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Aluminum Capacitors, Power General Purpose Miniaturized Screw Terminal



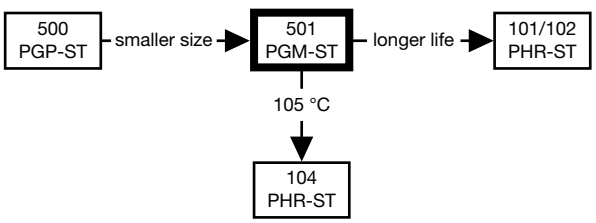

Fig. 1

FEATURES

- Useful life: 5000 h at +85 °C
- > 10 years 24/7 application life at 50 °C
- Up to 500 V available
- High ripple current
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

APPLICATIONS

- Energy storage in motor drives
- Heating, ventilation, and air conditioning
- UPS, welding, and x-ray equipment
- Microgrid interfaces, solar inverters
- Wind turbines
- Pulsed power scientific test equipment

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
- Name of manufacturer
- Code for factory of origin
- (Relevant part of) Ordering code

QUICK REFERENCE DATA		
DESCRIPTION	VALUE	
Nominal case size (Ø D x L in mm)	50 x 80 to 90 x 195	
Rated capacitance range, C_R	1000 µF to 18 000 µF	1000 µF to 12 000 µF
Tolerance on C_R	± 20 %	
Rated voltage range, U_R	400 V to 450 V	500 V
Category temperature range	-40 °C to +85 °C	-25 °C to +85 °C
Endurance test at 85 °C	2000 h	
Useful life at 85 °C	5000 h	
Shelf life at 0 V, 85 °C	1000 h	
Based on sectional specification	IEC 60384-4 / EN 130300	
Climatic category IEC 60068	40 / 085 / 56	25 / 085 / 56

SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

C_R (µF)	U_R (V)		
	400	450	500
1000	-	50 x 80	50 x 80
1200	-	50 x 80	50 x 80
1500	50 x 80	-	50 x 105
1800	-	50 x 105	-
2200	50 x 105	65 x 105	65 x 105
2700	-	65 x 105	65 x 105
3300	65 x 105	65 x 105	76 x 105
3900	65 x 105	-	76 x 105
4700	76 x 105	76 x 105	76 x 114
5600	76 x 105	76 x 114	76 x 146
6800	76 x 114	76 x 146	76 x 220
8200	76 x 146	-	76 x 220
10 000	90 x 146	76 x 220	90 x 195
12 000	90 x 146	76 x 220	90 x 195
15 000	76 x 220	90 x 195	-
18 000	90 x 195	-	-

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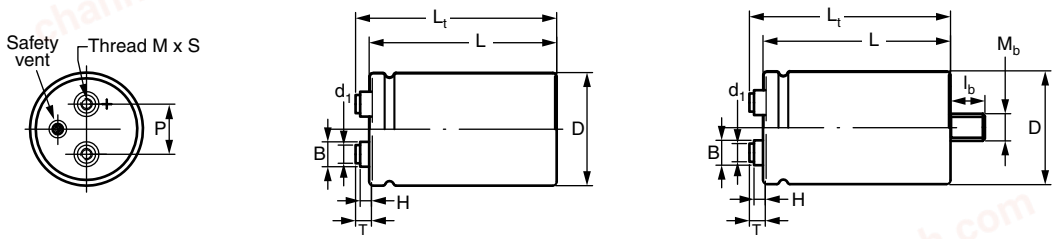
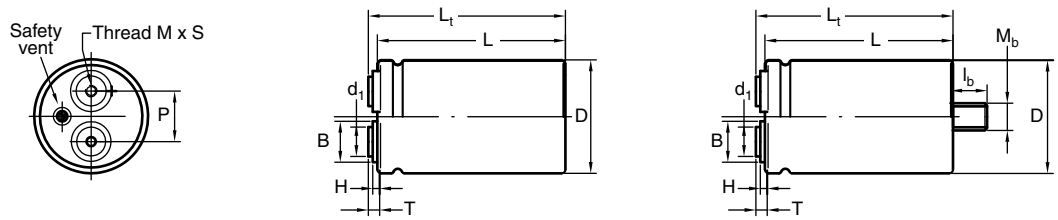
DIMENSIONS in millimeters **AND AVAILABLE FORMS**



Standard M5 disc | Clamp mounting (ST) | Threaded stud mounting (STB)

Fig. 2A - Mechanical drawings for standard M5 disc versions.
For details refer to Table 1



High current M6 disc | Clamp mounting (ST) | Threaded stud mounting (STB)

Fig. 2B - Mechanical drawings for high current M6 disc versions.
For details refer to Table 1

Notes

- Maximum permissible torque which may be applied to the termination screws: 2 Nm for M5; 2.5 Nm for M6
  For accessories refer to document “Mounting Accessories”, see www.vishay.com/doc?28348
  The capacitors are delivered with screws and washers
- High current disc with 1/4 28 UNF (US) thread is available on request

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**	**l_b ± 0.1**	**MASS (g)**
50 x 80	2A	82.8	88.8	51.0	22.2	7.1	4.8	11.0	7.9	M5	9.5	M12	16.0	200
50 x 105	2A	104.8	110.8	51.0	22.2	7.1	4.8	11.0	7.9	M5	9.5	M12	16.0	300
65 x 105	2A	104.8	110.7	65.0	28.5	7.0	4.6	11.9	7.9	M5	9.5	M12	16.0	480
65 x 105 HC	2B	104.8	109.2	65.0	28.5	5.5	3.5	18.0	13.0	M6	8.5	M12	16.0	480
76 x 105	2A	105.8	111.7	76.4	31.8	7.0	4.6	11.7	7.9	M5	9.5	M12	16.0	700
76 x 105 HC	2B	105.8	110.2	76.4	31.8	5.5	3.5	18.3	13.0	M6	8.5	M12	16.0	700
76 x 114	2A	115.8	121.7	76.4	31.8	7.0	4.6	11.7	7.9	M5	9.5	M12	16.0	800
76 x 114 HC	2B	115.8	120.2	76.4	31.8	5.5	3.5	18.3	13.0	M6	8.5	M12	16.0	800
76 x 146	2A	145.8	151.7	76.4	31.8	7.0	4.6	11.7	7.9	M5	9.5	M12	16.0	1000
76 x 146 HC	2B	145.8	150.2	76.4	31.8	5.5	3.5	18.3	13.0	M6	8.5	M12	16.0	1000
76 x 220	2A	219.8	225.7	76.4	31.8	7.0	4.6	11.7	7.9	M5	9.5	M12	16.0	1500
76 x 220 HC	2B	219.8	224.2	76.4	31.8	5.5	3.5	18.3	13.0	M6	8.5	M12	16.0	1500
90 x 146 HC	2B	150.1	155.4	89.4	31.8	7.9	0.0	13.0	13.0	M6	10.0	M12	16.0	1300
90 x 195 HC	2B	192.1	197.4	89.4	31.8	7.9	0.0	13.0	13.0	M6	10.0	M12	16.0	1800

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PACKAGING QUANTITIES AND DIMENSIONS in millimeters		
DESIGN	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS L x W x H
50 x 80	25	377 x 375 x 123
50 x 105	25	377 x 375 x 129
65 x 105	16	377 x 375 x 129
65 x 105 HC	16	377 x 375 x 129
76 x 105	12	377 x 375 x 129
76 x 105 HC	12	377 x 375 x 129
76 x 114	12	377 x 375 x 140
76 x 114 HC	12	377 x 375 x 140
76 x 146	12	377 x 375 x 168
76 x 146 HC	12	377 x 375 x 168
76 x 220	12	377 x 375 x 242
76 x 220 HC	12	377 x 375 x 242
90 x 146 HC	8	377 x 375 x 168
90 x 195 HC	8	377 x 375 x 214

Note

- For STB version < 90 mm diameter holds:
  H of cardboard box: + 10 mm

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	Rated capacitance at 100 Hz, tolerance ± 20 %
I_R	Rated RMS ripple current at 100 Hz, 85 °C
I_{L5}	Max. leakage current after 5 min at U_R
ESR	Equivalent series resistance at 100 Hz
Z	Max. impedance at 10 kHz

Note

- Unless otherwise specified, all electrical values in Table 2 and 3 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

ORDERING EXAMPLE

Electrolytic capacitor 501 series

4700 µF / 400 V; ± 20 %

Nominal case size: Ø 76 mm x 105 mm;
STB version; standard M5 disc

Ordering code: MAL250156472E3

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION											
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 TYP. 100 Hz (mΩ)	ESR MAX. 100 Hz (mΩ)	Z 10 kHz (mΩ)	STANDARD M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2501.....	STB ORDERING CODE MAL2501.....	ST ORDERING CODE MAL2501.....	STB ORDERING CODE MAL2501.....
400	1500	50 x 80	6.32	1.20	89	125	92	16152E3	56152E3	-	-
	2200	50 x 105	7.81	1.76	62	87	65	16222E3	56222E3	-	-
	3300	65 x 105	11.1	2.64	42	59	44	16332E3	56332E3	36332E3	76332E3
	3900	65 x 105	11.7	3.12	37	52	38	16392E3	56392E3	36392E3	76392E3
	4700	76 x 105	14.6	3.76	30	43	31	16472E3	56472E3	36472E3	76472E3
	5600	76 x 105	15.3	4.48	26	37	29	16562E3	56562E3	36562E3	76562E3
	6800	76 x 114	16.7	5.44	22	31	24	16682E3	56682E3	36682E3	76682E3
	8200	76 x 146	18.8	6.56	18	26	20	16822E3	56822E3	36822E3	76822E3
	10 000	90 x 146	23.8	8.00	14	20	16	-	-	36103E3	76103E3
	12 000	90 x 146	25.0	9.60	12	17	15	-	-	36123E3	76123E3
	15 000	76 x 220	26.1	12.00	10	15	12	16153E3	56153E3	36153E3	76153E3
	18 000	90 x 195	30.2	14.40	9	13	10	-	-	36183E3	76183E3

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ELECTRICAL DATA AND ORDERING INFORMATION

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 TYP. 100 Hz (mΩ)	ESR MAX. 100 Hz (mΩ)	Z 10 kHz (mΩ)	STANDARD M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2501.....	STB ORDERING CODE MAL2501.....	ST ORDERING CODE MAL2501.....	STB ORDERING CODE MAL2501.....
450	1000	50 x 80	5.49	0.90	115	162	111	17102E3	57102E3	-	-
	1200	50 x 80	5.89	1.08	99	139	97	17122E3	57122E3	-	-
	1800	50 x 105	7.36	1.62	67	94	68	17182E3	57182E3	-	-
	2200	65 x 105	9.74	1.98	53	75	52	17222E3	57222E3	37222E3	77222E3
	2700	65 x 105	10.5	2.43	45	64	45	17272E3	57272E3	37272E3	77272E3
	3300	65 x 105	11.2	2.97	39	55	40	17332E3	57332E3	37332E3	77332E3
	4700	76 x 105	14.6	4.23	28	40	29	17472E3	57472E3	37472E3	77472E3
	5600	76 x 114	15.9	5.04	24	34	24	17562E3	57562E3	37562E3	77562E3
	6800	76 x 146	17.9	6.12	19	27	20	17682E3	57682E3	37682E3	77682E3
	10 000	76 x 220	23.3	9.00	13	19	13	17103E3	57103E3	37103E3	77103E3
	12 000	76 x 220	24.7	10.80	11	16	12	17123E3	57123E3	37123E3	77123E3
	15 000	90 x 195	28.9	13.50	9	13	10	-	-	37153E3	77153E3
500	1000	50 x 80	5.30	1.00	167	234	188	19102E3	59102E3	-	-
	1200	50 x 80	5.67	1.20	142	199	162	19122E3	59122E3	-	-
	1500	50 x 105	6.65	1.50	113	159	128	19152E3	59152E3	-	-
	2200	65 x 105	9.40	2.20	77	108	87	19222E3	59222E3	39222E3	79222E3
	2700	65 x 105	10.1	2.70	64	90	73	19272E3	59272E3	39272E3	79272E3
	3300	76 x 105	12.6	3.30	52	73	59	19332E3	59332E3	39332E3	79332E3
	3900	76 x 105	13.3	3.90	45	64	52	19392E3	59392E3	39392E3	79392E3
	4700	76 x 114	14.5	4.70	38	54	44	19472E3	59472E3	39472E3	79472E3
	5600	76 x 146	16.3	5.60	32	45	37	19562E3	59562E3	39562E3	79562E3
	6800	76 x 220	19.6	6.80	25	36	29	19682E3	59682E3	39682E3	79682E3
	8200	76 x 220	21.1	8.20	21	30	24	19822E3	59822E3	39822E3	79822E3
	10 000	90 x 195	25.0	10.00	18	26	22	-	-	39103E3	79103E3
	12 000	90 x 195	26.4	12.00	15	22	19	-	-	39123E3	79123E3

ADDITIONAL ELECTRICAL DATA

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥ 400 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	$I_{L1} \leq 0.006\ C_R \times U_R + 4$ µA
	After 5 min at U_R	$I_{L5} \leq 0.002\ C_R \times U_R + 4$ µA
Inductance		
Equivalent series inductance (ESL)	Case Ø D = 50 mm	Typ. 16 nH
	Case Ø D = 65 mm	Typ. 19 nH
	Case Ø D = 76 mm	Typ. 20 nH
	Case Ø D = 90 mm	Typ. 20 nH

RIPPLE CURRENT AND USEFUL LIFE

Table 3

ENDURANCE TEST DURATION AND USEFUL LIFE	
ENDURANCE AT 85 °C (h)	USEFUL LIFE AT 85 °C (h)
2000	5000

Note

- Multiplier of useful life code: CCC205-05

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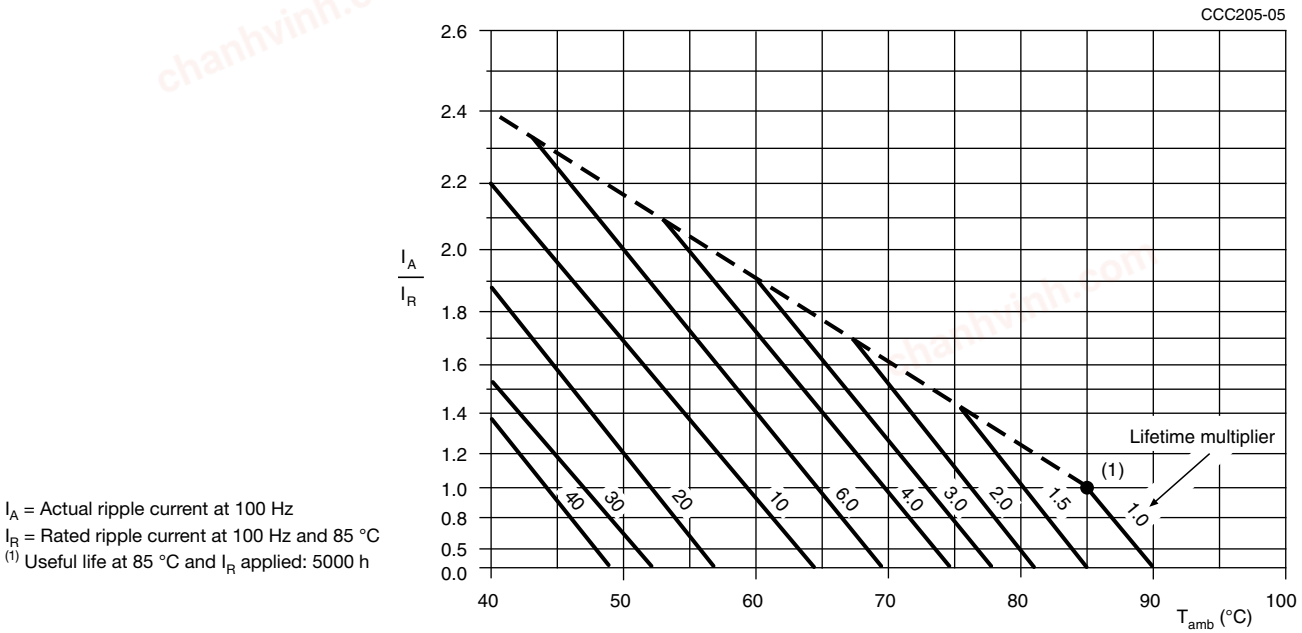

I_A = Actual ripple current at 100 Hz
I_R = Rated ripple current at 100 Hz and 85 °C
(1) Useful life at 85 °C and I_R applied: 5000 h

Fig. 3 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY					
FREQUENCY (Hz)					
50	**100**	**120**	**500**	**1000**	**≥ 10 000**
I_R MULTIPLIER					
0.80	1.00	1.05	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 / EN 130300 subclause 4.13	T_{amb} = 85 °C; U_R applied; 2000 h	ΔC/C: ± 10 % ESR ≤ 1.3 x spec. limit Z ≤ 2 x spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 85 °C; U_R and I_R applied; 5000 h	ΔC/C: ± 30 % ESR ≤ 3 x spec. limit Z ≤ 3 x spec. limit I_{L5} ≤ spec. limit no short or open circuit, no visible damage total failure percentage: ≤ 3 %
Shelf life (storage at high temperature)	IEC 60384-4 / EN 130300 subclause 4.17	T_{amb} = 85 °C; no voltage applied; 1000 h after test: U_R to be applied for 30 min, 24 h to 48 h before measurement	ΔC/C: ± 10 % ESR ≤ 1.2 x spec. limit I_{L5} ≤ 2 x 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.

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