Aluminium electrolytic capacitors
Axial Long Life, DIN-based

132/133 ALL-DIN

FEATURES

- Polarized aluminium electrolytic capacitors, non-solid
- Axial leads, cylindrical aluminium case, insulated with a blue sleeve
- Mounting ring version (single ended) not insulated
- Case ∅10 × 30 to 21 × 40 mm with pressure relief
- Taped versions up to ∅15 × 30 mm available for automatic insertion
- Charge and discharge proof
- Long useful life: 10000 to 15000 hours at 85 °C, high reliability
- High ripple current capability.

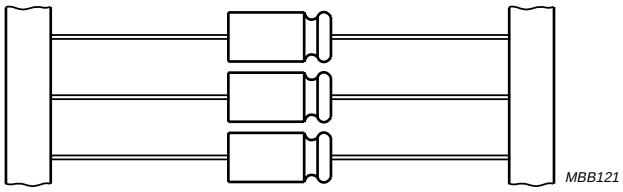
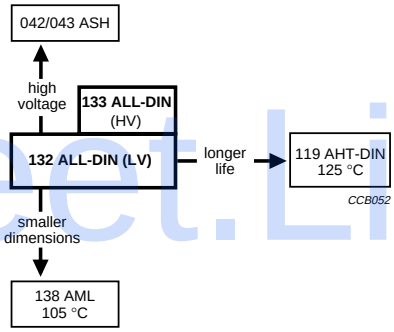


Fig.1 Component outlines.

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.



QUICK REFERENCE DATA

DESCRIPTION	VALUE		
Case sizes (∅D_{nom} × L_{nom} in mm)	6.5 × 18 and 8 × 18	10 × 18 and 10 × 25	10 × 30 to 21 × 40
Rated capacitance range, C_R	1 to 4700 µF		
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	10000 hours	15000 hours	15000 hours
Useful life at 40 °C, 1.8 × I_R applied	160000 hours	240000 hours	240000 hours
Shelf life at 0 V, 85 °C	500 hours		
Based on sectional specification	IEC 384-4/CECC 30300		
Detail specification	UTE C031/C033 (without approval)		
Climatic category IEC 68	40/085/56		

Selection chart for C_R, U_R and relevant nominal case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)

Preferred types in **bold**.

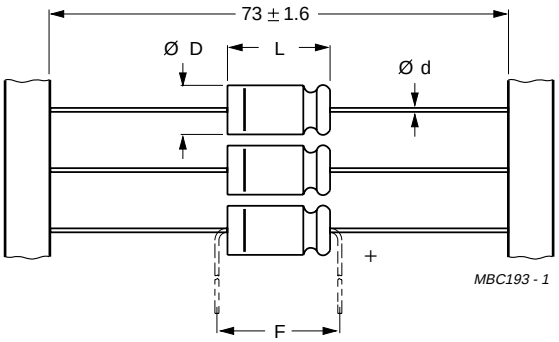
C_R (µF)	U_R (V)								
	10	**16**	**25**	**40**	**63**	**100**	**160**	**250**	**350**
1.0	–	–	–	–	–	6.5 × 18	–	–	6.5 × 18
2.2	–	–	–	–	–	6.5 × 18	**6.5 × 18**	8 × 18	8 × 18
4.7	–	–	–	–	6.5 × 18	**6.5 × 18**	8 × 18	10 × 18	**10 × 18**
10	–	–	–	–	**6.5 × 18**	**8 × 18**	10 × 18	10 × 25	12.5 × 30[1]
	–	–	–	–	–	–	–	10 × 30[1]	–
22	–	–	6.5 × 18	–	**8 × 18**	**10 × 18**	10 × 25	12.5 × 30[1]	15 × 30[1]
	–	–	–	–	–	–	10 × 30[1]	–	–
47	–	6.5 × 18	–	**8 × 18**	**10 × 18**	**10 × 25**	15 × 30[1]	18 × 30[1]	18 × 40[1]
	–	–	–	–		**10 × 30**	–	–	–
68	–	–	–	–	10 × 30	12.5 × 30	15 × 30[1]	18 × 40[1]	21 × 40[1]
100	–	**8 × 18**	–	**10 × 18**	**10 × 30**	**15 × 30**	18 × 30[1]	21 × 40[1]	–
150	–	–	–	12.5 × 30	15 × 30	18 × 30	18 × 40[1]	–	–
220	8 × 18	**10 × 18**	**10 × 25**	**12.5 × 30**	**15 × 30**	**18 × 40**	21 × 40[1]	–	–
	–	–	**12.5 × 30**	–	–	–	–	–	–
330	–	10 × 25	12.5 × 30	15 × 30	18 × 30	18 × 40	–	–	–
	–	12.5 × 30	–	–	–	–	–	–	–
470	**12.5 × 30**	10 × 25	**12.5 × 30**	**15 × 30**	**18 × 40**	**21 × 40**	–	–	–
	–	**12.5 × 30**	–	–	–	–	–	–	–
680	12.5 × 30	15 × 30	18 × 30	18 × 30	21 × 40	–	–	–	–
1000	**15 × 30**	**15 × 30**	**18 × 30**	**18 × 40**	**21 × 40**	–	–	–	–
1500	18 × 30	18 × 30	18 × 40	21 × 40	–	–	–	–	–
2200	**18 × 30**	**18 × 40**	**21 × 40**	**21 × 40**	–	–	–	–	–
3300	18 × 40	21 × 40	–	–	–	–	–	–	–
4700	**21 × 40**	**21 × 40**	–	–	–	–	–	–	–

Note

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

A

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.

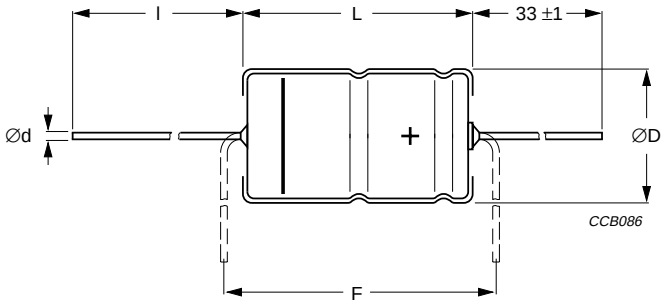
Form BR: Taped on reel,
case ∅D × L = 6.5 × 18 to 15 × 30 mm.

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

For dimensions see Table 1.

Tape dimensions are specified in this handbook, Section *"Packaging"*.

Fig.2 Dimensional outline; Forms BA and BR.



Dimensions in mm.

Form AA: Axial in box,
case ∅D × L = 10 × 30 to 21 × 40 mm

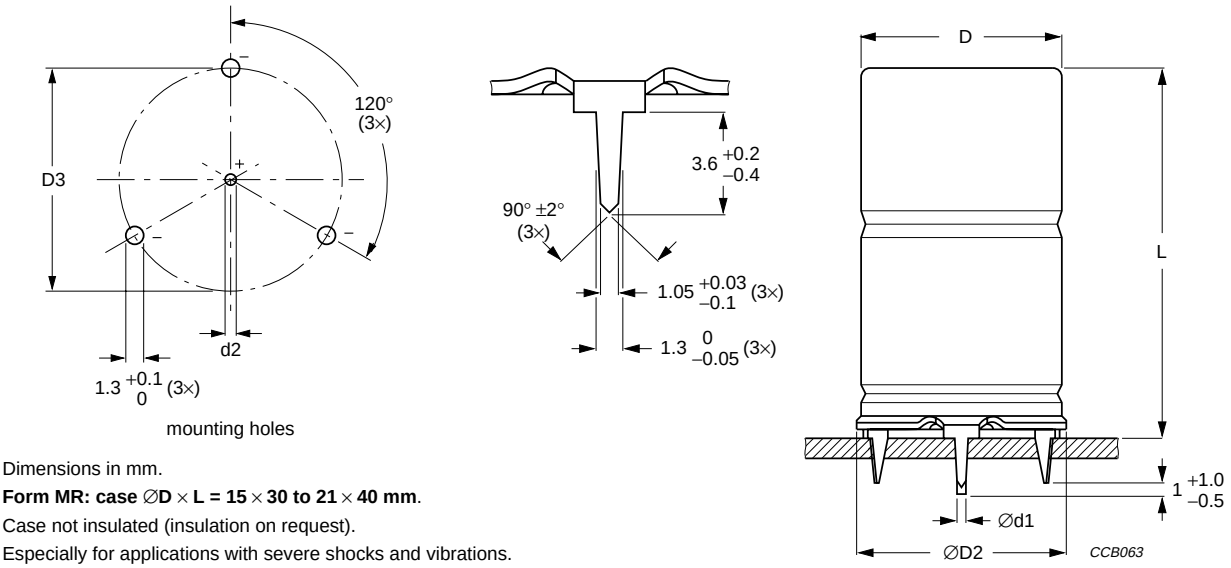
For case sizes 18 × 40 mm and 21 × 40 mm, the stated L may be exceeded by 0.7 mm.

For dimensions see Table 1.

Fig.3 Dimensional outline; Form AA.

Table 1 Axial; physical dimensions, mass and packaging quantities; see Figs 2 and 3

NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	AXIAL: FORM AA, BA, and BR					MASS (g)	PACKAGING QUANTITIES		
		∅d (mm)	l (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F_{min} (mm)		FORM AA	FORM BA	FORM BR
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	200	–	500
12.5 × 30	01	0.8	55 ±1	13.0	30.5	35	≈7.4	200	–	400
15 × 30	02	0.8	55 ±1	15.5	30.5	35	≈11.7	200	–	250
18 × 30	03	0.8	55 ±1	18.5	30.5	35	≈12.9	200	–	–
18 × 40	04	0.8	34 ±1	18.5	41.5	45	≈19.4	100	–	–
21 × 40	05	0.8	34 ±1	21.5	41.5	45	≈24.7	100	–	–



Dimensions in mm.
Form MR: case ∅D × L = 15 × 30 to 21 × 40 mm.
Case not insulated (insulation on request).
Especially for applications with severe shocks and vibrations.
For dimensions see Table 2.

Fig.4 Mounting hole diagram and outline; Form MR; single ended with mounting ring and pins.

Table 2 Single ended; physical dimensions, mass and packaging quantities; see Fig.4

NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	SINGLE ENDED WITH MOUNTING RING: FORM MR						MASS (g)	PACKAGING QUANTITIES
		∅d1 (mm)	∅d2 (mm)	$\varnothing D_{max}$ (mm)	$\varnothing D2_{max}$ (mm)	D3 (mm)	L_{max} (mm)		
15 × 30	02	0.8	1.0 +0.4	15.5	17.5	16.5 ±0.2	33	≈11.7	200
18 × 30	03	0.8	1.0 +0.4	18.5	19.5	18.5 ±0.2	33	≈12.9	200
18 × 40	04	0.8	1.0 +0.4	18.5	19.5	18.5 ±0.2	45	≈19.4	100
21 × 40	05	0.8	1.0 +0.4	21.5	22.5	21.5 ±0.2	45	≈24.7	100

A

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 3, 5, 7 and 9 apply at T_{amb} = 20 °C, P = 86 to 106 kPa, RH = 45 to 75%.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz (tolerance –10 to +50%)
I_R	rated RMS ripple current at 100 Hz, 85 °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 δ_{max} and C_R)
Z	max. impedance at 10 kHz or 100 kHz

Table 3 Electrical data; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)
10	220	8 × 18	190	25	8.4	0.18	1.3	0.73	0.70
	470	**12.5 × 30**	350	32	9.4	0.18	0.61	0.26	0.60
	680	12.5 × 30	460	45	13.6	0.18	0.42	0.20	0.40
	1000	**15 × 30**	640	64	20	0.18	0.28	0.12	–
	1500	18 × 30	800	94	30	0.22	0.23	0.10	–
	2200	**18 × 30**	1100	140	44	0.22	0.16	0.09	–
	3300	18 × 40	1300	200	66	0.27	0.13	0.05	–
	4700	**21 × 40**	1800	290	94	0.27	0.09	0.05	–
16	47	6.5 × 18	95	11	5.5	0.14	4.7	2.6	2.2
	100	**8 × 18**	150	19	7.2	0.14	2.2	1.2	1.1
	220	**10 × 18**	250	38	11	0.14	1.0	0.55	0.55
	330	10 × 25	320	56	14.6	0.14	0.67	0.36	0.36
	330	12.5 × 30	320	36	10.6	0.14	0.67	0.36	0.60
	470	10 × 25	450	78	19	0.14	0.47	0.26	0.26
	470	**12.5 × 30**	450	49	15	0.14	0.47	0.26	0.40
	680	15 × 30	550	69	22	0.14	0.33	0.14	–
	1000	**15 × 30**	780	100	32	0.14	0.22	0.12	–
	1500	18 × 30	950	150	48	0.15	0.16	0.10	–
	2200	**15 × 40**	1300	220	70	0.15	0.11	0.06	–
	3300	21 × 40	1600	320	110	0.15	0.07	0.05	–
	4700	**21 × 40**	2300	460	150	0.15	0.05	0.05	–

ORDERING INFORMATION

Ordering example

Electrolytic capacitor 132 series

100 μF/40 V; –10/+50%

Nominal case size: ∅10 × 18 mm; Form BR

Catalogue number: 2222 132 27101.

Table 4 Ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	CATALOGUE NUMBER 2222			
				AXIAL			SINGLE ENDED
				IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
10	220	8 × 18	5	–	132 24221	132 34221	–
	470	**12.5 × 30**	**01**	**132 14471**	**132 24471**	–	–
	680	12.5 × 30	01	132 14681	132 24681	–	–
	1000	**15 × 30**	**02**	**132 14102**	**132 24102**	–	**132 44102**
	1500	18 × 30	03	132 14152	–	–	132 44152
	2200	**18 × 30**	**03**	**132 14222**	–	–	**132 44222**
	3300	18 × 40	04	132 14332	–	–	132 44332
	4700	**21 × 40**	**05**	**132 14472**	–	–	**132 44472**
16	47	6.5 × 18	4	–	132 25479	132 35479	–
	100	**8 × 18**	**5**	–	132 25101	**132 35101**	–
	220	**10 × 18**	**6**	–	132 25221	**132 35221**	–
	330	10 × 25	7	–	132 90508	132 90509	–
	330	12.5 × 30	01	132 15331	132 25331	–	–
	470	10 × 25	7	–	132 90507	132 90502	–
	470	**12.5 × 30**	**01**	**132 15471**	**132 25471**	–	–
	680	15 × 30	02	132 15681	132 25681	–	132 45681
	1000	**15 × 30**	**02**	**132 15102**	**132 25102**	–	**132 45102**
	1500	18 × 30	03	132 15152	–	–	132 45152
	2200	**15 × 40**	**04**	**132 15222**	–	–	**132 45222**
	3300	21 × 40	05	132 15332	–	–	132 45332
	4700	**21 × 40**	**05**	**132 15472**	–	–	**132 45472**

A

ELECTRICAL DATA (continued)

Table 5 Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)
25	22	6.5 × 18	60	8.5	5.1	0.11	8.0	4.1	2.9
	220	**10 × 25**	340	58	15	0.11	0.8	0.40	0.40
	220	**12.5 × 30**	340	37	11	0.11	0.8	0.40	0.60
	330	12.5 × 30	410	54	16.5	0.11	0.53	0.30	0.40
	470	**12.5 × 30**	560	75	24	0.11	0.37	0.20	–
	680	18 × 30	700	106	34	0.11	0.26	0.10	–
	1000	**18 × 30**	1000	150	50	0.11	0.17	0.10	–
	1500	18 × 40	1100	230	75	0.12	0.13	0.06	–
	2200	**21 × 40**	1850	330	110	0.13	0.09	0.05	–
40	**47**	**8 × 18**	120	22	7.8	0.09	3.0	1.6	1.4
	100	**10 × 18**	210	43	12	0.09	1.4	0.75	0.75
	150	10 × 25	310	63	16	0.09	0.95	0.50	0.50
	150	12.5 × 30	310	40	12	0.09	0.95	0.50	0.60
	220	**12.5 × 30**	410	57	17.5	0.09	0.65	0.34	0.40
	330	15 × 30	550	83	26	0.09	0.43	0.20	–
	470	**15 × 30**	700	120	38	0.09	0.30	0.16	–
	680	18 × 30	900	170	54	0.09	0.21	0.10	–
	1000	**18 × 40**	1200	240	80	0.09	0.14	0.08	–
	1500	21 × 40	1500	360	120	0.10	0.10	0.06	–
	2200	**21 × 40**	1900	530	180	0.10	0.07	0.05	–

ORDERING INFORMATION (continued)

Table 6 Ordering information continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	CATALOGUE NUMBER 2222			
				AXIAL			SINGLE ENDED
				IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
25	22	6.5 × 18	4	–	132 26229	132 36229	–
	220	**10 × 25**	**7**	–	132 90503	**132 90504**	–
	220	**12.5 × 30**	**01**	**132 16221**	**132 26221**	–	–
	330	12.5 × 30	01	132 16331	132 26331	–	–
	470	**12.5 × 30**	**01**	**132 16471**	**132 26471**	–	–
	680	18 × 30	03	132 16681	–	–	132 46681
	1000	**18 × 30**	**03**	**132 16102**	–	–	**132 46102**
	1500	18 × 40	04	132 16152	–	–	132 46152
	2200	**21 × 40**	**05**	**132 16222**	–	–	**132 46222**
40	**47**	**8 × 18**	**5**	–	132 27479	**132 37479**	–
	100	**10 × 18**	**6**	–	132 27101	**132 37101**	–
	150	10 × 25	7	–	132 90511	132 90512	–
	150	12.5 × 30	01	132 17151	132 27151	–	–
	220	**12.5 × 30**	**01**	**132 17221**	**132 27221**	–	–
	330	15 × 30	02	132 17331	132 27331	–	132 47331
	470	**15 × 30**	**02**	**132 17471**	**132 27471**	–	**132 47471**
	680	18 × 30	03	132 17681	–	–	132 47681
	1000	**18 × 40**	**04**	**132 17102**	–	–	**132 47102**
	1500	21 × 40	05	132 17152	–	–	132 47152
	2200	**21 × 40**	**05**	**132 17222**	–	–	**132 47222**

A

ELECTRICAL DATA (continued)

Table 7 Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)
63	4.7	6.5 × 18	38	6.0	4.6	0.07	24	12	5
	10	**6.5 × 18**	64	9.3	5.3	0.07	11	5.5	3.3
	22	**8 × 18**	100	17	6.8	0.07	5.1	2.5	2.1
	47	**10 × 18**	170	33	9.9	0.07	2.4	1.2	1.2
	68	10 × 25	210	46	12.6	0.07	1.6	0.81	0.60
	68	10 × 30	210	30	8.6	0.07	1.6	0.80	0.60
	100	**10 × 30**	300	42	12.6	0.07	1.1	0.60	0.40
	150	15 × 30	350	61	19	0.07	0.74	0.37	–
	220	**15 × 30**	520	87	28	0.07	0.50	0.25	–
	330	18 × 30	600	130	42	0.07	0.34	0.15	–
	470	**18 × 40**	970	180	59	0.07	0.24	0.12	–
	680	21 × 40	1000	260	86	0.07	0.16	0.08	–
	1000	**21 × 40**	1600	380	130	0.07	0.11	0.06	–
100	1	6.5 × 18	20	4.0	4.0	0.06	95	45	6
	2.2	6.5 × 18	30	5.2	4.4	0.06	43	20	5
	4.7	**6.5 × 18**	48	7.7	4.9	0.06	20	9.6	4
	10	**8 × 18**	73	13	6	0.06	9.5	4.5	2.8
	22	**10 × 18**	130	25	8.4	0.06	4.3	2	1.3
	47	**10 × 25**	220	50	13.4	0.06	2.0	1	0.90
	47	**10 × 30**	220	32	9.4	0.06	2.0	1	0.90
	68	12.5 × 30	250	45	13.5	0.06	1.4	0.80	–
	100	**15 × 30**	380	64	20	0.06	0.95	0.50	–
	150	18 × 30	400	94	30	0.06	0.64	0.35	–
	220	**18 × 40**	660	140	44	0.06	0.43	0.20	–
	330	18 × 40	700	200	66	0.06	0.29	0.15	–
	470	**21 × 40**	1200	290	94	0.06	0.20	0.10	–

ORDERING INFORMATION (continued)

Table 8 Ordering information continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	CATALOGUE NUMBER 2222			
				AXIAL			SINGLE ENDED
				IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
63	4.7	6.5 × 18	4	–	132 28478	132 38478	–
	10	**6.5 × 18**	**4**	–	132 28109	**132 38109**	–
	22	**8 × 18**	**5**	–	132 28229	**132 38229**	–
	47	**10 × 18**	**6**	–	132 28479	**132 38479**	–
	68	10 × 25	7	–	132 90513	132 90514	–
	68	10 × 30	00	132 18689	132 28689	–	–
	100	**10 × 30**	**00**	**132 18101**	**132 28101**	–	–
	150	15 × 30	02	132 18151	132 28151	–	132 48151
	220	**15 × 30**	**02**	**132 18221**	**132 28221**	–	**132 48221**
	330	18 × 30	03	132 18331	–	–	132 48331
	470	**18 × 40**	**04**	**132 18471**	–	–	**132 48471**
	680	21 × 40	05	132 18681	–	–	132 48681
	1000	**21 × 40**	**05**	**132 18102**	–	–	**132 48102**
100	1	6.5 × 18	4	–	132 29108	132 39108	–
	2.2	6.5 × 18	4	–	132 29228	132 39228	–
	4.7	**6.5 × 18**	**4**	–	132 29478	**132 39478**	–
	10	**8 × 18**	**5**	–	132 29109	**132 39109**	–
	22	**10 × 18**	**6**	–	132 29229	**132 39229**	–
	47	**10 × 25**	**7**	–	132 90505	**132 90506**	–
	47	**10 × 30**	**00**	**132 19479**	**132 29479**	–	–
	68	12.5 × 30	01	132 19689	132 29689	–	–
	100	**15 × 30**	**02**	**132 19101**	**132 29101**	–	**132 49101**
	150	18 × 30	03	132 19151	–	–	132 49151
	220	**18 × 40**	**04**	**132 19221**	–	–	**132 49221**
	330	18 × 40	04	132 19331	–	–	132 49331
	470	**21 × 40**	**05**	**132 19471**	–	–	**132 49471**

A

ELECTRICAL DATA (continued)

Table 9 Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)
160	**2.2**	**6.5 × 18**	22	50	20	0.10	72	55	30
	4.7	8 × 18	37	50	20	0.10	34	26	20
	10	10 × 18	61	50	20	0.10	16	12	10
	22	10 × 25	120	50	20	0.10	7.2	5.5	2.5
250	2.2	8 × 18	25	50	20	0.10	72	50	30
	4.7	10 × 18	37	50	20	0.10	34	23	16
	10	10 × 25	66	50	20	0.10	16	11	9
350	1	6.5 × 18	15	50	20	0.10	160	100	40
	2.2	8 × 18	25	50	20	0.10	72	45	28
	4.7	**10 × 18**	43	50	20	0.10	34	21	15

ORDERING INFORMATION (continued)

Table 10 Ordering information continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	CATALOGUE NUMBER 2222			
				AXIAL			SINGLE ENDED
				IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
160	**2.2**	**6.5 × 18**	**4**	–	133 21228	**133 31228**	–
	4.7	8 × 18	5	–	133 21478	133 31478	–
	10	10 × 18	6	–	133 21109	133 31109	–
	22	10 × 25	7	–	133 90502	133 90503	–
250	2.2	8 × 18	5	–	133 23228	133 33228	–
	4.7	10 × 18	6	–	133 23478	133 33478	–
	10	10 × 25	7	–	133 23109	133 33109	–
350	1	6.5 × 18	4	–	133 25108	133 35108	–
	2.2	8 × 18	5	–	133 25228	133 35228	–
	4.7	**10 × 18**	**6**	–	133 25478	**133 35478**	–

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 62"*
- Rated voltage (in V)
- Upper category temperature (85 °C)
- Group number (132 or 133)
- Name of manufacturer (PHILIPS)
- Date code, in accordance with *"IEC 62"*
- Code indicating factory of origin
- Band to identify the negative terminal.

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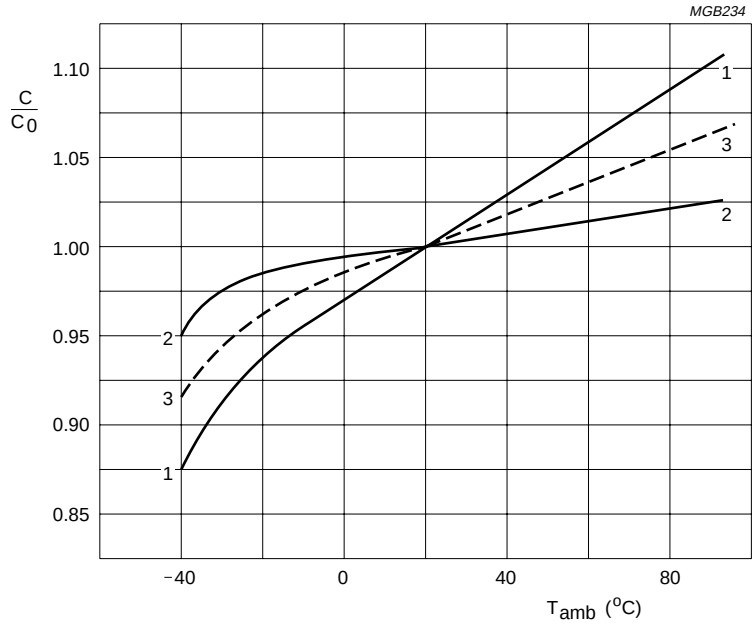
ELECTRICAL DATA (continued)

Additional electrical data

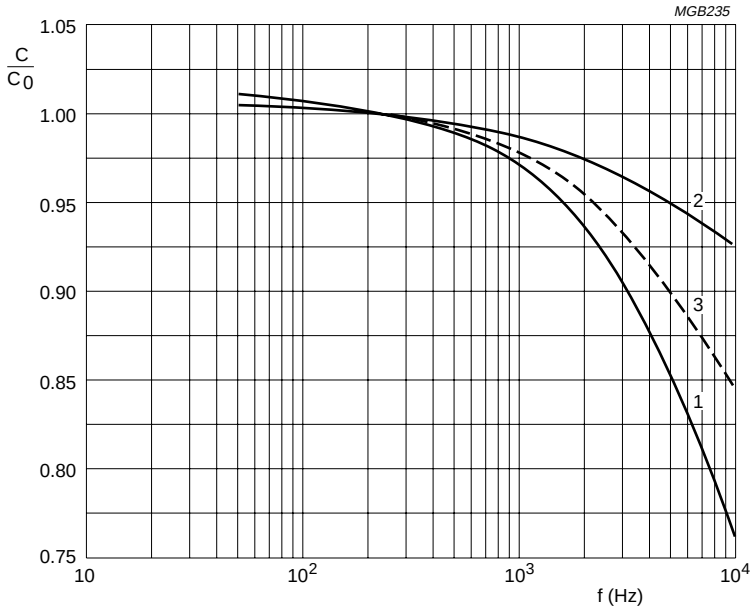
PARAMETER	CONDITIONS	VALUE	
		AXIAL	SINGLE ENDED
Voltage			
Surge voltage for short periods	U_R = 10 to 250 V	$U_s \leq 1.15 \times U_R$	
	U_R = 350 V	$U_s \leq 1.1 \times U_R$	
Reverse voltage		$U_{rev} \leq 1$ V	
Current			
Leakage current	after 1 minute: case ∅D × L = 6.5 × 18 to 10 × 25 mm: U_R = 10 to 100 V U_R = 160 to 350 V case ∅D × L = 10 × 30 to 21 × 40 mm: U_R = 10 to 100 V	 $I_{L1} \leq 0.01C_R \times U_R + 3$ µA $I_{L1} \leq 50$ µA $I_{L1} \leq 0.006C_R \times U_R + 3$ µA	
	after 5 minutes: case ∅D × L = 6.5 × 18 to 10 × 25 mm: U_R = 10 to 100 V U_R = 160 to 350 V case ∅D × L = 10 × 30 to 21 × 40 mm: U_R = 10 to 100 V	 $I_{L5} \leq 0.002C_R \times U_R + 4$ µA $I_{L5} \leq 20$ µA $I_{L5} \leq 0.002C_R \times U_R + 4$ µA	
Inductance			
Equivalent series inductance (ESL)	case ∅D × L mm:		
	6.5 × 18	typ. 15 nH	–
	8 × 18	typ. 35 nH	–
	10 × 18	typ. 69 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 × 40	typ. 54 nH	typ. 39 nH
	21 × 40	typ. 59 nH	typ. 39 nH

Capacitance (C)



Curve 1: 10 V.
Curve 2: 63 V.
Curve 3: ≥100 V.
C_0 = capacitance at 20 °C, 100 Hz.

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



Curve 1: 10 V.
Curve 2: 63 V.
Curve 3: ≥100 V.
C_0 = capacitance at 20 °C, 100 Hz.

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

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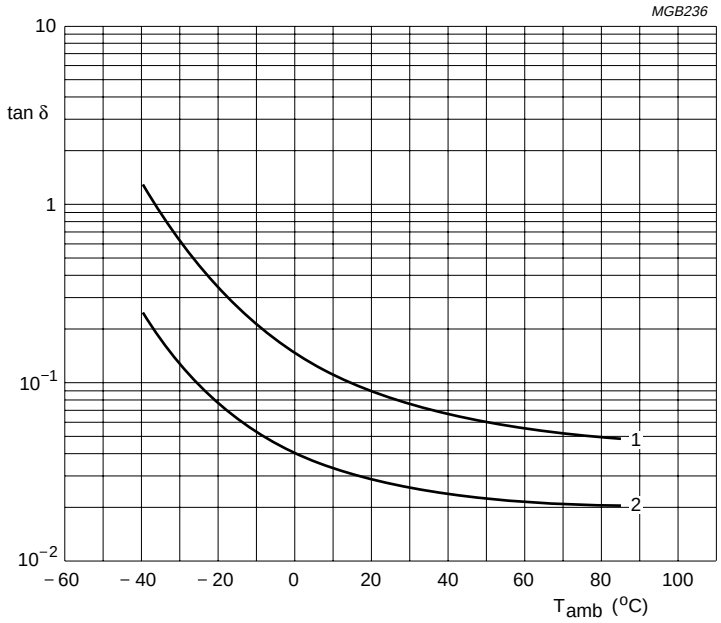
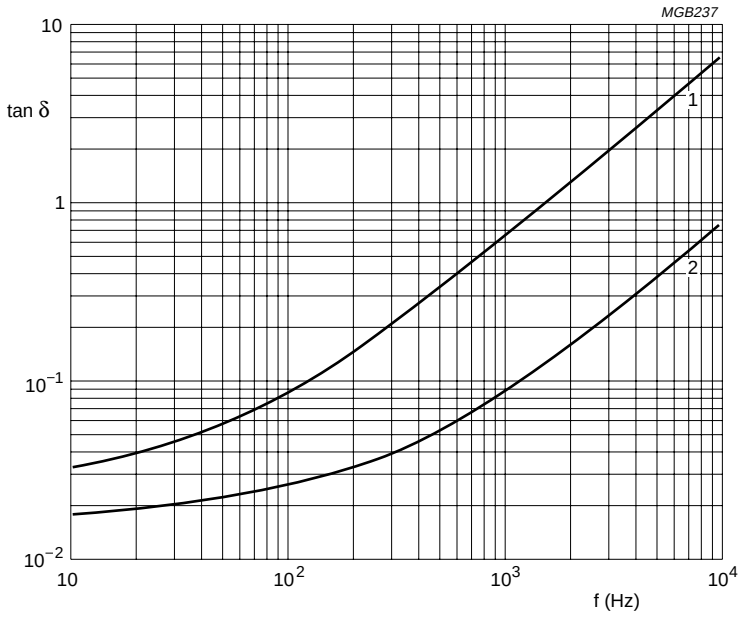
Dissipation factor (tan δ)



Curve 1: 16 V.
Curve 2: 100 V.
Case ∅D × L = 6.5 × 18 to 10 × 25 mm.
f = 100 Hz.

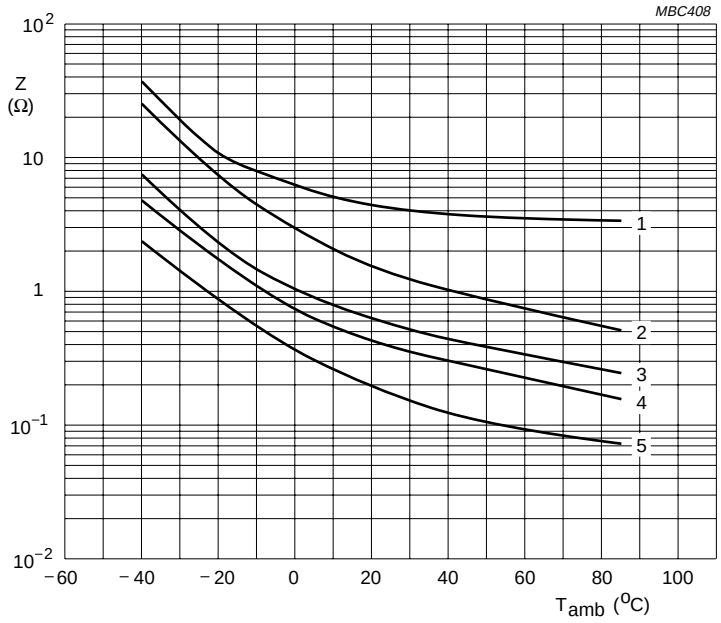
Fig.7 Typical tan δ as a function of ambient temperature.



Curve 1: 16 V.
Curve 2: 100 V.
Case ∅D × L = 6.5 × 18 to 10 × 25 mm.
T_{amb} = 20 °C.

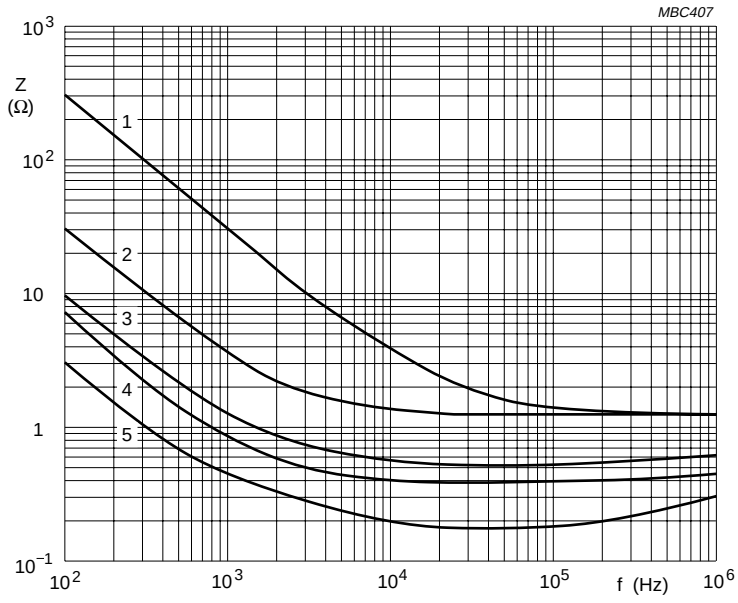
Fig.8 Typical tan δ as a function of frequency.

Impedance (Z)



Curve 1: 4.7 µF, 100 V.
Curve 2: 47 µF, 16 V.
Curve 3: 150 µF, 16 V.
Curve 4: 220 µF, 16 V.
Curve 5: 470 µF, 16 V.
Case ∅D × L = 6.5 × 18 to 10 × 25 mm.
f = 10 kHz.

Fig.9 Typical impedance as a function of ambient temperature.



Curve 1: 4.7 µF, 100 V.
Curve 2: 47 µF, 16 V.
Curve 3: 150 µF, 16 V.
Curve 4: 220 µF, 16 V.
Curve 5: 470 µF, 16 V.
Case ∅D × L = 6.5 × 18 to 10 × 25 mm.
T_{amb} = 20 °C.

Fig.10 Typical impedance as a function of frequency.

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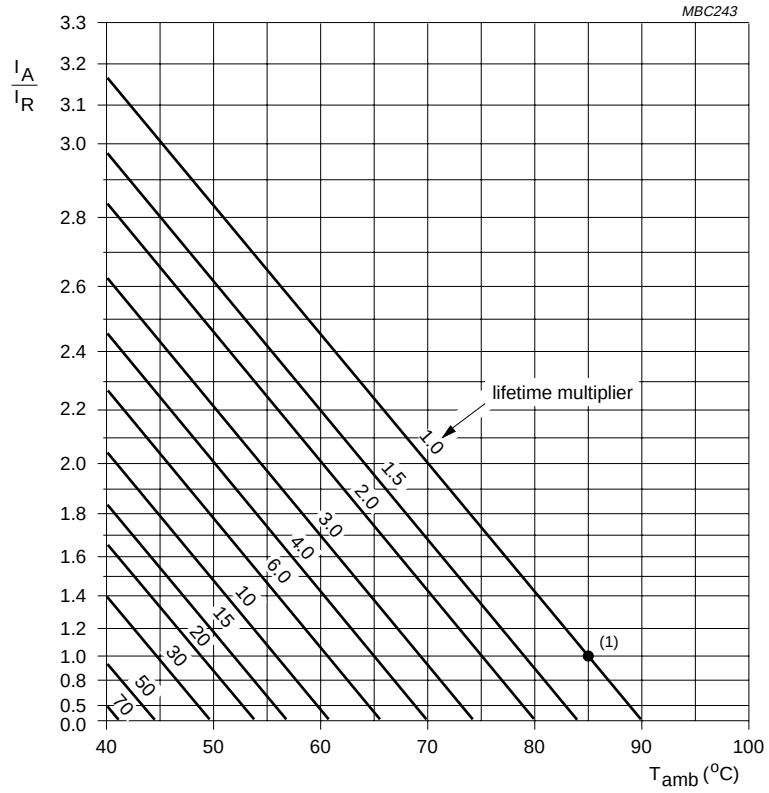
RIPPLE CURRENT AND USEFUL LIFE

Table 11 Multiplier of ripple current (I_R/I_{RO}) as a function of frequency; I_{RO} = ripple current at 85 °C, 100 Hz

FREQUENCY (Hz)	I_R MULTIPLIER		
	U_R = 10 to 16 V	U_R = 25 to 63 V	U_R = 100 to 350 V
50	0.95	0.9	0.85
100	1.0	1.0	1.0
300	1.07	1.12	1.2
1000	1.12	1.2	1.3
3000	1.15	1.25	1.35
≥10000	1.2	1.3	1.4



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 = 6.5 × 18 and 8 × 18 mm: 10000 hours
case ∅D × L = 10 × 18 to 21 × 40 mm: 15000 hours.

Fig.11 Multiplier of useful life as a function of ambient temperature and ripple current load.

SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this handbook, Section *"Tests and Requirements"*.

Table 12 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	**REFERENCE**		
Endurance	IEC 384-4/ CECC 30300, subclause 4.13	T_{amb} = 85 °C; U_R applied; case ∅D × L = 6.5 × 18 and 8 × 18 mm: 6000 hours; case ∅D × L = 10 × 18 to 21 × 40 mm: 8000 hours	U_R = 10 to 160 V; ΔC/C: ±15% U_R = 250 to 350 V; ΔC/C: ±10% tan δ ≤ 1.3 × 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 = 6.5 × 18 and 8 × 18 mm: 10000 hours; case ∅D × L = 10 × 18 to 21 × 40 mm: 15000 hours	U_R = 10 to 160 V; ΔC/C: ±45% U_R = 250 to 350 V; ΔC/C: ±30% 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 384-4/ CECC 30300, 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

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