

Aluminum Capacitors

Radial, High Temperature Miniature

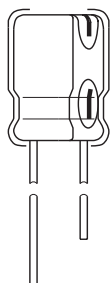
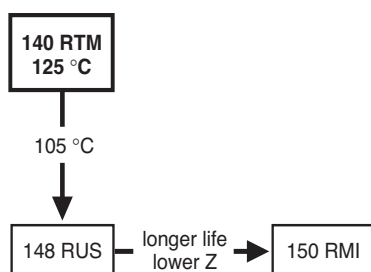


Fig.1 Component outline.



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
- Lead (Pb)-free versions are RoHS compliant.



RoHS
COMPLIANT

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 $\pm 20\%$).
- 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).

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes ($\varnothing D \times L$ in mm)	10 × 12 to 18 × 31
Rated capacitance range, C_R	22 to 4700 μF
Tolerance on C_R	$\pm 20\%$
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, $1.6 \times I_R$ 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

SELECTION CHART FOR C_R , U_R AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ 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
1000	—	—	—	—	—	16 × 20	—
	—	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	18 × 31
1200	—	—	—	16 × 20	—	—	—
2200	10 × 16	—	—	—	—	—	—
3300	10 × 20	12.5 × 25	16 × 25	16 × 31	18 × 31	—	—
	—	16 × 20	—	—	—	—	—
4700	—	16 × 25	16 × 31	18 × 31	—	—	—
	—	16 × 31	18 × 31	—	—	—	—

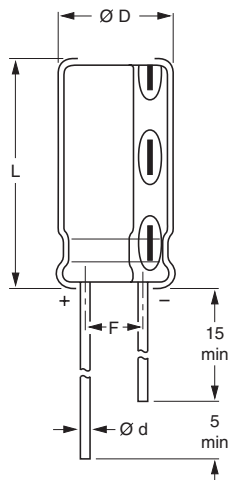
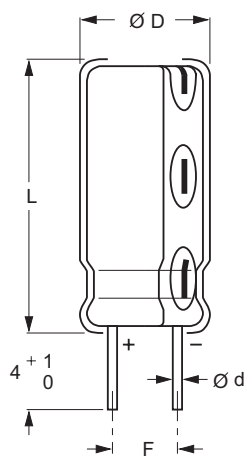
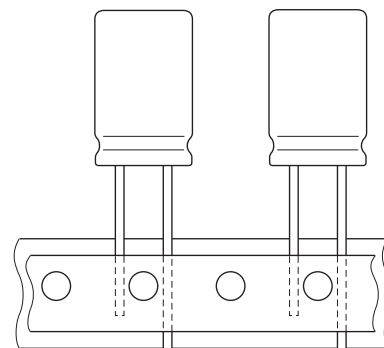
DIMENSIONS in millimeters, **AND AVAILABLE FORMS**

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 $\varnothing D \times L$	CASE CODE	$\varnothing d$	$\varnothing D_{max}$	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 × 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

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

Catalog number: 2222 140 36221.

*Note: For ordering lead (Pb)-free parts, please contact your Vishay sales agent.

**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)	$\text{ESR} = \tan \delta / 2\pi f C_R$

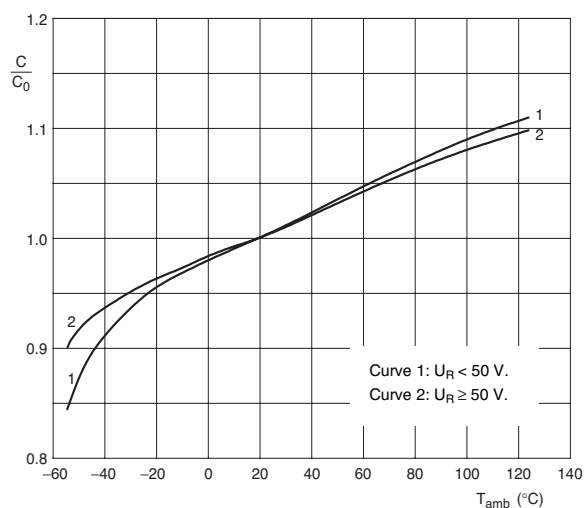
CAPACITANCE (C) C_0 = typical capacitance at 20 °C, 100 Hz.

Fig.5 Typical multiplier of capacitance as a function of ambient temperature.

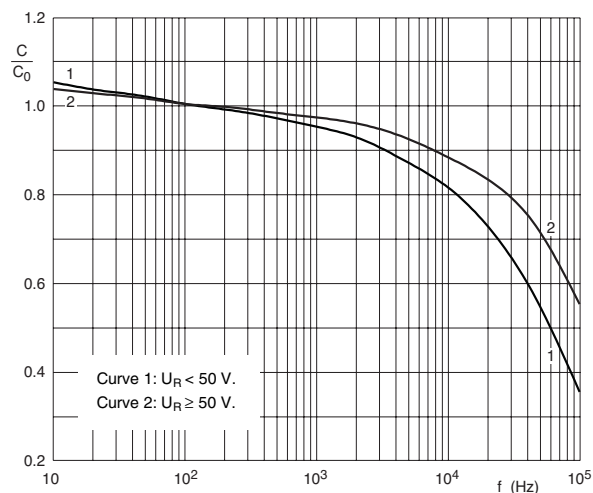
 C_0 = typical capacitance at 20 °C, 100 Hz. $T_{\text{amb}} = 20 \text{ }^{\circ}\text{C}$.

Fig.6 Typical multiplier of capacitance as a function of frequency.

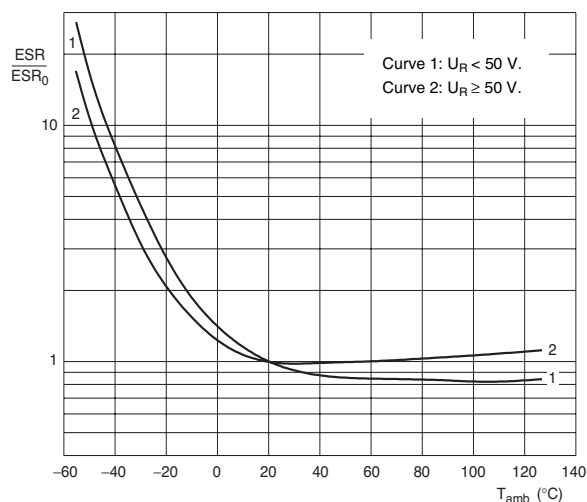
EQUIVALENT SERIES RESISTANCE (ESR) ESR_0 = typical ESR at 20 °C, 100 Hz.

Fig.7 Typical multiplier of ESR as a function of ambient temperature.

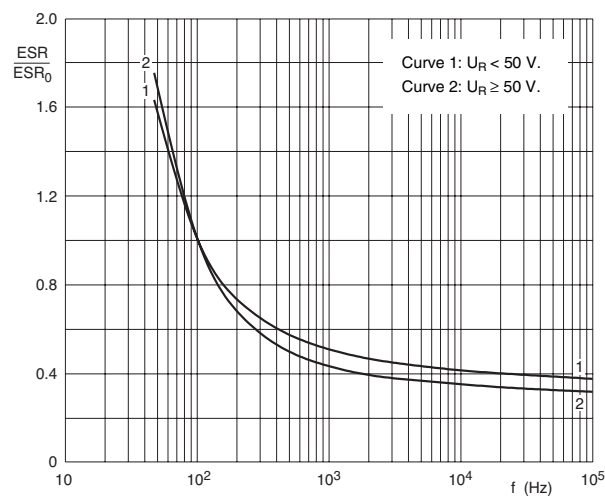
 ESR_0 = typical ESR at 20 °C, 100 Hz. $T_{\text{amb}} = 20 \text{ }^{\circ}\text{C}$.

Fig.8 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

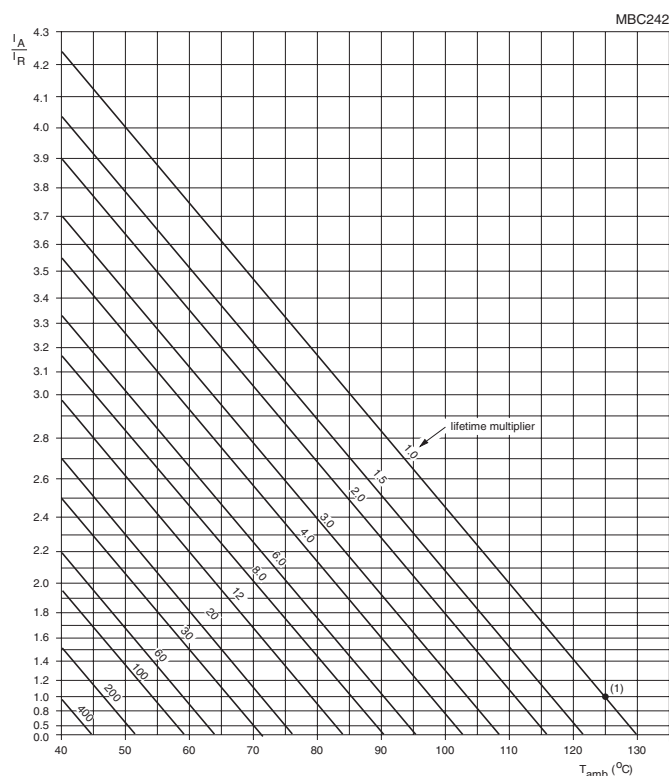
 I_A = actual ripple current at 100 kHz. I_R = rated ripple current at 100 kHz, 125 °C.(1) Useful life at 125 °C and I_R applied: see Table 3.

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

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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	$T_{amb} = 125\text{ }^{\circ}\text{C}$; 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	$T_{amb} = 125\text{ }^{\circ}\text{C}$; 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	$T_{amb} = 125\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$