

Aluminum Capacitors Radial High Temperature

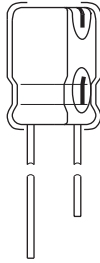
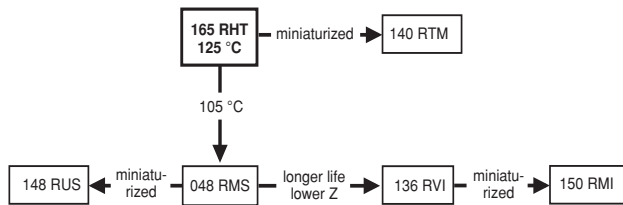


Fig.1 Component outline.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (∅D × L in mm)	10 × 12 to 16 × 35
Rated capacitance range, C _R	22 to 4700 μF
Tolerance on C _R	±20%
Rated voltage range, U _R	10 to 50 V
Category temperature range	-40 to +125 °C
Endurance test at 125 °C	1 000 hours
Useful life at 125 °C	1500 hours
Useful life at 40 °C, 1.6 × I _R applied	300 000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/125/56

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
- Very long useful life: 1500 at 105 °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 (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 (165).

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

C _R (μF)	U _R (V)					
	10	16	25	35	40	50
22	-	-	-	-	-	10 × 12
47	-	-	-	-	10 × 12	10 × 16
100	-	-	10 × 12	10 × 16	10 × 20	12.5 × 20
220	10 × 12	10 × 16	10 × 20	-	12.5 × 20	16 × 25
470	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	16 × 35
1000	-	12.5 × 25	16 × 31	-	16 × 35	16 × 35
2200	16 × 31	16 × 35	16 × 35	-	-	-
3300	16 × 35	16 × 35	-	-	-	-
4700	16 × 35	-	-	-	-	-

DIMENSIONS in millimeters, AND AVAILABLE FORMS

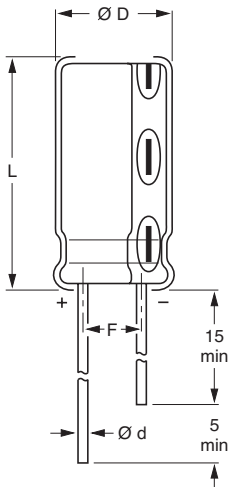


Fig.2 Form CA: Long leads.

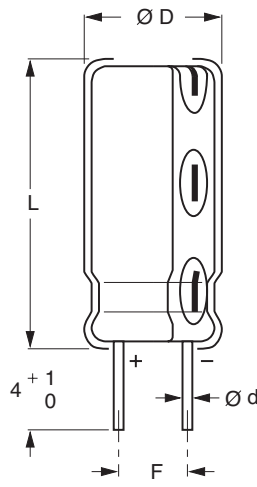
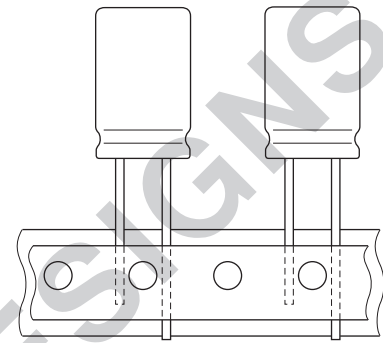


Fig.3 Form CB: Cut leads.



Case $\text{ØD} \times L \leq 16 \times 31$ mm.

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

Table 1

DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES									
NOMINAL CASE SIZE $\text{ØD} \times L$	CASE CODE	Ød	ØD_{max}	L_{max}	F	MASS (g)	PACKAGING QUANTITIES PER BOX		
							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	–

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 Hz, 125 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
Tan δ	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from tan δ_{max} and C_R)
Z	max. impedance at 10 kHz or 100 kHz

ORDERING EXAMPLE

Electrolytic capacitor 165 series
220 $\mu\text{F}/25\text{ V}$; $\pm 20\%$
Nominal case size: $\varnothing 10 \times 20\text{ mm}$; Form TFA
Catalog number: 2222 165 36221.

Note

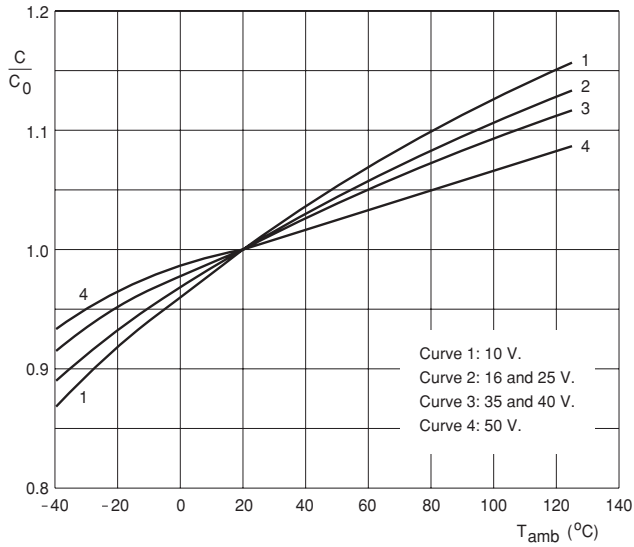
- Unless otherwise specified, all electrical values in Table 2 apply at $T_{amb} = 20\text{ °C}$, $P = 86\text{ to }106\text{ kPa}$, $RH = 45\text{ to }75\%$.

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION													
U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 125 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOG NUMBER 2222 165		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	FORM TFA
10	220	10 x 12	14	200	25	7	0.20	1.30	-	0.55	165 54221	165 64221	165 34221
	470	10 x 20	16	340	50	12	0.20	0.61	-	0.26	165 54471	165 64471	165 34471
	2200	16 x 31	20	930	220	47	0.24	0.16	0.07	-	165 54222	165 64222	165 34222
	3300	16 x 35	21	1200	330	69	0.26	0.11	0.05	-	165 54332	165 64332	-
	4700	16 x 35	21	1400	470	97	0.28	0.09	0.04	-	165 90502	165 90507	-
16	220	10 x 16	15	240	38	10	0.16	1.00	-	0.43	165 55221	165 65221	165 35221
	470	12.5 x 20	17	410	78	18	0.16	0.49	-	0.20	165 55471	165 65471	165 35471
	1000	12.5 x 25	18	650	160	35	0.16	0.23	-	0.10	165 55102	165 65102	165 35102
	2200	16 x 35	21	1100	360	73	0.20	0.13	0.05	-	165 55222	165 65222	-
	3300	16 x 35	21	1400	530	110	0.22	0.10	0.04	-	165 90503	165 90508	-
25	100	10 x 12	14	170	28	8	0.14	2.00	-	0.70	165 56101	165 66101	165 36101
	220	10 x 20	16	280	58	14	0.14	0.91	-	0.32	165 56221	165 66221	165 36221
	470	12.5 x 25	18	480	120	27	0.14	0.43	-	0.15	165 56471	165 66471	165 36471
	1000	16 x 31	20	830	250	53	0.14	0.20	-	0.07	165 56102	165 66102	165 36102
	2200	16 x 35	21	1200	550	110	0.18	0.12	0.04	-	165 90504	165 90509	-
35	100	10 x 16	15	200	38	10	0.12	1.70	-	0.65	165 50101	165 60101	165 30101
	470	16 x 25	19	600	170	36	0.12	0.37	-	0.14	165 50471	165 60471	165 30471
40	47	10 x 12	14	130	22	7	0.12	3.70	-	1.30	165 57479	165 67479	165 37479
	100	10 x 20	16	210	43	11	0.12	1.70	-	0.60	165 57101	165 67101	165 37101
	220	12.5 x 20	17	340	91	21	0.12	0.78	-	0.27	165 57221	165 67221	165 37221
	470	16 x 31	20	650	190	41	0.12	0.37	-	0.13	165 57471	165 67471	165 37471
	1000	16 x 35	21	1000	400	83	0.12	0.17	-	0.06	165 57102	165 67102	-
50	22	10 x 12	14	100	14	5	0.10	6.50	-	2.3	165 51229	165 61229	165 31229
	47	10 x 16	15	150	27	8	0.10	3.00	-	1.10	165 51479	165 61479	165 31479
	100	12.5 x 20	17	260	53	13	0.10	1.40	-	0.50	165 51101	165 61101	165 31101
	220	16 x 25	19	450	110	25	0.10	0.65	-	0.23	165 51221	165 61221	165 31221
	470	16 x 35	21	760	240	50	0.10	0.30	-	0.11	165 51471	165 61471	-
1000	16 x 35	21	1200	500	100	0.10	0.14	-	0.05	165 90506	165 90512	-	

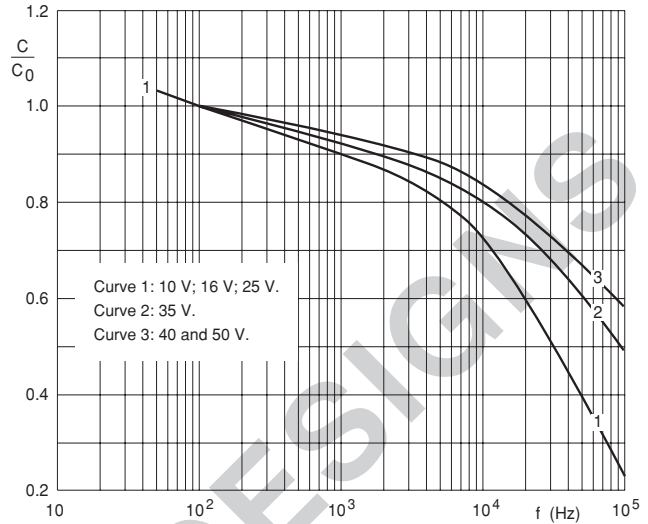
ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.3 U_R$
Reverse voltage		$U_{rev} \leq 1\text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.01 C_R \times U_R + 3\ \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 3\ \mu\text{A}$
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

CAPACITANCE (C)



C₀ = capacitance at 20 °C, 100 Hz.

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

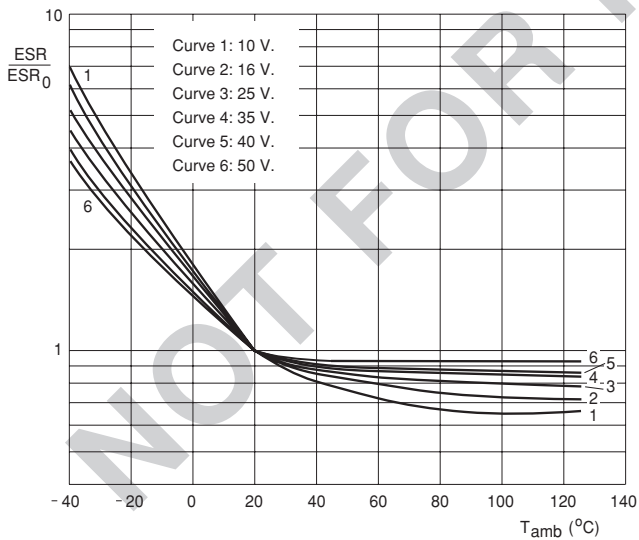


C₀ = capacitance at 20 °C, 100 Hz

T_{amb} = 20 °C.

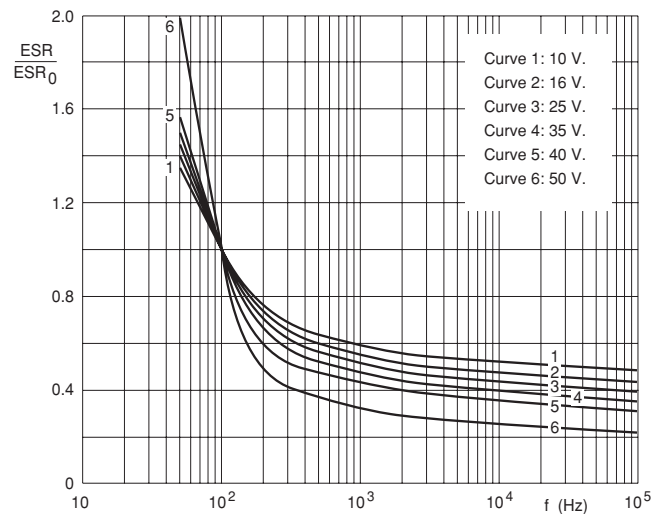
Fig.6 Typical multiplier of capacitance as a function of frequency.

EQUIVALENT SERIES RESISTANCE (ESR)



ESR₀ = typical at 20 °C, 100 Hz.

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



ESR₀ = typical at 20 °C, 100 Hz.

T_{amb} = 20 °C.

Fig.8 Typical multiplier of ESR as a function of frequency.

RIPPLE CURRENT AND USEFUL LIFE

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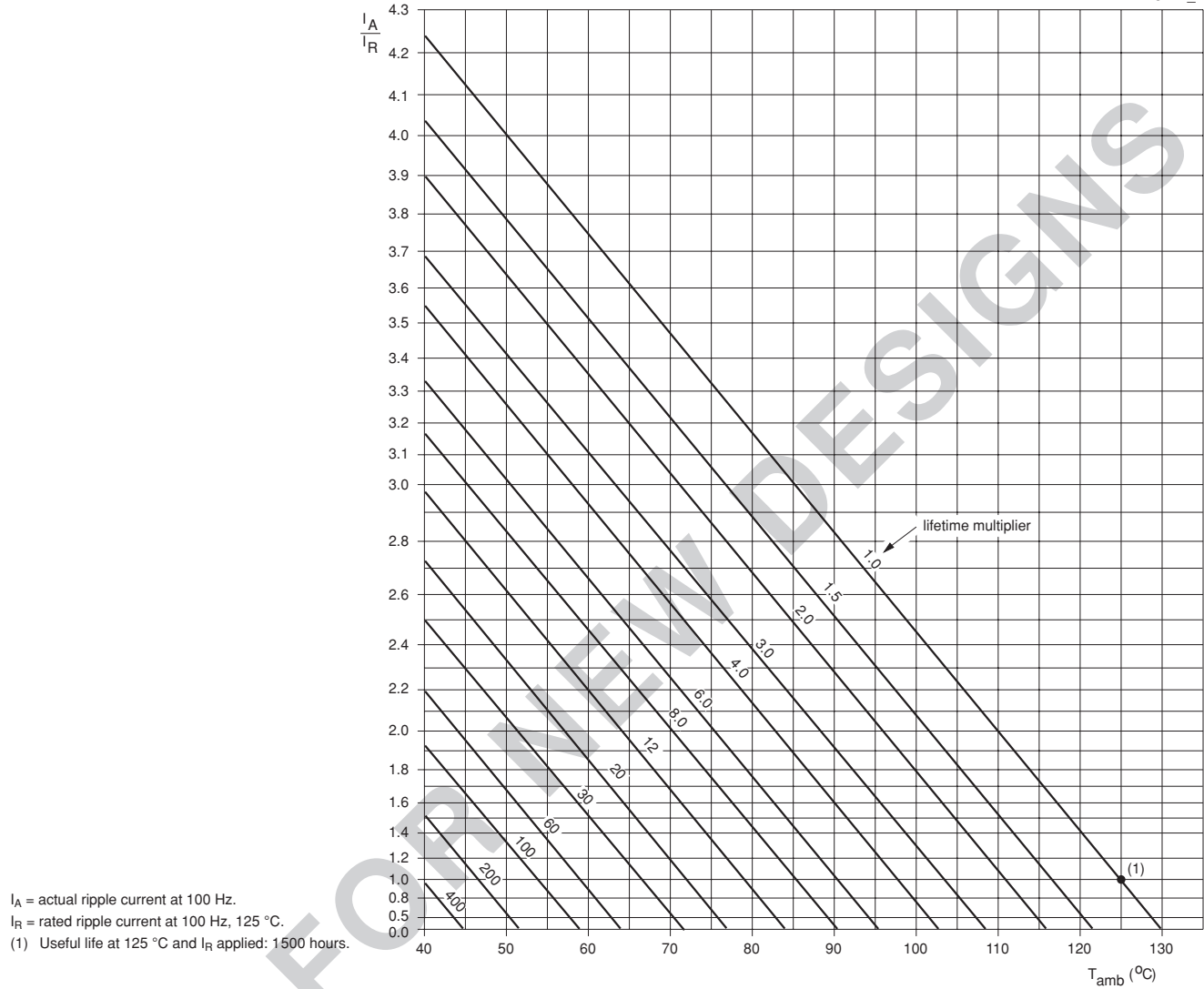


Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load.

Table 3

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 35$ or 40 V	$U_R = 50$ V
50	0.85	0.80	0.75
100	1.00	1.00	1.00
300	1.20	1.25	1.30
1000	1.30	1.40	1.50
3000	1.35	1.50	1.65
≥ 10000	1.40	1.60	1.80

Table 4

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125\text{ }^{\circ}\text{C}$; U_R applied; 1000 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; 1500 hours	$\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ 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	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$