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



ADDITIONAL RESOURCES

3D Models

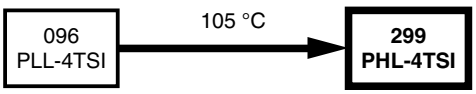


Fig. 1

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 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

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	-

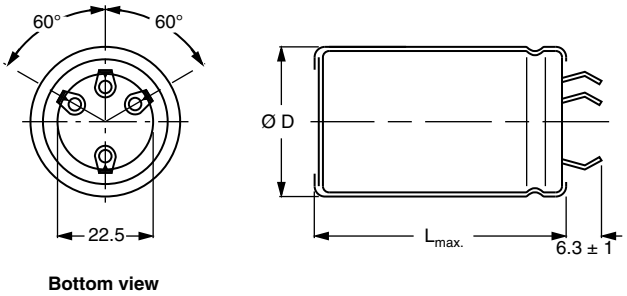
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DIMENSIONS in millimeters AND AVAILABLE FORMS

4-TERMINAL SNAP-IN



Bottom view

Fig. 2 - 4-Terminal snap-in

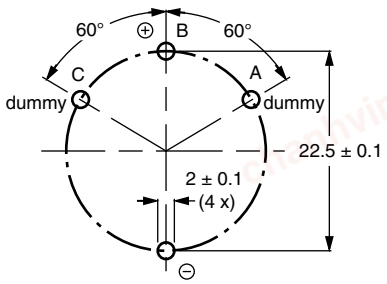


Fig. 3 - Mounting hole diagram

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

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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

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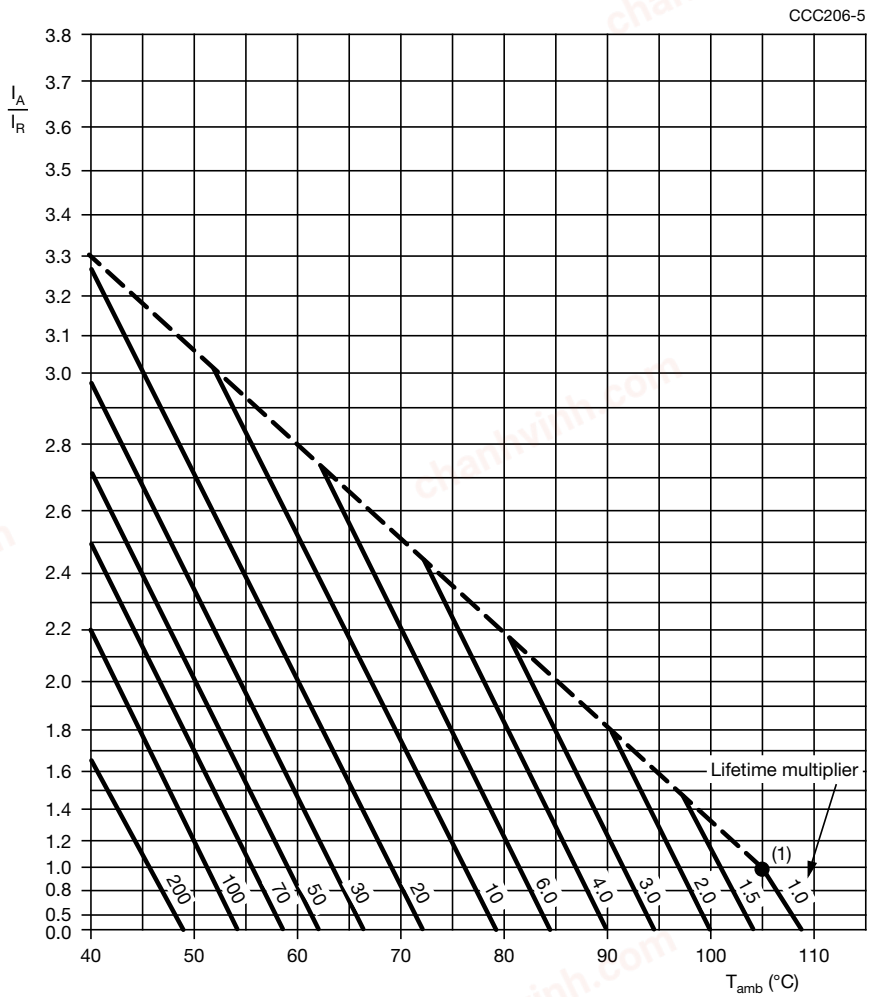
RIPPLE CURRENT AND USEFUL LIFE

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

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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} = 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

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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