

Aluminum Capacitors SMD (Chip) Standard

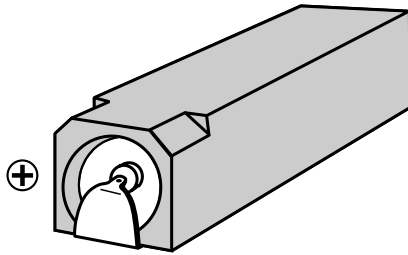
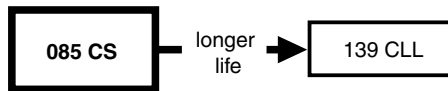


Fig.1 Component outlines



FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version, rectangular case, insulated
- Miniaturized, high CV per unit volume, low height
- Flexible terminals, reflow and wave solderable
- Charge and discharge proof
- Supplied in blister tape on reel



APPLICATIONS

- SMD technology, boards with restricted mounting height
- General applications, consumer electronics, low profile and lightweight equipment
- Decoupling, smoothing, filtering and buffering

MARKING

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

- Rated capacitance (in μF)
- Rated voltage code (see Table 1), the U_R code letter indicates the position of the decimal point in the capacitance value
- Name of manufacturer
- '-' sign indicating the cathode. The anode is identified by bevelled edges

Examples for C_R ; U_R marking:

H22 represents 0.22 μF ; 63 V

2G2 represents 2.2 μF ; 40 V

22C represents 22 μF ; 6.3 V

Table 1

RATED VOLTAGE MARKING CODE						
U_R (V)	6.3	10	16	25	40	63
Code letter	C	D	E	F	G	H

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (L x W x H in mm)	8.8 x 3.7 x 3.9 and 11.9 x 3.7 x 3.9
Rated capacitance range, C_R	0.47 to 22 μF
Tolerance on C_R	- 10 to + 50 % or ± 20 %
Rated voltage range, U_R	6.3 to 63 V
Category temperature range	- 40 to + 85 °C
Endurance test at 85 °C	1000 hours
Useful life at 85 °C	1500 hours
Useful life at 40 °C; 1.4 x I_R applied	40 000 hours
Shelf life at 0 V, 85 °C	500 hours
Resistance to soldering heat test	immersion in solder: 10 s at 260 °C or 20 s at 215 °C
Based on sectional specification	IEC 60384-18/CECC 32300
Climatic category IEC 60068	40/085/56

SELECTION CHART FOR C_R , U_R AND RELEVANT NOMINAL CASE SIZES (L x W x H in mm)						
C_R (μF)	U_R (V)					
	6.3	10	16	25	40	63
0.47	-	-	-	-	-	8.8 x 3.7 x 3.9
1.0	-	-	-	-	-	8.8 x 3.7 x 3.9
2.2	-	-	-	-	8.8 x 3.7 x 3.9	11.9 x 3.7 x 3.9
3.3	-	-	-	8.8 x 3.7 x 3.9	-	11.9 x 3.7 x 3.9
4.7	-	-	8.8 x 3.7 x 3.9	-	11.9 x 3.7 x 3.9	-
6.8	-	8.8 x 3.7 x 3.9	-	11.9 x 3.7 x 3.9	-	-
10	8.8 x 3.7 x 3.9	-	11.9 x 3.7 x 3.9	-	-	-
15	-	11.9 x 3.7 x 3.9	-	-	-	-
22	11.9 x 3.7 x 3.9	-	-	-	-	-

DIMENSIONS in millimeters

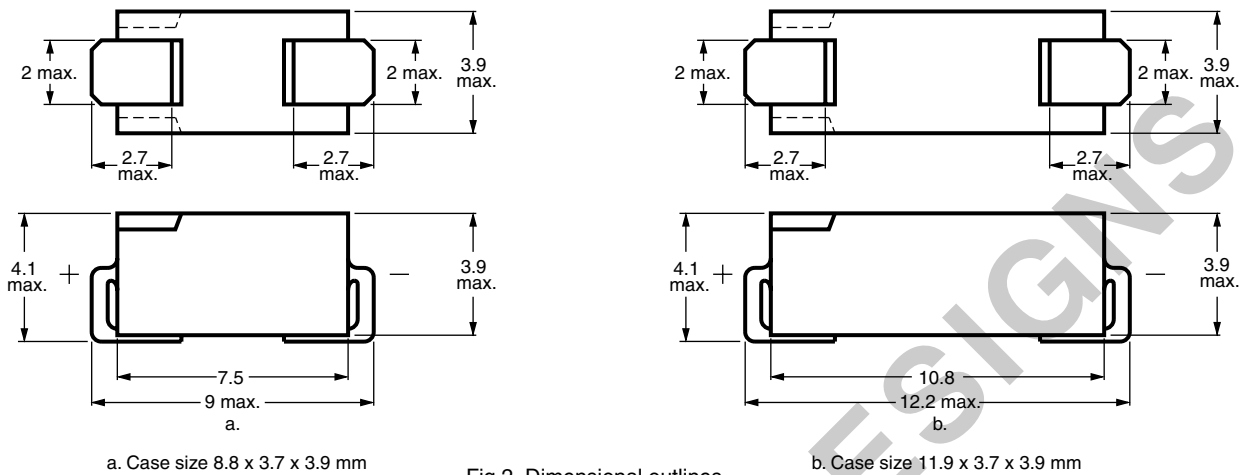


Fig.2 Dimensional outlines

PACKAGING

Tape on reel packaging: 2000 per reel
Detailed tape dimensions see section 'PACKAGING'

MOUNTING

The capacitors are designed for automatic placement on printed-circuit boards or hybrid circuits.
Optimum dimensions of soldering pads depend upon soldering method, mounting accuracy, print lay-out and/or adjacent components.
For recommended pad dimensions, refer to Fig. 3 and Table 2.

Table 2

RECOMMENDED SOLDERING PAD DIMENSIONS in millimeters (placement accuracy ± 0.25 mm)														
NOMINAL CASE SIZE L x W x H	FOR REFLOW SOLDERING							FOR WAVE SOLDERING						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
8.8 x 3.7 x 3.9	9.7	3.5	2.9	2.5	3.0	10.1	4.4	13.5	4.1	4.7	3.7	2.9	14.0	8.4
11.9 x 3.7 x 3.9	12.9	6.5	2.9	2.5	6.0	13.3	4.4	16.8	7.4	4.7	3.7	6.1	17.3	8.4

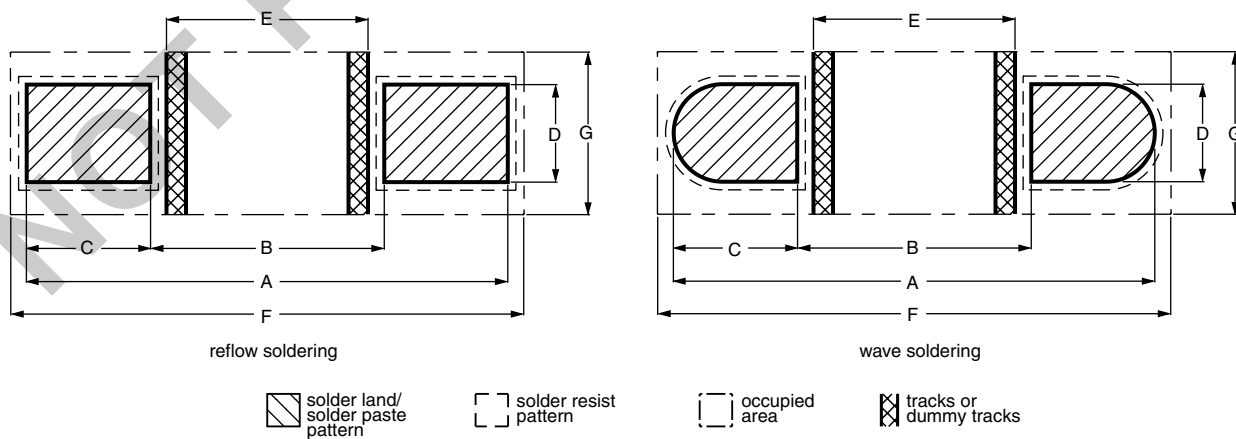
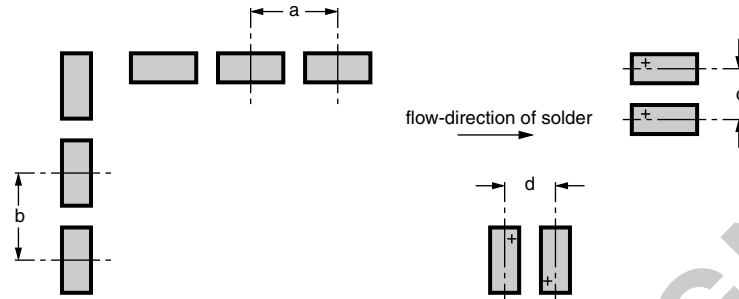


Fig.3 Recommended pad dimensions for reflow and wave soldering



For dimensions a, b, c and d, refer to Table 3
Flow direction of solder preferably onto side-walls or plus-side of the capacitors

Fig.4 Minimum distances between 085 CS capacitors on a printed-circuit board for wave soldering

SOLDERING

Soldering conditions are defined by the curve, temperature versus time. The temperature is that measured on the soldering pad during processing.

Any temperature/time curve which does not exceed the specified maximum curves may be applied.

For maximum conditions of different soldering methods see Figs 5, 6 and 7.

AS A GENERAL PRINCIPLE, TEMPERATURE AND DURATION SHALL BE THE MINIMUM NECESSARY REQUIRED TO ENSURE GOOD SOLDERING CONNECTIONS.

Table 3

MINIMUM DISTANCES BETWEEN CAPACITORS in millimeters					
NOMINAL CASE SIZE L x W x H	CASE CODE	a _{min.}	b _{min.}	c _{min.}	d _{min.}
8.8 x 3.7 x 3.9	1a	12	12	6.8	6.8
11.9 x 3.7 x 3.9	1	15	15	6.8	6.8

Table4

CURING CONDITIONS FOR SMD-GLUE	
MAX. T _{amb} (°C)	MAX. EXPOSURE TIME (minutes)
125	10
140	3
150	1
160	0.5

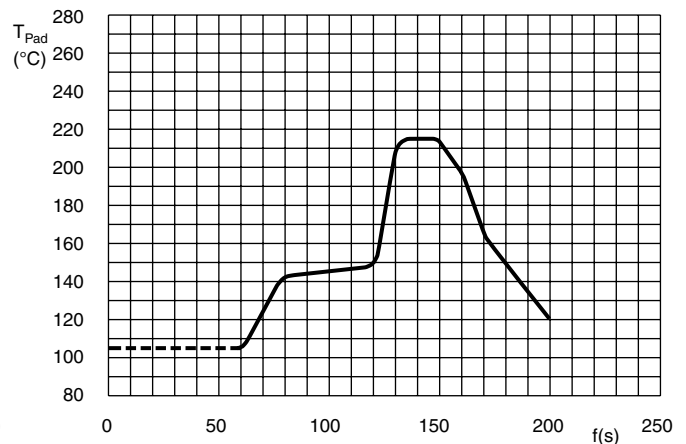
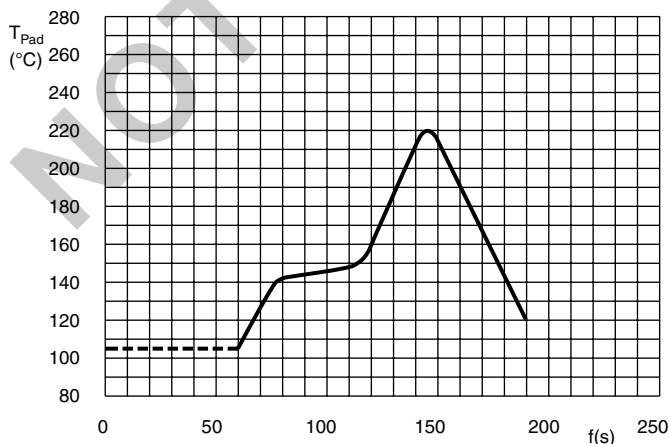


Fig.5 Maximum temperature load during infrared reflow soldering Fig.6 Maximum temperature load during vapor phase reflow soldering

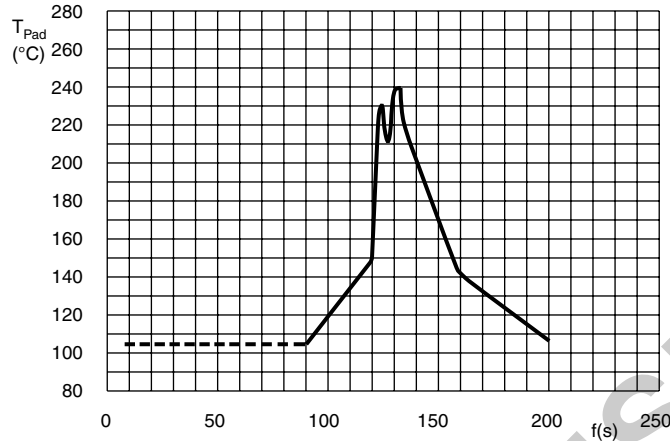


Fig.7 Maximum temperature load during (double-) wave soldering

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C _R	rated capacitance at 100 Hz (tolerance - 10 to + 50 % or ± 20 %)
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

ORDERING EXAMPLE

Electrolytic capacitor 085 series
 10 μF/16 V; - 10/+ 50 %
 Nominal case size: 11.9 x 3.7 x 3.9 mm; Form BR
 Ordering Code: MAL208525109E3
 Former 12NC: 2222 085 25109

Note

Unless otherwise specified, all electrical values in Table 6 apply at T_{amb} = 20 °C, P = 86 to 106 kPa, RH = 45 to 75 %.

Table 6

ELECTRICAL DATA AND ORDERING INFORMATION								
U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE L x W x H (mm)	I _R 100 Hz 85 °C (mA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	Z 10 kHz (Ω)	ORDERING CODE MAL2085.....	
							- 10/+ 50 %	± 20 %
							BLISTER TAPE ON REEL FORM BR	BLISTER TAPE ON REEL FORM BR
6.3	10.0	8.8 x 3.7 x 3.9	11	3.1	0.30	20	23109E3	63109E3
	22	11.9 x 3.7 x 3.9	20	3.3	0.30	9	23229E3	63229E3
10	6.8	8.8 x 3.7 x 3.9	10	3.1	0.25	24	24688E3	64688E3
	15	11.9 x 3.7 x 3.9	18	3.3	0.25	11	24159E3	64159E3
16	4.7	8.8 x 3.7 x 3.9	9	3.2	0.20	26	25478E3	65478E3
	10	11.9 x 3.7 x 3.9	16	3.3	0.20	12	25109E3	65109E3
25	3.3	8.8 x 3.7 x 3.9	8	3.2	0.18	27	26338E3	66338E3
	6.8	11.9 x 3.7 x 3.9	14	3.3	0.18	13	26688E3	66688E3
40	2.2	8.8 x 3.7 x 3.9	7	3.2	0.16	32	27228E3	67228E3
	4.7	11.9 x 3.7 x 3.9	13	3.4	0.16	15	27478E3	67478E3
63	0.47	8.8 x 3.7 x 3.9	4	3.1	0.10	120	28477E3	68477E3
	1.0	8.8 x 3.7 x 3.9	6	3.1	0.12	55	28108E3	68108E3
	2.2	11.9 x 3.7 x 3.9	11	3.3	0.14	25	28228E3	68228E3
	3.3	11.9 x 3.7 x 3.9	13	3.4	0.14	17	28338E3	68338E3

Table 7

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
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	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	nominal case size 8.8 x 3.7 x 3.9 mm	typ. 11 nH
	nominal case size 11.9 x 3.7 x 3.9 mm	typ. 13 nH
Resistance		
Equivalent series resistance (ESR)	calculated from $\tan \delta_{max}$ and C_R (see Table	$ESR = \tan \delta / 2 \pi f C_R$

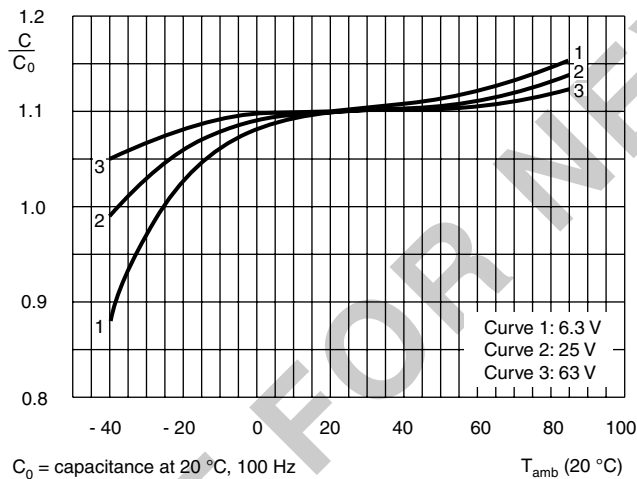
CAPACITANCE


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

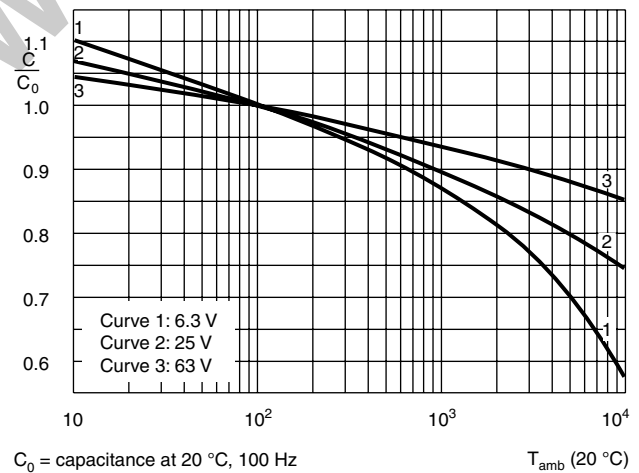
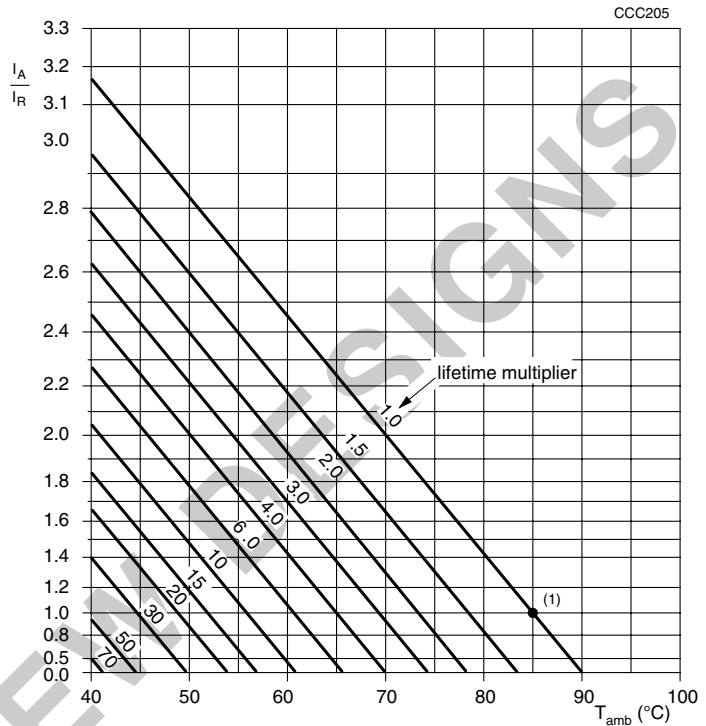


Fig.9 Typical multiplier of capacitance as a function of frequency

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 I_R applied: 1500 hours

Fig.10 Multiplier of useful life as a function of ambient temperature and ripple current load

Table 8

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
$\geq 10\ 000$	1.50	1.80	2.50



TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Mounting	IEC 60384-18, subclause 4.3	shall be performed prior to tests mentioned below; method: reflow or (double-) wave soldering; for maximum temperature load refer to chapter "Mounting"	$\Delta C/C: \pm 10\%$ $\tan \delta \leq \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$
Endurance	IEC 60384-18/ CECC 32300, subclause 4.15	$T_{\text{amb}} = 85\text{ }^\circ\text{C}$; U_R applied; 1000 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	$T_{\text{amb}} = 85\text{ }^\circ\text{C}$; U_R and I_R applied; 1500 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 60384-18/ CECC 32300, subclause 4.17	$T_{\text{amb}} = 85\text{ }^\circ\text{C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C, \tan \delta, Z$: for requirements see 'Endurance test' above $I_{L5} \leq 2 \times \text{spec. limit}$



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