

## Aluminum Capacitors Axial, Smallest Diameter

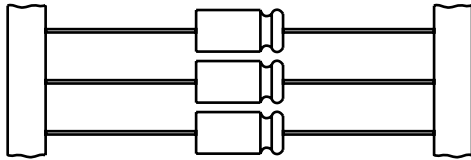
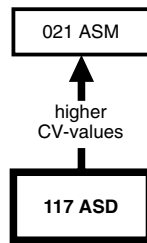


Fig.1 Component outlines



QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (Ø D x L in mm)	3.3 x 8 and 3.3 x 11
Rated capacitance range, C <sub>R</sub>	0.47 to 22 µF
Tolerance on C <sub>R</sub>	- 10 to + 50 % (± 20 % to special order)
Rated voltage range, U <sub>R</sub>	6.3 to 63 V
Category temperature range	- 40 to 85 °C
Endurance test at 85 °C	1500 hours
Useful life at 85 °C	2000 hours
Useful life at 40 °C, 1.4 I <sub>R</sub> applied	60 000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/085/56

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Taped for automatic insertion
- Charge and discharge proof
- Ultra miniature, diameter 3.3 mm
- Lead (Pb)-free versions are RoHS compliant



### APPLICATIONS

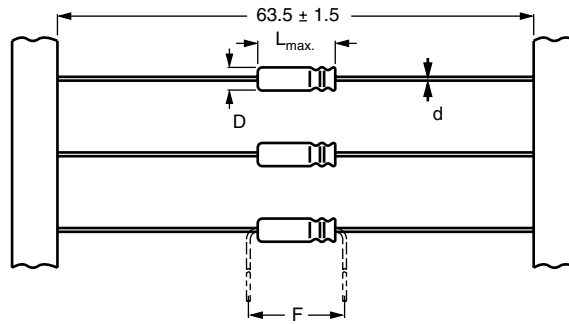
- General purpose, low profile and lightweight equipment
- Smoothing, filtering, buffering, decoupling, timing
- Boards with restricted mounting height

### MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in µF)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Code for factory of origin
- Name of manufacturer
- Band to indicate the negative terminal
- Series number (117)

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	40	63
0.47	→	→	→	→	→	3.3 x 8
1.0	→	→	→	→	→	3.3 x 8
2.2	→	→	→	→	3.3 x 8	3.3 x 11
3.3	→	→	→	3.3 x 8	→	3.3 x 11
4.7	→	→	3.3 x 8	→	3.3 x 11	-
6.8	→	3.3 x 8	→	3.3 x 11	-	-
10	3.3 x 8	-	3.3 x 11	-	-	-
22	3.3 x 11	-	-	-	-	-

**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**


Form BR: Taped on reel  
 Form BA: Taped in box  
 Case  $\varnothing D \times L = 3.3 \times 8$  mm and  $8 \times 11$  mm

Fig.2 Components insulated with a blue plastic sleeve

Table 1

AXIAL; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES								
NOMINAL CASE SIZE $\varnothing D \times L$	CASE CODE	AXIAL: FORM BA AND BR				MASS (g)	PACKAGING QUANTITIES	
		$\varnothing d$	$\varnothing D_{max.}$	$L_{max.}$	$F_{min}$		FORM BA	FORM BR
3.3 x 8	1a	0.6	3.5	9	12.5	≈ 0.3	1000	4000
3.3 x 11	1	0.6	3.5	12	15	≈ 0.35	1000	4000

**Note**

1. Detailed tape dimensions see section 'PACKAGING'.

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
$C_R$	rated capacitance at 100 Hz, tolerance - 10 to + 50 %
$I_R$	rated RMS ripple current at 100 Hz , 85 °C
$I_{L5}$	max. leakage current after 5 minutes at $U_R$
$\tan \delta$	max. dissipation factor at 100 Hz
$Z$	max. impedance at 10 kHz

**Note**

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

Table 1

ELECTRICAL DATA AND ORDERING INFORMATION								ORDERING CODE MAL2117.....	
$U_R$ (V)	$C_R$ 100 Hz ( $\mu F$ )	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$I_R$ 100 Hz 85 °C (mA)	$I_{L5}$ 5 min ( $\mu A$ )	$\tan \delta$ 100 Hz	$Z$ 10 kHz ( $\Omega$ )			
							ON REEL FORM BR	IN BOX FORM BA	
6.3	10	3.3 x 8	11	3	0.30	20	23109E3	33109E3	
	22	3.3 x 11	20	3	0.30	9	23229E3	33229E3	
10	6.8	3.3 x 8	10	3	0.25	24	24688E3	34688E3	
	4.7	3.3 x 8	9	3	0.20	26	25478E3	35478E3	
16	10	3.3 x 11	16	3	0.20	12	25109E3	35109E3	
	3.3	3.3 x 8	8	3	0.18	27	26338E3	36338E3	
25	6.8	3.3 x 11	14	3	0.18	13	26688E3	36688E3	
	2.2	3.3 x 8	7	3	0.16	32	27228E3	37228E3	
40	4.7	3.3 x 11	13	3	0.16	15	27478E3	37478E3	
	0.47	3.3 x 8	4	3	0.10	120	28477E3	38477E3	
63	1	3.3 x 8	6	3	0.12	55	28108E3	38108E3	
	2.2	3.3 x 11	11	3	0.14	25	28228E3	38228E3	
	3.3	3.3 x 11	13	3	0.14	17	28338E3	38338E3	

**ORDERING EXAMPLE**

Electrolytic capacitor 117 series  
 10  $\mu F$ /16 V; - 10/+ 50 %  
 Nominal case size:  $\varnothing 3.3 \times 11$  mm; Form BA  
 Former 12NC: 2222 117 35109  
 Ordering code: MAL211735109E3



ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
<b>Current</b>		
Leakage current	After 1 minute at $U_R$	$I_{L1} \leq 0.02 C_R \times U_R + 3 \mu\text{A}$
	After 5 minutes at $U_R$	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu\text{A}$
<b>Inductance</b>		
Equivalent series inductance (ESL)	Case $\varnothing D \times L = 3.3 \times 8 \text{ mm}$	typ. 13 nH
	Case $\varnothing D \times L = 3.3 \times 11 \text{ mm}$	typ. 15 nH
<b>Resistance</b>		
Equivalent series resistance (ESR)	Calculated from $\tan \delta_{max}$ and $C_R$ (see Table 1)	$ESR = \tan \delta / 2 \pi f C_R$

**RIPPLE CURRENT AND USEFUL LIFE**

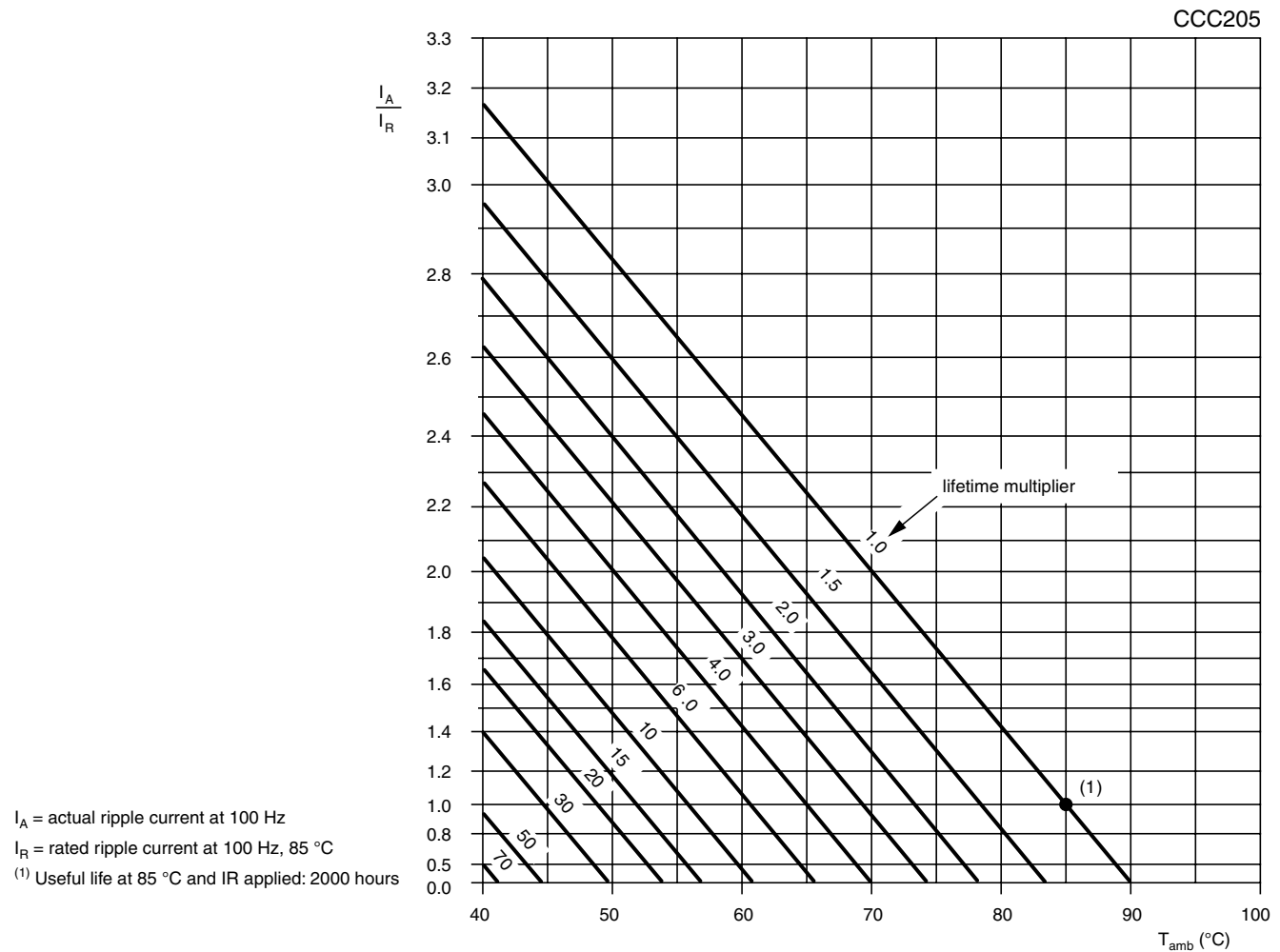


Fig.3 Multiplier of useful life as a function of ambient temperature and ripple current load



Table 2

<b>MULTIPLIER OF RIPPLE CURRENT (<math>I_R</math>) AS A FUNCTION OF FREQUENCY</b>			
FREQUENCY (Hz)	$I_R$ MULTIPLIER		
	$U_R = 6.3$ to $16$ V	$U_R = 25$ to $40$ V	$U_R = 63$ V
50	0.80	0.75	0.70
100	1.00	1.00	1.00
300	1.20	1.30	1.55
1000	1.35	1.55	1.90
3000	1.45	1.70	2.30
$\geq 10\ 000$	1.50	1.80	2.50

Table 3

<b>TEST PROCEDURES AND REQUIREMENTS</b>			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
Name of test	Reference		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\ ^\circ\text{C}$ ; $U_R$ applied; 1500 hours	$\Delta C/C: \pm 20\ \%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\ ^\circ\text{C}$ ; $U_R$ and $I_R$ applied; 2000 hours	$\Delta C/C: \pm 50\ \%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\ \%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\ ^\circ\text{C}$ ; no voltage applied; 500 hours  after test: $U_R$ to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C, \tan \delta, Z:$ for requirements see 'Endurance test' above $I_{L5} \leq 2 \times \text{spec. limit}$



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