Aluminum Capacitors
Axial Miniature, Long-Life

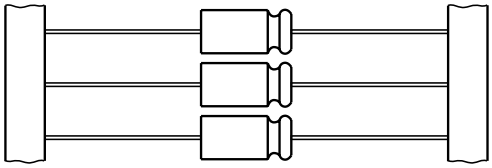
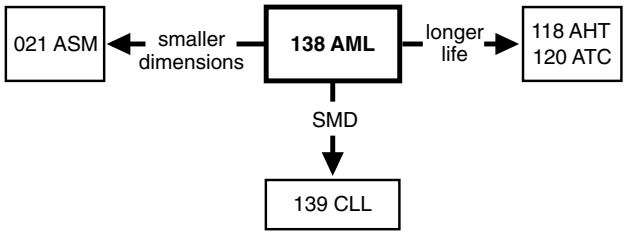


Fig.1 Component outlines



QUICK REFERENCE DATA		
DESCRIPTION	**VALUE**	
Nominal case sizes (∅ 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	1.0 to 15 000 µF	
Tolerance on C_R	± 20 %	
Rated voltage range, U_R	6.3 to 100 V	
Category temperature range	- 40 to + 105 °C	
Endurance test at 105 °C	1000 hours	5000 hours
Useful life at 105 °C	2000 hours	10 000 hours
Useful life at 40 °C, I_R applied	1.3 x I_R applied: 200 000 hours	1.8 x I_R applied: 500 000 hours
Shelf life at 0 V, 105 °C	500 hours	500 hours
Based on sectional specification	IEC 60384-4/EN130 300	
Climatic category IEC 60068	40/105/56	

FEATURES

Pb-free Available

RoHS* COMPLIANT

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve (case ∅ 6.3 x 12.7 and 7.7 x 12.7 mm are moulded with flame retardant plastic material)
- Mounting ring version not available in insulated form
- Taped versions up to case ∅ 15 x 30 mm available for automatic insertion
- Charge and discharge proof
- Long useful life: 2000 to 10 000 hours at 105 °C, high reliability
- High ripple current capability
- Miniaturized, high CV-product per unit volume
- Lead (Pb)-free versions are 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

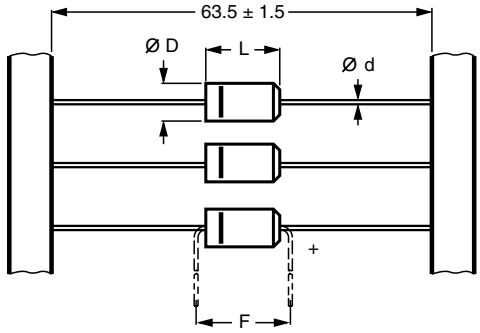
The capacitors are marked (where possible) with the following information:

- 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
- Band to indicate the negative terminal
- '+' sign to identify the positive terminal (not for case sizes L < 18 mm)
- Series number (138)

* Pb containing terminations are not RoHS compliant, exemptions may apply

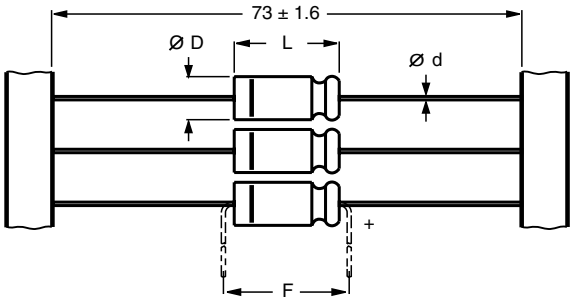
SELECTION CHART FOR CR, UR AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)								
C_R (µF)	U_R (V)							
	6.3	**10**	**16**	**25**	**40**	**50**	**63**	**100**
1.0	-	-	-	-	-	-	-	**6.3 x 12.7**
2.2	-	-	-	-	-	-	-	**6.3** x **12.7**
4.7	-	-	-	-	-	-	**6.3** x **12.7**	7.7 x 12.7
10	-	-	-	6.3 x 12.7	-	**6.3 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	-	-	-	**6.3** x **12.7**	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**



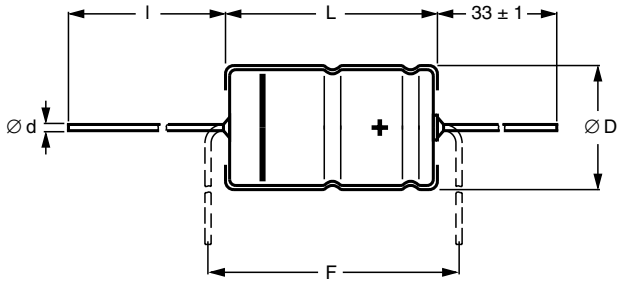
Form BR: Taped on reel
Form BA: Taped in box (ammopack)
Case ∅ D x L = 6.3 x 12.7 and 7.7 x 12.7 mm

Fig.2 **Forms BA and BR**



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

Fig.3 **Forms BA and BR**



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

Fig.4 **Form AA**

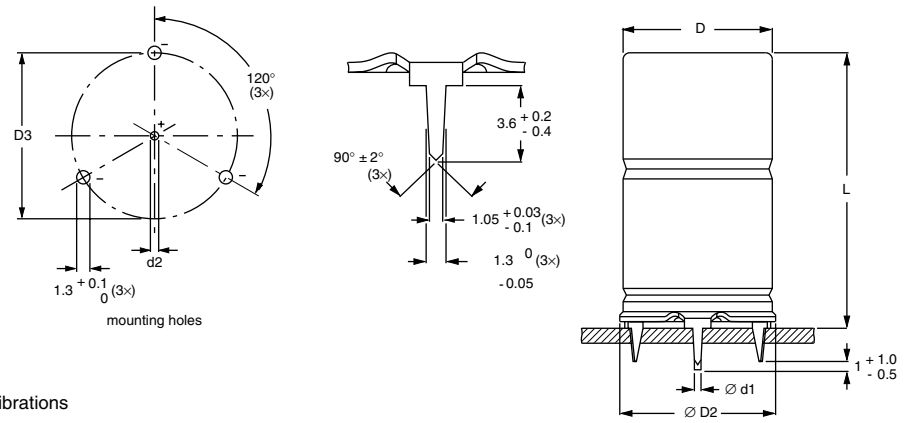
Table 1

AXIAL; DIMENSIONS in millimeters, **MASS AND PACKAGING QUANTITIES**										
NOMINAL CASE SIZE ∅ D x L (mm)	**CASE CODE**	**AXIAL: FORM AA, BA, and BR**					**MASS (g)**	**PACKAGING QUANTITIES**		
		∅ d	**l**	**∅ 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	25.0	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	39.0	44	≈ 19.0	125	-	-
21 x 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**; mounting ring and pins



Form MR: case ∅ D x L = 15 x 30 to 21 x 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 ∅ D x L	**CASE CODE**	**MOUNTING RING: FORM MR**						**MASS (g)**	**PACKAGING QUANTITIES**
		∅ d1	**∅ d2**	**∅ D_{max}**	**∅ $D2_{max}$**	**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

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 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 or 100 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 138 series

470 µF/10 V; ± 20 %

Nominal case size: ∅ 8 × 18 mm; Form BA

Catalog number: 2222 138 34471

* Note: To ensure delivery of lead (Pb)-free parts during the transition period, please contact your Vishay sales agent.

Table 3

ELECTRICAL DATA AND ORDERING INFORMATION

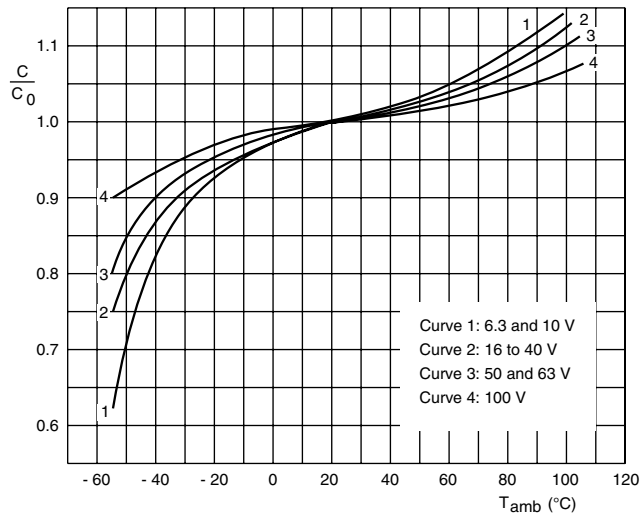
U_R (V)	C_R 100 HZ (µF)	NOMINAL CASE SIZE ∅ D x L (mm)	I_R 100 Hz 105 °C (mA)	I_{L5} 5 min (µA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOG NUMBER 2222 138			
									IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
6.3	100	6.3 x 12.7	99	5.3	0.24	3.8	3.0	1.8	-	23101	33101	-
	220	7.7 x 12.7	160	6.8	0.24	1.7	1.4	0.95	-	23221	33221	-
	470	6.5 x 18	250	9.9	0.24	0.81	0.64	0.5	-	23471	33471	-
	1000	10 x 18	430	17	0.24	0.38	0.30	0.24	-	23102	33102	-
	2200	10 x 25	640	32	0.29	0.21	0.18	0.15	-	23222	33222	-
10	150	7.7 x 12.7	140	7.0	0.2	2.1	1.3	0.95	-	24151	34151	-
	220	6.5 x 18	190	8.4	0.2	1.4	0.91	0.5	-	24221	34221	-
	470	8 x 18	300	13	0.2	0.68	0.43	0.35	-	24471	34471	-
	1000	10 x 25	520	24	0.2	0.32	0.20	0.16	-	24102	34102	-
	1500	10 x 30	670	34	0.28	0.32	0.26	0.26	14152	24152	-	-
	2200	12.5 x 30	890	48	0.29	0.22	0.19	0.19	14222	24222	-	-
	3300	15 x 30	1140	70	0.30	0.16	0.13	0.15	14332	24332	-	44332
	4700	18 x 30	1450	98	0.33	0.12	0.11	0.13	14472	-	-	44472
	6800	18 x 38	1880	140	0.34	0.085	0.074	0.11	14682	-	-	44682
	10 000	18 x 38	1980	200	0.41	0.070	0.062	0.10	14103	-	-	44103
	15 000	21 x 38	2200	300	0.55	0.063	0.058	0.099	14153	-	-	44153
16	22	6.3 x 12.7	58	4.7	0.12	8.7	7.3	2.7	-	25229	35229	-
	47	6.3 x 12.7	83	5.5	0.16	5.4	3.4	1.9	-	25479	35479	-
	100	7.7 x 12.7	130	7.2	0.16	2.5	1.6	1.0	-	25101	35101	-
	220	8 x 18	230	11	0.16	1.2	0.73	0.35	-	25221	35221	-
	470	10 x 18	360	19	0.16	0.54	0.34	0.25	-	25471	35471	-
	1000	10 x 30	630	36	0.20	0.34	0.27	0.26	15102	25102	-	-
	1500	12.5 x 30	860	52	0.20	0.23	0.19	0.19	15152	25152	-	-
	2200	15 x 30	1090	74	0.21	0.17	0.14	0.15	15222	25222	-	45222
	3300	18 x 30	1420	110	0.24	0.12	0.10	0.13	15332	-	-	45332
	4700	18 x 30	1480	150	0.28	0.10	0.090	0.12	15472	-	-	45472
	6800	18 x 38	1930	220	0.28	0.072	0.062	0.10	15682	-	-	45682
	10 000	21 x 38	2100	320	0.38	0.065	0.057	0.098	15103	-	-	45103
25	10	6.3 x 12.7	46	4.5	0.09	14	12	2.8	-	26109	36109	-
	22	6.3 x 12.7	61	5.1	0.14	10	5.5	2.5	-	26229	36229	-
	33	6.3 x 12.7	74	5.7	0.14	6.8	3.6	1.9	-	26339	36339	-
	47	7.7 x 12.7	96	6.4	0.14	4.7	2.6	1.0	-	26479	36479	-

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 HZ (µF)	NOMINAL CASE SIZE ∅ 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)	CATALOG NUMBER 2222 138			
									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	2.1	1.2	0.55	-	26101	36101	-
	220	10 x 18	270	15	0.13	0.94	0.55	0.27	-	26221	36221	-
	470	10 x 25	440	28	0.13	0.44	0.26	0.17	-	26471	36471	-
	680	10 x 30	580	38	0.14	0.36	0.26	0.25	16681	26681	-	-
	1000	12.5 x 30	790	54	0.15	0.25	0.18	0.19	16102	26102	-	-
	1500	15 x 30	1020	79	0.15	0.17	0.13	0.15	16152	26152	-	46152
	2200	18 x 30	1320	110	0.17	0.13	0.10	0.13	16222	-	-	46222
	3300	18 x 38	1720	170	0.17	0.090	0.071	0.11	16332	-	-	46332
	4700	18 x 38	1840	240	0.21	0.076	0.063	0.10	16472	-	-	46472
	6800	21 x 38	2100	340	0.27	0.068	0.058	0.099	16682	-	-	46682
40	33	7.7 x 12.7	91	6.6	0.11	5.3	2.7	1.0	-	27339	37339	-
	47	6.5 x 18	120	7.8	0.10	3.4	1.9	0.65	-	27479	37479	-
	100	8 x 18	180	12	0.10	1.6	0.9	0.40	-	27101	37101	-
	220	10 x 25	350	22	0.10	0.72	0.41	0.20	-	27221	37221	-
	330	10 x 30	490	30	0.09	0.47	0.32	0.30	17331	27331	-	-
	470	12.5 x 30	650	42	0.09	0.34	0.23	0.22	17471	27471	-	-
	680	12.5 x 30	750	58	0.10	0.25	0.18	0.18	17681	27681	-	-
	1000	15 x 30	970	84	0.10	0.17	0.12	0.14	17102	27102	-	47102
	1500	18 x 30	1250	120	0.12	0.13	0.098	0.12	17152	-	-	47152
	2200	18 x 38	1640	180	0.12	0.093	0.069	0.10	17222	-	-	47222
	3300	21 x 38	1810	270	0.15	0.079	0.061	0.10	17332	-	-	47332
50	10	6.3 x 12.7	51	5.0	0.09	14	7	2.7	-	21109	31109	-
	22	7.7 x 12.7	82	6.2	0.09	6.5	3.2	1.1	-	21229	31229	-
	100	10 x 18	230	14	0.08	1.3	0.7	0.30	-	21101	31101	-
63	4.7	6.3 x 12.7	35	4.6	0.09	30	17	5	-	28478	38478	-
	10	7.7 x 12.7	59	5.3	0.08	13	8	1.8	-	28109	38109	-
	22	6.5 x 18	100	6.8	0.07	5.1	3.6	0.85	-	28229	38229	-
	47	8 x 18	150	9.9	0.07	2.4	1.7	0.50	-	28479	38479	-
	100	10 x 25	280	17	0.07	1.1	0.8	0.27	-	28101	38101	-
	150	10 x 30	410	23	0.11	0.73	0.44	0.40	18151	28151	-	-
	220	12.5 x 30	560	32	0.11	0.50	0.31	0.29	18221	28221	-	-
	330	12.5 x 30	660	46	0.12	0.37	0.23	0.22	18331	28331	-	-
	470	15 x 30	860	63	0.12	0.26	0.16	0.16	18471	28471	-	48471
	680	18 x 30	1130	90	0.12	0.19	0.12	0.14	18681	-	-	48681
	1000	18 x 38	1460	130	0.12	0.13	0.086	0.11	18102	-	-	48102
	1500	21 x 38	1680	190	0.13	0.10	0.072	0.11	18152	-	-	48152
100	1.0	6.3 x 12.7	16	4.2	0.09	140	55	10	-	29108	39108	-
	2.2	6.3 x 12.7	24	4.4	0.09	65	25	8	-	29228	39228	-
	4.7	7.7 x 12.7	40	4.9	0.08	27	17	5	-	29478	39478	-
	10	6.5 x 18	67	6.0	0.07	11	8	2.4	-	29109	39109	-
	22	8 x 18	100	8.4	0.07	5.1	3.6	1.4	-	29229	39229	-
	47	10 x 25	190	13	0.07	2.4	1.7	0.67	-	29479	39479	-
	68	10 x 30	300	18	0.07	1.7	1.1	0.97	19689	29689	-	-
	100	12.5 x 30	410	24	0.07	1.1	0.77	0.67	19101	29101	-	-
	150	15 x 30	550	34	0.07	0.78	0.52	0.46	19151	29151	-	49151
	220	15 x 30	650	48	0.07	0.54	0.37	0.33	19221	29221	-	49221
	330	18 x 30	880	70	0.08	0.38	0.27	0.24	19331	-	-	49331
	470	18 x 38	1130	98	0.08	0.27	0.19	0.17	19471	-	-	49471
	680	21 x 38	1330	140	0.09	0.21	0.14	0.14	19681	-	-	49681

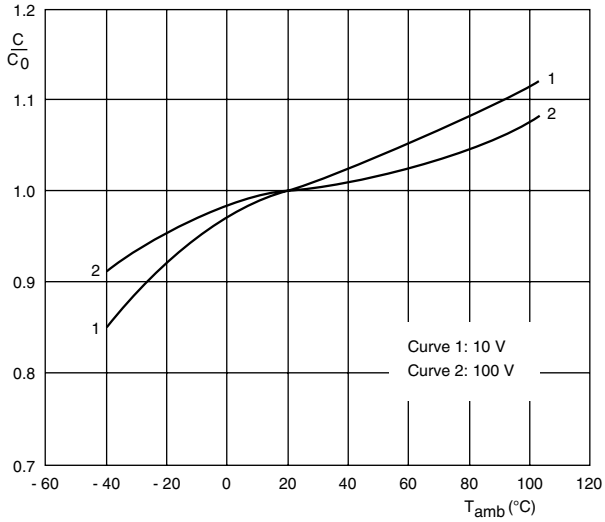
ADDITIONAL ELECTRICAL DATA			
PARAMETER	CONDITIONS	VALUE	
		AXIAL	MOUNTING RING
Voltage			
Surge voltage		$U_s \leq 1.15 \times U_R$	
Reverse voltage		$U_{rev} \leq 1$ V	
Current			
Leakage current	after 1 minute at U_R:		
	case ∅ D x L = 6.3 x 12.7 and 7.7 x 12.7 mm	$I_{L1} \leq 0.02\ C_R \times U_R + 3\ \mu A$	
	case ∅ D x L = 6.5 x 18 to 21 x 38 mm	$I_{L1} \leq 0.006\ C_R \times U_R + 4\ \mu A$	
	after 5 minutes at U_R	$I_{L5} \leq 0.002\ C_R \times U_R + 4\ \mu A$	
Inductance			
Equivalent series inductance (ESL)	case ∅ 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 ∅ D x L = 6.3 x 12.7 to 10 x 25 mm
C_0 = capacitance at 20 °C, 100 Hz

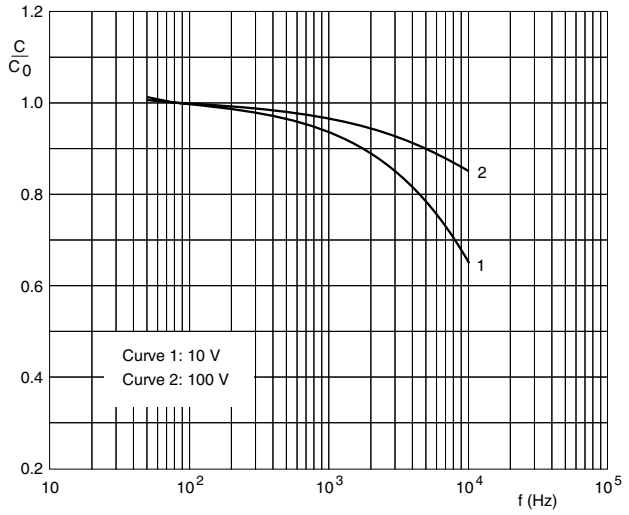
Fig.6 Typical multiplier of capacitance as a function of ambient temperature



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

Fig.7 Multiplier of capacitance as a function of ambient temperature

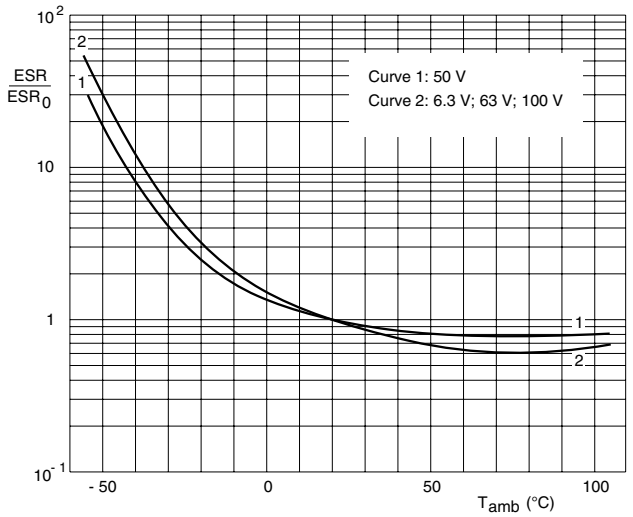
CAPACITANCE (C)



C_0 = capacitance at 20 °C, 100 Hz

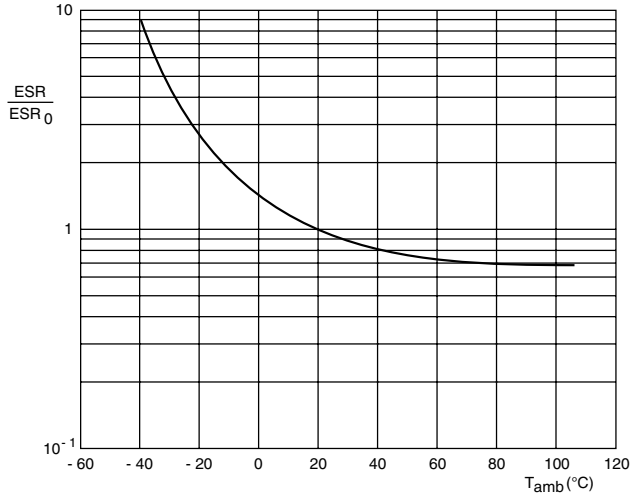
Fig.8 Typical multiplier of capacitance as a function of frequency

EQUIVALENT SERIES RESISTANCE (ESR)



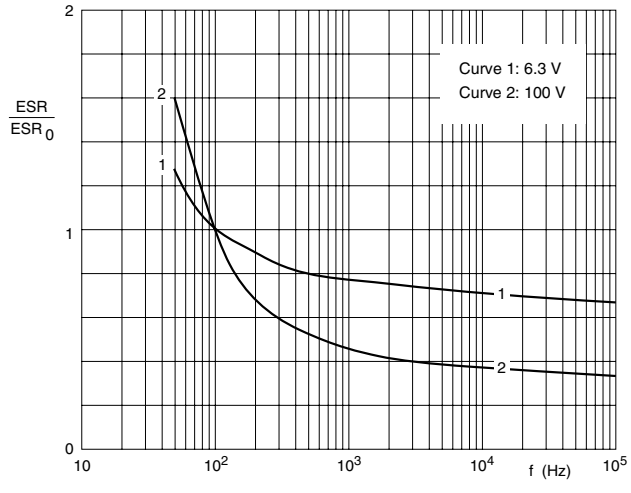
Case ∅ D x L = 6.3 x 12.7 to 10 x 25 mm
ESR_0 = typical ESR at 20 °C, 100 Hz

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



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

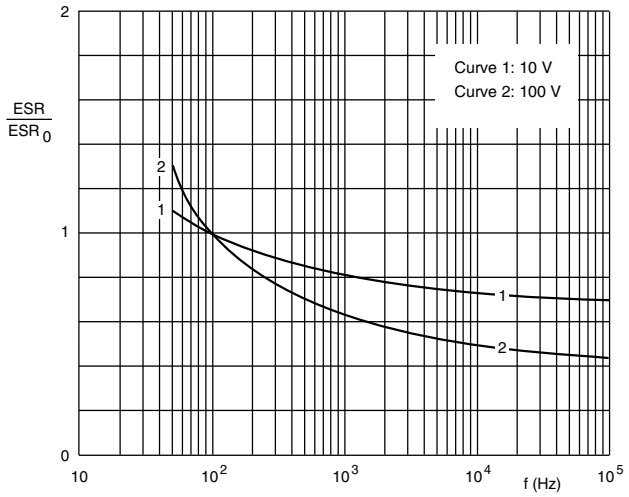
Fig.10 Typical multiplier of ESR as a function of ambient temperature



Case ∅ D x L = 6.3 x 12.7 to 10 x 25 mm
ESR_0 = typical ESR at 20 °C, 100 Hz

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

EQUIVALENT SERIES RESISTANCE (ESR)



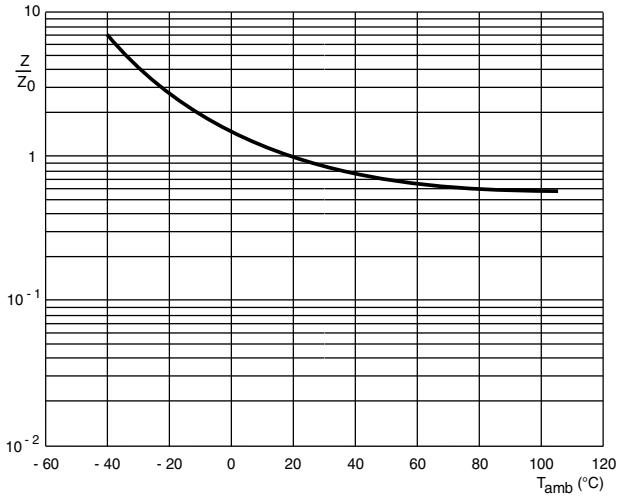
Case ∅ D x L = 10 x 30 to 21 x 38 mm
ESR_0 = typical ESR at 20 °C, 100 Hz

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

IMPEDANCE (Z)

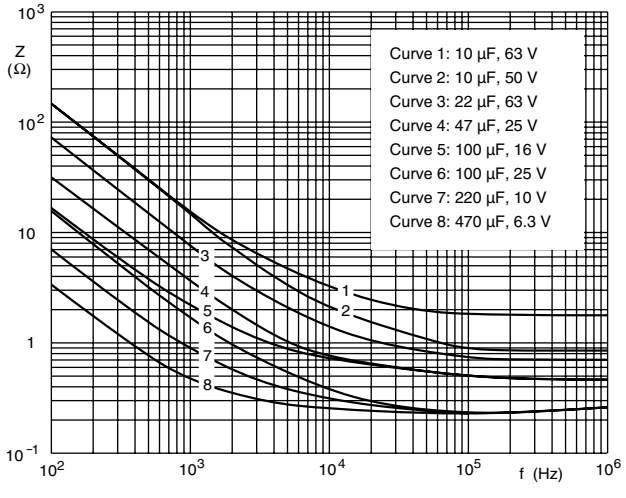
Table 4

IMPEDANCE x CAPACITANCE VALUES (case Ø D x L = 6.3 x 12.7 to 10 x 25 mm)								
Tamb	**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



Case ∅ D x L = 10 x 30 to 21 x 38 mm

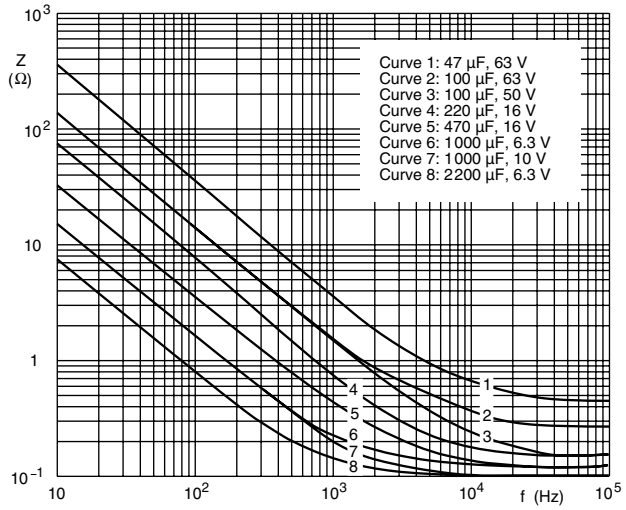
Fig.13 Typical impedance as a function of ambient temperature at 10 kHz



Case ∅ D x L = 6.3 x 12.7 to 6.5 x 18 mm T_{amb} = 20 °C

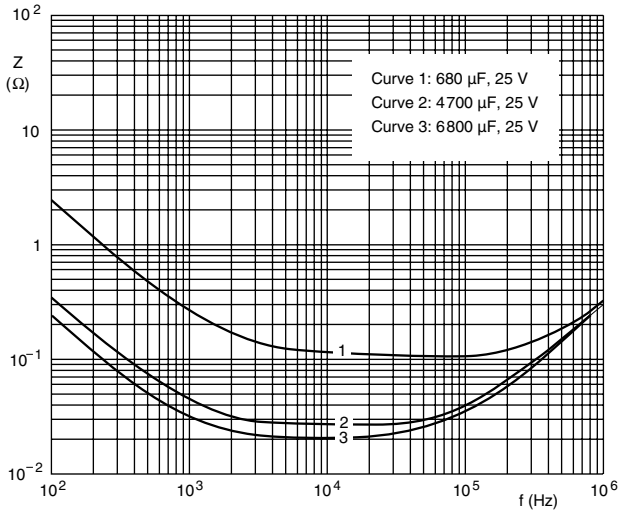
Fig.14 Typical impedance as a function of frequency

IMPEDANCE (Z)



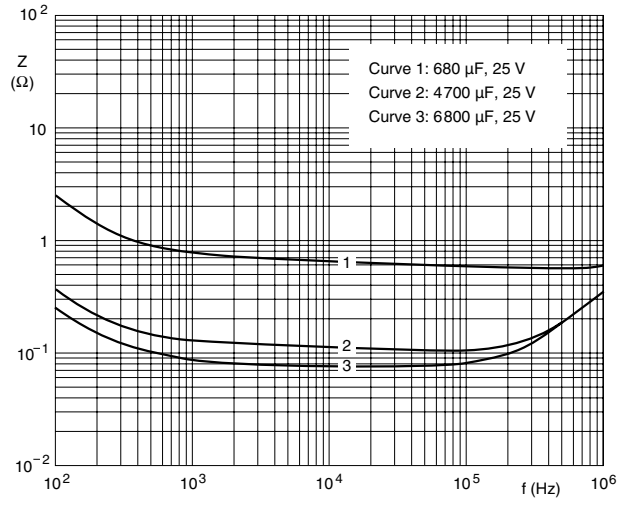
Case ∅ D x L = 8 x 18 to 10 x 25 mm T_{amb} = 20 °C

Fig.15 Typical impedance as a function of frequency



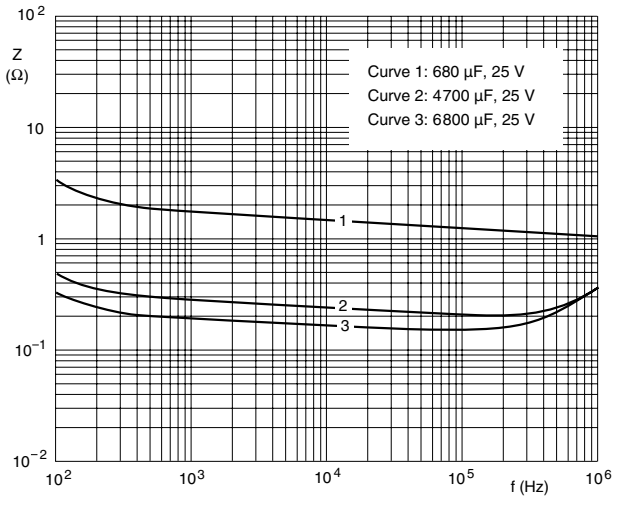
Case ∅ D x L = 10 x 30 to 21 x 38 mm T_{amb} = 20 °C

Fig.16 Typical impedance as a function of frequency



Case ∅ D x L = 10 x 30 to 21 x 38 mm T_{amb} = - 25 °C

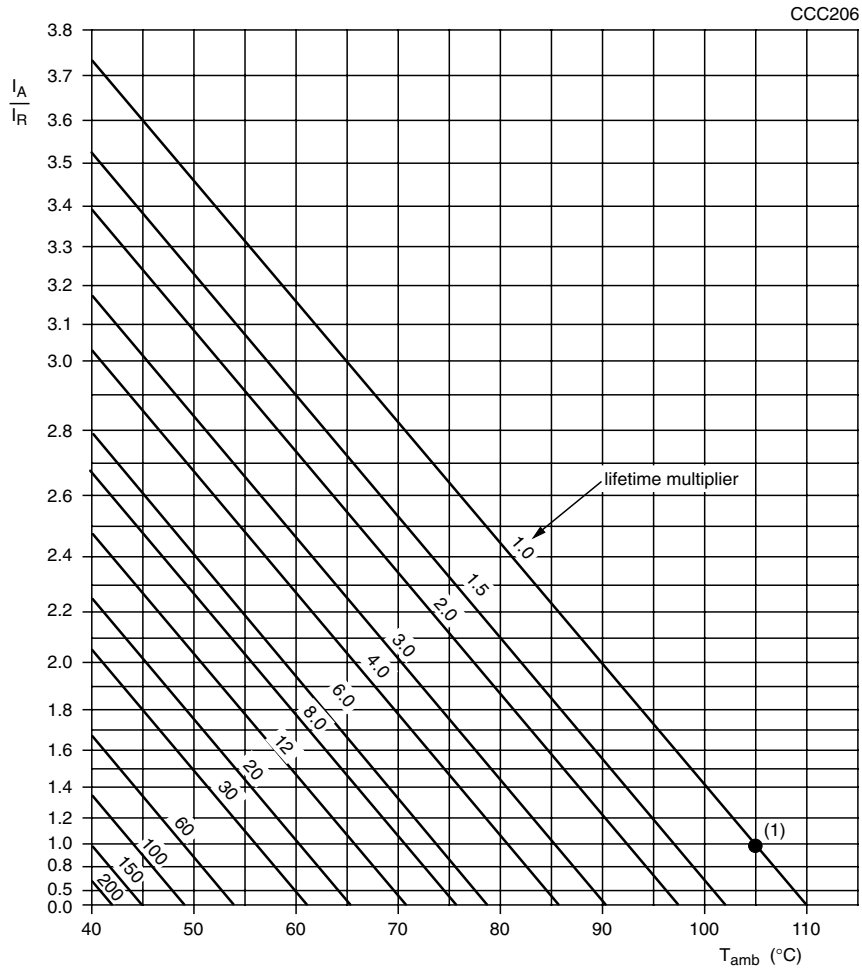
Fig.17 Typical impedance as a function of frequency



Case ∅ D x L = 10 x 30 to 21 x 38 mm T_{amb} = - 40 °C

Fig.18 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, 105 °C

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

Fig.19 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 10 V	U_R = 16 to 25 V	U_R = 40 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
≥ 10 000	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} = 105 °C; U_R applied; case ∅ D x L: 6.3 x 12.7 to 10 x 25 mm: 1000 hours; 10 x 30 to 21 x 38 mm: 5000 hours	$U_R \leq$ 6.3 V; ΔC/C: + 15/- 30 % $U_R >$ 6.3 V; ΔC/C: ± 15 % tan $\delta \leq$ 1.3 x spec. limit $Z \leq$ 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 ∅ D x L: 6.3 x 12.7 to 10 x 25 mm: 2000 hours; 10 x 30 to 21 x 38 mm: 10 000 hours	$U_R \leq$ 6.3 V; ΔC/C: + 45/- 50 % $U_R >$ 6.3 V; ΔC/C: ± 45 % tan $\delta \leq$ 3 x spec. limit $Z \leq$ 3 x spec. limit $I_{L5} \leq$ 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} = 105 °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 $I_{L5} \leq$ 2 x spec. limit

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