Aluminum Capacitors, Power General Purpose Screw Terminals



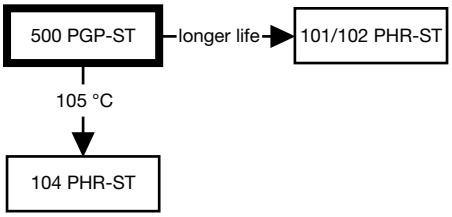


Fig. 1

FEATURES

- Useful life: 5000 h at +85 °C
- Efficient design
- 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 disc
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

APPLICATIONS

- UPS
- Energy storage in medical or industrial pulse systems
- Solar inverters

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
- Code number

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Nominal case size (Ø D x L in mm)	50 x 80 to 90 x 220	
Rated capacitance range, C_R	680 µF to 22 000 µF	
Tolerance on C_R	± 20 %	
Rated voltage range, U_R	350 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

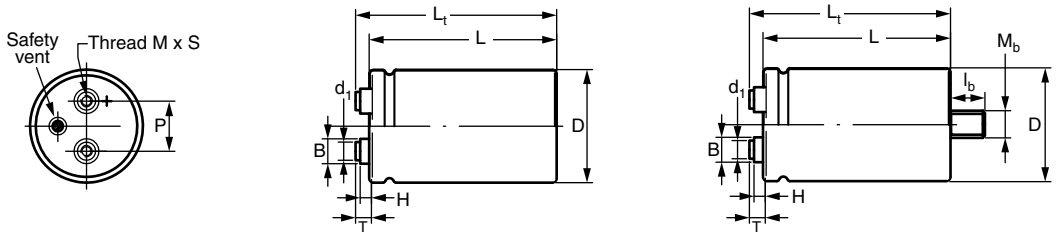
SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)

C_R (µF)	U_R (V)				
	350	400	420	450	500
680	-	-	-	-	50 x 80
1000	-	50 x 80	50 x 80	50 x 80	50 x 80
1200	-	50 x 80	50 x 80	50 x 80	50 x 105
1500	50 x 80	50 x 105	50 x 105	50 x 105	-
1800	-	50 x 105	50 x 105	50 x 105	65 x 105
2200	50 x 105	50 x 105 65 x 105	65 x 105	65 x 105	65 x 105
2700	-	65 x 105	65 x 105	65 x 105	76 x 105
3300	65 x 105	65 x 105	65 x 105	76 x 105	76 x 105
3900	-	65 x 105	76 x 105	76 x 105	-
4700	65 x 105	76 x 105	76 x 114	76 x 114	76 x 146
5600	76 x 105	76 x 114	-	76 x 146	76 x 146
6800	76 x 105	76 x 146	76 x 146	90 x 146	76 x 220
8200	-	90 x 146	90 x 146	76 x 220	76 x 220
10 000	76 x 146	76 x 220 90 x 146	76 x 220	76 x 220	-
12 000	76 x 220	76 x 220	-	90 x 220	90 x 220
15 000	76 x 220	90 x 220	90 x 220	90 x 220	-
18 000	-	90 x 220	-	-	-
22 000	90 x 220	-	-	-	-

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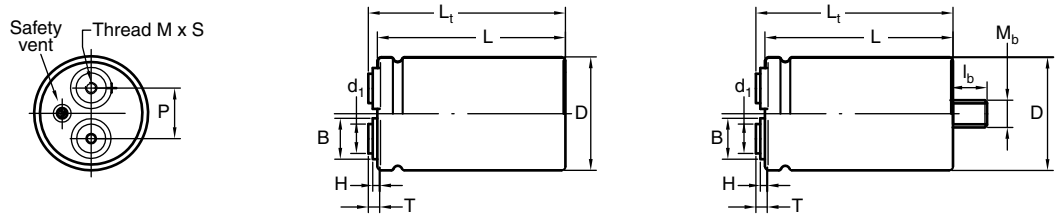
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DIMENSIONS in millimeters AND AVAILABLE FORMS



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 220 HC	2B	218.1	223.4	89.4	31.8	7.9	0.0	13.0	13.0	M6	10.0	M12	16.0	2000

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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 220 HC	8	377 x 375 x 242

Note

- For STB version 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	Max. 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 500 series

4700 µF / 400 V; ± 20 %

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

Ordering code: MAL2 500 56472 E3
Former 12NC: 2222 500 56472

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 MAX. 10 kHz (mΩ)	STANDARD M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2500.....	STB ORDERING CODE MAL2500.....	ST ORDERING CODE MAL2500.....	STB ORDERING CODE MAL2500.....
350	1500	50 x 80	5.56	1.05	58	70	47	15152E3	55152E3	-	-
	2200	50 x 105	6.87	1.54	41	50	34	15222E3	55222E3	-	-
	3300	65 x 105	9.79	2.31	27	33	23	15332E3	55332E3	35332E3	75332E3
	4700	65 x 105	11.6	3.29	20	25	17	15472E3	55472E3	35472E3	75472E3
	5600	76 x 105	13.5	3.92	18	22	15	15562E3	55562E3	35562E3	75562E3
	6800	76 x 105	15	4.76	14	17	13	15682E3	55682E3	35682E3	75682E3
	10 000	76 x 146	18.3	7	10	13	9	15103E3	55103E3	35103E3	75103E3
	12 000	76 x 220	20.6	8.4	9	11	9	15123E3	55123E3	35123E3	75123E3
	15 000	76 x 220	23	10.5	7	9	8	15153E3	55153E3	35153E3	75153E3
	22 000	90 x 220	30.2	15.4	5	7	5	-	-	35223E3	75223E3

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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 MAX. 10 kHz (mΩ)	STANDARD M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2500.....	STB ORDERING CODE MAL2500.....	ST ORDERING CODE MAL2500.....	STB ORDERING CODE MAL2500.....
400	1000	50 x 80	4.46	0.8	138	166	135	26102E3	66102E3	-	-
	1200	50 x 80	4.81	0.96	114	137	112	16122E3	56122E3	-	-
	1500	50 x 105	5.6	1.2	93	112	92	16152E3	56152E3	-	-
	1800	50 x 105	6.01	1.44	80	97	79	16182E3	56182E3	-	-
	2200	50 x 105	6.43	1.76	68	82	69	16222E3	56222E3	-	-
	2200	65 x 105	7.49	1.76	68	82	69	26222E3	66222E3	46222E3	86222E3
	2700	65 x 105	8.56	2.16	53	64	53	16272E3	56272E3	36272E3	76272E3
	3300	65 x 105	9.16	2.64	45	55	47	16332E3	56332E3	36332E3	76332E3
	3900	65 x 105	10.2	3.12	38	46	39	16392E3	56392E3	36392E3	76392E3
	4700	76 x 105	12.5	3.76	31	38	31	16472E3	56472E3	36472E3	76472E3
	5600	76 x 114	13.7	4.48	26	32	27	16562E3	56562E3	36562E3	76562E3
	6800	76 x 146	14.7	5.44	22	27	23	16682E3	56682E3	36682E3	76682E3
	8200	90 x 146	18	6.56	18	22	19	-	-	36822E3	76822E3
	10 000	76 x 220	18.4	8	16	20	17	16103E3	56103E3	36103E3	76103E3
	10 000	90 x 146	19.9	8	15	19	17	-	-	46103E3	86103E3
	12 000	76 x 220	20.4	9.6	13	16	14	16123E3	56123E3	36123E3	76123E3
	15 000	90 x 220	24.8	12	10	13	11	-	-	36153E3	76153E3
	18 000	90 x 220	27	14.4	9	11	10	-	-	36183E3	76183E3
420	1000	50 x 80	4.49	0.84	132	159	127	14102E3	54102E3	-	-
	1200	50 x 80	4.82	1.01	112	135	109	14122E3	54122E3	-	-
	1500	50 x 105	5.64	1.26	90	109	87	14152E3	54152E3	-	-
	1800	50 x 105	6.03	1.51	77	93	75	14182E3	54182E3	-	-
	2200	65 x 105	7.97	1.85	61	74	60	14222E3	54222E3	34222E3	74222E3
	2700	65 x 105	8.6	2.27	51	62	50	14272E3	54272E3	34272E3	74272E3
	3300	65 x 105	9.63	2.77	41	50	41	14332E3	54332E3	34332E3	74332E3
	3900	76 x 105	11.4	3.28	36	44	36	14392E3	54392E3	34392E3	74392E3
	4700	76 x 114	12.5	3.95	30	37	31	14472E3	54472E3	34472E3	74472E3
	6800	76 x 146	15.4	5.71	21	26	22	14682E3	54682E3	34682E3	74682E3
	8200	90 x 146	18.8	6.89	17	21	18	-	-	34822E3	74822E3
	10 000	76 x 220	18.5	8.4	15	19	17	14103E3	54103E3	34103E3	74103E3
	15 000	90 x 220	24.9	12.6	10	13	11	-	-	34153E3	74153E3
450	1000	50 x 80	4.53	0.9	124	149	117	17102E3	57102E3	-	-
	1200	50 x 80	4.86	1.08	106	128	101	17122E3	57122E3	-	-
	1500	50 x 105	5.69	1.35	84	101	80	17152E3	57152E3	-	-
	1800	50 x 105	6.06	1.62	74	89	73	17182E3	57182E3	-	-
	2200	65 x 105	8.04	1.98	57	69	54	17222E3	57222E3	37222E3	77222E3
	2700	65 x 105	8.65	2.43	48	58	47	17272E3	57272E3	37272E3	77272E3
	3300	76 x 105	10.8	2.97	39	47	37	17332E3	57332E3	37332E3	77332E3
	3900	76 x 105	11.8	3.51	33	40	32	17392E3	57392E3	37392E3	77392E3
	4700	76 x 114	13	4.23	27	33	27	17472E3	57472E3	37472E3	77472E3
	5600	76 x 146	14	5.04	24	29	24	17562E3	57562E3	37562E3	77562E3
	6800	90 x 146	17.1	6.12	20	25	19	-	-	37682E3	77682E3
	8200	76 x 220	17.5	7.38	17	21	17	17822E3	57822E3	37822E3	77822E3
	10 000	76 x 220	19.4	9	14	17	14	17103E3	57103E3	37103E3	77103E3
	12 000	90 x 220	23.4	10.8	11	14	11	-	-	37123E3	77123E3
	15 000	90 x 220	25.8	13.5	9	11	10	-	-	37153E3	77153E3

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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 MAX. 10 kHz (mΩ)	STANDARD M5 DISC		HIGH CURRENT M6 DISC	
								ST ORDERING CODE MAL2500.....	STB ORDERING CODE MAL2500.....	ST ORDERING CODE MAL2500.....	STB ORDERING CODE MAL2500.....
500	680	50 x 80	3.72	0.68	256	308	275	19681E3	59681E3	-	-
	1000	50 x 80	4.36	1	179	215	193	19102E3	59102E3	-	-
	1200	50 x 105	5.03	1.2	148	178	161	19122E3	59122E3	-	-
	1800	65 x 105	7.17	1.8	99	119	108	19182E3	59182E3	39182E3	79182E3
	2200	65 x 105	7.74	2.2	82	99	91	19222E3	59222E3	39222E3	79222E3
	2700	76 x 105	9.64	2.7	66	80	73	19272E3	59272E3	39272E3	79272E3
	3300	76 x 105	10.7	3.3	54	65	60	19332E3	59332E3	39332E3	79332E3
	4700	76 x 146	13.1	4.7	38	46	43	19472E3	59472E3	39472E3	79472E3
	5600	76 x 146	13.9	5.6	33	40	36	19562E3	59562E3	39562E3	79562E3
	6800	76 x 220	15.9	6.8	27	33	31	19682E3	59682E3	39682E3	79682E3
	8200	76 x 220	17.5	8.2	23	28	26	19822E3	59822E3	39822E3	79822E3
	12 000	90 x 220	23.1	12	16	20	18	-	-	39123E3	79123E3

ADDITIONAL ELECTRICAL DATA		
PARAMETER	**CONDITIONS**	**VALUE**
Voltage		
Surge voltage	≥ 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	$I_{L1} \leq 0.006\ C_R \times U_R + 4$ 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

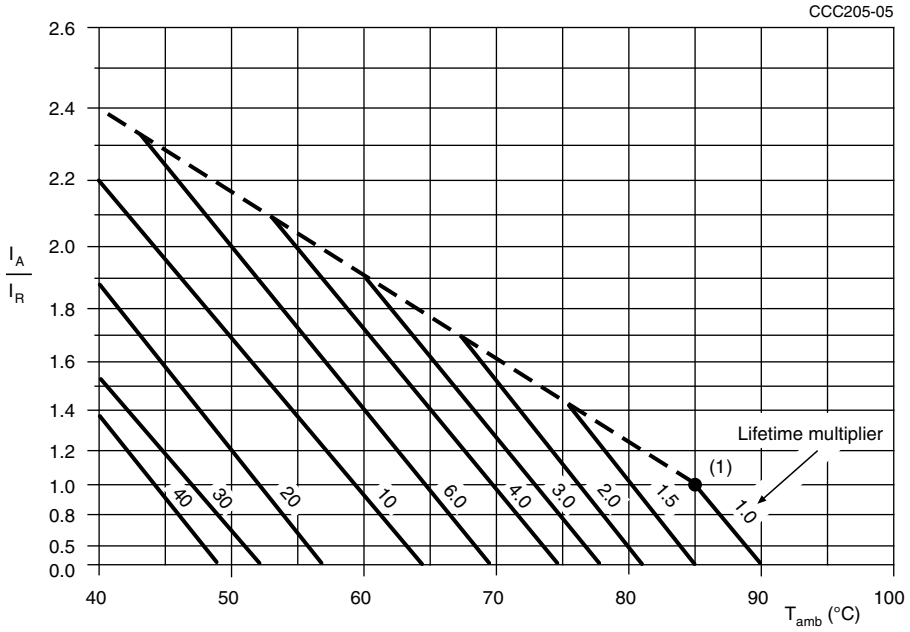
Table 3

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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