Aluminum Capacitors
SMD (Chip), High Temperature

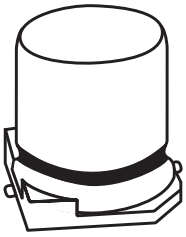
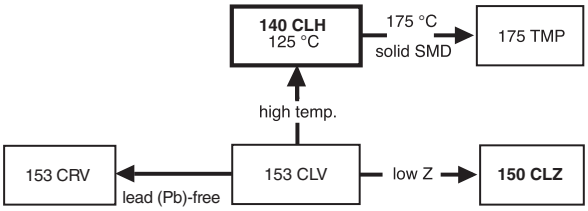


Fig.1 Component outline



FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, reflow solderable
- High temperature, 1500 hours at 125 °C
- High capacitance values
- Charge and discharge proof, no peak current limitation
- Lead (Pb)-free
- ATTENTION: for maximum safe soldering conditions refer to fig.4

APPLICATIONS

- SMD technology, for high mounting density
- Industrial and professional applications
- Automotive, general industrial
- Smoothing, filtering, buffering

MARKING

- Rated capacitance (in µF)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Black mark or '–' sign indicating the cathode (the anode is identified by bevelled edges)
- Code indicating group number (H)

PACKAGING

- Supplied in blister tape on reel

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (L x W x H in mm)	8 x 8 x 10 to 10 x 10 x 14
Rated capacitance range, C_R	10 to 680 µF
Tolerance on C_R	± 20 %
Rated voltage range, U_R	6.3 to 63 V
Category temperature range	- 55 to + 125 °C
Endurance test at 125 °C	1000 hours
Useful life at 125 °C	1500 hours
Useful life at 40 °C; 1.8 x I_R applied	150 000 hours
Shelf life at 0 V, 125 °C	1000 hours
Based on sectional specification	IEC 60384-18/CECC 32300
Climatic category IEC 60068	55/125/56

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	35	50	63
10	-	-	-	-	-	-	8 x 8 x 10
22	-	-	-	-	-	-	8 x 8 x 10
33	-	-	-	-	-	-	8 x 8 x 10
47	-	-	-	-	-	8 x 8 x 10	10 x 10 x 10
68	-	-	-	-	8 x 8 x 10	10 x 10 x 10	10 x 10 x 14
100	-	-	-	8 x 8 x 10	10 x 10 x 10	10 x 10 x 14	-
150	-	-	8 x 8 x 10	-	10 x 10 x 14	-	-
220	-	8 x 8 x 10	-	10 x 10 x 10	-	-	-
330	8 x 8 x 10	10 x 10 x 10	10 x 10 x 14	-	-	-	-
470	10 x 10 x 10	10 x 10 x 14	-	-	-	-	-
680	10 x 10 x 14	-	-	-	-	-	-

Table 1

DIMENSIONS in millimeters **AND MASS**									
NOMINAL CASE SIZE L x W x H	**CASE CODE**	**$L_{max.}$**	**$W_{max.}$**	**$H_{max.}$**	**Ø D**	**$B_{max.}$**	**S**	**$L_{1\ max.}$**	**MASS (g)**
8 x 8 x 10	0810	8.5	8.5	10.5	8.0	1.0	3.1	9.9	≈ 1.0
10 x 10 x 10	1010	10.5	10.5	10.5	10.0	1.0	4.5	11.8	≈ 1.3
10 x 10 x 14	1014	10.5	10.5	14.3	10.0	1.0	4.5	11.8	≈ 1.5

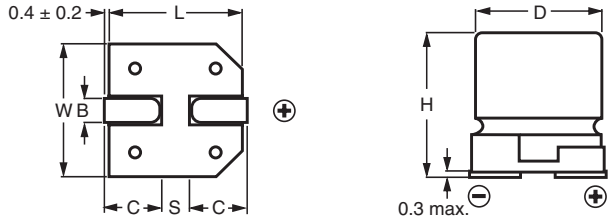


Fig.2 Dimensional outline

Table 2

TAPE AND REEL DIMENSIONS in millimeters, **PACKAGING QUANTITIES**						
NOMINAL CASE SIZE L x W x H	**CASE CODE**	**PITCH P_1**	**TAPE WIDTH W**	**TAPE THICKNESS T_2**	**REEL DIA.**	**PACKAGING QUANTITY PER REEL**
8 x 8 x 10	0810	16	24	11.3	380	500
10 x 10 x 10	1010	16	24	11.3	380	500
10 x 10 x 14	1014	16	24	14.8	330	250

Note
1. Detailed tape dimensions see section “PACKAGING”.

MOUNTING
The capacitors are designed for automatic placement on to printed-circuit boards.

Optimum dimensions of soldering pads depend amongst others on soldering method, mounting accuracy, print lay-out and/or adjacent components.

For recommended soldering pad dimensions, refer to Fig.3 and Table 3.

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

For maximum conditions refer to Fig.4.

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

Table 3

RECOMMENDED SOLDERING PAD DIMENSIONS in millimeters			
CASE CODE	**a**	**b**	**c**
0810	3.5	2.5	3.0
1010	4.3	2.5	4.0
1014	4.3	2.5	4.0

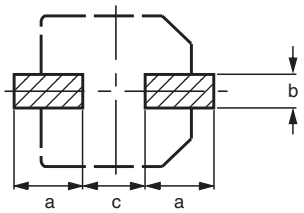


Fig. 3 Recommended solder pad dimensions

AS A GENERAL PRINCIPLE, TEMPERATURE AND DURATION SHALL BE THE **MINIMUM** NECESSARY REQUIRED TO ENSURE GOOD SOLDERING CONNECTIONS. HOWEVER, THE SPECIFIED MAXIMUM CURVES SHOULD NEVER BE EXCEEDED.

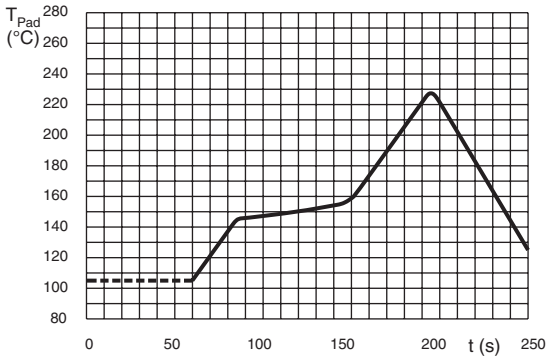


Fig. 4 Maximum temperature load during infrared reflow soldering measured on the soldering pad

ELECTRICAL DATA	
SYMBOL	**DESCRIPTION**
C_R	rated capacitance at 100 Hz, tolerance ± 20 %
I_R	rated RMS ripple current at 100 kHz, 125 °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

Unless otherwise specified, all electrical values in Table 4 apply at T_{amb} = 20 °C, P = 86 to 106 kPa, RH = 45 to 75 %.

ORDERING EXAMPLE

Electrolytic capacitor 140 CLH series

100 µF/50 V; ± 20 %

Nominal case size:
10 x 10 x 14 mm; taped on reel

Ordering code: MAL214095102E3
Former 12NC: 2222 140 95102

Table 4

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R (µF)	NOMINAL CASE SIZE L x W x H (mm)	I_R 100 kHz 125 °C (mA)	I_{L2} 2 min (µA)	tan δ	Z 100 kHz + 20 °C (Ω)	ORDERING CODE MAL2140.....
6.3	330	8 x 8 x 10	180	21	0.30	0.65	95303E3
	470	10 x 10 x 10	300	30	0.30	0.17	95301E3
	680	10 x 10 x 14	430	43	0.30	0.12	95302E3
10	220	8 x 8 x 10	180	22	0.26	0.65	95403E3
	330	10 x 10 x 10	300	33	0.26	0.17	95401E3
	470	10 x 10 x 14	430	47	0.26	0.12	95402E3
16	150	8 x 8 x 10	180	24	0.22	0.65	95502E3
	330	10 x 10 x 14	430	53	0.22	0.12	95501E3
25	100	8 x 8 x 10	180	25	0.18	0.65	95602E3
	220	10 x 10 x 10	300	55	0.18	0.19	95601E3
35	68	8 x 8 x 10	180	24	0.14	0.65	95003E3
	100	10 x 10 x 10	255	35	0.14	0.40	95001E3
	150	10 x 10 x 14	317	53	0.14	0.30	95002E3
50	47	8 x 8 x 10	145	24	0.12	1.00	95103E3
	68	10 x 10 x 10	205	34	0.12	0.56	95101E3
	100	10 x 10 x 14	255	50	0.12	0.42	95102E3
63	10	8 x 8 x 10	145	6.3	0.12	1.00	95805E3
	22	8 x 8 x 10	145	14	0.12	1.00	95803E3
	33	8 x 8 x 10	145	21	0.12	1.00	95804E3
	47	10 x 10 x 10	205	30	0.12	0.56	95801E3
	68	10 x 10 x 14	255	43	0.12	0.42	95802E3

ADDITIONAL ELECTRICAL DATA		
PARAMETER	**CONDITIONS**	**VALUE**
Voltage		
Surge voltage for short periods	IEC 60384-18, subclause 4.14	$U_s \leq 1.15 \times U_R$
Reverse voltage for short periods	IEC 60384-18, subclause 4.16	$U_{rev} \leq 0.5$ V
Current		
Leakage current	after 2 minutes at U_R	$I_{L2} \leq 0.01 \times C_R \times U_R$
Inductance		
Equivalent series inductance (ESL)		typ. 16 nH
Resistance		
Equivalent series resistance (ESR) at 100 Hz	calculated from tan $\delta_{max.}$ and C_R (see Table 4)	ESR = tan δ/2 πf C_R

CAPACITANCE (C)

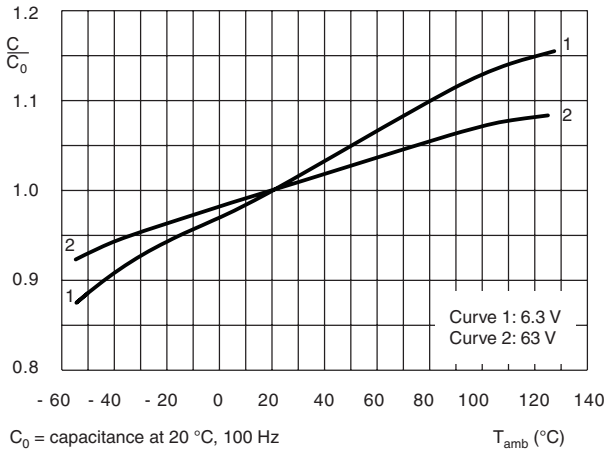


Fig.5 Typical multiplier of capacitance as a function of frequency of ambient temperature

DISSIPATION FACTOR (tan δ)

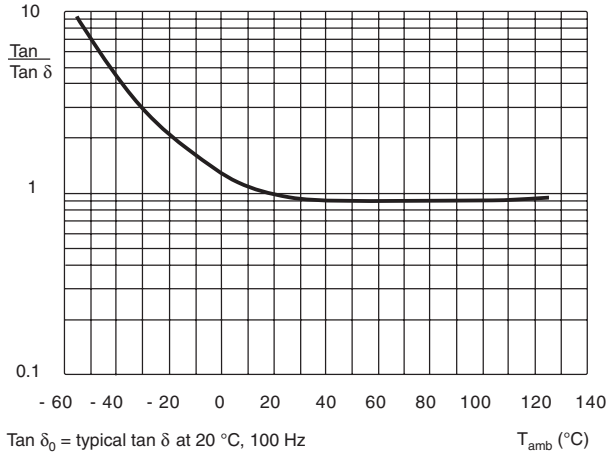


Fig.6 Typical multiplier of dissipation factor (Tan δ) as a function of ambient temperature

EQUIVALENT SERIES RESISTANCE (ESR)

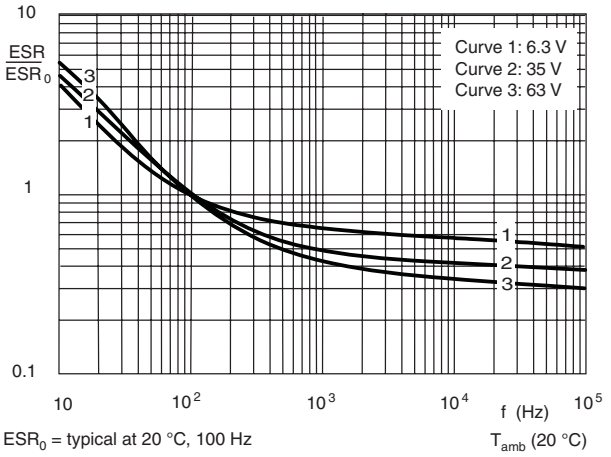


Fig.7 Typical multiplier of ESR as a function of frequency

IMPEDANCE (Z)

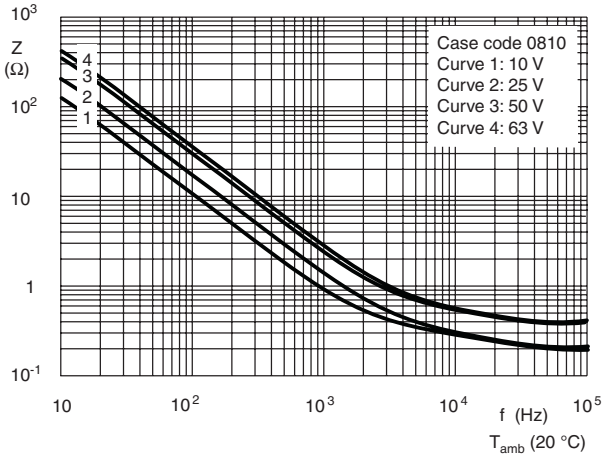


Fig.8 Typical multiplier of ESR as a function of frequency

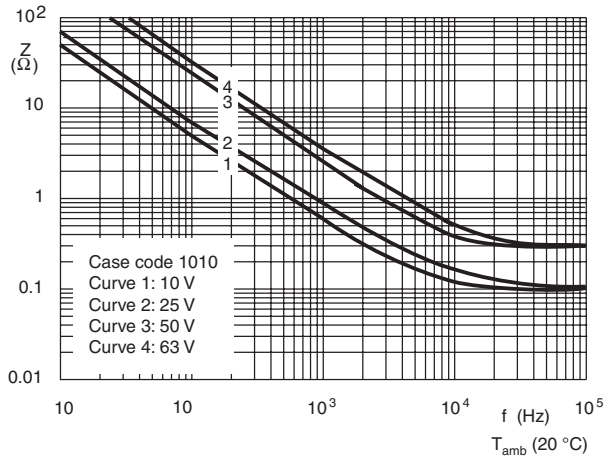


Fig.9 Typical impedance as a function of frequency

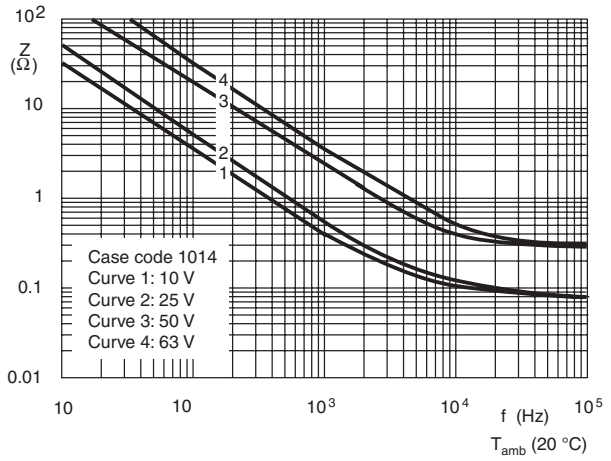
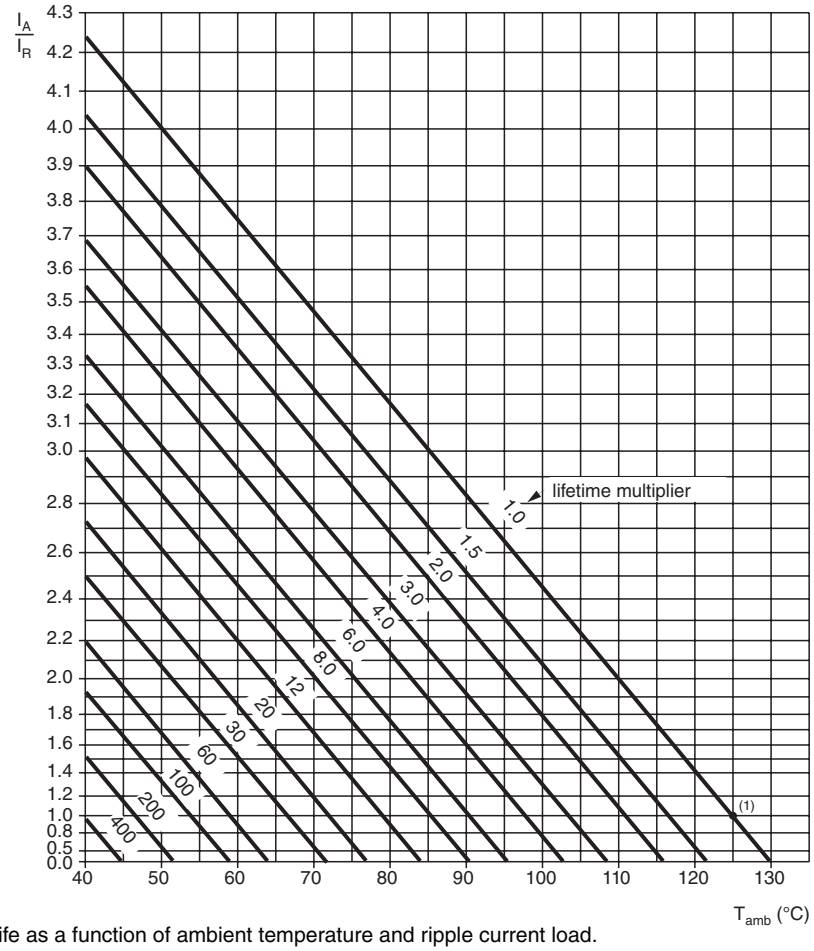


Fig.10 Typical impedance as a function of frequency

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 kHz
I_R = rated ripple current at 100 kHz, 125 °C
(1) Useful life at 125 °C and I_R applied: 1500 hours

Fig.11 Multiplier of useful life as a function of ambient temperature and ripple current load.

Table 5

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)	I_R MULTIPLIER		
	U_R = 6.3 to 25 V	U_R = 35 and 50 V	U_R = 63 V
50	0.60	0.45	0.40
100	0.70	0.60	0.55
300	0.80	0.75	0.70
1000	0.85	0.85	0.85
3000	0.90	0.90	0.90
10 000	0.95	0.95	0.95
30 000	0.97	0.97	0.97
100 000	1.00	1.00	1.00

Table 6

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; reflow soldering; for maximum temperature load refer to chapter “Mounting”	$\Delta C/C$: ± 5 % tan $\delta \leq$ spec. limit $I_{L2} \leq$ spec. limit
Endurance	IEC 60384-18/ CECC 32 300, subclause 4.15	T_{amb} = 125 °C; U_R applied; 1000 hours	U_R = 6.3 V; $\Delta C/C$: ± 25 % $U_R \geq$ 10 V; $\Delta C/C$: ± 20 % tan $\delta \leq$ 2 x spec. limit $I_{L2} \leq$ spec. limit
Useful life	CECC 30301, subclause 1.8.1	T_{amb} = 125 °C; U_R and I_R applied; 1500 hours	$\Delta C/C$: ± 50 % tan $\delta \leq$ 3 x spec. limit $I_{L2} \leq$ spec. limit no short or open circuit total failure percentage: ≤ 1 %
Shelf life (storage at high temperature)	IEC 60384-18/ CECC 32 300, subclause 4.17	T_{amb} = 125 °C; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	for requirements see ‘Endurance test’ above
Reverse voltage	IEC 60384-18/ CECC 32 300, subclause 4.16	T_{amb} = 125 °C: 125 hours at U = - 0.5 V, followed by 125 hours at U_R	$\Delta C/C$: ± 15 % tan $\delta \leq$ 1.5 x spec. limit $I_{L2} \leq$ spec. limit

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