

Aluminum Capacitors Axial Long Life, DIN-Based

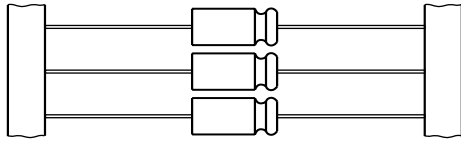
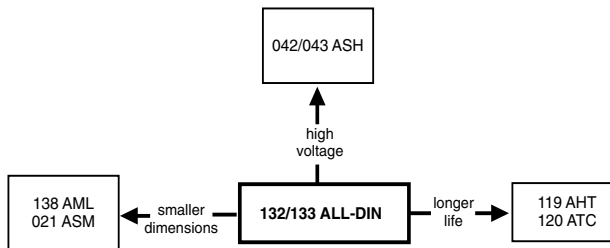


Fig.1 Component outlines



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 \varnothing 15 x 30 mm available for automatic insertion
- Charge and discharge proof
- Long useful life: up to 10 000 to 15 000 hours at 85 °C, high reliability
- Lead (Pb)-free versions are RoHS compliant



RoHS*
COMPLIANT

APPLICATIONS

- General industrial, power supplies, telecommunication, EDP
- Coupling, decoupling, timing; smoothing, filtering and buffering in SMPS
- For use where low mounting height is important
- Vibration and shock resistant

MARKING

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

- Rated capacitance (in μ F)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (T for - 10 to + 50 %)
- 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
- Series number (132 or 133)

QUICK REFERENCE DATA			
DESCRIPTION	VALUE		
Nominal case sizes (\varnothing D x L in mm)	6.5 x 18 and 8 x 18	10 x 18 and 10 x 25	10 x 30 to 21 x 38
Rated capacitance range, C_R	1 to 4700 μ F		
Tolerance on C_R	- 10 to + 50 %		
Rated voltage range, U_R	10 to 350 V		
Category temperature range	- 40 to + 85 °C		
Endurance test at 105 °C	2000 hours	2000 hours	-
Endurance test at 85 °C	6000 hours	8000 hours	8000 hours
Useful life at 105 °C	3000 hours	3000 hours	-
Useful life at 85 °C	10 000 hours	15 000 hours	15 000 hours
Useful life at 40 °C, 1.8 x I_R applied	160 000 hours	240 000 hours	240 000 hours
Shelf life at 0 V, 85 °C	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 (\varnothing D x L in mm)									
C_R (μ F)	U_R (V)								
	10	16	25	40	63	100	160	250	350
1.0	-	-	-	-	-	6.5 x 18	-	-	6.5 x 18
2.2	-	-	-	-	-	6.5 x 18	6.5 x 18	8 x 18	8 x 18
4.7	-	-	-	-	6.5 x 18	6.5 x 18	8 x 18	10 x 18	8 x 18
10	-	-	-	-	6.5 x 18	8 x 18	10 x 18	10 x 25	12.5 x 30 ⁽¹⁾
	-	-	-	-	-	-	-	10 x 30 ⁽¹⁾	-
22	-	-	6.5 x 18	-	8 x 18	10 x 18	10 x 25	12.5 x 30 ⁽¹⁾	15 x 30 ⁽¹⁾
	-	-	-	-	-	-	10 x 30 ⁽¹⁾	-	-

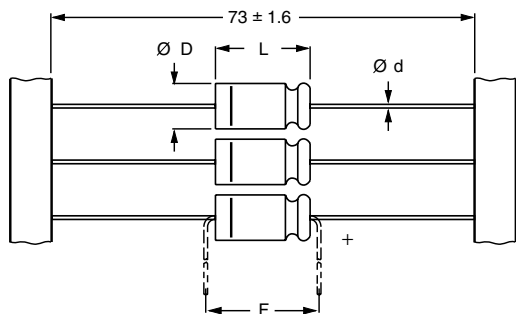
* Pb containing terminations are not RoHS compliant, exemptions may apply

SELECTION CHART FOR C_R , U_R AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ in mm)									
C_R (μF)	U_R (V)								
	10	16	25	40	63	100	160	250	350
47	-	6.5 x 18	-	8 x 18	10 x 18	10 x 25	15 x 30 ⁽¹⁾	18 x 30 ⁽¹⁾	18 x 38 ⁽¹⁾
68	-	-	-	-	-	10 x 30	-	-	-
100	-	8 x 18	-	10 x 18	10 x 30	15 x 30	18 x 30 ⁽¹⁾	18 x 38 ⁽¹⁾	21 x 38 ⁽¹⁾
150	-	-	-	12.5 x 30	15 x 30	18 x 30	18 x 38 ⁽¹⁾	-	-
220	8 x 18	10 x 18	10 x 25	12.5 x 30	15 x 30	18 x 38	21 x 38 ⁽¹⁾	-	-
330	-	-	12.5 x 30	-	-	-	-	-	-
470	-	10 x 25	12.5 x 30	15 x 30	18 x 30	18 x 38	-	-	-
680	12.5 x 30	10 x 25	12.5 x 30	15 x 30	18 x 38	21 x 38	-	-	-
1000	-	12.5 x 30	-	-	-	-	-	-	-
1500	12.5 x 30	15 x 30	18 x 30	18 x 30	21 x 38	-	-	-	-
2200	15 x 30	15 x 30	18 x 30	18 x 38	21 x 38	-	-	-	-
3300	18 x 30	18 x 30	18 x 38	21 x 38	-	-	-	-	-
4700	18 x 30	18 x 38	21 x 38	21 x 38	-	-	-	-	-
4700	18 x 38	21 x 38	-	-	-	-	-	-	-
4700	21 x 38	21 x 38	-	-	-	-	-	-	-

Note

1. For these CV-values see data sheet 041-043 ASH.

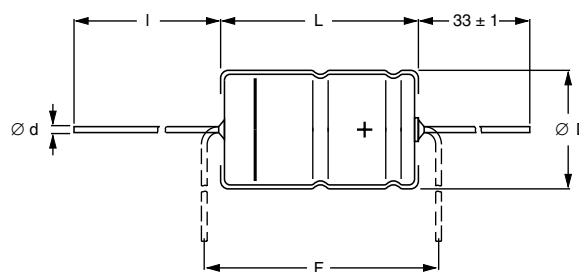
DIMENSIONS in millimeters AND AVAILABLE FORMS



Form BR: Taped on reel,
case $\varnothing D \times L = 6.5 \times 18$ to 15×30 mm.

Form BA: Taped in box (ammopack),
case $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm.

Fig.2 Forms BA and BR



Form AA: Axial in box,
case $\varnothing D \times L = 10 \times 30$ to 21×38 mm.

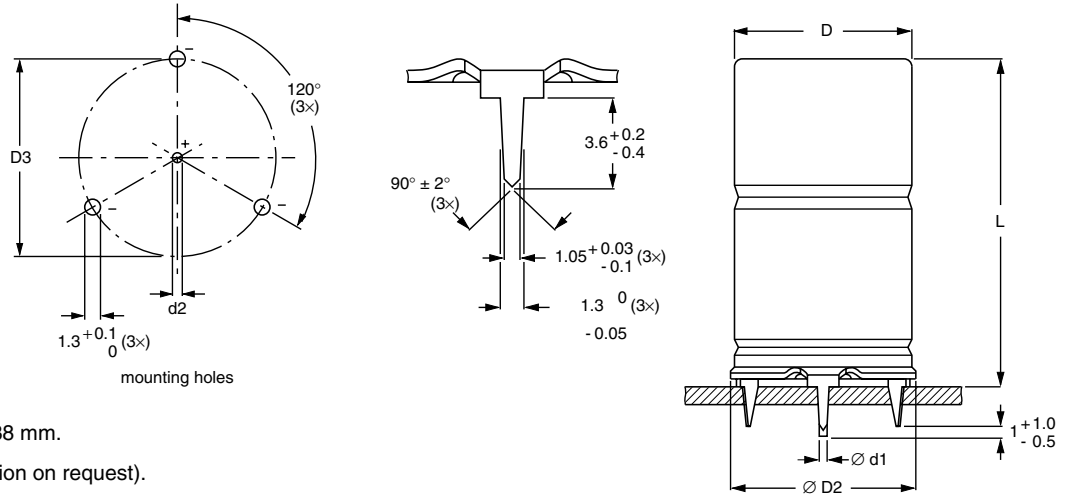
Fig.3 Form AA

Table 1

AXIAL; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES										
NOMINAL CASE SIZE $\varnothing D \times L$	CASE CODE	AXIAL FORM AA, BA, and BR					MASS (g)	PACKAGING QUANTITIES		
		$\varnothing d$	l	$\varnothing D_{max}$	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	25.0	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.4 Mounting hole diagram and outline; **Form MR**; mounting ring and pins.

Form MR: case

 $\varnothing D \times L = 15 \times 30$ 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 $\varnothing D \times L$	CASE CODE	MOUNTING RING: FORM MR						MASS (g)	PACKAGING QUANTITIES
		$\varnothing d1$	$\varnothing d2$	$\varnothing D_{max}$	$\varnothing D2_{max}$	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 - 10/+ 50 %
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

ORDERING EXAMPLE*

Electrolytic capacitor 132 series

 100 μ F/40 V; - 10/+ 50 %

 Nominal case size: $\varnothing 10 \times 18$ mm; Form BR

Catalog number: 2222 132 27101

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

Note

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



Table 3

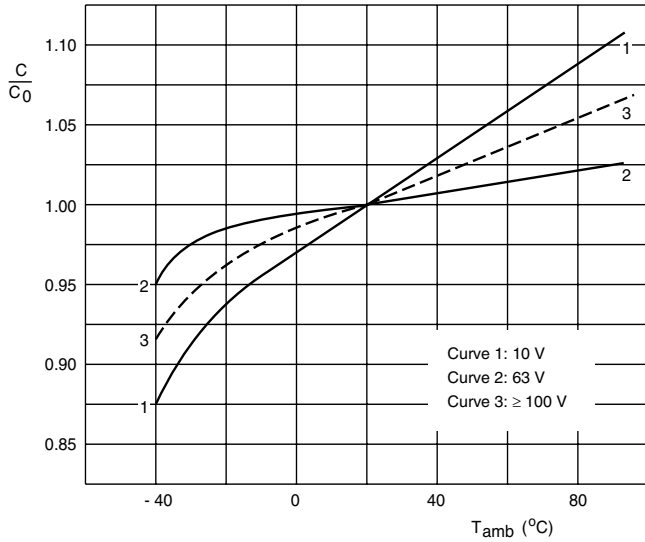
ELECTRICAL DATA AND ORDERING INFORMATION													
U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅ D x L (mm)	I _R 100 Hz 85 °C (mA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOG NUMBER 2222				
									IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR	
10	220	8 x 18	190	8.4	0.18	1.3	0.73	0.70	-	132 24221	132 34221	-	-
	470	12.5 x 30	350	9.4	0.18	0.61	0.26	0.60	132 14471	132 24471	-	-	
	680	12.5 x 30	460	13.6	0.18	0.42	0.20	0.40	132 14681	132 24681	-	-	
	1000	15 x 30	640	20	0.18	0.28	0.12	-	132 14102	132 24102	-	132 44102	
	1500	18 x 30	800	30	0.22	0.23	0.10	-	132 14152	-	-	132 44152	
	2200	18 x 30	1100	44	0.22	0.16	0.09	-	132 14222	-	-	132 44222	
	3300	18 x 38	1300	66	0.27	0.13	0.05	-	132 14332	-	-	132 44332	
	4700	21 x 38	1800	94	0.27	0.09	0.05	-	132 14472	-	-	132 44472	
	16	47	6.5 x 18	95	5.5	0.14	4.7	2.6	2.2	-	132 25479	132 35479	-
100		8 x 18	150	7.2	0.14	2.2	1.2	1.1	-	132 25101	132 35101	-	-
220		10 x 18	250	11	0.14	1.0	0.55	0.55	-	132 25221	132 35221	-	-
330		10 x 25	320	14.6	0.14	0.67	0.36	0.36	-	132 90508	132 90509	-	-
330		12.5 x 30	320	10.6	0.14	0.67	0.36	0.60	132 15331	132 25331	-	-	
470		10 x 25	450	19	0.14	0.47	0.26	0.26	-	132 90507	132 90502	-	-
470		12.5 x 30	450	15	0.14	0.47	0.26	0.40	132 15471	132 25471	-	-	
680		15 x 30	550	22	0.14	0.33	0.14	-	132 15681	132 25681	-	132 45681	
1000		15 x 30	780	32	0.14	0.22	0.12	-	132 15102	132 25102	-	132 45102	
1500		18 x 30	950	48	0.15	0.16	0.10	-	132 15152	-	-	132 45152	
2200		18 x 38	1300	70	0.15	0.11	0.06	-	132 15222	-	-	132 45222	
3300		21 x 38	1600	110	0.15	0.07	0.05	-	132 15332	-	-	132 45332	
4700		21 x 38	2300	150	0.15	0.05	0.05	-	132 15472	-	-	132 45472	
25	22	6.5 x 18	60	5.1	0.11	8.0	4.1	2.9	-	132 26229	132 36229	-	-
	220	10 x 25	340	15	0.11	0.8	0.40	0.40	-	132 90503	132 90504	-	-
	220	12.5 x 30	340	11	0.11	0.8	0.40	0.60	132 16221	132 26221	-	-	
	330	12.5 x 30	410	16.5	0.11	0.53	0.30	0.40	132 16331	132 26331	-	-	
	470	12.5 x 30	560	24	0.11	0.37	0.20	-	132 16471	132 26471	-	-	
	680	18 x 30	700	34	0.11	0.26	0.10	-	132 16681	-	-	132 46681	
	1000	18 x 30	1000	50	0.11	0.17	0.10	-	132 16102	-	-	132 46102	
	1500	18 x 38	1100	75	0.12	0.13	0.06	-	132 16152	-	-	132 46152	
2200	21 x 38	1850	110	0.13	0.09	0.05	-	132 16222	-	-	132 46222		
40	47	8 x 18	120	7.8	0.09	3.0	1.6	1.4	-	132 27479	132 37479	-	-
	100	10 x 18	210	12	0.09	1.4	0.75	0.75	-	132 27101	132 37101	-	-
	150	10 x 25	310	16	0.09	0.95	0.50	0.50	-	132 90511	132 90512	-	-
	150	12.5 x 30	310	12	0.09	0.95	0.50	0.60	132 17151	132 27151	-	-	
	220	12.5 x 30	410	17.5	0.09	0.65	0.34	0.40	132 17221	132 27221	-	-	
	330	15 x 30	550	26	0.09	0.43	0.20	-	132 17331	132 27331	-	132 47331	
	470	15 x 30	700	38	0.09	0.30	0.16	-	132 17471	132 27471	-	132 47471	
	680	18 x 30	900	54	0.09	0.21	0.10	-	132 17681	-	-	132 47681	
	1000	18 x 38	1200	80	0.09	0.14	0.08	-	132 17102	-	-	132 47102	
	1500	21 x 38	1500	120	0.10	0.10	0.06	-	132 17152	-	-	132 47152	
2200	21 x 38	1900	180	0.10	0.07	0.05	-	132 17222	-	-	132 47222		
63	4.7	6.5 x 18	38	4.6	0.07	24	12	5	-	132 28478	132 38478	-	-
	10	6.5 x 18	64	5.3	0.07	11	5.5	3.3	-	132 28109	132 38109	-	-
	22	8 x 18	100	6.8	0.07	5.1	2.5	2.1	-	132 28229	132 38229	-	-
	47	10 x 18	170	9.9	0.07	2.4	1.2	1.2	-	132 28479	132 38479	-	-
	68	10 x 25	210	12.6	0.07	1.6	0.81	0.60	-	132 90513	132 90514	-	-
	68	10 x 30	210	8.6	0.07	1.6	0.80	0.60	132 18689	132 28689	-	-	
	100	10 x 30	300	12.6	0.07	1.1	0.60	0.40	132 18101	132 28101	-	-	
	150	15 x 30	350	19	0.07	0.74	0.37	-	132 18151	132 28151	-	132 48151	
	220	15 x 30	520	28	0.07	0.50	0.25	-	132 18221	132 28221	-	132 48221	
	330	18 x 30	600	42	0.07	0.34	0.15	-	132 18331	-	-	132 48331	
	470	18 x 38	970	59	0.07	0.24	0.12	-	132 18471	-	-	132 48471	
	680	21 x 38	1000	86	0.07	0.16	0.08	-	132 18681	-	-	132 48681	
	1000	21 x 38	1600	130	0.07	0.11	0.06	-	132 18102	-	-	132 48102	



ELECTRICAL DATA AND ORDERING INFORMATION												
U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅ D x 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)	Z 100 kHz (Ω)	CATALOG NUMBER 2222			
									IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
100	1	6.5 x 18	20	4.0	0.06	95	45	6	-	132 29108	132 39108	-
	2.2	6.5 x 18	30	4.4	0.06	43	20	5	-	132 29228	132 39228	-
	4.7	6.5 x 18	48	4.9	0.06	20	9.6	4	-	132 29478	132 39478	-
	10	8 x 18	73	6	0.06	9.5	4.5	2.8	-	132 29109	132 39109	-
	22	10 x 18	130	8.4	0.06	4.3	2	1.3	-	132 29229	132 39229	-
	47	10 x 25	220	13.4	0.06	2.0	1	0.90	-	132 90505	132 90506	-
	47	10 x 30	220	9.4	0.06	2.0	1	0.90	132 19479	132 29479	-	-
	68	12.5 x 30	250	13.5	0.06	1.4	0.80	-	132 19689	132 29689	-	-
	100	15 x 30	380	20	0.06	0.95	0.50	-	132 19101	132 29101	-	132 49101
	150	18 x 30	400	30	0.06	0.64	0.35	-	132 19151	-	-	132 49151
	220	18 x 38	660	44	0.06	0.43	0.20	-	132 19221	-	-	132 49221
	330	18 x 38	700	66	0.06	0.29	0.15	-	132 19331	-	-	132 49331
470	21 x 38	1200	94	0.06	0.20	0.10	-	132 19471	-	-	132 49471	
160	2.2	6.5 x 18	22	20	0.10	72	55	30	-	133 21228	133 31228	-
	4.7	8 x 18	37	20	0.10	34	26	20	-	133 21478	133 31478	-
	10	10 x 18	61	20	0.10	16	12	10	-	133 21109	133 31109	-
	22	10 x 25	120	20	0.10	7.2	5.5	2.5	-	133 90502	133 90503	-
250	2.2	8 x 18	25	20	0.10	72	50	30	-	133 23228	133 33228	-
	4.7	10 x 18	37	20	0.10	34	23	16	-	133 23478	133 33478	-
	10	10 x 25	66	20	0.10	16	11	9	-	133 23109	133 33109	-
350	1	6.5 x 18	15	20	0.10	160	100	40	-	133 25108	133 35108	-
	2.2	8 x 18	25	20	0.10	72	45	28	-	133 25228	133 35228	-
	4.7	8 x 18	43	20	0.10	34	21	15	-	133 90511	133 90509	-

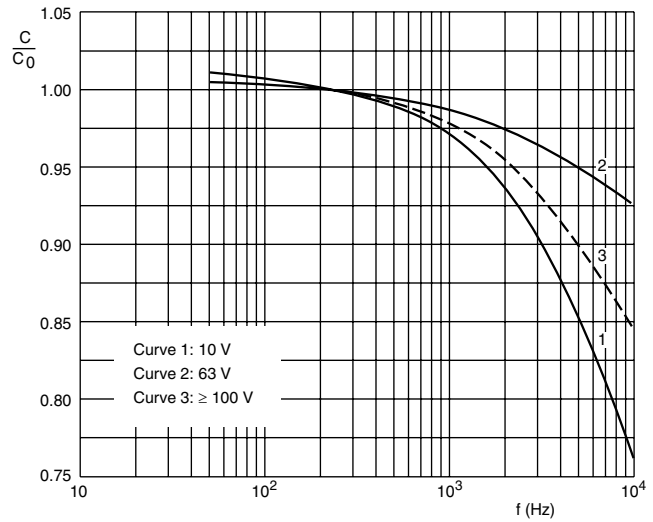
ADDITIONAL ELECTRICAL DATA			
PARAMETER	CONDITIONS	VALUE	
		AXIAL	MOUNTING RING
Voltage			
Surge voltage	U _R = 10 to 250 V	U _s ≤ 1.15 x U _R	
	U _R = 350 V	U _s ≤ 1.1 x U _R	
Reverse voltage		U _{rev} ≤ 1 V	
Current			
Leakage current	after 1 minute: case ∅ D x L = 6.5 x 18 to 10 x 25 mm: U _R = 10 to 100 V U _R = 160 to 350 V case ∅ D x L = 10 x 30 to 21 x 38 mm: U _R = 10 to 100 V	I _{L1} ≤ 0.01 C _R x U _R + 3 I _{L1} ≤ 50 μA	
	after 5 minutes: case ∅ D x L = 6.5 x 18 to 10 x 25 mm: U _R = 10 to 100 V U _R = 160 to 350 V case ∅ D x L = 10 x 30 to 21 x 38 mm: U _R = 10 to 100 V	I _{L5} ≤ 0.002 C _R x U _R + 4 I _{L5} ≤ 20 μA	
Inductance			
Equivalent series inductance (ESL)	case ∅ 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

CAPACITANCE (C)



C_0 = capacitance at 20 °C, 100 Hz

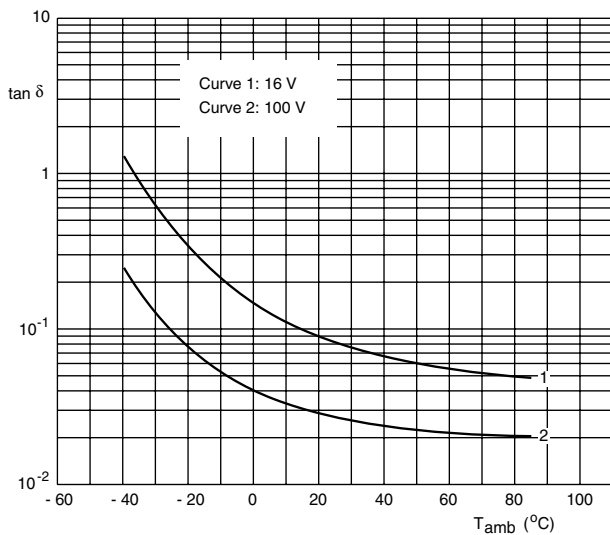
Fig.5 Typical multiplier of capacitance as a function of ambient temperature



C_0 = capacitance at 20 °C, 100 Hz

Fig.6 Typical multiplier of capacitance as a function of frequency

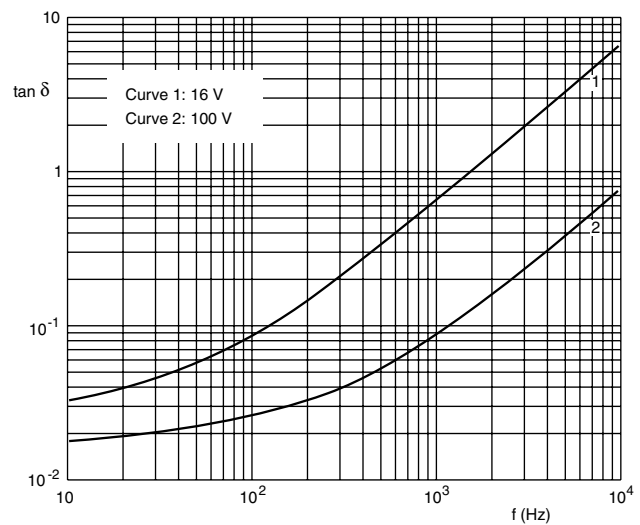
DISSIPATION FACTOR ($\tan \delta$)



Case $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm

$f = 100$ Hz

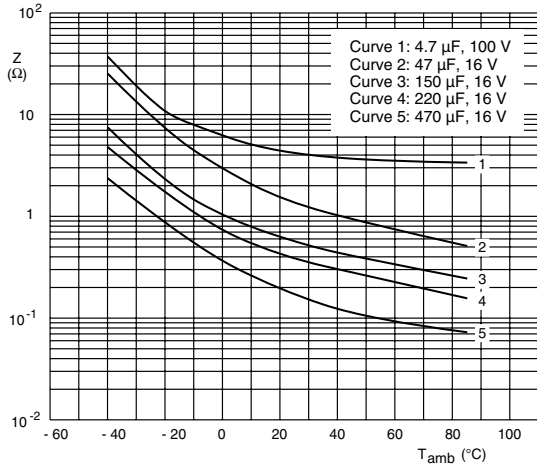
Fig.7 Typical $\tan \delta$ as a function of ambient temperature



Case $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm

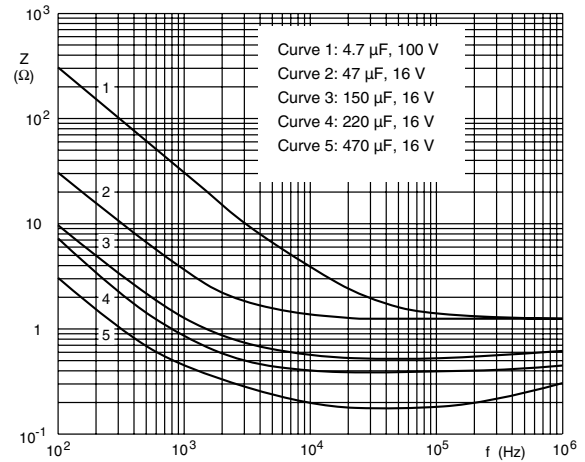
Fig.8 Typical $\tan \delta$ as a function of frequency

IMPEDANCE (Z)



Case \varnothing D x L = 6.5 x 18 mm to 10 x 25 mm $f = 10$ kHz

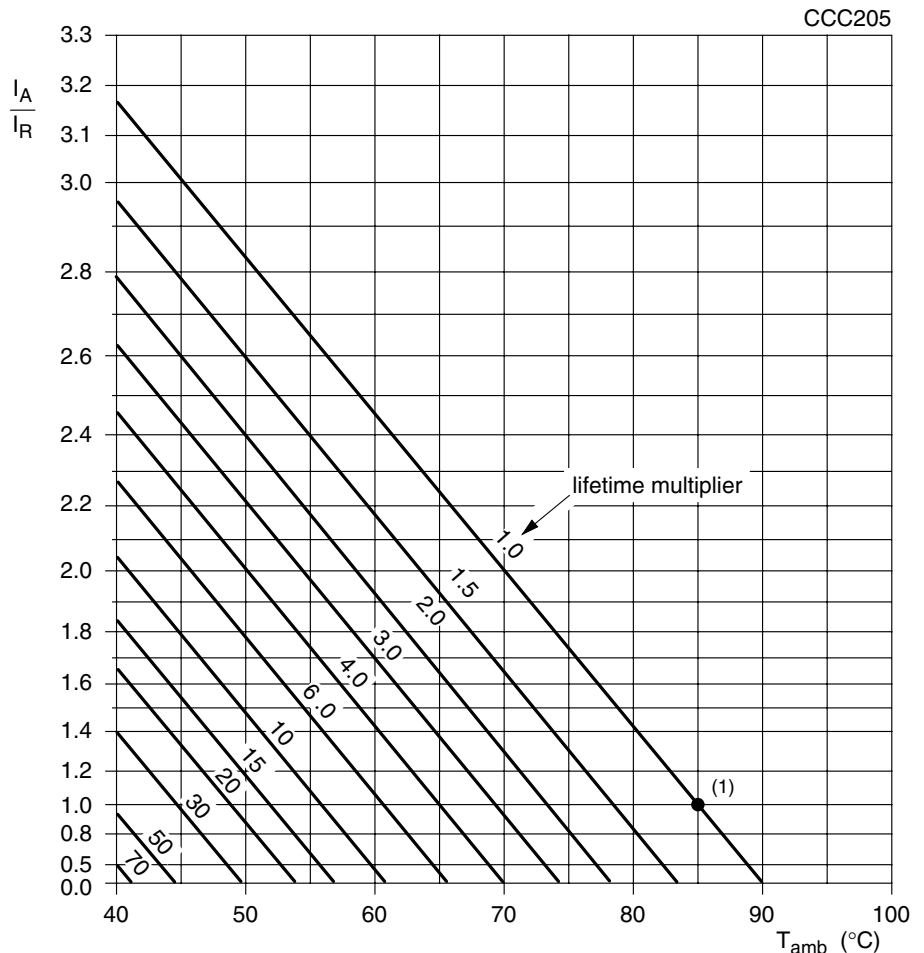
Fig.9 Typical impedance as a function of ambient temperature



Case \varnothing D x L = 6.5 x 18 mm to 10 x 25 mm $T_{\text{amb}} = 20$ °C

Fig.10 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 \varnothing D x L = 6.5 x 18 to 8 x 18 mm: 10000 hours
 case \varnothing D x L = 10 x 18 to 21 x 38 mm: 15000 hours

Fig.11 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		
	$U_R = 10$ and 16 V	$U_R = 25$ and 63 V	$U_R = 100$ to 350 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 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ }^\circ\text{C}$; U_R applied; case $\varnothing D \times L = 6.5 \times 18$ to 8×18 mm: 6000 hours; case $\varnothing D \times L = 10 \times 18$ to 21×38 mm: 8000 hours	$U_R = 10$ to 160 V; $\Delta C/C: \pm 15\%$ $U_R = 250$ to 350 V; $\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^\circ\text{C}$; U_R and I_R applied; case $\varnothing D \times L = 6.5 \times 18$ to 8×18 mm: 10 000 hours; case $\varnothing D \times L = 10 \times 18$ to 21×38 mm: 15 000 hours	$U_R = 10$ to 160 V; $\Delta C/C: \pm 45\%$ $U_R = 250$ to 350 V; $\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ }^\circ\text{C}$; no voltage applied; 500 hours; after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C$, $\tan \delta$, Z : for requirements see 'Endurance test' above $I_{L5} \leq 2 \times \text{spec. limit}$



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