Aluminum Electrolytic Capacitors
Power High Ripple Current Long Life 4-Terminal Snap-In

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 105 °C
- Temperature range up to 105 °C
- Stable mounting and keyed polarity
- High ripple current capability
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

ADDITIONAL RESOURCES

3D Models

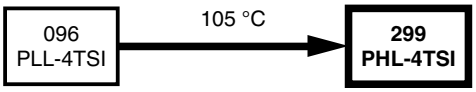


Fig. 1

APPLICATIONS

- Switched mode power supplies
- Renewable energy power converters
- 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
- Name of manufacturer
- Code for factory of origin
- "-" sign to identify the negative terminal, visible from the top and side of the capacitor
- (Partial) ordering code
- 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	470 µF to 2200 µF
Tolerance on C_R	± 20 %
Rated voltage range, U_R	400 V to 450 V
Category temperature range	-40 °C to +105 °C
Endurance test at 105 °C	2000 h
Useful life at 105 °C	5000 h
Shelf life at 0 V, 105 °C	1000 h
Based on sectional specification	IEC 60384-4 / EN 130300
Climatic category IEC 60068	40 / 105 / 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)	
	400	**450**
470	-	35 x 50
		40 x 40
560	35 x 50	35 x 60
		40 x 50
680	40 x 40	35 x 70
820	35 x 60	35 x 80
	40 x 50	40 x 60
1000	35 x 70	35 x 100
		40 x 80
		45 x 60
1200	35 x 80	45 x 70
	40 x 70	
	45 x 60	
1500	35 x 100	40 x 100
	45 x 70	45 x 80
1800	40 x 100	45 x 100
	45 x 80	
2200	45 x 100	-

DIMENSIONS in millimeters AND AVAILABLE FORMS

4-TERMINAL SNAP-IN

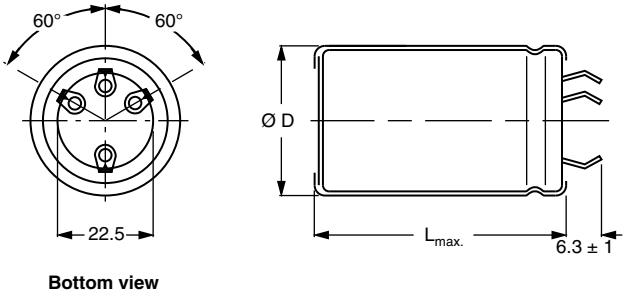


Fig. 2 - 4-Terminal snap-in

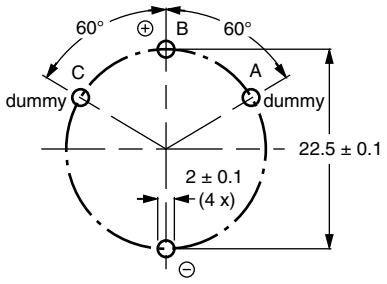


Fig. 3 - Mounting hole diagram

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

Table 1

DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES					
NOMINAL CASE SIZE Ø D x L	Ø $D_{MAX.}$	$L_{max.}$	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS L x W x H
35 x 50	36	52	72	50	390 x 198 x 60
35 x 60	36	62	91	50	390 x 198 x 70
35 x 70	36	72	103	50	377 x 375 x 97
35 x 80	36	82	115	50	377 x 375 x 107
35 x 100	36	102	151	50	377 x 375 x 127
40 x 40	41	42	70	50	440 x 223 x 60
40 x 50	41	52	94	50	440 x 223 x 70
40 x 60	41	62	118	25	230 x 230 x 80
40 x 70	41	72	134	25	230 x 230 x 90
40 x 80	41	82	150	25	230 x 230 x 100
40 x 100	41	102	176	25	230 x 230 x 120
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 105 °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 299 series

2200 µF / 400 V

4-terminal snap-in:

Ordering code: MAL2 299 56222 E3

Former 12NC: 2222 299 56222

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION									
U_R (V)	C_R (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 100 Hz 105 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz (mΩ)	MAX. ESR 100 Hz (mΩ)	TYP. Z 10 kHz (mΩ)	MAX. Z 10 kHz (mΩ)	CATALOG NUMBER MAL2299.....
400	560	35 x 50	2.70	0.452	170	220	130	160	56561E3
	680	40 x 40	2.79	0.548	150	190	110	140	56681E3
	820	35 x 60	3.44	0.660	120	150	90	110	56821E3
	820	40 x 50	3.51	0.660	120	160	90	110	66821E3
	1000	35 x 70	3.88	0.804	100	130	70	90	56102E3
	1200	35 x 80	4.34	0.964	90	110	60	80	56122E3
	1200	40 x 70	4.50	0.964	90	110	60	80	66122E3
	1200	45 x 60	4.61	0.964	90	110	60	80	76122E3
	1500	35 x 100	5.54	1.204	70	90	50	60	56152E3
	1500	45 x 70	5.20	1.204	70	90	60	70	66152E3
	1800	40 x 100	6.02	1.444	50	70	40	50	56182E3
	1800	45 x 80	5.74	1.444	60	80	50	60	66182E3
	2200	45 x 100	6.77	1.764	50	60	40	50	56222E3
450	470	35 x 50	2.54	0.427	190	240	130	160	57471E3
	470	40 x 40	2.45	0.427	190	240	140	170	67471E3
	560	35 x 60	2.96	0.508	160	200	100	130	57561E3
	560	40 x 50	3.05	0.508	160	200	110	140	67561E3
	680	35 x 70	3.34	0.616	120	160	90	110	57681E3
	820	35 x 80	3.76	0.742	110	140	70	90	57821E3
	820	40 x 60	3.73	0.742	110	140	80	100	67821E3
	1000	35 x 100	4.74	0.904	90	110	60	80	57102E3
	1000	40 x 80	4.41	0.904	90	110	60	80	67102E3
	1000	45 x 60	4.34	0.904	90	120	60	80	77102E3
	1200	45 x 70	4.84	1.084	80	100	60	70	57122E3
	1500	40 x 100	5.67	1.354	60	80	40	50	57152E3
	1500	45 x 80	5.39	1.354	60	80	50	60	67152E3
	1800	45 x 100	6.36	1.624	50	70	40	50	57182E3

ADDITIONAL ELECTRICAL DATA		
PARAMETER	**CONDITIONS**	**VALUE**
Voltage		
Surge voltage	≥ 400 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)	All case sizes	Ca. 20 nH

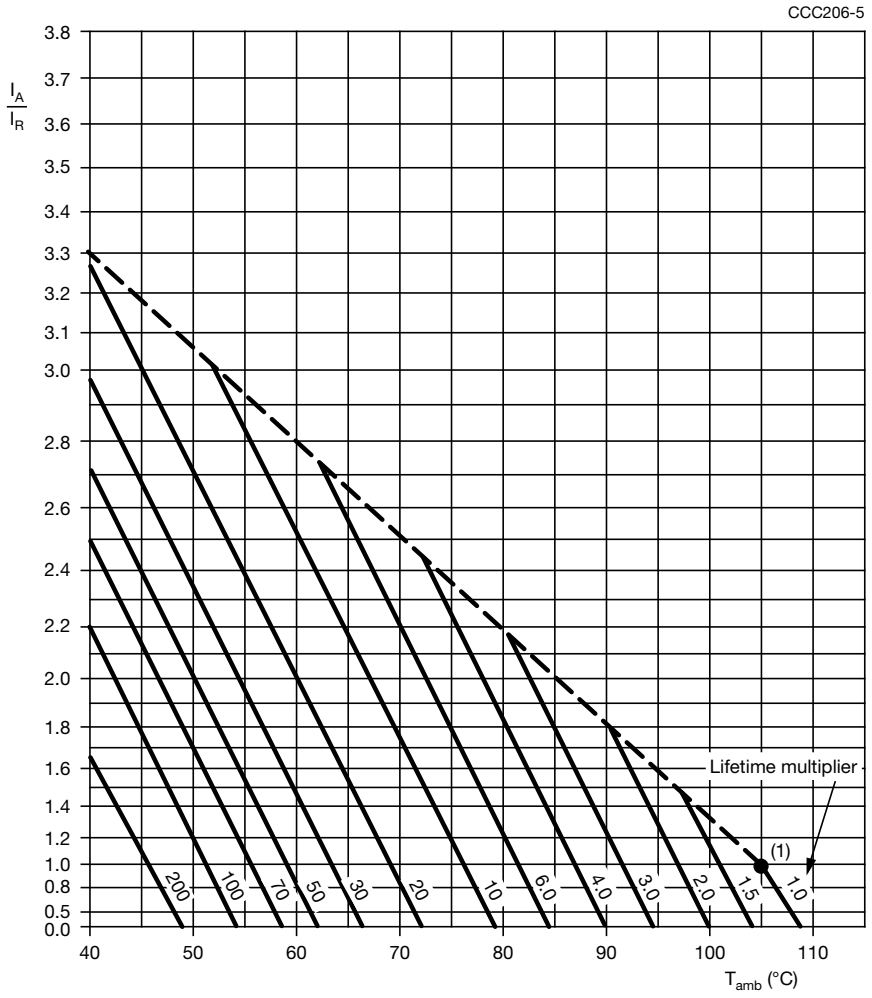
RIPPLE CURRENT AND USEFUL LIFE

Table 3

ENDURANCE TEST DURATION AND USEFUL LIFE	
ENDURANCE AT 105 °C (h)	USEFUL LIFE AT 105 °C (h)
2000	5000

Note

- Multiplier of useful life code: CCC206-5



I_A = Actual ripple current at 100 Hz
I_R = Actual ripple current at 100 Hz and 105 °C

(1) Useful life at 105 °C and I_R applied: 5000 h

Fig. 4 - 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	200	400	1000	10 000
I_R MULTIPLIER					
0.9	1.0	1.2	1.3	1.4	1.5

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} = 105 °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} = 105 °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} = 105 °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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