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Aluminum Capacitors
Power Long Life 4-Terminal Snap-In



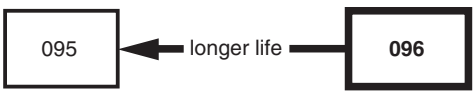


Fig. 1

FEATURES

- 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
- Very long useful life: 5000 h at 85 °C
- Temperature range up to 85 °C
- Keyed polarity
- Low ESR, high ripple current capability
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

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 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 (D x L in mm)	35 x 50 to 45 x 100
Rated capacitance range C_R	390 µF to 2700 µF
Tolerance on C_R	± 20 %
Rated voltage range, U_R	350 V to 500 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, 1.4 x I_R applied	200 000 h
Shelf life at 0 V, 85 °C	1000 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)					
	350	385	400	420	450	500
390	-	-	-	-	-	35 x 60
470	-	-	-	-	-	35 x 70
560	-	-	-	-	35 x 60	35 x 70 40 x 60
680	-	35 x 50 40 x 50	35 x 60 40 x 50	35 x 60 40 x 50	35 x 70 40 x 50	35 x 80 40 x 70
820	35 x 50 40 x 40	35 x 60 40 x 50	35 x 60 40 x 50	35 x 70 40 x 60	35 x 80 40 x 60	35 x 100 40 x 80
1000	35 x 60 40 x 50	35 x 70 40 x 60	35 x 70 40 x 60 45 x 50	35 x 80 40 x 60	35 x 100 40 x 70 45 x 60	40 x 100 45 x 70
1200	35 x 70 40 x 60	35 x 80 40 x 70	35 x 80 40 x 70 45 x 60	40 x 70	40 x 80 45 x 70	45 x 100
1500	35 x 80 40 x 70 45 x 60	40 x 80 45 x 60	35 x 100 40 x 80 45 x 70	40 x 100 45 x 70	40 x 100 45 x 80	45 x 100
1800	40 x 80 45 x 60	40 x 100 45 x 70	40 x 100 45 x 80	40 x 100 45 x 80	45 x 100	-
2200	40 x 100 45 x 70	40 x 100	45 x 100	45 x 100	-	-
2700	45 x 100	45 x 100	45 x 100	-	-	-

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DIMENSIONS in millimeters AND AVAILABLE FORMS

PRINTED WIRING

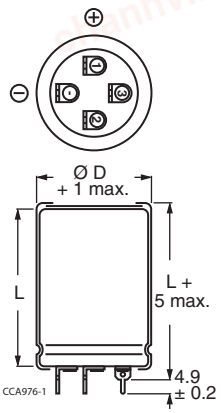


Fig. 2 - Printed wiring pin version
(Case Ø D = 35 mm)

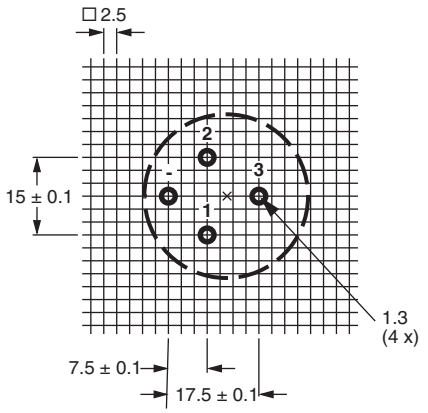


Fig. 3 - Mounting hole diagram viewed from component side
(Case Ø D = 35 mm)

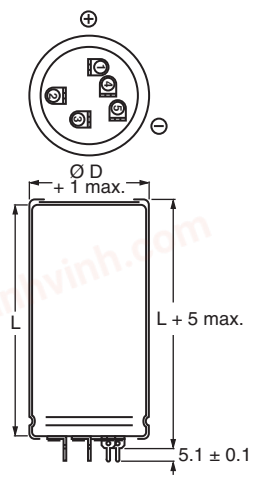


Fig. 4 - Printed wiring pin version
(Case Ø D = 40 mm)

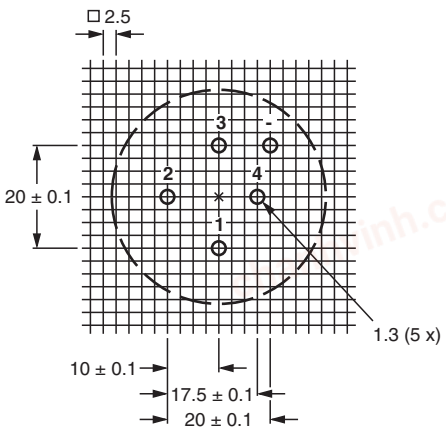
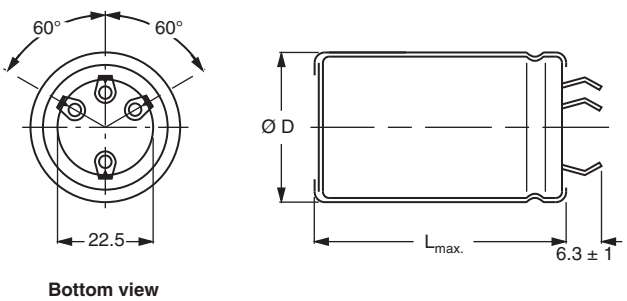


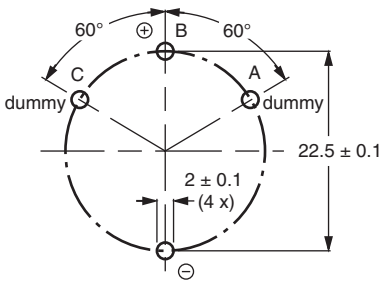
Fig. 5 - Mounting hole diagram viewed from component side
(Case Ø D = 40 mm)

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.

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Table 1

DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES						
NOMINAL CASE SIZE Ø D x L	Ø $D_{MAX.}$	4T-SI $L_{max.}$	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_R	Rated capacitance at 100 Hz
I_R	Rated RMS ripple current at 100 Hz and 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 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

ORDERING EXAMPLE

Electrolytic capacitor 096 series

820 µF/385 V;

Printed wiring:

Ordering code: MAL2 096 18821 E3
Former 12NC: 2222 096 18821

4-terminal snap-in:

Ordering code: MAL2 096 68821 E3
Former 12NC: 2222 096 68821

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)	ESR 100 Hz (mΩ)	$Z_{max.}$ 10 kHz (mΩ)	CATALOG NUMBER MAL2096.....	
							4T-SI	PW
350	820	35 x 50	4.0	578	126	82	15821E3	65821E3
	820	40 x 40	3.8	578	134	90	25821E3	75821E3
	1000	35 x 60	4.7	704	104	67	15102E3	65102E3
	1000	40 x 50	4.8	704	108	72	25102E3	75102E3
	1200	35 x 70	5.3	844	87	57	15122E3	65122E3
	1200	40 x 60	5.4	844	90	59	25122E3	75122E3
	1500	35 x 80	6.0	1054	71	47	15152E3	65152E3
	1500	40 x 70	6.2	1054	73	49	25152E3	75152E3
	1500	45 x 60	6.3	1054	76	52	35152E3	-
	1800	40 x 80	6.9	1264	62	41	25182E3	75182E3
	1800	45 x 60	6.6	1264	68	48	35182E3	-
	2200	40 x 100	8.2	1544	51	34	25222E3	75222E3
	2200	45 x 70	7.4	1544	57	41	35222E3	-
	2700	45 x 100	9.2	1894	44	30	35272E3	-

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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)	ESR 100 Hz (mΩ)	$Z_{max.}$ 10 kHz (mΩ)	CATALOG NUMBER MAL2096.....	
							4T-SI	PW
385	680	35 x 50	3.7	528	140	88	18681E3	68681E3
	680	40 x 50	4.2	528	140	87	28681E3	78681E3
	820	35 x 60	4.4	635	116	73	18821E3	68821E3
	820	40 x 50	4.5	635	120	76	28821E3	78821E3
	1000	35 x 70	5.0	774	96	60	18102E3	68102E3
	1000	40 x 60	5.1	774	99	63	28102E3	78102E3
	1200	35 x 80	5.5	928	81	51	18122E3	68122E3
	1200	40 x 70	5.7	928	83	53	28122E3	78122E3
	1500	40 x 80	6.5	1159	68	43	28152E3	78152E3
	1500	45 x 60	6.2	1159	74	50	38152E3	-
	1800	40 x 100	7.7	1390	56	36	28182E3	78182E3
	1800	45 x 70	7.0	1390	62	43	38182E3	-
	2200	40 x 100	8.2	1698	49	32	28222E3	78222E3
	2700	45 x 100	9.1	2083	43	29	38272E3	-
400	680	35 x 60	4.1	548	134	82	16681E3	66681E3
	680	40 x 50	4.2	548	138	85	26681E3	76681E3
	820	35 x 60	4.4	660	114	71	16821E3	66821E3
	820	40 x 50	4.5	660	119	75	26821E3	76821E3
	1000	35 x 70	5.0	804	94	59	16102E3	66102E3
	1000	40 x 60	5.1	804	97	62	26102E3	76102E3
	1000	45 x 50	5.1	804	103	67	36102E3	-
	1200	35 x 80	5.5	964	80	50	16122E3	66122E3
	1200	40 x 70	5.7	964	82	52	26122E3	76122E3
	1200	45 x 60	5.9	964	85	55	36122E3	-
	1500	35 x 100	7.1	1204	64	40	16152E3	66152E3
	1500	40 x 80	6.5	1204	67	43	26152E3	76152E3
	1500	45 x 70	6.6	1204	69	46	36152E3	-
	1800	40 x 100	7.7	1444	56	35	26182E3	76182E3
	1800	45 x 80	7.3	1444	59	39	36182E3	-
	2200	45 x 100	8.6	1764	48	32	36222E3	-
	2700	45 x 100	9.1	2164	42	29	36272E3	-
420	680	35 x 60	4.1	575	137	85	14681E3	64681E3
	680	40 x 50	4.2	575	141	89	24681E3	74681E3
	820	35 x 70	4.6	693	114	71	14821E3	64821E3
	820	40 x 60	4.7	693	117	74	24821E3	74821E3
	1000	35 x 80	5.1	844	95	59	14102E3	64102E3
	1000	40 x 60	5.1	844	100	64	24102E3	74102E3
	1200	40 x 70	5.7	1012	84	54	24122E3	74122E3
	1500	40 x 100	7.2	1264	66	42	24152E3	74152E3
	1500	45 x 70	6.6	1264	71	48	34152E3	-
	1800	40 x 100	7.6	1516	57	37	24182E3	74182E3
	1800	45 x 80	7.2	1516	60	40	34182E3	-
	2200	45 x 100	8.5	1852	49	33	34222E3	-

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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)	ESR 100 Hz (mΩ)	$Z_{max.}$ 10 kHz (mΩ)	CATALOG NUMBER MAL2096.....	
							4T-SI	PW
450	560	35 x 60	3.8	508	155	94	17561E3	67561E3
	680	35 x 70	4.2	616	129	78	17681E3	67681E3
	680	40 x 50	4.2	616	136	85	27681E3	77681E3
	820	35 x 80	4.8	742	108	66	17821E3	67821E3
	820	40 x 60	4.7	742	112	70	27821E3	77821E3
	1000	35 x 100	6.0	904	89	54	17102E3	67102E3
	1000	40 x 70	5.3	904	93	58	27102E3	77102E3
	1000	45 x 60	5.5	904	97	62	37102E3	-
	1200	40 x 80	6.0	1084	78	49	27122E3	77122E3
	1200	45 x 70	6.1	1084	81	52	37122E3	-
	1500	40 x 100	7.2	1354	63	39	27152E3	77152E3
	1500	45 x 80	6.8	1354	67	43	37152E3	-
	1800	45 x 100	8.0	1624	55	35	37182E3	-
500	390	35 x 60	2.9	394	475	421	19391E3	69391E3
	470	35 x 70	3.3	474	395	350	19471E3	69471E3
	560	35 x 70	3.6	564	333	296	19561E3	69561E3
	560	40 x 60	3.7	564	336	299	29561E3	79561E3
	680	35 x 80	4.1	684	275	245	19681E3	69681E3
	680	40 x 70	4.2	684	277	247	29681E3	79681E3
	820	35 x 100	5.1	824	229	203	19821E3	69821E3
	820	40 x 80	4.7	824	231	206	29821E3	79821E3
	1000	40 x 100	5.6	1004	189	169	29102E3	79102E3
	1000	45 x 70	5.3	1004	195	176	39102E3	-
	1200	45 x 100	6.4	1204	160	144	39122E3	-
	1500	45 x 100	7.0	1504	131	118	39152E3	-

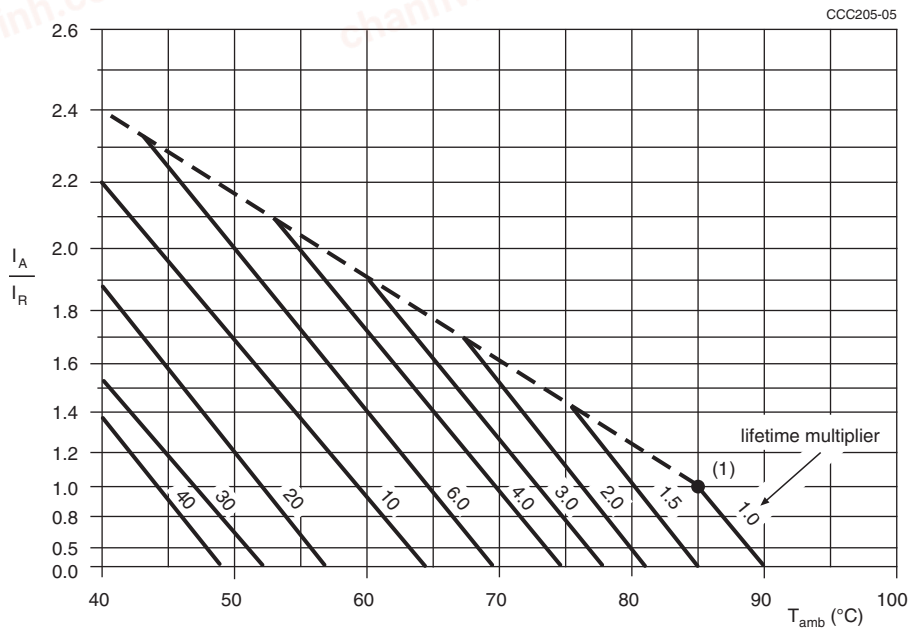
ADDITIONAL ELECTRICAL DATA

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥ 350 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1$
Current		
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	$I_{L5} \leq 0.002\ C_R \times U_R + 4\ \mu A$
Inductance		
Equivalent series inductance (ESL)	All case sizes	Ca. 20 nH

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RIPPLE CURRENT AND USEFUL LIFE



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. 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 (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: ± 10 % ESR ≤ 1.3 x spec. limit Z ≤ 2 x spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 4.13	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	IEC 60384-4/ EN130300 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

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