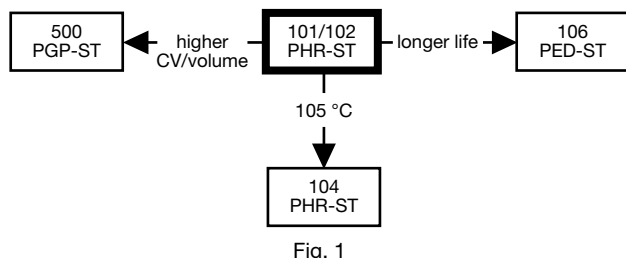


Aluminum Electrolytic Capacitors, Power High Ripple Current, Screw Terminals


RoHS
COMPLIANT

FEATURES

- Long useful life: 10 000 h to 15 000 h at +85 °C
- Available in case sizes up to Ø 90 mm x 220 mm
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief in the sealing
- Low ESR
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Buffering and filtering
- Motor drives, inverters, UPS, and traction systems
- Pulsed power supplies

MARKING

The capacitors are marked with the following information:

- Rated capacitance (in µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Date code (YYMM or in 2 digits according to IEC 60062)
- Name of manufacturer
- Code for factory of origin
- “-” sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number
- Climatic category in accordance with IEC 60068

QUICK REFERENCE DATA		
DESCRIPTION	VALUE	
	101	102
Nominal case size (Ø D x L in mm)	35 x 60 to 90 x 220	
Rated capacitance range (E6 series), C _R	220 µF to 1 F	
Tolerance on C _R	± 20 %	
Rated voltage range, U _R	25 V to 100 V	200 V to 450 V
Category temperature range	-40 °C to +85 °C	
Endurance test at 85 °C	2000 h	
Useful life at 85 °C	10 000 h (D ≤ 50 mm) 15 000 h (D ≥ 65 mm)	10 000 h
Useful life at 40 °C, 1.4 x I _R applied	400 000 h (D ≤ 50 mm) 600 000 h (D ≥ 65 mm)	400 000 h
Shelf life at 0 V, 85 °C	500 h	
Based on sectional specification	IEC 60384-4 / EN 130300	
Climatic category IEC 60068	40 / 085 / 056	

SELECTION CHART FOR C _R , U _R , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)										
C _R (µF)	U _R (V)									
	25	40	63	100	200					

SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ in mm)										
C_R (μF)	U_R (V)									
	25	40	63	100	200	250	350	385	400	450
3300	-	-	-	35 x 60	50 x 80	50 x 105	-	-	65 x 105	76 x 105
	-	-	-	35 x 80	50 x 105	65 x 105	65 x 105	76 x 105	76 x 105	76 x 146
4700	-	-	35 x 60	35 x 80	-	65 x 105	76 x 105	76 x 105	76 x 105	76 x 146
	-	-	-	35 x 105	65 x 105	76 x 105	76 x 146	76 x 146	76 x 146	-
5600	-	-	-	-	-	-	-	-	-	-
6800	-	-	35 x 60	35 x 105	65 x 105	76 x 105	-	-	76 x 146	76 x 220
	-	-	35 x 80	50 x 80	76 x 105	76 x 146	76 x 146	76 x 146	-	90 x 146
10 000	-	35 x 60	35 x 80	50 x 80	76 x 105	76 x 105	76 x 220	-	-	-
	-	-	35 x 105	50 x 105	76 x 146	76 x 146	90 x 146	-	-	90 x 220
15 000	35 x 60	35 x 60	35 x 105	50 x 105	76 x 146	76 x 146	-	-	-	-
	-	35 x 80	50 x 80	-	-	-	90 x 220	-	-	-
22 000	35 x 60	35 x 80	50 x 80	65 x 105	76 x 220	76 x 220	-	-	-	-
	-	50 x 80	50 x 105	76 x 105	90 x 146	90 x 146	-	-	-	-
33 000	35 x 80	35 x 105	50 x 105	76 x 105	-	-	-	-	-	-
	50 x 80	50 x 80	65 x 105	76 x 146	90 x 220	90 x 220	-	-	-	-
47 000	35 x 105	50 x 80	65 x 105	-	-	-	-	-	-	-
	50 x 80	50 x 105	76 x 105	76 x 146	-	-	-	-	-	-
68 000	50 x 80	50 x 105	76 x 105	76 x 146	-	-	-	-	-	-
	50 x 105	65 x 105	76 x 146	-	-	-	-	-	-	-
100 000	50 x 105	65 x 105	-	76 x 220	-	-	-	-	-	-
	65 x 105	76 x 105	76 x 146	90 x 146	-</					



Table 1

DIMENSIONS in millimeters AND MASS														
DESIGN	DRAWING	L ± 1	L _t ± 1	D ± 1	P ± 0.3	T ± 0.2	H ± 0.3	B ± 0.3	d ₁ ± 0.1	M	S - 0	M _b	I _b ± 0.1	MASS (g)
35 x 60	2A	63.3	68.7	35.3	12.8	7	4.6	11	7.9	M5	9.5	M8	12	75
35 x 80	2A	81.3	86.7	35.3	12.8	7	4.6	11	7.9	M5	9.5	M8	12	95
35 x 105	2A	103.3	108.7	35.3	12.8	7	4.6	11	7.9	M5	9.5	M8	12	130
50 x 80	2A	82.8	88.8	51	22.2	7.1	4.8	11	7.9	M5	9.5	M12	16	200
50 x 105	2A	104.8	110.8	51	22.2	7.1	4.8	11	7.9	M5	9.5	M12	16	300
65 x 105	2A	104.8	110.7	65	28.5	7	4.6	11.9	7.9	M5	9.5	M12	16	480
65 x 105 HC	2B	104.8	109.2	65	28.5	5.5	3.5	18	13	M6	8.5	M12	16	480
76 x 105	2A	105.8	111.7	76.4	31.8	7	4.6	11.7	7.9	M5	9.5	M12	16	700
76 x 105 HC	2B	105.8	110.2	76.4	31.8	5.5	3.5	18.3	13	M6	8.5	M12	16	700
76 x 146	2A	145.8	151.7	76.4	31.8	7	4.6	11.7	7.9	M5	9.5	M12	16	1000
76 x 146 HC	2B	145.8	150.2	76.4	31.8	5.5	3.5	18.3	13	M6	8.5	M12	16	1000
76 x 220	2A	219.8	225.7	76.4	31.8	7	4.6	11.7	7.9	M5	9.5	M12	16	1500
76 x 220 HC	2B	219.8	224.2	76.4	31.8	5.5	3.5	18.3	13	M6	8.5	M12	16	1500
90 x 146 HC	2B	150.1	155.4	89.4	31.8	7.9	0	13	13	M6	10	M12	16	1300
90 x 220 HC	2B	218.1	223.4	89.4	31.8	7.9	0	13	13	M6	10	M12	16	2000

Note

- For bolt version holds:
L = L standard - 0.5 mm
L_t = L_t standard - 0.5 mm

PACKAGING QUANTITIES AND DIMENSIONS in millimeters		
DESIGN	PACKAGING QUANTITIES (units per box)	CARDBOX DIMENSIONS L x W x H
35 x 60	50	377 x 375 x 88
35 x		



Table 2

ELECTRICAL DATA AND ORDERING INFORMATION FOR 101 SERIES											
U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 100 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 100 Hz (mΩ)	Z MAX. 20 kHz (mΩ)	LIFE CODE ⁽¹⁾	STANDARD HIGH POST M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2101.....	ST BOLT NUT ORDERING CODE MAL2101.....	ST ORDERING CODE MAL2101.....	ST BOLT NUT ORDERING CODE MAL2101.....
25	15 000	35 x 60	7.7	0.75	29	22	L1	16153E3	56153E3	-	-
	22 000	35 x 60	8.3	1.10	27	22	L1	16223E3	56223E3	-	-
	33 000	35 x 80	9.0	1.65	19	17	L1	16333E3	56333E3	-	-
	33 000	50 x 80	10.0	1.65	17	14	L1	26333E3	66333E3	-	-
	47 000	35 x 105	12.1	2.35	15	13	L1	16473E3	56473E3	-	-
	47 000	50 x 80	14.8	2.35	12	10	L1	26473E3	66473E3	-	-
	68 000	50 x 80	12.8	3.40	15	13	L1	16683E3	56683E3	-	-
	68 000	50 x 105	17.1	3.40	9	8	L1	26683E3	66683E3	-	-
	100 000	50 x 105	14.7	5.00	12	11	L1	16104E3	56104E3	-	-
	100 000	65 x 105	19.6	5.00	7	6	L2	26104E3	66104E3	46104E3	86104E3
	150 000	65 x 105	17.6	7.50	8	7	L2	16154E3	56154E3	36154E3	76154E3
	150 000	76 x 105	21.4	7.50	6	5	L2	26154E3	66154E3	46154E3	86154E3
	220 000	65 x 105	20.2	11.0	6	5	L2	16224E3	56224E3	36224E3	76224E3
	220 000	76 x 105	22.5	11.0	6	5	L2	26224E3	66224E3	46224E3	86224E3
	330 000	76 x 146	25.8	16.5	4	4	L2	26			

**ELECTRICAL DATA AND ORDERING INFORMATION FOR 101 SERIES**

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE Ø D x L (mm)	I _R 100 Hz 85 °C (A)	I _{L5} 5 min (mA)	ESR MAX. 100 Hz (mΩ)	Z MAX. 20 kHz (mΩ)	LIFE CODE ⁽¹⁾	STANDARD HIGH POST M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2101.....	ST BOLT NUT ORDERING CODE MAL2101.....	ST ORDERING CODE MAL2101.....	ST BOLT NUT ORDERING CODE MAL2101.....
63	4700	35 x 60	5.9	0.59	42	25	L1	18472E3	58472E3	-	-
	6800	35 x 60	6.6	0.86	38	25	L1	18682E3	58682E3	-	-
	6800	35 x 80	7.3	0.86	30	19	L1	28682E3	68682E3	-	-
	10 000	35 x 80	8.1	1.26	27	19	L1	18103E3	58103E3	-	-
	10 000	35 x 105	8.8	1.26	22	14	L1	28103E3	68103E3	-	-
	15 000	35 x 105	9.7	1.89	19	14	L1	18153E3	58153E3	-	-
	15 000	50 x 80	12.1	1.89	16	11	L1	28153E3	68153E3	-	-
	22 000	50 x 80	11.1	2.77	19	15	L1	18223E3	58223E3	-	-
	22 000	50 x 105	14.3	2.77	12	9	L1	28223E3	68223E3	-	-
	33 000	50 x 105	12.9	4.16	14	12	L1	18333E3	58333E3	-	-
	33 000	65 x 105	16.5	4.16	9	6	L2	28333E3	68333E3	48333E3	88333E3
	47 000	65 x 105	15.6	5.92	10	8	L2	18473E3	58473E3	38473E3	78473E3
	47 000	76 x 105	18.6	5.92	8	6	L2	28473E3	68473E3	48473E3	88473E3
	68 000	76 x 105	20.0	8.57	7	6	L2	18683E3	58683E3	38683E3	78683E3
	68 000	76 x 146	21.9	8.57	6	5	L2	28683E3	68683E3	48683E3	88683E3
	100 000	76 x 146	23.4	12.6	5	5	L2	28104E3	68104E3	48104E3	88104E3
	150 000	76 x 146	22.2	18.9	6	5	L2	18154E3	58154E3	38154E3	78154E3
	220 000	76 x 220	27.0	27.7							



Table 3

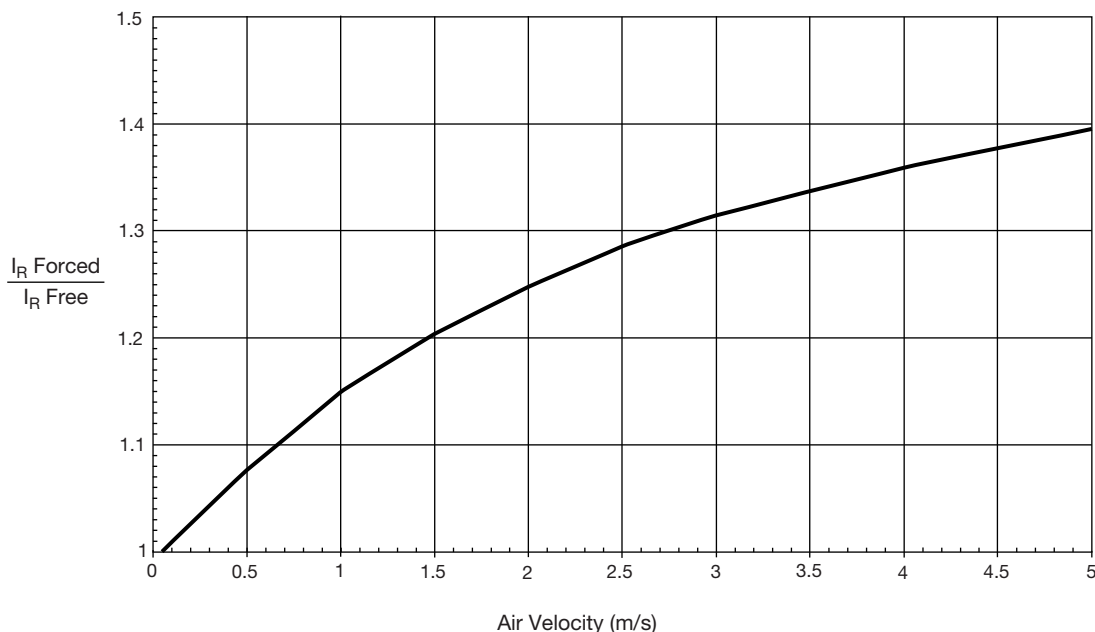
ELECTRICAL DATA AND ORDERING INFORMATION FOR 102 SERIES											
U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE Ø D x L (mm)	I _R 100 Hz 85 °C (A)	I _{L5} 5 min (mA)	ESR MAX. 100 Hz (mΩ)	Z MAX. 20 kHz (mΩ)	LIFE CODE ⁽¹⁾	HIGH POST M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2102.....	ST BOLT NUT ORDERING CODE MAL2102.....	ST ORDERING CODE MAL2102.....	ST BOLT NUT ORDERING CODE MAL2102.....
200	680	35 x 60	3.5	0.27	207	136	L1	12681E3	52681E3	-	-
	1000	35 x 80	4.4	0.40	144	95	L1	12102E3	52102E3	-	-
	1000	35 x 105	4.7	0.40	140	91	L1	22102E3	62102E3	-	-
	1500	35 x 105	5.5	0.60	100	67	L1	12152E3	52152E3	-	-
	1500	50 x 80	6.2	0.60	106	74	L1	22152E3	62152E3	-	-
	2200	50 x 80	8.0	0.88	67	44	L1	12222E3	52222E3	-	-
	3300	50 x 80	8.9	1.32	50	35	L1	12332E3	52332E3	-	-
	3300	50 x 105	9.9	1.32	46	32	L1	22332E3	62332E3	-	-
	4700	65 x 105	12.5	1.88	37	26	L1	22472E3	62472E3	42472E3	82472E3
	6800	65 x 105	15.2	2.72	25	18	L1	12682E3	52682E3	32682E3	72682E3
	6800	76 x 105	16.9	2.72	25	18	L1	22682E3	62682E3	42682E3	82682E3
	10 000	76 x 105	19.9	4.00	18	13	L1	12103E3	52103E3	32103E3	72103E3
	10 000	76 x 146	20.4	4.00	18	13	L1	22103E3	62103E3	42103E3	82103E3
	15 000	76 x 146	24.1	6.00	12	9	L1	12153E3	52153E3	32153E3	72153E3
	22 000	76 x 220	29.5	8.8	9	7	L1	12223E3	52223E3	32223E3	72223E3
	22 000	90 x 146	34.1	8.8	8	6	L1	-	-	42223E3	82223E3
	33 000	90 x 220	41.7	13.2	6	5					

**ELECTRICAL DATA AND ORDERING INFORMATION FOR 102 SERIES**

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE Ø D x L (mm)	I _R 100 Hz 85 °C (A)	I _{L5} 5 min (mA)	ESR MAX. 100 Hz (mΩ)	Z MAX. 20 kHz (mΩ)	LIFE CODE ⁽¹⁾	HIGH POST M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2102.....	ST BOLT NUT ORDERING CODE MAL2102.....	ST ORDERING CODE MAL2102.....	ST BOLT NUT ORDERING CODE MAL2102.....
385	220	35 x 60	2.1	0.17	575	380	L1	18221E3	58221E3	-	-
	330	35 x 80	2.7	0.26	386	257	L1	18331E3	58331E3	-	-
	470	35 x 80	3.1	0.37	279	188	L1	18471E3	58471E3	-	-
	680	35 x 105	3.9	0.53	196	133	L1	18681E3	58681E3	-	-
	1000	50 x 80	5.6	0.77	132	89	L1	18102E3	58102E3	-	-
	1500	50 x 105	7.1	1.16	90	61	L1	18152E3	58152E3	-	-
	2200	65 x 105	10.0	1.70	61	42	L1	18222E3	58222E3	38222E3	78222E3
	3300	76 x 105	13.4	2.55	42	29	L1	18332E3	58332E3	38332E3	78332E3
	4700	76 x 105	15.0	3.62	31	22	L1	18472E3	58472E3	38472E3	78472E3
	4700	76 x 146	16.3	3.62	29	20	L1	28472E3	68472E3	48472E3	88472E3
400	6800	76 x 146	18.3	5.24	22	16	L1	18682E3	58682E3	38682E3	78682E3
	220	35 x 60	2.1	0.18	557	363	L1	16221E3	56221E3	-	-
	330	35 x 60	2.5	0.26	383	254	L1	16331E3	56331E3	-	-
	330	35 x 80	2.7	0.26	374	245	L1	26331E3	66331E3	-	-
	470	35 x 80	3.1	0.38	271	180	L1	16471E3	56471E3	-	-
	470	35 x 105	3.3	0.38	265	175	L1	26471E3	66471E3	-	-
	680	35 x 105	3.9	0.55	191	128	L1	16681E3	56681E3	-	-
	680	50 x 80	4.5	0.54	199	136	L1	26681E3			

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤ 250 V versions	$U_S = 1.15 \times U_R$
	≥ 350 V versions	$U_S = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1$ V
Current		
Leakage current	After 1 min at U_R	$I_{L1} \leq 0.006 C_R \times U_R$
	After 5 min at U_R	$I_{L5} \leq 0.002 C_R \times U_R$
Inductance		
Equivalent series inductance (ESL)	Case $\varnothing D = 35$ mm	Typ. 13 nH
	Case $\varnothing D = 50$ mm	Typ. 16 nH
	Case $\varnothing D = 65$ mm	Typ. 19 nH ⁽¹⁾
	Case $\varnothing D = 76$ mm	Typ. 20 nH ⁽¹⁾
	Case $\varnothing D = 90$ mm	Typ. 21 nH ⁽¹⁾

Note
⁽¹⁾ Low ESL designs available on request

RIPPLE CURRENT AND USEFUL LIFE

Fig. 3 - Multiplier of ripple current (I_R) as a function of air flow

MAXIMUM RIPPLE CURRENT			
PARAMETER	CONDITION	MAXIMUM RIPPLE CURRENT MULTIPLIER	VALUE
Ambient temperature (T_{amb})	70 °C	From nomogram; see Fig. 4	1.6
Operating frequency (f)	400 Hz	From frequency; see Table 4	1.3
Air flow	2 m/s	From air flow; see Fig. 3	1.25

Note

- Calculation example for 102 series. maximum ripple current multiplier = $1.6 \times 1.3 \times 1.25 = 2.6$

Table 4

ENDURANCE TEST DURATION AND USEFUL LIFE		
LIFE CODE	ENDURANCE AT 85 °C (h)	USEFUL LIFE AT 85 °C (h)
L1	2000	10 000
L2	2000	15 000

Note

- Multiplier of useful life code: CCC205-05

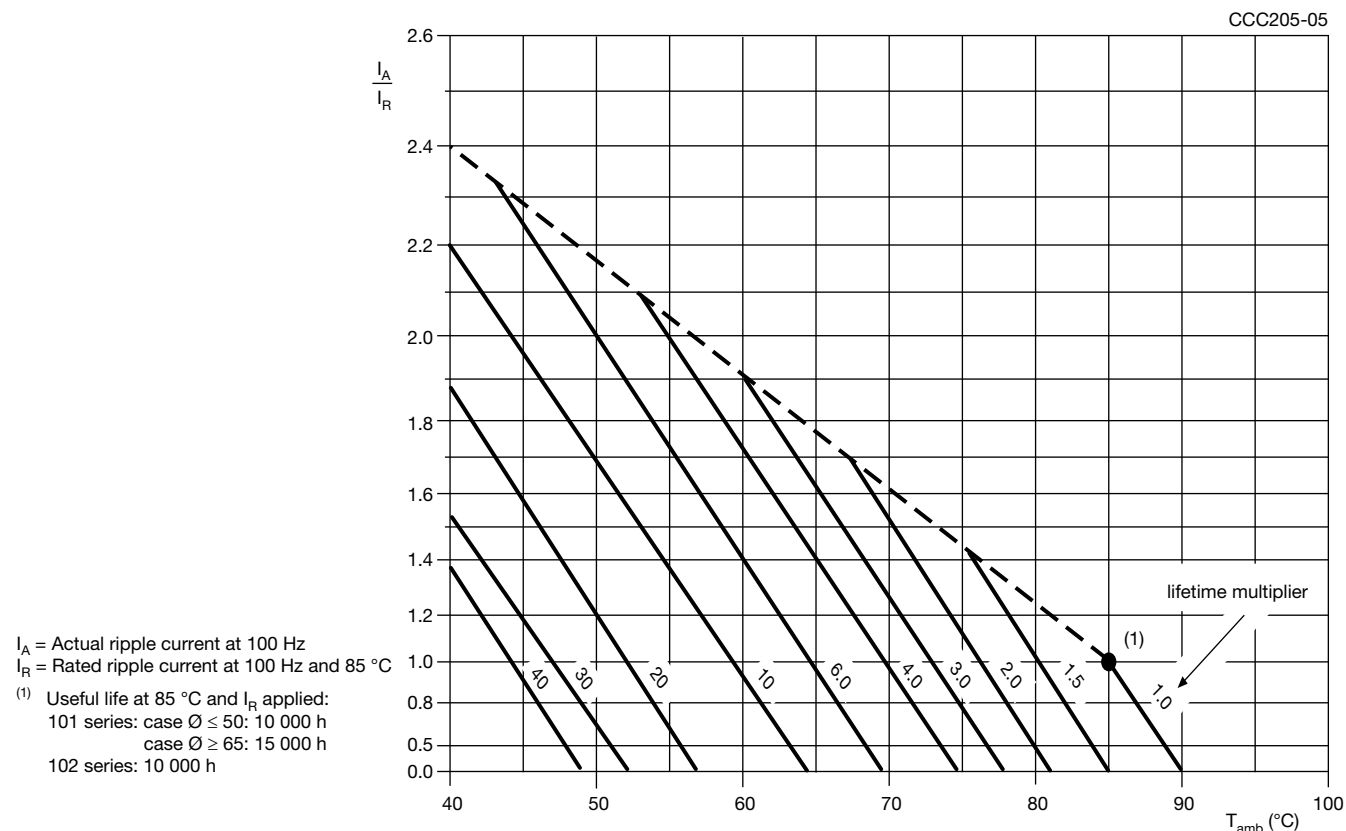


Fig. 4 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 5

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY						
U_R (V)	FREQUENCY (Hz)					
	50	100	200	400	1000	10 000
	I_R MULTIPLIER					
25	0.85	1.00	1.10	1.15	1.20	1.30
40	0.85	1.00	1.10	1.15	1.20	1.30
63	0.85	1.00	1.10	1.15	1.20	1.30
100	0.85	1.00	1.10	1.15	1.20	1.30
200	0.90	1.00	1.20	1.30	1.40	1.50
250	0.90	1.00	1.20	1.30	1.40	1.50
350	0.90	1.00	1.20	1.30	1.40	1.50
385	0.90	1.00	1.20	1.30	1.40	1.50
400	0.90	1.00	1.20	1.30	1.40	1.50
450	0.90	1.00	1.20	1.30	1.40	1.50


Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 / EN130300 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied; 2000 h	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied 101 series: case $\varnothing D \leq 50$: 10 000 h case $\varnothing D \geq 65$: 15 000 h 102 series: 10 000 h	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage Total failure percentage: $U_R \leq 100\text{ V}; \leq 1\%$ $U_R > 100\text{ V}; \leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4 / EN130300 subclause 4.17	$T_{amb} = 85\text{ }^{\circ}\text{C}$; no voltage applied; 500 h After test: U_R to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

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.



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.

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.