

Aluminum Capacitors Radial Miniature, Low Impedance

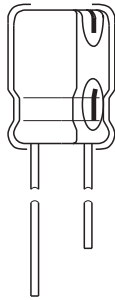
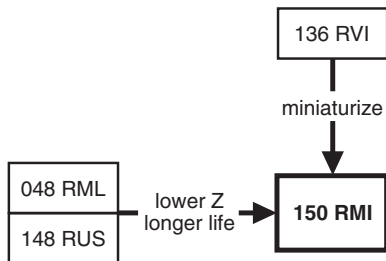


Fig.1 Component outline.



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
- Very long useful life: 4000 to 10000 hours at 105 °C, high stability, high reliability
- Very low impedance or ESR respectively, at smaller case sizes than the 136 RVI series
- Excellent ripple current capability
- Lead (Pb)-free versions are RoHS compliant.



APPLICATIONS

- Power supplies (SMPS, DC/DC converters) for general industrial, EDP, audio-video, automotive and telecommunications
- Smoothing, filtering, buffering.

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 $\pm 20\%$).
- 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 (150).

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes ($\varnothing D \times L$ in mm)	10 × 12 to 16 × 35
Rated capacitance range, C_R	100 to 6800 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	10 to 63 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C	3000 to 5000 hours
Useful life at 105 °C	4000 to 10000 hours
Useful life at 40 °C, $1.8 \times I_R$ applied	200000 to 500000 hours
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/105/56

SELECTION CHART FOR C_R , U_R AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ in mm)						
C_R (μF)	U_R (V)					
	10	16	25	35	50	63
100	-	-	-	-	-	10 × 12
150	-	-	-	-	10 × 12	10 × 16
220	-	-	-	10 × 12	10 × 16	10 × 20
330	-	-	10 × 12	10 × 16	10 × 20	12.5 × 20
470	-	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 25
680	-	-	-	-	-	16 × 20
	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 20
1000	-	-	-	-	-	16 × 25
	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31
1200	-	-	-	16 × 20	-	-
1500	-	-	-	-	16 × 31	-
1500	-	12.5 × 20	12.5 × 25	16 × 20	16 × 31	-
2200	12.5 × 20	12.5 × 25	16 × 20	16 × 31	-	-
3300	12.5 × 25	16 × 20	16 × 31	-	-	-
4700	16 × 25	16 × 31	16 × 35	-	-	-
6800	16 × 31	16 × 35	-	-	-	-

* Pb containing terminations are not RoHS compliant, exemptions may apply

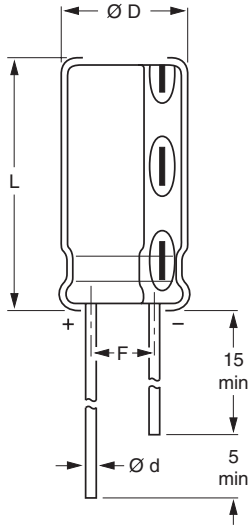
DIMENSIONS in millimeters **AND AVAILABLE FORMS**


Fig.2 Form CA: Long Leads.

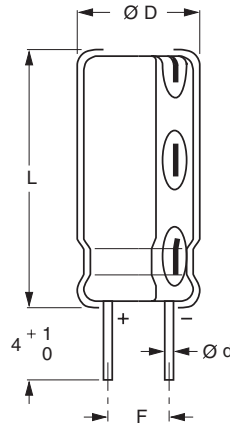


Fig.3 Form CB: Cut leads.

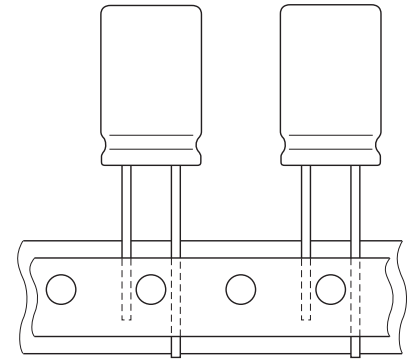


Fig.4 Form TFA: Taped in box (ammopack).

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
16 × 35	21	0.8	16.5	37.5	7.5 ±0.5	≈11.0	100	100	–



ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C _R	rated capacitance at 100 Hz , tolerance ±20%
I _R	rated RMS ripple current at 100 kHz , 105°C
I _{L2}	max. leakage current after 2 minutes at U _R
Tan δ	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°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 ∅D × L (mm)	I _R 100 kHz 105 °C (mA)	I _{L2} 2 min (µA)	Tan δ 100 Hz	Z 100 kHz +20 °C (Ω)	Z 100 kHz -40 °C (Ω)	CATALOG NUMBER 2222 150		
								BULK PACKAGING		TAPED
								FORM CA	FORM CB	FORM TFA
10	680	10 × 12	730	71	0.19	0.097	0.680	54681	64681	34681
	1000	10 × 16	950	103	0.19	0.066	0.460	54102	64102	34102
	2200	12.5 × 20	1460	223	0.21	0.037	0.260	54222	64222	34222
	3300	12.5 × 25	1950	333	0.21	0.029	0.200	54332	64332	34332
	4700	16 × 25	2390	473	0.23	0.022	0.150	54472	64472	34472
	6800	16 × 31	2890	683	0.25	0.019	0.130	54682	64682	34682
16	470	10 × 12	730	78	0.16	0.097	0.680	55471	65471	35471
	680	10 × 16	950	112	0.16	0.066	0.460	55681	65681	35681
	1000	10 × 20	1180	163	0.16	0.049	0.340	55102	65102	35102
	1500	12.5 × 20	1460	243	0.16	0.037	0.260	55152	65152	35152
	2200	12.5 × 25	1950	355	0.18	0.029	0.200	55222	65222	35222
	3300	16 × 20	1840	531	0.20	0.028	0.200	55332	65332	35332
	4700	16 × 31	2890	755	0.22	0.019	0.130	55472	65472	35472
	6800	16 × 35	3100	1091	0.24	0.018	0.130	55682	65682	-
25	330	10 × 12	730	86	0.14	0.097	0.680	56331	66331	36331
	470	10 × 16	950	121	0.14	0.066	0.460	56471	66471	36471
	680	10 × 20	1180	173	0.14	0.049	0.340	56681	66681	36681
	1000	12.5 × 20	1460	253	0.14	0.037	0.260	56102	66102	36102
	1500	12.5 × 25	1950	378	0.14	0.029	0.200	56152	66152	36152
	2200	16 × 20	1840	553	0.16	0.028	0.200	56222	66222	36222
	3300	16 × 31	2890	828	0.16	0.019	0.130	56332	66332	36332
	4700	16 × 35	3100	1178	0.18	0.018	0.130	56472	66472	-
35	220	10 × 12	730	80	0.12	0.097	0.680	50221	60221	30221
	330	10 × 16	950	118	0.12	0.066	0.460	50331	60331	30331
	470	10 × 20	1180	167	0.12	0.049	0.340	50471	60471	30471
	680	12.5 × 20	1460	241	0.12	0.037	0.260	50681	60681	30681
	1000	12.5 × 25	1950	353	0.12	0.029	0.200	50102	60102	30102
	1000	16 × 20	1840	353	0.12	0.028	0.200	90105	90106	90103
	1500	16 × 20	1840	528	0.12	0.028	0.200	50152	60152	30152
	2200	16 × 31	2890	773	0.14	0.019	0.130	50222	60222	30222
50	150	10 × 12	500	78	0.10	0.200	1.400	51151	61151	31151
	220	10 × 16	700	113	0.10	0.120	0.840	51221	61221	31221
	330	10 × 20	900	168	0.10	0.090	0.630	51331	61331	31331
	470	12.5 × 20	1100	238	0.10	0.062	0.430	51471	61471	31471
	680	12.5 × 25	1400	343	0.10	0.048	0.340	51681	61681	31681
	1000	16 × 25	1800	503	0.10	0.034	0.240	51102	61102	31102
	1200	16 × 31	2200	603	0.10	0.027	0.190	51122	61122	31122
	1500	16 × 31	2200	753	0.10	0.027	0.190	51152	61152	31152
63	100	10 × 12	420	66	0.10	0.270	1.890	58101	68101	38101
	150	10 × 16	560	97	0.10	0.190	1.330	58151	68151	38151
	220	10 × 20	700	141	0.10	0.150	1.050	58221	68221	38221
	330	12.5 × 20	930	211	0.10	0.095	0.670	58331	68331	38331
	470	12.5 × 25	1200	299	0.10	0.067	0.470	58471	68471	38471
	470	16 × 20	1100	299	0.10	0.074	0.520	98475	98476	98473
	680	16 × 20	1100	431	0.10	0.074	0.520	58681	68681	38681
	680	16 × 25	1500	431	0.10	0.054	0.380	98685	98686	98683
	1000	16 × 31	1900	633	0.10	0.042	0.295	58102	68102	38102

ORDERING EXAMPLE*

Electrolytic capacitor 150 series

470µF/16 V; ±20%

Nominal case size: ∅10 × 12 mm; Form TFA

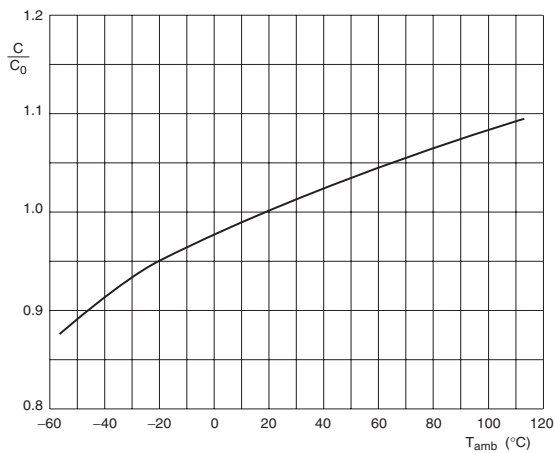
Catalog number: 2222 150 35471.

* To ensure delivery of lead (Pb)-free parts during the transition period, please contact your Vishay sales agent.



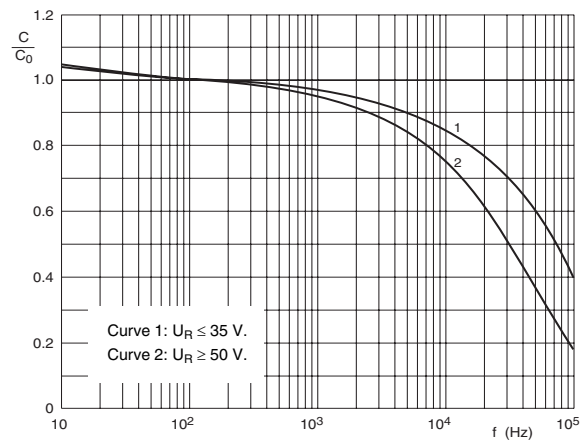
ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 2 minutes at U_R	$I_{L2} \leq 0.01 C_R \times U_R + 3 \mu A$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	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)	$ESR = \tan \delta / 2\pi f C_R$

CAPACITANCE (C)



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

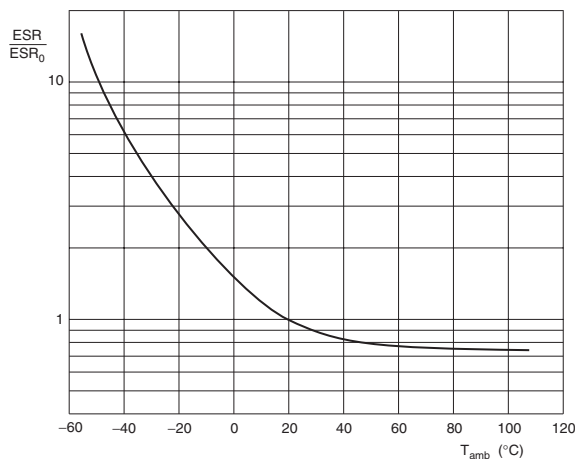
Fig.5 Typical multiplier of capacitance as a function of ambient temperature.



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

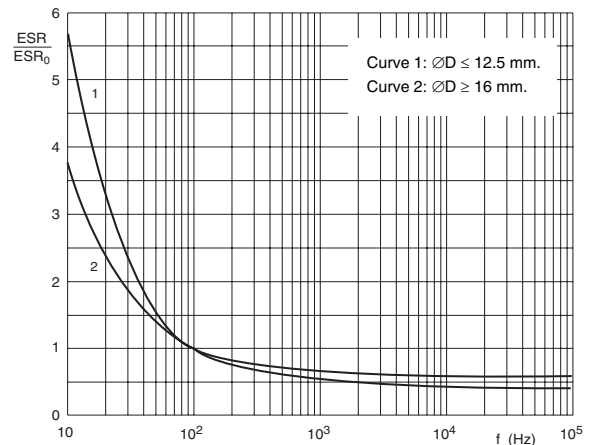
Fig.6 Typical multiplier of capacitance as a function of frequency.

EQUIVALENT SERIES RESISTANCE (ESR)



ESR_0 = typical ESR at 20 °C, 100 Hz.

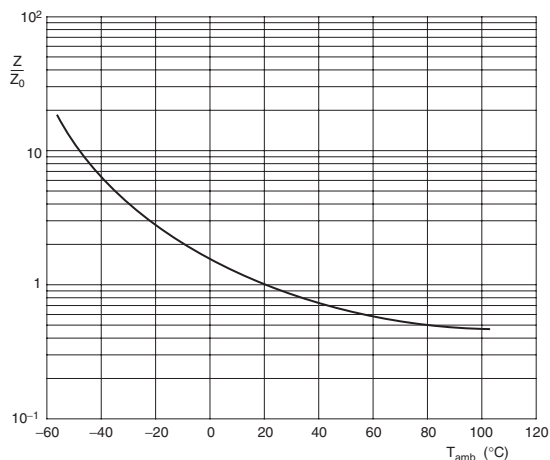
Fig.7 Typical multiplier of ESR as a function of ambient temperature.



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

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

IMPEDANCE (Z)



Z_0 = typical impedance at 20 °C, 100 kHz.
Fig.9 Typical multiplier of impedance as a function of ambient temperature.

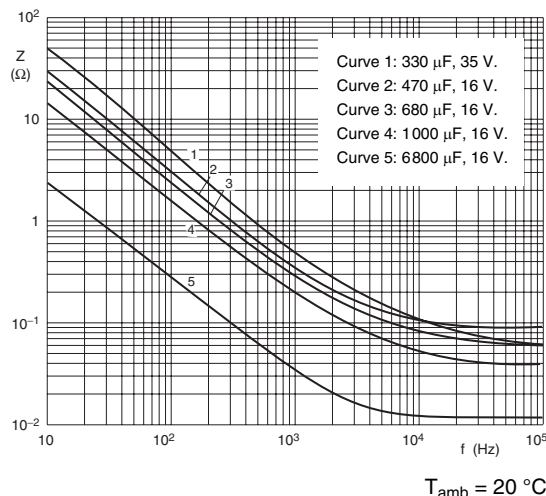


Fig.10 Typical impedance as a function of frequency.

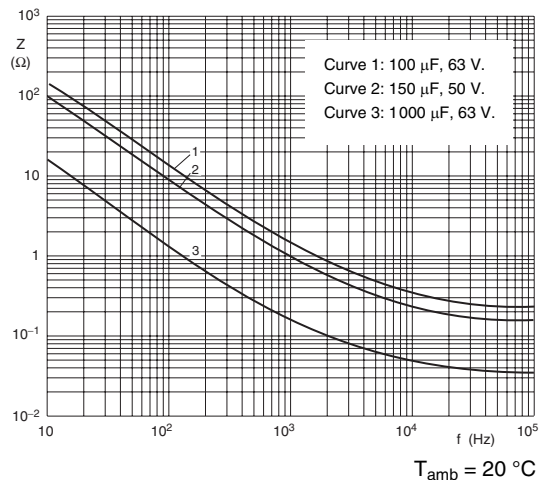


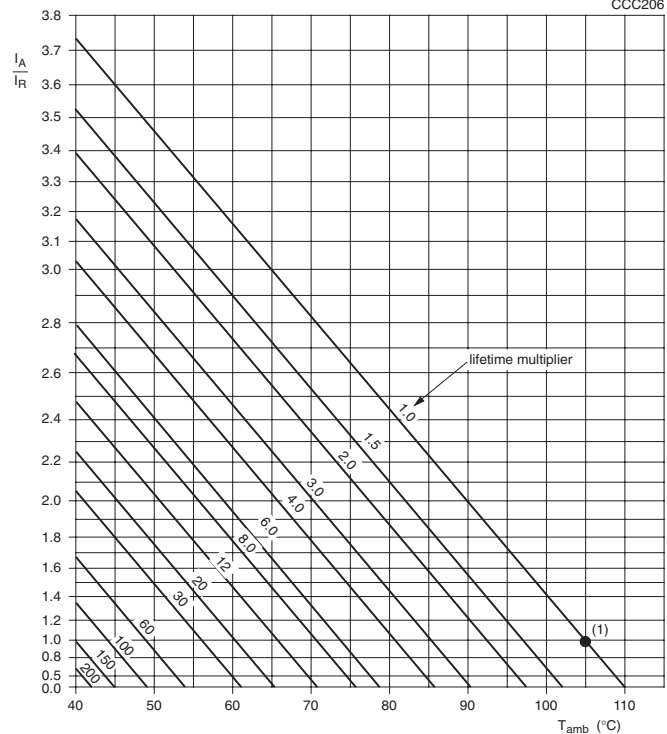
Fig.11 Typical impedance as a function of frequency.

RIPPLE CURRENT AND USEFUL LIFE

Table 3

ENDURANCE TEST DURATION AND USEFUL LIFE AS A FUNCTION OF CASE SIZE			
NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	ENDURANCE at 105 °C (hours)	USEFUL LIFE at 105 °C (hours)
10 × 12	14	3000	4000
10 × 16	15	3000	6000
10 × 20	16	3000	6000
12.5 × 20	17	3000	7000
12.5 × 25	18	5000	8000
16 × 20	19a	3000	7000
16 × 25	19	5000	10000
16 × 31	20	5000	10000
16 × 35	21	5000	10000

CCC206



I_A = actual ripple current at 100 kHz.
 I_R = rated ripple current at 100 kHz, 105 °C.
 (1) Useful life at 105 °C and I_R applied; see Table 4.

Fig.12 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	
	$\varnothing = 10$ and 12.5 mm	$\varnothing = 16$ mm
100	0.65	0.76
300	0.76	0.85
1000	0.85	0.91
3000	0.89	0.94
10000	0.90	0.96
30000	0.97	0.98
100000	1.00	1.00

Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105^\circ\text{C}$; U_R applied; for test duration see Table 4	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105^\circ\text{C}$; U_R and I_R applied; for test duration see Table 4	$\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105^\circ\text{C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$



Notice

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.