Aluminum Electrolytic Capacitors
Power Ultra Miniature Snap-In





Fig. 1

FEATURES

- Long useful life: 5000 h at 85 °C
- Low ESR
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Charge and discharge proof
- High ripple current capability
- Keyed polarity version available
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

APPLICATIONS

- General purpose, industrial and audio / video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems

MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in µF)
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Date code (YYMM)
- 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**
Nominal case size (Ø D x L in mm)	22 x 25 to 35 x 60
Rated capacitance range (E6 series), C_R	1000 µF to 22 000 µF
Tolerance on C_R	± 20 %
Rated voltage range, U_R	16 V to 100 V
Category temperature range	-40 °C to +85 °C
Endurance test at 85 °C	2000 h
Useful life at 85 °C	5000 h
Useful life at 40 °C and 1.4 x I_R applied	90 000 h
Shelf life at 0 V, 85 °C	500 h
Based on sectional specification	IEC 60384-4 / EN130300
Climatic category IEC 60068	40 / 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)						
	16	**25**	**40**	**50**	**63**	**80**	**100**
1000	-	-	-	-	-	-	22 x 30
1200	-	-	-	-	-	-	22 x 35
1500	-	-	-	-	22 x 25	22 x 30	25 x 30
1800	-	-	-	-	25 x 25	-	-
2200	-	-	-	22 x 25	22 x 30	25 x 30	25 x 40
	-	-	-	-	25 x 25	-	30 x 30
2700	-	-	22 x 25	-	25 x 30	-	30 x 35
3300	-	-	22 x 30	22 x 30	25 x 35	25 x 40	30 x 40
	-	-	25 x 25	-	-	-	35 x 30
3900	-	-	-	25 x 30	25 x 40	-	-
4700	-	-	25 x 30	25 x 35	22 x 50	30 x 40	30 x 50
	-	22 x 25	-	-	30 x 30	-	35 x 40

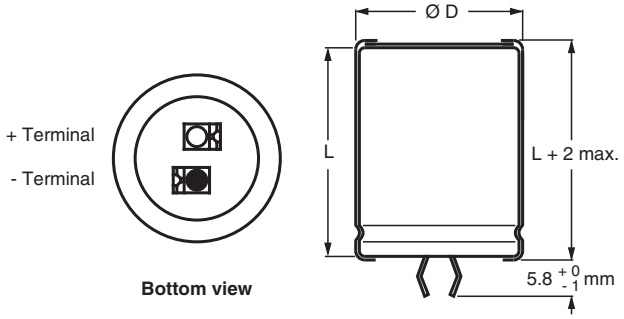
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SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)							
C_R (µF)	U_R (V)						
	16	25	40	50	63	80	100
5600	-	25 x 25	-	25 x 40	30 x 35	-	-
6800	-	-	25 x 40	30 x 30	30 x 40	30 x 50	35 x 50
8200	-	-	30 x 30	30 x 35	30 x 50	-	35 x 60
10 000	25 x 30	22 x 40	30 x 35	30 x 40	35 x 40	35 x 50	-
12 000	-	25 x 40	30 x 40	30 x 50	35 x 50	-	-
15 000	25 x 40	30 x 35	30 x 50	-	35 x 60	-	-
	30 x 30	-	-	-	-	-	-
18 000	-	30 x 40	35 x 40	35 x 50	-	-	-
22 000	30 x 35	-	35 x 50	35 x 60	-	-	-
27 000	-	35 x 40	-	-	-	-	-
39 000	35 x 40	-	-	-	-	-	-

DIMENSIONS in millimeters AND AVAILABLE FORMS

TWO TERMINAL SNAP-IN



The minus terminal can be marked with a black dot or with an imprinted "-" sign.

Fig. 2 - Two terminal snap-in

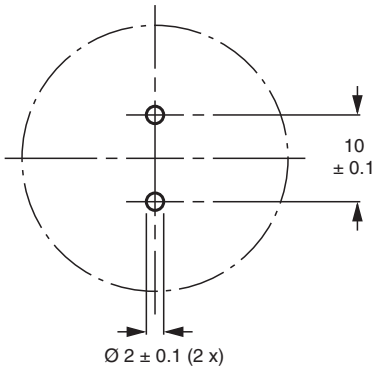
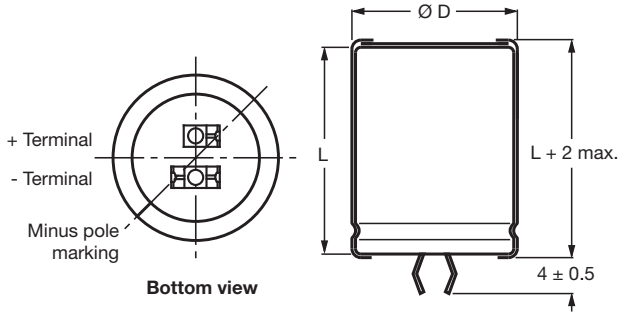


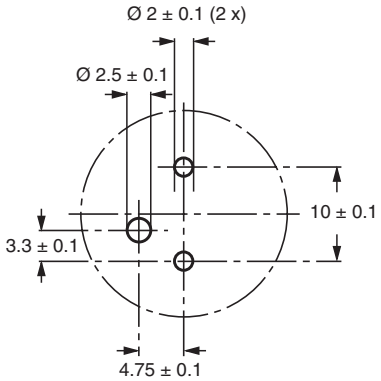
Fig. 3 - Mounting hole diagram

THREE TERMINAL SNAP-IN



The negative terminal has **TWO** pins which are **BOTH** electrically connected.

Fig. 4 - Three terminal snap-in



The 10 mm spacing of the 2 pin snap-in is used as the base layout and a third hole is added.
The third hole is closer to the negative primary hole so that polarization is always maintained, together with added mechanical stability.

Fig. 5 - Mounting hole diagram

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Table 1

DIMENSIONS in millimeters, **MASS AND PACKAGING QUANTITIES**					
NOMINAL CASE SIZE Ø D x L	**Ø $D_{max.}$ (mm)**	**$L_{max.}$ (mm)**	**MASS (g)**	**PACKAGING QUANTITIES (units per box)**	**CARDBOARD BOX DIMENSIONS L x W x H**
22 x 25	23	27	≈ 12	100	260 x 250 x 39
22 x 30	23	32	≈ 16	100	260 x 250 x 44
22 x 35	23	37	≈ 20	100	260 x 250 x 49
22 x 40	23	42	≈ 23	100	260 x 250 x 54
22 x 50	23	52	≈ 29	100	260 x 250 x 64
25 x 25	26	27	≈ 20	100	290 x 280 x 39
25 x 30	26	32	≈ 22	100	290 x 280 x 44
25 x 35	26	37	≈ 24	100	290 x 280 x 49
25 x 40	26	42	≈ 27	100	290 x 280 x 54
30 x 30	31	32	≈ 30	100	340 x 330 x 44
30 x 35	31	37	≈ 35	100	340 x 330 x 49
30 x 40	31	42	≈ 42	100	340 x 330 x 54
30 x 50	31	52	≈ 52	100	340 x 330 x 64
35 x 30	36	32	≈ 40	50	390 x 198 x 44
35 x 40	36	42	≈ 55	50	390 x 198 x 54
35 x 50	36	52	≈ 72	50	390 x 198 x 64
35 x 60	36	62	≈ 84	50	390 x 198 x 74

ELECTRICAL DATA	
SYMBOL	**DESCRIPTION**
C_R	Rated capacitance at 100 Hz
I_R	Rated RMS ripple current at 100 Hz and 85 °C
I_{L1}	Max. leakage current after 1 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 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

ORDERING EXAMPLE

Electrolytic capacitor 156 series

1000 µF / 25 V; ± 20 %

Nominal case size: Ø 25 x 40 mm

2-terminal snap-in:

Ordering code: MAL2 156 26123 E3
Former 12NC: 2222 156 26123

3-terminal snap-in:

Ordering code: MAL2 156 66123 E3
Former 12NC: 2222 156 66123

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 (µA)**	**MAX. ESR 100 Hz (mΩ)**	**MAX. Z 10 kHz (mΩ)**	**ORDERING CODE MAL2156.....**	
							2-TERM.	**3-TERM.**
16	10 000	25 x 30	3.93	324	49	33	25103E3	65103E3
	15 000	25 x 40	4.98	484	36	26	35153E3	75153E3
	18 000	30 x 30	4.12	580	53	33	35183E3	75183E3
	22 000	30 x 35	4.71	708	44	29	25223E3	65223E3
	39 000	35 x 40	5.17	1252	45	26	25393E3	65393E3
25	4700	22 x 25	2.37	239	100	90	16472E3	56472E3
	5600	25 x 25	3.03	284	74	46	26562E3	66562E3
	10 000	22 x 40	4.40	504	41	27	16103E3	56103E3
	12 000	25 x 40	4.73	604	40	27	26123E3	66123E3
	15 000	30 x 35	4.55	754	47	31	26153E3	66153E3
	18 000	30 x 40	5.06	904	41	27	16183E3	56183E3
	27 000	35 x 40	5.04	1354	47	27	26273E3	66273E3

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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 (µA)	MAX. ESR 100 Hz (mΩ)	MAX. Z 10 kHz (mΩ)	ORDERING CODE MAL2156.....	
							2-TERM.	3-TERM.
40	2700	22 x 25	2.47	220	97	57	17272E3	57272E3
	3300	22 x 30	2.98	268	74	43	27332E3	67332E3
	3300	25 x 25	2.69	268	93	58	17332E3	57332E3
	4700	25 x 30	3.32	380	68	44	27472E3	67472E3
	6800	25 x 40	4.26	548	49	33	37682E3	77682E3
	8200	30 x 30	3.49	660	74	44	37822E3	77822E3
	10 000	30 x 35	4.02	804	60	38	17103E3	57103E3
	12 000	30 x 40	4.49	964	52	33	17123E3	57123E3
	15 000	30 x 50	5.39	1204	41	28	37153E3	77153E3
	18 000	35 x 40	4.39	1444	62	33	17183E3	57183E3
	22 000	35 x 50	5.34	1764	47	28	27223E3	67223E3
50	2200	22 x 25	2.34	224	107	62	11222E3	51222E3
	3300	22 x 30	2.92	334	76	46	11332E3	51332E3
	3900	25 x 30	3.17	394	74	47	21392E3	61392E3
	4700	25 x 35	3.64	474	62	40	21472E3	61472E3
	5600	25 x 40	4.09	564	53	35	21562E3	61562E3
	6800	30 x 30	3.35	684	79	48	21682E3	61682E3
	8200	30 x 35	3.88	824	65	40	21822E3	61822E3
	10 000	30 x 40	4.32	1004	56	35	11103E3	51103E3
	12 000	30 x 50	5.23	1204	43	29	11123E3	51123E3
	18 000	35 x 50	5.18	1804	50	29	11183E3	51183E3
	22 000	35 x 60	5.97	2204	51	46	11223E3	51223E3
63	1500	22 x 25	2.13	193	128	68	18152E3	58152E3
	1800	25 x 25	2.37	231	120	69	18182E3	58182E3
	2200	22 x 30	2.66	281	92	50	18222E3	58222E3
	2200	25 x 25	2.42	281	115	70	28222E3	68222E3
	2700	25 x 30	2.95	344	86	51	28272E3	68272E3
	3300	25 x 35	3.39	420	71	43	28332E3	68332E3
	3900	25 x 40	3.81	495	61	37	28392E3	68392E3
	4700	22 x 50	4.26	596	50	30	18472E3	58472E3
	4700	30 x 30	3.25	596	85	53	38472E3	78472E3
	5600	30 x 35	3.75	710	69	45	28562E3	68562E3
	6800	30 x 40	4.19	861	59	39	18682E3	58682E3
	6800	35 x 30	3.28	861	97	53	28682E3	68682E3
	8200	30 x 50	5.05	1037	46	32	38822E3	78822E3
	10 000	35 x 40	4.23	1264	67	39	18103E3	58103E3
	12 000	35 x 50	5.15	1516	51	32	18123E3	58123E3
	15 000	35 x 60	5.89	1894	52	47	18153E3	58153E3

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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 (µA)	MAX. ESR 100 Hz (mΩ)	MAX. Z 10 kHz (mΩ)	ORDERING CODE MAL2156.....	
							2-TERM.	3-TERM.
80	1500	22 x 30	1.83	244	318	308	12152E3	52152E3
	2200	25 x 30	2.23	356	230	224	22222E3	62222E3
	3300	25 x 40	2.92	532	155	152	22332E3	62332E3
	4700	30 x 40	3.44	756	121	119	12472E3	52472E3
	6800	30 x 50	4.18	1092	88	87	12682E3	52682E3
	10 000	35 x 50	4.51	1604	74	73	12103E3	52103E3
100	1000	22 x 30	1.72	204	338	312	19102E3	59102E3
	1200	22 x 35	1.98	244	282	261	29122E3	59122E3
	1500	25 x 30	2.12	304	239	223	29152E3	69152E3
	2200	25 x 40	2.77	444	164	154	29222E3	69222E3
	2200	30 x 30	2.55	444	181	171	39222E3	79222E3
	2700	30 x 35	2.94	544	148	140	29272E3	69272E3
	3300	30 x 40	3.32	664	123	116	19332E3	59332E3
	3300	35 x 30	2.84	664	147	140	29332E3	69332E3
	4700	30 x 50	4.04	944	90	86	19472E3	59472E3
	4700	35 x 40	3.67	944	102	98	29472E3	69472E3
	6800	35 x 50	4.39	1364	76	73	19682E3	59682E3
	8200	35 x 60	5.21	1644	63	61	19822E3	59822E3

ADDITIONAL ELECTRICAL DATA		
PARAMETER	**CONDITIONS**	**VALUE**
Voltage		
Surge voltage		$U_s = 1.15 \times U_R$
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)	All case sizes	Typ. 19 nH
		Max. 25 nH

RIPPLE CURRENT AND USEFUL LIFE

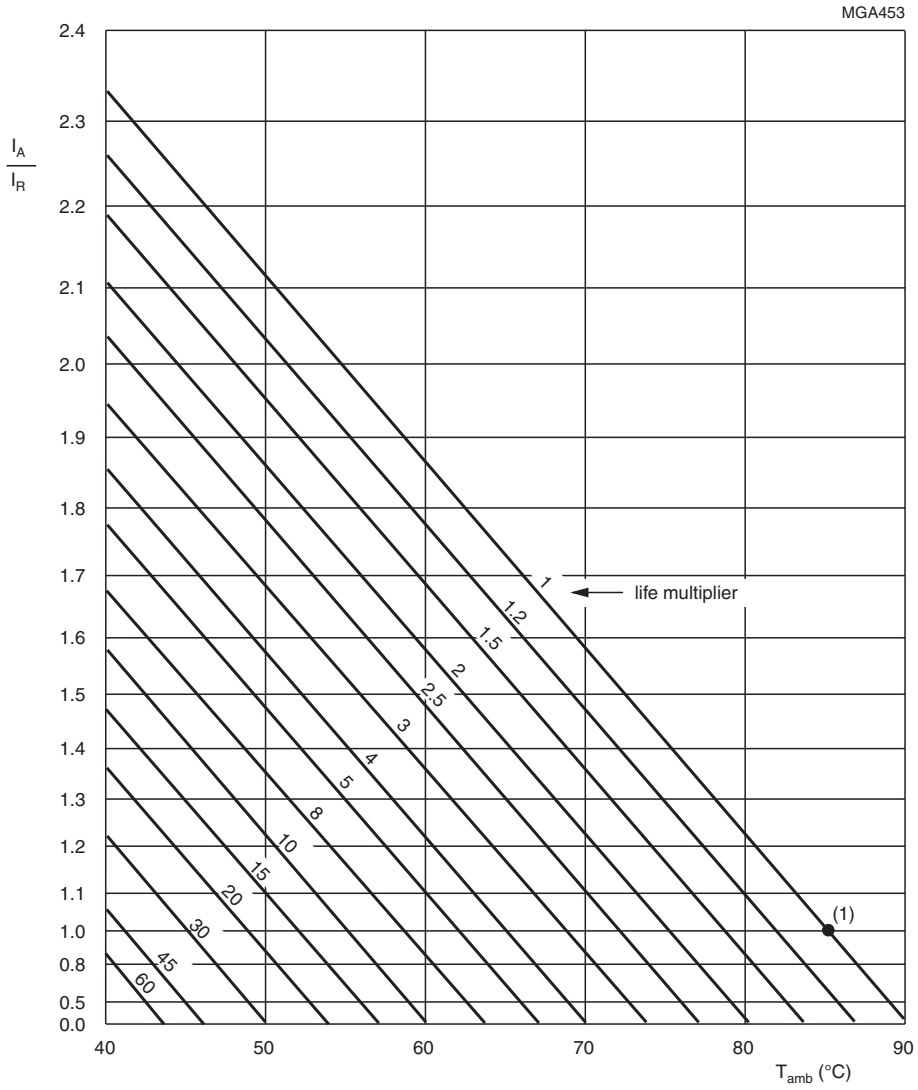
Table 3

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: MGA453

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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. 6 - 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								
U_R (V)	FREQUENCY (Hz)							
	50	100	200	400	1000	2000	4000	≥ 10 000
	I_R MULTIPLIER							
16	0.93	1.00	1.04	1.07	1.11	1.13	1.15	1.18
25	0.93	1.00	1.04	1.07	1.11	1.13	1.15	1.18
40	0.91	1.00	1.05	1.09	1.13	1.15	1.18	1.22
50	0.91	1.00	1.05	1.09	1.13	1.15	1.18	1.22
63	0.91	1.00	1.05	1.09	1.13	1.15	1.18	1.22
80	0.91	1.00	1.05	1.09	1.13	1.15	1.18	1.22
100	0.91	1.00	1.05	1.09	1.13	1.15	1.18	1.22

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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 °C; U_R applied: 2000 h	ΔC/C: ± 15 % 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: ± 15 % 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: ≤ 1 %
Shelf life (storage at high temperature)	IEC 60384-4 / EN130300 subclause 4.17	T_{amb} = 85 °C; no voltage applied; 500 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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