

## Aluminum Electrolytic Capacitors Radial Semi-Professional

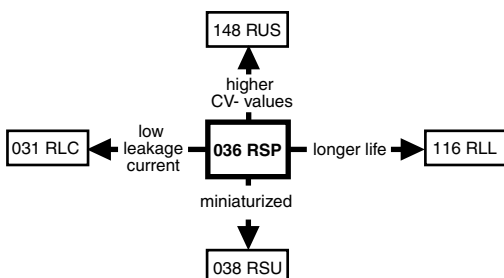
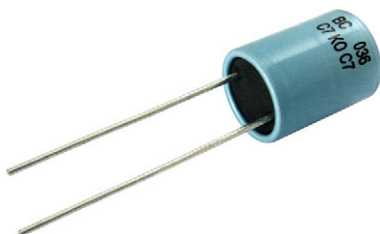


Fig. 1

### QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (Ø D x L in mm)	8.2 x 11
Rated capacitance range, C <sub>R</sub>	10 µF to 470 µF
Tolerance on C <sub>R</sub>	± 20 %; ± 10 % on request
Rated voltage range, U <sub>R</sub>	6.3 V to 100 V
Category temperature range	-55 °C to +85 °C
Endurance test at 85 °C	2000 h
Useful life at 105 °C	750 h
Useful life at 85 °C	3000 h
Useful life at 40 °C, 1.4 x I <sub>R</sub> applied	80 000 h
Shelf life at 0 V, 85 °C	500 h
Based on sectional specification	IEC 60384-4 / EN130300
Climatic category IEC 60068	55 / 085 / 56

### FEATURES

- Useful life: 3000 h at +85 °C, 750 h at +105 °C
- Reduced leakage current
- Miniaturized, high CV-product per unit volume
- Natural pitch 5 mm
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, all-insulated (light blue)
- Charge and discharge proof
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

### APPLICATIONS

- Automotive, telecommunication, industrial, EDP, and audio-video
- Coupling, decoupling, smoothing, filtering, buffering, timing
- Portable and mobile equipment (small size, low mass)

### 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
- Minus-sign on top to identify the negative terminal
- Series number (036)

### SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub>, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

C <sub>R</sub> (µF)	U <sub>R</sub> (V)								
	6.3	10	16	25	35	40	50	63	100
10	-	-	-	-	-	-	-	-	8.2 x 11
22	-	-	-	-	-	-	-	8.2 x 11	-
33	-	-	-	-	-	-	-	8.2 x 11	8.2 x 11
47	-	-	-	-	-	-	8.2 x 11	8.2 x 11	-
68	-	-	-	-	-	8.2 x 11	-	8.2 x 11	-
100	-	-	-	8.2 x 11	-	-	8.2 x 11	-	-
150	-	-	8.2 x 11	-	8.2 x 11	-	-	-	-
220	-	8.2 x 11	8.2 x 11	8.2 x 11	-	-	-	-	-
330	8.2 x 11	-	8.2 x 11	-	-	-	-	-	-
470	-	8.2 x 11	-	-	-	-	-	-	-

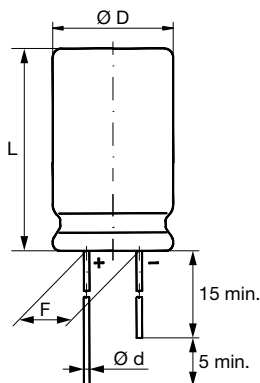
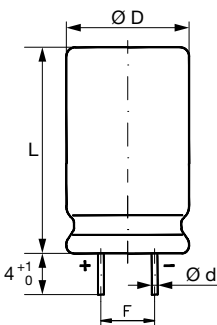
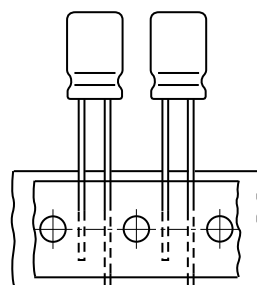
**DIMENSIONS in millimeters AND AVAILABLE FORMS**

Fig. 2 - **Form CA:** long leads

Fig. 3 - **Form CB:** cut leads

Case Ø D x L = 8.2 mm x 11 mm  
Pitch F = 5 mm

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

**Table 1**

<b>DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b>								
NOMINAL CASE SIZE Ø D x L	CASE CODE	Ø d	Ø D <sub>max.</sub>	L <sub>max.</sub>	F	MASS (g)	PACKAGING QUANTITIES	
							FORM CA, CB	FORM TFA
8.2 x 11	13N	0.6	8.7	12	5.0 ± 0.5	≈ 1.1	1000	1000

**Note**

- For tape dimensions, please see [www.vishay.com/doc?28360](http://www.vishay.com/doc?28360).

<b>ELECTRICAL DATA</b>	
SYMBOL	DESCRIPTION
C <sub>R</sub>	Rated capacitance at 100 Hz, tolerance ± 20 %
I <sub>R</sub>	Rated RMS ripple current at 100 Hz, 85 °C
I <sub>L1</sub>	Max. leakage current after 1 min at U <sub>R</sub>
tan δ	Max. dissipation factor at 100 Hz
Z	Max. impedance at 10 kHz and 20 °C

**Note**

- Unless otherwise specified, all electrical values in Table 2 apply at T<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

**ORDERING EXAMPLE**

Electrolytic capacitor 036 series

100 µF / 16 V; ± 20 %

Nominal case size: Ø 5 x 11 mm; Form TFA

Ordering code: MAL203635101E3

Former 12NC: 2222 036 35101

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION												
U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE Ø D x L (mm)	I <sub>R</sub> 100 Hz 85 °C (mA)	I <sub>L1</sub> 1 min (μA)	tan δ 100 Hz	Z 10 kHz (Ω)	ORDERING CODE MAL2036.....					
							BULK PACKAGING				TAPED AMMOPACK	
							LONG LEADS		CUT LEADS			
							FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)
6.3	330	8.2 x 11	300	16	0.20	0.52	53331E3	5.0	63331E3	5.0	33331E3	5.0
10	220	8.2 x 11	260	17	0.16	0.59	54221E3	5.0	64221E3	5.0	34221E3	5.0
	470	8.2 x 11	400	31	0.20	0.43	54471E3	5.0	64471E3	5.0	34471E3	5.0
16	150	8.2 x 11	230	18	0.14	0.6	55151E3	5.0	65151E3	5.0	35151E3	5.0
	220	8.2 x 11	280	24	0.16	0.55	55221E3	5.0	65221E3	5.0	35221E3	5.0
	330	8.2 x 11	390	35	0.16	0.48	55331E3	5.0	65331E3	5.0	35331E3	5.0
25	100	8.2 x 11	210	18	0.12	0.7	56101E3	5.0	66101E3	5.0	36101E3	5.0
	220	8.2 x 11	310	36	0.14	0.55	56221E3	5.0	66221E3	5.0	36221E3	5.0
35	150	8.2 x 11	270	35	0.12	0.6	90099E3	5.0	90101E3	5.0	90103E3	5.0
40	68	8.2 x 11	180	20	0.10	0.81	57689E3	5.0	67689E3	5.0	37689E3	5.0
50	47	8.2 x 11	160	18	0.08	0.96	90011E3	5.0	90012E3	5.0	90031E3	5.0
	100	8.2 x 11	250	33	0.10	0.7	90109E3	5.0	90111E3	5.0	90113E3	5.0
63	10	8.2 x 11	120	7	0.04	2.8	90036E3	5.0	90041E3	5.0	90181E3	5.0
	22	8.2 x 11	150	11	0.05	1.4	90117E3	5.0	90118E3	5.0	90139E3	5.0
	33	8.2 x 11	160	16	0.06	1.2	58339E3	5.0	68339E3	5.0	38339E3	5.0
	47	8.2 x 11	190	21	0.07	1.0	58479E3	5.0	68479E3	5.0	38479E3	5.0
	68	8.2 x 11	210	29	0.08	0.88	58689E3	5.0	68689E3	5.0	38689E3	5.0
100	10	8.2 x 11	80	9	0.06	3.5	59109E3	5.0	69109E3	5.0	39109E3	5.0
	22	8.2 x 11	110	16	0.06	1.8	59229E3	5.0	69229E3	5.0	39229E3	5.0

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage		$U_g \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
<b>Current</b>		
Leakage current	After 1 min $U_R = 6.3 V$ to 100 V	$I_{L1} \leq 0.006 C_R \times U_R + 3 \mu A$
	After 5 min $U_R = 6.3 V$ to 100 V	$I_{L5} \leq 0.001 C_R \times U_R + 3 \mu A$
<b>Inductance</b>		
Equivalent series inductance (ESL)	Case $\varnothing$ D x L = 8.2 mm x 11 mm	Typ. 16 nH
<b>Resistance</b>		
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)

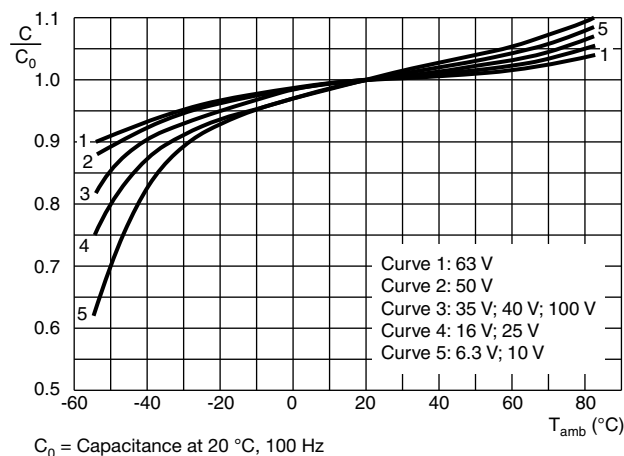


Fig. 5 - Typical multiplier of capacitance as a function of ambient temperature

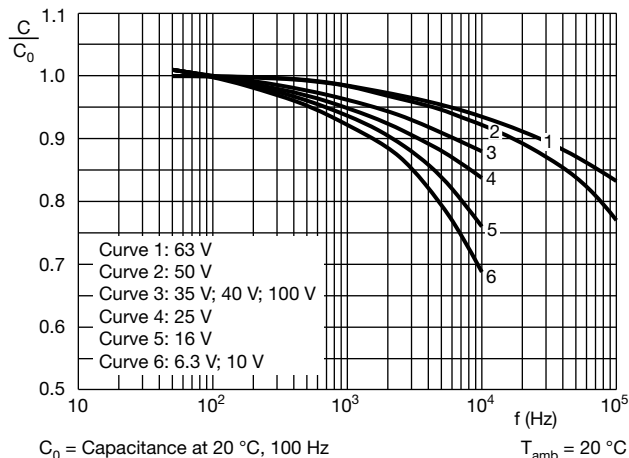


Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature

## IMPEDANCE (Z)

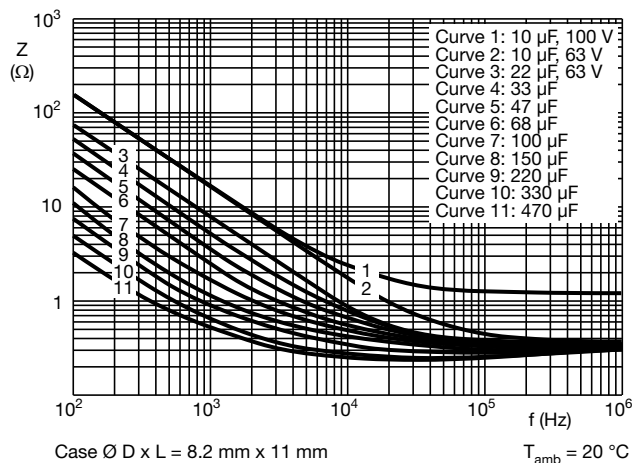


Fig. 7 - Typical impedance as a function of frequency

## RIPPLE CURRENT AND USEFUL LIFE

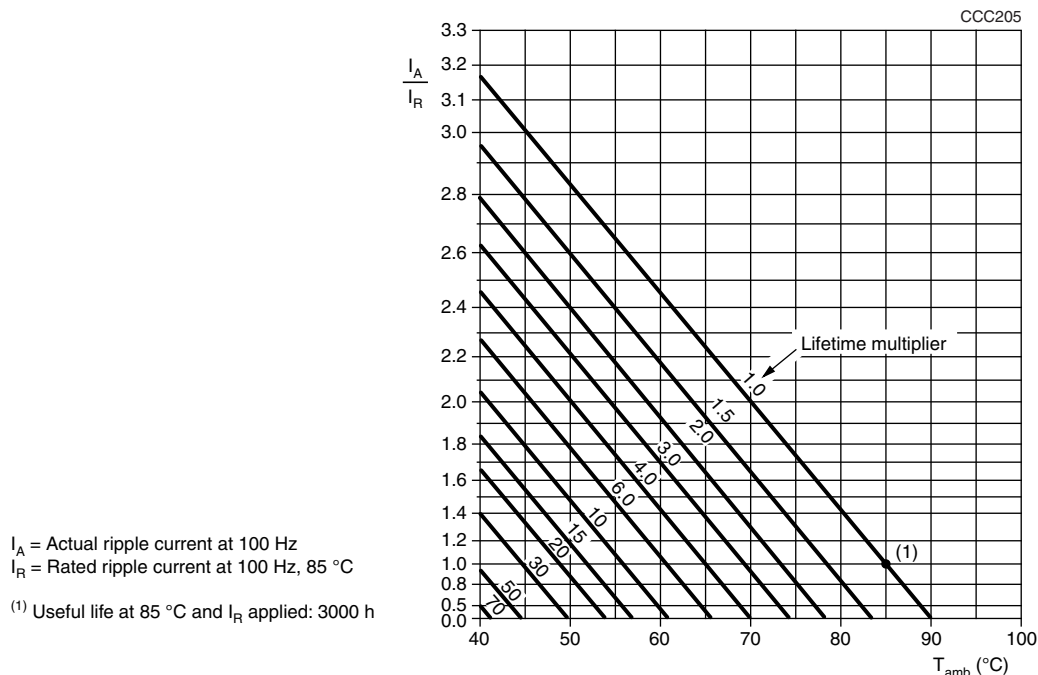


Fig. 8 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 3

MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)	$I_R$ MULTIPLIER		
	$U_R = 6.3 \text{ V TO } 10 \text{ V}$	$U_R = 16 \text{ V TO } 35 \text{ V}$	$U_R = 40 \text{ V TO } 100 \text{ V}$
50	0.90	0.85	0.80
100	1.00	1.00	1.00
300	1.12	1.20	1.25
1000	1.20	1.30	1.40
3000	1.25	1.35	1.50
$\geq 10\,000$	1.30	1.40	1.60

Table 4

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 / EN130300 subclause 4.13	$T_{amb} = 85 \text{ °C}$ ; $U_R$ applied; 2000 h	$U_R \leq 6.3 \text{ V}$ ; $\Delta C/C$ : +15 % / -30 % $U_R > 6.3 \text{ V}$ ; $\Delta C/C$ : $\pm 15 \%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85 \text{ °C}$ ; $U_R$ and $I_R$ applied; 3000 h	$U_R \leq 6.3 \text{ V}$ ; $\Delta C/C$ : +45 % / -50 % $U_R > 6.3 \text{ V}$ ; $\Delta C/C$ : $\pm 45 \%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ No short or open circuit Total failure percentage: $\leq 1 \%$
Shelf life (storage at high temperature)	IEC 60384-4 / EN130300 subclause 4.17	$T_{amb} = 85 \text{ °C}$ ; no voltage applied; 500 h After test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C$ , $\tan \delta$ , $Z$ : for requirements see "Endurance test" above $I_{L5} \leq \text{spec. limit}$

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