

## Aluminum Capacitors High Temperature Solid Electrolytic SMD

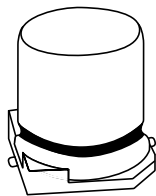
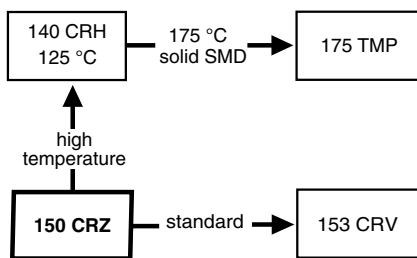


Fig.1 Component outline



### FEATURES

- Polarized aluminum electrolytic capacitors SMD, solid electrolyte MnO<sub>2</sub>
- 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<sub>R</sub> allowed
- AC voltage up to 0.8 x U<sub>R</sub> allowed
- High shock and vibration capability
- High ripple current per volume in SMD



**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 <sub>R</sub>	1 to 68 μF
Tolerance on C <sub>R</sub>	± 20 %
Rated voltage range, U <sub>R</sub>	4 to 40 V
Rated temperature range	- 55 to + 85 °C
Category temperature range:	
U <sub>C1</sub> = 4 to 25 V	- 55 to + 125 °C
U <sub>C2</sub> = 4 to 16 V	- 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 <sub>R</sub> 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 <sub>R</sub> , U <sub>R</sub> AND RELEVANT NOMINAL CASE SIZES							
C <sub>R</sub> (μF)	U <sub>R</sub> (V) at T <sub>amb</sub> = 85 °C						
	4	6.3	10	16	20	25	40
	U <sub>C1</sub> (V) at T <sub>amb</sub> = 125 °C						
	4	6.3	10	16	20	25	25
	U <sub>C2</sub> (V) at T <sub>amb</sub> = 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 <sub>1</sub>	TAPE WIDTH W	TAPE THICKNESS T <sub>2</sub>	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 <sub>max.</sub>	W <sub>max.</sub>	H <sub>max.</sub>	Ø D	B <sub>max.</sub>	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

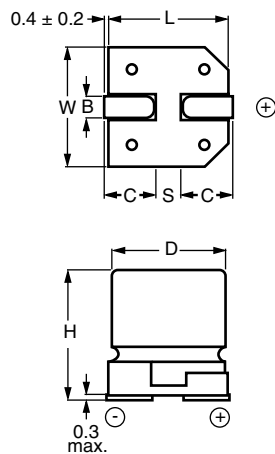


Fig.2 Dimensional outline

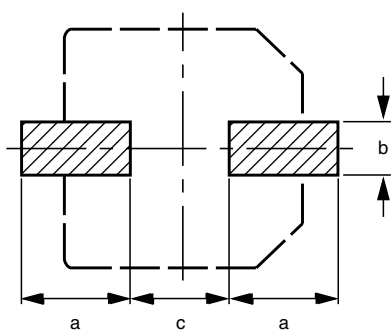


Fig.3 Recommended soldering pad dimensions

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

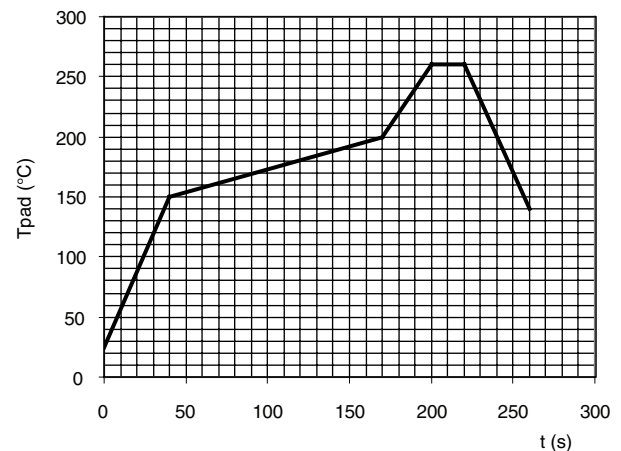


Fig.4 Maximum temperature load during infrared reflow soldering measured on the soldering pad



ELECTRICAL DATA	
SYMBOL	DESCRIPTION
$C_R$	rated capacitance at 100 Hz, tolerance $\pm 20\%$
$I_R$	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

### ORDERING EXAMPLE

Electrolytic capacitor 175 TMP series

47  $\mu\text{F}/6.3\text{ V}; \pm 20\%$

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

Lead (Pb)-free terminations

Ordering code: MAL217573479E3

Former 12NC: 222217573479

### Note

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

Table 4

ELECTRICAL DATA AND ORDERING INFORMATION											
$U_R$ (V)	$U_{C1}$ 125 $^\circ\text{C}$ (V)	$U_{C2}$ 175 $^\circ\text{C}$ (V)	$C_R$ ( $\mu\text{F}$ )	NOMINAL CASE SIZE L x W x H (mm)	$I_R$ 100 kHz 175 $^\circ\text{C}$ (mA)	$I_R$ 100 kHz 40 $^\circ\text{C}$ (mA)	$I_{L5}$ 5 min (mA)	TYP. ESR 100 kHz ( $\Omega$ )	TYP. $Z_{F RES}$ ( $\Omega$ )	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



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



**VOLTAGE**

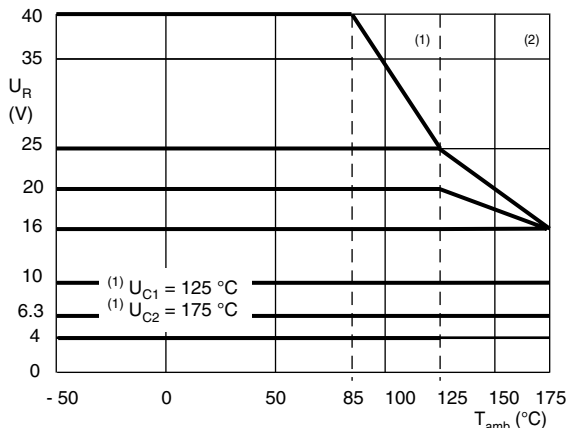
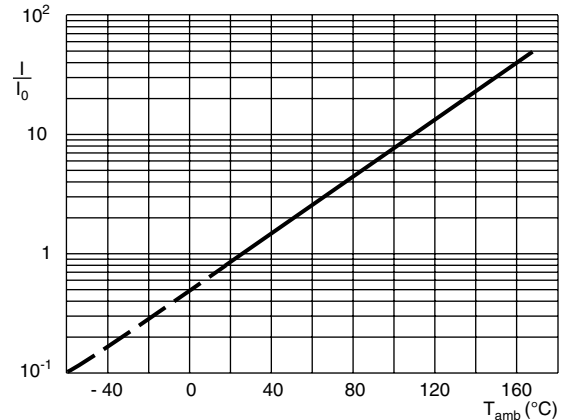


Fig.5 Maximum permissible voltage up to Tamb = 175 °C

**LEAKAGE CURRENT**



I<sub>0</sub> = leakage current during continuous operation at U<sub>R</sub> and T<sub>amb</sub> = 25 °C  
Fig.8 Typical multiplier of leakage current as a function of ambient temperature

**CAPACITANCE (C)**

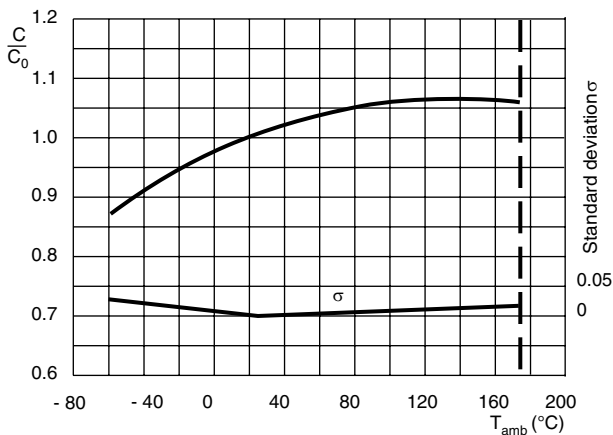


Fig.6 Typical multiplier of capacitance and standard deviation as functions of ambient temperature

**EQUIVALENT SERIES RESISTANCE (ESR)**

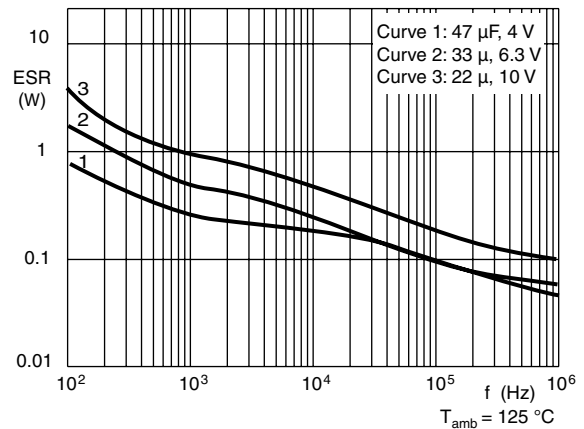


Fig.9 Typical ESR as a function of frequency at 125 °C

**DISSIPATION FACTOR (tan δ)**

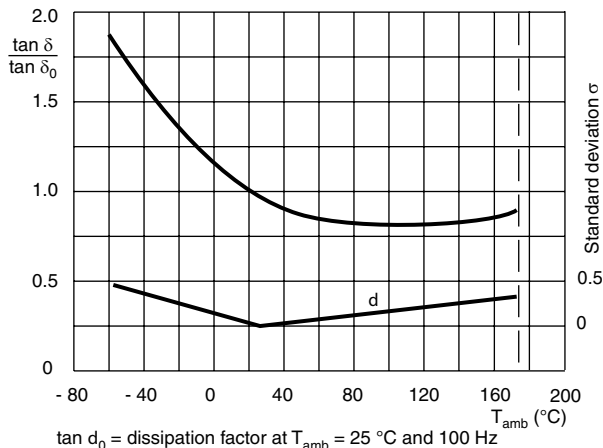


Fig.7 Typical multiplier of dissipation factor and standard deviation as functions of ambient temperature

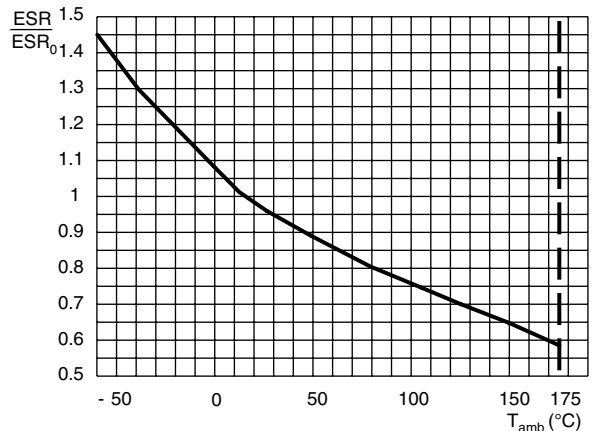


Fig.10 ESR correction multiplier as a function of temperature



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**IMPEDANCE (Z)**

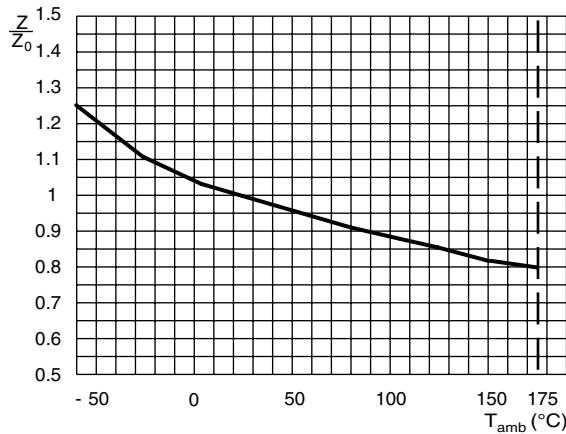


Fig.11 Z correction multiplier as a function of temperature

**RIPPLE CURRENT (I<sub>R</sub>)**

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

PARAMETER	T <sub>amb</sub>					
	40 °C	85 °C	105 °C	125 °C	150 °C	175 °C
I <sub>R</sub> 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 <sub>L2</sub> ≤ spec. limit
Endurance	IEC 60384-4/ EN130300 subclause 4.13	T <sub>amb</sub> = 125 °C; U <sub>R</sub> = 4 to 25 V with U <sub>R</sub> applied; U <sub>R</sub> = 40 V with U <sub>C</sub> applied; 10 000 h  T <sub>amb</sub> = 175 °C; U <sub>R</sub> = 4 to 16 V with U <sub>R</sub> applied; U <sub>R</sub> = 20 to 40 V with U <sub>C</sub> applied; 1000 h	ΔC/C: ± 10 % tan δ ≤ 1.2 x spec. limit Z ≤ 1.2 x spec. limit I <sub>L5</sub> ≤ spec. limit
Useful life	CECC 30302 subclause 1.8.1	T <sub>amb</sub> = 175 °C; I <sub>R</sub> applied and: U <sub>R</sub> = 4 to 16 V with U <sub>R</sub> applied; U <sub>R</sub> = 20 and 40 V with U <sub>C</sub> applied; 2000 h	ΔC/C: ± 15 % tan δ ≤ 1.5 x spec. limit Z ≤ 1.5 x spec. limit I <sub>L5</sub> ≤ 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 <sub>amb</sub> = 125 °C; no voltage applied; 500 h	ΔC/C: ± 10 % tan δ ≤ 1.2 x spec. limit I <sub>L5</sub> ≤ 1 x spec. limit
Charge and discharge	IEC 60384-4-2 subclause 9.21	10 <sup>6</sup> cycles without series resistance: 0.5 s to U <sub>R</sub> ; 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



<b>TEST PROCEDURES AND REQUIREMENTS</b>			
<b>TEST</b>		<b>PROCEDURE (quick reference)</b>	<b>REQUIREMENTS (1)</b>
<b>NAME OF TEST</b>	<b>REFERENCE</b>		
Solvent resistance	IEC 60068-2-45, test XA IEC 60653	immersion: $5 \pm 0.5$ min with or without ultrasonic at $55 \pm 5$ °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 $\Delta C/C: \pm 5\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1.5 \times \text{spec. limit}$
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 $\Delta C/C: \pm 5\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1.5 \times \text{spec. limit}$
Bump	IEC 60384-4/ EN 130300 subclass 4.9	40 g; 2 directions; 4000 bumps total	no visible damage $\Delta C/C: \pm 5\%$ with respect to initial measurement
Passive flammability	IEC 60695-2-2	capacitor mounted to a vertical printed-circuit board, one flame on capacitor body; $T_{\text{amb}} = 20$ 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

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## Disclaimer

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