

Aluminum Capacitors

Radial, High Temperature Miniature

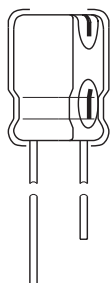
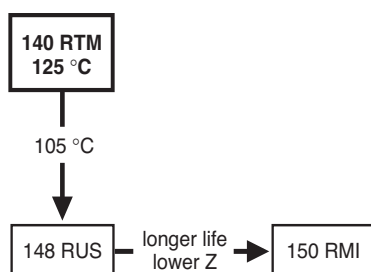


Fig.1 Component outline.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (ØD × L in mm)	10 × 12 to 18 × 31
Rated capacitance range, C _R	22 to 4700 µF
Tolerance on C _R	±20%
Rated voltage range, U _R	6.3 to 63 V
Category temperature range	-55 to +125 °C
Endurance test at 125 °C	2000 hours
Useful life at 125 °C	2500 to 4000 hours
Useful life at 40 °C, 1.6 × I _R applied	300000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/125/56

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue sleeve
- Charge and discharge proof
- Very long useful life:
2500 to 4000 hours at 125 °C, high stability, high reliability
- Extended temperature range up to 125 °C
- High ripple current capability.

APPLICATIONS

- EDP, telecommunication, industrial, automotive and military
- Smoothing, filtering, buffering in SMPS
- High ambient temperature environments.

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 (125 °C).
- Negative terminal identification.
- Series number (140).

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

C _R (µF)	U _R (V)						
	6.3	10	16	25	35	50	63
22	–	–	–	–	–	–	10 × 12
47	–	–	–	–	–	10 × 12	10 × 12
100	–	–	–	–	10 × 12	10 × 16	10 × 20
220	–	–	10 × 12	10 × 16	10 × 16	12.5 × 20	16 × 20
330	–	10 × 12	10 × 16	10 × 20	–	12.5 × 20	16 × 20
470	–	10 × 16	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25
	–	–	–	–	–	16 × 20	–
1000	–	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	18 × 31
	–	–	–	16 × 20	–	–	–
1200	10 × 16	–	–	–	–	–	–
2200	10 × 20	12.5 × 25	16 × 25	16 × 31	18 × 31	–	–
	–	16 × 20	–	–	–	–	–
3300	–	16 × 25	16 × 31	18 × 31	–	–	–
4700	–	16 × 31	18 × 31	–	–	–	–

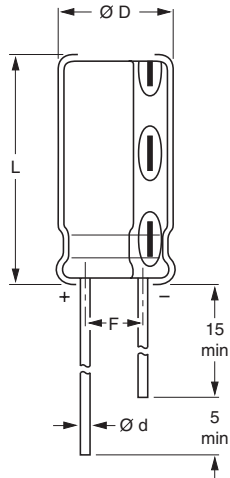
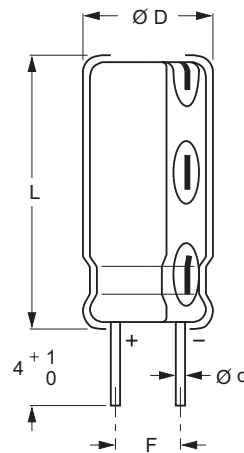
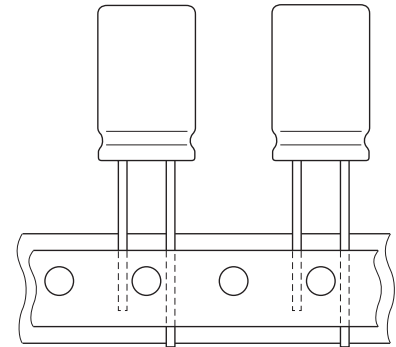
DIMENSIONS in millimeters, **AND AVAILABLE FORMS**

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 ØD × L	CASE CODE	Ød	ØD _{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 × 31	20	0.8	16.5	33.5	7.5 ±0.5	≈9.0	100	100	250
18 × 31	1831	0.8	18.5	33.5	7.5 ±0.5	≈12.5	100	100	–

Note

1. Detailed tape dimensions see section 'PACKAGING'.

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 kHz, 125 °C
I_{L1}	max. leakage current after 1 minute at U_R
$\tan \delta$	max. dissipation factor at 100 Hz
Z	max. impedance at 100 kHz

Note

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

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION										
U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 kHz 125 °C (mA)	I_{L1} 1 min (μA)	$\tan \delta$ 100 Hz	Z 100 kHz +20 °C (Ω)	Z 100 kHz -40 °C (Ω)	CATALOG NUMBER 2222 140		
								BULK PACKAGING		TAPED
								FORM CA	FORM CB	FORM TFA
6.3	1200	10 × 16	760	79	0.28	0.15	1.10	53122	63122	33122
	2200	10 × 20	850	142	0.28	0.12	0.85	53222	63222	33222
10	330	10 × 12	480	36	0.20	0.200	1.40	54331	64331	34331
	470	10 × 16	760	50	0.20	0.150	1.10	54471	64471	34471
	1000	10 × 20	850	103	0.20	0.120	0.85	54102	64102	34102
	2200	12.5 × 25	1400	223	0.24	0.050	0.40	94225	94226	94223
	2200	16 × 20	1400	223	0.24	0.050	0.40	54222	64222	34222
	3300	16 × 25	1900	333	0.24	0.034	0.25	54332	64332	34332
	4700	16 × 31	2200	473	0.24	0.030	0.20	54472	64472	34472
16	220	10 × 12	480	38	0.16	0.200	1.40	55221	65221	35221
	330	10 × 16	760	56	0.16	0.150	1.10	55331	65331	35331
	470	10 × 16	760	78	0.16	0.150	1.10	55471	65471	35471
	1000	12.5 × 20	1200	163	0.16	0.073	0.50	55102	65102	35102
	2200	16 × 25	1900	355	0.18	0.034	0.25	55222	65222	35222
	3300	16 × 31	2200	531	0.18	0.030	0.20	55332	65332	35332
	4700	18 × 31	2200	755	0.18	0.030	0.20	55472	65472	—
25	220	10 × 16	750	58	0.14	0.150	1.10	56221	66221	36221
	330	10 × 20	850	86	0.14	0.120	0.85	56331	66331	36331
	470	10 × 20	850	121	0.14	0.120	0.85	56471	66471	36471
	1000	12.5 × 25	1400	253	0.14	0.050	0.40	96105	96106	96103
	1000	16 × 20	1400	253	0.14	0.050	0.40	56102	66102	36102
	2200	16 × 31	2200	553	0.16	0.030	0.20	56222	66222	36222
	3300	18 × 31	2200	828	0.16	0.030	0.20	56332	66332	—
35	100	10 × 12	480	38	0.12	0.200	1.40	50101	60101	30101
	220	10 × 16	760	80	0.12	0.150	1.10	50221	60221	30221
	470	12.5 × 20	1200	168	0.12	0.073	0.50	50471	60471	30471
	1000	16 × 25	1500	353	0.12	0.034	0.25	50102	60102	30102
	2200	18 × 31	2200	773	0.14	0.030	0.20	50222	60222	—
50	47	10 × 12	300	27	0.10	0.300	2.00	51479	61479	31479
	100	10 × 16	380	53	0.10	0.200	1.40	51101	61101	31101
	220	12.5 × 20	580	113	0.10	0.120	0.85	51221	61221	31221
	330	12.5 × 20	870	168	0.10	0.120	0.85	51331	61331	31331
	470	12.5 × 25	1100	238	0.10	0.085	0.60	91475	91476	91473
	470	16 × 20	1100	238	0.10	0.085	0.60	51471	61471	31471
	1000	16 × 31	1700	503	0.10	0.045	0.30	51102	61102	31102
63	22	10 × 12	380	17	0.10	0.300	2.00	58229	68229	38229
	47	10 × 12	380	33	0.10	0.300	2.00	58479	68479	38479
	100	10 × 20	650	66	0.10	0.160	1.10	58101	68101	38101
	220	16 × 20	1100	142	0.10	0.085	0.60	58221	68221	38221
	330	16 × 20	1100	211	0.10	0.085	0.60	58331	68331	38331
	470	16 × 25	1500	299	0.10	0.055	0.40	58471	68471	38471
	1000	18 × 31	1800	633	0.10	0.040	0.28	58102	68102	—

ORDERING EXAMPLE

Electrolytic capacitor 140 series

220 μF /25 V; $\pm 20\%$ Nominal case size: $\varnothing 10 \times 16\text{ mm}$; Form TFA

Catalog number: 2222 140 36221.

**ADDITIONAL ELECTRICAL DATA**

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.3 U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH
Resistance		
Equivalent series resistance (ESR)	calculated from $\tan \delta_{\max}$ and C_R (see Table 2)	$\text{ESR} = \tan \delta / 2\pi f C_R$

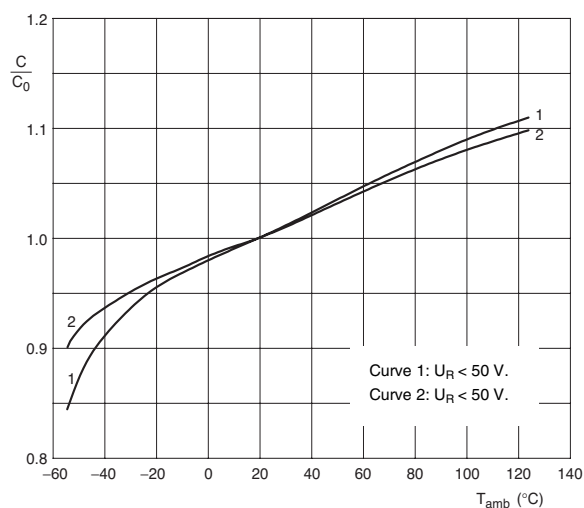
CAPACITANCE (C) C_0 = typical capacitance at 20 °C, 100 Hz.

Fig.4 Typical multiplier of capacitance as a function of ambient temperature.

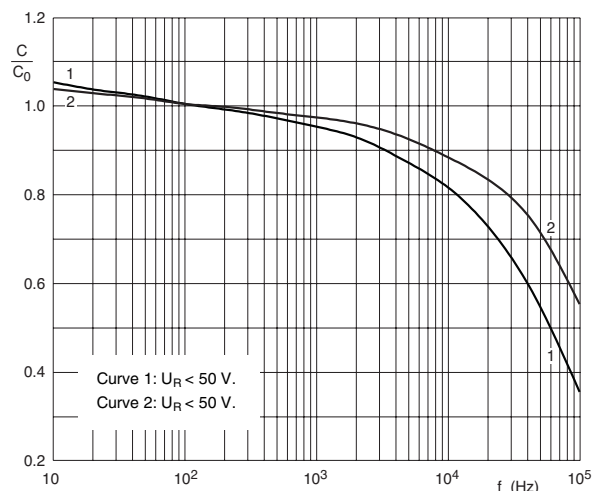
 C_0 = typical capacitance at 20 °C, 100 Hz. $T_{\text{amb}} = 20 \text{ }^{\circ}\text{C}$.

Fig.5 Typical multiplier of capacitance as a function of frequency.

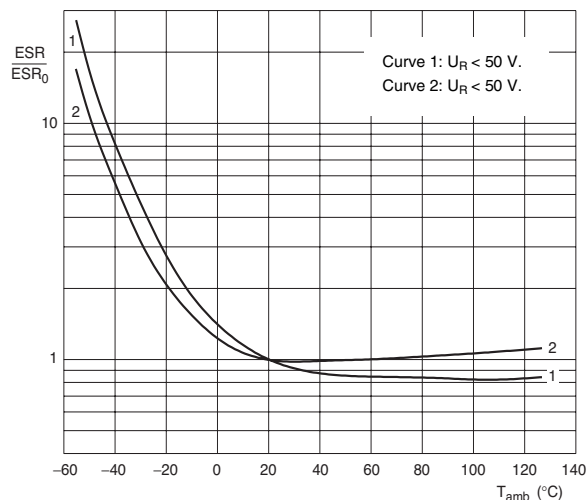
EQUIVALENT SERIES RESISTANCE (ESR) ESR_0 = typical ESR at 20 °C, 100 Hz.

Fig.6 Typical multiplier of ESR as a function of ambient temperature.

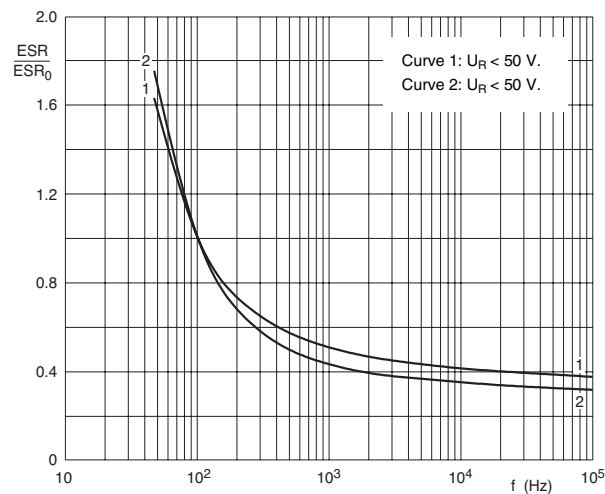
 ESR_0 = typical ESR at 20 °C, 100 Hz. $T_{\text{amb}} = 20 \text{ }^{\circ}\text{C}$.

Fig.7 Typical multiplier of ESR as a function of frequency.

RIPPLE CURRENT AND USEFUL LIFE

Table 3

ENDURANCE AND USEFUL LIFE AS A FUNCTION OF CASE SIZE			
NOMINAL CASE SIZE $\varnothing \times L$ (mm)	CASE CODE	ENDURANCE TEST AT 125 °C (HOURS)	USEFUL LIFE AT 125 °C (HOURS)
10 × 12	14	2000	2500
10 × 16	15	2000	3000
10 × 20	16	2000	3000
12.5 × 20	17	2000	3000
12.5 × 25	18	2000	3000
16 × 20	19a	2000	3000
16 × 25	19	2000	4000
16 × 31	20	2000	4000
18 × 31	1831	2000	4000

I_A = actual ripple current at 100 kHz.

I_R = rated ripple current at 100 kHz, 125 °C.

(1) Useful life at 125 °C and I_R applied: see Table 3.

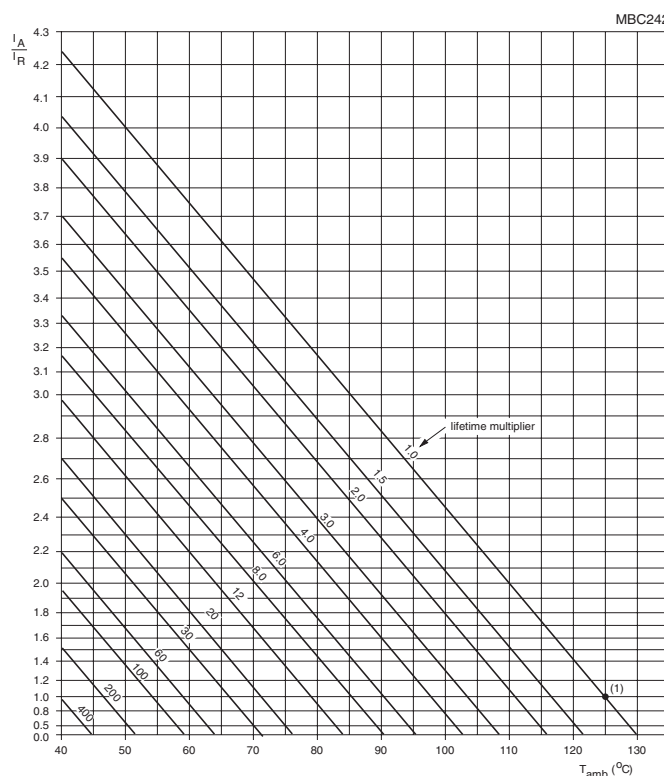


Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load.

Table 4

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 6.3$ to 25 V	$U_R = 35$ V	$U_R = 50$ and 63 V
50	0.60	0.50	0.35
100	0.70	0.65	0.50
300	0.85	0.80	0.65
1000	0.90	0.85	0.80
3000	0.95	0.90	0.90
10000	1.00	0.95	0.90
100000	1.00	1.00	1.00

Aluminum Capacitors
Radial, High Temperature Miniature

Vishay BCcomponents

Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125\text{ °C}$; U_R applied; 2000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 125\text{ °C}$; U_R and I_R applied; for test duration see Table 3	$\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$