Aluminum Capacitors
High Temperature Solid Electrolytic SMD

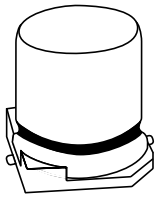
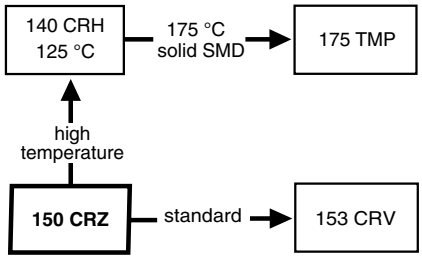


Fig.1 Component outline



FEATURES

- Polarized aluminum electrolytic capacitors SMD, solid electrolyte MnO_2
- Extremely long useful life, 20 000 h/125 °C
- High temperature, usable up to 175 °C
- Excellent impedance and ESR behavior, at low and high temperature
- Charge and discharge proof, application with 0 Ω resistance allowed
- Reverse DC voltage up to 0.5 x U_R allowed
- AC voltage up to 0.8 x U_R allowed
- High shock and vibration capability
- High ripple current per volume in SMD

Pb-free

RoHS
COMPLIANT

APPLICATIONS

- SMD technology
- Smoothing, filtering, buffering
- Telecommunications, professional industrial, EDP, high end power conversion
- Power supplies, SMPS for telecommunications

PACKAGING

Supplied in blister tape on reel.

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 (V) HT

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (L x W x H in mm)	8 x 8 x 10
Rated capacitance range, C_R	1 to 68 µF
Tolerance on C_R	± 20 %
Rated voltage range, U_R	4 to 40 V
Rated temperature range	- 55 to + 85 °C
Category temperature range: U_{C1} = 4 to 25 V U_{C2} = 4 to 16 V	 - 55 to + 125 °C - 55 to + 175 °C
Endurance test at 175 °C	1000 hours
Endurance test at 125 °C	10 000 hours
Useful life at 175 °C	2000 hours
Useful life at 125 °C	20 000 hours
Useful life at 40 °C, I_R applied	> 300 000 hours
Shelf life at 0 V, 125 °C	500 h
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/175/56

SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES

C_R (µF)	U_R (V) at T_{amb} = 85 °C						
	4	6.3	10	16	20	25	40
	U_{C1} (V) at T_{amb} = 125 °C						
	4	6.3	10	16	20	25	25
	U_{C2} (V) at T_{amb} = 175 °C						
	4	6.3	10	16	16	16	16
1	-	-	-	-	-	-	0810
2.2	-	-	-	-	-	-	0810
3.3	-	-	-	-	-	0810	-
4.7	-	-	-	-	-	0810	-
6.8	-	-	-	-	0810	0810	-
10	-	-	-	0810	-	0810	-
15	-	-	0810	-	-	-	-
22	-	-	0810	-	-	-	-
33	-	0810	-	-	-	-	-
47	-	0810	-	-	-	-	-
68	0810	-	-	-	-	-	-

Table 1

TAPE AND REEL DIMENSIONS in millimeters					
CASE CODE	**PITCH P_1**	**TAPE WIDTH W**	**TAPE THICKNESS T_2**	**REEL DIA.**	**PACKAGING QUANTITY PER REEL**
0810	16	24	11	380	500

Table 2

DIMENSIONS in millimeters **AND MASS** (see Fig.2)									
NOMINAL CASE SIZE L x W x H	**CASE CODE**	**$L_{max.}$**	**$W_{max.}$**	**$H_{max.}$**	**Ø D**	**$B_{max.}$**	**S**	**C**	**MASS (g)**
8.0 x 8.0 x 10.0	0810	8.4	8.4	10.7	8.0	1	4.7	2.2 ± 0.2	≈ 0.8

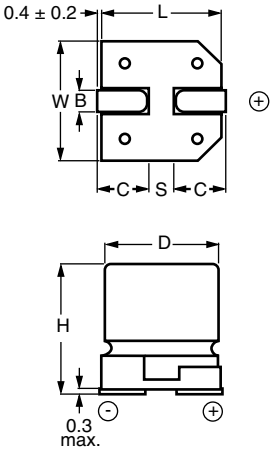


Fig.2 Dimensional outline

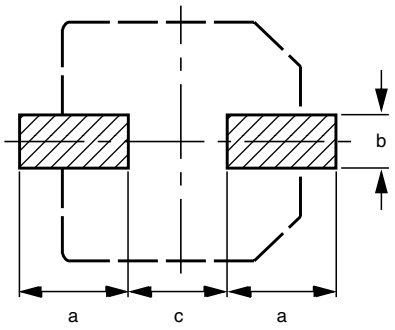


Fig.3 Recommended soldering pad dimensions

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

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 layout 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.

Resistant against 260 °C reflow temperature; see 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	3.0	2.5	4.0

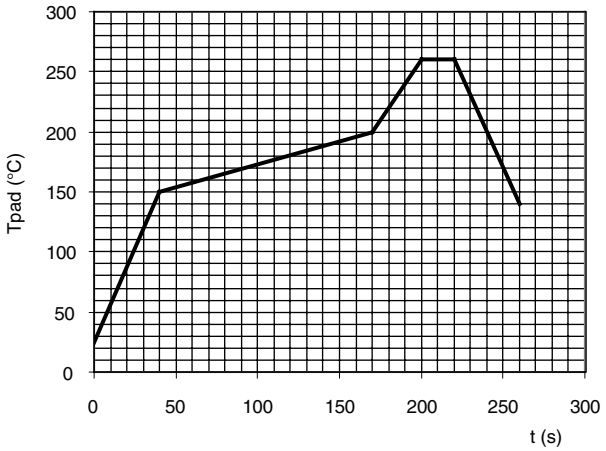


Fig.4 Maximum temperature load during infrared reflow soldering measured on the soldering pad

ELECTRICAL DATA	
SYMBOL	**DESCRIPTION**
C_R	rated capacitance at 100 Hz, tolerance ± 20 %
I_R	typical RMS ripple current no necessary DC voltage applied
I_{L5}	typical leakage current after 5 minutes at U_R
ESR	typical equivalent series resistance at 100 kHz
$Z_{F\ RES}$	typical impedance at average resonance frequency

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 175 TMP series

47 µF/6.3 V; ± 20 %

Nominal case size: 8 x 8 x 10 mm; taped on reel

Lead (Pb)-free terminations

Ordering code: MAL2 175 73479 E3

Former 12NC: 2222 175 73479

Table 4

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	U_{C1} 125 °C (V)	U_C2 175 °C (V)	C_R (µF)	NOMINAL CASE SIZE L x W x H (mm)	I_R 100 kHz 175 °C (mA)	I_R 100 kHz 40 °C (mA)	I_{L5} 5 min (mA)	TYP. ESR 100 kHz (Ω)	TYP. $Z_{F\ RES}$ (Ω)	TYP. $Z_{F\ RES}$ (MHz)	ORDERING CODE MAL2175.....
4	4	4	68	8.0 x 8.0 x 10.0	426	2660	5	0.15	0.11	0.65	72689E3
6.3	6.3	6.3	33	8.0 x 8.0 x 10.0	426	2660	4	0.15	0.1	0.71	73339E3
			47	8.0 x 8.0 x 10.0	413	2580	5	0.16	0.11	0.73	73479E3
10	10	10	15	8.0 x 8.0 x 10.0	234	1460	3	0.5	0.25	2.0	74159E3
			22	8.0 x 8.0 x 10.0	301	1880	3	0.31	0.22	2.0	74229E3
16	16	16	10	8.0 x 8.0 x 10.0	186	1160	3	0.79	0.38	3.2	75109E3
20	20	16	6.8	8.0 x 8.0 x 10.0	142	890	2	1.31	0.69	5.1	78688E3
25	25	16	3.3	8.0 x 8.0 x 10.0	91	653	2	2.0	0.7	7.7	76338E3
			4.7	8.0 x 8.0 x 10.0	131	740	2	1.6	0.63	6.4	76478E3
			6.8	8.0 x 8.0 x 10.0	139	870	4	1.33	0.52	4.95	76688E3
			10	8.0 x 8.0 x 10.0	186	1160	4	0.79	0.38	3.2	76109E3
40	25	16	1.0	8.0 x 8.0 x 10.0	94	590	2	3.12	0.86	9.6	77108E3
			2.2	8.0 x 8.0 x 10.0	112	700	2	2.16	0.74	7.5	77228E3

ADDITIONAL ELECTRICAL DATA		
PARAMETER	**CONDITIONS**	**VALUE**
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage	T_{amb} = 85 °C:	
	at U_R = 4 to 16 V	$U_{rev} < 0.5\ U_R$
	at U_R = 20 V	$U_{rev} < 0.4\ U_R$
	at U_R = 25 to 40 V	$U_{rev} < 0.3\ U_R$
	T_{amb} = 125 °C:	
	at U_R = 4 to 16 V	$U_{rev} < 0.4\ U_R$
	at U_R = 20 V	$U_{rev} < 0.2\ U_R$
	at U_R = 25 to 40 V	$U_{rev} < 0.1\ U_R$
	T_{amb} = 175 °C:	
	at U_R = 4 to 16 V	$U_{rev} < 0.3\ U_R$
	at U_R = 20 V	$U_{rev} < 0.15\ U_R$
	at U_R = 25 to 40 V	$U_{rev} < 0.1\ U_R$
Maximum peak AC voltage	Reverse voltage applied	≤ 2 V
Maximum peak AC voltage, without reverse voltage applied	T_{amb} = 85 °C:	
	at f ≤ 0.1 Hz	0.30 x U_R
	at 0.1 Hz < f ≤ 1 Hz	0.45 x U_R
	at 1 Hz < f ≤ 10 Hz	0.60 x U_R
	at 10 Hz < f ≤ 50 Hz	0.65 x U_R
	at f > 50 Hz	0.80 x U_R
	85 °C < T_{amb} ≤ 125 °C:	
	at f ≤ 0.1 Hz	0.15 x U_R
	at 0.1 Hz < f ≤ 1 Hz	0.22 x U_R
	at 1 Hz < f ≤ 10 Hz	0.30 x U_R
	at 10 Hz < f ≤ 50 Hz	0.32 x U_R
	at f > 50 Hz	0.40 x U_R
	125 °C ≤ T_{amb} ≤ 175 °C:	
	at f < 50 Hz	0.1 x U_R
	at f > 50 Hz	0.2 x U_R
Inductance		
Equivalent series inductance (ESL)	Case sizes (mm):	
	8 x 8 x 10	typ. 9 to 14 nH
Dissipation		
Maximum power dissipation	Case sizes (mm):	$P_{max.} = P_{125}$ mW
	8 x 8 x 10	350
Current		
Maximum leakage current	After 5 minutes at U_R and T_{amb} = 25 °C	see Table 4

VOLTAGE

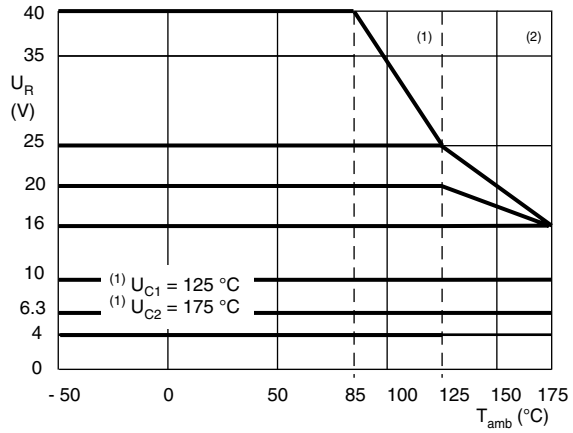
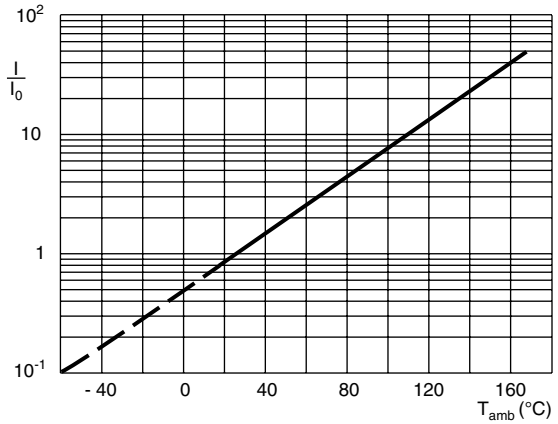


Fig.5 Maximum permissible voltage up to T_{amb} = 175 °C

LEAKAGE CURRENT



I_0 = leakage current during continuous operation at U_R and T_{amb} = 25 °C

Fig.8 Typical multiplier of leakage current as a function of ambient temperature

CAPACITANCE (C)

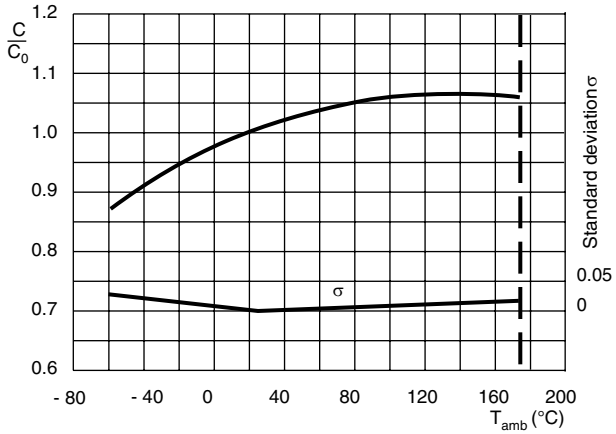


Fig.6 Typical multiplier of capacitance and standard deviation as functions of ambient temperature

EQUIVALENT SERIES RESISTANCE (ESR)

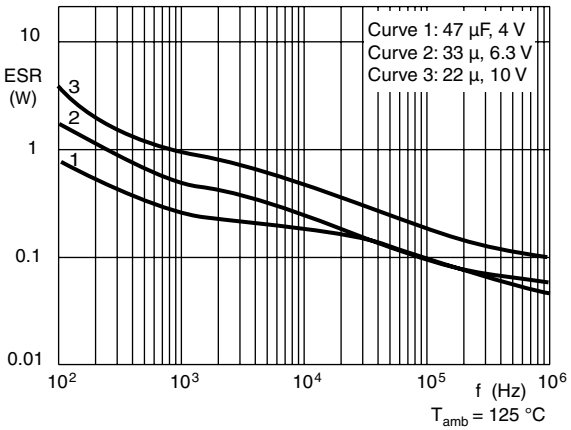
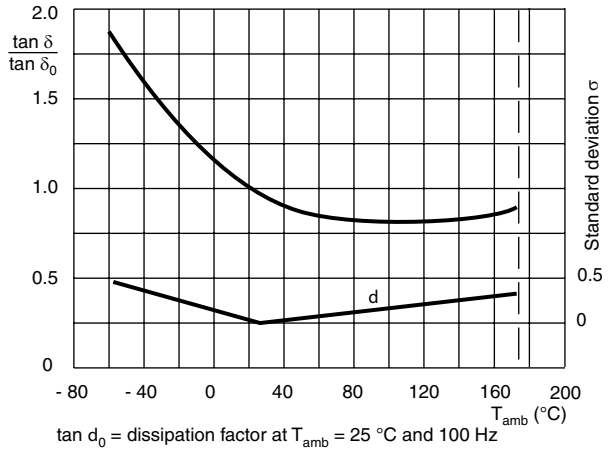


Fig.9 Typical ESR as a function of frequency at 125 °C

DISSIPATION FACTOR (tan δ)



tan d_0 = dissipation factor at T_{amb} = 25 °C and 100 Hz

Fig.7 Typical multiplier of dissipation factor and standard deviation as functions of ambient temperature

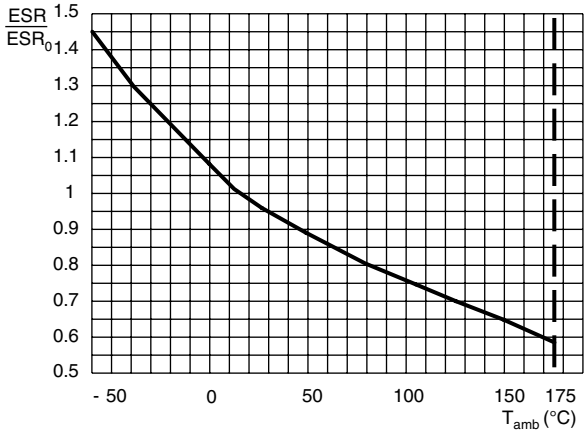


Fig.10 ESR correction multiplier as a function of temperature

IMPEDANCE (Z)

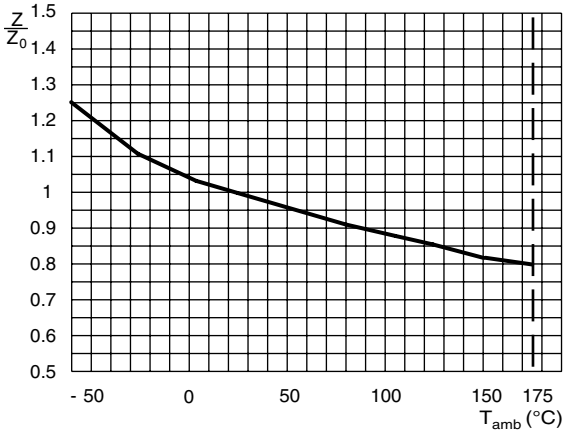


Fig.11 Z correction multiplier as a function of temperature

RIPPLE CURRENT (I_R)

Applying the maximum RMS ripple current given in below table will cause a device temperature of 175 °C.

PARAMETER	T_{amb}					
	40 °C	85 °C	105 °C	125 °C	150 °C	175 °C
I_R multiplier; 100 kHz	1.0	0.87	0.78	0.67	0.5	0.16

Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS (1)
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”	ΔC/C: ± 10 % tan δ ≤ spec. limit I_{L2} ≤ spec. limit
Endurance	IEC 60384-4/ EN130300 subclause 4.13	T_{amb} = 125 °C; U_R = 4 to 25 V with U_R applied; U_R = 40 V with U_C applied; 10 000 h T_{amb} = 175 °C; U_R = 4 to 16 V with U_R applied; U_R = 20 to 40 V with U_C applied; 1000 h	ΔC/C: ± 10 % tan δ ≤ 1.2 x spec. limit Z ≤ 1.2 x spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30302 subclause 1.8.1	T_{amb} = 175 °C; I_R applied and: U_R = 4 to 16 V with U_R applied; U_R = 20 and 40 V with U_C applied; 2000 h	ΔC/C: ± 15 % tan δ ≤ 1.5 x spec. limit Z ≤ 1.5 x spec. limit I_{L5} ≤ spec. limit no short or open circuit, no visible damage total failure percentage: < 1 %
Shelf life (2)	IEC 60384-4/ EN130300 subclause 4.17	T_{amb} = 125 °C; no voltage applied; 500 h	ΔC/C: ± 10 % tan δ ≤ 1.2 x spec. limit I_{L5} ≤ 1 x spec. limit
Charge and discharge	IEC 60384-4-2 subclause 9.21	10^6 cycles without series resistance: 0.5 s to U_R; 0.5 s to ground	ΔC/C: ± 5 % no short or open circuit, no visible damage

Notes
(1) Specification limits on request
(2) MSL acc. J-STD-020D is not specified

TEST PROCEDURES AND REQUIREMENTS

TEST		PROCEDURE (quick reference)	REQUIREMENTS (1)
NAME OF TEST	REFERENCE		
Solvent resistance	IEC 60068-2-45, test XA IEC 60653	immersion: 5 ± 0.5 min with or without ultrasonic at 55 ± 5 °C solvents: demineralized water and/or calgonite solution (20 g/l)	visual appearance not affected
Vibration	IEC 60068-2-6 test Fc	10 to 2000 Hz; 1.5 mm or 20 g; 1 octave/min; 3 directions; 2 h per direction; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C$: ± 5 % tan $\delta \leq$ 1.2 x spec. limit $Z \leq$ 1.2 x spec. limit $I_{L5} \leq$ 1.5 x spec. limit
Shock	IEC 60068-2-27 test Ea	half-sine or sawtooth pulse shape; 50 g; 11 ms; 3 successive shocks in each direction of 3 mutually perpendicular axes; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C$: ± 5 % tan $\delta \leq$ 1.2 x spec. limit $Z \leq$ 1.2 x spec. limit $I_{L5} \leq$ 1.5 x spec. limit
Bump	IEC 60384-4/ EN 130300 subclass 4.9	40 g; 2 directions; 4000 bumps total	no visible damage $\Delta C/C$: ± 5 % with respect to initial measurement
Passive flammability	IEC 60695-2-2	capacitor mounted to a vertical printed-circuit board, one flame on capacitor body; T_{amb} = 20 to 25 °C; test duration = 20 s	after removing the test flame from the capacitor, the capacitor must not continue to burn for more than 15 s no burning particles must drop from the sample

Notes
(1) Specification limits on request
(2) MSL acc. J-STD-020D is not specified

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