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Aluminum Electrolytic Capacitors
Axial Miniature, Long-Life

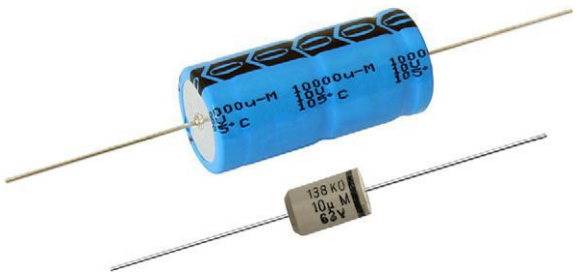




Fig. 1

QUICK REFERENCE DATA		
DESCRIPTION	**VALUE**	
Nominal case sizes (Ø D x L in mm)	6.3 x 12.7 to 10 x 25	10 x 30 to 21 x 38
Rated capacitance range, C_R	2.2 µF to 15 000 µF	
Tolerance on C_R	± 20 %	
Rated voltage range, U_R	6.3 V to 100 V	
Category temperature range	-40 °C to +105 °C	
Endurance test at 105 °C	1000 h	5000 h
Useful life at 105 °C	2000 h	10 000 h
Useful life at 40 °C, I_R applied	1.3 x I_R applied: 200 000 h	1.8 x I_R applied: 500 000 h
Shelf life at 0 V, 105 °C	500 h	
Based on sectional specification	IEC 60384-4 / EN130 300	
Climatic category IEC 60068	40 / 105 / 56	

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
  (case Ø 6.3 mm x 12.7 mm and 7.7 mm x 12.7 mm are molded with flame retardant plastic material)
- Mounting ring version not available in insulated form
- Taped versions up to case Ø 15 mm x 30 mm available for automatic insertion
- Charge and discharge proof
- Long useful life: 2000 h to 10 000 h at 105 °C, high reliability
- High ripple current capability
- Miniaturized, high CV-product per unit volume
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

APPLICATIONS

- Industrial, automotive, EDP and telecommunication
- Smoothing, filtering, buffering in SMPS; coupling, decoupling, timing
- Portable and mobile equipment (small size, low mass)
- Stand-by applications
- Low mounting height boards, vibration and shock resistant

MARKING

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

- Rated capacitance (in µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Date code, in accordance with IEC 60062
- Code for factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (138)

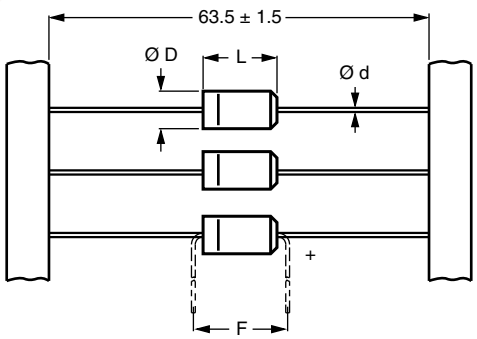
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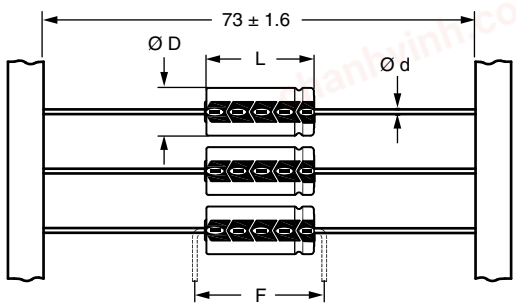
SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)								
C_R (µF)	U_R (V)							
	6.3	10	16	25	40	50	63	100
2.2	-	-	-	-	-	-	-	6.3 x 12.7
4.7	-	-	-	-	-	-	6.3 x 12.7	7.7 x 12.7
10	-	-	-	6.3 x 12.7	-	6.3 x 12.7	7.7 x 12.7	6.5 x 18
22	-	-	6.3 x 12.7	6.3 x 12.7	-	7.7 x 12.7	6.5 x 18	8 x 18
33	-	-	-	-	7.7 x 12.7	-	-	-
47	-	-	6.3 x 12.7	7.7 x 12.7	6.5 x 18	-	8 x 18	10 x 25
68	-	-	-	-	-	-	-	10 x 30
100	6.3 x 12.7	-	7.7 x 12.7	6.5 x 18	8 x 18	10 x 18	10 x 25	12.5 x 30
150	-	7.7 x 12.7	-	-	-	-	10 x 30	15 x 30
220	7.7 x 12.7	6.5 x 18	8 x 18	10 x 18	10 x 25	-	12.5 x 30	15 x 30
330	-	-	-	-	10 x 30	-	12.5 x 30	18 x 30
470	6.5 x 18	8 x 18	10 x 18	10 x 25	12.5 x 30	-	15 x 30	18 x 38
680	-	-	-	10 x 30	12.5 x 30	-	18 x 30	21 x 38
1000	10 x 18	10 x 25	10 x 30	12.5 x 30	15 x 30	-	18 x 38	-
1500	-	10 x 30	12.5 x 30	15 x 30	18 x 30	-	21 x 38	-
2200	10 x 25	12.5 x 30	15 x 30	18 x 30	18 x 38	-	-	-
3300	-	15 x 30	18 x 30	18 x 38	21 x 38	-	-	-
4700	-	18 x 30	18 x 30	18 x 38	-	-	-	-
6800	-	18 x 38	18 x 38	21 x 38	-	-	-	-
10 000	-	18 x 38	21 x 38	-	-	-	-	-
15 000	-	21 x 38	-	-	-	-	-	-

DIMENSIONS in millimeters AND AVAILABLE FORMS



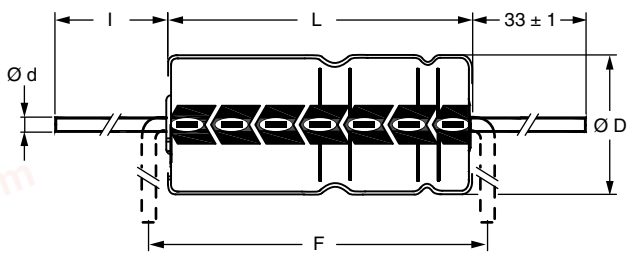
Form BR: Taped on reel
Form BA: Taped in box (ammopack)
Case Ø D x L = 6.3 mm x 12.7 mm to 7.7 mm x 12.7 mm

Fig. 2 - **Forms BA** and **BR**



Form BR: Taped on reel
Case Ø D x L = 6.5 mm x 18 mm to 15 mm x 30 mm
Form BA: Taped in box (ammopack)
Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm

Fig. 3 - **Forms BA** and **BR**



Form AA: Axial in box
Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm

Fig. 4 - **Form AA**

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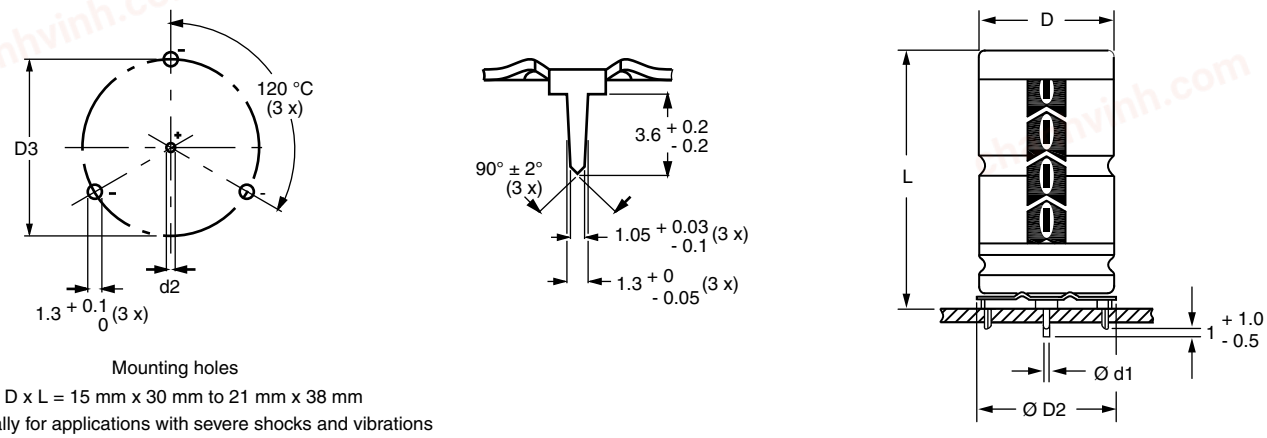
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Table 1

AXIAL; DIMENSIONS in millimeters, **MASS AND PACKAGING QUANTITIES**										
NOMINAL CASE SIZE Ø D x L (mm)	**CASE CODE**	**AXIAL: FORM AA, BA, AND BR**					**MASS (g)**	**PACKAGING QUANTITIES**		
		Ø d	**l**	**Ø $D_{max.}$**	**$L_{max.}$**	**$F_{min.}$**		**FORM AA**	**FORM BA**	**FORM BR**
6.3 x 12.7	(2)	0.6	-	6.5	12.9	17.5	≈ 1.1	-	1000	1000
7.7 x 12.7	(3)	0.6	-	7.9	12.9	17.5	≈ 1.3	-	500	500
6.5 x 18	4	0.8	-	6.9	18.5	25	≈ 1.3	-	1000	1000
8 x 18	5	0.8	-	8.5	18.5	25	≈ 1.7	-	500	500
10 x 18	6	0.8	-	10.5	18.5	25	≈ 2.5	-	500	500
10 x 25	7	0.8	-	10.5	25.5	30	≈ 3.3	-	500	500
10 x 30	00	0.8	55 ± 1	10.5	30.5	35	≈ 4.8	340	-	500
12.5 x 30	01	0.8	55 ± 1	13.0	30.5	35	≈ 7.4	260	-	400
15 x 30	02	0.8	55 ± 1	15.5	30.5	35	≈ 11.7	200	-	250
18 x 30	03	0.8	55 ± 1	18.5	30.5	35	≈ 12.9	120	-	-
18 x 38	04	0.8	34 ± 1	18.5	39.5	44	≈ 19.0	125	-	-
21 x 38	05	0.8	34 ± 1	21.5	39.5	44	≈ 24.0	100	-	-

Note

- For detailed tape dimensions refer to packaging information: www.vishay.com/doc?28361



Mounting holes
Case Ø D x L = 15 mm x 30 mm to 21 mm x 38 mm
Especially for applications with severe shocks and vibrations

Fig. 5 - Mounting hole diagram and outline; **Form MR:** With mounting ring and pins

Table 2

MOUNTING RING; DIMENSIONS in millimeters, **MASS AND PACKAGING QUANTITIES**									
NOMINAL CASE SIZE Ø D x L	**CASE CODE**	**MOUNTING RING: FORM MR**						**MASS (g)**	**PACKAGING QUANTITIES**
		Ø d1	**Ø d2**	**$D_{max.}$**	**Ø $D2_{max.}$**	**D3**	**$L_{max.}$**		
15 x 30	02	0.8	1.0 + 0.4	15.5	17.5	16.5 ± 0.2	33	≈ 11.7	200
18 x 30	03	0.8	1.0 + 0.4	18.5	19.5	18.5 ± 0.2	33	≈ 12.9	240
18 x 38	04	0.8	1.0 + 0.4	18.5	19.5	18.5 ± 0.2	42	≈ 19.0	100
21 x 38	05	0.8	1.0 + 0.4	21.5	22.5	21.5 ± 0.2	42	≈ 24.0	100

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ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	Rated capacitance at 100 Hz, tolerance ± 20 %
I_R	Rated RMS ripple current at 100 Hz, 105 °C
I_{L5}	Max. leakage current after 5 min at U_R
tan δ	Max. dissipation factor at 100 Hz
ESR	Equivalent series resistance at 100 Hz (calculated from tan $\delta_{max.}$ and C_R)
Z	Max. impedance at 10 kHz or 100 kHz

Note

- Unless otherwise specified, all electrical values in Table 3 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %.

ORDERING EXAMPLE

Electrolytic capacitor 138 series

470 µF / 10 V; ± 20 %

Nominal case size: Ø 8 mm x 18 mm; Form BA

Ordering code: MAL213834471E3
Former 12 NC: 2222 138 34471

Table 3

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 105 °C (mA)	I_{L5} 5 min (µA)	tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	ORDERING CODE MAL2138.....			
									IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
	100	6.3 x 12.7	99	5.3	0.24	3.800	3.000	1.800	-	23101E3	33101E3	-
	220	7.7 x 12.7	160	6.8	0.24	1.700	1.400	0.950	-	23221E3	33221E3	-
6.3	470	6.5 x 18	250	9.9	0.24	0.810	0.640	0.500	-	23471E3	33471E3	-
	1000	10 x 18	430	17	0.24	0.380	0.300	0.240	-	23102E3	33102E3	-
	2200	10 x 25	640	32	0.29	0.210	0.180	0.150	-	23222E3	33222E3	-
	150	7.7 x 12.7	140	7.0	0.2	2.100	1.300	0.950	-	24151E3	34151E3	-
	220	6.5 x 18	190	8.4	0.2	1.400	0.910	0.500	-	24221E3	34221E3	-
	470	8 x 18	300	13	0.2	0.680	0.430	0.350	-	24471E3	34471E3	-
	1000	10 x 25	520	24	0.2	0.320	0.200	0.160	-	24102E3	34102E3	-
	1500	10 x 30	670	34	0.28	0.320	0.260	0.260	14152E3	24152E3	-	-
10	2200	12.5 x 30	890	48	0.29	0.220	0.190	0.190	14222E3	24222E3	-	-
	3300	15 x 30	1140	70	0.30	0.160	0.130	0.150	14332E3	24332E3	-	44332E3
	4700	18 x 30	1450	98	0.33	0.120	0.110	0.130	14472E3	-	-	44472E3
	6800	18 x 38	1880	140	0.34	0.085	0.074	0.110	14682E3	-	-	44682E3
	10 000	18 x 38	1980	200	0.41	0.070	0.062	0.100	14103E3	-	-	44103E3
	15 000	21 x 38	2200	300	0.55	0.063	0.058	0.099	14153E3	-	-	44153E3
	22	6.3 x 12.7	58	4.7	0.12	8.700	7.300	2.700	-	25229E3	35229E3	-
	47	6.3 x 12.7	83	5.5	0.16	5.400	3.400	1.900	-	25479E3	35479E3	-
	100	7.7 x 12.7	130	7.2	0.16	2.500	1.600	1.000	-	25101E3	35101E3	-
	220	8 x 18	230	11	0.16	1.200	0.730	0.350	-	25221E3	35221E3	-
	470	10 x 18	360	19	0.16	0.540	0.340	0.250	-	25471E3	35471E3	-
16	1000	10 x 30	630	36	0.20	0.340	0.270	0.260	15102E3	25102E3	-	-
	1500	12.5 x 30	860	52	0.20	0.230	0.190	0.190	15152E3	25152E3	-	-
	2200	15 x 30	1090	74	0.21	0.170	0.140	0.150	15222E3	25222E3	-	45222E3
	3300	18 x 30	1420	110	0.24	0.120	0.100	0.130	15332E3	-	-	45332E3
	4700	18 x 30	1480	150	0.28	0.100	0.090	0.120	15472E3	-	-	45472E3
	6800	18 x 38	1930	220	0.28	0.072	0.062	0.100	15682E3	-	-	45682E3
	10 000	21 x 38	2100	320	0.38	0.065	0.057	0.098	15103E3	-	-	45103E3
	10	6.3 x 12.7	46	4.5	0.09	14.000	12.000	2.800	-	26109E3	36109E3	-
25	22	6.3 x 12.7	61	5.1	0.14	10.000	5.500	2.500	-	26229E3	36229E3	-
	47	7.7 x 12.7	96	6.4	0.14	4.700	2.600	1.000	-	26479E3	36479E3	-

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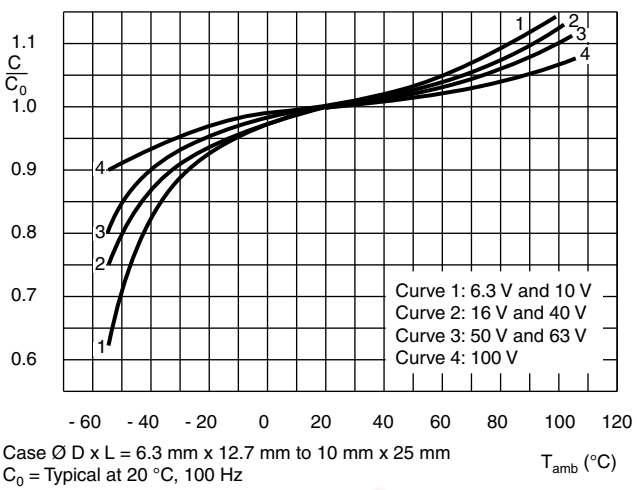
U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 100 Hz 105 °C (mA)	I_{L5} 5 min (µA)	tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	ORDERING CODE MAL2138.....			
									IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
25	100	6.5 x 18	160	9.0	0.13	2.100	1.200	0.550	-	26101E3	36101E3	-
	220	10 x 18	270	15	0.13	0.940	0.550	0.270	-	26221E3	36221E3	-
	470	10 x 25	440	28	0.13	0.440	0.260	0.170	-	26471E3	36471E3	-
	680	10 x 30	580	38	0.14	0.360	0.260	0.250	16681E3	26681E3	-	-
	1000	12.5 x 30	790	54	0.15	0.250	0.180	0.190	16102E3	26102E3	-	-
	1500	15 x 30	1020	79	0.15	0.170	0.130	0.150	16152E3	26152E3	-	46152E3
	2200	18 x 30	1320	110	0.17	0.130	0.100	0.130	16222E3	-	-	46222E3
	3300	18 x 38	1720	170	0.17	0.090	0.071	0.110	16332E3	-	-	46332E3
	4700	18 x 38	1840	240	0.21	0.076	0.063	0.100	16472E3	-	-	46472E3
	6800	21 x 38	2100	340	0.27	0.068	0.058	0.099	16682E3	-	-	46682E3
40	33	7.7 x 12.7	91	6.6	0.11	5.300	2.700	1.000	-	27339E3	37339E3	-
	47	6.5 x 18	120	7.8	0.10	3.400	1.900	0.650	-	27479E3	37479E3	-
	100	8 x 18	180	12	0.10	1.600	0.900	0.400	-	27101E3	37101E3	-
	220	10 x 25	350	22	0.10	0.720	0.410	0.200	-	27221E3	37221E3	-
	330	10 x 30	490	30	0.10	0.470	0.320	0.300	17331E3	27331E3	-	-
	470	12.5 x 30	650	42	0.10	0.340	0.230	0.220	17471E3	27471E3	-	-
	680	12.5 x 30	750	58	0.10	0.250	0.180	0.180	17681E3	27681E3	-	-
	1000	15 x 30	970	84	0.10	0.170	0.120	0.140	17102E3	27102E3	-	47102E3
	1500	18 x 30	1250	120	0.12	0.130	0.098	0.120	17152E3	-	-	47152E3
	2200	18 x 38	1640	180	0.12	0.093	0.069	0.100	17222E3	-	-	47222E3
	3300	21 x 38	1810	270	0.15	0.079	0.061	0.100	17332E3	-	-	47332E3
50	10	6.3 x 12.7	51	5.0	0.09	14.00	7.000	2.700	-	21109E3	31109E3	-
	22	7.7 x 12.7	82	6.2	0.09	6.500	3.200	1.100	-	21229E3	31229E3	-
	100	10 x 18	230	14	0.08	1.300	0.700	0.300	-	21101E3	31101E3	-
63	4.7	6.3 x 12.7	35	4.6	0.09	30.00	17.000	5.000	-	28478E3	38478E3	-
	10	7.7 x 12.7	59	5.3	0.08	13.00	8.000	1.800	-	28109E3	38109E3	-
	22	6.5 x 18	100	6.8	0.07	5.100	3.600	0.850	-	28229E3	38229E3	-
	47	8 x 18	150	9.9	0.07	2.400	1.700	0.500	-	28479E3	38479E3	-
	100	10 x 25	280	17	0.07	1.100	0.800	0.270	-	28101E3	38101E3	-
	150	10 x 30	410	23	0.11	0.730	0.440	0.400	18151E3	28151E3	-	-
	220	12.5 x 30	560	32	0.11	0.500	0.310	0.290	18221E3	28221E3	-	-
	330	12.5 x 30	660	46	0.12	0.370	0.230	0.220	18331E3	28331E3	-	-
	470	15 x 30	860	63	0.12	0.260	0.160	0.160	18471E3	28471E3	-	48471E3
	680	18 x 30	1130	90	0.12	0.190	0.120	0.140	18681E3	-	-	48681E3
	1000	18 x 38	1460	130	0.12	0.130	0.086	0.110	18102E3	-	-	48102E3
	1500	21 x 38	1680	190	0.13	0.100	0.072	0.110	18152E3	-	-	48152E3
100	2.2	6.3 x 12.7	24	4.4	0.09	65.00	25.000	8.000	-	29228E3	39228E3	-
	4.7	7.7 x 12.7	40	4.9	0.08	27.00	17.000	5.000	-	29478E3	39478E3	-
	10	6.5 x 18	67	6.0	0.07	11.00	8.000	2.400	-	29109E3	39109E3	-
	22	8 x 18	100	8.4	0.07	5.100	3.600	1.400	-	29229E3	39229E3	-
	47	10 x 25	190	13	0.07	2.400	1.700	0.670	-	29479E3	39479E3	-
	68	10 x 30	300	18	0.07	1.700	1.100	0.970	19689E3	29689E3	-	-
	100	12.5 x 30	410	24	0.07	1.100	0.770	0.670	19101E3	29101E3	-	-
	150	15 x 30	550	34	0.07	0.780	0.520	0.460	19151E3	29151E3	-	49151E3
	220	15 x 30	650	48	0.07	0.540	0.370	0.330	19221E3	29221E3	-	49221E3
	330	18 x 30	880	70	0.08	0.380	0.270	0.240	19331E3	-	-	49331E3
	470	18 x 38	1130	98	0.08	0.270	0.190	0.170	19471E3	-	-	49471E3
	680	21 x 38	1330	140	0.09	0.210	0.140	0.140	19681E3	-	-	49681E3

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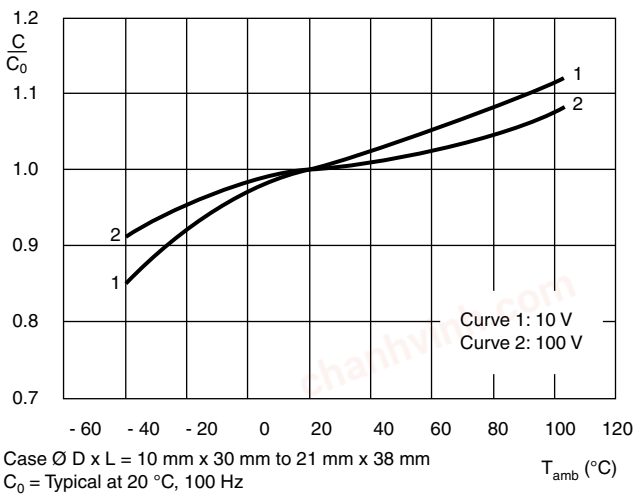
ADDITIONAL ELECTRICAL DATA			
PARAMETER	**CONDITIONS**	**VALUE**	
		AXIAL	**MOUNTING RING**
Voltage			
Surge voltage		$U_s \leq 1.15 \times U_R$	
Reverse voltage		$U_{rev} \leq 1\ V$	
Current			
Leakage current	After 1 min at U_R: case Ø D x L = 6.3 mm x 12.7 mm and 7.7 mm x 12.7 mm	$I_{L1} \leq 0.02\ C_R \times U_R + 3\ \mu A$	
	case Ø D x L = 6.5 mm x 18 mm to 21 mm x 38 mm	$I_{L1} \leq 0.006\ C_R \times U_R + 4\ \mu A$	
	After 5 min at U_R	$I_{L5} \leq 0.002\ C_R \times U_R + 4\ \mu A$	
Inductance			
Equivalent series inductance (ESL)	Case Ø D x L mm:		
	6.3 x 12.7	Typ. 20 nH	-
	7.7 x 12.7	Typ. 30 nH	-
	6.5 x 18	Typ. 15 nH	-
	8 x 18	Typ. 35 nH	-
	10 x 18	Typ. 69 nH	-
	10 x 25	Typ. 38 nH	-
	10 x 30	Typ. 38 nH	-
	12.5 x 30	Typ. 46 nH	-
	15 x 30	Typ. 48 nH	Typ. 39 nH
	18 x 30	Typ. 50 nH	Typ. 39 nH
	18 x 38	Typ. 54 nH	Typ. 39 nH
	21 x 38	Typ. 59 nH	Typ. 39 nH

CAPACITANCE (C)



Case Ø D x L = 6.3 mm x 12.7 mm to 10 mm x 25 mm
C_0 = Typical at 20 °C, 100 Hz

Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature



Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm
C_0 = Typical at 20 °C, 100 Hz

Fig. 7 - Typical multiplier of capacitance as a function of ambient temperature

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EQUIVALENT SERIES RESISTANCE (ESR)

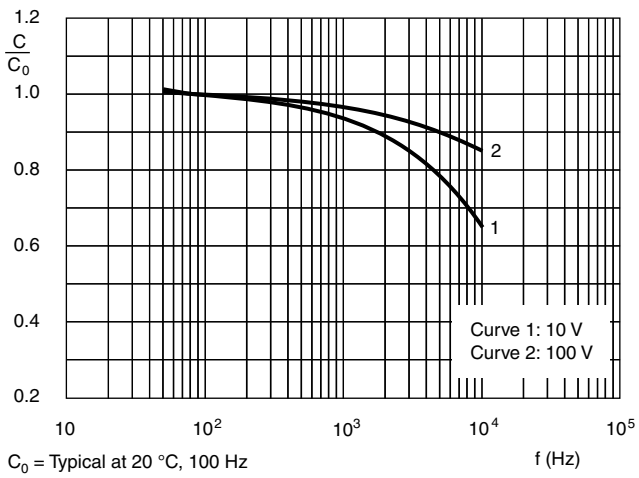


Fig. 8 - Typical multiplier of capacitance as a function of frequency

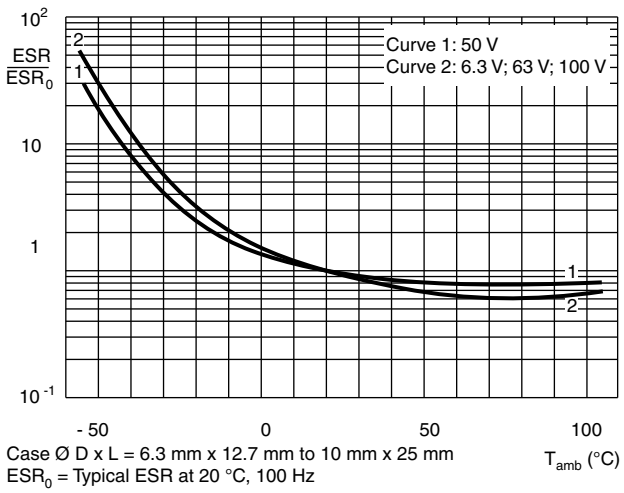


Fig. 9 - Typical multiplier of ESR as a function of ambient temperature

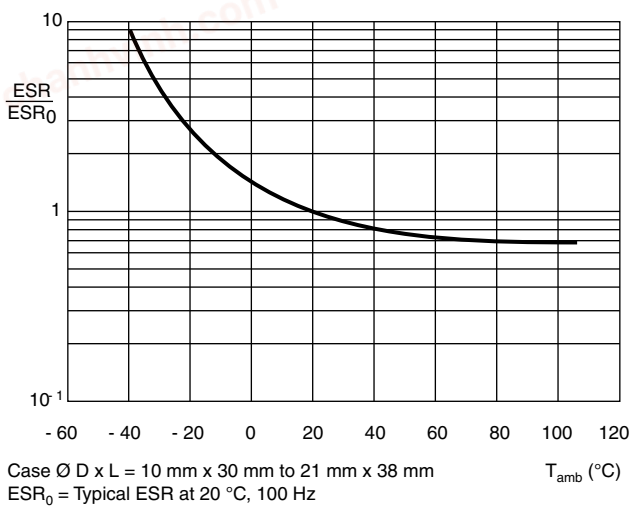


Fig. 10 - Typical multiplier of ESR as a function of ambient temperature

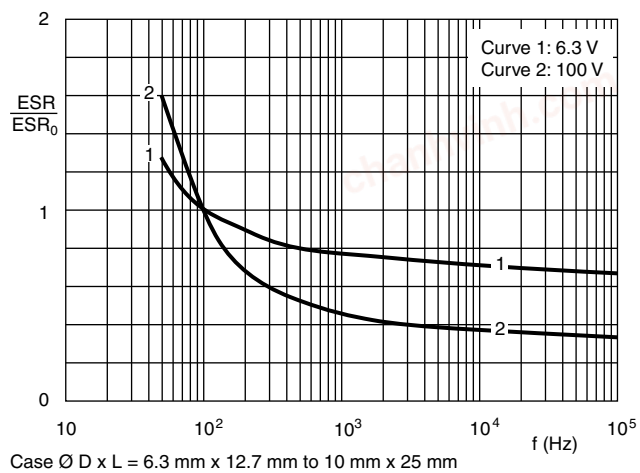


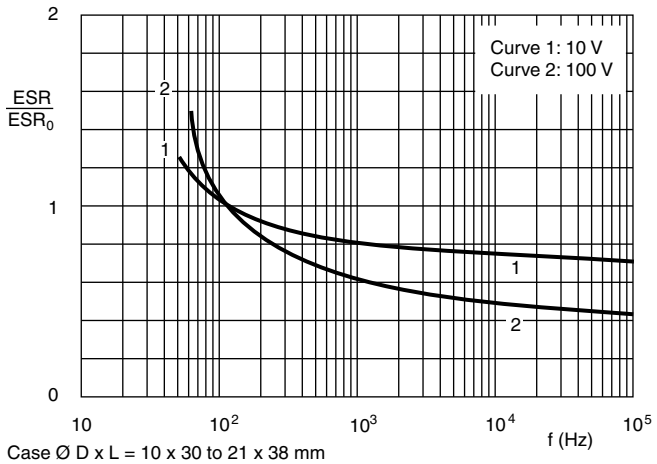
Fig. 11 - Typical multiplier ESR as a function of frequency

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EQUIVALENT SERIES RESISTANCE (ESR)



Case Ø D x L = 10 x 30 to 21 x 38 mm
ESR_0 = typical ESR at 20 °C, 100 Hz

Fig. 12 - Typical multiplier ESR as a function of frequency

IMPEDANCE (Z)

Table 4

IMPEDANCE VS. CAPACITANCE VALUES (Case Ø D x L = 6.3 mm x 12.7 mm to 10 mm x 25 mm)								
T_{amb}	**Z x C_R (Ω x µF) AT 10 kHz**							
	6.3 V	**10 V**	**16 V**	**25 V**	**40 V**	**50 V**	**63 V**	**100 V**
+20 °C	≤ 300	≤ 200	≤ 160	≤ 120	≤ 90	≤ 70	≤ 80	≤ 80
-25 °C	≤ 2000	≤ 1200	≤ 750	≤ 560	≤ 450	≤ 300	≤ 550	≤ 550
-40 °C	≤ 5500	≤ 3200	≤ 2000	≤ 1500	≤ 1200	≤ 900	≤ 1500	≤ 1500

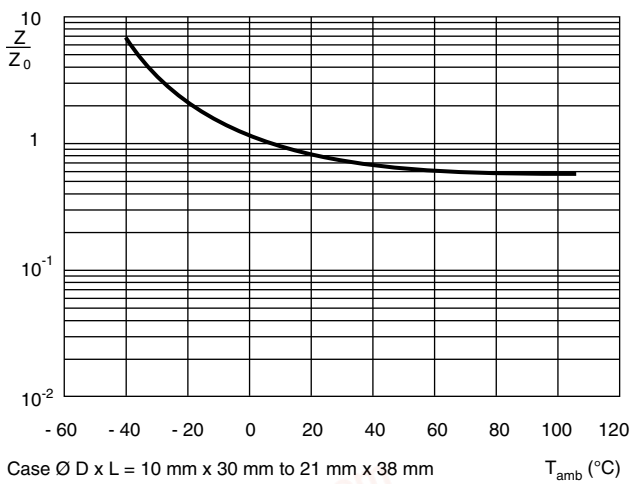


Fig. 13 - Typical multiplier of ESR as a function of ambient temperature at 10 kHz

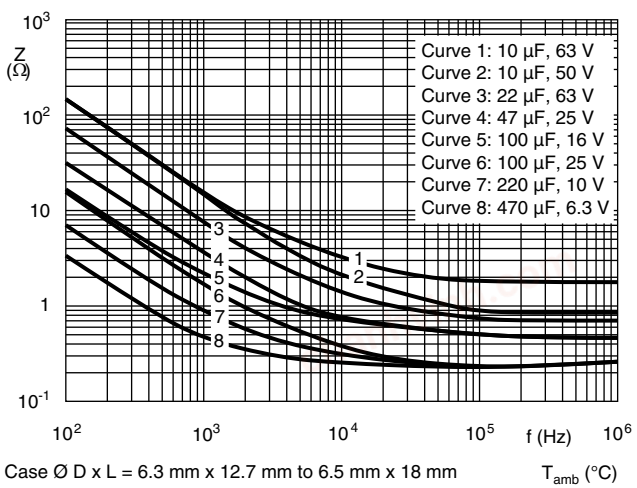


Fig. 14 - Typical impedance as a function of frequency

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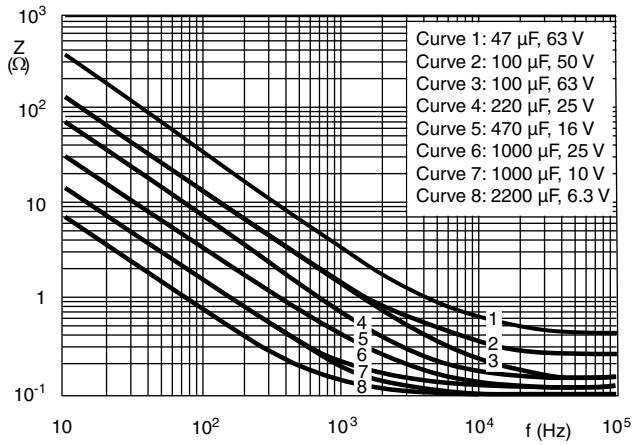


Fig. 15 - Typical impedance as a function of frequency

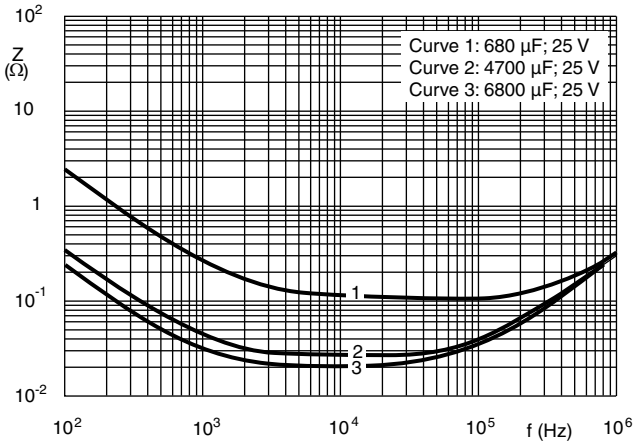


Fig. 16 - Typical impedance as a function of frequency

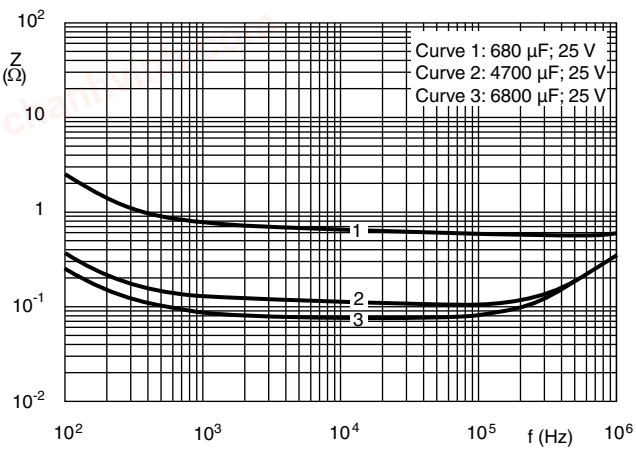


Fig. 17 - Typical impedance as a function of frequency

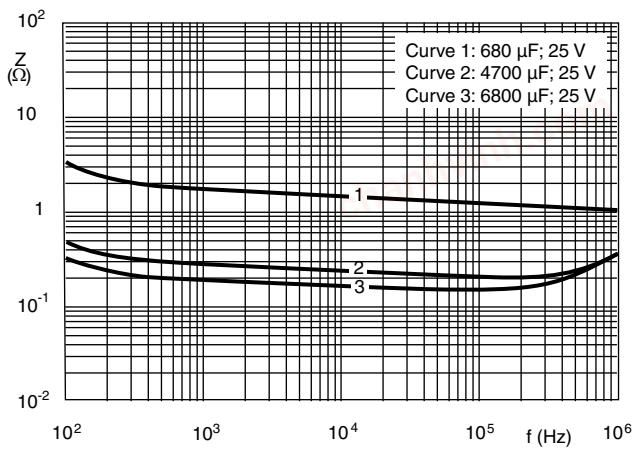


Fig. 18 - Typical impedance as a function of frequency

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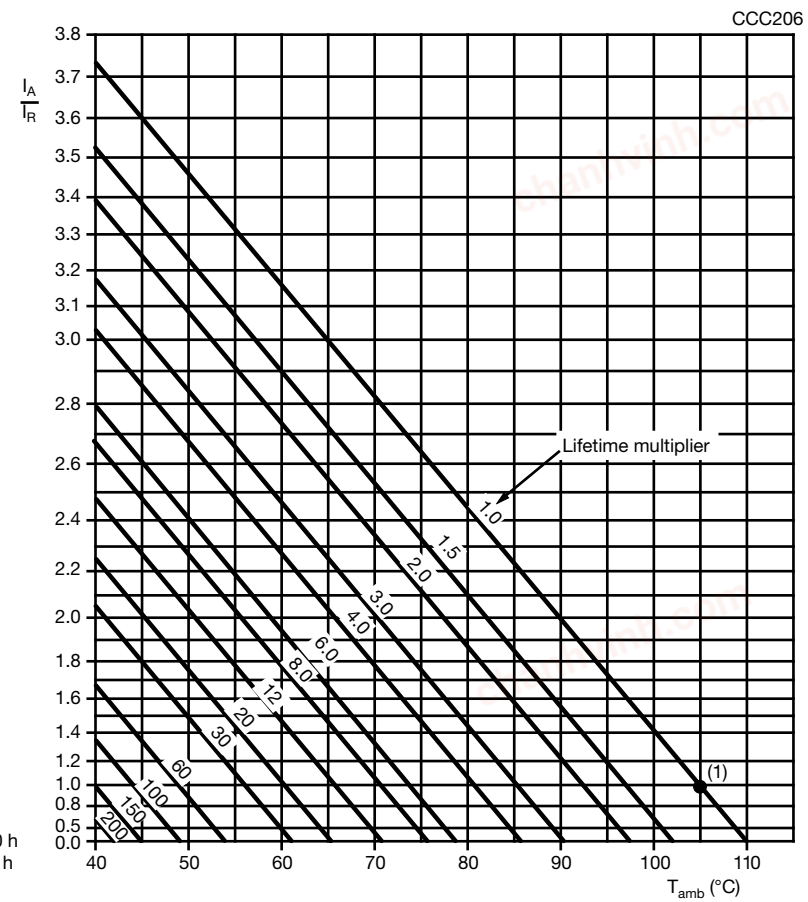
RIPPLE CURRENT AND USEFUL LIFE

Table 5

ENDURANCE TEST DURATION AND USEFUL LIFE		
NOMINAL CASE SIZE Ø D x L (mm)	ENDURANCE AT 105 °C (h)	USEFUL LIFE AT 105 °C (h)
6.3 x 12.7	1000	2000
7.7 x 12.7	1000	2000
6.5 x 18	1000	2000
8 x 18	1000	2000
10 x 18	1000	2000
10 x 25	1000	2000
10 x 30	5000	10 000
12.5 x 30	5000	10 000
15 x 30	5000	10 000
18 x 30	5000	10 000
18 x 38	5000	10 000
21 x 38	5000	10 000

Note

- Multiplier of useful life code: CCC206



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

(1) Useful life at 105 °C and I_R applied:
Case Ø D x L = 6.3 mm x 12.7 mm to 10 mm x 25 mm: 2000 h
Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm: 10 000 h

Fig. 19 - Multiplier of useful life as a function of ambient temperature and ripple current load

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Table 6

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY						
U_R (V)	FREQUENCY (Hz)					
	50	100	300	1000	3000	≥ 10 000
	I_R MULTIPLIER					
6.3	0.95	1.00	1.07	1.12	1.15	1.20
10	0.95	1.00	1.07	1.12	1.15	1.20
16	0.90	1.00	1.12	1.20	1.25	1.30
25	0.90	1.00	1.12	1.20	1.25	1.30
40	0.85	1.00	1.20	1.30	1.35	1.40
50	0.85	1.00	1.20	1.30	1.35	1.40
63	0.85	1.00	1.20	1.30	1.35	1.40
100	0.85	1.00	1.20	1.30	1.35	1.40

Table 7

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; Case Ø D x L: 6.3 mm x 12.7 mm to 10 mm x 25 mm: 1000 h; 10 mm x 30 mm to 21 mm x 38 mm: 5000 h	$U_R \leq$ 6.3 V; ΔC/C: +15 % / -30 % $U_R >$ 6.3 V; ΔC/C: ± 15 % tan δ ≤ 1.3 x spec. limit Z ≤ 2 x spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 105 °C; U_R and I_R applied; Case Ø D x L: 6.3 mm x 12.7 mm to 10 mm x 25 mm: 2000 h; 10 mm x 30 mm to 21 mm x 38 mm: 10 000 h	$U_R \leq$ 6.3 V; ΔC/C: +45 % / -50 % $U_R >$ 6.3 V; ΔC/C: ± 45 % tan δ ≤ 3 x spec. limit Z ≤ 3 x spec. limit $I_{L5} \leq$ spec. limit no short open circuit total failure percentage: ≤ 1 %
Shelf life (storage at high temperature)	IEC 60384-4 / EN130300, subclause 4.17	T_{amb} = 105 °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, tan δ, Z: for requirements see “Endurance test” above $I_{L5} \leq$ 2 x spec. limit

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