.0	56109	66109	36109
	22	12.5 × 25	150	334	0.15	3.8	56229	66229	36229
	22	16 × 20	150	334	0.15	3.8	96225	96226	96223
	33	16 × 20	190	466	0.15	2.6	56339	66339	36339
	47	16 × 25	240	634	0.15	2.0	56479	66479	36479
	68	16 × 35	310	886	0.15	1.7	56689	66689	–
	100	18 × 35	380	1270	0.15	0.9	56101	66101	–
450	2.2	10 × 16	50	99	0.20	26.0	57228	67228	37228
	4.7	10 × 20	65	133	0.20	20.0	57478	67478	37478
	6.8	12.5 × 20	80	162	0.20	16.0	57688	67688	37688
	10	12.5 × 20	90	205	0.20	10.0	57109	67109	37109
	22	16 × 25	150	367	0.20	4.6	57229	67229	37229
	22	18 × 20	150	367	0.20	4.6	97225	97226	–
	33	16 × 35	200	516	0.20	3.4	57339	67339	–
	33	18 × 25	200	516	0.20	3.4	97335	97336	–
	47	18 × 35	260	705	0.20	2.0	57479	67479	–

ADDITIONAL ELECTRICAL DATA		
PARAMETER	**CONDITIONS**	**VALUE**
Voltage		
Surge voltage	U_R = 200 to 250 V	$U_s \leq 1.15 \times U_R$
	U_R = 400 to 450 V	$U_s \leq 1.10 \times U_R$
Reverse voltage		$U_{rev} \leq 1$ V
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.03\ C_R \times U_R + 70$ µA
	after 5 minutes at U_R	$I_{L5} \leq 0.015\ C_R \times U_R + 30$ µA
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

Table 3

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY		
FREQUENCY (Hz)	I_R MULTIPLIER	
	$U_R \leq 250$ V	$U_R > 250$ V
50	0.75	0.75
100	1.00	1.00
300	1.50	1.30
1000	2.00	1.60
3000	2.20	1.90
10000	2.50	2.20
≥100000	3.00	2.50



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.

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

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; 2000 hours	ΔC/C: ±20% tan δ ≤ 2 × 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; case ØD = 10 and 12.5 : 3000 hours case ØD = 16 and 18 : 4000 hours	ΔC/C: ±50% 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; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	ΔC/C: ±20% tan δ ≤ 2 × spec. limit Z ≤ 2 × spec. limit I_{L5} ≤ 2 × spec. limit
Reverse voltage	IEC 60384-4/ EN130300 subclause 4.15	T_{amb} = 105 °C: 125 hours at U = −1 V, followed by 125 hours at U_R	ΔC/C: ±15% I_{L5} ≤ spec. limit tan δ ≤ spec. limit