Aluminum Capacitors
Axial, Smallest Diameter

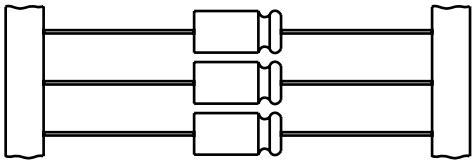
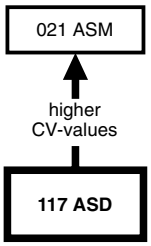


Fig.1 Component outlines



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

Pb-free

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:

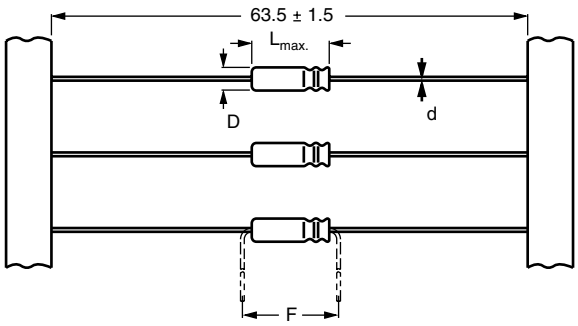
- Rated capacitance (in µF)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Code for factory of origin
- Name of manufacturer
- Band to indicate the negative terminal
- Series number (117)

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_R	0.47 to 22 µF
Tolerance on C_R	- 10 to + 50 % (± 20 % to special order)
Rated voltage range, U_R	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_R 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

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

C_R (µF)	U_R (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 Ø D x L = 3.3 x 8 mm and 8 x 11 mm

Fig.2 Components insulated with a blue plastic sleeve

Table 1

AXIAL; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES								
NOMINAL CASE SIZE Ø D x L	CASE CODE	AXIAL: FORM BA AND BR				MASS (g)	PACKAGING QUANTITIES	
		Ø d	Ø $D_{max.}$	$L_{max.}$	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 δ	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 %.

ORDERING EXAMPLE

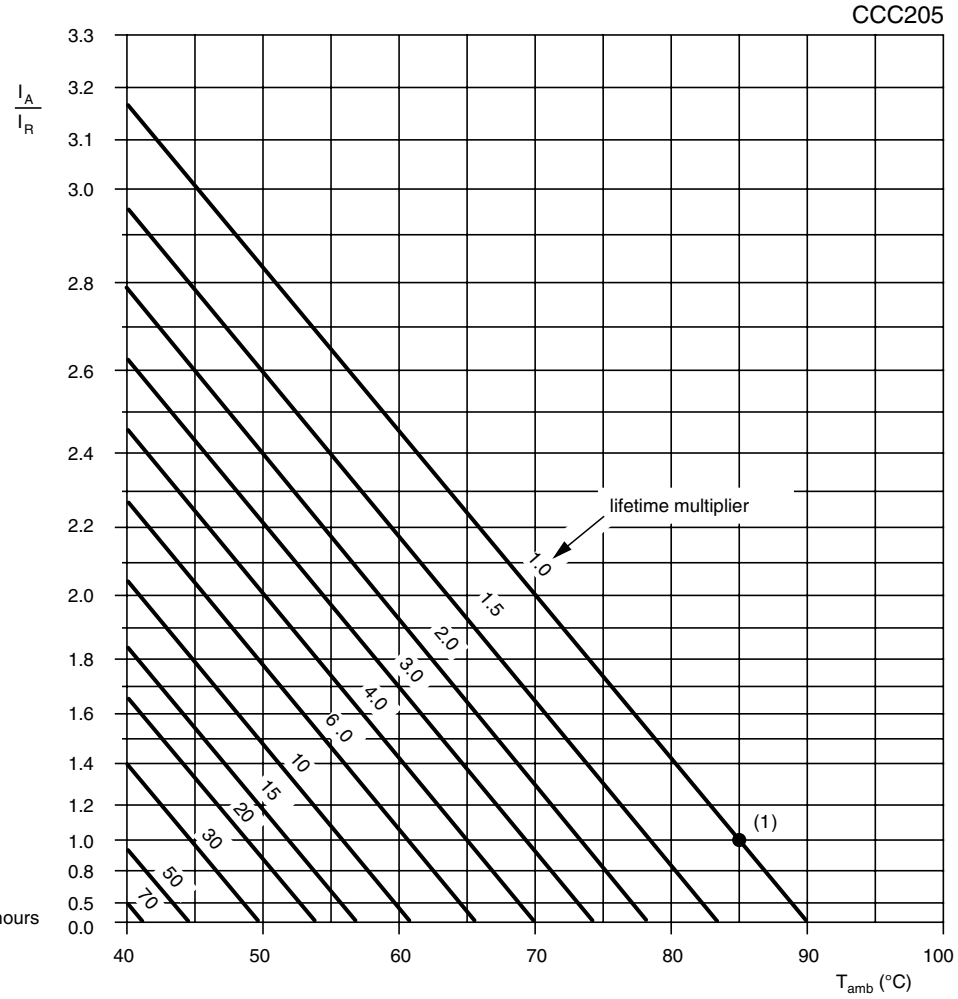
Electrolytic capacitor 117 series
10 µF/16 V; - 10/+ 50 %
Nominal case size: Ø 3.3 x 11 mm; Form BA
Former 12NC: 2222 117 35109
Ordering code: MAL211735109E3

Table 1

ELECTRICAL DATA AND ORDERING INFORMATION								
U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 100 Hz 85 °C (mA)	I_{L5} 5 min (µA)	tan δ 100 Hz	Z 10 kHz (Ω)	ORDERING CODE MAL2117.....	
							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
16	4.7	3.3 x 8	9	3	0.20	26	25478E3	35478E3
	10	3.3 x 11	16	3	0.20	12	25109E3	35109E3
25	3.3	3.3 x 8	8	3	0.18	27	26338E3	36338E3
	6.8	3.3 x 11	14	3	0.18	13	26688E3	36688E3
40	2.2	3.3 x 8	7	3	0.16	32	27228E3	37228E3
	4.7	3.3 x 11	13	3	0.16	15	27478E3	37478E3
63	0.47	3.3 x 8	4	3	0.10	120	28477E3	38477E3
	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

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 1 minute at U_R	$I_{L1} \leq 0.02\ C_R \times U_R + 3\ \mu A$
	After 5 minutes at U_R	$I_{L5} \leq 0.002\ C_R \times U_R + 3\ \mu A$
Inductance		
Equivalent series inductance (ESL)	Case Ø D x L = 3.3 x 8 mm	typ. 13 nH
	Case Ø D x L = 3.3 x 11 mm	typ. 15 nH
Resistance		
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



I_A = actual ripple current at 100 Hz

I_R = rated ripple current at 100 Hz, 85 °C

(1) Useful life at 85 °C and IR applied: 2000 hours

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

Table 2

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY			
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
≥ 10 000	1.50	1.80	2.50

Table 3

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

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