Aluminum Capacitors
Axial Standard Miniature

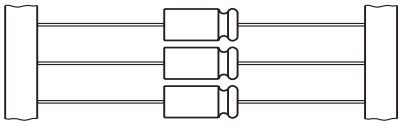
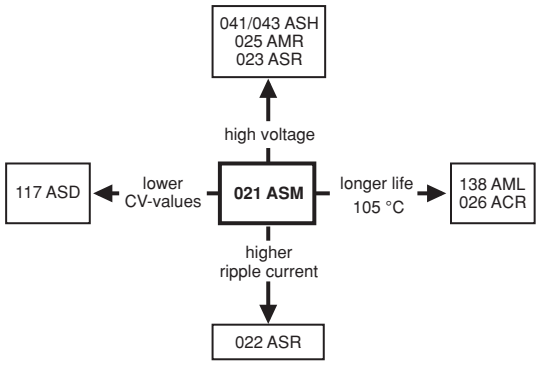


Fig. 1 Component outlines.



FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte.
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve.
- Mounting ring version not available in insulated form.
- Taped versions up to case ∅15 × 30 mm available for automatic insertion
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume.

APPLICATIONS

- General purpose, industrial, automotive, audio-video
- Coupling, decoupling, smoothing, filtering, buffering
- Portable and mobile equipment (small size, low mass)
- 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 (85 °C).
- Date code in accordance with IEC 60062.
- Code for factory of origin.
- Name of manufacturer.
- Band to indicate the negative terminal.
- '+' sign to identify the positive terminal (not for case sizes L < 18 mm).
- Series number (021).

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Nominal case sizes (∅D × L in mm)	4.5 × 10 to 10 × 25	10 × 30 to 21 × 38
Rated capacitance range, C_R	0.47 to 15000 μF	
Tolerance on C_R	±20%	
Rated voltage range, U_R	6.3 to 100 V	
Category temperature range	–40 to +85 °C	
Endurance test at 85 °C:		
U_R = 6.3 to 25 V	1000 hours	5000 hours
U_R = 40 to 100 V	2000 hours	5000 hours
Endurance test at 105 °C	–	1500 hours
Useful life at 85 °C	2500 hours	8000 hours
Useful life at 40 °C, 1.4 × I_R applied	70000 hours	200000 hours
Shelf life at 0 V, 85 °C	500 hours	500 hours
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	40/085/56	

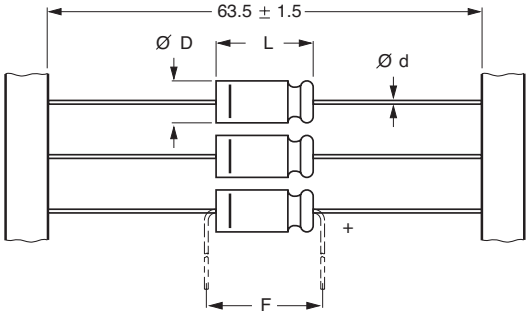
SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (∅D × L in mm)

C_R (μF)	U_R (V)						
	6.3	10	16	25	40	63	100
0.47	–	–	–	–	–	4.5 × 10	–
1.0	–	–	–	–	–	4.5 × 10	4.5 × 10
2.2	–	–	–	–	–	4.5 × 10	4.5 × 10
3.3	–	–	–	–	–	4.5 × 10	–
4.7	–	–	–	–	–	4.5 × 10	4.5 × 10
10	–	–	–	–	–	4.5 × 10	6 × 10
15	–	–	–	–	–	4.5 × 10	8 × 11
	–	–	–	–	–	–	6.5 × 18
22	–	–	–	–	4.5 × 10	6 × 10	8 × 11
	–	–	–	–	–	–	6.5 × 18
33	–	–	–	–	–	6 × 10	6.5 × 18

SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (∅D × L in mm)

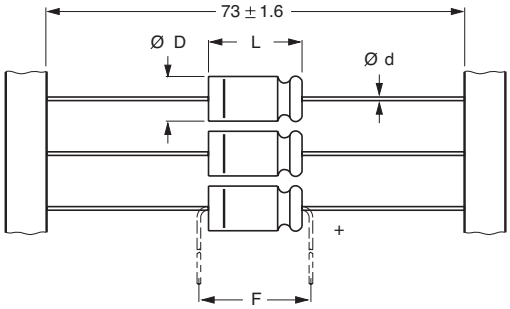
C_R (µF)	U_R (V)						
	6.3	10	16	25	40	63	100
47	–	–	–	4.5 × 10	6 × 10	8 × 11	8 × 18
	–	–	–	–	–	6.5 × 18	–
68	–	–	4.5 × 10	–	–	8 × 11	10 × 18
	–	–	–	–	–	6.5 × 18	–
100	–	4.5 × 10	–	6 × 10	8 × 11	8 × 18	10 × 25
	–	–	–	–	6.5 × 18	–	10 × 30
150	–	–	6 × 10	8 × 11	8 × 18	10 × 18	12.5 × 30
	–	–	–	6.5 × 18	–	–	–
220	–	6 × 10	8 × 11	6.5 × 18	10 × 18	10 × 25	12.5 × 30
	–	–	–	–	–	10 × 30	–
330	–	8 × 11	6.5 × 18	8 × 18	10 × 25	12.5 × 30	15 × 30
470	8 × 11	6.5 × 18	8 × 18	10 × 18	10 × 25	12.5 × 30	18 × 30
	–	–	–	–	10 × 30	–	–
680	–	8 × 18	10 × 18	10 × 25	12.5 × 30	15 × 30	18 × 38
	–	–	–	10 × 30	–	–	–
1000	8 × 18	10 × 18	10 × 25	12.5 × 30	12.5 × 30	18 × 30	21 × 38
	–	–	10 × 30	–	–	–	–
1500	–	10 × 25	12.5 × 30	12.5 × 30	15 × 30	18 × 38	–
	–	10 × 30	–	–	–	–	–
2200	10 × 25	12.5 × 30	12.5 × 30	15 × 30	18 × 30	21 × 38	–
3300	–	12.5 × 30	15 × 30	18 × 30	18 × 38	–	–
4700	–	15 × 30	18 × 30	18 × 38	21 × 38	–	–
6800	–	18 × 30	18 × 38	21 × 38	–	–	–
10000	–	18 × 38	21 × 38	–	–	–	–
15000	–	21 × 38	–	–	–	–	–

DIMENSIONS in millimeters AND AVAILABLE FORMS



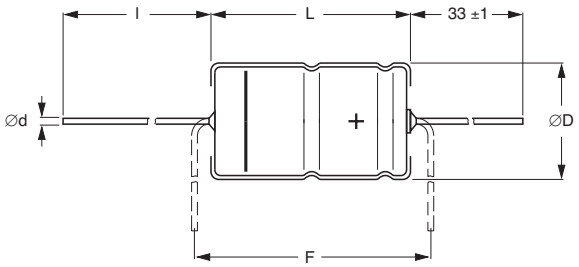
Form BR: Taped on reel.
Form BA: Taped in box (ammopack).
Case ∅D × L = 4.5 × 10 to 8 × 11 mm.

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



Form BR: Taped on reel,
case ∅D × L = 6.5 × 18 to 15 × 30 mm.
Form BA: Taped in box (ammopack),
case ∅D × L = 6.5 × 18 to 10 × 25 mm.

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



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

Fig.4 **Form AA**.

Table 1

AXIAL; DIMENSIONS in millimeters, **MASS AND PACKAGING QUANTITIES**										
NOMINAL CASE SIZE ØD × L	**CASE CODE**	**AXIAL: FORM AA, BA, and BR**					**MASS (g)**	**PACKAGING QUANTITIES**		
		Ød	**l**	**ØD$_{max}$**	**L$_{max}$**	**F$_{min}$**		**FORM AA**	**FORM BA**	**FORM BR**
4.5 × 10	2	0.6	–	5.0	10.5	15	≈0.50	–	1000	3000
6 × 10	3	0.6	–	6.3	10.5	15	≈0.70	–	1000	1000
8 × 11	5a	0.6	–	8.5	11.5	15	≈1.1	–	500	500
6.5 × 18	4	0.8	–	6.9	18.5	25	≈1.3	–	1000	1000
8 × 18	5	0.8	–	8.5	18.5	25	≈1.7	–	500	500
10 × 18	6	0.8	–	10.5	18.5	25	≈2.5	–	500	500
10 × 25	7	0.8	–	10.5	25.0	30	≈3.3	–	500	500
10 × 30	00	0.8	55 ±1	10.5	30.5	35	≈4.8	340	–	500
12.5 × 30	01	0.8	55 ±1	13.0	30.5	35	≈7.4	260	–	400
15 × 30	02	0.8	55 ±1	15.5	30.5	35	≈11.7	300	–	250
18 × 30	03	0.8	55 ±1	18.5	30.5	35	≈12.9	200	–	–
18 × 38	04	0.8	34 ±1	18.5	39.0	44	≈19.0	125	–	–
21 × 38	05	0.8	34 ±1	21.5	39.0	44	≈24.0	100	–	–

Note

1. Detailed tape dimensions see section ‘PACKAGING’.

Fig. 5 Mounting hole diagram and outline; **Form MR;** with mounting ring and pins.

Form MR: case ∅D × L = 15 × 30 to 21 × 38 mm.
Case not insulated (insulation on request).
Especially for applications with severe shocks and vibrations

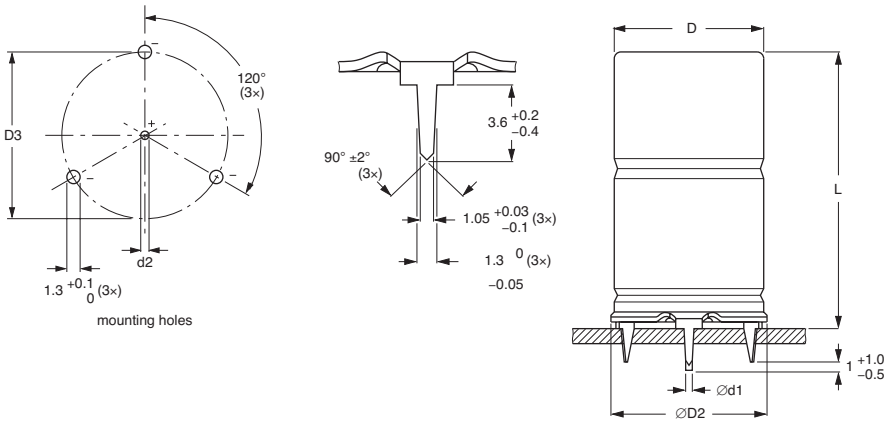


Table 2

MOUNTING RING; DIMENSIONS in millimeters, **MASS AND PACKAGING QUANTITIES**								
NOMINAL CASE SIZE ØD × L	**CASE CODE**	**MOUNTING RING: FORM MR**					**MASS (g)**	**PACKAGING QUANTITIES**
		Ød1	**Ød2**	**ØD2$_{max}$**	**D3**	**L$_{max}$**		
15 × 30	02	0.8	1.0 +0.4	17.5	16.5 ±0.2	33	≈11.7	200
18 × 30	03	0.8	1.0 +0.4	19.5	18.5 ±0.2	33	≈12.9	240
18 × 38	04	0.8	1.0 +0.4	19.5	18.5 ±0.2	42	≈19.0	100
21 × 38	05	0.8	1.0 +0.4	22.5	21.5 ±0.2	42	≈24.0	100

ELECTRICAL DATA

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance ±20%
I_R	rated RMS ripple current at 100 Hz, 85 °C
I_{L5}	max. leakage current after 5 minutes at U_R
Tan δ	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from tan δ_{max} and C_R)
Z	max. impedance at 10 kHz

Note

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

ORDERING EXAMPLE

Electrolytic capacitor 021 series

1000 μF/16 V; ±20%

Nominal case size: ∅10 × 25 mm; Form BA

Catalog number: 2222 021 90518.

Table 3

ELECTRICAL DATA AND ORDERING INFORMATION

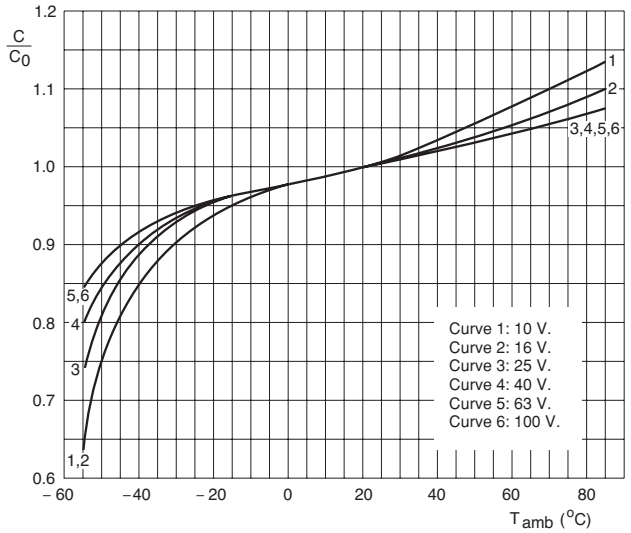
U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ØD × L (mm)	I_R 100 Hz 85 °C (mA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOG NUMBER 2222 021			
								IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
6.3	470	8 × 11	260	10	0.25	0.85	0.64	–	23471	33471	–
	1000	8 × 18	440	17	0.25	0.4	0.5	–	23102	33102	–
	2200	10 × 25	710	32	0.29	0.21	0.16	–	90588	90589	–
10	100	4.5 × 10	100	6	0.20	3.2	2.0	–	24101	34101	–
	220	6 × 10	160	8.4	0.20	1.5	0.91	–	24221	34221	–
	330	8 × 11	230	11	0.20	1.0	0.61	–	24331	34331	–
	470	6.5 × 18	310	13	0.20	0.68	0.43	–	24471	34471	–
	680	8 × 18	400	18	0.20	0.47	0.29	–	24681	34681	–
	1000	10 × 18	550	24	0.20	0.32	0.20	–	24102	34102	–
	1500	10 × 25	690	34	0.23	0.25	0.18	–	90524	90525	–
	1500	10 × 30	740	34	0.23	0.245	0.18	14152	24152	–	–
	2200	12.5 × 30	980	48	0.25	0.177	0.095	14222	24222	–	–
	3300	12.5 × 30	1090	70	0.27	0.128	0.095	14332	24332	–	–
	4700	15 × 30	1320	98	0.29	0.100	0.07	14472	24472	–	44472
	6800	18 × 30	1590	140	0.34	0.079	0.065	14682	–	–	44682
	10000	18 × 38	2090	204	0.40	0.064	0.04	14103	–	–	44103
	15000	21 × 38	2250	304	0.50	0.054	0.035	14153	–	–	44153
16	68	4.5 × 10	90	6.2	0.16	3.8	2.4	–	25689	35689	–
	150	6 × 10	140	8.8	0.16	1.7	1.1	–	25151	35151	–
	220	8 × 11	210	11	0.16	1.2	0.73	–	25221	35221	–
	330	6.5 × 18	290	15	0.16	0.77	0.48	–	25331	35331	–
	470	8 × 18	380	19	0.16	0.55	0.34	–	25471	35471	–
	680	10 × 18	500	26	0.16	0.38	0.24	–	25681	35681	–
	1000	10 × 25	660	36	0.16	0.26	0.18	–	90517	90518	–
	1000	10 × 30	700	36	0.16	0.260	0.175	15102	25102	–	–
	1500	12.5 × 30	950	52	0.19	0.205	0.095	15152	25152	–	–
	2200	12.5 × 30	1040	74	0.21	0.150	0.095	15222	25222	–	–
	3300	15 × 30	1290	110	0.23	0.111	0.07	15332	25332	–	45332
	4700	18 × 30	1560	154	0.25	0.087	0.065	15472	–	–	45472
	6800	18 × 38	2040	222	0.30	0.070	0.04	15682	–	–	45682
	10000	21 × 38	2170	324	0.36	0.058	0.035	15103	–	–	45103
25	47	4.5 × 10	80	6.4	0.14	4.8	2.6	–	26479	36479	–
	100	6 × 10	150	9	0.14	2.3	1.2	–	26101	36101	–
	150	8 × 11	190	12	0.14	1.5	0.80	–	90534	90535	–
	150	6.5 × 18	210	12	0.14	1.5	0.80	–	26151	36151	–
	220	6.5 × 18	250	15	0.14	1.0	0.55	–	26221	36221	–
	330	8 × 18	340	21	0.14	0.68	0.36	–	26331	36331	–
	470	10 × 18	450	28	0.14	0.48	0.26	–	26471	36471	–
	680	10 × 25	560	38	0.14	0.33	0.18	–	90527	90528	–
	680	10 × 30	640	38	0.14	0.323	0.175	16681	26681	–	–
	1000	12.5 × 30	840	54	0.14	0.220	0.095	16102	26102	–	–
	1500	12.5 × 30	950	79	0.17	0.179	0.095	16152	26152	–	–

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE ØD × L (mm)	I_R 100 Hz 85 °C (mA)	I_{L5} 5 min (µA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOG NUMBER 2222 021			
								IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
25	2200	15 × 30	1180	114	0.19	0.132	0.07	16222	26222	–	46222
	3300	18 × 30	1470	169	0.21	0.099	0.065	16332	–	–	46332
	4700	18 × 38	1920	239	0.23	0.079	0.04	16472	–	–	46472
	6800	21 × 38	2070	344	0.28	0.064	0.035	16682	–	–	46682
40	22	4.5 × 10	60	5.8	0.11	8.0	3.2	–	27229	37229	–
	47	6 × 10	110	7.8	0.11	3.8	1.5	–	27479	37479	–
	100	8 × 11	170	12	0.11	1.8	0.70	–	90537	90538	–
	100	6.5 × 18	190	12	0.11	1.8	0.70	–	27101	37101	–
	150	8 × 18	250	16	0.11	1.1	0.47	–	27151	37151	–
	220	10 × 18	330	22	0.11	0.8	0.32	–	27221	37221	–
	330	10 × 25	430	30	0.11	0.53	0.21	–	27331	37331	–
	470	10 × 25	520	42	0.11	0.37	0.18	–	90514	90515	–
	470	10 × 30	590	42	0.12	0.404	0.175	17471	27471	–	–
	680	12.5 × 30	800	58	0.12	0.297	0.110	17681	27681	–	–
	1000	12.5 × 30	900	84	0.12	0.190	0.110	17102	27102	–	–
	1500	15 × 30	1120	124	0.15	0.159	0.07	17152	27152	–	47152
	2200	18 × 30	1390	180	0.17	0.118	0.065	17222	–	–	47222
	3300	18 × 38	1810	268	0.19	0.090	0.04	17332	–	–	47332
	4700	21 × 38	1940	380	0.21	0.072	0.035	17472	–	–	47472
63	0.47	4.5 × 10	8	4.1	0.09	310	120	–	28477	38477	–
	1	4.5 × 10	12	4.1	0.09	150	55	–	28108	38108	–
	2.2	4.5 × 10	21	4.3	0.09	65	25	–	28228	38228	–
	3.3	4.5 × 10	25	4.4	0.09	44	17	–	28338	38338	–
	4.7	4.5 × 10	31	4.6	0.09	31	12	–	28478	38478	–
	10	4.5 × 10	50	5.3	0.08	13	5.5	–	28109	38109	–
	15	4.5 × 10	55	5.9	0.08	8.5	3.7	–	28159	38159	–
	22	6 × 10	90	6.8	0.08	5.8	2.5	–	28229	38229	–
	33	6 × 10	100	8.2	0.08	3.9	1.7	–	28339	38339	–
	47	8 × 11	140	10	0.08	2.7	1.2	–	90541	90542	–
	47	6.5 × 18	150	10	0.08	2.7	1.2	–	28479	38479	–
	68	8 × 11	160	13	0.08	1.9	0.81	–	90544	90545	–
	68	6.5 × 18	170	13	0.08	1.9	0.81	–	28689	38689	–
	100	8 × 18	250	17	0.08	1.3	0.55	–	28101	38101	–
	150	10 × 18	320	23	0.08	0.85	0.37	–	28151	38151	–
	220	10 × 25	430	32	0.08	0.60	0.25	–	90511	90512	–
	220	10 × 30	480	32	0.08	0.614	0.26	18221	28221	–	–
	330	12.5 × 30	610	46	0.08	0.409	0.19	18331	28331	–	–
	470	12.5 × 30	700	63	0.08	0.287	0.13	18471	28471	–	–
	680	15 × 30	890	90	0.08	0.199	0.095	18681	28681	–	48681
	1000	18 × 30	1170	130	0.08	0.135	0.075	18102	–	–	48102
	1500	18 × 38	1530	193	0.11	0.122	0.045	18152	–	–	48152
	2200	21 × 38	1780	281	0.13	0.099	0.040	18222	–	–	48222
100	1	4.5 × 10	14	4.2	0.08	130	90	–	29108	39108	–
	2.2	4.5 × 10	20	4.4	0.08	58	41	–	29228	39228	–
	4.7	4.5 × 10	30	4.9	0.08	27	19	–	29478	39478	–
	10	6 × 10	65	6	0.08	13	9	–	29109	39109	–
	15	8 × 11	77	7	0.08	8.5	6	–	90547	90548	–
	15	6.5 × 18	85	7	0.08	8.5	6	–	29159	39159	–
	22	8 × 11	95	8.4	0.08	5.8	4.1	–	90551	90552	–
	22	6.5 × 18	100	8.4	0.08	5.8	4.1	–	29229	39229	–
	33	6.5 × 18	120	10.6	0.08	3.9	2.7	–	29339	39339	–
	47	8 × 18	160	13.4	0.08	2.7	1.9	–	29479	39479	–
	68	10 × 18	220	17.6	0.08	1.9	1.3	–	29689	39689	–
	100	10 × 25	300	24	0.08	1.3	0.9	–	90531	90532	–
	100	10 × 30	340	24	0.07	1.150	1.0	19101	29101	–	–
	150	12.5 × 30	490	34	0.07	0.645	0.61	19151	29151	–	–
	220	12.5 × 30	560	48	0.08	0.610	0.56	19221	29221	–	–
	330	15 × 30	740	70	0.09	0.420	0.40	19331	29331	–	49331
	470	18 × 30	980	98	0.09	0.310	0.29	19471	–	–	49471
	680	18 × 38	1260	140	0.09	0.195	0.18	19681	–	–	49681
	1000	21 × 38	1470	204	0.10	0.160	0.15	19102	–	–	49102

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 minute at U_R	$I_{L1} \leq 0.006 C_R \times U_R + 4$ μA	
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 4$ μA	
Inductance			
Equivalent series inductance (ESL)	case ∅D × L mm:		
	4.5 × 10	typ. 10 nH	–
	6 × 10	typ. 22 nH	–
	8 × 11	typ. 85 nH	–
	6.5 × 18	typ. 25 nH	–
	8 × 18	typ. 40 nH	–
	10 × 18	typ. 61 nH	–
	10 × 25	typ. 38 nH	–
	10 × 30	typ. 38 nH	–
	12.5 × 30	typ. 46 nH	–
	15 × 30	typ. 48 nH	typ. 39 nH
	18 × 30	typ. 50 nH	typ. 39 nH
	18 × 38	typ. 54 nH	typ. 39 nH
	21 × 38	typ. 59 nH	typ. 39 nH

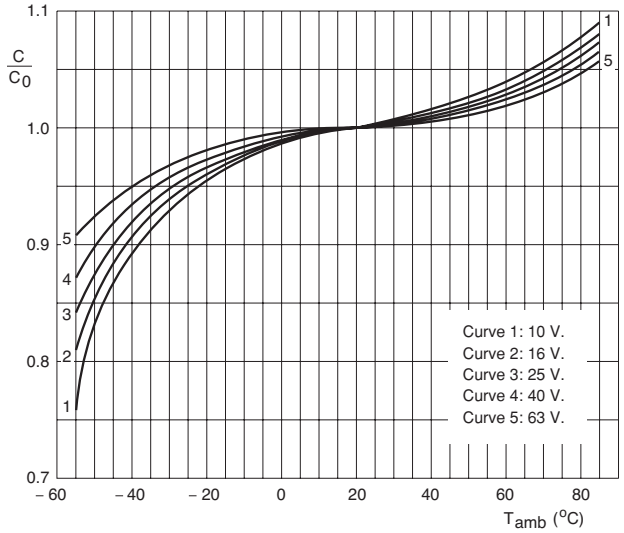
CAPACITANCE (C)



Case ∅D × L = 4 .5 × 10 to 10 × 25 mm.

C_0 = capacitance at 20 °C, 100 Hz.

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

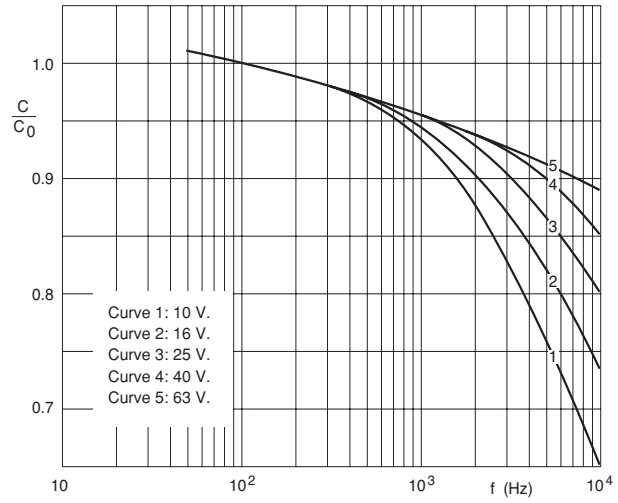


Case ∅D × L = 10 × 30 to 21 × 38 mm.

C_0 = capacitance at 20 °C, 100 Hz.

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

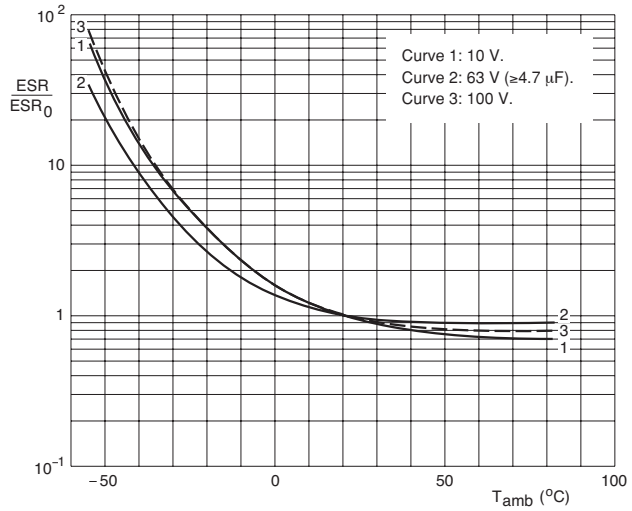
CAPACITANCE (C)



C_0 = capacitance at 20 °C, 100 Hz.

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

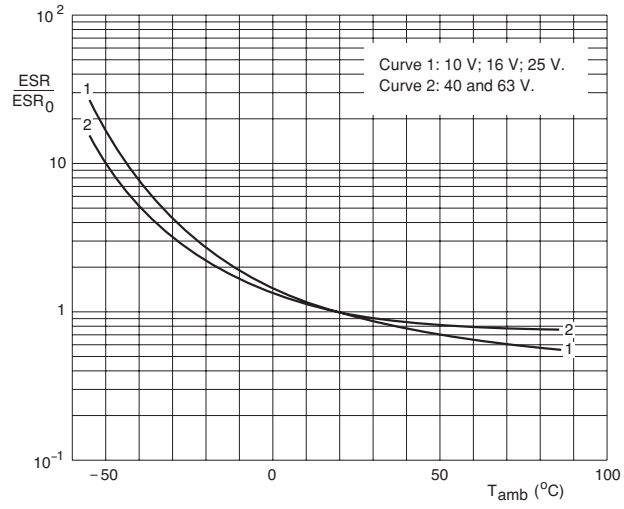
EQUIVALENT SERIES RESISTANCE (ESR)



Case ∅D × L = 4.5 × 10 to 10 × 25 mm.

ESR_0 = typical ESR at 20 °C, 100 Hz.

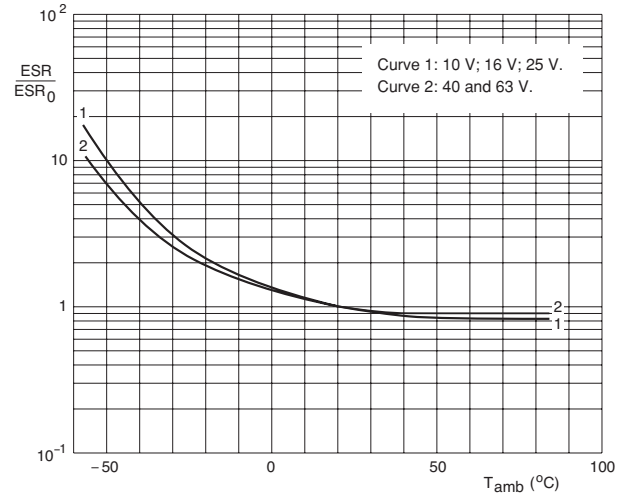
Fig.9 Typical multiplier of ESR as a function of ambient temperature.



Case ∅D × L = 10 × 30, 12.5 × 30 and 15 × 30 mm.

ESR_0 = typical ESR at 20 °C, 100 Hz.

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

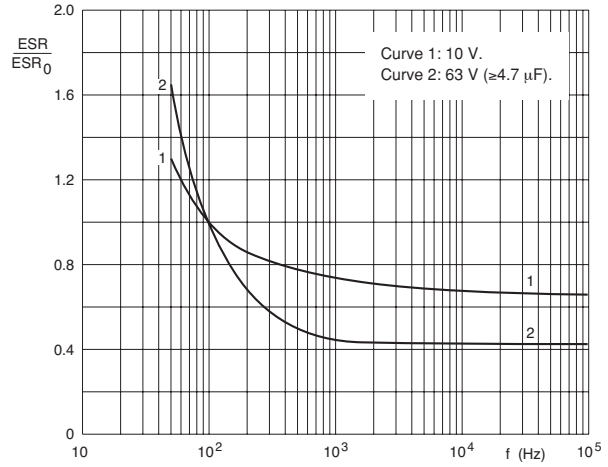


Case ∅D × L = 18 × 30, 18 × 38 and 21 × 38 mm.

ESR_0 = typical ESR at 20 °C, 100 Hz.

Fig.11 Typical multiplier of ESR as a function of ambient temperature.

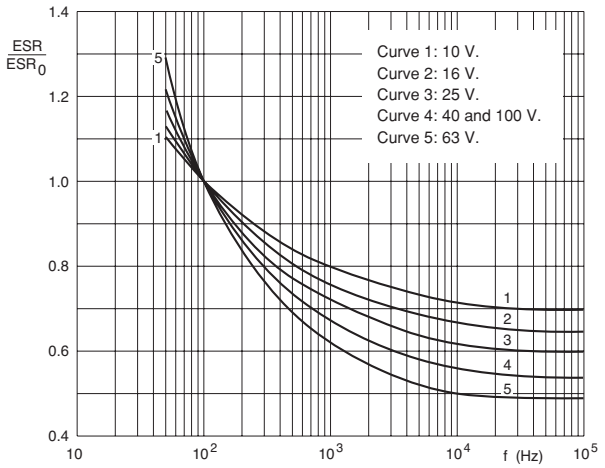
EQUIVALENT SERIES RESISTANCE (ESR)



Case ∅D × L = 4.5 × 10 to 10 × 25 mm.

ESR_0 = typical ESR at 20 °C, 100 Hz.

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



Case ∅D × L = 10 × 30 to 21 × 38 mm.

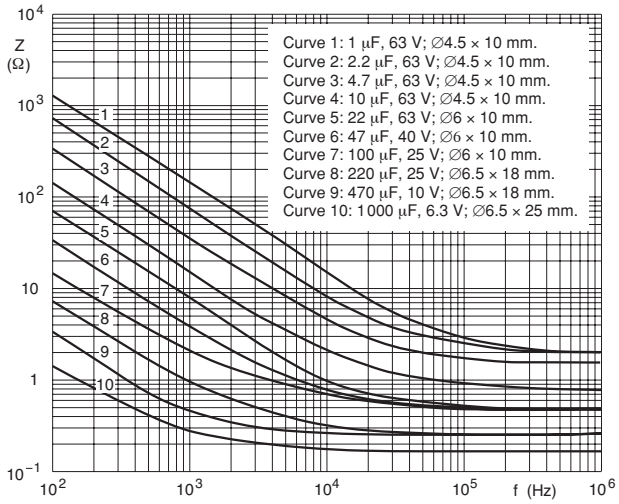
ESR_0 = typical ESR at 20 °C, 100 Hz.

Fig.13 Typical multiplier of ESR as a function of frequency.

IMPEDANCE (Z)

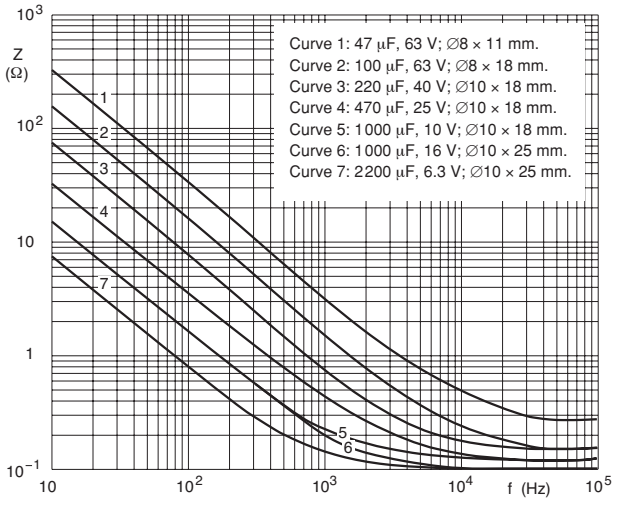
Table 4

IMPEDANCE x CAPACITANCE VALUES (case ∅D × L = 4.5 × 10 to 10 × 25 mm)							
T_{amb}	**Z × C_R (Ω × µF) at 10 kHz**						
	6.3 V	**10 V**	**16 V**	**25 V**	**40 V**	**63 V**	**100 V**
+20 °C	≤300	≤200	≤160	≤120	≤70	≤55	≤90
–25 °C	≤2000	≤1200	≤750	≤560	≤300	≤180	≤600
–40 °C	≤5500	≤3200	≤2000	≤1500	≤900	≤500	≤1600



Case ∅D × L = 4.5 × 10 to 6.5 × 25 mm.

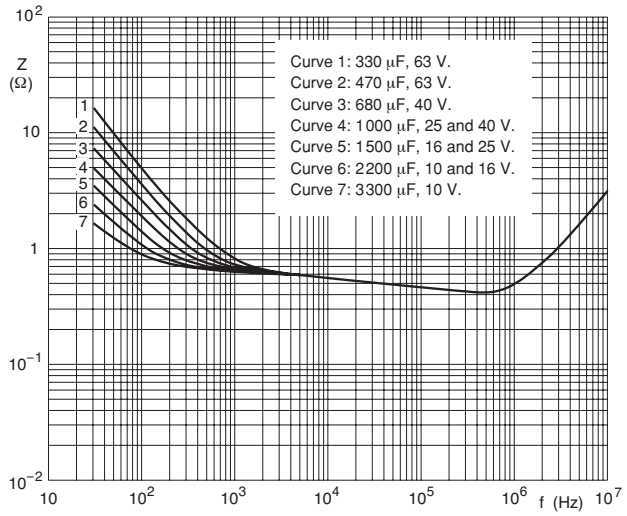
Fig.14 Typical impedance as a function of frequency.



Case ∅D × L = 8 × 11 to 10 × 25 mm.

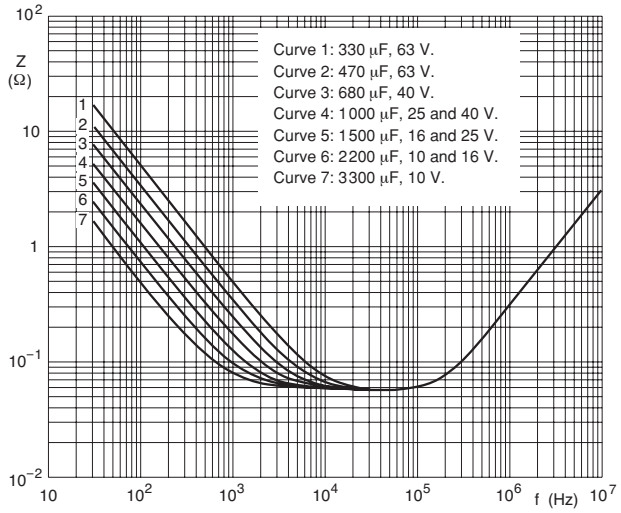
Fig.15 Typical impedance as a function of frequency.

IMPEDANCE (Z)



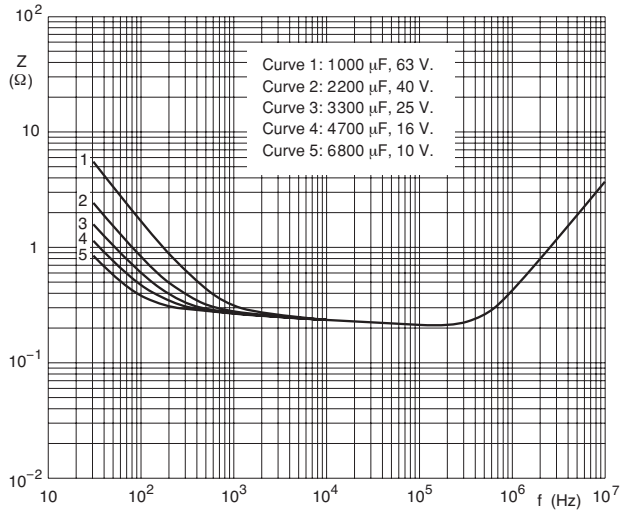
Case ∅D × L = 12.5 × 30 mm. T_{amb} = 40 °C.

Fig.16 Typical impedance as a function of frequency.



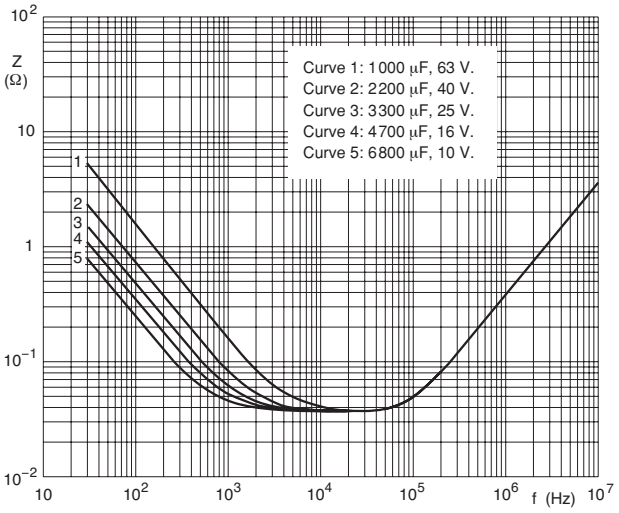
Case ∅D × L = 12.5 × 30 mm. T_{amb} = 20 °C.

Fig.17 Typical impedance as a function of frequency.



Case ∅D × L = 18 × 30 mm. T_{amb} = 40 °C.

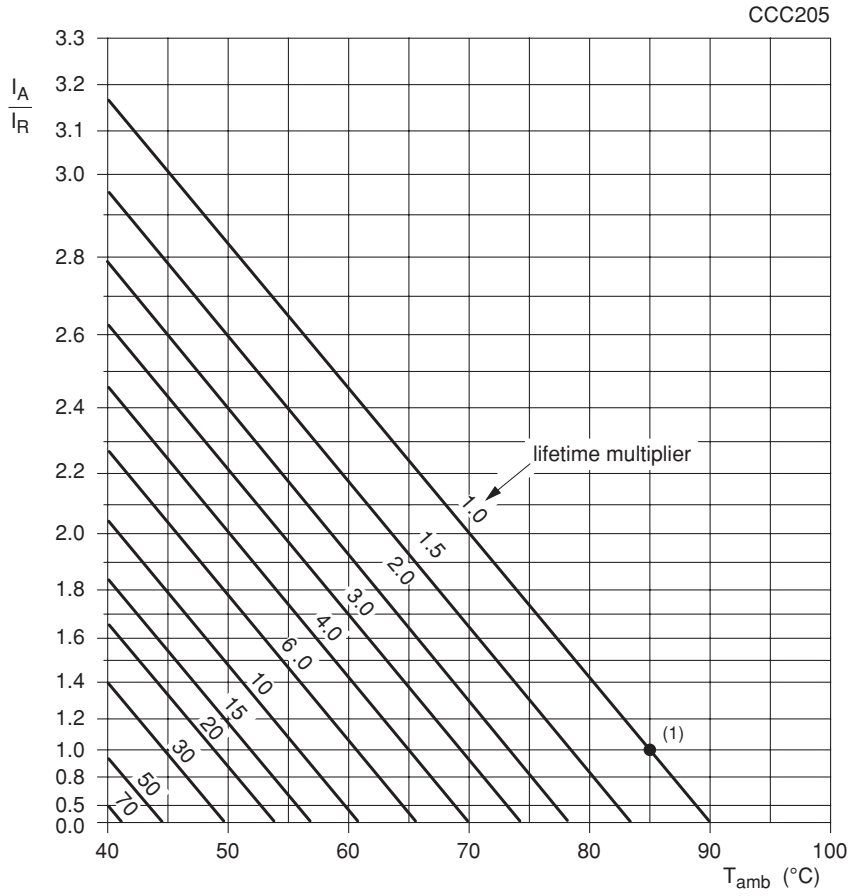
Fig.18 Typical impedance as a function of frequency.



Case ∅D × L = 18 × 30 mm. T_{amb} = 20 °C.

Fig.19 Typical impedance as a function of frequency.

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 Hz.

I_R = rated ripple current at 100 Hz, 85 °C.

(1) Useful life at 85 °C and I_R applied:
case ∅D × L = 4.5 × 10 to 10 × 25 mm: 2500 hours
case ∅D × L = 10 × 30 to 21 × 38 mm: 8000 hours.

Fig.20 Multiplier of useful life as a function of ambient temperature and ripple current load

Table 5

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)	I_R MULTIPLIER		
	U_R = 6.3 to 16 V	U_R = 25 to 40 V	U_R = 63 to 100 V
50	0.95	0.90	0.85
100	1.00	1.00	1.00
300	1.07	1.12	1.20
1000	1.12	1.20	1.30
3000	1.15	1.25	1.35
≥10000	1.20	1.30	1.40

Table 6

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; case ∅D × L = 4.5 × 10 to 10 × 25 mm: U_R = 6.3 to 25 V: 1000 hours; U_R = 40 to 100 V: 2000 hours; case ∅D × L = 10 × 30 to 21 × 38 mm: U_R = 6.3 to 100 V: 5000 hours	$U_R \leq 6.3$ V; ΔC/C: +15/-30% $U_R > 6.3$ V; ΔC/C: ±15% tan δ ≤ 1.3 × spec. limit Z ≤ 2 × spec. limit I_{L5} ≤ spec. limit
		T_{amb} = 105 °C; U_R applied; case ∅D × L = 10 × 30 to 21 × 38 mm: 1500 hours	ΔC/C: ≤ ±15% tan δ ≤ 1.6 × spec. limit Z ≤ 2 × spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 85 °C; U_R and I_R applied; case ∅D × L = 4.5 × 10 to 10 × 25 mm: 2500 hours; case ∅D × L = 10 × 30 to 21 × 38 mm: 8000 hours	$U_R \leq 6.3$ V; ΔC/C: +45/-50% $U_R > 6.3$ V; ΔC/C: ±45% tan δ ≤ 3 × spec. limit Z ≤ 3 × spec. limit I_{L5} ≤ spec. limit no short or open circuit total failure percentage: ≤ 1%
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	T_{amb} = 85 °C; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	ΔC/C, tan δ, Z: for requirements see 'Endurance test' above I_{L5} ≤ 2 × spec. limit