

## Aluminum Electrolytic Capacitors Power Long Life 4-Terminal Snap-In

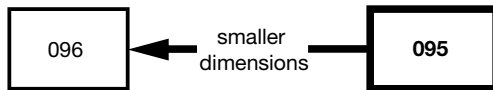


Fig. 1


**RoHS  
COMPLIANT**

### FEATURES

- Very long useful life: 10 000 h at 85 °C
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the side of the aluminum case
- Temperature range up to 85 °C
- Keyed polarity
- Low ESR, high ripple current capability
- High reliability
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### APPLICATIONS

- Telecommunication and industrial systems
- Smoothing and filtering applications
- Switched mode power supplies
- Renewable energy power converters
- Energy storage in pulse systems
- For excellent mounting stability

### MARKING

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

- Rated capacitance (in  $\mu\text{F}$ )
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for  $\pm 20\%$ )
- 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 (D x L in mm)	35 x 50 to 45 x 100
Rated capacitance range $C_R$	390 $\mu\text{F}$ to 2200 $\mu\text{F}$
Tolerance on $C_R$	$\pm 20\%$
Rated voltage range, $U_R$	350 V to 450 V
Category temperature range	-40 °C to +85 °C
Endurance test at 85 °C	3000 h
Useful life at 85 °C	10 000 h
Useful life at 40 °C, 1.4 x $I_R$ applied	400 000 h
Shelf life at 0 V, 85 °C	1000 h
Max. RMS value of ripple voltage	12 V
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 ( $\varnothing$ D x L in mm)				
$C_R$ ( $\mu\text{F}$ )	$U_R$ (V)			
	350	400	420	450
390	-	-	-	35 x 50 40 x 40
470	-	35 x 50 40 x 40	35 x 50 40 x 40	35 x 60 40 x 50 45 x 40
560	35 x 50	35 x 60 45 x 40	35 x 60	35 x 70 40 x 60
680	35 x 60 40 x 50	35 x 70 40 x 60 45 x 50	35 x 70 40 x 60 45 x 50	35 x 80 40 x 60 45 x 50
820	35 x 70 40 x 60	35 x 80 40 x 60	35 x 80 40 x 70 45 x 50	40 x 70 45 x 60
1000	35 x 80 40 x 60 45 x 50	35 x 100 40 x 70 45 x 60	35 x 100 40 x 80 45 x 60	40 x 100 45 x 70
1500	40 x 80 45 x 70	40 x 100 45 x 80	40 x 100 45 x 80	45 x 100
1800	40 x 100	45 x 100	45 x 100	-
2200	45 x 100	-	-	-

**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**

**PRINTED WIRING**

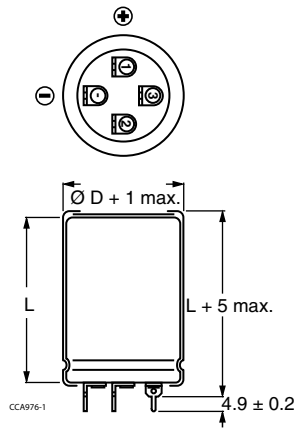


Fig. 2 - Printed wiring pin version (Case Ø D = 35 mm)

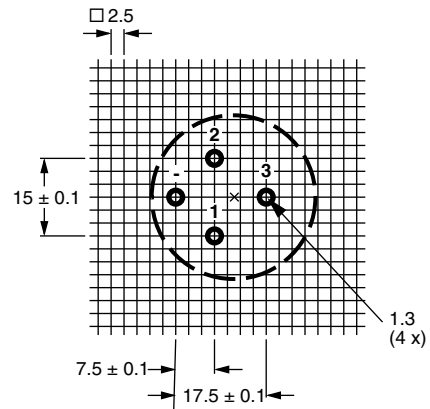


Fig. 3 - Mounting hole diagram viewed from component side (Case Ø D = 35 mm)

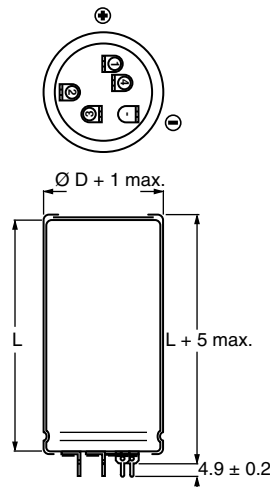


Fig. 4 - Printed wiring pin version (Case Ø D = 40 mm)

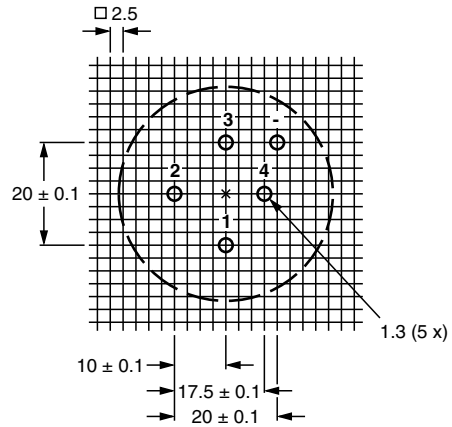
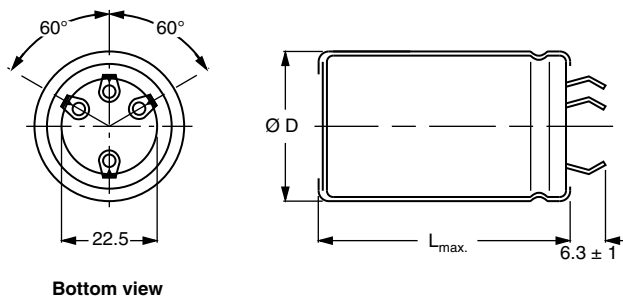


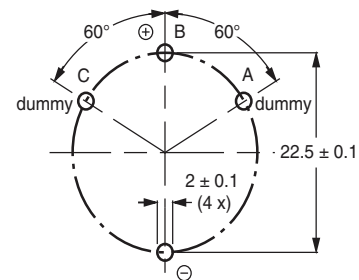
Fig. 5 - Mounting hole diagram viewed from component side (Case Ø D = 40 mm)

**FOUR TERMINAL SNAP-IN**



Bottom view

Fig. 6 - 4-Terminal snap-in



Dummy terminals (A and C) must be free from the electrical circuit

Fig. 7 - Mounting hole diagram

**Pin number 1 is the positive terminal. Pin “-” is the negative terminal.**

**Pin numbers 2, 3 and 4 (if present) should be free from the electrical circuit or connected to the minus terminal.**



Table 1

DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES						
NOMINAL CASE SIZE Ø D x L	Ø D <sub>max.</sub>	4T-SI L <sub>max.</sub>	PW L + 5	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS L x W x H
35 x 50	36	52	55	72	50	390 x 198 x 60
35 x 60	36	62	65	91	50	390 x 198 x 70
35 x 70	36	72	75	103	50	377 x 375 x 97
35 x 80	36	82	85	115	50	377 x 375 x 107
35 x 100	36	102	105	151	50	377 x 375 x 127
40 x 40	41	42	45	70	50	440 x 223 x 60
40 x 50	41	52	55	94	50	440 x 223 x 70
40 x 60	41	62	65	118	25	230 x 230 x 80
40 x 70	41	72	75	134	25	230 x 230 x 90
40 x 80	41	82	85	150	25	230 x 230 x 100
40 x 100	41	102	105	176	25	230 x 230 x 120
45 x 40	46	42	-	88	36	TBD
45 x 50	46	52	-	119	36	377 x 375 x 77
45 x 60	46	62	-	150	36	377 x 375 x 87
45 x 70	46	72	-	170	36	377 x 375 x 97
45 x 80	46	82	-	190	36	377 x 375 x 107
45 x 100	46	102	-	250	36	377 x 375 x 127

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C <sub>R</sub>	Rated capacitance at 100 Hz
I <sub>R</sub>	Rated RMS ripple current at 100 Hz and 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

**Note**

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

**ORDERING EXAMPLE**

Electrolytic capacitor 095 series  
 1000 µF/450 V;  
 Nominal case size: Ø 40 mm x 100 mm  
 4-terminal snap-in:  
 Ordering code: MAL2 095 27102 E3  
 Former 12NC: 2222 095 27102  
 Printed wiring:  
 Ordering code: MAL2 095 77102 E3  
 Former 12NC: 2222 095 77102

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> 100 Hz 85 °C (A)	I <sub>L5</sub> 5 min (µA)	ESR <sub>max.</sub> 100 Hz (mΩ)	Z <sub>max.</sub> 10 kHz (mΩ)	ORDERING CODE MAL2095.....	
							4T-SI	PW
350	560	35 x 50	3.4	396	196	120	15561E3	65561E3
	680	35 x 60	4.0	480	162	99	15681E3	65681E3
	680	40 x 50	4.1	480	165	102	25681E3	75681E3
	820	35 x 70	4.5	578	135	82	15821E3	65821E3
	820	40 x 60	4.6	578	137	85	25821E3	75821E3
	1000	35 x 80	5.1	704	112	68	15102E3	65102E3
	1000	40 x 60	5.0	704	116	73	25102E3	75102E3
	1000	45 x 50	5.0	704	121	78	35102E3	-
	1500	40 x 80	6.5	1054	79	50	25152E3	75152E3
	1500	45 x 70	6.5	1054	82	53	35152E3	-
	1800	40 x 100	7.5	1264	66	42	25182E3	75182E3
	2200	45 x 100	8.6	1544	57	37	35222E3	-



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> 100 Hz 85 °C (A)	I <sub>L5</sub> 5 min (µA)	ESR <sub>max.</sub> 100 Hz (mΩ)	Z <sub>max.</sub> 10 kHz (mΩ)	ORDERING CODE MAL2095.....	
							4T-SI	PW
400	470	35 x 50	3.2	380	215	126	16471E3	66471E3
	470	40 x 40	3.0	380	222	132	26471E3	76471E3
	560	35 x 60	3.7	452	180	105	16561E3	66561E3
	560	45 x 40	3.2	452	192	116	36561E3	-
	680	35 x 70	4.1	548	149	87	16681E3	66681E3
	680	40 x 60	4.3	548	151	89	26681E3	76681E3
	680	45 x 50	4.3	548	156	93	36681E3	-
	820	35 x 80	4.7	660	125	73	16821E3	66821E3
	820	40 x 60	4.6	660	129	77	26821E3	76821E3
	1000	35 x 100	5.9	804	102	60	16102E3	66102E3
	1000	40 x 70	5.2	804	107	64	26102E3	76102E3
	1000	45 x 60	5.4	804	110	67	36102E3	-
	1500	40 x 100	7.2	1204	72	43	26152E3	76152E3
	1500	45 x 80	6.7	1204	75	47	36152E3	-
	1800	45 x 100	7.9	1444	63	38	36182E3	-
	420	470	35 x 50	3.1	399	232	141	14471E3
470		40 x 40	3.0	399	238	147	24471E3	74471E3
560		35 x 60	3.6	474	194	119	14561E3	64561E3
680		35 x 70	4.1	575	161	98	14681E3	64681E3
680		40 x 60	4.3	575	163	100	24681E3	74681E3
680		45 x 50	4.3	575	167	104	34681E3	-
820		35 x 80	4.6	693	134	82	14821E3	64821E3
820		40 x 70	4.8	693	136	84	24821E3	74821E3
820		45 x 50	4.6	693	143	91	34821E3	-
1000		35 x 100	5.8	844	110	67	14102E3	64102E3
1000		40 x 80	5.4	844	112	69	24102E3	74102E3
1000		45 x 60	5.4	844	117	75	34102E3	-
1500		40 x 100	7.2	1264	77	48	24152E3	74152E3
1500		45 x 80	6.7	1264	80	51	34152E3	-
1800		45 x 100	7.8	1516	67	43	34182E3	-
450		390	35 x 50	2.9	355	246	142	17391E3
	390	40 x 40	2.8	355	253	148	27391E3	77391E3
	470	35 x 60	3.4	427	204	118	17471E3	67471E3
	470	40 x 50	3.5	427	208	121	27471E3	77471E3
	470	45 x 40	3.0	427	217	129	37471E3	-
	560	35 x 70	3.8	508	172	99	17561E3	67561E3
	560	40 x 60	4.0	508	174	101	27561E3	77561E3
	680	35 x 80	4.3	616	143	82	17681E3	67681E3
	680	40 x 60	4.3	616	147	87	27681E3	77681E3
	680	45 x 50	4.3	616	153	91	37681E3	-
	820	40 x 70	4.8	742	123	72	27821E3	77821E3
	820	45 x 60	5.0	742	126	76	37821E3	-
	1000	40 x 100	6.0	904	99	57	27102E3	77102E3
	1000	45 x 70	5.6	904	104	63	37102E3	-
	1200	40 x 100	6.4	1084	85	50	27122E3	77122E3
	1500	45 x 100	7.4	1354	71	42	37152E3	-



ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage	≥ 350 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1$
<b>Current</b>		
Leakage current	After 1 min at $U_R$	$I_{L1} \leq 0.006 C_R \times U_R + 4 \mu A$
	After 5 min at $U_R$	$I_{L5} \leq 0.002 C_R \times U_R + 4 \mu A$
<b>Inductance</b>		
Equivalent series inductance (ESL)	All case sizes	Ca. 20 nH

**RIPPLE CURRENT AND USEFUL LIFE**

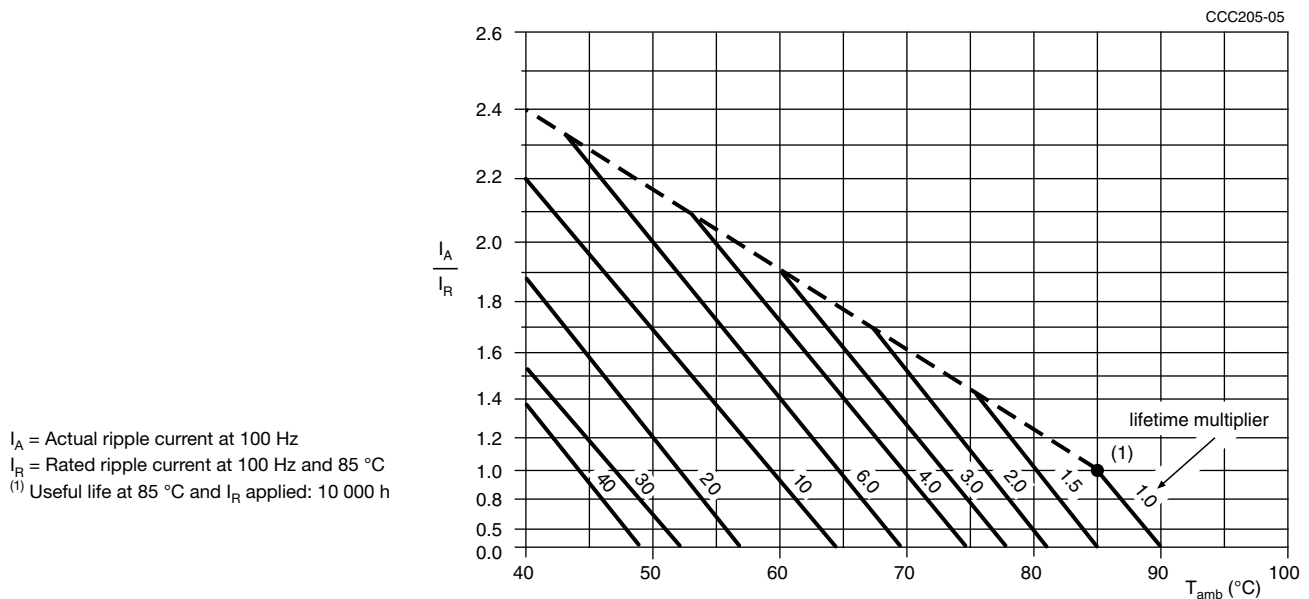


Fig. 8 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 3

MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY	
FREQUENCY (Hz)	$I_R$ MULTIPLIER
50	0.9
100	1.0
200	1.2
400	1.3
1000	1.4
10 000	1.5



Table 4

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ applied; 3000 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 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 10 000 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	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ }^{\circ}\text{C}$ ; no voltage applied; 1000 h  after test: $U_R$ to be applied for 30 min 24 h to 48 h before measurement	$\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$



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