

## Aluminum Capacitors, Power General Purpose Screw Terminals

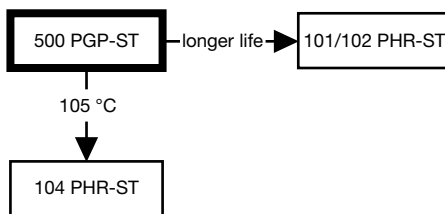


Fig. 1

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
	500
Nominal case size (Ø D x L in mm)	50 x 80 to 90 x 220
Rated capacitance range, C <sub>R</sub>	1000 µF to 15 000 µF
Tolerance on C <sub>R</sub>	± 20 %
Rated voltage range, U <sub>R</sub>	400 V to 450 V
Category temperature range	-40 °C to +85 °C
Endurance test at 85 °C	2000 h
Useful life at 85 °C	3000 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 / 56

SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)			
C <sub>R</sub> (µF)	U <sub>R</sub> (V)		
	400	420	450
1000	50 x 80	50 x 80	50 x 80
1200	50 x 80	50 x 80	50 x 80
1500	50 x 105	50 x 105	50 x 105
1800	50 x 105	50 x 105	50 x 105
2200	50 x 105 65 x 105	65 x 105	65 x 105
2700	65 x 105	65 x 105	65 x 105
3300	65 x 105	65 x 105	76 x 105
3900	65 x 105	76 x 105	76 x 105
4700	76 x 105	76 x 114	76 x 114
5600	76 x 114	-	76 x 146
6800	76 x 146	76 x 146	90 x 146
8200	90 x 146	90 x 146	76 x 220
10 000	76 x 220 90 x 146	76 x 220	76 x 220
12 000	76 x 220	-	90 x 220
15 000	90 x 220	90 x 220	-

### FEATURES

- Useful life: 3000 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](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

### APPLICATIONS

- UPS
- Energy storage in medical or industrial pulse systems

### 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

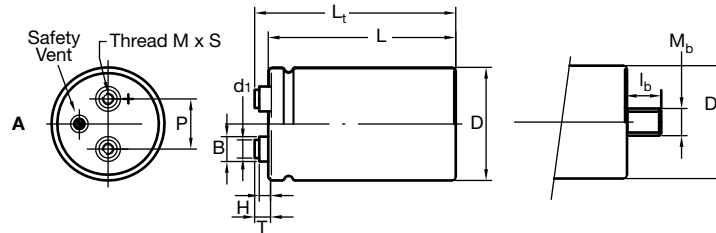
**DIMENSIONS in millimeters AND AVAILABLE FORMS**


Fig. 2 A: Standard M5 disc: Screw Terminal (ST) and Screw Terminal Bolt nut (STB)

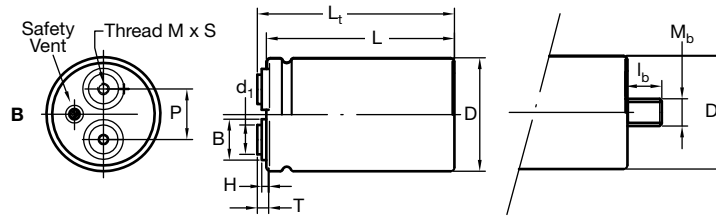


Fig. 2 B: High current M6 disc: Screw Terminal (ST) and Screw Terminal Bolt nut (STB)

**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](http://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**

<b>DIMENSIONS in millimeters AND MASS</b>														
DESIGN	DRAWING	L ± 1	L <sub>t</sub> ± 1	D ± 1	P ± 0.3	T ± 0.2	H ± 0.3	B ± 0.3	D <sub>1</sub> ± 0.1	M	S - 0	M <sub>b</sub>	l <sub>b</sub> ± 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

**Note**

- For bolt version holds:  
L = L standard - 0.5 mm  
L<sub>t</sub> = L<sub>t</sub> standard - 0.5 mm



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	18	520 x 270 x 280
76 x 220 HC	18	520 x 270 x 280
90 x 146 HC	8	377 x 375 x 168
90 x 220 HC	10	520 x 270 x 280

**Note**

- For bolt version holds:  
H of cardboard box: + 10 mm

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C <sub>R</sub>	Rated capacitance at 100 Hz, tolerance ± 20 %
I <sub>R</sub>	Rated RMS ripple current at 100 Hz, 85 °C
I <sub>L5</sub>	Max. leakage current after 5 min at U <sub>R</sub>
ESR	Max. equivalent series resistance at 100 Hz
Z	Max. impedance at 10 kHz

**ORDERING EXAMPLE**

Electrolytic capacitor 500 series  
 4700 µF / 400 V; ± 20 %  
 Nominal case size: Ø 76 mm x 105 mm;  
 STB version; high post M5 disc  
 Ordering code: MAL2 500 56472 E3  
 Former 12NC: 2222 500 56472

**Note**

- Unless otherwise specified, all electrical values in Table 2 and 3 apply at T<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

**Table 2**

ELECTRICAL DATA AND ORDERING INFORMATION											
U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I <sub>R</sub> 120 Hz 85 °C (A)	I <sub>R</sub> 120 Hz 40 °C (A)	I <sub>L5</sub> 5 min (mA)	ESR MAX. 120 Hz (mΩ)	Z MAX. 10 kHz (mΩ)	HIGH POST M5 DISC		HIGH CURRENT M6 DISC	
								ORDERING CODE ST MAL2500.....	ORDERING CODE STB MAL2500.....	ORDERING CODE ST MAL2500.....	ORDERING CODE STB MAL2500.....
400	1000	50 x 80	4.2	11.2	0.80	125	98	26102E3	66102E3	-	-
	1200	50 x 80	4.5	12.0	0.96	107	85	16122E3	56122E3	-	-
	1500	50 x 105	5.1	14.1	1.20	86	68	16152E3	56152E3	-	-
	1800	50 x 105	5.6	15.1	1.44	73	59	16182E3	56182E3	-	-
	2200	50 x 105	6.3	17.1	1.76	58	46	16222E3	56222E3	-	-
	2200	65 x 105	7.4	19.9	1.76	58	46	26222E3	66222E3	46222E3	86222E3
	2700	65 x 105	7.9	21.5	2.16	49	39	16272E3	56272E3	36272E3	76272E3
	3300	65 x 105	8.9	24.0	2.64	39	31	16332E3	56332E3	36332E3	76332E3
	3900	65 x 105	9.4	25.5	3.12	34	28	16392E3	56392E3	36392E3	76392E3
	4700	76 x 105	11.1	30.0	3.76	30	25	16472E3	56472E3	36472E3	76472E3
	5600	76 x 114	12.1	32.6	4.48	26	21	16562E3	56562E3	36562E3	76562E3
	6800	76 x 146	13.6	36.6	5.44	21	18	16682E3	56682E3	36682E3	76682E3
	8200	90 x 146	17.7	47.7	6.56	16	13	-	-	36822E3	76822E3
	10 000	76 x 220	17.0	45.8	8.00	15	12	16103E3	56103E3	36103E3	76103E3
	10 000	90 x 146	19.3	52.2	8.00	13	11	-	-	46103E3	86103E3
	12 000	76 x 220	17.8	48.1	9.60	13	11	16123E3	56123E3	36123E3	76123E3
15 000	90 x 220	23.6	63.7	12.00	9	8	-	-	36153E3	76153E3	



ELECTRICAL DATA AND ORDERING INFORMATION											
U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I <sub>R</sub> 120 Hz 85 °C (A)	I <sub>R</sub> 120 Hz 40 °C (A)	I <sub>L5</sub> 5 min (mA)	ESR MAX. 120 Hz (mΩ)	Z MAX. 10 kHz (mΩ)	HIGH POST M5 DISC		HIGH CURRENT M6 DISC	
								ORDERING CODE ST MAL2500.....	ORDERING CODE STB MAL2500.....	ORDERING CODE ST MAL2500.....	ORDERING CODE STB MAL2500.....
420	1000	50 x 80	4.3	11.5	0.84	105	74	14102E3	54102E3	-	-
	1200	50 x 80	4.6	12.4	1.01	90	65	14122E3	54122E3	-	-
	1500	50 x 105	5.3	14.4	1.26	72	52	14152E3	54152E3	-	-
	1800	50 x 105	5.7	15.3	1.52	62	46	14182E3	54182E3	-	-
	2200	65 x 105	7.5	20.4	1.85	49	35	14222E3	54222E3	34222E3	74222E3
	2700	65 x 105	8.1	21.9	2.27	42	31	14272E3	54272E3	34272E3	74272E3
	3300	65 x 105	9.1	24.6	2.78	33	24	14332E3	54332E3	34332E3	74332E3
	3900	76 x 105	10.7	28.8	3.28	29	22	14392E3	54392E3	34392E3	74392E3
	4700	76 x 114	11.7	31.5	3.95	25	19	14472E3	54472E3	34472E3	74472E3
	6800	76 x 146	13.8	37.2	5.72	18	14	14682E3	54682E3	34682E3	74682E3
	8200	90 x 146	17.6	47.6	6.89	14	10	-	-	34822E3	74822E3
	10 000	76 x 220	17.3	46.6	8.40	13	10	14103E3	54103E3	34103E3	74103E3
	15 000	90 x 220	24.1	65.0	12.60	8	6	-	-	34153E3	74153E3
450	1000	50 x 80	4.2	11.3	0.90	126	88	17102E3	57102E3	-	-
	1200	50 x 80	4.5	12.1	1.08	100	76	17122E3	57122E3	-	-
	1500	50 x 105	5.3	14.2	1.35	79	61	17152E3	57152E3	-	-
	1800	50 x 105	5.9	15.9	1.62	64	48	17182E3	57182E3	-	-
	2200	65 x 105	7.4	20.0	1.98	54	41	17222E3	57222E3	37222E3	77222E3
	2700	65 x 105	8.3	22.5	2.43	43	33	17272E3	57272E3	37272E3	77272E3
	3300	76 x 105	9.9	26.8	2.97	37	28	17332E3	57332E3	37332E3	77332E3
	3900	76 x 105	10.5	28.4	3.51	32	25	17392E3	57392E3	37392E3	77392E3
	4700	76 x 114	11.5	31.0	4.23	28	22	17472E3	57472E3	37472E3	77472E3
	5600	76 x 146	12.8	34.6	5.04	23	18	17562E3	57562E3	37562E3	77562E3
	6800	90 x 146	16.6	44.8	6.12	17	13	-	-	37682E3	77682E3
	8200	76 x 220	16.0	43.3	7.38	16	13	17822E3	57822E3	37822E3	77822E3
	10 000	76 x 220	17.0	45.8	9.00	14	11	17103E3	57103E3	37103E3	77103E3
12 000	90 x 220	22.1	59.5	10.80	10	8	-	-	37123E3	77123E3	

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage	≥ 400 V versions	U <sub>s</sub> = 1.1 x U <sub>R</sub>
Reverse voltage		U <sub>rev</sub> ≤ 1 V
<b>Current</b>		
Leakage current	After 1 min at U <sub>R</sub>	I <sub>L1</sub> ≤ 0.006 C <sub>R</sub> x U <sub>R</sub> + 4 µA
	After 5 min at U <sub>R</sub>	I <sub>L5</sub> ≤ 0.002 C <sub>R</sub> x U <sub>R</sub> + 4 µA
<b>Inductance</b>		
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	2000

**Note**

- Multiplier of useful life code: CCC205-05

CCC205-05

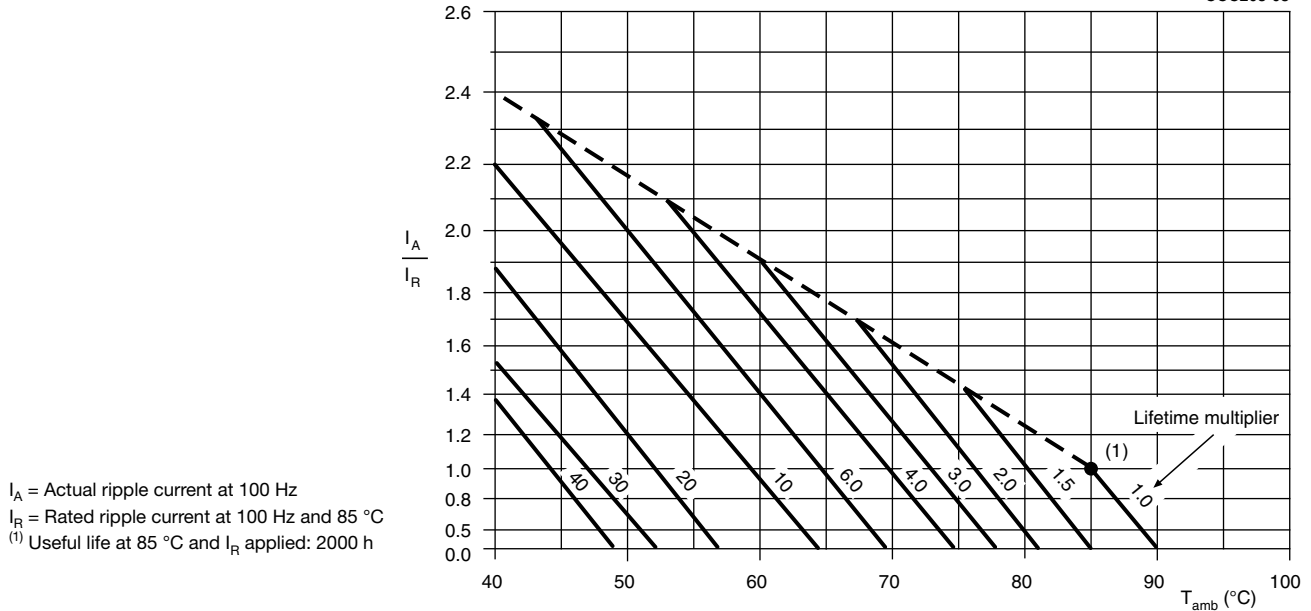


Fig. 3 - Multiplier of useful life as a function of ambient temperature and ripple current load

**Table 4**

MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY					
FREQUENCY (Hz)					
60	100	120	500	1000	≥ 10 000
$I_R$ MULTIPLIER					
0.70	0.95	1.00	1.20	1.30	1.40

**Table 5**

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 / EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$ ; $U_R$ applied; 2000 h	$\Delta C/C: \pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$ ; $U_R$ and $I_R$ applied; 3000 h	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4 / EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$ ; no voltage applied; 500 h after test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

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.



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