Aluminum Capacitors
Axial High Temperature

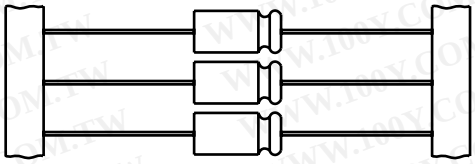
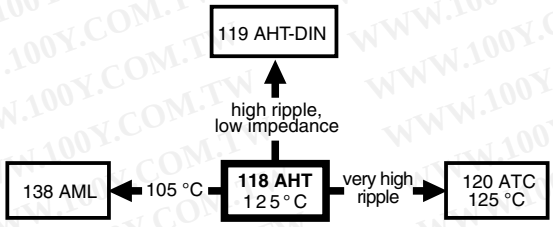


Fig.1 Component outlines



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 Ø 15 mm x 30 mm available for automatic insertion.
- Charge and discharge proof
- Extra long useful life: up to 8000 hours at 125 °C, high reliability
- Extended temperature range: 125 °C (usable up to 150 °C)
- Miniaturized, high CV-product per unit volume
- Compliant to RoHS directive 2002/95/EC

Pb-free
RoHS COMPLIANT

APPLICATIONS

- Automotive, industrial and telecommunication
- Smoothing, filtering, coupling, decoupling, timing
- For use after very long storage (10 years) without voltage applied
- Portable and mobile equipment (small size, low mass)
- Low mounting height boards, vibration and shock resistant
- Outdoor applications, e.g. aerial amplifiers

MARKING

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

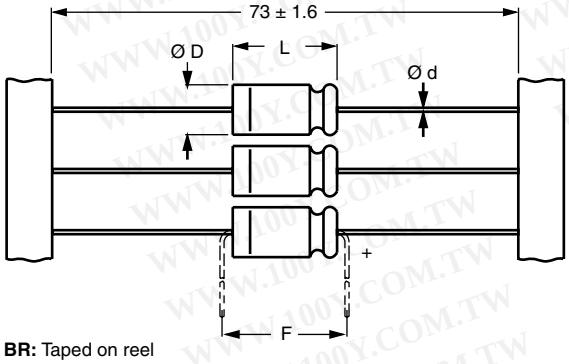
- Rated capacitance (in µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V) at 125 °C and 85 °C
- Date code, in accordance with IEC 60062
- Code indicating factory of origin
- Name of manufacturer
- Band to indicate the negative terminal
- '+' sign to identify the positive terminal
- Series number (118)

QUICK REFERENCE DATA		
DESCRIPTION	**VALUE**	
Nominal case sizes (Ø D x L in mm)	6.5 x 18 to 10 x 25	10 x 30 to 21 x 38
Rated capacitance range, C_R	1 µF to 10 000 µF	
Tolerance on C_R	± 20 %	
Rated voltage range, U_R	6.3 V to 200 V	
Category temperature range	- 40 °C to + 125 °C	- 55 °C to + 125 °C
Endurance test at 150 °C (6.3 to 100 V)	500 hours	500 hours
Endurance test at 125 °C	2000 hours	3000 hours
Useful life at 125 °C	4000 hours	8000 hours
Useful life at 40 °C, 1.8 x I_R applied	500 000 hours	1 000 000 hours
Shelf life at 0 V, 125 °C:		
U_R = 6.3 to 63 V	500 hours	
U_R = 100 and 200 V	100 hours	
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	40/125/56	55/125/56

For technical questions, contact: aluminumcaps1@vishay.com

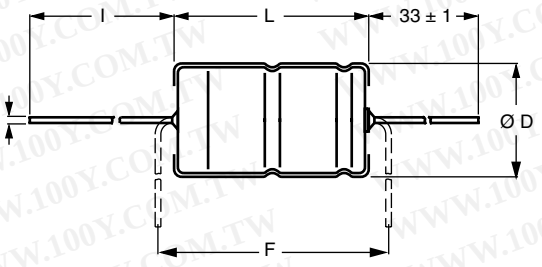
SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)								
C_R (µF)	U_R (V)							
	6.3	10	16	25	40	63	100	200
1.0	-	-	-	-	-	6.5 x 18	-	-
2.2	-	-	-	-	-	6.5 x 18	-	6.5 x 18
4.7	-	-	-	-	-	6.5 x 18	6.5 x 18	8 x 18
10	-	-	-	-	-	6.5 x 18	6.5 x 18	10 x 25
15	-	-	-	-	-	-	-	10 x 30
22	-	-	-	-	-	6.5 x 18	8 x 18	12.5 x 30
33	-	-	-	-	-	-	10 x 25	15 x 30
47	-	-	-	-	6.5 x 18	8 x 18	10 x 25	18 x 30
	-	-	-	-	-	-	10 x 30	-
68	-	-	-	-	-	-	12.5 x 30	18 x 38
100	-	-	-	6.5 x 18	8 x 18	10 x 25	12.5 x 30	21 x 38
	-	-	-	-	-	10 x 30	-	-
150	-	-	-	-	10 x 18	12.5 x 30	15 x 30	-
220	-	6.5 x 18	8 x 18	10 x 18	10 x 25	12.5 x 30	18 x 30	-
	-	-	-	-	10 x 30	-	-	-
330	-	8 x 18	10 x 18	10 x 25	12.5 x 30	15 x 30	18 x 38	-
470	-	8 x 18	10 x 18	10 x 25	12.5 x 30	18 x 30	21 x 38	-
	-	-	-	10 x 30	-	-	-	-
680	-	-	10 x 30	12.5 x 30	15 x 30	18 x 38	-	-
1000	10 x 18	10 x 25	12.5 x 30	12.5 x 30	18 x 30	21 x 38	-	-
	-	10 x 30	-	-	-	-	-	-
1500	10 x 25	12.5 x 30	12.5 x 30	15 x 30	18 x 38	-	-	-
2200	-	12.5 x 30	15 x 30	18 x 30	21 x 38	-	-	-
3300	-	15 x 30	18 x 30	18 x 38	-	-	-	-
4700	-	18 x 30	18 x 38	21 x 38	-	-	-	-
6800	-	18 x 38	21 x 38	-	-	-	-	-
10 000	-	21 x 38	-	-	-	-	-	-

DIMENSIONS in millimeters **AND AVAILABLE FORMS**



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.2 **Forms BA and BR**



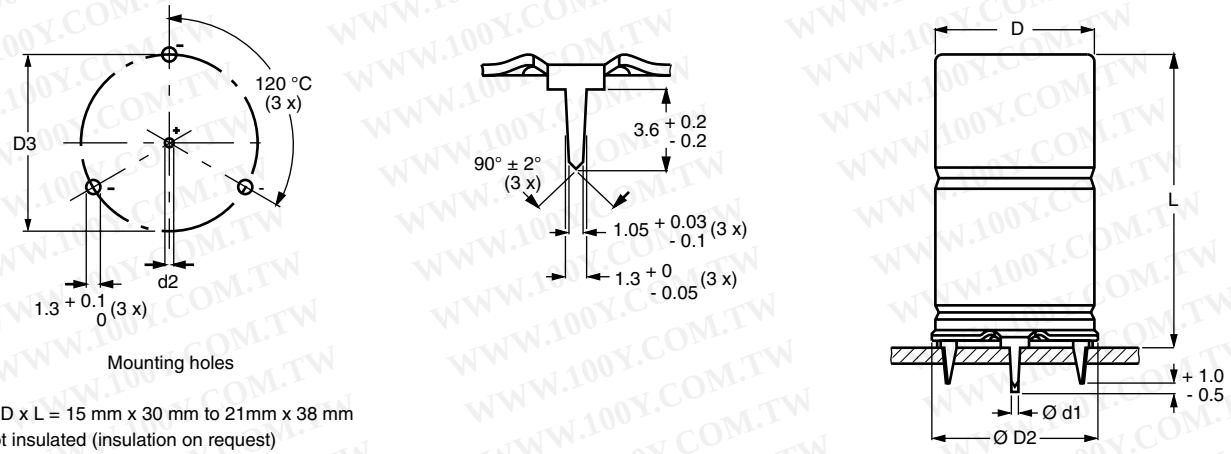
Form AA: Axial in box
case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm

Fig.3 **Form AA**

Table 1

AXIAL; DIMENSIONS in millimeters, **MASS AND PACKAGING QUANTITIES**										
NOMINAL CASE SIZE Ø D x L	**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**
6.5 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
Detailed tape dimensions see section 'PACKAGING'



Case Ø D x L = 15 mm x 30 mm to 21mm x 38 mm
Case not insulated (insulation on request)
Especially for applications with severe shocks and vibrations

Fig.4 Mounting hole digram and outline; **Form MR:** With mounting ring and pins

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**	**Ø $D_{max.}$**	**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	≈ 8.6	200
18 x 30	03	0.8	1.0 + 0.4	18.5	19.5	18.5 ± 0.2	33	≈ 11.5	240
18 x 38	04	0.8	1.0 + 0.4	18.5	19.5	18.5 ± 0.2	42	≈ 14.0	100
21 x 38	05	0.8	1.0 + 0.4	21.5	22.5	21.5 ± 0.2	42	≈ 19.0	100

ELECTRICAL DATA	
C_R	rated capacitance at 100 Hz, tolerance ± 20 %
I_R	rated RMS ripple current at 100 Hz, 125 °C
I_{L1}	max. leakage current after 1 minute at U_R
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 $\delta_{max.}$ and C_R)
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 118 series

1000 µF/10 V; ± 20 %

Nominal case size: Ø 10 mm x 30 mm; Form BR

Ordering code: MAL211824102E3
Former 12NC: 2222 118 24102

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	CASE CODE	I_R 100 Hz 125 °C (mA)	I_{L1} 1 min (µA)	I_{L5} 5 min (µA)	tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	ORDERING CODE MAL2118.....			
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
6.3	1000	10 x 18	6	251	42	17	0.50	0.79	0.8	-	23102E3	33102E3	-
	1500	10 x 25	7	352	61	23	0.50	0.53	0.53	-	90502E3	90503E3	-
10	220	6.5 x 18	4	109	20	8.4	0.35	2.53	2.1	-	24221E3	34221E3	-
	330	8 x 18	5	150	24	11	0.35	1.69	1.4	-	24331E3	34331E3	-
	470	8 x 18	5	179	32	13	0.35	1.19	1.0	-	24471E3	34471E3	-
	1000	10 x 25	7	343	64	24	0.35	0.56	0.55	-	90504E3	90505E3	-
	1000	10 x 30	00	550	64	24	0.32	0.505	0.45	14102E3	24102E3	-	-
	1500	12.5 x 30	01	740	94	34	0.32	0.340	0.28	14152E3	24152E3	-	-
	2200	12.5 x 30	01	830	136	48	0.40	0.290	0.27	14222E3	24222E3	-	-
	3300	15 x 30	02	1070	202	70	0.40	0.190	0.18	14332E3	24332E3	-	44332E3
	4700	18 x 30	03	1350	286	98	0.46	0.155	0.15	14472E3	-	-	44472E3
	6800	18 x 38	04	1730	412	140	0.53	0.100	0.10	14682E3	-	-	44682E3
	10000	21 x 38	05	1860	604	200	0.53	0.084	0.10	14103E3	-	-	44103E3
16	220	8 x 18	5	145	25	11	0.25	1.81	1.5	-	25221E3	35221E3	-
	330	10 x 18	6	204	36	15	0.25	1.21	1.2	-	25331E3	35331E3	-
	470	10 x 18	6	243	49	19	0.25	0.85	0.83	-	25471E3	35471E3	-
	680	10 x 30	00	510	69	30	0.22	0.525	0.45	15681E3	25681E3	-	-
	1000	12.5 x 30	01	720	100	36	0.22	0.345	0.28	15102E3	25102E3	-	-
	1500	12.5 x 30	01	790	148	52	0.29	0.305	0.27	15152E3	25152E3	-	-
	2200	15 x 30	02	1010	215	74	0.29	0.205	0.18	15222E3	25222E3	-	45222E3
	3300	18 x 30	03	1300	321	110	0.34	0.165	0.15	15332E3	-	-	45332E3
	4700	18 x 38	04	1670	455	150	0.34	0.105	0.10	15472E3	-	-	45472E3
	6800	21 x 38	05	1790	657	220	0.38	0.088	0.10	15682E3	-	-	45682E3
25	100	6.5 x 18	4	102	20	9	0.18	2.86	2.3	-	26101E3	36101E3	-
	220	10 x 18	6	196	37	15	0.18	1.30	1.25	-	26221E3	36221E3	-
	330	10 x 25	7	274	54	21	0.18	0.87	0.82	-	26331E3	36331E3	-
	470	10 x 25	7	327	75	28	0.18	0.61	0.57	-	90508E3	90509E3	-
	470	10 x 30	00	490	75	28	0.18	0.61	0.50	16471E3	26471E3	-	-
	680	12.5 x 30	01	680	106	38	0.18	0.42	0.30	16681E3	26681E3	-	-
	1000	12.5 x 30	01	760	154	54	0.24	0.375	0.28	16102E3	26102E3	-	-
	1500	15 x 30	02	980	229	79	0.25	0.263	0.22	16152E3	26152E3	-	46152E3
	2200	18 x 30	03	1240	334	110	0.26	0.185	0.17	16222E3	-	-	46222E3
	3300	18 x 38	04	1610	499	170	0.26	0.12	0.11	16332E3	-	-	46332E3
	4700	21 x 38	05	1710	709	240	0.28	0.095	0.10	16472E3	-	-	46472E3
40	47	6.5 x 18	4	89.8	20	7.8	0.11	3.72	2.8	-	27479E3	37479E3	-
	100	8 x 18	5	147	28	12	0.11	1.75	1.3	-	27101E3	37101E3	-
	150	10 x 18	6	207	40	16	0.11	1.17	1.0	-	27151E3	37151E3	-
	220	10 x 25	7	287	57	22	0.11	0.80	0.68	-	90511E3	90512E3	-
	220	10 x 30	00	390	57	22	0.10	0.70	0.55	17221E3	27221E3	-	-
	330	12.5 x 30	01	570	83	30	0.10	0.43	0.33	17331E3	27331E3	-	-
	470	12.5 x 30	01	620	117	42	0.11	0.38	0.30	17471E3	27471E3	-	-
	680	15 x 30	02	810	167	58	0.11	0.255	0.23	17681E3	27681E3	-	47681E3
	1000	18 x 30	03	1070	244	84	0.13	0.205	0.18	17102E3	-	-	47102E3
	1500	18 x 38	04	1390	364	120	0.13	0.13	0.11	17152E3	-	-	47152E3
	2200	21 x 38	05	1540	532	180	0.15	0.105	0.10	17222E3	-	-	47222E3

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	CASE CODE	I_R 100 Hz 125 °C (mA)	I_{L1} 1 min (µA)	I_{L5} 5 min (µA)	tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	ORDERING CODE MAL2118..... IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
63	1.0	6.5 x 18	4	16.4	20	4.1	0.07	110	22	-	28108E3	38108E3	-
	2.2	6.5 x 18	4	24.3	20	4.3	0.07	51	15	-	28228E3	38228E3	-
	4.7	6.5 x 18	4	35.6	20	4.6	0.07	24	8.9	-	28478E3	38478E3	-
	10	6.5 x 18	4	51.9	20	5.3	0.07	11	5.6	-	28109E3	38109E3	-
	22	6.5 x 18	4	77.0	20	6.8	0.07	5.1	3.2	-	28229E3	38229E3	-
	47	8 x 18	5	126	22	9.9	0.07	2.4	1.5	-	28479E3	38479E3	-
	100	10 x 25	7	243	42	17	0.07	1.1	0.7	-	90513E3	90514E3	-
	100	10 x 30	00	340	42	17	0.07	1.91	1.62	18101E3	28101E3	-	-
	150	12.5 x 30	01	490	61	23	0.07	1.00	0.79	18151E3	28151E3	-	-
	220	12.5 x 30	01	550	87	32	0.08	0.94	0.82	18221E3	28221E3	-	-
	330	15 x 30	02	730	129	46	0.09	0.63	0.56	18331E3	28331E3	-	48331E3
	470	18 x 30	03	970	182	63	0.09	0.44	0.39	18471E3	-	-	48471E3
	680	18 x 38	04	1230	261	90	0.09	0.30	0.26	18681E3	-	-	48681E3
	1000	21 x 38	05	1400	383	130	0.10	0.16	0.20	18102E3	-	-	48102E3
100	4.7	6.5 x 18	4	36	20	4.9	0.07	24	19	-	29478E3	39478E3	-
	10	6.5 x 18	4	52	20	6.0	0.07	11	9.0	-	29109E3	39109E3	-
	22	8 x 18	5	91	20	8.4	0.07	5.1	4.0	-	29229E3	39229E3	-
	33	10 x 25	7	140	24	11	0.07	3.4	2.7	-	29339E3	39339E3	-
	47	10 x 25	7	170	33	13	0.07	2.6	2.0	-	90535E3	90536E3	-
	47	10 x 30	00	240	33	13	0.08	2.6	2.0	19479E3	29479E3	-	-
	68	12.5 x 30	01	320	45	18	0.08	1.8	1.2	19689E3	29689E3	-	-
	100	12.5 x 30	01	380	64	24	0.09	1.4	1.15	19101E3	29101E3	-	-
	150	15 x 30	02	500	94	34	0.10	0.94	0.78	19151E3	29151E3	-	49151E3
	220	18 x 30	03	690	136	48	0.10	0.66	0.55	19221E3	-	-	49221E3
	330	18 x 38	04	890	202	70	0.10	0.45	0.37	19331E3	-	-	49331E3
	470	21 x 38	05	1050	286	98	0.10	0.33	0.28	19471E3	-	-	49471E3
200	2.2	6.5 x 18	4	27	20	4.9	0.06	44	23	-	90537E3	90538E3	-
	4.7	8 x 18	5	46	20	5.9	0.06	21	11	-	90539E3	90541E3	-
	10	10 x 25	7	85	20	8.0	0.06	9.4	5.0	-	90542E3	90543E3	-
	15	10 x 30	00	150	22	10	0.046	4.76	3.75	92159E3	90012E3	-	-
	22	12.5 x 30	01	210	31	13	0.046	3.17	2.22	92229E3	90013E3	-	-
	33	15 x 30	02	290	44	17	0.046	2.11	1.11	92339E3	90014E3	-	90002E3
	47	18 x 30	03	390	61	23	0.046	1.48	0.60	92479E3	-	-	90003E3
	68	18 x 38	04	500	86	31	0.046	1.02	0.42	92689E3	-	-	90004E3
	100	21 x 38	05	610	124	44	0.046	0.96	0.39	92101E3	-	-	90005E3

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	$I_{L1} \leq 0.006\ C_R \times U_R + 4\ \mu A$ or 20 µA (whichever is greater)	
	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 Ø D x L mm:		
	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

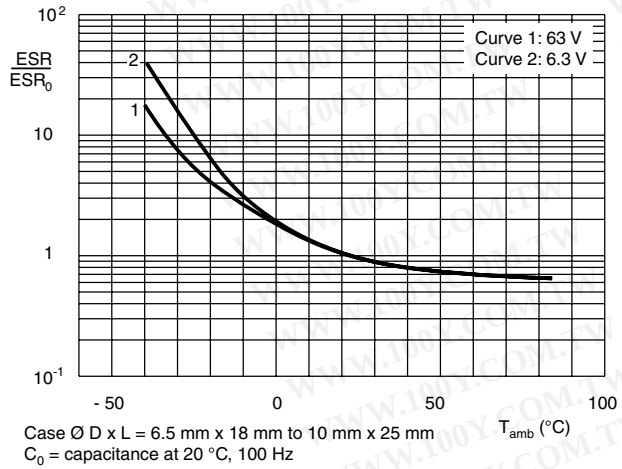
Table 3

UPRATING VALUES AT REDUCED AMBIENT TEMPERATURE										
SYMBOL	CONDITIONS	VALUES								UNIT
U_R	$T_{amb} > 85$ to 125 °C	6.3	10	16	25	40	63	100	200	V
U_{R2}	$T_{amb} \leq 85$ °C	10	16	25	40	63	100	125	250	V

Note

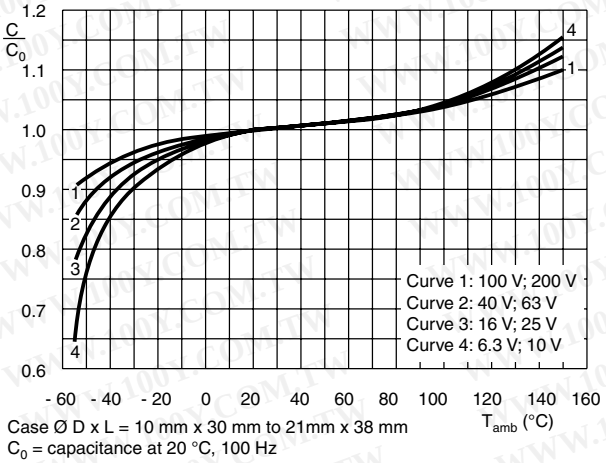
For applications at ambient temperatures of ≤ 85 °C, the rated voltage (U_R) may be raised to U_{R2}.

CAPACITANCE



Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm
C_0 = capacitance at 20 °C, 100 Hz

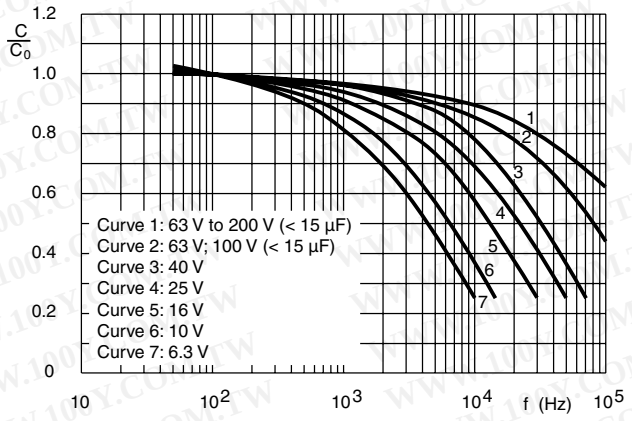
Fig.5 Typical multiplier of capacitance as a function of ambient temperature



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

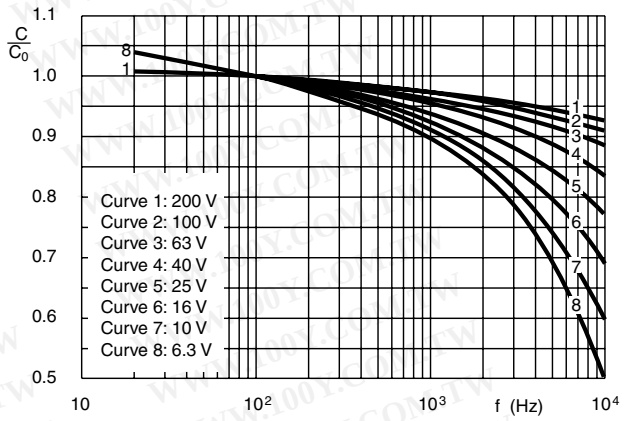
Fig.6 Typical multiplier of capacitance as a function of ambient temperature

CAPACITANCE



Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm
C_0 = capacitance at 20 °C, 100 Hz

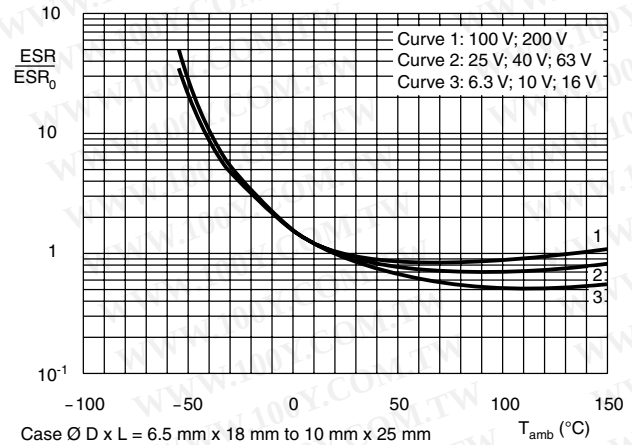
Fig.7 Typical multiplier of capacitance as a function of frequency



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

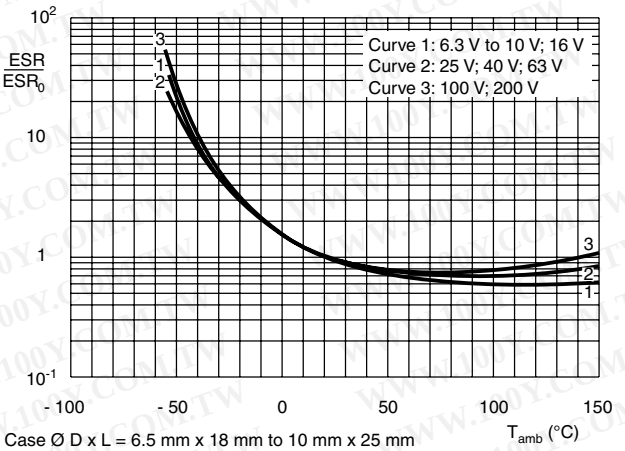
Fig.8 Typical multiplier of capacitance as a function of frequency

EQUIVALENT SERIES RESISTANCE (ESR)



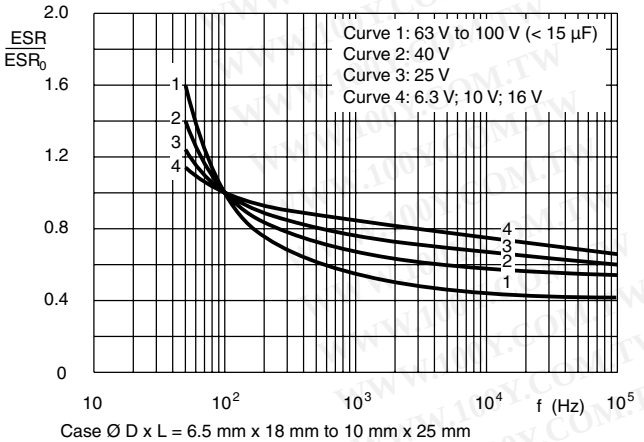
Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm
ESR_0 = typical at 20 °C, 100 Hz

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



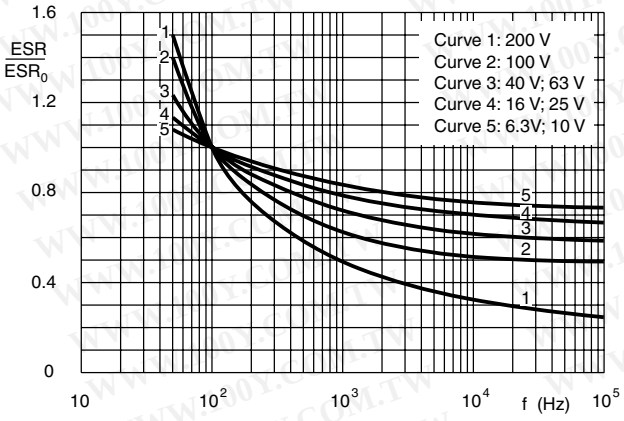
Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm
ESR_0 = typical at 20 °C, 100 Hz

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



Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm
ESR_0 = typical at 20 °C, 100 Hz

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



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

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

IMPEDANCE (Z)

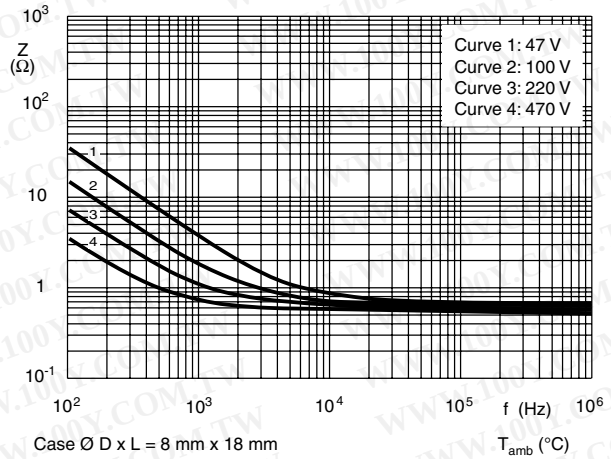


Fig.13 Typical impedance as a function of frequency

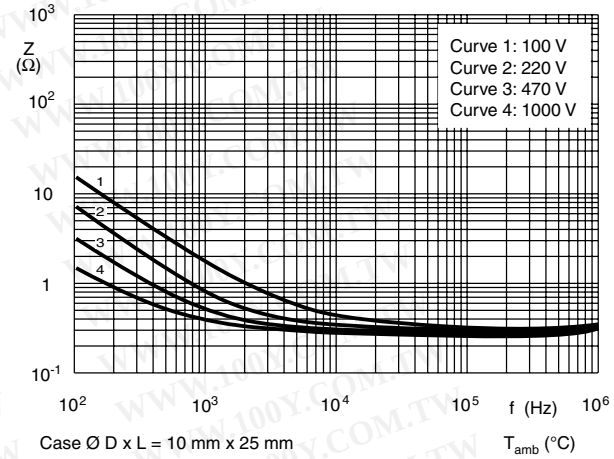


Fig.14 Typical impedance as a function of frequency

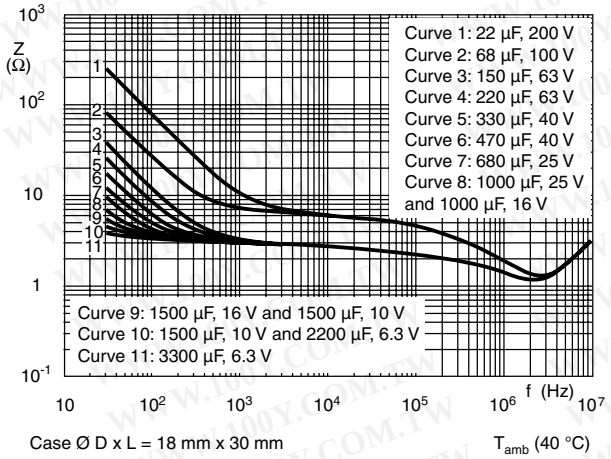


Fig.15 Typical impedance as a function of frequency

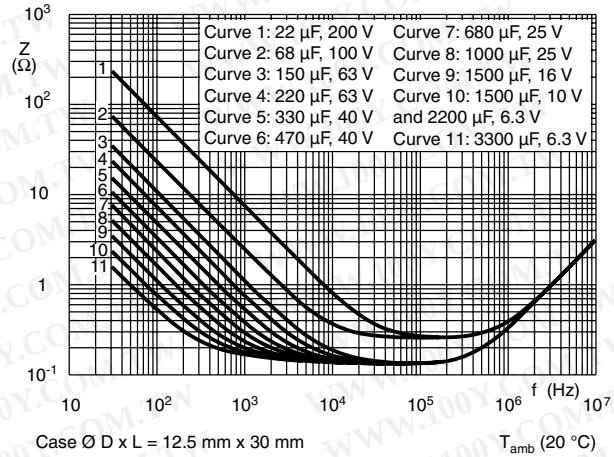


Fig.16 Typical impedance as a function of frequency

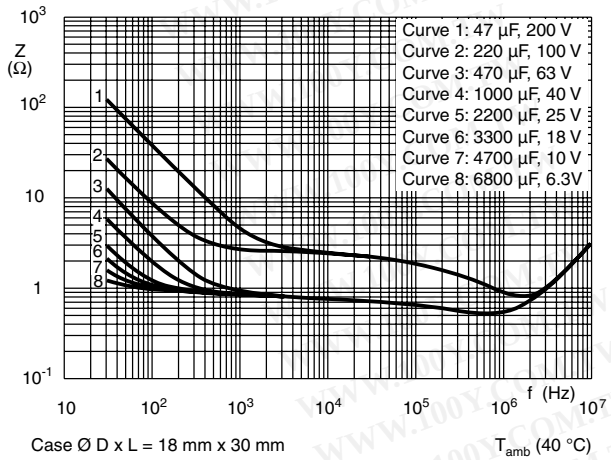


Fig.17 Typical impedance as a function of frequency

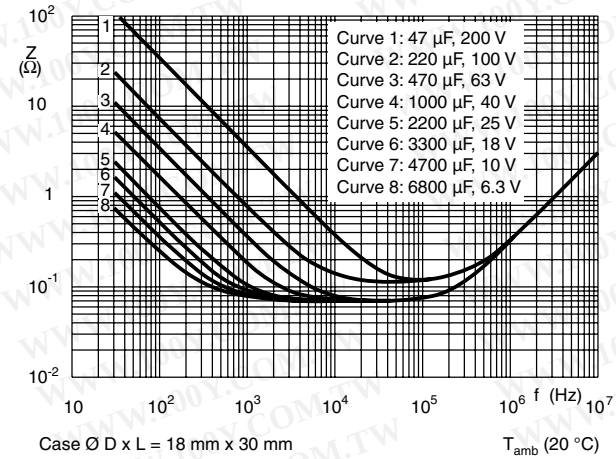
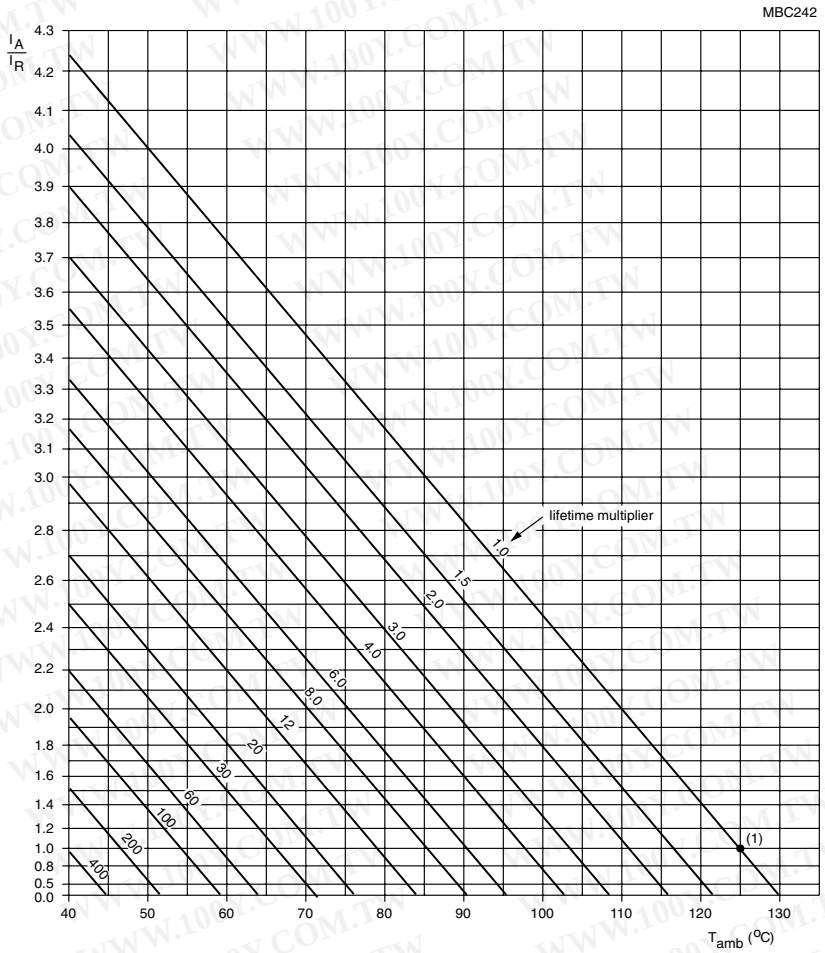


Fig.18 Typical impedance as a function of frequency

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 Hz
I_R = rated ripple current at 100 Hz, 125 °C
(1) Useful life at 125 °C and I_R applied:
case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm: 4000 hours
case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm: 8000 hours

Fig.19 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)	I_R MULTIPLIER		
	U_R = 6.3 V to 25 V	U_R = 40 V to 63 V	U_R = 100 V to 200 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 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		**PROCEDURE (quick reference)**	**REQUIREMENTS**
NAME OF TEST	**REFERENCE**		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	T_{amb} = 125 °C; U_R applied; Case sizes: 6.5 mm x 18 mm to 10 mm x 25 mm: 2000 hours; 10 mm x 30 mm to 21 mm x 38 mm: 3000 hours	$U_R \leq 6.3$ 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} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 125 °C; U_R and I_R applied; Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm: 4000 hours; case Ø D x L = 10 mm x 30 mm to 21 mm x 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 x spec. limit Z ≤ 3 x spec. limit I_{L5} ≤ spec. limit no short or open circuit total failure percentage: ≤ 1 % (200 V ≤ 3 %)
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	T_{amb} = 125 °C; no voltage applied; U_R = 6.3 V to 63 V: 500 hours; U_R = 100 V and 200 V: 100 hours After test: U_R to be applied for 30 minutes, 24 hours to 48 hours before measurement	ΔC/C, tan δ, Z: for requirements see 'Endurance test' above I_{L5} ≤ 2 x spec. limit
Reverse voltage	IEC 60384-4/ EN130300 subclause 4.15	T_{amb} = 125 °C: 125 hours at U = - 1 V followed by 125 hours at U_R	ΔC/C: ± 20 % tan δ ≤ spec. limit I_{L5} ≤ spec. limit

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