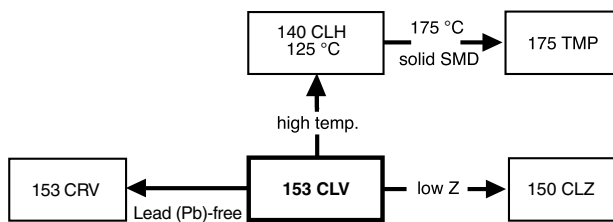


Aluminum Capacitors SMD (Chip) Long Life Vertical



FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, vertical construction requiring minimum board space, reflow solderable
- High CV per unit volume
- Long useful life: 2000 h to 3000 h at 105 °C
- Charge and discharge proof, no peak current limitation
- Supplied in blister tape on reel
- Lead (Pb)-free
- ATTENTION: for maximum safe soldering conditions refer to fig.4

APPLICATIONS

- SMD technology, for high mounting density
- Coupling, decoupling, smoothing, filtering, buffering, timing
- Telecommunications, general industrial, EDP, automotive, portable and lightweight 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 bevelled edges)
- Code indicating group number (V)

PACKAGING

Supplied in blister tape on reel

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (L x W x H in mm)	4.0 x 4.0 x 5.3 to 10 x 10 x 14
Rated capacitance range, C_R	0.47 μF to 1000 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	6.3 V to 100 V
Category temperature range	- 55 °C to + 105 °C
Endurance test at 105 °C:	
Case sizes 4.0 x 4.0 x 5.3 to 6.3 x 6.3 x 5.3	1000 h
Case sizes 8.0 x 8.0 x 6.5 to 10 x 10 x 14	2000 h
Useful life at 105 °C:	
Case sizes 4.0 x 4.0 x 5.3 to 6.3 x 6.3 x 5.3	2000 h
Case sizes 8.0 x 8.0 x 6.5 to 10 x 10 x 14	3000 h
Useful life at 40 °C; 1.3 x I_R applied:	
Case sizes 4.0 x 4.0 x 5.3 to 6.3 x 6.3 x 5.3	200 000 h
Case sizes 8.0 x 8.0 x 6.5 to 10 x 10 x 14	300 000 h
Shelf life at 0 V, 105 °C	1000 h
Based on sectional specification	IEC 60384-18/ CECC 32300
Climatic category IEC 60068	55/105/56

153 CLV

Vishay BCcomponents

Aluminum Capacitors
SMD (Chip) Long Life Vertical



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	100
0.47	-	-	-	-	-	4.0 x 4.0 x 5.3	-	-
1.0	-	-	-	-	-	4.0 x 4.0 x 5.3	-	-
2.2	-	-	-	-	-	4.0 x 4.0 x 5.3	-	-
3.3	-	-	-	-	-	4.0 x 4.0 x 5.3	-	-
4.7	-	-	-	-	4.0 x 4.0 x 5.3	5.0 x 5.0 x 5.3	-	-
10	-	-	4.0 x 4.0 x 5.3	-	5.0 x 5.0 x 5.3	6.3 x 6.3 x 5.3	-	-
22	4.0 x 4.0 x 5.3	-	5.0 x 5.0 x 5.3	-	6.3 x 6.3 x 5.3	8.0 x 8.0 x 6.5	-	-
33	-	5.0 x 5.0 x 5.3	-	6.3 x 6.3 x 5.3	8.0 x 8.0 x 6.5	8.0 x 8.0 x 10	-	10 x 10 x 14
47	5.0 x 5.0 x 5.3	-	6.3 x 6.3 x 5.3	8.0 x 8.0 x 6.5	-	8.0 x 8.0 x 10	-	-
100	6.3 x 6.3 x 5.3	-	8.0 x 8.0 x 6.5	8.0 x 8.0 x 10	-	10 x 10 x 10	10 x 10 x 14	-
	-	-	-	-	-	-	-	-
220	-	8.0 x 8.0 x 10	10 x 10 x 10	-	-	-	-	-
330	8.0 x 8.0 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	-	-	-	-	-	-
1000	10 x 10 x 14	-	-	-	-	-	-	-

Table 1

TAPE AND REEL DIMENSIONS in millimeters AND PACKAGING QUANTITIES					
CASE CODE	PITCH P ₁	TAPE WIDTH W	TAPE THICKNESS T ₂	REEL DIA.	PACKAGING QUANTITY PER REEL
0405	8	12	5.8	380	2000
0505	12	12	5.8	380	1000
0605	12	16	5.8	380	1000
0807	12	16	6.8	380	1000
0810	16	24	11.3	380	500
1010	16	24	11.3	380	500
1014	16	24	14.8	330	250

Note

- Detailed tape dimensions see section 'PACKAGING'.



Aluminum Capacitors
SMD (Chip) Long Life Vertical

Vishay BCcomponents

Table 2

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	C	MASS (g)
4.0 x 4.0 x 5.3	0405	4.5	4.5	5.5	4.0	0.8	1.0	2.0 ± 0.2	≈ 0.13
5.0 x 5.0 x 5.3	0505	5.5	5.5	5.5	5.0	0.8	1.4	2.3 ± 0.2	≈ 0.20
6.3 x 6.3 x 5.3	0605	6.8	6.8	5.5	6.3	0.8	2.0	2.7 ± 0.2	≈ 0.30
8.0 x 8.0 x 6.5	0807	8.6	8.6	6.8	8.0	0.8	2.3	3.4 ± 0.2	≈ 0.50
8.0 x 8.0 x 10	0810	8.6	8.6	10.5	8.0	1.1	3.1	3.0 ± 0.2	≈ 1.00
10 x 10 x 10	1010	10.6	10.6	10.5	10.0	1.1	4.7	3.3 ± 0.2	≈ 1.30
10 x 10 x 14	1014	10.6	10.6	14.3	10.0	1.2	4.5	3.9 ± 0.2	≈ 1.50

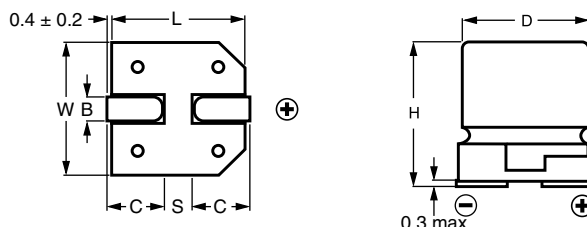


Fig.2 Dimensional outline

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.

For maximum conditions refer to Fig.4.

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

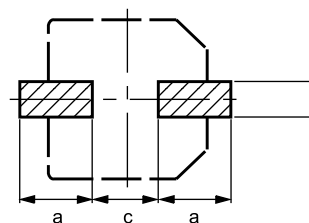


Fig.3 Recommended solder pad dimensions

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.

Table 3

RECOMMENDED SOLDERING PAD DIMENSIONS in millimeters			
CASE CODE	a	b	c
0405	2.6	1.6	1.0
0505	3.0	1.6	1.4
0605	3.5	1.6	1.9
0807	4.0	1.6	2.1
0810	3.5	2.5	3.0
1010	4.0	2.5	4.0
1014	4.3	2.5	4.0

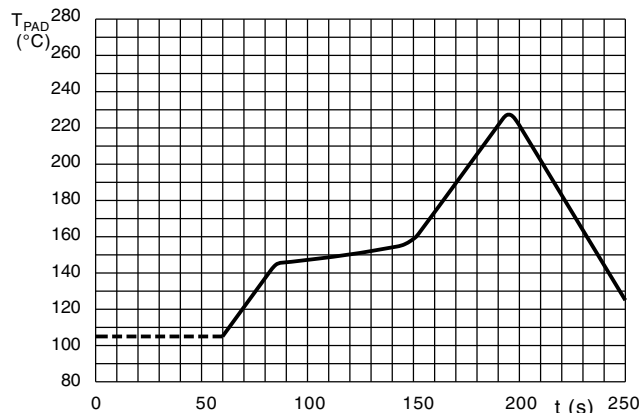


Fig.4 Maximum temperature load during infrared reflow soldering measured on the soldering pad

153 CLV

Vishay BCcomponents

Aluminum Capacitors
SMD (Chip) Long Life Vertical



ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz or 120 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz or 120 Hz, 105 °C
I_{L2}	max. leakage current after 2 minutes at U_R
$\tan \delta$	max. dissipation factor at 100 or 120 Hz
ESR	equivalent series resistance at 100 kHz

ORDERING EXAMPLE

Electrolytic capacitor 153 series

100 $\mu\text{F}/25\text{ V}$; $\pm 20\%$

Nominal case size:

8 mm x 8 mm x 10 mm; taped on reel

Ordering code: MAL215366101E3

Former 12NC: 2222 153 66101

Note

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

Table 4

ELECTRICAL DATA AND ORDERING INFORMATION							
U_R (V)	C_R (μF)	NOMINAL CASE SIZE L x W x H (mm)	I_R 105 °C (mA)	I_{L2} 2 min (μA)	$\tan \delta$	ESR 100 kHz (Ω)	ORDERING CODE MAL2153.....
6.3	22	4.0 x 4.0 x 5.3	21	3.0	0.30	8	63229E3
	47	5.0 x 5.0 x 5.3	36	3.0	0.30	4	63479E3
	100	6.3 x 6.3 x 5.3	61	6.3	0.30	2	63101E3
	330	8.0 x 8.0 x 10	180	21	0.30	0.5	63331E3
	470	10 x 10 x 10	320	30	0.30	0.3	63471E3
	1000	10 x 10 x 14	400	63	0.24	0.24	63102E3
10	33	5.0 x 5.0 x 5.3	31	3.3	0.26	4	64339E3
	220	8.0 x 8.0 x 10	180	22	0.26	0.5	64221E3
	330	10 x 10 x 10	320	33	0.26	0.3	64331E3
	680	10 x 10 x 14	380	68	0.19	0.24	64681E3
16	10	4.0 x 4.0 x 5.3	16	3.0	0.22	8	65109E3
	22	5.0 x 5.0 x 5.3	28	3.5	0.22	4	65229E3
	47	6.3 x 6.3 x 5.3	47	7.5	0.22	2.2	65479E3
	100	8.0 x 8.0 x 6.5	110	16	0.22	1.2	65101E3
	220	10 x 10 x 10	320	35	0.22	0.3	65221E3
	470	10 x 10 x 14	370	75	0.16	0.25	65471E3
25	33	6.3 x 6.3 x 5.3	44	8.3	0.16	2.2	66339E3
	47	8.0 x 8.0 x 6.5	110	12	0.16	1.2	66479E3
	100	8.0 x 8.0 x 10	180	25	0.16	0.5	66101E3
	330	10 x 10 x 14	300	83	0.14	0.27	66331E3
35	4.7	4.0 x 4.0 x 5.3	14	3.0	0.13	8	60478E3
	10	5.0 x 5.0 x 5.3	23	3.5	0.13	4	60109E3
	22	6.3 x 6.3 x 5.3	50	7.7	0.13	2.2	60229E3
	33	8.0 x 8.0 x 6.5	110	12	0.13	1.2	60339E3
50	0.47	4.0 x 4.0 x 5.3	5	3.0	0.12	12	61477E3
	1.0	4.0 x 4.0 x 5.3	7	3.0	0.12	12	61108E3
	2.2	4.0 x 4.0 x 5.3	10	3.0	0.12	12	61228E3
	3.3	4.0 x 4.0 x 5.3	12	3.0	0.12	12	61338E3
	4.7	5.0 x 5.0 x 5.3	17	3.0	0.12	6	61478E3
	10	6.3 x 6.3 x 5.3	26	5.0	0.12	3	61109E3
	22	8.0 x 8.0 x 6.5	110	11	0.12	1.2	61229E3
	33	8.0 x 8.0 x 10	180	17	0.12	0.5	61339E3
	47	8.0 x 8.0 x 10	180	24	0.12	0.5	61479E3
	100	10 x 10 x 10	320	50	0.12	0.3	61101E3
63	100	10 x 10 x 14	240	63	0.09	0.41	68101E3
100	33	10 x 10 x 14	170	33	0.07	0.65	69339E3



Aluminum Capacitors
SMD (Chip) Long Life Vertical

Vishay BCcomponents

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	IEC 60384-18, subclause 4.14	$U_s \leq 1.15 \times U_R$
Reverse voltage	IEC 60384-18, subclause 4.16	$U_{rev} \leq 1 V$
Current		
Leakage current	after 2 min at U_R	$I_{L2} \leq 0.01 \times C_R \times U_R$ or $3 \mu A$, whichever is greater
Inductance		
Equivalent series inductance (ESL)	case codes 0405 to 0605	typ. 10 nH
	case codes 0807 to 1010	typ. 15 nH
	case codes 1014	typ. 16 nH

CAPACITANCE (C)

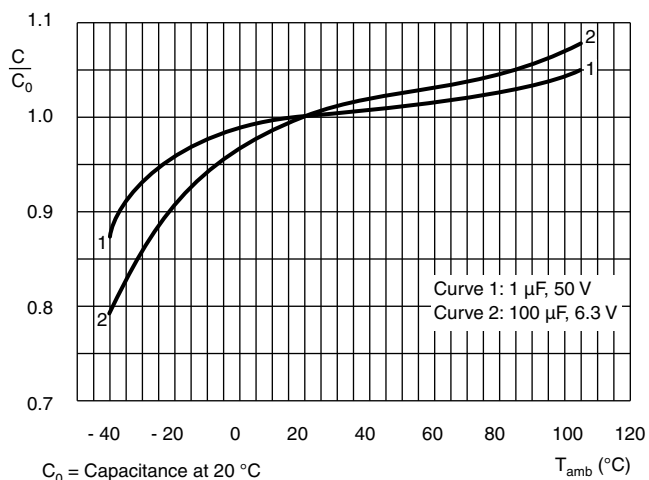


Fig.5 Typical multiplier of capacitance at 100 Hz or 120 Hz as a function of ambient temperature

EQUIVALENT SERIES RESISTANCE (ESR)

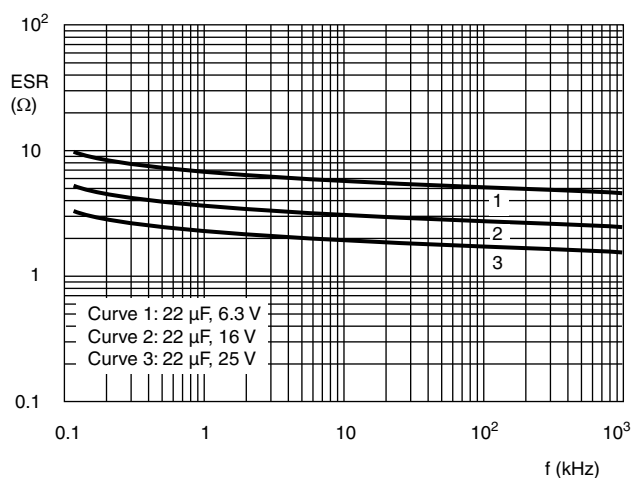


Fig.6 Typical ESR as a function of frequency at 20 °C

DISSIPATION FACTOR (tan δ)

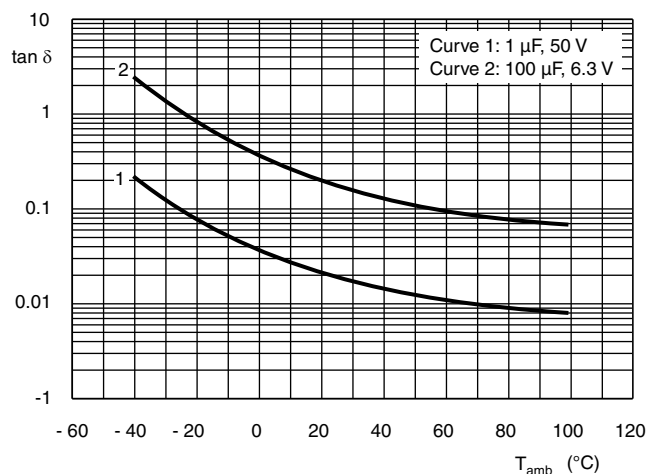


Fig.7 Typical dissipation factor ($\tan \delta$) at 100 Hz or 120 Hz as a function of ambient temperature

IMPEDANCE (Z)

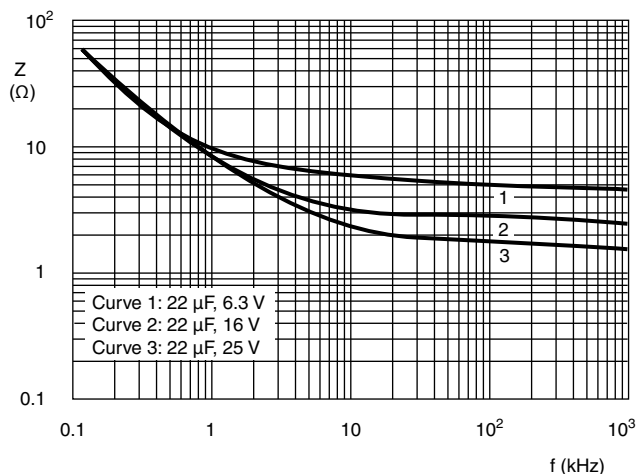


Fig.8 Typical impedance as a function of frequency at 20 °C

153 CLV

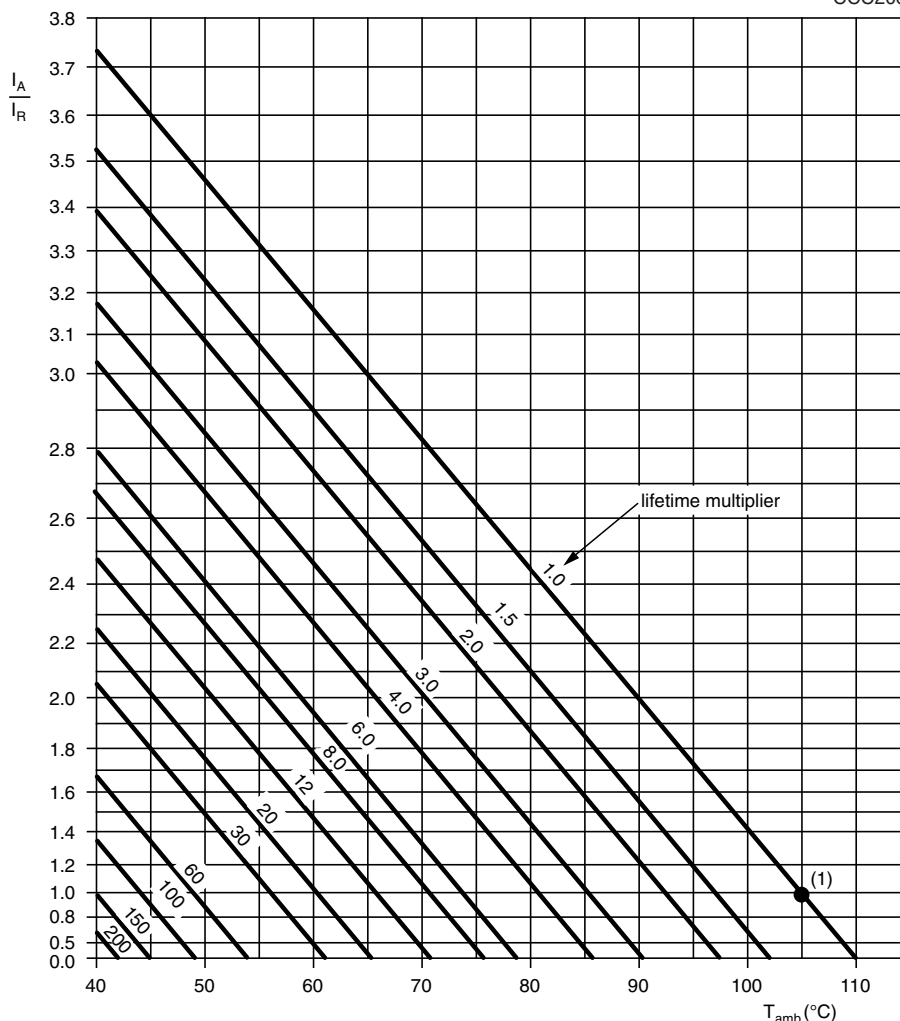
Vishay BCcomponents

Aluminum Capacitors
SMD (Chip) Long Life Vertical



RIPPLE CURRENT AND USEFUL LIFE

CCC206



I_A = actual ripple current at 100 Hz or 120 Hz
 I_R = rated ripple current at 100 Hz or 120 Hz at 105 °C

For case codes 0405 to 1010 max. $I_A/I_R = 2.4$

(1) Useful life at 105 °C and I_R applied:

case codes 0405 to 0605: 2000 h

case codes 0807 to 1014: 3000 h

Fig.9 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		
	$U_R = 6.3 \text{ V to } 16 \text{ V}$	$U_R = 25 \text{ V or } 35 \text{ V}$	$U_R = 50 \text{ V to } 100 \text{ V}$
50 or 60	0.80	0.80	0.80
100 or 120	1.00	1.00	1.00
300	1.10	1.15	1.20
1000	1.15	1.25	1.35
3000	1.20	1.35	1.45
$\geq 10\ 000$	1.25	1.40	1.50



Aluminum Capacitors
SMD (Chip) Long Life Vertical

Vishay BCcomponents

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"	$\Delta C/C: \pm 10 \%$ $\tan \delta \leq \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Endurance	IEC 60384-18/ CECC 32300, subclause 4.15	$T_{\text{amb}} = 105 \text{ }^\circ\text{C}$; U_R applied; 1000 h, case codes 0405 to 0605 2000 h, case codes 0807 to 1014	$\Delta C/C: \pm 20 \%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{\text{amb}} = 105 \text{ }^\circ\text{C}$; U_R and I_R applied; 2000 h, case codes 0405 to 0605 3000 h, case codes 0807 to 1014	$\Delta C/C: \pm 50 \%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1 \%$
Shelf life (storage at high temperature)	IEC 60384-18/ CECC 32300, subclause 4.17	$T_{\text{amb}} = 105 \text{ }^\circ\text{C}$; 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



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.