

## Conductive Polymer Aluminum Capacitors SMD (Chip), Low Impedance, High Temperature

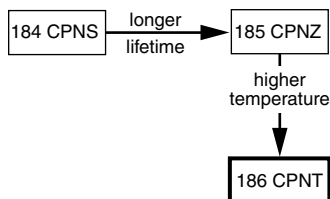


Fig. 1

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (L x W x H in mm)	6.3 x 6.3 x 5.8 to 10.0 x 10.0 x 12.4
Rated capacitance range, C <sub>R</sub>	10 μF to 1500 μF
Tolerance on C <sub>R</sub>	± 20 %
Rated voltage range, U <sub>R</sub>	6.3 V to 50 V
Category temperature range	-55 °C to +125 °C
Endurance test at 125 °C	2000 h
Useful life at 125 °C	2000 h
Shelf life at 0 V, 125 °C	1000 h
Based on sectional specification	IEC 60384-25 / CECC 32300
Climatic category IEC 60068	55 / 125 / 56

### FEATURES

- Useful life: up to 2000 h at 125 °C
- Very low ESR and high ripple current
- Voltages up to 50 V
- AEC-Q200 qualified products on request
- SMD-version with base plate, lead (Pb)-free reflow solderable
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

- Automotive electronics
- Industrial and professional applications
- Telecommunications and IT
- Portable and mobile equipment

### 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 beveled edges)
- Code indicating group number (86)

### PACKAGING

Supplied in blister tape on reel

SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES (L x W x H in mm)							
$C_R$ ( $\mu F$ )	$U_R$ (V)						
	6.3	10	16	20	25	35	50
10	→	→	→	→	→	6.3 x 6.3 x 5.8	8.0 x 8.0 x 7.7
12	→	→	→	→	→	→	6.3 x 6.3 x 7.7
22	→	→	→	→	6.3 x 6.3 x 5.8	→	8.0 x 8.0 x 8.7 10.0 x 10.0 x 8.7
27	→	→	→	→	→	6.3 x 6.3 x 7.7	8.0 x 8.0 x 11.7
33	→	→	→	6.3 x 6.3 x 5.8	→	8.0 x 8.0 x 11.7	10.0 x 10.0 x 10.5
47	→	→	6.3 x 6.3 x 5.8	→	6.3 x 6.3 x 7.7 8.0 x 8.0 x 11.7	→	10.0 x 10.0 x 12.4
56	→	6.3 x 6.3 x 5.8	→	→	→	8.0 x 8.0 x 11.7	-
68	→	→	→	6.3 x 6.3 x 7.7	8.0 x 8.0 x 7.7	-	-
82	→	→	→	→	8.0 x 8.0 x 8.7 8.0 x 8.0 x 11.7	-	-
100	6.3 x 6.3 x 5.8	→	6.3 x 6.3 x 7.7	→	→	10.0 x 10.0 x 10.5 10.0 x 10.0 x 12.4	10.0 x 10.0 x 12.4
120	→	→	8.0 x 8.0 x 7.7	8.0 x 8.0 x 7.7	8.0 x 8.0 x 11.7 10.0 x 10.0 x 10.5	-	-
150	→	→	8.0 x 8.0 x 8.7 10.0 x 10.0 x 8.7	→	→	8.0 x 8.0 x 11.7	-
180	→	6.3 x 6.3 x 7.7	8.0 x 8.0 x 11.7 10.0 x 10.0 x 8.7	8.0 x 8.0 x 11.7	10.0 x 10.0 x 12.4	10.0 x 10.0 x 10.5	10.0 x 10.0 x 12.4
220	→	→	8.0 x 8.0 x 11.7	10.0 x 10.0 x 10.5	-	-	-
270	6.3 x 6.3 x 7.7	8.0 x 8.0 x 7.7	-	-	-	-	-
330	→	10.0 x 10.0 x 8.7	10.0 x 10.0 x 10.5	10.0 x 10.0 x 12.4	-	-	-
390	→	→	10.0 x 10.0 x 12.4	-	-	-	-
470	8.0 x 8.0 x 7.7	8.0 x 8.0 x 11.7	-	-	-	-	-
560	→	10.0 x 10.0 x 10.5	10.0 x 10.0 x 12.4	-	-	-	-
820	8.0 x 8.0 x 11.7	10.0 x 10.0 x 12.4	-	-	-	-	-
1000	10.0 x 10.0 x 10.5	-	-	-	-	-	-
1500	10.0 x 10.0 x 12.4	-	-	-	-	-	-

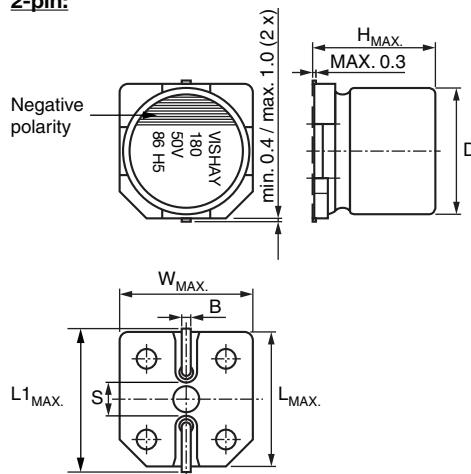
**2-pin:**


Fig. 2 - Dimensional outline

Table 1

<b>DIMENSIONS</b> in millimeters <b>AND MASS</b>									
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	L1 <sub>MAX.</sub>	MASS (g)
6.3 x 6.3 x 5.8	0606	6.7	6.7	6.1	6.3	0.8	2.2	7.4	0.3
6.3 x 6.3 x 7.7	0608	6.7	6.7	8.0	6.3	0.8	2.2	7.4	0.4
8.0 x 8.0 x 7.7	0808	8.5	8.5	8.0	8.0	1.1	3.1	9.2	0.6
8.0 x 8.0 x 8.7	0809	8.5	8.5	9.0	8.0	1.1	3.1	9.2	0.7
8.0 x 8.0 x 11.7	0812	8.5	8.5	12.0	8.0	1.1	3.1	9.2	0.8
10.0 x 10.0 x 8.7	1009	10.5	10.5	9.0	10.0	1.1	4.5	11.2	1.0
10.0 x 10.0 x 10.5	1010	10.5	10.5	10.8	10.0	1.1	4.5	11.2	1.3
10.0 x 10.0 x 12.4	1012	10.5	10.5	12.7	10.0	1.1	4.5	11.2	1.4

Table 2

<b>TAPE AND REEL DIMENSIONS</b> in millimeters, <b>PACKAGING QUANTITIES</b>						
NOMINAL CASE SIZE L x W x H	CASE CODE	PITCH P <sub>1</sub>	TAPE WIDTH W	TAPE THICKNESS T <sub>2</sub>	REEL DIAMETER	PACKAGING QUANTITY PER REEL
6.3 x 6.3 x 5.8	0606	12	16	6.2	380	1000
6.3 x 6.3 x 7.7	0608	12	16	8.0	380	900
8.0 x 8.0 x 7.7	0808	12	16	8.2	380	700
8.0 x 8.0 x 8.7	0809	16	24	11.0	380	500
8.0 x 8.0 x 11.7	0812	16	24	13.0	380	400
10.0 x 10.0 x 8.7	1009	16	24	11.0	380	500
10.0 x 10.0 x 10.5	1010	16	24	11.0	380	500
10.0 x 10.0 x 12.4	1012	16	24	12.9	380	400

## 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 component 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.

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.

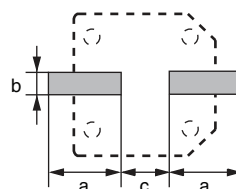


Fig. 3 - Recommended soldering pad dimensions

**Table 3**

<b>RECOMMENDED SOLDERING PAD DIMENSIONS</b> in millimeters				
<b>NOMINAL CASE SIZE L x W x H</b>	<b>CASE CODE</b>	<b>a</b>	<b>b</b>	<b>c</b>
6.3 x 6.3 x 5.8	0606	3.5	1.6	2.1
6.3 x 6.3 x 7.7	0608	3.5	1.6	2.1
8.0 x 8.0 x 7.7	0808	4.2	1.9	2.8
8.0 x 8.0 x 8.7	0809	4.2	1.9	2.8
8.0 x 8.0 x 11.7	0812	4.2	1.9	2.8
10.0 x 10.0 x 8.7	1009	4.4	1.9	4.3
10.0 x 10.0 x 10.5	1010	4.4	1.9	4.3
10.0 x 10.0 x 12.4	1012	4.4	1.9	4.3

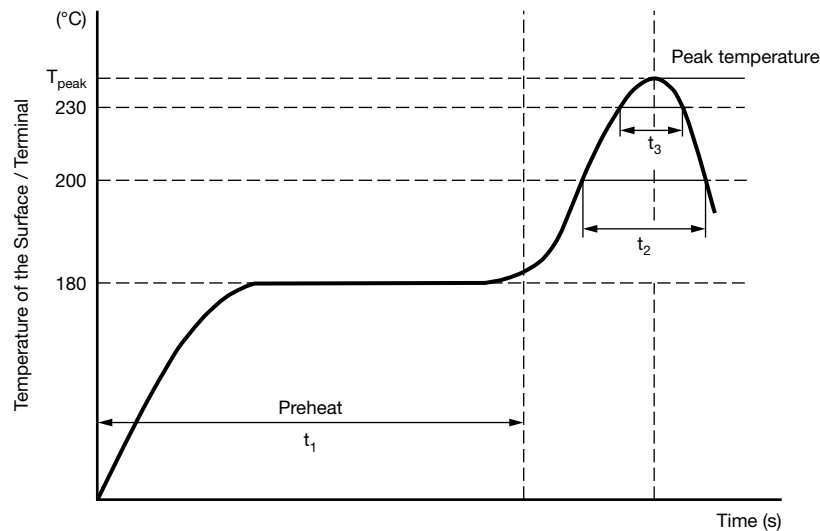
**SOLDERING PROFILE FOR LEAD (Pb)-FREE REFLOW PROCESS**


Fig. 4 - Maximum temperature load during reflow soldering

**Table 4**

<b>REFLOW SOLDERING CONDITIONS</b> for MAL2186xxxxxE3			
<b>PROFILE FEATURES</b>	<b>2.5 V TO 10 V</b>	<b>16 V TO 25 V</b>	<b>35 V TO 50 V</b>
Maximum time between 150 °C to 180 °C ( $t_1$ )	120 s	120 s	120 s
Maximum time above 200 °C ( $t_2$ )	90 s	80 s	70 s
Maximum time above 230 °C ( $t_3$ )	60 s	50 s	30 s
Peak temperature $T_{Peak}$	250 °C	240 °C	240 °C
Maximum reflow cycles	2	2	1

**Note**

- Temperature measuring point on top of the case and on terminals



ELECTRICAL DATA	
SYMBOL	DESCRIPTION
$C_R$	Rated capacitance at 120 Hz, tolerance $\pm 20\%$
$I_R$ 105 °C	Max. allowed ripple current at 100 kHz
$I_R$ 125 °C	Rated RMS ripple current at 100 kHz
$I_{L2}$	Max. leakage current after 2 min at $U_R$
$\tan \delta$	Max. dissipation factor at 120 Hz
ESR	Max. ESR at 100 kHz

**Note**

- Unless otherwise specified, all electrical values in Table 5 apply at  $T_{amb} = 20\text{ °C}$ ,  $P = 86\text{ kPa}$  to  $106\text{ kPa}$ ,  $RH = 45\%$  to  $75\%$

Table 5

ELECTRICAL DATA AND ORDERING INFORMATION								
$U_R$ (V)	$C_R$ ( $\mu\text{F}$ )	NOMINAL CASE SIZE L x W x H (mm)	$I_R$ 105 °C 100 kHz (mA)	$I_R$ 125 °C 100 kHz (mA)	$I_{L2}$ 2 min ( $\mu\text{A}$ )	$\tan \delta$ 120 Hz	ESR 100 kHz 20 °C (m $\Omega$ )	ORDERING CODE MAL2186...
6.3	100	6.3 x 6.3 x 5.8	2200	695	300	0.08	35	97301E3
	270	6.3 x 6.3 x 7.7	2800	885	340	0.08	25	97302E3
	470	8.0 x 8.0 x 7.7	3500	1100	592	0.08	25	97303E3
	820	8.0 x 8.0 x 11.7	4700	1490	1033	0.08	15	97304E3
	1000	10.0 x 10.0 x 10.5	4400	1390	1260	0.08	18	97305E3
	1500	10.0 x 10.0 x 12.4	5100	1610	1890	0.08	15	97306E3
10	56	6.3 x 6.3 x 5.8	2200	695	300	0.08	35	97401E3
	180	6.3 x 6.3 x 7.7	2800	885	360	0.08	25	97402E3
	270	8.0 x 8.0 x 7.7	3000	950	540	0.08	25	97403E3
	330	10.0 x 10.0 x 8.7	3500	1100	660	0.08	25	97404E3
	470	8.0 x 8.0 x 11.7	4200	1330	940	0.08	15	97405E3
	560	10.0 x 10.0 x 10.5	4000	1265	1120	0.08	18	97406E3
	820	10.0 x 10.0 x 12.4	4500	1420	1640	0.08	15	97407E3
16	47	6.3 x 6.3 x 5.8	1600	505	400	0.10	50	97501E3
	100	6.3 x 6.3 x 7.7	2200	695	400	0.10	30	97502E3
	120	8.0 x 8.0 x 7.7	2800	885	400	0.12	30	97503E3
	150	8.0 x 8.0 x 8.7	3000	950	480	0.12	28	97504E3
	150	10.0 x 10.0 x 8.7	3000	930	480	0.12	35	97505E3
	180	8.0 x 8.0 x 11.7	3800	1200	576	0.12	20	97506E3
	180	10.0 x 10.0 x 8.7	3000	930	576	0.12	35	97507E3
	220	8.0 x 8.0 x 11.7	3800	1200	704	0.12	20	97508E3
	330	10.0 x 10.0 x 10.5	3500	1105	1056	0.12	25	97509E3
	390	10.0 x 10.0 x 12.4	4000	1265	1248	0.12	20	97511E3
	560	10.0 x 10.0 x 12.4	4000	1265	1792	0.12	20	97512E3
20	33	6.3 x 6.3 x 5.8	1600	505	600	0.10	50	97551E3
	68	6.3 x 6.3 x 7.7	2200	695	600	0.10	35	97552E3
	120	8.0 x 8.0 x 7.7	2800	885	600	0.12	35	97553E3
	180	8.0 x 8.0 x 11.7	3800	1200	720	0.12	25	97554E3
	220	10.0 x 10.0 x 10.5	3500	1105	880	0.12	27	97555E3
	330	10.0 x 10.0 x 12.4	4000	1265	1320	0.12	25	97556E3

**ORDERING EXAMPLE**

Conductive polymer 186 CPNT series

100  $\mu\text{F}$  / 16 V;  $\pm 20\%$ Nominal case size: 6.3 mm x 6.3 mm x 7.7 mm;  
taped on reel

Ordering code: MAL218697502E3



ELECTRICAL DATA AND ORDERING INFORMATION								
U <sub>R</sub> (V)	C <sub>R</sub> (μF)	NOMINAL CASE SIZE L x W x H (mm)	I <sub>R</sub> 105 °C 100 kHz (mA)	I <sub>R</sub> 125 °C 100 kHz (mA)	I <sub>L2</sub> 2 min (μA)	tan δ 120 Hz	ESR 100 kHz 20 °C (mΩ)	ORDERING CODE MAL2186...
25	22	6.3 x 6.3 x 5.8	1500	474	600	0.10	60	97601E3
	47	6.3 x 6.3 x 7.7	2200	695	600	0.10	35	97602E3
	47	8.0 x 8.0 x 11.7	3500	1100	600	0.12	25	97603E3
	68	8.0 x 8.0 x 7.7	2800	885	600	0.12	35	97604E3
	82	8.0 x 8.0 x 8.7	3000	950	600	0.12	30	97605E3
	82	8.0 x 8.0 x 11.7	3800	1200	600	0.12	25	97606E3
	120	8.0 x 8.0 x 11.7	3800	1200	600	0.12	25	97607E3
	120	10.0 x 10.0 x 10.5	3500	1105	600	0.12	27	97608E3
	180	10.0 x 10.0 x 12.4	4000	1265	900	0.12	25	97609E3
35	10	6.3 x 6.3 x 5.8	980	310	600	0.12	75	97001E3
	27	6.3 x 6.3 x 7.7	1400	450	600	0.12	60	97002E3
	33	8.0 x 8.0 x 11.7	2300	730	600	0.12	35	97003E3
	56	8.0 x 8.0 x 11.7	2300	730	600	0.12	35	97004E3
	100	10.0 x 10.0 x 10.5	2500	800	700	0.12	32	97005E3
	100	10.0 x 10.0 x 12.4	3100	980	700	0.12	30	97006E3
	150	8.0 x 8.0 x 11.7	4800	1650	1050	0.12	25	97007E3
	180	10.0 x 10.0 x 10.5	4400	1390	1260	0.12	30	97008E3
50	10	8.0 x 8.0 x 7.7	1400	450	100	0.12	75	97101E3
	12	6.3 x 6.3 x 7.7	1400	450	120	0.12	75	97102E3
	22	8.0 x 8.0 x 8.7	1800	570	220	0.12	50	97103E3
	22	10.0 x 10.0 x 8.7	1800	570	220	0.12	55	97104E3
	27	8.0 x 8.0 x 11.7	2400	760	270	0.12	40	97105E3
	33	10.0 x 10.0 x 10.5	2200	700	330	0.12	42	97106E3
	47	10.0 x 10.0 x 12.4	2800	885	470	0.12	30	97107E3
	100	10.0 x 10.0 x 12.4	2800	885	1000	0.12	30	97108E3
	180	10.0 x 10.0 x 12.4	3000	950	1800	0.12	24	97109E3

Table 6

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage for short periods	IEC 60384-25, subclause 4.14	U <sub>s</sub> ≤ 1.15 x U <sub>R</sub>

**USEFUL LIFE AND ENDURANCE**

Table 7

ENDURANCE TEST AND USEFUL LIFE							
SERIES	CASE CODE	USEFUL LIFE AT 125 °C (h) <sup>(1)</sup>	ENDURANCE AT 125 °C (h)	ENDURANCE AT 105 °C (h)	ENDURANCE AT 85 °C (h)	ENDURANCE AT 75 °C (h)	ENDURANCE AT 65 °C (h)
186 CPNT	0606 to 1012	2000	2000	20 000	200 000	630 000	2 000 000

**Note**

<sup>(1)</sup> Identical with endurance for this series

Endurance can be calculated by formula below:

$$L = L_{T_{max.}} \times 10^{\frac{T_{max.} - T_a}{20}}$$

L: estimated lifetime (h)

$L_{T_{max.}}$ : base lifetime specified at maximum operating temperature with applied DC voltage (h)

$T_{max.}$ : rated maximum operating temperature (°C)

$T_a$ : actual ambient temperature (°C)

Table 8

MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)			
120	1000	10 000	≥ 100 000
$I_R$ MULTIPLIER			
0.05	0.3	0.7	1

Table 9

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Mounting	IEC 60384-25, subclause 4.3	Shall be performed prior to tests mentioned below; reflow soldering; for maximum temperature load refer to chapter "Mounting"	$\Delta C/C: \pm 5 \%$ $\tan \delta \leq \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Endurance	IEC 60384-25 / CECC 32300, subclause 4.15	$T_{amb} = 125 \text{ °C}$ ; $U_R$ applied; for test duration see Table 7	$\Delta C/C: \pm 20 \%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ $ESR \leq 1.5 \times \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{amb} = 125 \text{ °C}$ ; $U_R$ and $I_R$ applied; for test duration see Table 7	$\Delta C/C: \pm 20 \%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ $ESR \leq 1.5 \times \text{spec. limit}$
Shelf life (storage at high temperature)	IEC 60384-25 / CECC 32300, subclause 4.16	$T_{amb} = 125 \text{ °C}$ ; no voltage applied; 1000 h after test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement	For requirements see "Endurance test" above

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.



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