



Aluminum Electrolytic Capacitors

Data Handbook BC01
2000/2001



PROVIDING KNOWLEDGE. CREATING SOLUTIONS.

QUALITY ASSURED

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

PRODUCT SAFETY

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be 'chemical', 'special' or sometimes 'industrial' waste. Disposal as domestic waste is usually not permitted.

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Customers of BC Components who are using or selling these products for use in such applications do so at their own risk and agree to fully indemnify BC Components for any damages resulting from such improper use or sale.

CAUTION
CLEANING SOLVENTS, ADHESIVES, COATING MATERIALS
Some cleaning agents, adhesives or coating materials have an adverse affect on electrolytic capacitors.
For cleaning, varnishing, coating, lacquering, embedding or gluing at the capacitor's sealing, ensure that the materials used are halogene-free in all their constituent parts (base material, thinners, binders, reacting agents, propellants, additives).

Electrolytic Capacitors

TYPE INDEX

Replacement list for withdrawn series

GENERAL DATA

Selection charts; selection guide; general introduction; product safety; tests and requirements; generic quality flowchart

PACKAGING

Surface Mounting Devices (SMD); radial leaded devices; axial leaded devices

PRODUCT SPECIFICATIONS

Surface Mounting Devices

SMD

Radial leaded

R

Axial leaded

A

Large types and mounting accessories (Snap-In; DIN-PW; Screw Terminal)

L

Solid Aluminum

SAL

Energy Storage Capacitors (Double layer)

ES

NEW PRODUCTS IN THIS DATA HANDBOOK

SERIES NAME	RATED TEMP.	DESCRIPTION	PAGE
Radials			
038 RSU	85 °C	low voltage, smallest dimensions, smaller than 037 RSM	144
148 RUS	105 °C	low voltage, smallest dimensions, smaller than 047 RMS and 048 RML	227
152 RMH	105 °C	high voltage, smallest dimensions, smaller than 151 RLH	283
150 RMI	105 °C	low ESR, high ripple, smaller size than 136 RVI	354
140 RTM	125 °C	high temperature, smallest dimensions, smaller than 165 RHT	342
Axials			
042/043 AMH-ELB	85 °C	smallest dimensions, lighting ballast	425
042/043 AHH-ELB	105 °C	smallest dimensions, lighting ballast	434
120 ATC	125 °C	low voltage, highest ripple current, higher ripple than 118 AHT	516
Power			
198 PHR-SI	85 °C	high voltage, high ripple current, very long useful life	603
Screw terminals			
NAFTA 3186 086/087 PS-ST	85 °C	power, standard screw terminals - 500 V series added and NAFTA part numbering	664
NAFTA 3191 004 POC-ST	85 °C	power, output (filter) current for industrial systems and audio power supplies	680
NAFTA 002 002 PHRC-ST	85 °C	power, high ripple current for uninterruptable power supplies, standard SMPS, welding, motor control devices	691
NAFTA 3199 006 PPS-ST	85 °C	power, performance style for industrial systems and audio power supplies	698
NAFTA 3188 088/089 PHC-ST	105 °C	power, low voltage for industrial systems and audio power supplies	726
NAFTA 3198 005 PLV-ST	85 °C	low voltage, smallest dimensions, smaller than 037 RSM	144

Electrolytic Capacitors

CONTENTS

	Page
TYPE INDEX	4
Replacement list for withdrawn series	6
GENERAL	
Selection charts	7
Selection guide	11
General introduction	25
Product safety	47
Tests and requirements	53
Quality flowchart	62
PACKAGING	
Surface Mounting Devices	63
Radial Leaded Devices	67
Axial Leaded Devices	83
PRODUCT SPECIFICATIONS	89
Data handbook system	853

Electrolytic capacitors

Type index

Sequence of catalogue numbers

2222	SERIES	PAGE
002	PHRC-ST	693
004	POC-ST	682
005	PLV-ST	728
006	PPS-ST	700
013	RLC	190
021	ASM	381
030/031	AS	400
036	RSP	204
037	RSM	160
038	RSU	144
041 to 043	ASH	413
042/043	AHH-ELB	436
042/043	AMH-ELB	427
044	RSH	178
046	RSL	304
047	RMS	217
048	RML	272
050/052	PED-PW	633
051/053	PEC-PW	615
056/057	PSM-SI	554
058/059	PLL-SI	573
085	CS	90
086/087	PS-ST	666
088/089	PHC-ST	713
097	RLP 7	137
114/115	PED-ST	750
116	RLL	244
117	ASD	372
118	AHT	484
119	AHT-DIN	502
120	ATC	518
122	SAL-RP	797
123	SAL-A	815

Sequence of series names

SEQUENCE	2222	PAGE
AHH-ELB	042/043	436
AHT	118	484
AHT-DIN	119	502
ALL-DIN	132/133	468
AMH-ELB	042/043	427
AML	138	446
AS	030/031	400
ASD	117	372
ASH	041 to 043	413
ASM	021	381
ATC	120	518
CLL	139	104
CLV	153	117
CS	085	90
DLC	196	844
PEC-PW	051/053	615
PEC-ST	154/155	741
PED-PW	050/052	633
PED-ST	114/115	750
PHC-ST	3188	713
PHC-ST	088/089	713
PHR-SI	198	605
PHRC-ST	002	693
PLL-PW	162/163	654
PLL-SI	058/059	573
PLL-4TSI	168/169	598
PLV-ST	3198	728
PLV-ST	005	728
POC-ST	3191	682
POC-ST	004	682
PPS-ST	3199	700
PPS-ST	006	700
PS-ST	3186	666

Technical sequence in handbook

	SEQUENCE		PAGE
SMD	085	CS	90
	139	CLL	104
	153	CLV	117
	134	RLP 5	130
	097	RLP 7	137
	038	RSU	144
	037	RSM	160
	044	RSH	178
	013	RLC	190
	036	RSP	204
	047	RMS	217
	148	RUS	229
	116	RLL	244
	135	RLI	258
	048	RML	272
RADIAL	152	RMH	285
	151	RLH	295
	046	RSL	304
	136	RVI	317
	165	RHT	334
	140	RTM	344
	150	RMI	356
	117	ASD	372
	021	ASM	381
	030/031	AS	400
	041 to 043	ASH	413
	042/043	AMH-ELB	427
	042/043	AHH-ELB	436
	138	AML	446
	132/133	ALL-DIN	468
AXIAL	118	AHT	484
	119	AHT-DIN	502
	120	ATC	518

Electrolytic capacitors

Type index

Sequence of catalogue numbers

2222	SERIES	PAGE
128	SAL-RPM	778
132/133	ALL-DIN	468
134	RLP 5	130
135	RLI	258
136	RVI	317
138	AML	446
139	CLL	104
140	RTM	344
148	RUS	229
150	RMI	356
151	RLH	295
152	RMH	285
153	CLV	117
154/155	PEC-ST	741
157	PUM-SI	532
159	PUL-SI	543
162/163	PLL-PW	654
165	RHT	334
166/167	PSM-4TSI	591
168/169	PLL-4TSI	598
196	DLC	844
198	PHR-SI	605
3186	PS-ST	666
3188	PHC-ST	713
3191	POC-ST	682
3198	PLV-ST	728
3199	PPS-ST	700

Sequence of series names

SEQUENCE	2222	PAGE
PS-ST	086/087	666
PSM-SI	056/057	470
PSM-4TSI	166/167	506
PUL-SI	159	459
PUM-SI	157	448
RHT	165	293
RLC	013	170
RLH	151	254
RLI	135	227
RLL	116	214
RLP 5	134	130
RLP 7	097	137
RMH	152	285
RMI	150	356
RML	048	272
RMS	047	217
RSH	044	178
RSL	046	304
RSM	037	160
RSP	036	204
RSU	038	144
RTM	140	344
RUS	148	229
RVI	136	317
SAL-A	123	815
SAL-RP	122	797
SAL-RPM	128	778

Technical sequence in handbook

	SEQUENCE	PAGE	
POWER	157	PUM-SI	532
	159	PUL-SI	543
	056/057	PSM-SI	554
	058/059	PLL-SI	573
	166/167	PSM-4TSI	591
	168/169	PLL-4TSI	598
	198	PHR-SI	605
	051/053	PEC-PW	615
	050/052	PED-PW	633
	162/163	PLL-PW	654
	086/087	PS-ST	666
	004	POC-ST	682
	006	PPS-ST	700
	088/089	PHC-ST	713
	005	PLV-ST	728
154/155	PEC-ST	741	
114/115	PED-ST	750	
NAFTA	3186	PS-ST	666
	3191	POC-ST	682
	002	PHRC-ST	693
	3199	PPS-ST	700
	3188	PHC-ST	713
3198	PLV-ST	728	
SAL	128	SAL-RPM	778
	122	SAL-RP	797
	123	SAL-A	815
E	196	DLC	844

CUSTOMIZED PRODUCTS

If you are unable to find the capacitor you require, please contact your local BC Components sales organization; we are able to design and manufacture customized capacitors to meet your specific requirements, for example:

- Higher CV per unit volume
- Lower ESR
- Higher ripple current
- Lower leakage current
- Extended useful life
- Extended temperature range
- DC-capacitance selection (e.g. for timing applications)
- Deviating capacitance tolerances
- Customized marking
- Packaging deviations
- Higher resistance to shock and vibration
- Keyed polarity
- Bi-polar (non-polar) products.

Electrolytic capacitors

Replacement list
for withdrawn series

REPLACEMENT LIST FOR WITHDRAWN SERIES

WITHDRAWN SERIES			REPLACEMENT SERIES
CATALOGUE NUMBER	VERSION	REMARK	
2222 014	axial	low impedance	021 ASM
2222 015	axial		021 ASM
2222 016	axial		021 ASM
2222 017	axial		021 ASM
2222 032	axial		021 ASM
2222 033	axial		021 ASM
2222 034	radial		RSM 037
2222 035	radial		RSM 037
2222 039	axial	bipolar	137 ABA or 137 92 AB
2222 040	axial	high voltage	041-043 ASH
2222 042/043	axial (ASH-ELB)	for lighting ballast	042/043 AMH-ELB or AHH-ELB
2222 045	radial		046 RSL or 048 RML
2222 048 95	radial SMD	CLB 048	153 CLV
2222 049	axial	ASC	021 ASM
2222 054	power		056 PSM-SI
2222 055	power		057 PSM-SI
2222 065	axial	low leakage current	021 ASM
2222 106	power		114 PED-ST or 154 PEC-ST
2222 107	power		115 PED-ST or 155 PEC-ST
2222 108	axial		132 ALL-DIN or 138 AML
2222 121	solid axial	SAL-A	123 SAL-A
2222 124	solid radial	cubic, SAL-RQ	128 SAL-RPM
2222 129	solid radial	SAL-RDC	128 SAL-RPM
2222 133	axial	Ø10 × 30 to Ø21 × 40 mm only	041-043 ASH
2222 172	SMD	CLP 172	153 CLV

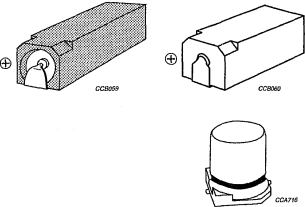
SELECTION CHARTS



Electrolytic capacitors

Selection charts

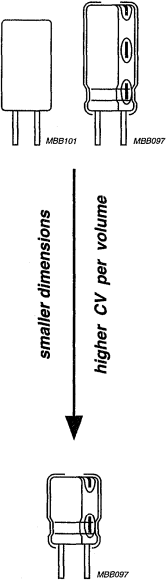
SMD ALUMINUM ELECTROLYTIC CAPACITORS ('CHIPS')



STANDARD	INDUSTRIAL	PROFESSIONAL
085 CS 1500 hours 85 °C page 90	139 CLL 2000 hours 105 °C page 104	153 CLV 2000 to 3000 hours 105 °C page 117

CCB095

RADIAL ALUMINUM ELECTROLYTIC CAPACITORS



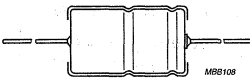
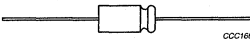
smaller dimensions

higher CV per volume

STANDARD and MINIATURE 1500 to 3000 hours 85 °C	SEMI-PROFESSIONAL 750 to 2500 hours 105 °C	LONG-LIFE 2000 to 4000 hours 105 °C	EXTRA LONG-LIFE or HIGH TEMPERATURE 1500 hours / 125 °C ≥4000 hours / 105 °C
	013 RLC <i>low leakage</i> page 190	046 RSL <i>maintenance type</i> page 304	165 RHT 125 °C <i>maintenance type</i> page 334
044 RSH <i>high voltage</i> page 178	135 RLI <i>low Z</i> page 258	151 RLH <i>high voltage</i> page 295	140 RTM 125 °C NEW page 344
037 RSM <i>low voltage</i> page 160	page 204 036 RSP 047 RMS page 217	page 244 116 RLL 048 RML page 272	136 RVI 105 °C <i>very low Z</i> page 317
038 RSU <i>low voltage</i> NEW page 144		152 RMH <i>high voltage</i> NEW page 285	150 RMI 105 °C <i>very low Z</i> NEW page 356
page 137 097 RLP 7 H: 7 mm 134 RLP 5 H: 5 mm page 130		148 RUS <i>miniature</i> NEW page 229	

CCB096

AXIAL ALUMINUM ELECTROLYTIC CAPACITORS

MINIATURE
 1500 to 8000 hours
 85 °C

STANDARD and SEMI-PROFESSIONAL
 5000 to 15000 hours
 85 °C

LONG-LIFE
 2000 to 10000 hours
 105 °C

EXTRA LONG-LIFE or HIGH TEMPERATURE
 4000 to 8000 hours
 125 °C

smaller dimensions
 ↓
 higher CV per volume


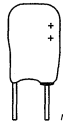
041/042/043 ASH page 413	042/043 AMH-ELB lighting ballast NEW page 427	119 AHT-DIN page 502
030/031 AS page 400	132 ALL-DIN page 468	042/043 AHH-ELB lighting ballast NEW page 436
117 ASD page 372	021 ASM page 381	138 AML page 446
		120 ATC NEW page 518

CCC167

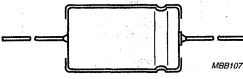
SOLID ALUMINUM (SAL) ELECTROLYTIC CAPACITORS

PROFESSIONAL
20000 hours / 125 °C

RADIAL (pearl)


AXIAL



128 SAL-RPM H: 9 mm page 778	122 SAL-RP H: 12 mm page 797
123 SAL-A page 815	

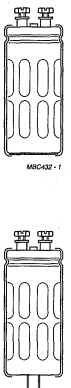
CCB110

SNAP-IN/DIN-PW CAPACITORS

		ECONOMY	LONG-LIFE	LONG-LIFE HIGH TEMPERATURE
		2500 to 12000 hours 85 °C	15000 hours 85 °C	3000 to 10000 hours 105 °C
<p>smaller dimensions ↓ higher CV per volume</p> 		051-053 PEC-PW <i>page 615</i>	050-052 PED-PW <i>page 633</i>	162/163 PLL-PW <i>page 654</i>
		166/167 PSM-4TSI <i>page 591</i>		168/169 PLL-4TSI <i>page 588</i>
		056/057 PSM-SI <i>page 554</i>		058/059 PLL-SI <i>page 573</i>
		157 PUM-SI <i>page 532</i>	198 PHR-SI <i>page 605</i>	159 PUL-SI <i>page 543</i>

CCB097

SCREW TERMINAL CAPACITORS




		STANDARD	LONG-LIFE	HIGH TEMPERATURE LONG-LIFE	ECONOMY/ EURO-DIN
		2000 to 5000 hours 85 °C	4000 to 6000 hours 85 °C	5000 hours 105 °C	5000 to 20000 hours 85 °C
<p>higher ripple current ↑</p> 		NAFTA 002 2222 002 PHRC-ST <i>page 693</i>			
		NAFTA 3191 2251 004 9.... POC-ST <i>page 682</i>	NAFTA 3188 2222 088/089 PHC-ST <i>page 713</i>	NAFTA 3198 2222 005 9.... PLV-ST <i>page 728</i>	114/115 PED-ST/ PED-STB <i>page 750</i>
		NAFTA 3186 2222 086/087 PS-ST <i>page 666</i>	NAFTA 3199 2251 006 PPS-ST <i>page 700</i>		154/155 PEC-ST/ PEC-STB <i>page 741</i>

CCB098

Electrolytic capacitors

Selection guide

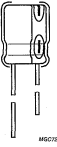
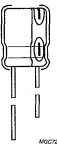
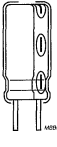
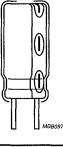
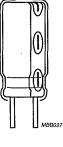
SURFACE MOUNT DEVICES (SMD)

SERIES	FEATURES, STANDARDS, APPROVALS	C _R (μ F)	U _R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
SMD Aluminum electrolytic capacitors						
 085 CS	low height wave solderable general purpose	0.47 to 22	6.3 to 63	1500 h/85 °C 40000 h/40 °C 40/085/56	consumer low profile equipment	90
 139 CLL	moulded extended CV range wave solderable long life	1.0 to 220	6.3 to 100	2000 h/105 °C 200000 h/40 °C 55/105/56	automotive telecom general industrial domestic appliances	104
 153 CLV	vertical construction extended CV range long life	0.47 to 1000	6.3 to 100	2-3000 h/105 °C 200-300000 h/40 °C 55/105/65	automotive telecom EDP general industrial portable and lightweight equipment	117

Electrolytic capacitors

Selection guide

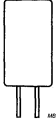

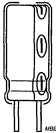
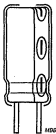
RADIAL

SERIES	FEATURES, STANDARDS, APPROVALS	C _R (μF)	U _R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
Standard types						
 134 RLP 5	miniature very low profile height 5 mm general purpose	1.0 to 100	6.3 to 50	1500 h/85 °C 40000 h/40 °C 40/085/56	consumer low profile equipment high mounting density portable equipment	130
 097 RLP 7	miniature low profile height 7 mm general purpose	0.1 to 220	6.3 to 63	1500 h/85 °C 40000 h/40 °C 40/085/56	consumer automotive low profile equipment portable equipment	137
 037 RSM	high CV/volume general purpose	0.47 to 10000	6.3 to 100	2500 h/85 °C 70000 h/40 °C 40/085/56	consumer automotive general industrial audio-video	160
NEW  038 RSU	miniature very high CV/volume general purpose	0.1 to 22000	6.3 to 100	2500-3000 h/105 °C 60-80000 h/40 °C 40/085/56	consumer automotive general industrial audio-video	144
 044 RSH	high voltage long life	1.0 to 100	160 to 450	3000 h/85 °C 80000 h/40 °C 40/085/56	consumer, lighting general industrial power supply smoothing	178

Electrolytic capacitors

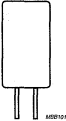
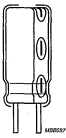
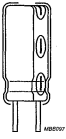
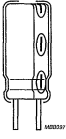
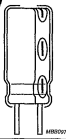
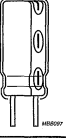
Selection guide

RADIAL (continued)

SERIES	FEATURES, STANDARDS, APPROVALS	C _R (μF)	U _R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
Semi-professional types						
 013 RLC	low leakage current e-pitch 2.5 or 5 mm, all-insulated	0.47 to 470	6.3 to 50	750 h/105 °C 3000 h/85 °C 80000 h/40 °C 55/085/56	audio-video telecom general industrial timing, coupling	190
 036 RSP	high CV/volume long life e-pitch 2.5 or 5 mm, all-insulated	0.47 to 470	6.3 to 160	750 h/105 °C 3000 h/85 °C 80000 h/40 °C 55/085/56	automotive telecom general industrial EDP	204
 047 RMS	high CV/volume high temp. 105 °C long life	100 to 10000	16 to 63	1500 h/105 °C 150000 h/40 °C 40/105/56	audio-video automotive telecom, EDP SMPS	217
NEW  148 RUS	miniature very high CV/volume long life	47 to 22000	6.3 to 100	2-3000 h/105 °C 140-200000 h/40 °C 40/105/56	audio-video automotive general industrial telecom, EDP	229

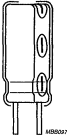
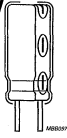
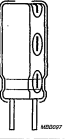

Electrolytic capacitors

Selection guide

SERIES	FEATURES, STANDARDS, APPROVALS	C _R (μF)	U _R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
Long-life types						
	116 RLL high CV/volume e-pitch 2.5 or 5 mm, all insulated long life	0.47 to 470	6.3 to 100	2000 h/105 °C 200000 h/40 °C 55/105/56	automotive telecom, EDP general industrial DC-DC converters	244
	135 RLI low impedance high ripple long life	22 to 10000	6.3 to 100	1500-2500 h/105 °C 150-250000 h/40 °C 55/105/56	general industrial telecom, EDP SMPS DC-DC converters	258
	048 RML miniature high CV/volume long life	100 to 10000	6.3 to 63	3-4000 h/105 °C 200-260000 h/40 °C 40/105/56	automotive telecom, EDP SMPS stand-by	272
	151 RLH miniature high CV/volume long life	1 to 220	160 to 450	3-4000 h/105 °C 200-260000 h/40 °C 40/105/56	high-reliability lighting, consumer general industrial filtering	295
NEW 	152 RMH miniature very high CV/volume long life	4.7 to 220	200 to 450	3-4000 h/105 °C 200-260000 h/40 °C 40/105/56	high-reliability lighting, consumer general industrial filtering	285
	046 RSL standard dimensions high ripple long life maintenance type	22 to 10000	6.3 to 63	3-4000 h/105 °C 200-260000 h/40 °C 40/105/56	telecom, EDP general industrial SMPS stand-by	304

Electrolytic capacitors



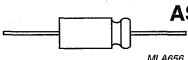
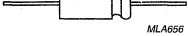


Selection guide

SERIES	FEATURES, STANDARDS, APPROVALS	C_R (μ F)	U_R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
Extra-long-life types						
 136 RVI	very low impedance very high ripple extra long life	22 to 10000	10 to 100	4-10000 h/105 °C 200-500000 h/40 °C 55/105/56	general industrial telecom, EDP automotive, SMPS DC-DC converters	317
NEW  150 RMI	miniature very low impedance very high ripple extra long life	100 to 6800	10 to 63	4-10000 h/105 °C 200-300000 h/40 °C 55/105/56	general industrial telecom, EDP automotive, SMPS DC-DC converters	356
 165 RHT	standard dimensions high temp. 125 °C extra long life maintenance type	22 to 4700	10 to 50	1500 h/125 °C 300000 h/40 °C 40/125/56	automotive outdoor electronics professional telecom, military	334
NEW  140 RTM	miniature high temp: 125 °C. extra long life	22 to 4700	10 to 63	1500 h/125 °C 200-500000 h/40 °C 55/125/56	automotive outdoor electronics professional telecom military	344

Electrolytic capacitors


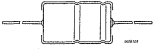
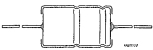
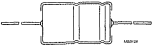
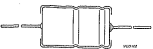
Selection guide

AXIAL

SERIES	FEATURES, STANDARDS, APPROVALS	C_R (μ F)	U_R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
Miniature types						
 <p>117 ASD</p>	ultra miniature diameter 3.3 mm general purpose	0.47 to 22	6.3 to 63	2000 h/85 °C 60000 h/40 °C 40/085/56	consumer low height low profile equipment	372
 <p>021 ASM</p>	miniature high CV/volume general purpose long life	0.47 to 15000	6.3 to 100	case length \leq 25 mm: 2500 h/85 °C, 70000 h/40 °C case length \geq 30 mm: 8000 h/85 °C, 200000 h/40 °C 40/085/56	consumer automotive general industrial audio-video telecom, EDP SMPS	381
Semi-professional types						
 <p>030/031 AS</p>	standard dimensions general purpose long life	0.47 to 1000	6.3 to 100	1500-3000 h/85 °C 40-80000 h/40 °C 40/085/56	consumer, telecom general industrial automotive SMPS	400
 <p>041-043 ASH</p>	high voltage long life	1.0 to 220	160 to 450	5-15000 h/85 °C 120-240000 h/40 °C 40/085/56	consumer, lighting industrial power supply smoothing	413
<p>NEW</p>  <p>042/043 AMH-ELB</p>	very high voltage 550 V/24 h/85 °C long life	10 to 33	450	20000 h/85 °C 100000 h/70 °C 25/085/56	electronic lighting ballast, power supply	427
<p>NEW</p>  <p>042/043 AHH-ELB</p>	very high voltage 550 V/24 h/85 °C long life, 105 °C	10 to 33	450	10000 h/105 °C 100000 h/85 °C 25/105/56	electronic lighting ballast, power supply	436

Electrolytic capacitors

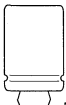


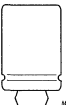



Selection guide

SERIES	FEATURES, STANDARDS, APPROVALS	C _R (μ F)	U _R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
Long-life types						
138 AML 	miniature high CV/volume high temp. 105 °C long life	1.0 to 15000	6.3 to 100	2-10000 h/105 °C 2-500000 h/40 °C 40/105/56	automotive general industrial telecom, EDP SMPS, stand-by	446
132/133 ALL-DIN 	long life, high reliability high ripple current UTE C031/C033, (without approval)	1.0 to 4700	10 to 350	10-15000 h/85 °C 160-240000 h/40 °C 40/085/56	telecom EDP general industrial power supply	468
High temperature (extra-long-life) types						
118 AHT 	miniature high CV/volume high temp. 125 °C extra long life	1.0 to 10000	6.3 to 200	4-8000 h/125 °C 500-1000000 h/40 °C (40)55/125/56	automotive general industrial telecom military	484
119 AHT-DIN 	high temp. 125 °C high ripple current extra long life UTE C031/C033	4.7 to 4700	10 to 200	4-8000 h/125 °C 500-1000000 h/40 °C 55/125/56	general industrial telecom, SMPS professional outdoor electronics military	502
NEW 120 ATC 	high temp. 125 °C very high ripple current very low ESR max. temp. > 125 °C	47 to 6800	16 to 100	8000 h/125 °C 40000 h/85 °C 40/125/56	automotive military industrial	518

Electrolytic capacitors




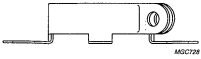
Selection guide

LARGE

SERIES	FEATURES, STANDARDS, APPROVALS	C _R (μF)	U _R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
Snap-in types						
 157 PUM-SI	very high CV/volume snap-in	56 to 2200	200 to 450	2500 h/85 °C 45000 h/40 °C (25) 40/085/56	general industrial audio-video power supply smoothing	532
NEW  198 PHR-SI	very high CV/volume very high ripple very long life snap-in	56 to 680	400 and 450	15000 h/85 °C 1000000 h/40 °C 25/085/56	motor control industrial standard and switched mode power supplies	605
 056/057 PSM-SI	high CV/volume snap-in	47 to 68000	10 to 450	12000 h/85 °C 210000 h/40 °C 40/085/56	general industrial audio-video power supply smoothing	554
 159 PUL-SI	very high CV/volume very long life snap-in 105 °C	56 to 1800	200 to 450	5000 h/105 °C 500000 h/40 °C (25) 40/105/56	general industrial audio-video power supply smoothing	543
 058/059 PLL-SI	high CV/volume very long life high temp. 105 °C	33 to 47000	10 to 400	10000 h/105 °C 250000 h/40 °C 40/105/56	general industrial telecom power supply smoothing	573
4-terminal snap-in types						
 166/167 PSM-4TSI	high CV/volume 4 snap-in pins keyed polarity	330 to 68000	10 to 400	10000 h/85 °C 175000 h/40 °C 40/085/56	general industrial power supply smoothing	591
 168/169 PLL-4TSI	high CV/volume 4 snap-in pins keyed polarity high temp. 105 °C	220 to 47000	10 to 400	5000 h/105 °C 125000 h/40 °C 40/105/56	general industrial power supply smoothing	598

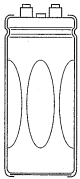
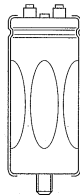
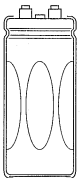
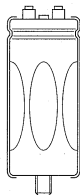
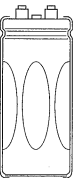
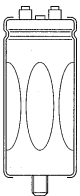
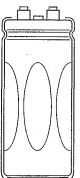
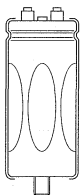
Electrolytic capacitors

Selection guide

SERIES	FEATURES, STANDARDS, APPROVALS	C_R (μ F)	U_R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
PW-pin types						
 050/052 PED-PW	high ripple, low ESR keyed polarity high shock and vibration resistance	47 to 68000	10 to 400	15000 h/85 °C 250000 h/40 °C 40/085/56	general industrial telecom power supply smoothing	633
 051/053 PEC-PW	high CV/volume keyed polarity high shock and vibration resistance	68 to 150000	10 to 400	12000 h/85 °C 200000 h/40 °C 40/085/56	general industrial audio-video power supply smoothing	615
 162/163 PLL-PW	high CV/volume very long life high temp. 105 °C keyed polarity high shock and vibration resistance	68 to 150000	10 to 400	5000 h/105 °C 150000 h/40 °C 40/105/56	general industrial telecom power supply smoothing	654
Mounting accessories						
	clamps washers nuts				for large and screw terminal types	771

Electrolytic capacitors

Selection guide

SERIES	FEATURES, STANDARDS, APPROVALS	C_R (μ F)	U_R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E	
Screw terminal/bolt types							
NAFTA 3186 	086/087 PS-ST 	very high CV/volume high ripple high shock and vibration resistance	220 to 820000	16 to 500	5000 h/85 °C 120000 h/40 °C 40/085/56	motor control uninterruptable power supplies welding	666
NAFTA 3191 	004 POC-ST 	high ripple symmetrical ESR high shock and vibration resistance	2700 to 150000	7.5 to 55	2000 h/85 °C 60000 h/40 °C 40/85/56	power supplies	682
NAFTA 002 	002 PHRC-ST 	high CV/volume very high ripple high shock and vibration resistance	680 to 5600	400 to 500	3000 h/85 °C 90000 h/40 °C 40/085/56	motor control uninterruptable power supplies welding	693
NAFTA 3199 	006 PPS-ST 	high CV/volume high ripple low ESR	3900 to 1200000	7.5 to 75	6000 h/85 °C 180000 h/40 °C 55/085/56	general industrial power supply audio	700

Electrolytic capacitors



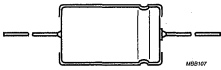
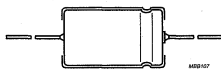
Selection guide

SERIES		FEATURES, STANDARDS, APPROVALS	C_R (μ F)	U_R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
NAFTA 3188	088/089 PHC-ST	high ripple very low ESR high temp. 105 °C high shock and vibration resistance	270 to 820000	16 to 450	4-5000 h/85 °C 120-150000 h/40 °C 40/85/56	motor control uninterruptable power supplies welding energy storage in pulse systems	713
NAFTA 3198	005 PLV-ST	very long life high ripple low ESR	2700 to 1200000	7.5 to 75	5000 h/105 °C 125000 h/40 °C 55/105/56	general industrial power supply audio	728
	114/115 PED-ST	very long life high ripple low ESR DIN 45910-T128	150 to 220000	10 to 400	20000 h/85 °C 350000 h/40 °C 40/085/56	general industrial telecom power supply smoothing	750
	154/155 PEC-ST	high CV/volume high ripple	220 to 470000	10 to 400	12000 h/85 °C 200000 h/40 °C 40/085/56	general industrial power supply smoothing	741

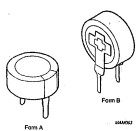
Electrolytic capacitors

Selection guide

SOLID ALUMINIUM

SERIES	FEATURES, STANDARDS, APPROVALS	C _R (μF)	U _R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	P A G E
 <p>128 SAL-RPM</p>	low profile height 9 mm CECC 30302	0.1 to 68	6.3 to 40	20000 h/125 °C 300000 h/40 °C 55/125/56	general industrial automotive telecom, EDP audio-video	778
 <p>122 SAL-RP</p>	height 12 mm CECC 30302	0.33 to 68	6.3 to 40	20000 h/125 °C 300000 h/40 °C 55/125/56	general industrial automotive telecom, EDP audio-video	797
 <p>123 SAL-A</p>	extremely long life very high reliability CECC 30302-003	1.0 to 1500	6.3 to 40	20000 h/125 °C 450000 h/40 °C 55/125/56	general industrial telecom SMPS military	815
 <p>123 8 SAL-AG</p>	shock-proof 10000 g	1.0 to 1500	6.3 to 40	20000 h/125 °C 450000 h/40 °C 55/125/56	aerospace military	815

ENERGY STORAGE CAPACITORS (DOUBLE LAYER)

SERIES	FEATURES, STANDARDS, APPROVALS	C _R (F)	U _R (V)	USEFUL LIFE, CLIMATIC CATEGORY	PREFERRED APPLICATIONS	PAGE
196 DLC 	high charge density ecologically beneficial maintenance-free	0.047 to 1.0	5.5 or 6.3	1000 h/70 °C or 85 °C 8000 h/40 °C or 23000 h/40 °C 25/070/21 or 25/085/21	energy storage IC memory backup (CMOS) telecom, EDP audio-video	844

CUSTOMIZED PRODUCTS

If you are unable to find the capacitor you require, please contact your local BC Components sales organization; we are able to design and manufacture customized capacitors to meet your specific requirements, for example:

- Higher CV per unit volume
- Lower ESR
- Higher ripple current
- Lower leakage current
- Extended useful life
- Extended temperature range
- DC-capacitance selection (e.g. for timing applications)
- Deviating capacitance tolerances
- Customized marking
- Packaging deviations
- Higher resistance to shock and vibration
- Keyed polarity
- Bi-polar (non-polar) products.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

GENERAL INTRODUCTION

	Page
Translation of technical terms	26
Capacitor principles	27
Electrical behaviour	28
Construction	29
Definitions of the electrical parameters	32
Storage	35
Operational conditions	35
Mounting	44
Marking	45

Electrolytic capacitors

General introduction

TRANSLATION OF TECHNICAL TERMS

SOME IMPORTANT TERMS	DES TERMES IMPORTANTES	EINIGE WICHTIGE BEGRIFFE
Ambient temperature (T_{amb})	température ambiante	Umgebungstemperatur
Assessment level	niveau d'assurance	Gütebestätigungsstufe
Axial terminations	sorties axiales	axiale Anschlußdrähte
Capacitance	capacité	Kapazität
Charge	charge	laden
Climatic category	catégorie climatique	Klimakategorie
Dimensions	dimensions	Maße
Discharge	décharge	entladen
Dissipation factor ($\tan \delta$)	tangente de l'angle de pertes	Verlustfaktor
Endurance	endurance	Dauerspannungsprüfung
Equivalent series resistance (ESR)	résistance série équivalente	äquivalenter Serienwiderstand
Equivalent series inductance (ESL)	inductance série équivalente	äquivalente Serieninduktivität
Failure rate	taux de fiabilité	Ausfallrate
Frequency (f)	fréquence	Frequenz
General purpose grade	usage général	allgemeine Anforderungen
Impedance (Z)	impédance	Scheinwiderstand, Impedanz
Leadless	sans fils	unbedrahtet
Leakage current (I_l)	courant de fuite	Reststrom
Long life grade	longue durée de vie	erhöhte Anforderungen
Method	méthode	Verfahren
Mounting	montage	Montage
No visible damage	aucun dommage	keine sichtbaren Schäden
Open circuit	circuit ouvert	Unterbrechung
Mounting hole diagram	dessin de montage	Bohrungsraster
Rated capacitance (C_R)	capacité nominale	Nennkapazität
Rated voltage (U_R)	tension nominale	Nennspannung
Recovery	reprise	Nachbehandlung
Forming voltage (U_F)	tension de formation	Formierspannung
Requirements	exigences	Anforderungen
Reverse voltage (U_{rev})	tension inverse	Umpolspannung
Ripple current (I_R)	courant ondulé	überlagerter Wechselstrom
Short circuit	court-circuit	Kurzschluß
Surface mounting device (SMD)	composant pour montage en surface	oberflächenmontierbares Bauelement
Surge voltage (U_S)	surtension	Spitzenspannung
Terminal pitch	distance entre les connections	Rastermaß
Terminations	sorties	Anschlüsse
Useful life	durée de vie	Brauchbarkeitsdauer
Visual examination	examen visuel	Sichtkontrolle

Electrolytic capacitors

General introduction

CAPACITOR PRINCIPLES

The essential property of a capacitor is to store electrical charge. The amount of electrical charge (Q) in the capacitor (C) is proportional to the applied voltage (U). The relationship of these parameters is:

$$Q = C \times U$$

where:

Q = charge in coulombs (C)

C = capacitance in farads (F)

U = voltage in volts (V).

The value of capacitance is directly proportional to the (anode) surface area and inversely proportional to the thickness of the dielectric layer, thus:

$$C = \epsilon_0 \times \epsilon_r \times \frac{A}{d}$$

where:

ϵ_0 = absolute permittivity (8.85×10^{-12} F/m)

ϵ_r = relative dielectric constant (dimensionless)

A = surface area (m²)

d = thickness of the dielectric (oxide layer in electrolytic capacitors) (m).

Energy content of a capacitor

The energy content of a capacitor is given by:

$$W_E = \frac{1}{2} \times C \times U^2$$

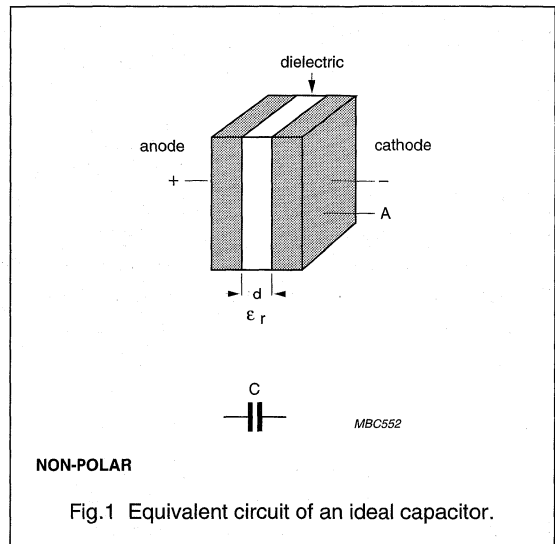


Fig.1 Equivalent circuit of an ideal capacitor.

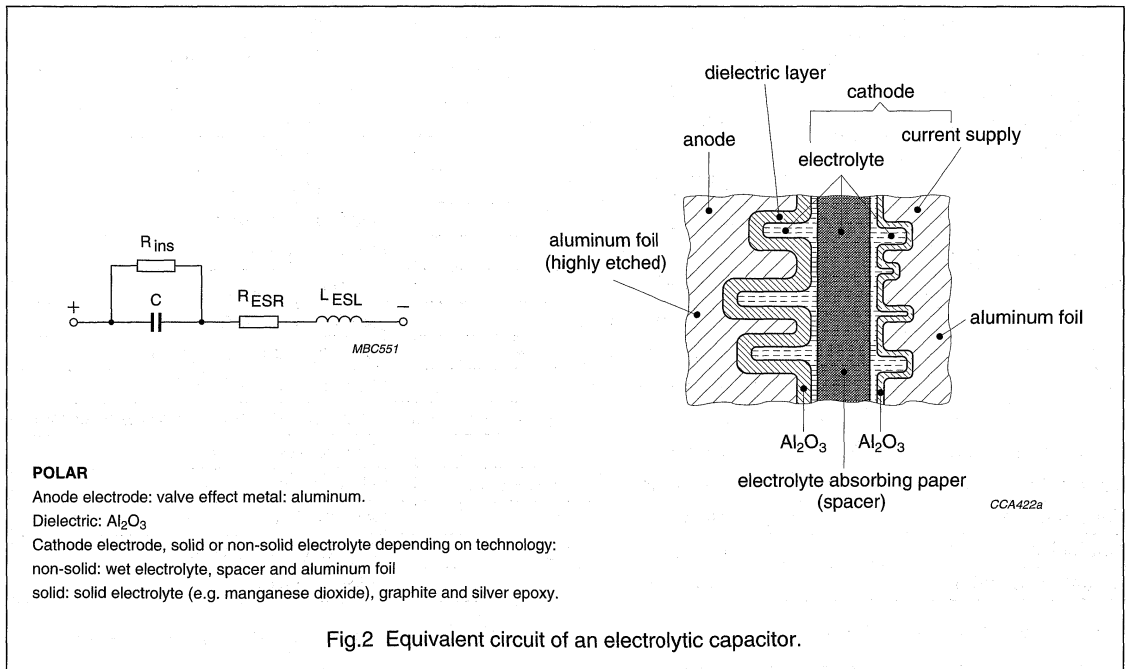


Fig.2 Equivalent circuit of an electrolytic capacitor.

ELECTRICAL BEHAVIOUR

CHARACTERISTICS OF ELECTROLYTIC CAPACITORS VARY WITH TEMPERATURE, TIME AND APPLIED VOLTAGE.

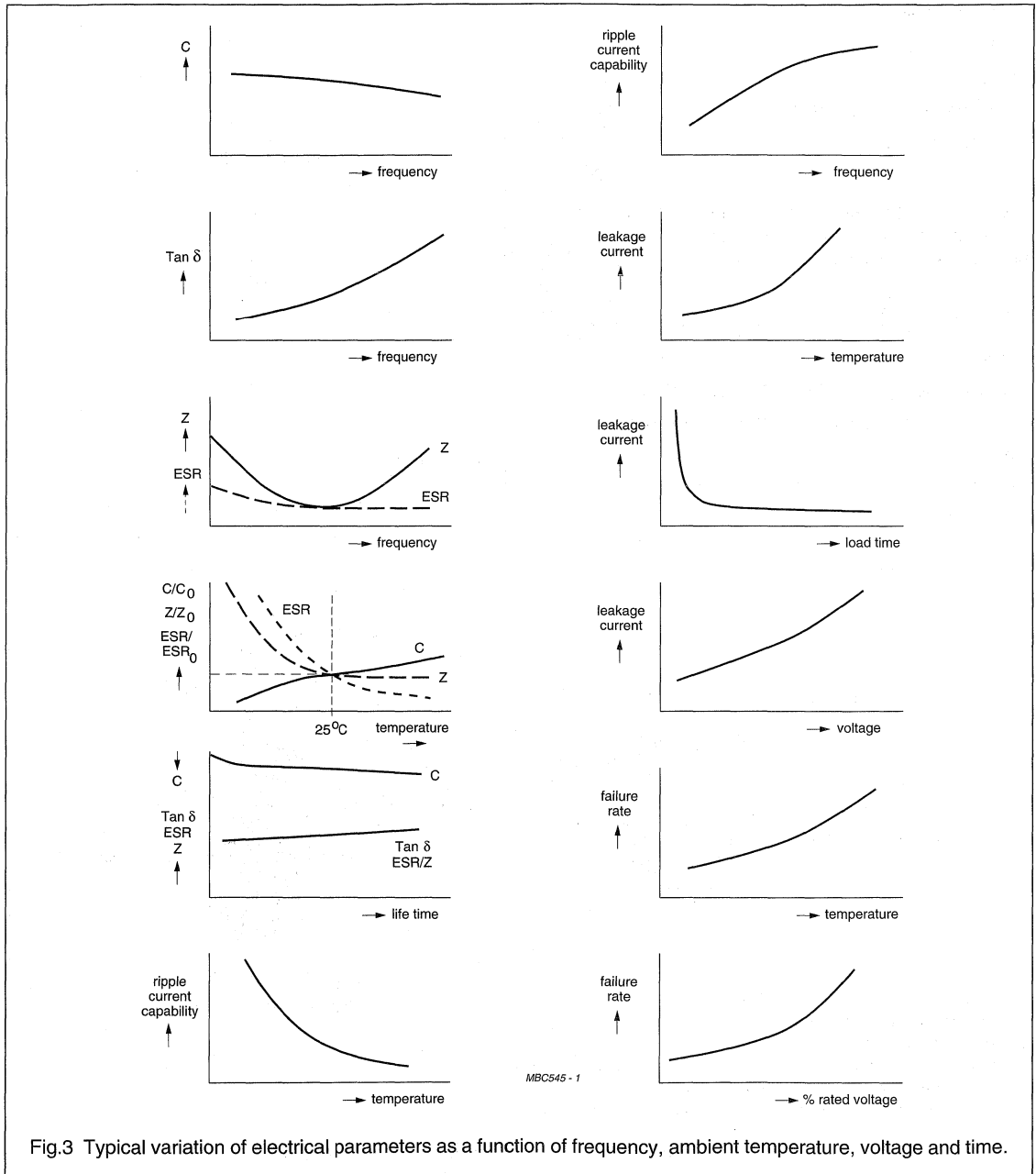
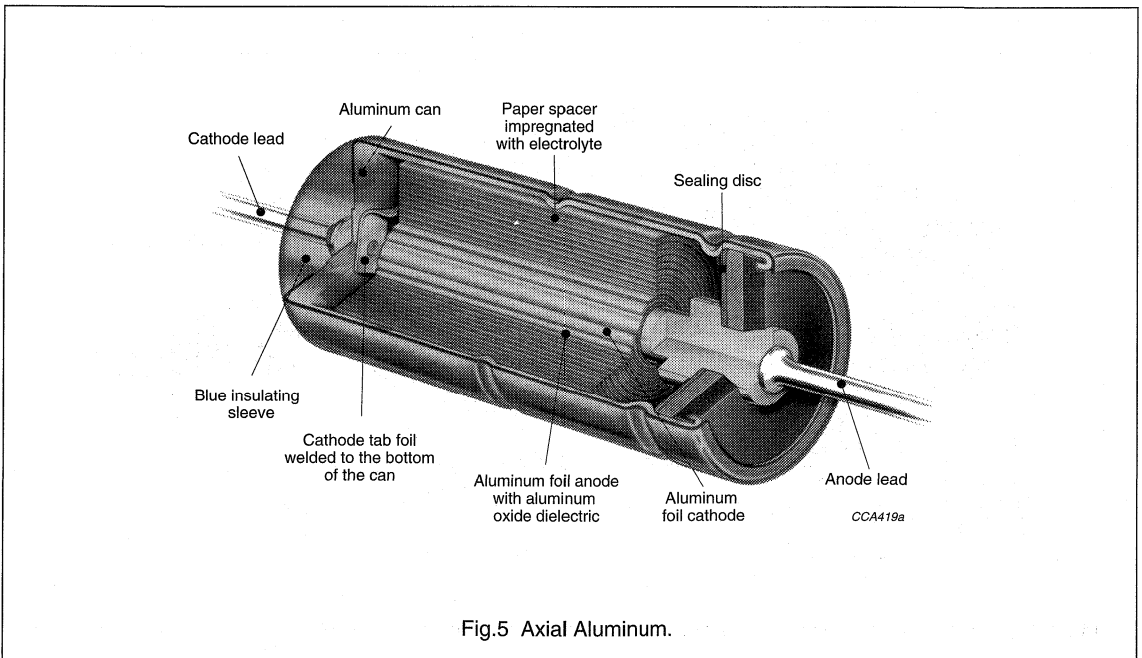
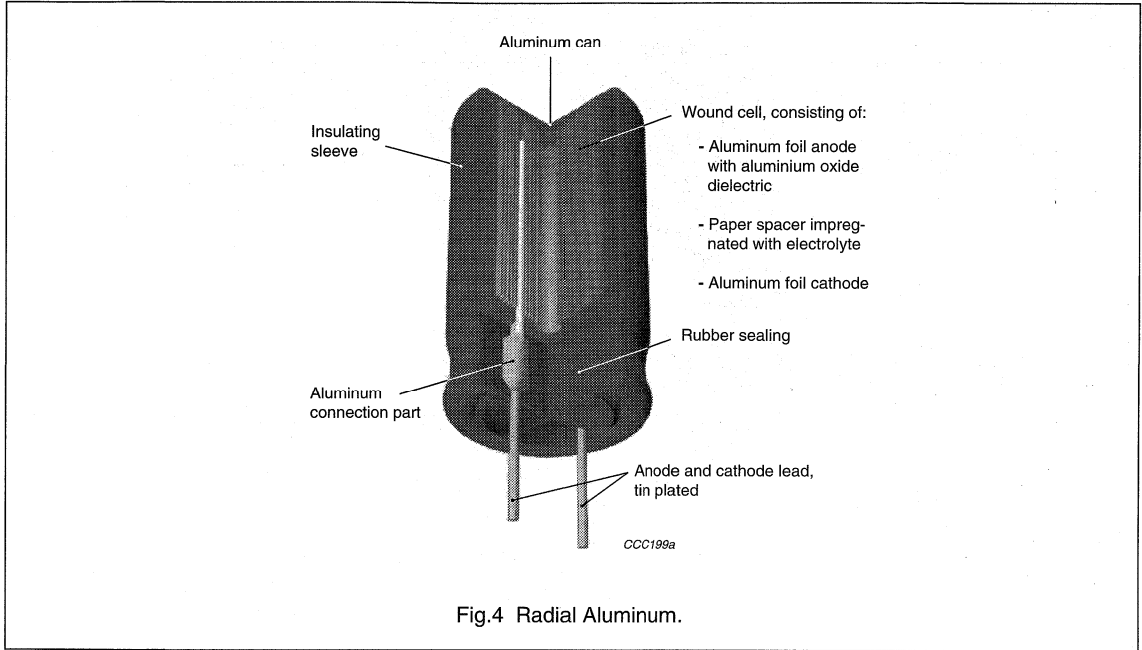


Fig.3 Typical variation of electrical parameters as a function of frequency, ambient temperature, voltage and time.

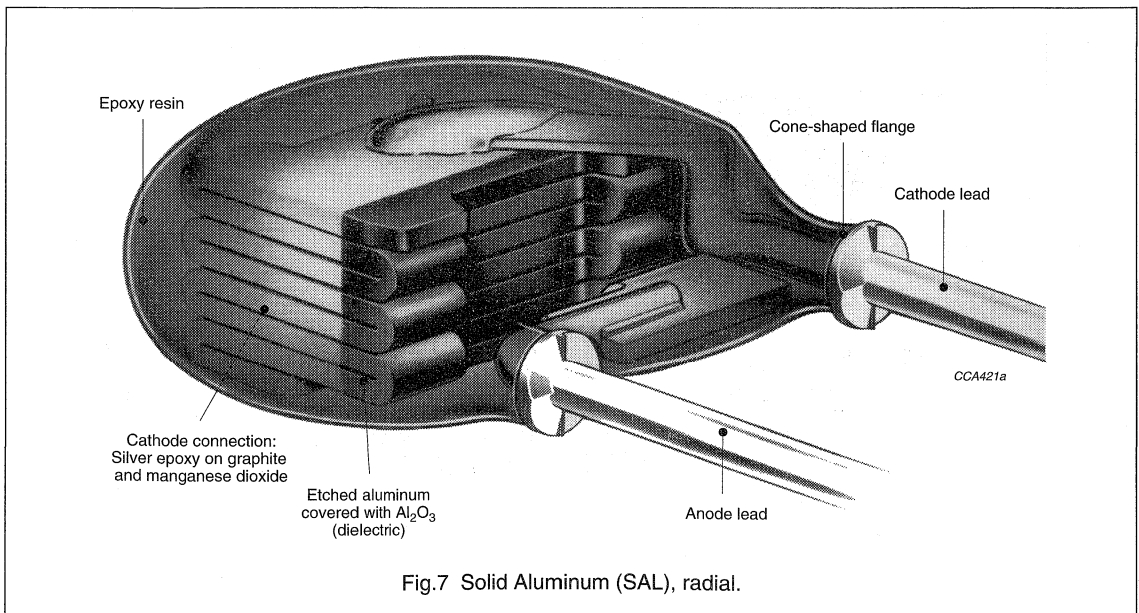
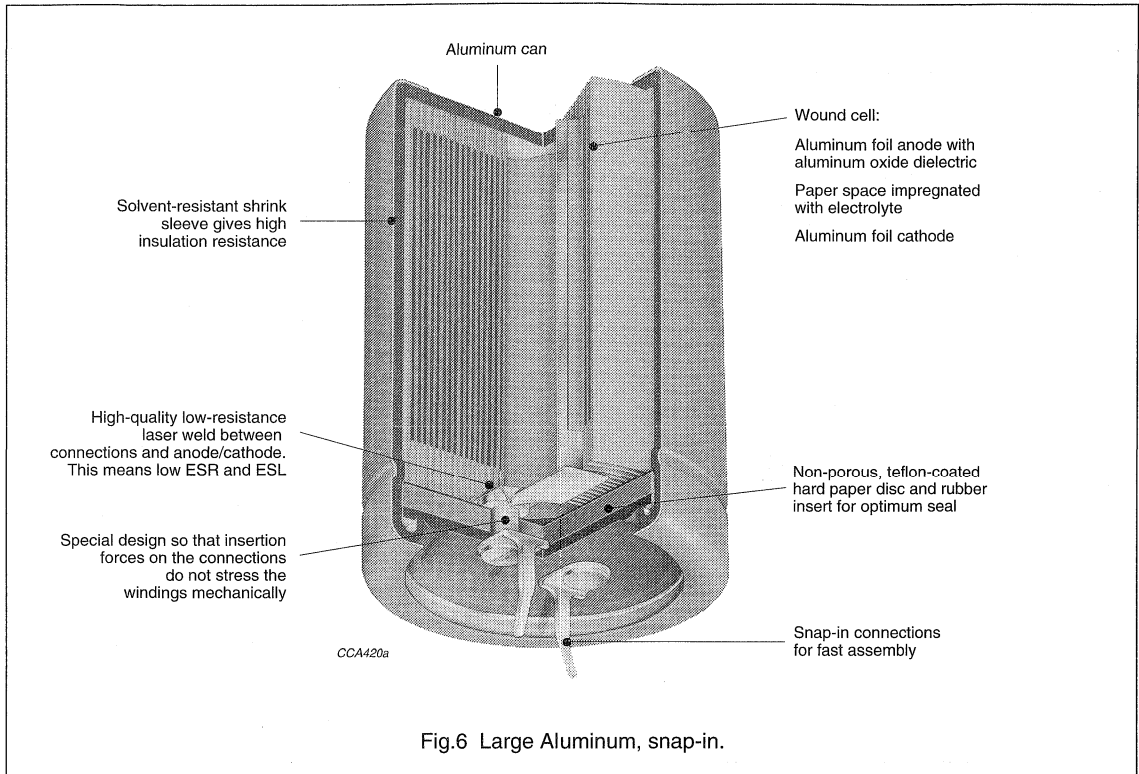
CONSTRUCTION

Examples



Electrolytic capacitors

General introduction



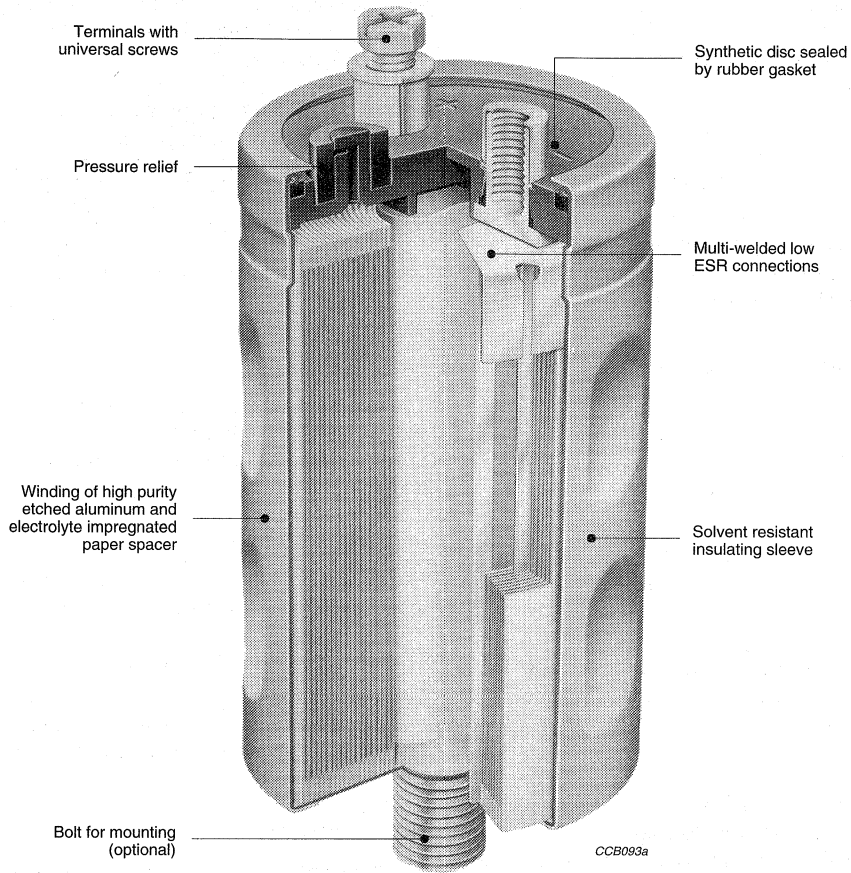


Fig.8 Large Aluminum, screw terminal.

Electrolytic capacitors

General introduction

DEFINITIONS OF ELECTRICAL PARAMETERS

Sequence of measurement for tests are in accordance with "IEC 60384-4":

1. Leakage current (I_L)
2. Capacitance (C_R)
3. Dissipation factor ($\tan \delta$ or ESR)
4. Impedance (Z).

Capacitance**AC CAPACITANCE OF AN ELECTROLYTIC CAPACITOR**

The capacitance of an equivalent circuit, having capacitance, resistance and inductance in series, measured with alternating current of approximately sinusoidal waveform at a specified frequency; refer to Fig.9.

Standard measuring frequencies for electrolytic capacitors are 100 or 120 Hz.

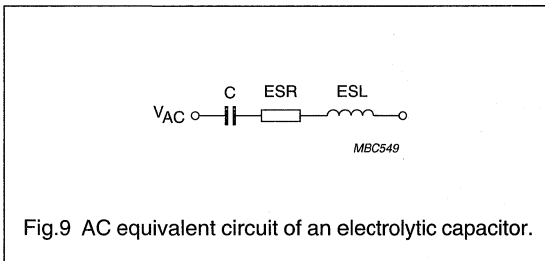


Fig.9 AC equivalent circuit of an electrolytic capacitor.

DC CAPACITANCE OF AN ELECTROLYTIC CAPACITOR (FOR TIMING CIRCUITS)

DC capacitance is given by the amount of charge which is stored in the capacitor at the rated voltage (U_R).

DC capacitance is measured by a single discharge of the capacitor under defined conditions. Measuring procedures are described in "DIN 41328, sheet 4" (withdrawn).

At any given time, the DC capacitance is higher than the AC capacitance.

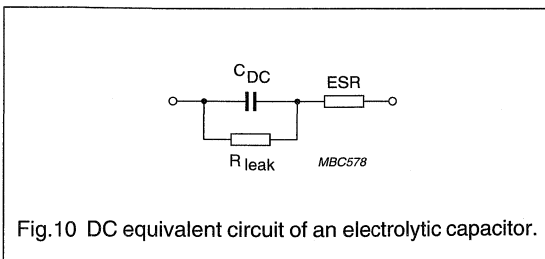


Fig.10 DC equivalent circuit of an electrolytic capacitor.

RATED CAPACITANCE (C_R)

The capacitance value for which the capacitor has been designed and which is usually indicated upon it.

Preferred values of rated capacitance and their decimal multiples are preferably chosen from the E3 series of "IEC Publication 60063".

TOLERANCE ON RATED CAPACITANCE

Preferred values of tolerances on rated capacitance

-20/+20%	-10/+50%	-10/+30%	-10/+10%
M	T	Q	K

These values depend on the relevant series.

Voltage**RATED VOLTAGE (U_R)**

The maximum direct voltage, or peak value of pulse voltage which may be applied continuously to a capacitor at any temperature between the lower category temperature and the rated temperature.

CATEGORY VOLTAGE (U_C)

The maximum voltage which may be applied continuously to a capacitor at its upper category temperature.

TEMPERATURE DERATED VOLTAGE

The temperature derated voltage is the maximum voltage that may be applied continuously to a capacitor, for any temperature between the rated temperature and the upper category temperature.

RIPPLE VOLTAGE (U_{RPL})

An alternating voltage may be applied, provided that the peak voltage resulting from the alternating voltage, when superimposed on the direct voltage, does not exceed the value of rated direct voltage or fall under 0 V and that the ripple current is not exceeded.

REVERSE VOLTAGE (U_{REV})

The maximum voltage applied in the reverse polarity direction to the capacitor terminations.

SURGE VOLTAGE (U_S)

The maximum instantaneous voltage which may be applied to the terminations of the capacitor for a specified time at any temperature within the category temperature range.

Temperature

CATEGORY TEMPERATURE RANGE

The range of ambient temperatures for which the capacitor has been designed to operate continuously; this is defined by the temperature limits of the appropriate category.

RATED TEMPERATURE

The maximum ambient temperature at which the rated voltage may be continuously applied.

MINIMUM STORAGE TEMPERATURE

The minimum permissible ambient temperature which the capacitor shall withstand in the non-operating condition, without damage.

Resistance/Reactance

EQUIVALENT SERIES RESISTANCE (ESR)

The ESR of an equivalent circuit having capacitance, inductance and resistance in series measured with alternating current of approximately sinusoidal waveform at a specified frequency; refer to Fig.9.

EQUIVALENT SERIES INDUCTANCE (ESL)

The ESL of an equivalent circuit having capacitance, resistance and inductance in series measured with alternating current of approximately sinusoidal waveform at a specified frequency; refer to Fig.9.

DISSIPATION FACTOR (TANGENT OF LOSS ANGLE; $\tan \delta$)

The power loss of the capacitor divided by the reactive power of the capacitor at a sinusoidal voltage of specified frequency:

$$\tan \delta = \text{ESR} \times 2 \pi f C \text{ (approximation formula)}$$

IMPEDANCE (Z)

The impedance (Z) of an electrolytic capacitor is given by capacitance, ESR and ESL in accordance with the following equation (see Fig.11):

$$Z = \sqrt{\text{ESR}^2 + \left(2\pi f \text{ESL} - \frac{1}{2\pi f C}\right)^2}$$

CurrentLEAKAGE CURRENT (I_L)

Leakage current flows through a capacitor when a DC voltage is applied in correct polarity. It is dependent on voltage, temperature and time.

Leakage current for acceptance test (I_{L5})

In accordance with international standards ("IEC 60384-4" and "EN130300") the leakage current (I_{L5}) **after 5 minutes** application of rated voltage at 20 °C, is considered as an acceptance requirement.

The leakage current requirements for the majority of BC Components electrolytic capacitors, are lower than specified in "IEC 60384-4" or "EN130300".

If, for example, after prolonged storage and/or storage at excessive temperature (>40 °C), the leakage current at the first measurement does not meet the requirements, pre-conditioning shall be carried out in accordance with "EN130300 subclause 4.1".

Leakage current at delivery (I_{L1} or I_{L2})

In addition to I_{L5} , the leakage current **after 1 minute** application of rated voltage (I_{L1}) is specified in most of the detail specifications.

For some series this value is specified **after 2 minutes** (I_{L2}).

Operational leakage current (I_{OP})

After continuous operation (1 hour or longer) the leakage current will normally decrease to less than 20% of the 5 minute value (I_{L5}).

The operational leakage current depends on applied voltage and ambient temperature; see Tables 1 and 2.

Leakage current after storage with no voltage applied (shelf life)

If non-solid electrolytic capacitors are stored above room temperature for long periods of time, the oxide layer may react with the electrolyte, causing increased leakage current when switched on for the first time after storage.

Table 1 Typical multiplier of operational leakage current as a function of ambient temperature (as far as allowed for the corresponding series)

SYMBOL	MULTIPLIER									
	T _{amb} (°C)	-55	-40	-25	0	20	45	65	85	105
I _{OP} /I _L	<0.5	0.5	0.6	0.8	1	1.5	2.5	4	7	10

Table 2 Typical multiplier of operational leakage current as a function of applied voltage

SYMBOL	MULTIPLIER									
	U/U _R	<0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
I _{OP} /I _L	0.1	0.15	0.2	0.3	0.4	0.5	0.65	0.8	1	

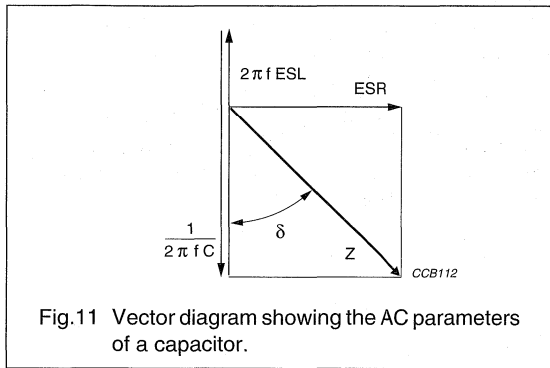


Fig.11 Vector diagram showing the AC parameters of a capacitor.

Ripple current (I_R)

Any pulsating voltage (or ripple voltage superimposed on DC bias) across a capacitor results in an alternating current through the capacitor.

Because of ohmic and dielectric losses in the capacitor, this alternating current produces an increase of temperature in the capacitor cell.

The heat generation depends on frequency and waveform of the alternating current.

The maximum RMS value of this alternating current, which is permitted to pass through the capacitor during its entire specified useful life (at defined frequency and defined ambient temperature), is called **rated ripple current** (I_R).

The rated ripple current is specified in the relevant detail specifications at 100 or 120 Hz (in special cases at 100 kHz) and at upper category temperature.

Usually the rated ripple current will cause a temperature increase of the capacitor's surface of approximately 3 or 5 K (dependent on series) compared with ambient temperature. A further temperature increase of 3 or 5 K will be found in the core of the capacitor.

This temperature rise is the result of the balance between heat generated by electric losses:

$$P = I_R^2 ESR$$

and the heat carried off by radiation, convection and conduction:

$$P = \Delta T \times A \times \beta$$

I_R can be determined by the equation:

$$I_R = \sqrt{\frac{\Delta T \times A \times \beta}{ESR}}$$

where:

ΔT = difference of temperature between ambient and case surface

A = geometric surface area of the capacitor

β = specific heat conductivity, dependent on the size of the capacitor.

The heat, generated by ripple current, is an important factor of influence for non-solid electrolytic capacitors for calculating the useful life under certain circumstances.

In the detail specifications this factor is considered in the so-called 'life-time nomograms' ('Multiplier of useful life' graph) as a ratio between actual ripple current (I_A) and rated ripple current (I_R), drawn on the vertical axis.

Care should be taken to ensure that the actual ripple current remains inside the graph at any time of the entire useful life. If this cannot be realized, it is more appropriate to choose a capacitor with a higher rated voltage or higher capacitance, than originally required by the application.

The internal losses and the resultant ripple current capability of electrolytic capacitors are frequency dependent. Therefore, a relevant frequency conversion table ('Multiplier of ripple current as a function of frequency') is stated in the detail specifications.

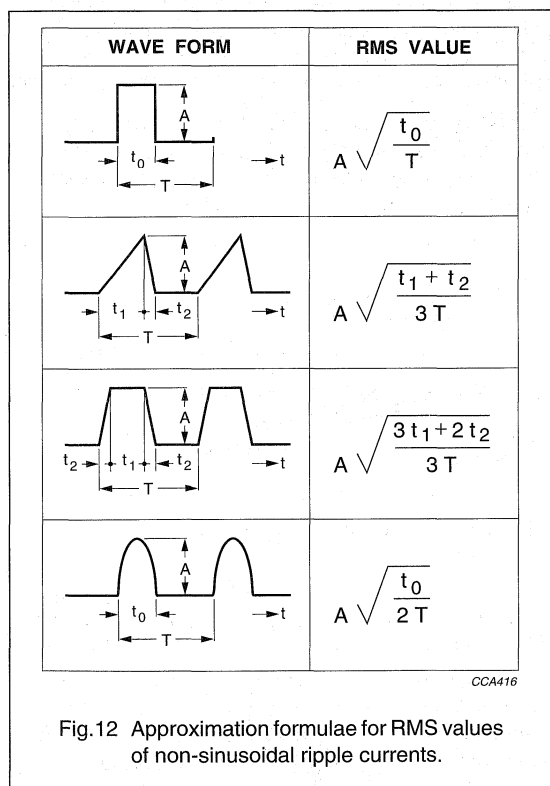
Electrolytic capacitors

General introduction

CALCULATION OF THE APPLICABLE RMS RIPPLE CURRENT

Non-sinusoidal ripple currents (if not accessible by direct measurement) have to be analyzed into a number of sinusoidal ripple currents by means of Fourier-analysis; the vectorial sum of the currents thus found may not exceed the applicable ripple current.

For some frequently occurring waveforms, approximation formulae are stated in Fig.12 for calculating the corresponding RMS value.



STORAGE

No pre-condition will be necessary for BC Components electrolytic capacitors, when stored under standard atmospheric conditions (15 to 25 °C; 25 to 75% RH; 860 to 1060 mbar) or the following periods of time:

- 3 years for non-solid 85 °C types
- 4 years for non-solid 105 °C types
- 10 years for non-solid 125 °C types
- 20 years for solid types.

After these periods, the leakage current for acceptance test shall not exceed twice the specified I_{LS} requirement.

A limited current can be applied to reduce the leakage current of long stored capacitors to normal values. The maximum allowed current when doing this at room temperature is given by the following formula:

$$I(\text{mA})_{\text{max}} = \frac{1 \text{ mW}}{\text{mm}^2} \times \frac{A(\text{mm}^2)}{U_r(\text{V})}$$

In this formula A represents the total capacitor surface in mm^2 and U_r the rated voltage in Volts. During this reforming process, the rated voltage shall not be exceeded.

To ensure good solderability and quality of taping, for all types and prior to mounting, the storage time shall not exceed 3 years. This means for example: 2 years storage time between manufacture and arrival at the customer, plus 1 year in customer storage.

OPERATIONAL CONDITIONS

Charge-discharge proof

This term means the capability of capacitors to withstand frequent switching operations without significant change of capacitance.

BC Components Al-electrolytic capacitors are charge-discharge proof in accordance with "IEC 60384-4" and "EN130300 subclause 4.20": unless otherwise specified, 10^6 switching operations ($RC = 0.1 \text{ s}$) shall not cause a capacitance change of more than 10%.

Non-frequent charging and discharging, without a series resistor, will not damage the capacitor.

If a capacitor is charged and discharged continuously several times per minute, the charge and discharge currents have to be considered as ripple currents flowing through the capacitor. The RMS value of these currents should be determined and the resultant value must not exceed the applicable limit.

Endurance test

In "IEC 60384-4" or "EN130300" the criteria for the acceptable drift of electrical parameters after the endurance test at U_r and upper category temperature are defined.

Test duration and conditions per series are stated in the relevant detail specification.

The endurance test does not provide information about the useful life of a capacitor, as no failure percentage is defined for this investigation.

Useful life

Useful life (other names: load life, life time or typical life time) is that period of time, during which a given failure percentage may occur, under well defined conditions and requirements. Useful life data are usually calculated with a confidence level of 60%.

High quality of materials and controlled manufacturing processes provided, the useful life of non-solid electrolytic capacitors is, in most cases, determined by evaporation of electrolyte through the sealing.

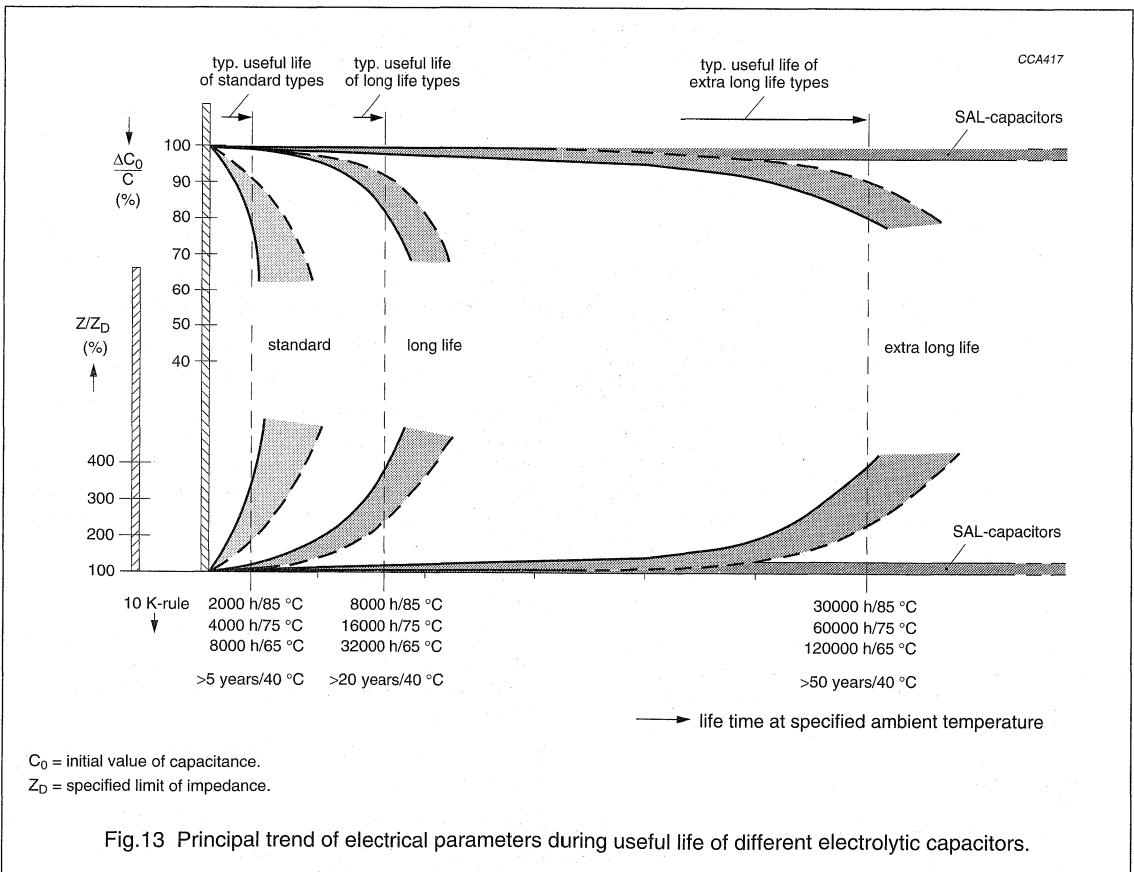
Figure 13 shows the principal electrical consequences of this electrolyte loss: increasing impedance and decreasing capacitance at the end of useful life, for different non-solid types.

Due to the fact that no liquid electrolyte is used in solid aluminum electrolytic capacitors, the associated failure mechanism does not occur.

For non-solid electrolytic capacitors the influence of temperature on useful life is indicated by the so-called '10 K-rule' under the horizontal axis of the graph. The '10 K-rule' means approximately, that double the life time can be expected per 10 K temperature decrease; this principle is derived from the well known law of Arrhenius about acceleration of reaction processes.

The exact temperature dependence of useful life for a particular range is given in the corresponding detail specification in the 'life-time nomogram' ('Multiplier of useful life' graph in the detail specifications). Detailed performance requirements, on which the definition 'useful life' is based, are also stated in the relevant detail specifications.

Exceeding those requirements shall not necessarily induce a malfunction of the equipment involved. The performance requirements offer advice on the choice of components and design of the circuitry.



Electrolytic capacitors

General introduction

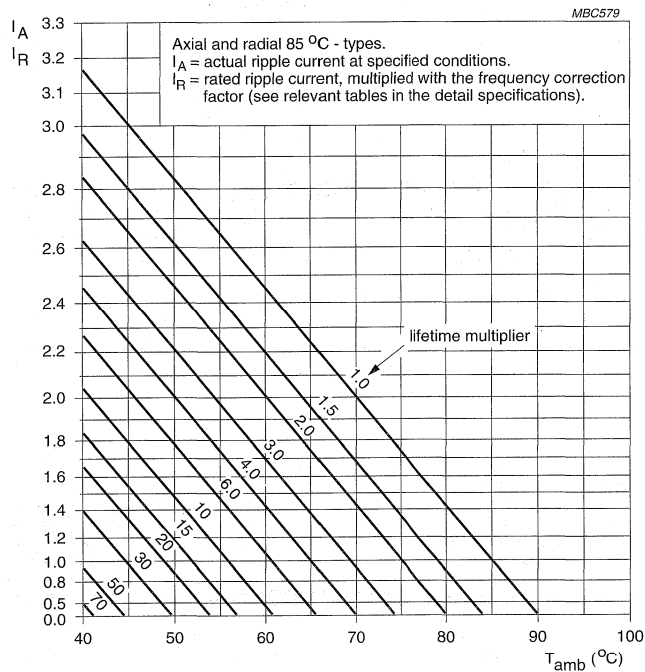
CALCULATION OF USEFUL LIFE BY MEANS OF 'LIFE-TIME NOMOGRAMS'

Based on the Arrhenius law and on experience for some decades, a nomogram is specified in the detail specification for each range, where the influence of ambient temperature and ripple current on the expected useful life is shown. Ripple currents at other frequencies than specified must be corrected using the frequency conversion tables in the relevant detail specification.

The ratio of ripple current (I_A/I_R) is plotted on the vertical axis and the ambient temperature (T_{amb}) on the horizontal.

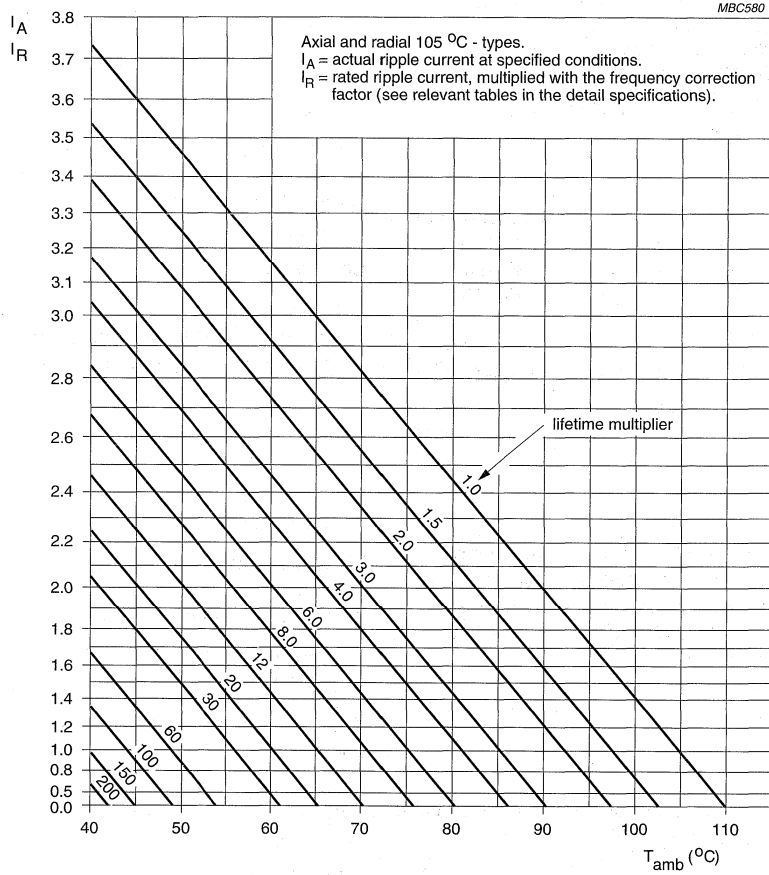
At the intersection of these two operational conditions the appropriate multiplier (correction factor) for useful life can be read. The useful life under certain conditions shall be calculated by multiplying (or dividing respectively) the specified useful life, with the resultant correction factor.

The useful life determined by this procedure is normally valid for applications without forced cooling. Under certain conditions and with additional cooling, the useful life may be considerably extended.



Axial and radial 85 °C types.

Fig.14 Typical example of a life-time nomogram: useful life as a function of ambient temperature and ripple current load.



Axial and radial 105 °C types.

Fig.15 Typical example of a life-time nomogram:
useful life as a function of ambient temperature and ripple current load.

Electrolytic capacitors

General introduction

EXAMPLES FOR THE USE OF 'LIFE-TIME NOMOGRAMS'

Example 1

Temperature in (operating) equipment is 45 °C.

Ripple current load is exactly the rated value (thus: $I_A/I_R = 1$).

Which useful life can be expected (without pause and storage times):

1. for a capacitor with a specified useful life of 2000 hours at 85 °C?
2. for a capacitor with a specified useful life of 2000 hours at 105 °C?

Solution:

The corresponding life-time multiplier may be found at the intersection between the vertical '45 °C'-line and the horizontal '1'-line. For the 85 °C type this is '30' (see Fig.14) and for the 105 °C type it is '90' (see Fig.15).

Resulting useful life is thus:

1. for 85 °C type: 30×2000 hours = 60000 hours or about 7 years
2. for 105 °C type: 90×2000 hours = 180000 hours or about 20 years.

Example 2

Which life time requirement has to be fulfilled by the capacitors, if the equipment life shall be 10 years (approx. 100000 hours), consisting of 1000 hours at 75 °C + 9000 hours at 65 °C + 90000 hours at 40 °C? No ripple current applied (thus: $I_A/I_R = 0$).

Solution:

The mentioned life-times shall be converted to specified 85 °C or 105 °C life-times, i.e. they have to be divided through the correction factors found at the intersection of the respective operational conditions (see Table 4).

The required life-time can be fulfilled by types with a specified useful life of:

1. >2970 hours at 85 °C i.e. a 3000 hours/85 °C type, or
2. >935 hours at 105 °C i.e. a 1000 hours/105 °C type.

Example 3

Which internal temperature may occur in the equipment, if the actual ripple current at 10 kHz is 3 times higher than specified for a 16 V-type and the load limit may not be exceeded?

Solution:

The ripple current must first be converted from 10 kHz to 100 Hz by using the conversion table (see typical example, Table 3). This shows that the conversion factor for a 16 V-type is 1.2.

$I_A/I_R = 3$ at 10 kHz and must be divided by 1.2, resulting in $I_A/I_R = 2.5$ at 100 Hz.

The load limit is defined by the diagonal line 'multiplier 1' in the relevant nomogram.

This means here: the vertical line on the intersection of $I_A/I_R = 2.5$ and the multiplier 1-line shows the maximum permitted internal temperature:

1. for 85 °C types this is max. 59 °C
2. for 105 °C types this is max. 79 °C.

The corresponding life-time in this case is equal to the specified useful life.

Table 3 Typical example of a frequency conversion table (I_R/I_{R0}) as a function of frequency; I_{R0} = ripple current at 100 Hz

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 6.3$ to 25 V	$U_R = 35$ and 40 V	$U_R = 50$ and 63 V
50	0.95	0.85	0.80
100	1.00	1.00	1.00
300	1.07	1.20	1.25
1000	1.12	1.30	1.40
3000	1.15	1.35	1.50
≥10000	1.20	1.40	1.60

Electrolytic capacitors

General introduction

Table 4 Life-time calculation in "Example 2"

LIFE CONDITIONS	85 °C TYPES (see Fig.14)	105 °C TYPES (see Fig.15)
1000 hours at 75 °C	1000/2.9 = 345 hours	1000/8 = 125 hours
9000 hours at 65 °C	9000/6 = 1500 hours	9000/20 = 450 hours
90000 hours at 40 °C	90000/80 = 1125 hours	90000/250 = 360 hours
	sum for 85 °C = 2970 hours	sum for 105 °C = 935 hours

FAILURE RATE (λ) TOTAL FAILURE PERCENTAGE

Electrolytic capacitors, like many other electronic components and devices, exhibit a failure rate which varies with time as depicted in the familiar 'bathtub' curve (see Fig.16). Three distinct regions can be discerned:

(a) Burn-in period, showing a rapidly decreasing failure rate. During production of BC Components' electrolytic capacitors all capacitors undergo a re-forming process which is a short burn-in. All capacitors shipped have passed burn-in.

(b) Constant failure period, showing a low failure rate for a long period. This is the 'useful life' period of the electrolytic capacitor. The detail specifications of the relevant series specify the upper limit for the total failure percentage (TFP) during this period. For non-solid electrolytic capacitors this limit is usually not reached before the wear-out period begins.

(c) Wear-out period, showing an increasing failure rate due to gradual deterioration. For electrolytic capacitors with non-solid electrolyte, the onset of this period can be calculated with the nomogram (see Fig.17).

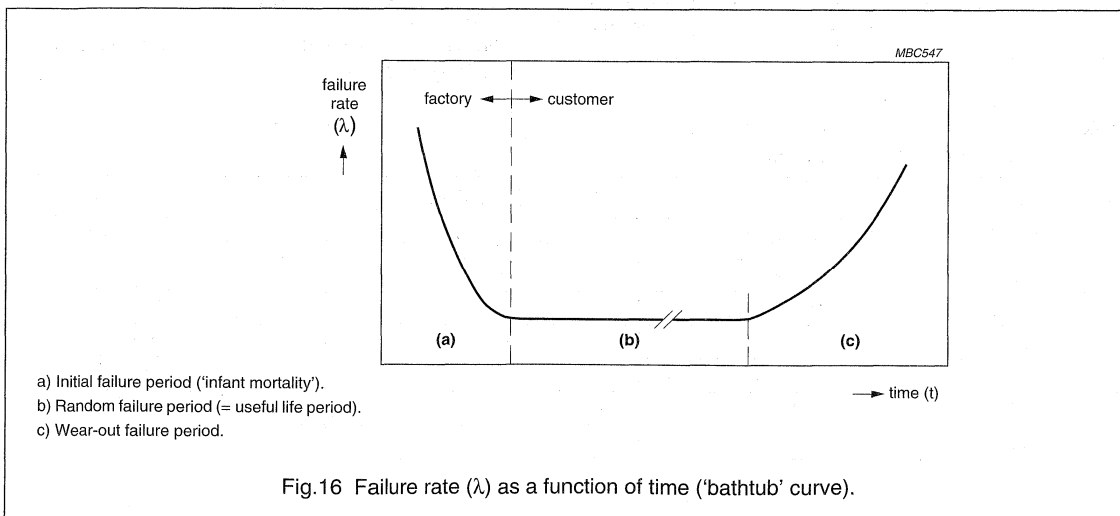
The failure rate is the number of components failing within a unit of time. For region (b), where the failure rate has a constant value λ , the total failure percentage as a function of time, TFP(t), can be expressed as:

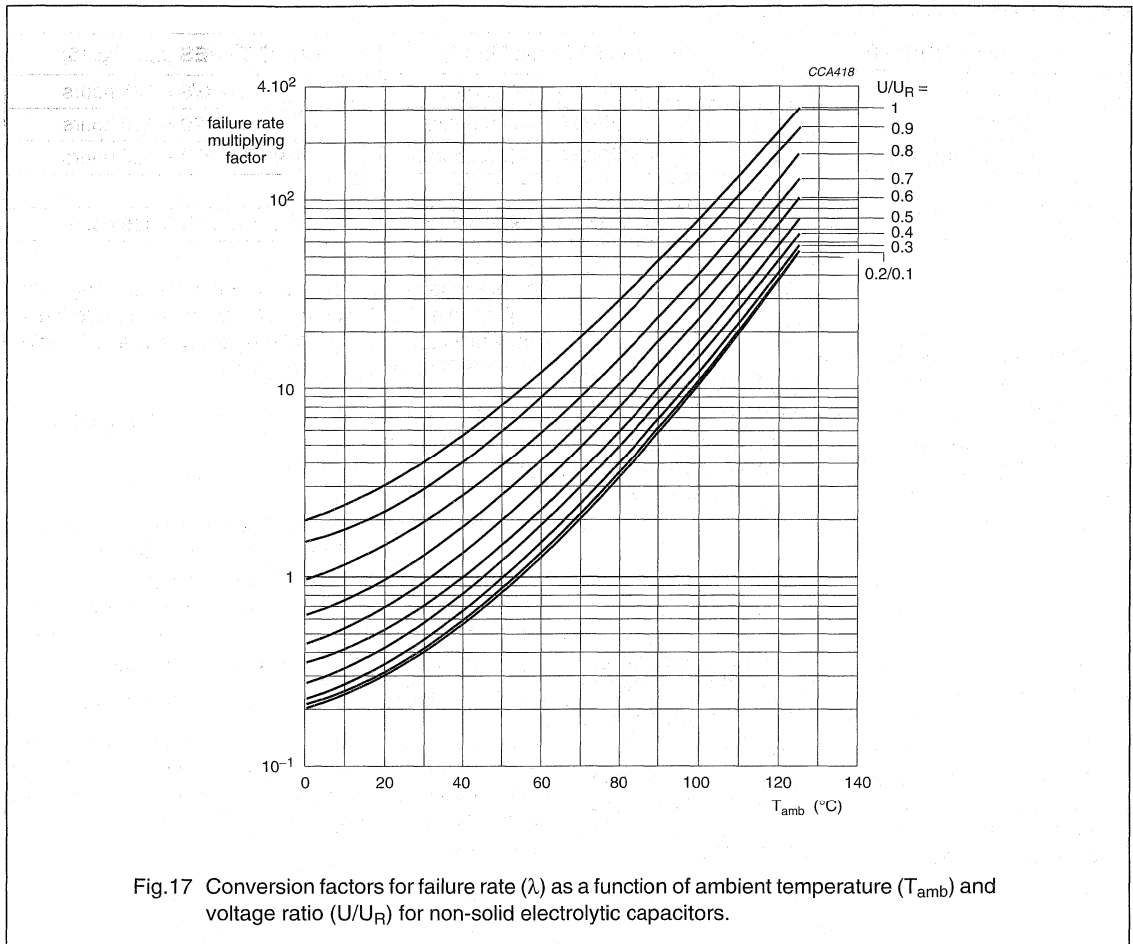
$$TFP(t) = \left\{ 1 - \frac{N(t)}{N(0)} \right\} \times 100\% = (1 - e^{-\lambda \times t}) \times 100\%$$

$$\text{with } \lambda = \lambda_{40^\circ\text{C}, 0.5U_R} \times \text{mult}(T, U/U_R)$$

$N(t)$ is the number of components that have not failed after time t . As λ mainly depends on two stress factors, temperature and the ratio of applied voltage to rated voltage, it is common to normalise it to reference conditions, $T_{\text{amb}} = 40^\circ\text{C}$ and $U = 0.5 \times U_R$. The value for $\lambda_{40^\circ\text{C}, 0.5U_R}$ is calculated from results of periodical tests in the quality laboratories or derived from field observations.

In order to calculate λ for other operating conditions, the value for the failure rate multiplying factor, $\text{mult}(T, U/U_R)$ in the formula above, must be taken from Fig.17 (non-solid electrolytic capacitors) or Fig.18 (SAL electrolytic capacitors).

Fig.16 Failure rate (λ) as a function of time ('bathtub' curve).



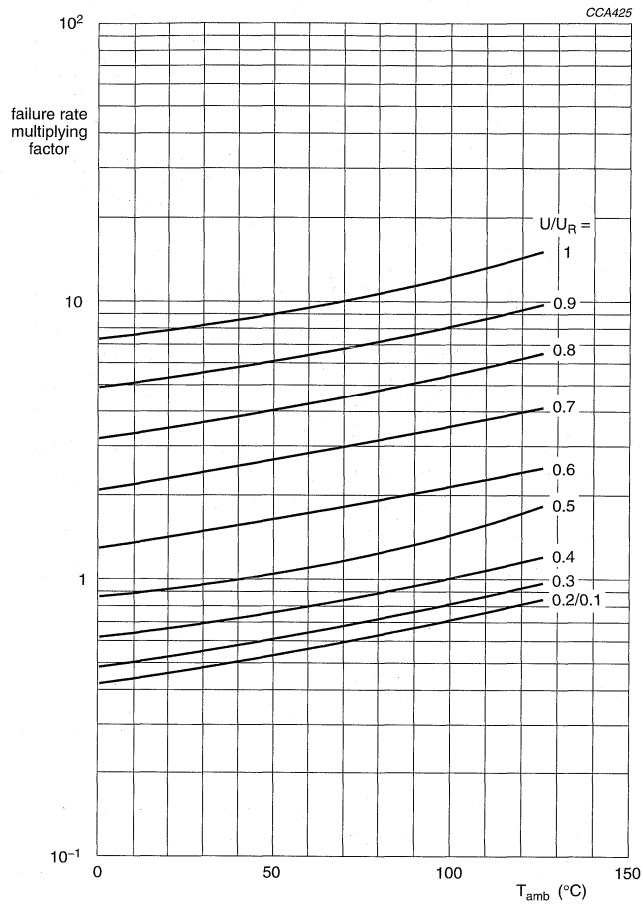


Fig.18 Conversion factors for failure rate (λ) as a function of ambient temperature (T_{amb}) and voltage ratio (U/U_R) for SAL electrolytic capacitors.

Electrolytic capacitors

General introduction

CLIMATIC CATEGORY

For each capacitor range the climatic category in accordance with "IEC 60068-1" is stated in the relevant detail specification. The climatic category consists of three digit groups; example given in Table 5.

Table 5 Example of climatic categories

Example:	40 /	085 /	56	
	40			lower category temperature (here: -40 °C)
		085		upper category temperature (here: +85 °C)
			56	duration of test 'damp heat, steady state' (here: 56 days)

Table 6 Maximum humidity condition indication for the application class

CODE LETTER	RELATIVE AIR HUMIDITY			
	YEARLY AVERAGE	30 DAYS PER YEAR	OCCASIONALLY	DEWING
C	≤95%	100%	100%	permitted
D	≤80%	100%	90%	permitted
E	≤75%	95%	85%	slightly/rarely
F	≤75%	95%	85%	not permitted

APPLICATION CLASS

Although the German standard "DIN 40040" has been withdrawn, it is still widely used in industrial specifications for the definition of climatic working conditions. The application class consists of 3 code letters which have the following meanings.

Code letter meanings

1 st letter:	lower category temperature F: -55 °C; G: -40 °C; H: -25 °C
2 nd letter:	upper category temperature P: +85 °C; M: +100 (+105) °C; K: +125 °C
3 rd letter:	maximum humidity conditions (see Table 6)

MOUNTING**Mounting position of non-solid Al-electrolytic capacitors**

Snap-in and printed wiring (PW) as well as solder lug (SL) power electrolytic capacitors, in addition to the larger case sizes of axial and radial types, are normally equipped with pressure relief in the aluminum case. These and all smaller case size types, may be mounted in any position.

Screw-terminal power electrolytic capacitors have a pressure relief in the sealing disc. These types shall be mounted so that no emissions of electrolyte or vapour may reach either the conductors under voltage, or other parts of the printed circuit board. Vertical (pressure relief up) or horizontal (pressure relief on the upper side) mounting position is recommended.

Design rules for 'capacitor batteries'**MECHANICAL**

BC Components power electrolytic capacitors are mainly used in power supply applications under high ripple current load. In these circumstances, the capacitors must be mounted with a distance of ≥ 15 mm from each other, in order to allow sufficient air circulation and to prevent mutual radiation.

Likewise, if axial or radial types are subject to high ripple load, they shall be mounted with sufficient distance (e.g. ≥ 10 mm) from each other for good convection.

ELECTRICAL*Parallel connection*

Al-electrolytic capacitors may be connected in parallel, but for safety reasons, large sizes should be individually guarded against sudden energy discharge of the whole battery due to a defective specimen.

Series connection

If two electrolytic capacitors are connected in series, balancing resistors are required; see Fig.19. Without these resistors, leakage current through both capacitors is the same. Because the leakage current for two capacitors can be quite different when the same voltage is applied, forcing the same current through both capacitors will mean that the voltage will not divide evenly. One capacitor might be subjected to a voltage exceeding its rated voltage. Parallel balancing resistors limit the difference in voltage across the capacitors under DC conditions.

For practical purposes the following equation can be used to calculate the maximum possible resistor

$$\text{values in ohms: } R = \frac{2 \times U_m - U_{\text{total}}}{I_{L5}}$$

Here, U_m is the maximum (rated) voltage that may be present on one of the capacitors and I_{L5} is the specified leakage current in amperes after 5 minutes (used as an approximation of the difference in leakage current between C1 and C2).

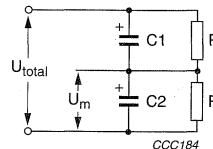


Fig.19 Balancing resistors for two electrolytic capacitors in series.

Combined series/parallel connection

The above mentioned rules for both series and parallel connection are accordingly valid for any combination of these two cases.

MARKING

BC Components electrolytic capacitors are identified in accordance with "IEC" rules. When sufficient space is available, capacitors are marked with the following details:

Rated capacitance in μF (the ' μ ' sign represents the position of the decimal point)

Rated voltage in V

Tolerance on rated capacitance if necessary, as a letter code in accordance with "IEC 60062", e.g.

T for $-10/+50\%$

M for $\pm 20\%$

K for $\pm 10\%$

Q for $-10/+30\%$

A for tolerance according to detail specification

Group number 3-digit part of the catalogue number, e.g. 036 for RSP series

Catalogue number or last 8-digits of the catalogue number

Name of manufacturer BC Components or BCC or BC

Date code abbreviation in 2 digits ("IEC 60062"), e.g.

1st digit

2nd digit

D = 1993

1 = January

E = 1994

2 = February

F = 1995

...

H = 1996

9 = September

J = 1997

O = October

K = 1998

N = November

L = 1999

D = December

M = 2000

N = 2001

example:

J5 = produced in 1997, May

production date may also be stated as year/week code

example: 9725 = produced in 1997, 25th week

Date code may also be stamped in the case.

Factory code indicating the factory of origin

Polarity identification strip, band or negative symbol ('-' sign) to indicate the negative terminal and/or a '+' sign to identify the positive terminal.

PRODUCT SAFETY



Electrolytic capacitors

Product safety

WARNING

Correct application and strict adherence to the important information listed below, will ensure optimum performance of the capacitors over their entire specified useful life.

Please note, that ignoring these rules may reduce the equipment life time or even destroy the capacitor, together with parts of the equipment or property involved. The consequences may be a short or open circuit of the component, leakage of electrolyte or heat generation. Opening of the case or vent (danger of injury) may be regarded as hazardous and cause liquids, vapours or dust to be released. Similar precautions should be taken when testing electrolytic capacitors.

Please consult your local BC Components sales organization, if one or more of these limits cannot be adhered to.

GUIDELINES

PARAMETER	IMPORTANT INFORMATION – PRODUCT SAFETY	MORE DETAILS
POLARITY, REVERSE VOLTAGE	<p>Electrolytic capacitors for DC applications require polarization.</p> <p>Check the polarity of each capacitor: both in circuit design and in mounting (polarity is clearly indicated on the capacitor). For short periods a limited reverse voltage is allowed (see detail specification); for conditions and maximum parameter changes, see this handbook, section "<i>Tests and Requirements</i>". Exceeding reverse voltage may result in early failures.</p>	<p>detail specification</p> <p>TESTS AND REQUIREMENTS</p>
VOLTAGE	<p>Do not apply a voltage exceeding the capacitor's voltage rating.</p> <p>Check the maximum voltage across the capacitor which can occur over the whole equipment life. In normal operation the rated voltage of the capacitor shall not be exceeded; if so, early failures may occur. However, for short periods the voltage may be raised up to surge voltage value (see detail specification); for conditions and maximum parameter changes, see this handbook, section "<i>Tests and Requirements</i>".</p>	<p>detail specification</p> <p>TESTS AND REQUIREMENTS</p>
RIPPLE LOAD	<p>Do not allow excessive ripple current to pass.</p> <p>The rated ripple current given for certain conditions (temperature, frequency and useful life) shall not be exceeded. If so, early failure may result.</p> <p>Keep ripple voltage within ratings.</p> <p>The sum of DC-bias and maximum amplitude of ripple voltage shall be within rated voltage and 0 V. Electrolytic capacitors are not normally designed for AC application.</p>	<p>detail specification</p>
TEMPERATURE RANGE	<p>Use capacitors within specified temperature range.</p> <p>Applicable temperature range is given in the relevant detail specification.</p> <p>A general principle is that lower ambient temperature means longer life; therefore, wherever possible, electrolytic capacitors should be placed at the coolest positions on the board (please ensure that electrolytic capacitors are placed away from 'heating' components such as power resistors, switching diodes/transistors or transformers). Exceeding the permitted temperature range may cause early failures.</p>	<p>detail specification</p>

Electrolytic capacitors

Product safety

PARAMETER	IMPORTANT INFORMATION – PRODUCT SAFETY	MORE DETAILS
CHARGE-DISCHARGE	<p>Observe charge-discharge limitations.</p> <p>Frequent charge-discharge load via low resistance may cause capacitance drop or destroy the capacitor. Under well defined conditions (see this handbook, section “<i>Tests and Requirements</i>”) frequent charge-discharge operation is allowed. The resulting current through the capacitor may not exceed the ripple current limit. Electrolytic capacitors are not suitable for flash applications.</p>	TESTS AND REQUIREMENTS
SERIES/PARALLEL CONNECTIONS	<p>When connecting in series/parallel, apply corresponding design rules.</p> <p>Connecting electrolytic capacitors in series/parallel is possible, provided that balancing resistors are applied to each capacitor, in order to stabilize the voltage over each individual capacitor. Rules for correct design are given in the introduction.</p>	INTRODUCTION
PC BOARD DESIGN	<p>Conducting tracks or lands should not be located under upright mounted electrolytic capacitors; short circuits under the capacitor with danger of fire could be the result.</p>	
INSULATION	<p>The capacitor case is not insulated from the cathode terminal.</p> <p>Axial capacitors have a direct contact between case and cathode terminal; radial and power capacitors exhibit an indeterminate resistance between the cathode terminal and the metal case. Metal parts other than terminals should never make contact to conducting tracks or metal parts of other components. Dummy pins are connected to the cathode.</p>	
STORAGE AND TRANSPORT	<p>Excessive storage time or conditions may have adverse effects on capacitors.</p> <p>Capacitors should be stored at room temperature, low humidity and out of direct sunlight. Storage at elevated temperature and/or high relative humidity may have a negative influence to taping accuracy, solderability, leakage current and life expectancy. Packages with electrolytic capacitors should be handled with care, or bent leads and/or incorrect taping dimensions could be the result.</p>	INTRODUCTION TESTS AND REQUIREMENTS
HIGH AIR PRESSURE	<p>Do not expose capacitors to overpressure.</p> <p>Maximum operating pressure is 150 kPa. Higher pressure may cause a short circuit.</p>	
LOW AIR PRESSURE	<p>The capacitors may be used at an altitude of ≤ 12000 m.</p> <p>Minimum air pressure: 8.5 kPa for short periods (in accordance with “IEC 60384-4, subclause 4.11.4”).</p>	TESTS AND REQUIREMENTS

Electrolytic capacitors

Product safety

PARAMETER	IMPORTANT INFORMATION – PRODUCT SAFETY	MORE DETAILS
MOUNTING	<p>Avoid excessive stress to the lead wires or terminals.</p> <p>Excessive stress can be caused by component processing machines if lead wires are not sufficiently fixed during bending, cutting, cropping or inserting operations. Other possible reasons are incorrect hole distance on printed-circuit or bending of the component after soldering. Care should be taken when the manual bending of terminals or mounted capacitors is required. For maximum allowed mechanical load and time of application, see this handbook, section <i>“Tests and Requirements”</i>.</p> <p>Mechanically damaged capacitors may not be used.</p> <p>Pressure relief should have enough space to function correctly.</p>	TESTS AND REQUIREMENTS
SOLDERING	<p>Keep soldering temperature and time under control.</p> <p>For maximum soldering conditions, see this handbook, section <i>“Tests and Requirements”</i>. Additional temperature load e.g. for curing the glue of Surface Mount Devices (SMDs) are allowed to a certain limit, which depends on series and exact details, please apply to your sales engineer for your specific conditions. Molten solder or the soldering iron should not make contact with the capacitor's insulation. Reflow soldering is only suitable for SMD components.</p>	TESTS AND REQUIREMENTS
BOARD CLEANING	<p>No guarantees can be given with regard to solvents based on halogenated hydrocarbons or ozone depleting chemicals (ODCs).</p> <p>Warning: such solvents are hazardous to the environment.</p> <p>Component cleaning using solvents such as demineralized or distilled water, isopropanol, methanol, ethanol and propanol would not normally have any detrimental effects and therefore do not require any special precautions. Aqueous cleaning methods may be used in conjunction with saponification using a neutral detergent like calgonite at 20 g/l. It is recommended that immediate drying of the component in hot air is carried out at approximately 85 °C (or 70 °C for products with an upper category temperature of 70 °C) for at least 5 minutes. For further information regarding the application of solvent temperatures exceeding the temperature mentioned in <i>“IEC 60068-2-45”</i>, consult your local BC Components sales organization.</p>	
ADHESIVES, COATING MATERIALS	<p>Some adhesives and coating materials affect capacitors adversely.</p> <p>For varnishing, coating, lacquering, embedding or gluing at the capacitor's sealing, ensure that the materials used are halogene-free in all their constituent parts (base material, thinners, binders, reacting agents, propellants, additives). For reasons see 'BOARD CLEANING' above.</p> <p>When applying such materials, ensure that the rubber area is not completely sealed off.</p>	

Electrolytic capacitors

Product safety

PARAMETER	IMPORTANT INFORMATION – PRODUCT SAFETY	MORE DETAILS
DISPOSAL <small>0 143800</small>	<p>Electrolytic capacitors are subject to special waste regulations.</p> <p>Aluminum electrolytic capacitors are free from PCB- or PBDE-containing substances. Dioxines or furanes are not constituent parts of electrolytic capacitors. However, because of other polluting ingredients, larger quantities (in weight) of electrolytic capacitors are subject to special waste regulations in accordance with the relevant national laws; please consult your local BC Components sales organization.</p> <p>In general, electrolytic capacitors have to be disposed under controlled circumstances in a high temperature incinerator at minimum 900 °C.</p>	
PERSONNEL SAFETY	<p>WARNING NOTE.</p> <p>Non-solid electrolytic capacitors may contain chemicals which can be regarded as hazardous if handled incorrectly. Caution is necessary if the outer case is fractured; vapours or dust particles should not be inhaled (good ventilation is essential); skin, eye or clothing contact with liquids should be avoided. In case of such contact, flush thoroughly with running water as soon as possible, then wash skin or clothing with soap and water or a mild detergent. Any possible discoloration of the wetted skin will disappear after a few days.</p> <p>In the event of fire, the organic parts of electrolytic capacitors may release such constituents as carbon monoxide, nitric oxides or dust particles; take caution when breathing-in.</p>	

TESTS AND REQUIREMENTS



Electrolytic capacitors

Tests and requirements

TESTS AND REQUIREMENTS

This chapter contains an abridged version of tests and requirements given in "IEC 60384-4" or "EN130300" respectively. Series specific tests and requirements are given in the relevant detail specification of this data handbook. Correct sequence of measurement for electrical parameters in accordance with "IEC 60384-4":

1. Leakage current
2. Capacitance
3. Tan δ or ESR
4. Impedance.

Table 1 Non-solid aluminum types

NAME OF TEST	IEC 60384-4/ EN130300 subclause	IEC 60068-2 TEST METHOD	PROCEDURE (quick reference)	REQUIREMENTS
Robustness of terminations: Tensile strength Bending Torsion Torque on nut (stud)	4.4	Ua Ub Uc Ud	leaded types: loading force 10 N for 10 s; power types: loading force 20 N for 10 s leaded types: loading force 5 N; two consecutive bends leaded types, axial: two successive rotations of 180° in opposite direction; 5 s per rotation power types/screw terminal: torque of 1.76 Nm gradually applied	no visible damage no visible damage no visible damage no visible damage
Resistance to soldering heat	4.5	Tb (method 1A)	solder bath: 260 °C; 10 s	no visible damage; marking legible $\Delta C/C: \pm 5\%$
Solderability	4.6	Ta	solder bath: 235 °C; 2 s; immersed up to 2 mm from the body; non-activated flux	no visible damage; marking legible $\geq 95\%$ tinning
Rapid change of temperature	4.7	Na	for power capacitors: 5 cycles of 3 hours at lower and upper category temperature for axial, radial and SMD capacitors: 5 cycles of 30 minutes at lower and upper category temperature	no visible damage; no leakage of electrolyte
Vibration (note 1)	4.8	Fc	10 to 500 Hz; 0.75 mm or 10 g (whichever is less); 3 directions; 2 hours per direction Form MR types: 10 to 55 Hz; 0.75 mm or 10 g (whichever is less); 3 directions; 2 hours per direction	no visible damage; no leakage of electrolyte; marking legible $\Delta C/C \pm 5\%$ with respect to initial measurements

Electrolytic capacitors

Tests and requirements

NAME OF TEST	IEC 60384-4/ EN130300 subclause	IEC 60068-2 TEST METHOD	PROCEDURE (quick reference)	REQUIREMENTS
Bump (note 1)	4.9	Eb	40 g; 2 directions; 4000 bumps total Form MR types: 40 g; 2 directions; 1000 bumps total	no visible damage; no leakage of electrolyte $\Delta C/C: \pm 5\%$ with respect to initial measurement
Climatic sequence:	4.11			
Dry heat	4.11.1	Ba	16 hours at upper category temperature; no voltage applied	no visible damage; no leakage of electrolyte
Damp heat, cyclic	4.11.2	Db	1 cycle (55 °C → 25 °C) of 24 hours; RH 95 to 100%; no voltage applied	
Cold	4.11.3	Aa	2 hours at lower category temperature; no voltage applied	no visible damage; no leakage of electrolyte
Low air pressure	4.11.4	M	5 minutes at 25 ±10 °C; at atmospheric pressure of 8.5 kPa; U _R applied during last minute	no visible damage; no evidence of breakdown or flashover
Damp heat, cyclic	4.11.5	Db	5 cycles (55 °C → 25 °C) of 24 hours each; RH 95 to 100%; no voltage applied	
Sealing	4.11.6 4.11.7	Qc	1 minute in water at 90 °C final measurement after climatic sequence	no continuous chain of bubbles no visible damage; no leakage of electrolyte; marking legible leakage current ≤ stated limit $\tan \delta \leq 1.2 \times$ stated limit $\Delta C/C: \pm 10\%$
Insulation resistance	4.3.5		external insulation: foil method	insulation resistance ≥100 MΩ
Voltage proof	4.3.6		external insulation: foil method; 1000 V for 1 minute	no breakdown or flashover

Note

- For vibration and bump testing, the components shall be mounted by their terminations (with mounting accessories where applicable). The following capacitors shall also be clamped by their body:
 - Radial types: $\varnothing D_{nom} \geq 12.5$ mm; $L_{nom} \geq 15$ mm
 - Axial types: $\varnothing D_{nom} \geq 12.5$ mm; $L_{nom} \geq 30$ mm.

Electrolytic capacitors

Tests and requirements

Non-solid aluminum types (continued)

NAME OF TEST	IEC 60384-4/ EN130300 subclause	IEC 60068-2 TEST METHOD	PROCEDURE (quick reference)	REQUIREMENTS
Damp heat, steady state	4.12	Ca	56 days at 40 °C; RH 90 to 95%; no voltage applied	no visible damage; no leakage of electrolyte; marking legible leakage current \leq stated limit $\tan \delta \leq 1.2 \times$ stated limit insulation resistance $>100 \text{ M}\Omega$; no breakdown or flashover below 1000 V $\Delta C/C: \pm 10\%$
Endurance	4.13		for test duration, refer to the relevant data sheet in this data handbook; at upper category temperature; U_R applied	no visible damage; no leakage of electrolyte; marking legible leakage current \leq stated limit insulation resistance $>100 \text{ M}\Omega$; no breakdown or flashover below 1000 V $U_R \leq 6.3 \text{ V}; \Delta C/C: +15/-30\%$; $U_R 10 \text{ to } 160 \text{ V}; \Delta C/C: \pm 15\%$; $U_R \geq 200 \text{ V}; \Delta C/C: \pm 10\%$ $\tan \delta \leq 1.3 \times$ stated limit impedance $\leq 2 \times$ stated limit
Surge	4.14		from source of $1.15 \times U_R$ for $U_R \leq 315 \text{ V}$ or $1.1 \times U_R$ for $U_R > 315 \text{ V}$; $RC = 0.1 \pm 0.05 \text{ s}$; 1000 cycles of 30 s on, 330 s off, at upper category temperature	no visible damage; no leakage of electrolyte leakage current \leq stated limit $\tan \delta \leq$ stated limit $\Delta C/C: \pm 15\%$
Reverse voltage	4.15		1 V in reverse polarity followed by U_R in forward polarity, both for 125 hours at upper category temperature	leakage current \leq stated limit $\tan \delta \leq$ stated limit $\Delta C/C: \pm 10\%$
Pressure relief (only for types with vent)	4.16		DC voltage applied in reverse direction producing a current of 1 to 10 A	pressure relief opens prior to danger of explosion or fire

Electrolytic capacitors

Tests and requirements

NAME OF TEST	IEC 60384-4/ EN130300 subclause	IEC 60068-2 TEST METHOD	PROCEDURE (quick reference)	REQUIREMENTS
Storage at upper category temperature	4.17	Ba	test duration 500 hours at upper category temperature; for longer test duration (shelf life), refer to the relevant data sheet in this data handbook	no visible damage; no leakage of electrolyte leakage current $\leq 2 \times$ stated limit $\tan \delta \leq 1.2 \times$ stated limit $\Delta C/C: \pm 10\%$
Storage at low temperature	4.18	Ab	72 hours at the lower category temperature	no visible damage; no leakage of electrolyte leakage current \leq stated limit $\tan \delta \leq$ stated limit $\Delta C/C: \pm 10\%$
Characteristics at high and low temperatures	4.19		step 1: reference measurement of impedance at 20 °C and 100 Hz	
		Aa	step 2: measurement at lower category temperature	impedance at 100 Hz: $\leq 7 \times$ value of step 1 for $U_R \leq 6.3$ V or $U_R > 160$ V; $\leq 5 \times$ value of step 1 for 6.3 V $< U_R \leq 16$ V; $\leq 4 \times$ value of step 1 for 16 V $< U_R \leq 160$ V
		Ba	step 3: measurement at upper category temperature	leakage current: $\leq 10 \times$ stated limit at 125 °C; $\leq 8 \times$ stated limit at 105 °C; $\leq 5 \times$ stated limit at 85 °C; $\leq 3 \times$ stated limit at 70 °C
Charge and discharge	4.20		for $U_R \leq 160$ V: 10^6 cycles of 0.5 s charge to U_R (RC = 0.1 s) and 0.5 s discharge (RC = 0.1 s); for $U_R > 160$ V: under consideration	no visible damage; no leakage of electrolyte $\Delta C/C: \pm 10\%$
Additional tests in accordance with IEC 60384-1 and EN 130000				
Solvent resistance	4.31	Xa	immersion: 5 ± 0.5 minutes with or without ultrasonic at 55 ± 0.5 °C solvents: demineralized water and/or calgonite solution (20 g/l)	visual appearance not affected
Passive flammability	4.38	IEC 60695-2-2	needle flame test	category of flammability: B

Electrolytic capacitors

Tests and requirements

Table 2 Solid aluminum types, SAL

NAME OF TEST	IEC 60384-4/ EN130300 subclause	IEC 60068-2 TEST METHOD	PROCEDURE (quick reference)	REQUIREMENTS
Robustness of terminations: Tensile strength Bending Torsion (axial types)	4.4	Ua Ub Uc	loading force; note 1: 10 N for 10 s loading force; note 1: 5 N; two consecutive bends two successive rotations of 180° in opposite direction; 5 s duration per rotation	no visible damage no visible damage no visible damage
Resistance to soldering heat	4.5	Tb (method 1A)	radial types: solder bath: 260 °C; 10 s	no visible damage; markings legible
		Tb (method 1B)	axial types: solder bath 350 °C for 3.5 s	$\Delta C/C$: $\pm 5\%$ with respect to initial measurement
Solderability	4.6	Ta (method 1)	solder bath: 235 °C; 2 s; immersed up to 2 mm from the body; non-activated flux	no visible damage; marking legible $\geq 95\%$ tinning
Rapid change of temperature	4.7	Na	5 cycles of 30 minutes at lower and upper category temperature	no visible damage leakage current $\tan \delta$ and $Z \leq$ stated limit
Vibration (note 2)	4.8	Fc	10 to 500 Hz; 0.75 mm or 10 g (whichever is less severe); in 3 directions; 2 hours per direction	no visible damage; markings legible $\Delta C/C$: $\pm 5\%$ with respect to initial measurement
			10 to 2000 Hz; 1.5 mm or 20 g (whichever is less severe); in 3 directions; 2 hours per direction	no visible damage; markings legible $\Delta C/C$: $\pm 5\%$ with respect to initial measurement
Bump (note 2)	4.9	Eb	40 g; 2 directions; 4000 bumps total	no visible damage $\Delta C/C$: $\pm 5\%$ with respect to initial measurement
Shock (note 2)	4.10	Ea	123 SAL-AG: acceleration: 29400 m/sec ² or 3000 g; duration of pulse: 0.2 ms; total number of shocks: 18	no visible damage $\Delta C/C$: $\pm 5\%$ with respect to initial measurement

Notes

- SPECIAL PLIERS MUST BE USED TO PROTECT THE CELL BODY AND CONSEQUENTLY KEEP THE BENDING LOCATION UNDER CONTROL.
- Axial capacitors shall be mounted by clamping both the body and the leads.

Electrolytic capacitors

Tests and requirements

Solid aluminum types, SAL (continued)

NAME OF TEST	IEC 60384-4/ EN130300 subclause	IEC 60068-2 TEST METHOD	PROCEDURE (quick reference)	REQUIREMENTS
Climatic sequence:	4.11			
Dry heat	4.11.1	Ba	16 hours at upper category temperature; no voltage applied	no breakdown, flashover, or harmful deformation of case no visible damage; markings legible leakage current \leq stated limit $\tan \delta$ and $Z \leq 1.2 \times$ stated limit axial types: $\Delta C/C$: $\pm 5\%$ with respect to initial measurement radial types: $\Delta C/C$: $\pm 10\%$ with respect to initial measurement
Damp heat, cyclic	4.11.2	Db	1 cycle (55 °C \rightarrow 25 °C) of 24 hours; RH 95 to 100%; no voltage applied	
Cold	4.11.3	Aa	2 hours at lower category temperature; no voltage applied	
Low air pressure	4.11.4	M	5 minutes at 25 ± 10 °C; atmospheric pressure: 8.5 kPa; U_R applied during last minute of test	
Damp heat, cyclic	4.11.5	Db	5 cycles (55 °C \rightarrow 25 °C) of 24 hours each; 25 °C; RH 95 to 100%; no voltage applied	
	4.11.7		final measurements after climatic sequence	
Damp heat, steady state	4.12	Ca	56 days at 40 °C; RH 90 to 95%; no voltage applied	no visible damage; markings legible leakage current \leq stated limit $\tan \delta$ and $Z \leq 1.2 \times$ stated limit $\Delta C/C$: $\pm 10\%$ of initial measurement
Insulation resistance	4.3.5		external insulation: foil method	insulation resistance ≥ 100 M Ω
Voltage proof	4.3.6		external insulation: foil method; 1000 V for 1 minute	no breakdown or flashover

Electrolytic capacitors

Tests and requirements

Solid aluminum types, SAL (continued)

NAME OF TEST	IEC 60384-4/ EN130300 subclause	IEC 60068-2 TEST METHOD	PROCEDURE (quick reference)	REQUIREMENTS
Endurance	4.13		for test duration, refer to the relevant data sheet in this data handbook; at upper category temperature; U_R applied (note 1).	no visible damage; markings legible leakage current \leq stated limit $\Delta C/C$: $\pm 10\%$ with respect to initial measurement $\tan \delta$ and $Z \leq 1.2 \times$ stated limit axial types: insulation resistance $\geq 100 \text{ M}\Omega$; no breakdown or flashover at 1000 V
Endurance (additional) SAL-A			2000 hours at 175 °C; maximum $0.63 \times U_R$ applied	leakage current \leq stated limit $\Delta C/C$: $\pm 20\%$ with respect to initial measurement $\tan \delta \leq 1.5 \times$ stated limit $Z \leq 2.5 \times$ stated limit
Surge	4.14		applied voltage source of $1.15 \times U_R$ (note 1) at 125 °C; 1000 cycles; 30 s on, 330 s off	no visible damage leakage current \leq stated limit $\tan \delta \leq$ stated limit axial types: $\Delta C/C$: $\pm 5\%$ with respect to initial measurement radial types: $\Delta C/C$: $\pm 10\%$ with respect to initial measurement
Reverse voltage				0.15 $\times U_R$ (note 1) in reverse polarity at 125 °C, for 125 hours, followed by U_R (note 1) in forward polarity at 125 °C for 125 hours
Reverse voltage (additional): Radial types	4.15		0.30 $\times U_R$ (note 1) in reverse polarity at 125 °C for 125 hours, followed by U_R (note 1) in forward polarity at 125 °C for 125 hours	leakage current stated limit $\Delta C/C$: $\pm 10\%$ with respect to initial measurement $\tan \delta$ and $Z \leq$ stated limit
Reverse voltage (additional): SAL-A			0.30 $\times U_R$ in reverse polarity at 125 °C for 2000 hours	leakage current \leq stated limit $\Delta C/C$: $\pm 10\%$ with respect to initial measurement $\tan \delta$ and $Z \leq$ stated limit

Electrolytic capacitors

Tests and requirements

NAME OF TEST	IEC 60384-4/ EN130300 subclause	IEC 60068-2 TEST METHOD	PROCEDURE (quick reference)	REQUIREMENTS
Storage at upper category temperature	4.17	Ba	500 hours at upper category temperature	no visible damage leakage current \leq stated limit $\Delta C/C$: $\pm 10\%$ with respect to initial measurement
Long storage ≥ 1 year (additional)			at ambient temperature	leakage current \leq stated limit
Characteristics at high and low temperature	4.19		step 1: reference measurement at 20 °C of capacitance, $\tan \delta$ and impedance at 100 Hz	
			step 2: measurement at -55 °C; capacitance, $\tan \delta$ and impedance at 100 Hz	$\Delta C/C$: $\pm 20\%$ with respect to value in step 1 impedance ratio (100 Hz) $\leq 2 \times$ the value of step 1 $\tan \delta \leq 2 \times$ the stated limit
			step 3: measurement at 125 °C; capacitance, leakage current and $\tan \delta$	leakage current $\leq 15 \times$ the stated limit; notes 2 and 3 $\Delta C/C$: $\pm 20\%$ of the value measured in step 1 $\tan \delta \leq$ stated limit
Charge and discharge	4.20		10^6 cycles charging to U_R for 0.5 s, and then discharging for 0.5 s	no visible damage $\Delta C/C$: $\pm 5\%$ with respect to initial measurement
Additional tests in accordance with IEC 60384-1 and EN130000				
Solvent resistance	4.31	Xa	immersion: 5 \pm 0.5 minutes with or without ultrasonic at 55 \pm 0.5 °C solvents: demineralized water and/or calgonite solution (20 g/l)	visual appearance not affected
Passive flammability	4.38	IEC 60695-2-2	needle flame test	category of flammability: B

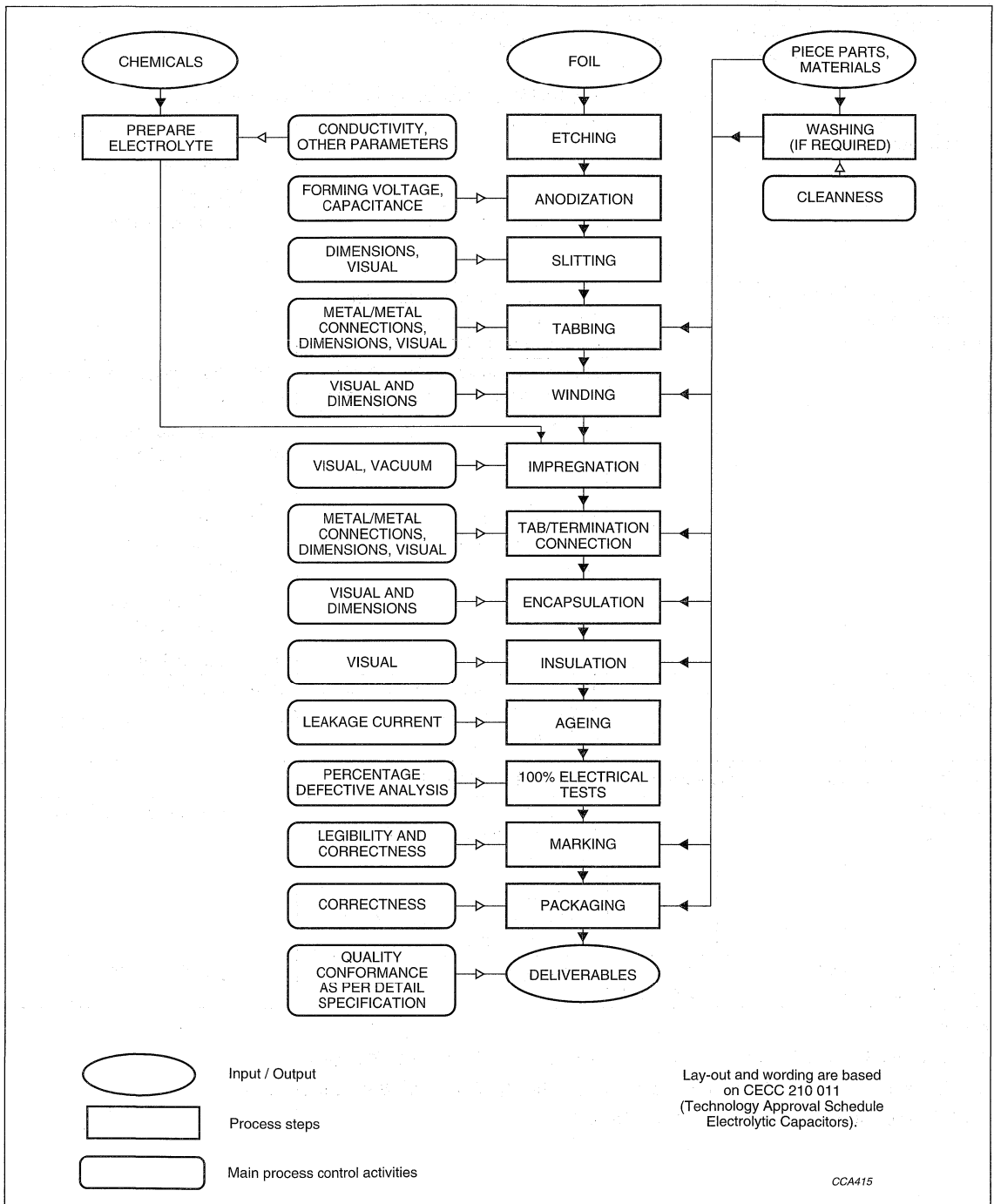
Notes

- 25 V for 35 and 40 V versions (capacitor types 122 SAL-RP and 128 SAL-RPM).
- For capacitors type 122 SAL-RP and 128 SAL-RPM, 40 V version: $< 8 \times$ the stated limit.
- Leakage current for 123 SAL-A: $\leq 1.5 \times U_R \times C_R$.

Electrolytic capacitors

Quality flowchart

GENERIC QUALITY FLOWCHART FOR NON-SOLID ELECTROLYTIC CAPACITORS



PACKAGING - SURFACE MOUNTING DEVICES (SMD)



SMD electrolytic capacitors

Packaging

TAPE AND REEL DATA

The information contained within this part is valid for the following series:

- 085 CS; 139 CLL

For catalogue numbers, refer to the relevant detail specification in this data handbook.

BC Components SMD aluminum electrolytic capacitors are available in taped version based on "IEC 60286-3". They are most suitable for use on automatic placement machines and are supplied in blister tape on reel.

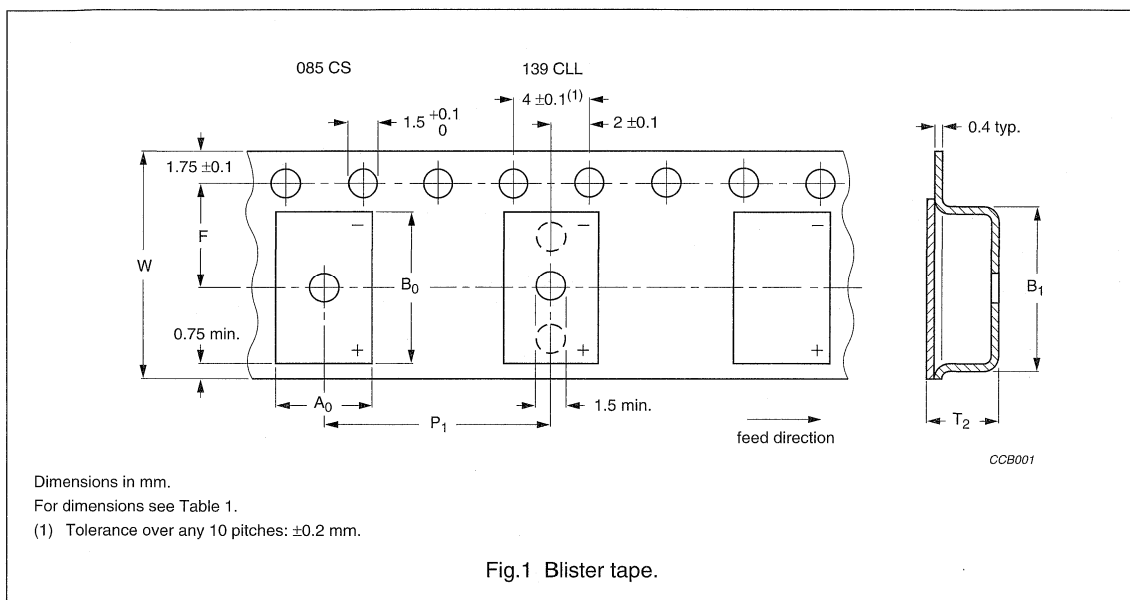


Table 1 Physical dimensions of blister tape (in mm) and packaging quantities; see Fig.1

PARAMETER	085 CS		139 CLL		TOLERANCE
	1a	1	2	3	
Case code	1a	1	2	3	—
Case size:					
L_{nom}	8.8	11.9	14.3	14.3	—
W_{nom}	3.7	3.7	6.2	7.6	—
H_{nom}	3.9	3.9	6.9	8.2	—
W	16	24	24	24	± 0.3
T_2	4.9	4.9	7.7	9.1	max.
F	7.5	11.5	11.5	11.5	± 0.1
P_1	8	8	12	12	± 0.1
A_0	4.1	4.1	6.5	7.9	± 0.2
B_0	9.3	12.5	14.8	14.8	± 0.2
B_1	10	13.2	15.5	15.5	max.
Quantity per reel	2000	2000	700	700	—

SMD electrolytic capacitors

Packaging

The information contained within this part is valid for the following series:

- 153 CLV; 140 CLH; 150 CLZ

For catalogue numbers, refer to the relevant detail specification in this data handbook.

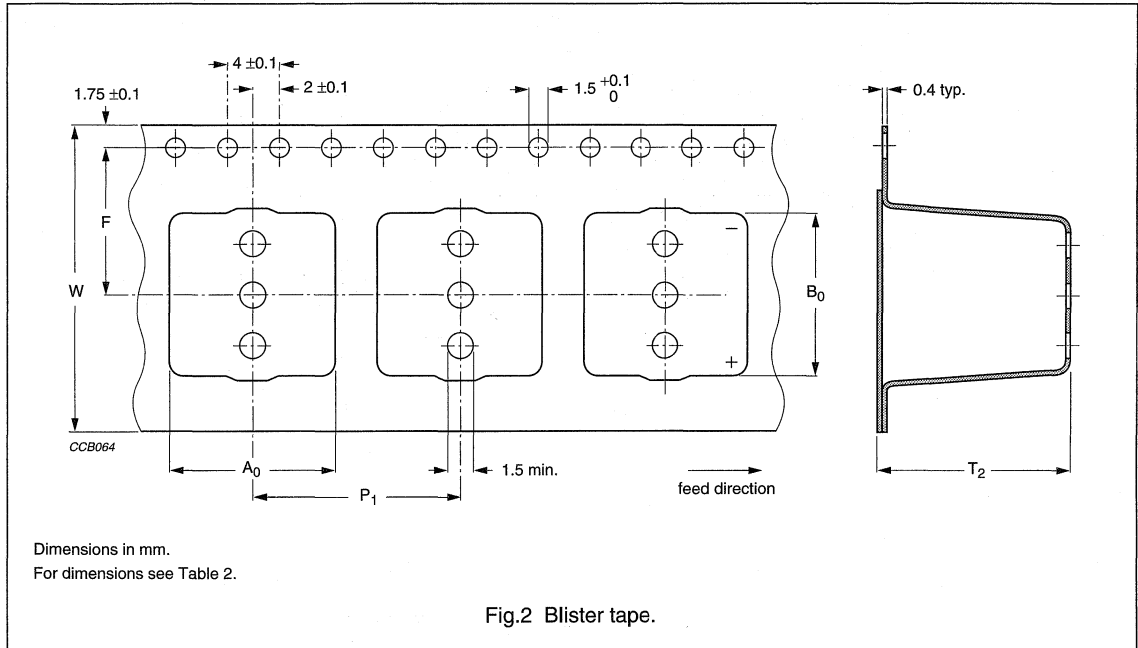


Table 2 Physical dimensions of blister tape (in mm) and packaging quantities; see Fig.2

PARAMETER	153 CLV; 140 CLH; 150 CLZ								TOLERANCE
Case code	0405	0505	0605	0807	0810	1010	1012	1014	-
Case size:									
L _{nom}	4.0	5.0	6.3	8.0	8.0	10.0	10.0	10.0	-
W _{nom}	4.0	5.0	6.3	8.0	8.0	10.0	10.0	10.0	-
H _{nom}	5.3	5.3	5.3	6.5	10.0	10.0	12.0	14.0	-
W	12	12	16	16	24	24	24	24	±0.3
T ₂	5.8	5.8	5.8	6.8	11.0	11.0	13.0	15.0	max.
F	5.5	5.5	7.5	7.5	11.5	11.5	11.5	11.5	±0.1
P ₁	8	12	12	12	16	16	16	16	±0.1
A ₀	5.0	6.0	7.0	8.7	8.7	10.7	10.8	10.8	±0.2
B ₀	5.0	6.0	7.0	8.7	8.7	10.7	10.8	10.8	±0.2
Quantity per reel	2000	1000	1000	1000	500	500	250	250	-

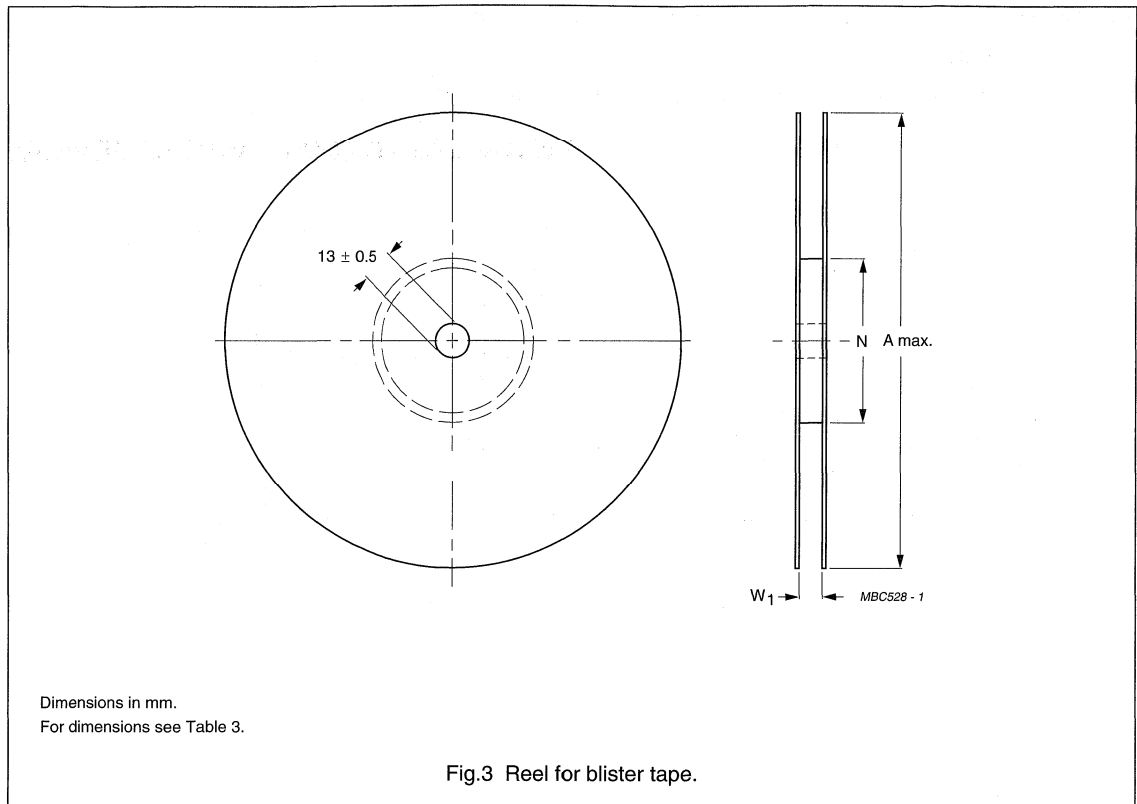


Table 3 Reel dimensions; see Fig.3

TAPE WIDTH (mm)	A MAX. (mm)		N MIN. (mm)	W ₁ (mm)	
	085 CS 139 CLL	153 CLV; 140 CLH; 150 CLZ			
		CASE SIZE ≥1012			CASE SIZE ≤1010
12	–	–	380	50	14
16	330	–	380	50	18
24	330	330	330 or 380 ⁽¹⁾	50	26

Note

1. Depending on production location.

PACKAGING - RADIAL LEADED DEVICES



Radial electrolytic capacitors

Packaging

TAPING

BC Components radial, aluminum and solid aluminum electrolytic capacitors in sizes up to $\varnothing D = 16$ mm, are available in taped versions corresponding to "IEC 60286-2" or "JIS C 0805" respectively. They are most suitable for use on automatic insertion machines, mounting robots or cutting and forming equipment and are supplied in boxes (ammopacks).

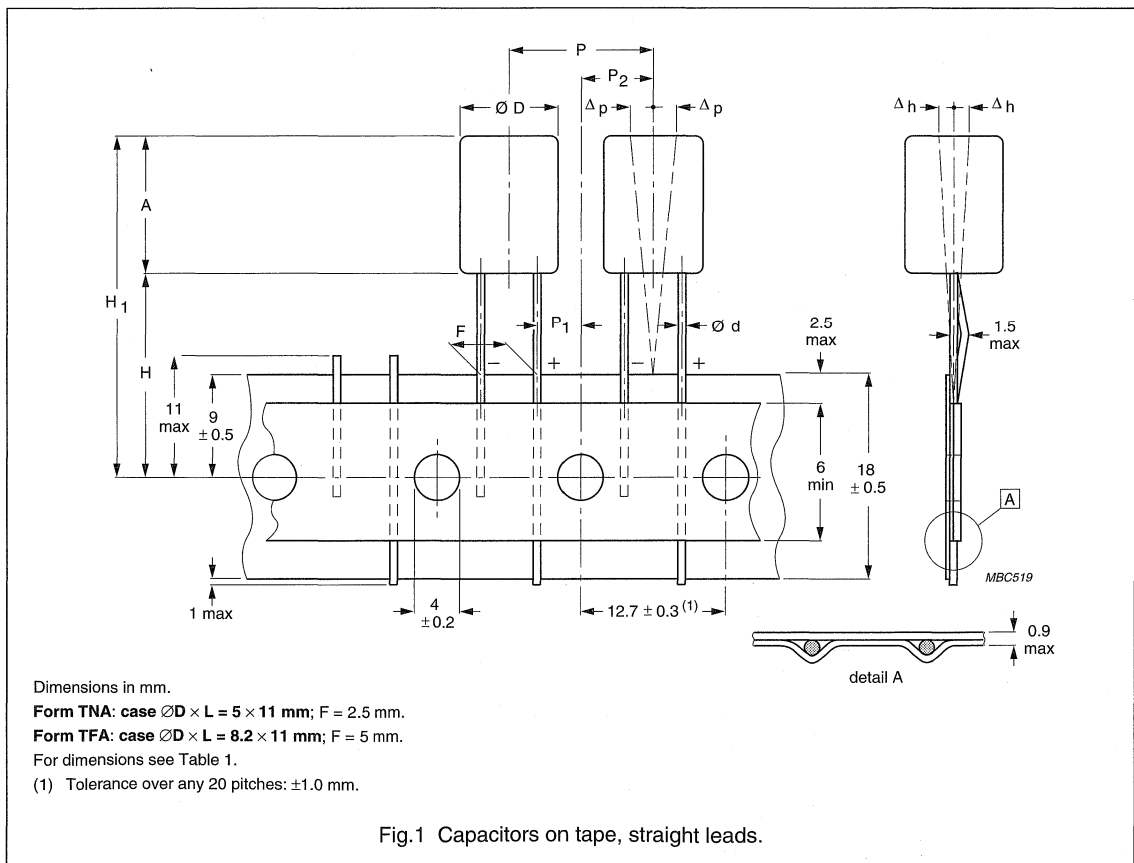
CAUTION

Packages must be handled with care to avoid bent leads.

For catalogue numbers, refer to the relevant detail specification in this data handbook.

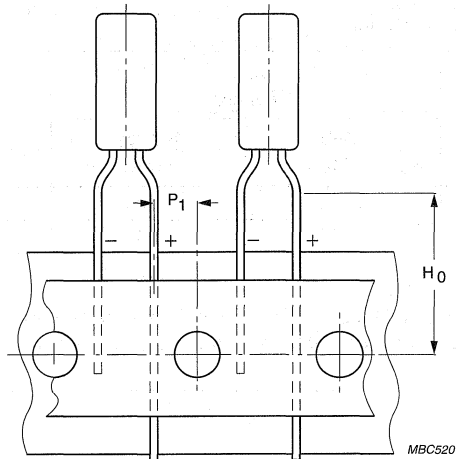
The information contained within this part is valid for the following series:

- 013 RLC
- 036 RSP
- 116 RLL



Radial electrolytic capacitors

Packaging



Dimensions in mm.

Form TFA: case $\varnothing D \times L = 5 \times 11$ mm; $F = 5$ mm.

For dimensions see Table 1.

Fig.2 Capacitors on tape, formed leads.

Table 1 Dimensions of capacitors on tape; see Figs 1 and 2

PARAMETER	NOMINAL CASE SIZE ($\varnothing D \times L$) in mm			TOLERANCE
	FORM TNA: $F = 2.5$ mm	FORM TFA: $F = 5$ mm		
	5 × 11 (straight leads) (mm)	5 × 11 (formed leads) (mm)	8.2 × 11 (straight leads) (mm)	
$\varnothing D$	5.5	5.5	8.7	max.
A	12	12	12	max.
$\varnothing d$	0.5	0.5	0.6	± 0.05
P	12.7	12.7	12.7	± 1.0
P_1	5.1	3.85	3.85	± 0.7
P_2	6.35	6.35	6.35	± 0.7
F	2.5	5.0	5.0	$+0.6/-0.1$
Δh	0	0	0	± 2.0
Δp	0	0	0	± 1.3
H	18	18	18	$+1.5/-0$
H_0	–	16	–	± 0.5
H_1	32	32	32	max.

Radial electrolytic capacitors

Packaging

Series 013 RLC, 036 RSP and 116 RLL (continued)

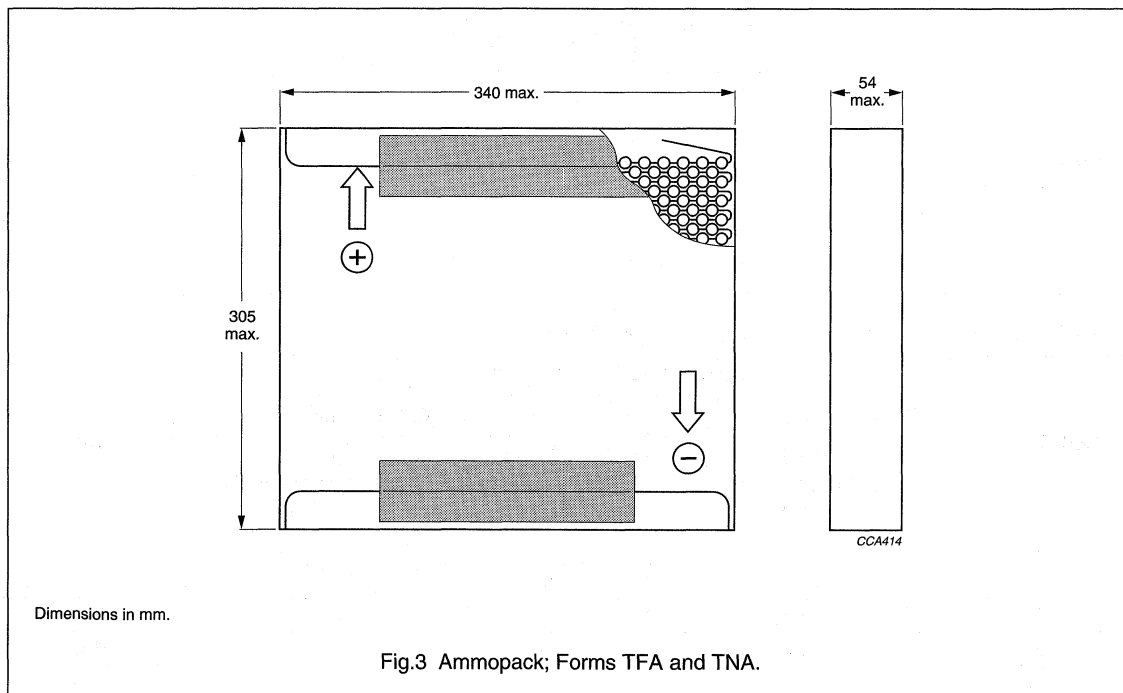
QUANTITIES PER PACKAGING UNIT

Table 2 Number of capacitors per packaging unit

NOMINAL CASE SIZE ($\varnothing D \times L$) (mm)	CASE CODE	BULK PER BOX		TAPED AMMOPACK ⁽¹⁾	
		FORM CA	FORM CB	FORM TFA	FORM TNA
5 × 11	11	1000	1000	2000	2000
8.2 × 11	13	1000	1000	1000	1000

Note

1. Ammopack taping (Form TFA) case $\varnothing D \times L = 8.2 \times 11$ mm. To ensure optimum straightness of the leads and correct position of the capacitors in the folding area of the zig-zag shaped tape, every 25th capacitor is omitted.



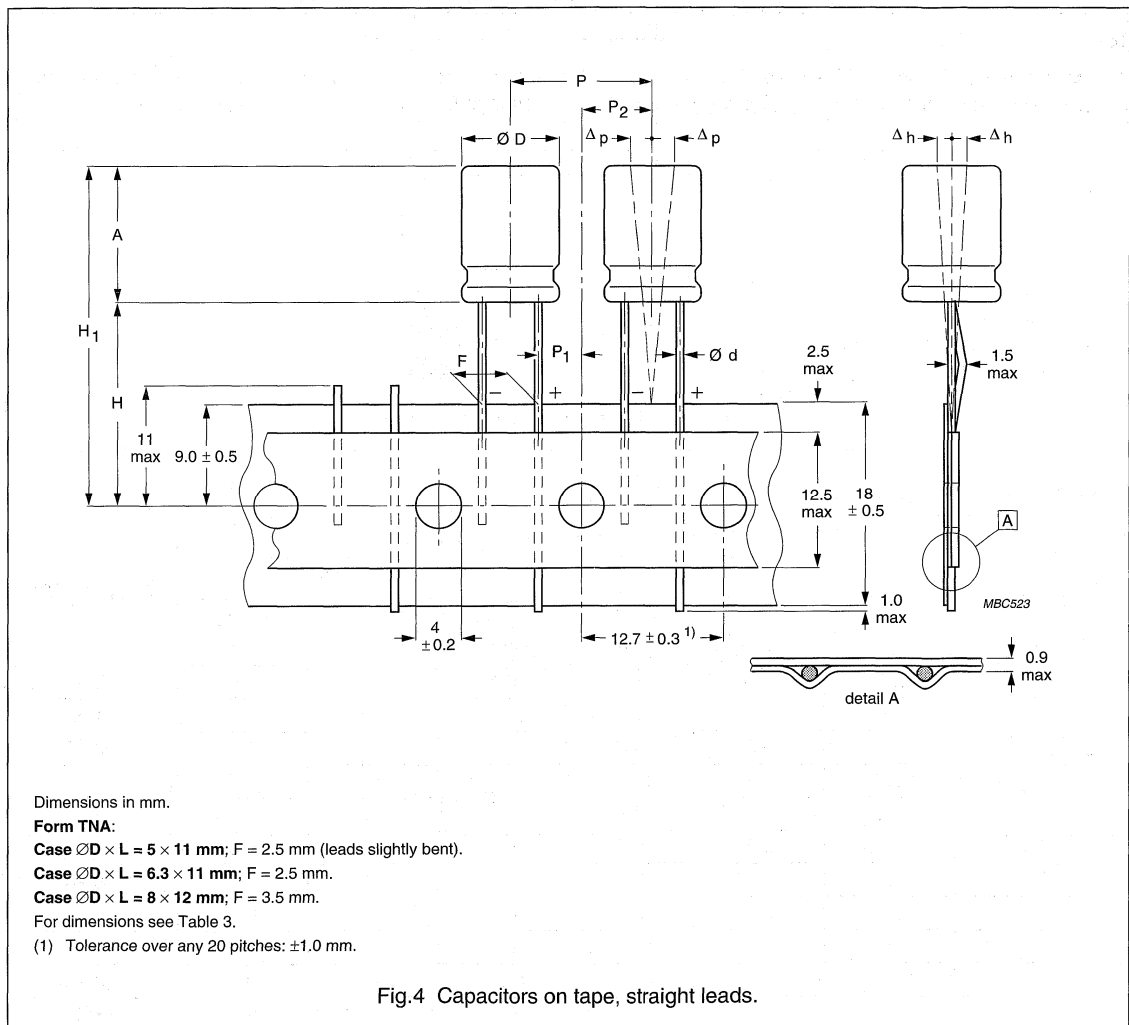
Radial electrolytic capacitors

Packaging

The information contained within this part is valid for the following series with a case $\varnothing D = 3$ to 8 mm:

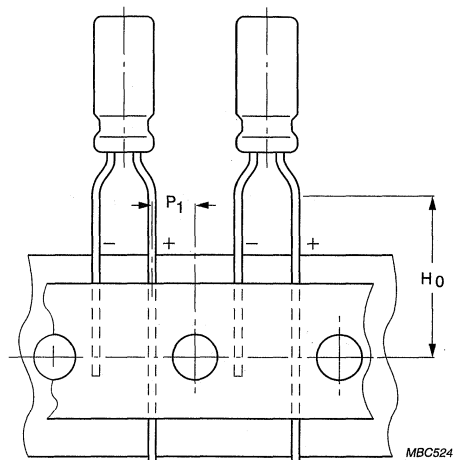
- 134 RLP 5
- 097 RLP 7
- 037 RSM
- 038 RSU
- 044 RSH
- 135 RLI

For catalogue numbers, refer to the relevant detail specification in this data handbook.



Radial electrolytic capacitors

Packaging



Dimensions in mm.

Form TFA: F = 5 mm.

Case $\varnothing D \times L = 5 \times 11, 6.3 \times 11$ and 8×12 mm.

For dimensions see Table 3.

Fig.5 Capacitors on tape, formed leads.

Table 3 Dimensions of capacitors on tape; see Figs 4 and 5

PARAMETER	NOMINAL CASE SIZE ($\varnothing D \times L$) in mm						TOLERANCE
	FORM TNA			FORM TFA			
	5 × 11 (mm)	6.3 × 11 (mm)	8 × 12 (mm)	5 × 11 (mm)	6.3 × 11 (mm)	8 × 12 (mm)	
$\varnothing D$	5.5	6.8	8.5	5.5	6.8	8.5	max.
A	12.5	12.5	13	12.5	12.5	13	max.
$\varnothing d$	0.5	0.5	0.6	0.5	0.5	0.6	± 0.05
P	12.7	12.7	12.7	12.7	12.7	12.7	± 1.0
P_1	5.1	5.1	4.6	3.85	3.85	3.85	± 0.7
P_2	6.35	6.35	6.35	6.35	6.35	6.35	± 1.0
F	2.5	2.5	3.5	5.0	5.0	5.0	+0.8/-0.2
Δh	0	0	0	0	0	0	± 2.0
Δp	0	0	0	0	0	0	± 1.3
H	18.5	18.5	20	18.5	18.5	20	± 0.75
H_0	–	–	–	16	16	16	± 0.5
H_1	32.2	32.2	32.2	32.2	32.2	32.2	max.

Radial electrolytic capacitors

Packaging

Series 134 RLP 5, 097 RLP 7, 037 RSM, 038 RSU, 044 RSH and 135 RLI , $\varnothing D = 3$ to 8 mm (continued)

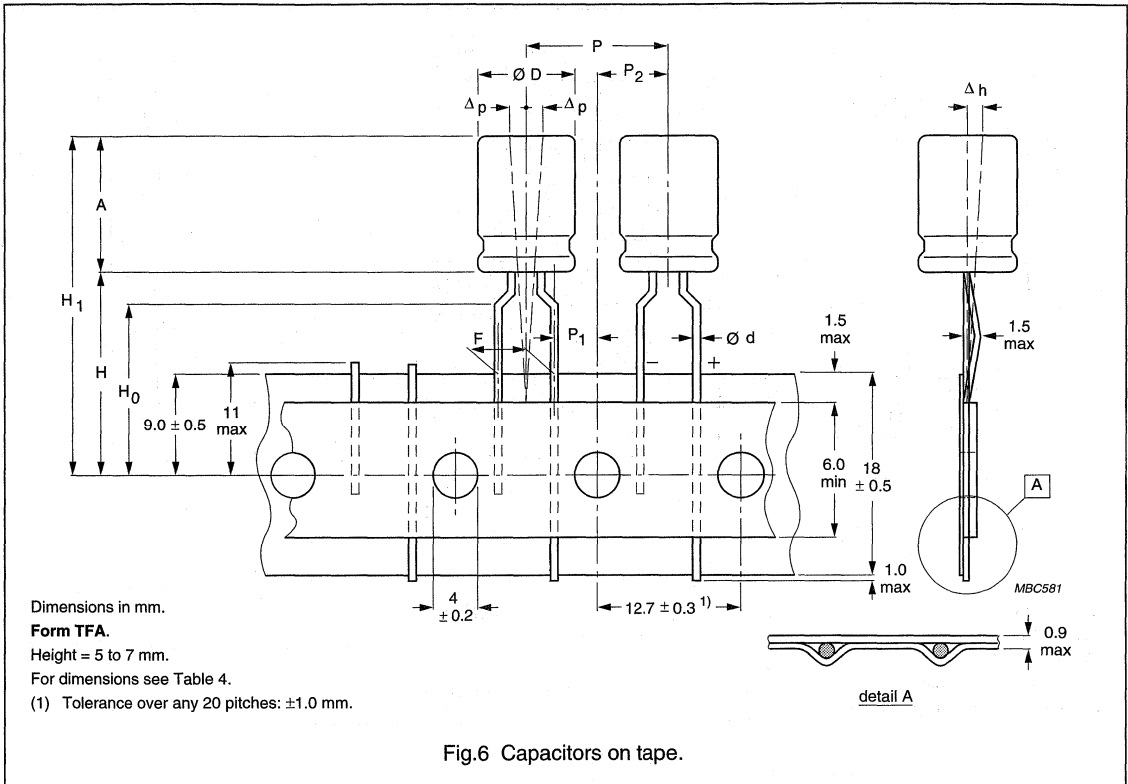


Fig.6 Capacitors on tape.

Table 4 Dimensions of capacitors on tape; see Fig.6

PARAMETER	NOMINAL CASE SIZE ($\varnothing D \times L$) in mm								TOLERANCE
	FORM TFA								
	3 × 5 (mm)	3.5 × 5 (mm)	4 × 5 (mm)	5 × 5 (mm)	6.3 × 5 (mm)	4 × 7 (mm)	5 × 7 (mm)	6.3 × 7 (mm)	
$\varnothing D$	3.5	4.0	4.5	5.5	6.8	4.5	5.5	6.8	max.
A	6.0	6.0	6.0	6.0	6.0	8.0	8.0	8.0	max.
$\varnothing d$	0.4	0.4	0.45	0.45	0.45	0.45	0.45	0.45	± 0.05
P	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	± 1.0
P_1	5.1	5.1	3.85	3.85	3.85	3.85	3.85	3.85	± 0.7
P_2	6.35	6.35	6.35	6.35	6.35	6.35	6.35	6.35	± 1.0
F	2.5	2.5	5.0	5.0	5.0	5.0	5.0	5.0	+0.8/-0.2
Δh	0	0	0	0	0	0	0	0	± 2.0
Δp	0	0	0	0	0	0	0	0	± 1.3
H	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	± 0.75
H_0	16	16	16	16	16	16	16	16	± 0.5
H_1	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	max.

DIMENSIONS OF AMMOPACK

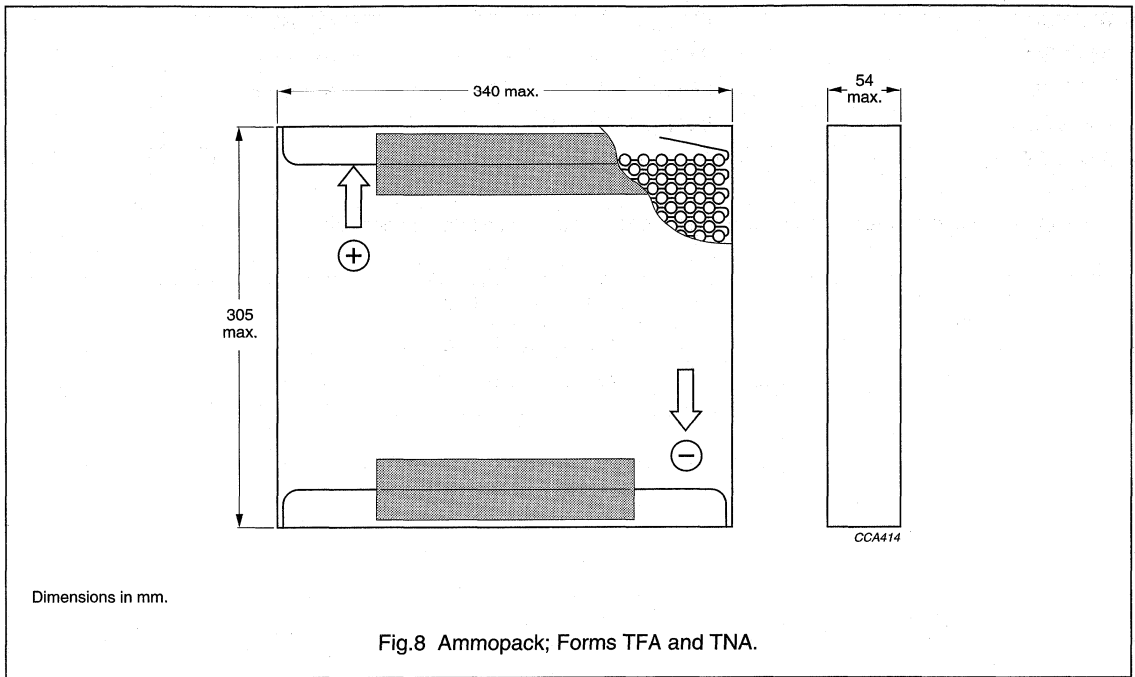
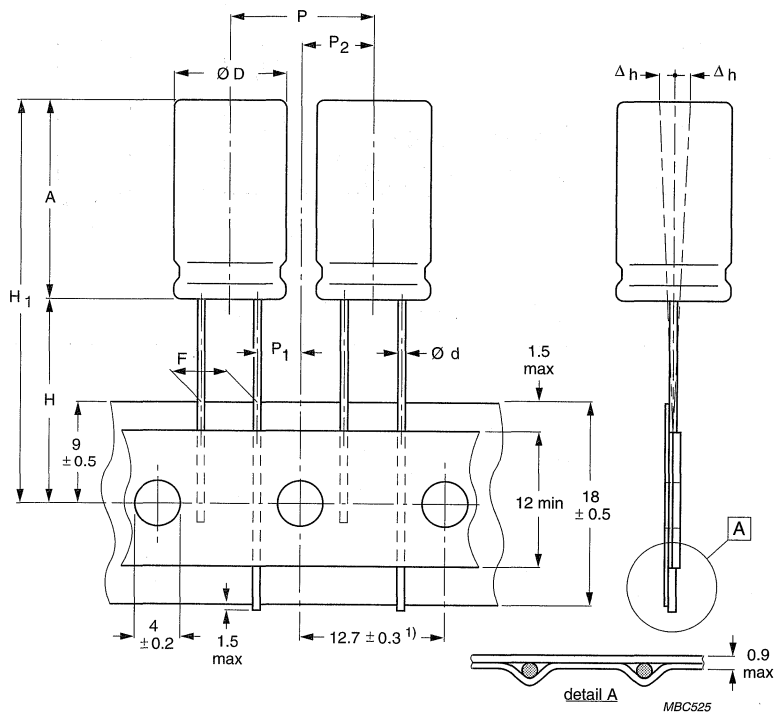


Fig.8 Ammopack; Forms TFA and TNA.

The information contained in this part is valid for the following series with a case $\varnothing D = 10$ to 16 mm:

- 037 RSM
- 044 RSH
- 038 RSU
- 046 RSL
- 047 RMS
- 048 RML
- 135 RLI
- 136 RVI
- 150 RMI
- 151 RLH
- 152 RMH
- 165 RHT
- 140 RTM

For catalogue numbers, refer to the relevant detail specification in this data handbook.



Dimensions in mm.

Case $\varnothing D = 10$ mm.

For dimensions see Table 6.

(1) Tolerance over any 20 pitches: ± 1.0 mm.

Fig.9 Capacitors on tape.

Radial electrolytic capacitors

Packaging

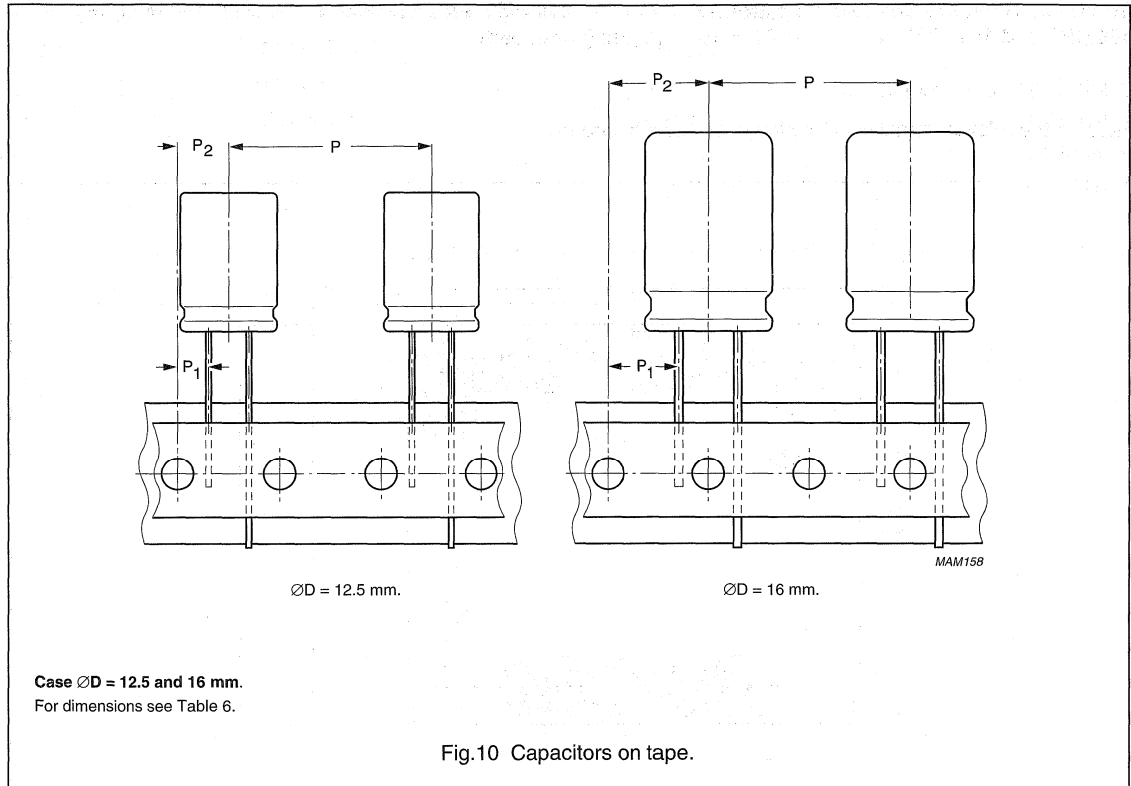


Table 6 Dimensions of capacitors on tape; see Figs 9 and 10

PARAMETER	NOMINAL CASE SIZE ($\varnothing D \times L$) in mm								TOLERANCE
	10 × 12 (mm)	10 × 16 (mm)	10 × 20 (mm)	12.5 × 20 (mm)	12.5 × 25 (mm)	16 × 20 (mm)	16 × 25 (mm)	16 × 31 (mm)	
$\varnothing D$	10.5	10.5	10.5	13.0	13.0	16.5	16.5	16.5	max.
A	13.5	17.5	22	22	27	22	27	33.5	max.
$\varnothing d$	0.6	0.6	0.6	0.6	0.6	0.8	0.8	0.8	± 0.05
P	12.7	12.7	12.7	25.4	25.4	25.4	25.4	25.4	± 1.0
P_1	3.85	3.85	3.85	3.85	3.85	8.95	8.95	8.95	± 0.7
P_2	6.35	6.35	6.35	6.35	6.35	12.7	12.7	12.7	± 1.3
F	5.0	5.0	5.0	5.0	5.0	7.5	7.5	7.5	$+0.8/-0.2$
Δh	0	0	0	0	0	0	0	0	± 3.0
H	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	± 0.75
H_1	$H_1 = H + A$								
B	54	62	62	62	68	68	68	75	max.

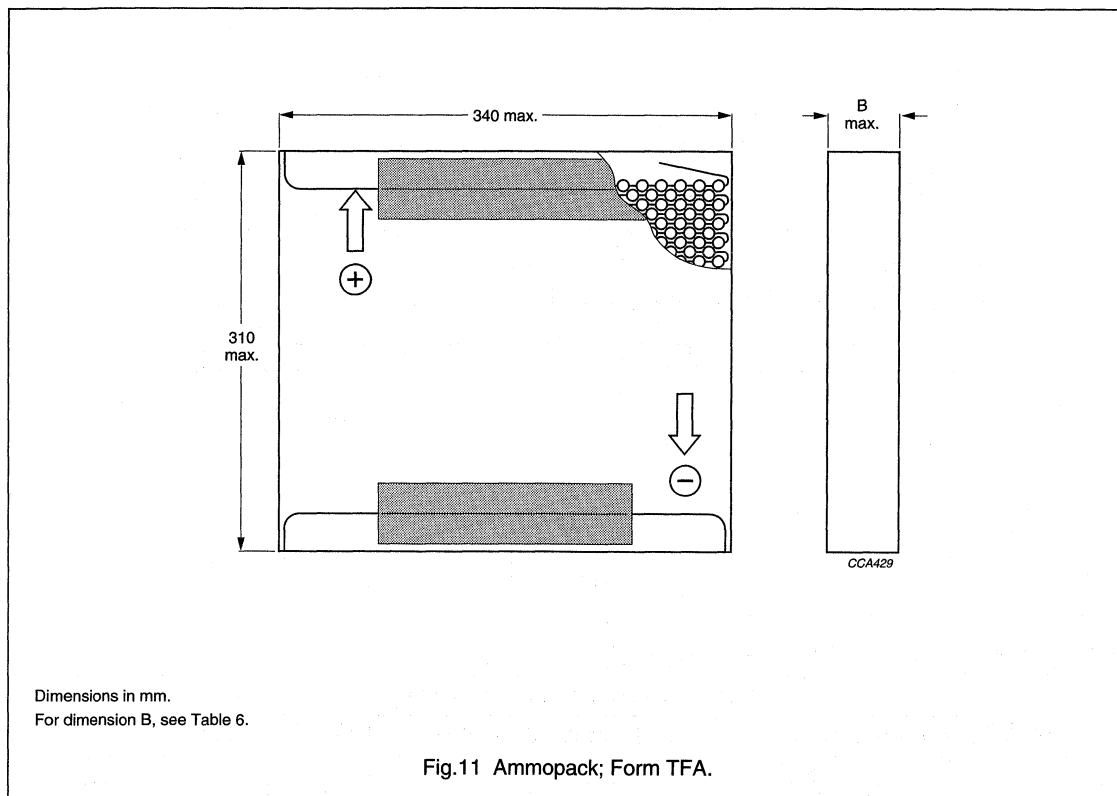
Radial electrolytic capacitors

Packaging

Series 037 RSM, 038 RSU, 044 RSH, 046 RSL, 047 RMS, 048 RML, 135 RLI, 136 RVI, 150 RMI, 151 RLH, 152 RMH, 165 RHT and 140 RTM with a case $\varnothing D = 10$ to 16 mm (continued)

QUANTITIES PER PACKAGING UNIT

Refer to the relevant detail specification in this data handbook.



Note

1. Ammopack taping (Form TFA). To ensure optimum straightness of the leads and correct position of the components in the folding area of the zig-zag shaped tape, where necessary, one capacitor is omitted at each folding edge.

Radial electrolytic capacitors

Packaging

The information contained within this part is valid for the following series:

- 122 SAL-RP
- 128 SAL-RPM

For catalogue numbers, refer to the relevant detail specification in this data handbook.

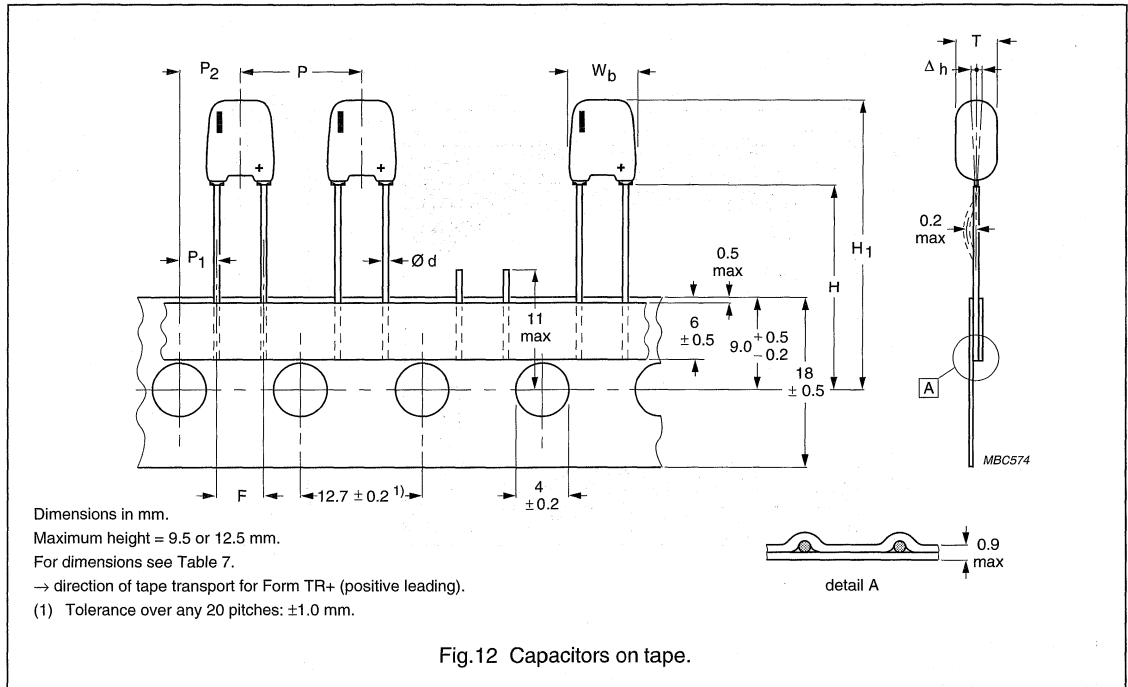


Table 7 Tape dimensions (in mm) for solid radial capacitors; see Fig.12

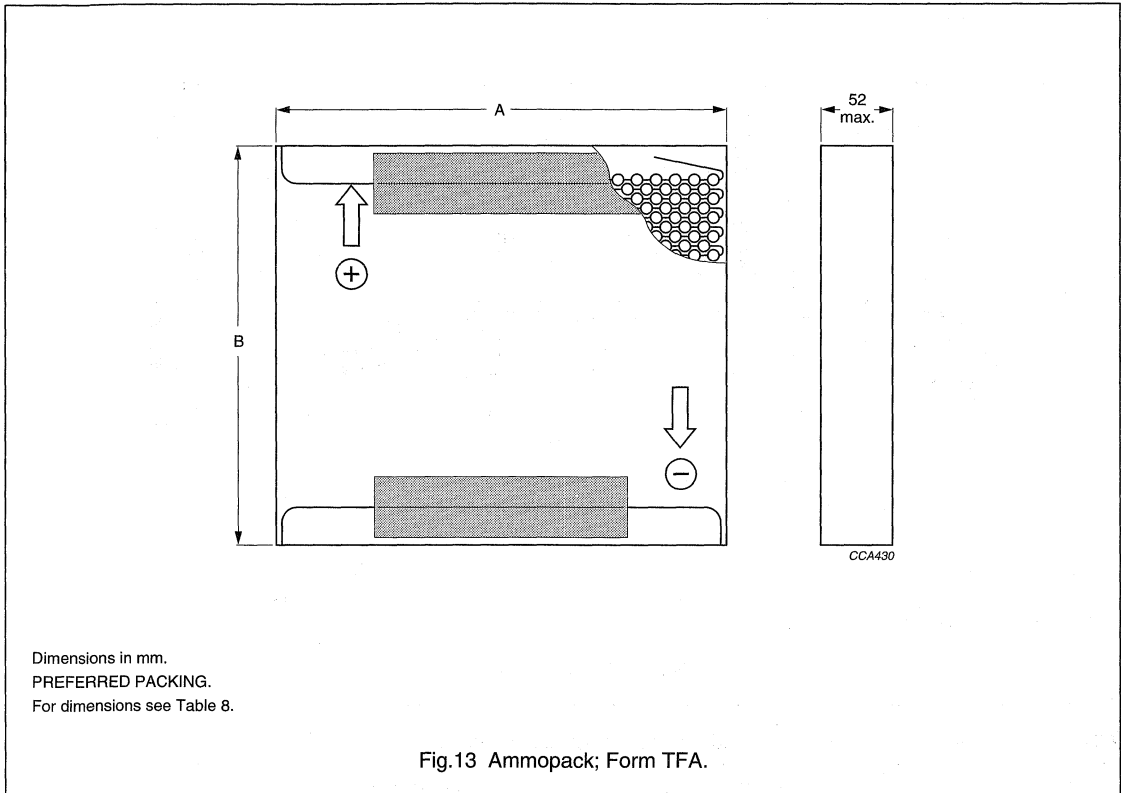
PARAMETER	122 SAL-RP MAX. HEIGHT 12.5 mm				128 SAL-RPM MAX. HEIGHT 9.5 mm						TOLERANCE
	CASE CODE				CASE CODE						
	1	2	3	4	10	20	30	40	50	60	
T	3.5	4.5	5.0	6.0	3.0	3.5	4.0	5.0	5.0	6.0	max.
W _b	8.0	8.0	8.0	8.0	7.0	7.0	7.0	7.0	8.0	8.0	max.
Ød	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	+0.02/-0
P	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	±1.0
P ₁	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	±0.7
P ₂	6.35	6.35	6.35	6.35	6.35	6.35	6.35	6.35	6.35	6.35	±1.0
F	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	±0.2
Δh	0	0	0	0	0	0	0	0	0	0	±1.0
H	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	±0.75
H ₁	32	32	32	32	28	28	28	28	28	28	max.

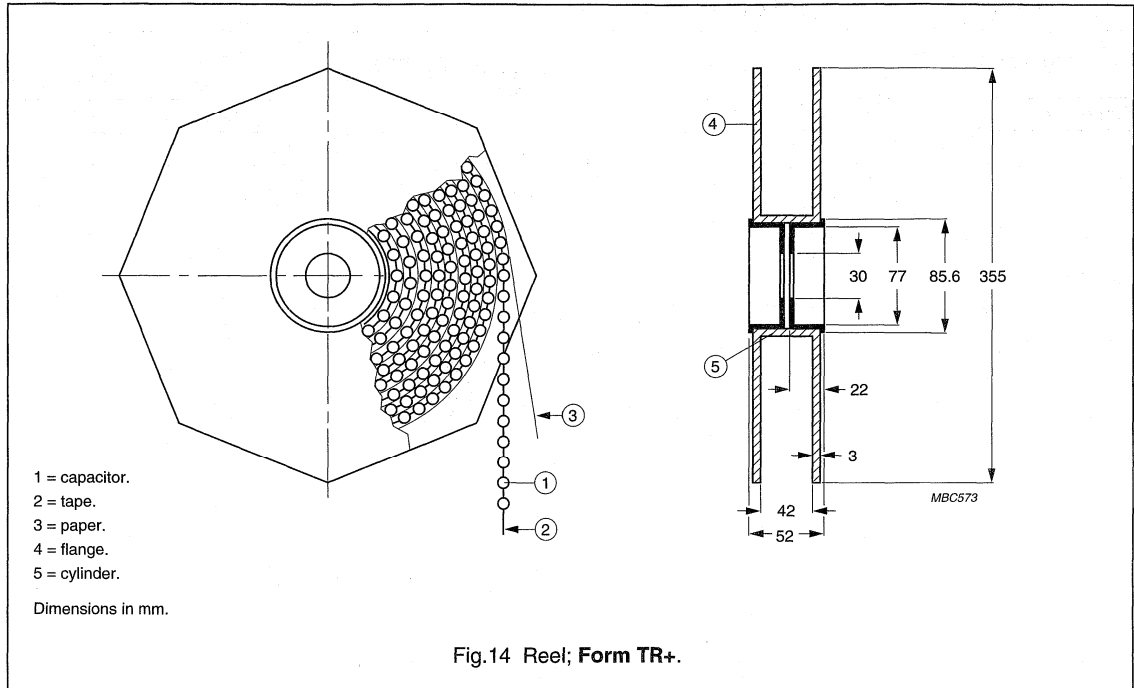
Radial electrolytic capacitors

Packaging

Table 8 Ammopack dimensions for the relevant case codes

PARAMETER	122 SAL-RP	128 SAL-RPM	A _{max} (mm)	B _{max} (mm)
Case code	1 to 4	10 to 60	340	176





QUANTITIES PER PACKAGING UNIT

Table 9 Number of capacitors per packaging unit

CASE SIZE $H_{max} \times W_{max} \times T_{max}$ (mm)	CASE CODE	BULK PER BOX		TAPED PER REEL	TAPED PER BOX
		FORM CA	FORM CB	FORM TR+	FORM TFA
12.5 × 8.0 × 3.5	1	1000	1000	2000	1000
12.5 × 8.0 × 4.5	2	1000	1000	2000	1000
12.5 × 8.0 × 5.0	3	1000	1000	1000	1000
12.5 × 8.0 × 6.0	4	800	1000	1000	1000
9.5 × 7.0 × 3.0	10	1000	1000	2000	1000
9.5 × 7.0 × 3.5	20	1000	1000	2000	1000
9.5 × 7.0 × 4.0	30	1000	1000	2000	1000
9.5 × 7.0 × 5.0	40	1000	1000	1000	1000
9.5 × 8.0 × 5.0	50	1000	1000	1000	1000
9.5 × 8.0 × 6.0	60	1000	1000	1000	1000

PACKAGING - AXIAL LEADED DEVICES



Axial electrolytic capacitors

Packaging

TAPING

BC Components axial, aluminum and solid aluminum electrolytic capacitors in sizes up to $\varnothing D = 15$ mm, are available in taped version corresponding to "IEC 60286-1".

They are most suitable for use on automatic insertion machines, cutting and forming equipment and are supplied in box (ammopack preferred), or on reel.

CAUTION

Packages must be handled with care to avoid bent leads.

For catalogue numbers, refer to the relevant detail specification in this data handbook.

Tape, reel and ammopack data

Table 1 Taping dimensions; see Figs 1 and 2

NOMINAL CASE SIZE ($\varnothing D \times L$) (mm)	CASE CODE	A (mm)	S (mm)	T FOR NUMBER (n)		L_{max} (mm)	C (mm)	D (mm)
				n < 50	50 < n < 100			
Non-solid types								
3.3 × 8	1a	63.5 ± 1.5 ⁽¹⁾	5 ± 0.4	5(n-1) ± 2	5(n-1) ± 4	9	83.5	94.5
3.3 × 11	1	63.5 ± 1.5 ⁽¹⁾	5 ± 0.4	5(n-1) ± 2	5(n-1) ± 4	12	83.5	94.5
4.5 × 10	2	63.5 ± 1.5 ⁽¹⁾	5 ± 0.4	5(n-1) ± 2	5(n-1) ± 4	10.5	83.5	94.5
6 × 10	3	63.5 ± 1.5 ⁽¹⁾	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	10.5	83.5	94.5
6.3 × 12.7	(2)	63.5 ± 1.5 ⁽¹⁾	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	12.9	83.5	94.5
7.7 × 12.7	(3)	63.5 ± 1.5 ⁽¹⁾	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	12.9	83.5	94.5
8 × 11	5a	63.5 ± 1.5 ⁽¹⁾	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	11.5	83.5	94.5
6.5 × 18	4	73 ± 1.6 ⁽¹⁾	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	18.5	88.5	99.5
8 × 18	5	73 ± 1.6 ⁽¹⁾	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	18.5	88.5	99.5
10 × 18	6	73 ± 1.6 ⁽¹⁾	15 ± 0.75	15(n-1) ± 2	15(n-1) ± 4	18.5	88.5	99.5
10 × 25	7	73 ± 1.6	15 ± 0.75	15(n-1) ± 2	15(n-1) ± 4	25.0	88.5	99.5
10 × 30	00	73 ± 1.6	15 ± 0.75	15(n-1) ± 2	15(n-1) ± 4	30.5	90	100
12.5 × 30	01	73 ± 1.6	15 ± 0.75	15(n-1) ± 2	15(n-1) ± 4	30.5	90	100
15 × 30	02	73 ± 1.6	20 ± 0.75	20(n-1) ± 2	20(n-1) ± 4	30.5	90	100
Solid types								
6.5 × 15	1	73 ± 1.6	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	15.3	90	100
7.5 × 20	2A	73 ± 1.6	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	20.4	90	100
9 × 22.5	4	73 ± 1.6	10 ± 0.4	10(n-1) ± 2	10(n-1) ± 4	23.3	90	100
10 × 31.5	5	73 ± 1.6	15 ± 0.75	15(n-1) ± 2	15(n-1) ± 4	32	90	100
12.5 × 31.5	6	73 ± 1.6	15 ± 0.75	15(n-1) ± 2	15(n-1) ± 4	32	90	100

Note

1. 52 ± 1.5 mm on request.

Axial electrolytic capacitors

Packaging

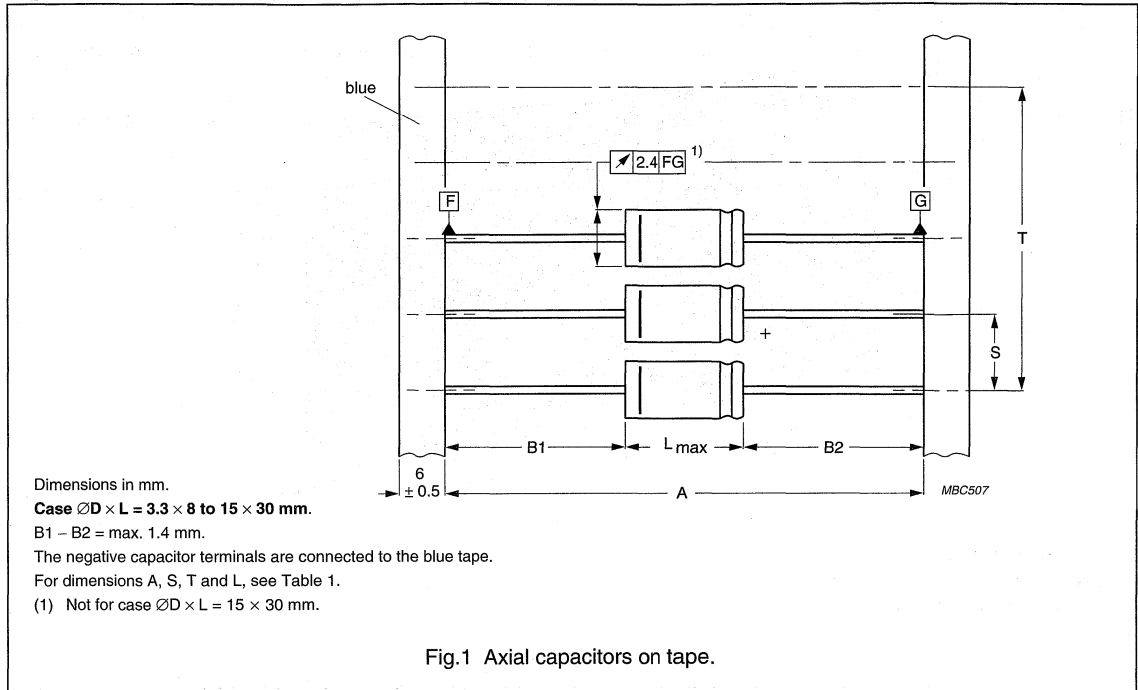


Fig.1 Axial capacitors on tape.

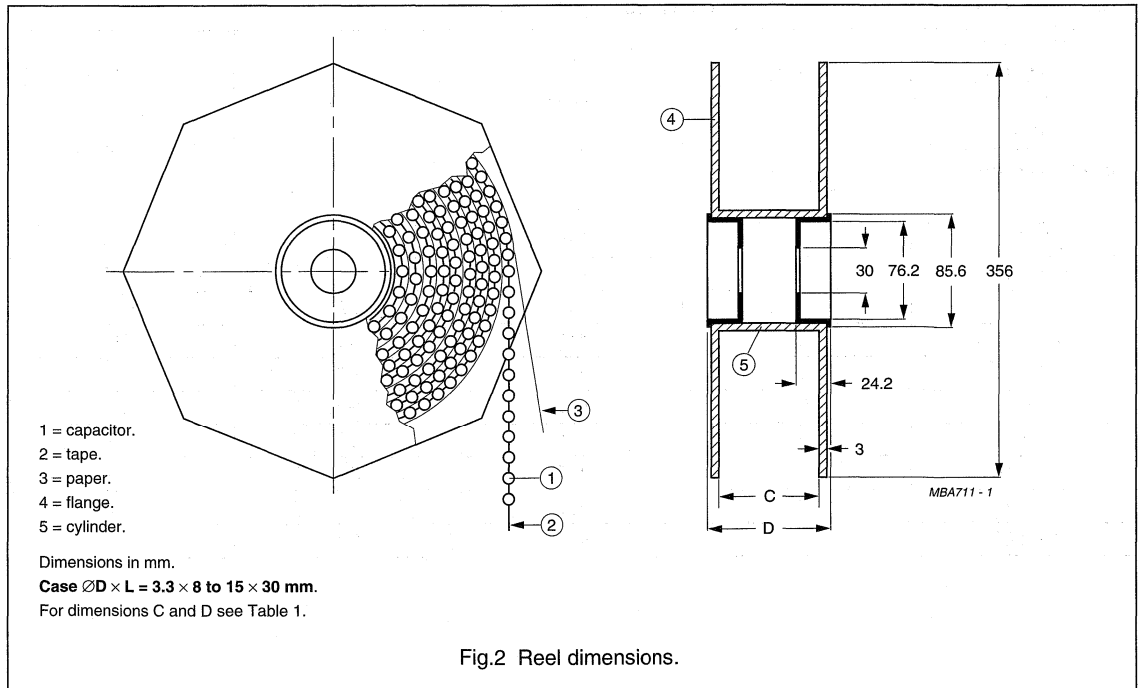


Fig.2 Reel dimensions.

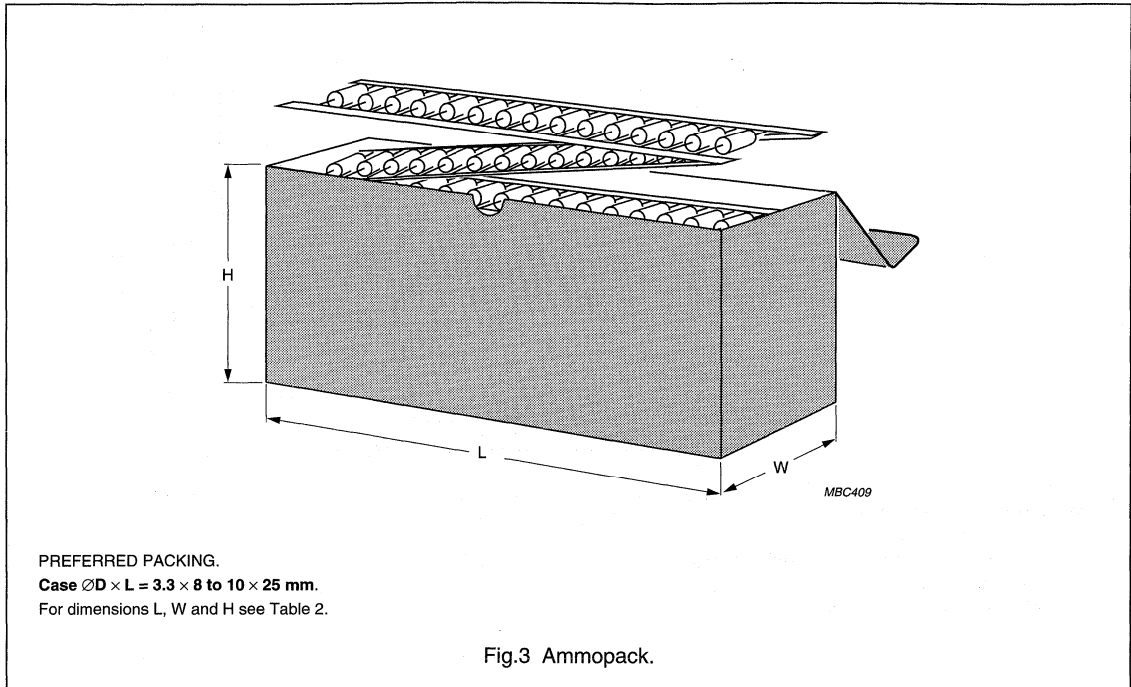


Table 2 Nominal outer dimensions of ammpack; see Fig.3

NOMINAL CASE SIZE ($\varnothing D \times L$) (mm)	CASE CODE	L (mm)	W (mm)	H (mm)
Non-solid types				
3.3 × 8	1a	282	92	64
3.3 × 11	1	282	92	64
4.5 × 10	2	282	92	116
6 × 10	3	415	92	107
6.3 × 12.7	(2)	415	92	107
7.7 × 12.7	(3)	415	92	107
8 × 11	5a	415	92	107
6.5 × 18	4	415	98	127
8 × 18	5	415	98	127
10 × 18	6	415	98	159
10 × 25	7	415	98	159

Axial electrolytic capacitors

Packaging

QUANTITIES PER PACKAGING UNIT

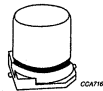
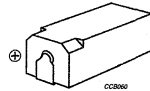
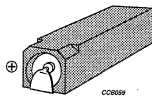
Table 3 Number of capacitors per packaging unit

NOMINAL CASE SIZE ($\varnothing D \times L$) (mm)	CASE CODE	AXIAL			SINGLE ENDED, MOUNTING RING (BULK) FORM MR
		TAPED IN AMMOPACK FORM BA	TAPED ON REEL FORM BR	BULK OR PAPERSTRIP FORM AA	
Non-solid types					
3.3 × 8	1a	1000	4000	–	–
3.3 × 11	1	1000	4000	–	–
4.5 × 10	2	1000	3000	–	–
6 × 10	3	1000	1000	–	–
6.3 × 12.7	(2)	1000	1000	–	–
7.7 × 12.7	(3)	500	500	–	–
8 × 11	5a	500	500	–	–
6.5 × 18	4	1000	1000	–	–
8 × 18	5	500	500	–	–
10 × 18	6	500	500	–	–
10 × 25	7	500	500	–	–
10 × 30	00	–	500	200	–
12.5 × 30	01 ⁽¹⁾	–	400	200	–
15 × 30	02 ⁽¹⁾	–	250	200	200
18 × 30	03 ⁽¹⁾	–	–	200	200
18 × 40	04 ⁽¹⁾	–	–	100	100
21 × 40	05	–	–	100	100
Solid types					
6.5 × 15	1	–	800	100	–
7.5 × 20	2A	–	800	100	–
9 × 22.5	4	–	500	100	–
10 × 31.5	5	–	500	100	–
12.5 × 31.5	6	–	400	100	–

Note

1. Non-solid axial types in case sizes 12.5 × 30 mm to 18 × 40 mm are available in preformed (cut and bent) version on request.

SMD ALUMINUM ELECTROLYTIC CAPACITORS ('CHIPS')



STANDARD

085 CS

1500 hours 85 °C
page 90

INDUSTRIAL

139 CLL

2000 hours 105 °C
page 104

PROFESSIONAL

153 CLV

2000 to 3000 hours
105 °C
page 117

CCB085

SMD

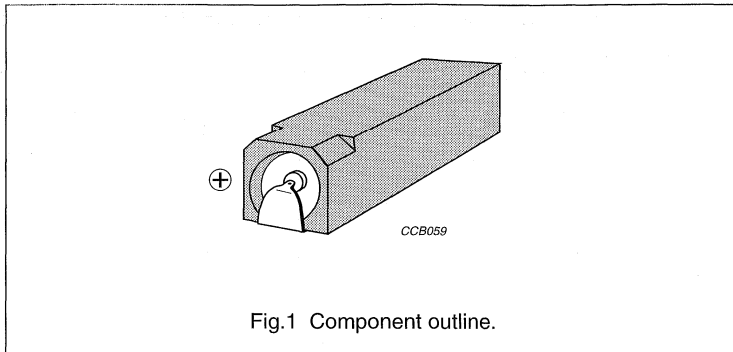
Aluminum electrolytic capacitors

SMD (Chip) Standard

085 CS

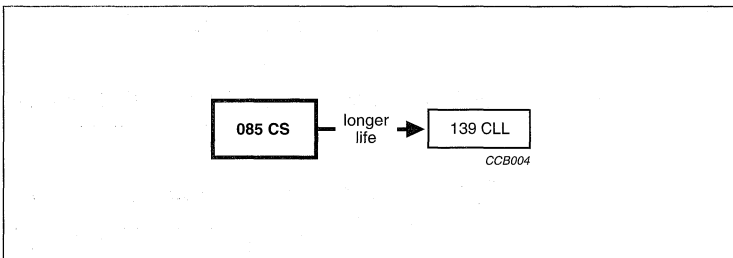
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version, rectangular case, insulated
- Miniaturized, high CV per unit volume, low height
- Flexible terminals, reflow and wave solderable
- Charge and discharge proof
- Supplied in blister tape on reel.



APPLICATIONS

- SMD technology, boards with restricted mounting height
- General applications, consumer electronics, low profile and lightweight equipment
- Decoupling, smoothing, filtering and buffering.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (L × W × H in mm)	8.8 × 3.7 × 3.9 and 11.9 × 3.7 × 3.9
Rated capacitance range, C _R	0.47 to 22 μF
Tolerance on C _R	-10 to +50% or ±20%
Rated voltage range, U _R	6.3 to 63 V
Category temperature range	-40 to +85 °C
Endurance test at 85 °C	1000 hours
Useful life at 85 °C	1500 hours
Useful life at 40 °C, 1.4 × I _R applied	40000 hours
Shelf life at 0 V, 85 °C	500 hours
Resistance to soldering heat test	immersion in solder: 10 s at 260 °C or 20 s at 215 °C
Based on sectional specification	IEC 60384-18/CECC 32300
Climatic category IEC 60068	40/085/56

Aluminum electrolytic capacitors

SMD (Chip) Standard

085 CS

Selection chart for C_R , U_R and relevant nominal case sizes (L × W × H in mm)

Preferred types in **bold**.

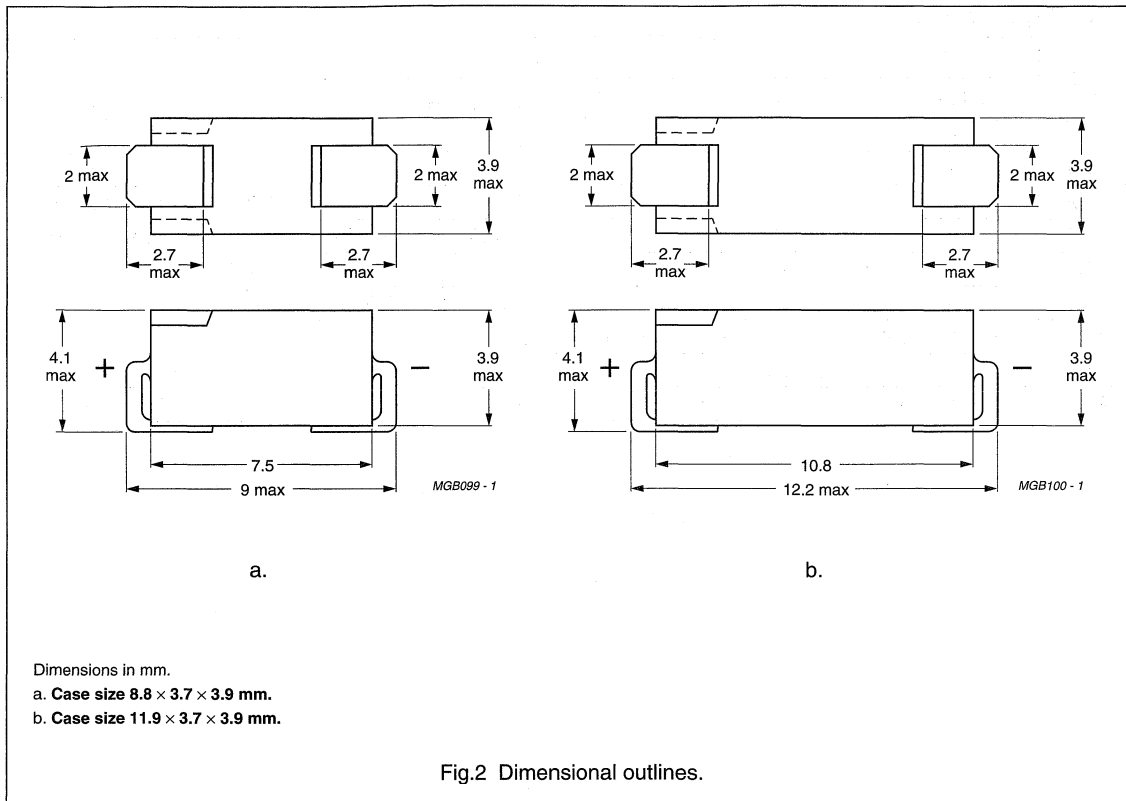
C_R (μF)	U_R (V)					
	6.3	10	16	25	40	63
0.47	–	–	–	–	–	8.8 × 3.7 × 3.9
1.0	–	–	–	–	–	8.8 × 3.7 × 3.9
2.2	–	–	–	–	8.8 × 3.7 × 3.9	11.9 × 3.7 × 3.9
3.3	–	–	–	8.8 × 3.7 × 3.9	–	11.9 × 3.7 × 3.9
4.7	–	–	8.8 × 3.7 × 3.9	–	11.9 × 3.7 × 3.9	–
6.8	–	8.8 × 3.7 × 3.9	–	11.9 × 3.7 × 3.9	–	–
10	8.8 × 3.7 × 3.9	–	11.9 × 3.7 × 3.9	–	–	–
15	–	11.9 × 3.7 × 3.9	–	–	–	–
22	11.9 × 3.7 × 3.9	–	–	–	–	–

SMD

Aluminum electrolytic capacitors SMD (Chip) Standard

085 CS

MECHANICAL DATA



PACKAGING QUANTITIES

- Tape on reel packaging:
2000 per reel.

MARKING

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

- Rated capacitance (in μF).
- Rated voltage code (see Table 1), the U_R code letter indicates the position of the decimal point in the capacitance value.
- Name of manufacturer.
- \ominus sign indicating the cathode.
The anode is identified by bevelled edges.

Examples for C_{nom} ; U_R marking:

H22 represents 0.22 μF ; 63 V
 2G2 represents 2.2 μF ; 40 V
 22C represents 22 μF ; 6.3 V.

Table 1 Rated voltage marking code

U_R (V)	6.3	10	16	25	40	63
Code letter	C	D	E	F	G	H

Aluminum electrolytic capacitors SMD (Chip) Standard

085 CS

MOUNTING

The capacitors are designed for automatic placement on printed-circuit boards or hybrid circuits.

Optimum dimensions of soldering pads depend upon soldering method, mounting accuracy, print lay-out and/or adjacent components.

For recommended pad dimensions, refer to Fig.3 and Table 2.

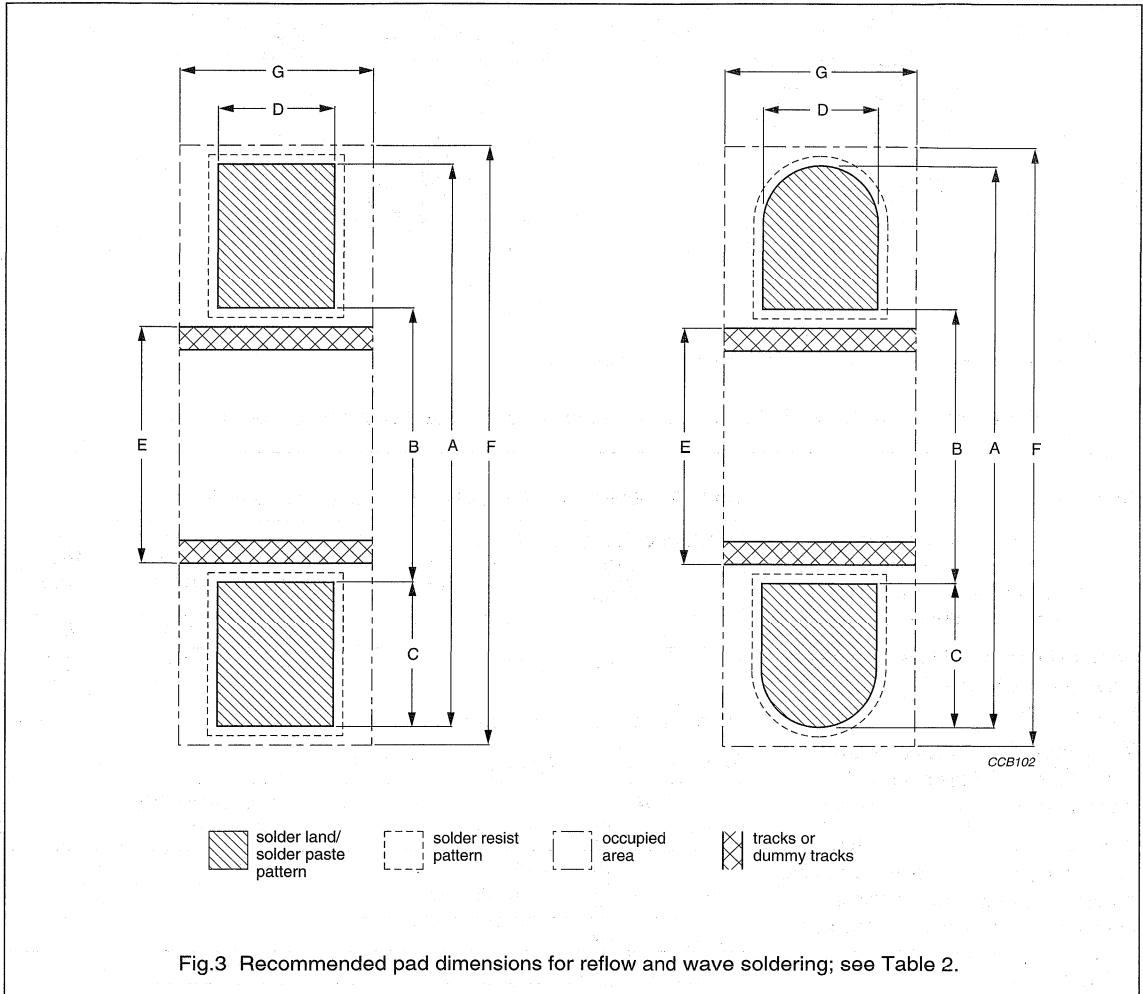
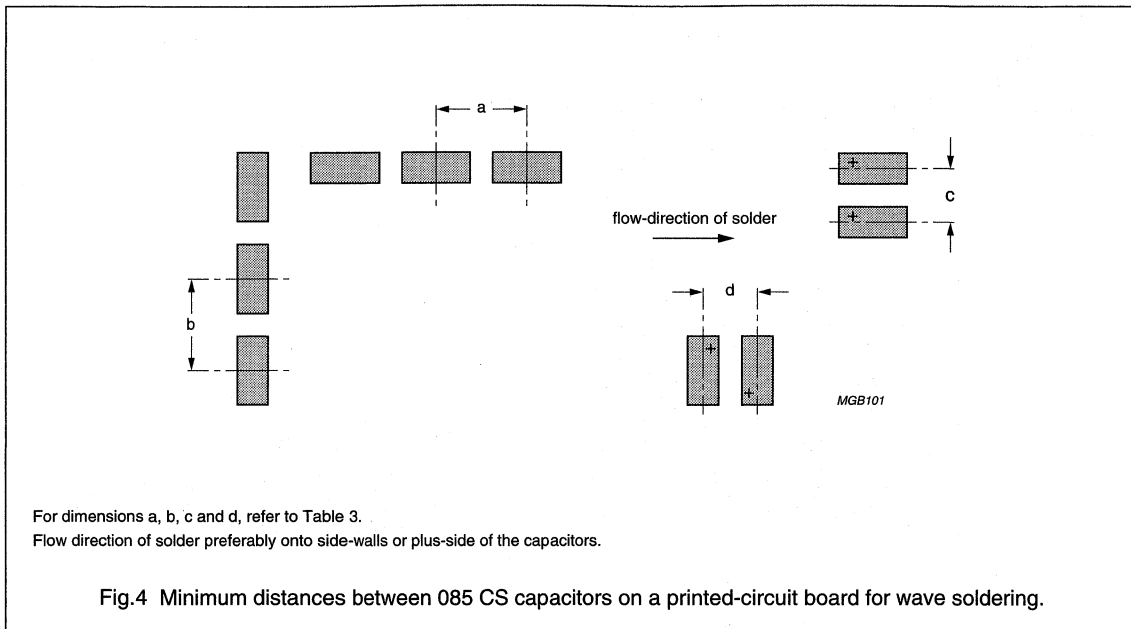


Table 2 Recommended soldering pad dimensions in mm (placement accuracy ± 0.25 mm); see Fig.3

NOMINAL CASE SIZE L x W x H (mm)	FOR REFLOW SOLDERING							FOR WAVE SOLDERING						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
8.8 x 3.7 x 3.9	9.7	3.5	2.9	2.5	3.0	10.1	4.4	13.5	4.1	4.7	3.7	2.9	14.0	8.4
11.9 x 3.7 x 3.9	12.9	6.5	2.9	2.5	6.0	13.3	4.4	16.8	7.4	4.7	3.7	6.1	17.3	8.4

Aluminum electrolytic capacitors SMD (Chip) Standard

085 CS



Soldering

Soldering conditions are defined by the curve, temperature versus time. The temperature is that measured on the soldering pad during processing.

For maximum conditions of different soldering methods see Figs 5, 6 and 7.

Any temperature/time curve which does not exceed the specified maximum curves may be applied.

After soldering under maximum conditions, some drift of the electrical parameters may occur. Typical behaviour which can be expected under these circumstances is shown in Fig.8.

AS A GENERAL PRINCIPLE, TEMPERATURE AND DURATION SHALL BE THE **MINIMUM** NECESSARY REQUIRED TO ENSURE GOOD SOLDERING CONNECTIONS.

Table 3 Minimum distances between capacitors; see Fig.4

NOMINAL CASE SIZE L × W × H (mm)	a _{min} (mm)	b _{min} (mm)	c _{min} (mm)	d _{min} (mm)
8.8 × 3.7 × 3.9	12	12	6.8	6.8
11.9 × 3.7 × 3.9	15	15	6.8	6.8

Maximum temperature load

Table 4 Curing conditions for SMD-glue

MAX. T _{amb} (°C)	MAX. EXPOSURE TIME (minutes)
125	10
140	3
150	1
160	0.5

Aluminum electrolytic capacitors
SMD (Chip) Standard

085 CS

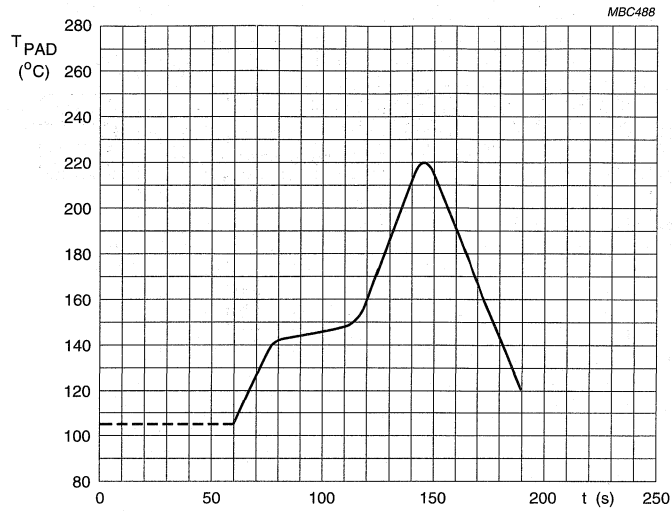


Fig.5 Maximum temperature load during infrared reflow soldering.

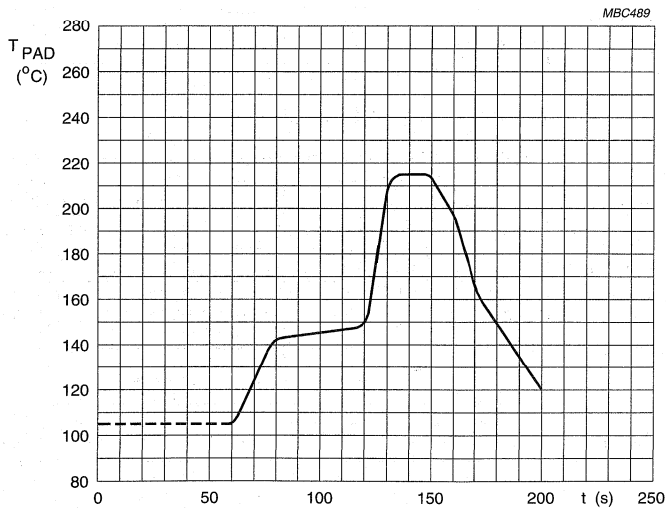
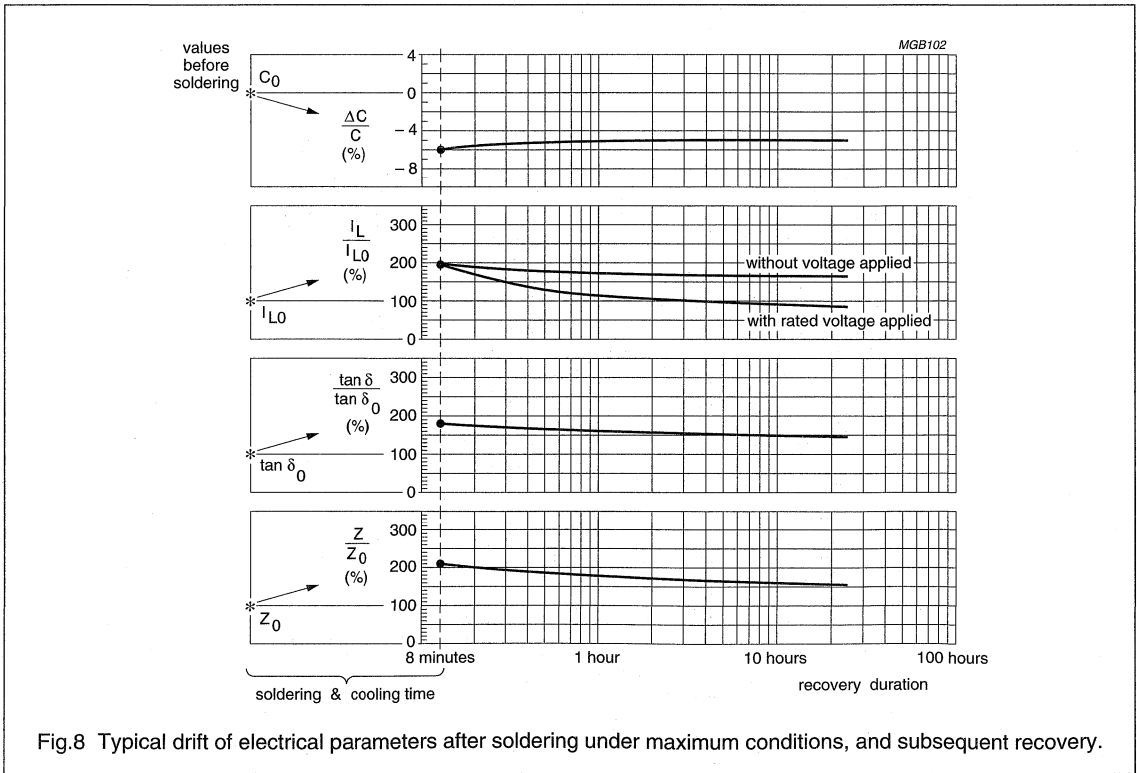
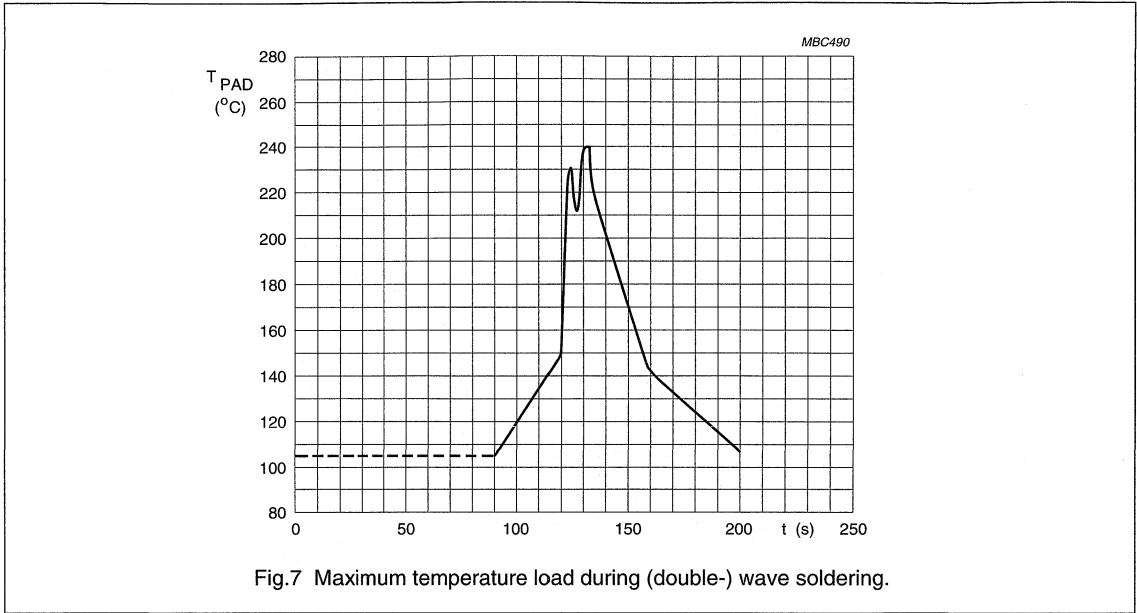


Fig.6 Maximum temperature load during vapour phase reflow soldering.

SMD

Aluminum electrolytic capacitors SMD (Chip) Standard

085 CS



Aluminum electrolytic capacitors
SMD (Chip) Standard

085 CS

Ordering example

Electrolytic capacitor 085 series

10 μ F/16 V; -10/+50%

Nominal case size: 11.9 \times 3.7 \times 3.9 mm;
Form BR

Catalogue number: 2222 085 25109.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 5 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% or \pm 20%)
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

Table 5 Electrical data and catalogue numbers; preferred types in **bold**

U _R (V)	C _R 100 Hz (μ F)	NOMINAL CASE SIZE L \times W \times H (mm)	CASE CODE	I _R 100 Hz 85 °C (mA)	I _{L1} 1 min (μ A)	I _{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222	
										-10/+50%	\pm 20%
										BLISTER TAPE ON REEL FORM BR	BLISTER TAPE ON REEL FORM BR
6.3	10.0	8.8 \times 3.7 \times 3.9	1a	11	4	3.1	0.30	48	20	085 23109	085 63109
	22	11.9 \times 3.7 \times 3.9	1	20	6	3.3	0.30	22	9	085 23229	085 63229
10	6.8	8.8 \times 3.7 \times 3.9	1a	10	4	3.1	0.25	59	24	085 24688	085 64688
	15	11.9 \times 3.7 \times 3.9	1	18	6	3.3	0.25	27	11	085 24159	085 64159
16	4.7	8.8 \times 3.7 \times 3.9	1a	9	5	3.2	0.20	68	26	085 25478	085 65478
	10	11.9 \times 3.7 \times 3.9	1	16	6	3.3	0.20	32	12	085 25109	085 65109
25	3.3	8.8 \times 3.7 \times 3.9	1a	8	5	3.2	0.18	87	27	085 26338	085 66338
	6.8	11.9 \times 3.7 \times 3.9	1	14	6	3.3	0.18	42	13	085 26688	085 66688
40	2.2	8.8 \times 3.7 \times 3.9	1a	7	5	3.2	0.16	120	32	085 27228	085 67228
	4.7	11.9 \times 3.7 \times 3.9	1	13	7	3.4	0.16	54	15	085 27478	085 67478
63	0.47	8.8 \times 3.7 \times 3.9	1a	4	4	3.1	0.10	340	120	085 28477	085 68477
	1.0	8.8 \times 3.7 \times 3.9	1a	6	4	3.1	0.12	190	55	085 28108	085 68108
	2.2	11.9 \times 3.7 \times 3.9	1	11	6	3.3	0.14	87	25	085 28228	085 68228
	3.3	11.9 \times 3.7 \times 3.9	1	13	7	3.4	0.14	68	17	085 28338	085 68338



Aluminum electrolytic capacitors

SMD (Chip) Standard

085 CS

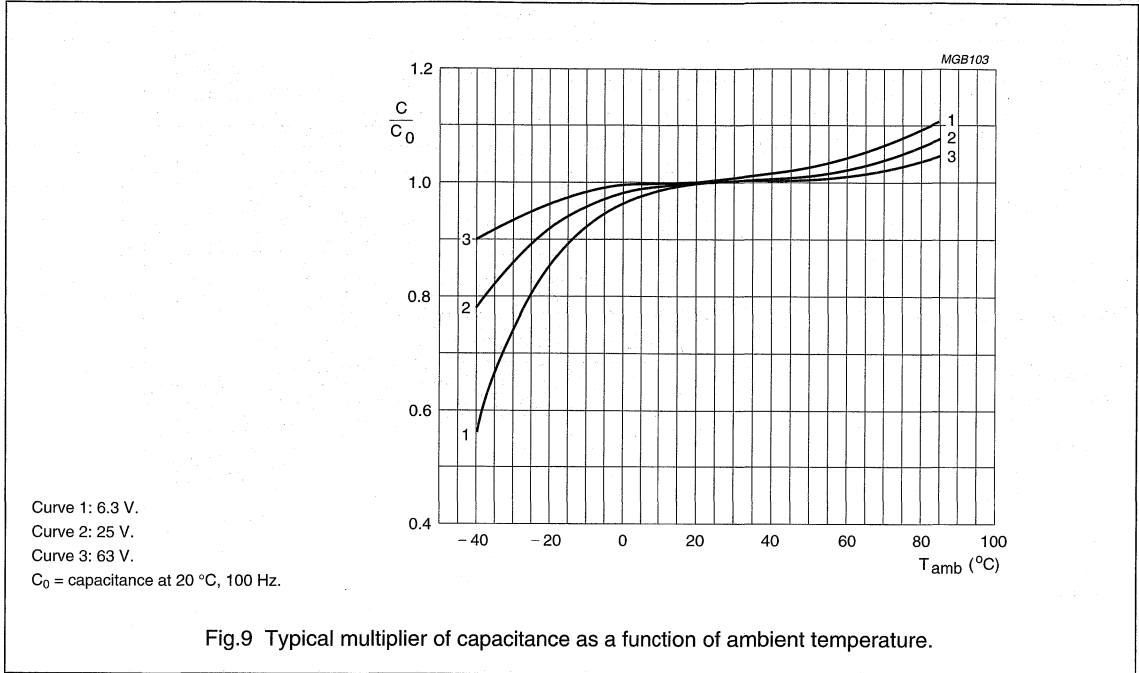
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.02C_R \times U_R + 3 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	nominal case size $8.8 \times 3.7 \times 3.9 \text{ mm}$	typ. 11 nH
	nominal case size $11.9 \times 3.7 \times 3.9 \text{ mm}$	typ. 13 nH

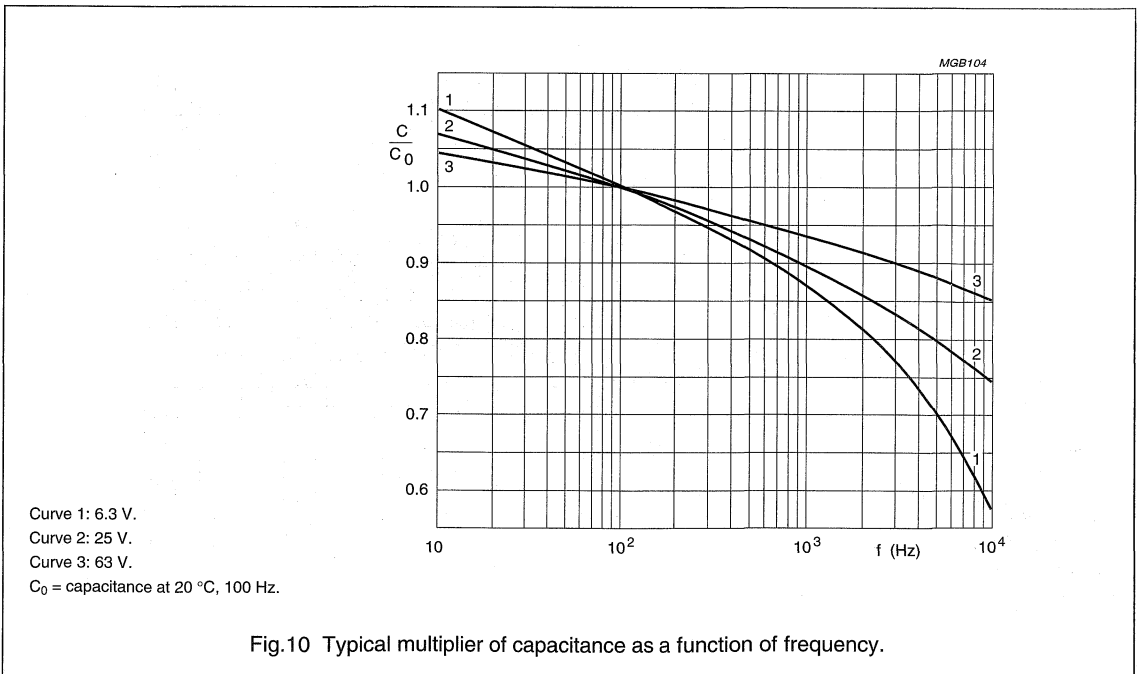
Aluminum electrolytic capacitors SMD (Chip) Standard

085 CS

Capacitance (C)



SMD

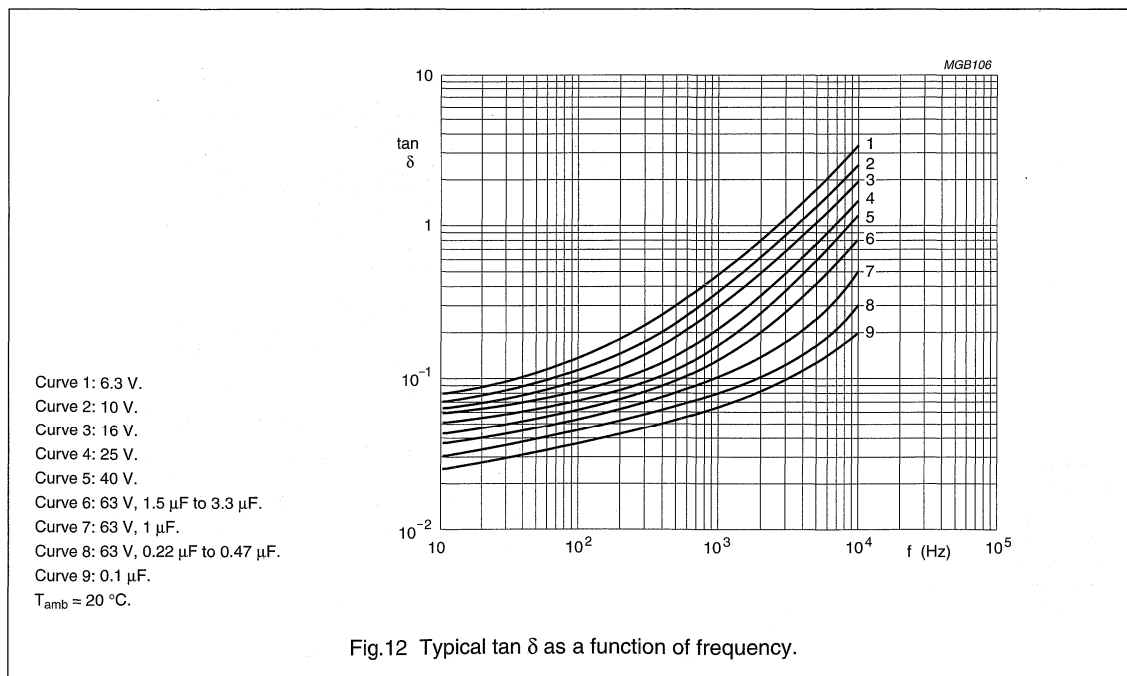
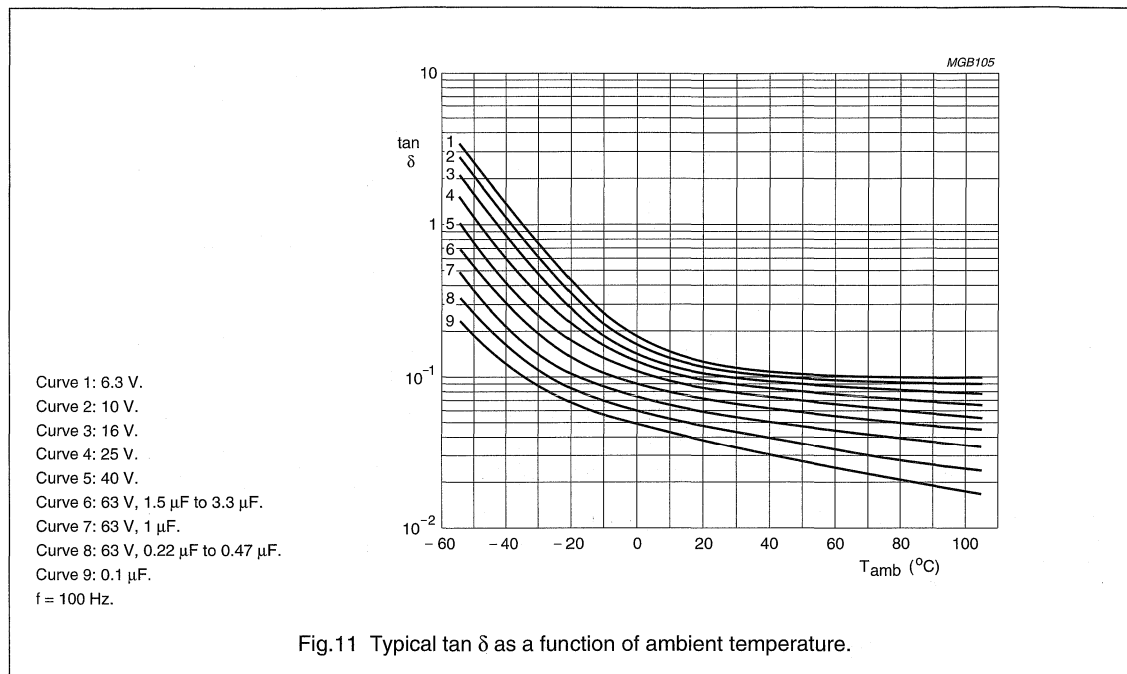


Aluminum electrolytic capacitors

SMD (Chip) Standard

085 CS

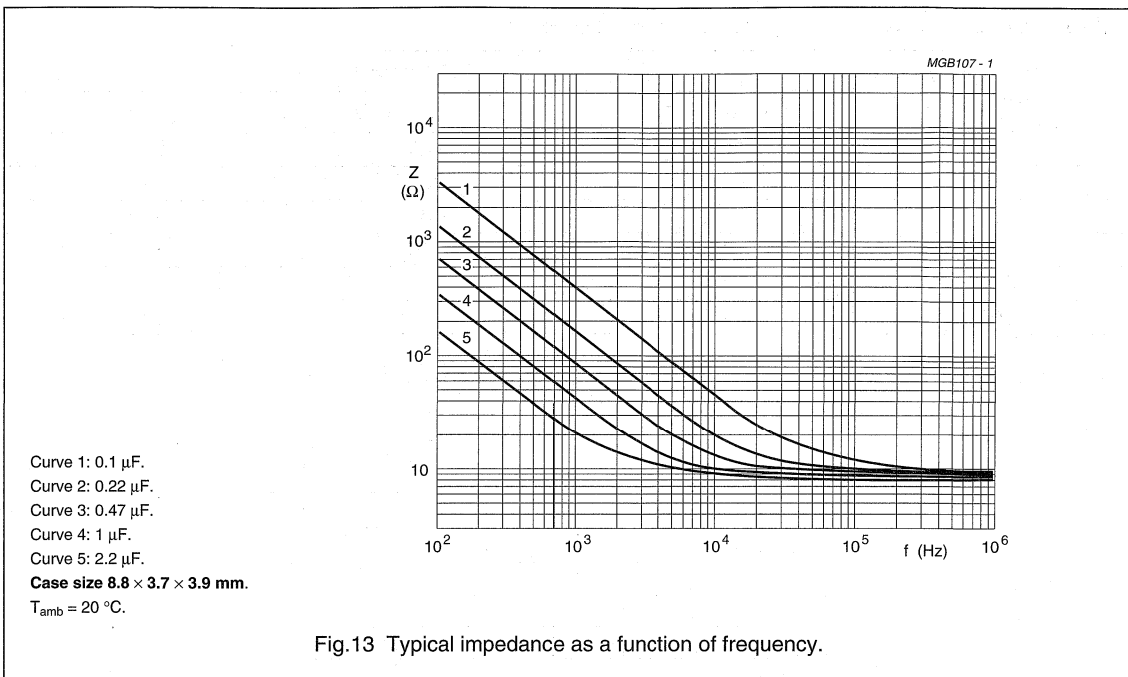
Dissipation factor ($\tan \delta$)



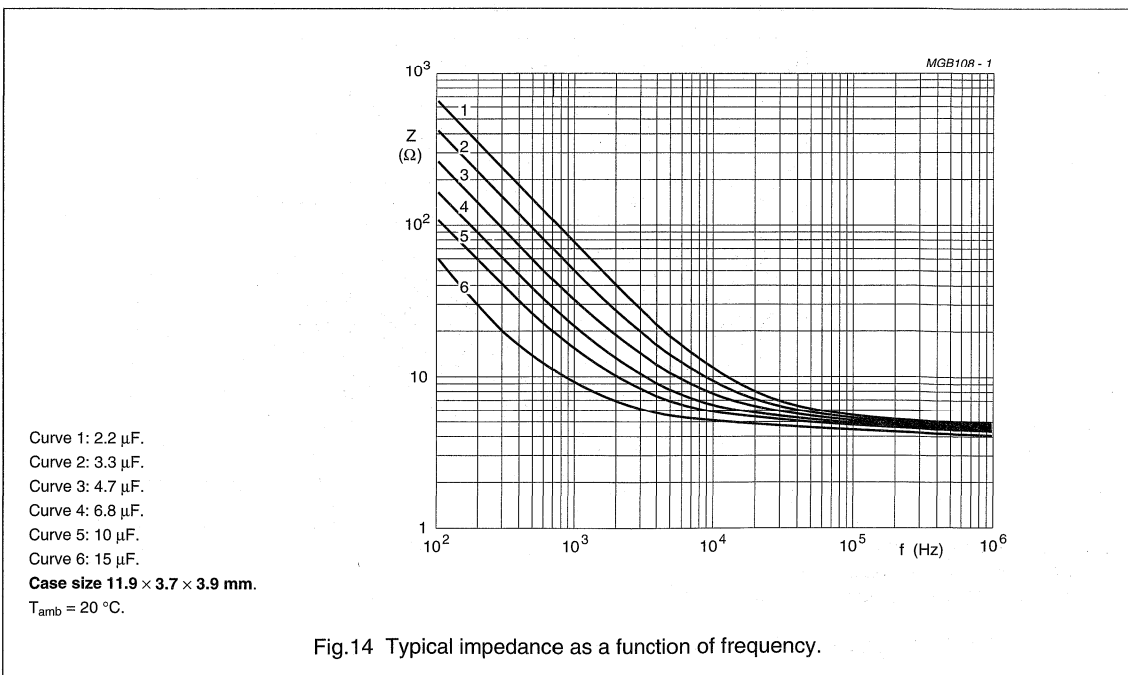
Aluminum electrolytic capacitors SMD (Chip) Standard

085 CS

Impedance (Z)



SMD



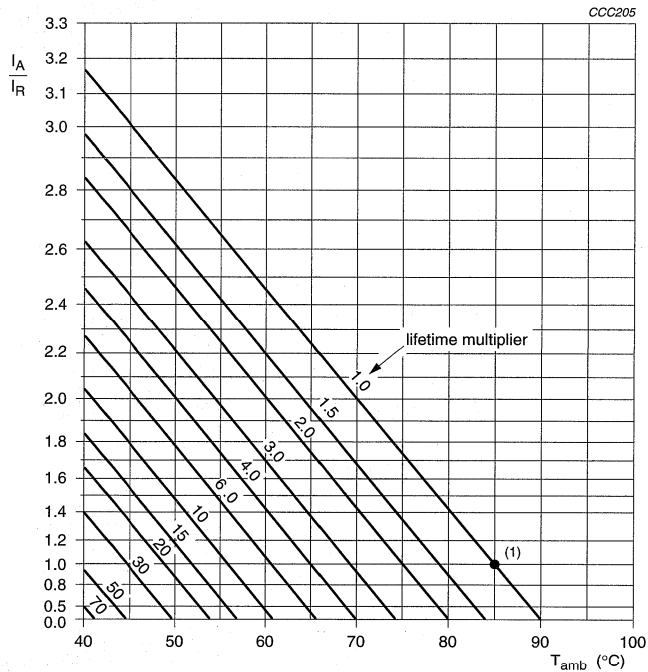
Aluminum electrolytic capacitors SMD (Chip) Standard

085 CS

RIPPLE CURRENT AND USEFUL LIFE

Table 6 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	$U_R = 63$ V
50	0.8	0.75	0.7
100	1.0	1.0	1.0
300	1.2	1.3	1.55
1000	1.35	1.55	1.9
3000	1.45	1.7	2.3
≥ 10000	1.5	1.8	2.5



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: 1500 hours.

Fig.15 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

SMD (Chip) Standard

085 CS

SPECIFIC TESTS AND REQUIREMENTS

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

Table 7 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Mounting	IEC 60384-18, subclause 4.3	shall be performed prior to tests mentioned below; method: reflow or (double-) wave soldering; for maximum temperature load refer to chapter "Mounting"	$\Delta C/C: \pm 10\%$ $\tan \delta \leq \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$
Endurance	IEC 60384-18/ CECC 32300, subclause 4.15	$T_{\text{amb}} = 85\text{ }^\circ\text{C}$; U_R applied; 1000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{\text{amb}} = 85\text{ }^\circ\text{C}$; U_R and I_R applied; 1500 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-18/ CECC 32300, subclause 4.17	$T_{\text{amb}} = 85\text{ }^\circ\text{C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

SMD

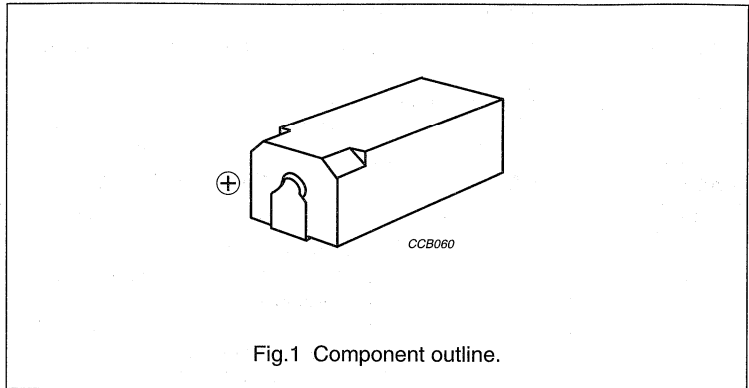
Aluminum electrolytic capacitors

SMD (Chip) Long Life

139 CLL

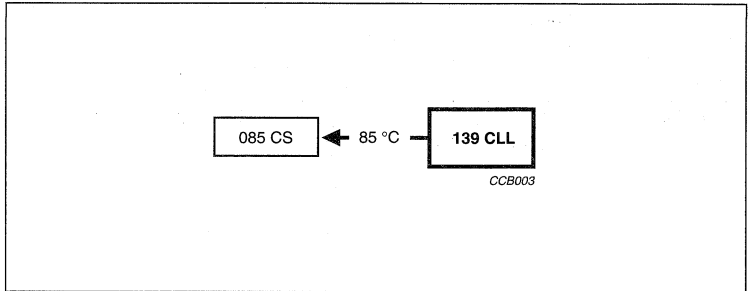
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- Extended voltage and capacitance range
- SMD-version, fully moulded, insulated
- Flexible terminals, reflow and wave solderable
- Compact, rectangular shape
- Charge and discharge proof, no peak current limitation
- Supplied in blister tape on reel.



APPLICATIONS

- SMD technology
- Industrial and professional applications
- Telecommunications, automotive, EDP general industrial
- Coupling, decoupling, smoothing, filtering, buffering, timing.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (L × W × H in mm)	14.3 × 6.2 × 6.9 and 14.3 × 7.6 × 8.2
Rated capacitance range, C _R	1.0 to 220 μF
Tolerance on C _R	±20%
Rated voltage range, U _R	6.3 to 100 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C	1000 hours
Useful life at 105 °C	2000 hours
Useful life at 40 °C; 1.3 × I _R applied	200000 hours
Shelf life at 0 V, 105 °C	500 hours
Resistance to soldering heat test	immersion in solder: 10 s at 260 °C or 40 s at 215 °C
Based on sectional specification	IEC 60384-18/CECC 32300
Climatic category IEC 60068	55/105/56

Aluminum electrolytic capacitors

SMD (Chip) Long Life

139 CLL

Selection chart for C_R , U_R and relevant nominal case sizes (L × W × H in mm)

Preferred types in **bold**.

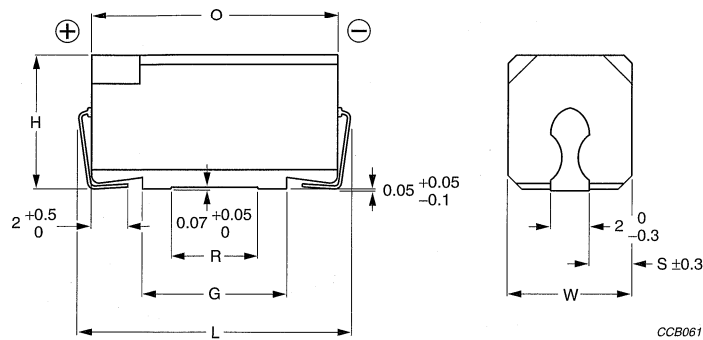
C_R (μF)	U_R (V)							
	6.3	10	16	25	40	50	63	100
1	-	-	-	-	-	-	-	14.3 × 6.2 × 6.9
2.2	-	-	-	-	-	-	14.3 × 6.2 × 6.9	14.3 × 6.2 × 6.9
3.3	-	-	-	-	-	-	14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2
4.7	-	-	-	-	-	-	14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2
10	-	-	-	14.3 × 6.2 × 6.9	-	14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2	-
15	-	-	-	-	14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2	-	-
22	-	-	-	14.3 × 6.2 × 6.9	-	14.3 × 7.6 × 8.2	-	-
33	-	-	-	14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2	-	-	-
47	-	-	14.3 × 6.2 × 6.9	14.3 × 7.6 × 8.2	-	-	-	-
68	-	14.3 × 6.2 × 6.9	-	-	-	-	-	-
100	14.3 × 6.2 × 6.9	-	14.3 × 7.6 × 8.2	-	-	-	-	-
150	-	14.3 × 7.6 × 8.2	-	-	-	-	-	-
220	14.3 × 7.6 × 8.2	-	-	-	-	-	-	-

SMD

Aluminum electrolytic capacitors

SMD (Chip) Long Life

139 CLL

MECHANICAL DATA

Dimensions in mm.
For dimensions see Table 1.

Fig.2 Dimensional outline.

Table 1 Physical dimensions, mass and packaging quantities; see Fig.2

NOMINAL CASE SIZE L × W × H (mm)	CASE CODE	L _{max} (mm)	W _{max} (mm)	H _{max} (mm)	O _{max} (mm)	S (mm)	G _{max} (mm)	R _{min} (mm)	MASS (g)	PACKAGING QUANTITIES PER REEL
14.3 × 6.2 × 6.9	2	14.5	6.3	7.05	13.0	2.15	7.5	4.7	≈0.95	700
14.3 × 7.6 × 8.2	3	14.5	7.7	8.35	13.0	2.85	7.5	4.7	≈1.3	700

MARKING

- Rated capacitance (in μF)
- Rated voltage (in V)
- Series number (139)
- Name of manufacturer
- Date code (year and month) in accordance with "IEC 60062"
- '⊖' sign indicating the cathode. The anode is identified by bevelled edges.

Aluminum electrolytic capacitors SMD (Chip) Long Life

139 CLL

MOUNTING

The capacitors are designed for automatic placement on to printed-circuit boards or hybrid circuits.

Optimum dimensions of soldering pads depend amongst others on soldering method, mounting accuracy, print lay-out and/or adjacent components.

For recommended soldering pad dimensions, refer to Fig.3 and Table 2.

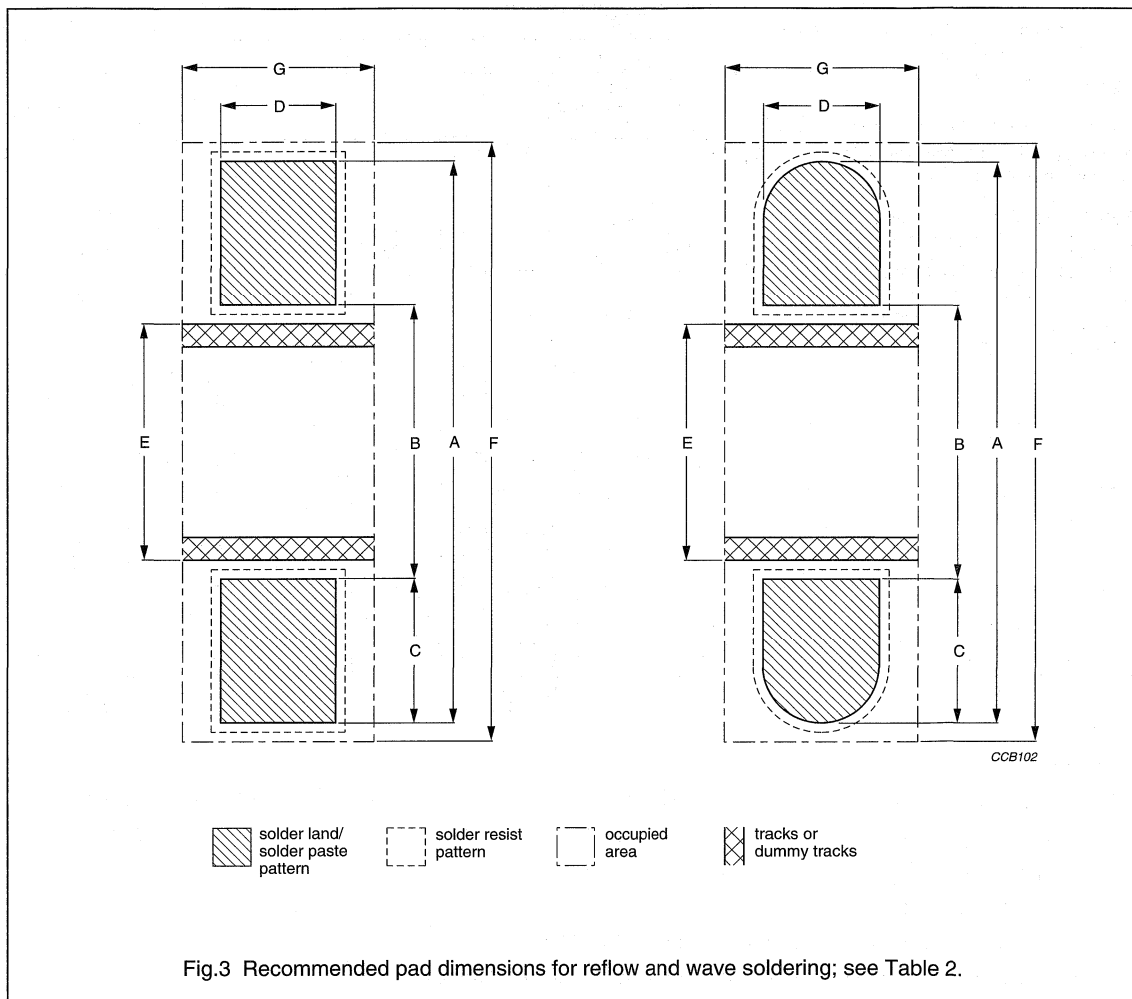


Table 2 Recommended soldering pad dimensions in mm (placement accuracy ± 0.25 mm); see Fig.3

NOMINAL CASE SIZE L × W × H (mm)	FOR REFLOW SOLDERING							FOR WAVE SOLDERING						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
14.3 × 6.2 × 6.9	15.8	8.8	3.5	2.8	8.0	16.2	7.7	18.6	10.0	4.3	5.0	8.8	20.5	11.5
14.3 × 7.6 × 8.2	15.8	8.8	3.5	2.8	8.0	16.2	9.1	18.6	10.0	4.3	6.0	8.8	21.5	13.0

Aluminum electrolytic capacitors

SMD (Chip) Long Life

139 CLL

Soldering

Soldering conditions are defined by the curve, temperature versus time, where the temperature is that measured on the soldering pad during processing.

For maximum conditions of different soldering methods see Figs 4, 5 and 6.

Any temperature versus time curve which does not exceed the specified maximum curves may be applied.

AS A GENERAL PRINCIPLE, TEMPERATURE AND DURATION SHALL BE THE **MINIMUM** NECESSARY REQUIRED TO ENSURE GOOD SOLDERING CONNECTIONS.

Maximum temperature load

Table 3 Curing conditions for SMD-glue

MAX. T_{amb} (°C)	MAX. EXPOSURE TIME (minutes)
125	30
140	10
150	5
160	2

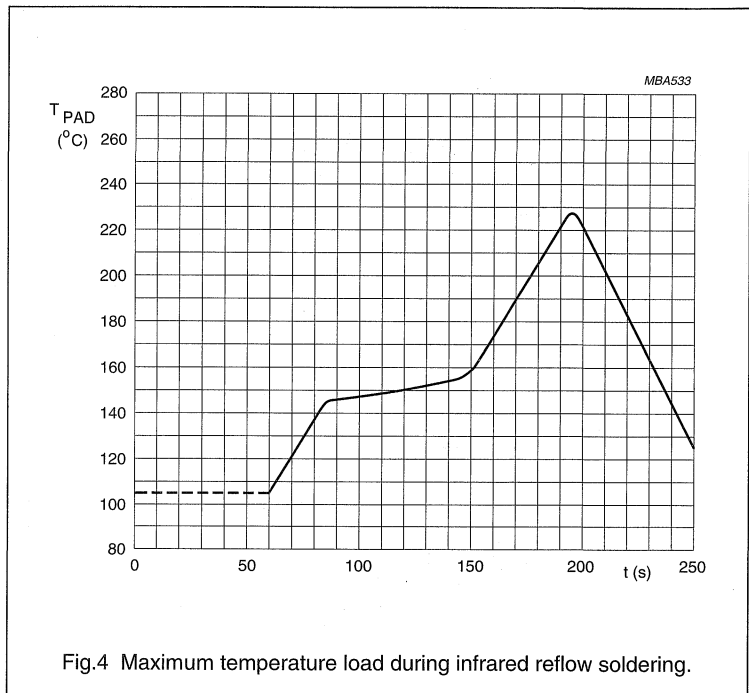
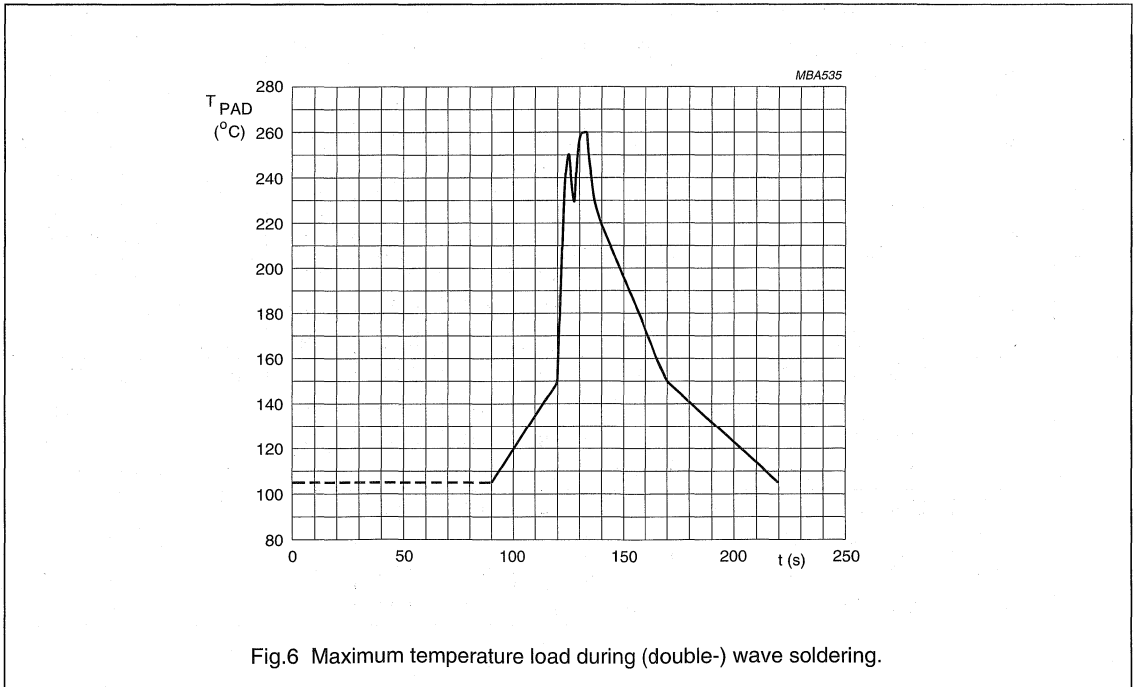
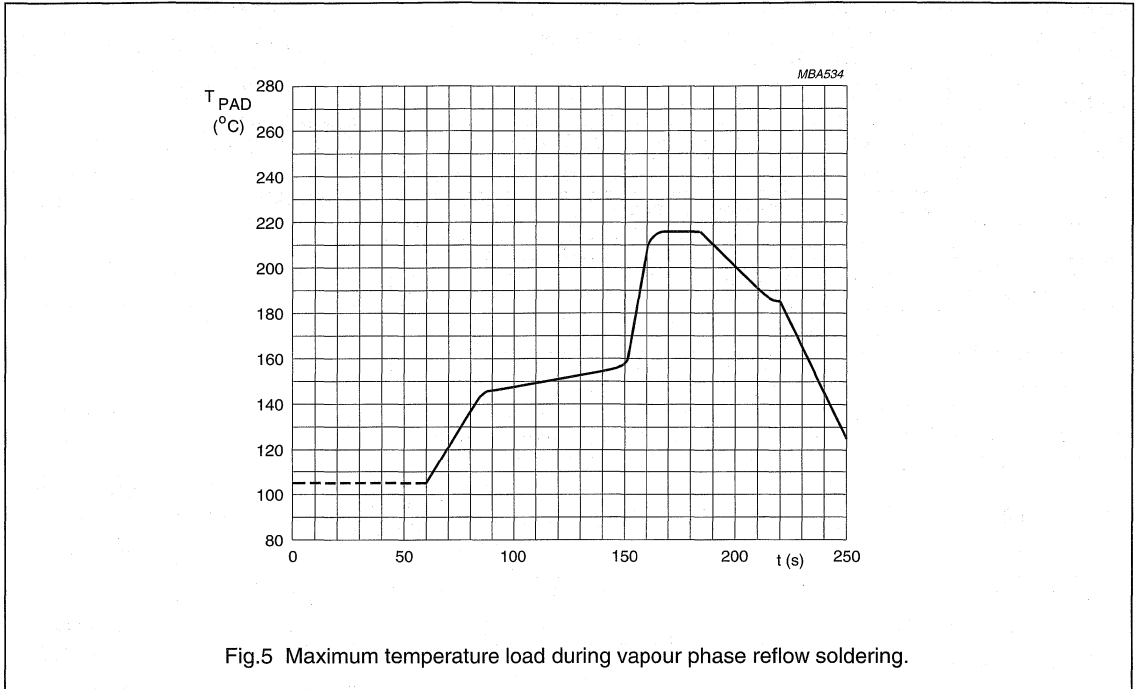


Fig.4 Maximum temperature load during infrared reflow soldering.

Aluminum electrolytic capacitors
SMD (Chip) Long Life

139 CLL



Aluminum electrolytic capacitors

SMD (Chip) Long Life

139 CLL

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 4 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86\text{ to }106\text{ kPa}$, $RH = 45\text{ to }75\%$.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\tan \delta$	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

Ordering example

Electrolytic capacitor 139 series

100 $\mu\text{F}/16\text{ V}$; $\pm 20\%$

Nominal case size:

14.3 \times 7.6 \times 8.2 mm; taped on reel

Catalogue number: 2222 139 65101.

Table 4 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE L \times W \times H (mm)	CASE CODE	I_R 100 Hz 105 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222
6.3	100	14.3 \times 6.2 \times 6.9	2	79	16	4.3	0.24	3.8	3.0	139 63101
	220	14.3 \times 7.6 \times 8.2	3	120	32	5.8	0.24	1.7	1.4	139 63221
10	68	14.3 \times 6.2 \times 6.9	2	71	17	4.4	0.20	4.7	2.9	139 64689
	150	14.3 \times 7.6 \times 8.2	3	110	33	6.0	0.20	2.1	1.3	139 64151
16	47	14.3 \times 6.2 \times 6.9	2	66	18	4.5	0.16	5.4	3.4	139 65479
	100	14.3 \times 7.6 \times 8.2	3	100	35	6.2	0.16	2.5	1.6	139 65101
25	10	14.3 \times 6.2 \times 6.9	2	40	8	3.5	0.09	14	12	139 66109
	22	14.3 \times 6.2 \times 6.9	2	48	14	4.1	0.14	10	5.5	139 66229
	33	14.3 \times 6.2 \times 6.9	2	59	19	4.7	0.14	6.8	3.7	139 66339
	47	14.3 \times 7.6 \times 8.2	3	79	27	5.4	0.14	4.7	2.6	139 66479
40	15	14.3 \times 6.2 \times 6.9	2	45	15	4.2	0.11	12	6	139 67159
	33	14.3 \times 7.6 \times 8.2	3	75	29	5.6	0.11	5.3	2.7	139 67339
50	10	14.3 \times 6.2 \times 6.9	2	40	13	4.0	0.09	14	7	139 61109
	15	14.3 \times 7.6 \times 8.2	3	56	18	4.5	0.09	9.5	4.7	139 61159
	22	14.3 \times 7.6 \times 8.2	3	67	25	5.2	0.09	6.5	3.2	139 61229
63	2.2	14.3 \times 6.2 \times 6.9	2	19	6	3.3	0.09	65	25	139 68228
	3.3	14.3 \times 6.2 \times 6.9	2	23	7	3.4	0.09	43	21	139 68338
	4.7	14.3 \times 6.2 \times 6.9	2	28	9	3.6	0.09	30	17	139 68478
	10	14.3 \times 7.6 \times 8.2	3	48	16	4.3	0.08	13	8	139 68109
100	1.0	14.3 \times 6.2 \times 6.9	2	12	5	3.2	0.09	140	55	139 69108
	2.2	14.3 \times 6.2 \times 6.9	2	19	7	3.4	0.09	65	29	139 69228
	3.3	14.3 \times 7.6 \times 8.2	3	27	10	3.7	0.08	39	17	139 69338
	4.7	14.3 \times 7.6 \times 8.2	3	33	12	3.9	0.08	27	11	139 69478

Aluminum electrolytic capacitors

SMD (Chip) Long Life

139 CLL

Additional electrical data

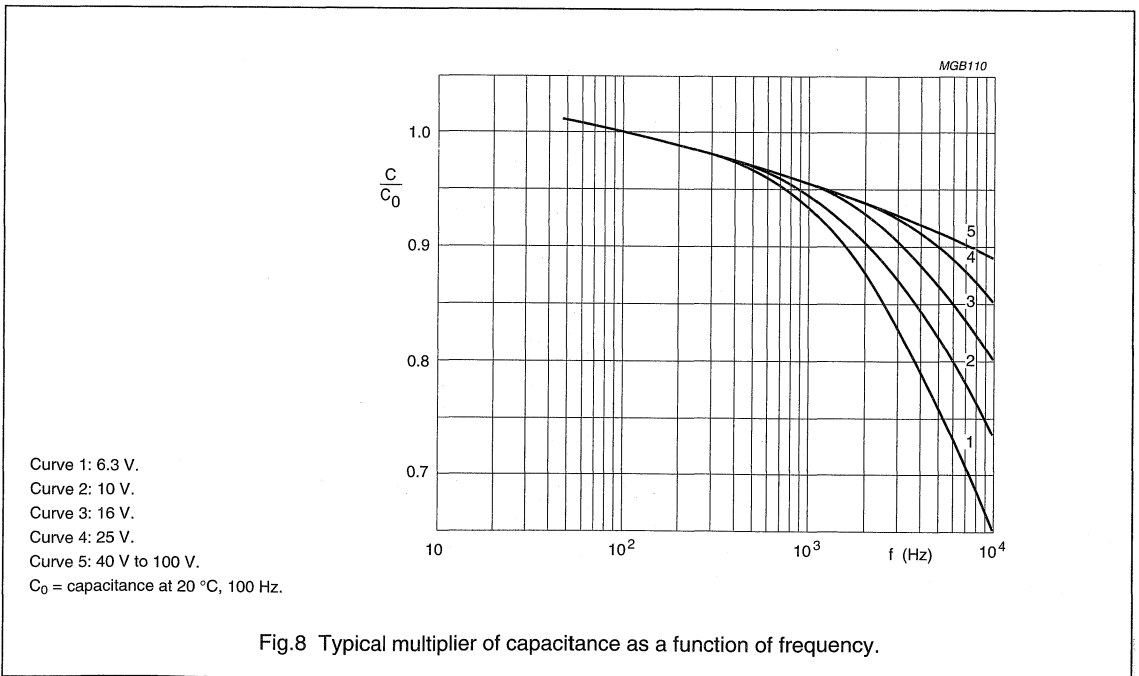
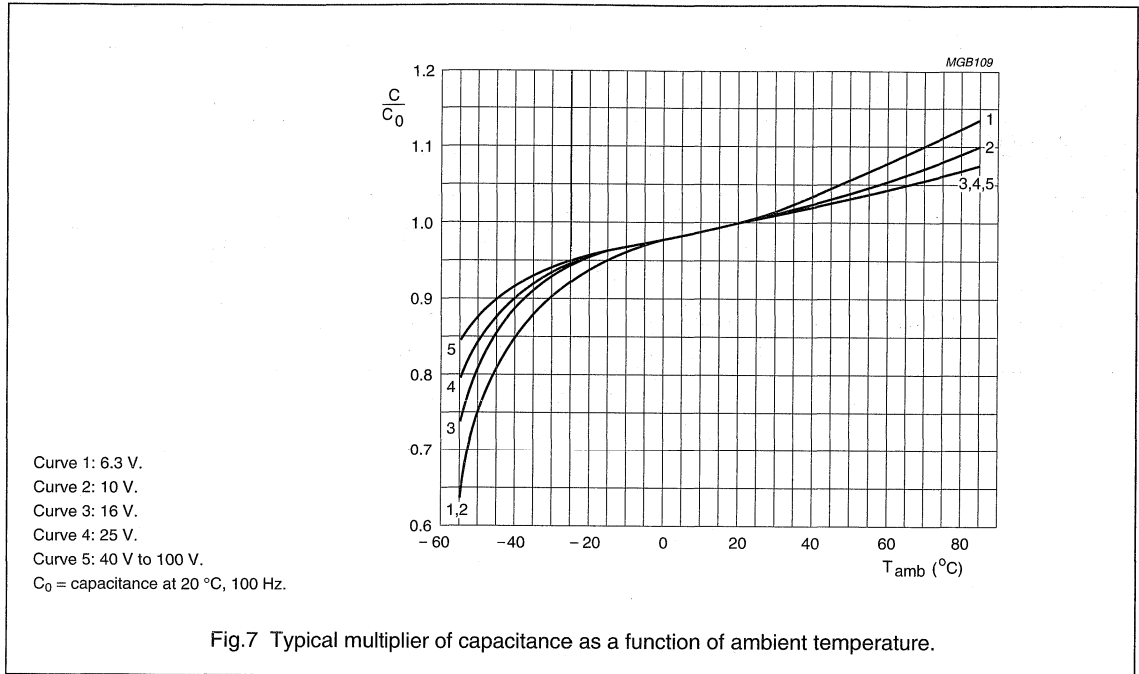
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.02C_R \times U_R + 3 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	nominal case size 14.3 × 6.2 × 6.9 mm	typ. 18 nH
	nominal case size 14.3 × 7.6 × 8.2 mm	typ. 28 nH

SMD

Aluminum electrolytic capacitors SMD (Chip) Long Life

139 CLL

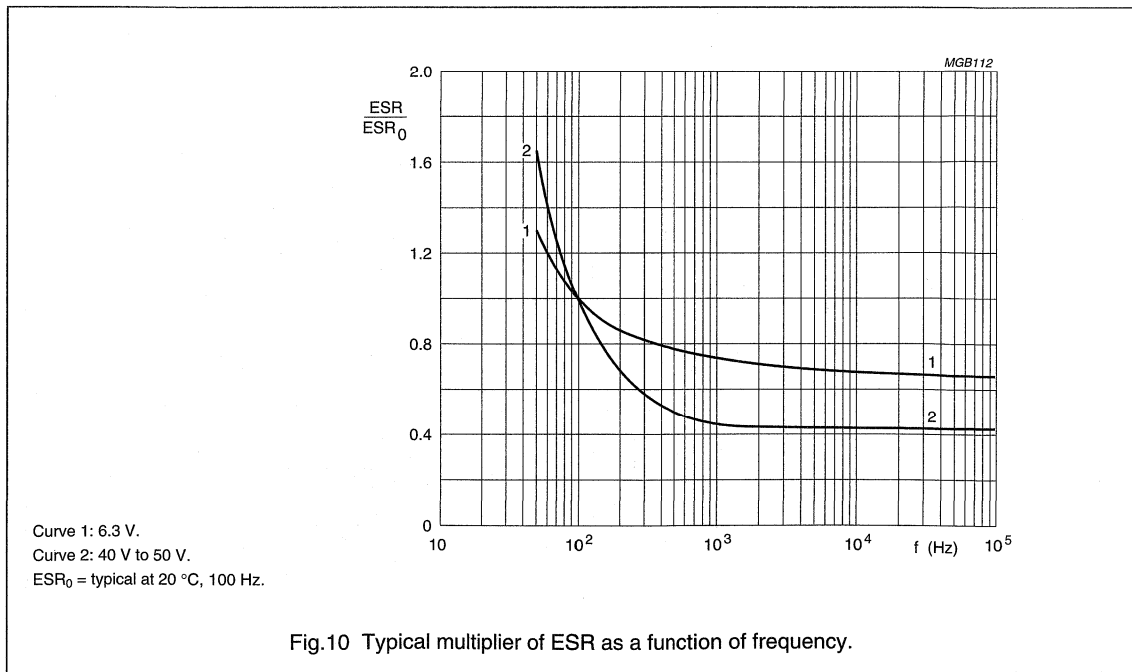
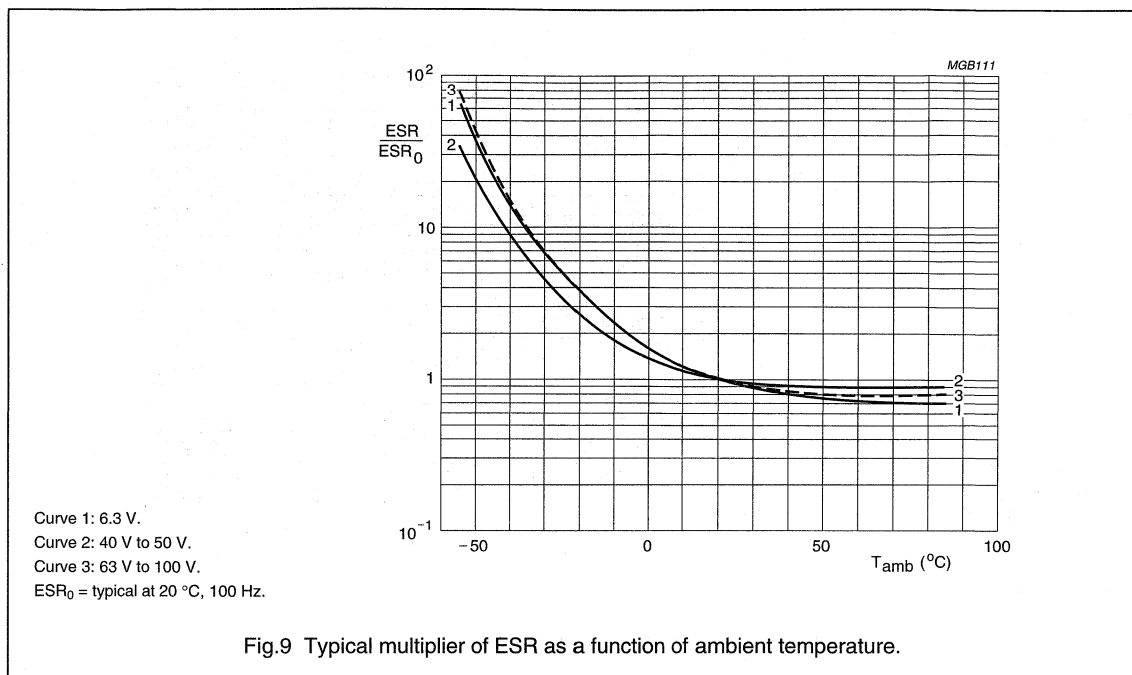
Capacitance (C)



Aluminum electrolytic capacitors SMD (Chip) Long Life

139 CLL

Equivalent series resistance (ESR)



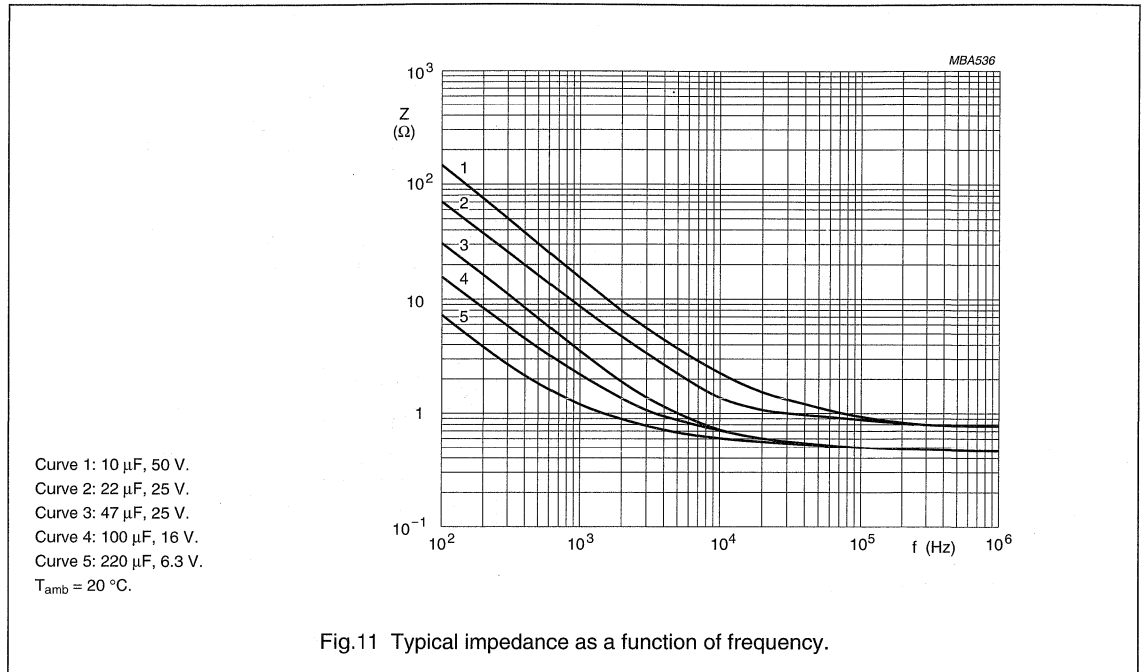
SMD

Aluminum electrolytic capacitors

SMD (Chip) Long Life

139 CLL

Impedance (Z)



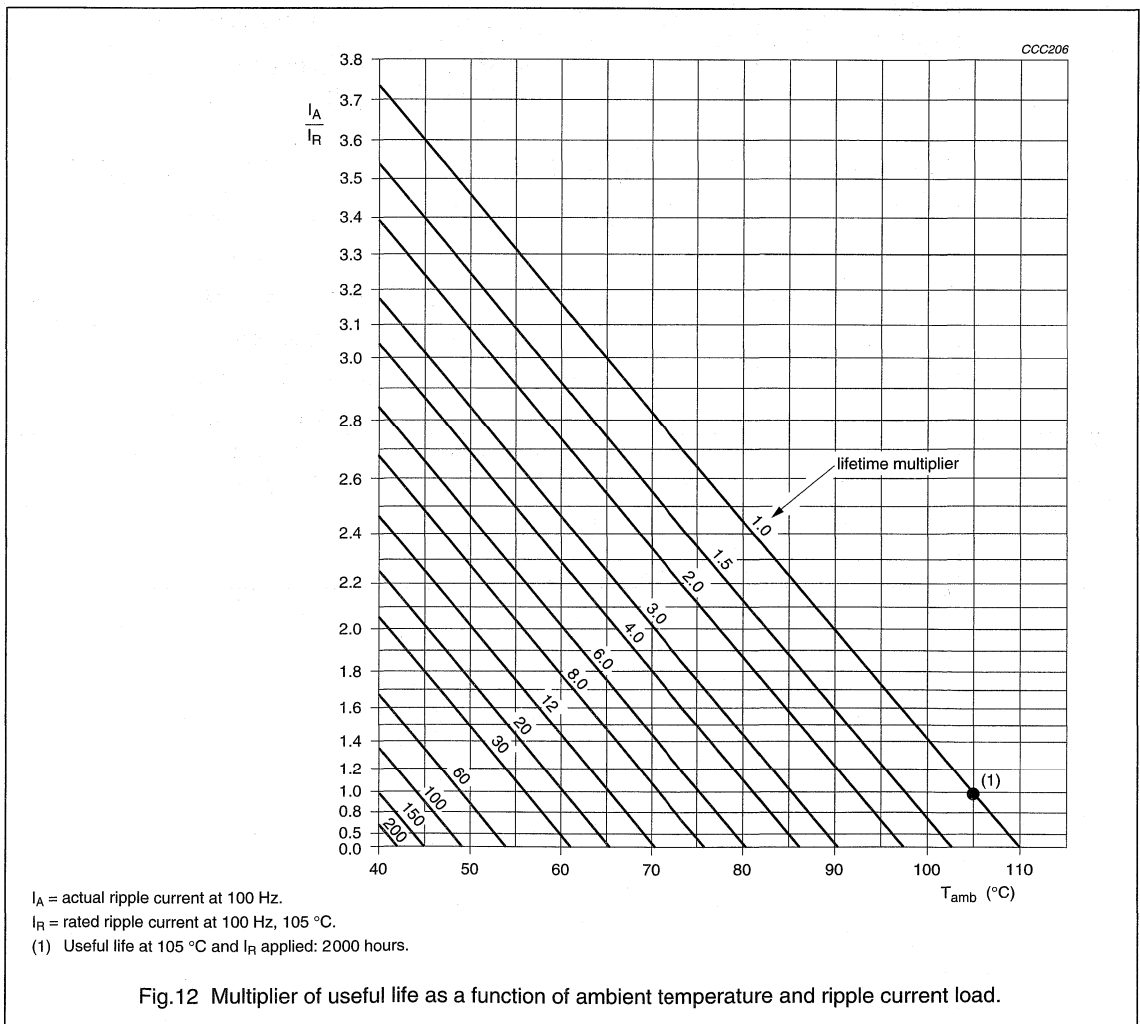
Aluminum electrolytic capacitors SMD (Chip) Long Life

139 CLL

RIPPLE CURRENT AND USEFUL LIFE

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 50 V	$U_R = 63$ to 100 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



SMD

Aluminum electrolytic capacitors

SMD (Chip) Long Life

139 CLL

SPECIFIC TESTS AND REQUIREMENTS

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

Table 6 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Mounting	IEC 60384-18, subclause 4.3	shall be performed prior to tests mentioned below; reflow or (double-) wave soldering; for maximum temperature load refer to chapter "Mounting"	$\Delta C/C: \pm 5\%$ $\tan \delta \leq \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Endurance	IEC 60384-18/ CECC 32300, subclause 4.15	$T_{\text{amb}} = 105\text{ }^{\circ}\text{C}$; U_R applied; 1000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C: +15/-30\%$ $U_R = 10\text{ to }100\text{ V}$; $\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{\text{amb}} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; 2000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C: +45/-50\%$ $U_R = 10\text{ to }100\text{ V}$; $\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-18/ CECC 32300, subclause 4.17	$T_{\text{amb}} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	for requirements see 'Endurance test' above

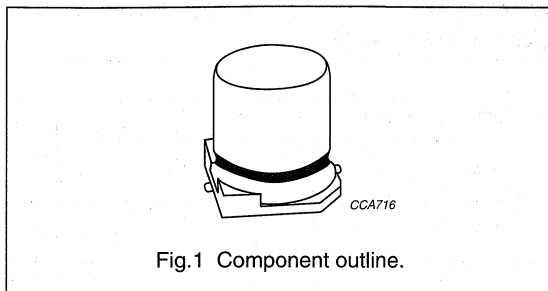
Aluminum electrolytic capacitors

SMD (Chip) Long Life Vertical

153 CLV

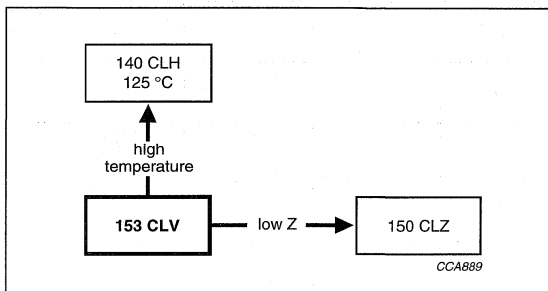
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, vertical construction requiring minimum board space, reflow solderable
- High CV per unit volume
- Long useful life: 2000 to 3000 hours at 105 °C
- Charge and discharge proof, no peak current limitation
- Supplied in blister tape on reel.



APPLICATIONS

- SMD technology, for high mounting density
- Coupling, decoupling, smoothing, filtering, buffering, timing
- Telecommunications, general industrial, EDP, automotive, portable and lightweight equipment.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (L × W × H in mm)	4.0 × 4.0 × 5.3 to 10 × 10 × 14
Rated capacitance range, C _R	0.47 to 1000 μF
Tolerance on C _R	±20%
Rated voltage range, U _R	6.3 to 100 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C:	
case sizes 4.0 × 4.0 × 5.3 to 6.3 × 6.3 × 5.3	1000 hours
case sizes 8.0 × 8.0 × 6.5 to 10 × 10 × 14	2000 hours
Useful life at 105 °C:	
case sizes 4.0 × 4.0 × 5.3 to 6.3 × 6.3 × 5.3	2000 hours
case sizes 8.0 × 8.0 × 6.5 to 10 × 10 × 14	3000 hours
Useful life at 40 °C; 1.3 × I _R applied:	
case sizes 4.0 × 4.0 × 5.3 to 6.3 × 6.3 × 5.3	200000 hours
case sizes 8.0 × 8.0 × 6.5 to 10 × 10 × 14	300000 hours
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-18/CECC 32300
Climatic category IEC 60068	55/105/56

SMD

Aluminum electrolytic capacitors

SMD (Chip) Long Life Vertical

153 CLV

Selection chart for C_R , U_R and relevant nominal case sizes (L × W × H in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	6.3	10	16	25	35	50	63	100
0.47	-	-	-	-	-	4.0 × 4.0 × 5.3	-	-
1.0	-	-	-	-	-	4.0 × 4.0 × 5.3	-	-
2.2	-	-	-	-	-	4.0 × 4.0 × 5.3	-	-
3.3	-	-	-	-	-	4.0 × 4.0 × 5.3	-	-
4.7	-	-	-	-	4.0 × 4.0 × 5.3	5.0 × 5.0 × 5.3	-	-
10	-	-	4.0 × 4.0 × 5.3	-	5.0 × 5.0 × 5.3	6.3 × 6.3 × 5.3	-	10 × 10 × 12
22	4.0 × 4.0 × 5.3	-	5.0 × 5.0 × 5.3	-	6.3 × 6.3 × 5.3	8.0 × 8.0 × 6.5	-	10 × 10 × 12
33	-	5.0 × 5.0 × 5.3	-	6.3 × 6.3 × 5.3	8.0 × 8.0 × 6.5	8.0 × 8.0 × 10	-	10 × 10 × 14
47	5.0 × 5.0 × 5.3	-	6.3 × 6.3 × 5.3	8.0 × 8.0 × 6.5	-	8.0 × 8.0 × 10	10 × 10 × 12	-
100	6.3 × 6.3 × 5.3	-	8.0 × 8.0 × 6.5	8.0 × 8.0 × 10	-	10 × 10 × 10	10 × 10 × 14	-
	-	-	-	-	-	10 × 10 × 12	-	-
220	-	8.0 × 8.0 × 10	10 × 10 × 10	10 × 10 × 12	10 × 10 × 12	-	-	-
330	8.0 × 8.0 × 10	10 × 10 × 10	10 × 10 × 12	10 × 10 × 14	-	-	-	-
470	10 × 10 × 10	10 × 10 × 12	10 × 10 × 14	-	-	-	-	-
680	10 × 10 × 12	10 × 10 × 14	-	-	-	-	-	-
1000	10 × 10 × 14	-	-	-	-	-	-	-

Aluminum electrolytic capacitors

SMD (Chip) Long Life Vertical

153 CLV

PACKAGING

Supplied in blister tape on reel. For general packaging information refer to this data handbook, section "Packaging".

Table 1 Tape and reel dimensions

CASE CODE	PITCH P ₁ (mm)	TAPE WIDTH W (mm)	TAPE THICKNESS T ₂ (mm)	REEL DIA. (mm)	PACKAGING QUANTITY PER REEL
0405	8	12	5.8	380	2000
0505	12	12	5.8	380	1000
0605	12	16	5.8	380	1000
0807	12	16	6.8	380	1000
0810	16	24	11	380	500
1010	16	24	11	380 ⁽¹⁾	500
				330 ⁽¹⁾	250
1012	16	24	13	330	250
1014	16	24	15	330	250

Note

- Depending on production location.

MARKING

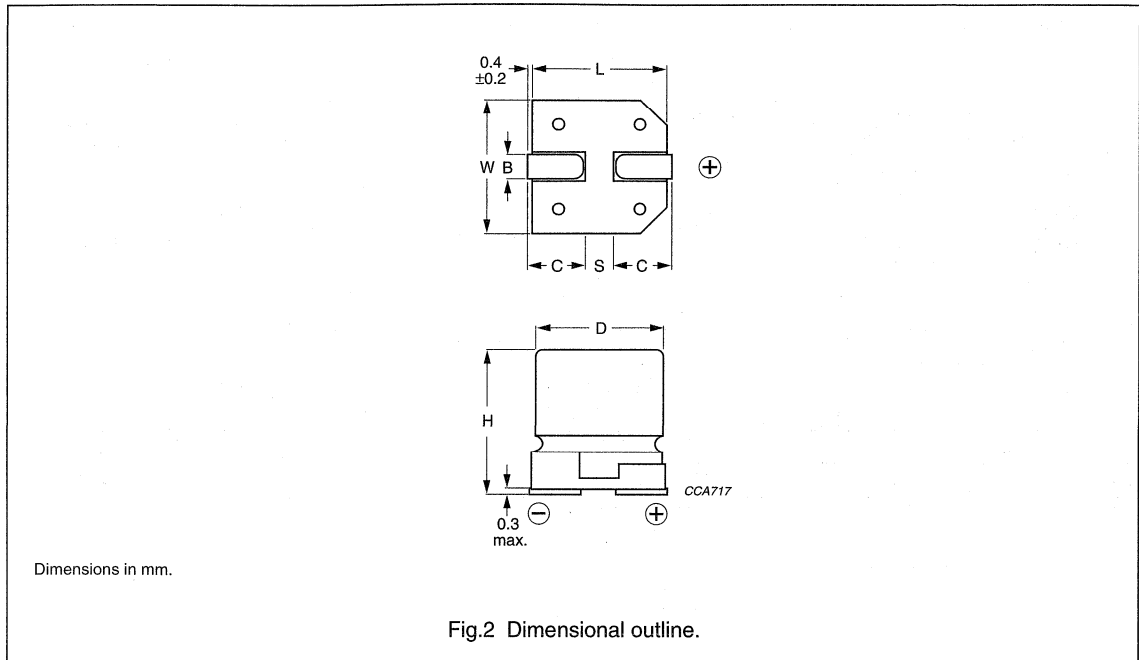
- Rated capacitance (in μF)
- Rated voltage (in V)
- Black mark or '-' sign indicating the cathode (the anode is identified by bevelled edges)
- Code indicating group number (V)
- Date code, in accordance with "IEC 60062".



Aluminum electrolytic capacitors

SMD (Chip) Long Life Vertical

153 CLV

MECHANICAL DATA**Table 2** Physical dimensions, mass and packaging quantities; see Fig.2

NOMINAL CASE SIZE L × W × H (mm)	CASE CODE	L _{max} (mm)	W _{max} (mm)	H _{max} (mm)	∅D (mm)	B _{max} (mm)	S (mm)	C (mm)	MASS (g)
4.0 × 4.0 × 5.3	0405	4.5	4.5	5.5	4.0	0.8	1.0	2.0 ±0.2	≈0.13
5.0 × 5.0 × 5.3	0505	5.5	5.5	5.5	5.0	0.8	1.4	2.3 ±0.2	≈0.20
6.3 × 6.3 × 5.3	0605	6.8	6.8	5.5	6.3	0.8	2.0	2.7 ±0.2	≈0.30
8.0 × 8.0 × 6.5	0807	8.6	8.6	6.8	8.0	0.8	2.3	3.4 ±0.2	≈0.50
8.0 × 8.0 × 10	0810	8.6	8.6	10.5	8.0	1.1	3.1	3.0 ±0.2	≈1.00
10 × 10 × 10	1010	10.6	10.6	10.5	10.0	1.1	4.7	3.3 ±0.2	≈1.30
10 × 10 × 12	1012	10.6	10.6	12.3	10.0	1.2	4.5	3.9 ±0.2	≈1.40
10 × 10 × 14	1014	10.6	10.6	14.3	10.0	1.2	4.5	3.9 ±0.2	≈1.50

Aluminum electrolytic capacitors SMD (Chip) Long Life Vertical

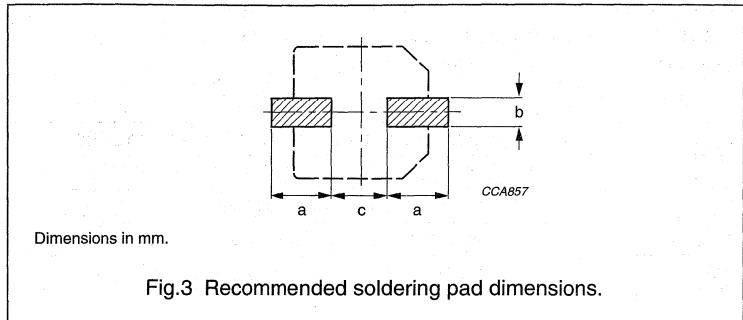
153 CLV

MOUNTING

The capacitors are designed for automatic placement on to printed-circuit boards.

Optimum dimensions of soldering pads depend amongst others on soldering method, mounting accuracy, print lay-out and/or adjacent components.

For recommended soldering pad dimensions, refer to Fig.3 and Table 3.



Soldering

Soldering conditions are defined by the curve, temperature versus time, where the temperature is that measured on the soldering pad during processing.

For maximum conditions refer to Fig.4.

Any temperature versus time curve which does not exceed the specified maximum curves may be applied.

AS A GENERAL PRINCIPLE, TEMPERATURE AND DURATION SHALL BE THE **MINIMUM** NECESSARY REQUIRED TO ENSURE GOOD SOLDERING CONNECTIONS.

Table 3 Recommended soldering pad dimensions

CASE CODE	a (mm)	b (mm)	c (mm)
0405	2.6	1.6	1.0
0505	3.0	1.6	1.4
0605	3.5	1.6	1.9
0807	4.0	1.6	2.1
0810	3.5	2.5	3.0
1010	4.0	2.5	4.0
1012	4.3	2.5	4.0
1014	4.3	2.5	4.0

SMD

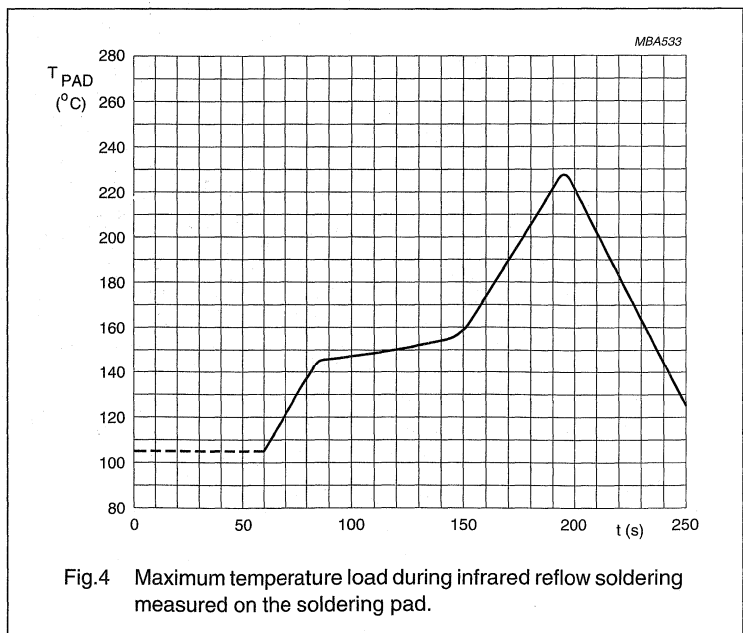


Fig.4 Maximum temperature load during infrared reflow soldering measured on the soldering pad.

Aluminum electrolytic capacitors

SMD (Chip) Long Life Vertical

153 CLV

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 4 apply at
 $T_{amb} = 20\text{ }^{\circ}\text{C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 or 120 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 or 120 Hz, $105\text{ }^{\circ}\text{C}$
I_{L2}	max. leakage current after 2 minutes at U_R
$\tan \delta$	max. dissipation factor at 100 or 120 Hz
ESR	equivalent series resistance at 100 kHz

Ordering example

Electrolytic capacitor 153 series

100 $\mu\text{F}/25\text{ V}$; $\pm 20\%$

Nominal case size:
 $8 \times 8 \times 10\text{ mm}$; taped on reel

Catalogue number: 2222 153 66101.

Table 4 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R (μF)	NOMINAL CASE SIZE L × W × H (mm)	CASE CODE	I_R $105\text{ }^{\circ}\text{C}$ (mA)	I_{L2} 2 min (μA)	$\tan \delta$	ESR 100 kHz (Ω)	CATALOGUE NUMBER 2222
6.3	22	4.0 × 4.0 × 5.3	0405	21	3.0	0.30	8	153 63229
	47	5.0 × 5.0 × 5.3	0505	36	3.0	0.30	4	153 63479
	100	6.3 × 6.3 × 5.3	0605	61	6.3	0.30	2	153 63101
	330	8.0 × 8.0 × 10	0810	180	21	0.30	0.5	153 63331
	470	10 × 10 × 10	1010	320	30	0.30	0.3	153 63471
	680	10 × 10 × 12	1012	340	43	0.24	0.29	153 63681
1000	10 × 10 × 14	1014	400	63	0.24	0.24	153 63102	
10	33	5.0 × 5.0 × 5.3	0505	31	3.3	0.26	4	153 64339
	220	8.0 × 8.0 × 10	0810	180	22	0.26	0.5	153 64221
	330	10 × 10 × 10	1010	320	33	0.26	0.3	153 64331
	470	10 × 10 × 12	1012	330	47	0.19	0.29	153 64471
	680	10 × 10 × 14	1014	380	68	0.19	0.24	153 64681
16	10	4.0 × 4.0 × 5.3	0405	16	3.0	0.22	8	153 65109
	22	5.0 × 5.0 × 5.3	0505	28	3.5	0.22	4	153 65229
	47	6.3 × 6.3 × 5.3	0605	47	7.5	0.22	2.2	153 65479
	100	8.0 × 8.0 × 6.5	0807	110	16	0.22	1.2	153 65101
	220	10 × 10 × 10	1010	320	35	0.22	0.3	153 65221
	330	10 × 10 × 12	1012	330	53	0.16	0.29	153 65331
	470	10 × 10 × 14	1014	370	75	0.16	0.25	153 65471
25	33	6.3 × 6.3 × 5.3	0605	44	8.3	0.16	2.2	153 66339
	47	8.0 × 8.0 × 6.5	0807	110	12	0.16	1.2	153 66479
	100	8.0 × 8.0 × 10	0810	180	25	0.16	0.5	153 66101
	220	10 × 10 × 12	1012	270	55	0.14	0.29	153 66221
	330	10 × 10 × 14	1014	300	83	0.14	0.27	153 66331

Aluminum electrolytic capacitors

SMD (Chip) Long Life Vertical

153 CLV

U_R (V)	C_R (μ F)	NOMINAL CASE SIZE L × W × H (mm)	CASE CODE	I_R 105 °C (mA)	I_{L2} 2 min (μ A)	Tan δ	ESR 100 kHz (Ω)	CATALOGUE NUMBER 2222
35	4.7	4.0 × 4.0 × 5.3	0405	14	3.0	0.13	8	153 60478
	10	5.0 × 5.0 × 5.3	0505	23	3.5	0.13	4	153 60109
	22	6.3 × 6.3 × 5.3	0605	50	7.7	0.13	2.2	153 60229
	33	8.0 × 8.0 × 6.5	0807	110	12	0.13	1.2	153 60339
	220	10 × 10 × 12	1012	270	77	0.12	0.29	153 60221
50	0.47	4.0 × 4.0 × 5.3	0405	5	3.0	0.12	12	153 61477
	1.0	4.0 × 4.0 × 5.3	0405	7	3.0	0.12	12	153 61108
	2.2	4.0 × 4.0 × 5.3	0405	10	3.0	0.12	12	153 61228
	3.3	4.0 × 4.0 × 5.3	0405	12	3.0	0.12	12	153 61338
	4.7	5.0 × 5.0 × 5.3	0505	17	3.0	0.12	6	153 61478
	10	6.3 × 6.3 × 5.3	0605	26	5.0	0.12	3	153 61109
	22	8.0 × 8.0 × 6.5	0807	110	11.0	0.12	1.2	153 61229
	33	8.0 × 8.0 × 10	0810	180	17	0.12	0.5	153 61339
	47	8.0 × 8.0 × 10	0810	180	24	0.12	0.5	153 61479
	100	10 × 10 × 10	1010	320	50	0.12	0.3	153 61101
	100	10 × 10 × 12	1012	230	50	0.12	0.29	153 91106
63	47	10 × 10 × 12	1012	220	30	0.09	0.29	153 68479
	100	10 × 10 × 14	1014	240	63	0.09	0.41	153 68101
100	10	10 × 10 × 12	1012	150	10	0.07	0.9	153 69109
	22	10 × 10 × 12	1012	150	25	0.07	0.9	153 69229
	33	10 × 10 × 14	1014	170	33	0.07	0.65	153 69339

SMD

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	IEC 60384-18, subclause 4.14	$U_s \leq 1.15 \times U_R$
Reverse voltage	IEC 60384-18, subclause 4.16	$U_{rev} \leq 1 V$
Current		
Leakage current	after 2 minutes at U_R	$I_{L2} \leq 0.01 \times C_R \times U_R$ or 3 μ A, whichever is greater
Inductance		
Equivalent series inductance (ESL)	case codes 0405 to 0605	typ. 10 nH
	case codes 0807 to 1010	typ. 15 nH
	case codes 1012 and 1014	typ. 16 nH

Aluminum electrolytic capacitors
SMD (Chip) Long Life Vertical

153 CLV

Capacitance (C)

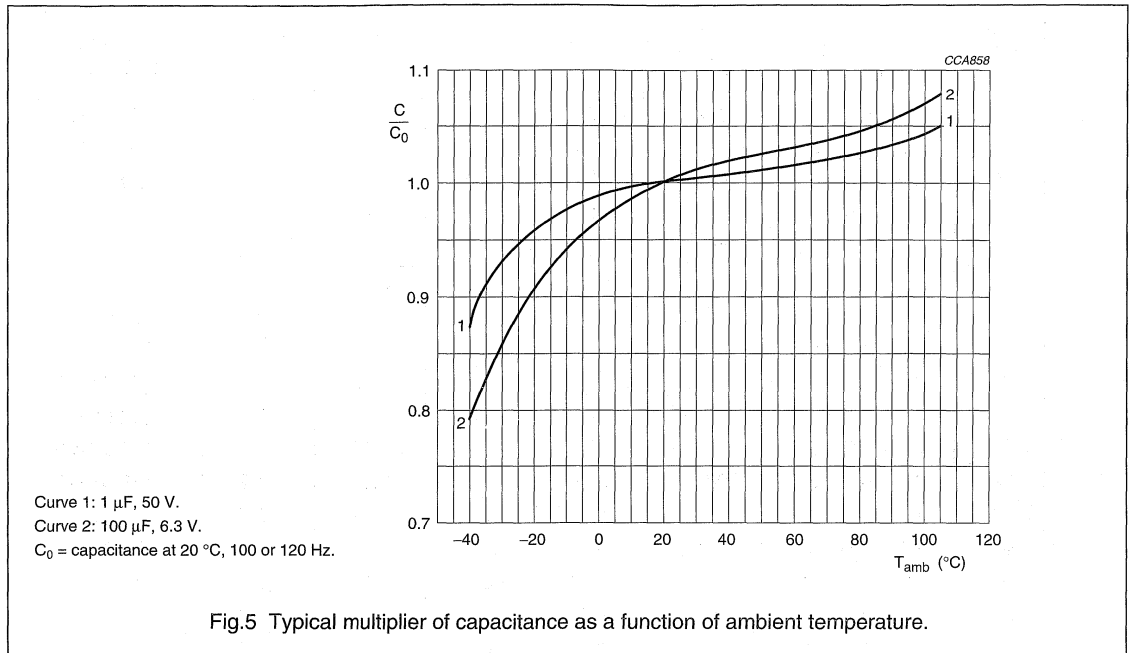


Fig.5 Typical multiplier of capacitance as a function of ambient temperature.

Dissipation factor ($\tan \delta$)

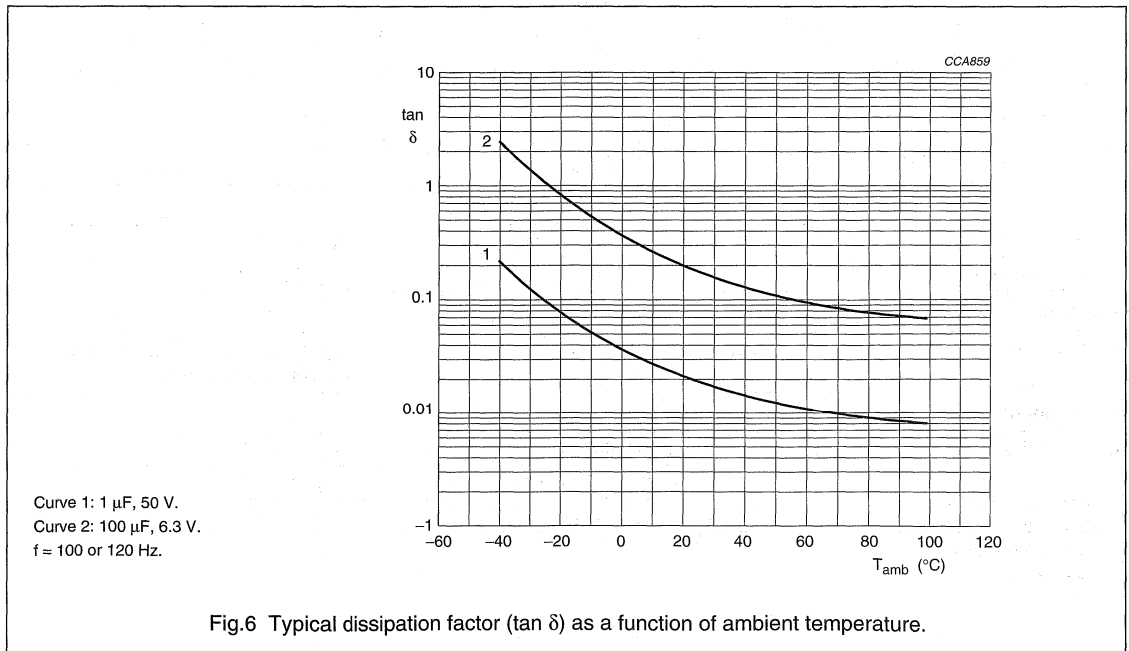


Fig.6 Typical dissipation factor ($\tan \delta$) as a function of ambient temperature.

Aluminum electrolytic capacitors SMD (Chip) Long Life Vertical

153 CLV

Equivalent series resistance (ESR)

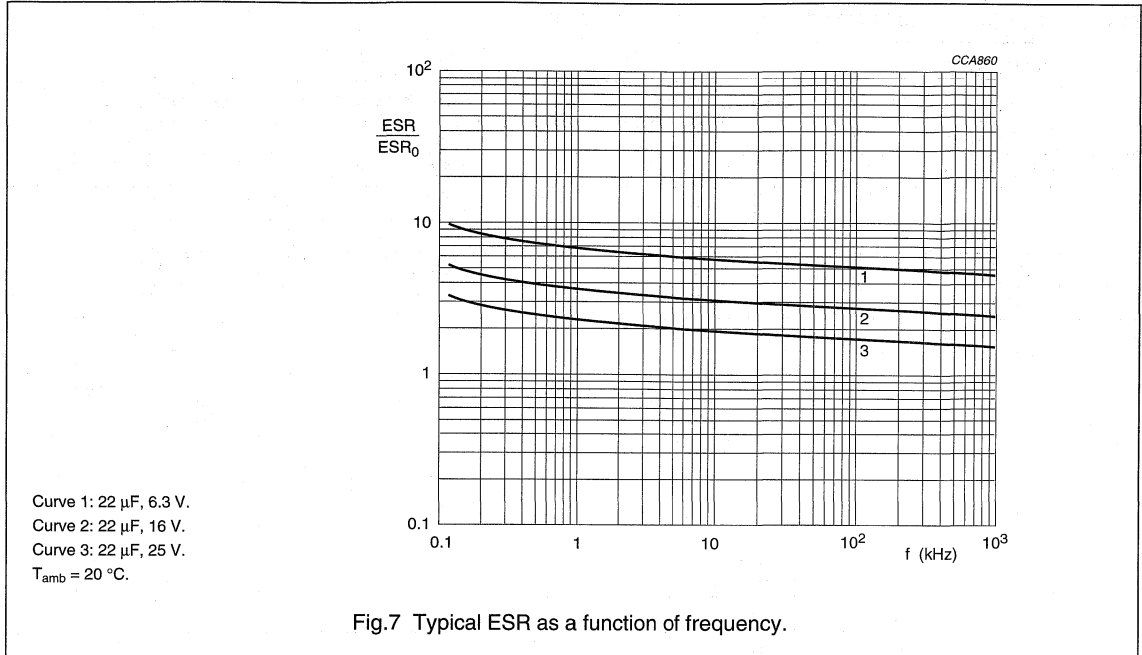


Fig.7 Typical ESR as a function of frequency.

Impedance (Z)

SMD

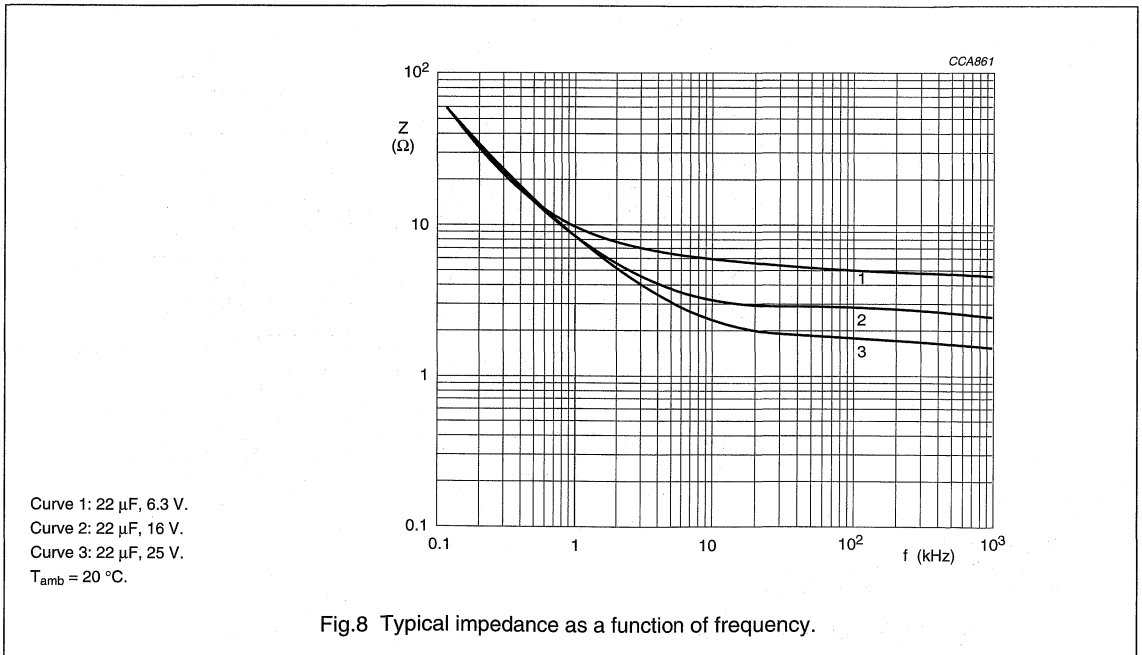


Fig.8 Typical impedance as a function of frequency.

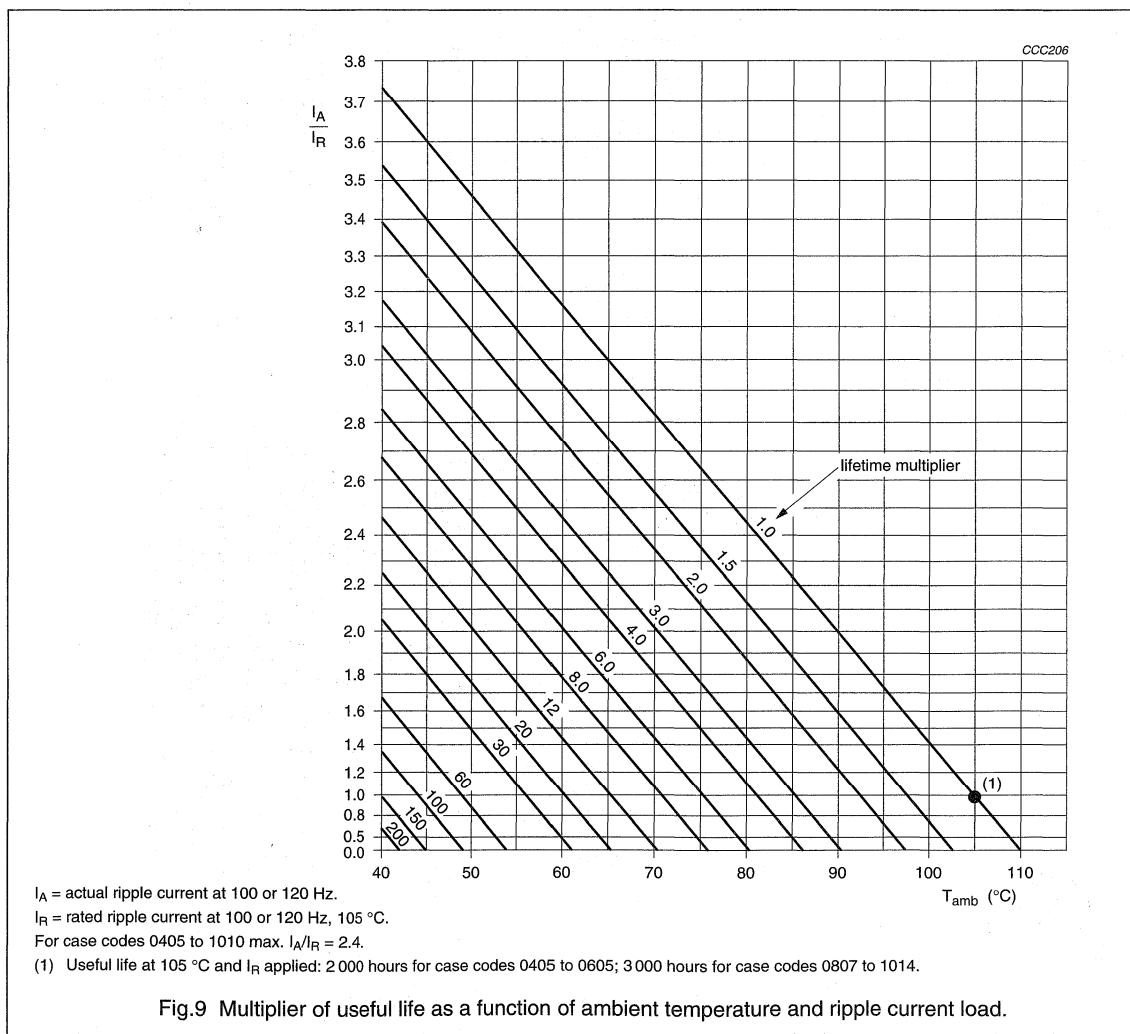
Aluminum electrolytic capacitors SMD (Chip) Long Life Vertical

153 CLV

RIPPLE CURRENT AND USEFUL LIFE

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	$U_R = 25$ or 35 V	$U_R = 50$ to 100 V
50 or 60	0.80	0.80	0.80
100 or 120	1.00	1.00	1.00
300	1.10	1.15	1.20
1000	1.15	1.25	1.35
3000	1.20	1.35	1.45
≥ 10000	1.25	1.40	1.50



Aluminum electrolytic capacitors

SMD (Chip) Long Life Vertical

153 CLV

SPECIFIC TESTS AND REQUIREMENTS


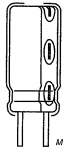
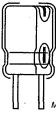
General tests and requirements are specified in this data handbook, section "Tests and Requirements".

Table 6 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Mounting	IEC 60384-18, subclause 4.3	shall be performed prior to tests mentioned below; reflow soldering; for maximum temperature load refer to chapter "Mounting"	$\Delta C/C: \pm 10\%$ $\tan \delta \leq \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Endurance	IEC 60384-18/ CECC 32300, subclause 4.15	$T_{\text{amb}} = 105\text{ }^\circ\text{C}$; U_R applied; 1 000 hours, case codes 0405 to 0605 2 000 hours, case codes 0807 to 1014	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{\text{amb}} = 105\text{ }^\circ\text{C}$; U_R and I_R applied; 2 000 hours, case codes 0405 to 0605 3 000 hours, case codes 0807 to 1014	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-18/ CECC 32300, subclause 4.17	$T_{\text{amb}} = 105\text{ }^\circ\text{C}$; no voltage applied; 1 000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	for requirements see 'Endurance test' above

SMD

RADIAL ALUMINUM ELECTROLYTIC CAPACITORS

	STANDARD and MINIATURE	SEMI-PROFESSIONAL	LONG-LIFE	EXTRA LONG-LIFE or HIGH TEMPERATURE
 MBB101  MBB097 <div style="display: flex; align-items: center; justify-content: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;">smaller dimensions</div> <div style="font-size: 2em; margin: 0 10px;">↓</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;">higher CV per volume</div> </div>  MBB097	1500 to 3000 hours 85 °C	750 to 2500 hours 105 °C	2000 to 4000 hours 105 °C	1500 hours / 125 °C ≥4000 hours / 105 °C
		013 RLC <i>low leakage</i> <i>page 190</i>	046 RSL <i>maintenance type</i> <i>page 304</i>	165 RHT 125 °C <i>maintenance type</i> <i>page 334</i>
	044 RSH <i>high voltage</i> <i>page 178</i>	135 RLI <i>low Z</i> <i>page 258</i>	151 RLH <i>high voltage</i> <i>page 295</i>	140 RTM 125 °C <i>NEW</i> <i>page 344</i>
	037 RSM <i>low voltage</i> <i>page 160</i>	<i>page 204</i> 036 RSP 047 RMS <i>page 217</i>	<i>page 244</i> 116 RLL 048 RML <i>page 272</i>	136 RVI 105 °C <i>very low Z</i> <i>page 317</i>
	038 RSU <i>low voltage</i> <i>NEW</i> <i>page 144</i>		<i>NEW</i> 152 RMH <i>high voltage</i> <i>page 285</i>	<i>NEW</i> 150 RMI 105 °C <i>very low Z</i> <i>page 356</i>
	<i>page 137</i> 097 RLP 7 H: 7 mm 134 RLP 5 H: 5 mm <i>page 130</i>		<i>NEW</i> 148 RUS <i>miniature</i> <i>page 229</i>	

Aluminum electrolytic capacitors

Radial Low Profile, 5 mm

134 RLP 5

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Very low profile, 5 mm height
- Extremely miniaturized.

APPLICATIONS

- General purpose, industrial, automotive and audio-video
- Coupling, decoupling, smoothing, filtering and timing
- High mounting density
- Portable and mobile equipment (very small size and very low mass), low profile equipment.

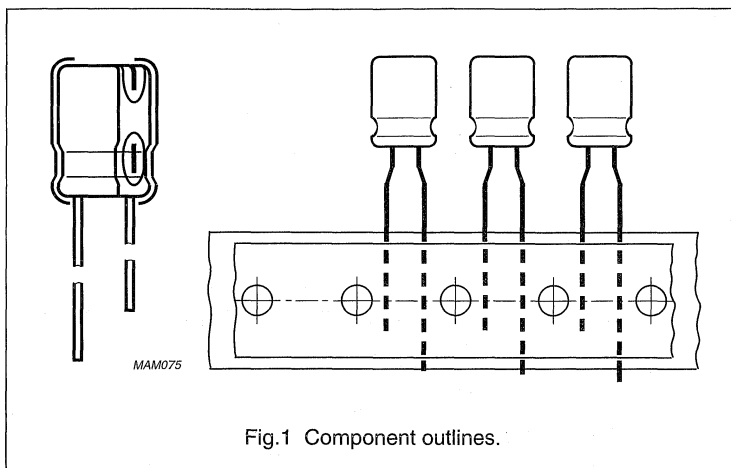
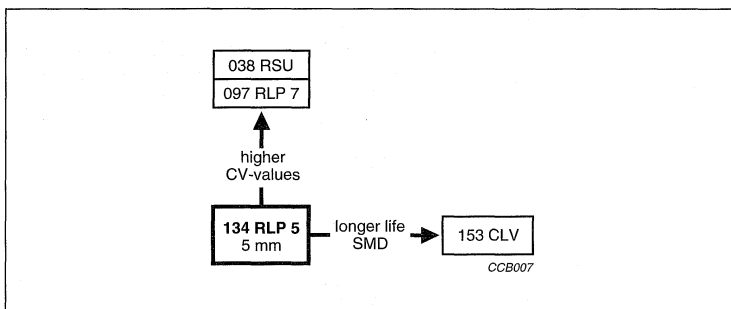


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	3×5 to 6.3×5
Rated capacitance range, C_R	1.0 to 100 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	6.3 to 50 V
Category temperature range	-40 to $+85$ °C
Endurance test at 85 °C	1000 hours
Useful life at 85 °C	1500 hours
Useful life at 40 °C, $1.4 \times I_R$ applied	40000 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

Aluminum electrolytic capacitors

Radial Low Profile, 5 mm

134 RLP 5

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	$U_R(\text{V})$					
	6.3	10	16	25	35	50
1.0	–	–	–	–	–	3 × 5
2.2	–	–	–	–	3 × 5	3.5 × 5
3.3	–	–	–	3 × 5	–	4 × 5
4.7	–	–	–	3.5 × 5	4 × 5	5 × 5
10	–	–	3.5 × 5	–	5 × 5	6.3 × 5
22	4 × 5	–	5 × 5	–	6.3 × 5	–
33	–	5 × 5	–	6.3 × 5	–	–
47	5 × 5	–	6.3 × 5	–	–	–
100	6.3 × 5	–	–	–	–	–

MARKING

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

- Rated capacitance (in μF)
- Rated voltage (in V)
- Negative terminal identification
- Group number (134)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062".



Aluminum electrolytic capacitors

Radial Low Profile, 5 mm

134 RLP 5

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

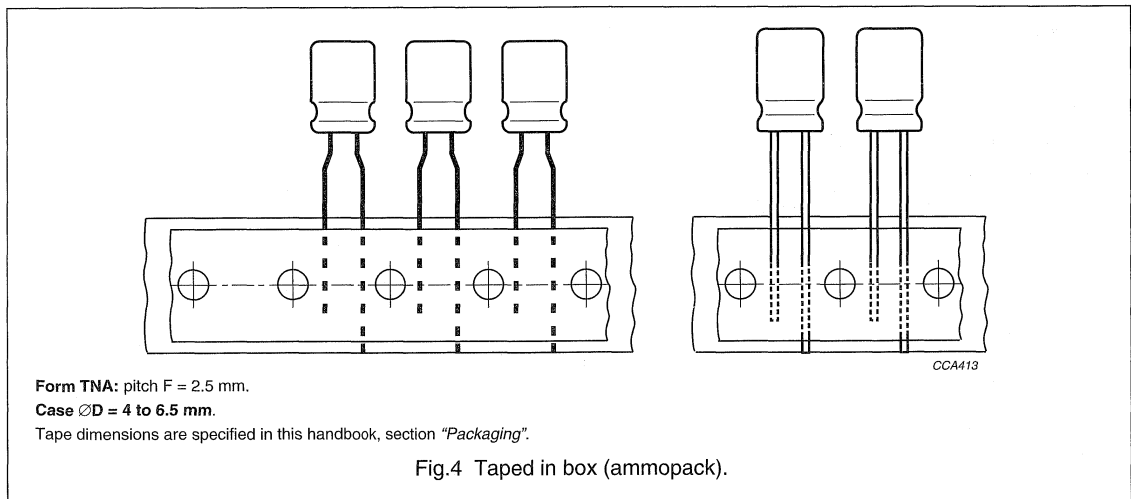
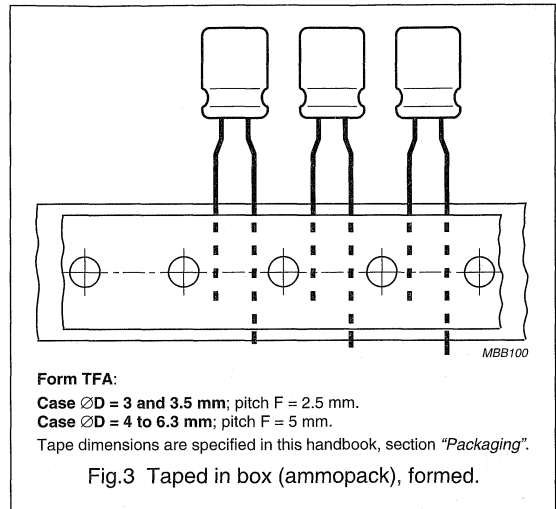
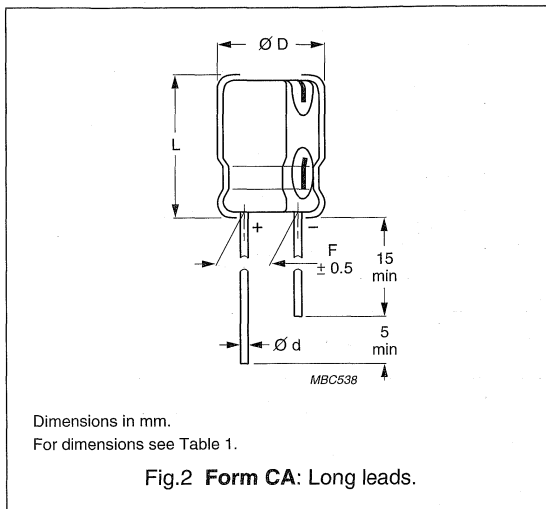


Table 1 Physical dimensions and packaging quantities; see Figs 2, 3 and 4

NOMINAL CASE SIZE $\text{ØD} \times L$ (mm)	CASE CODE	Ød (mm)	ØD_{max} (mm)	L_{max} (mm)	F (mm)	PACKAGING QUANTITIES		
						FORM CA	FORM TFA	FORM TNA
3 × 5	51	0.40	3.5	6.0	1.0 ±0.3	3000	3000	–
3.5 × 5	52	0.40	4.0	6.0	1.0 ±0.3	3000	3000	–
4 × 5	53	0.45	4.5	6.0	1.5 ±0.5	2000	2000	2000
5 × 5	54	0.45	5.5	6.0	2.0 ±0.5	2000	2000	2000
6.3 × 5	55	0.45	6.8	6.0	2.5 ±0.5	2000	2000	2000

Aluminum electrolytic capacitors Radial Low Profile, 5 mm

134 RLP 5

Ordering example

Electrolytic capacitor 134 series
22 $\mu\text{F}/16 \text{ V}$; $\pm 20\%$
Nominal case size: $\varnothing 5 \times 5 \text{ mm}$; Form TFA
Catalogue number: 2222 134 35229.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20^\circ\text{C}$,
 $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 120 Hz, 85°C
I_{L2}	max. leakage current after 2 minutes at U_R
$\text{Tan } \delta$	max. dissipation factor at 120 Hz
ESR	equivalent series resistance at 120 Hz (calculated from $\text{tan } \delta_{\text{max}}$ and C_R)
Z	max. impedance at 10 kHz and 100 kHz

Table 2 Electrical data and ordering information; preferred types in bold

U_R 120 Hz (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85°C (mA)	I_{L2} 2 min (μA)	$\text{Tan } \delta$ 120 Hz	ESR 120 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER					
										BULK LONG LEADS		TAPED AMMOPACK			
										FORM CA	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
6.3	22	4 × 5	53	23	3	0.24	14	12	11	134 53229	1.5	134 33229	5.0	134 73229	2.5
	47	5 × 5	54	38	3	0.24	6.8	6.7	5.2	134 53479	2.0	134 33479	5.0	134 73479	2.5
	100	6.3 × 5	55	60	7	0.24	3.2	4.4	3.4	134 53101	2.5	134 33101	5.0	134 73101	2.5
10	33	5 × 5	54	35	4	0.20	8.0	7.7	6.0	134 54339	2.0	134 34339	5.0	134 74339	2.5
16	10	3.5 × 5	52	17	3	0.16	21	18	17	134 55109	1.0	134 35109	2.5	—	—
	22	5 × 5	54	32	4	0.16	9.6	8.0	6.4	134 55229	2.0	134 35229	5.0	134 75229	2.5
	47	6.3 × 5	55	50	8	0.16	4.5	5.2	4.2	134 55479	2.5	134 35479	5.0	134 75479	2.5
25	3.3	3 × 5	51	9.5	3	0.14	56	29	24	134 56338	1.0	134 36338	2.5	—	—
	4.7	3.5 × 5	52	12	3	0.14	40	22	19	134 56478	1.0	134 36478	2.5	—	—
	33	6.3 × 5	55	45	9	0.14	5.6	6.0	4.6	134 56339	2.5	134 36339	5.0	134 76339	2.5

Aluminum electrolytic capacitors
Radial Low Profile, 5 mm

134 RLP 5

CATALOGUE NUMBER 2222															
U _R 120 Hz (V)	C _R 120 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 120 Hz 85 °C (mA)	I _{L2} 2 min (μA)	Tan δ 120 Hz (Ω)	ESR 120 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	BULK LONG LEADS		TAPED AMMOPACK			
										FORM CA	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
35	2.2	3 × 5	51	8.3	3	0.12	72	48	41	134 50228	1.0	134 30228	2.5	-	-
	4.7	4 × 5	53	15	3	0.12	34	31	27	134 50478	1.5	134 30478	5.0	134 70478	2.5
	10	5 × 5	54	25	4	0.12	16	21	17	134 50109	2.0	134 30109	5.0	134 70109	2.5
	22	6.3 × 5	55	40	8	0.12	7.2	13	11	134 50229	2.5	134 30229	5.0	134 70229	2.5
	1.0	3 × 5	51	6.2	3	0.10	130	70	50	134 51108	1.0	134 31108	2.5	-	-
50	2.2	3.5 × 5	52	10	3	0.10	60	44	33	134 51228	1.0	134 31228	2.5	-	-
	3.3	4 × 5	53	14	3	0.10	40	36	25	134 51338	1.5	134 31338	5.0	134 71338	2.5
	4.7	5 × 5	54	19	3	0.10	28	29	22	134 51478	2.0	134 31478	5.0	134 71478	2.5
	10	6.3 × 5	55	29	5	0.10	13	19	14	134 51109	2.5	134 31109	5.0	134 71109	2.5
	1.0	3 × 5	51	6.2	3	0.10	130	70	50	134 51108	1.0	134 31108	2.5	-	-

Additional electrical data

DESCRIPTION	CONDITIONS	VALUE
Voltage		
Surge voltage		U _s ≤ 1.15 × U _R
Reverse voltage		U _{rev} ≤ 1 V
Current		
Leakage current	after 2 minutes at U _R	I _{L2} ≤ 0.01 C _R × U _R or 3 μA (whichever is greater)

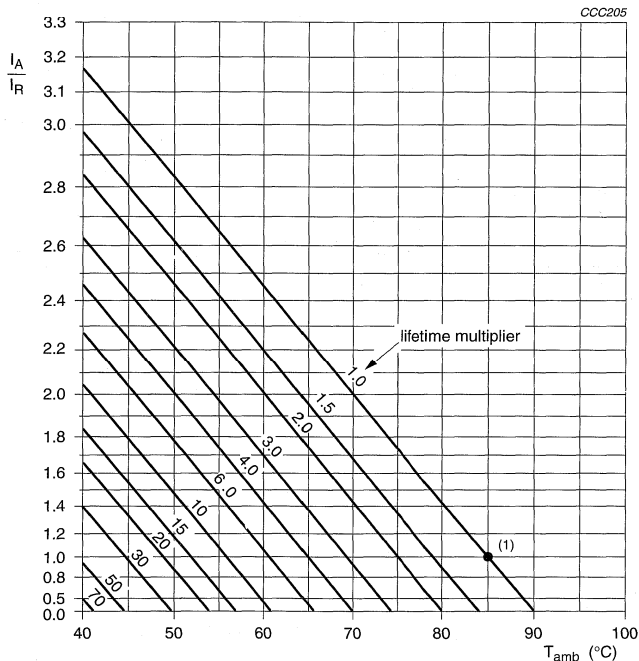
Aluminum electrolytic capacitors Radial Low Profile, 5 mm

134 RLP 5

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.6
120	1.0
400	1.2
800	1.3
≥ 2000	1.4



I_A = actual ripple current at 120 Hz.

I_R = rated ripple current at 120 Hz, 85 °C.

(1) Useful life at 85 °C and I_R applied: 1500 hours.

Fig.5 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Low Profile, 5 mm

134 RLP 5

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300, subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 1000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 1500 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300, subclause 4.17	$T_{amb} = 85\text{ °C}$; 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 $I_{L2} \leq \text{spec. limit}$

Aluminum electrolytic capacitors

Radial Low Profile, 7 mm

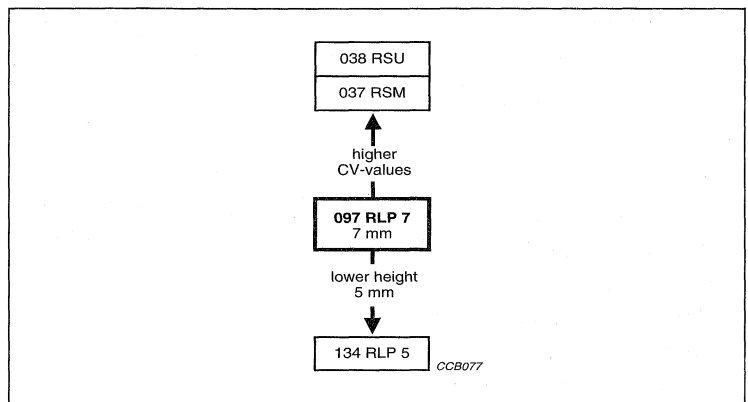
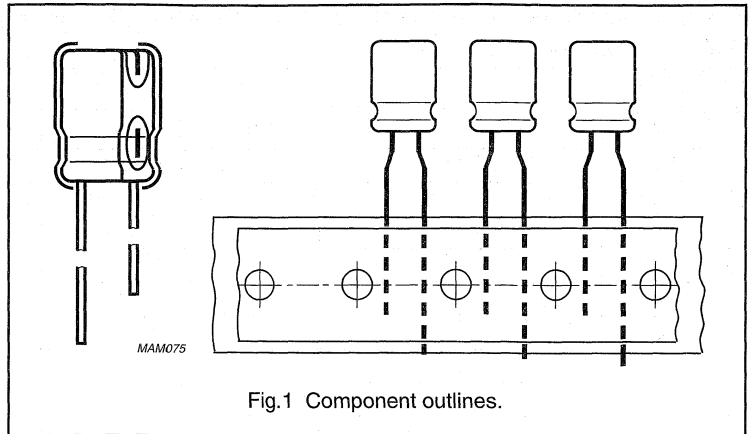
097 RLP 7

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Low profile, 7 mm height
- Miniaturized, high CV-product per unit volume.

APPLICATIONS

- General purpose; industrial, automotive and audio-video
- Low surface demand on printed-circuit board
- Coupling, decoupling, smoothing, filtering and timing
- Portable and mobile equipment (small size, low mass), low profile equipment.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	4 × 7 to 6.3 × 7
Rated capacitance range, C_R	0.1 to 220 μ F
Tolerance on C_R	±20%
Rated voltage, U_R	6.3 to 63 V
Category temperature range	-40 to +85 °C
Endurance test at 85 °C	1 000 hours
Useful life at 85 °C	1 500 hours
Useful life at 40 °C, $1.4 \times I_R$ applied	40 000 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

Aluminum electrolytic capacitors

Radial Low Profile, 7 mm

097 RLP 7

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)						
	6.3	10	16	25	35	50	63
0.10	–	–	–	–	–	–	4 × 7
0.22	–	–	–	–	–	–	4 × 7
0.47	–	–	–	–	–	–	4 × 7
1.0	–	–	–	–	–	–	4 × 7
2.2	–	–	–	–	–	–	4 × 7
3.3	–	–	–	–	–	4 × 7	5 × 7
4.7	–	–	–	–	4 × 7	5 × 7	6.3 × 7
10	–	–	4 × 7	–	5 × 7	6.3 × 7	6.3 × 7
22	4 × 7	–	5 × 7	–	6.3 × 7	6.3 × 7	–
33	–	5 × 7	–	6.3 × 7	6.3 × 7	–	–
47	5 × 7	–	6.3 × 7	6.3 × 7	–	–	–
100	–	6.3 × 7	6.3 × 7	–	–	–	–
220	6.3 × 7	–	–	–	–	–	–

MARKING

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

- Rated capacitance (in μF)
- Rated voltage (in V)
- Negative terminal identification
- Group number (097)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062".

Aluminum electrolytic capacitors

Radial Low Profile, 7 mm

097 RLP 7

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

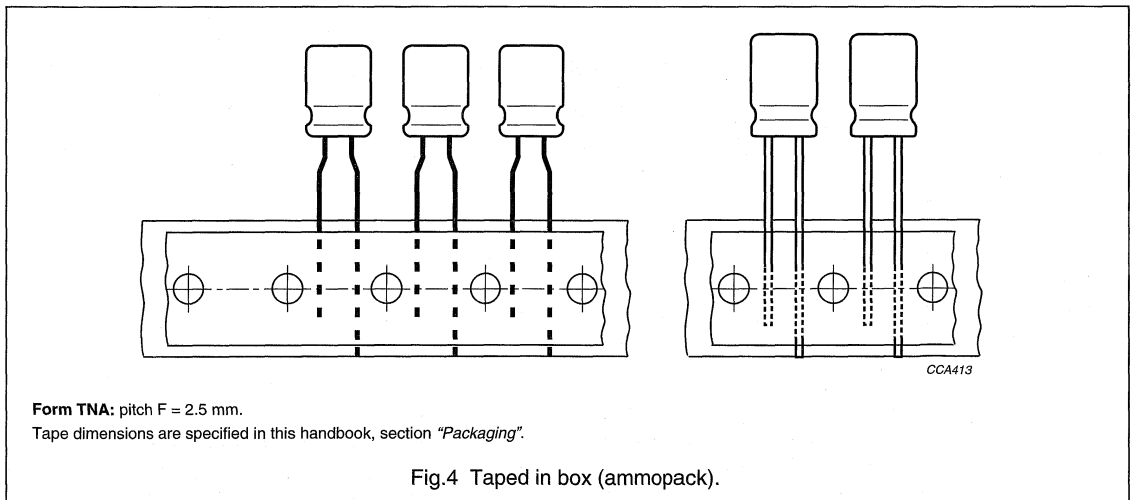
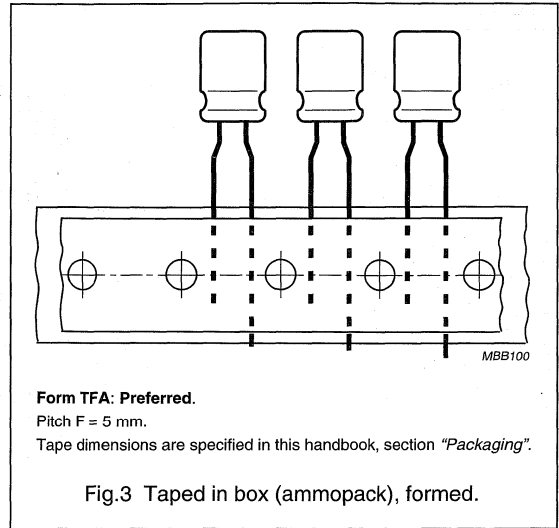
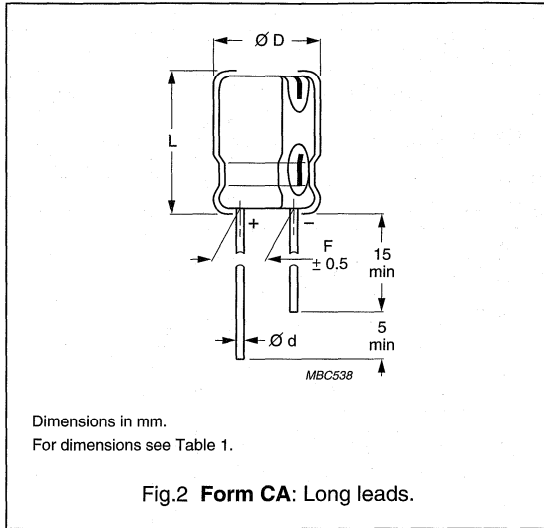


Table 1 Physical dimensions and packaging quantities; see Figs 2, 3 and 4

NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	PACKAGING QUANTITIES		
						FORM CA	FORM TFA	FORM TNA
4 × 7	71	0.45	4.5	8	1.5 ± 0.5	2000	2000	2000
5 × 7	72	0.45	5.5	8	2.0 ± 0.5	1000	2000	2000
6.3 × 7	73	0.45	6.8	8	2.5 ± 0.5	1000	2000	2000

Aluminum electrolytic capacitors

Radial Low Profile, 7 mm

097 RLP 7

Ordering example

Electrolytic capacitor 097 series

100 μ F/16 V; \pm 20%Nominal case size: \varnothing 6.3 \times 7 mm; Form TFA

Catalogue number: 2222 097 35101.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{amb} = 20\text{ }^{\circ}\text{C}$,
 $P = 86$ to 106 kPa, RH = 45 to 75%.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz, tolerance \pm 20%
I_R	rated RMS ripple current at 120 Hz, 85 $^{\circ}\text{C}$
I_{L2}	max. leakage current after 2 minutes at U_R
Tan δ	max. dissipation factor at 120 Hz
ESR	equivalent series resistance at 120 Hz (calculated from tan δ_{max} and C_R)
Z	max. impedance at 10 kHz and 100 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R 120 Hz (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 $^{\circ}\text{C}$ (mA)	I_{L2} 2 min (μ A)	Tan δ 120 Hz (Ω)	ESR 120 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER					
										BULK LONG LEADS			TAPED AMMOPACK		
										FORM CA	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
6.3	22	4 \times 7	71	31	3	0.24	14	9.6	8.4	097 53229	1.5	097 33229	5.0	097 73229	2.5
	47	5 \times 7	72	47	3	0.24	6.8	5	4.6	097 53479	2.0	097 33479	5.0	097 73479	2.5
	220	6.3 \times 7	74	90	14	0.24	1.4	2	1.8	097 53221	2.5	097 33221	5.0	097 73221	2.5
10	33	5 \times 7	72	43	4	0.20	8.0	4	3.7	097 54339	2.0	097 34339	5.0	097 74339	2.5
	100	6.3 \times 7	73	80	10	0.20	2.7	2.3	2.2	097 54101	2.5	097 34101	5.0	097 74101	2.5
16	10	4 \times 7	71	25	3	0.16	21	11	10	097 55109	1.5	097 35109	5.0	097 75109	2.5
	22	5 \times 7	72	39	4	0.16	9.6	6	5	097 55229	2.0	097 35229	5.0	097 75229	2.5
	47	6.3 \times 7	73	59	8	0.16	4.5	4	3.5	097 55479	2.5	097 35479	5.0	097 75479	2.5
	100	6.3 \times 7	74	90	16	0.16	2.1	3	2.5	097 55101	2.5	097 35101	5.0	097 75101	2.5
25	33	6.3 \times 7	73	53	9	0.14	5.6	3.3	2.6	097 56339	2.5	097 36339	5.0	097 76339	2.5
	47	6.3 \times 7	74	65	12	0.14	4.0	2.5	1.9	097 56479	2.5	097 36479	5.0	097 76479	2.5

Aluminum electrolytic capacitors
Radial Low Profile, 7 mm

097 RLP 7

CATALOGUE NUMBER 2222															
U _R (V)	C _R 120 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 120 Hz 85 °C (mA)	I _{L2} 2 min (μA)	Tan δ 120 Hz	ESR 120 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	TAPED AMMOPACK					
										LONG LEADS		F		FORM	
		FORM CA		F (mm)		FORM TFA		F (mm)		FORM TNA		F (mm)			
35	4.7 10 22 33	4 × 7 5 × 7 6.3 × 7 6.3 × 7	71 72 73 74	20 30 47 60	3 4 8 12	0.12 0.12 0.12 0.12	34 16 7.2 4.8	12 6.5 3.3 2.9	10	097 50478 097 50109 097 50229 097 50339	1.5 2.0 2.5 2.5	097 30478 097 30109 097 30229 097 30339	5.0 5.0 5.0 5.0	097 70478 097 70109 097 70229 097 70339	2.5 2.5 2.5 2.5
50	3.3 4.7 10 22	4 × 7 5 × 7 6.3 × 7 6.3 × 7	71 72 73 74	18 23 34 53	3 3 5 11	0.10 0.10 0.10 0.10	40 28 13 6.0	16 12 6.2 3.2	14	097 51338 097 51478 097 51109 097 51229	1.5 2.0 2.5 2.5	097 31338 097 31478 097 31109 097 31229	5.0 5.0 5.0 5.0	097 71338 097 71478 097 71109 097 71229	2.5 2.5 2.5 2.5
63	0.10 0.22 0.47 1 2.2 3.3 4.7 10	4 × 7 4 × 7 4 × 7 4 × 7 4 × 7 5 × 7 6.3 × 7 6.3 × 7	71 71 71 71 71 72 73 74	1.3 2.9 7.9 11 17 21 26 40	3 3 3 3 3 3 3 7	0.08 0.08 0.08 0.08 0.08 0.08 0.08 0.08	1100 480 230 110 48 32 23 11	238 138 88 42 22 16 12 6.2	170	097 58107 097 58227 097 58477 097 58108 097 58228 097 58338 097 58478 097 58109	1.5 1.5 1.5 1.5 1.5 2.0 2.5 2.5	097 38107 097 38227 097 38477 097 38108 097 38228 097 38338 097 38478 097 38109	5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0	097 78107 097 78227 097 78477 097 78108 097 78228 097 78338 097 78478 097 78109	2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5

Additional electrical data

DESCRIPTION	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 2 minutes at U _R	$I_{L2} \leq 0.01 C_R \times U_R$ or 3 μA (whichever is greater)



Aluminum electrolytic capacitors

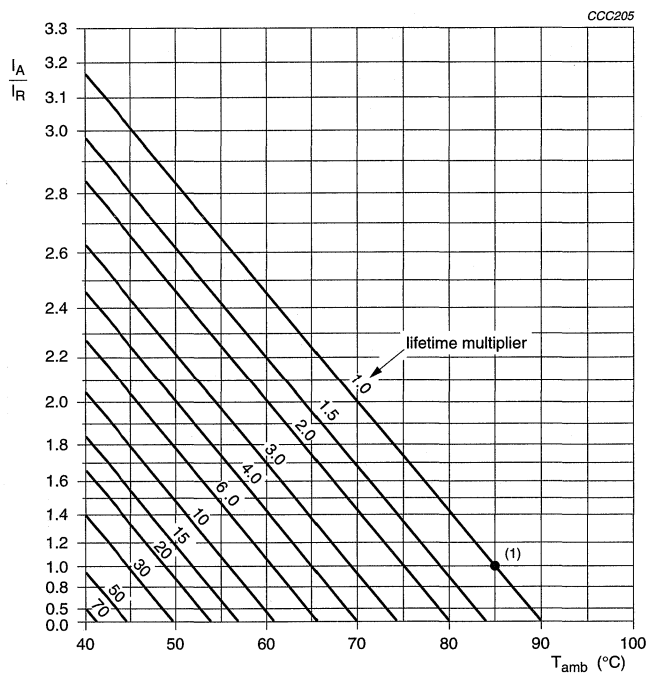
Radial Low Profile, 7 mm

097 RLP 7

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.6
120	1.0
400	1.2
800	1.3
≥ 2000	1.4



I_A = actual ripple current at 120 Hz.
 I_R = rated ripple current at 120 Hz, 85 °C.
 (1) Useful life at 85 °C and I_R applied: 1500 hours.

Fig.5 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Low Profile, 7 mm

097 RLP 7

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130 300, subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$, U_R applied; 1000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$, U_R and I_R applied; 1500 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$
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 $I_{L2} \leq \text{spec. limit}$



Aluminum electrolytic capacitors Radial Standard Ultra Miniature

038 RSU

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue vinyl sleeve
- Pressure relief for case $\varnothing D \geq 6.3$ mm
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume.

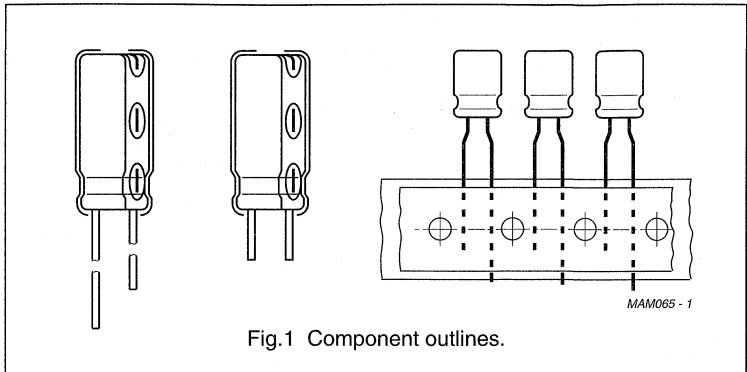
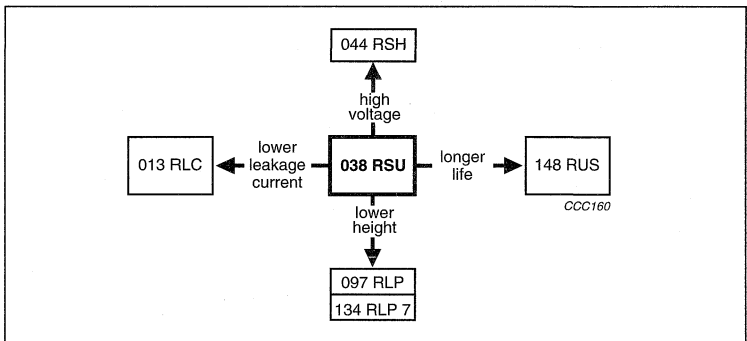


Fig.1 Component outlines.

APPLICATIONS

- General purpose, industrial, automotive and audio-video
- Coupling, decoupling, timing, smoothing, filtering, buffering in SMPS
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	5 × 11 to 18 × 40
Rated capacitance range, C_R	0.1 to 22000 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	6.3 to 100 V
Category temperature range	-40 to +85 °C
Endurance test at 85 °C: case size $\varnothing D \leq 8$ mm case size $\varnothing D \geq 10$ mm	2000 hours 3000 hours
Useful life at 85 °C: case size $\varnothing D \leq 8$ mm case size $\varnothing D \geq 10$ mm	2500 hours 3500 hours
Useful life at 40 °C, $1.4 \times I_R$ applied: case size $\varnothing D \leq 8$ mm case size $\varnothing D \geq 10$ mm	60000 hours 90000 hours
Shelf life at 0 V, 85 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/085/56

Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	6.3	10	16	25	35	50	63	100
0.1	-	-	-	-	-	-	5 × 11	-
0.22	-	-	-	-	-	-	5 × 11	-
0.33	-	-	-	-	-	-	5 × 11	-
0.47	-	-	-	-	-	-	5 × 11	5 × 11
1.0	-	-	-	-	-	-	5 × 11	5 × 11
2.2	-	-	-	-	-	-	5 × 11	5 × 11
3.3	-	-	-	-	-	-	5 × 11	5 × 11
4.7	-	-	-	-	-	-	5 × 11	5 × 11
10	-	-	-	-	-	-	5 × 11	6.3 × 11
22	-	-	-	-	-	5 × 11	5 × 11	6.3 × 11
33	-	-	-	-	-	5 × 11	6.3 × 11	8 × 12
47	-	-	-	-	5 × 11	6.3 × 11	6.3 × 11	10 × 12
100	-	5 × 11	5 × 11	6.3 × 11	6.3 × 11	8 × 12	10 × 12	10 × 20
220	5 × 11	5 × 11	6.3 × 11	8 × 12	8 × 12	10 × 12	10 × 16	13 × 25
330	6.3 × 11	6.3 × 11	8 × 12	8 × 12	10 × 12	10 × 16	10 × 20	13 × 25
470	6.3 × 11	6.3 × 11	8 × 12	10 × 12	10 × 16	10 × 20	13 × 20	16 × 25
1000	8 × 12	10 × 12	10 × 16	10 × 20	13 × 20	13 × 25	16 × 25	18 × 40
2200	10 × 16	10 × 20	13 × 20	13 × 25	16 × 25	16 × 31	18 × 35	-
3300	10 × 20	13 × 20	13 × 25	16 × 25	16 × 35	18 × 35	-	-
4700	13 × 20	13 × 25	16 × 25	16 × 31	18 × 35	-	-	-
6800	13 × 25	16 × 25	16 × 31	18 × 35	-	-	-	-
10000	16 × 25	16 × 35	18 × 35	-	-	-	-	-
22000	18 × 40	-	-	-	-	-	-	-

R

Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

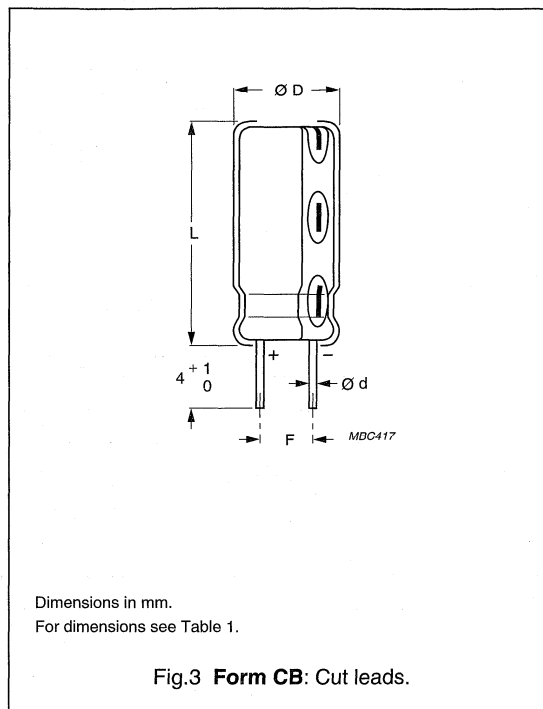
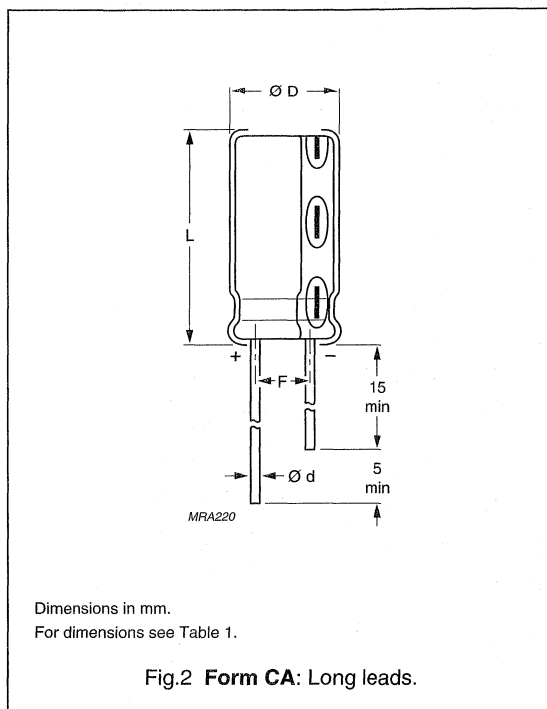


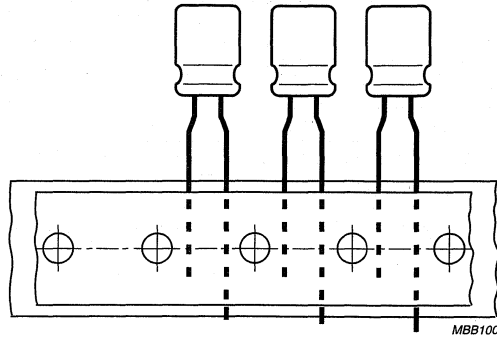
Table 1 Physical dimensions, mass and packaging quantities; see Figs 2, 3, 4 and 5

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{\max}$ (mm)	L_{\max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA, TNA
5 × 11	11	0.5	5.5	12.5	2.0 ± 0.5	≈ 0.4	25000	–	2000
6.3 × 11	12	0.5	6.8	12.5	2.5 ± 0.5	≈ 0.6	20000	–	2000
8 × 12	13	0.6	8.5	13.0	3.5 ± 0.5	≈ 1.1	12000	–	1000
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	7500	7500	500
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	5000	5000	500
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	5000	5000	500
13 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	3000	3000	500
13 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	2500	2500	500
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	1500	1500	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	1000	1000	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11.0	1000	1000	250
18 × 35	22	0.8	16.5	37.5	7.5 ± 0.5	≈ 14.5	1000	1000	250
18 × 40	23	0.8	16.5	42.0	7.5 ± 0.5	≈ 16.0	1000	1000	250

Aluminum electrolytic capacitors
Radial Standard Ultra Miniature

038 RSU

Taped products

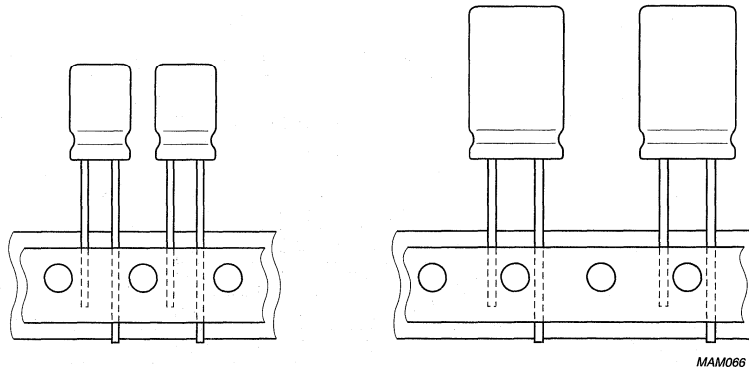


Form TFA:

Case $\varnothing D = 5$ to 8 mm; pitch F = 5 mm.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.4 Taped in box (ammopack), formed.



Form TNA:

Case $\varnothing D = 5$ mm; pitch F = 2.5 mm (leads slightly bent).

Case $\varnothing D = 6.3$ mm; pitch F = 2.5 mm.

Case $\varnothing D = 8$ mm; pitch F = 3.5 mm.

Form TFA:

Case $\varnothing D = 10$ and 12.5 mm; pitch F = 5 mm.

Case $\varnothing D = 16$ mm; pitch F = 7.5 mm.

Fig.5 Taped in box (ammopack), straight leads.

Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2, 4, 6 and 8 apply at $T_{amb} = 20\text{ }^{\circ}\text{C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, $85\text{ }^{\circ}\text{C}$
I_{L1}	max. leakage current after 2 minutes at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\text{Tan } \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\text{tan } \delta_{max}$ and C_R)
Z	max. impedance at 10 kHz

Table 2 Electrical data; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz $85\text{ }^{\circ}\text{C}$ (mA)	I_{L2} 2 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)
6.3	220	5×11	11	200	14	5.8	0.23	1.7
	330	6.3×11	12	270	21	7.2	0.23	1.1
	470	6.3×11	12	320	30	8.9	0.23	0.78
	1000	8×12	13	540	63	16	0.23	0.37
	2200	10×16	15	785	139	31	0.25	0.17
	3300	10×20	16	1185	208	45	0.27	0.11
	4700	13×20	17	1545	296	62	0.29	0.08
	6800	13×25	18	1880	428	89	0.33	0.05
	10000	18×40	19	2330	630	129	0.41	0.04
	22000	6.3×11	23	3320	1386	280	0.65	0.02
10	100	5×11	11	145	10	5.0	0.20	3.2
	220	5×11	11	160	22	7.4	0.20	1.5
	330	6.3×11	12	290	33	9.6	0.20	0.97
	470	6.3×11	12	350	47	12	0.20	0.68
	1000	10×12	14	650	100	23	0.20	0.32
	2200	10×20	16	1070	220	47	0.22	0.14
	3300	13×25	17	1420	330	69	0.24	0.10
	4700	13×25	18	1780	470	97	0.26	0.07
	6800	16×25	19	2220	680	139	0.30	0.05
	10000	16×35	21	2760	1000	203	0.38	0.03

Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 038 series

470 $\mu\text{F}/25\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 10 \times 12\text{ mm}$; Form TFA

Catalogue number: 2222 038 36471.

Table 3 Ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA	F (mm)	FORM TNA	F (mm)
			FORM CA	F (mm)	FORM CB	F (mm)				
6.3	220	11	038 53221	2.0	–	–	038 33221	5.0	038 73221	2.5
	330	12	038 53331	2.5	–	–	038 33331	5.0	038 73331	2.5
	470	12	038 53471	2.5	–	–	038 33471	5.0	038 73471	2.5
	1000	13	038 53102	3.5	–	–	038 33102	5.0	038 73102	2.5
	2200	15	038 53222	5.0	038 63222	5.0	038 33222	5.0	–	–
	3300	16	038 53322	5.0	038 63322	5.0	038 33322	5.0	–	–
	4700	17	038 53472	5.0	038 63472	5.0	038 33472	5.0	–	–
	6800	18	038 53682	5.0	038 63682	5.0	038 33682	5.0	–	–
	10000	19	038 53103	7.5	038 63103	7.5	038 33103	7.5	–	–
	22000	23	038 53223	7.5	038 63223	7.5	–	–	–	–
10	100	11	038 54101	2.0	–	–	038 34101	5.0	038 74101	2.5
	220	11	038 54221	2.0	–	–	038 34221	5.0	038 74221	2.5
	330	12	038 54331	2.5	–	–	038 34331	5.0	038 74331	2.5
	470	12	038 54471	2.5	–	–	038 34471	5.0	038 74471	2.5
	1000	14	038 54102	5.0	038 64102	5.0	038 34102	5.0	–	–
	2200	16	038 54222	5.0	038 64222	5.0	038 34222	5.0	–	–
	3300	17	038 54332	5.0	038 64332	5.0	038 34332	5.0	–	–
	4700	18	038 54472	5.0	038 64472	5.0	038 34472	5.0	–	–
	6800	19	038 54682	7.5	038 64682	7.5	038 34682	7.5	–	–
	10000	21	038 54103	7.5	038 64103	7.5	–	–	–	–

R

Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

ELECTRICAL DATA (continued)**Table 4** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L2} 2 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)
16	100	5 × 11	11	160	16	6.2	0.16	2.6
	220	6.3 × 11	12	260	35	10	0.16	1.2
	330	8 × 12	13	370	53	14	0.16	0.77
	470	8 × 12	13	440	75	18	0.16	0.54
	1000	10 × 16	15	785	160	35	0.16	0.25
	2200	13 × 20	17	1295	352	73	0.18	0.12
	3300	13 × 25	18	1655	528	109	0.20	0.08
	4700	16 × 25	19	2090	752	153	0.22	0.05
	6800	16 × 31	20	2520	1088	221	0.26	0.04
10000	18 × 35	22	2920	1600	323	0.34	0.03	
25	100	6.3 × 11	12	190	25	8.0	0.14	2.2
	220	8 × 12	13	320	55	14	0.14	1.0
	330	8 × 12	13	440	83	20	0.14	0.68
	470	10 × 12	14	545	118	27	0.14	0.47
	1000	10 × 20	16	955	250	53	0.14	0.22
	2200	13 × 25	18	1540	550	113	0.16	0.1
	3300	16 × 25	19	1975	825	168	0.18	0.07
	4700	16 × 31	20	2420	1175	238	0.20	0.05
	6800	18 × 35	22	2880	1700	343	0.24	0.03
35	47	5 × 11	11	130	17	6.3	0.12	4.0
	100	6.3 × 12	12	210	35	10	0.12	1.9
	220	8 × 12	13	385	77	18	0.12	0.87
	330	10 × 12	14	490	116	26	0.12	0.58
	470	10 × 16	15	740	165	36	0.12	0.41
	1000	13 × 25	17	1145	350	73	0.12	0.19
	2200	16 × 25	19	1785	770	157	0.14	0.09
	3300	16 × 35	21	2275	1155	234	0.16	0.06
	4700	18 × 35	22	2700	1645	332	0.18	0.04

Aluminum electrolytic capacitors
Radial Standard Ultra Miniature

038 RSU

ORDERING INFORMATION (continued)

Table 5 Ordering information continued; preferred types in bold

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
16	100	11	038 55101	2.0	-	-	038 35101	5.0	038 75101	2.5
	220	12	038 55221	2.5	-	-	038 35221	5.0	038 75221	2.5
	330	13	038 55331	3.5	-	-	038 35331	5.0	038 75331	3.5
	470	13	038 55471	3.5	-	-	038 35471	5.0	038 75471	3.5
	1000	15	038 55102	5.0	038 65102	5.0	038 35102	5.0	-	-
	2200	17	038 55222	5.0	038 65222	5.0	038 35222	5.0	-	-
	3300	18	038 55332	5.0	038 65332	5.0	038 35332	5.0	-	-
	4700	19	038 55472	7.5	038 65472	7.5	038 35472	7.5	-	-
	6800	20	038 55682	7.5	038 65682	7.5	038 35682	7.5	-	-
	10000	22	038 55103	7.5	038 65103	7.5	-	-	-	-
25	100	12	038 56101	2.5	-	-	038 36101	5.0	038 76101	2.5
	220	13	038 56221	3.5	-	-	038 36221	5.0	038 76221	3.5
	330	13	038 56331	3.5	-	-	038 36331	5.0	038 76331	3.5
	470	14	038 56471	5.0	038 66471	5.0	038 36471	5.0	-	-
	1000	16	038 56102	5.0	038 66102	5.0	038 36102	5.0	-	-
	2200	18	038 56222	5.0	038 66222	5.0	038 36222	5.0	-	-
	3300	19	038 56332	5.0	038 66332	5.0	038 36332	5.0	-	-
	4700	20	038 56472	7.5	038 66472	7.5	038 36472	7.5	-	-
	6800	22	038 56682	7.5	038 66682	7.5	-	7.5	-	-
	35	47	11	038 50479	2.0	-	-	038 30479	5.0	038 70479
100		12	038 50101	5.0	-	-	038 30101	5.0	038 70101	2.5
220		13	038 50221	5.0	-	-	038 30331	5.0	-	-
330		14	038 50331	5.0	038 60331	5.0	038 30331	5.0	-	-
470		15	038 50471	5.0	038 60471	5.0	038 30471	5.0	-	-
1000		17	038 50102	5.0	038 60102	5.0	038 30102	5.0	-	-
2200		19	038 50222	7.5	038 60222	7.5	038 30222	7.5	-	-
3300		21	038 50332	7.5	038 60332	7.5	-	-	-	-
4700		22	038 50472	7.5	038 60472	7.5	-	-	-	-



Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

ELECTRICAL DATA (continued)

Table 6 Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L2} 2 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)
50	22	5 × 11	11	95	11	5.2	0.10	7.2
	33	5 × 11	11	125	17	6.3	0.10	4.8
	47	6.3 × 11	12	165	24	7.7	0.10	3.3
	100	8 × 12	13	260	50	13	0.10	1.5
	220	10 × 12	14	455	110	25	0.10	0.72
	330	10 × 16	15	585	165	36	0.10	0.48
	470	10 × 20	16	755	235	50	0.10	0.34
	1000	13 × 25	18	1340	500	103	0.10	0.16
	2200	16 × 31	20	1885	1100	223	0.12	0.07
3300	18 × 35	22	2500	1650	333	0.14	0.05	
63	0.10	5 × 11	11	3	3.0	3.0	0.09	1433
	0.22	5 × 11	11	4.5	3.0	3.0	0.09	651
	0.33	5 × 11	11	7.5	3.0	3.0	0.09	434
	0.47	5 × 11	11	9.5	3.0	3.1	0.09	305
	1.0	5 × 11	11	17	3.0	3.1	0.09	143
	2.2	5 × 11	11	28	3.0	3.3	0.09	65
	3.3	5 × 11	11	34	3.0	3.4	0.09	43
	4.7	5 × 11	11	45	3.0	3.6	0.09	30
	10	5 × 11	11	70	6.3	4.3	0.09	14
	22	5 × 11	11	105	14	5.8	0.09	6.5
	33	6.3 × 11	12	140	21	7.2	0.09	4.3
	47	6.3 × 11	12	170	30	8.9	0.09	3.1
	100	10 × 12	14	320	63	16	0.09	1.4
	220	10 × 16	15	90	139	31	0.09	0.65
	330	10 × 20	16	710	208	45	0.09	0.43
	470	13 × 20	17	900	296	62	0.09	0.3
	1000	16 × 25	19	1560	630	129	0.09	0.14
2200	18 × 35	22	1950	1386	280	0.11	0.07	

Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

ORDERING INFORMATION (continued)**Table 7** Ordering information continued; preferred types in **bold**

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
50	22	11	038 51229	2.0	–	–	038 31229	5.0	038 71229	2.5
	33	11	038 51339	2.0	–	–	038 31339	5.0	038 71339	2.5
	47	12	038 51479	2.5	–	–	038 31479	5.0	038 71479	2.5
	100	13	038 51101	3.5	–	–	038 31101	5.0	038 71101	3.5
	220	14	038 51221	3.5	038 61221	5.0	038 31221	5.0	–	–
	330	15	038 51331	5.0	038 61331	5.0	038 31331	5.0	–	–
	470	16	038 51471	5.0	038 61471	5.0	038 31471	5.0	–	–
	1000	18	038 51102	5.0	038 61102	5.0	038 31102	5.0	–	–
	2200	20	038 51222	5.0	038 61222	5.0	038 31222	5.0	–	–
	3300	22	038 51332	7.5	038 61332	7.5	–	–	–	–
	63	0.10	11	038 58107	2.0	–	–	038 38107	5.0	038 78107
0.22		11	038 58227	2.0	–	–	038 38227	5.0	038 78227	2.5
0.33		11	038 58337	2.0	–	–	038 38337	5.0	038 78337	2.5
0.47		11	038 58447	2.0	–	–	038 38447	5.0	038 78447	2.5
1.0		11	038 58108	2.0	–	–	038 38108	5.0	038 78108	2.5
2.2		11	038 58228	2.0	–	–	038 38228	5.0	038 78228	2.5
3.3		11	038 58338	2.0	–	–	038 38338	5.0	038 78338	2.5
4.7		11	038 58478	2.0	–	–	038 38478	5.0	038 78478	2.5
10		11	038 58109	2.0	–	–	038 38109	5.0	038 78109	2.5
22		11	038 58229	2.0	–	–	038 38229	5.0	038 78229	2.5
33		12	038 58339	2.5	–	–	038 38339	5.0	038 78339	2.5
47		12	038 58479	2.5	–	–	038 38479	5.0	038 78479	2.5
100		14	038 58101	5.0	038 68101	5.0	038 38101	5.0	–	–
220		15	038 58221	5.0	038 68221	5.0	038 38221	5.0	–	–
330		16	038 58331	5.0	038 68331	5.0	038 38331	5.0	–	–
470		17	038 58471	5.0	038 68471	5.0	038 38471	5.0	–	–
1000		19	038 58102	7.5	038 68102	7.5	038 38102	7.5	–	–
2200		22	038 58222	7.5	038 68222	7.5	–	–	–	–

R

Aluminum electrolytic capacitors
Radial Standard Ultra Miniature

038 RSU

ELECTRICAL DATA (continued)

Table 8 Electrical data continued; preferred types in bold

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L2} 2 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)
100	0.47	5 × 11	11	12	3.0	3.1	0.08	271
	1.0	5 × 11	11	22	3.0	3.2	0.08	127
	2.2	5 × 11	11	33	3.0	3.4	0.08	58
	3.3	5 × 11	11	40	3.3	3.7	0.08	39
	4.7	5 × 11	11	48	4.7	3.9	0.08	27
	10	6.3 × 11	12	80	10	5.0	0.08	13
	22	6.3 × 11	12	115	22	7.4	0.08	5.8
	33	8 × 12	13	145	33	9.6	0.08	3.9
	47	10 × 12	14	235	47	12	0.08	2.7
	100	10 × 20	16	370	100	23	0.08	1.3
	220	13 × 25	18	675	220	47	0.08	0.58
	330	13 × 25	18	825	330	69	0.08	0.39
	470	16 × 25	19	1070	470	97	0.08	0.27
	1000	18 × 40	20	2410	1000	203	0.08	0.13

Aluminum electrolytic capacitors
Radial Standard Ultra Miniature

038 RSU

ORDERING INFORMATION (continued)

Table 9 Ordering information continued; preferred types in **bold**

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
100	0.47	11	038 59477	2.0	—	—	038 39477	5.0	038 79477	2.5
	1.0	11	038 59108	2.0	—	—	038 39108	5.0	038 79108	2.5
	2.2	11	038 59228	2.0	—	—	038 39228	5.0	038 79228	2.5
	3.3	11	038 59338	2.0	—	—	038 39338	5.0	038 79338	2.5
	4.7	11	038 59478	2.0	—	—	038 39478	5.0	038 79478	2.5
	10	12	038 59109	2.5	—	—	038 39109	5.0	038 79109	2.5
	22	12	038 59229	2.5	—	—	038 39229	5.0	038 79229	2.5
	33	13	038 59339	3.5	—	—	038 39339	5.0	038 79339	3.5
	47	14	038 59479	5.0	038 69479	5.0	038 39479	5.0	—	—
	100	16	038 59101	5.0	038 69101	5.0	038 39101	5.0	—	—
	220	18	038 59221	5.0	038 69221	5.0	038 39221	5.0	—	—
	330	18	038 59331	5.0	038 69331	5.0	038 39331	7.5	—	—
	470	19	038 59471	7.5	038 69471	7.5	038 39471	7.5	—	—
	1000	20	038 59102	7.5	038 69102	7.5	—	—	—	—



Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

ELECTRICAL DATA (continued)**Additional electrical data**

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 2 minutes at U_R	$I_{L1} \leq 0.01 C_R \times U_R$ or $3 \mu\text{A}$, whichever is greater
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \leq 8 \text{ mm}$	typ. 13 nH
	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

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"
- Rated voltage (in V)
- Group number (038)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Negative terminal identification.

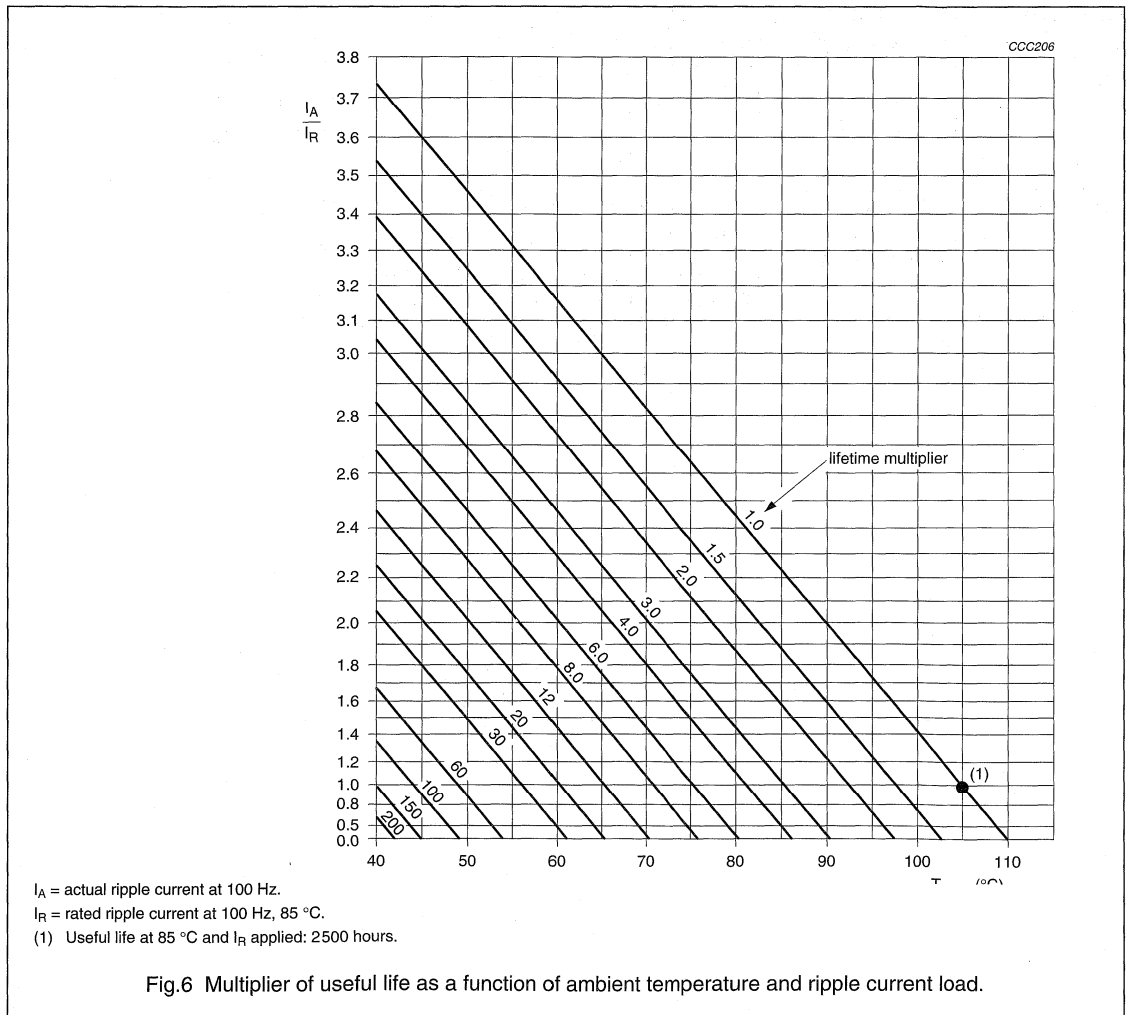
Aluminum electrolytic capacitors Radial Standard Ultra Miniature

038 RSU

RIPPLE CURRENT AND USEFUL LIFE

Table 10 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$C_R < 100 \mu F$	$C_R = 100 \text{ to } 1000 \mu F$	$C_R > 1000 \mu F$
50	0.70	0.75	0.80
100	1.00	1.00	1.00
500	1.30	1.20	1.10
1000	1.40	1.30	1.12
≥ 10000	1.50	1.35	1.15



Aluminum electrolytic capacitors

Radial Standard Ultra Miniature

038 RSU

SPECIFIC TESTS AND REQUIREMENTS

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

Table 11 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; case $\varnothing \leq 8\text{ mm}$: 2000 hours case $\varnothing \geq 10\text{ mm}$: 3000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; case $\varnothing \leq 8\text{ mm}$: 2500 hours case $\varnothing \geq 10\text{ mm}$: 3500 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$

**Aluminum electrolytic capacitors
Radial Standard Ultra Miniature**

038 RSU

NOTES



Aluminum electrolytic capacitors Radial Standard Miniature

037 RSM

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue vinyl sleeve
- Pressure relief for case $\varnothing D \geq 6.3$ mm
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume.

APPLICATIONS

- General purpose, industrial, automotive and audio-video
- Coupling, decoupling, timing, smoothing, filtering, buffering in SMPS
- Portable and mobile equipment (small size, low mass).

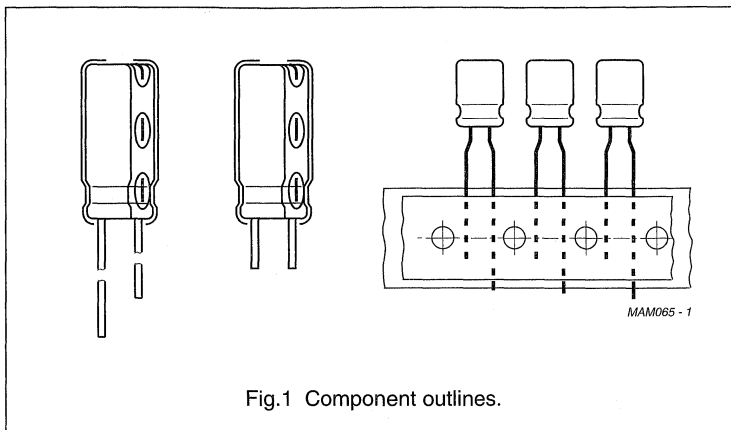
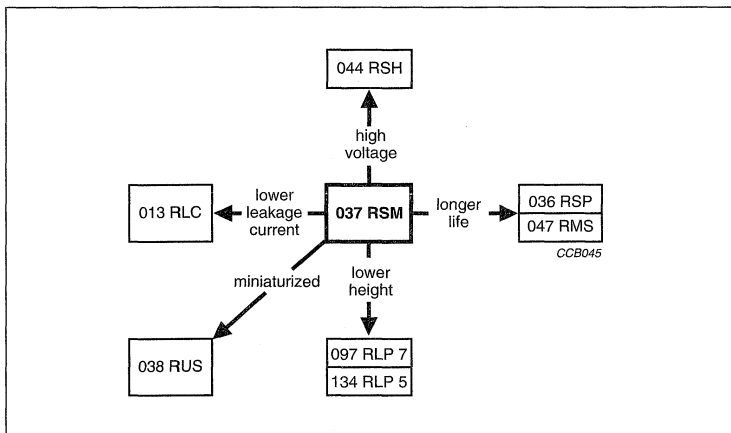


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	5 × 11 to 16 × 31
Rated capacitance range, C_R	0.47 to 10000 μF
Tolerance on C_R	$\pm 20\%$; $\pm 10\%$ on request
Rated voltage range, U_R	6.3 to 100 V
Category temperature range	-40 to +85 °C
Endurance test at 85 °C	2000 hours
Useful life at 85 °C	2500 hours
Useful life at 40 °C, $1.4 \times I_R$ applied	70000 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

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)								
	6.3	10	16	25	35	40	50	63	100
0.47	-	-	-	-	-	-	-	5 × 11	5 × 11
1.0	-	-	-	-	-	-	-	5 × 11	5 × 11
2.2	-	-	-	-	-	-	-	5 × 11	5 × 11
3.3	-	-	-	-	-	-	-	5 × 11	5 × 11
4.7	-	-	-	-	-	-	-	5 × 11	5 × 11
10	-	-	-	-	-	-	5 × 11	5 × 11	6.3 × 11
22	-	-	-	-	-	-	5 × 11	6.3 × 11	8 × 12
33	-	-	-	-	5 × 11	6.3 × 11	-	6.3 × 11	10 × 12
47	-	-	-	5 × 11	-	6.3 × 11	6.3 × 11	8 × 12	10 × 16
68	-	-	5 × 11	6.3 × 11	-	-	8 × 12	10 × 12	-
100	-	5 × 11	6.3 × 11	6.3 × 11	-	-	8 × 12	10 × 12	10 × 20
150	-	6.3 × 11	-	8 × 12	-	10 × 12	-	10 × 16	-
220	-	6.3 × 11	8 × 12	8 × 12	10 × 12	-	10 × 16	10 × 20	12.5 × 25
330	6.3 × 11	-	8 × 12	10 × 12	10 × 16	-	10 × 20	12.5 × 20	16 × 25
470	-	8 × 12	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 20	12.5 × 25	16 × 31
680	-	-	10 × 16	-	12.5 × 20	12.5 × 25	12.5 × 25	16 × 25	-
1000	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 25	16 × 31	-
1500	10 × 20	-	12.5 × 20	12.5 × 25	16 × 25	-	-	-	-
2200	12.5 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	-	-	-	-
3300	12.5 × 20	12.5 × 25	16 × 25	16 × 31	-	-	-	-	-
4700	-	16 × 25	16 × 31	-	-	-	-	-	-
6800	-	16 × 31	-	-	-	-	-	-	-
10000	16 × 31	-	-	-	-	-	-	-	-

R

Aluminum electrolytic capacitors
Radial Standard Miniature

037 RSM

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

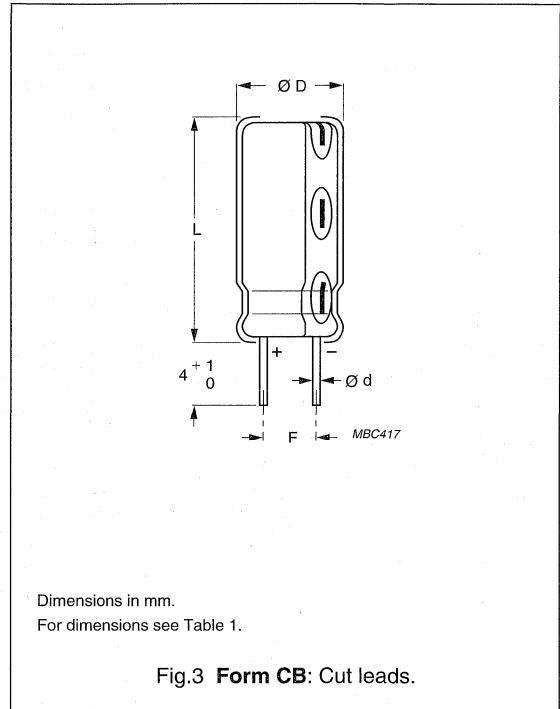
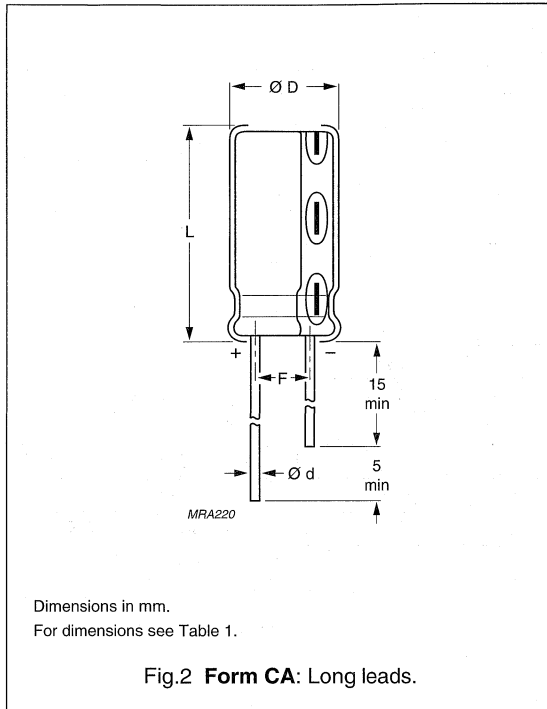


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

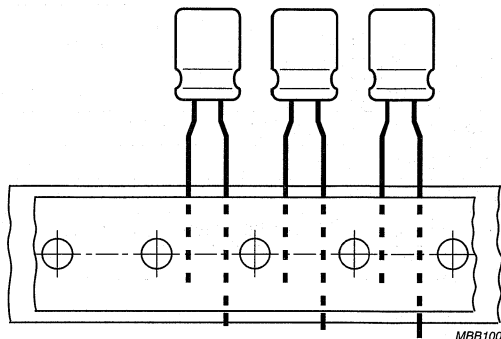
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA, TNA
5 × 11	11	0.5	5.5	12.5	2.0 ± 0.5	≈ 0.4	3000	—	2000
6.3 × 11	12	0.5	6.8	12.5	2.5 ± 0.5	≈ 0.6	2000	—	2000
8 × 12	13	0.6	8.5	13.0	3.5 ± 0.5	≈ 1.1	1000	—	1000
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	1000	500
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	1000	1000	500
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	1000	500	500
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	1000	2000	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	500	2000	500
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	500	1000	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	200	1000	250

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

Taped products

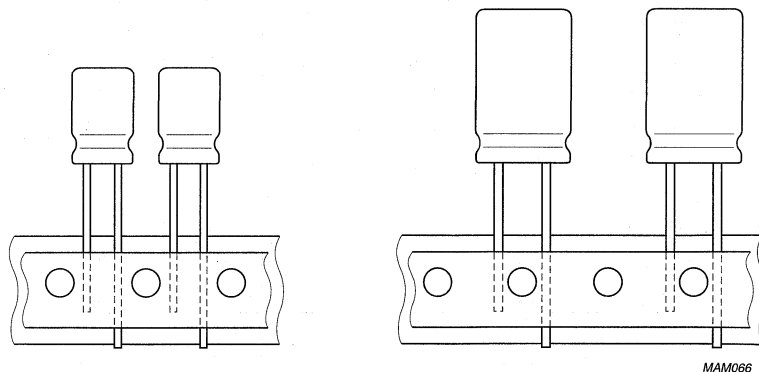


Form TFA:

Case $\varnothing D = 5$ to 8 mm; pitch $F = 5$ mm.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.4 Taped in box (ammopack), formed.



Form TNA:

Case $\varnothing D = 5$ mm; pitch $F = 2.5$ mm (leads slightly bent).

Case $\varnothing D = 6.3$ mm; pitch $F = 2.5$ mm.

Case $\varnothing D = 8$ mm; pitch $F = 3.5$ mm.

Form TFA:

Case $\varnothing D = 10$ and 12.5 mm; pitch $F = 5$ mm.

Case $\varnothing D = 16$ mm; pitch $F = 7.5$ mm.

Fig.5 Taped in box (ammopack), straight leads.

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2, 4, 6 and 8 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
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
$\text{Tan } \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\text{tan } \delta_{max}$ and C_R)
Z	max. impedance at 10 kHz

Table 2 Electrical data; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)
6.3	330	6.3×11	12	280	24	7.2	0.24	1.2	1.8
	1000	10×12	14	530	66	16	0.24	0.38	0.6
	1500	10×20	16	730	98	22	0.25	0.27	0.4
	2200	12.5×20	17	990	140	31	0.26	0.19	0.27
	3300	12.5×20	17	1150	210	45	0.28	0.14	0.18
	10000	16×31	20	2250	630	130	0.42	0.07	0.07
10	100	5×11	11	140	13	5	0.20	3.2	4.5
	150	6.3×11	12	180	18	6	0.20	2.1	3.0
	220	6.3×11	12	250	25	7.4	0.20	1.4	2.0
	470	8×12	13	410	50	12	0.20	0.68	0.96
	1000	10×16	15	630	100	23	0.20	0.32	0.45
	2200	12.5×20	17	1050	220	47	0.22	0.16	0.20
	3300	12.5×25	18	1350	330	69	0.24	0.12	0.14
	4700	16×25	19	1800	470	97	0.28	0.09	0.10
	6800	16×31	20	2200	680	140	0.32	0.07	0.07

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 037 series

1000 $\mu\text{F}/16\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 10 \times 20\text{ mm}$; Form TFA

Catalogue number: 2222 037 35102.

Table 3 Ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA		FORM TNA	
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
6.3	330	12	037 90021	2.5	–	–	037 90027	5.0	037 90028	2.5
	1000	14	037 53102	5.0	037 63102	5.0	037 33102	5.0	–	–
	1500	16	037 53152	5.0	037 63152	5.0	037 33152	5.0	–	–
	2200	17	037 53222	5.0	037 63222	5.0	037 33222	5.0	–	–
	3300	17	037 53332	5.0	037 63332	5.0	037 33332	5.0	–	–
	10000	20	037 53103	7.5	037 63103	7.5	037 33103	7.5	–	–
10	100	11	037 54101	2.0	–	–	037 34101	5.0	037 74101	2.5
	150	12	037 54151	2.5	–	–	037 34151	5.0	037 74151	2.5
	220	12	037 90029	2.5	–	–	037 90036	5.0	037 90037	2.5
	470	13	037 54471	3.5	–	–	037 34471	5.0	037 74471	3.5
	1000	15	037 54102	5.0	037 64102	5.0	037 34102	5.0	–	–
	2200	17	037 54222	5.0	037 64222	5.0	037 34222	5.0	–	–
	3300	18	037 54332	5.0	037 64332	5.0	037 34332	5.0	–	–
	4700	19	037 54472	7.5	037 64472	7.5	037 34472	7.5	–	–
6800	20	037 54682	7.5	037 64682	7.5	037 34682	7.5	–	–	

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

ELECTRICAL DATA (continued)**Table 4** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	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)
16	68	5 × 11	11	130	14	5.2	0.16	3.7	4.7
	100	6.3 × 11	12	180	19	6.2	0.16	2.5	3.2
	220	8 × 12	13	300	38	10	0.16	1.2	1.5
	330	8 × 12	13	370	56	14	0.16	0.77	0.97
	470	10 × 12	14	420	78	18	0.16	0.54	0.68
	680	10 × 16	15	520	110	25	0.16	0.37	0.47
	1000	10 × 20	16	740	160	35	0.16	0.25	0.32
	1500	12.5 × 20	17	900	240	51	0.17	0.18	0.21
	2200	12.5 × 25	18	1200	360	73	0.18	0.13	0.15
	3300	16 × 25	19	1650	530	109	0.20	0.10	0.10
4700	16 × 31	20	2100	760	150	0.24	0.08	0.07	
25	47	5 × 11	11	120	15	5.4	0.14	4.7	4.7
	68	6.3 × 11	12	130	20	6.4	0.14	3.3	3.2
	100	6.3 × 11	12	190	28	8	0.14	2.2	2.2
	150	8 × 12	13	230	41	11	0.14	1.5	1.5
	220	8 × 12	13	320	58	14	0.14	1.0	1.0
	330	10 × 12	14	410	86	20	0.14	0.68	0.67
	470	10 × 16	15	510	120	26	0.14	0.47	0.47
	1000	12.5 × 20	17	910	250	53	0.14	0.22	0.22
	1500	12.5 × 25	18	1100	380	78	0.15	0.16	0.15
	2200	16 × 25	19	1500	550	110	0.16	0.12	0.10
3300	16 × 31	20	1900	830	170	0.18	0.09	0.07	
35	33	5 × 11	11	110	15	5.3	0.12	5.8	4.5
	220	10 × 12	14	330	80	18	0.12	0.87	0.68
	330	10 × 16	15	450	120	26	0.12	0.58	0.45
	470	10 × 20	16	590	170	36	0.12	0.41	0.32
	680	12.5 × 20	17	830	240	51	0.12	0.28	0.22
	1000	12.5 × 25	18	1050	350	73	0.12	0.19	0.15
	1500	16 × 25	19	1400	530	110	0.13	0.14	0.10
	2200	16 × 31	20	1750	770	160	0.14	0.10	0.07

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

ORDERING INFORMATION (continued)**Table 5** Ordering information continued; preferred types in **bold**

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
16	68	11	037 55689	2.0	–	–	037 35689	5.0	037 75689	2.5
	100	12	037 55101	2.5	–	–	037 35101	5.0	037 75101	2.5
	220	13	037 55221	3.5	–	–	037 35221	5.0	037 75221	3.5
	330	13	037 90038	3.5	–	–	037 90045	5.0	037 90046	3.5
	470	14	037 55471	5.0	037 65471	5.0	037 35471	5.0	–	–
	680	15	037 55681	5.0	037 65681	5.0	037 35681	5.0	–	–
	1000	16	037 55102	5.0	037 65102	5.0	037 35102	5.0	–	–
	1500	17	037 55152	5.0	037 65152	5.0	037 35152	5.0	–	–
	2200	18	037 55222	5.0	037 65222	5.0	037 35222	5.0	–	–
	3300	19	037 55332	7.5	037 65332	7.5	037 35332	7.5	–	–
4700	20	037 55472	7.5	037 65472	7.5	037 35472	7.5	–	–	
25	47	11	037 56479	2.0	–	–	037 36479	5.0	037 76479	2.5
	68	12	037 56689	2.5	–	–	037 36689	5.0	037 76689	2.5
	100	12	037 90047	2.5	–	–	037 90054	5.0	037 90055	2.5
	150	13	037 56151	3.5	–	–	037 36151	5.0	037 76151	3.5
	220	13	037 56221	3.5	–	–	037 36221	5.0	037 76221	3.5
	330	14	037 56331	5.0	037 66331	5.0	037 36331	5.0	–	–
	470	15	037 56471	5.0	037 66471	5.0	037 36471	5.0	–	–
	1000	17	037 56102	5.0	037 66102	5.0	037 36102	5.0	–	–
	1500	18	037 56152	5.0	037 66152	5.0	037 36152	5.0	–	–
	2200	19	037 56222	7.5	037 66222	7.5	037 36222	7.5	–	–
3300	20	037 56332	7.5	037 66332	7.5	037 36332	7.5	–	–	
35	33	11	037 50339	2.0	–	–	037 30339	5.0	037 70339	2.5
	220	14	037 50221	5.0	037 60221	5.0	037 30221	5.0	–	–
	330	15	037 50331	5.0	037 60331	5.0	037 30331	5.0	–	–
	470	16	037 50471	5.0	037 60471	5.0	037 30471	5.0	–	–
	680	17	037 50681	5.0	037 60681	5.0	037 30681	5.0	–	–
	1000	18	037 50102	5.0	037 60102	5.0	037 30102	5.0	–	–
	1500	19	037 50152	7.5	037 60152	7.5	037 30152	7.5	–	–
	2200	20	037 50222	7.5	037 60222	7.5	037 30222	7.5	–	–

R

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

ELECTRICAL DATA (continued)**Table 6** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)
40	33	6.3 × 11	12	110	16	5.6	0.12	5.8	3.9
	47	6.3 × 11	12	130	22	6.8	0.12	4.1	2.8
	150	10 × 12	14	250	63	15	0.12	1.3	0.87
	470	12.5 × 20	17	670	190	41	0.12	0.41	0.28
	680	12.5 × 25	18	850	280	57	0.12	0.28	0.19
	1000	16 × 25	19	1200	400	83	0.12	0.19	0.13
50	10	5 × 11	11	65	8	4	0.10	16	9.5
	22	5 × 11	11	95	14	5.2	0.10	7.2	4.3
	47	6.3 × 11	12	150	27	7.7	0.10	3.4	2.0
	68	8 × 12	13	190	37	10	0.10	2.3	1.4
	100	8 × 12	13	260	53	13	0.10	1.6	0.95
	220	10 × 16	15	400	110	25	0.10	0.72	0.43
	330	10 × 20	16	580	170	36	0.10	0.48	0.29
	470	12.5 × 20	17	740	240	50	0.10	0.34	0.20
	680	12.5 × 25	18	950	340	71	0.10	0.23	0.14
	1000	16 × 25	19	1350	500	100	0.10	0.16	0.10

Aluminum electrolytic capacitors
Radial Standard Miniature

037 RSM

ORDERING INFORMATION (continued)

Table 7 Ordering information continued; preferred types in bold

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA	F (mm)	FORM TNA	F (mm)
			FORM CA	F (mm)	FORM CB	F (mm)				
40	33	12	037 57339	2.5	—	—	037 37339	5.0	037 77339	2.5
	47	12	037 57479	2.5	—	—	037 37479	5.0	037 77479	2.5
	150	14	037 57151	5.0	037 67151	5.0	037 37151	5.0	—	—
	470	17	037 57471	5.0	037 67471	5.0	037 37471	5.0	—	—
	680	18	037 57681	5.0	037 67681	5.0	037 37681	5.0	—	—
	1000	19	037 57102	7.5	037 67102	7.5	037 37102	7.5	—	—
50	10	11	037 51109	2.0	—	—	037 31109	5.0	037 71109	2.5
	22	11	037 90056	2.0	—	—	037 90063	5.0	037 90064	2.5
	47	12	037 90065	2.5	—	—	037 90072	5.0	037 90073	2.5
	68	13	037 51689	3.5	—	—	037 31689	5.0	037 71689	3.5
	100	13	037 51101	3.5	—	—	037 31101	5.0	037 71101	3.5
	220	15	037 51221	5.0	037 61221	5.0	037 31221	5.0	—	—
	330	16	037 51331	5.0	037 61331	5.0	037 31331	5.0	—	—
	470	17	037 51471	5.0	037 61471	5.0	037 31471	5.0	—	—
	680	18	037 51681	5.0	037 61681	5.0	037 31681	5.0	—	—
	1000	19	037 51102	7.5	037 61102	7.5	037 31102	7.5	—	—

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

ELECTRICAL DATA (continued)**Table 8** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	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)
63	0.47	5 × 11	11	11	3.3	3.1	0.09	300	170
	1.0	5 × 11	11	16	3.6	3.1	0.09	140	80
	2.2	5 × 11	11	29	4.4	3.3	0.09	65	36
	3.3	5 × 11	11	35	5.1	3.4	0.09	43	24
	4.7	5 × 11	11	45	6.0	3.6	0.09	30	17
	10	5 × 11	11	70	9.3	4.3	0.09	14	8.0
	22	6.3 × 11	12	110	17	5.8	0.09	6.5	3.6
	33	6.3 × 11	12	140	24	7.2	0.09	4.3	2.4
	47	8 × 12	13	190	33	8.9	0.09	3.0	1.7
	68	10 × 12	14	200	46	12	0.09	2.1	1.2
	100	10 × 12	14	260	66	16	0.09	1.4	0.80
	150	10 × 16	15	320	98	22	0.09	0.95	0.53
	220	10 × 20	16	460	140	31	0.09	0.65	0.36
	330	12.5 × 20	17	650	210	45	0.09	0.43	0.24
	470	12.5 × 25	18	850	300	62	0.09	0.30	0.17
	680	16 × 25	19	1150	430	89	0.09	0.21	0.12
1000	16 × 31	20	1550	630	130	0.09	0.14	0.08	
100	0.47	5 × 11	11	12	3.5	3.1	0.07	237	130
	1.0	5 × 11	11	22	4	3.2	0.07	111	60
	2.2	5 × 11	11	33	5.2	3.4	0.07	51	27
	3.3	5 × 11	11	40	6.3	3.7	0.07	34	18
	4.7	5 × 11	11	48	7.7	3.9	0.07	24	13
	10	6.3 × 11	12	80	13	5	0.07	11	6.0
	22	8 × 12	13	130	25	7.4	0.07	5.1	2.7
	33	10 × 12	14	160	36	9.6	0.07	3.4	1.8
	47	10 × 16	15	210	50	12	0.07	2.4	1.3
	100	10 × 20	16	350	100	23	0.07	1.1	0.60
	220	12.5 × 25	18	580	220	47	0.07	0.51	0.27
	330	16 × 25	19	710	330	69	0.07	0.34	0.18
	470	16 × 31	20	900	470	97	0.07	0.24	0.13

Aluminum electrolytic capacitors
Radial Standard Miniature

037 RSM

ORDERING INFORMATION (continued)

Table 9 Ordering information continued; preferred types in bold

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA	F (mm)	FORM TNA	F (mm)
			FORM CA	F (mm)	FORM CB	F (mm)				
63	0.47	11	037 58477	2.0	–	–	037 38477	5.0	037 78477	2.5
	1.0	11	037 58108	2.0	–	–	037 38108	5.0	037 78108	2.5
	2.2	11	037 58228	2.0	–	–	037 38228	5.0	037 78228	2.5
	3.3	11	037 58338	2.0	–	–	037 38338	5.0	037 78338	2.5
	4.7	11	037 58478	2.0	–	–	037 38478	5.0	037 78478	2.5
	10	11	037 58109	2.0	–	–	037 38109	5.0	037 78109	2.5
	22	12	037 58229	2.5	–	–	037 38229	5.0	037 78229	2.5
	33	12	037 90074	2.5	–	–	037 90081	5.0	037 90082	2.5
	47	13	037 58479	3.5	–	–	037 38479	5.0	037 78479	3.5
	68	14	037 58689	5.0	037 68689	5.0	037 38689	5.0	–	–
	100	14	037 58101	5.0	037 68101	5.0	037 38101	5.0	–	–
	150	15	037 58151	5.0	037 68151	5.0	037 38151	5.0	–	–
	220	16	037 58221	5.0	037 68221	5.0	037 38221	5.0	–	–
	330	17	037 58331	5.0	037 68331	5.0	037 38331	5.0	–	–
	470	18	037 58471	5.0	037 68471	5.0	037 38471	5.0	–	–
680	19	037 58681	7.5	037 68681	7.5	037 38681	7.5	–	–	
1000	20	037 58102	7.5	037 68102	7.5	037 38102	7.5	–	–	
100	0.47	11	037 59477	2.0	–	–	037 39477	5.0	037 79477	2.5
	1.0	11	037 59108	2.0	–	–	037 39108	5.0	037 79108	2.5
	2.2	11	037 59228	2.0	–	–	037 39228	5.0	037 79228	2.5
	3.3	11	037 59338	2.0	–	–	037 39338	5.0	037 79338	2.5
	4.7	11	037 59478	2.0	–	–	037 39478	5.0	037 79478	2.5
	10	12	037 59109	2.5	–	–	037 39109	5.0	037 79109	2.5
	22	13	037 59229	3.5	–	–	037 39229	5.0	037 79229	3.5
	33	14	037 59339	5.0	037 69339	5.0	037 39339	5.0	–	–
	47	15	037 59479	5.0	037 69479	5.0	037 39479	5.0	–	–
	100	16	037 59101	5.0	037 69101	5.0	037 39101	5.0	–	–
	220	18	037 59221	5.0	037 69221	5.0	037 39221	5.0	–	–
	330	19	037 59331	7.5	037 69331	7.5	037 39331	7.5	–	–
	470	20	037 59471	7.5	037 69471	7.5	037 39471	7.5	–	–



Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

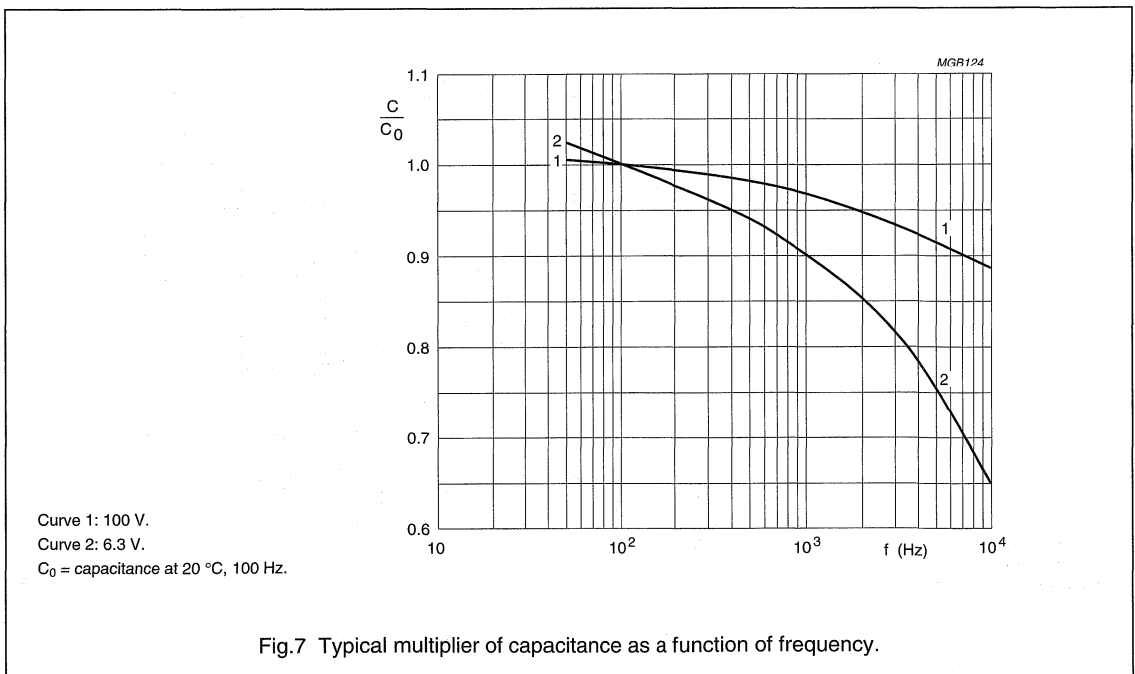
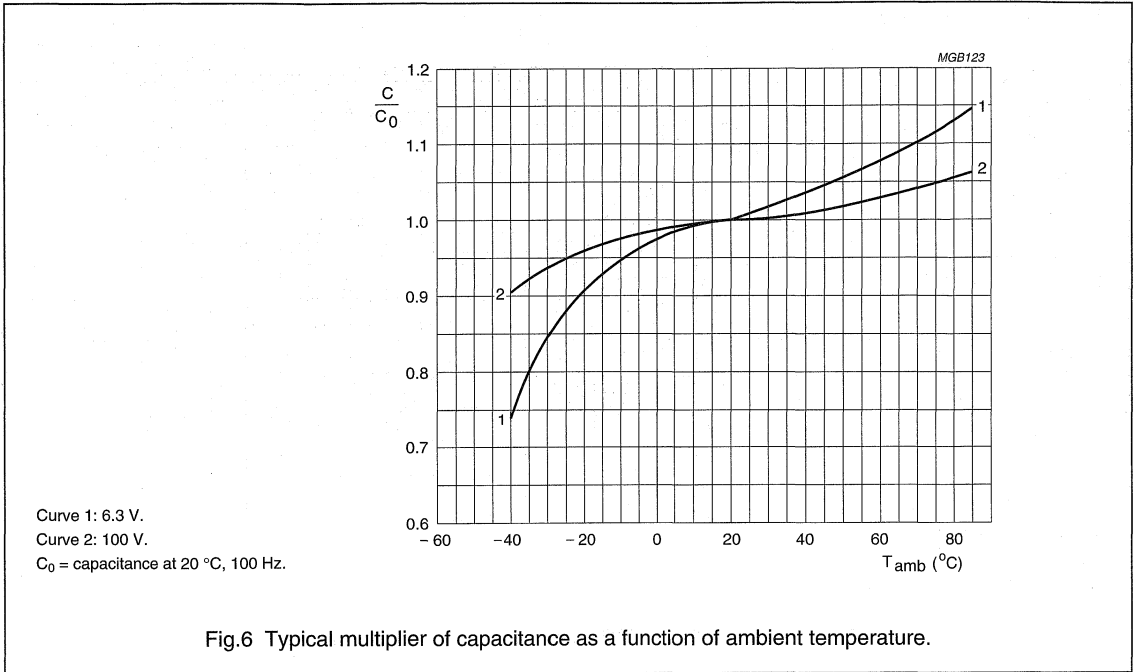
ELECTRICAL DATA (continued)**Additional electrical data**

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.01C_R \times U_R + 3 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \leq 8 \text{ mm}$	typ. 13 nH
	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

Aluminum electrolytic capacitors
Radial Standard Miniature

037 RSM

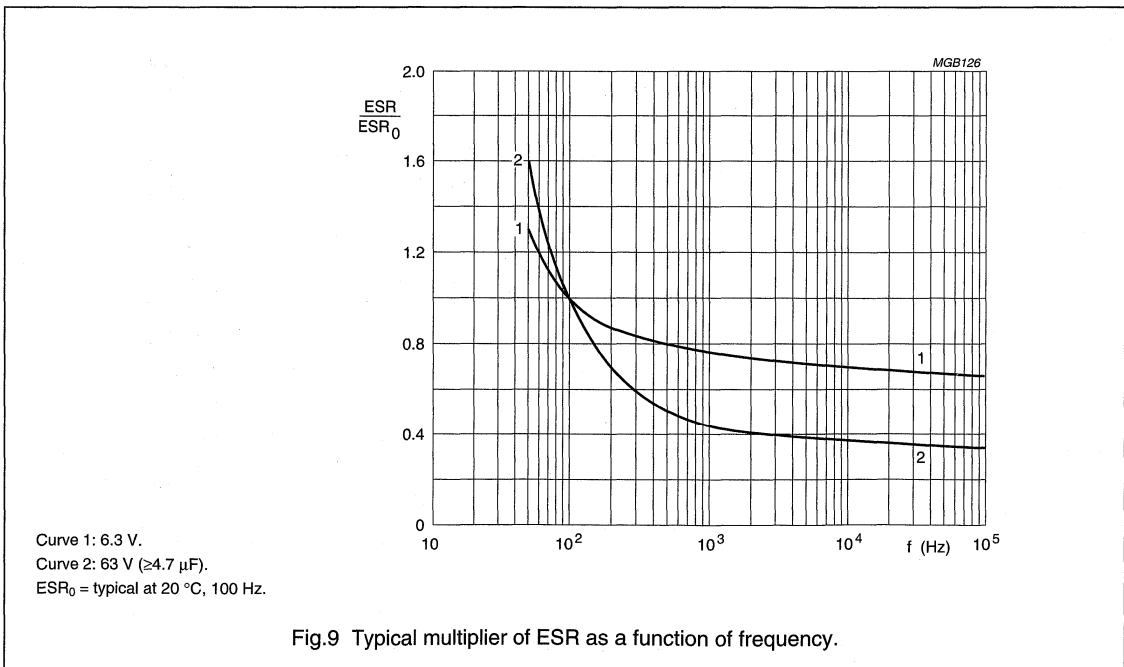
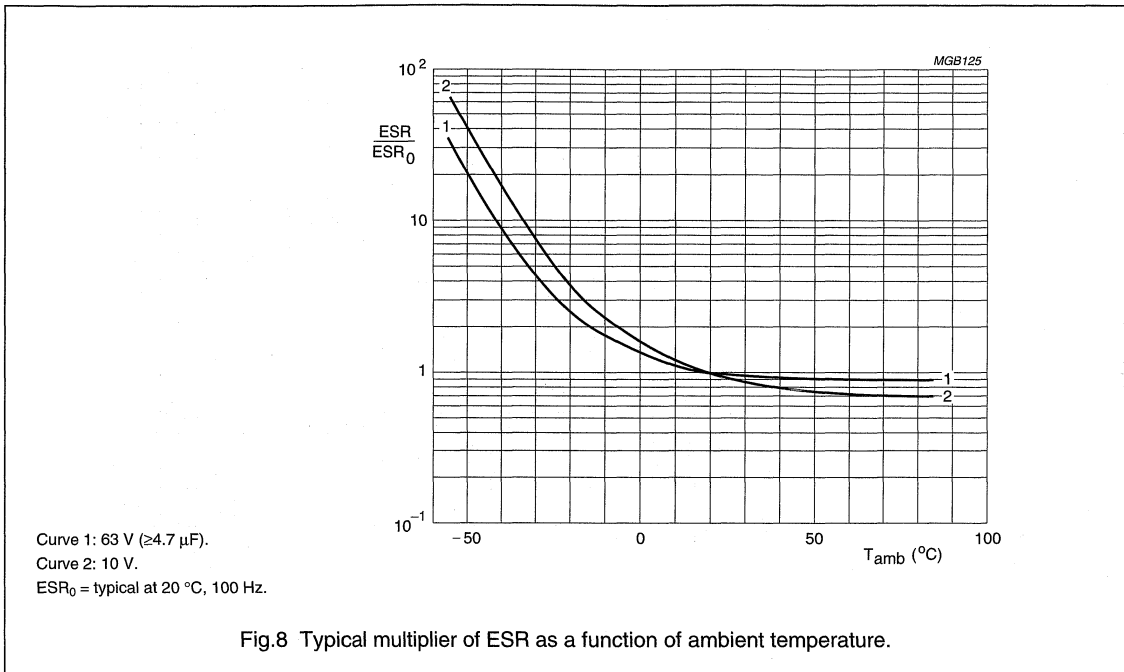
Capacitance (C)



Aluminum electrolytic capacitors
Radial Standard Miniature

037 RSM

Equivalent series resistance (ESR)

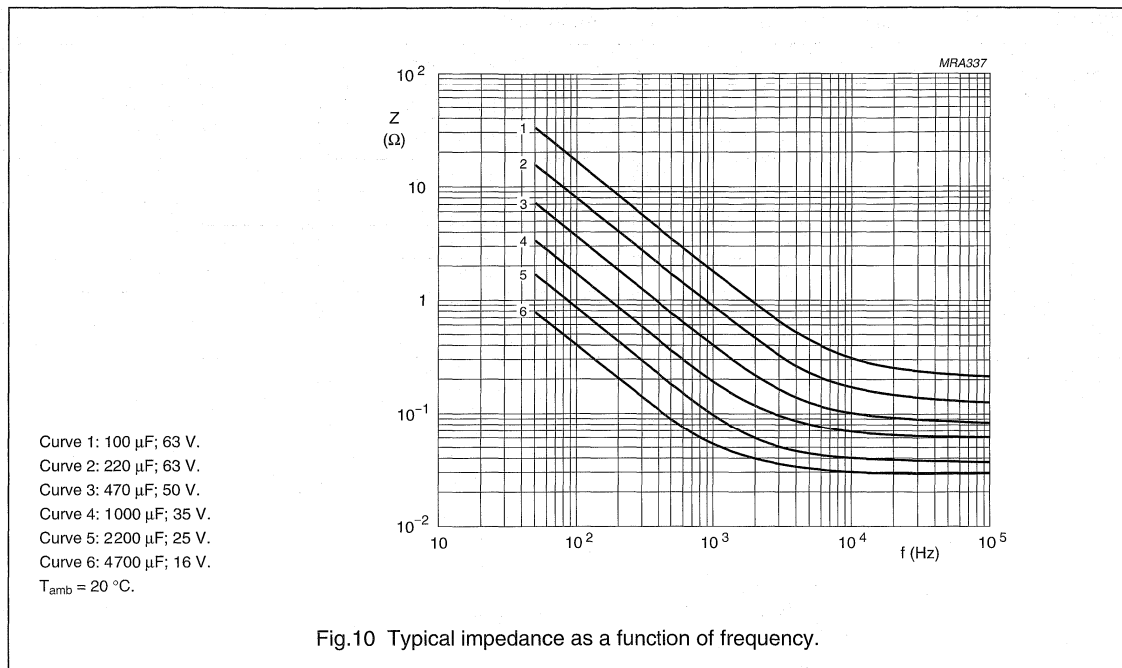


Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

Impedance (Z)



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"
- Rated voltage (in V)
- Group number (037)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Negative terminal identification.

Aluminum electrolytic capacitors

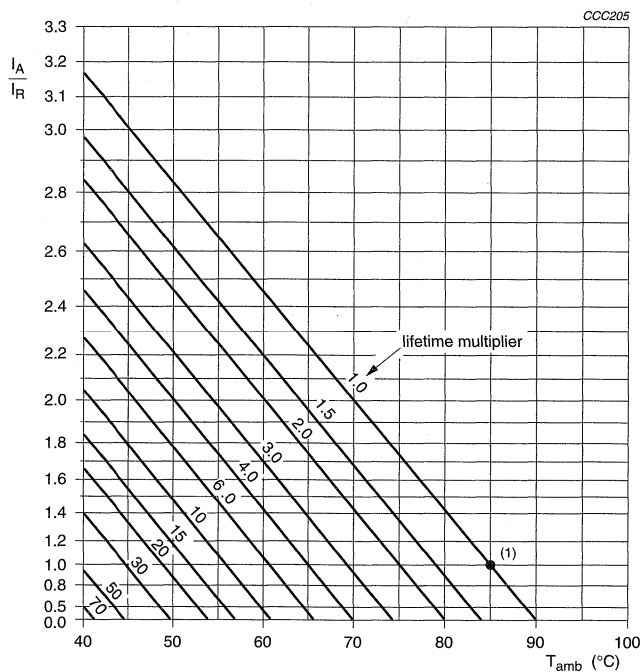
Radial Standard Miniature

037 RSM

RIPPLE CURRENT AND USEFUL LIFE

Table 10 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 35 V	$U_R = 40$ to 100 V
50	0.9	0.85	0.8
100	1.0	1.0	1.0
300	1.12	1.2	1.25
1000	1.2	1.3	1.4
3000	1.25	1.35	1.5
≥ 10000	1.3	1.4	1.6



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: 2500 hours.

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

Aluminum electrolytic capacitors

Radial Standard Miniature

037 RSM

SPECIFIC TESTS AND REQUIREMENTS

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

Table 11 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 2000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 20\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 2500 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +45/-50% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors

Radial Standard, High Voltage

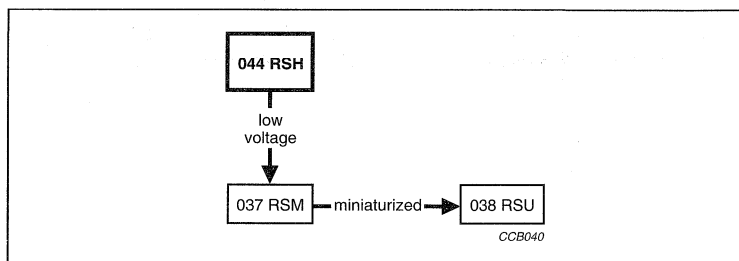
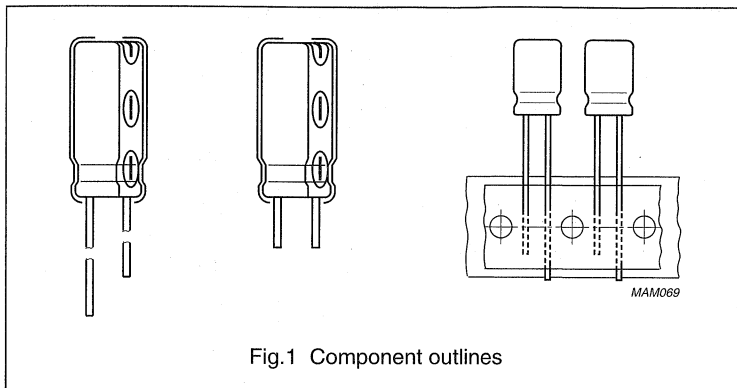
044 RSH

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue vinyl sleeve
- Pressure relief
- Charge and discharge proof
- Reduced dimensions
- High rated voltage, up to 450 V.

APPLICATIONS

- General purpose, audio-video, lighting, general industrial
- Smoothing, filtering, buffering of high voltages.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	6.3 × 11 to 16 × 31
Rated capacitance range, C_R	1.0 to 100 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	160 to 450 V
Category temperature range	≤400 V: -40 to +85 °C; 450 V: -25 to +85 °C
Endurance test at 85 °C	2000 hours
Useful life at 85 °C	3000 hours
Useful life at 40 °C, $1.4 \times I_R$ applied	80 000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	≤400 V: 40/085/56; 450 V: 25/085/56

Aluminum electrolytic capacitors

Radial Standard, High Voltage

044 RSH

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	160	200	250	350	400	450
1.0	–	–	6.3 × 11	–	8 × 12	10 × 12
2.2	–	–	8 × 12	10 × 12	10 × 12	10 × 16
4.7	–	10 × 12	10 × 12	10 × 16	10 × 20	12.5 × 20
10	10 × 16	10 × 16	10 × 20	12.5 × 20	12.5 × 20	12.5 × 25
22	10 × 20	10 × 20	12.5 × 25	12.5 × 25	16 × 25	16 × 31
47	–	12.5 × 25	16 × 25	16 × 31	–	–
100	16 × 25	16 × 31	–	–	–	–

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"
- Rated voltage (in V)
- Group number (044)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Negative terminal identification.

Aluminum electrolytic capacitors

Radial Standard, High Voltage

044 RSH

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

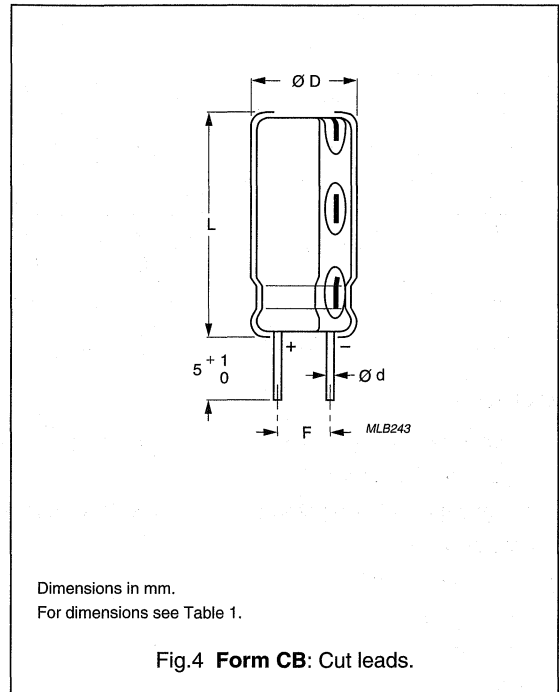
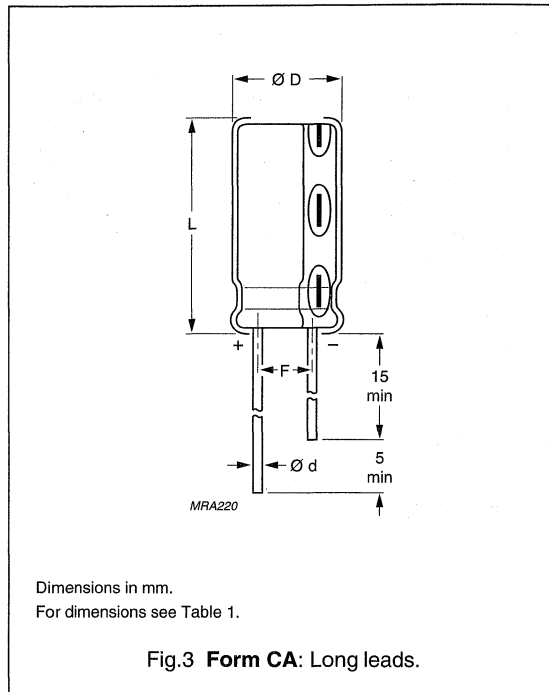


Table 1 Physical dimensions, mass and packaging quantities; see Figs 3 and 4

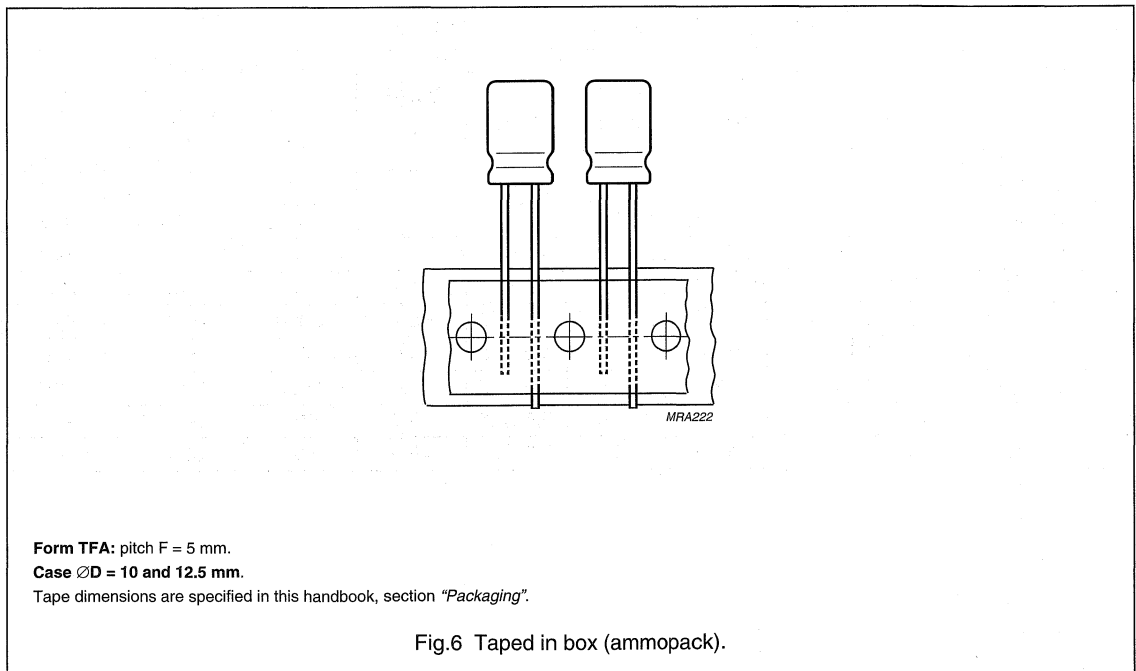
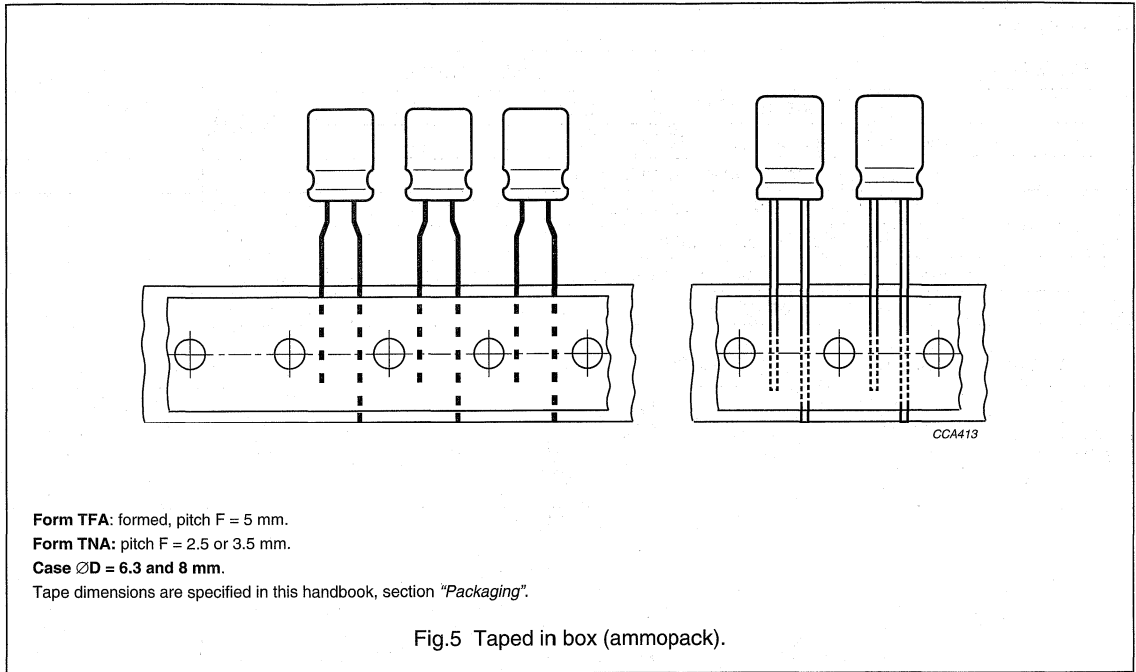
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA, TNA
6.3 × 11	12	0.5	6.8	12.5	2.5 ± 0.5	≈ 0.6	2000	2000	2000
8 × 12	13	0.6	8.5	13.0	3.5 ± 0.5	≈ 1.1	1000	2000	1000
10 × 12	14	0.6	10.5	14.0	5.0 ± 0.5	≈ 1.6	2000	1500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	2000	1500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	2000	1500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	1000	1500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	1000	1500	500
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	500	500	—
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	500	500	—

Aluminum electrolytic capacitors

Radial Standard, High Voltage

044 RSH

Taped products



Aluminum electrolytic capacitors

Radial Standard, High Voltage

044 RSH

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2 and 4 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
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
$\tan \delta$	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 and $+20$ or -25 °C

Table 2 Electrical data; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz $+20\text{ °C}$ (Ω)	Z 10 kHz -25 °C (Ω)
160	10	10 × 16	15	83	120	54	0.14	22	12	180
	22	10 × 20	16	140	180	83	0.14	10	5.5	82
	100	16 × 25	19	380	550	270	0.14	2.2	1.8	26
200	4.7	10 × 12	14	51	96	43	0.14	47	26	380
	10	10 × 16	15	85	130	60	0.14	22	12	180
	22	10 × 20	16	140	200	96	0.14	10	5.5	82
	47	12.5 × 25	18	230	350	170	0.14	4.7	2.6	38
	100	16 × 31	20	400	670	330	0.14	2.2	1.5	22
250	1.0	6.3 × 11	12	17	55	23	0.14	220	110	1800
	2.2	8 × 12	13	30	73	32	0.14	100	55	820
	4.7	10 × 12	14	51	110	48	0.14	47	26	380
	10	10 × 20	16	95	150	68	0.14	22	12	180
	22	12.5 × 25	18	160	240	110	0.14	10	5.5	82
	47	16 × 25	19	260	420	210	0.14	4.7	2.6	38
350	2.2	10 × 12	14	39	86	38	0.13	94	39	550
	4.7	10 × 16	15	63	120	55	0.13	44	18	260
	10	12.5 × 20	17	120	180	83	0.13	21	8.5	120
	22	12.5 × 25	18	180	300	150	0.13	9.4	3.9	55
	47	16 × 31	20	320	560	280	0.13	4.4	2.3	31

Aluminum electrolytic capacitors

Radial Standard, High Voltage

044 RSH

ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 044 series

47 μ F/250 V; \pm 20%Nominal case size: \varnothing 16 \times 25 mm; Form CB

Catalogue number: 2222 044 63479.

Table 3 Ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA	F (mm)	FORM TNA	F (mm)
			FORM CA	F (mm)	FORM CB	F (mm)				
160	10	15	044 51109	5.0	044 61109	5.0	044 31109	5.0	–	–
	22	16	044 51229	5.0	044 61229	5.0	044 31229	5.0	–	–
	100	19	044 51101	7.5	044 61101	7.5	–	–	–	–
200	4.7	14	044 52478	5.0	044 62478	5.0	044 32478	5.0	–	–
	10	15	044 52109	5.0	044 62109	5.0	044 32109	5.0	–	–
	22	16	044 52229	5.0	044 62229	5.0	044 32229	5.0	–	–
	47	18	044 90516	5.0	044 90517	5.0	044 90519	5.0	–	–
	100	20	044 52101	7.5	044 62101	7.5	–	–	–	–
250	1.0	12	044 90501	2.5	–	–	044 90506	5.0	044 90507	2.5
	2.2	13	044 90015	3.5	–	–	044 90019	5.0	044 90529	3.5
	4.7	14	044 53478	5.0	044 63478	5.0	044 33478	5.0	–	–
	10	16	044 53109	5.0	044 63109	5.0	044 33109	5.0	–	–
	22	18	044 53229	5.0	044 63229	5.0	044 33229	5.0	–	–
	47	19	044 53479	7.5	044 63479	7.5	–	–	–	–
350	2.2	14	044 55228	5.0	044 65228	5.0	044 35228	5.0	–	–
	4.7	15	044 55478	5.0	044 65478	5.0	044 35478	5.0	–	–
	10	17	044 55109	5.0	044 65109	5.0	044 35109	5.0	–	–
	22	18	044 90525	5.0	044 90526	5.0	044 90528	5.0	–	–
	47	20	044 55479	7.5	044 65479	7.5	–	–	–	–

R

Aluminum electrolytic capacitors

Radial Standard, High Voltage

044 RSH

ELECTRICAL DATA (continued)**Table 4** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	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 +20 °C (Ω)	Z 10 kHz -25 °C (Ω)
400	1.0	8 × 12	13	22	64	27	0.15	240	85	1200
	2.2	10 × 12	14	39	93	41	0.15	110	39	550
	4.7	10 × 20	16	70	130	58	0.15	51	18	260
	10	12.5 × 20	17	110	190	90	0.15	24	8.5	120
	22	16 × 25	19	200	330	160	0.15	11	3.9	55
450	1.0	10 × 14	14	25	67	29	0.26	410	120	2000
	2.2	10 × 16	15	42	99	45	0.26	190	55	910
	4.7	12.5 × 20	17	75	130	62	0.26	88	26	380
	10	12.5 × 25	18	120	210	100	0.26	41	12	260
	22	16 × 31	20	210	370	180	0.26	19	5.5	82

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	$U_R = 160$ to 250 V	$U_s \leq 1.15 \times U_R$
	$U_R = 350$ to 450 V	$U_s \leq 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1$ V
Current		
Leakage current	after 1 minute at U_R :	
	$CV \leq 1000$ μC	$I_{L1} \leq 0.06C_R \times U_R + 40$ μA
	$CV > 1000$ μC	$I_{L1} \leq 0.03C_R \times U_R + 70$ μA
	after 5 minutes at U_R :	
$CV \leq 1000$ μC	$I_{L5} \leq 0.03C_R \times U_R + 15$ μA	
$CV > 1000$ μC	$I_{L5} \leq 0.015C_R \times U_R + 30$ μA	
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 6.3$ and 8 mm	typ. 13 nH
	case $\varnothing D = 10$ mm	typ. 16 nH
	case $\varnothing D \geq 12.5$ mm	typ. 18 nH

Aluminum electrolytic capacitors

Radial Standard, High Voltage

044 RSH

ORDERING INFORMATION (continued)**Table 5** Ordering information continued; preferred types in **bold**

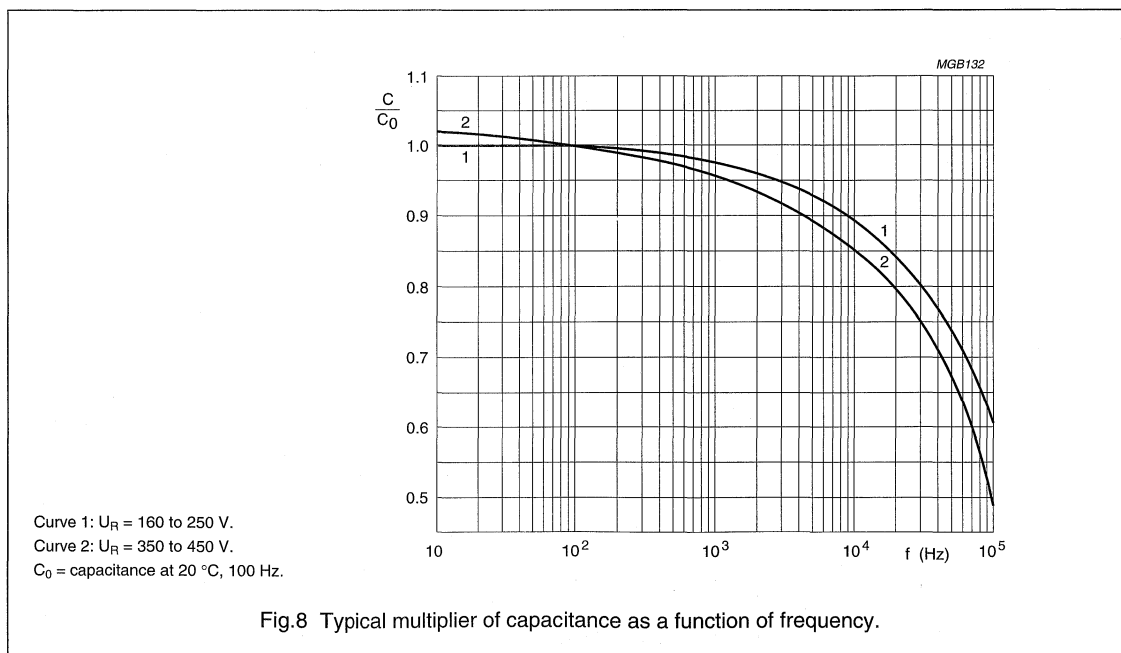
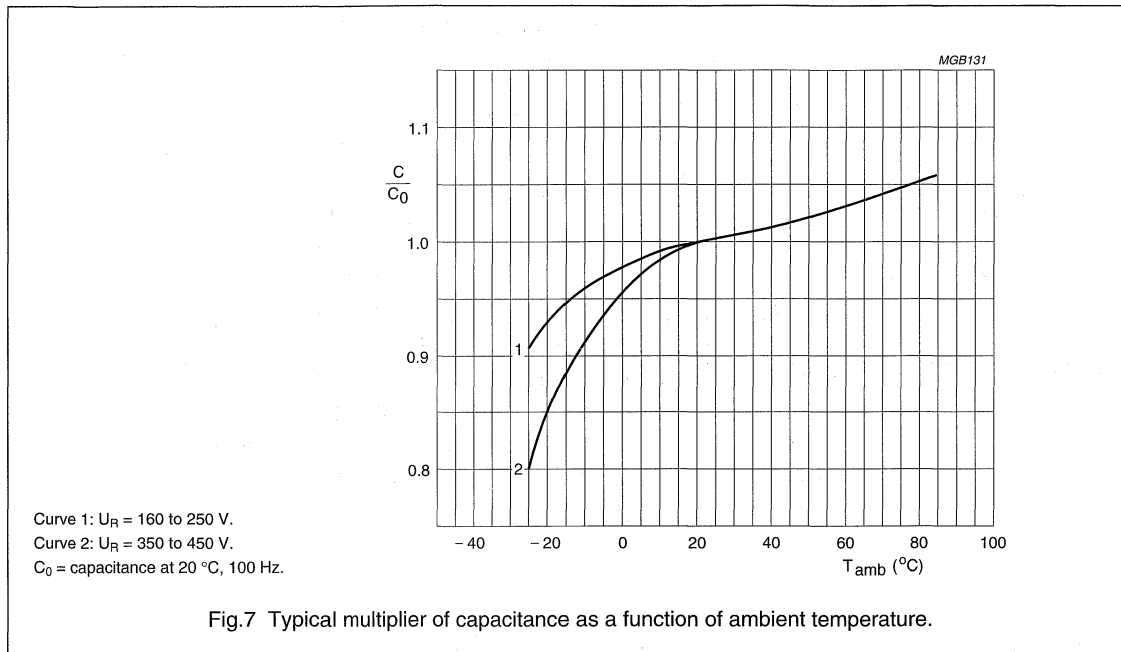
U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
400	1.0	13	044 56108	3.5	–	–	044 36108	5.0	044 76108	3.5
	2.2	14	044 56228	5.0	044 66228	5.0	044 36228	5.0	–	–
	4.7	16	044 56478	5.0	044 66478	5.0	044 36478	5.0	–	–
	10	17	044 56109	5.0	044 66109	5.0	044 36109	5.0	–	–
	22	19	044 56229	7.5	044 66229	7.5	–	–	–	–
450	1.0	14	044 57108	5.0	044 67108	5.0	044 37108	5.0	–	–
	2.2	15	044 57228	5.0	044 67228	5.0	044 37228	5.0	–	–
	4.7	17	044 57478	5.0	044 67478	5.0	044 37478	5.0	–	–
	10	18	044 57109	5.0	044 67109	5.0	044 37109	5.0	–	–
	22	20	044 57229	7.5	044 67229	7.5	–	–	–	–

Aluminum electrolytic capacitors
Radial Standard, High Voltage

044 RSH

ELECTRICAL DATA (continued)

Capacitance (C)



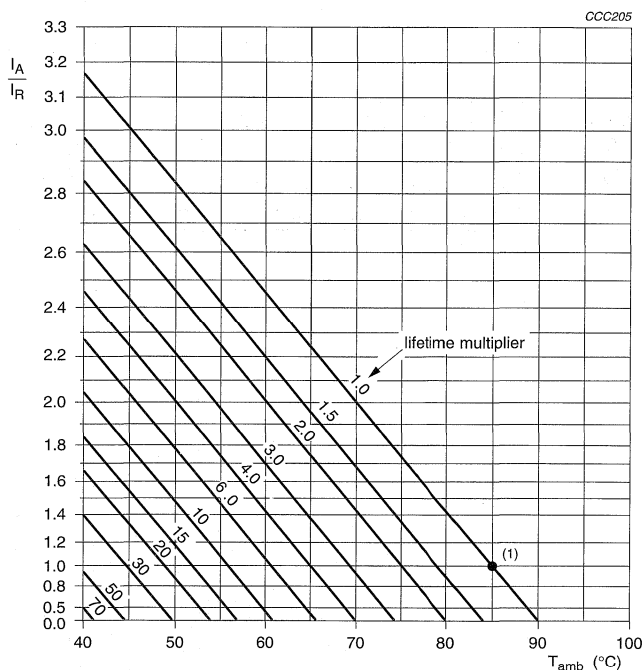
Aluminum electrolytic capacitors Radial Standard, High Voltage

044 RSH

RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.75
100	1.0
300	1.2
1000	1.35
3000	1.45
≥ 10000	1.5



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: 3000 hours.

Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Standard, High Voltage

044 RSH

SPECIFIC TESTS AND REQUIREMENTS

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

Table 7 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 2000 hours	$\Delta C/C: \pm 20\%$ $\leq 400\text{ V}: \tan \delta \leq 2 \times \text{spec. limit}$ $450\text{ V}: \tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 3000 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors
Radial Standard, High Voltage

044 RSH

NOTES



Aluminum electrolytic capacitors Radial Low Leakage Current

013 RLC

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, all-insulated (light blue)
- Natural pitch 2.5 mm and 5 mm
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume
- Low leakage current, low energy consumption.

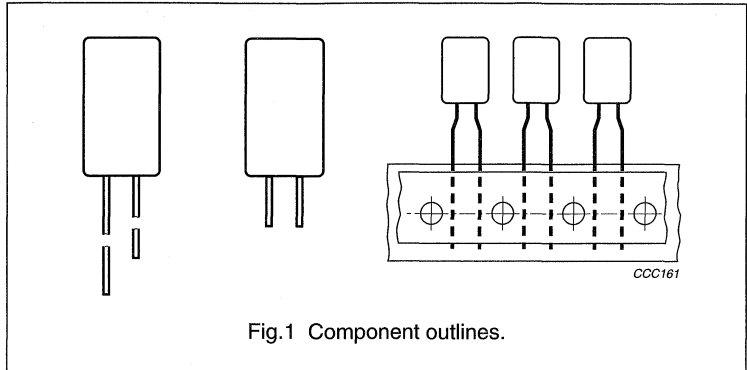
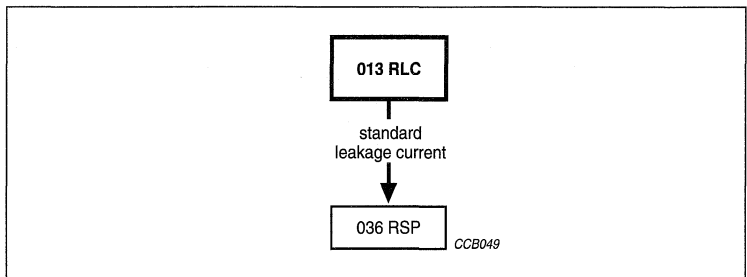


Fig.1 Component outlines.

APPLICATIONS

- Telecommunication, automotive, audio-video, EDP and industrial
- Coupling, decoupling, buffering, timing, energy storage
- Portable and mobile equipment
- Low surface demand on printed-circuit board.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	5 × 11 and 8.2 × 11
Rated capacitance range, C_R	0.47 to 470 μF
Tolerance on C_R	$\pm 20\%$; $\pm 10\%$ available on request
Rated voltage range, U_R	6.3 to 50 V
Category temperature range	-40 to +85 °C
Leakage current after 2 minutes: $U_R = 6.3$ to 25 V $U_R = 35$ and 50 V	$0.002C_R \times U_R$ or $0.7 \mu A$, whichever is greater $0.002C_R \times U_R + 1 \mu A$
Endurance test at 85 °C	2000 hours
Useful life at 105 °C	750 hours
Useful life at 85 °C	3000 hours
Useful life at 40 °C, $1.4 \times I_R$ applied	80000 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

Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	6.3	10	16	25	35	50
0.47	–	–	–	–	–	5 × 11
1.0	–	–	–	5 × 11	–	5 × 11
2.2	–	–	–	5 × 11	–	5 × 11
3.3	–	–	–	5 × 11	–	5 × 11
4.7	–	–	–	5 × 11	–	5 × 11
10	–	–	–	5 × 11	–	5 × 11
22	–	–	–	5 × 11	–	5 × 11
33	–	–	5 × 11	–	5 × 11	8.2 × 11
47	–	5 × 11	5 × 11	8.2 × 11	–	8.2 × 11
68	–	5 × 11	–	–	–	8.2 × 11
100	–	5 × 11	8.2 × 11	–	8.2 × 11	–
220	–	8.2 × 11	–	–	–	–
330	8.2 × 11	–	–	–	–	–
470	8.2 × 11	–	–	–	–	–

R

Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

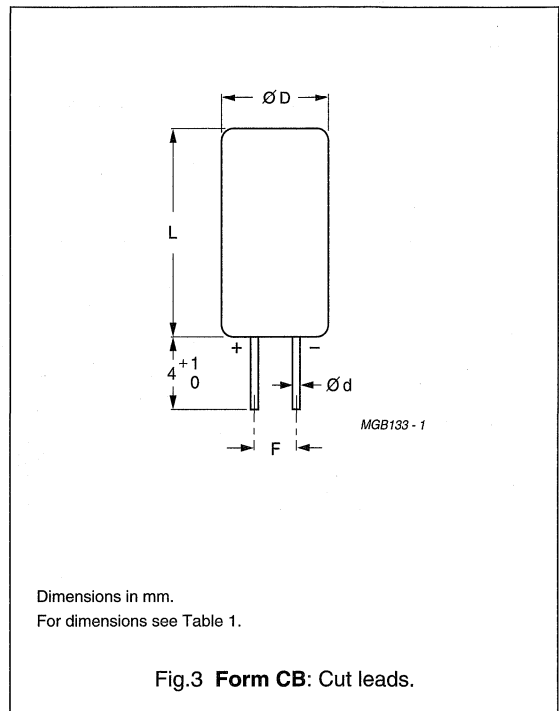
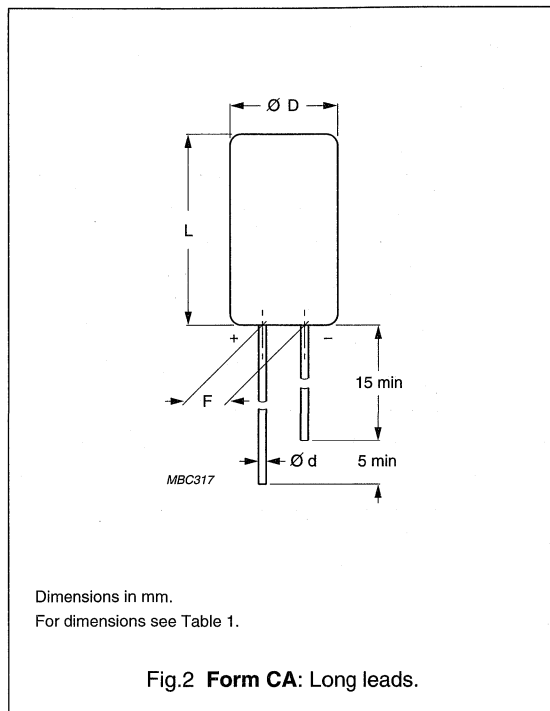


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

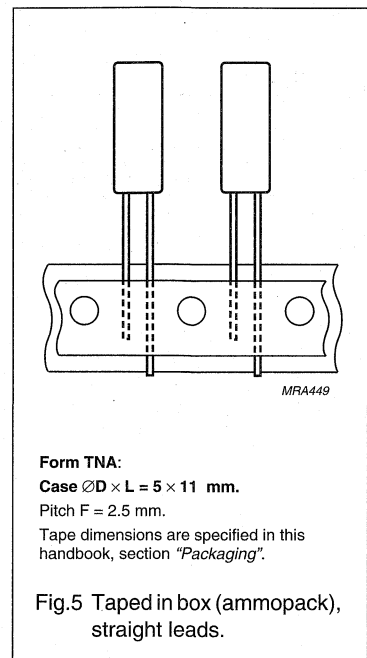
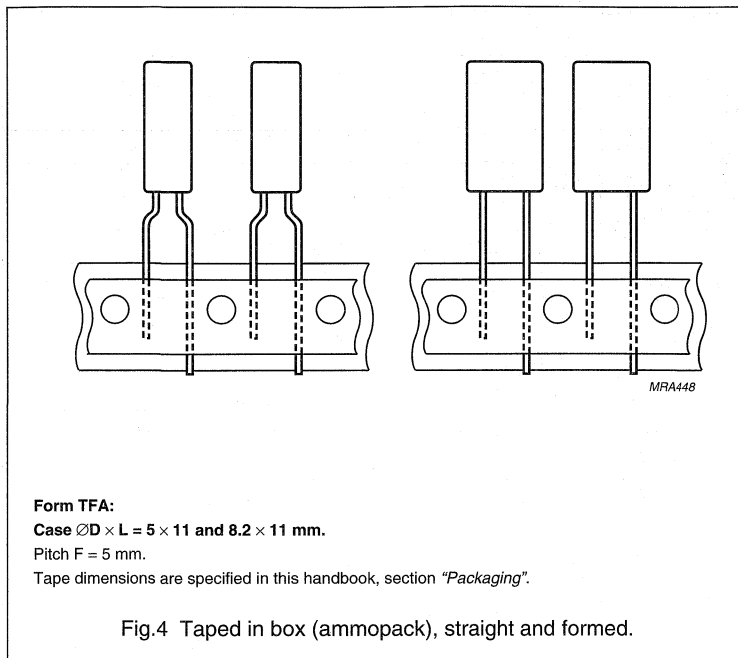
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES	
							FORM CA, CB	FORM TFA, TNA
5 × 11	11	0.5	5.5	12	2.5 ± 0.5	≈ 0.4	1000	2000
8.2 × 11	13	0.6	8.7	12	5.0 ± 0.5	≈ 1.1	1000	1000

Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

Taped products



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"
- Rated voltage (in V)
- Group number (013)
- Name of manufacturer
- Date code in accordance with "IEC 60062"
- Code indicating factory of origin
- Minus-sign on top to identify the negative terminal.



Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2 and 4 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, 85 °C
I_{L2}	max. leakage current after 2 minutes at U_R
$\tan \delta$	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 and +20, -25 or -40 °C

Table 2 Electrical data; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L2} 2 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz +20 °C (Ω)	Z 10 kHz -25 °C (Ω)	Z 10 kHz -40 °C (Ω)
6.3	330	8.2 × 11	13	210	4.2	0.2	1.0	0.9	5.2	15
	470	8.2 × 11	13	250	5.9	0.2	0.7	0.64	3.5	10
10	47	5 × 11	11	75	1.0	0.16	5.4	2.8	15	53
	68	5 × 11	11	90	1.4	0.16	3.7	2.5	13	47
	100	5 × 11	11	110	2.0	0.16	2.5	1.7	9.0	25
	220	8.2 × 11	13	190	4.4	0.16	1.2	0.9	5.2	15
16	33	5 × 11	11	70	1.1	0.13	6.3	2.8	14	52
	47	5 × 11	11	85	1.5	0.13	4.4	2.1	9.5	36
	100	8.2 × 11	13	150	3.2	0.13	2.1	1.0	5.5	17
25	1.0	5 × 11	11	5	0.7	0.06	95	40	130	400
	2.2	5 × 11	11	10	0.7	0.06	43	18	59	180
	3.3	5 × 11	11	18	0.7	0.06	29	12	39	120
	4.7	5 × 11	11	25	0.7	0.06	20	8.5	27	85
	10	5 × 11	11	50	0.7	0.06	9.5	4.0	17	65
	22	5 × 11	11	75	1.1	0.08	5.8	2.7	15	56
	47	8.2 × 11	13	130	2.4	0.08	2.7	1.3	6.5	17
35	33	5 × 11	11	70	3.3	0.13	6.3	2.8	14	52
	100	8.2 × 11	13	150	8.0	0.13	2.1	1.0	5.5	17

Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 013 series

100 $\mu\text{F}/16\text{ V}$; $\pm 20\%$ Nominal case size: $\text{Ø}8.2 \times 11\text{ mm}$; Form TFA

Catalogue number: 2222 013 35101.

Table 3 Ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA		FORM TNA	
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
6.3	330	13	013 53331	5.0	013 63331	5.0	013 33331	5.0	–	–
	470	13	013 53471	5.0	013 63471	5.0	013 33471	5.0	–	–
10	47	11	013 54479	2.5	–	–	013 34479	5.0	013 74479	2.5
	68	11	013 54689	2.5	–	–	013 34689	5.0	013 74689	2.5
	100	11	013 54101	2.5	–	–	013 34101	5.0	013 74101	2.5
	220	13	013 54221	5.0	013 64221	5.0	013 34221	5.0	–	–
16	33	11	013 55339	2.5	–	–	013 35339	5.0	013 75339	2.5
	47	11	013 55479	2.5	–	–	013 35479	5.0	013 75479	2.5
	100	13	013 55101	5.0	013 65101	5.0	013 35101	5.0	–	–
25	1.0	11	013 56108	2.5	–	–	013 36108	5.0	013 76108	2.5
	2.2	11	013 56228	2.5	–	–	013 36228	5.0	013 76228	2.5
	3.3	11	013 56338	2.5	–	–	013 36338	5.0	013 76338	2.5
	4.7	11	013 56478	2.5	–	–	013 36478	5.0	013 76478	2.5
	10	11	013 56109	2.5	–	–	013 36109	5.0	013 76109	2.5
	22	11	013 56229	2.5	–	–	013 36229	5.0	013 76229	2.5
	47	13	013 56479	5.0	013 66479	5.0	013 36479	5.0	–	–
35	33	11	013 50339	5.0	–	–	013 30339	5.0	013 70339	2.5
	100	13	013 50101	5.0	013 60101	5.0	013 30101	5.0	–	–

Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

ELECTRICAL DATA (continued)**Table 4** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85°C (mA)	I_{L2} 2 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz +20°C (Ω)	Z 10 kHz -25°C (Ω)	Z 10 kHz -40°C (Ω)
50	0.47	5 × 11	11	5	1.1	0.06	200	85	230	850
	1.0	5 × 11	11	10	1.1	0.06	95	40	130	400
	2.2	5 × 11	11	20	1.2	0.06	43	18	59	180
	3.3	5 × 11	11	32	1.3	0.06	29	12	39	120
	4.7	5 × 11	11	38	1.5	0.06	20	8.5	27	85
	10	5 × 11	11	55	2.0	0.06	9.5	4.0	17	65
	22	5 × 11	11	75	3.2	0.08	5.8	2.7	15	56
	33	8.2 × 11	13	110	4.3	0.06	2.9	1.4	7.0	18
	47	8.2 × 11	13	130	5.7	0.08	2.7	1.3	6.5	17
	68	8.2 × 11	13	150	7.8	0.08	1.9	1.2	6.0	17

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.3 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 2 minutes at U_R : $U_R = 6.3$ to 25 V $U_R = 35$ and 50 V	$I_{L2} \leq 0.002C_R \times U_R$ or $0.7 \mu\text{A}$, whichever is greater $I_{L2} \leq 0.002C_R \times U_R + 1 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \times L = 5 \times 11 \text{ mm}$	typ. 13 nH
	case $\varnothing D \times L = 8.2 \times 11 \text{ mm}$	typ. 16 nH

Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

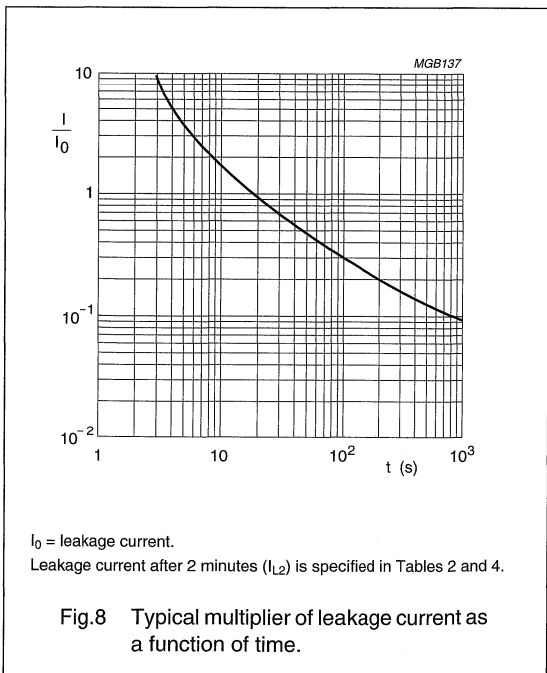
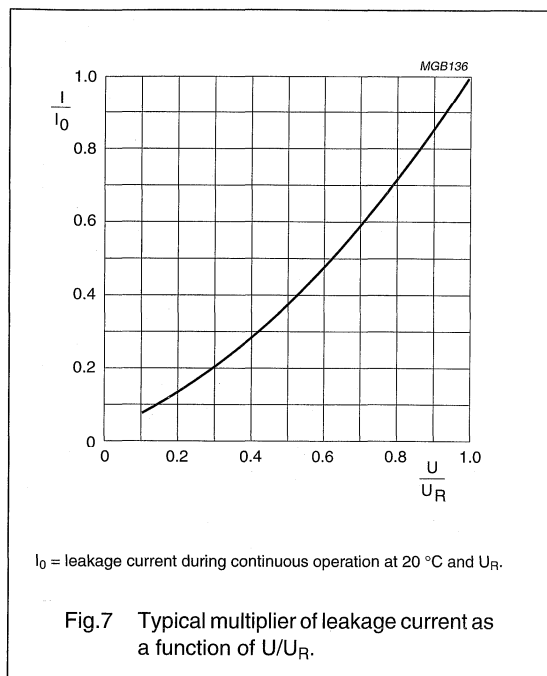
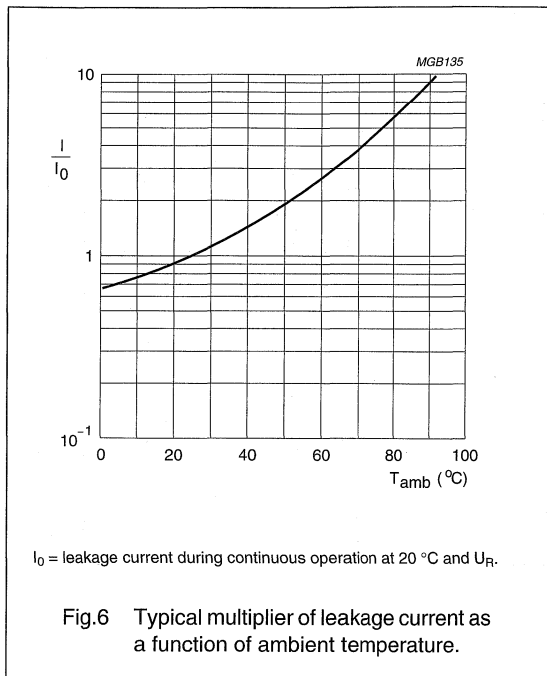
ORDERING INFORMATION (continued)**Table 5** Ordering information continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA	F (mm)	FORM TNA	F (mm)
			FORM CA	F (mm)	FORM CB	F (mm)				
50	0.47	11	013 51477	2.5	–	–	013 31477	5.0	013 71477	2.5
	1.0	11	013 51108	2.5	–	–	013 31108	5.0	013 71108	2.5
	2.2	11	013 51228	2.5	–	–	013 31228	5.0	013 71228	2.5
	3.3	11	013 51338	2.5	–	–	013 31338	5.0	013 71338	2.5
	4.7	11	013 51478	2.5	–	–	013 31478	5.0	013 71478	2.5
	10	11	013 51109	2.5	–	–	013 31109	5.0	013 71109	2.5
	22	11	013 51229	2.5	–	–	013 31229	5.0	013 71229	2.5
	33	13	013 51339	5.0	013 61339	5.0	013 31339	5.0	–	–
	47	13	013 51479	5.0	013 61479	5.0	013 31479	5.0	–	–
	68	13	013 51689	5.0	013 61689	5.0	013 31689	5.0	–	–

Aluminum electrolytic capacitors Radial Low Leakage Current

013 RLC

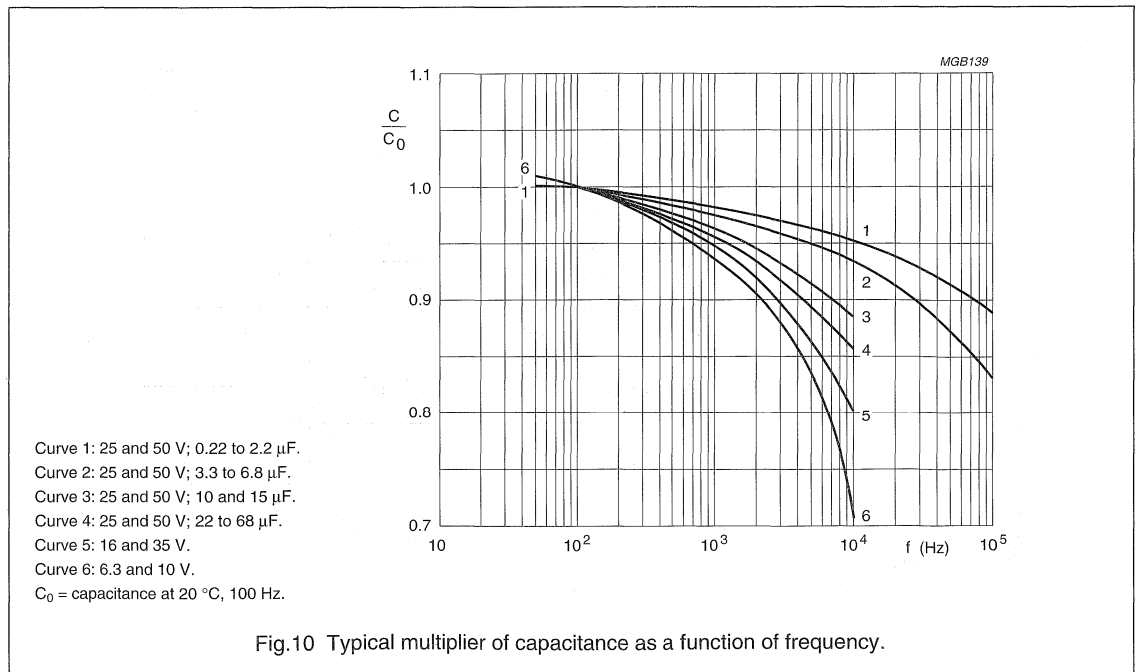
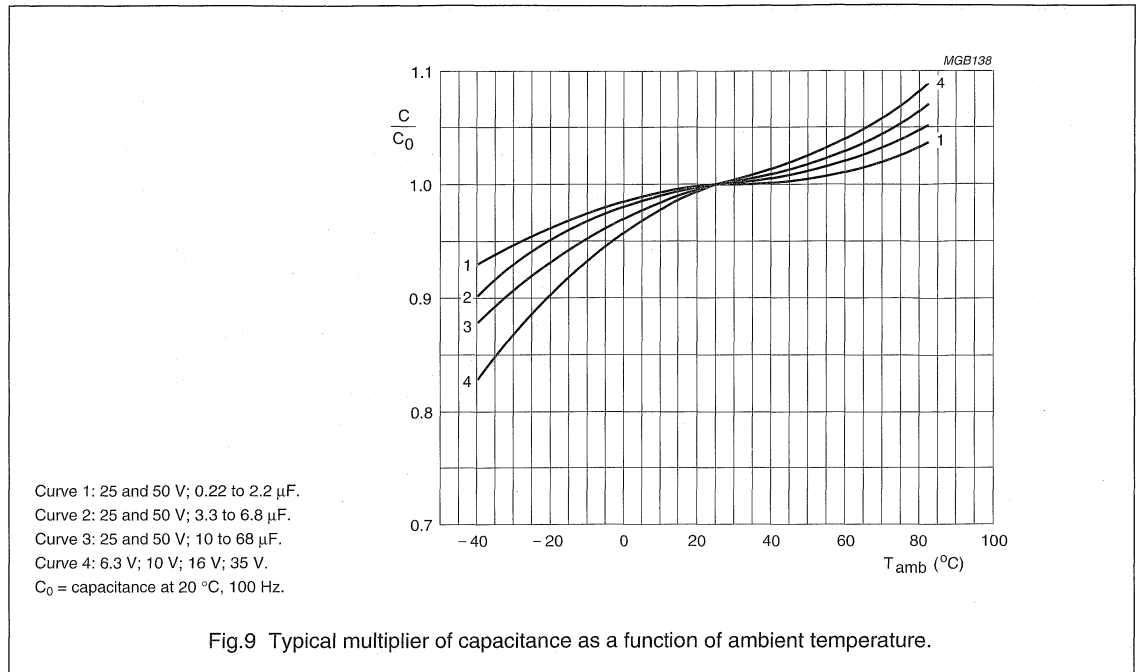
ELECTRICAL DATA (continued)



Aluminum electrolytic capacitors Radial Low Leakage Current

013 RLC

Capacitance (C)



Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

Equivalent series resistance (ESR)

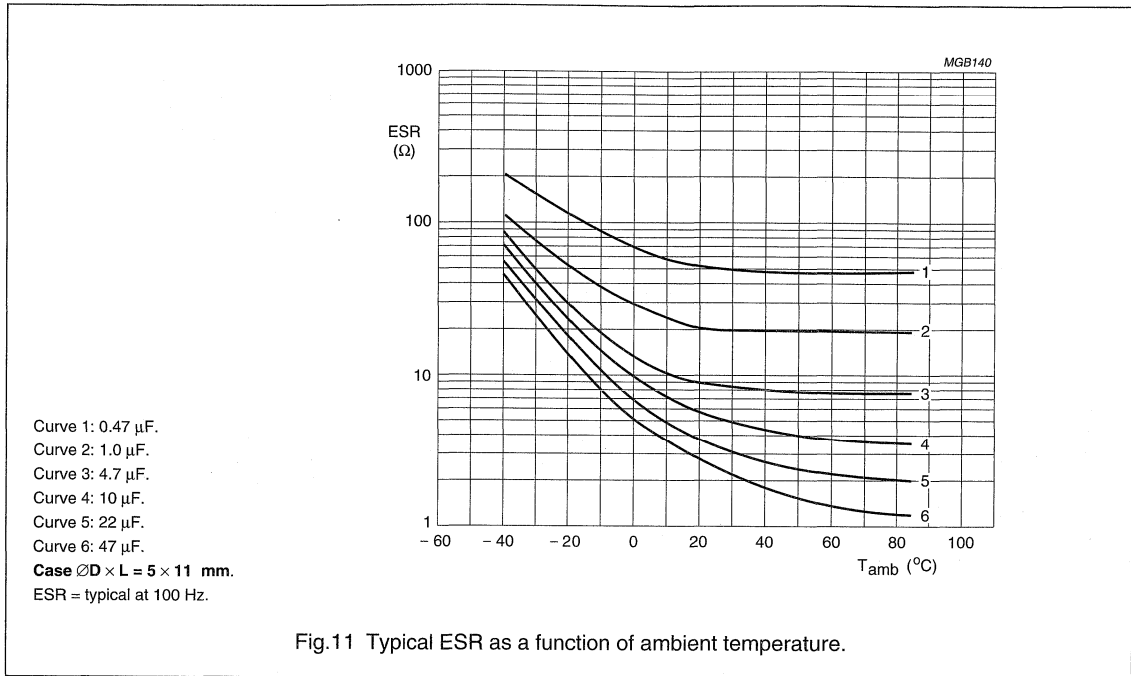


Fig.11 Typical ESR as a function of ambient temperature.

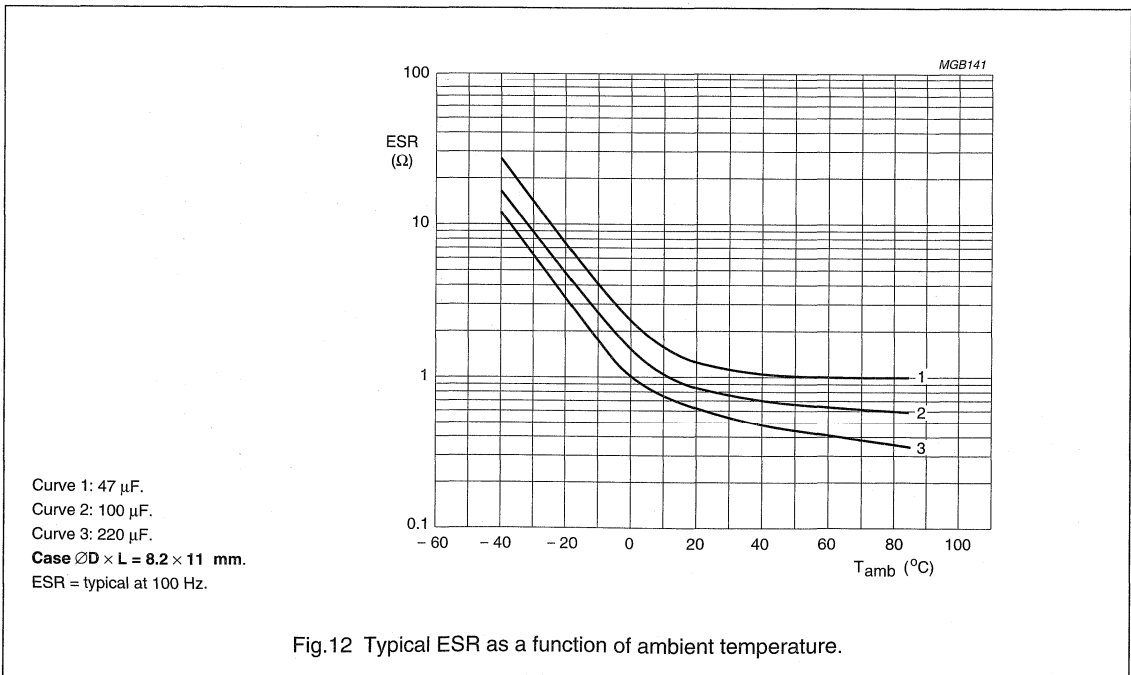
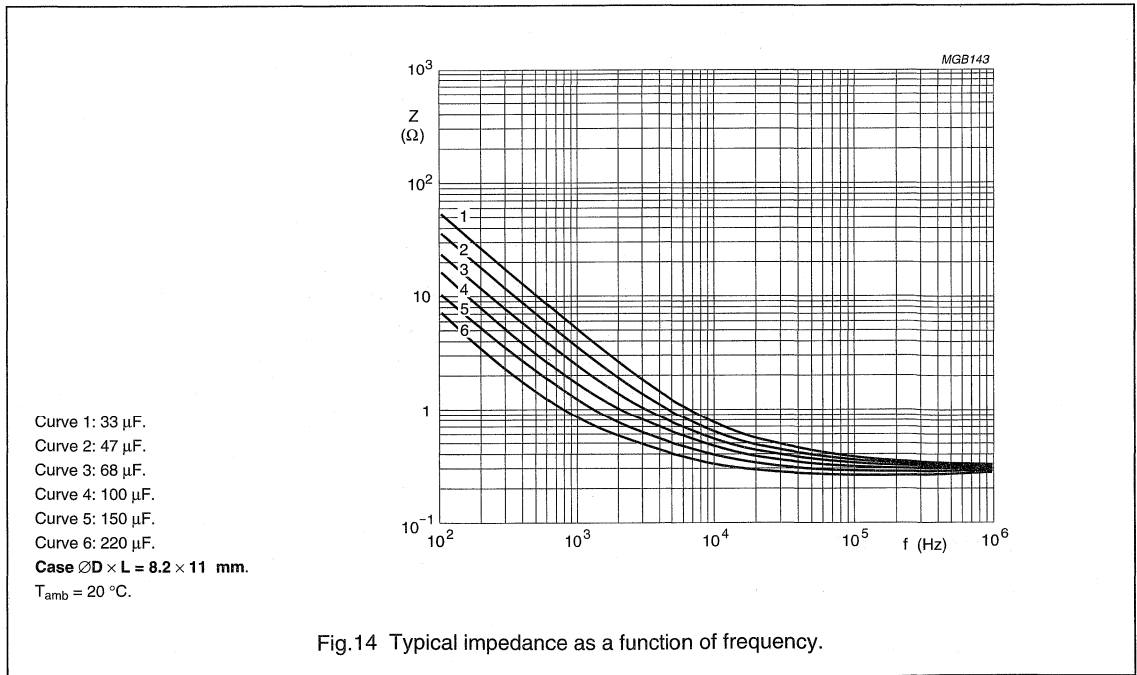
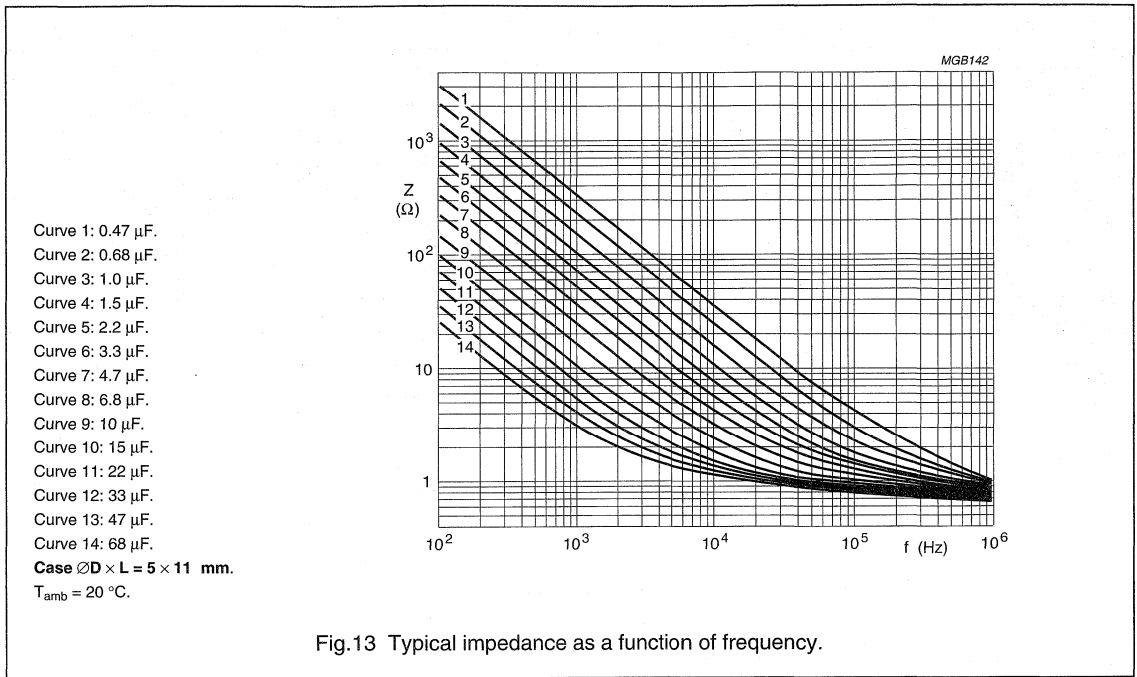


Fig.12 Typical ESR as a function of ambient temperature.

Aluminum electrolytic capacitors Radial Low Leakage Current

013 RLC

Impedance (Z)



Aluminum electrolytic capacitors

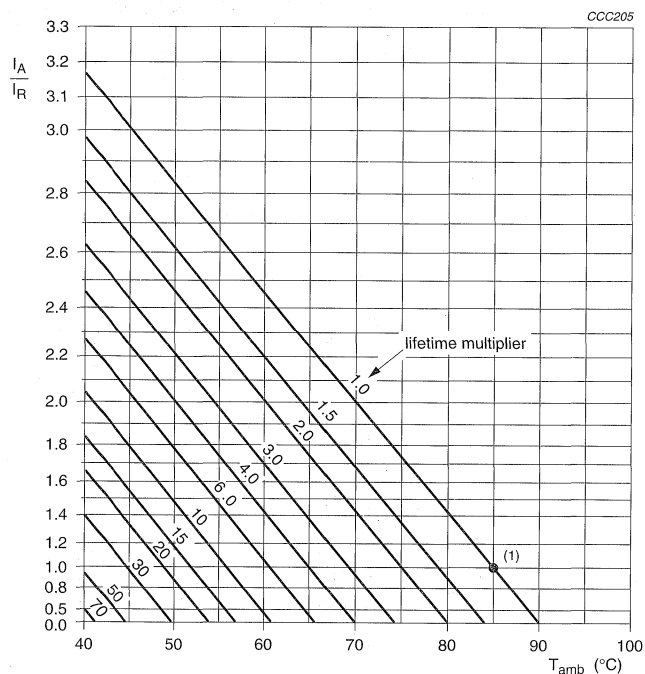
Radial Low Leakage Current

013 RLC

RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 6.3$ V	$U_R = 10, 16$ and 35 V	$U_R = 25$ and 50 V
50	0.9	0.85	0.8
100	1.0	1.0	1.0
300	1.12	1.2	1.25
1000	1.2	1.3	1.4
3000	1.25	1.35	1.5
≥ 10000	1.3	1.4	1.6



I_A = actual ripple current at 100 Hz.

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

(1) Useful life at 85 °C and I_R applied: 3000 hours.

Fig.15 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Low Leakage Current

013 RLC

SPECIFIC TESTS AND REQUIREMENTS

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

Table 7 Test procedures and requirements

TEST		PROCEDURE	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300, subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 2000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 3000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +45/-50% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; 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 $I_{L2} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors Radial Semi-Professional

036 RSP

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, all-insulated (light blue)
- Natural pitch 2.5 mm and 5 mm
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume
- Reduced leakage current.

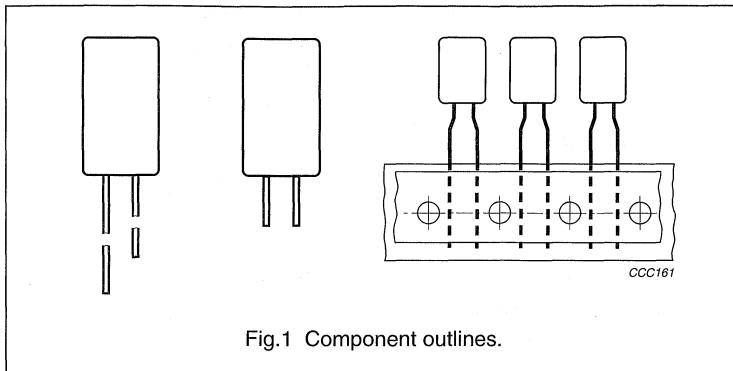
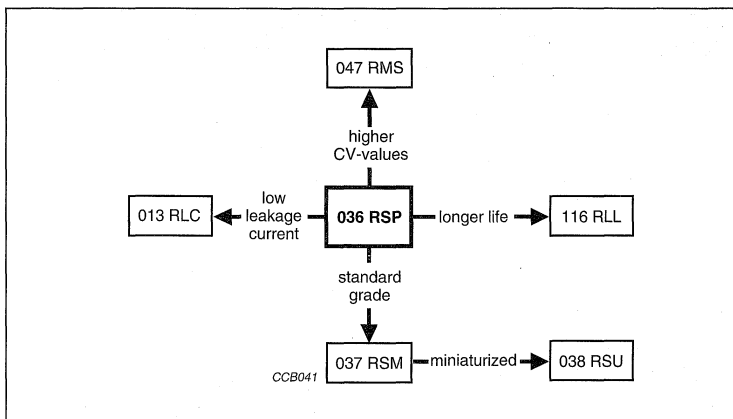


Fig.1 Component outlines.

APPLICATIONS

- Automotive, telecommunication, industrial, EDP and audio-video
- Coupling, decoupling, smoothing, filtering, buffering, timing
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	5 × 11 and 8.2 × 11
Rated capacitance range, C_R	0.47 to 470 μ F
Tolerance on C_R	$\pm 20\%$; $\pm 10\%$ on request
Rated voltage range, U_R	6.3 to 160 V
Category temperature range	-55 to +85 °C
Endurance test at 85 °C	2000 hours
Useful life at 105 °C	750 hours
Useful life at 85 °C	3000 hours
Useful life at 40 °C, $1.4 \times I_R$ applied	80000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130 300
Climatic category IEC 60068	55/085/56

Aluminum electrolytic capacitors

Radial Semi-Professional

036 RSP

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)									
	6.3	10	16	25	35	40	50	63	100	160
0.47	-	-	-	-	-	-	-	5 × 11	-	-
1.0	-	-	-	-	-	-	-	5 × 11	-	-
2.2	-	-	-	-	-	-	-	5 × 11	-	8.2 × 11
3.3	-	-	-	-	-	-	-	5 × 11	-	-
4.7	-	-	-	-	-	-	-	5 × 11	-	8.2 × 11
6.8	-	-	-	-	-	-	-	5 × 11	-	-
10	-	-	-	-	-	-	5 × 11	5 × 11	8.2 × 11	-
	-	-	-	-	-	-	-	8.2 × 11	-	-
15	-	-	-	-	-	5 × 11	-	5 × 11	-	-
22	-	-	-	-	5 × 11	-	-	5 × 11	8.2 × 11	-
	-	-	-	-	-	-	-	8.2 × 11	-	-
33	-	-	5 × 11	-	-	-	5 × 11	8.2 × 11	-	-
47	-	5 × 11	-	-	5 × 11	-	8.2 × 11	8.2 × 11	-	-
68	-	-	-	5 × 11	-	8.2 × 11	-	8.2 × 11	-	-
100	5 × 11	-	5 × 11	8.2 × 11	-	-	8.2 × 11	-	-	-
150	-	5 × 11	8.2 × 11	-	8.2 × 11	-	-	-	-	-
220	-	8.2 × 11	8.2 × 11	8.2 × 11	-	-	-	-	-	-
330	8.2 × 11	-	8.2 × 11	-	-	-	-	-	-	-
470 ⁽¹⁾	-	8.2 × 11	-	-	-	-	-	-	-	-

Note

- For higher CV-values see data sheet "047 RMS".



Aluminum electrolytic capacitors
Radial Semi-Professional

036 RSP

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

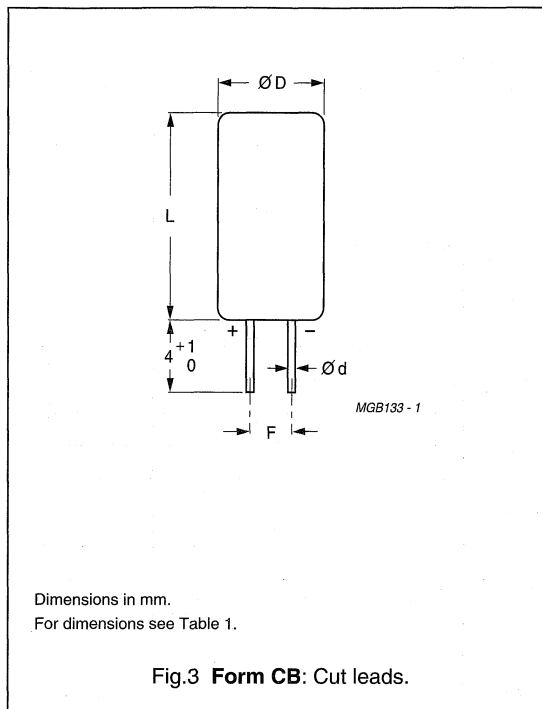
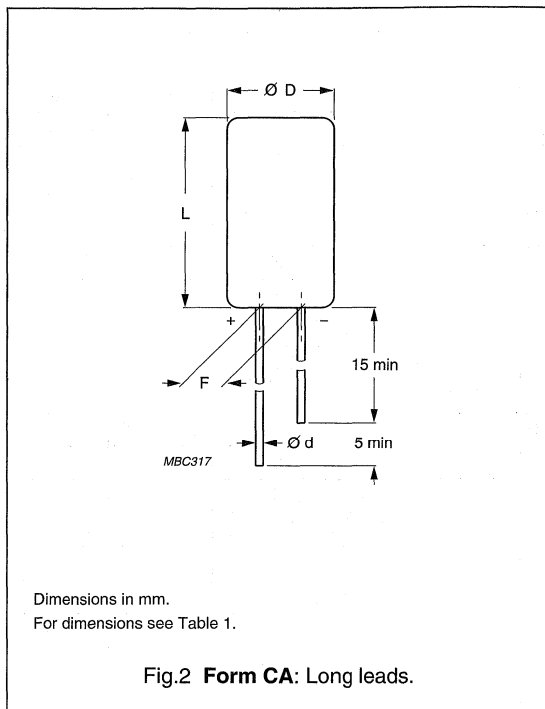


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

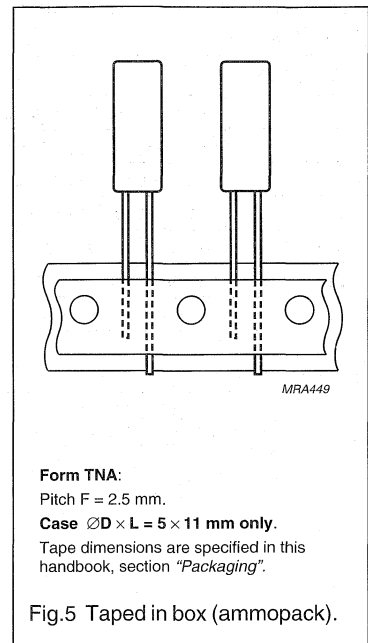
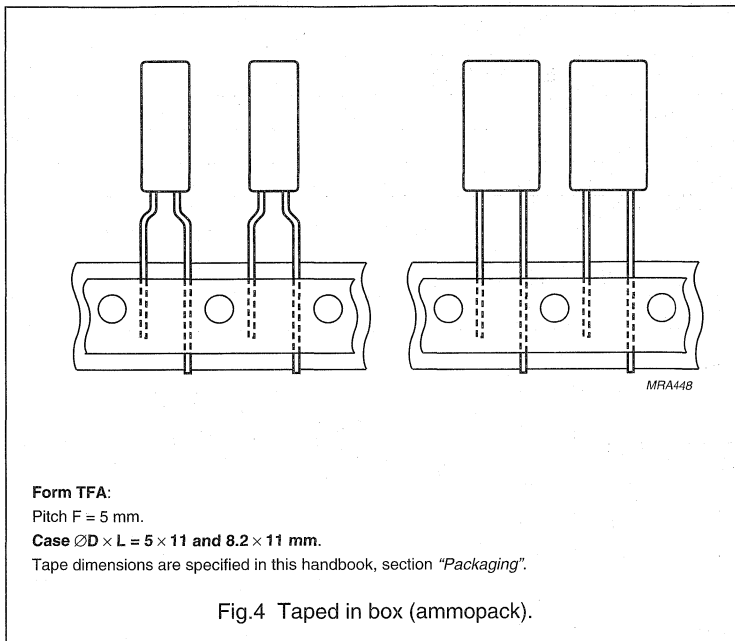
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES	
							FORM CA, CB	FORM TFA, TNA
5 × 11	11	0.5	5.5	12	2.5 ± 0.5	≈ 0.4	1000	2000
8.2 × 11	13	0.6	8.7	12	5.0 ± 0.5	≈ 1.1	1000	1000

Aluminum electrolytic capacitors

Radial Semi-Professional

036 RSP

Taped products



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"
- Rated voltage (in V)
- Group number (036)
- Name of manufacturer
- Date code in accordance with "IEC 60062"
- Code indicating factory of origin
- Minus-sign on top to identify the negative terminal.



Aluminum electrolytic capacitors

Radial Semi-Professional

036 RSP

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2 and 4 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
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
$\tan \delta$	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 and 20, -25 or -40 °C

Table 2 Electrical data; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz 20 °C (Ω)	Z 10 kHz -25 °C (Ω)	Z 10 kHz -40 °C (Ω)
6.3	100	5 × 11	11	130	7	3.6	0.20	3.2	1.7	9.0	25
	330	8.2 × 11	13	300	16	5.1	0.20	1.0	0.52	2.7	7.6
10	47	5 × 11	11	95	6	3.5	0.16	5.4	2.8	12	32
	150	5 × 11	11	150	12	4.5	0.20	2.1	1.3	8.0	21
	220	8.2 × 11	13	260	17	5.2	0.16	1.2	0.59	2.6	6.8
	470	8.2 × 11	13	400	31	7.7	0.20	0.68	0.43	2.6	6.8
16	33	5 × 11	11	90	7	3.5	0.14	6.8	2.7	12	33
	100	5 × 11	11	160	13	4.6	0.16	2.5	1.6	7.5	20.0
	150	8.2 × 11	13	230	18	5.4	0.14	1.5	0.6	2.7	7.3
	220	8.2 × 11	13	280	24	6.5	0.16	1.2	0.55	2.5	6.8
	330	8.2 × 11	13	390	35	8.3	0.16	0.7	0.48	2.3	6.1
25	68	5 × 11	11	140	13	4.7	0.14	3.3	1.8	8.2	22
	100	8.2 × 11	13	210	18	5.5	0.12	1.9	0.7	3.0	9.0
	220	8.2 × 11	13	310	36	8.5	0.14	1	0.55	2.6	6.8
35	22	5 × 11	11	87	8	3.8	0.10	7.2	2.7	11	34
	47	5 × 11	11	130	13	4.6	0.12	4.1	1.9	8.5	23
	150	8.2 × 11	13	270	35	8.3	0.12	1.3	0.6	2.7	7.3
40	15	5 × 11	11	72	7	3.6	0.10	11	3.7	15	47
	68	8.2 × 11	13	180	20	5.7	0.10	2.3	0.81	3.2	10
50	10	5 × 11	11	60	6	3.5	0.08	13	4.5	16	58
	33	5 × 11	11	110	13	4.7	0.10	4.8	2.1	9.1	27
	47	8.2 × 11	13	160	18	5.4	0.08	2.7	0.96	3.4	12
	100	8.2 × 11	13	250	33	8.0	0.10	1.6	0.7	3.0	9.0

Aluminum electrolytic capacitors

Radial Semi-Professional

036 RSP

ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 036 series

100 μF /16 V; $\pm 20\%$ Nominal case size: $\varnothing 5 \times 11$ mm; Form TFA

Catalogue number: 2222 036 35101.

Table 3 Ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA	F (mm)	FORM TNA	F (mm)
			FORM CA	F (mm)	FORM CB	F (mm)				
6.3	100	11	036 53101	2.5	–	–	036 33101	5.0	036 73101	2.5
	330	13	036 53331	5.0	036 63331	5.0	036 33331	5.0	–	–
10	47	11	036 54479	2.5	–	–	036 34479	5.0	036 74479	2.5
	150	11	036 54151	2.5	–	–	036 34151	5.0	036 74151	2.5
	220	13	036 54221	5.0	036 64221	5.0	036 34221	5.0	–	–
	470	13	036 54471	5.0	036 64471	5.0	036 34471	5.0	–	–
16	33	11	036 55339	2.5	–	–	036 35339	5.0	036 75339	2.5
	100	11	036 55101	2.5	–	–	036 35101	5.0	036 75101	2.5
	150	13	036 55151	5.0	036 65151	5.0	036 35151	5.0	–	–
	220	13	036 55221	5.0	036 65221	5.0	036 35221	5.0	–	–
	330	13	036 55331	5.0	036 65331	5.0	036 35331	5.0	–	–
25	68	11	036 56689	2.5	–	–	036 36689	5.0	036 76689	2.5
	100	13	036 56101	5.0	036 66101	5.0	036 36101	5.0	–	–
	220	13	036 56221	5.0	036 66221	5.0	036 36221	5.0	–	–
35	22	11	036 90001	2.5	–	–	036 90027	5.0	036 90389	2.5
	47	11	036 90094	2.5	–	–	036 90098	5.0	036 90391	2.5
	150	13	036 90099	5.0	036 90101	5.0	036 90103	5.0	–	–
40	15	11	036 57159	2.5	–	–	036 37159	5.0	036 77159	2.5
	68	13	036 57689	5.0	036 67689	5.0	036 37689	5.0	–	–
50	10	11	036 90004	2.5	–	–	036 90028	5.0	036 90392	2.5
	33	11	036 90104	2.5	–	–	036 90108	5.0	036 90393	2.5
	47	13	036 90011	5.0	036 90012	5.0	036 90031	5.0	–	–
	100	13	036 90109	5.0	036 90111	5.0	036 90113	5.0	–	–

Aluminum electrolytic capacitors

Radial Semi-Professional

036 RSP

ELECTRICAL DATA (continued)**Table 4** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	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 20 °C (Ω)	Z 10 kHz -25 °C (Ω)	Z 10 kHz -40 °C (Ω)
63	0.47	5 × 11	11	5	4	3	0.06	200	85	280	850
	1.0	5 × 11	11	11	4	3.1	0.06	95	40	130	400
	2.2	5 × 11	11	25	4	3.1	0.06	43	18	59	180
	3.3	5 × 11	11	38	5	3.2	0.06	29	12	39	120
	4.7	5 × 11	11	45	5	3.3	0.06	20	8.5	27	85
	6.8	5 × 11	11	55	6	3.4	0.06	14	5.9	19	59
	10	5 × 11	11	70	7	3.6	0.06	9.5	4.0	13	40
	10	8.2 × 11	13	120	7	3.6	0.04	6.5	2.8	7	19
	15	5 × 11	11	80	9	3.9	0.07	7.4	3.1	12	36
	22	5 × 11	11	100	11	4.4	0.08	5.8	2.7	10	32
	22	8.2 × 11	13	150	11	4.4	0.05	3.6	1.4	5.1	15
	33	8.2 × 11	13	160	16	5.1	0.06	2.9	1.2	3.9	12
	47	8.2 × 11	13	190	21	6.0	0.07	2.4	1.0	3.5	11
68	8.2 × 11	13	210	29	7.3	0.08	1.9	0.88	3.2	10	
100	10	8.2 × 11	13	80	9	4	0.06	9.5	3.5	15	45
	22	8.2 × 11	13	110	16	5.2	0.06	4.3	1.8	7.3	23
160	2.2	8.2 × 11	13	45	75	15	0.05	36	14	70	170
	4.7	8.2 × 11	13	62	115	21	0.07	24	9.6	60	150

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_S \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute: $U_R = 6.3 \text{ to } 100 \text{ V}$ $U_R = 160 \text{ V}$	$I_{L1} \leq 0.006 C_R \times U_R + 3 \mu\text{A}$ $I_{L1} \leq 0.1 C_R \times U_R + 40 \mu\text{A}$
	after 5 minutes: $U_R = 6.3 \text{ to } 100 \text{ V}$ $U_R = 160 \text{ V}$	$I_{L5} \leq 0.001 C_R \times U_R + 3 \mu\text{A}$ $I_{L5} \leq 0.015 C_R \times U_R + 10 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \times L = 5 \times 11 \text{ mm}$	typ. 13 nH
	case $\varnothing D \times L = 8.2 \times 11 \text{ mm}$	typ. 16 nH

Aluminum electrolytic capacitors

Radial Semi-Professional

036 RSP

ORDERING INFORMATION (continued)**Table 5** Ordering information continued; preferred types in **bold**

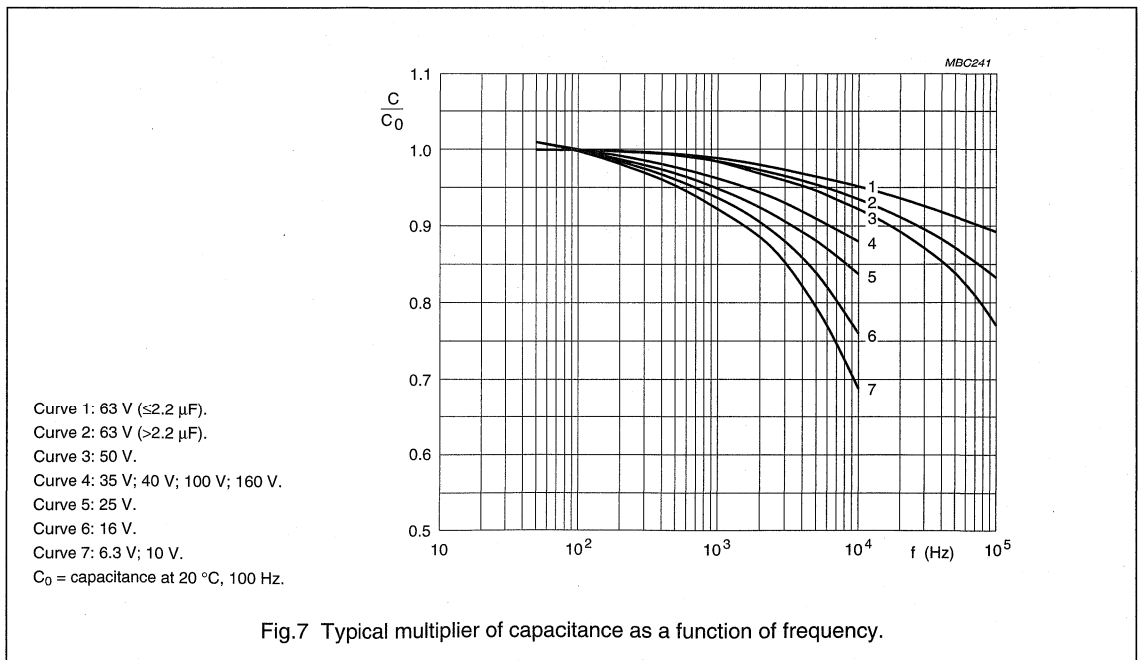
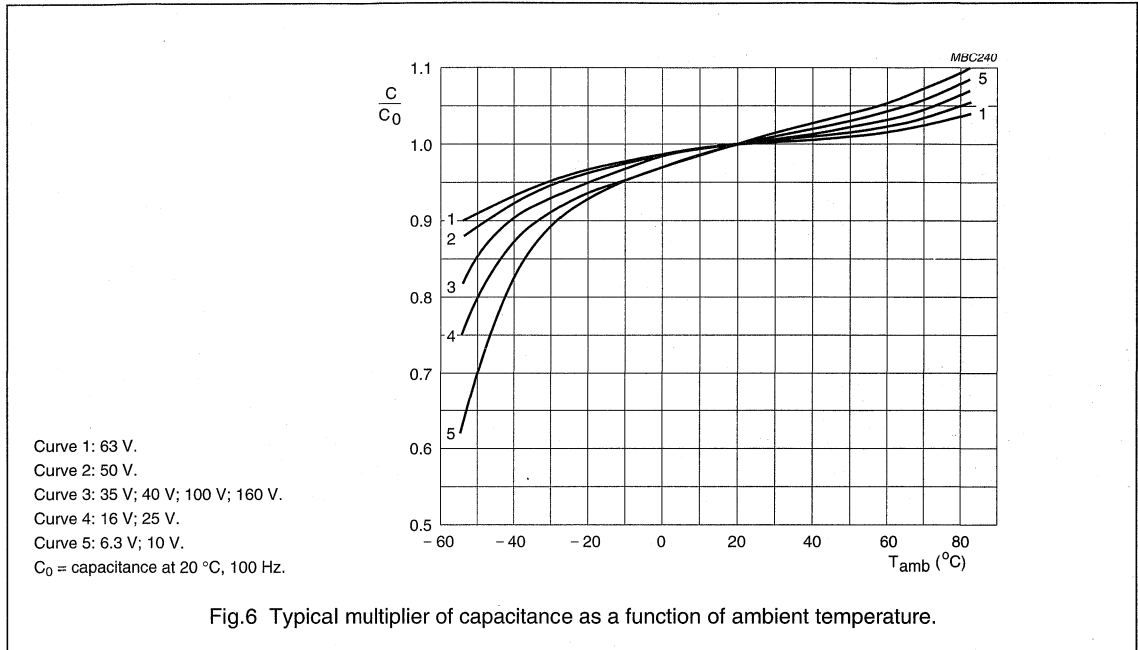
U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS		FORM TFA	F (mm)	FORM TNA	F (mm)
			FORM CA	F (mm)	FORM CB	F (mm)				
63	0.47	11	036 58477	2.5	–	–	036 38477	5.0	036 78477	2.5
	1.0	11	036 58108	2.5	–	–	036 38108	5.0	036 78108	2.5
	2.2	11	036 58228	2.5	–	–	036 38228	5.0	036 78228	2.5
	3.3	11	036 58338	2.5	–	–	036 38338	5.0	036 78338	2.5
	4.7	11	036 58478	2.5	–	–	036 38478	5.0	036 78478	2.5
	6.8	11	036 58688	2.5	–	–	036 38688	5.0	036 78688	2.5
	10	11	036 58109	2.5	–	–	036 38109	5.0	036 78109	2.5
	10	13	036 90036	5.0	036 90041	5.0	036 90181	5.0	–	–
	15	11	036 58159	2.5	–	–	036 38159	5.0	036 78159	2.5
	22	11	036 58229	2.5	–	–	036 38229	5.0	036 78229	2.5
	22	13	036 90117	5.0	036 90118	5.0	036 90139	5.0	–	–
	33	13	036 58339	5.0	036 68339	5.0	036 38339	5.0	–	–
	47	13	036 58479	5.0	036 68479	5.0	036 38479	5.0	–	–
68	13	036 58689	5.0	036 68689	5.0	036 38689	5.0	–	–	
100	10	13	036 59109	5.0	036 69109	5.0	036 39109	5.0	–	–
	22	13	036 59229	5.0	036 69229	5.0	036 39229	5.0	–	–
160	2.2	13	036 90333	5.0	036 90334	5.0	036 90336	5.0	–	–
	4.7	13	036 90337	5.0	036 90338	5.0	036 90341	5.0	–	–

Aluminum electrolytic capacitors
Radial Semi-Professional

036 RSP

ELECTRICAL DATA (continued)

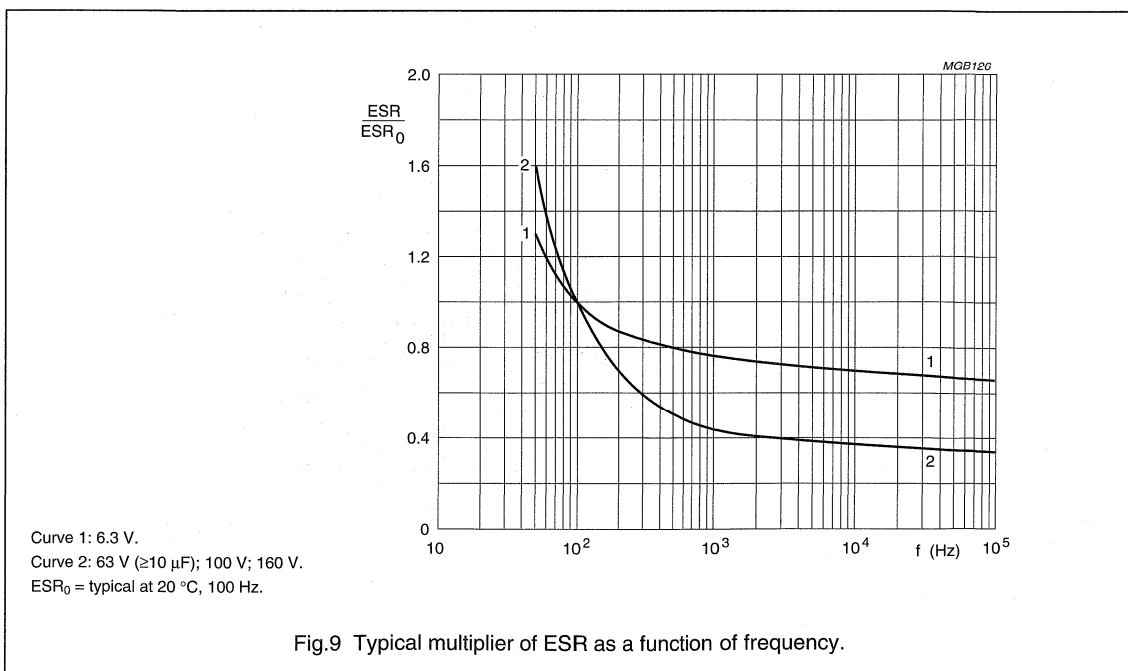
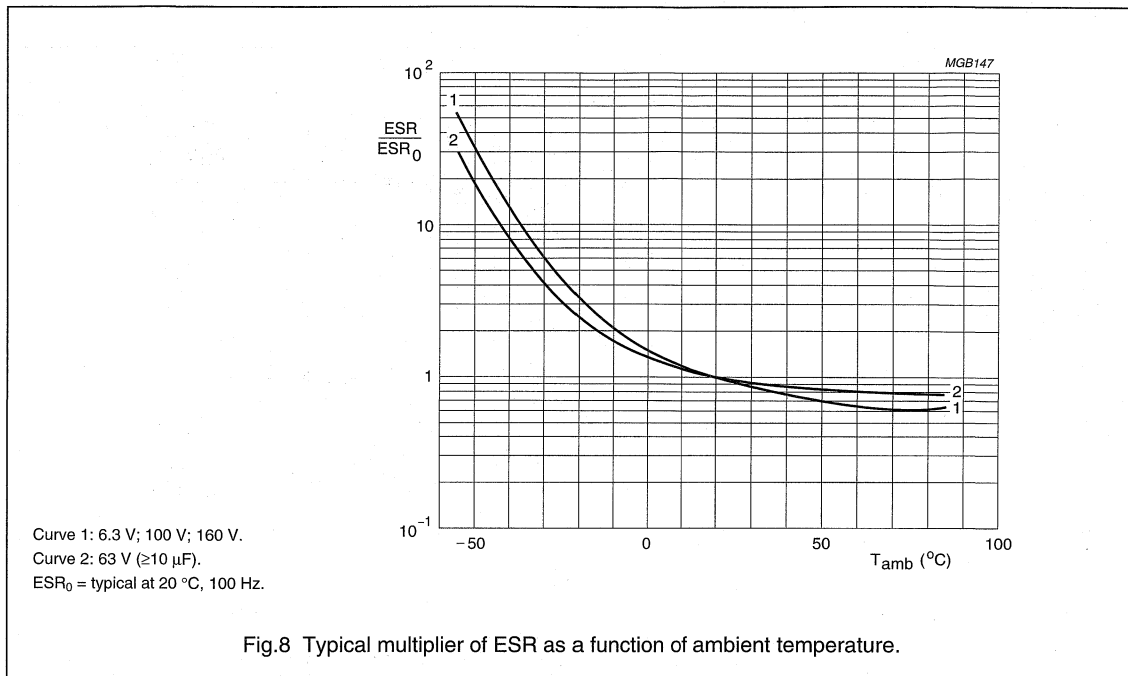
Capacitance (C)



Aluminum electrolytic capacitors Radial Semi-Professional

036 RSP

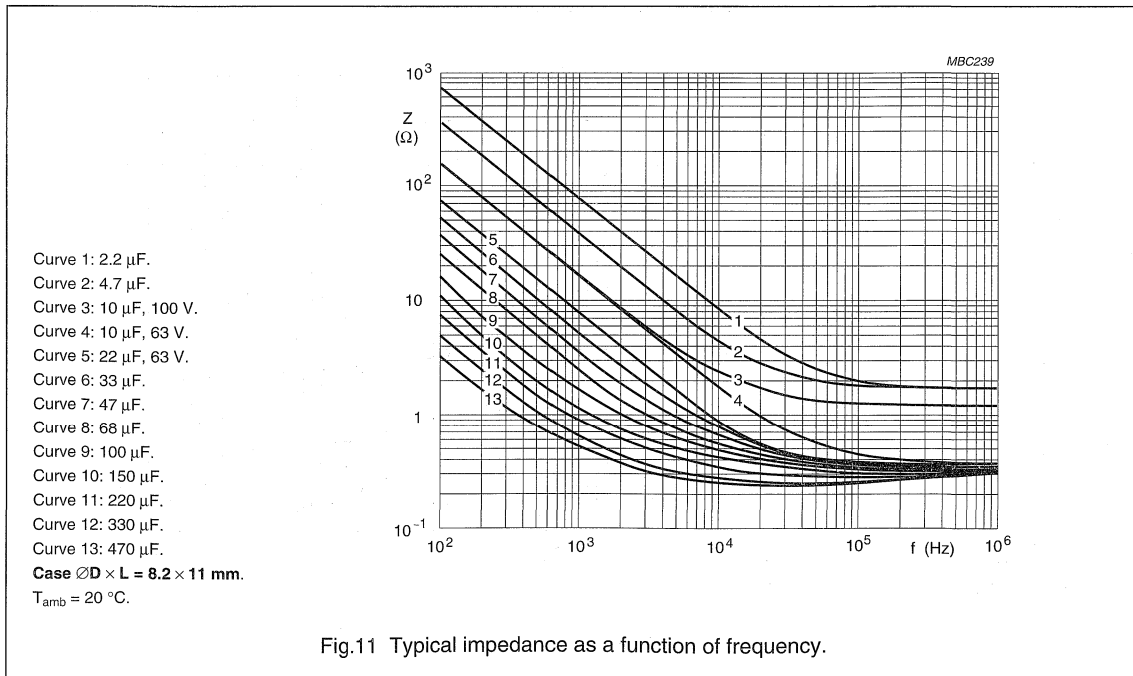
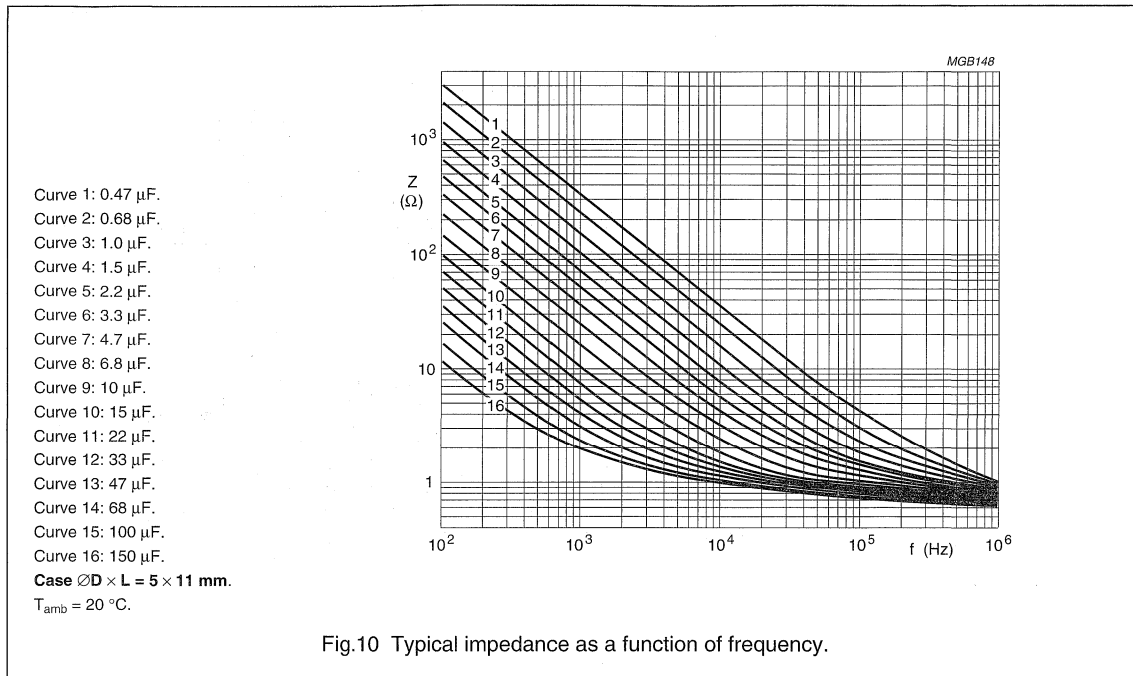
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors
Radial Semi-Professional

036 RSP

Impedance (Z)



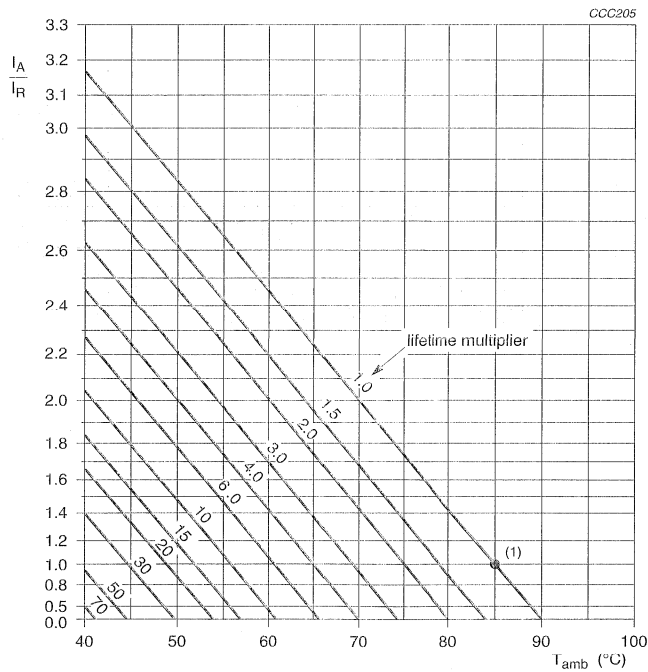
Aluminum electrolytic capacitors Radial Semi-Professional

036 RSP

RIPPLE CURRENT AND USEFUL LIFE

Table 6 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 35 V	$U_R = 40$ to 160 V
50	0.9	0.85	0.8
100	1.0	1.0	1.0
300	1.12	1.2	1.25
1000	1.2	1.3	1.4
3000	1.25	1.35	1.5
≥ 10000	1.3	1.4	1.6



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: 3000 hours.

Fig.12 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Semi-Professional

036 RSP

SPECIFIC TESTS AND REQUIREMENTS

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

Table 7 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 2000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 3000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +45/-50% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; 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 $I_{L5} \leq \text{spec. limit}$

Aluminum electrolytic capacitors

Radial Miniature Semi-Professional

047 RMS

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Long useful life:
1500 hours at 105 °C
- Miniaturized, high CV-product per unit volume.

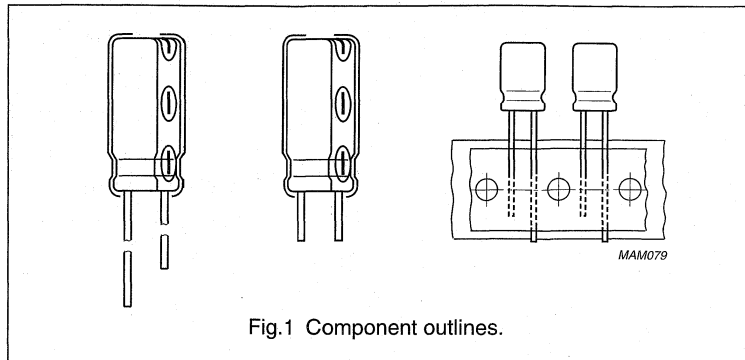
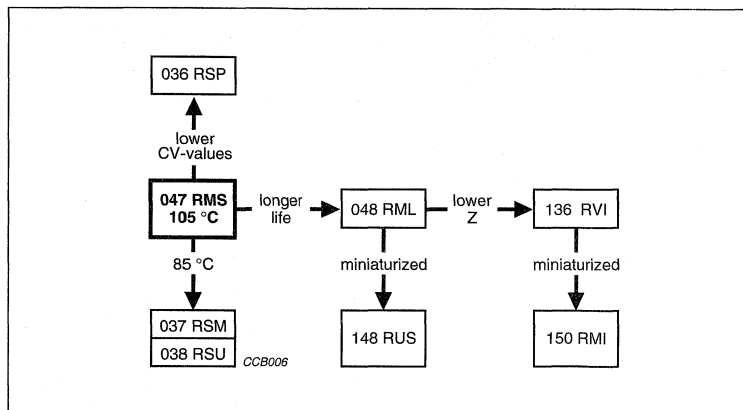


Fig.1 Component outlines.

APPLICATIONS

- EDB, telecommunication, industrial, automotive and audio-video
- Smoothing, filtering, buffering in SMPS, timing
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	100 to 10000 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	16 to 63 V
Category temperature range	-40 to +105 °C
Endurance test at 105 °C	1000 hours
Useful life at 105 °C	1500 hours
Useful life at 40 °C, $1.3 \times I_R$ applied	150000 hours
Shelf life at 0 V, 105 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

Aluminum electrolytic capacitors

Radial Miniature Semi-Professional

047 RMS

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	16	25	35	40	50	63
100 ⁽¹⁾	–	–	–	–	–	10 × 12
220	–	–	10 × 12	–	10 × 16	10 × 20
330	–	–	10 × 16	10 × 20	–	12.5 × 20
470	10 × 12	10 × 16	10 × 20	–	12.5 × 20	12.5 × 25
1000	10 × 20	12.5 × 20	12.5 × 25	–	16 × 25	16 × 31
2200	12.5 × 25	16 × 25	16 × 31	16 × 35	18 × 35	18 × 35
3300	16 × 25	16 × 31	18 × 35	18 × 35	18 × 35	–
4700	16 × 31	18 × 35	18 × 35	–	–	–
6800	16 × 35	18 × 35	–	–	–	–
10000	18 × 35	–	–	–	–	–

Note

- For lower CV-values see data sheet "036 RSP".

Aluminum electrolytic capacitors Radial Miniature Semi-Professional

047 RMS

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

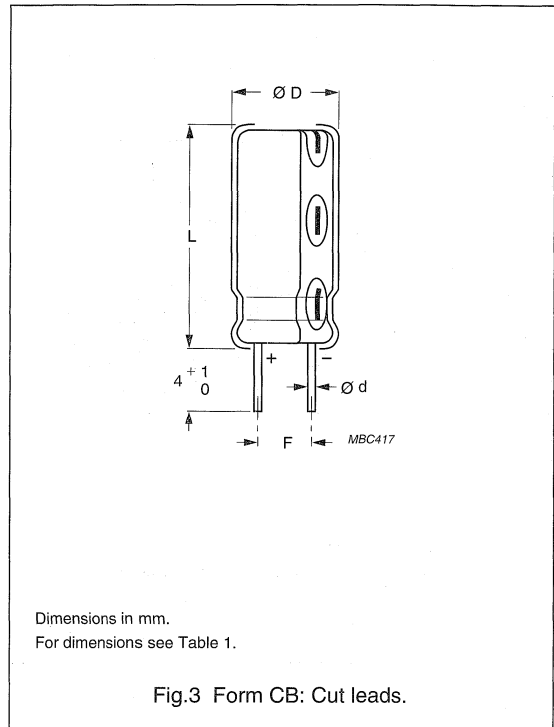
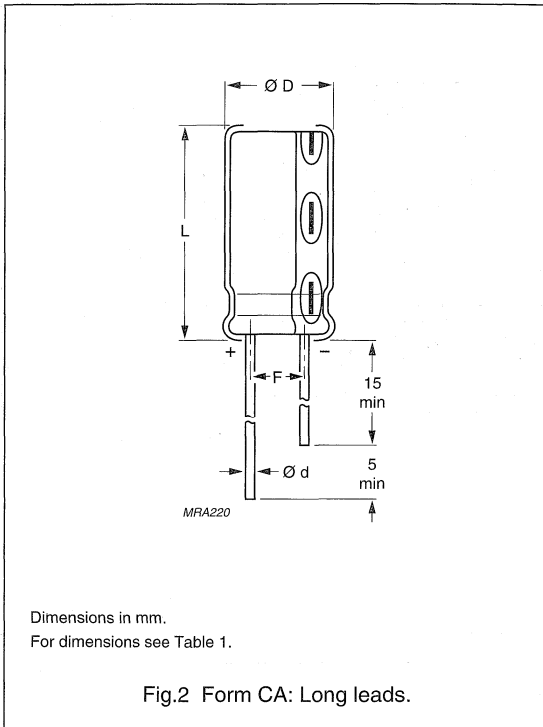


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

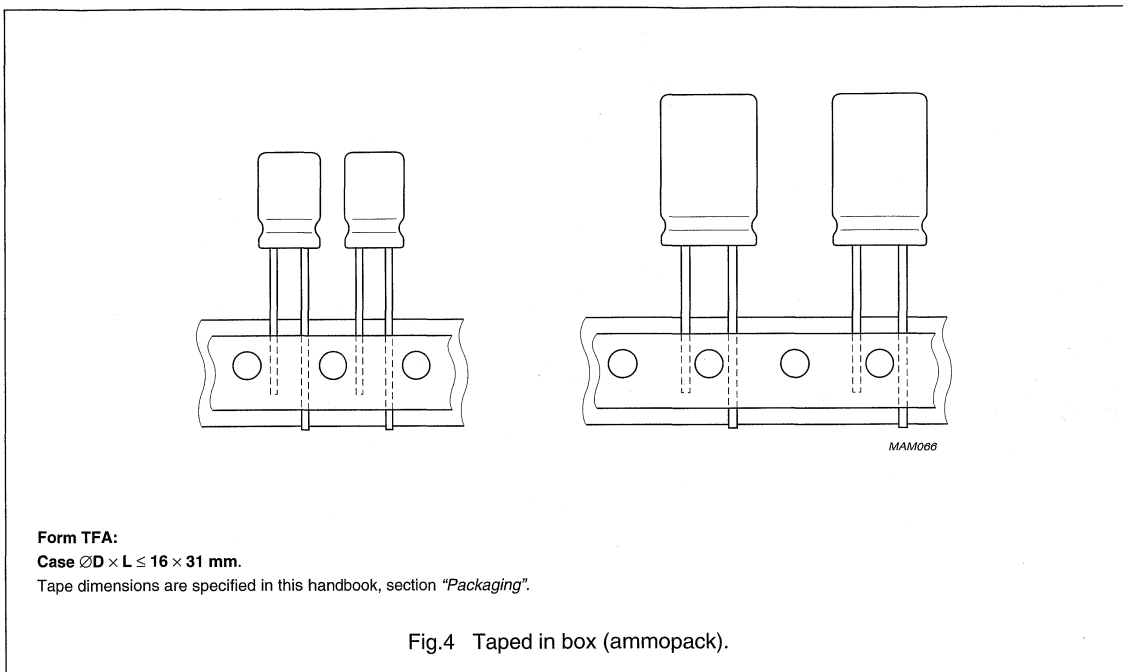
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA per box	FORM CB per box	FORM TFA per box
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11.5	100	100	—
18 × 35	22	0.8	18.5	37.5	7.5 ± 0.5	≈ 14.5	100	100	—

Aluminum electrolytic capacitors

Radial Miniature Semi-Professional

047 RMS

Taped products



MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105°C)
- Group number (047)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

Aluminum electrolytic capacitors

Radial Miniature Semi-Professional

047 RMS

Ordering example

Electrolytic capacitor 047 series

1000 $\mu\text{F}/35\text{ V}; \pm 20$ Nominal case size: $\varnothing 12.5 \times 25\text{ mm}$; Form TFA

Catalogue number: 2222 047 30102.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20\text{ }^{\circ}\text{C}$,
 $P = 86\text{ to }106\text{ kPa}$, $\text{RH} = 45\text{ to }75\%$.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, 105 $^{\circ}\text{C}$
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 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 105 $^{\circ}\text{C}$ (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)	CATALOGUE NUMBER 2222			
											BULK PACKAGING			FORM TFA
											FORM CA	FORM CB	FORM TFA	
16	470	10 \times 12	14	330	78	18	0.16	0.51	0.45	0.33	047 55471	047 65471	047 35471	
	1000	10 \times 20	16	540	160	35	0.16	0.24	0.21	0.17	047 55102	047 65102	047 35102	
	2200	12.5 \times 25	18	830	360	73	0.20	0.14	0.12	0.10	047 55222	047 65222	047 35222	
	3300	16 \times 25	19	1100	530	110	0.22	0.10	0.09	0.08	047 55332	047 65332	047 35332	
	4700	16 \times 31	20	1300	760	150	0.24	0.08	0.07	0.07	047 55472	047 65472	047 35472	
	6800	16 \times 35	21	1600	1100	220	0.28	0.06	0.06	0.06	047 55682	047 65682	—	
	10000	18 \times 35	22	1800	1600	320	0.36	0.05	0.05	0.05	047 55103	047 65103	—	
25	470	10 \times 16	15	360	120	27	0.14	0.45	0.38	0.25	047 56471	047 66471	047 36471	
	1000	12.5 \times 20	17	630	250	53	0.14	0.21	0.18	0.13	047 56102	047 66102	047 36102	
	2200	16 \times 25	19	990	550	110	0.18	0.12	0.09	0.08	047 56222	047 66222	047 36222	
	3300	16 \times 31	20	1200	830	170	0.20	0.09	0.07	0.07	047 56332	047 66332	047 36332	
	4700	18 \times 35	22	1500	1200	240	0.22	0.07	0.05	0.05	047 56472	047 66472	—	
	6800	18 \times 35	22	1700	1700	340	0.26	0.06	0.04	0.04	047 56682	047 66682	—	

Aluminum electrolytic capacitors

Radial Miniature Semi-Professional

047 RMS

	U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 105 °C (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222		
												BULK PACKAGING		FORM TFA
												FORM CA	FORM CB	
	35	220	10 × 12	14	270	80	18	0.12	0.83	0.57	0.38	047 50221	047 60221	047 30221
		330	10 × 16	15	350	120	26	0.12	0.55	0.38	0.28	047 50331	047 60331	047 30331
		470	10 × 20	16	450	170	36	0.12	0.39	0.27	0.22	047 50471	047 60471	047 30471
		1000	12.5 × 25	18	780	350	73	0.12	0.18	0.13	0.12	047 50102	047 60102	047 30102
		2200	16 × 31	20	1200	770	160	0.16	0.11	0.07	0.07	047 50222	047 60222	047 30222
		3300	18 × 35	22	1500	1200	230	0.18	0.09	0.05	0.05	047 50332	047 60332	-
		4700	18 × 35	22	1800	1600	330	0.20	0.06	0.04	0.04	047 50472	047 60472	-
	40	330	10 × 20	16	380	140	29	0.12	0.55	0.33	0.26	047 57331	047 67331	047 37331
		2200	16 × 35	21	1200	880	180	0.16	0.11	0.06	0.06	047 57222	047 67222	-
		3300	18 × 35	22	1500	1300	270	0.18	0.08	0.04	0.04	047 57332	047 67332	-
	50	220	10 × 16	15	310	110	25	0.10	0.69	0.43	0.33	047 51221	047 61221	047 31221
		470	12.5 × 20	17	540	240	50	0.10	0.32	0.20	0.17	047 51471	047 61471	047 31471
		1000	16 × 25	19	940	500	100	0.10	0.15	0.10	0.09	047 51102	047 61102	047 31102
		2200	18 × 35	22	1400	1100	220	0.14	0.10	0.05	0.05	047 51222	047 61222	-
		3300	18 × 35	22	1600	1700	330	0.16	0.07	0.03	0.04	047 51332	047 61332	-
	63	100	10 × 12	14	210	66	16	0.09	1.40	0.75	0.65	047 58101	047 68101	047 38101
		220	10 × 20	16	350	140	31	0.09	0.62	0.34	0.32	047 58221	047 68221	047 38221
		330	12.5 × 20	17	470	210	45	0.09	0.41	0.23	0.22	047 58331	047 68331	047 38331
		470	12.5 × 25	18	620	300	62	0.09	0.29	0.16	0.16	047 58471	047 68471	047 38471
		1000	16 × 31	20	1100	630	130	0.09	0.14	0.08	0.08	047 58102	047 68102	047 38102
		2200	18 × 35	22	1500	1400	280	0.13	0.09	0.04	0.04	047 58222	047 68222	-

Aluminum electrolytic capacitors

Radial Miniature Semi-Professional

047 RMS

Additional electrical data

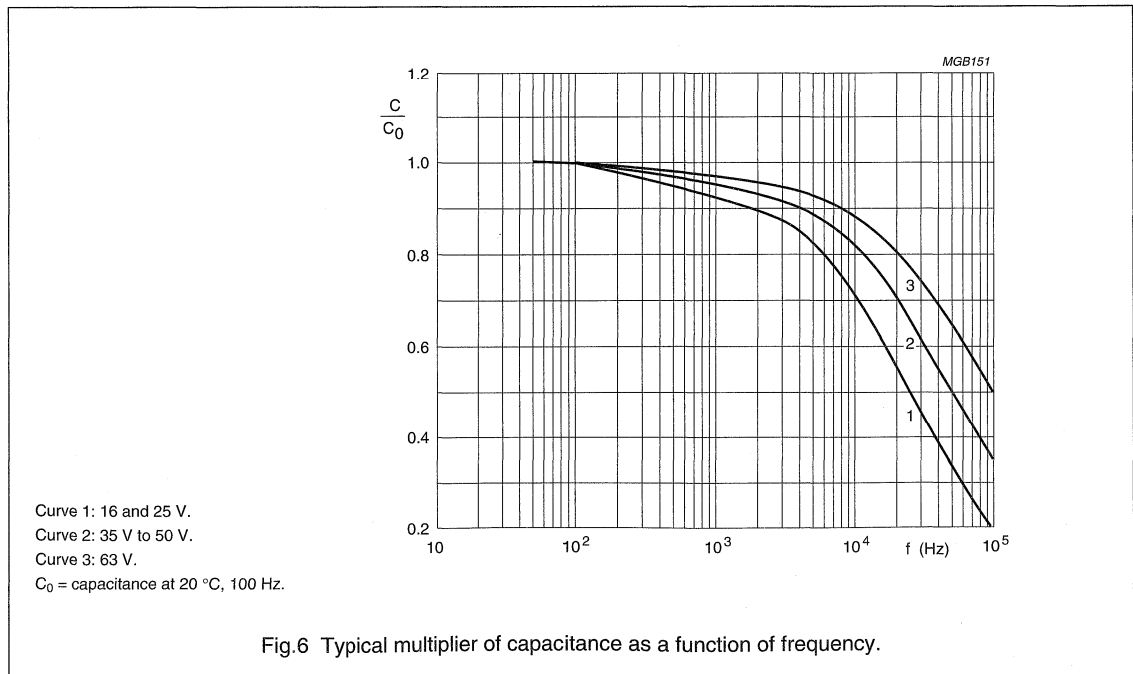
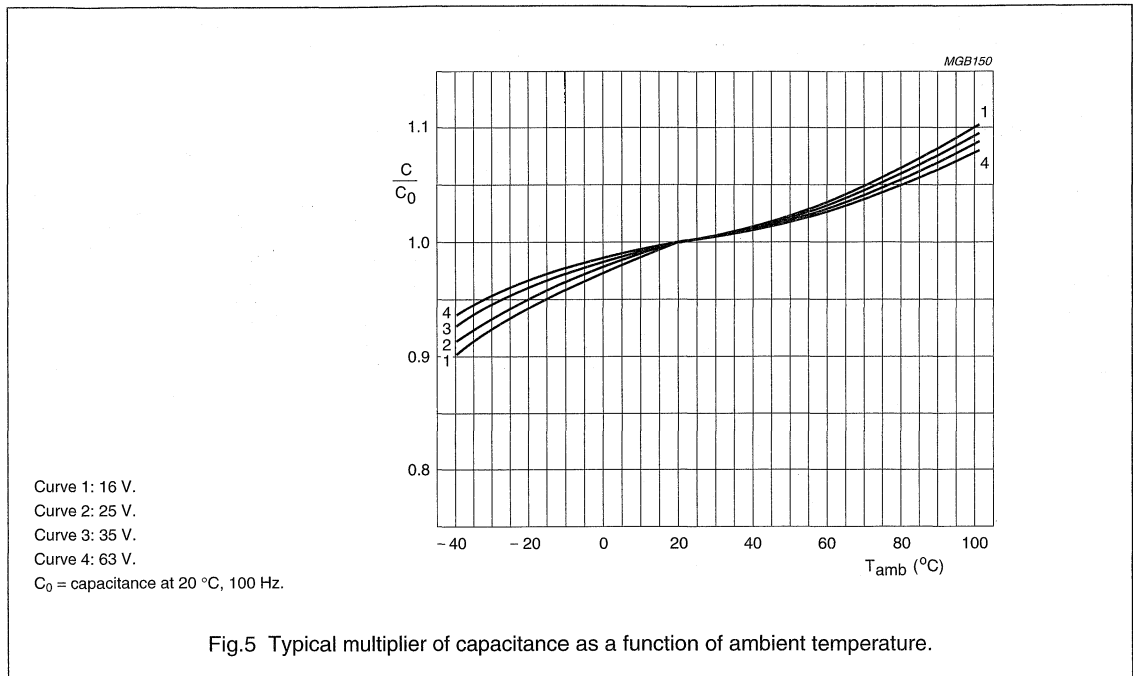
DESCRIPTION	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu A$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu A$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH



Aluminum electrolytic capacitors
Radial Miniature Semi-Professional

047 RMS

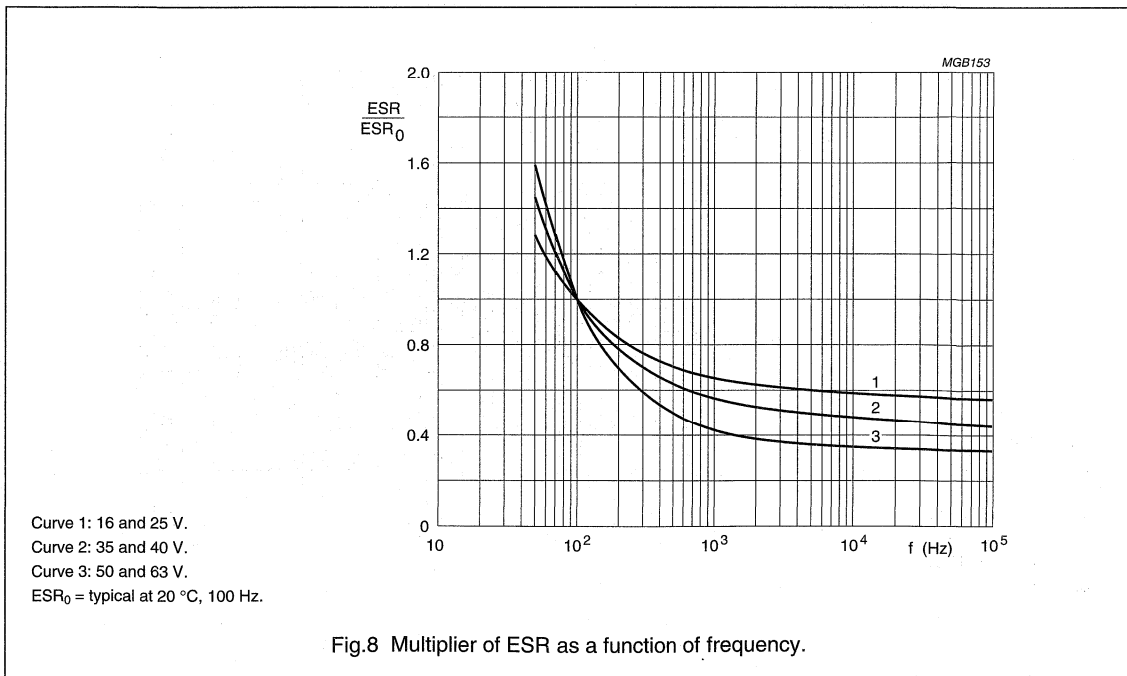
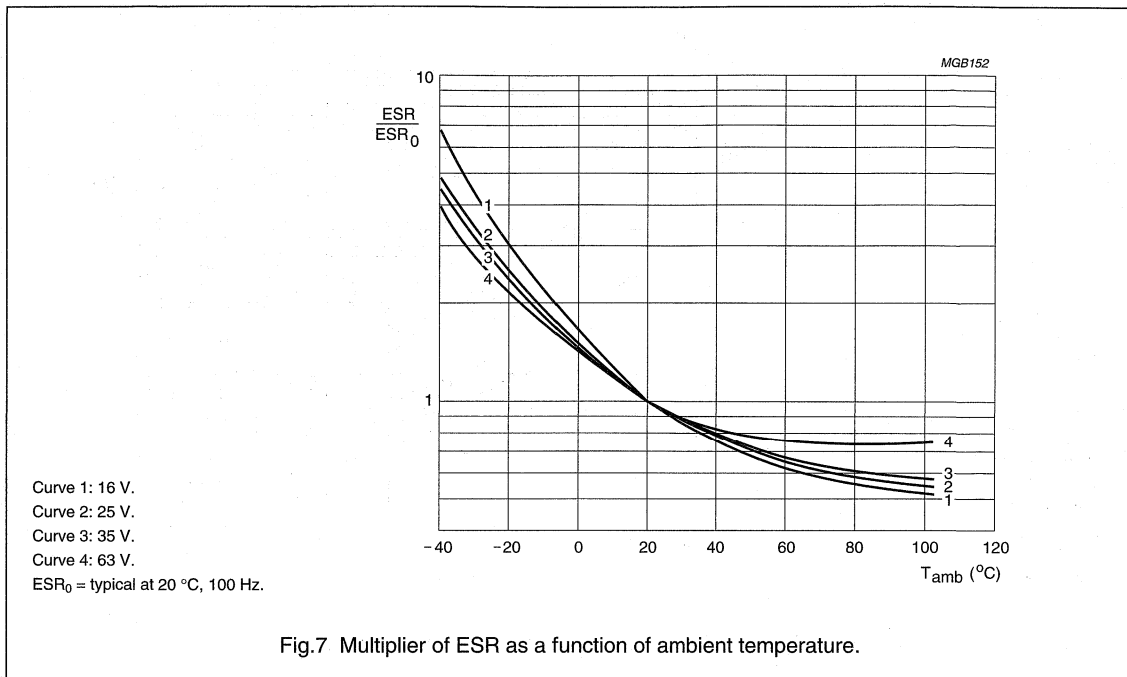
Capacitance (C)



Aluminum electrolytic capacitors
Radial Miniature Semi-Professional

047 RMS

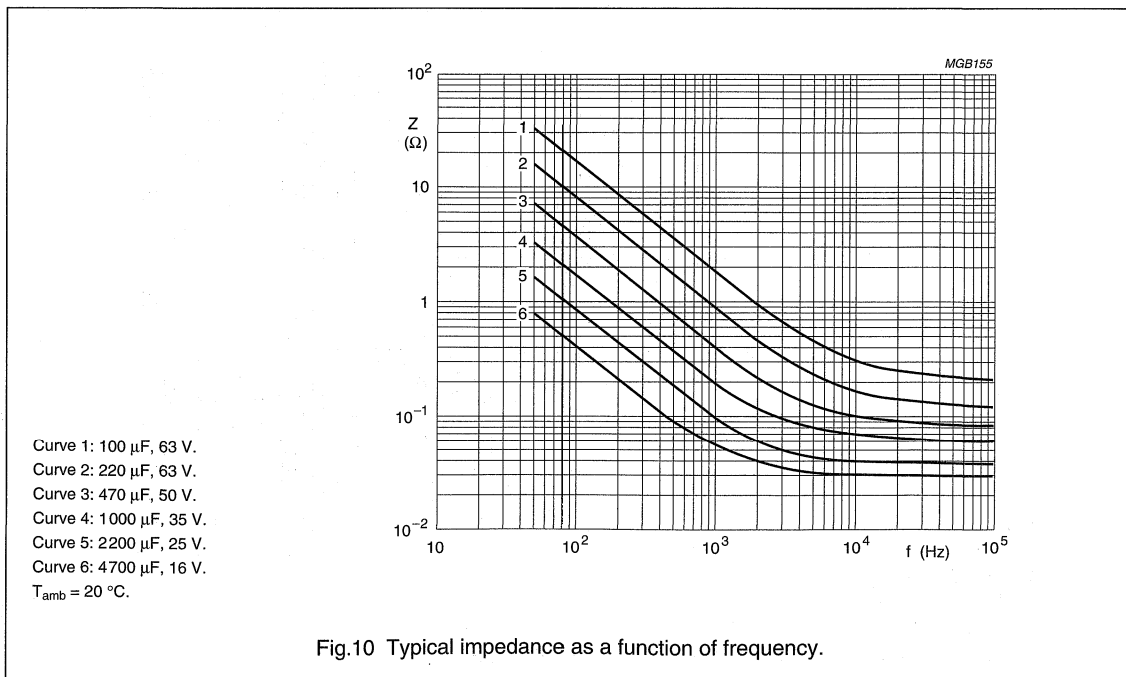
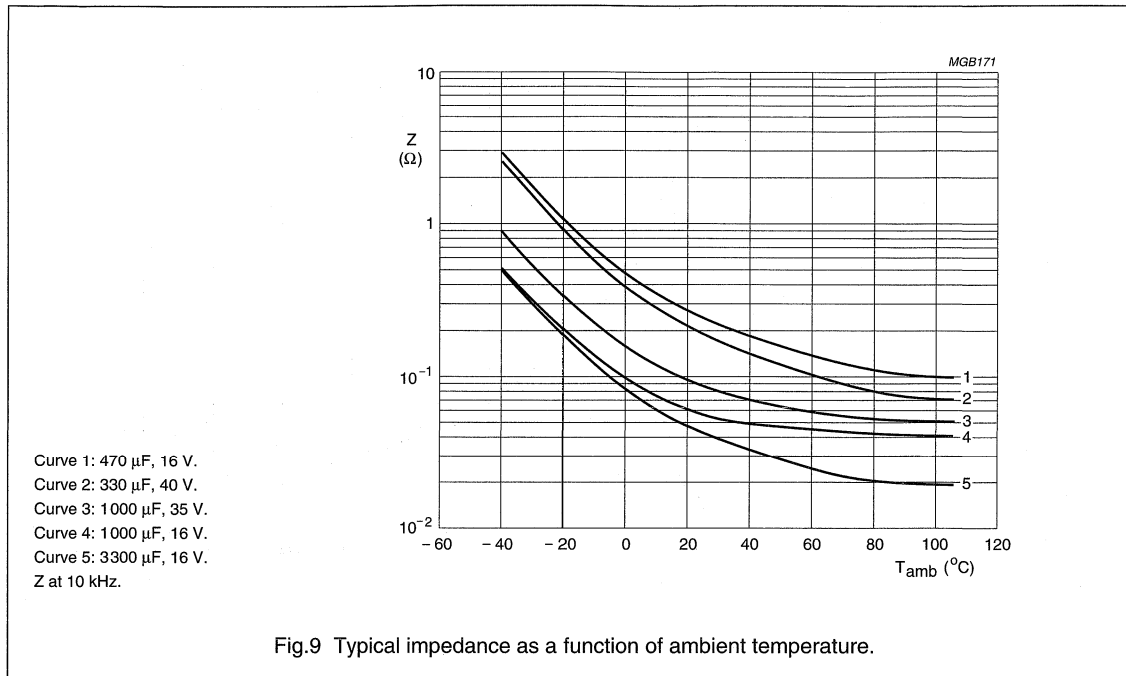
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors
Radial Miniature Semi-Professional

047 RMS

Impedance (Z)



Aluminum electrolytic capacitors Radial Miniature Semi-Professional

047 RMS

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 16$ and 25 V	$U_R = 35$ and 40 V	$U_R = 50$ and 63 V
50	0.95	0.85	0.80
100	1.00	1.00	1.00
300	1.07	1.20	1.25
1000	1.12	1.30	1.40
3000	1.15	1.35	1.50
≥ 10000	1.20	1.40	1.60

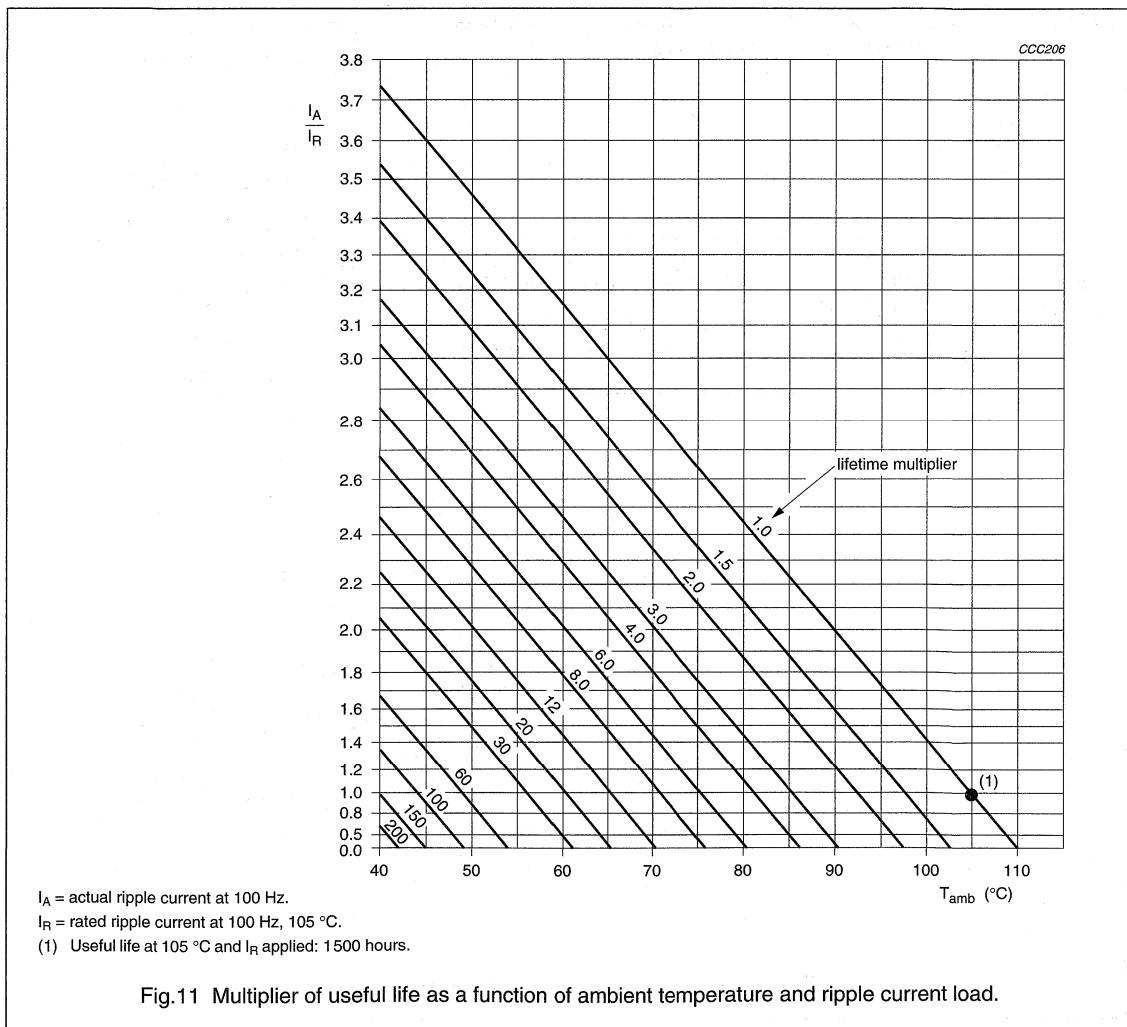


Fig.11 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Miniature Semi-Professional

047 RMS

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ °C}$; U_R applied; 1000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; 1500 hours	$\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300, subclause 4.17	$T_{amb} = 105\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS

FEATURES

- Polarized aluminium electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminium case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Miniaturized, ultra high CV-product per unit volume
- Very long useful life: 3000 hours at 105 °C, high reliability.

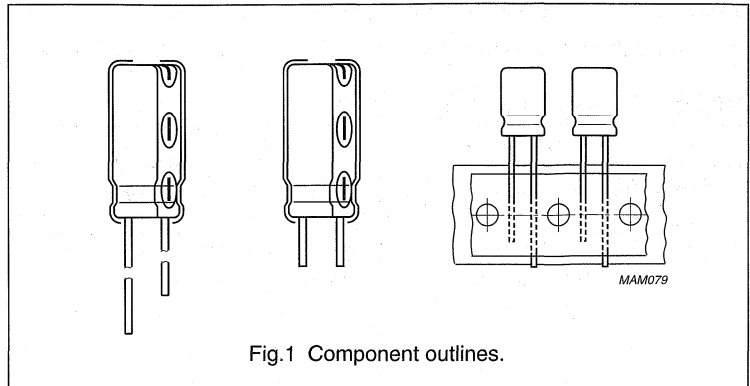
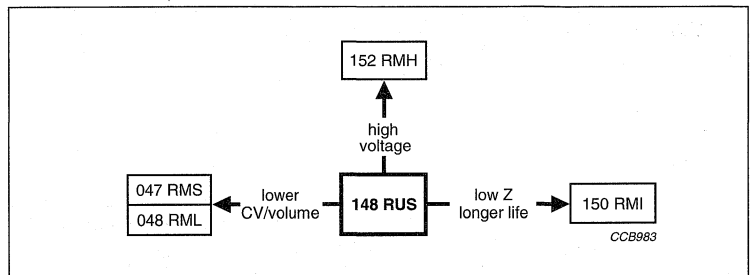


Fig.1 Component outlines.

APPLICATIONS

- EDP, telecommunication, industrial, automotive and audio-video
- Smoothing, filtering, buffering in SMPS, timing
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	47 to 22000 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	6.3 to 100 V
Category temperature range	-40 to +105 °C
Endurance test at 105 °C:	
case $\varnothing D = 10$ mm	1000 hours
case $\varnothing D \geq 12.5$ mm	2000 hours
Useful life at 105 °C:	
case $\varnothing D = 10$ mm	2000 hours
case $\varnothing D \geq 12.5$ mm	3000 hours
Useful life at 40 °C, $1.6 \times I_R$ applied:	
case $\varnothing D = 10$ mm	140000 hours
case $\varnothing D \geq 12.5$ mm	200000 hours
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	6.3	10	16	25	35	50	63	100
47 ⁽¹⁾	–	–	–	–	–	–	–	10 × 12
68	–	–	–	–	–	–	–	10 × 16
100	–	–	–	–	–	–	10 × 12	10 × 20
150	–	–	–	–	–	–	–	12.5 × 20
220	–	–	–	–	–	10 × 12	10 × 16	12.5 × 25
	–	–	–	–	–	–	–	16 × 20
330	–	–	–	–	10 × 12	10 × 16	12.5 × 20	16 × 25
470	–	–	–	10 × 12	10 × 16	10 × 20	12.5 × 20	16 × 31
680	–	–	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 25	–
	–	–	–	–	–	–	16 × 20	–
1000	–	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25	–
	–	–	–	–	–	16 × 20	–	–
1500	–	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	–
	–	–	–	–	16 × 20	–	–	–
2200	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	18 × 35	–
	–	–	–	16 × 20	–	–	–	–
3300	–	12.5 × 20	12.5 × 25	16 × 25	16 × 31	18 × 35	–	–
	–	–	16 × 20	–	–	–	–	–
4700	12.5 × 20	12.5 × 25	16 × 25	16 × 31	18 × 35	–	–	–
	–	16 × 20	–	–	–	–	–	–
6800	16 × 20	16 × 25	16 × 31	18 × 35	–	–	–	–
10000	16 × 25	16 × 31	18 × 35	–	–	–	–	–
15000	16 × 31	18 × 35	–	–	–	–	–	–
22000	18 × 35	–	–	–	–	–	–	–

Note

- For lower CV-values see data sheet "116 RLL".

Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

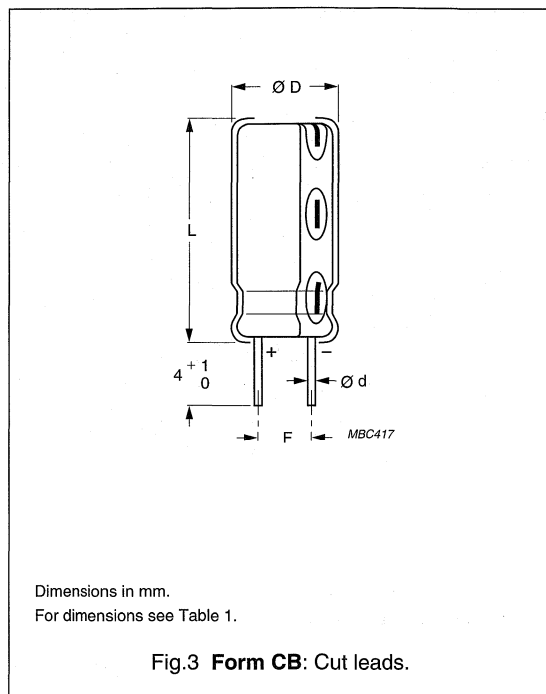
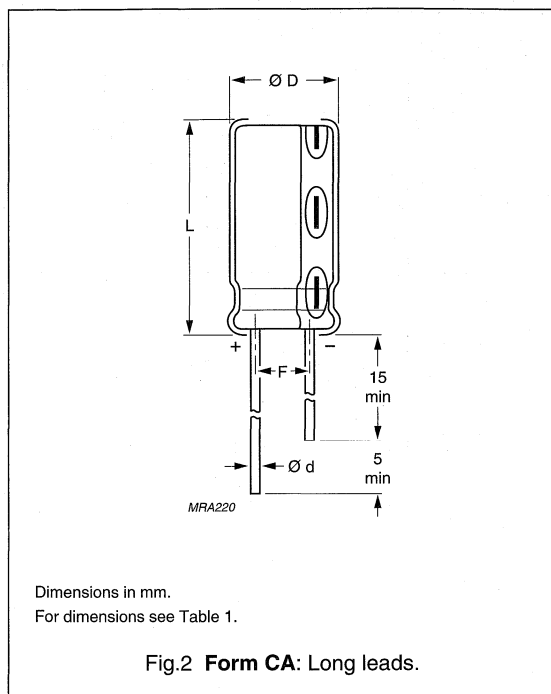


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2, 3 and 4

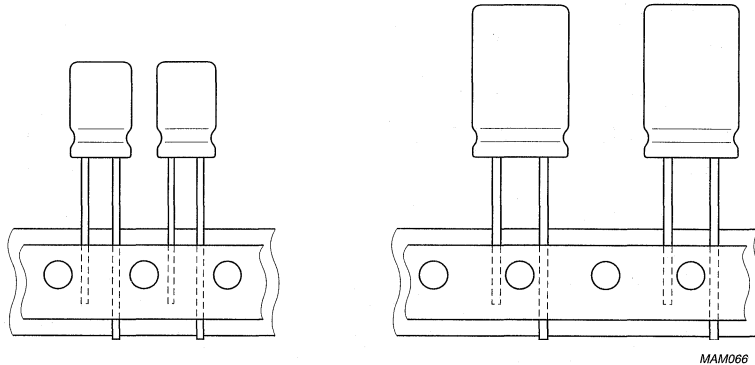
NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES PER BOX		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 20	19a	0.8	16.5	22.0	7.5 ± 0.5	≈ 6.0	250	250	250
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	100	100	250
18 × 35	22	0.8	18.5	37.5	7.5 ± 0.5	≈ 14.5	100	100	—

Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS

Taped products



Form TFA:

Case $\varnothing D \times L \leq 16 \times 31$ mm.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.4 Taped in box (ammopack).

MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (148)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

Aluminum electrolytic capacitors
Radial Ultra high CV per volume Semi-professional

148 RUS

Ordering example

Electrolytic capacitor 148 series

470 μ F/25 V; \pm 20%

Nominal case size: \varnothing 10 \times 12 mm; Form TFA

Catalogue number: 2222 148 36471.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{amb} = 20^\circ C$,

$P = 86$ to 106 kPa, $RH = 45$ to 75%.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance \pm 20%
I_R	rated RMS ripple current at 100 Hz, 105 $^\circ C$
I_{L1}	max. leakage current after 2 minutes 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 100 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 105 $^\circ C$ (mA)	I_{L2} 2 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 100 kHz +20 $^\circ C$ (Ω)	Z 100 kHz -40 $^\circ C$ (Ω)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	
6.3	2200	10 \times 16	15	720	139	28	0.30	0.217	0.170	1.90	148 53222	148 63222	148 33222
	4700	12.5 \times 20	17	1100	296	59	0.34	0.115	0.085	0.60	148 53472	148 63472	148 33472
	6800	16 \times 20	19a	1210	428	86	0.38	0.089	0.060	0.30	148 53682	148 63682	148 33682
	10000	16 \times 25	19	1660	630	126	0.46	0.073	0.045	0.25	148 53103	148 63103	148 33103
	15000	16 \times 31	20	2050	945	189	0.56	0.059	0.033	0.15	148 53153	148 63153	148 33153
	22000	18 \times 35	22	2350	1386	277	0.66	0.048	0.032	0.05	148 53223	148 63223	-
	1000	10 \times 12	14	460	100	20	0.24	0.382	0.240	3.00	148 54102	148 64102	148 34102
	1500	10 \times 16	15	620	150	30	0.24	0.255	0.170	1.90	148 54152	148 64152	148 34152
	2200	10 \times 20	16	750	220	44	0.26	0.188	0.130	1.50	148 54222	148 64222	148 34222
	3300	12.5 \times 20	17	1010	330	66	0.28	0.135	0.085	0.60	148 54332	148 64332	148 34332
4700	12.5 \times 25	18	1260	470	94	0.30	0.102	0.065	0.50	148 54472	148 64472	148 34472	
4700	16 \times 20	19a	1260	470	94	0.30	0.102	0.060	0.30	148 94475	148 94476	148 94473	
6800	16 \times 25	19	1590	680	136	0.34	0.080	0.045	0.25	148 54682	148 64682	148 34682	
10000	16 \times 31	20	1910	1000	200	0.42	0.067	0.033	0.15	148 54103	148 64103	148 34103	
15000	18 \times 35	22	2200	1500	300	0.52	0.055	0.032	0.05	148 54153	148 64153	-	

Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{L2} 2 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 100 kHz +20 °C (Ω)	Z 100 kHz -40 °C (Ω)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		FORM TFA
											FORM CA	FORM CB	
16	680	10 × 12	14	450	109	22	0.20	0.468	0.240	3.00	148 55681	148 65681	148 35681
	1000	10 × 16	15	570	160	32	0.20	0.318	0.180	2.00	148 55102	148 65102	148 35102
	1500	10 × 20	16	720	240	48	0.20	0.212	0.130	1.50	148 55152	148 65152	148 35152
	2200	12.5 × 20	17	930	352	70	0.22	0.159	0.090	0.60	148 55222	148 65222	148 35222
	3300	12.5 × 25	18	1180	528	106	0.24	0.116	0.065	0.50	148 55332	148 65332	148 35332
	3300	16 × 20	19a	1120	528	106	0.24	0.116	0.060	0.30	148 95335	148 95336	148 95333
	4700	16 × 25	19	1480	752	150	0.26	0.088	0.045	0.25	148 55472	148 65472	148 35472
	6800	16 × 31	20	1790	1088	218	0.30	0.070	0.035	0.20	148 55682	148 65682	148 35682
	10000	18 × 35	22	2100	1600	320	0.36	0.057	0.032	0.05	148 55103	148 65103	-
	25	470	10 × 12	14	410	118	24	0.16	0.542	0.260	3.20	148 56471	148 66471
	680	10 × 16	15	550	170	34	0.16	0.375	0.190	2.10	148 56681	148 66681	148 36681
	1000	10 × 20	16	690	250	50	0.16	0.255	0.130	1.50	148 56102	148 66102	148 36102
	1500	12.5 × 20	17	850	375	75	0.16	0.170	0.100	0.70	148 56152	148 66152	148 36152
	2200	12.5 × 25	18	1110	550	110	0.18	0.130	0.070	0.50	148 56222	148 66222	148 36222
	2200	16 × 20	19a	1050	550	110	0.18	0.130	0.060	0.30	148 96225	148 96226	148 96223
	3300	16 × 25	19	1420	825	165	0.20	0.097	0.045	0.25	148 56332	148 66332	148 36332
	4700	16 × 31	20	1750	1175	235	0.22	0.075	0.035	0.20	148 56472	148 66472	148 36472
	6800	18 × 35	22	2050	1700	340	0.26	0.061	0.033	0.05	148 56682	148 66682	-
35	330	10 × 12	14	350	116	23	0.14	0.676	0.270	3.30	148 50331	148 60331	148 30331
	470	10 × 16	15	480	165	33	0.14	0.474	0.190	2.10	148 50471	148 60471	148 30471
	680	10 × 20	16	580	238	48	0.14	0.328	0.140	1.60	148 50681	148 60681	148 30681
	1000	12.5 × 20	17	810	350	70	0.14	0.223	0.100	0.70	148 50102	148 60102	148 30102
	1500	12.5 × 25	18	950	525	105	0.14	0.149	0.070	0.50	148 50152	148 60152	148 30152
	1500	16 × 20	19a	970	525	105	0.14	0.149	0.063	0.30	148 90155	148 90156	148 90153
	2200	16 × 25	19	1270	770	154	0.16	0.116	0.045	0.25	148 50222	148 60222	148 30222
	3300	16 × 31	20	1620	1155	231	0.18	0.087	0.037	0.20	148 50332	148 60332	148 30332
	4700	18 × 35	22	1930	1645	329	0.20	0.068	0.033	0.05	148 50472	148 60472	-

Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{L2} 2 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 100 kHz +20 °C (Ω)	Z 100 kHz -40 °C (Ω)	CATALOGUE NUMBER 2222			
											BULK PACKAGING			TAPED
											FORM CA	FORM CB	FORM TFA	
50	220	10 × 12	14	330	110	22	0.12	0.869	0.280	3.40	148 51221	148 61221	148 31221	
	330	10 × 16	15	420	165	33	0.12	0.579	0.200	2.20	148 51331	148 61331	148 31331	
	470	10 × 20	16	530	235	47	0.12	0.407	0.140	1.60	148 51471	148 61471	148 31471	
	680	12.5 × 20	17	720	340	68	0.12	0.281	0.100	0.70	148 51681	148 61681	148 31681	
	1000	12.5 × 25	18	950	500	100	0.12	0.191	0.070	0.50	148 51102	148 61102	148 31102	
	1000	16 × 20	19a	880	500	100	0.12	0.191	0.068	0.35	148 91105	148 91106	148 91103	
	1500	16 × 25	19	1180	750	150	0.12	0.127	0.047	0.30	148 51152	148 61152	148 31152	
	2200	16 × 31	20	1520	1100	220	0.14	0.101	0.039	0.20	148 51222	148 61222	148 31222	
	3300	18 × 35	22	1810	1650	330	0.16	0.077	0.035	0.06	148 51332	148 61332	-	
	63	100	10 × 12	14	230	63	13	0.10	1.592	0.320	3.90	148 58101	148 68101	148 38101
		220	10 × 16	15	350	139	28	0.10	0.724	0.240	2.70	148 58221	148 68221	148 38221
		330	12.5 × 20	17	540	208	42	0.10	0.483	0.130	0.90	148 58331	148 68331	148 38331
		470	12.5 × 20	17	540	296	59	0.10	0.339	0.130	0.90	148 58471	148 68471	148 38471
		680	12.5 × 25	18	760	428	86	0.10	0.234	0.085	0.65	148 58681	148 68681	148 38681
		680	16 × 20	19a	820	428	86	0.10	0.234	0.070	0.50	148 98685	148 98686	148 98683
		1000	16 × 25	19	980	630	126	0.10	0.159	0.049	0.25	148 58102	148 68102	148 38102
		1500	16 × 31	20	1390	945	189	0.10	0.106	0.042	0.20	148 58152	148 68152	148 38152
		2200	18 × 35	22	1670	1386	277	0.12	0.087	0.038	0.06	148 58222	148 68222	-
		100	47	10 × 12	14	165	47	9	0.08	2.710	0.640	19.20	148 59479	148 69479
	68		16 × 16	15	190	68	14	0.08	1.873	0.580	17.40	148 59689	148 69689	148 39689
	100		10 × 20	16	260	100	20	0.08	1.274	0.380	11.40	148 59101	148 69101	148 39101
	150		12.5 × 20	17	360	150	30	0.08	0.849	0.260	7.80	148 59151	148 69151	148 39151
220	12.5 × 25		18	440	220	44	0.08	0.579	0.170	2.10	148 59221	148 69221	148 39221	
220	16 × 20		19a	590	220	44	0.08	0.579	0.140	1.70	148 99225	148 99226	148 99223	
330	16 × 25		19	630	330	66	0.08	0.386	0.120	1.50	148 59331	148 69331	148 39331	
470	16 × 31		20	750	470	94	0.08	0.271	0.100	1.20	148 59471	148 69471	148 39471	

Aluminum electrolytic capacitors
Radial Ultra high CV per volume Semi-professional

148 RUS

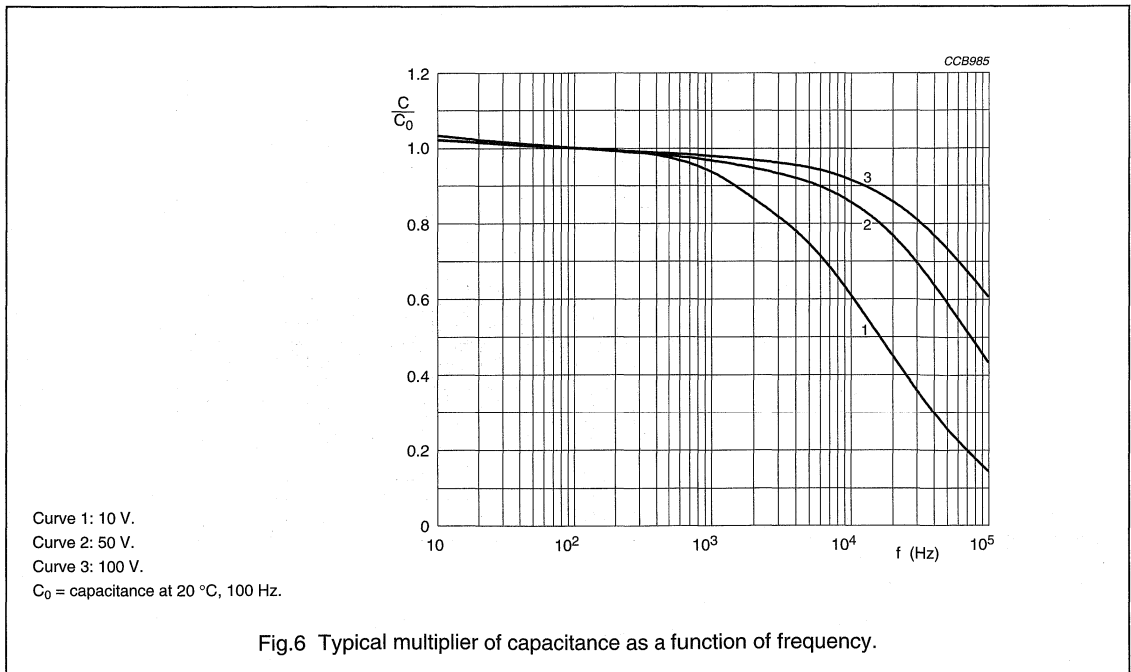
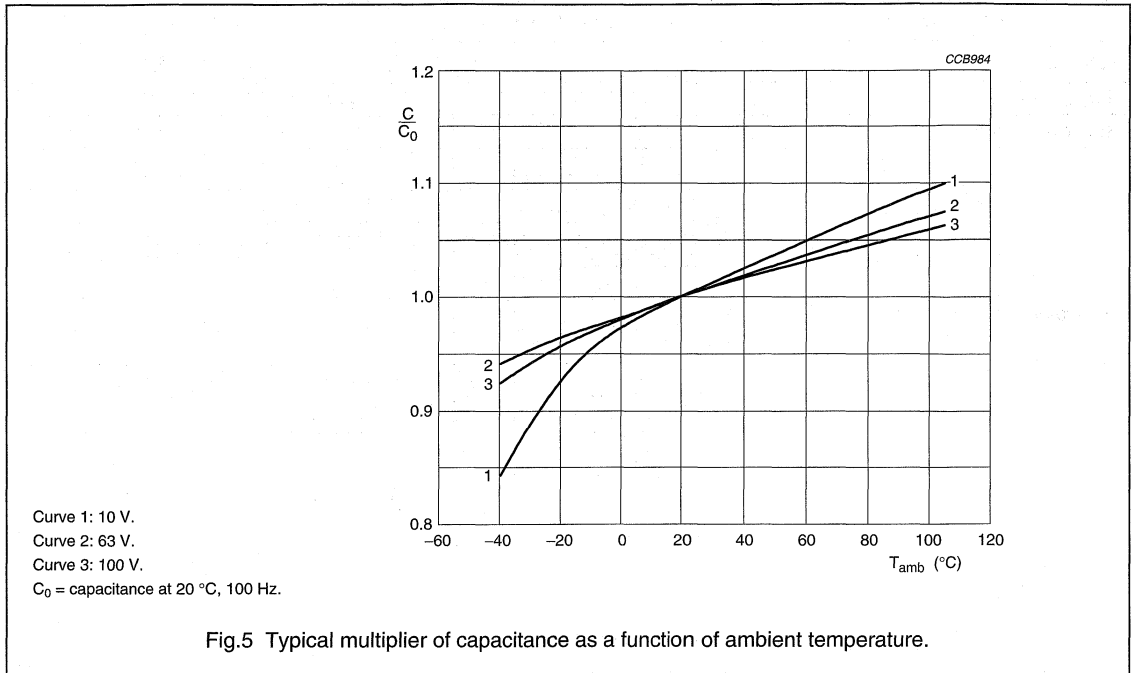
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 2 minutes at U_R	$I_{L1} \leq 0.01 C_R \times U_R$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

Aluminum electrolytic capacitors
 Radial Ultra high CV per volume Semi-professional

148 RUS

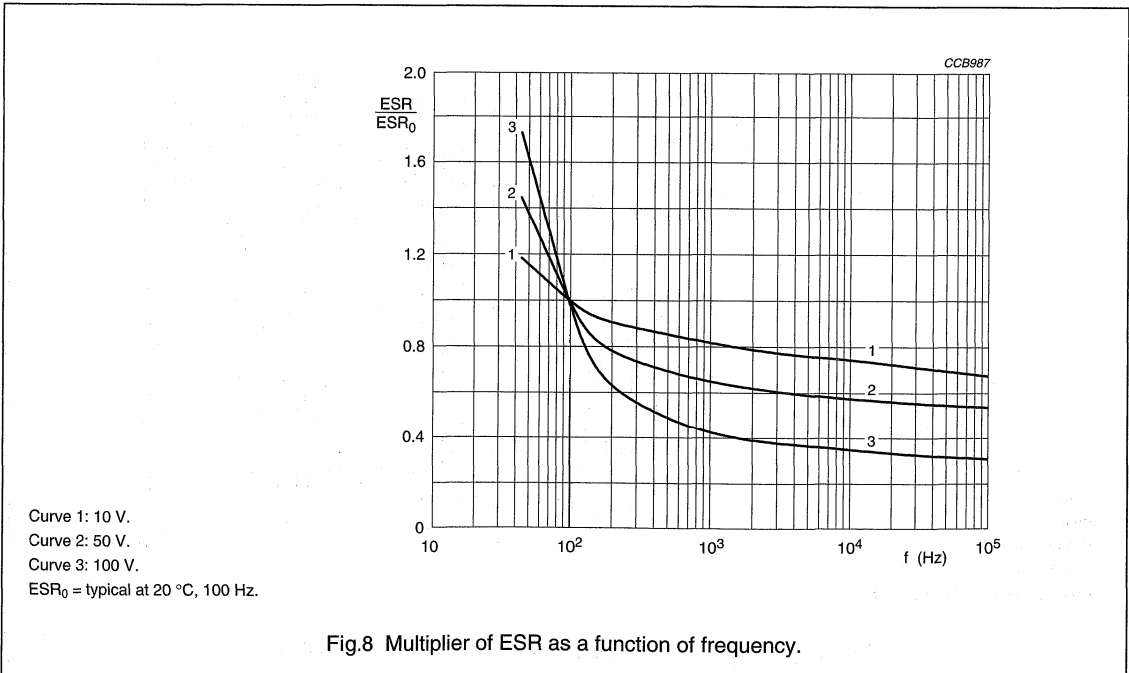
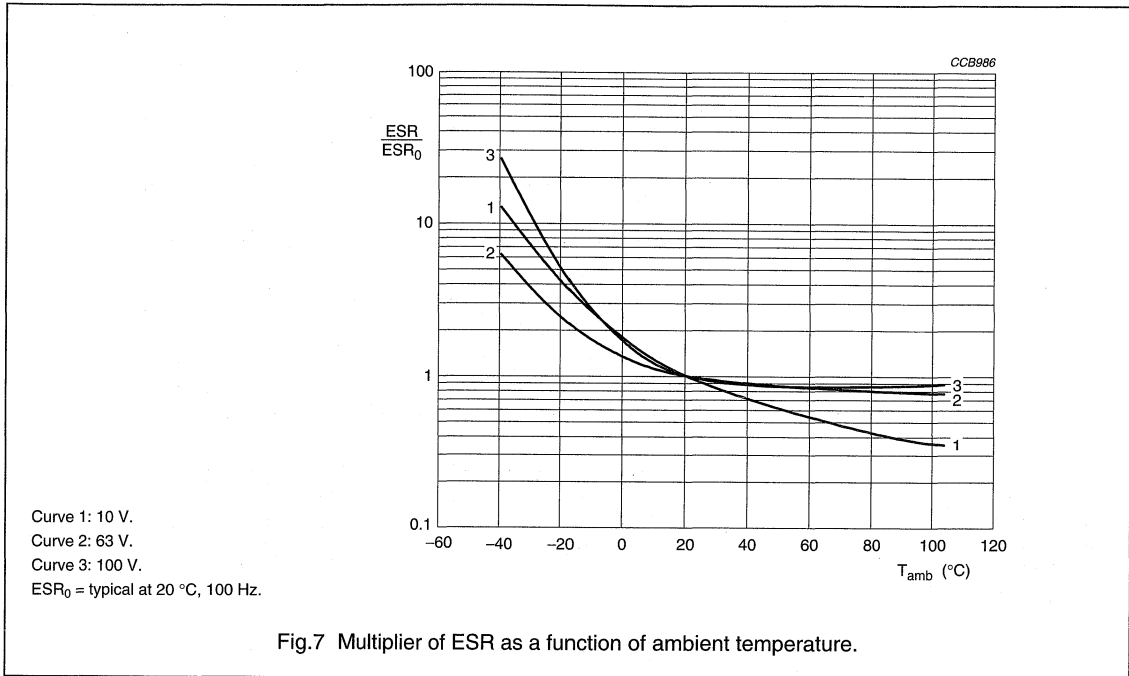
Capacitance (C)



Aluminum electrolytic capacitors Radial Ultra high CV per volume Semi-professional

148 RUS

Equivalent series resistance (ESR)

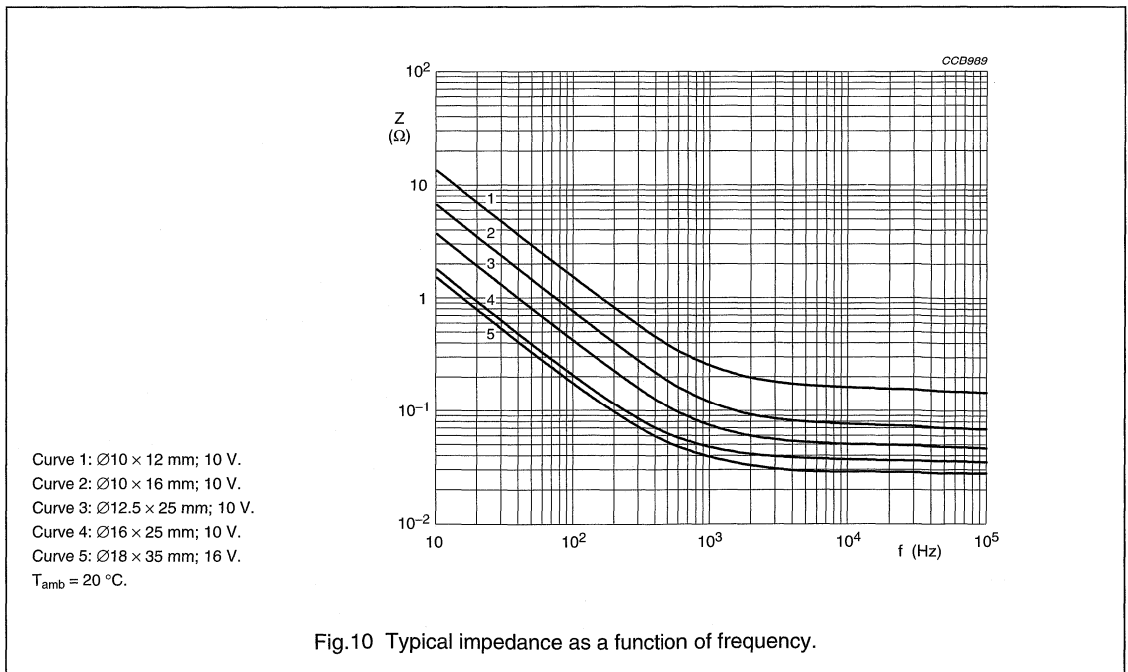
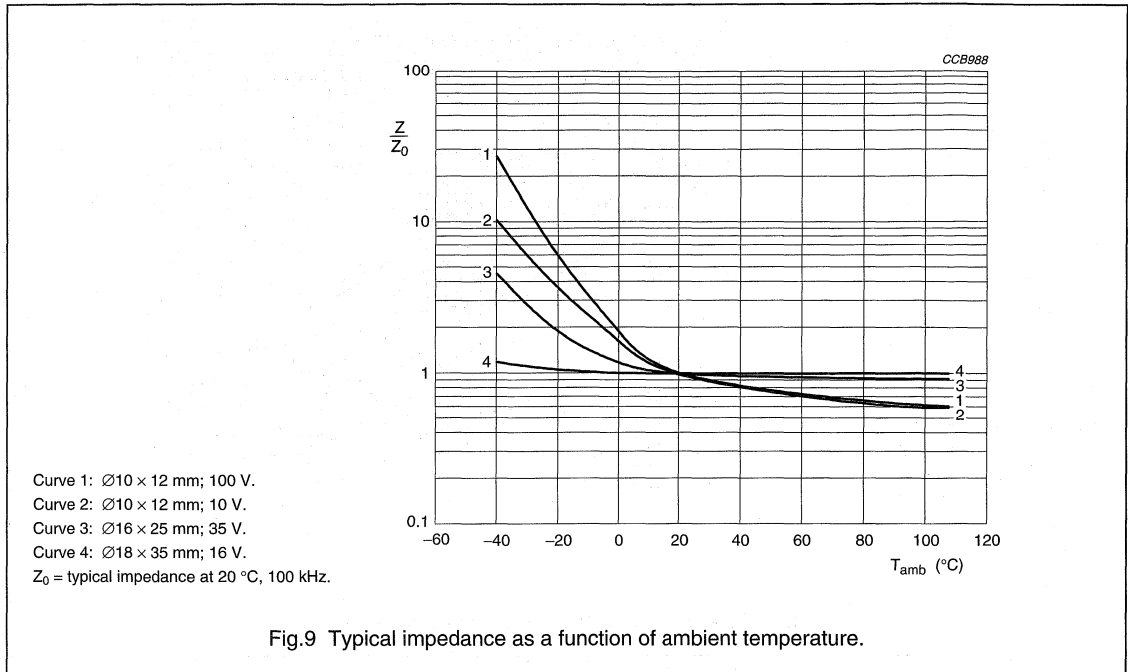


Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS

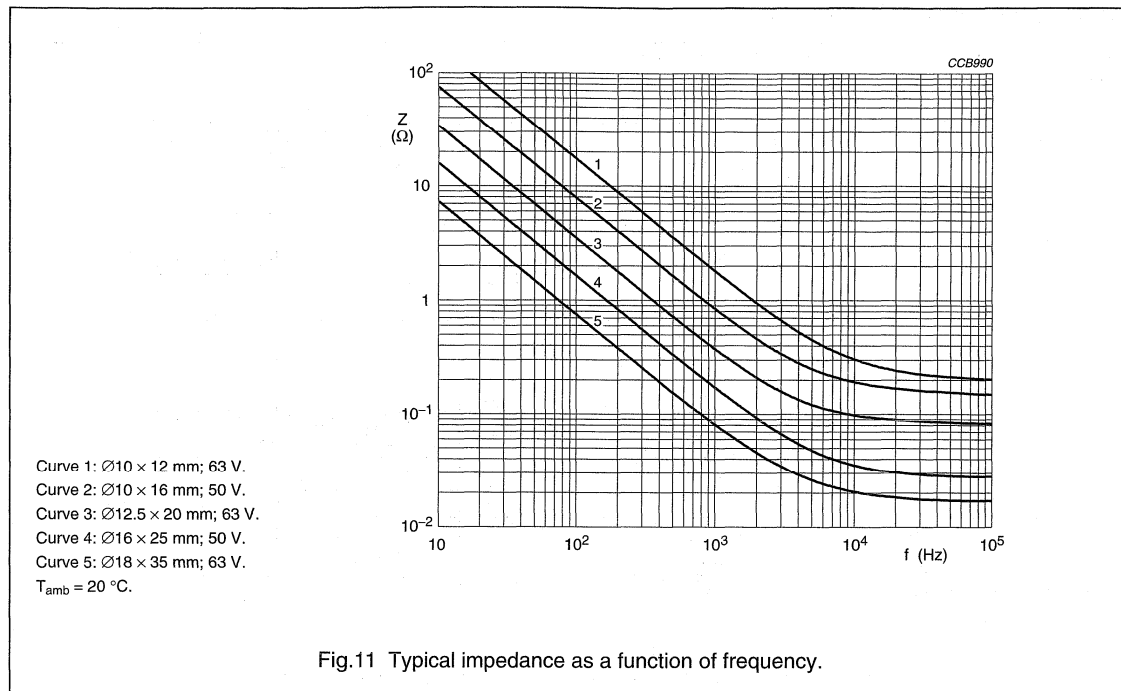
Impedance (Z)



Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS



Aluminum electrolytic capacitors

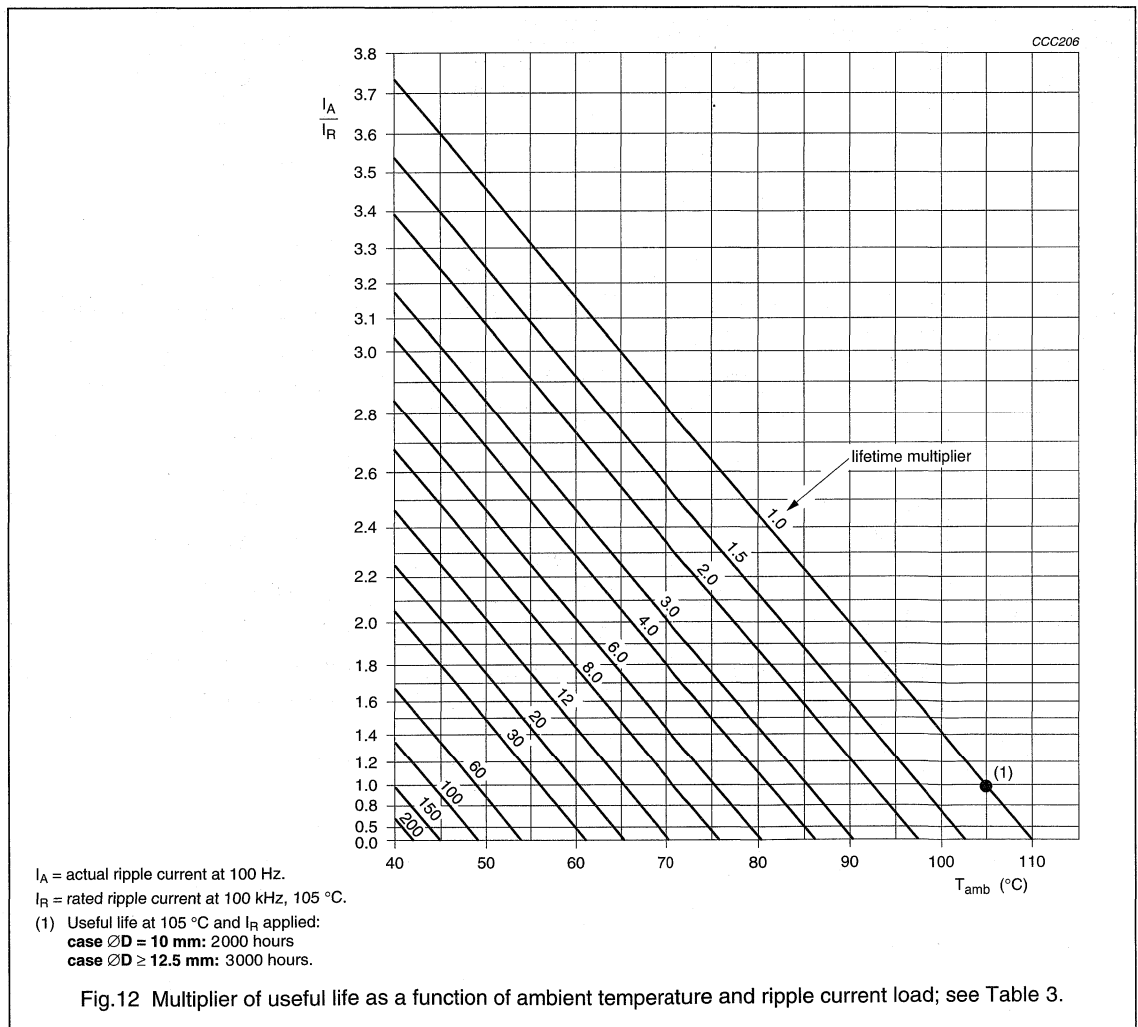
Radial Ultra high CV per volume Semi-professional

148 RUS

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 6.3$ to 25 V	$U_R = 35$ V	$U_R = 50$ to 100 V
50	0.95	0.85	0.80
100	1.00	1.00	1.00
300	1.07	1.20	1.25
1000	1.12	1.30	1.40
3000	1.15	1.35	1.50
≥ 10000	1.20	1.40	1.60



Aluminum electrolytic capacitors

Radial Ultra high CV per volume Semi-professional

148 RUS

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; case $\varnothing D = 10\text{ mm}$: 1000 hours; case $\varnothing D \geq 12.5\text{ mm}$: 2000 hours	$U_R = 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R \geq 10\text{ V}$; $\Delta C/C$: $\pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; case $\varnothing D = 10\text{ mm}$: 2000 hours; case $\varnothing D \geq 12.5\text{ mm}$: 3000 hours	$U_R = 6.3\text{ V}$; $\Delta C/C$: +45/-50% $U_R \geq 10\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$U_R = 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R \geq 10\text{ V}$; $\Delta C/C$: $\pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$
Surge	IEC 60384-4/ EN130300 subclause 4.14	from source of $1.15 \times U_R$: $RC = 0.1 \pm 0.05\text{ s}$; 1000 cycles of 30 s on, 330 s off, at $105\text{ }^{\circ}\text{C}$	$\Delta C/C$: $\pm 20\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Reverse voltage	IEC 60384-4/ EN130300 subclause 4.15	$T_{amb} = 105\text{ }^{\circ}\text{C}$: 125 hours at $U = -1\text{ V}$, followed by 125 hours at U_R	$\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$

Aluminum electrolytic capacitors
Radial Ultra high CV per volume Semi-professional

148 RUS

NOTES

R

Aluminum electrolytic capacitors

Radial Long Life

116 RLL

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, all-insulated (light blue)
- Natural pitch 2.5 mm and 5 mm
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume
- Long useful life: 2000 hours at 105 °C, high reliability.

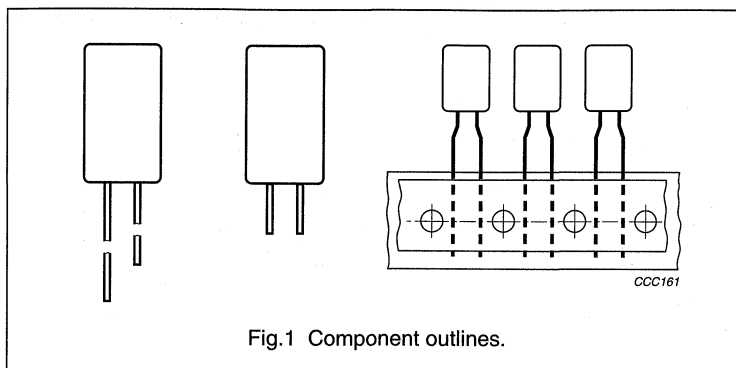
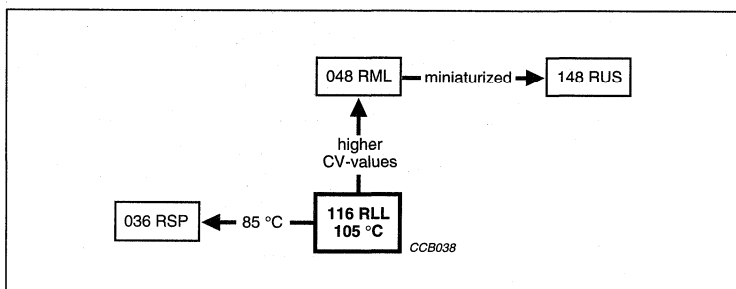


Fig.1 Component outlines.

APPLICATIONS

- Automotive, telecommunication, industrial and EDP
- Stand-by applications in audio and video equipment
- Coupling, decoupling, timing; smoothing, filtering and buffering in DC-DC converters
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	5 × 11 and 8.2 × 11
Rated capacitance range, C_R	0.47 to 470 μ F
Tolerance on C_R	±20%
Rated voltage range, U_R	6.3 to 100 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C	1500 hours
Endurance test at 85 °C	5000 hours
Useful life at 105 °C	2000 hours
Useful life at 40 °C, $1.3 \times I_R$ applied	200000 hours
Shelf life at 0 V, 105 °C	1500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/105/56

Aluminum electrolytic capacitors

Radial Long Life

116 RLL

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)								
	6.3	10	16	25	35	40	50	63	100
0.47	-	-	-	-	-	-	5 × 11	-	-
1.0	-	-	-	-	-	-	5 × 11	-	-
1.5	-	-	-	-	-	-	5 × 11	-	-
2.2	-	-	-	-	-	-	5 × 11	-	8.2 × 11
3.3	-	-	-	-	-	-	5 × 11	-	-
4.7	-	-	-	-	-	-	5 × 11	-	8.2 × 11
6.8	-	-	-	-	-	-	5 × 11	-	-
10	-	-	-	-	-	-	5 × 11	8.2 × 11	8.2 × 11
	-	-	-	-	-	-	8.2 × 11	-	-
15	-	-	-	-	-	-	5 × 11	-	-
22	-	-	-	-	-	-	5 × 11	8.2 × 11	-
	-	-	-	-	-	-	8.2 × 11	-	-
33	-	-	-	-	5 × 11	5 × 11	8.2 × 11	-	-
47	-	-	-	5 × 11	-	-	8.2 × 11	-	-
68	-	-	5 × 11	-	-	-	8.2 × 11	-	-
100	-	5 × 11	-	-	8.2 × 11	8.2 × 11	-	-	-
150	5 × 11	-	-	8.2 × 11	-	-	-	-	-
220	-	-	8.2 × 11	-	-	-	-	-	-
330	-	8.2 × 11	-	-	-	-	-	-	-
470 ⁽¹⁾	8.2 × 11	-	-	-	-	-	-	-	-

Note

- For higher CV-values see data sheet "048 RML".

R

Aluminum electrolytic capacitors

Radial Long Life

116 RLL

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

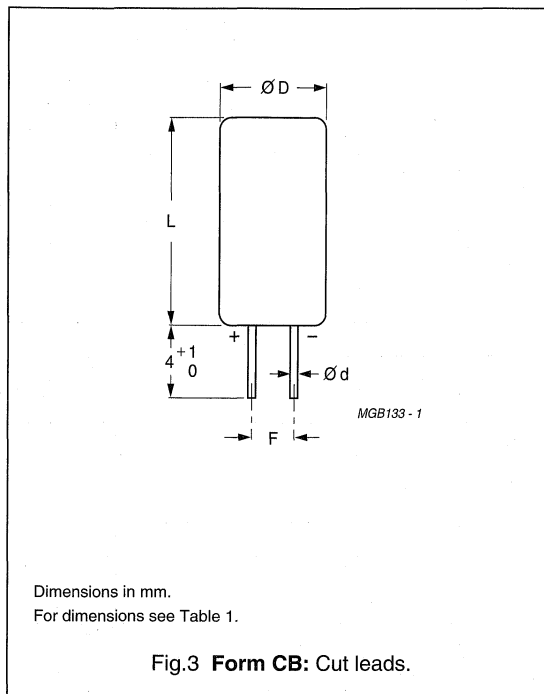
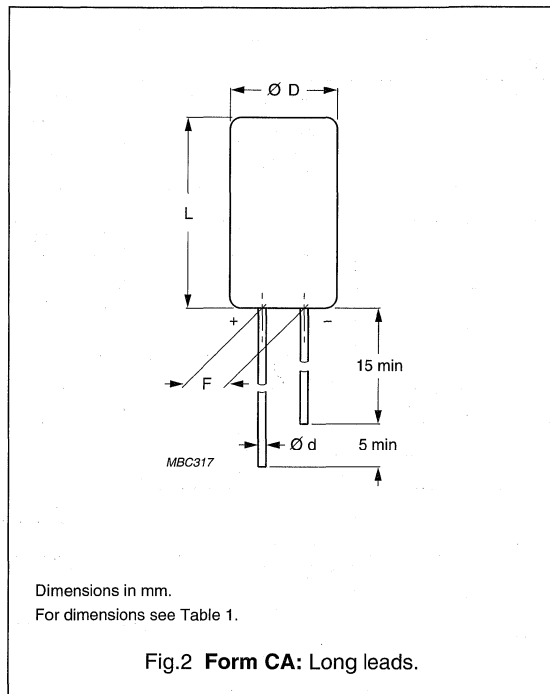


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

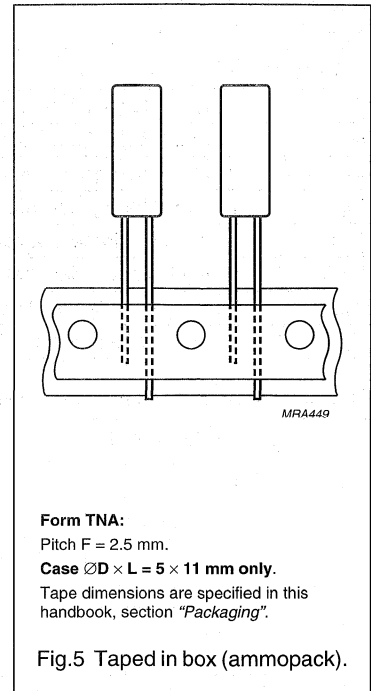
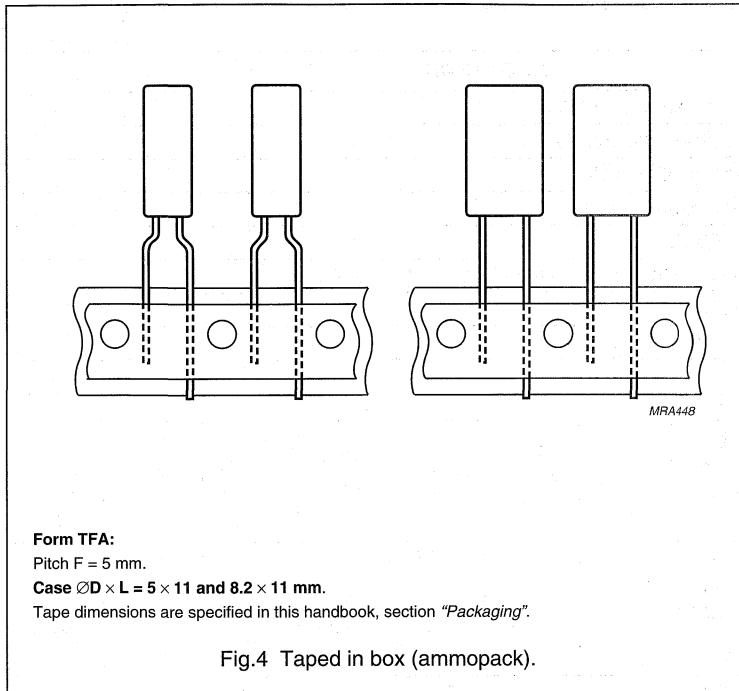
NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA, CB	FORM TR+, TN+	FORM TFA, TNA
5 × 11	11	0.5	5.5	12	2.5 ± 0.5	≈ 0.4	1000	1000	2000
8.2 × 11	13	0.6	8.7	12	5 ± 0.5	≈ 1.1	1000	500	1000

Aluminum electrolytic capacitors

Radial Long Life

116 RLL

Taped products



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"
- Rated voltage (in V)
- Group number (116)
- Name of manufacturer
- Date code in accordance with "IEC 60062"
- Code indicating factory of origin
- Minus-sign on top to identify the negative terminal.



Aluminum electrolytic capacitors

Radial Long Life

116 RLL

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2 and 4 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 kHz, 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\tan \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\tan \delta_{max}$ and C_R)
Z_{10}	max. impedance at 10 kHz and 20 or -40 °C
Z_{100}	max. impedance at 100 kHz and 20 °C

Table 2 Electrical data; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 kHz 105 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z_{10} 10 kHz 20 °C (Ω)	Z_{100} 100 kHz 20 °C (Ω)	Z_{10} 10 kHz -40 °C (Ω)
6.3	150	5×11	11	130	8.7	3.9	0.25	2.7	2	1.3	32
	470	8.2×11	13	300	21	6	0.25	0.8	0.64	0.45	10
10	100	5×11	11	130	9	4	0.2	3.2	2	1.4	32
	330	8.2×11	13	280	23	6.3	0.2	1.0	0.61	0.45	9.7
16	68	5×11	11	130	9.5	4.1	0.16	3.7	2.4	1.5	29
	220	8.2×11	13	280	24	6.5	0.16	1.2	0.73	0.5	9.1
25	47	5×11	11	120	10	4.2	0.14	4.7	2.6	1.6	32
	150	8.2×11	13	260	26	6.8	0.14	1.5	0.8	0.5	10
35	33	5×11	11	110	9.9	4.2	0.12	5.8	2.7	1.7	33
	100	8.2×11	13	240	24	6.5	0.12	1.9	0.9	0.55	11
40	33	5×11	11	110	10.9	4.3	0.12	5.8	2.7	1.7	33
	100	8.2×11	13	240	27	7	0.12	1.9	0.9	0.55	11

Aluminum electrolytic capacitors

Radial Long Life

116 RLL

ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 116 series

220 $\mu\text{F}/16\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 8.2 \times 11\text{ mm}$; Form TFA

Catalogue number: 2222 116 35221.

Table 3 Ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
6.3	150	11	116 53151	2.5	–	–	116 33151	5.0	116 73151	2.5
	470	13	116 53471	5.0	116 63471	5.0	116 33471	5.0	–	–
10	100	11	116 54101	2.5	–	–	116 34101	5.0	116 74101	2.5
	330	13	116 54331	5.0	116 64331	5.0	116 34331	5.0	–	–
16	68	11	116 55689	2.5	–	–	116 35689	5.0	116 75689	2.5
	220	13	116 55221	5.0	116 65221	5.0	116 35221	5.0	–	–
25	47	11	116 56479	2.5	–	–	116 36479	5.0	116 76479	2.5
	150	13	116 56151	5.0	116 66151	5.0	116 36151	5.0	–	–
35	33	11	116 50339	2.5	–	–	116 30339	5.0	116 70339	2.5
	100	13	116 50101	5.0	116 60101	5.0	116 30101	5.0	–	–
40	33	11	116 57339	2.5	–	–	116 37339	5.0	116 77339	2.5
	100	13	116 57101	5.0	116 67101	5.0	116 37101	5.0	–	–

Aluminum electrolytic capacitors

Radial Long Life

116 RLL

ELECTRICAL DATA (continued)**Table 4** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 kHz 105 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z_{10} 10 kHz 20 °C (Ω)	Z_{100} 100 kHz 20 °C (Ω)	Z_{10} 10 kHz -40 °C (Ω)
50	0.47	5 × 11	11	30	3.1	3	0.09	300	150	10	1900
	1.0	5 × 11	11	40	3.3	3.1	0.09	140	70	6	900
	1.5	5 × 11	11	50	3.5	3.1	0.09	95	47	4	600
	2.2	5 × 11	11	60	3.7	3.1	0.09	65	32	3.5	410
	3.3	5 × 11	11	65	4	3.2	0.09	43	21	3.1	270
	4.7	5 × 11	11	70	4.4	3.2	0.09	30	15	2.8	190
	6.8	5 × 11	11	75	5	3.3	0.09	21	10	2.5	130
	10	5 × 11	11	80	6	3.5	0.09	14	7	2.2	90
	10	8.2 × 11	13	160	6	3.5	0.05	8.0	3.6	1.0	40
	15	5 × 11	11	90	7.5	3.8	0.09	9.5	4.7	2.0	60
	22	5 × 11	11	110	9.6	4.1	0.09	6.5	3.2	1.9	41
	22	8.2 × 11	13	190	9.6	4.1	0.06	4.4	2.2	0.9	29
	33	8.2 × 11	13	190	13	4.7	0.09	4.3	2.1	0.77	27
	47	8.2 × 11	13	210	17	5.4	0.09	3.0	1.5	0.65	19
68	8.2 × 11	13	240	23	6.4	0.09	2.1	1.0	0.55	13	
63	10	8.2 × 11	13	160	7	3.6	0.06	9.5	3.5	1.3	45
	22	8.2 × 11	13	190	11	4.4	0.06	4.4	1.8	0.9	23
100	2.2	8.2 × 11	13	60	4.3	3.2	0.06	43	18	4	190
	4.7	8.2 × 11	13	75	5.8	3.5	0.07	24	12	3.5	170
	10	8.2 × 11	13	100	9	4	0.08	13	4.5	3	70

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_S \leq 1.3 U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006 C_R \times U_R + 3 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.001 C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \times L = 5 \times 11 \text{ mm}$	typ. 13 nH
	case $\varnothing D \times L = 8.2 \times 11 \text{ mm}$	typ. 16 nH

Aluminum electrolytic capacitors

Radial Long Life

116 RLL

ORDERING INFORMATION (continued)**Table 5** Ordering information continued; preferred types in **bold**

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
50	0.47	11	116 51477	2.5	–	5.0	116 31477	5.0	116 71477	2.5
	1.0	11	116 51108	2.5	–	5.0	116 31108	5.0	116 71108	2.5
	1.5	11	116 51158	2.5	–	5.0	116 31158	5.0	116 71158	2.5
	2.2	11	116 51228	2.5	–	5.0	116 31228	5.0	116 71228	2.5
	3.3	11	116 51338	2.5	–	5.0	116 31338	5.0	116 71338	2.5
	4.7	11	116 51478	2.5	–	5.0	116 31478	5.0	116 71478	2.5
	6.8	11	116 51688	2.5	–	5.0	116 31688	5.0	116 71688	2.5
	10	11	116 51109	2.5	–	5.0	116 31109	5.0	116 71109	2.5
	10	13	116 90084	5.0	116 90085	5.0	116 90036	5.0	–	–
	15	11	116 51159	2.5	–	5.0	116 31159	5.0	116 71159	2.5
	22	11	116 51229	2.5	–	5.0	116 31229	5.0	116 71229	2.5
	22	13	116 90025	5.0	116 90086	5.0	116 90039	5.0	–	–
	33	13	116 51339	5.0	116 61339	5.0	116 31339	5.0	–	–
	47	13	116 51479	5.0	116 61479	5.0	116 31479	5.0	–	–
68	13	116 51689	5.0	116 61689	5.0	116 31689	5.0	–	–	
63	10	13	116 58109	5.0	116 68109	5.0	116 38109	5.0	–	–
	22	13	116 58229	5.0	116 68229	5.0	116 38229	5.0	–	–
100	2.2	13	116 59228	5.0	116 69228	5.0	116 39228	5.0	–	–
	4.7	13	116 59478	5.0	116 69478	5.0	116 39478	5.0	–	–
	10	13	116 59109	5.0	116 69109	5.0	116 39109	5.0	–	–

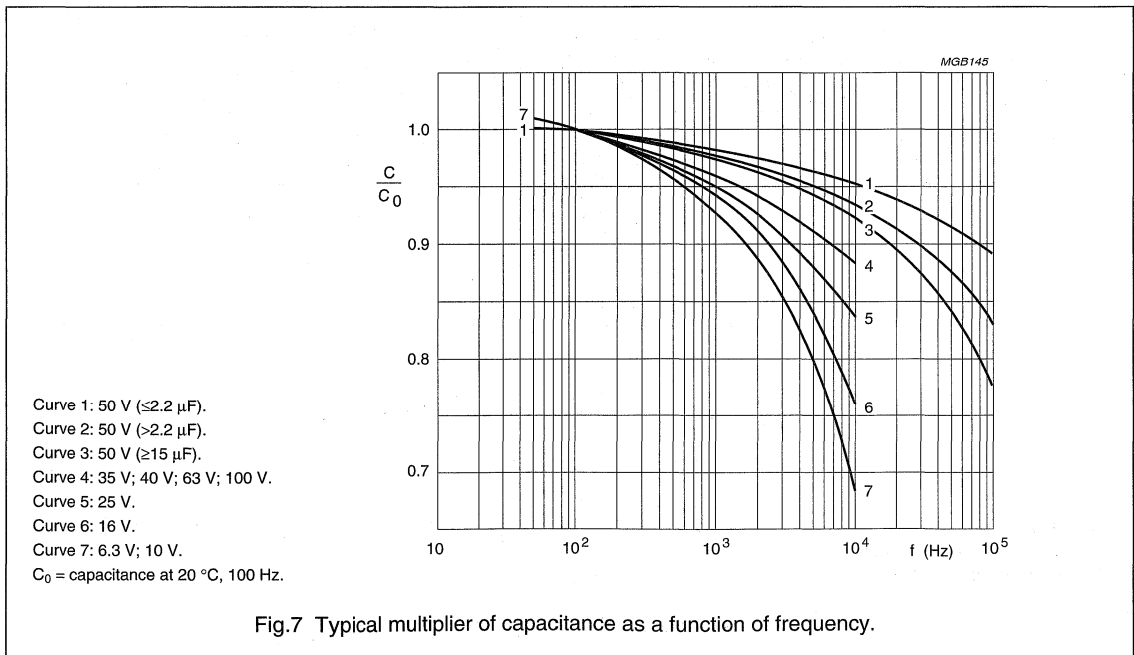
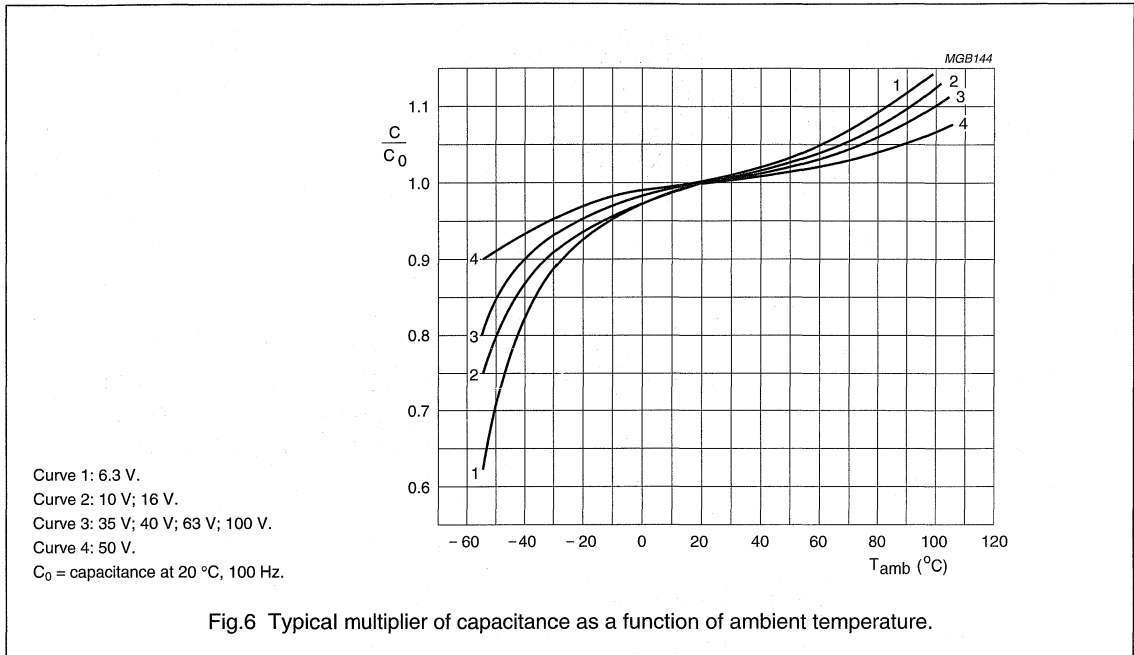
Aluminum electrolytic capacitors

Radial Long Life

116 RLL

ELECTRICAL DATA (continued)

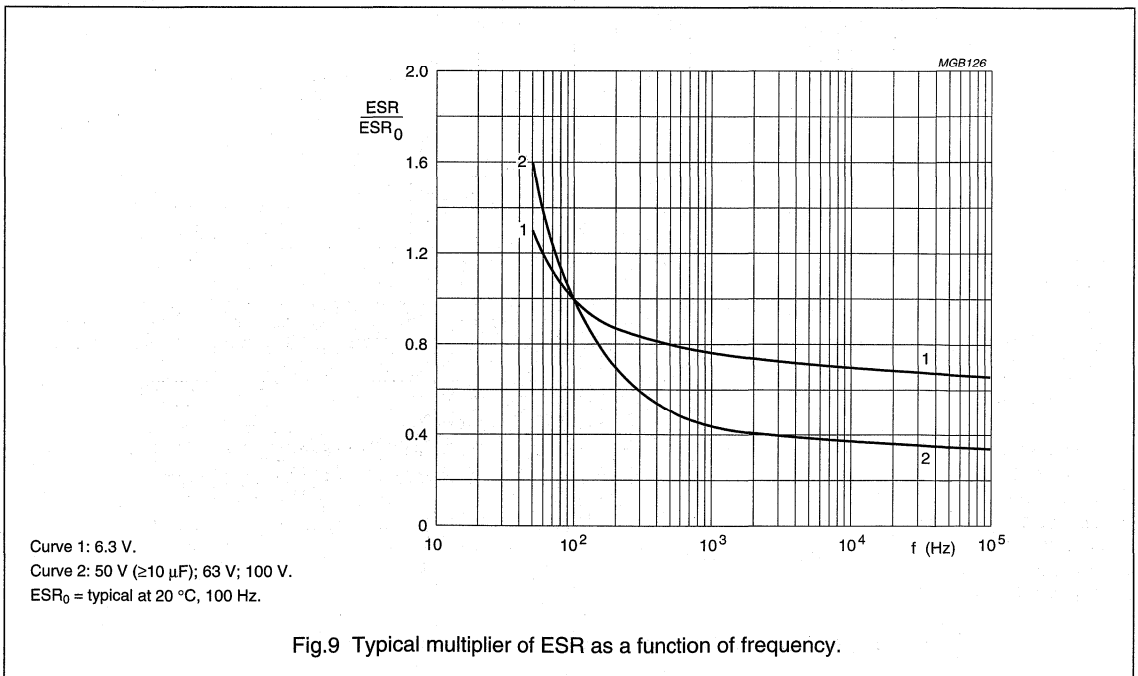
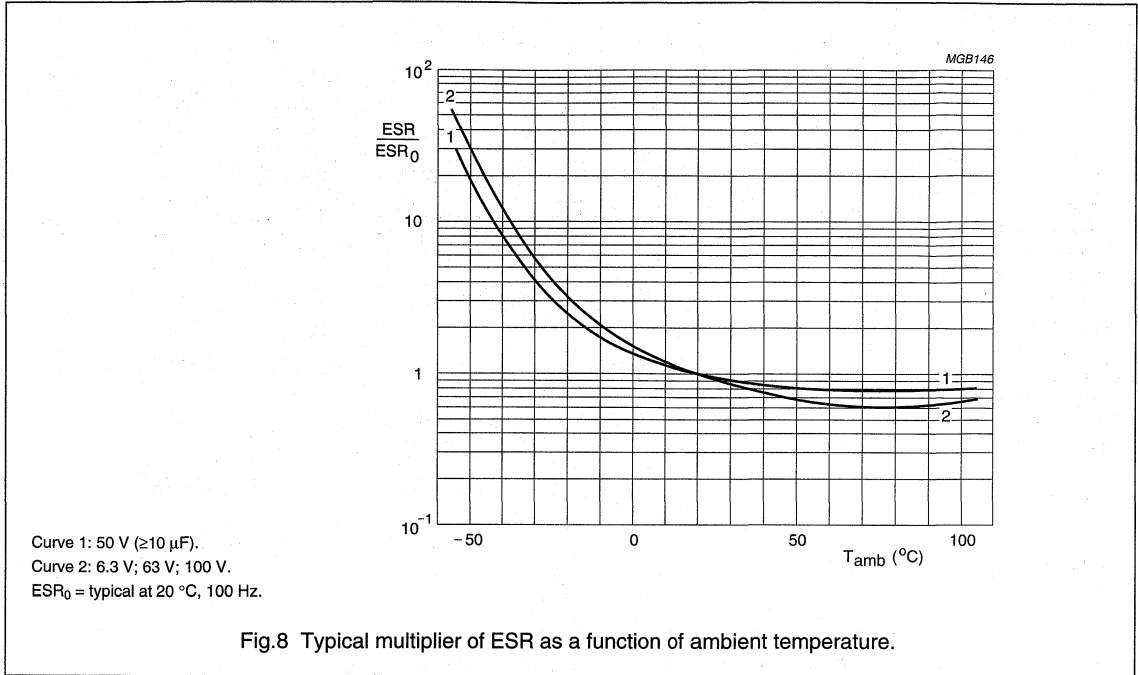
Capacitance (C)



Aluminum electrolytic capacitors Radial Long Life

116 RLL

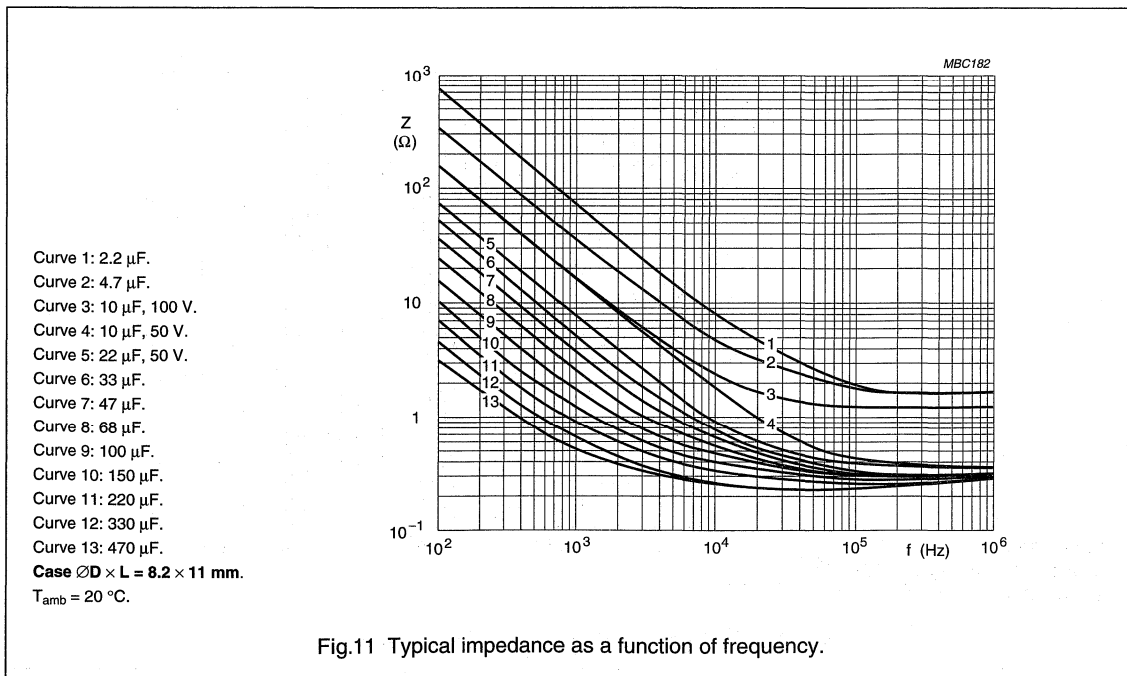
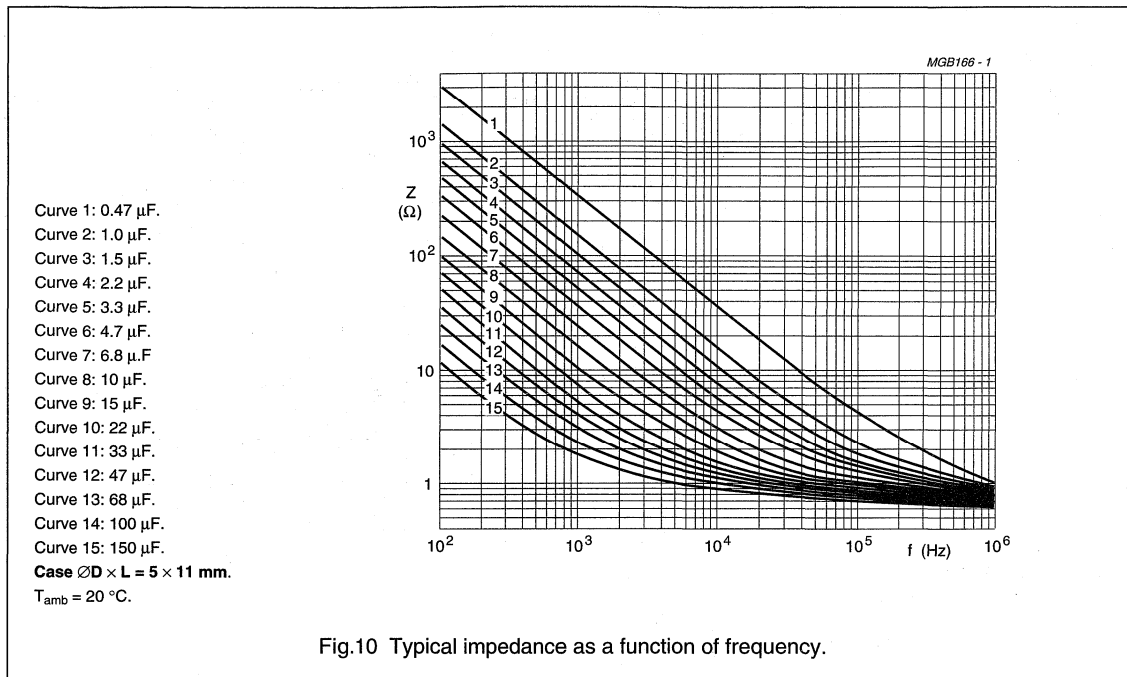
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors Radial Long Life

116 RLL

Impedance (Z)



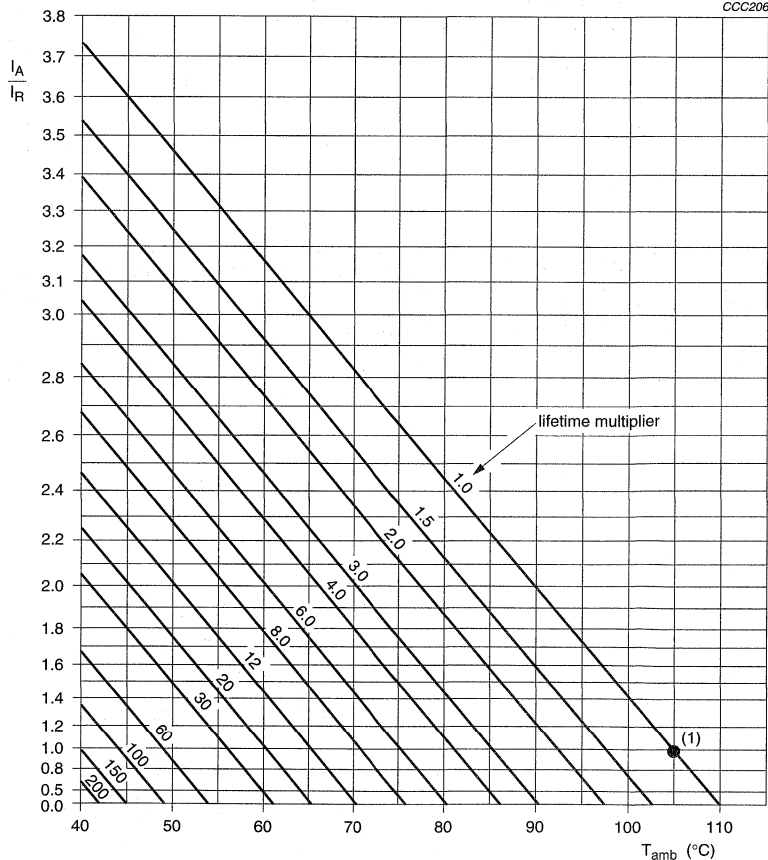
Aluminum electrolytic capacitors Radial Long Life

116 RLL

RIPPLE CURRENT AND USEFUL LIFE

Table 6 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 35 V	$U_R = 40$ to 100 V ($C_R \geq 10 \mu\text{F}$)
50	0.7	0.6	0.5
100	0.77	0.71	0.63
300	0.86	0.85	0.78
1000	0.92	0.93	0.88
3000	0.96	0.96	0.94
10 to 100 k	1.0	1.0	1.0



I_A = actual ripple current at 100 kHz.

I_R = rated ripple current at 100 kHz, 105 °C.

(1) Useful life at 105 °C and I_R applied: 2000 hours.

Fig.12 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Long Life

116 RLL

SPECIFIC TESTS AND REQUIREMENTS

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

Table 7 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; 1500 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z_{10} \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; 2000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +45/-50% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z_{10} \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 1500 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 $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors
Radial Long Life

116 RLL

NOTES



Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Long useful life: 1500 to 2500 hours at 105 °C
- Low ESR, low impedance, high ripple current capability.

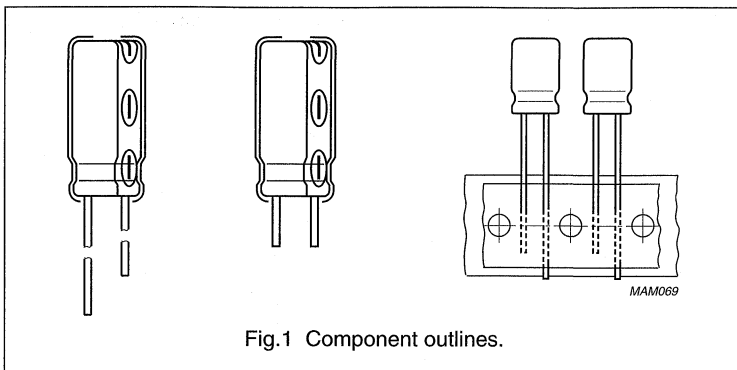
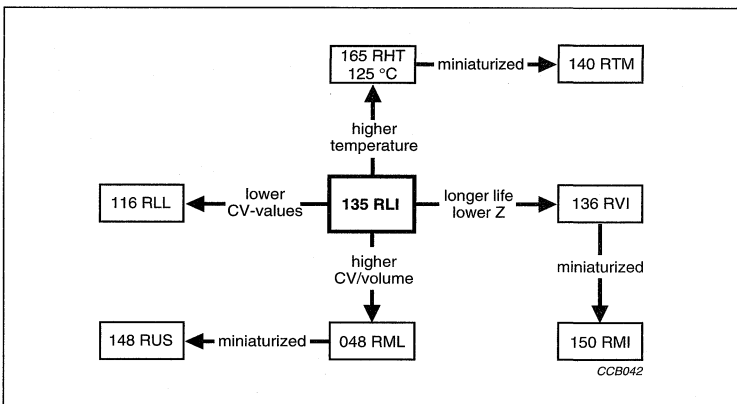


Fig.1 Component outlines.

APPLICATIONS

- General industrial, EDP, telecommunication and audio-video
- Smoothing, filtering, buffering in SMPS and DC/DC converters.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	8 × 12 to 8 × 20	10 × 12 to 18 × 40
Rated capacitance range, C_R	22 to 10000 μ F	
Tolerance on C_R	±20%	
Rated voltage range, U_R	6.3 to 100 V	
Category temperature range	-55 to +105 °C	
Endurance test at 105 °C	1 000 hours	2 000 hours
Useful life at 105 °C	1 500 hours	2 500 hours
Useful life at 40 °C, $1.3 \times I_R$ applied	150 000 hours	250 000 hours
Shelf life at 0 V, 105 °C	1 000 hours	1 000 hours
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	55/105/56	

Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	6.3	10	16	25	35	50	63	100
22	–	–	–	–	–	–	–	8 × 12
47	–	–	–	–	–	–	8 × 12	–
100	–	–	–	–	8 × 12	10 × 16	–	12.5 × 20
220	–	–	8 × 12	8 × 15	8 × 20	10 × 25	12.5 × 20	16 × 25
330	–	–	8 × 15	–	10 × 20	12.5 × 20	–	16 × 31
	–	–	–	–	–	–	–	18 × 25
470	10 × 12	8 × 15	8 × 20	10 × 20	10 × 30	12.5 × 25	16 × 25	16 × 40
	–	–	–	–	–	18 × 15	–	–
680	10 × 16	–	10 × 20	–	12.5 × 25	–	16 × 31	18 × 40
1000	–	12.5 × 16	10 × 30	12.5 × 25	12.5 × 31	16 × 31	16 × 40	–
	–	–	–	–	16 × 20	–	–	–
1500	–	10 × 30	12.5 × 25	12.5 × 31	12.5 × 40	16 × 40	–	–
2200	12.5 × 20	12.5 × 25	12.5 × 31	12.5 × 40	16 × 35	18 × 40	–	–
	–	18 × 15	16 × 20	18 × 20	18 × 31	–	–	–
3300	–	12.5 × 35	–	16 × 35	18 × 40	–	–	–
	–	16 × 20	–	18 × 31	–	–	–	–
4700	–	16 × 31	16 × 35	18 × 40	–	–	–	–
	–	18 × 25	18 × 31	–	–	–	–	–
6800	16 × 31	16 × 35	18 × 35	–	–	–	–	–
10000	18 × 31	18 × 40	–	–	–	–	–	–

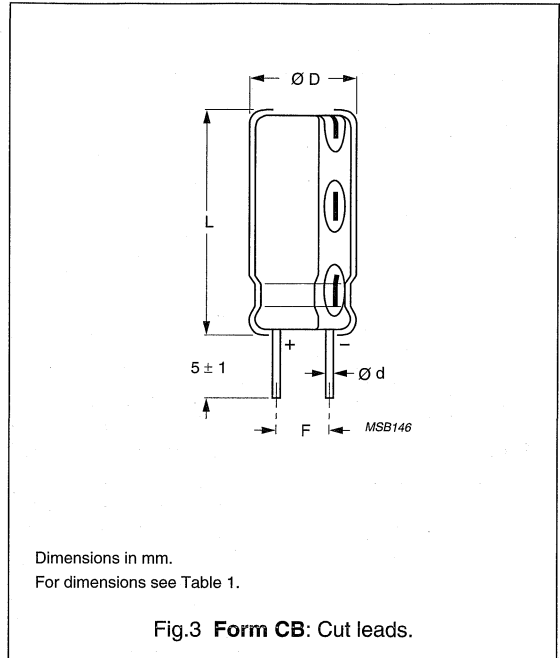
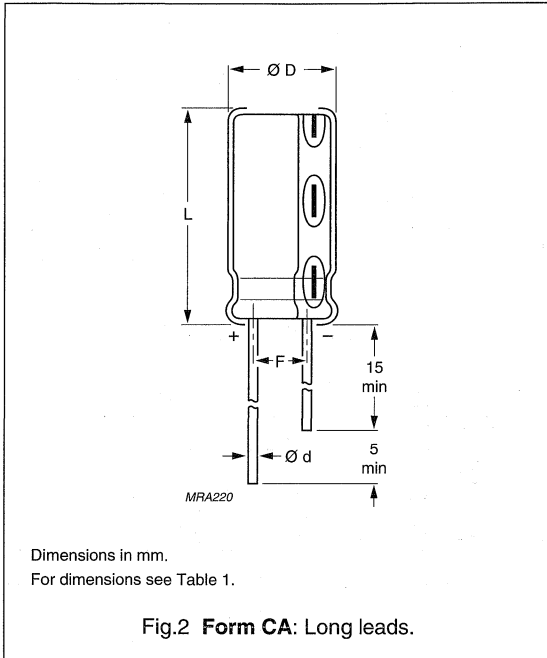
R

Aluminum electrolytic capacitors

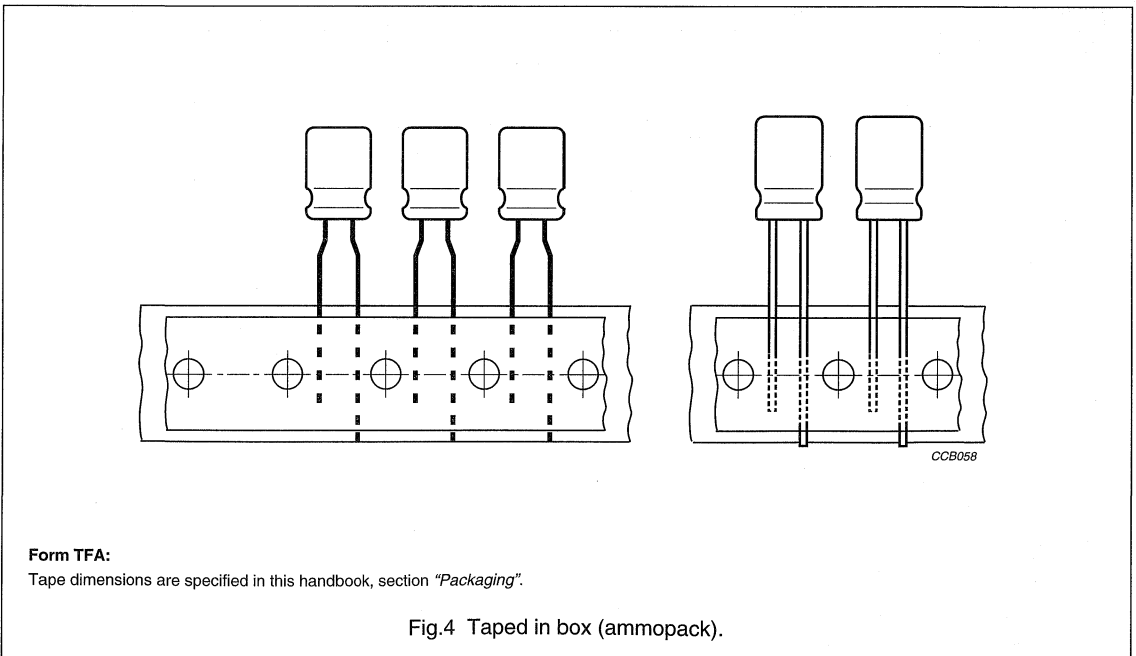
Radial, Low Impedance

135 RLI

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Taped products



Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

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

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA
8 × 12	13	0.6	8.5	13	3.5 ±0.5	≈1.1	1000	2000	1000
8 × 15	13L	0.6	8.5	16	3.5 ±0.5	≈1.3	1000	2000	1000
8 × 20	13LL	0.6	8.5	21	3.5 ±0.5	≈1.5	1000	1000	1000
10 × 12	14	0.6	10.5	13.5	5 ±0.5	≈1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5 ±0.5	≈1.9	500	500	800
10 × 20	16	0.6	10.5	22	5 ±0.5	≈2.2	500	500	800
10 × 25	16L	0.6	10.5	27	5 ±0.5	≈3.0	1000	1500	800
10 × 30	16LL	0.6	10.5	32	5 ±0.5	≈3.5	1000	750	–
12.5 × 16	17a	0.6	13	17.5	5 ±0.5	≈2.7	1000	1500	500
12.5 × 20	17	0.6	13	22	5 ±0.5	≈4.0	500	500	500
12.5 × 25	18	0.6	13	27	5 ±0.5	≈5.0	250	250	500
12.5 × 31	18L	0.6	13	33.5	5 ±0.5	≈5.5	1000	750	–
12.5 × 35	18LL	0.6	13	37.5	5 ±0.5	≈6.0	500	750	–
12.5 × 40	1240	0.6	13	42	5 ±0.5	≈7.5	500	750	–
16 × 20	19a	0.8	16.5	22	7.5 ±0.5	≈6.0	250	250	250
16 × 25	19	0.8	16.5	27	7.5 ±0.5	≈8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ±0.5	≈9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ±0.5	≈11	100	100	–
16 × 40	21L	0.8	16.5	42	7.5 ±0.5	≈13	250	500	–
18 × 15	1815	0.8	18.5	17	7.5 ±0.5	≈6.0	500	500	–
18 × 20	1820	0.8	18.5	22	7.5 ±0.5	≈8.0	100	100	–
18 × 25	1825	0.8	18.5	27.0	7.5 ±0.5	≈10	100	100	–
18 × 31	1831	0.8	18.5	33.5	7.5 ±0.5	≈12.5	100	100	–
18 × 35	22	0.8	18.5	37.5	7.5 ±0.5	≈14.5	100	100	–
18 × 40	23	0.8	18.5	42	7.5 ±0.5	≈16	250	500	–

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"
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (135)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Negative terminal identification.

Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2, 4 and 6 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 120 Hz, 105 °C
I_{RH}	rated RMS ripple current at 100 kHz, 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L2}	max. leakage current after 2 minutes at U_R
Tan δ	max. dissipation factor at 120 Hz
ESR	equivalent series resistance at 120 Hz (calculated from tan δ_{max} and C_R)
Z	max. impedance at 100 kHz and 20 or -10 °C

Table 2 Electrical data; preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 105 °C (mA)	I_{RH} 100 kHz 105 °C (mA)	I_{L1} 1 min (μA)	I_{L2} 2 min (μA)	Tan δ 120 Hz	ESR 120 Hz (Ω)	Z 100 kHz 20 °C (Ω)	Z 100 kHz -10 °C (Ω)
6.3	470	10 × 12	14	410	510	89	30	0.22	0.62	0.28	0.73
	680	10 × 16	15	510	640	129	43	0.22	0.43	0.22	0.57
	2200	12.5 × 20	17	1000	1100	416	140	0.24	0.14	0.089	0.23
	6800	16 × 31	20	1600	1800	1290	430	0.32	0.062	0.055	0.14
	10000	18 × 31	1831	1800	2000	1890	630	0.40	0.053	0.047	0.12
10	470	8 × 15	13L	400	500	141	47	0.19	0.54	0.24	0.62
	1000	12.5 × 16	17a	780	970	300	100	0.19	0.25	0.12	0.31
	1500	10 × 30	16LL	1000	1200	450	150	0.19	0.17	0.093	0.24
	2200	12.5 × 25	18	1200	1300	660	220	0.21	0.13	0.073	0.19
	2200	18 × 15	1815	1200	1300	660	220	0.21	0.13	0.080	0.21
	3300	12.5 × 35	18LL	1600	1800	990	330	0.23	0.092	0.052	0.14
	3300	16 × 20	19a	1200	1400	990	330	0.23	0.092	0.075	0.20
	4700	16 × 31	20	1600	1800	1410	470	0.25	0.071	0.054	0.14
	4700	18 × 25	1825	1700	1800	1410	470	0.25	0.071	0.053	0.14
	6800	16 × 35	21	1800	2000	2040	680	0.29	0.057	0.046	0.12
	10000	18 × 40	23	2200	2500	3000	1000	0.37	0.049	0.037	0.096

Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

ORDERING EXAMPLE

Electrolytic capacitor 135 series

1000 μ F/16 V; \pm 20%Nominal case size: \varnothing 10 \times 30 mm; Form CB

Catalogue number: 2222 135 65102.

Table 3 Ordering information; preferred types in **bold**

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	CATALOGUE NUMBER 2222					
				BULK PACKAGING				TAPED	
				LONG LEADS		CUT LEADS			
				FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)
6.3	470	10 \times 12	14	135 53471	5.0	135 63471	5.0	135 33471	5.0
	680	10 \times 16	15	135 53681	5.0	135 63681	5.0	135 33681	5.0
	2200	12.5 \times 20	17	135 53222	5.0	135 63222	5.0	135 33222	5.0
	6800	16 \times 31	20	135 53682	7.5	135 63682	7.5	135 33682	7.5
	10000	18 \times 31	1831	135 53103	7.5	135 63103	7.5	–	–
10	470	8 \times 15	13L	135 54471	3.5	135 84471	3.5	135 34471	5.0
	1000	12.5 \times 16	17a	135 54102	5.0	135 64102	5.0	135 34102	5.0
	1500	10 \times 30	16LL	135 54152	5.0	135 64152	5.0	–	–
	2200	12.5 \times 25	18	135 54222	5.0	135 64222	5.0	135 34222	5.0
	2200	18 \times 15	1815	135 90001	7.5	135 90002	7.5	–	–
	3300	12.5 \times 35	18LL	135 54332	5.0	135 64332	5.0	–	–
	3300	16 \times 20	19a	135 90025	7.5	135 90026	7.5	135 90042	7.5
	4700	16 \times 31	20	135 54472	7.5	135 64472	7.5	135 34472	7.5
	4700	18 \times 25	1825	135 90003	7.5	135 90004	7.5	–	–
	6800	16 \times 35	21	135 54682	7.5	135 64682	7.5	–	–
	10000	18 \times 40	23	135 54103	7.5	135 64103	7.5	–	–

R

Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

ELECTRICAL DATA (continued)**Table 4** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 105 °C (mA)	I_{RH} 100 kHz 105 °C (mA)	I_{L1} 1 min (μA)	I_{L2} 2 min (μA)	Tan δ 120 Hz	ESR 120 Hz (Ω)	Z 100 kHz 20 °C (Ω)	Z 100 kHz -10 °C (Ω)
16	220	8 × 12	13	220	400	106	35	0.16	0.96	0.33	0.86
	330	8 × 15	13L	350	500	158	53	0.16	0.64	0.23	0.60
	470	8 × 20	13LL	520	650	226	75	0.16	0.45	0.18	0.47
	680	10 × 20	16	690	860	326	110	0.16	0.31	0.14	0.36
	1000	10 × 30	16LL	920	1200	480	160	0.16	0.21	0.091	0.24
	1500	12.5 × 25	18	1200	1300	720	240	0.16	0.14	0.072	0.19
	2200	12.5 × 31	18L	1400	1500	1060	350	0.18	0.11	0.063	0.16
	2200	16 × 20	19a	1200	1400	1060	350	0.18	0.11	0.073	0.19
	4700	16 × 35	21	1800	2000	2260	750	0.22	0.062	0.046	0.12
	4700	18 × 31	1831	1800	2000	2260	750	0.22	0.062	0.046	0.12
6800	18 × 35	22	2000	2200	3260	1100	0.26	0.051	0.040	0.10	
25	220	8 × 15	13L	350	500	165	55	0.14	0.84	0.23	0.60
	470	10 × 20	16	690	860	353	120	0.14	0.40	0.14	0.36
	1000	12.5 × 25	18	1100	1300	750	250	0.14	0.19	0.071	0.18
	1500	12.5 × 31	18L	1400	1500	1125	380	0.14	0.12	0.062	0.16
	2200	12.5 × 40	1240	1800	2000	1650	550	0.16	0.10	0.044	0.11
	2200	18 × 20	1820	1400	1600	1650	550	0.16	0.10	0.060	0.16
	3300	16 × 35	21	1800	2000	2475	830	0.18	0.072	0.045	0.12
	3300	18 × 31	1831	1800	2000	2475	830	0.18	0.072	0.045	0.12
	4700	18 × 40	23	2200	2500	3525	1200	0.20	0.056	0.036	0.94
35	100	8 × 12	13	280	400	105	35	0.12	1.59	0.32	0.83
	220	8 × 20	13LL	460	650	231	77	0.12	0.72	0.18	0.47
	330	10 × 20	16	610	860	347	120	0.12	0.48	0.13	0.34
	470	10 × 30	16LL	920	1200	490	160	0.12	0.34	0.089	0.23
	680	12.5 × 25	18	1100	1300	714	240	0.12	0.23	0.070	0.18
	1000	12.5 × 31	18L	1400	1500	1050	350	0.12	0.16	0.061	0.16
	1000	16 × 20	19a	1100	1370	1050	350	0.12	0.16	0.071	0.18
	1500	12.5 × 40	1240	1800	2000	1575	530	0.12	0.11	0.043	0.11
	2200	16 × 35	21	1800	2000	2310	770	0.14	0.084	0.044	0.11
	2200	18 × 31	1831	1800	2000	2310	770	0.14	0.084	0.044	0.11
	3300	18 × 40	23	2200	2500	3465	1200	0.16	0.064	0.035	0.091

Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

ORDERING INFORMATION (continued)**Table 5** Ordering information continued; preferred types in **bold**

U _R (V)	C _R 120 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	CATALOGUE NUMBER 2222					
				BULK PACKAGING				TAPED	
				LONG LEADS		CUT LEADS		FORM TFA	F (mm)
				FORM CA	F (mm)	FORM CB	F (mm)		
16	220	8 × 12	13	135 55221	3.5	135 85221	3.5	135 35221	5.0
	330	8 × 15	13L	135 55331	3.5	135 85331	3.5	135 35331	5.0
	470	8 × 20	13LL	135 55471	3.5	135 85471	3.5	135 35471	5.0
	680	10 × 20	16	135 55681	5.0	135 65681	5.0	135 35681	5.0
	1000	10 × 30	16LL	135 55102	5.0	135 65102	5.0	–	–
	1500	12.5 × 25	18	135 55152	5.0	135 65152	5.0	135 35152	5.0
	2200	12.5 × 31	18L	135 55222	5.0	135 65222	5.0	–	–
	2200	16 × 20	19a	135 90007	7.5	135 90008	7.5	135 90043	7.5
	4700	16 × 35	21	135 55472	7.5	135 65472	7.5	–	–
	4700	18 × 31	1831	135 90009	7.5	135 90011	7.5	–	–
6800	18 × 35	22	135 55682	7.5	135 65682	7.5	–	–	
25	220	8 × 15	13L	135 56221	3.5	135 86221	3.5	135 36221	5.0
	470	10 × 20	16	135 56471	5.0	135 66471	5.0	135 36471	5.0
	1000	12.5 × 25	18	135 56102	5.0	135 66102	5.0	135 36102	5.0
	1500	12.5 × 31	18L	135 56152	5.0	135 66152	5.0	–	–
	2200	12.5 × 40	1240	135 56222	5.0	135 66222	5.0	–	–
	2200	18 × 20	1820	135 90012	7.5	135 90013	7.5	–	–
	3300	16 × 35	21	135 56332	7.5	135 66332	7.5	–	–
	3300	18 × 31	1831	135 90014	7.5	135 90015	7.5	–	–
	4700	18 × 40	23	135 56472	7.5	135 66472	7.5	–	–
	35	100	8 × 12	13	135 50101	3.5	135 80101	3.5	135 30101
220		8 × 20	13LL	135 50221	3.5	135 80221	3.5	135 30221	5.0
330		10 × 20	16	135 50331	5.0	135 60331	5.0	135 30331	5.0
470		10 × 30	16LL	135 50471	5.0	135 60471	5.0	–	–
680		12.5 × 25	18	135 50681	5.0	135 60681	5.0	135 30681	5.0
1000		12.5 × 31	18L	135 50102	5.0	135 60102	5.0	–	–
1000		16 × 20	19a	135 90016	7.5	135 90017	7.5	135 90044	7.5
1500		12.5 × 40	1240	135 50152	5.0	135 60152	5.0	–	–
2200		16 × 35	21	135 50222	7.5	135 60222	7.5	–	–
2200		18 × 31	1831	135 90018	7.5	135 90019	7.5	–	–
3300		18 × 40	23	135 50332	7.5	135 60332	7.5	–	–

R

Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

ELECTRICAL DATA (continued)**Table 6** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 105 °C (mA)	I_{RH} 100 kHz 105 °C (mA)	I_{L1} 1 min (μA)	I_{L2} 2 min (μA)	Tan δ 120 Hz	ESR 120 Hz (Ω)	Z 100 kHz 20 °C (Ω)	Z 100 kHz -10 °C (Ω)
50	100	10 × 16	15	450	640	150	50	0.10	1.33	0.20	0.52
	220	10 × 25	16L	730	1000	330	110	0.10	0.60	0.11	0.29
	330	12.5 × 20	17	790	1100	495	170	0.10	0.40	0.081	0.22
	470	12.5 × 25	18	1100	1300	705	240	0.10	0.28	0.068	0.19
	470	18 × 15	1815	1000	1300	705	240	0.10	0.28	0.074	0.19
	1000	16 × 31	20	1500	1800	1500	500	0.10	0.13	0.050	0.13
	1500	16 × 40	21L	2100	2300	2250	750	0.10	0.088	0.035	0.091
	2200	18 × 40	23	2200	2500	3300	1100	0.12	0.072	0.034	0.091
63	47	8 × 12	13	220	300	89	30	0.08	2.26	0.56	1.5
	220	12.5 × 20	17	630	890	416	140	0.08	0.48	0.16	0.42
	470	16 × 25	19	1200	1400	888	300	0.08	0.23	0.091	0.25
	680	16 × 31	20	1400	1800	1285	430	0.08	0.16	0.065	0.18
	1000	16 × 40	21L	1800	2200	1890	630	0.08	0.11	0.049	0.13
100	22	8 × 12	13	120	310	66	22	0.07	4.22	0.53	1.4
	100	12.5 × 20	17	630	890	300	100	0.07	0.93	0.15	0.40
	220	16 × 25	19	1000	1400	660	220	0.07	0.42	0.086	0.23
	330	16 × 31	20	1300	1800	990	330	0.07	0.28	0.062	0.17
	330	18 × 25	1825	1200	1700	990	330	0.07	0.28	0.074	0.20
	470	16 × 40	21L	1800	2200	1410	470	0.07	0.20	0.047	0.13
	680	18 × 40	23	1900	2400	2040	680	0.07	0.14	0.043	0.12

Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

ORDERING INFORMATION (continued)**Table 7** Ordering information continued; preferred types in **bold**

U _R (V)	C _R 120 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	CATALOGUE NUMBER 2222					
				BULK PACKAGING				TAPED	
				LONG LEADS		CUT LEADS			
				FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)
50	100	10 × 16	15	135 51101	5.0	135 61101	5.0	135 31101	5.0
	220	10 × 25	16L	135 51221	5.0	135 61221	5.0	135 31221	5.0
	330	12.5 × 20	17	135 51331	5.0	135 61331	5.0	135 31331	5.0
	470	12.5 × 25	18	135 51471	5.0	135 61471	5.0	135 31471	5.0
	470	18 × 15	1815	135 90021	7.5	135 90022	7.5	–	–
	1000	16 × 31	20	135 51102	7.5	135 61102	7.5	135 31102	7.5
	1500	16 × 40	21L	135 51152	7.5	135 61152	7.5	–	–
	2200	18 × 40	23	135 51222	7.5	135 61222	7.5	–	–
63	47	8 × 12	13	135 58479	3.5	135 88479	3.5	135 38479	5.0
	220	12.5 × 20	17	135 58221	5.0	135 68221	5.0	135 38221	5.0
	470	16 × 25	19	135 58471	7.5	135 68471	7.5	135 38471	7.5
	680	16 × 31	20	135 58681	7.5	135 68681	7.5	135 38681	7.5
	1000	16 × 40	21L	135 58102	7.5	135 68102	7.5	–	–
100	22	8 × 12	13	135 59229	3.5	135 89229	3.5	135 39229	5.0
	100	12.5 × 20	17	135 59101	5.0	135 69101	5.0	135 39101	5.0
	220	16 × 25	19	135 59221	7.5	135 69221	7.5	–	–
	330	16 × 31	20	135 59331	7.5	135 69331	7.5	–	–
	330	18 × 25	1825	135 90023	7.5	135 90024	7.5	–	–
	470	16 × 40	21L	135 59471	7.5	135 69471	7.5	–	–
	680	18 × 40	23	135 59681	7.5	135 69681	7.5	–	–

Aluminum electrolytic capacitors

Radial, Low Impedance

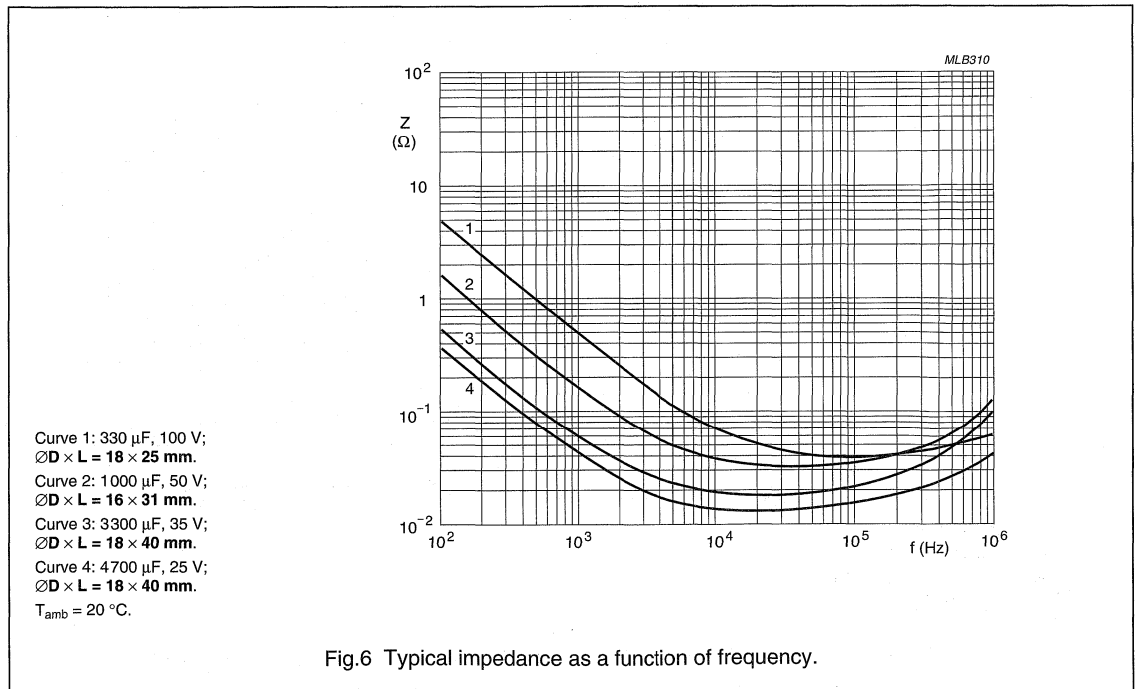
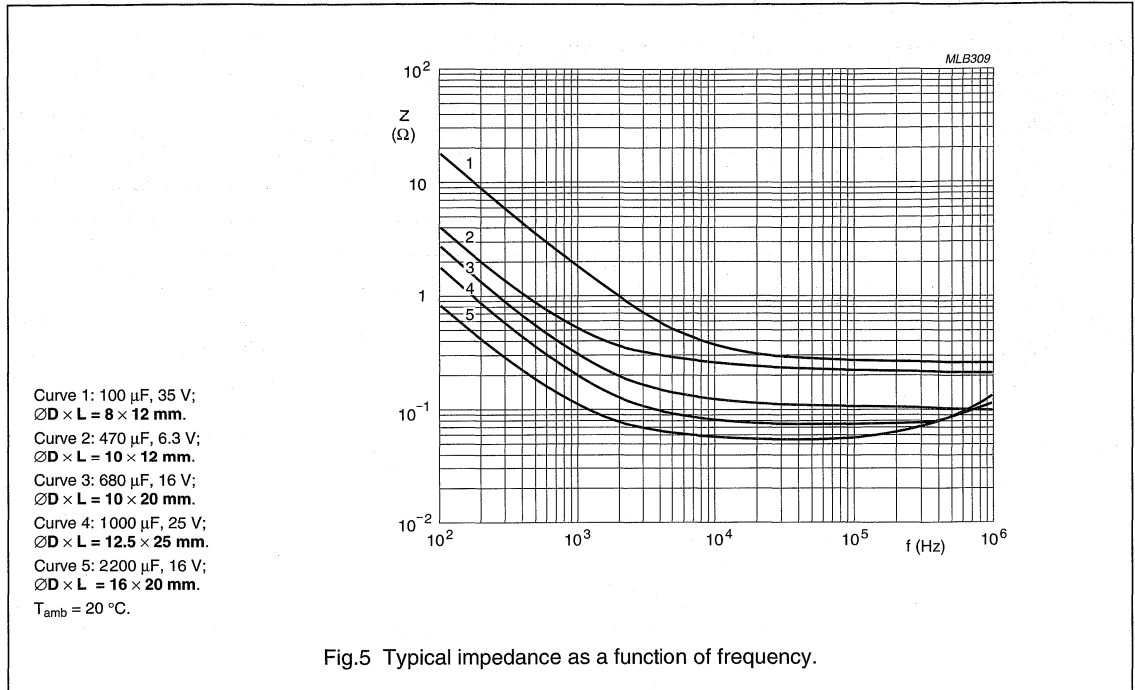
135 RLI

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.03 C_R \times U_R$
	after 2 minutes at U_R	$I_{L2} \leq 0.01 C_R \times U_R$
Capacitance (C)		
Ratio of capacitance at 120 Hz	$U_R = 6.3 V$	$C_{-55^\circ C} / C_{20^\circ C} \geq 0.7$
	$U_R = 10 \text{ to } 100 V$	$C_{-55^\circ C} / C_{20^\circ C} \geq 0.8$
Impedance (Z)		
Ratio of impedance at 120 Hz		$Z_{-55^\circ C} / Z_{20^\circ C} \leq 3$

Aluminum electrolytic capacitors
Radial, Low Impedance

135 RLI



Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

RIPPLE CURRENT AND USEFUL LIFE

Table 8 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER			
	22 μ F	33 to 330 μ F	470 to 1 000 μ F	>1 000 μ F
50	0.4	0.6	0.65	0.8
120	0.5	0.7	0.8	0.9
300	0.6	0.8	0.9	0.95
1000	0.8	0.9	0.98	0.98
10000	0.9	0.95	1.0	1.0
100000	1.0	1.0	1.0	1.0

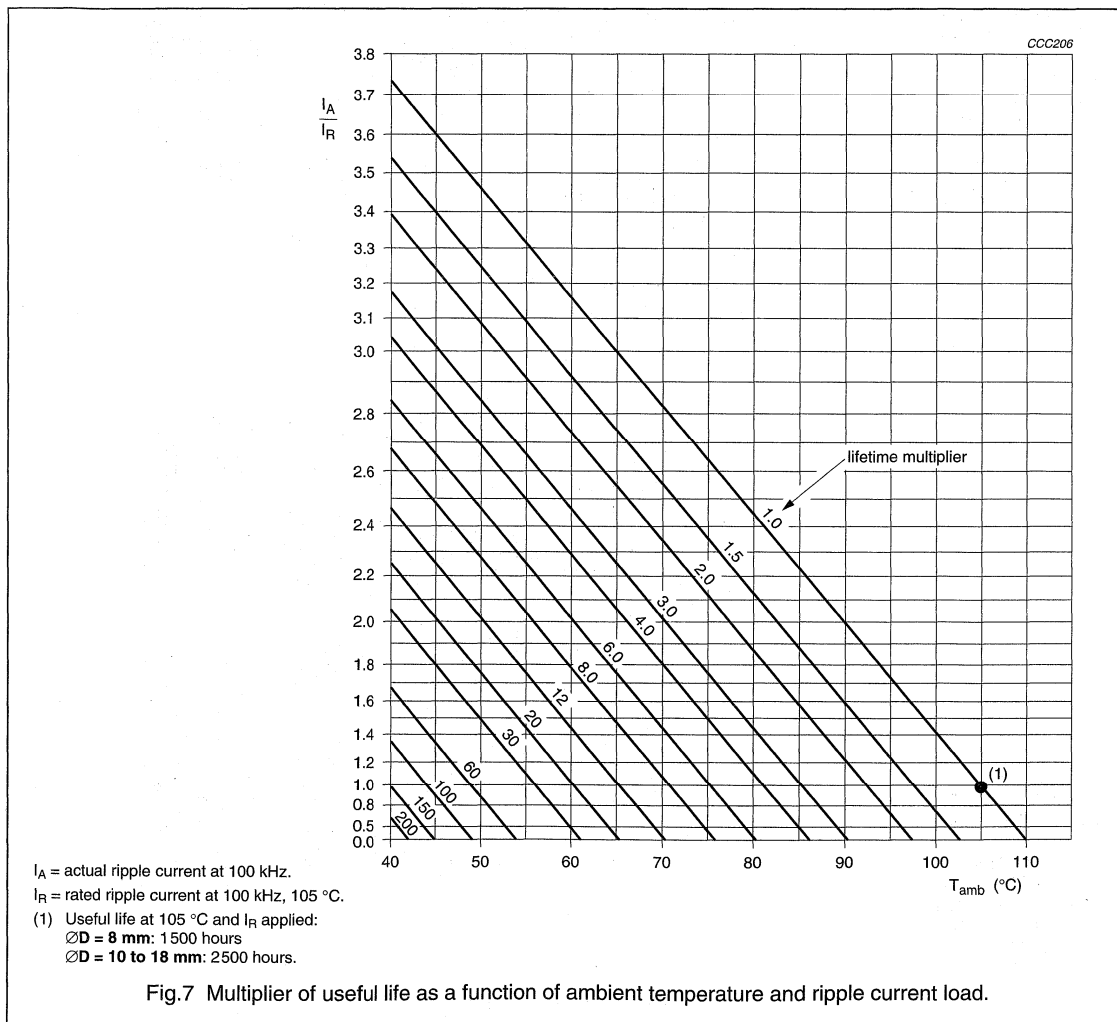


Fig.7 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial, Low Impedance

135 RLI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 9 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ °C}$; U_R applied; $\varnothing D = 8\text{ mm}$: 1000 hours $\varnothing D = 10\text{ to }18\text{ mm}$: 2000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; $\varnothing D = 8\text{ mm}$: 1500 hours $\varnothing D = 10\text{ to }18\text{ mm}$: 2500 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130 300, subclause 4.17	$T_{amb} = 105\text{ °C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$

R

Aluminum electrolytic capacitors Radial Miniature Long-Life

048 RML

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume
- Very long useful life: 3000 to 4000 hours at 105 °C, high reliability.

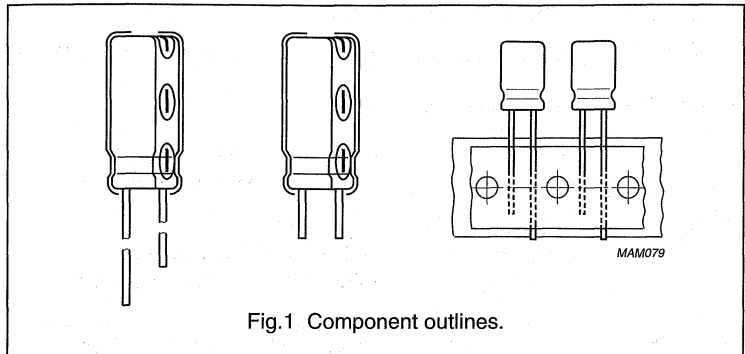
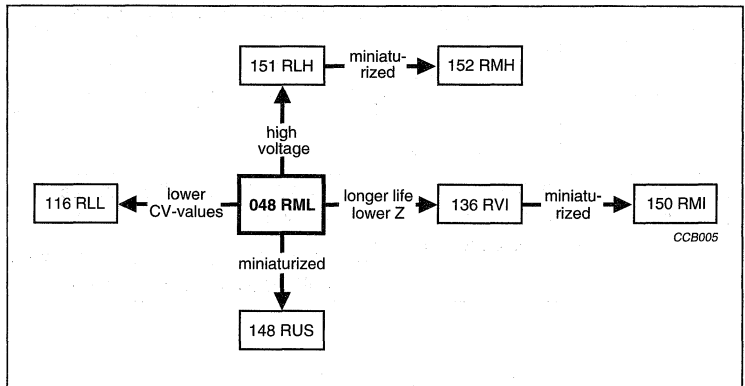


Fig. 1 Component outlines.

APPLICATIONS

- EDP, telecommunication, industrial, automotive and audio-video
- Smoothing, filtering, buffering in SMPS, timing
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	100 to 10000 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	6.3 to 63 V
Category temperature range	-40 to +105 °C
Endurance test at 105 °C	2000 hours
Useful life at 105 °C: case $\varnothing D = 10$ and 12.5 mm	3000 hours
case $\varnothing D = 16$ and 18 mm	4000 hours
Useful life at 40 °C, $1.6 \times I_R$ applied: case $\varnothing D = 10$ and 12.5 mm	200000 hours
case $\varnothing D = 16$ and 18 mm	260000 hours
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	6.3	10	16	25	35	40	50	63
100 ⁽¹⁾	–	–	–	–	–	–	–	10 × 12
220	–	–	–	–	10 × 12	–	10 × 16	10 × 20
330	–	–	–	–	–	–	–	12.5 × 20
470	–	–	10 × 12	10 × 16	10 × 20	–	12.5 × 20	12.5 × 25
1000	–	10 × 16	10 × 20	12.5 × 20	12.5 × 25	–	16 × 25	16 × 31
2200	–	12.5 × 20	12.5 × 25	16 × 25	16 × 31	16 × 35	18 × 35	18 × 35
3300	–	12.5 × 25	16 × 25	16 × 31	18 × 35	18 × 35	18 × 35	–
4700	–	16 × 25	16 × 31	18 × 35	18 × 35	–	–	–
6800	16 × 25	16 × 31	16 × 35	–	–	–	–	–
10000	16 × 35	18 × 35	18 × 35	–	–	–	–	–

Note

1. For lower CV-values see data sheet "116 RLL".

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

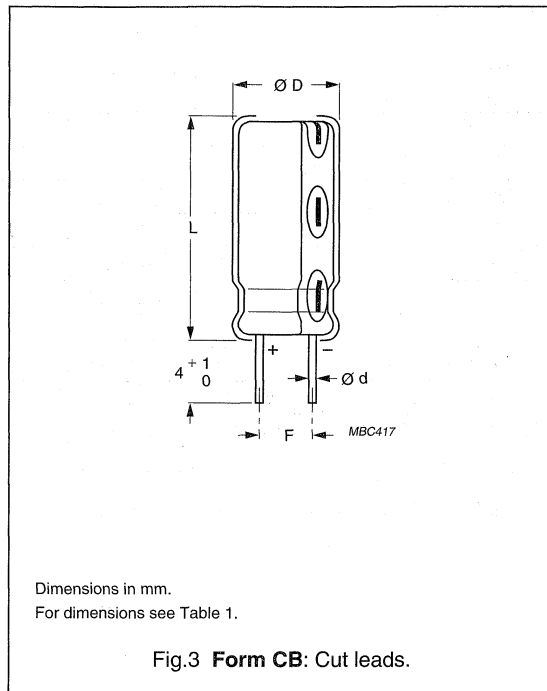
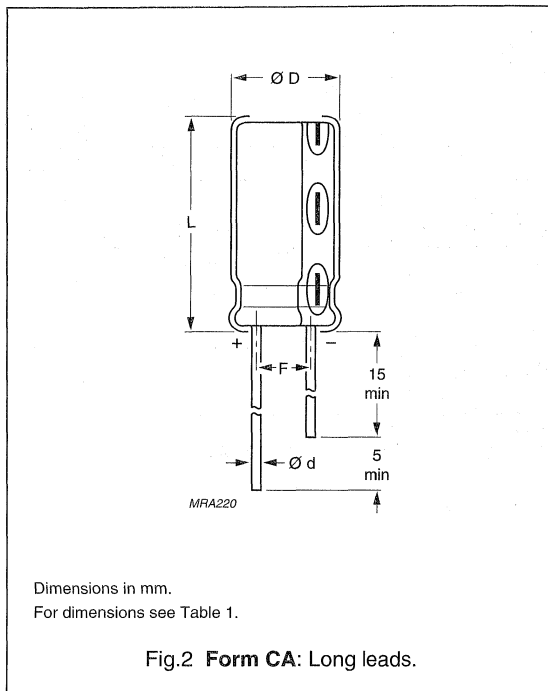


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

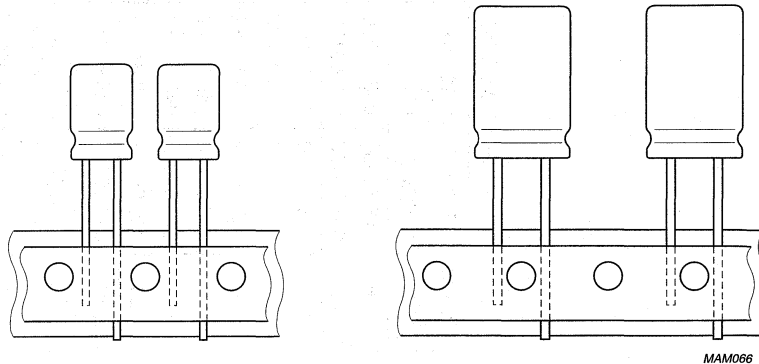
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES PER BOX		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11.5	100	100	–
18 × 35	22	0.8	18.5	37.5	7.5 ± 0.5	≈ 14.5	100	100	–

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

Taped products



Form TFA

Case $\varnothing D \times L \leq 16 \times 31$ mm.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.4 Taped in box (ammopack).

MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (048)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

R

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

Ordering example

Electrolytic capacitor 048 series

2200 $\mu\text{F}/16\text{ V}; \pm 20\%$ Nominal case size: $\varnothing 12.5 \times 25\text{ mm}$; Form TFA

Catalogue number: 2222 048 35222.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20\text{ }^{\circ}\text{C}$,
 $P = 86\text{ to }106\text{ kPa}$, $\text{RH} = 45\text{ to }75\%$.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, $105\text{ }^{\circ}\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\text{Tan } \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\text{tan } \delta_{\text{max}}$ and C_R)
Z	max. impedance at 10 kHz or 100 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz $105\text{ }^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	Z 100 kHz (m Ω)	CATALOGUE NUMBER 2222						
											BULK PACKAGING		TAPED				
				FORM CA	FORM CB	FORM TFA											
6.3	6800	16×25	19	1350	430	89	0.32	75	60	56	048 53682	048 63682	048 33682	048 33682	048 33682	048 33682	048 33682
	10000	16×35	21	1700	630	130	0.40	64	46	42	048 53103	048 63103	048 33103	048 33103	048 33103	048 33103	048 33103
10	1000	10×16	15	470	100	23	0.19	300	220	180	048 54102	048 64102	048 34102	048 34102	048 34102	048 34102	048 34102
	2200	12.5×20	17	800	220	47	0.21	150	110	90	048 54222	048 64222	048 34222	048 34222	048 34222	048 34222	048 34222
	3300	12.5×25	18	1000	330	69	0.23	110	76	68	048 54332	048 64332	048 34332	048 34332	048 34332	048 34332	048 34332
	4700	16×25	19	1270	470	97	0.25	85	61	56	048 54472	048 64472	048 34472	048 34472	048 34472	048 34472	048 34472
	6800	16×31	20	1550	680	140	0.29	68	49	45	048 54682	048 64682	048 34682	048 34682	048 34682	048 34682	048 34682
	10000	18×35	22	1870	1000	200	0.37	59	40	36	048 54103	048 64103	048 34103	048 34103	048 34103	048 34103	048 34103
16	470	10×12	14	360	78	18	0.16	540	340	250	048 55471	048 65471	048 35471	048 35471	048 35471	048 35471	048 35471
	1000	10×20	16	600	160	35	0.16	250	160	140	048 55102	048 65102	048 35102	048 35102	048 35102	048 35102	048 35102
	2200	12.5×25	18	1000	360	73	0.18	130	82	70	048 55222	048 65222	048 35222	048 35222	048 35222	048 35222	048 35222
	3300	16×25	19	1220	530	110	0.20	100	61	56	048 55332	048 65332	048 35332	048 35332	048 35332	048 35332	048 35332
	4700	16×31	20	1500	760	150	0.22	75	49	45	048 55472	048 65472	048 35472	048 35472	048 35472	048 35472	048 35472
	6800	16×35	21	1690	1100	220	0.26	61	46	42	048 55682	048 65682	048 35682	048 35682	048 35682	048 35682	048 35682
	10000	18×35	22	1980	1600	320	0.34	54	38	34	048 55103	048 65103	048 35103	048 35103	048 35103	048 35103	048 35103

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 105 °C (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	Z 100 kHz (m Ω)	CATALOGUE NUMBER 2222			
											BULK PACKAGING			TAPED
											FORM CA	FORM CB	FORM TFA	
25	470	10 × 16	15	440	120	27	0.14	470	240	180	048 56471	048 66471	048 36471	
	1000	12.5 × 20	17	720	250	53	0.14	220	120	100	048 56102	048 66102	048 36102	
	2200	16 × 25	19	1120	550	110	0.16	120	63	56	048 56222	048 66222	048 36222	
	3300	16 × 31	20	1450	830	170	0.18	87	50	45	048 56332	048 66332	048 36332	
	4700	18 × 35	22	1720	1200	240	0.20	68	40	36	048 56472	048 66472	—	
35	220	10 × 12	14	310	80	18	0.12	870	360	280	048 50221	048 60221	048 30221	
	470	10 × 20	16	500	170	36	0.12	410	170	150	048 50471	048 60471	048 30471	
	1000	12.5 × 25	18	900	350	73	0.12	190	90	75	048 50102	048 60102	048 30102	
	2200	16 × 31	20	1340	770	160	0.14	100	52	45	048 50222	048 60222	048 30222	
	3300	18 × 35	22	1600	1200	230	0.16	77	42	36	048 50332	048 60332	—	
	4700	18 × 35	22	1950	1600	330	0.18	61	40	34	048 50472	048 60472	—	
40	2200	16 × 35	21	1500	880	180	0.13	94	48	45	048 57222	048 67222	—	
	3300	18 × 35	22	1600	1300	270	0.15	72	40	36	048 57332	048 67332	—	
50	220	10 × 16	15	340	110	25	0.10	720	300	250	048 51221	048 61221	048 31221	
	470	12.5 × 20	17	620	240	50	0.10	340	130	110	048 51471	048 61471	048 31471	
	1000	16 × 25	19	1030	500	100	0.10	160	70	60	048 51102	048 61102	048 31102	
	2200	18 × 35	22	1500	1100	220	0.12	87	50	50	048 51222	048 61222	—	
	3300	18 × 35	22	1900	1700	330	0.14	68	40	40	048 51332	048 61332	—	
63	100	10 × 12	14	240	66	16	0.09	1400	550	310	048 58101	048 68101	048 38101	
	220	10 × 20	16	400	140	31	0.09	650	250	200	048 58221	048 68221	048 38221	
	330	12.5 × 20	17	550	210	45	0.09	430	170	120	048 58331	048 68331	048 38331	
	470	12.5 × 25	18	700	300	62	0.09	300	110	80	048 58471	048 68471	048 38471	
	1000	16 × 31	20	1150	630	130	0.09	140	55	49	048 58102	048 68102	048 38102	
	2200	18 × 35	22	1600	1400	280	0.11	80	45	45	048 58222	048 68222	—	

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

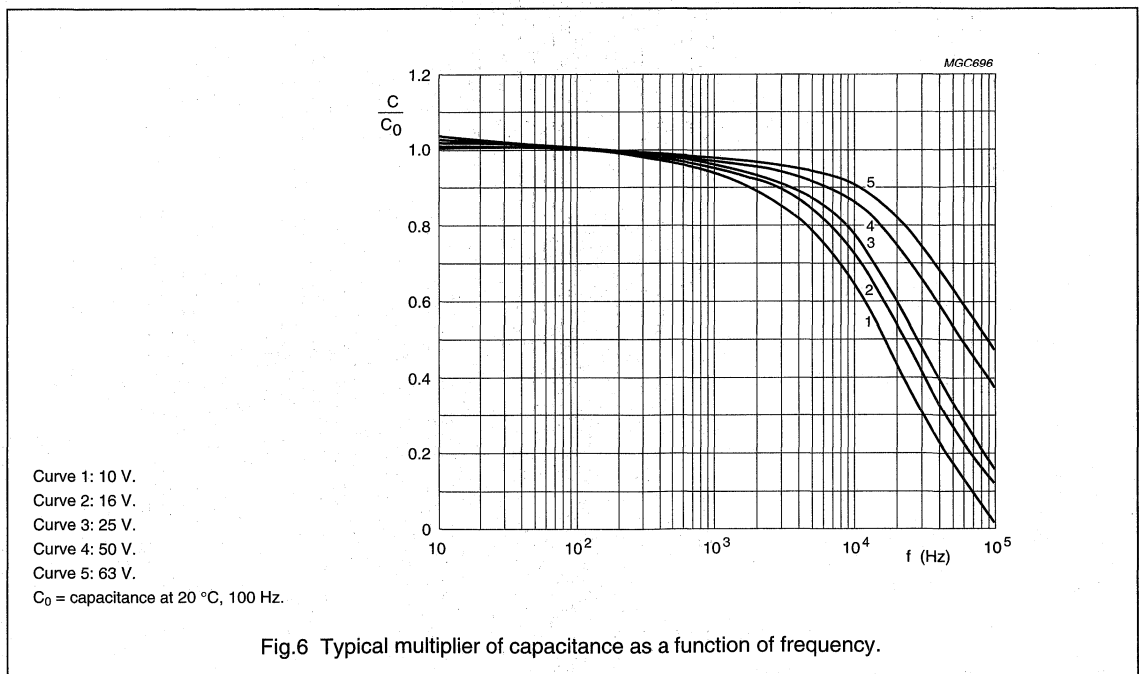
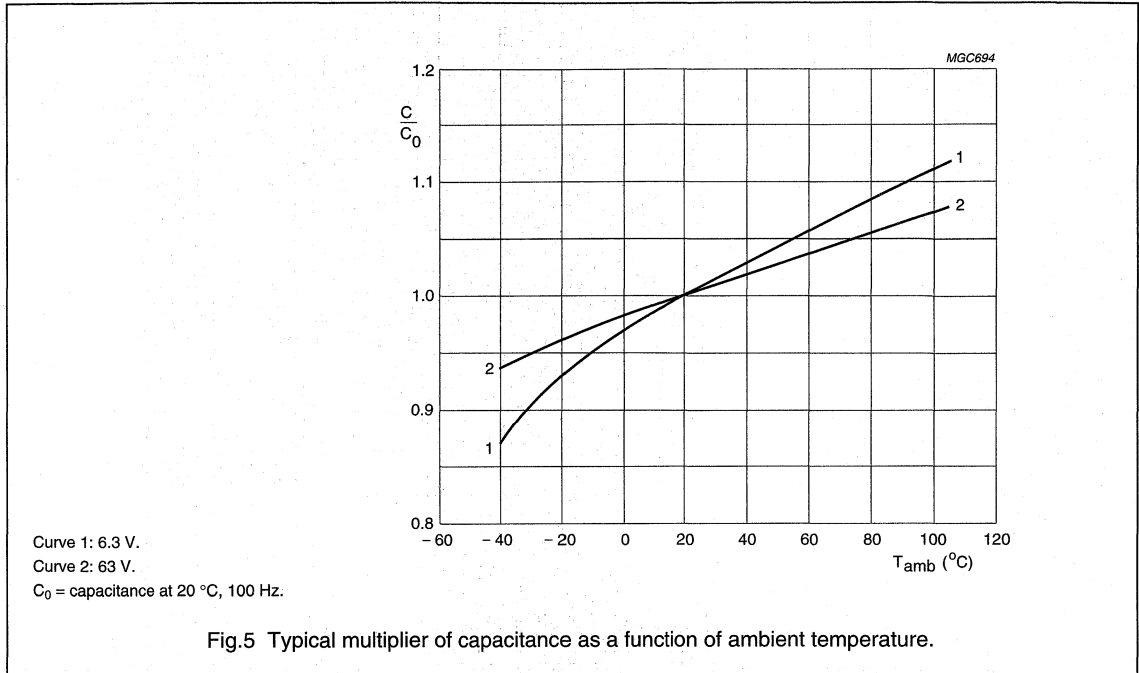
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu A$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu A$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

Aluminum electrolytic capacitors
Radial Miniature Long-Life

048 RML

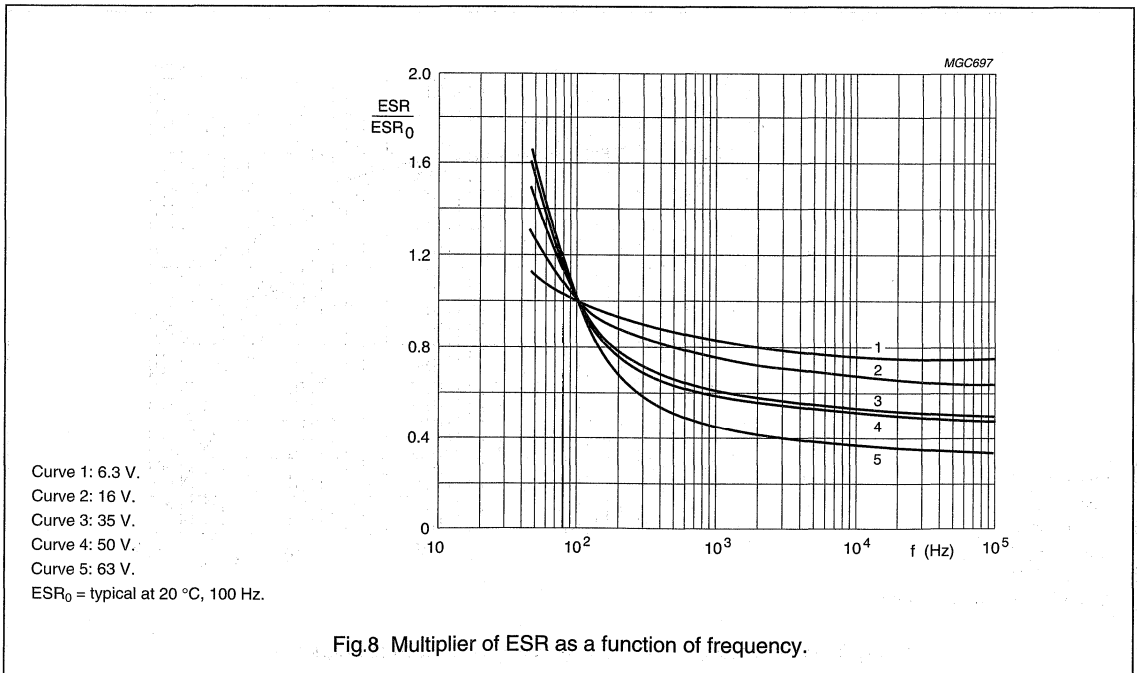
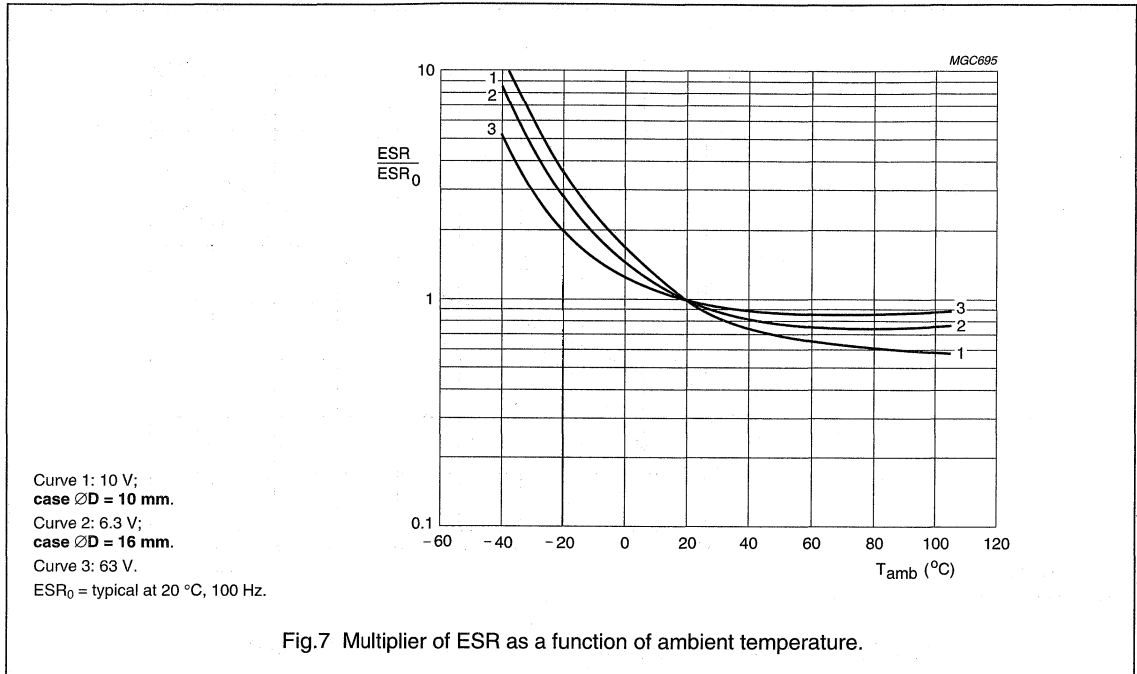
Capacitance (C)



Aluminum electrolytic capacitors Radial Miniature Long-Life

048 RML

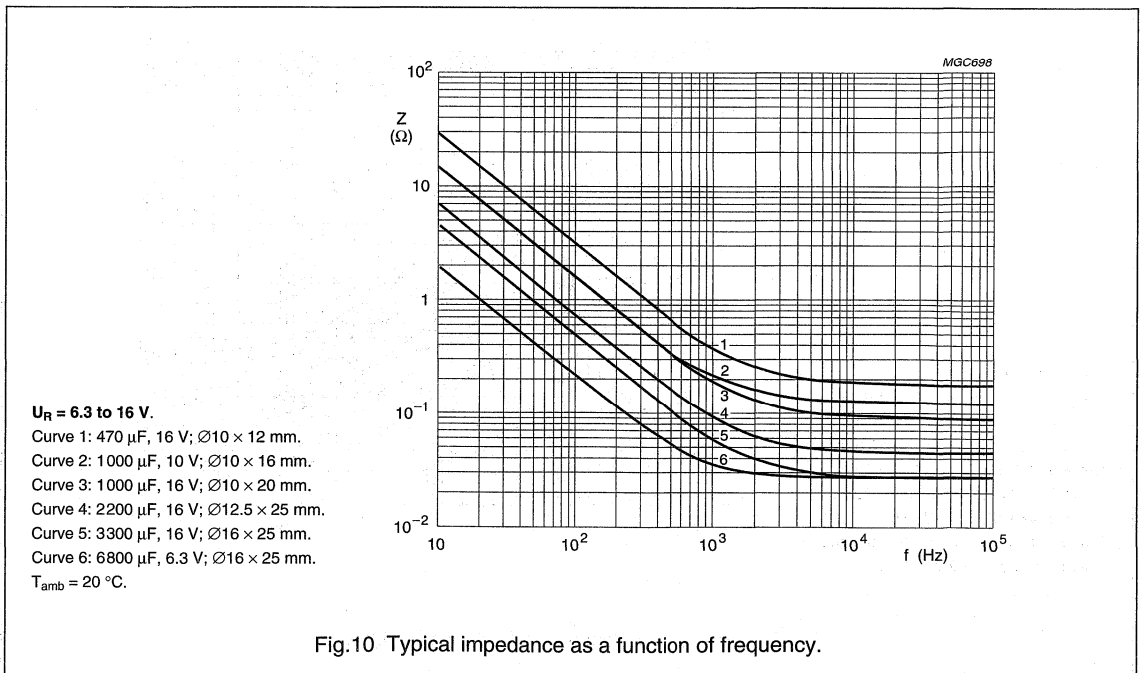
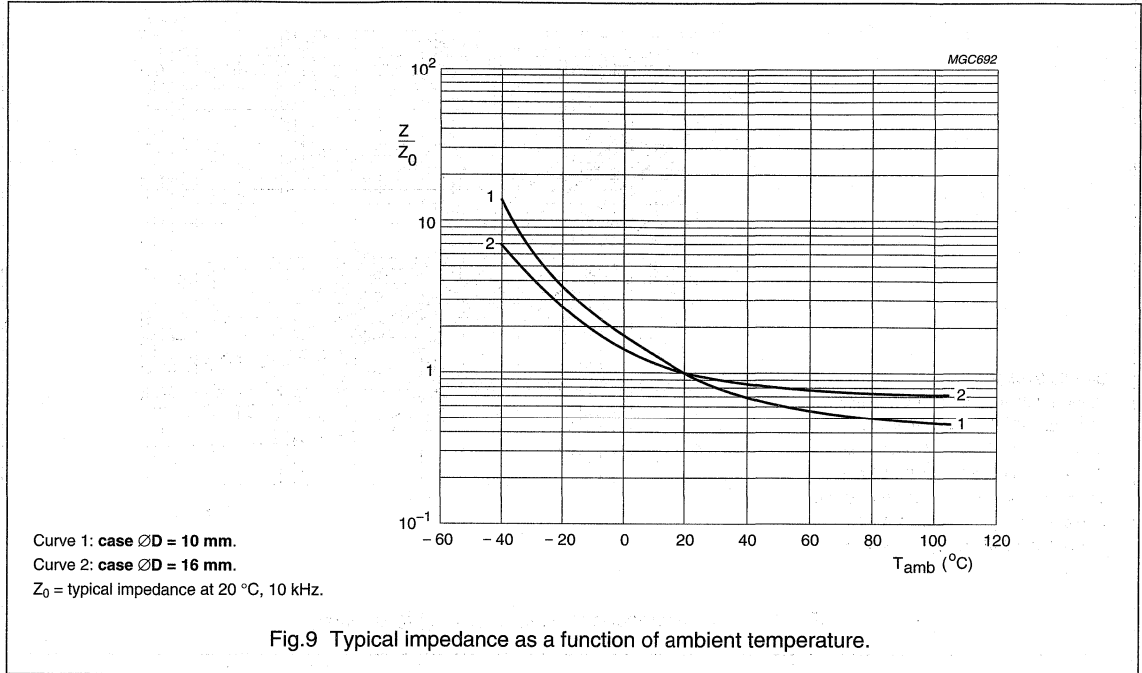
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors Radial Miniature Long-Life

048 RML

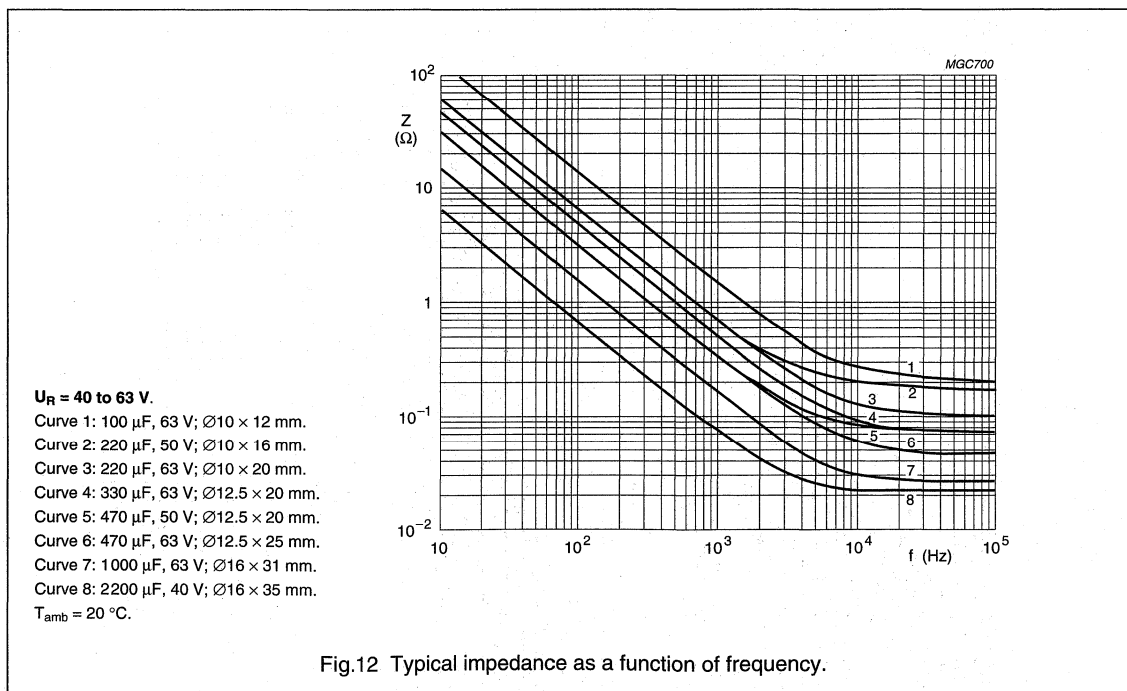
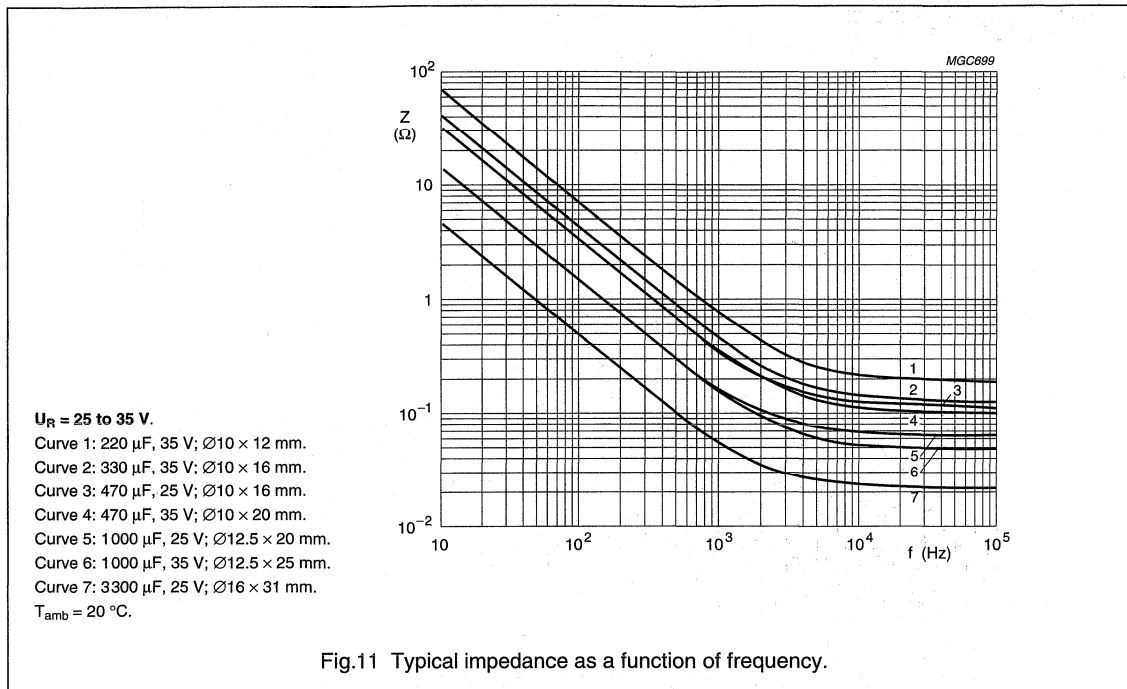
Impedance (Z)



Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML



Aluminum electrolytic capacitors Radial Miniature Long-Life

048 RML

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 6.3$ to 25 V	$U_R = 35$ and 40 V	$U_R = 50$ and 63 V
50	0.95	0.85	0.80
100	1.00	1.00	1.00
300	1.07	1.20	1.25
1000	1.12	1.30	1.40
3000	1.15	1.35	1.50
≥ 10000	1.20	1.40	1.60

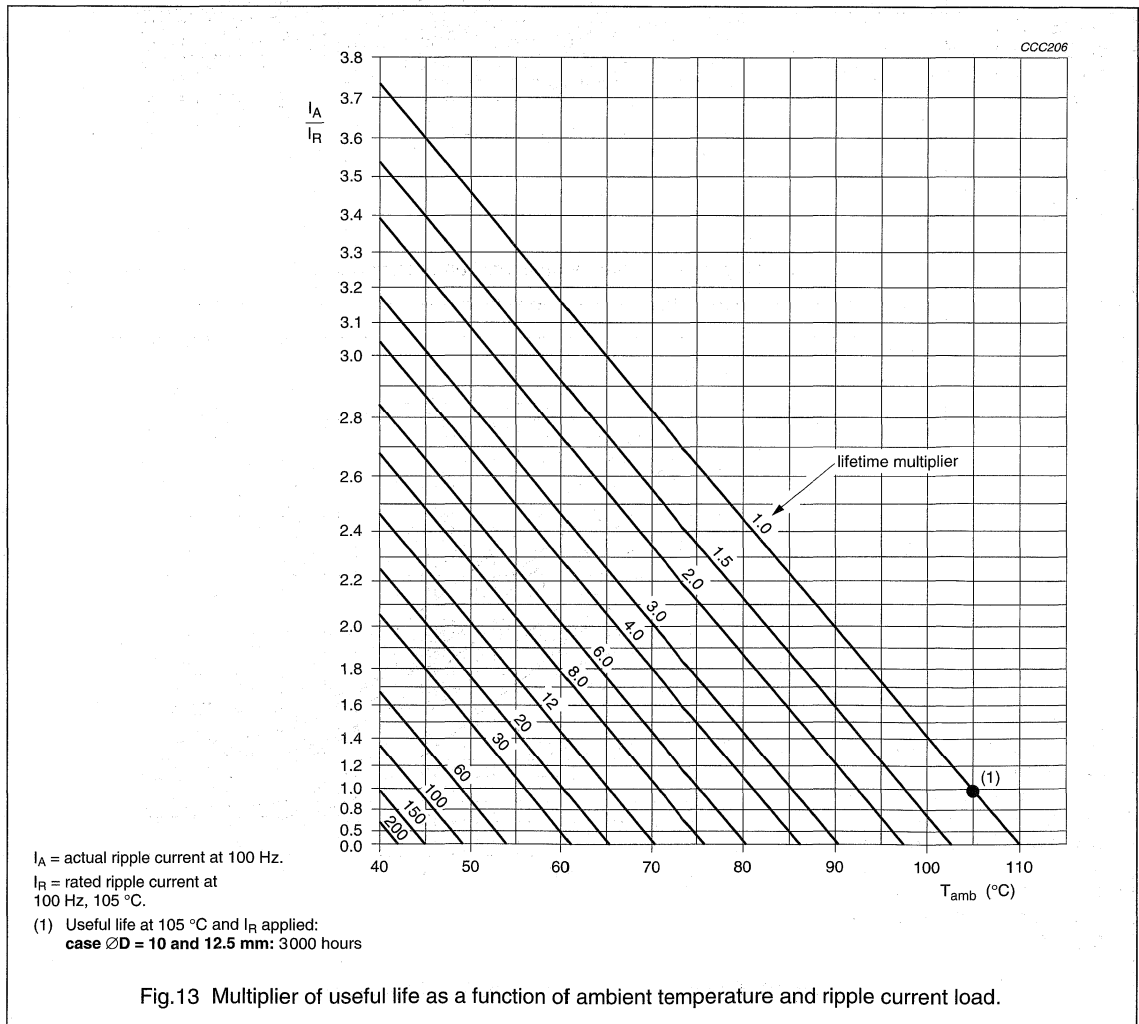


Fig.13 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Miniature Long-Life

048 RML

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; 2000 hours	$U_R = 6.3\text{ V}$; $\Delta C/C: +15/-30\%$ $U_R > 6.3\text{ V}$; $\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; case $\varnothing D = 10$ and 12.5 mm : 3000 hours; case $\varnothing D = 16$ and 18 mm : 4000 hours	$U_R = 6.3\text{ V}$; $\Delta C/C: +45/-50\%$ $U_R > 6.3\text{ V}$; $\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$U_R = 6.3\text{ V}$; $\Delta C/C: +15/-30\%$ $U_R > 6.3\text{ V}$; $\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue vinyl sleeve
- Pressure relief
- Charge and discharge proof
- Miniaturized, ultra high CV-product per unit volume
- Long useful life: 3000 to 4000 hours at 105 °C, high reliability

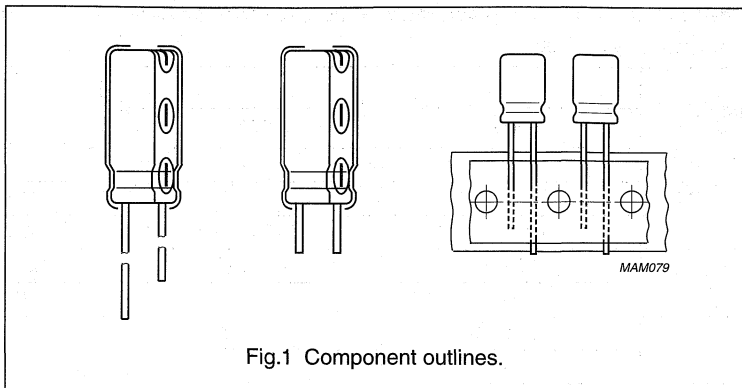
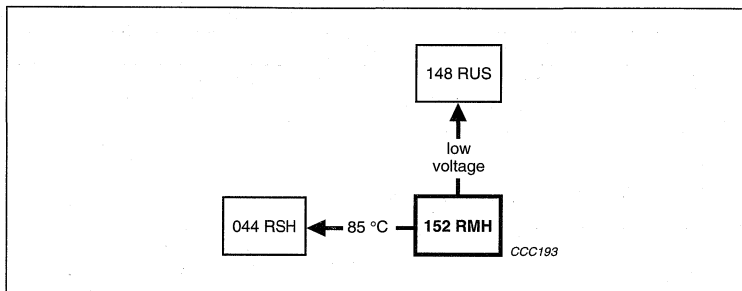


Fig.1 Component outlines.

APPLICATIONS

- High-reliability and professional applications
- Lighting, monitors, consumer electronics, general industrial
- Filtering of high voltages in power supplies.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{\text{nom}} \times L_{\text{nom}}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	4.7 to 220 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	200 to 450 V
Category temperature range	-40 to +105 °C
Endurance test at 105 °C	2000 hours
Useful life at 105 °C:	
case $\varnothing D = 10$ and 12.5 mm	3000 hours
case $\varnothing D = 16$ and 18 mm	4000 hours
Useful life at 40 °C, $1.6 \times I_R$ applied:	
case $\varnothing D = 10$ and 12.5 mm	200000 hours
case $\varnothing D = 16$ and 18 mm	260000 hours
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF) ⁽¹⁾	U_R (V)			
	200	250	400	450
4.7	–	–	10 × 16 ⁽²⁾	10 × 20
6.8	–	–	10 × 16	12.5 × 20
10	10 × 12	10 × 16	10 × 20	12.5 × 20
22	10 × 16	12.5 × 20	12.5 × 25	16 × 25
	–	–	16 × 20	18 × 20
33	10 × 20	12.5 × 20	16 × 20	16 × 35
	–	–	–	18 × 25
47	12.5 × 20	12.5 × 25	16 × 25	18 × 35
	–	16 × 20	–	–
68	12.5 × 25	–	16 × 35	–
100	16 × 20	16 × 25	18 × 35	–
220	16 × 35	–	–	–

Notes

- Other values are available on request.
- Also available in case size 10 × 12.

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

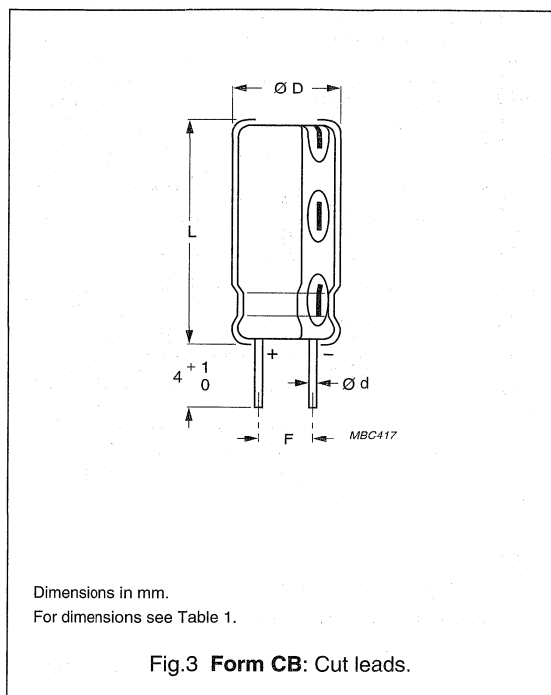
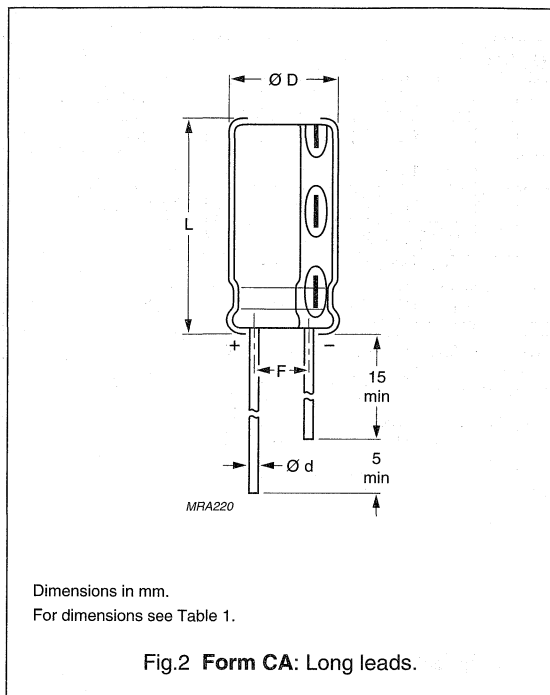


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

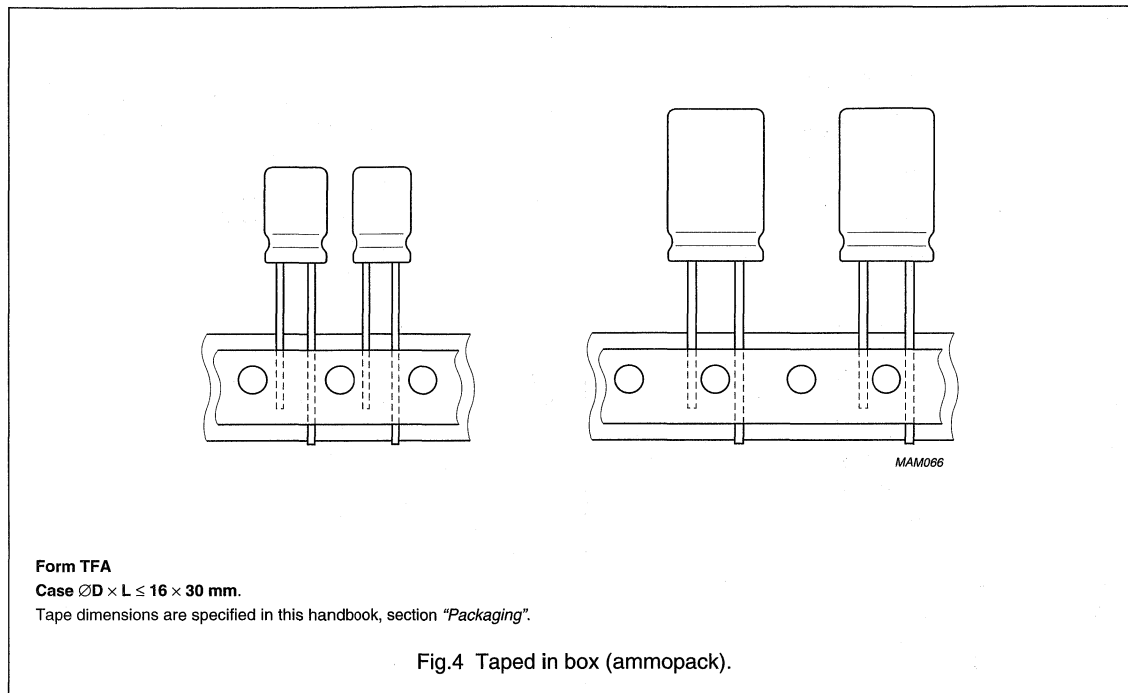
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES PER BOX		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 20	19a	0.8	16.5	22.0	7.5 ± 0.5	≈ 6.0	250	250	250
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11.0	100	100	—
18 × 20	1820	0.8	18.5	22.0	7.5 ± 0.5	≈ 8.0	100	100	—
18 × 25	1825	0.8	18.5	27.0	7.5 ± 0.5	≈ 10.0	100	100	—
18 × 35	22	0.8	18.5	37.5	7.5 ± 0.5	≈ 14.5	100	100	—

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

Taped products



MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (152)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

Ordering example

Electrolytic capacitor 152 series

4.7 $\mu\text{F}/400\text{ V}$; $\pm 20\%$

Nominal case size: $\varnothing 10 \times 16\text{ mm}$; Form TFA

Catalogue number: 2222 152 36478.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20\text{ }^\circ\text{C}$,
 $P = 86\text{ to }106\text{ kPa}$, $RH = 45\text{ to }75\%$.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz; tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz; 105 $^\circ\text{C}$
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

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 105 $^\circ\text{C}$ (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz +20 $^\circ\text{C}$ (Ω)	CATALOGUE NUMBER 2222		
										BULK PACKAGING		FORM TFA
										FORM CA	FORM CB	FORM TFA
200	10	10 x 12	14	85	130	60	0.12	19.1	6.3	152 52109	152 62109	152 32109
	22	10 x 16	15	120	202	96	0.12	8.7	3.2	152 52229	152 62229	152 32229
	33	10 x 20	16	150	268	129	0.12	5.8	2.3	152 52339	152 62339	152 32339
	47	12.5 x 20	17	240	352	171	0.12	4.1	0.9	152 52479	152 62479	152 32479
	68	12.5 x 25	18	310	478	234	0.12	2.8	0.6	152 52689	152 62689	152 32689
	100	16 x 20	19a	340	670	330	0.12	1.9	0.4	152 52101	152 62101	152 32101
	220	16 x 35	21	630	1390	690	0.12	0.9	0.2	152 52221	152 62221	—
250	10	10 x 16	15	105	145	68	0.12	19.1	6.3	152 53109	152 63109	152 33109
	22	12.5 x 20	17	180	235	113	0.12	8.7	2.3	152 53229	152 63229	152 33229
	33	12.5 x 20	17	180	318	154	0.12	5.8	1.5	152 53339	152 63339	152 33339
	47	12.5 x 25	18	310	423	206	0.12	4.1	0.9	152 53479	152 63479	152 33479
	47	16 x 20	19a	310	423	206	0.12	4.1	0.9	152 93475	152 93476	152 93473
	100	16 x 25	19	340	820	405	0.12	1.9	0.4	152 53101	152 63101	152 33101

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{L1} 1 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz +20 °C (Ω)	CATALOGUE NUMBER 2222		
										BULK PACKAGING		FORM TFA
										FORM CA	FORM CB	
400	4.7	10 × 16	15	65	126	58	0.15	50.8	18.0	152 56478	152 66478	152 36478
	6.8	10 × 16	15	65	152	71	0.15	35.1	12.0	152 56688	152 66688	152 36688
	10	10 × 20	16	80	190	90	0.15	23.9	9.0	152 56109	152 66109	152 36109
	22	12.5 × 25	18	150	334	162	0.15	10.9	3.8	152 56229	152 66229	152 36229
	22	16 × 20	19a	150	334	162	0.15	10.9	3.8	152 96226	152 96226	152 96223
	33	16 × 20	19a	190	466	228	0.15	7.2	2.6	152 56339	152 66339	152 36339
	47	16 × 25	19	240	634	312	0.15	5.1	2.0	152 56479	152 66479	152 36479
	68	16 × 35	21	310	886	138	0.15	3.5	1.7	152 56689	152 66689	-
	100	18 × 35	22	380	1270	630	0.15	2.4	0.9	152 56101	152 66101	-
450	4.7	10 × 20	16	65	133	62	0.20	67.8	20.0	152 57478	152 67478	152 37478
	6.8	12.5 × 20	17	80	162	76	0.20	46.8	16.0	152 57688	152 67688	152 37688
	10	12.5 × 20	17	90	205	98	0.20	31.8	10.0	152 57109	152 67109	152 37109
	22	16 × 25	19	150	367	179	0.20	14.5	4.6	152 57229	152 67229	152 37229
	22	18 × 20	1820	150	367	179	0.20	14.5	4.6	152 97225	152 97226	-
	33	16 × 35	21	200	516	253	0.20	9.7	3.4	152 57339	152 67339	-
	33	18 × 25	1825	200	516	253	0.20	9.7	3.4	152 97335	152 97336	-
	47	18 × 35	22	260	705	347	0.20	6.8	2.0	152 57479	152 67479	-

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

Additional electrical data

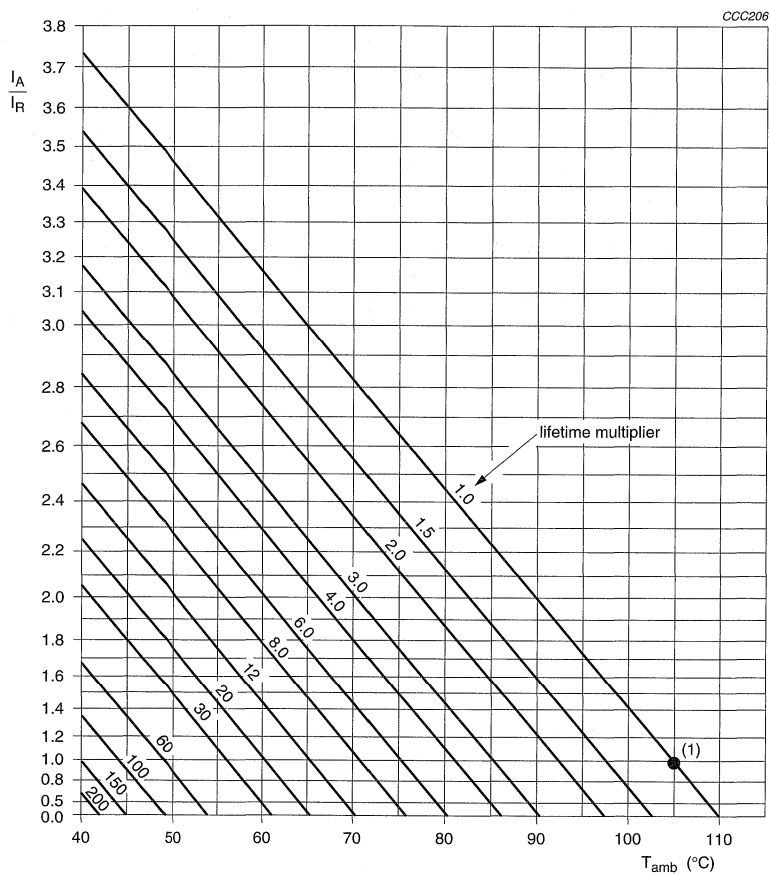
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	$U_R = 200$ to 250 V	$U_s \leq 1.15 \times U_R$
	$U_R = 400$ to 450 V	$U_s \leq 1.10 \times U_R$
Reverse voltage		$U_{rev} \leq 1$ V
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.03C_R \times U_R + 70 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.015C_R \times U_R + 30 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10$ mm	typ. 16 nH
	case $\varnothing D \geq 12.5$ mm	typ. 18 nH

R

Aluminum electrolytic capacitors Radial Miniature, High voltage

152 RMH

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: see Table 4.

Fig.5 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER	
	$U_R \leq 250$ V	$U_R > 250$ V
50	0.75	0.75
100	1.00	1.00
300	1.50	1.30
1000	2.00	1.60
3000	2.20	1.90
10000	2.50	2.20
≥ 100000	3.00	2.50

Table 4 Endurance test duration and useful life as a function of case size; see Fig.5

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	ENDURANCE TEST at 105 °C (hours)	USEFUL LIFE at 105 °C (hours)
10 × 12	14	2000	3000
10 × 16	15	2000	3000
10 × 20	16	2000	3000
12.5 × 20	17	2000	3000
12.5 × 25	18	2000	3000
16 × 20	19a	2000	4000
16 × 25	19	2000	4000
16 × 35	21	2000	4000
18 × 20	1820	2000	4000
18 × 25	1825	2000	4000
18 × 35	22	2000	4000

Aluminum electrolytic capacitors

Radial Miniature, High voltage

152 RMH

SPECIFIC TESTS AND REQUIREMENTS

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

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; 2000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; for test duration see Table 4	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$
Reverse voltage	IEC 60384-4/ EN130300 subclause 4.15	$T_{amb} = 105\text{ }^{\circ}\text{C}$: 125 hours at $U = -1\text{ V}$, followed by 125 hours at U_R	$\Delta C/C: \pm 15\%$ $I_{L5} \leq \text{spec. limit}$ $\tan \delta \leq \text{spec. limit}$

Aluminum electrolytic capacitors

Radial Long-Life, High voltage

151 RLH

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue vinyl sleeve
- Pressure relief
- Charge and discharge proof
- Long useful life:
3000 to 4000 hours at 105 °C, high reliability
- High rated voltage, up to 450 V.

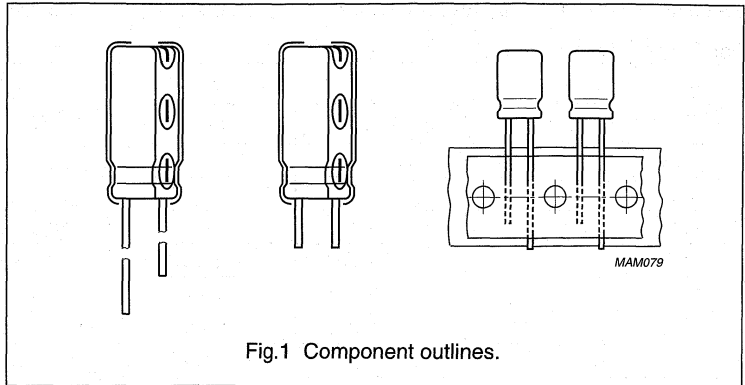
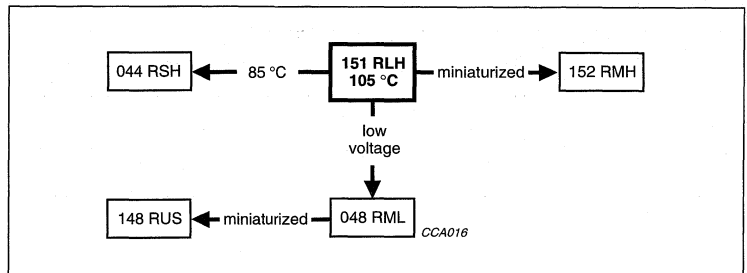


Fig.1 Component outlines.

APPLICATIONS

- High-reliability and professional applications
- Lighting, monitors, consumer electronics, general industrial
- Filtering of high voltages in power supplies.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	1 to 220 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	160 to 450 V
Category temperature range	-40 to +105 °C
Endurance test at 105 °C	2000 hours
Useful life at 105 °C: case $\varnothing D = 10$ and 12.5 mm case $\varnothing D = 16$ and 18 mm	3000 hours 4000 hours
Useful life at 40 °C, $1.6 \times I_R$ applied: case $\varnothing D = 10$ and 12.5 mm case $\varnothing D = 16$ and 18 mm	200000 hours 260000 hours
Shelf life at 0 V, 105 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

Aluminum electrolytic capacitors

Radial Long-Life, High voltage

151 RLH

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	160	200	250	350	400	450
1.0	–	–	–	–	–	10 × 12
2.2	–	–	–	–	10 × 12	10 × 16
3.3	–	–	–	10 × 12	10 × 16	10 × 20
4.7	–	10 × 12	10 × 12	10 × 16	10 × 20	12.5 × 20
10	10 × 16	10 × 16	10 × 20	12.5 × 20	12.5 × 20	16 × 20
22	10 × 20	10 × 20	12.5 × 25	12.5 × 25	16 × 25	16 × 31
	–	–	16 × 20	16 × 20	18 × 20	18 × 25
33	12.5 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	18 × 35
	–	–	16 × 20	–	18 × 25	–
47	12.5 × 25	12.5 × 25	16 × 25	16 × 35	18 × 31	–
	16 × 20	16 × 20	18 × 20	18 × 31	–	–
100	16 × 25	16 × 31	16 × 31	–	–	–
	18 × 20	18 × 25	18 × 25	–	–	–
220	18 × 35	–	–	–	–	–

Aluminum electrolytic capacitors

Radial Long-Life, High voltage

151 RLH

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

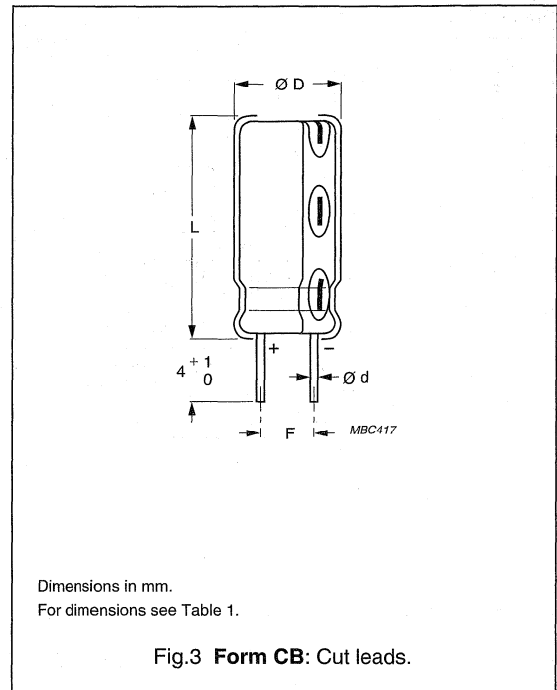
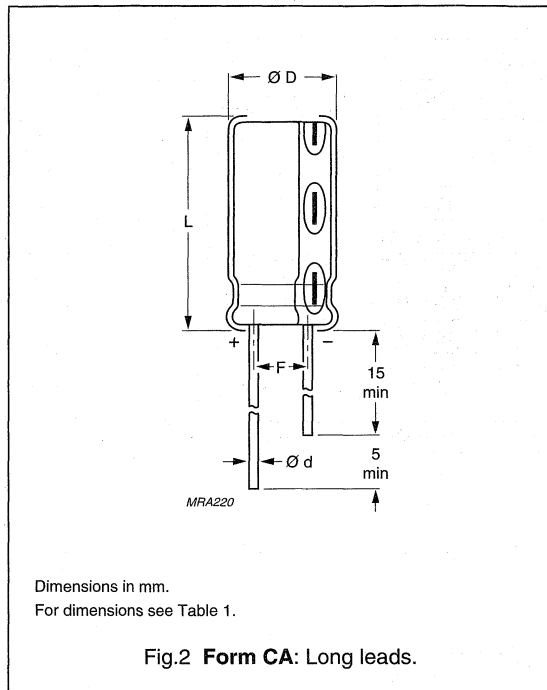


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

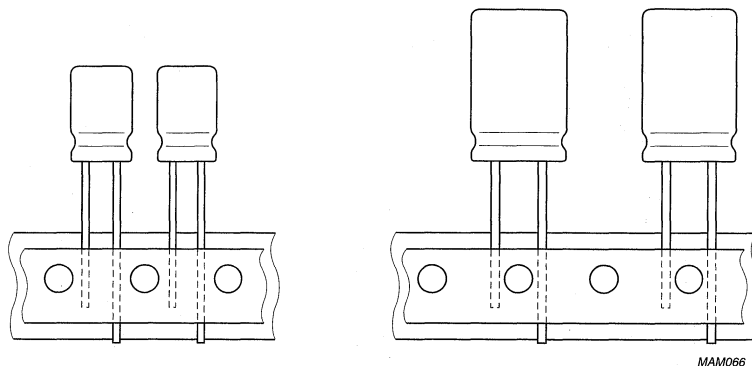
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES PER BOX		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 20	19a	0.8	16.5	22.0	7.5 ± 0.5	≈ 6.0	250	250	250
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11.0	100	100	—
18 × 20	1820	0.8	18.5	22.0	7.5 ± 0.5	≈ 8.0	100	100	—
18 × 25	1825	0.8	18.5	27.0	7.5 ± 0.5	≈ 10.0	100	100	—
18 × 31	1831	0.8	18.5	33.5	7.5 ± 0.5	≈ 12.5	100	100	—
18 × 35	22	0.8	18.5	37.5	7.5 ± 0.5	≈ 14.5	100	100	—

Aluminum electrolytic capacitors

Radial Long-Life, High voltage

151 RLH

Taped products



Form TFA

Case $\varnothing D \times L \leq 16 \times 31$ mm.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.4 Taped in box (ammopack).

MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (151)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

Aluminum electrolytic capacitors Radial Long-Life, High voltage

151 RLH

Ordering example

Electrolytic capacitor 151 series

4.7 $\mu\text{F}/400\text{ V}$; $\pm 20\%$

Nominal case size: $\varnothing 10 \times 20\text{ mm}$; Form TFA

Catalogue number: 2222 151 36478.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20\text{ }^\circ\text{C}$, $P = 86\text{ to }106\text{ kPa}$, $\text{RH} = 45\text{ to }75\%$.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, $105\text{ }^\circ\text{C}$
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

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 105 $^\circ\text{C}$ (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222			
										BULK PACKAGING			FORM TFA
										FORM CA	FORM CB	FORM TFA	
160	10	10 x 16	15	95	118	54	0.12	19	6.3	151 51109	151 61109	151 31109	
	22	10 x 20	16	145	176	83	0.12	9	3.2	151 51229	151 61229	151 31229	
	33	12.5 x 20	17	190	228	109	0.12	6	2.3	151 51339	151 61339	151 31339	
	47	12.5 x 25	18	280	296	143	0.12	4	1.7	151 51479	151 61479	151 31479	
	47	16 x 20	19a	280	296	143	0.12	4	1.7	151 91475	151 91476	151 91473	
	100	16 x 25	19	380	550	270	0.12	2	1.1	151 51101	151 61101	151 31101	
	100	18 x 20	1820	380	550	270	0.12	2	1.1	151 91105	151 91106	-	
	220	18 x 35	22	630	1126	558	0.12	0.9	0.8	151 51221	151 61221	-	
200	4.7	10 x 12	14	60	96	43	0.12	41	13.0	151 52478	151 62478	151 32478	
	10	10 x 16	15	95	130	60	0.12	19	6.3	151 52109	151 62109	151 32109	
	22	10 x 20	16	145	202	96	0.12	9	3.2	151 52229	151 62229	151 32229	
	33	12.5 x 20	17	190	268	129	0.12	6	2.3	151 52339	151 62339	151 32339	
	47	12.5 x 25	18	280	352	171	0.12	4	1.7	151 52479	151 62479	151 32479	
	47	16 x 20	19a	280	352	171	0.12	4	1.7	151 92475	151 92476	151 92473	
	100	16 x 31	20	410	670	330	0.12	2	1.1	151 52101	151 62101	151 32101	
	100	18 x 25	1825	410	670	330	0.12	2	1.1	151 92105	151 92106	-	

Aluminum electrolytic capacitors

Radial Long-Life, High voltage

151 RLH

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{L1} 1 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222		
										BULK PACKAGING		
										FORM CA	FORM CB	TAPED FORM TFA
250	4.7	10 × 12	14	60	105	48	0.12	41	13.0	151 53478	151 63478	151 33478
	10	10 × 20	16	105	145	68	0.12	19	6.3	151 53109	151 63109	151 33109
	22	12.5 × 25	18	180	235	113	0.12	9	3.2	151 53229	151 63229	151 33229
	22	16 × 20	19a	180	235	113	0.12	9	3.2	151 93225	151 93226	151 93223
	33	12.5 × 25	18	250	318	154	0.12	6	2.3	151 53339	151 63339	151 33339
	33	16 × 20	19a	250	318	154	0.12	6	2.3	151 93335	151 93336	151 93333
	47	16 × 25	19	300	423	206	0.12	4	1.7	151 53479	151 63479	151 33479
	47	18 × 20	1820	300	423	206	0.12	4	1.7	151 93475	151 93476	-
	100	16 × 31	20	410	820	405	0.12	2	1.1	151 53101	151 63101	151 33101
	100	18 × 25	1825	410	820	405	0.12	2	1.1	151 93105	151 93106	-
350	3.3	10 × 12	14	50	105	47	0.15	72	22.0	151 55338	151 65338	151 35338
	4.7	10 × 16	15	65	119	55	0.15	51	16.0	151 55478	151 65478	151 35478
	10	12.5 × 20	17	120	175	83	0.15	24	7.6	151 55109	151 65109	151 35109
	22	12.5 × 25	18	180	301	146	0.15	11	3.8	151 55229	151 65229	151 35229
	22	16 × 20	19a	180	301	146	0.15	11	3.8	151 95225	151 95226	151 95223
	33	16 × 25	19	210	417	203	0.15	7	2.6	151 55339	151 65339	151 35339
	47	16 × 35	21	300	564	277	0.15	5	2.0	151 55479	151 65479	-
	47	18 × 31	1831	300	564	277	0.15	5	2.0	151 95475	151 95476	-
	2.2	10 × 12	14	40	93	41	0.15	109	33.0	151 56228	151 66228	151 36228
	3.3	10 × 16	15	50	110	50	0.15	72	22.0	151 56338	151 66338	151 36338
400	4.7	10 × 20	16	70	126	58	0.15	51	16.0	151 56478	151 66478	151 36478
	10	12.5 × 20	17	120	190	90	0.15	24	7.6	151 56109	151 66109	151 36109
	22	16 × 25	19	200	334	162	0.15	11	3.8	151 56229	151 66229	151 36229
	22	18 × 20	1820	200	334	162	0.15	11	3.8	151 96225	151 96226	-
	33	16 × 31	20	245	466	228	0.15	7	2.6	151 56339	151 66339	151 36339
	33	18 × 25	1825	245	466	228	0.15	7	2.6	151 96335	151 96336	-
	47	18 × 31	1831	300	634	312	0.15	5	2.0	151 56479	151 66479	-

Aluminum electrolytic capacitors

Radial Long-Life, High voltage

151 RLH

U _R (V)	C _R 100 Hz (µF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{L1} 1 min (µA)	I _{L5} 5 min (µA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222		
										BULK PACKAGING		FORM TFA
										FORM CA	FORM CB	
450	1.0	10 × 12	14	30	67	29	0.2	318	94.0	151 57108	151 67108	151 37108
	2.2	10 × 16	15	45	99	45	0.2	145	43.0	151 57228	151 67228	151 37228
	3.3	10 × 20	16	65	115	52	0.2	96	29.0	151 57338	151 67338	151 37338
	4.7	12.5 × 20	17	80	133	62	0.2	68	20.0	151 57478	151 67478	151 37478
	10	16 × 20	19a	140	205	98	0.2	32	10.0	151 57109	151 67109	151 37109
	22	16 × 31	20	220	367	179	0.2	14	4.6	151 57229	151 67229	151 37229
	22	18 × 25	1825	220	367	179	0.2	14	4.6	151 97225	151 97226	-
	33	18 × 35	22	280	516	253	0.2	10	3.4	151 57339	151 67339	-

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	IEC 60384-4, subclause 4.14: U _R = 160 to 250 V U _R = 350 to 400 V	U _s ≤ 1.15 × U _R U _s ≤ 1.10 × U _R
Reverse voltage	IEC 60384-4, subclause 4.15	U _{rev} ≤ 1 V
Current		
Leakage current	after 1 minute at U _R : CV ≤ 1000 µC CV > 1000 µC after 5 minutes at U _R : CV ≤ 1000 µC CV > 1000 µC	I _{L1} ≤ 0.06C _R × U _R + 40 µA I _{L1} ≤ 0.03C _R × U _R + 70 µA I _{L5} ≤ 0.03C _R × U _R + 15 µA I _{L5} ≤ 0.015C _R × U _R + 30 µA
Inductance		
Equivalent series inductance (ESL)	case ∅D = 10 mm case ∅D ≥ 12.5 mm	typ. 16 nH typ. 18 nH



Aluminum electrolytic capacitors

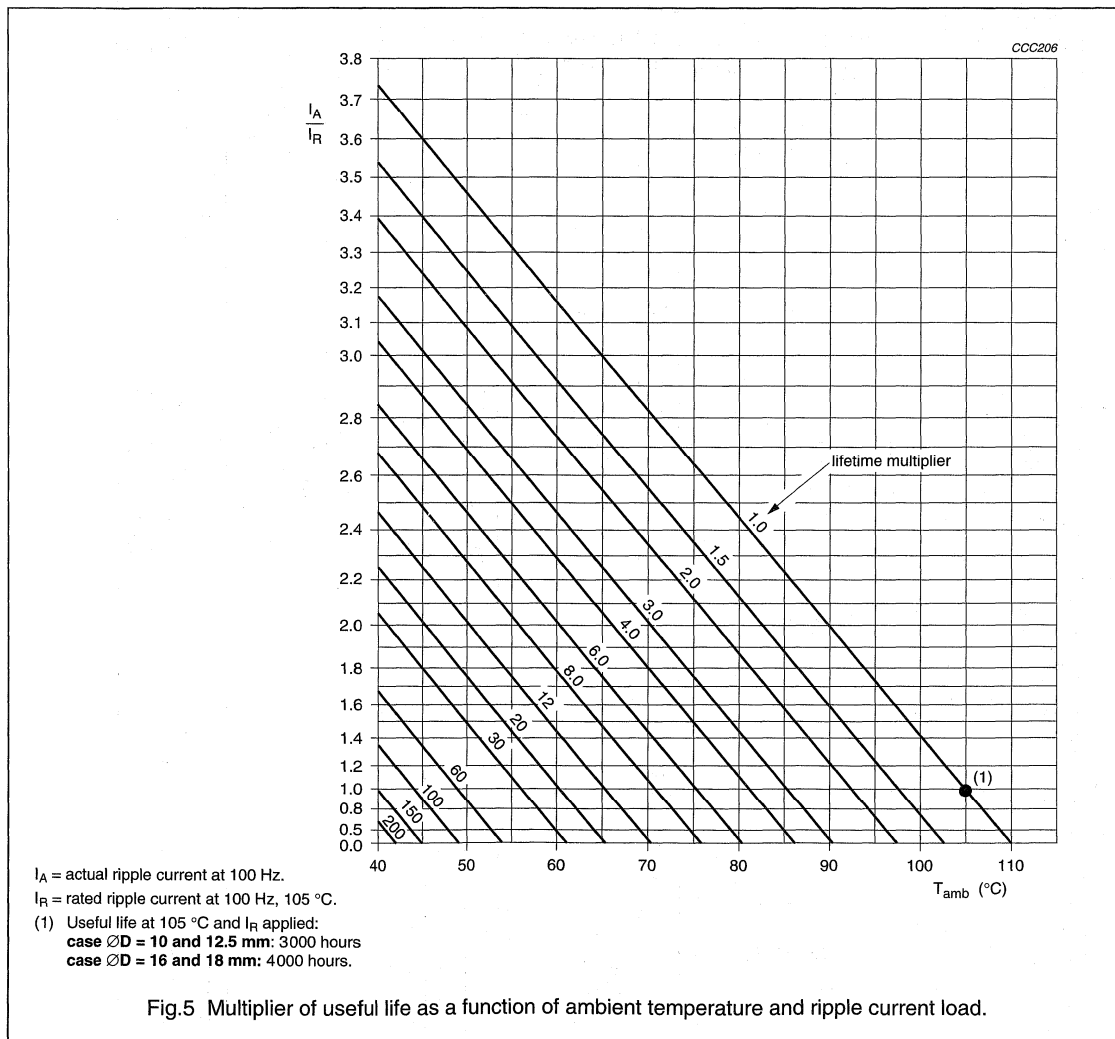
Radial Long-Life, High voltage

151 RLH

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.75
100	1.00
300	1.20
1000	1.35
3000	1.45
≥ 10000	1.50



Aluminum electrolytic capacitors

Radial Long-Life, High voltage

151 RLH

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.15	$T_{amb} = 105\text{ °C}$; U_R applied; 2000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; case $\varnothing D = 10$ and 12.5 mm: 3000 hours; case $\varnothing D = 16$ and 18 mm: 4000 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

R

Aluminum electrolytic capacitors

Radial Standard Long-Life

046 RSL

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Very long useful life: 3000 to 4000 hours at 105 °C, high reliability
- High ripple current capability, low impedance, low ESR.

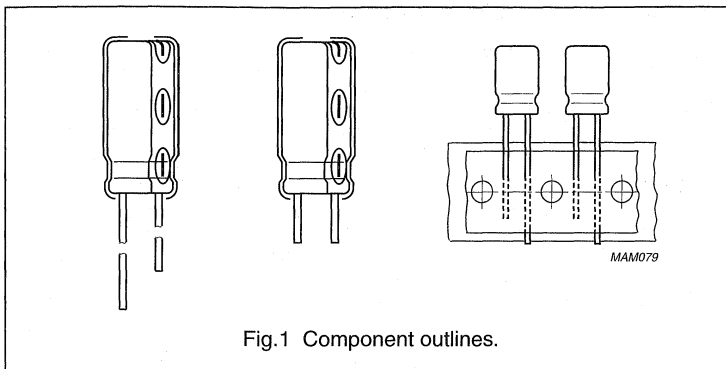
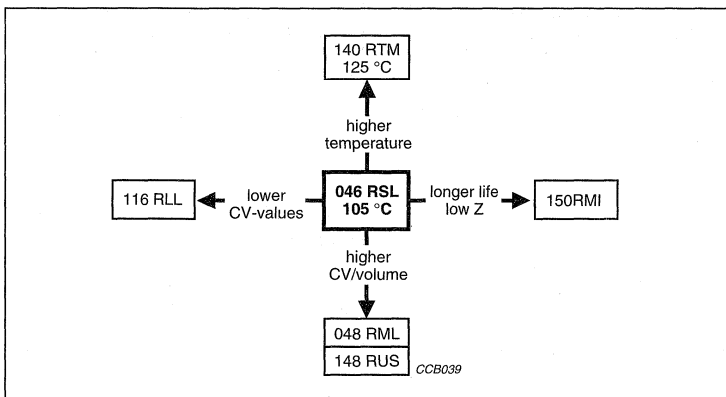


Fig.1 Component outlines.

APPLICATIONS

- Power conversion, EDP, telecommunication, industrial and audio-video
- Smoothing, filtering, buffering in SMPS, timing.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 40
Rated capacitance range, C_R	22 to 10000 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	6.3 to 63 V
Category temperature range	-40 to +105 °C
Endurance test at 105 °C	2000 hours
Useful life at 105 °C: case $\varnothing D = 10$ and 12.5 mm case $\varnothing D = 16$ and 18 mm	3000 hours 4000 hours
Useful life at 40 °C, $1.6 \times I_R$ applied: case $\varnothing D = 10$ and 12.5 mm case $\varnothing D = 16$ and 18 mm	200000 hours 260000 hours
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

Aluminum electrolytic capacitors

Radial Standard Long-Life

046 RSL

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	6.3	10	16	25	35	40	50	63
22 ⁽¹⁾	–	–	–	–	–	–	–	10 × 12
47	–	–	–	–	–	–	–	10 × 12
100	–	–	–	–	–	10 × 12	10 × 16	10 × 20
220	–	–	10 × 12	–	10 × 16	10 × 20	12.5 × 20	12.5 × 25
330	–	10 × 12	10 × 16	–	10 × 20	12.5 × 20	12.5 × 25	16 × 25
470	10 × 12	10 × 16	10 × 20	–	12.5 × 20	12.5 × 25	–	16 × 25
1000	10 × 20	12.5 × 20	12.5 × 25	12.5 × 25	16 × 25	–	16 × 31	18 × 35
2200	12.5 × 25	–	16 × 25	16 × 31	16 × 35	18 × 35	18 × 40	–
3300	16 × 25	–	16 × 31	18 × 35	–	18 × 40	–	–
4700	16 × 31	16 × 35	18 × 35	18 × 40	–	–	–	–
6800	16 × 35	18 × 35	18 × 40	–	–	–	–	–
10 000	18 × 35	18 × 40	–	–	–	–	–	–

Note

1. For lower CV-values see data sheet "116 RLL".

Aluminum electrolytic capacitors

Radial Standard Long-Life

046 RSL

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

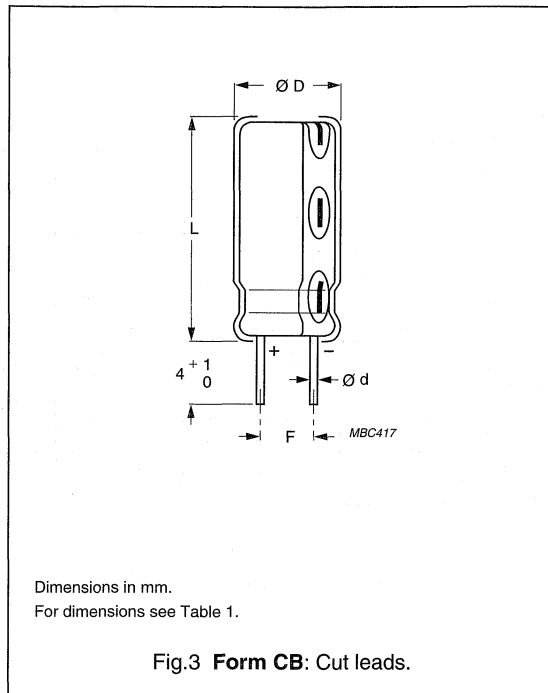
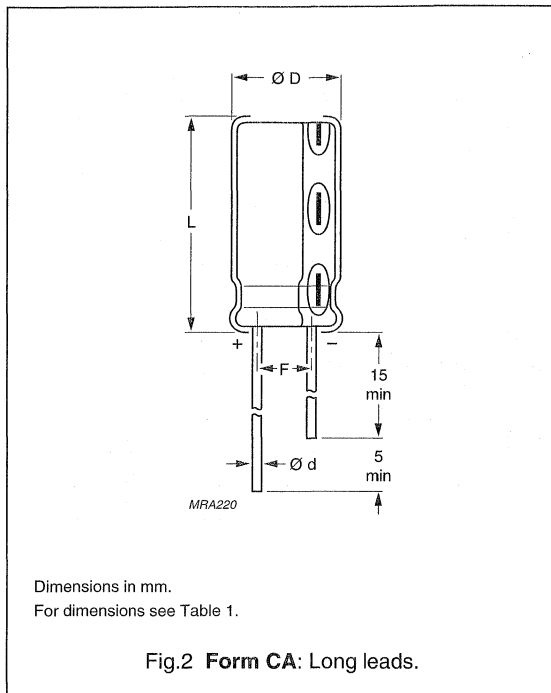


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

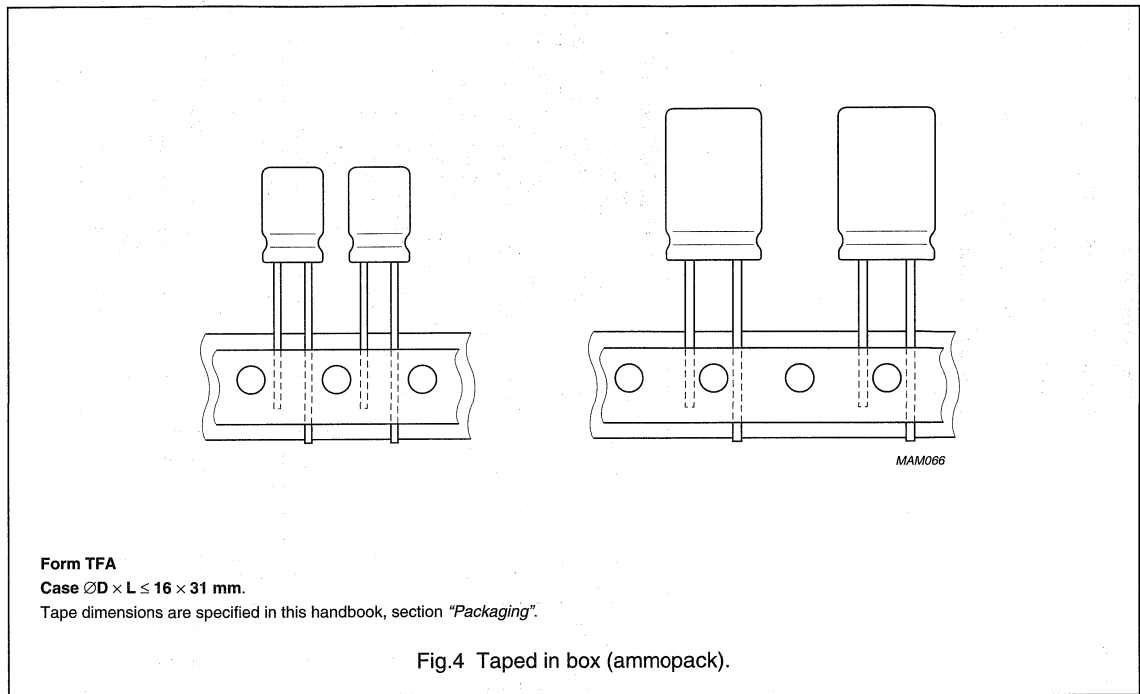
NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	Ød (mm)	ØD _{max} (mm)	L _{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11.5	100	100	–
18 × 35	22	0.8	18.5	37.5	7.5 ± 0.5	≈ 14.5	300	1000	–
18 × 40	23	0.8	18.5	42.0	7.5 ± 0.5	≈ 16.0	300	1000	–

Aluminum electrolytic capacitors

Radial Standard Long-Life

046 RSL

Taped products



MARKING

The capacitors are marked with the following information:

- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105°C)
- Group number (046)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.



Aluminum electrolytic capacitors Radial Standard Long-Life

046 RSL

Ordering example

Electrolytic capacitor 046 series

2200 μ F/16 V; \pm 20%

Nominal case size: \varnothing 16 x 25 mm; Form TFA

Catalogue number: 2222 046 35222.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{amb} = 20\text{ }^{\circ}\text{C}$, $P = 86$ to 106 kPa, RH = 45 to 75%.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance \pm 20%
I_R	rated RMS ripple current at 100 Hz, 105 $^{\circ}\text{C}$
I_{RH}	rated RMS ripple current at 100 kHz, 105 $^{\circ}\text{C}$
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 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 105 $^{\circ}\text{C}$ (mA)	I_{RH} 100 kHz 105 $^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222		
												BULK PACKAGING		TAPED
												FORM CA	FORM CB	FORM TFA
6.3	470	10 x 12	14	360	600	33	9	0.19	0.64	0.32	0.28	046 53471	046 63471	046 33471
	1000	10 x 20	16	600	1000	66	16	0.19	0.30	0.15	0.14	046 53102	046 63102	046 33102
	2200	12.5 x 25	18	950	1500	140	31	0.23	0.17	0.08	0.07	046 53222	046 63222	046 33222
	3300	16 x 25	19	1200	1700	210	45	0.25	0.12	0.06	0.06	046 53332	046 63332	046 33332
	4700	16 x 31	20	1400	2000	300	62	0.27	0.09	0.05	0.05	046 53472	046 63472	046 33472
	6800	16 x 35	21	1600	2100	430	89	0.31	0.07	0.05	0.05	046 53682	046 63682	-
	10000	18 x 35	22	1800	2300	630	130	0.39	0.06	0.04	0.04	046 53103	046 63103	-
10	330	10 x 12	14	370	620	36	10	0.15	0.72	0.38	0.31	046 54331	046 64331	046 34331
	470	10 x 16	15	460	800	50	12	0.15	0.51	0.27	0.22	046 54471	046 64471	046 34471
	1000	12.5 x 20	17	770	1100	100	23	0.15	0.24	0.13	0.12	046 54102	046 64102	046 34102
	4700	16 x 35	21	1600	2300	470	97	0.23	0.08	0.04	0.04	046 54472	046 64472	-
	6800	18 x 35	22	1800	2500	680	140	0.27	0.06	0.03	0.03	046 54682	046 64682	-
	10000	18 x 40	23	2000	2600	1000	200	0.35	0.06	0.03	0.03	046 54103	046 64103	-

Aluminum electrolytic capacitors
Radial Standard Long-Life

046 RSL

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{RH} 100 kHz 105 °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)	CATALOGUE NUMBER 2222			
												BULK PACKAGING		FORM TFA	
												FORM CA	FORM CB		FORM TFA
16	220	10 × 12	14	350	620	38	10	0.13	0.94	0.40	0.31	046 55221	046 65221	046 35221	
	330	10 × 16	15	430	800	56	14	0.13	0.63	0.30	0.22	046 55331	046 65331	046 35331	
	470	10 × 20	16	560	920	78	18	0.13	0.44	0.21	0.18	046 55471	046 65471	046 35471	
	1000	12.5 × 25	18	900	1500	160	35	0.13	0.21	0.10	0.10	046 65102	046 65102	046 35102	
	2200	16 × 25	19	1300	1800	360	73	0.17	0.12	0.06	0.05	046 55222	046 65222	046 35222	
	3300	16 × 31	20	1600	2200	530	110	0.19	0.09	0.04	0.04	046 55332	046 65332	046 35332	
	4700	18 × 35	22	1800	2500	760	150	0.21	0.07	0.03	0.03	046 55472	046 65472	—	
	6800	18 × 40	23	2000	2600	1100	220	0.25	0.06	0.03	0.03	046 55682	046 65682	—	
	25	1000	12.5 × 25	18	900	1500	250	53	0.11	0.18	0.09	0.08	046 56102	046 66102	046 36102
		2200	16 × 31	20	1600	2100	550	110	0.15	0.11	0.04	0.04	046 56222	046 66222	046 36222
3300		18 × 35	22	1900	2500	830	170	0.17	0.08	0.03	0.03	046 56332	046 66332	—	
4700		18 × 40	23	2000	2600	1200	240	0.19	0.06	0.03	0.03	046 56472	046 66472	—	
35	220	10 × 16	15	400	740	80	18	0.10	0.72	0.30	0.23	046 50221	046 60221	046 30221	
	330	10 × 20	16	510	880	120	26	0.10	0.48	0.26	0.16	046 50331	046 60331	046 30331	
	470	12.5 × 20	17	650	1000	170	36	0.10	0.34	0.14	0.11	046 50471	046 60471	046 30471	
	1000	16 × 25	19	1200	1600	350	73	0.10	0.16	0.07	0.06	046 50102	046 60102	046 30102	
	2200	16 × 35	21	1800	2000	770	160	0.12	0.10	0.04	0.04	046 50222	046 60222	—	
	100	10 × 12	14	300	560	43	11	0.09	1.43	0.60	0.35	046 57101	046 67101	046 37101	
40	220	10 × 20	16	450	850	91	21	0.09	0.65	0.27	0.17	046 57221	046 67221	046 37221	
	330	12.5 × 20	17	590	1000	140	29	0.09	0.43	0.18	0.13	046 57331	046 67331	046 37331	
	470	12.5 × 25	18	750	1300	190	41	0.09	0.30	0.13	0.08	046 57471	046 67471	046 37471	
	2200	18 × 35	22	1900	2500	880	180	0.11	0.08	0.03	0.03	046 57222	046 67222	—	
	3300	18 × 40	23	2100	2600	1300	270	0.12	0.06	0.03	0.03	046 57332	046 67332	—	
	100	10 × 16	15	310	610	53	13	0.07	1.11	0.50	0.28	046 51101	046 61101	046 31101	
	220	12.5 × 20	17	500	980	110	25	0.07	0.51	0.23	0.13	046 51221	046 61221	046 31221	
	330	12.5 × 25	18	680	1200	170	36	0.07	0.34	0.15	0.09	046 51331	046 61331	046 31331	
50	1000	16 × 31	20	1400	1800	500	100	0.07	0.11	0.05	0.05	046 51102	046 61102	046 31102	
	2200	18 × 40	23	2000	2600	1100	220	0.09	0.07	0.03	0.03	046 51222	046 61222	—	

Aluminum electrolytic capacitors
Radial Standard Long-Life

046 RSL

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{RH} 100 kHz 105 °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)	CATALOGUE NUMBER 2222		
												BULK PACKAGING		
												FORM CA	FORM CB	FORM TFA
63	22	10 × 12	14	170	310	17	9	0.06	4.3	1.6	0.7	046 58229	046 68229	046 38229
	47	10 × 12	14	230	430	33	9	0.06	2.03	0.96	0.40	046 58479	046 68479	046 38479
	100	10 × 20	16	360	710	66	16	0.06	0.95	0.45	0.20	046 58101	046 68101	046 38101
	220	12.5 × 25	18	610	1100	140	31	0.06	0.43	0.20	0.11	046 58221	046 68221	046 38221
	330	16 × 25	19	750	1300	210	45	0.06	0.29	0.14	0.08	046 58331	046 68331	046 38331
	470	16 × 25	19	950	1600	300	62	0.06	0.20	0.10	0.06	046 58471	046 68471	046 38471
	1000	18 × 35	22	1500	2100	630	130	0.06	0.10	0.04	0.04	046 58102	046 68102	—

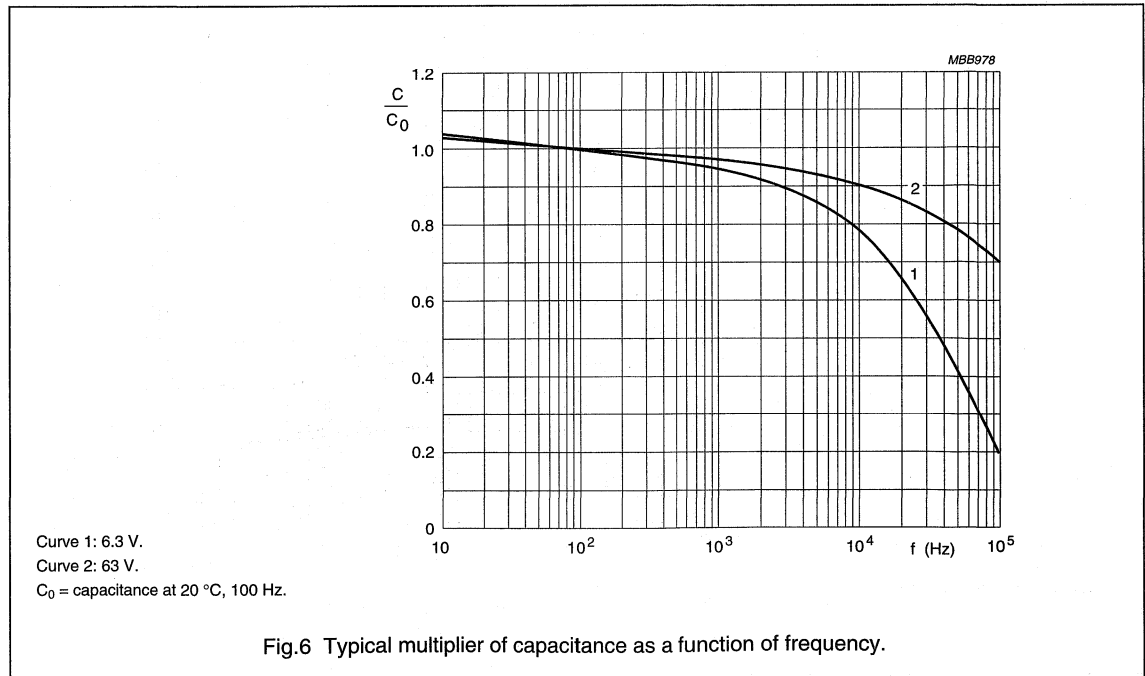
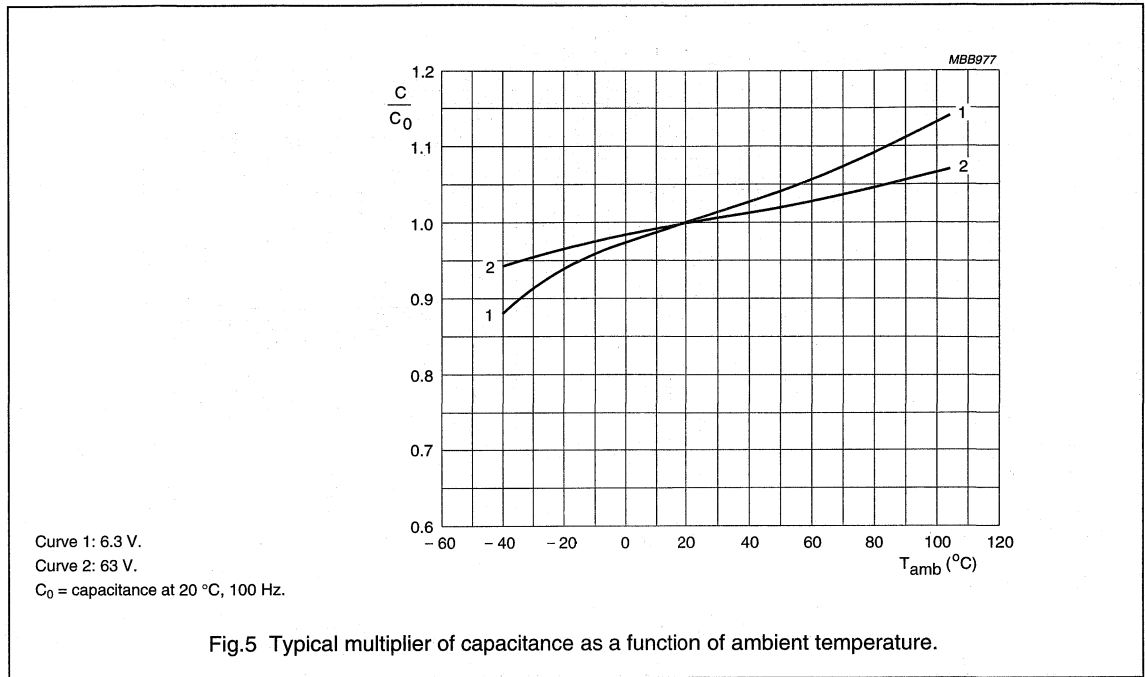
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 1 minute at U _R	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu A$
	after 5 minutes at U _R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu A$
Inductance		
Equivalent series inductance (ESL)	case ∅D = 10 mm	typ. 16 nH
	case ∅D ≥ 12.5 mm	typ. 18 nH

Aluminum electrolytic capacitors
Radial Standard Long-Life

046 RSL

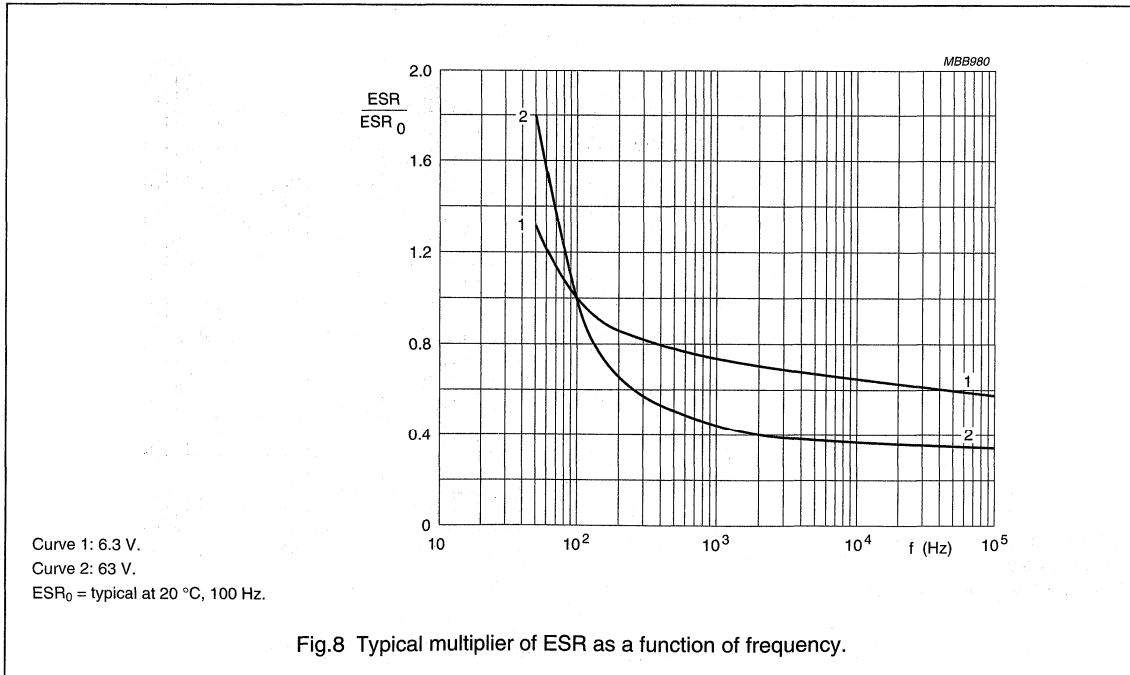
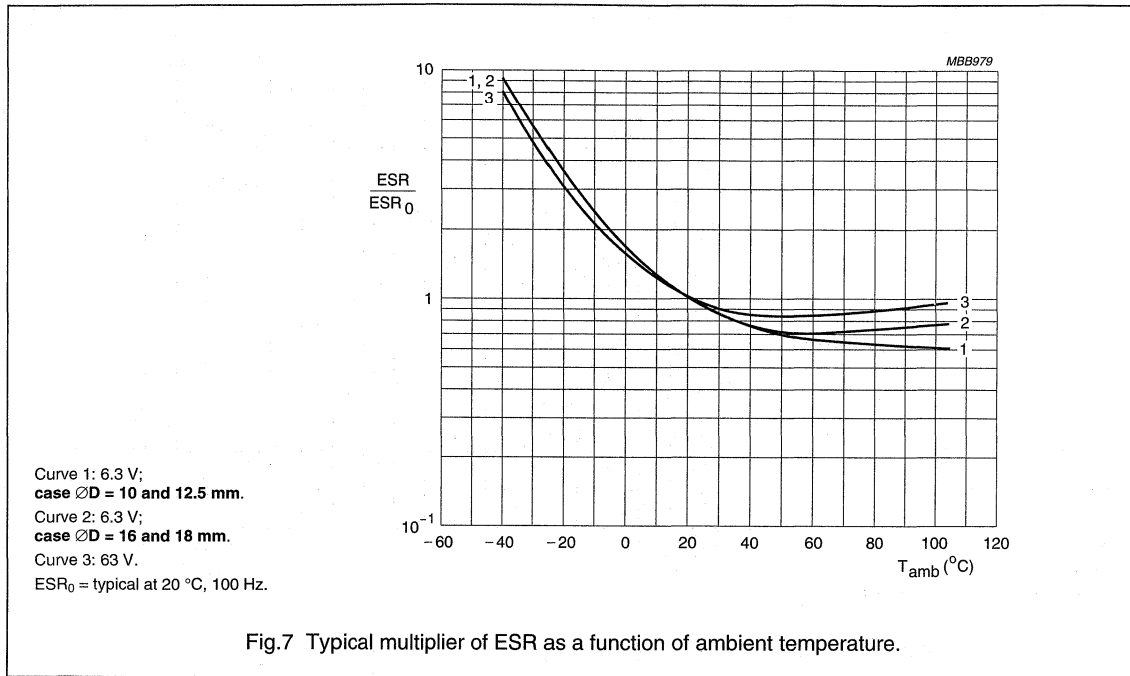
Capacitance (C)



Aluminum electrolytic capacitors Radial Standard Long-Life

046 RSL

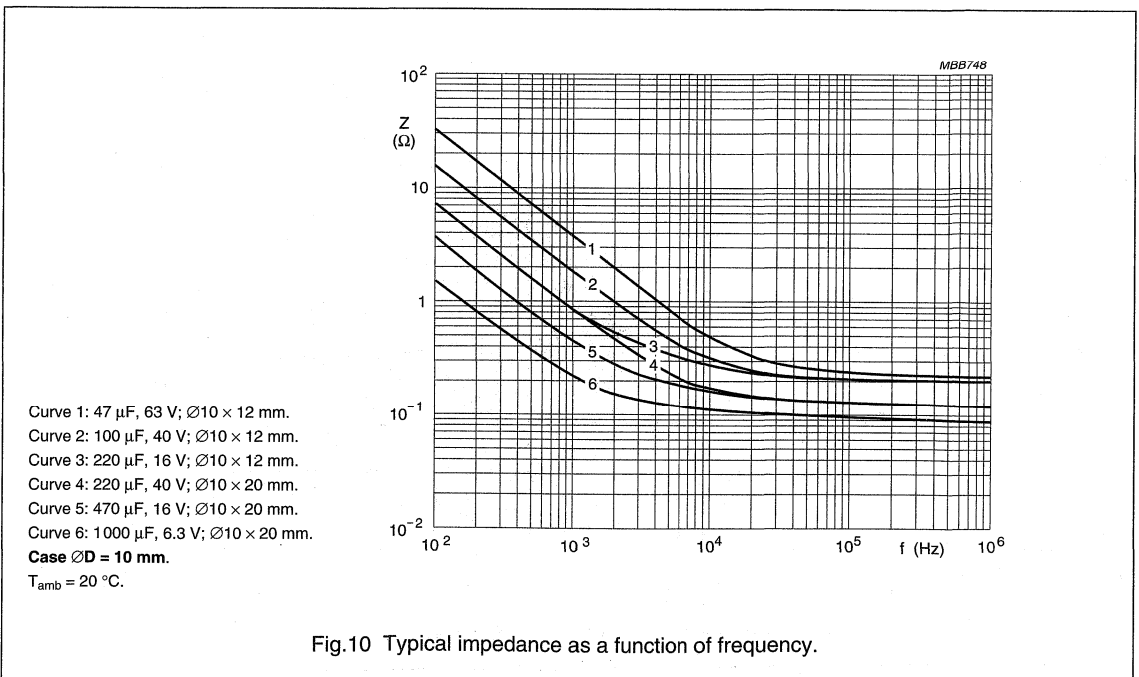
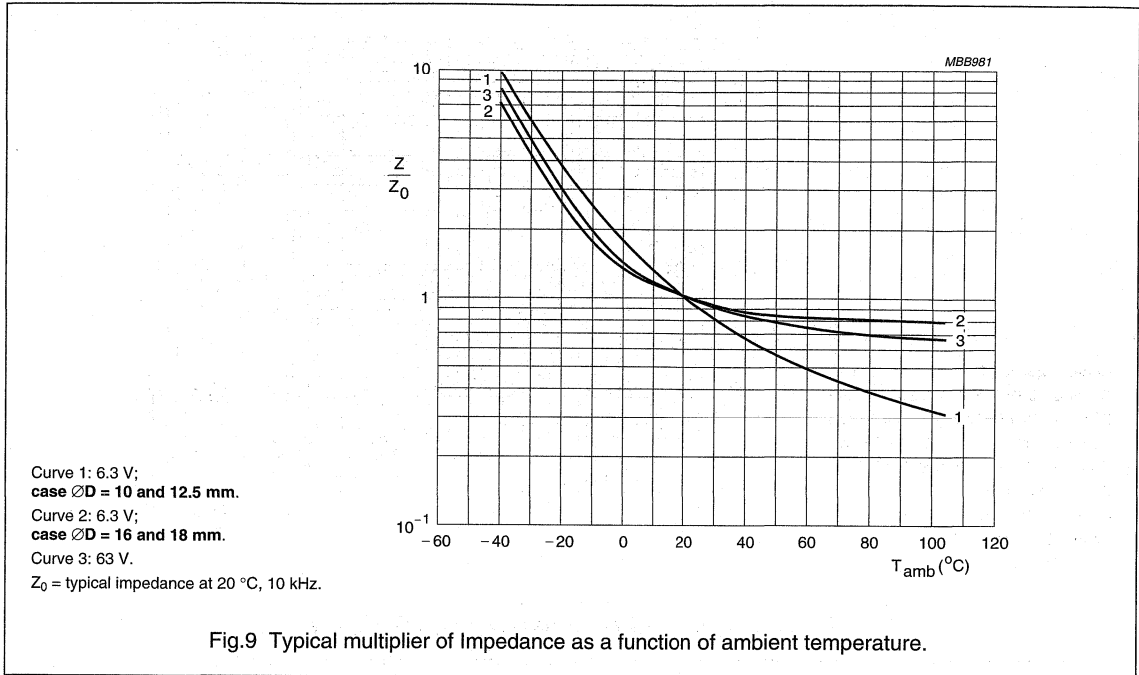
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors
Radial Standard Long-Life

046 RSL

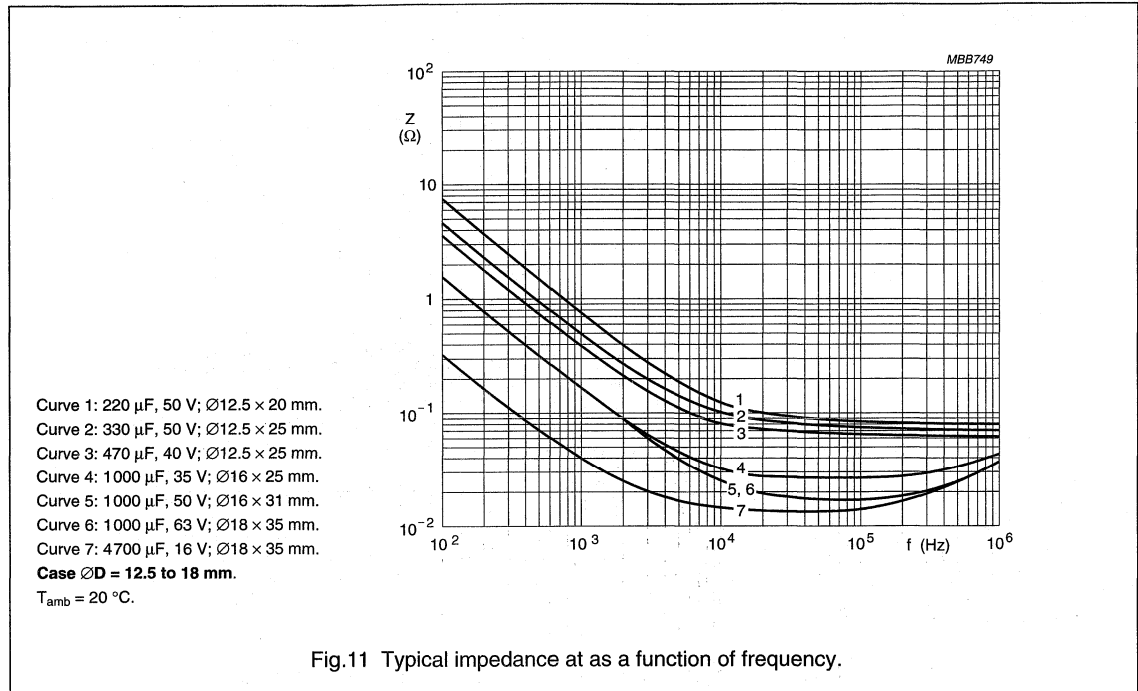
Impedance (Z)



Aluminum electrolytic capacitors

Radial Standard Long-Life

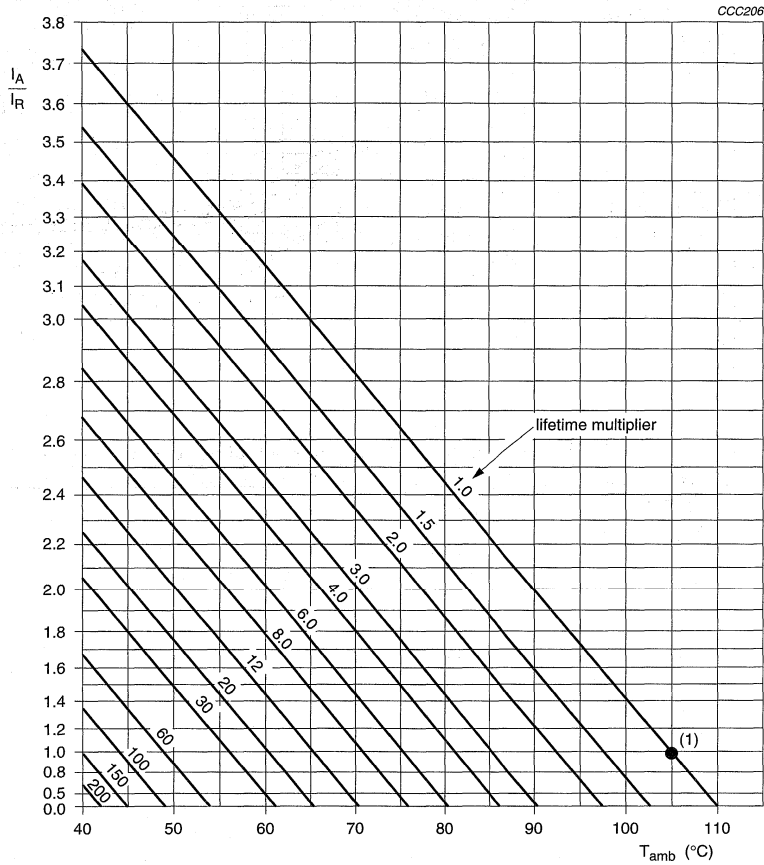
046 RSL



Aluminum electrolytic capacitors
Radial Standard Long-Life

046 RSL

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 Hz or 100 kHz.
 I_R = rated ripple current at 100 Hz or 100 kHz, 105 °C.

(1) Useful life at 105 °C and I_R applied:
 case $\varnothing D = 10$ and 12.5 mm; 3000 hours
 case $\varnothing D = 16$ and 18 mm; 4000 hours.

Fig.12 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Standard Long-Life

046 RSL

SPECIFIC TESTS AND REQUIREMENTS

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

Table 3 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; 2000 hours	$U_R = 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; 3000 hours, case $\varnothing D = 10$ and 12.5 mm; 4000 hours, case $\varnothing D = 16$ and 18 mm	$U_R = 6.3\text{ V}$; $\Delta C/C$: +45/-50% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$U_R = 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors

Radial, Very Low Impedance

136 RVI

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Very long useful life: 4000 to 10000 hours at 105 °C, very high reliability
- Very low impedance or ESR respectively, which is significantly lower than the RLI 135 series
- Excellent ripple current capability.

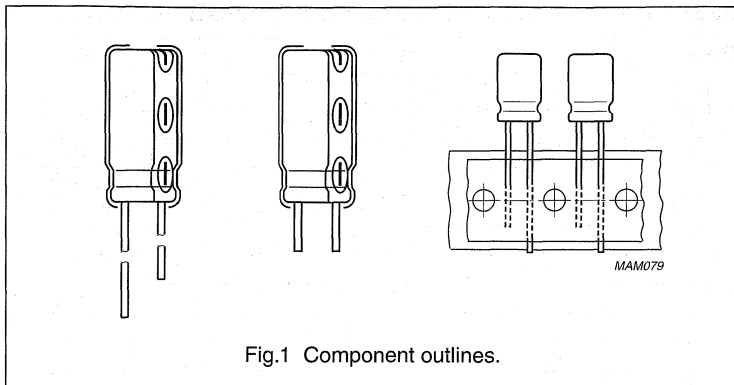
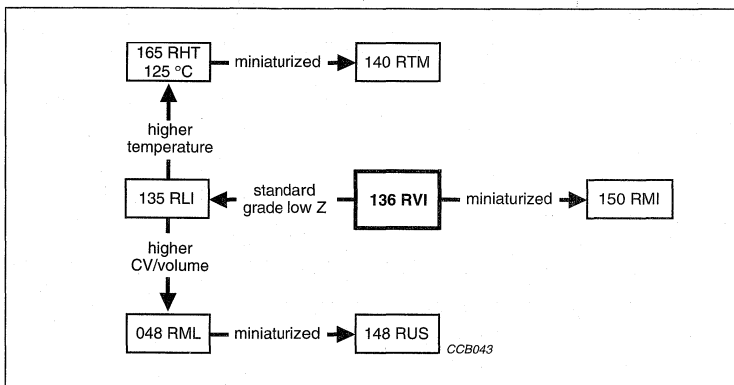


Fig.1 Component outlines.

APPLICATIONS

- Power supplies (SMPS, DC/DC converters) for general industrial, EDP, audio-video, automotive and telecommunications
- Smoothing, filtering, buffering.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	22 to 10000 μ F
Tolerance on C_R	±20%
Rated voltage range, C_R	10 to 100 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C	3000 to 5000 hours (dependent on case size)
Useful life at 105 °C	4000 to 10000 hours (dependent on case size)
Useful life at 40 °C, $1.8 \times I_R$ applied	200000 to 500000 hours (dependent on case size)
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/105/56

Aluminum electrolytic capacitors

Radial, Very Low Impedance

136 RVI

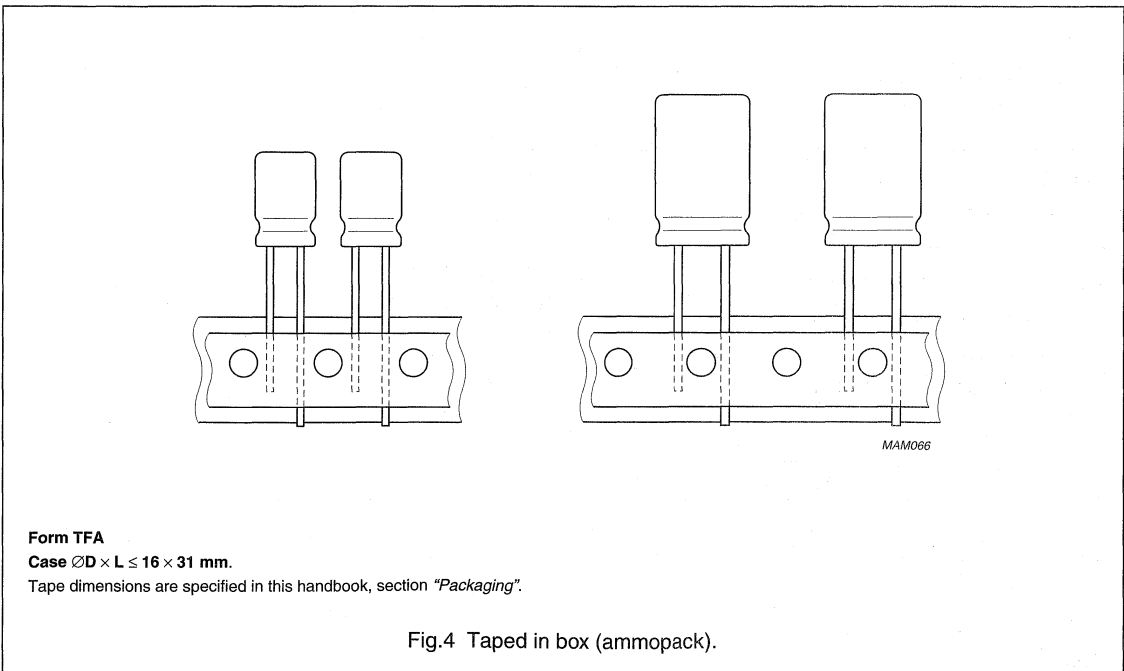
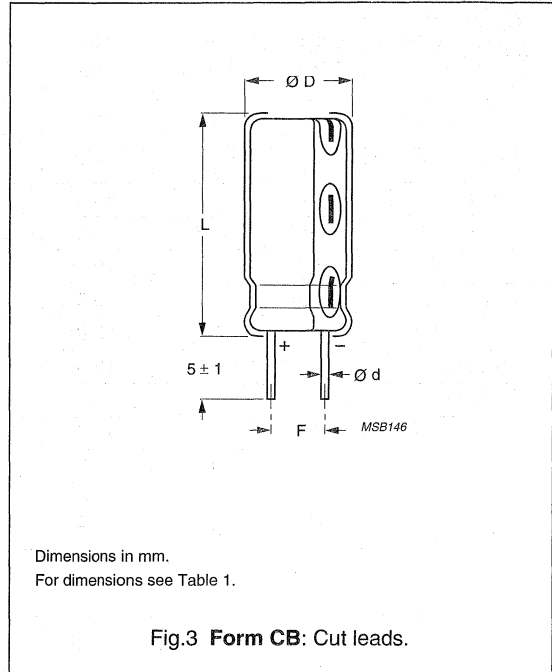
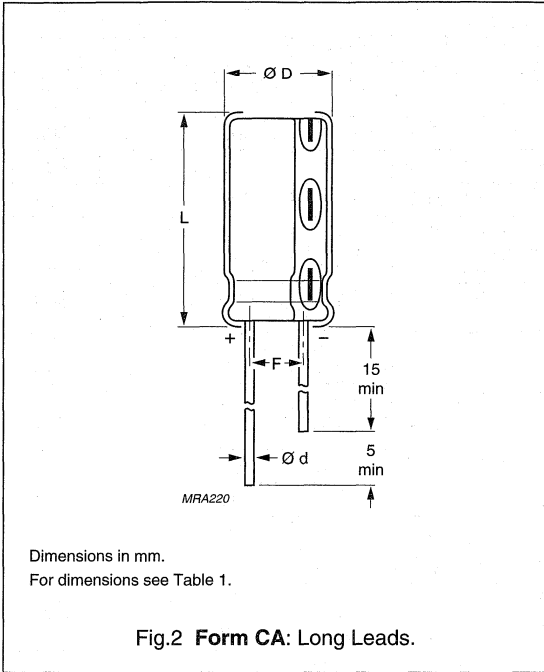
Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm); preferred types in bold

C_R (μF)	U_R (V)						
	10	16	25	35	50	63	100
22	-	-	-	-	-	-	10 × 12
33	-	-	-	-	-	-	10 × 12
47	-	-	-	-	-	10 × 12	10 × 16
56	-	-	-	-	-	10 × 12	-
68	-	-	-	-	-	10 × 16	10 × 20
82	-	-	-	-	10 × 12	-	-
100	-	-	-	-	10 × 12	10 × 16	12.5 × 20
120	-	-	-	10 × 12	10 × 16	10 × 20	-
	-	-	-	-	-	12.5 × 16	-
150	-	-	-	10 × 12	10 × 20	10 × 25	16 × 20
180	-	-	10 × 12	-	10 × 20	10 × 30	-
	-	-	-	-	12.5 × 16	-	-
220	-	-	10 × 12	10 × 16	10 × 25	12.5 × 20	16 × 25
270	-	10 × 12	-	-	-	12.5 × 25	-
330	-	10 × 12	10 × 16	10 × 20	10 × 30	16 × 20	16 × 31
	-	-	-	12.5 × 16	12.5 × 20	-	-
390	10 × 12	-	-	10 × 25	-	12.5 × 31	-
470	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 35
	-	-	12.5 × 16	-	-	-	18 × 31
560	-	-	10 × 25	10 × 30	12.5 × 31	-	-
	-	-	-	12.5 × 20	-	-	-
680	10 × 16	10 × 20	-	12.5 × 25	16 × 20	16 × 31	18 × 35
	-	12.5 × 16	-	-	-	18 × 25	-
820	-	10 × 25	10 × 30	-	16 × 25	16 × 35	-
	-	-	12.5 × 20	-	-	-	-
1000	10 × 20	12.5 × 20	12.5 × 25	12.5 × 31	16 × 31	18 × 31	-
	12.5 × 16	-	-	16 × 20	18 × 20	-	-
1200	10 × 25	10 × 30	-	16 × 25	16 × 35	-	-
	-	12.5 × 20	-	-	-	-	-
1500	10 × 30	12.5 × 25	12.5 × 31	16 × 25	18 × 31	18 × 35	-
	12.5 × 20	-	16 × 20	-	-	-	-
1800	12.5 × 20	-	16 × 25	16 × 31	-	-	-
2200	12.5 × 25	12.5 × 31	16 × 31	16 × 35	18 × 35	-	-
	-	16 × 20	18 × 20	18 × 31	-	-	-
2700	12.5 × 31	16 × 25	16 × 31	-	-	-	-
3300	16 × 20	16 × 25	16 × 35	18 × 35	-	-	-
	-	-	18 × 31	-	-	-	-
3900	16 × 25	16 × 31	-	-	-	-	-
4700	16 × 31	16 × 35	18 × 35	-	-	-	-
	-	18 × 31	-	-	-	-	-
5600	16 × 31	-	-	-	-	-	-
	18 × 25	-	-	-	-	-	-
6800	16 × 35	18 × 35	-	-	-	-	-
	18 × 31	-	-	-	-	-	-
10000	18 × 35	-	-	-	-	-	-

Aluminum electrolytic capacitors Radial, Very Low Impedance

136 RVI

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors

Radial, Very Low Impedance

136 RVI

Table 1 Physical dimensions mass and packaging quantities; see Figs 2, 3 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ±0.5	≈1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ±0.5	≈1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ±0.5	≈2.2	500	500	800
10 × 25	16L	0.6	10.5	27.0	5.0 ±0.5	≈3.0	1000	1500	800
10 × 30	16LL	0.6	10.5	32.0	5.0 ±0.5	≈3.5	1000	750	–
12.5 × 16	17a	0.6	13.0	17.5	5.0 ±0.5	≈2.7	1000	1500	500
12.5 × 20	17	0.6	13.0	22.0	5.0 ±0.5	≈4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ±0.5	≈5.0	250	250	500
12.5 × 31	18L	0.6	13.0	33.5	5.0 ±0.5	≈5.5	1000	750	–
16 × 20	19a	0.8	16.5	22.0	7.5 ±0.5	≈6.0	250	250	250
16 × 25	19	0.8	16.5	27.0	7.5 ±0.5	≈8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ±0.5	≈9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ±0.5	≈11.0	100	100	–
18 × 20	1820	0.8	18.5	22.0	7.5 ±0.5	≈8.0	100	100	–
18 × 25	1825	0.8	18.5	27.0	7.5 ±0.5	≈10.0	100	100	–
18 × 31	1831	0.8	18.5	33.5	7.5 ±0.5	≈12.5	100	100	–
18 × 35	22	0.8	18.5	37.5	7.5 ±0.5	≈14.5	100	100	–

MARKING

The capacitors are marked with the following information:

- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (136)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

Aluminum electrolytic capacitors Radial, Very Low Impedance

136 RVI

Ordering example

Electrolytic capacitor 136 series

1000 µF/25 V; ±20%

Nominal case size: Ø12.5 × 25 mm; Form TFA

Catalogue number: 2222 136 36102.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 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 ±20%
I _R	rated RMS ripple current at 100 kHz, 105 °C
I _{L2}	max. leakage current after 2 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 100 kHz and +20 or -10 °C

Table 2 Electrical data and ordering information; preferred types in **bold**

U _R (V)	C _R 100 Hz (µF)	NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	I _R 100 kHz 105 °C (mA)	I _{L2} 2 min (µA)	Tan δ 100 Hz	ESR 100 Hz (mΩ)	Z 100 kHz +20 °C (mΩ)	Z 100 kHz -10 °C (mΩ)	CATALOGUE NUMBER		
										BULK PACKAGING		TAPED
										FORM CA	FORM CB	FORM TFA
10	390	10 × 12	14	630	39	0.19	780	120	240	136 54391	136 64391	136 34391
	470	10 × 12	14	630	47	0.19	640	120	240	136 54471	136 64471	136 34471
	680	10 × 16	15	830	68	0.19	450	84	170	136 54681	136 64681	136 34681
	1000	10 × 20	16	1000	100	0.19	300	62	130	136 54102	136 64102	136 34102
	1000	12.5 × 16	17a	940	100	0.19	300	76	160	136 94105	136 94106	136 94103
	1200	10 × 25	16L	1300	120	0.19	250	52	110	136 54122	136 64122	136 34122
	1500	10 × 30	16LL	1400	150	0.19	200	44	88	136 94155	136 94156	—
	1500	12.5 × 20	17	1300	150	0.19	200	46	92	136 54152	136 64152	136 34152
	1800	12.5 × 20	17	1340	180	0.19	170	46	92	136 54182	136 64182	136 34182
	2200	12.5 × 25	18	1700	220	0.21	150	34	68	136 54222	136 64222	136 34222
	2700	12.5 × 31	18L	2000	270	0.21	120	30	60	136 54272	136 64272	—
	3300	16 × 20	19a	1600	330	0.23	110	38	76	136 54332	136 64332	136 34332
	3900	16 × 25	19	2100	390	0.23	94	28	56	136 54392	136 64392	136 34392
	4700	16 × 31	20	2400	470	0.25	85	25	50	136 54472	136 64472	136 34472
	5600	16 × 31	20	2400	560	0.27	77	25	50	136 54562	136 64562	136 34562
	5600	18 × 25	1825	2270	560	0.27	77	25	50	136 94565	136 94566	—

Aluminum electrolytic capacitors

Radial, Very Low Impedance

136 RVI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 kHz 105 °C (mA)	I_{L2} 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (m Ω)	Z 100 kHz +20 °C (m Ω)	Z 100 kHz -10 °C (m Ω)	CATALOGUE NUMBER								
										2222								
										BULK PACKAGING								
			FORM CA	FORM CB	FORM TFA													
10	6800	16 × 35	21	2600	680	0.29	68	22	44	136 54682	136 64682	-						
	6800	18 × 31	1831	2760	680	0.29	68	23	46	136 94685	136 94686	-						
	10000	18 × 35	22	3180	1000	0.31	49	21	42	136 54103	136 64103	-						
16	270	10 × 12	14	630	43	0.16	940	120	240	136 55271	136 65271	136 35271						
	330	10 × 12	14	630	53	0.16	770	120	240	136 55331	136 65331	136 35331						
	470	10 × 16	15	830	75	0.16	540	84	170	136 55471	136 65471	136 35471						
	680	10 × 20	16	1000	110	0.16	380	62	130	136 55681	136 65681	136 35681						
	680	12.5 × 16	17a	940	110	0.16	380	76	160	136 95685	136 95686	136 95683						
	820	10 × 25	16L	1300	130	0.16	310	52	110	136 55821	136 65821	136 35821						
	1000	12.5 × 20	17	1300	160	0.16	260	48	96	136 55102	136 65102	136 35102						
	1200	10 × 30	16LL	1400	190	0.16	210	44	88	136 95125	136 95126	-						
	1200	12.5 × 20	17	1300	190	0.16	210	46	92	136 55122	136 65122	136 35122						
	1500	12.5 × 25	18	1700	240	0.16	170	34	68	136 55152	136 65152	136 35152						
	2200	12.5 × 31	18L	2000	350	0.18	130	30	60	136 95225	136 95226	-						
	2200	16 × 20	19a	1600	350	0.18	130	38	76	136 55222	136 65222	136 35222						
	2700	16 × 25	19	2100	430	0.18	110	28	56	136 55272	136 65272	136 35272						
	3300	16 × 25	19	2100	530	0.20	97	28	56	136 55332	136 65332	136 35332						
	3900	16 × 31	20	2400	620	0.20	82	25	50	136 55392	136 65392	136 35392						
4700	16 × 35	21	2600	750	0.22	75	22	44	136 55472	136 65472	-							
4700	18 × 31	1831	2560	750	0.22	75	23	46	136 95475	136 95476	-							
6800	18 × 35	22	3000	1090	0.24	56	21	42	136 55682	136 65682	-							

Aluminum electrolytic capacitors
Radial, Very Low Impedance

136 RV1

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 kHz 105 °C (mA)	I _{L2} 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (mΩ)	Z 100 kHz +20 °C (mΩ)	Z 100 kHz -10 °C (mΩ)	CATALOGUE NUMBER		
										2222		
										BULK PACKAGING		TAPED
FORM CA		FORM CB	FORM TFA									
25	180	10 × 12	14	630	45	0.14	1200	120	240	136 56181	136 66181	136 36181
	220	10 × 12	14	630	55	0.14	1000	120	240	136 56221	136 66221	136 36221
	330	10 × 16	15	830	83	0.14	680	84	170	136 56331	136 66331	136 36331
	470	10 × 20	16	1000	120	0.14	470	62	130	136 56471	136 66471	136 36471
	470	12.5 × 16	17a	940	120	0.14	470	76	160	136 96475	136 96476	136 96473
	560	10 × 25	16L	1300	140	0.14	400	52	110	136 56561	136 66561	136 36561
	820	10 × 30	16LL	1400	210	0.14	270	44	88	136 96825	136 96826	-
	820	12.5 × 20	17	1300	210	0.14	270	46	92	136 56821	136 66821	136 36821
	1000	12.5 × 25	18	1700	250	0.14	220	34	68	136 56102	136 66102	136 36102
	1500	12.5 × 31	18L	2000	380	0.14	150	30	60	136 96155	136 96156	-
	1500	16 × 20	19a	1700	380	0.14	150	38	76	136 56152	136 66152	136 36152
	1800	16 × 25	19	2100	450	0.14	120	28	56	136 56182	136 66182	136 36182
	2200	16 × 31	20	2400	550	0.16	120	25	50	136 56222	136 66222	136 36222
	2200	18 × 20	1820	1680	550	0.16	116	28	56	136 96225	136 96226	-
	2700	16 × 31	20	2400	680	0.16	94	25	50	136 56272	136 66272	136 36272
	3300	16 × 35	21	2600	830	0.18	87	22	44	136 56332	136 66332	-
	3300	18 × 31	1831	2490	830	0.18	87	27	54	136 96335	136 96336	-
	4700	18 × 35	22	3000	1180	0.20	68	21	42	136 56472	136 66472	-
35	120	10 × 12	14	630	42	0.12	1600	120	240	136 50121	136 60121	136 30121
	150	10 × 12	14	630	53	0.12	1300	120	240	136 50151	136 60151	136 30151
	220	10 × 16	15	830	77	0.12	870	84	170	136 50221	136 60221	136 30221
	330	10 × 20	16	1000	120	0.12	580	62	130	136 50331	136 60331	136 30331
	330	12.5 × 16	17a	940	120	0.12	580	76	160	136 90335	136 90336	136 90333
	390	10 × 25	16L	1300	140	0.12	490	52	110	136 50391	136 60391	136 30391
	470	12.5 × 20	17	1300	170	0.12	410	48	96	136 50471	136 60471	136 30471
	560	10 × 30	16LL	1400	200	0.12	340	44	88	136 90565	136 90566	-
	560	12.5 × 20	17	1300	200	0.12	340	46	92	136 50561	136 60561	136 30561
	680	12.5 × 25	18	1700	240	0.12	280	34	68	136 50681	136 60681	136 30681
	1000	12.5 × 31	18L	2000	350	0.12	190	30	60	136 90105	136 90106	-

Aluminum electrolytic capacitors
Radial, Very Low Impedance

136 RVI

U _R 100 Hz (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 kHz 105 °C (mA)	I _{L2} 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (mΩ)	Z 100 kHz +20 °C (mΩ)	Z 100 kHz -10 °C (mΩ)	CATALOGUE NUMBER		
										2222		
										BULK PACKAGING		TAPED
FORM CA		FORM CB	FORM TFA									
35	1000	16 × 20	19a	1700	350	0.12	190	38	76	136 50102	136 60102	136 30102
	1200	16 × 25	19	2100	420	0.12	160	28	56	136 50122	136 60122	136 30122
	1500	16 × 25	19	2100	530	0.12	130	28	56	136 50152	136 60152	136 30152
	1800	16 × 31	20	2400	630	0.12	110	25	50	136 50182	136 60182	136 30182
	2200	16 × 35	21	2600	770	0.14	100	22	44	136 50222	136 60222	-
	2200	18 × 31	1831	2320	770	0.14	101	27	54	136 90225	136 90226	-
	3300	18 × 35	22	2890	1160	0.16	77	21	42	136 50332	136 60332	-
50	82	10 × 12	14	480	41	0.10	1900	200	400	136 51829	136 61829	136 31829
	100	10 × 12	14	480	50	0.10	1600	200	400	136 51101	136 61101	136 31101
	120	10 × 16	15	760	60	0.10	1300	100	200	136 51121	136 61121	136 31121
	150	10 × 20	16	850	75	0.10	1100	90	180	136 51151	136 61151	136 31151
	180	10 × 20	16	950	90	0.10	880	75	150	136 51181	136 61181	136 31181
	180	12.5 × 16	17a	780	90	0.10	880	110	120	136 91185	136 91186	136 91183
	220	10 × 25	16L	1200	110	0.10	720	63	130	136 51221	136 61221	136 31221
	330	10 × 30	16LL	1300	170	0.10	480	54	110	136 91335	136 91336	-
	330	12.5 × 20	17	1200	170	0.10	480	59	120	136 51331	136 61331	136 31331
	470	12.5 × 25	18	1500	240	0.10	340	44	88	136 51471	136 61471	136 31471
	560	12.5 × 31	18L	1700	280	0.10	280	39	78	136 51561	136 61561	-
	680	16 × 20	19a	1400	340	0.10	230	50	100	136 51681	136 61681	136 31681
	820	16 × 25	19	1900	410	0.10	190	34	68	136 51821	136 61821	136 31821
	1000	16 × 31	20	2200	500	0.10	160	30	60	136 51102	136 61102	136 31102
	1000	18 × 20	1820	1510	500	0.10	159	41	82	136 91105	136 91106	-
	1200	16 × 35	21	2300	600	0.10	130	27	54	136 51122	136 61122	-
	1500	18 × 31	1831	2200	750	0.10	106	31	62	136 51152	136 61152	-
	2200	18 × 35	22	2650	1100	0.12	87	27	54	136 51222	136 61222	-

Aluminum electrolytic capacitors
Radial, Very Low Impedance

136 RVI

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 kHz 105 °C (mA)	I _{L2} 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (mΩ)	Z 100 kHz +20 °C (mΩ)	Z 100 kHz -10 °C (mΩ)	CATALOGUE NUMBER 2222			
										BULK PACKAGING		FORM TFA	
										FORM CA	FORM CB		TAPED
63	47	10 × 12	14	380	30	0.10	3400	300	750	136 58479	136 68479	136 38479	
	56	10 × 12	14	420	35	0.10	2800	270	680	136 58569	136 68569	136 38569	
	68	10 × 16	15	520	43	0.10	2300	210	530	136 58689	136 68689	136 38689	
	100	10 × 16	15	580	63	0.10	1600	190	480	136 58101	136 68101	136 38101	
	120	10 × 20	16	650	76	0.10	1300	160	400	136 58121	136 68121	136 38121	
	120	12.5 × 16	17a	610	76	0.10	1300	180	450	136 98125	136 98126	136 98123	
	150	10 × 25	16L	780	95	0.10	1100	130	330	136 58151	136 68151	136 38151	
	180	10 × 30	16LL	960	110	0.10	880	100	250	136 58181	136 68181	-	
	220	12.5 × 20	17	870	140	0.10	720	110	280	136 58221	136 68221	136 38221	
	270	12.5 × 25	18	1200	170	0.10	590	74	190	136 58271	136 68271	136 38271	
	330	16 × 20	19a	1100	210	0.10	480	85	220	136 58331	136 68331	136 38331	
	390	12.5 × 31	18L	1300	250	0.10	410	68	170	136 58391	136 68391	-	
	470	16 × 25	19	1500	300	0.10	340	55	140	136 58471	136 68471	136 38471	
	680	16 × 31	20	1700	430	0.10	230	46	120	136 58681	136 68681	136 38681	
	680	18 × 25	1825	1470	430	0.10	234	54	108	136 98685	136 98686	-	
	820	16 × 35	21	1900	520	0.10	190	40	100	136 58821	136 68821	-	
	1000	18 × 31	1831	1950	630	0.10	159	39	78	136 58102	136 68102	-	
	1500	18 × 35	22	2350	950	0.10	106	33	66	136 58152	136 68152	-	
	100	22	10 × 12	14	300	22	0.07	5100	450	2300	136 59229	136 69229	136 39229
		33	10 × 12	14	320	33	0.07	3400	390	2000	136 59339	136 69339	136 39339
47		10 × 16	15	450	47	0.07	2400	320	1600	136 59479	136 69479	136 39479	
68		10 × 20	16	520	68	0.07	1600	240	1200	136 59689	136 69689	136 39689	
100		12.5 × 20	17	800	100	0.07	1100	150	750	136 59101	136 69101	136 39101	
150		16 × 20	19a	1000	150	0.07	740	110	550	136 59151	136 69151	136 39151	
220		16 × 25	19	1300	220	0.07	510	81	400	136 59221	136 69221	136 39221	
330		16 × 31	20	1600	330	0.07	340	58	290	136 59331	136 69331	136 39331	
470		16 × 35	21	1800	470	0.07	240	45	230	136 59471	136 69471	-	
470		18 × 31	1831	1800	470	0.07	240	45	230	136 99475	136 99476	-	
680	18 × 35	22	2000	680	0.07	160	39	200	136 59681	136 69681	-		



Aluminum electrolytic capacitors

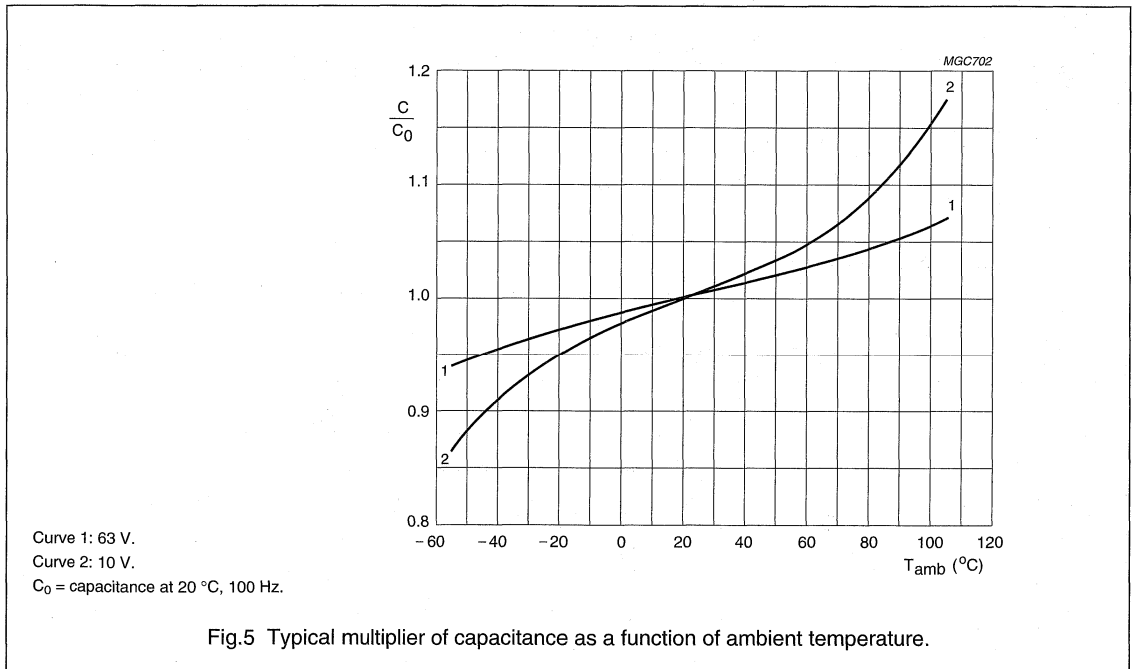
Radial, Very Low Impedance

136 RVI

Additional electrical data

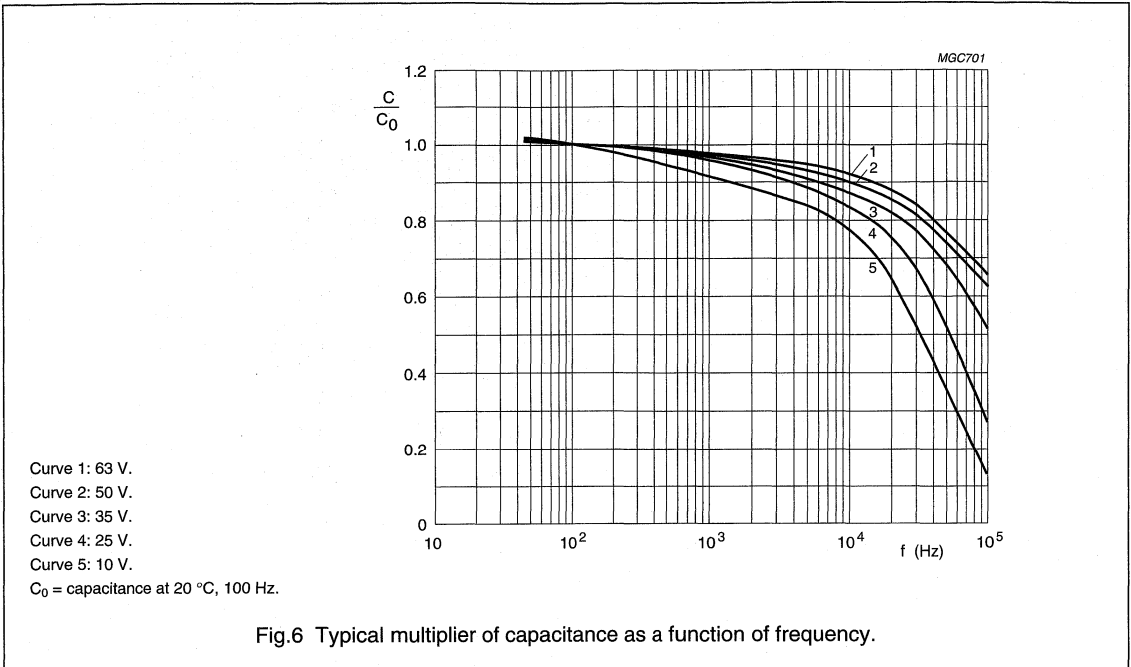
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 2 minutes at U_R	$I_{L2} \leq 0.01 C_R \times U_R$ or $3 \mu\text{A}$, whichever is greater
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

Capacitance (C)

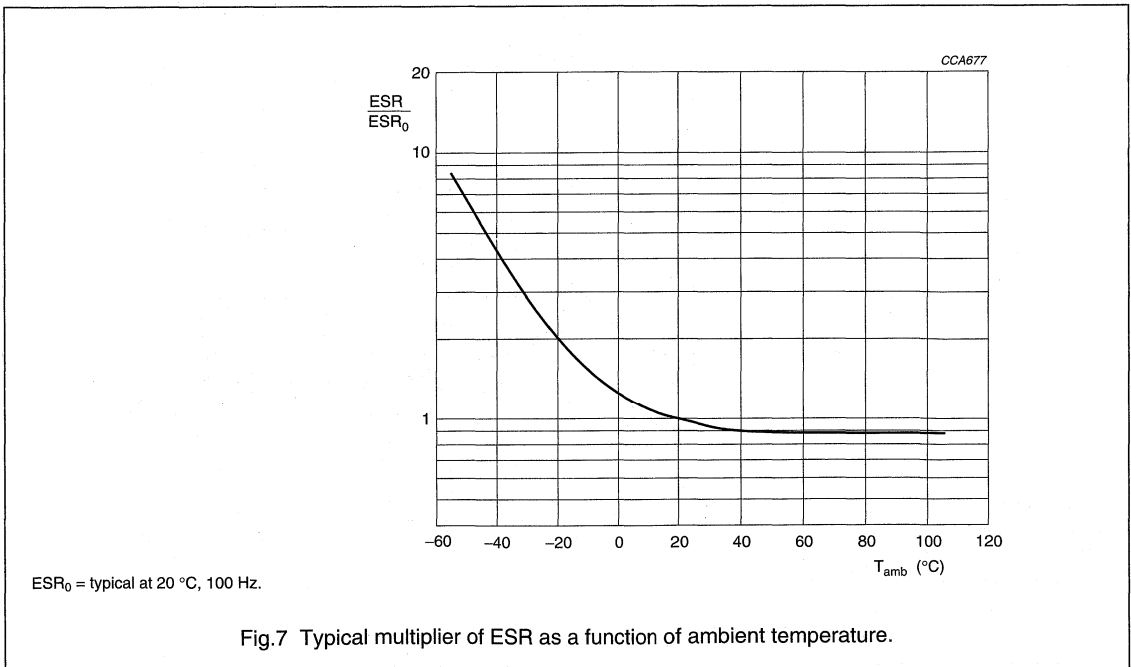


Aluminum electrolytic capacitors
Radial, Very Low Impedance

136 RVI



Equivalent series resistance (ESR)

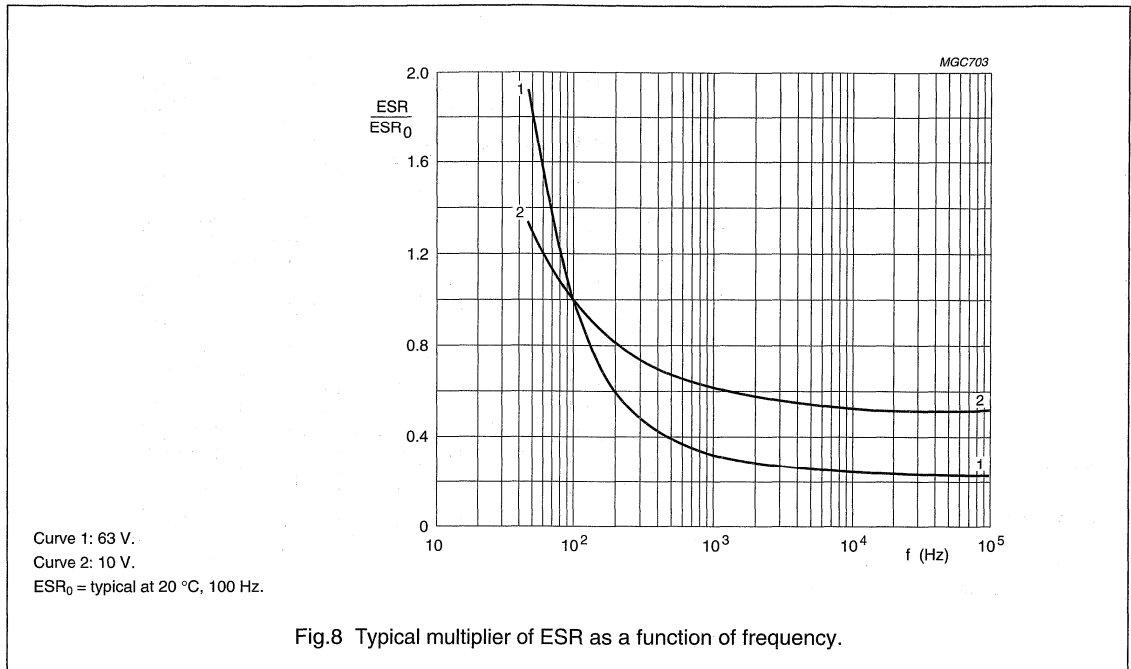


R

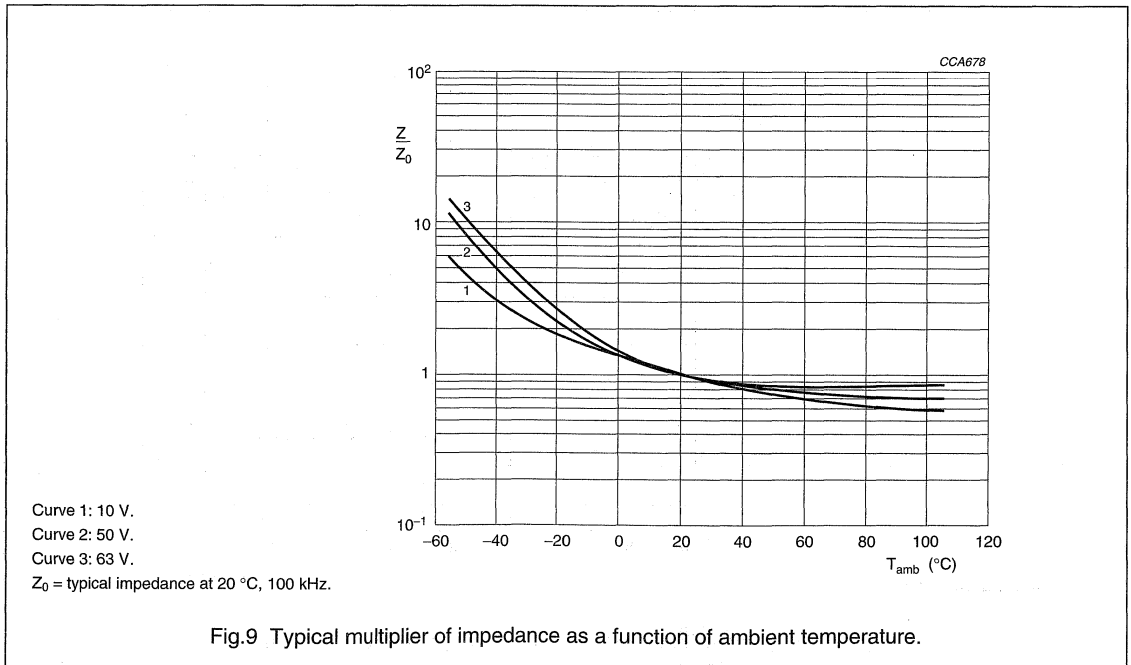
Aluminum electrolytic capacitors

Radial, Very Low Impedance

136 RVI



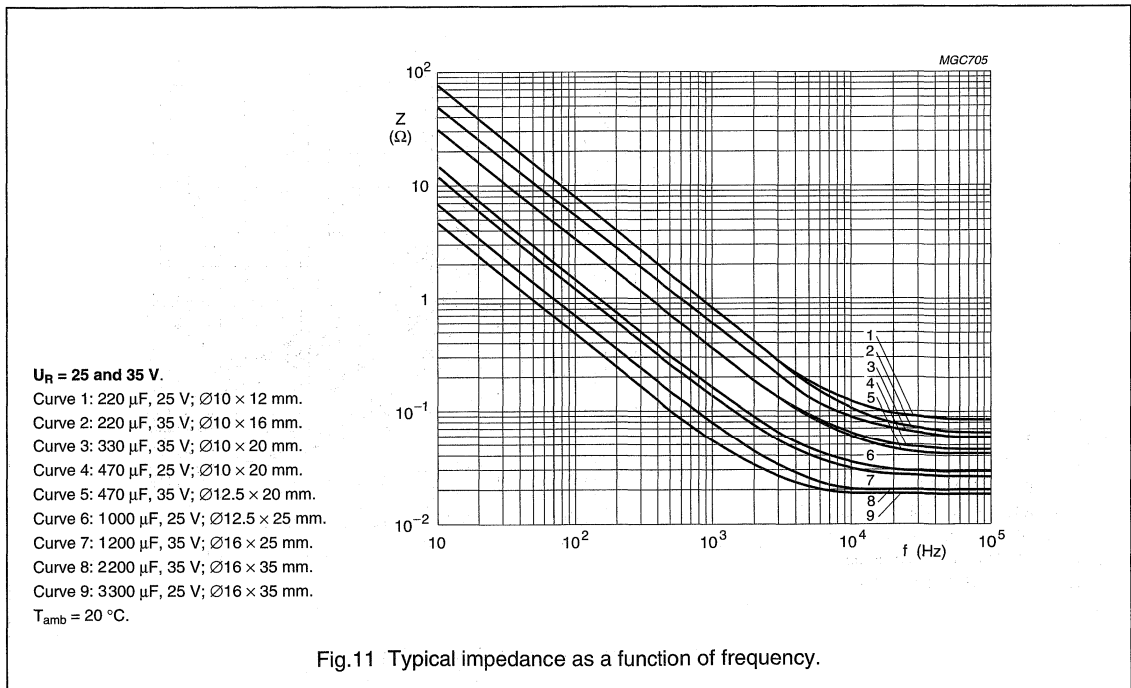
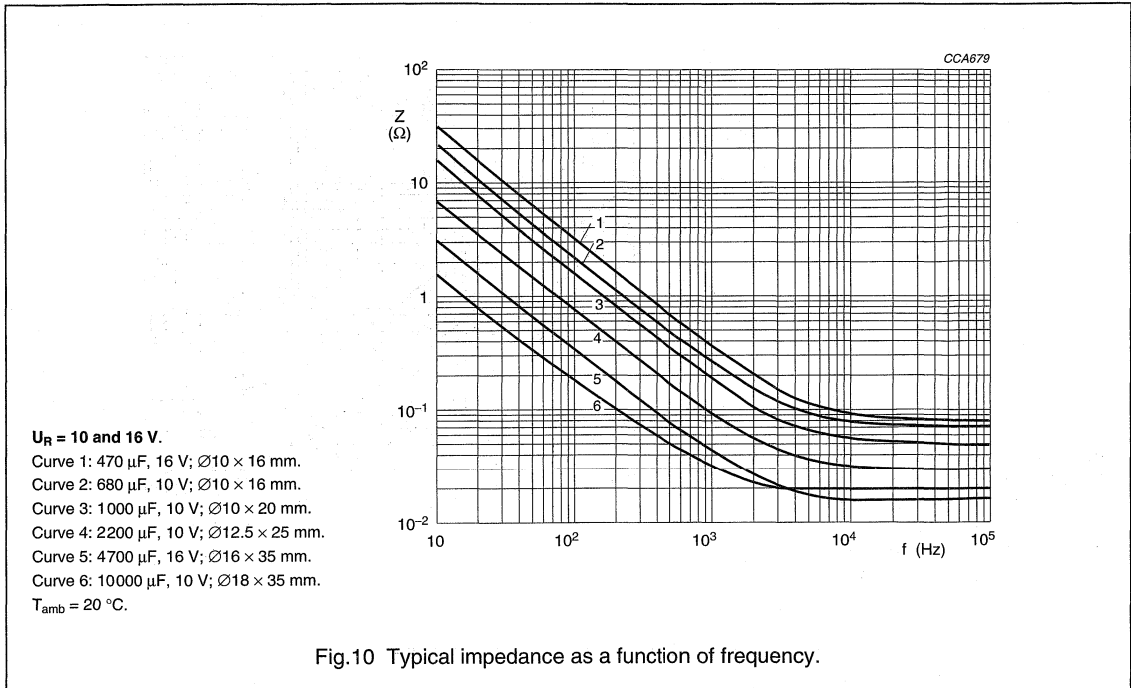
Impedance (Z)



Aluminum electrolytic capacitors

Radial, Very Low Impedance

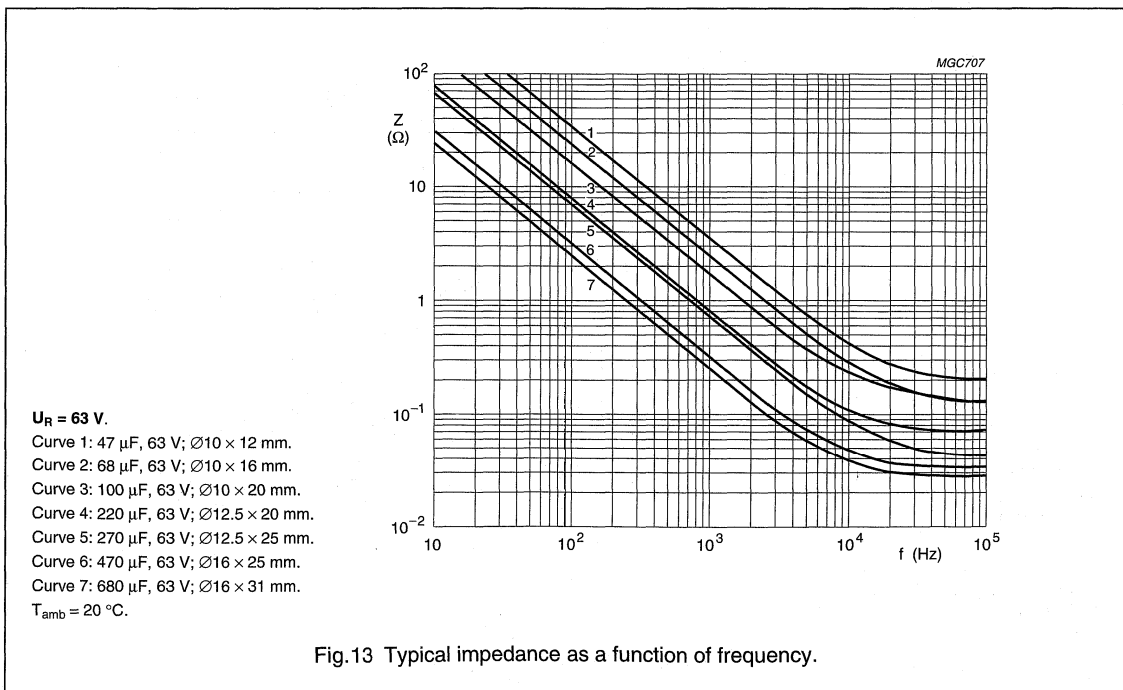
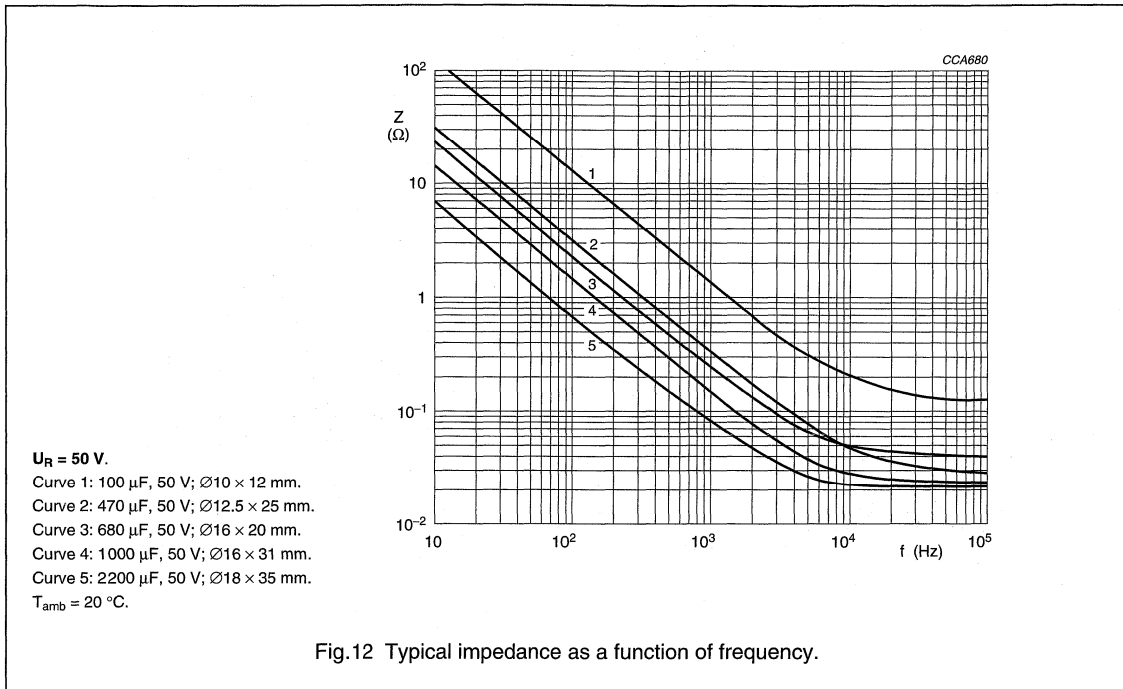
136 RVI



Aluminum electrolytic capacitors

Radial, Very Low Impedance

136 RVI



Aluminum electrolytic capacitors

Radial, Very Low Impedance

136 RVI

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

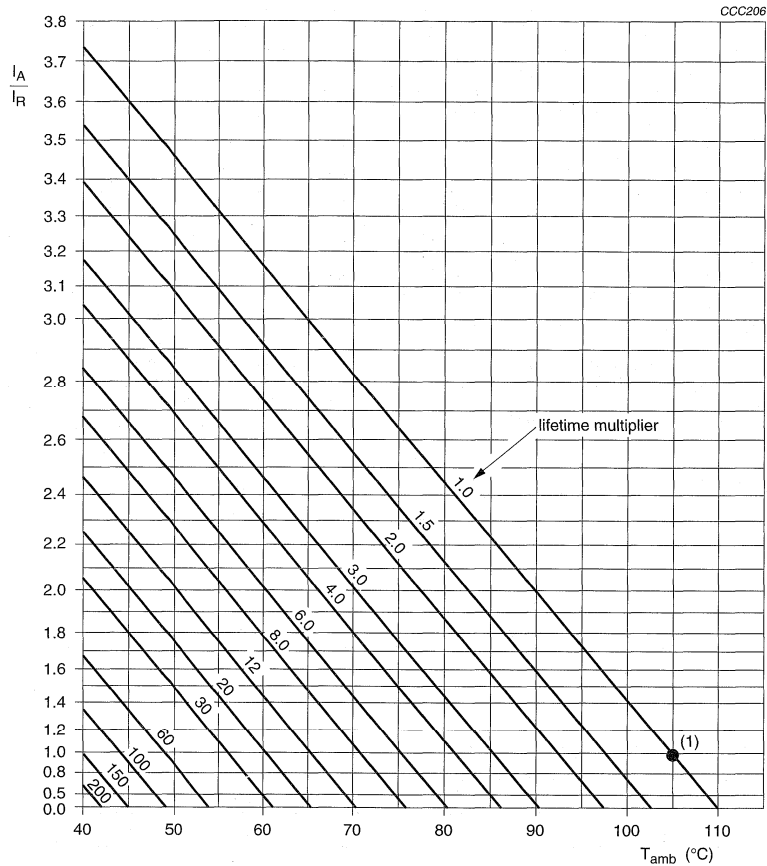
FREQUENCY (Hz)	I_R MULTIPLIER							
	$U_R = 10\text{ V}$		$U_R = 16\text{ and }25\text{ V}$		$U_R = 35\text{ and }50\text{ V}$		$U_R = 63\text{ and }100\text{ V}$	
	$\varnothing \leq 12.5$	$\varnothing \geq 16$	$\varnothing \leq 12.5$	$\varnothing \geq 16$	$\varnothing \leq 12.5$	$\varnothing \geq 16$	$\varnothing \leq 12.5$	$\varnothing \geq 16$
100	0.7	0.83	0.63	0.69	0.5	0.6	0.35	0.5
300	0.8	0.9	0.72	0.79	0.61	0.71	0.51	0.64
1000	0.88	0.95	0.8	0.87	0.72	0.8	0.66	0.74
3000	0.92	0.98	0.88	0.92	0.81	0.88	0.76	0.83
10000	0.96	0.99	0.92	0.96	0.88	0.93	0.85	0.9
30000	0.99	1.0	0.98	0.99	0.94	0.96	0.92	0.95
100000	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Table 4 Endurance test duration and useful life as a function of case size; see Fig.14

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	ENDURANCE TEST at 105 °C (hours)	USEFUL LIFE at 105 °C (hours)
10 × 12	14	3000	4000
10 × 16	15	3000	6000
10 × 20	16	3000	6000
10 × 25	16L	5000	7000
10 × 30	16LL	5000	7000
12.5 × 16	17a	3000	5000
12.5 × 20	17	3000	7000
12.5 × 25	18	5000	8000
12.5 × 31	18L	5000	8000
16 × 20	19a	3000	7000
16 × 25	19	5000	10000
16 × 31	20	5000	10000
16 × 35	21	5000	10000
18 × 20	1820	3000	7000
18 × 25	1825	5000	10000
18 × 31	1831	5000	10000
18 × 35	22	5000	10000

Aluminum electrolytic capacitors
Radial, Very Low Impedance

136 RVI



I_A = actual ripple current at 100 kHz.
 I_R = rated ripple current at 100 kHz, 105 °C.
 (1) Useful life at 105 °C and I_R applied; see Table 4.

Fig.14 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial, Very Low Impedance

136 RVI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; for test duration see Table 4	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; for test duration see Table 4	$\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$



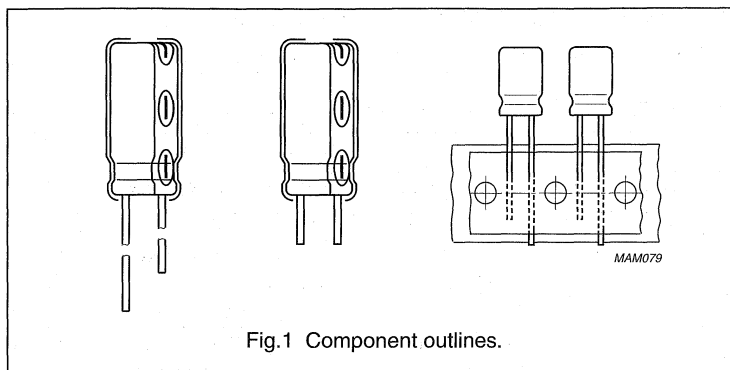
Aluminum electrolytic capacitors

Radial High Temperature

165 RHT

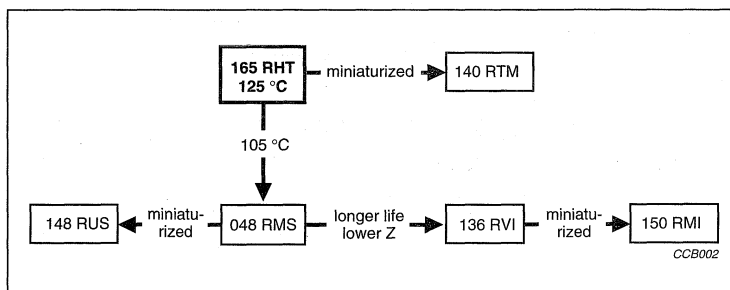
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue sleeve
- Charge and discharge proof
- Very long useful life: 1500 hours at 125 °C, high stability, high reliability
- Extended temperature range up to 125 °C
- High ripple current capability.



APPLICATIONS

- EDP, telecommunication, industrial, automotive and military
- Smoothing, filtering, buffering in SMPS
- High ambient temperature environments.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 16 × 35
Rated capacitance range, C_R	22 to 4700 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	10 to 50 V
Category temperature range	-40 to +125 °C
Endurance test at 125 °C	1 000 hours
Useful life at 125 °C	1 500 hours
Useful life at 40 °C, $1.6 \times I_R$ applied	300 000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/125/56

Aluminum electrolytic capacitors

Radial High Temperature

165 RHT

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	35	40	50
22	–	–	–	–	–	10 × 12
47	–	–	–	–	10 × 12	10 × 16
100	–	–	10 × 12	10 × 16	10 × 20	12.5 × 20
220	10 × 12	10 × 16	10 × 20	–	12.5 × 20	16 × 25
470	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	16 × 35
1000	–	12.5 × 25	16 × 31	–	16 × 35	16 × 35
2200	16 × 31	16 × 35	16 × 35	–	–	–
3300	16 × 35	16 × 35	–	–	–	–
4700	16 × 35	–	–	–	–	–

Aluminum electrolytic capacitors

Radial High Temperature

165 RHT

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

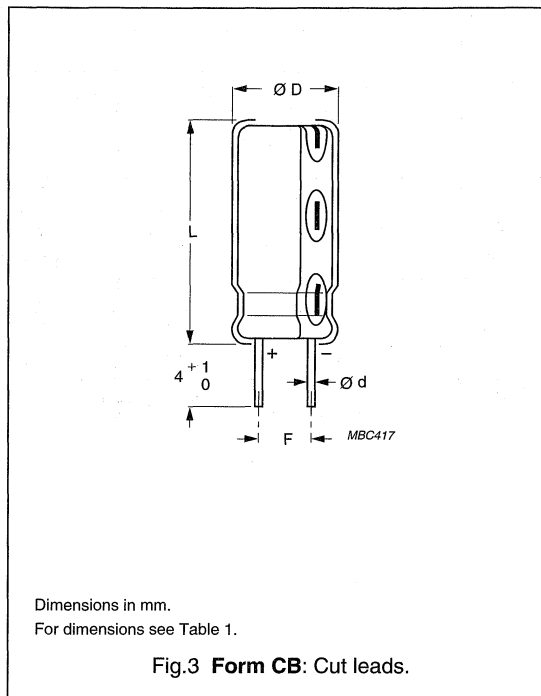
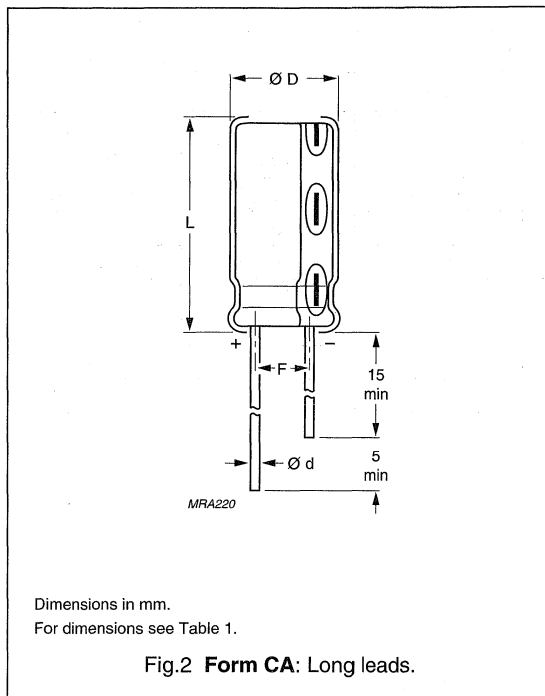


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

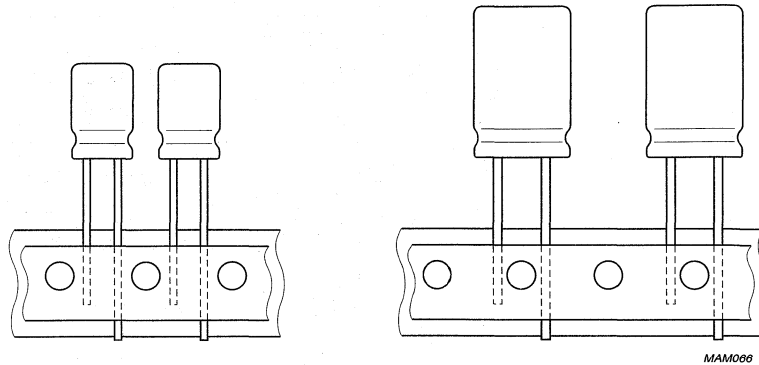
NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES PER BOX		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11.5	100	100	–

Aluminum electrolytic capacitors

Radial High Temperature

165 RHT

Taped products



Form TFA

Case $\varnothing D \times L \leq 16 \times 31\text{mm}$.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.4 Taped in box (ammopack).

MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature ($125\text{ }^\circ\text{C}$)
- Group number (165)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.



Aluminum electrolytic capacitors Radial High Temperature

165 RHT

Ordering example

Electrolytic capacitor 165 series
220 µF/25 V, ±20%
Nominal case size: Ø10 × 20 mm; Form TFA
Catalogue number: 2222 165 36221.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 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 ±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 δ _{max} and C _R)
Z	max. impedance at 10 kHz or 100 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U _R (V)	C _R 100 Hz (µF)	NOMINAL CASE SIZE ØD × 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)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	
10	220	10 × 12	14	200	25	7	0.20	1.30	—	0.55	165 54221	165 64221	165 34221
	470	10 × 20	16	340	50	12	0.20	0.61	—	0.26	165 54471	165 64471	165 34471
	2200	16 × 31	20	930	220	47	0.24	0.16	0.07	—	165 54222	165 64222	165 34222
	3300	16 × 35	21	1200	330	69	0.26	0.11	0.05	—	165 54332	165 64332	—
	4700	16 × 35	21	1400	470	97	0.28	0.09	0.04	—	165 90502	165 90507	—
16	220	10 × 16	15	240	38	10	0.16	1.00	—	0.43	165 55221	165 65221	165 35221
	470	12.5 × 20	17	410	78	18	0.16	0.49	—	0.20	165 55471	165 65471	165 35471
	1000	12.5 × 25	18	650	160	35	0.16	0.23	—	0.10	165 55102	165 65102	165 35102
	2200	16 × 35	21	1100	360	73	0.20	0.13	0.05	—	165 55222	165 65222	—
	3300	16 × 35	21	1400	530	110	0.22	0.10	0.04	—	165 90503	165 90508	—
25	100	10 × 12	14	170	28	8	0.14	2.00	—	0.70	165 56101	165 66101	165 36101
	220	10 × 20	16	280	58	14	0.14	0.91	—	0.32	165 56221	165 66221	165 36221
	470	12.5 × 25	18	480	120	27	0.14	0.43	—	0.15	165 56471	165 66471	165 36471
	1000	16 × 31	20	830	250	53	0.14	0.20	—	0.07	165 56102	165 66102	165 36102
	2200	16 × 35	21	1200	550	110	0.18	0.12	0.04	—	165 90504	165 90509	—

Aluminum electrolytic capacitors
Radial High Temperature

165 RHT

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × 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)	Z 100 kHz (Ω)	CATALOGUE NUMBER		
											2222		
											BULK PACKAGING	TAPED	
FORM CA	FORM CB	FORM TFA											
35	100	10 × 16	15	200	38	10	0.12	1.70	—	0.65	165 50101	165 60101	165 30101
	470	16 × 25	19	600	170	36	0.12	0.37	—	0.14	165 50471	165 60471	165 30471
40	47	10 × 12	14	130	22	7	0.12	3.70	—	1.30	165 57479	165 67479	165 37479
	100	10 × 20	16	210	43	11	0.12	1.70	—	0.60	165 57101	165 67101	165 37101
	220	12.5 × 20	17	340	91	21	0.12	0.78	—	0.27	165 57221	165 67221	165 37221
	470	16 × 31	20	650	190	41	0.12	0.37	—	0.13	165 57471	165 67471	165 37471
50	1000	16 × 35	21	1000	400	83	0.12	0.17	—	0.06	165 57102	165 67102	—
	22	10 × 12	14	100	14	5	0.10	6.50	—	2.3	165 51229	165 61229	165 31229
	47	10 × 16	15	150	27	8	0.10	3.00	—	1.10	165 51479	165 61479	165 31479
	100	12.5 × 20	17	260	53	13	0.10	1.40	—	0.50	165 51101	165 61101	165 31101
	220	16 × 25	19	450	110	25	0.10	0.65	—	0.23	165 51221	165 61221	165 31221
470	470	16 × 35	21	760	240	50	0.10	0.30	—	0.11	165 51471	165 61471	—
	1000	16 × 35	21	1200	500	100	0.10	0.14	—	0.05	165 90506	165 90512	—

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		U _s ≤ 1.3 U _R
Reverse voltage		U _{rev} ≤ 1 V
Current		
Leakage current	after 1 minute at U _R	I _{L1} ≤ 0.01 C _R × U _R + 3 μA
	after 5 minutes at U _R	I _{L5} ≤ 0.002 C _R × U _R + 3 μA
Inductance		
Equivalent series inductance (ESL)	case ∅D = 10 mm	typ. 16 nH
	case ∅D ≥ 12.5 mm	typ. 18 nH

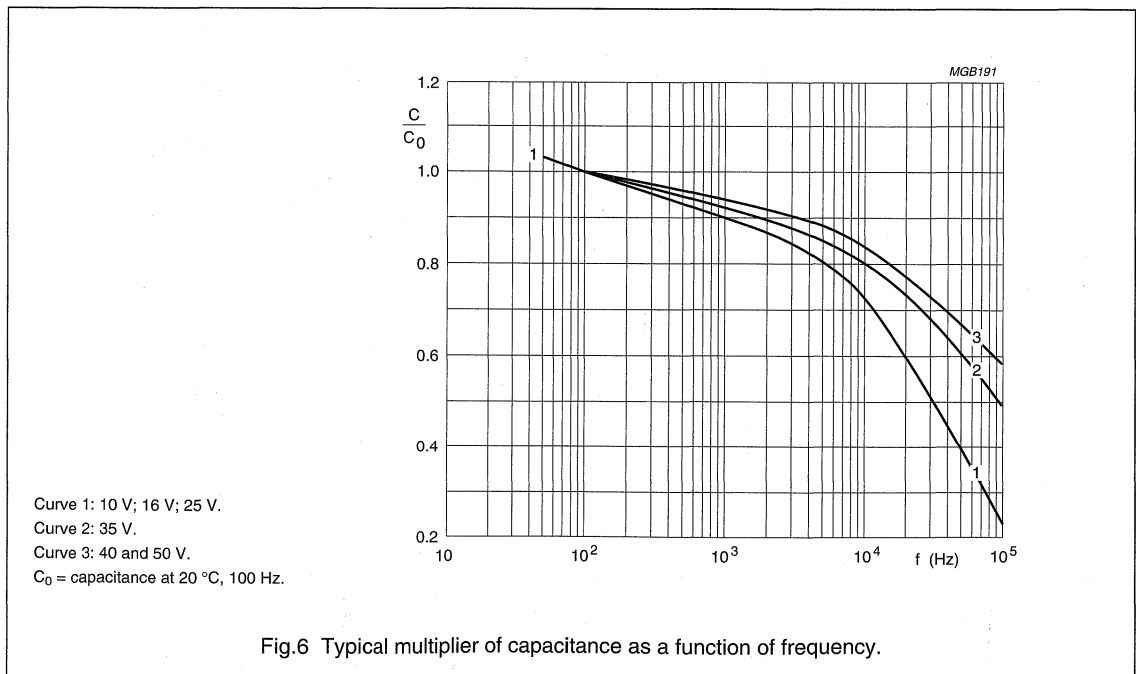
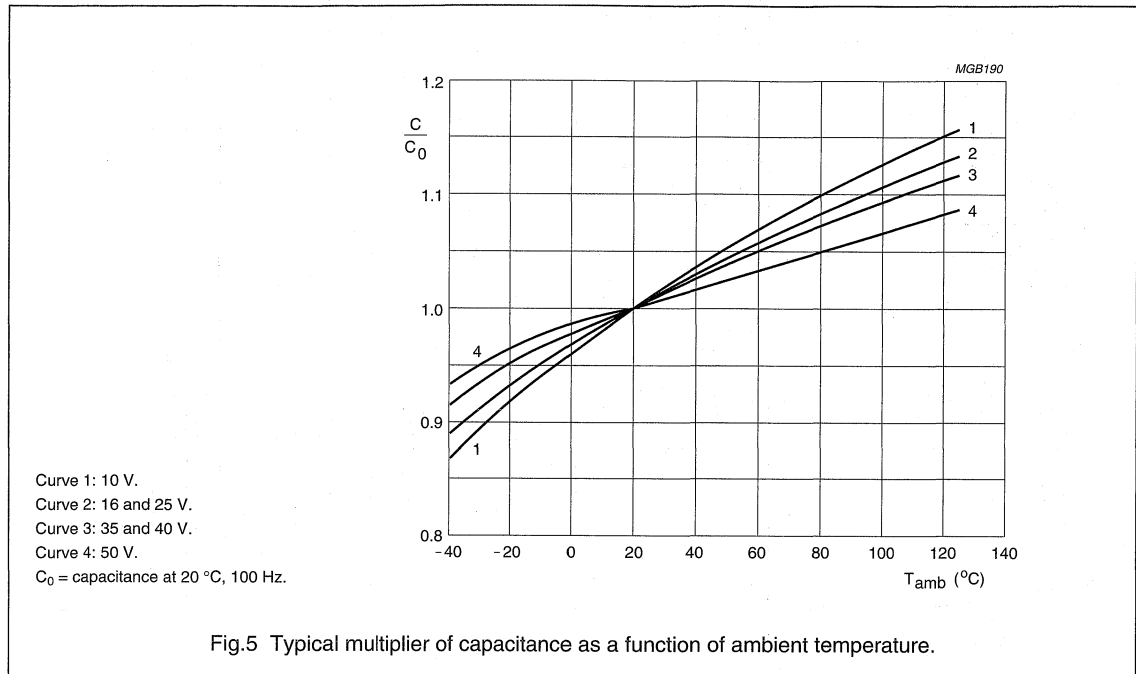


Aluminum electrolytic capacitors

Radial High Temperature

165 RHT

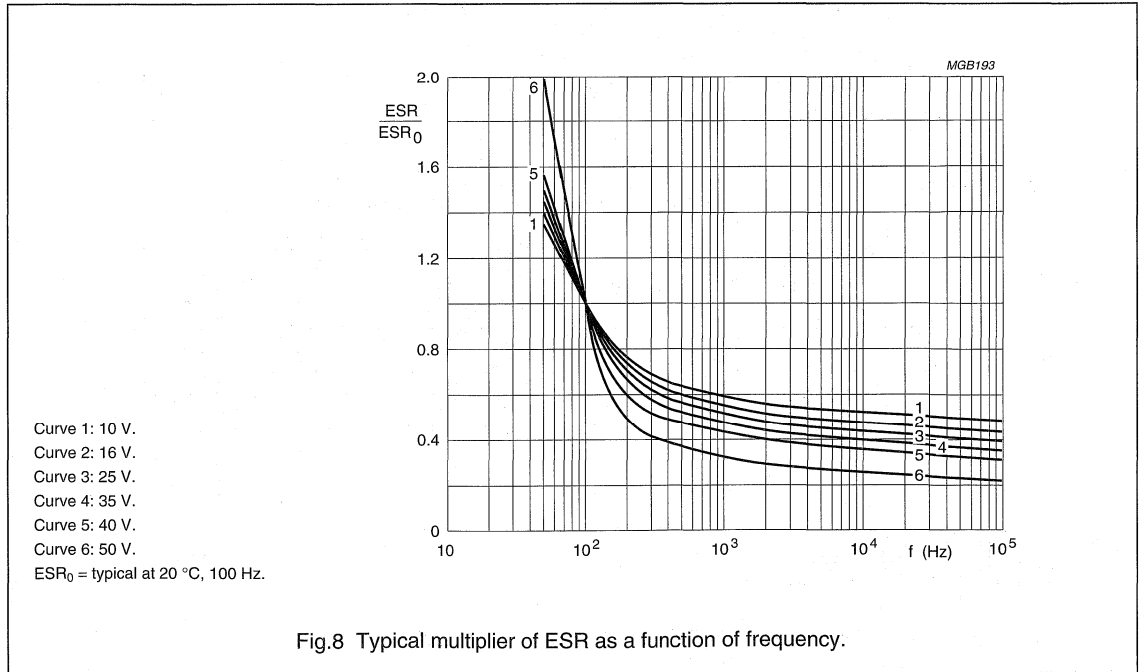
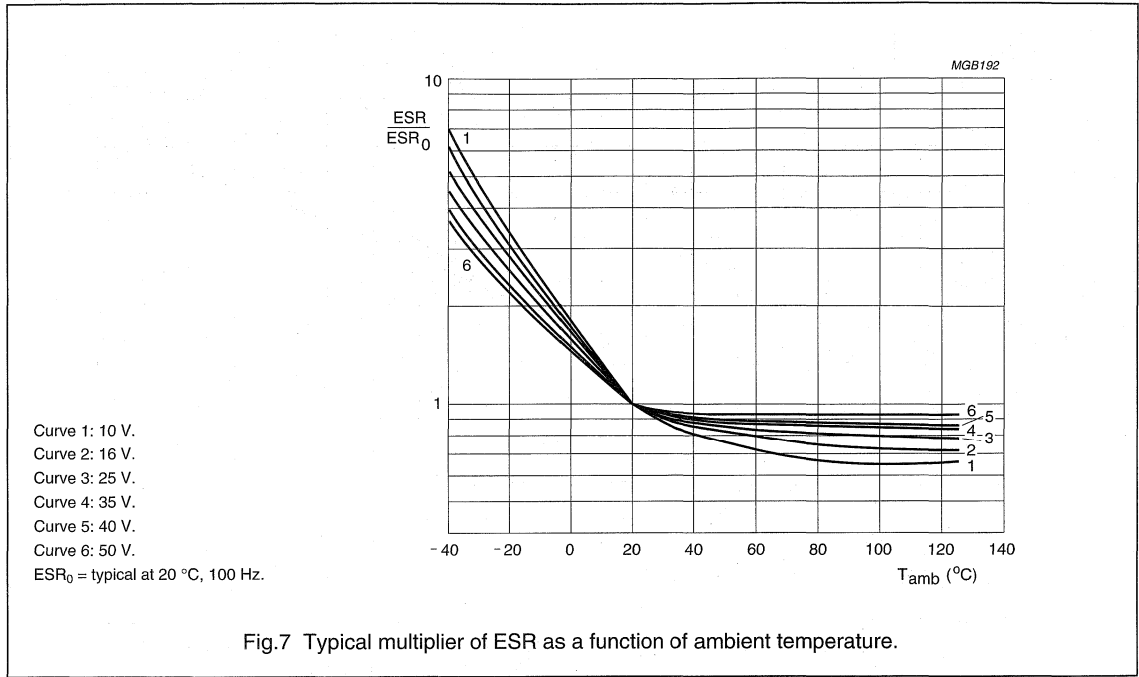
Capacitance (C)



Aluminum electrolytic capacitors Radial High Temperature

165 RHT

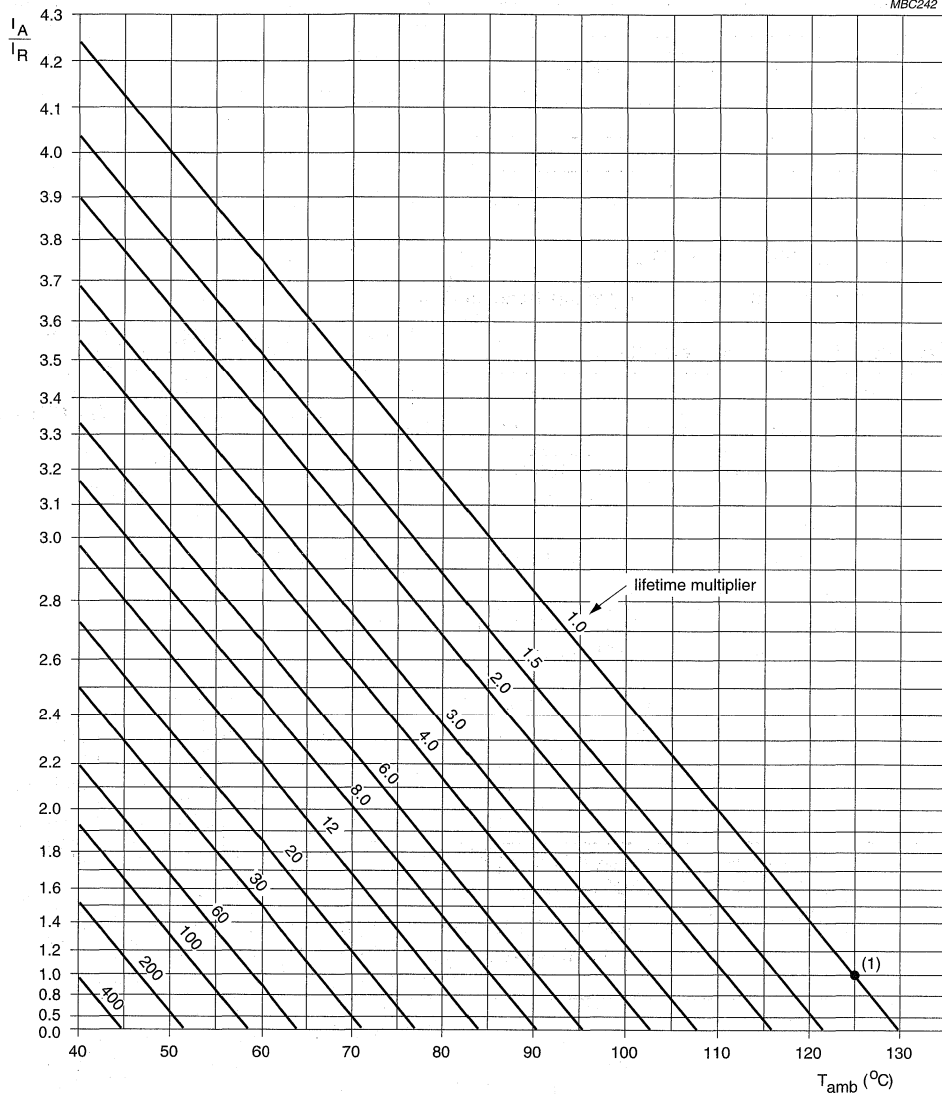
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors Radial High Temperature

165 RHT

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: 1500 hours.

Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load; see Table 3.

Aluminum electrolytic capacitors

Radial High Temperature

165 RHT

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 35$ or 40 V	$U_R = 50$ V
50	0.85	0.80	0.75
100	1.00	1.00	1.00
300	1.20	1.25	1.30
1000	1.30	1.40	1.50
3000	1.35	1.50	1.65
≥ 10000	1.40	1.60	1.80

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 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; 1000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 125$ °C; U_R and I_R applied; 1500 hours	$\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125$ °C; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

R

Aluminum electrolytic capacitors Radial High Temperature Miniature

140 RTM

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue sleeve
- Charge and discharge proof
- Very long useful life: 2500 to 4000 hours at 125 °C, high stability, high reliability
- Extended temperature range up to 125 °C
- High ripple current capability.

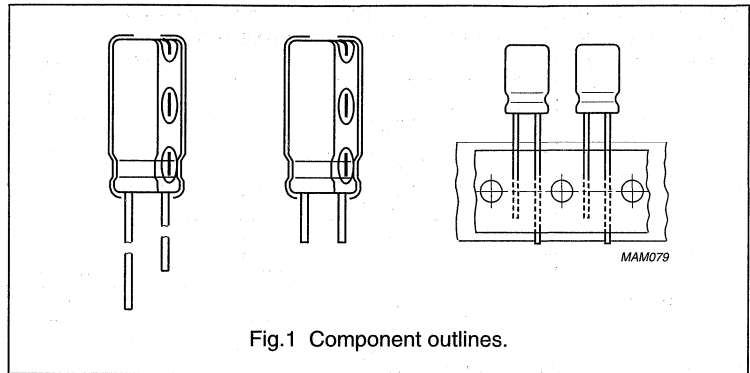
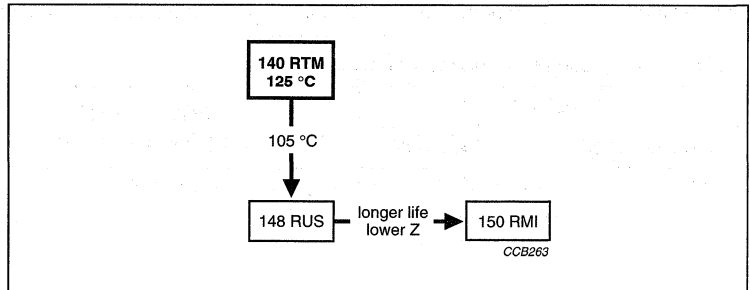


Fig.1 Component outlines.

APPLICATIONS

- EDP, telecommunication, industrial, automotive and military
- Smoothing, filtering, buffering in SMPS
- High ambient temperature environments.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 31
Rated capacitance range, C_R	22 to 4700 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	10 to 63 V
Category temperature range	-55 to +125 °C
Endurance test at 125 °C	2000 hours
Useful life at 125 °C	2500 to 4000 hours (dependent on case size)
Useful life at 40 °C, $1.6 \times I_R$ applied	300000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/125/56

Aluminum electrolytic capacitors

Radial High Temperature Miniature

140 RTM

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

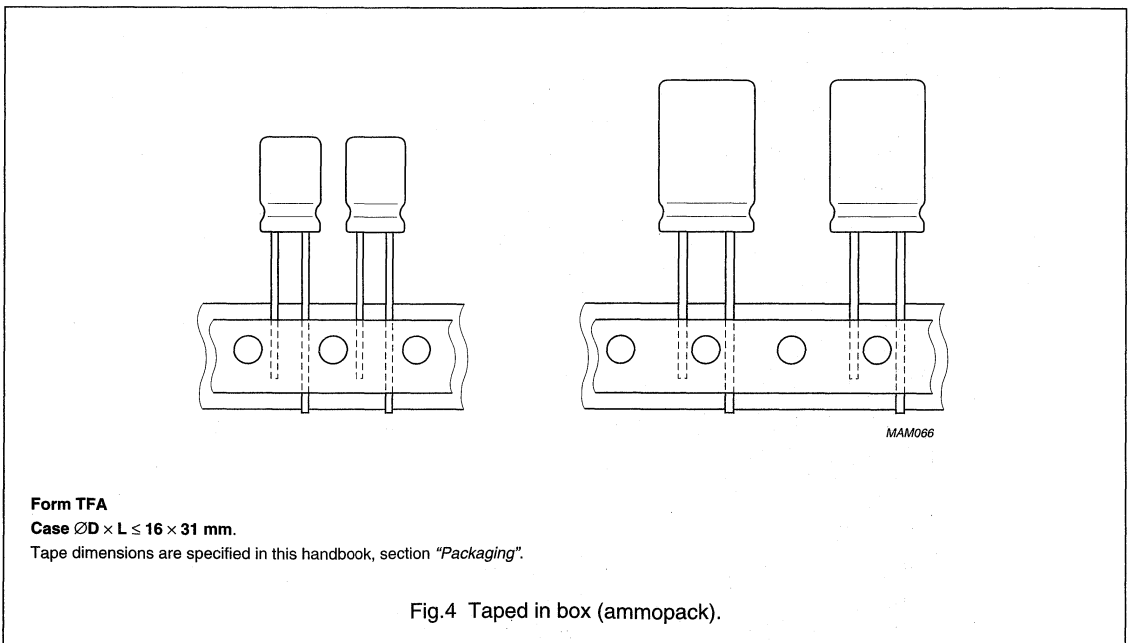
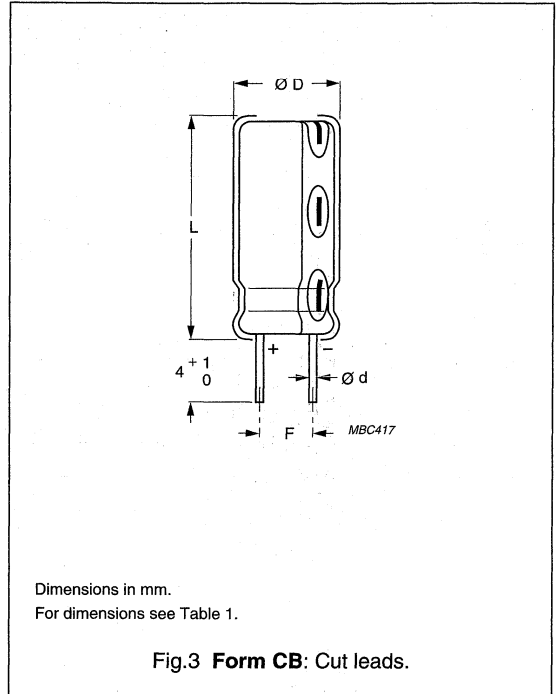
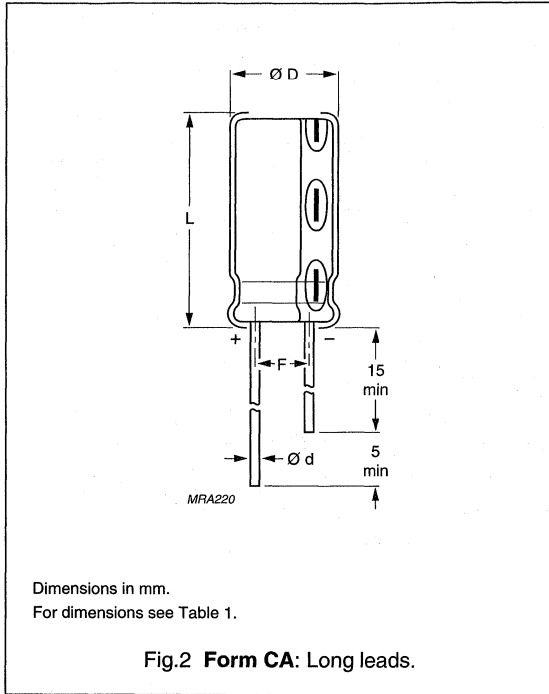
Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	35	50	63
22	–	–	–	–	–	10 × 12
47	–	–	–	–	10 × 12	10 × 12
100	–	–	–	10 × 12	10 × 16	10 × 20
220	–	10 × 12	10 × 16	10 × 16	12.5 × 20	16 × 20
330	10 × 12	10 × 16	10 × 20	–	12.5 × 20	16 × 20
470	10 × 16	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25
	–	–	–	–	16 × 20	–
1000	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31	18 × 31
	–	–	16 × 20	–	–	–
2200	12.5 × 25	16 × 25	16 × 31	18 × 31	–	–
	16 × 20	–	–	–	–	–
3300	16 × 25	16 × 31	18 × 31	–	–	–
4700	16 × 31	18 × 31	–	–	–	–

Aluminum electrolytic capacitors Radial High Temperature Miniature

140 RTM

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors

Radial High Temperature Miniature

140 RTM

Table 1 Physical dimensions, mass and packaging quantities; see Figs 2, 3 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES PER BOX		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 20	19a	0.8	16.5	22.0	7.5 ± 0.5	≈ 6.0	250	250	250
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	100	100	250
18 × 31	1831	0.8	18.5	33.5	7.5 ± 0.5	≈ 12.5	100	100	–

MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (125 °C)
- Group number (140)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

Aluminum electrolytic capacitors

Radial High Temperature Miniature

140 RTM

Ordering example

Electrolytic capacitor 140 series

220 $\mu\text{F}/25\text{ V}; \pm 20\%$ Nominal case size: $\varnothing 10 \times 16\text{ mm}$; Form TFA

Catalogue number: 2222 140 36221.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20\text{ }^{\circ}\text{C}$,
 $P = 86\text{ to }106\text{ kPa}$, $\text{RH} = 45\text{ to }75\%$.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 kHz, 125 $^{\circ}\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\text{Tan } \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\text{tan } \delta_{\text{max}}$ and C_R)
Z	max. impedance at 100 kHz and +20 or $-40\text{ }^{\circ}\text{C}$

Table 2 Electrical data and ordering information; preferred types in bold

U_R 100 Hz (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 kHz 125 $^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 100 kHz +20 $^{\circ}\text{C}$ (Ω)	Z 100 kHz $-40\text{ }^{\circ}\text{C}$ (Ω)	CATALOGUE NUMBER		
										CASE CODE	FORM CA	FORM CB
10	330	10 \times 12	480	36	10	0.20	0.96	0.200	1.40	140 54331	140 64331	140 34331
	470	10 \times 16	760	50	12	0.20	0.68	0.150	1.10	140 54471	140 64471	140 34471
	1000	10 \times 20	850	103	23	0.20	0.32	0.120	0.85	140 54102	140 64102	140 34102
	2200	12.5 \times 25	1400	223	47	0.24	0.17	0.050	0.40	140 94225	140 94226	140 94223
	2200	16 \times 20	1400	223	47	0.24	0.17	0.050	0.40	140 54222	140 64222	140 34222
	3300	16 \times 25	1900	333	69	0.24	0.12	0.034	0.25	140 54332	140 64332	140 34332
	4700	16 \times 31	2200	473	97	0.24	0.08	0.030	0.20	140 54472	140 64472	140 34472
16	220	10 \times 12	480	38	10	0.16	1.16	0.200	1.40	140 55221	140 65221	140 35221
	330	10 \times 16	760	56	14	0.16	0.77	0.150	1.10	140 55331	140 65331	140 35331
	470	10 \times 16	760	78	18	0.16	0.54	0.150	1.10	140 55471	140 65471	140 35471
	1000	12.5 \times 20	1200	163	35	0.16	0.25	0.120	0.50	140 55102	140 65102	140 35102
	2200	16 \times 25	1900	355	73	0.18	0.13	0.034	0.25	140 55222	140 65222	140 35222
	3300	16 \times 31	2200	531	109	0.18	0.09	0.030	0.20	140 55332	140 65332	140 35332
	4700	18 \times 31	2200	755	153	0.18	0.06	0.030	0.20	140 55472	140 65472	—

Aluminum electrolytic capacitors Radial High Temperature Miniature

140 RTM

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 kHz 125 °C (mA)	I _{L1} 1 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 100 kHz +20 °C (Ω)	Z 100 kHz -40 °C (Ω)	CATALOGUE NUMBER			
											2222			
											BULK PACKAGING		TAPED	
FORM CA	FORM CB	FORM TFA												
25	220	10 × 16	15	750	58	14	0.14	1.01	0.150	1.10	140 56221	140 66221	140 36221	
	330	10 × 20	16	850	86	20	0.14	0.68	0.120	0.85	140 56331	140 66331	140 36331	
	470	10 × 20	16	850	121	27	0.14	0.47	0.120	0.85	140 56471	140 66471	140 36471	
	1000	12.5 × 25	18	1400	253	53	0.14	0.22	0.050	0.40	140 96105	140 96106	140 96103	
	1000	16 × 20	19a	1400	253	53	0.14	0.22	0.050	0.40	140 56102	140 66102	140 36102	
	2200	16 × 31	20	2200	553	113	0.16	0.12	0.030	0.20	140 56222	140 66222	140 36222	
	3300	18 × 31	1831	2200	828	168	0.16	0.08	0.030	0.20	140 56332	140 66332	—	
	35	100	10 × 12	14	480	38	10	0.12	1.91	0.200	1.40	140 50101	140 60101	140 30101
	220	220	10 × 16	15	760	80	18	0.12	0.87	0.150	1.10	140 50221	140 60221	140 30221
	470	470	12.5 × 20	17	1200	168	36	0.12	0.41	0.073	0.50	140 50471	140 60471	140 30471
50	1000	16 × 25	19	1500	353	73	0.12	0.19	0.034	0.25	140 50102	140 60102	140 30102	
	2200	18 × 31	1831	2200	773	157	0.14	0.10	0.030	0.20	140 50222	140 60222	—	
	47	10 × 12	14	300	27	8	0.10	3.39	0.300	2.00	140 51479	140 61479	140 31479	
	100	10 × 16	15	380	53	13	0.10	1.59	0.200	1.40	140 51101	140 61101	140 31101	
	220	12.5 × 20	17	580	113	25	0.10	0.72	0.120	0.85	140 51221	140 61221	140 31221	
	330	12.5 × 20	17	870	168	36	0.10	0.48	0.120	0.85	140 51331	140 61331	140 31331	
	470	12.5 × 25	18	1100	238	50	0.10	0.34	0.085	0.60	140 91475	140 91476	140 91473	
	470	16 × 20	19a	1100	238	50	0.10	0.34	0.085	0.60	140 51471	140 61471	140 31471	
	1000	16 × 31	20	1700	503	103	0.10	0.16	0.045	0.30	140 51102	140 61102	140 31102	
	63	22	10 × 12	14	380	17	6	0.10	7.23	0.300	2.00	140 58229	140 68229	140 38229
47	47	10 × 12	14	380	33	9	0.10	3.39	0.300	2.00	140 58479	140 68479	140 38479	
100	100	10 × 20	16	650	66	16	0.10	1.59	0.160	1.10	140 58101	140 68101	140 38101	
220	220	16 × 20	19a	1100	142	31	0.10	0.72	0.085	0.60	140 58221	140 68221	140 38221	
330	330	16 × 20	19a	1100	211	45	0.10	0.48	0.085	0.60	140 58331	140 68331	140 38331	
470	470	16 × 25	19	1500	299	62	0.10	0.34	0.055	0.40	140 58471	140 68471	140 38471	
1000	1000	18 × 31	1831	1800	633	129	0.10	0.16	0.040	0.28	140 58102	140 68102	—	

Aluminum electrolytic capacitors
Radial High Temperature Miniature

140 RTM

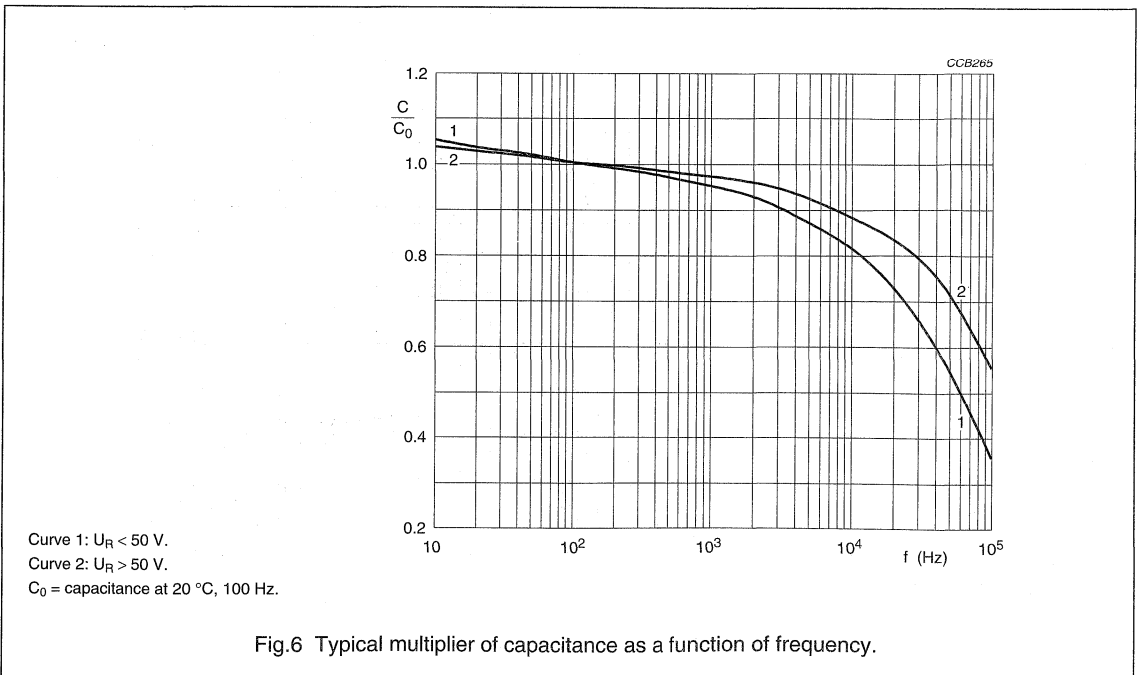
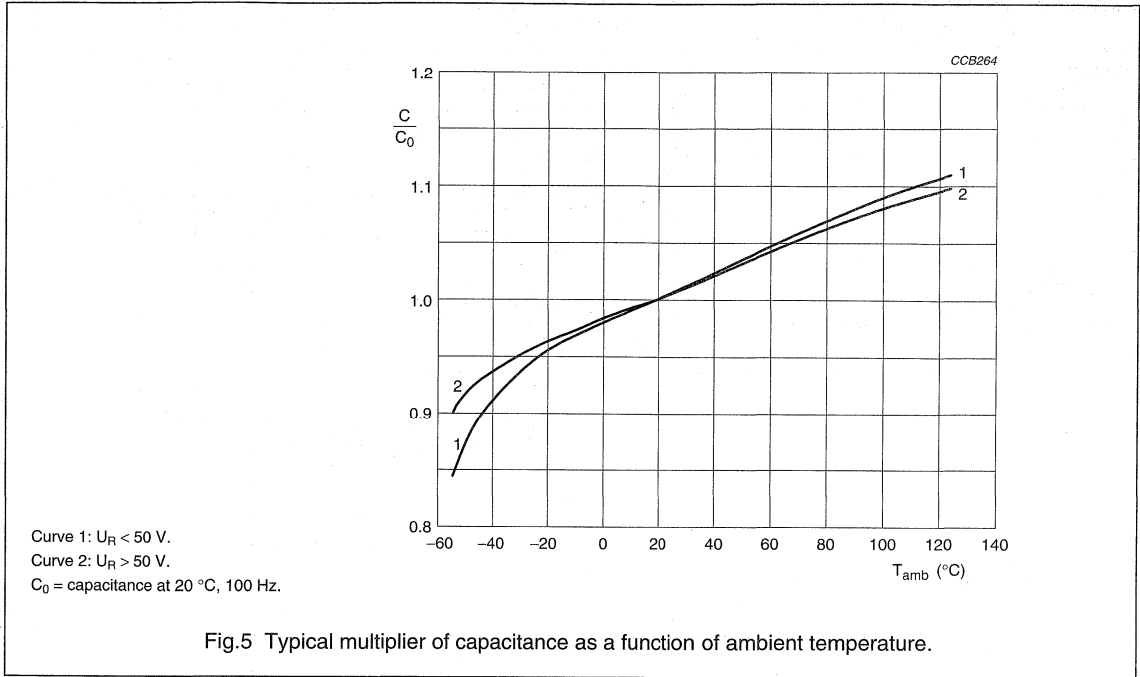
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.3 U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu A$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu A$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

Aluminum electrolytic capacitors Radial High Temperature Miniature

140 RTM

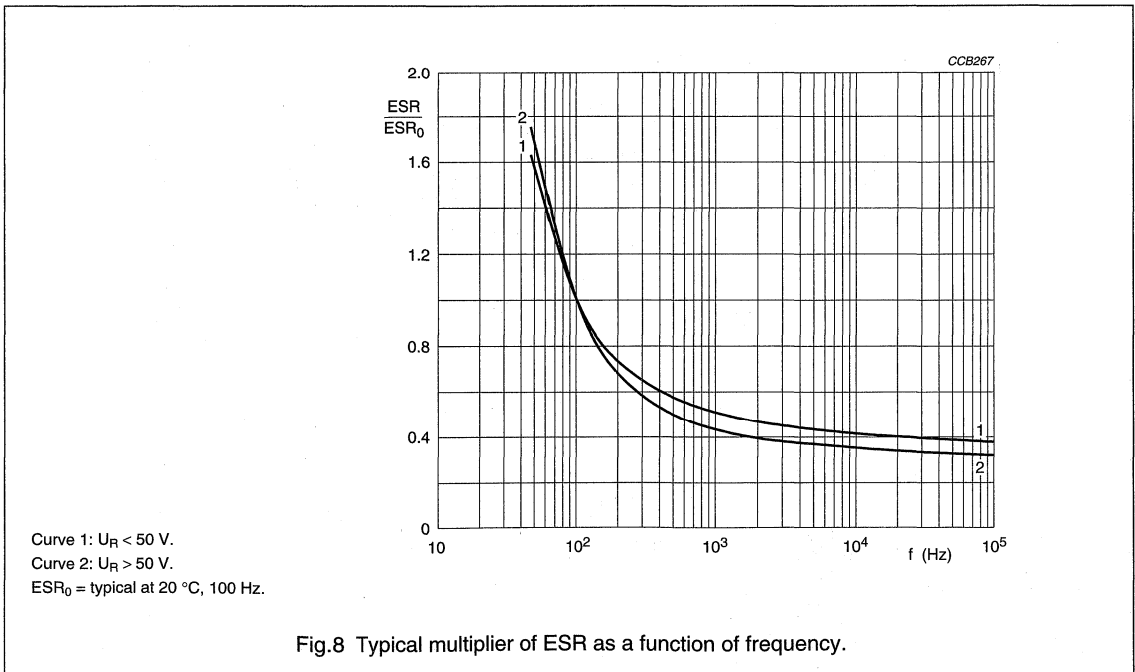
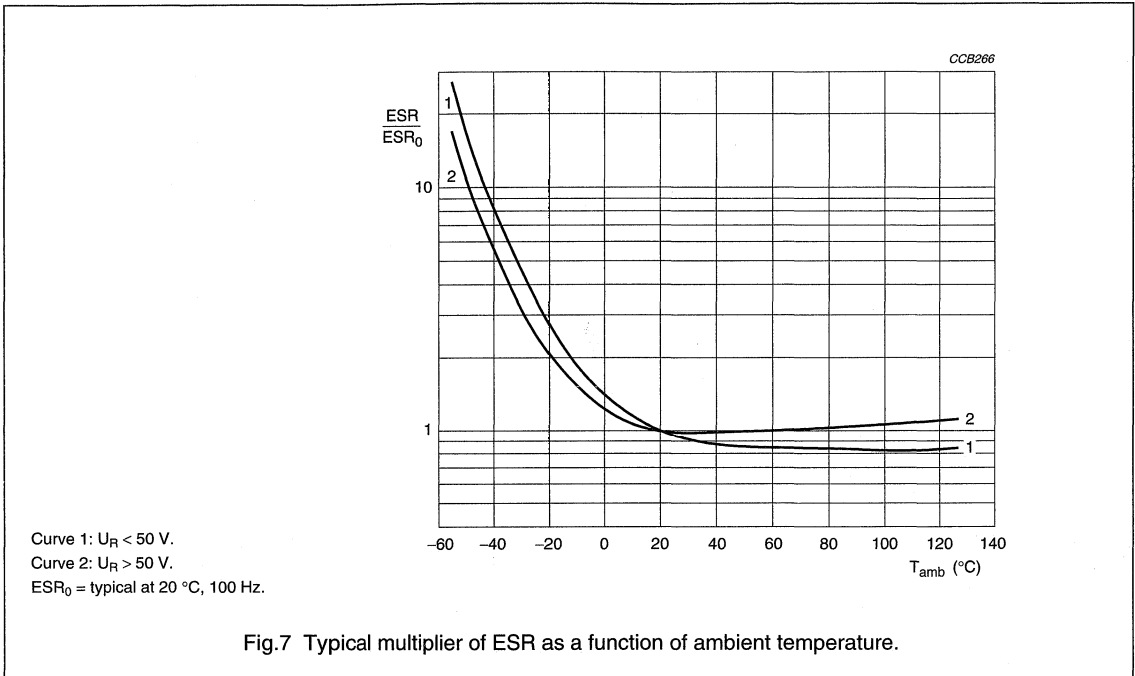
Capacitance (C)



Aluminum electrolytic capacitors Radial High Temperature Miniature

140 RTM

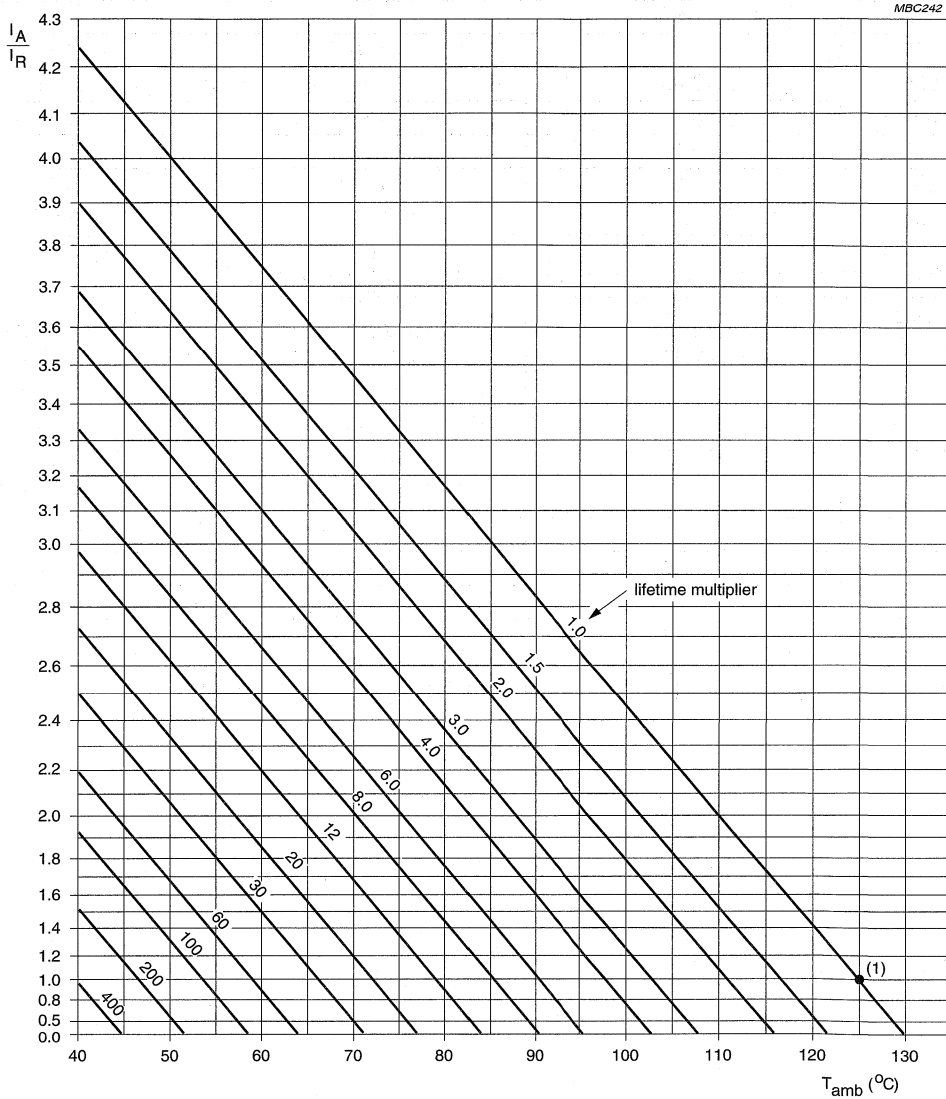
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors Radial High Temperature Miniature

140 RTM

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 kHz.

I_R = rated ripple current at 100 kHz, 125 °C.

(1) Useful life at 125 °C and I_R applied: 2500 to 4 000 hours; see Table 4.

Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load; see Table 3.

Aluminum electrolytic capacitors

Radial High Temperature Miniature

140 RTM

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 35$ V	$U_R = 50$ and 63 V
50	0.6	0.5	0.35
100	0.7	0.65	0.5
300	0.85	0.8	0.65
1000	0.9	0.85	0.8
3000	0.95	0.9	0.9
10000	1.0	0.95	0.9
100000	1.0	1.0	1.0

Table 4 Endurance test duration and useful life as a function of case size; see Fig.9

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	ENDURANCE TEST at 125°C (hours)	USEFUL LIFE at 125°C (hours)
10×12	14	2000	2500
10×16	15	2000	3000
10×20	16	2000	3000
12.5×20	17	2000	3000
12.5×25	18	2000	3000
16×20	19a	2000	3000
16×25	19	2000	4000
16×31	20	2000	4000
18×31	1831	2000	4000

Aluminum electrolytic capacitors

Radial High Temperature Miniature

140 RTM

SPECIFIC TESTS AND REQUIREMENTS

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

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125\text{ °C}$; U_R applied; 2000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 125\text{ °C}$; U_R and I_R applied; for test duration see Table 4	$\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

R

Aluminum electrolytic capacitors

Radial Miniature, Low Impedance

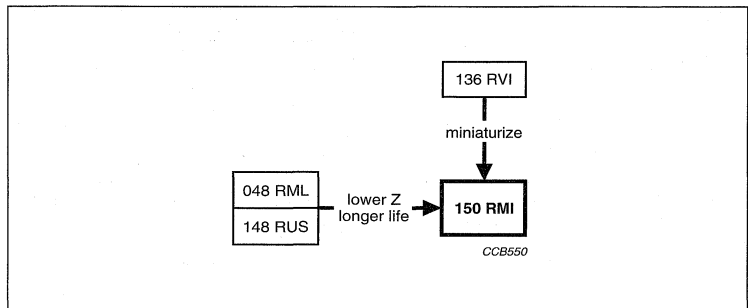
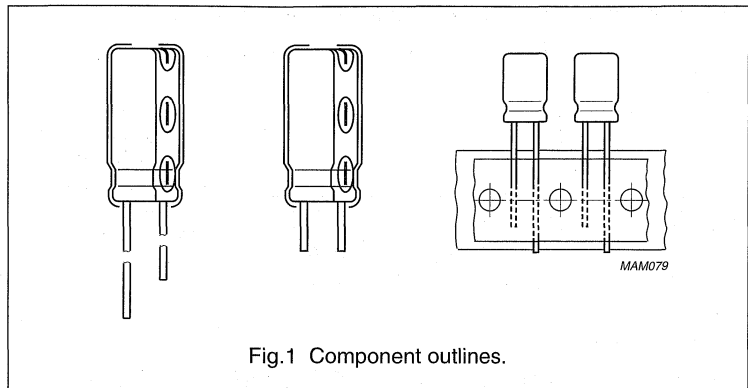
150 RMI

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Very long useful life: 4000 to 10000 hours at 105 °C, high stability, high reliability
- Very low impedance or ESR respectively, at smaller case sizes than the 150 RVI series
- Excellent ripple current capability.

APPLICATIONS

- Power supplies (SMPS, DC/DC converters) for general industrial, EDP, audio-video, automotive and telecommunications
- Smoothing, filtering, buffering.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 16 × 35
Rated capacitance range, C_R	100 to 6800 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	10 to 63 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C	3000 to 5000 hours (dependent on case size)
Useful life at 105 °C	4000 to 10000 hours (dependent on case size)
Useful life at 40 °C, $1.8 \times I_R$ applied	200000 to 500000 hours (dependent on case size)
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/105/56

Aluminum electrolytic capacitors

Radial Miniature, Low Impedance

150 RMI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm); note 1

Preferred types in **bold**.

$C_R^{(2)}$ (μF)	U_R (V)					
	10	16	25	35	50	63
100	–	–	–	–	–	10 × 12
150	–	–	–	–	10 × 12	10 × 16
220	–	–	–	10 × 12	10 × 16	10 × 20
330	–	–	10 × 12	10 × 16	10 × 20	12.5 × 20
470	–	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 25
	–	–	–	–	–	16 × 20
680	10 × 12	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 20
	–	–	–	–	–	16 × 25
1000	10 × 16	10 × 20	12.5 × 20	12.5 × 25	16 × 25	16 × 31
	–	–	–	16 × 20	–	–
1500	–	12.5 × 20	12.5 × 25	16 × 20	16 × 31	–
2200	12.5 × 20	12.5 × 25	16 × 20	16 × 31	–	–
3300	12.5 × 25	16 × 20	16 × 31	–	–	–
4700	16 × 25	16 × 31	16 × 35	–	–	–
6800	16 × 31	16 × 35	–	–	–	–

Notes

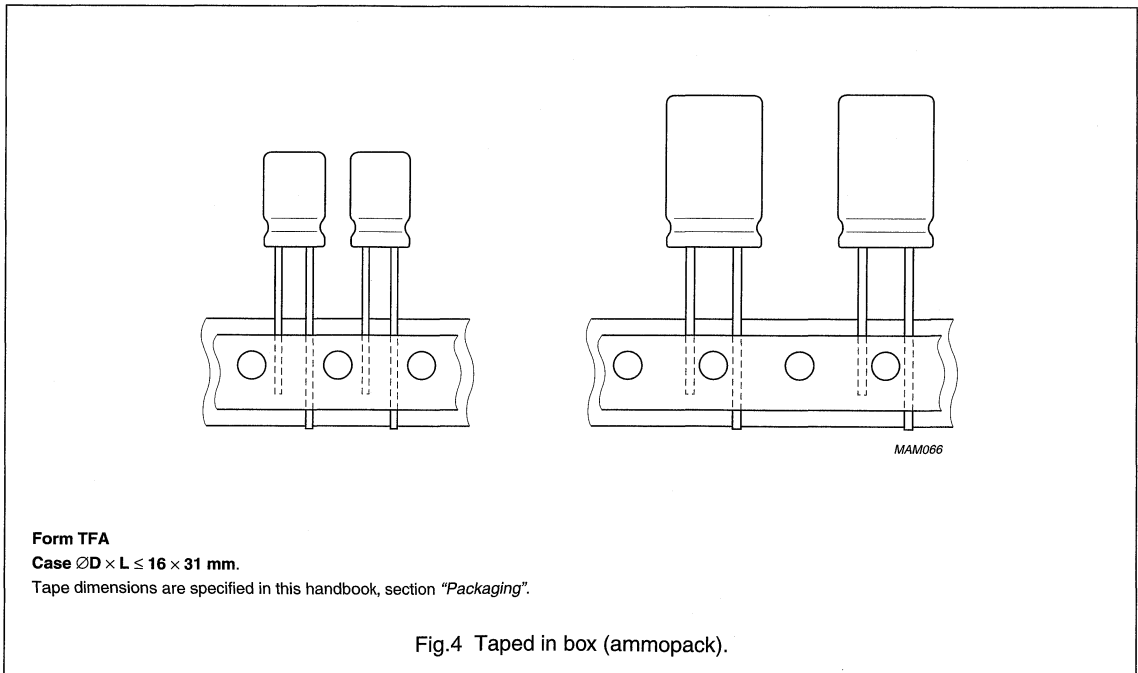
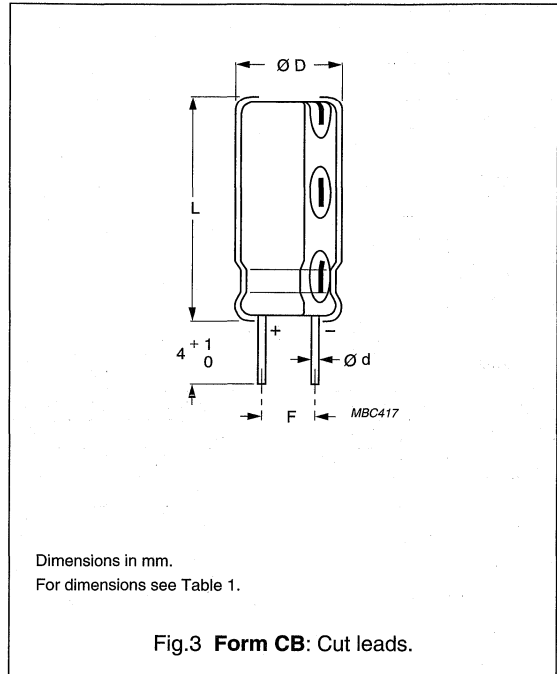
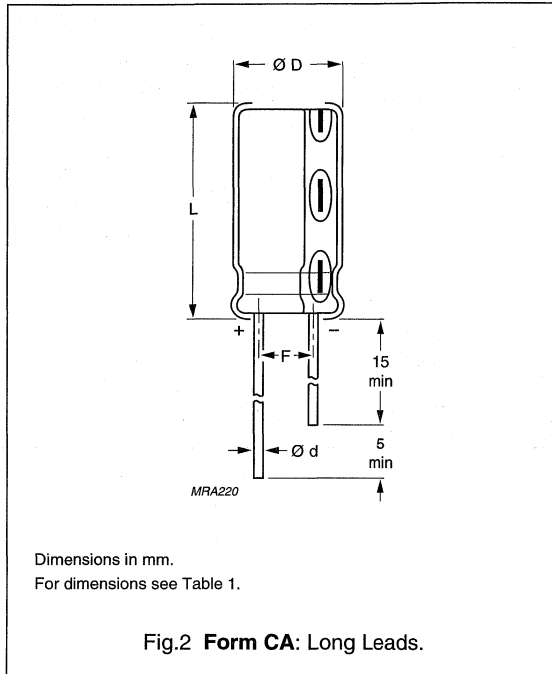
- For case sizes 18 × 20 to 18 × 35 see data sheet "136 RVI".
- E12 values on request.



Aluminum electrolytic capacitors Radial Miniature, Low Impedance

150 RMI

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors

Radial Miniature, Low Impedance

150 RMI

Table 1 Physical dimensions mass and packaging quantities; see Figs 2, 3 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA
10 × 12	14	0.6	10.5	13.5	5.0 ±0.5	≈1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ±0.5	≈1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ±0.5	≈2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ±0.5	≈4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ±0.5	≈5.0	250	250	500
16 × 20	19a	0.8	16.5	22.0	7.5 ±0.5	≈6.0	250	250	250
16 × 25	19	0.8	16.5	27.0	7.5 ±0.5	≈8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ±0.5	≈9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ±0.5	≈11.0	100	100	—

MARKING

The capacitors are marked with the following information:

- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (150)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.



Aluminum electrolytic capacitors

Radial Miniature, Low Impedance

150 RMI

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{amb} = 20\text{ }^{\circ}\text{C}$,
 $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 kHz, $105\text{ }^{\circ}\text{C}$
I_{L2}	max. leakage current after 2 minutes at U_R
$\tan \delta$	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 100 kHz and $+20$ or $-40\text{ }^{\circ}\text{C}$

Ordering example

Electrolytic capacitor 150 series

$470\text{ }\mu\text{F}/16\text{ V}; \pm 20\%$

Nominal case size: $\varnothing 10 \times 12\text{ mm}$; Form TFA

Catalogue number: 2222 150 35471.

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 kHz $105\text{ }^{\circ}\text{C}$ (mA)	I_{L2} 2 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 100 kHz $+20\text{ }^{\circ}\text{C}$ (Ω)	Z 100 kHz $-40\text{ }^{\circ}\text{C}$ (Ω)	CATALOGUE NUMBER			
										2222			
										BULK PACKAGING		TAPED	
		FORM CA	FORM CB	FORM TFA									
10	680	10×12	14	730	71	0.19	0.450	0.097	0.680	150 54681	150 64681	150 34681	
	1000	10×16	15	950	103	0.19	0.300	0.066	0.460	150 54102	150 64102	150 34102	
	2200	12.5×20	17	1460	223	0.21	0.152	0.037	0.260	150 54222	150 64222	150 34222	
	3300	12.5×25	18	1950	333	0.21	0.100	0.029	0.200	150 54332	150 64332	150 34332	
	4700	16×25	19	2390	473	0.23	0.078	0.022	0.150	150 54472	150 64472	150 34472	
	6800	16×31	20	2890	683	0.25	0.059	0.019	0.130	150 54682	150 64682	150 34682	
16	470	10×12	14	730	78	0.16	0.540	0.097	0.680	150 55471	150 65471	150 35471	
	680	10×16	15	950	112	0.16	0.375	0.066	0.460	150 55681	150 65681	150 35681	
	1000	10×20	16	1180	163	0.16	0.255	0.049	0.340	150 55102	150 65102	150 35102	
	1500	12.5×20	17	1460	243	0.16	0.170	0.037	0.260	150 55152	150 65152	150 35152	
	2200	12.5×25	18	1950	355	0.18	0.130	0.029	0.200	150 55222	150 65222	150 35222	
	3300	16×20	19a	1840	531	0.20	0.097	0.028	0.200	150 55332	150 65332	150 35332	
	4700	16×31	20	2890	755	0.22	0.075	0.019	0.130	150 55472	150 65472	150 35472	
	6800	16×35	21	3100	1091	0.24	0.056	0.018	0.130	150 55682	150 65682	150 35682	

Aluminum electrolytic capacitors
Radial Miniature, Low Impedance

150 RMI

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 kHz 105 °C (mA)	I _{L2} 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 100 kHz +20 °C (Ω)	Z 100 kHz -40 °C (Ω)	CATALOGUE NUMBER			
										2222			
										BULK PACKAGING		TAPED	
FORM CA		FORM CB	FORM TFA										
25	330	10 × 12	14	730	86	0.14	0.676	0.097	0.680	150 56331	150 66331	150 36331	
	470	10 × 16	15	950	121	0.14	0.474	0.066	0.460	150 56471	150 66471	150 36471	
	680	10 × 20	16	1180	173	0.14	0.328	0.049	0.340	150 56681	150 66681	150 36681	
	1000	12.5 × 20	17	1460	253	0.14	0.222	0.037	0.260	150 56102	150 66102	150 36102	
	1500	12.5 × 25	18	1950	378	0.14	0.149	0.029	0.200	150 56152	150 66152	150 36152	
	2200	16 × 20	19a	1840	553	0.16	0.116	0.028	0.200	150 56222	150 66222	150 36222	
	3300	16 × 31	20	2890	828	0.16	0.077	0.019	0.130	150 56332	150 66332	150 36332	
	4700	16 × 35	21	3100	1178	0.18	0.061	0.018	0.130	150 56472	150 66472	-	
	35	220	10 × 12	14	730	80	0.12	0.869	0.097	0.680	150 50221	150 60221	150 30221
		330	10 × 16	15	950	118	0.12	0.579	0.066	0.460	150 50331	150 60331	150 30331
470		10 × 20	16	1180	167	0.12	0.407	0.049	0.340	150 50471	150 60471	150 30471	
680		12.5 × 20	17	1460	241	0.12	0.281	0.037	0.260	150 50681	150 60681	150 30681	
1000		12.5 × 25	18	1950	353	0.12	0.191	0.029	0.200	150 50102	150 60102	150 30102	
1000		16 × 20	19a	1840	353	0.12	0.191	0.028	0.200	150 90105	150 90106	150 90103	
1500		16 × 20	19a	1840	528	0.12	0.127	0.028	0.200	150 50152	150 60152	150 30152	
2200		16 × 31	20	2890	773	0.14	0.101	0.019	0.130	150 50222	150 60222	150 30222	
50		150	10 × 12	14	500	78	0.10	1.062	0.200	1.400	150 51151	150 61151	150 31151
		220	10 × 16	15	700	113	0.10	0.724	0.120	0.840	150 51221	150 61221	150 31221
	330	10 × 20	16	900	168	0.10	0.483	0.090	0.630	150 51331	150 61331	150 31331	
	470	12.5 × 20	17	1100	238	0.10	0.339	0.062	0.430	150 51471	150 61471	150 31471	
	680	12.5 × 25	18	1400	343	0.10	0.234	0.048	0.340	150 51681	150 61681	150 31681	
	1000	16 × 25	19	1800	503	0.10	0.159	0.034	0.240	150 51102	150 61102	150 31102	
	1500	16 × 31	20	2200	753	0.10	0.106	0.027	0.190	150 51152	150 61152	150 31152	

Aluminum electrolytic capacitors
Radial Miniature, Low Impedance

150 RMI

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 kHz 105 °C (mA)	I _{L2} 2 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 100 kHz +20 °C (Ω)	Z 100 kHz -40 °C (Ω)	CATALOGUE NUMBER		
										BULK PACKAGING		FORM TFA
										FORM CA	FORM CB	
63	100	10 × 12	14	420	66	0.10	1.592	0.270	1.890	150 58101	150 68101	150 38101
	150	10 × 16	15	560	97	0.10	1.062	0.190	1.330	150 58151	150 68151	150 38151
	220	10 × 20	16	700	141	0.10	0.724	0.150	1.050	150 58221	150 68221	150 38221
	330	12.5 × 20	17	930	211	0.10	0.483	0.095	0.670	150 58331	150 68331	150 38331
	470	12.5 × 25	18	1200	299	0.10	0.339	0.067	0.470	150 58471	150 68471	150 38471
	470	16 × 20	19a	1100	299	0.10	0.339	0.074	0.520	150 98475	150 98476	150 98473
	680	16 × 20	19a	1100	431	0.10	0.234	0.074	0.520	150 58681	150 68681	150 38681
	680	16 × 25	19	1500	431	0.10	0.234	0.054	0.380	150 98685	150 98686	150 98683
	1000	16 × 31	20	1900	633	0.10	0.159	0.042	0.295	150 58102	150 68102	150 38102

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 V$
Current		
Leakage current	after 2 minutes at U _R	$I_{L2} \leq 0.01 C_R \times U_R + 3 \mu A$
Inductance		
Equivalent series inductance (ESL)	case ∅D = 10 mm	typ. 16 nH
	case ∅D ≥ 12.5 mm	typ. 18 nH

Aluminum electrolytic capacitors
Radial Miniature, Low Impedance

150 RMI

Capacitance (C)

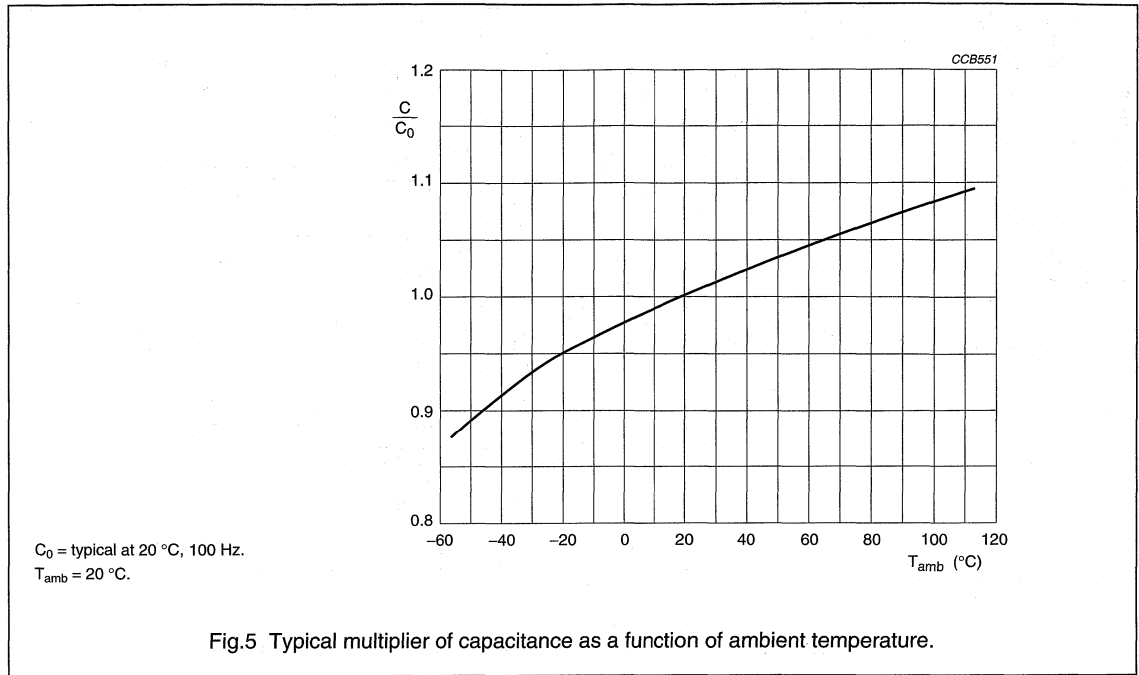


Fig.5 Typical multiplier of capacitance as a function of ambient temperature.

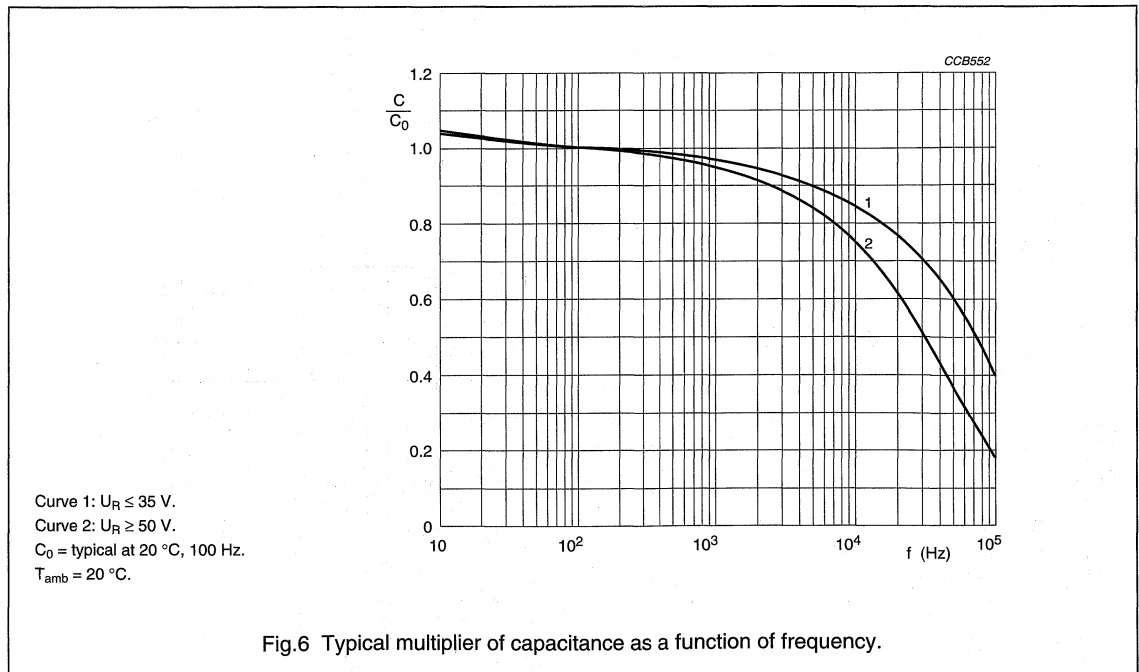
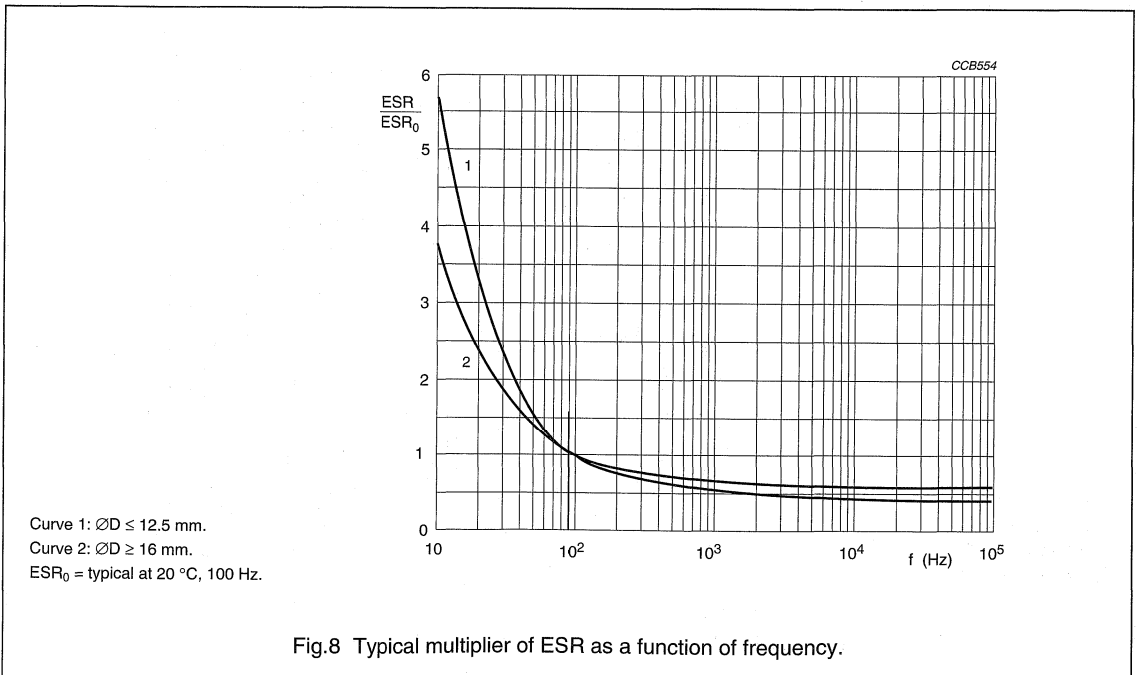
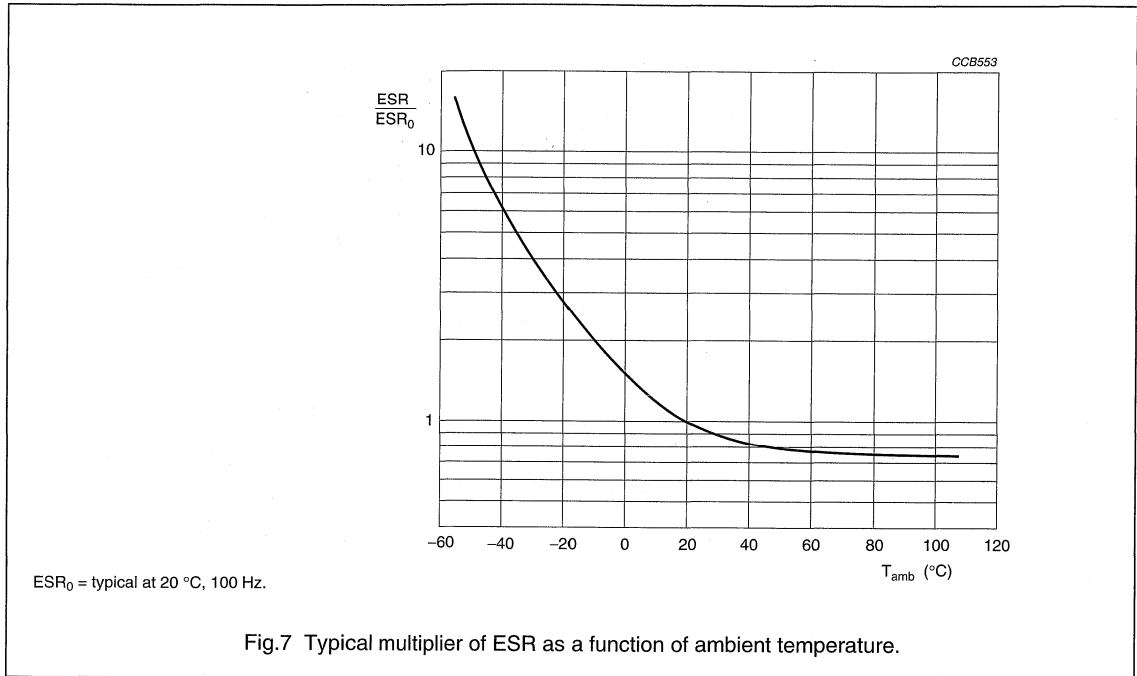


Fig.6 Typical multiplier of capacitance as a function of frequency.

Aluminum electrolytic capacitors
Radial Miniature, Low Impedance

150 RMI

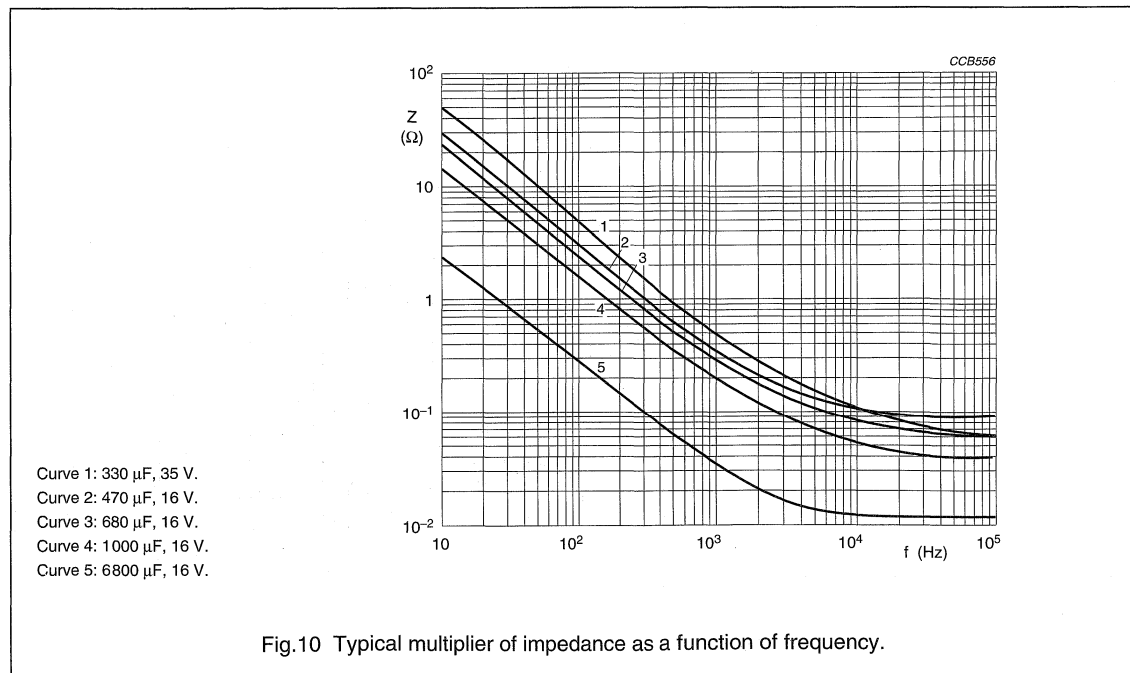
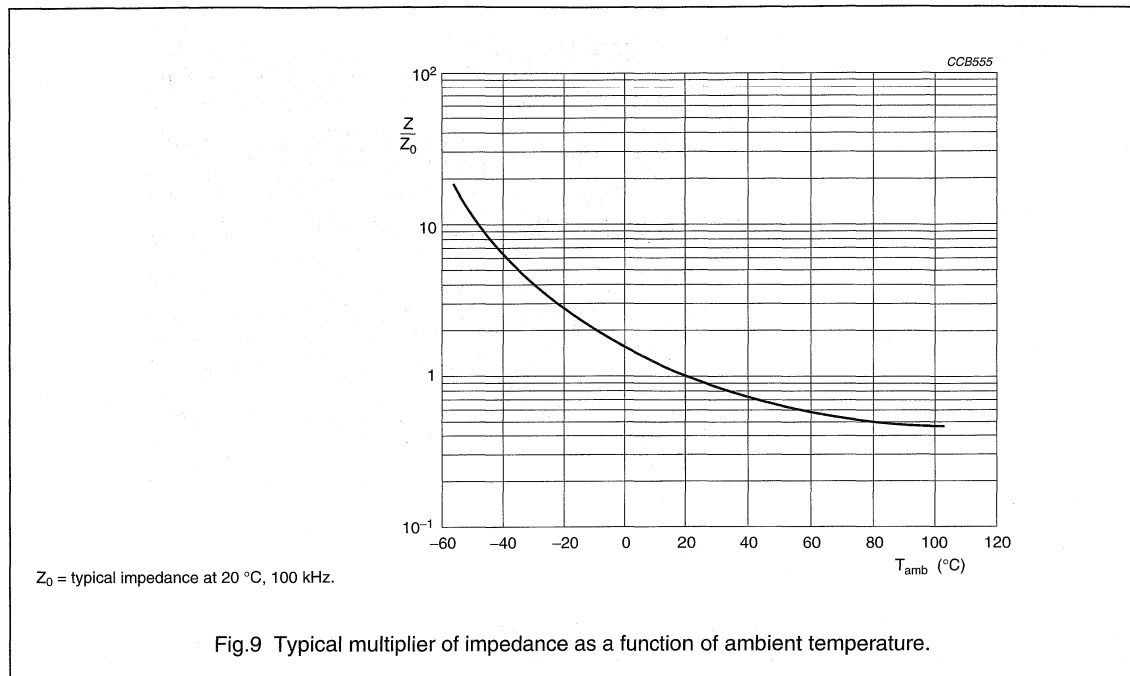
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors Radial Miniature, Low Impedance

150 RMI

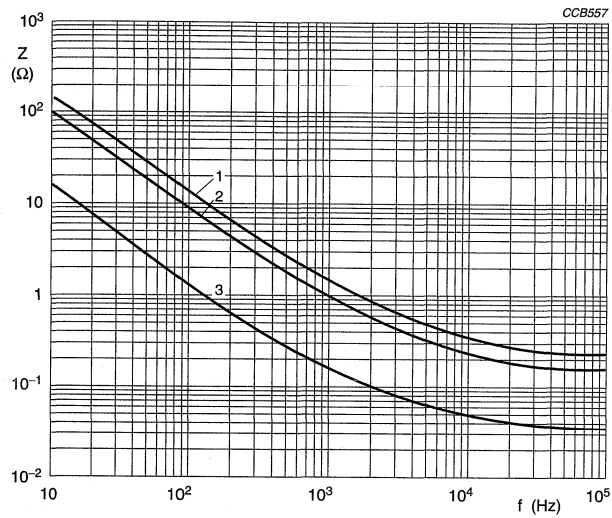
Impedance (Z)



Aluminum electrolytic capacitors

Radial Miniature, Low Impedance

150 RMI



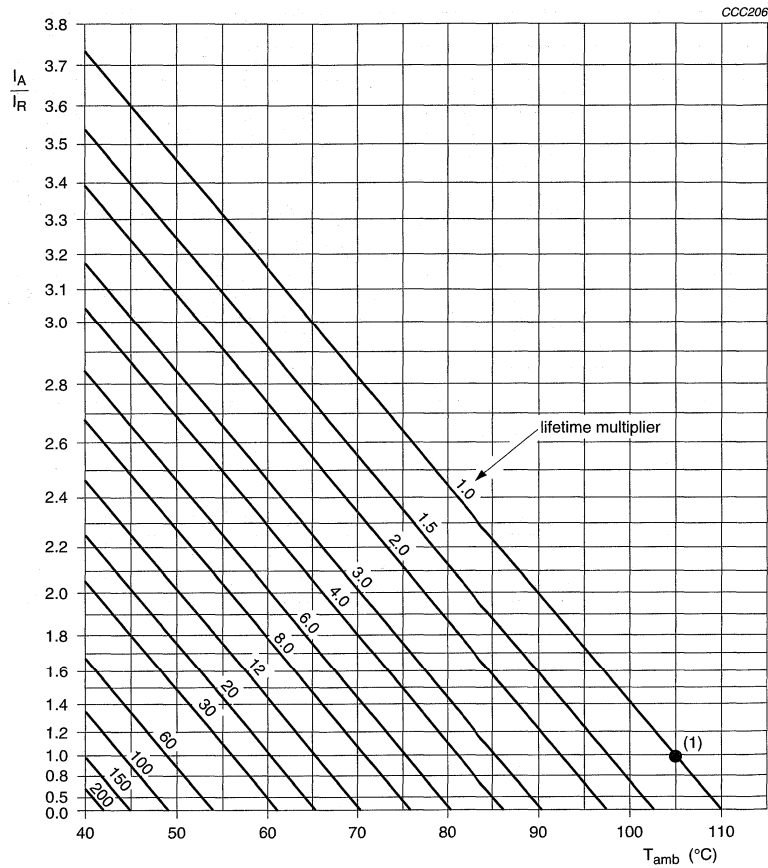
Curve 1: 100 μ F, 63 V.
Curve 2: 150 μ F, 50 V.
Curve 3: 1000 μ F, 63 V.

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

Aluminum electrolytic capacitors
Radial Miniature, Low Impedance

150 RMI

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 kHz.

I_R = rated ripple current at 100 kHz, 105 °C.

(1) Useful life at 105 °C and I_R applied; see Table 4.

Fig.12 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Radial Miniature, Low Impedance

150 RMI

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER	
	$\varnothing = 10$ and 12.5 mm	$\varnothing = 16$ mm
100	0.65	0.76
300	0.76	0.85
1000	0.85	0.91
3000	0.89	0.94
10000	0.90	0.96
30000	0.97	0.98
100000	1.0	1.0

Table 4 Endurance test duration and useful life as a function of case size; see Fig.12

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	ENDURANCE TEST at 105°C (hours)	USEFUL LIFE at 105°C (hours)
10×12	14	3000	4000
10×16	15	3000	6000
10×20	16	3000	6000
12.5×20	17	3000	7000
12.5×25	18	5000	8000
16×20	19a	3000	7000
16×25	19	5000	10000
16×31	20	5000	10000
16×35	21	5000	10000

Aluminum electrolytic capacitors

Radial Miniature, Low Impedance

150 RMI

SPECIFIC TESTS AND REQUIREMENTS


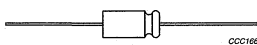
General tests and requirements are specified in this handbook, section "Tests and Requirements".

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; for test duration see Table 4	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; for test duration see Table 4	$\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$



AXIAL ALUMINUM ELECTROLYTIC CAPACITORS

	MINIATURE	STANDARD and SEMI-PROFESSIONAL	LONG-LIFE	EXTRA LONG-LIFE or HIGH TEMPERATURE
 <p style="text-align: right; font-size: small;">MSB108</p>	1500 to 8000 hours 85 °C	5000 to 15000 hours 85 °C	2000 to 10000 hours 105 °C	4000 to 8000 hours 125 °C
<div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;">smaller dimensions</div> <div style="font-size: 2em; margin: 0 10px;">↓</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;">higher CV per volume</div> </div>	041/042/043 ASH <i>page 413</i>	030/031 AS <i>page 400</i>	042/043 AMH-ELB <i>lighting ballast</i> <i>NEW</i> <i>page 427</i>	119 AHT-DIN <i>page 502</i>
<div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;">smaller dimensions</div> <div style="font-size: 2em; margin: 0 10px;">↓</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;">higher CV per volume</div> </div>	117 ASD <i>page 372</i>	132 ALL-DIN <i>page 468</i>	042/043 AHH-ELB <i>lighting ballast</i> <i>NEW</i> <i>page 436</i>	118 AHT <i>page 484</i>
 <p style="text-align: right; font-size: small;">CCC168</p>	021 ASM <i>page 381</i>		138 AML <i>page 446</i>	120 ATC <i>NEW</i> <i>page 518</i>

CCC167



Aluminum electrolytic capacitors

Axial, Smallest Diameter

117 ASD

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Taped for automatic insertion
- Charge and discharge proof
- Ultra miniature, diameter 3.3 mm.

APPLICATIONS

- General purpose, low profile and lightweight equipment
- Smoothing, filtering, buffering, decoupling, timing
- Boards with restricted mounting height.

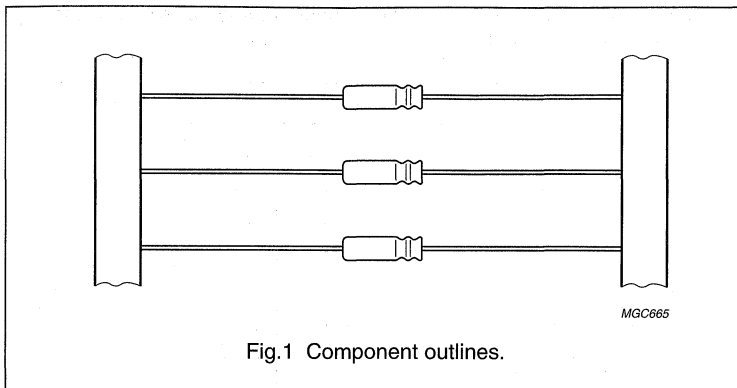
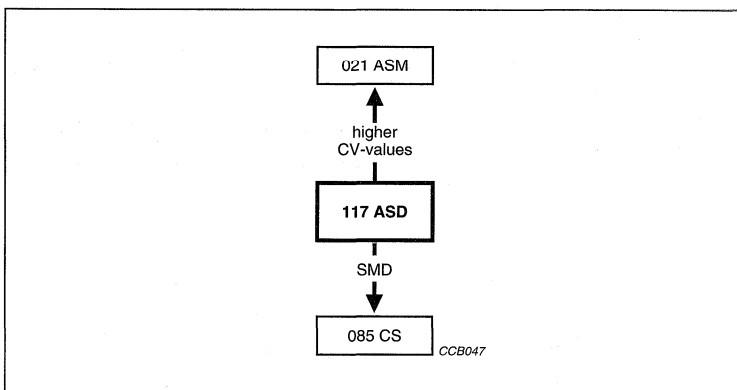


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	3.3 × 8 and 3.3 × 11
Rated capacitance range, C_R	0.47 to 22 μ F
Tolerance on C_R	-10 to +50% (\pm 20% to special order)
Rated voltage range, U_R	6.3 to 63 V
Category temperature range	-40 to +85 °C
Endurance test at 85 °C	1500 hours
Useful life at 85 °C	2000 hours
Useful life at 40 °C, 1.4 I_R applied	60000 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

Aluminum electrolytic capacitors

Axial, Smallest Diameter

117 ASD

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

C_R (μF)	U_R (V)					
	6.3	10	16	25	40	63
0.47	–	–	–	–	–	3.3 × 8
1.0	–	–	–	–	–	3.3 × 8
2.2	–	–	–	–	3.3 × 8	3.3 × 11
3.3	–	–	–	3.3 × 8	–	3.3 × 11
4.7	–	–	3.3 × 8	–	3.3 × 11	–
6.8	–	3.3 × 8	–	3.3 × 11	–	–
10	3.3 × 8	–	3.3 × 11	–	–	–
22	3.3 × 11	–	–	–	–	–

A

Aluminum electrolytic capacitors

Axial, Smallest Diameter

117 ASD

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

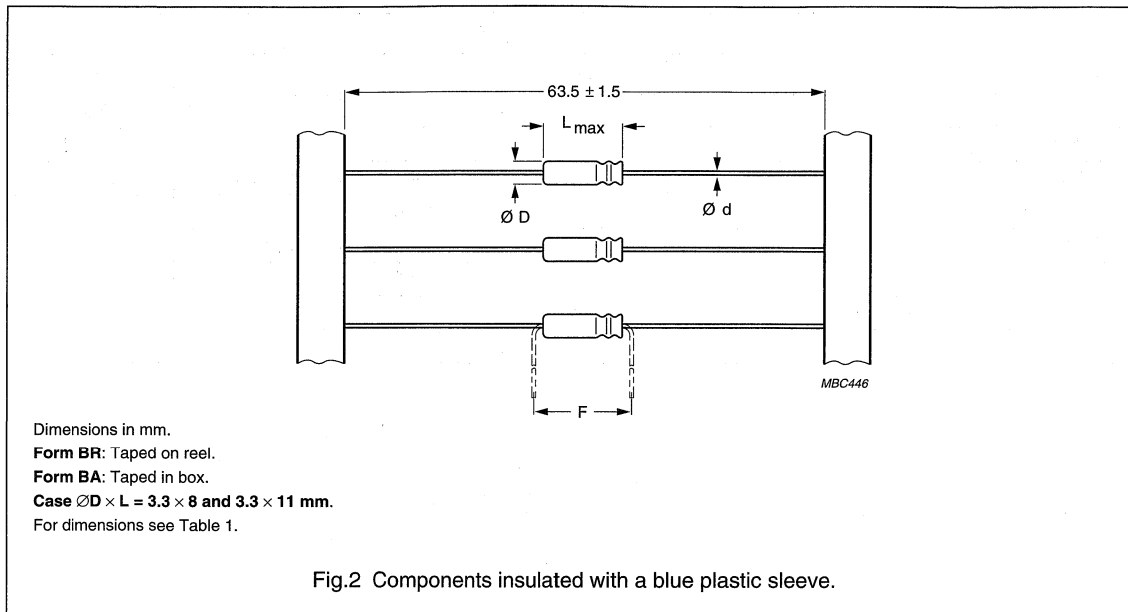


Table 1 Physical dimensions, mass and packaging quantities; see Fig.2

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	AXIAL: FORM BA and BR				MASS (g)	PACKAGING QUANTITIES	
		$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F_{min} (mm)		FORM BA	FORM BR
3.3×8	1a	0.6	3.5	9	12.5	≈ 0.3	1000	4000
3.3×11	1	0.6	3.5	12	15	≈ 0.35	1000	4000

MARKING

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

- Rated capacitance (in μF)
- Rated voltage (in V)
- Group number (117)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to identify the negative terminal.

Aluminum electrolytic capacitors

Axial, Smallest Diameter

117 ASD

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86\text{ to }106\text{ kPa}$, $RH = 45\text{ to }75\%$.

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
$\tan \delta$	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

Ordering example

Electrolytic capacitor 117 series

10 μF /16 V; -10/+50%Nominal case size: $\varnothing 3.3 \times 11\text{ mm}$;
Form BA

Catalogue number: 2222 117 35109.

Table 2 Electrical data and ordering information

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222	
										ON REEL FORM BR	IN BOX FORM BA
6.3	10	3.3 × 8	1a	11	4	3	0.30	48	20	117 23109	117 33109
	22	3.3 × 11	1	20	6	3	0.30	22	9	117 23229	117 33229
10	6.8	3.3 × 8	1a	10	4	3	0.25	59	24	117 24688	117 34688
	16	3.3 × 8	1a	9	5	3	0.20	68	26	117 25478	117 35478
16	10	3.3 × 11	1	16	6	3	0.20	32	12	117 25109	117 35109
	25	3.3	3.3 × 8	1a	8	5	3	0.18	87	27	117 26338
6.8		3.3 × 11	1	14	6	3	0.18	42	13	117 26688	117 36688
40	2.2	3.3 × 8	1a	7	5	3	0.16	120	32	117 27228	117 37228
	4.7	3.3 × 11	1	13	7	3	0.16	54	15	117 27478	117 37478
63	0.47	3.3 × 8	1a	4	4	3	0.10	340	120	117 28477	117 38477
	1	3.3 × 8	1a	6	4	3	0.12	190	55	117 28108	117 38108
	2.2	3.3 × 11	1	11	6	3	0.14	87	25	117 28228	117 38228
	3.3	3.3 × 11	1	13	7	3	0.14	68	17	117 28338	117 38338

Aluminum electrolytic capacitors

Axial, Smallest Diameter

117 ASD

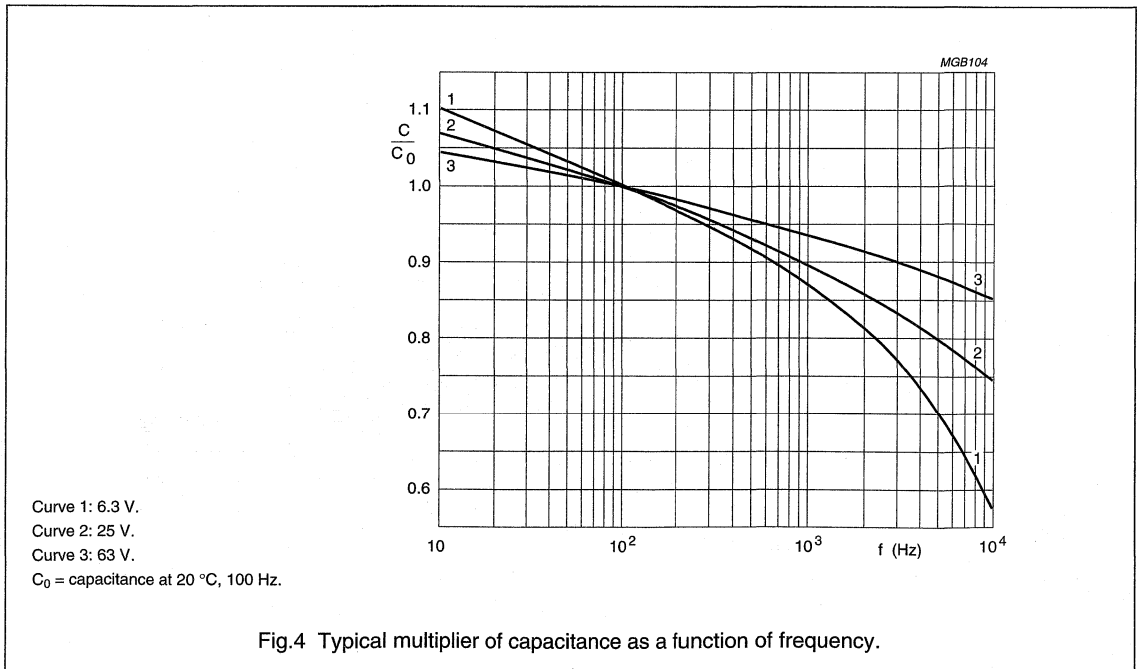
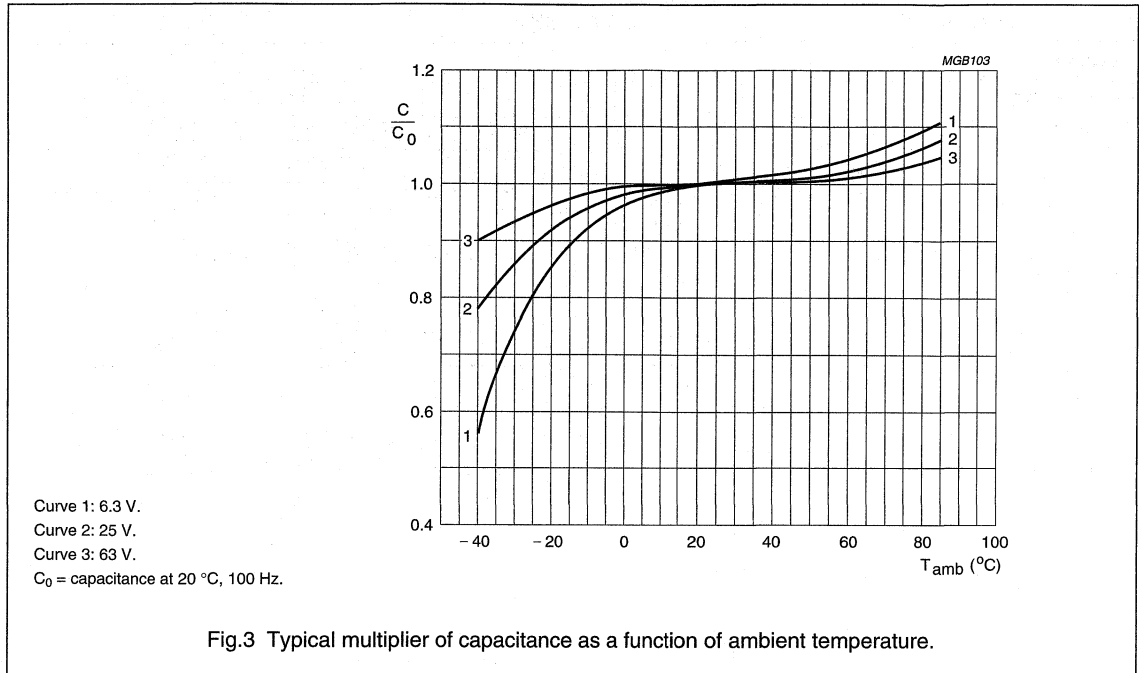
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.02C_R \times U_R + 3 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \times L = 3.3 \times 8 \text{ mm}$	typ. 13 nH
	case $\varnothing D \times L = 3.3 \times 11 \text{ mm}$	typ. 15 nH

Aluminum electrolytic capacitors Axial, Smallest Diameter

117 ASD

Capacitance (C)

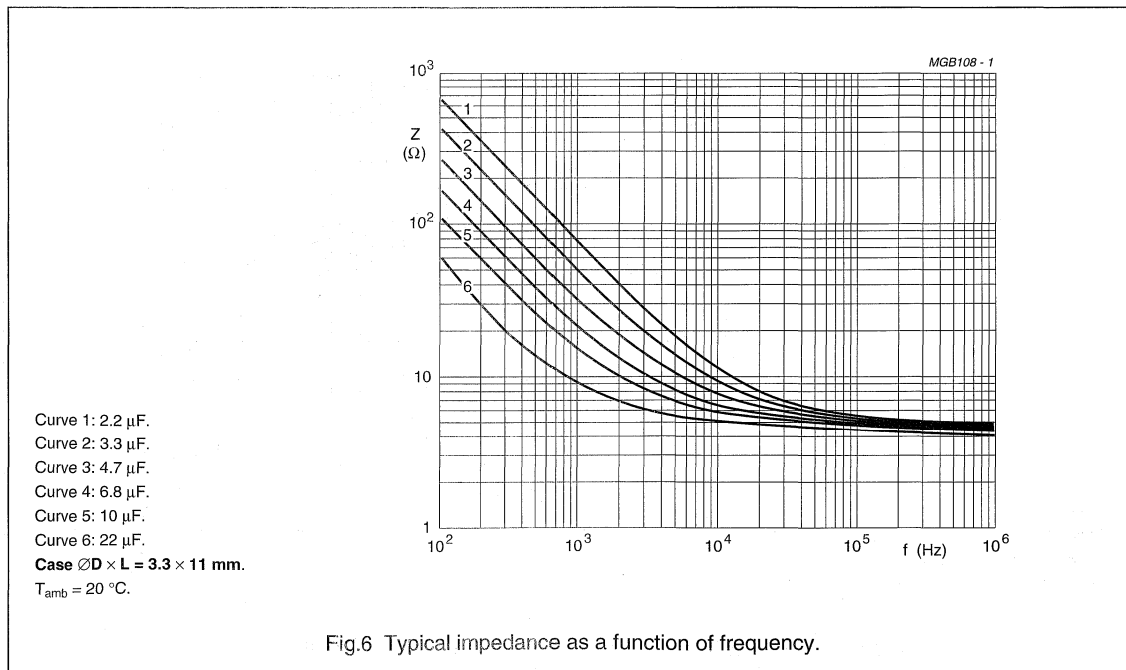
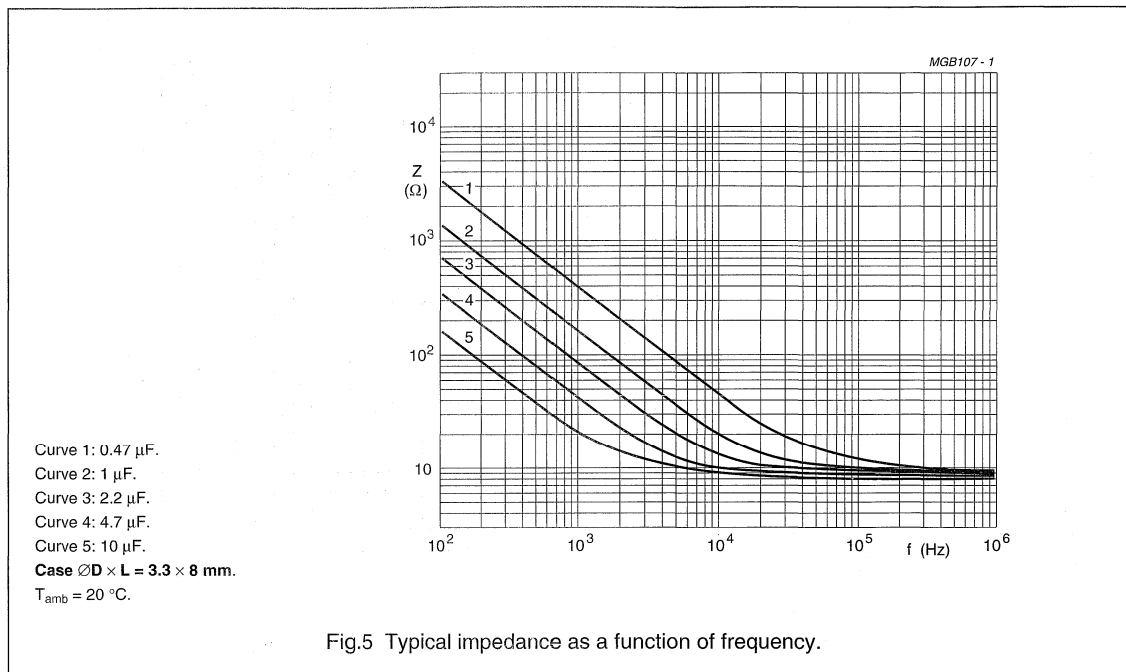


Aluminum electrolytic capacitors

Axial, Smallest Diameter

117 ASD

Impedance (Z)



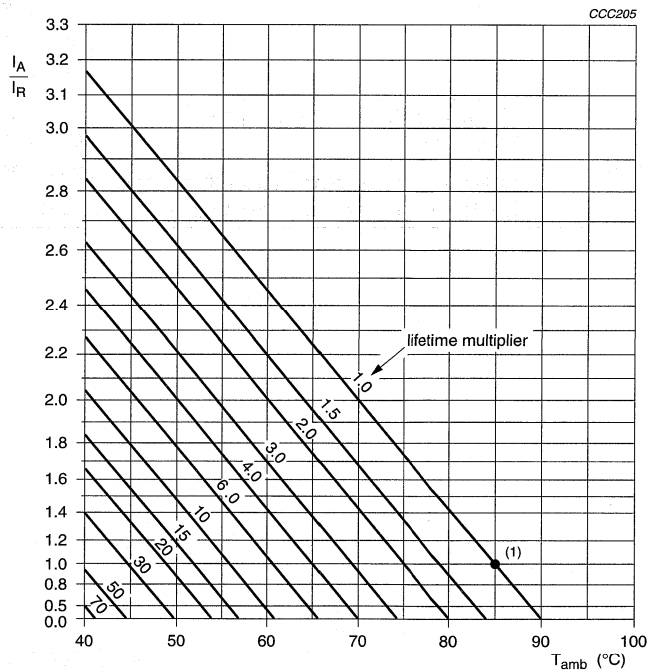
Aluminum electrolytic capacitors Axial, Smallest Diameter

117 ASD

RIPPLE CURRENT AND USEFUL LIFE

Table 3 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	$U_R = 63$ V
50	0.8	0.75	0.7
100	1.0	1.0	1.0
300	1.2	1.3	1.55
1000	1.35	1.55	1.9
3000	1.45	1.7	2.3
≥ 10000	1.5	1.8	2.5



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: 2000 hours.

Fig.7 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Axial, Smallest Diameter

117 ASD

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 1500 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 2000 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors Axial Standard Miniature

021 ASM

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Mounting ring version (single ended) not insulated
- Charge and discharge proof
- Taped versions up to case $\varnothing 15 \times 30$ mm available for automatic insertion
- Miniaturized, high CV-product per unit volume.

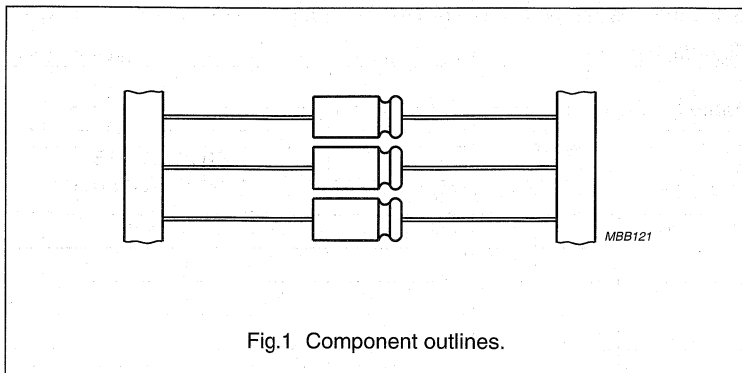
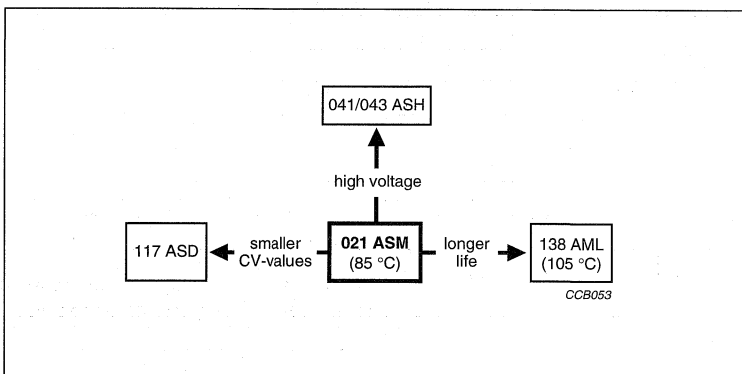


Fig.1 Component outlines.

APPLICATIONS

- General purpose, industrial, automotive, audio-video
- Coupling, decoupling, smoothing, filtering, buffering and timing
- Portable and mobile equipment (small size, low mass)
- Low mounting height boards, vibration and shock resistant.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	4.5 × 10 to 10 × 25	10 × 30 to 21 × 40
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
Useful life at 85 °C	2500 hours	8000 hours
Useful life at 40 °C, $1.4 \times I_R$ 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	

A

Aluminum electrolytic capacitors

Axial Standard Miniature

021 ASM

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)						
	6.3	10	16	25	40	63	100
0.47	–	–	–	–	–	4.5 × 10	–
1	–	–	–	–	–	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
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 × 40
	–	–	–	10 × 30	–	–	–
1000	8 × 18	10 × 18	10 × 25	12.5 × 30	12.5 × 30	18 × 30	21 × 40
	–	–	10 × 30	–	–	–	–
1500	–	10 × 25	12.5 × 30	12.5 × 30	15 × 30	18 × 40	–
	–	10 × 30	–	–	–	–	–
2200	10 × 25	12.5 × 30	12.5 × 30	15 × 30	18 × 30	21 × 40	–
3300	–	12.5 × 30	15 × 30	18 × 30	18 × 40	–	–
4700	–	15 × 30	18 × 30	18 × 40	21 × 40	–	–
6800	–	18 × 30	18 × 40	21 × 40	–	–	–
10000	–	18 × 40	21 × 40	–	–	–	–
15000	–	21 × 40	–	–	–	–	–

Aluminum electrolytic capacitors Axial Standard Miniature

021 ASM

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

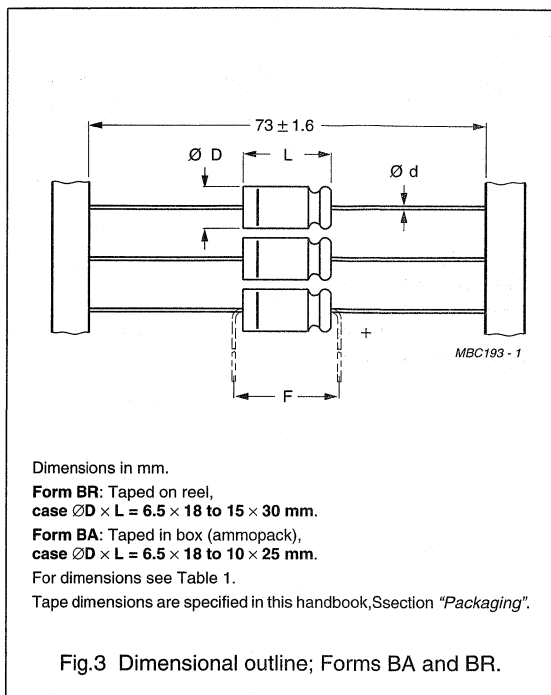
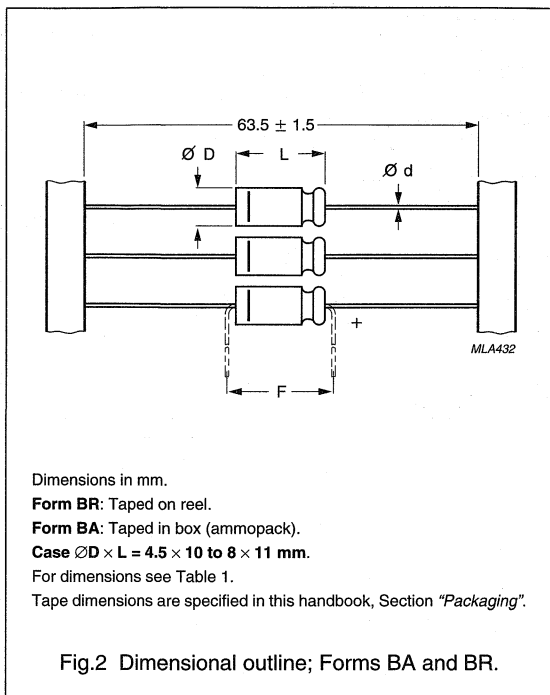


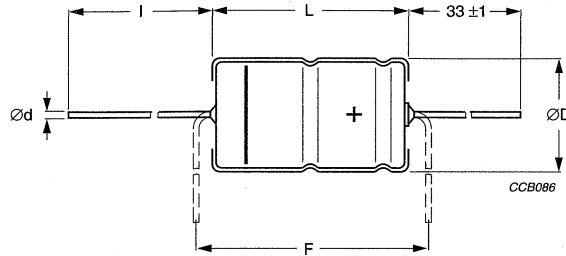
Table 1 Axial; physical dimensions, mass and packaging quantities; see Figs 2, 3 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	AXIAL: FORM AA, BA, and BR					MASS (g)	PACKAGING QUANTITIES		
		$\varnothing d$	l	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F_{min} (mm)		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	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	—	—

Aluminum electrolytic capacitors

Axial Standard Miniature

021 ASM



Dimensions in mm.

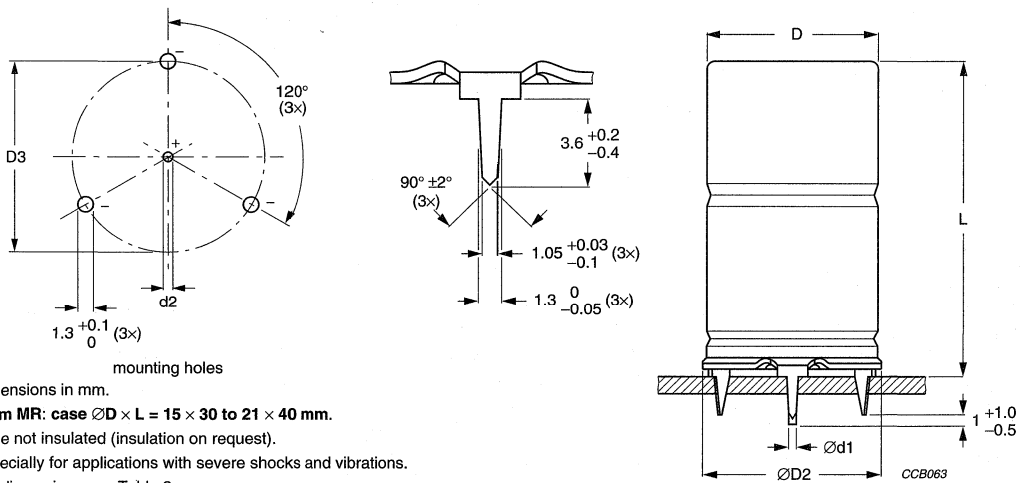
Form AA: Axial in box.

Case ØD × L = 10 × 30 and 21 × 40 mm.

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

For dimensions see Table 1.

Fig.4 Dimensional outline; Form AA.



Dimensions in mm.

Form MR: case ØD × 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.5 Mounting hole diagram and outline; Form MR; single ended with mounting ring and pins.

Table 2 Single ended; mass and packaging quantities; see Fig.5

NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	SINGLE ENDED WITH MOUNTING RING: FORM MR					MASS (g)	PACKAGING QUANTITIES
		Ød1 (mm)	Ød2 (mm)	ØD2 _{max} (mm)	D3 (mm)	L _{max} (mm)		
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	200
18 × 40	04	0.8	1.0 +0.4	19.5	18.5 ±0.2	45	≈19.4	100
21 × 40	05	0.8	1.0 +0.4	22.5	21.5 ±0.2	45	≈24.7	100

Aluminum electrolytic capacitors
Axial Standard Miniature

021 ASM

CATALOGUE NUMBER 2222														
U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	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)	AXIAL			SINGLE ENDED MOUNTING RING FORM MR	
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA		
16	68	4.5 × 10	2	90	11	6.2	0.16	3.8	2.4	-	021 25689	021 35689	-	
	150	6 × 10	3	140	18	8.8	0.16	1.7	1.1	-	021 25151	021 35151	-	
	220	8 × 11	5a	210	25	11	0.16	1.2	0.73	-	021 25221	021 35221	-	
	330	6.5 × 18	4	290	36	15	0.16	0.77	0.48	-	021 25331	021 35331	-	
	470	8 × 18	5	380	49	19	0.16	0.55	0.34	-	021 25471	021 35471	-	
	680	10 × 18	6	500	69	26	0.16	0.38	0.24	-	021 25681	021 35681	-	
	1000	10 × 25	7	660	100	36	0.16	0.26	0.18	-	021 90517	021 90518	-	
	1000	10 × 30	00	700	100	36	0.16	0.260	0.175	-	021 15102	021 25102	-	
	1500	12.5 × 30	01	950	148	52	0.19	0.205	0.095	-	021 15152	021 25152	-	
	2200	12.5 × 30	01	1040	216	74	0.21	0.150	0.095	-	021 15222	021 25222	-	
	3300	15 × 30	02	1290	321	110	0.23	0.111	0.07	-	021 15332	021 25332	-	
	4700	18 × 30	03	1560	455	154	0.25	0.087	0.065	-	021 15472	-	021 45332	
	6800	18 × 40	04	2040	656	222	0.30	0.070	0.04	-	021 15682	-	021 45472	
	10000	21 × 40	05	2170	964	324	0.36	0.058	0.035	-	021 15103	-	021 45682	
	25	47	4.5 × 10	2	80	11	6.4	0.14	4.8	2.6	-	021 26479	021 36479	-
		100	6 × 10	3	150	19	9	0.14	2.3	1.2	-	021 26101	021 36101	-
		150	8 × 11	5a	190	27	12	0.14	1.5	0.80	-	021 90534	021 90535	-
		150	6.5 × 18	4	210	27	12	0.14	1.5	0.80	-	021 26151	021 36151	-
		220	6.5 × 18	4	250	37	15	0.14	1.0	0.55	-	021 26221	021 36221	-
		330	8 × 18	5	340	54	21	0.14	0.68	0.36	-	021 26331	021 36331	-
470		10 × 18	6	450	75	28	0.14	0.48	0.26	-	021 26471	021 36471	-	
680		10 × 25	7	560	106	38	0.14	0.33	0.18	-	021 90527	021 90528	-	
680		10 × 30	00	640	106	38	0.14	0.323	0.175	-	021 16681	021 26681	-	
1000		12.5 × 30	01	840	154	54	0.14	0.220	0.095	-	021 16102	021 26102	-	
1500	12.5 × 30	01	950	229	79	0.17	0.179	0.095	-	021 16152	021 26152	-		
2200	15 × 30	02	1180	334	114	0.19	0.132	0.07	-	021 16222	021 26222	-		
3300	18 × 30	03	1470	499	169	0.21	0.099	0.065	-	021 16332	-	021 46222		
4700	18 × 40	04	1920	709	239	0.23	0.079	0.04	-	021 16472	-	021 46332		
6800	21 × 40	05	2070	1024	344	0.28	0.064	0.035	-	021 16682	-	021 46472		
													021 46682	

Aluminum electrolytic capacitors
Axial Standard Miniature

021 ASM

CATALOGUE NUMBER 2222													
UR (V)	CR 100 Hz (µF)	NOMINAL CASE SIZE ØD x L (mm)	CASE CODE	IR 100 Hz 85 °C (mA)	IL1 1 min (µA)	IL5 5 min (µA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	AXIAL			SINGLE ENDED MOUNTING FORM MR
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	
40	22	4.5 x 10	2	60	9	5.8	0.11	8.0	3.2	-	021 27229	021 37229	-
	47	6 x 10	3	110	15	7.8	0.11	3.8	1.5	-	021 27479	021 37479	-
	100	8 x 11	5a	170	28	12	0.11	1.8	0.70	-	021 90537	021 90538	-
	100	6.5 x 18	4	190	28	12	0.11	1.8	0.70	-	021 27101	021 37101	-
	150	8 x 18	5	250	40	16	0.11	1.1	0.47	-	021 27151	021 37151	-
	220	10 x 18	6	330	57	22	0.11	0.8	0.32	-	021 27221	021 37221	-
	330	10 x 25	7	430	83	30	0.11	0.53	0.21	-	021 27331	021 37331	-
	470	10 x 25	7	520	117	42	0.11	0.37	0.18	-	021 90514	021 90515	-
	470	10 x 30	00	590	117	42	0.12	0.404	0.175	-	021 17471	021 27471	-
	680	12.5 x 30	01	800	167	58	0.12	0.297	0.110	-	021 17681	021 27681	-
	1000	12.5 x 30	01	900	244	84	0.12	0.190	0.110	-	021 17102	021 27102	-
	1500	15 x 30	02	1120	364	124	0.15	0.159	0.07	-	021 17152	021 27152	-
	2200	18 x 30	03	1390	532	180	0.17	0.118	0.065	-	021 17222	-	021 47152
	3300	18 x 40	04	1810	796	268	0.19	0.090	0.04	-	021 17332	-	021 47222
	4700	21 x 40	05	1940	1132	380	0.21	0.072	0.035	-	021 17472	-	021 47332
63	0.47	4.5 x 10	2	8	4.2	4.1	0.09	310	120	-	021 28477	021 38477	-
	1	4.5 x 10	2	12	4.4	4.1	0.09	150	55	-	021 28108	021 38108	-
	2.2	4.5 x 10	2	21	4.8	4.3	0.09	65	25	-	021 28228	021 38228	-
	3.3	4.5 x 10	2	25	5.2	4.4	0.09	44	17	-	021 28338	021 38338	-
	4.7	4.5 x 10	2	31	5.8	4.6	0.09	31	12	-	021 28478	021 38478	-
	10	4.5 x 10	2	50	7.8	5.3	0.08	13	5.5	-	021 28109	021 38109	-
	15	4.5 x 10	2	55	9.5	5.9	0.08	8.5	3.7	-	021 28159	021 38159	-
	22	6 x 10	3	90	12	6.8	0.08	5.8	2.5	-	021 28229	021 38229	-
	33	6 x 10	3	100	16	8.2	0.08	3.9	1.7	-	021 28339	021 38339	-
	47	8 x 11	5a	140	22	10	0.08	2.7	1.2	-	021 90541	021 90542	-
	47	6.5 x 18	4	150	22	10	0.08	2.7	1.2	-	021 28479	021 38479	-
	68	8 x 11	5a	160	30	13	0.08	1.9	0.81	-	021 90544	021 90545	-
	68	6.5 x 18	4	170	30	13	0.08	1.9	0.81	-	021 28689	021 38689	-
	100	8 x 18	5	250	42	17	0.08	1.3	0.55	-	021 28101	021 38101	-

A

Aluminum electrolytic capacitors
Axial Standard Miniature

021 ASM

CATALOGUE NUMBER 2222														
U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	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)	AXIAL			SINGLE ENDED MOUNTING RING FORM MR	
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA		
63	150	10 × 18	6	320	61	23	0.08	0.85	0.37	-	021 28151	021 38151	021 38151	-
	220	10 × 25	7	430	88	32	0.08	0.60	0.25	-	021 90511	021 90512	021 90512	-
	220	10 × 30	00	480	88	32	0.08	0.614	0.26	021 18221	021 28221	-	-	-
	330	12.5 × 30	01	610	129	46	0.08	0.409	0.19	021 18331	021 28331	-	-	-
	470	12.5 × 30	01	700	182	63	0.08	0.287	0.13	021 18471	021 28471	-	-	-
	680	15 × 30	02	890	261	90	0.08	0.199	0.095	021 18681	021 28681	-	-	021 48681
	1000	18 × 30	03	1170	382	130	0.08	0.135	0.075	021 18102	-	-	-	021 48102
	1500	18 × 40	04	1530	571	193	0.11	0.122	0.045	021 18152	-	-	-	021 48152
	2200	21 × 40	05	1780	836	281	0.13	0.099	0.040	021 18222	-	-	-	021 48222
	100	1	4.5 × 10	2	14	4.6	4.2	0.08	130	90	-	021 29108	021 39108	-
100	2.2	4.5 × 10	2	20	5.3	4.4	0.08	58	41	-	021 29228	021 39228	-	-
	4.7	4.5 × 10	2	30	7	4.9	0.08	27	19	-	021 29478	021 39478	-	-
	10	6 × 10	3	65	10	6	0.08	13	9	-	021 29109	021 39109	-	-
	15	8 × 11	5a	77	13	7	0.08	8.5	6	-	021 90547	021 90548	-	-
	15	6.5 × 18	4	85	13	7	0.08	8.5	6	-	021 29159	021 39159	-	-
	22	8 × 11	5a	95	17	8.4	0.08	5.8	4.1	-	021 90551	021 90552	-	-
	22	6.5 × 18	4	100	17	8.4	0.08	5.8	4.1	-	021 29229	021 39229	-	-
	33	6.5 × 18	4	120	24	10.6	0.08	3.9	2.7	-	021 29339	021 39339	-	-
	47	8 × 18	5	160	32	13.4	0.08	2.7	1.9	-	021 29479	021 39479	-	-
	68	10 × 18	6	220	45	17.6	0.08	1.9	1.3	-	021 29689	021 39689	-	-
100	10 × 25	7	300	64	24	0.08	1.3	0.9	-	021 90531	021 90532	-	-	
100	10 × 30	00	340	64	24	0.07	1.150	1.0	021 19101	021 29101	-	-	-	
150	12.5 × 30	01	490	94	34	0.07	0.645	0.61	021 19151	021 29151	-	-	-	
220	12.5 × 30	01	560	136	48	0.08	0.610	0.56	021 19221	021 29221	-	-	-	
330	15 × 30	02	740	202	70	0.09	0.420	0.40	021 19331	021 29331	-	-	021 49331	
470	18 × 30	03	980	286	98	0.09	0.310	0.29	021 19471	-	-	-	021 49471	
680	18 × 40	04	1260	412	140	0.09	0.195	0.18	021 19681	-	-	-	021 49681	
1000	21 × 40	05	1470	604	204	0.10	0.160	0.15	021 19102	-	-	-	021 49102	

Aluminum electrolytic capacitors

Axial Standard Miniature

021 ASM

Additional electrical data

PARAMETER	CONDITIONS	VALUE	
		AXIAL	SINGLE ENDED
Voltage			
Surge voltage		$U_s \leq 1.15 \times U_R$	
Reverse voltage		$U_{rev} \leq 1 \text{ V}$	
Current			
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$	
	after 5 minutes at U_R : $U_R = 6.3 \text{ V to } 100 \text{ V}$	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$	
Inductance			
Equivalent series inductance (ESL)	case $\varnothing D \times L$ 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 × 40	typ. 54 nH	typ. 39 nH	
21 × 40	typ. 59 nH	typ. 39 nH	

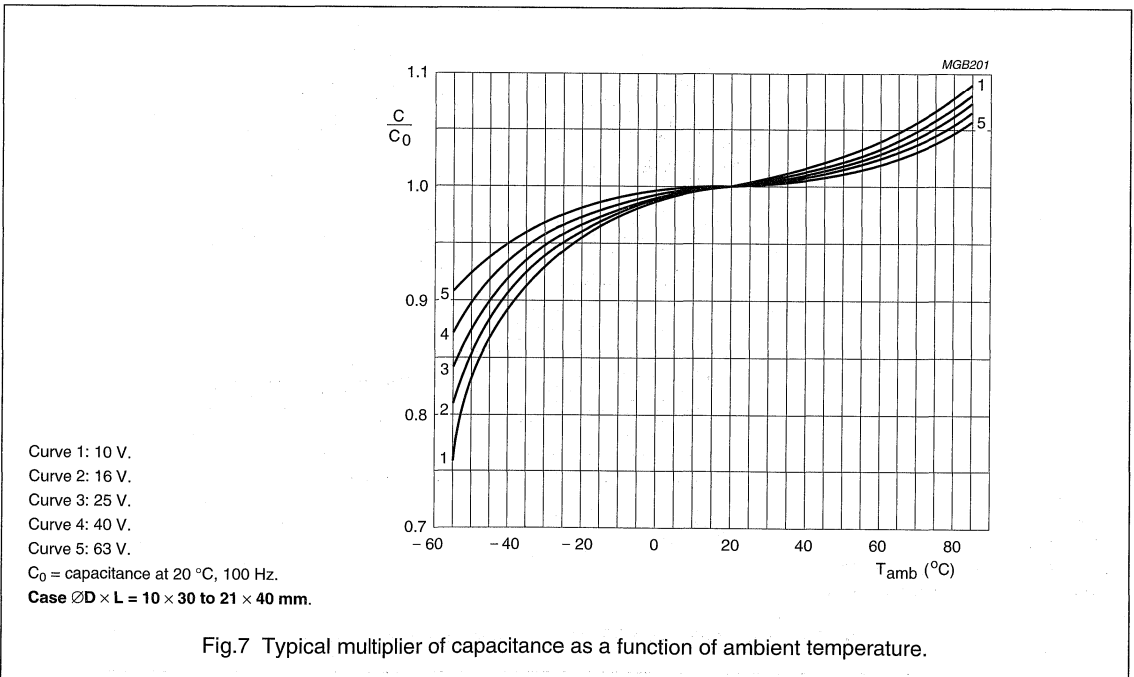
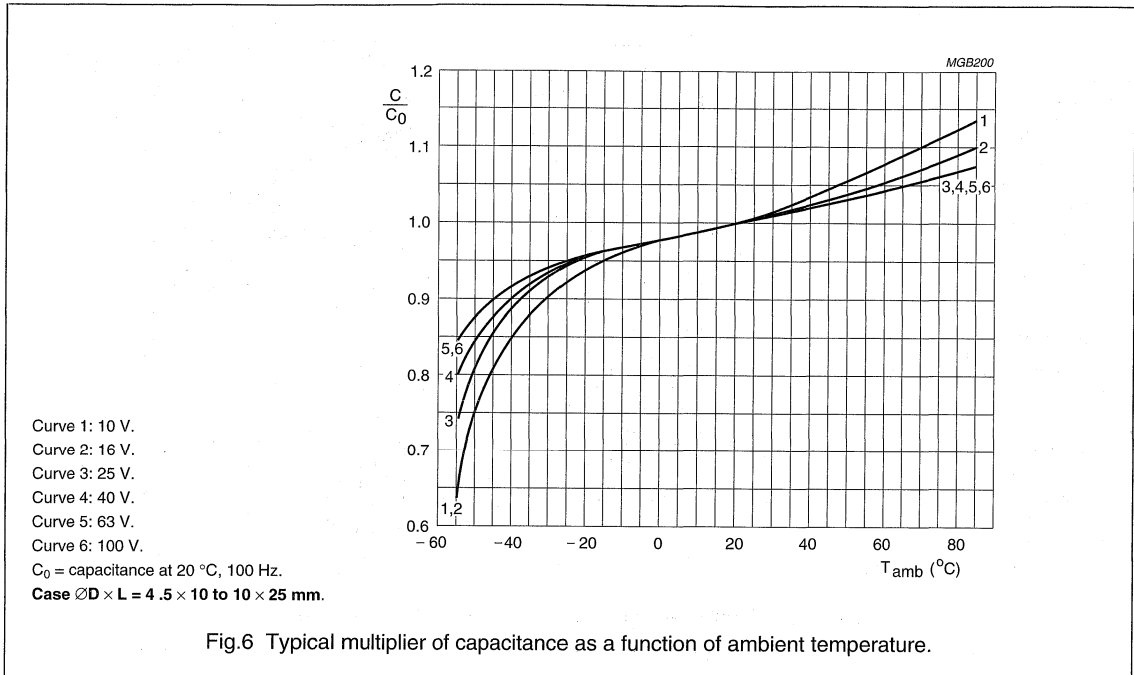
A

Aluminum electrolytic capacitors

Axial Standard Miniature

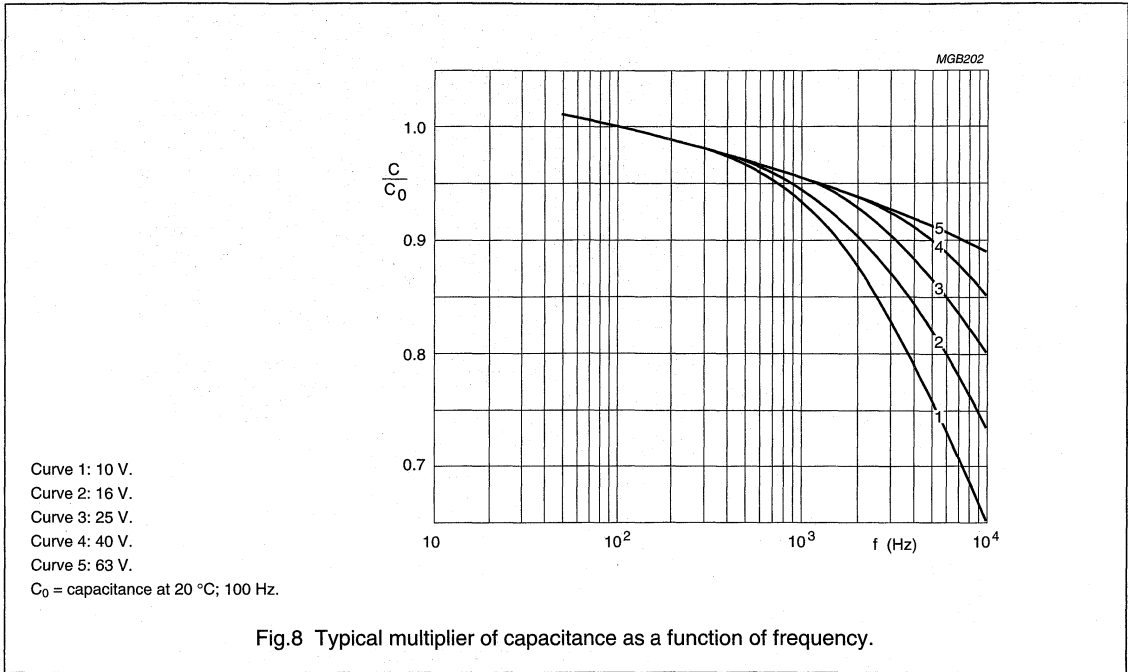
021 ASM

Capacitance (C)

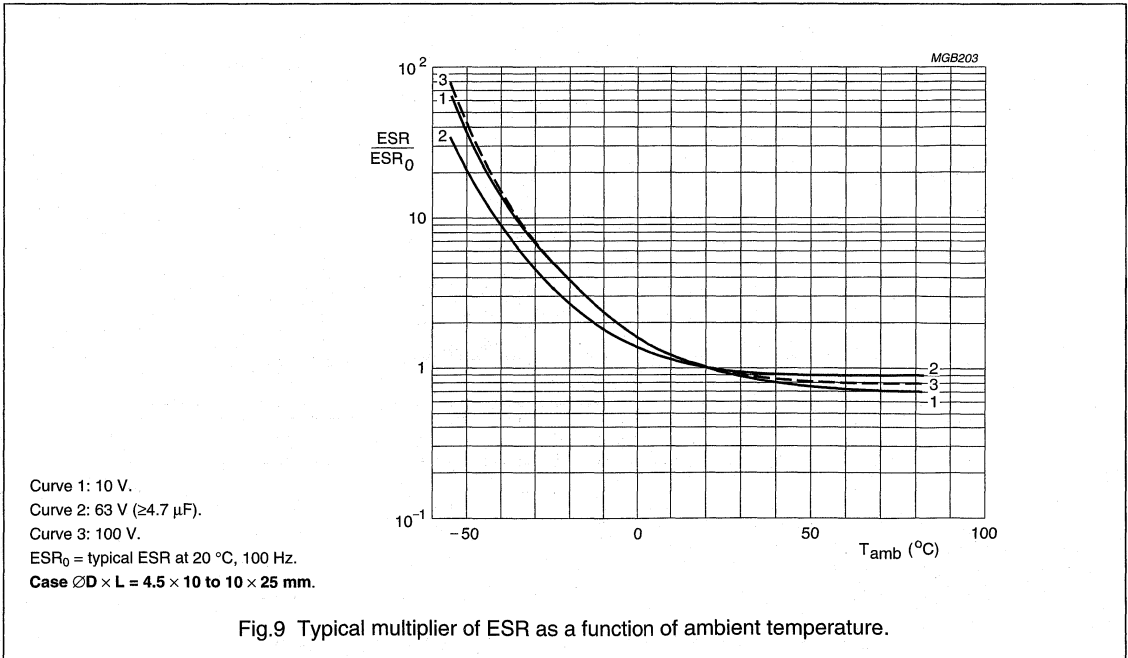


Aluminum electrolytic capacitors
Axial Standard Miniature

021 ASM

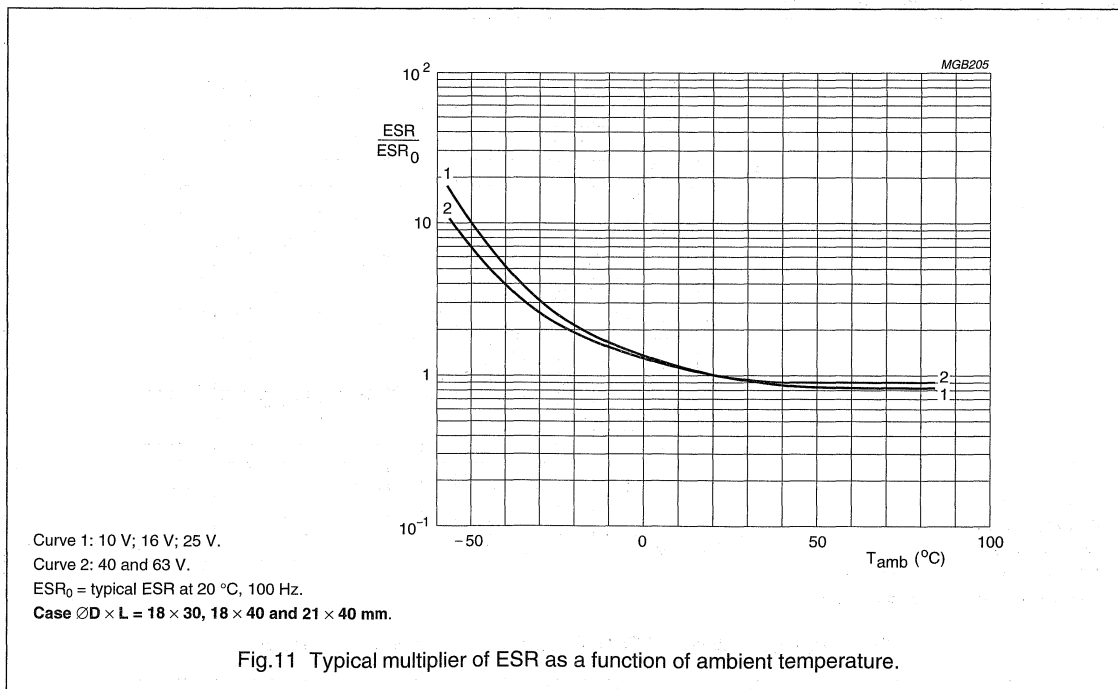
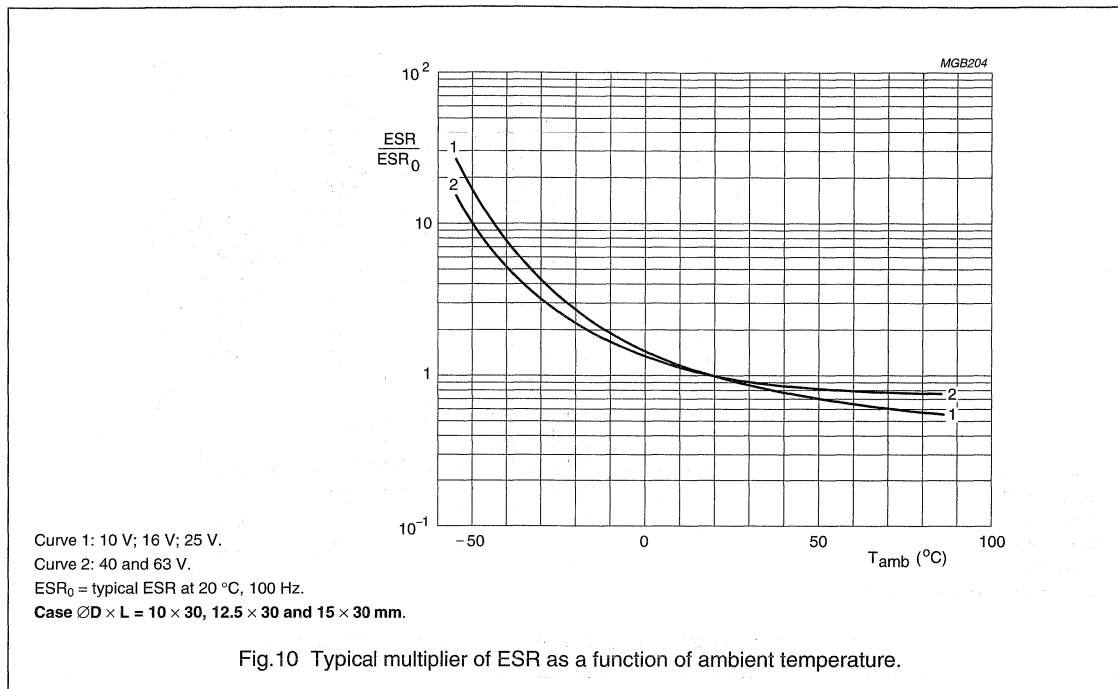


Equivalent series resistance (ESR)



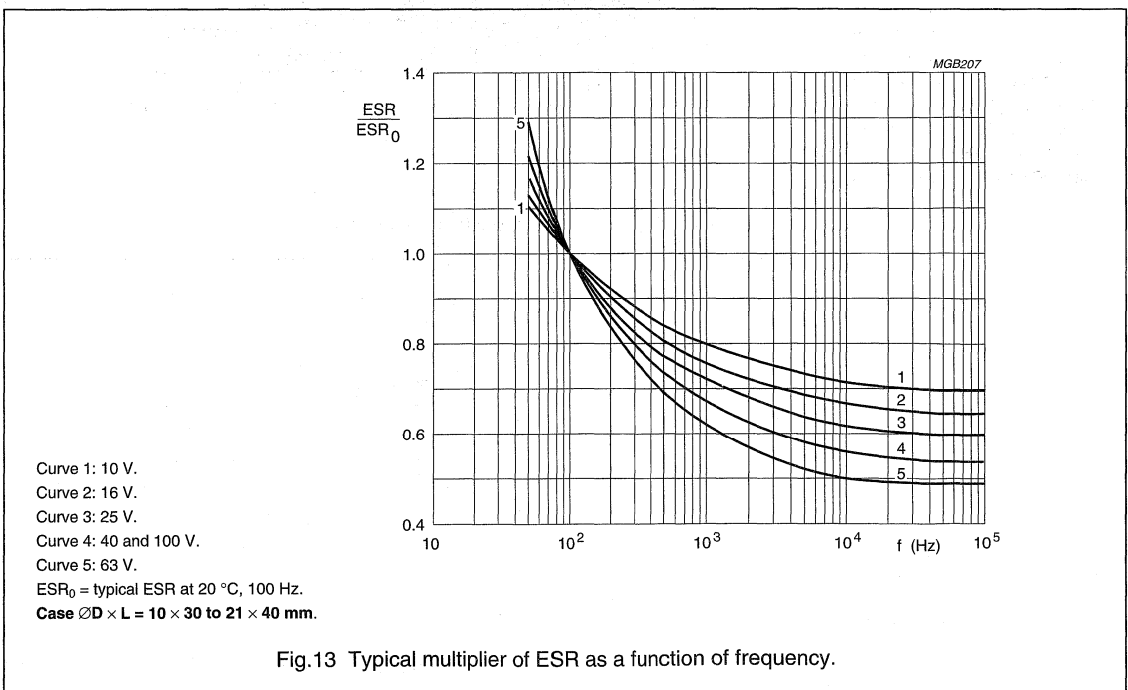
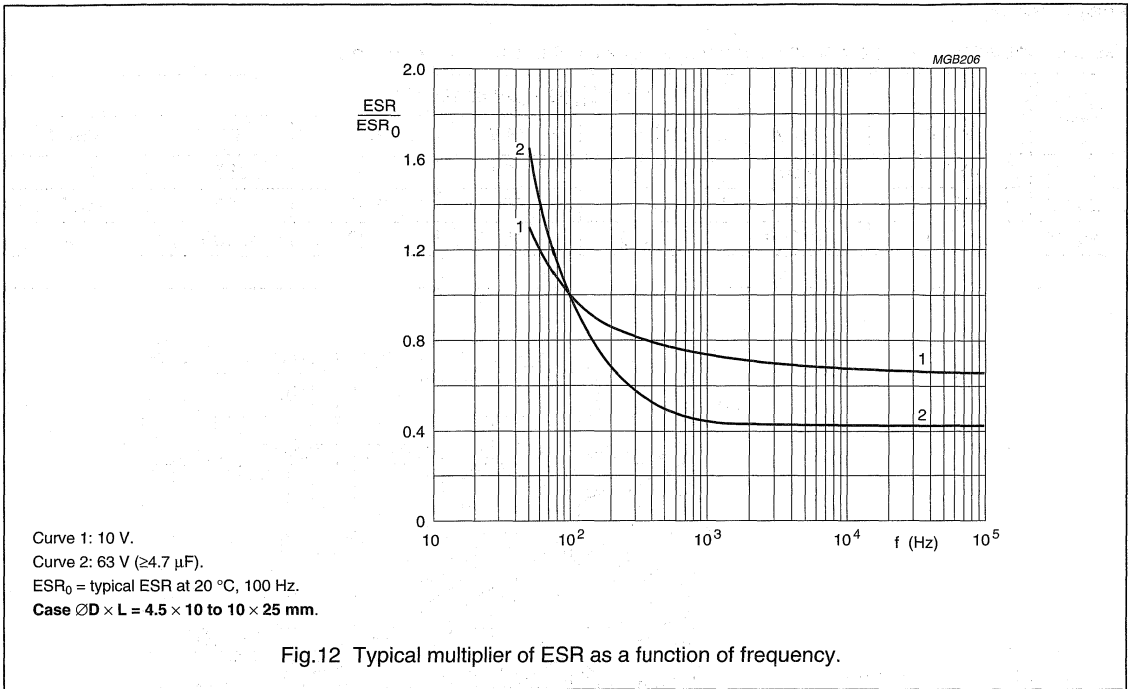
Aluminum electrolytic capacitors
Axial Standard Miniature

021 ASM



Aluminum electrolytic capacitors
Axial Standard Miniature

021 ASM



Aluminum electrolytic capacitors

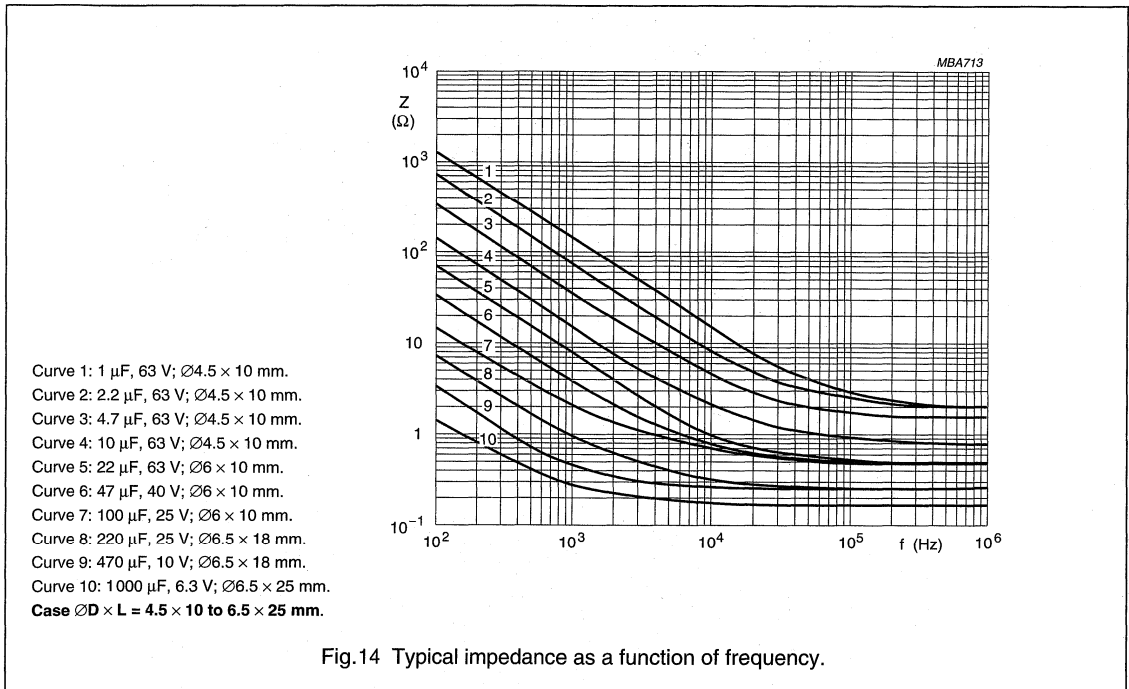
Axial Standard Miniature

021 ASM

Impedance (Z)

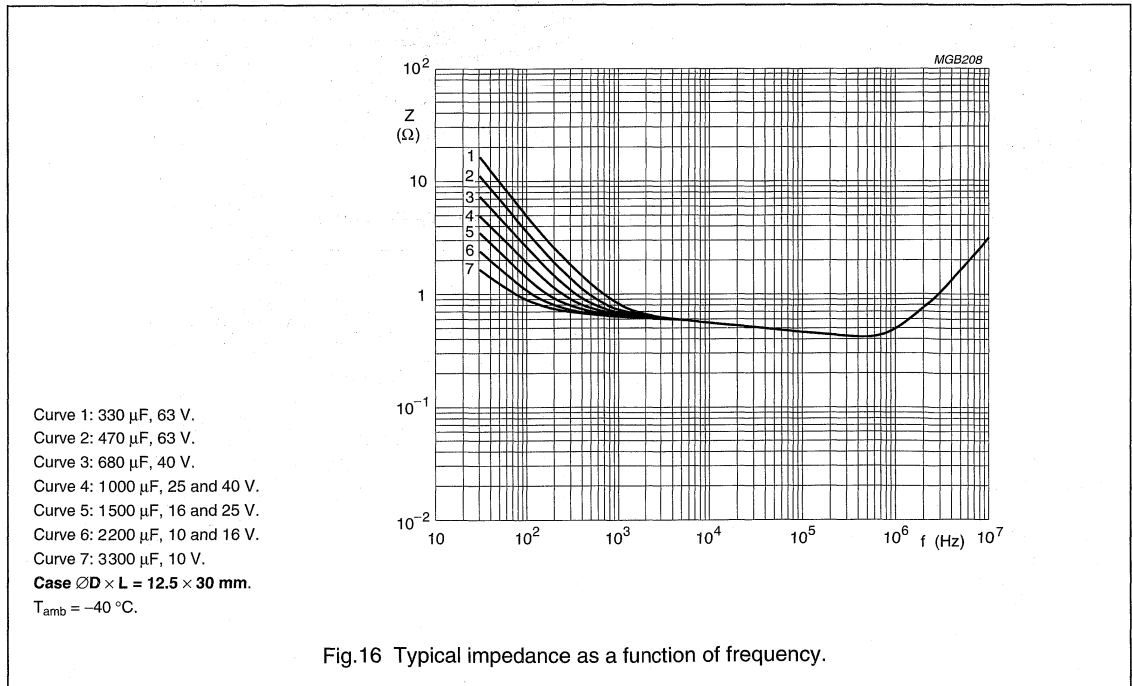
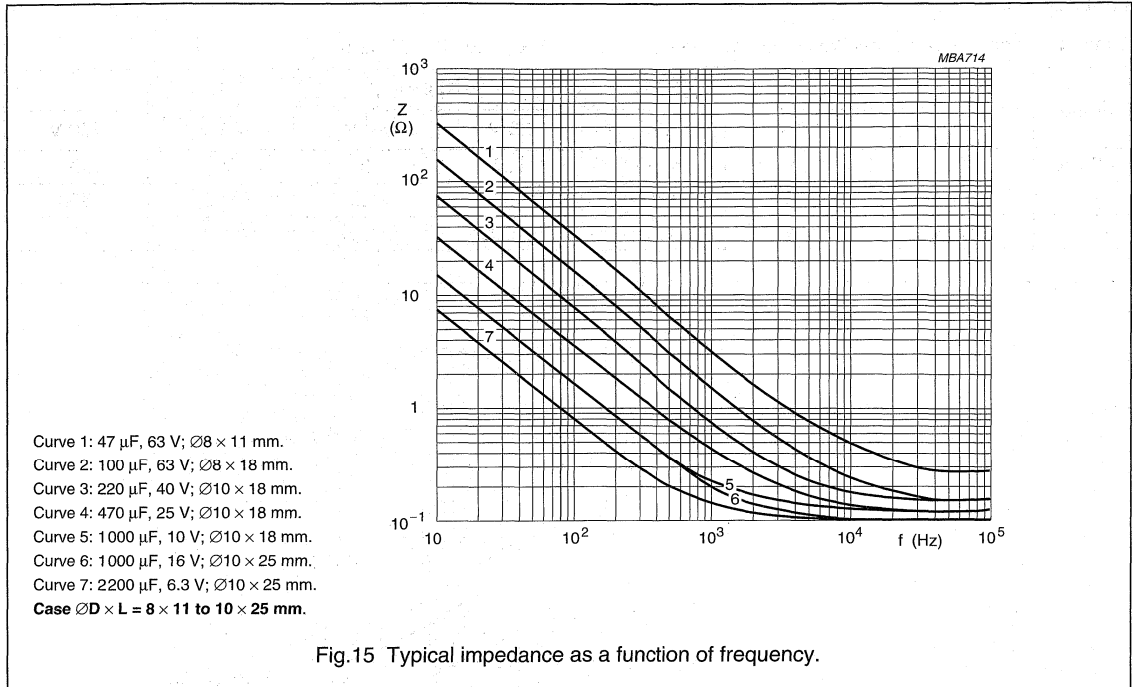
Table 4 Impedance × capacitance values (case ØD × L = 4.5 × 10 to 10 × 25 mm)

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



Aluminum electrolytic capacitors
Axial Standard Miniature

021 ASM



A

Aluminum electrolytic capacitors

Axial Standard Miniature

021 ASM

Curve 1: 330 μF , 63 V.
 Curve 2: 470 μF , 63 V.
 Curve 3: 680 μF , 40 V.
 Curve 4: 1000 μF , 25 and 40 V.
 Curve 5: 1500 μF , 16 and 25 V.
 Curve 6: 2200 μF , 10 and 16 V.
 Curve 7: 3300 μF , 10 V.
Case $\varnothing\text{D} \times \text{L} = 12.5 \times 30 \text{ mm}$.
 $T_{\text{amb}} = 20 \text{ }^\circ\text{C}$.

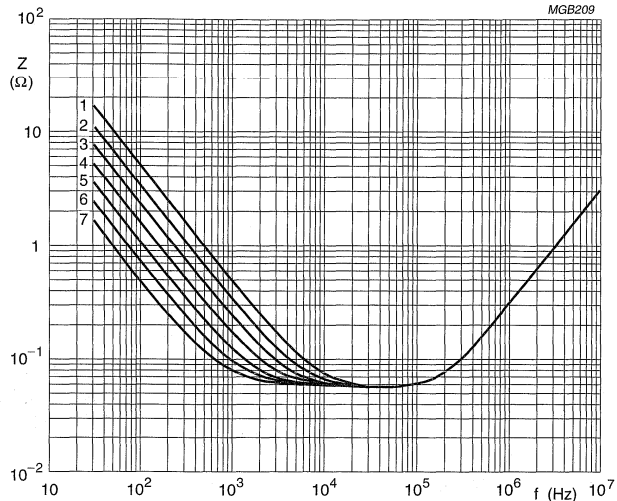


Fig.17 Typical impedance as a function of frequency.

Curve 1: 1000 μF , 63 V.
 Curve 2: 2200 μF , 40 V.
 Curve 3: 3300 μF , 25 V.
 Curve 4: 4700 μF , 16 V.
 Curve 5: 6800 μF , 10 V.
Case $\varnothing\text{D} \times \text{L} = 18 \times 30 \text{ mm}$.
 $T_{\text{amb}} = -40 \text{ }^\circ\text{C}$.

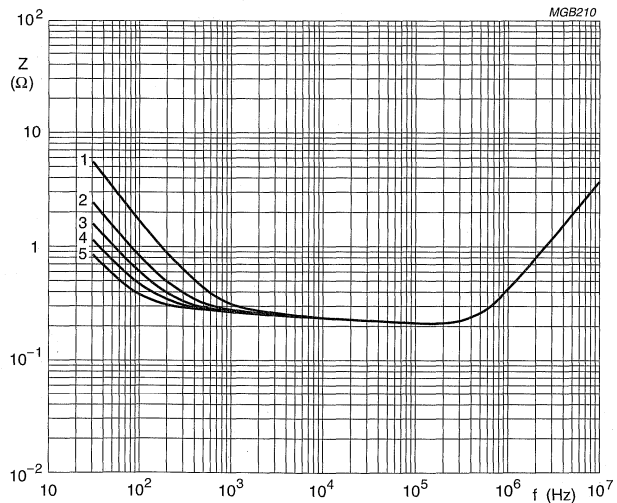
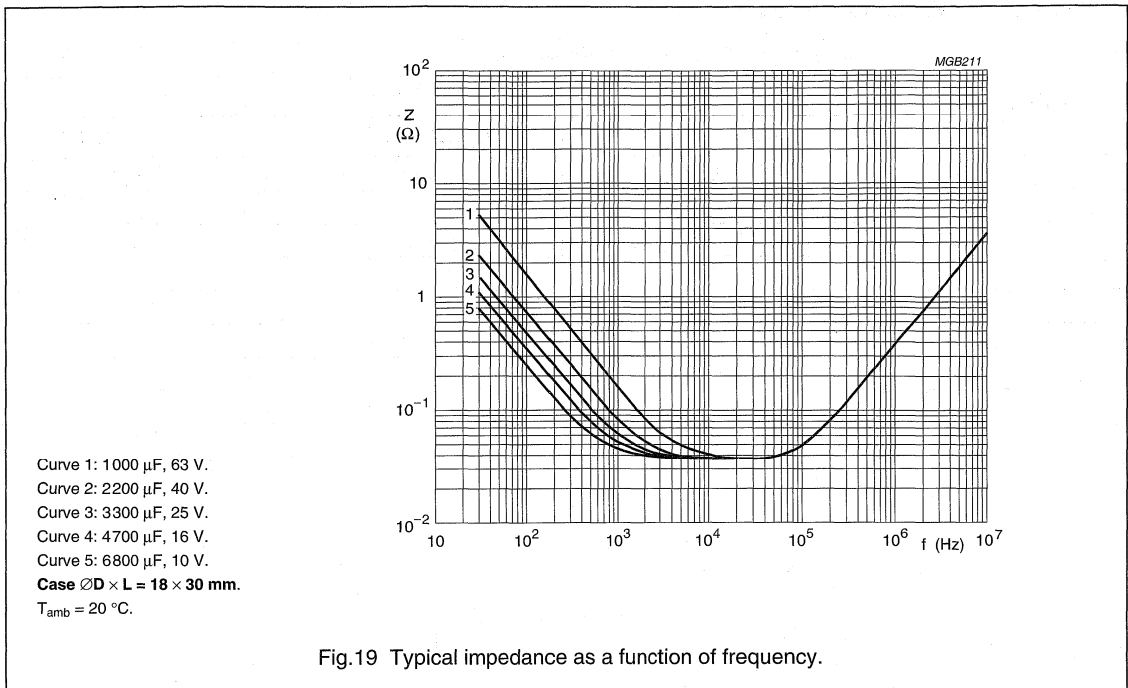


Fig.18 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors

Axial Standard Miniature

021 ASM



MARKING

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

- Rated capacitance (in μF)
- Tolerance on nominal capacitance (in accordance with "IEC 60062")
- Rated voltage (in V)
- Group number (021)
- Name of manufacturer
- Date code in accordance with "IEC 60062"
- Code for factory of origin
- Band to indicate the negative terminal
- '+' sign to identify the positive terminal (not for case sizes $L < 18 \text{ mm}$).

A

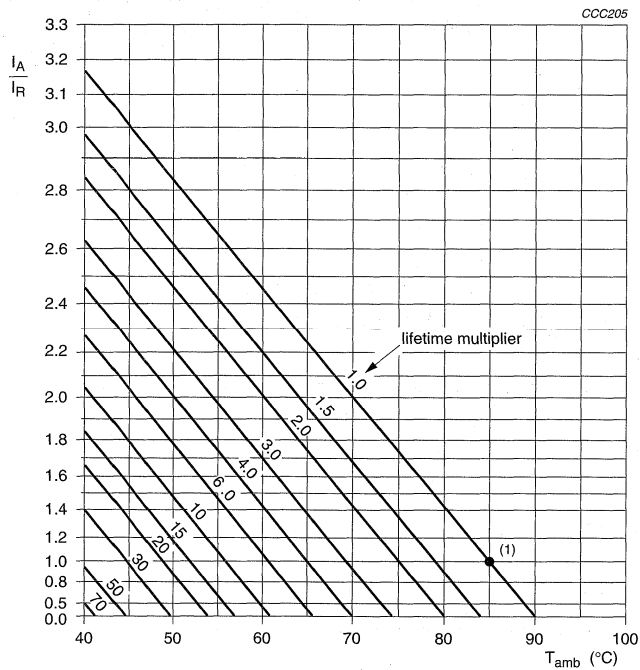
Aluminum electrolytic capacitors Axial Standard Miniature

021 ASM

RIPPLE CURRENT AND USEFUL LIFE

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	0.9	0.85
100	1	1	1
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 $\varnothing D \times L = 4.5 \times 10$ to 10×25 mm: 2500 hours

case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 8000 hours.

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

Aluminum electrolytic capacitors

Axial Standard Miniature

021 ASM

SPECIFIC TESTS AND REQUIREMENTS

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

Table 6 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied; case $\varnothing D \times L = 4.5 \times 10$ to 10×25 mm: $U_R = 6.3$ to 25 V: 1000 hours; $U_R = 40$ to 100 V: 2000 hours; case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: $U_R = 6.3$ to 100 V: 5000 hours	$U_R \leq 6.3$ V; $\Delta C/C$: $+15/-30\%$ $U_R > 6.3$ V; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; case $\varnothing D \times L = 4.5 \times 10$ to 10×25 mm: 2500 hours; case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 8000 hours	$U_R \leq 6.3$ V; $\Delta C/C$: $+45/-50\%$ $U_R > 6.3$ V; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ 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 $I_{L5} \leq 2 \times \text{spec. limit}$

A

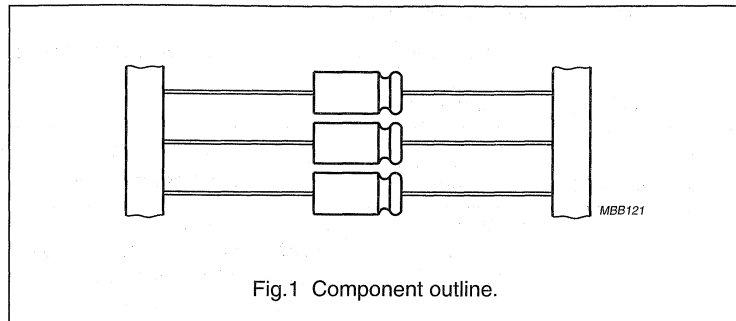
Aluminum electrolytic capacitors

Axial Standard

030/031 AS

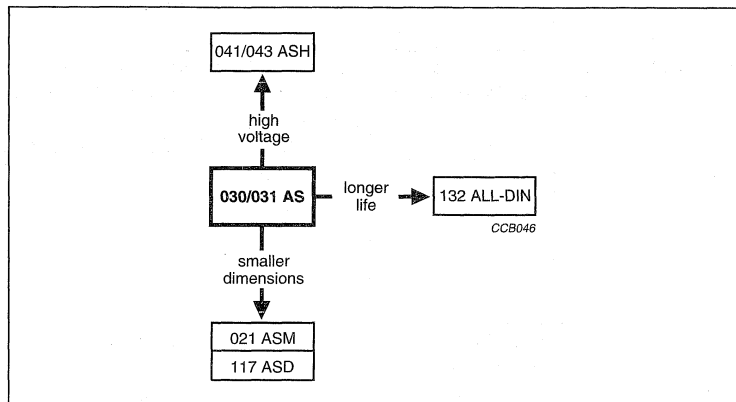
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Taped version available for automatic insertion
- Charge and discharge proof
- Useful life: 3000 hours at 85 °C (case \varnothing D = 3.3 mm: 1500 hours)
- Standard dimensions.



APPLICATIONS

- General purpose and industrial, automotive, telecommunication, audio-video
- Coupling, decoupling, timing, smoothing, filtering, buffering in SMPS
- Boards with restricted mounting height, vibration and shock resistant.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	3.3 × 11	4.5 × 10 to 10 × 25
Rated capacitance range, C_R	0.47 to 1000 μ F	
Tolerance on C_R	-10 to +50%	
Rated voltage range, U_R	6.3 to 100 V	
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	1000 hours	2000 hours
Useful life at 85 °C	1500 hours	3000 hours
Useful life at 40 °C, $1.4 \times I_R$ applied	40000 hours	80000 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	

Aluminum electrolytic capacitors

Axial Standard

030/031 AS

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

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
	–	–	–	–	–	3.3 × 11	–
2.2	–	–	–	–	3.3 × 11	4.5 × 10	4.5 × 10
3.3	–	–	–	–	–	4.5 × 10	4.5 × 10
4.7	–	–	3.3 × 11	–	–	4.5 × 10	6 × 10
6.8	–	–	–	–	–	4.5 × 10	6 × 10
10	3.3 × 11	–	–	4.5 × 10	4.5 × 10	6 × 10	8 × 11
	–	–	–	–	–	–	6.5 × 18
15	–	–	–	–	4.5 × 10	6 × 10	–
22	–	–	–	4.5 × 10	6 × 10	8 × 11	8 × 18
	–	–	–	–	–	6.5 × 18	–
33	–	–	4.5 × 10	–	6 × 10	–	10 × 18
47	–	4.5 × 10	–	6 × 10	8 × 11	8 × 18	10 × 25
	–	–	–	–	6.5 × 18	–	–
68	4.5 × 10	–	6 × 10	–	–	10 × 18	–
100	–	6 × 10	–	8 × 11	8 × 18	10 × 25	–
	–	–	–	6.5 × 18	–	–	–
150	6 × 10	–	8 × 11	8 × 18	10 × 18	–	–
	–	–	6.5 × 18	–	–	–	–
220	–	8 × 11	8 × 18	10 × 18	10 × 25	–	–
	–	6.5 × 18	–	–	–	–	–
330	–	8 × 18	10 × 18	10 × 25	–	–	–
470	8 × 18	10 × 18	10 × 25	–	–	–	–
680	10 × 18	10 × 25	–	–	–	–	–
1000⁽¹⁾	10 × 25	–	–	–	–	–	–

Note

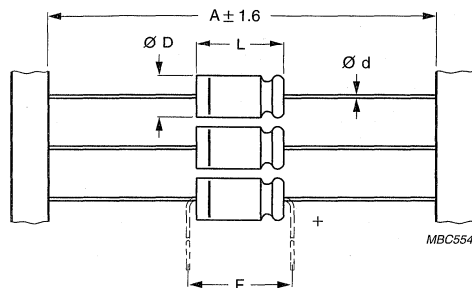
- For larger CV-values see data sheet "021 ASM".

Aluminum electrolytic capacitors

Axial Standard

030/031 AS

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.

Form BR: Taped on reel, **non-preferred**.

Form BA: Taped in box (ammopack), **preferred**.

Case $\varnothing D \times L = 3.3 \times 11$ to 10×25 mm.

For dimensions see Table 1.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.2 Dimensional outline.

Table 1 Axial; Physical dimensions, mass and packaging quantities; see Fig. 2

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	AXIAL FORM BA and BR					MASS (g)	PACKAGING QUANTITIES	
		$\varnothing d$ (mm)	A (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F_{min} (mm)		FORM BA	FORM BR
3.3 × 11	1	0.6	63.5 ± 1.5	3.5	12	17.5	≈ 0.35	1000	4000
4.5 × 10	2	0.6	63.5 ± 1.5	5.0	10.5	15	≈ 0.5	1000	3000
6 × 10	3	0.6	63.5 ± 1.5	6.3	10.5	15	≈ 0.7	1000	1000
8 × 11	5a	0.6	63.5 ± 1.5	8.5	11.5	15	≈ 1.1	500	500
6.5 × 18	4	0.8	73 ± 1.6	6.9	18.5	25	≈ 1.3	1000	1000
8 × 18	5	0.8	73 ± 1.6	8.5	18.5	25	≈ 1.7	500	500
10 × 18	6	0.8	73 ± 1.6	10.5	18.5	25	≈ 2.5	500	500
10 × 25	7	0.8	73 ± 1.6	10.5	25.0	30	≈ 3.3	500	500

Aluminum electrolytic capacitors Axial Standard

030/031 AS

Ordering example

Electrolytic capacitor 031 series

330 $\mu\text{F}/10\text{ V}$; $-10/+50\%$

Nominal case size: $\varnothing 8 \times 18\text{ mm}$; Form BA

Catalogue number: 2222 031 34331.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20^\circ\text{C}$,
 $P = 86$ 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
$\text{Tan } \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\text{tan } \delta_{\text{max}}$ and C_R)
Z	max. impedance at 10 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R 100 Hz (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85°C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222	
										TAPED ON REEL FORM BR	TAPED IN BOX FORM BA
6.3	10	3.3 × 11	1	15	5	5	0.30	47.8	20	030 23109	030 33109
	68	4.5 × 10	2	75	22	5.9	0.25	5.86	2.9	030 23689	030 33689
	150	6 × 10	3	120	10	6.9	0.25	2.66	1.3	030 23151	030 33151
	470	8 × 18	5	330	22	11	0.25	0.85	0.43	031 23471	031 33471
	680	10 × 18	6	430	30	14	0.25	0.59	0.29	031 23681	031 33681
	1000	10 × 25	7	560	42	18	0.25	0.40	0.20	031 23102	031 33102
10	47	4.5 × 10	2	70	24	5.9	0.20	6.78	3.4	030 24479	030 34479
	100	6 × 10	3	10	110	7	0.20	3.19	1.6	030 24101	030 34101
	220	8 × 11	5a	210	18	9.4	0.20	1.45	0.73	030 24221	030 34221
	220	6.5 × 18	4	210	18	9.4	0.20	1.45	0.73	031 24221	031 34221
	330	8 × 18	5	310	24	12	0.20	0.97	0.48	031 24331	031 34331
	470	10 × 18	6	410	33	14	0.20	0.68	0.34	031 24471	031 34471
	680	10 × 25	7	510	45	19	0.20	0.47	0.24	031 24681	031 34681



Aluminum electrolytic capacitors

Axial Standard

030/031 AS

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222	
										TAPED ON REEL FORM BR	TAPED IN BOX FORM BA
16	4.7	3.3 x 11	1	15	5	5	0.20	67.8	26	030 25478	030 35478
	33	4.5 x 10	2	65	27	6.1	0.16	7.72	3.6	030 25339	030 35339
	68	6 x 10	3	110	11	7.2	0.16	3.75	1.8	030 25689	030 35689
	150	8 x 11	5a	200	19	9.8	0.16	1.70	0.80	030 25151	030 35151
	150	6.5 x 18	4	200	19	9.8	0.16	1.70	0.80	031 25151	031 35151
	220	8 x 18	5	270	26	12	0.16	1.16	0.55	031 25221	031 35221
	330	10 x 18	6	410	36	16	0.16	0.78	0.36	031 25331	031 35331
25	470	10 x 25	7	480	49	20	0.16	0.55	0.26	031 25471	031 35471
	10	4.5 x 10	2	50	13	5.5	0.14	22.3	9	030 26109	030 36109
	22	4.5 x 10	2	60	28	6.1	0.14	10.2	4.1	030 26229	030 36229
	47	6 x 10	3	100	12	7.4	0.14	4.8	1.9	030 26479	030 36479
	100	8 x 11	5a	160	19	10	0.14	2.23	0.90	030 26101	030 36101
	100	6.5 x 18	4	160	19	10	0.14	2.23	0.90	031 26101	031 36101
	150	8 x 18	5	240	27	13	0.14	1.49	0.60	031 26151	031 36151
40	220	10 x 18	6	350	37	16	0.14	1.02	0.41	031 26221	031 36221
	330	10 x 25	7	460	54	22	0.14	0.68	0.27	031 26331	031 36331
	2.2	3.3 x 11	1	15	5	5	0.15	109	32	030 27228	030 37228
	10	4.5 x 10	2	50	20	5.8	0.11	17.6	7	030 27109	030 37109
	15	4.5 x 10	2	55	30	6.2	0.11	11.7	4.7	030 27159	030 37159
	22	6 x 10	3	75	9	6.8	0.11	8.0	3.2	030 27229	030 37229
	33	6 x 10	3	95	12	7.7	0.11	5.31	2.1	030 27339	030 37339
150	47	8 x 11	5a	150	16	8.8	0.11	3.73	1.5	030 27479	030 37479
	47	6.5 x 18	4	150	16	8.8	0.11	3.73	1.5	031 27479	031 37479
	100	8 x 18	5	220	28	13	0.11	1.75	0.70	031 27101	031 37101
	150	10 x 18	6	300	40	17	0.11	1.17	0.47	031 27151	031 37151
	220	10 x 25	7	430	57	23	0.11	0.80	0.32	031 27221	031 37221

Aluminum electrolytic capacitors
Axial Standard

030/031 AS

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	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)	CATALOGUE NUMBER 2222	
										TAPED ON REEL FORM BR	TAPED IN BOX FORM BA
63	1.0	3.3 × 11	1	10	5	5	0.12	191	55	030 90067	030 90068
	1.0	4.5 × 10	2	13	5	5	0.09	143	55	030 28108	030 38108
	2.2	4.5 × 10	2	25	7	5.3	0.09	65.2	25	030 28228	030 38228
	3.3	4.5 × 10	2	35	11	5.4	0.09	46.5	17	030 28338	030 38338
	4.7	4.5 × 10	2	40	15	5.6	0.09	30.5	12	030 28478	030 38478
	6.8	4.5 × 10	2	46	22	5.9	0.09	21.1	8.1	030 28688	030 38688
	10	6 × 10	3	70	7	6.3	0.08	12.8	5.5	030 28109	030 38109
	15	6 × 10	3	79	10	6.9	0.08	8.5	3.7	030 28159	030 38159
	22	8 × 11	5a	110	13	7.8	0.08	5.79	2.5	030 28229	030 38229
	22	6.5 × 18	4	110	13	7.8	0.08	5.79	2.5	031 28229	031 38229
	47	8 × 18	5	190	22	11	0.08	2.71	1.2	031 28479	031 38479
	68	10 × 18	6	250	30	14	0.08	1.88	0.81	031 28689	031 38689
	100	10 × 25	7	300	42	18	0.08	1.28	0.55	031 28101	031 38101
100	0.47	4.5 × 10	2	9	5	5	0.08	271	96	030 29477	030 39477
	1.0	4.5 × 10	2	20	5	5	0.08	128	45	030 29108	030 39108
	2.2	4.5 × 10	2	30	11	11	0.08	57.9	21	030 29228	030 39228
	3.3	4.5 × 10	2	40	17	17	0.08	38.6	14	030 29338	030 39338
	4.7	6 × 10	3	50	22	22	0.07	23.7	9.6	030 29478	030 39478
	6.8	6 × 10	3	70	34	34	0.07	16.4	6.6	030 29688	030 39688
	10	8 × 11	5a	90	50	50	0.07	11.2	4.5	030 29109	030 39109
	10	6.5 × 18	4	90	50	50	0.07	11.2	4.5	031 29109	031 39109
	22	8 × 18	5	120	80	80	0.07	5.07	2.1	031 29229	031 39229
	33	10 × 18	6	200	119	119	0.07	3.38	1.4	031 29339	031 39339
	47	10 × 25	7	260	33	33	0.07	2.37	0.96	031 29479	031 39479



Aluminum electrolytic capacitors

Axial Standard

030/031 AS

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R : case $\varnothing D \times L = 3.3 \times 11$ and 4.5×10 mm case $\varnothing D \times L = 6 \times 10$ to 10×25 mm	$I_{L1} \leq 0.05C_R \times U_R$ or $5 \mu\text{A}$, whichever is greater I_{L1} for $CV \leq 1000 \mu\text{C}$: $\leq 0.01C_R \times U_R$ or $1 \mu\text{A}$, whichever is greater I_{L1} for $CV > 1000 \mu\text{C}$: $\leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes: $U_R = 6.3$ to 63 V $U_R = 100 \text{ V}$	$I_{L5} \leq 0.002C_R \times U_R + 5 \mu\text{A}$ $I_{L5} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \times L$ mm:	
	3.3 × 11	typ. 11 nH
	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	

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" (not for case code 1)
- Rated voltage (in V)
- Group number (030 or 031)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Band to identify the negative terminal
- '+' sign to indicate the positive terminal (not for case sizes $L < 18$ mm).

Aluminum electrolytic capacitors

Axial Standard

030/031 AS

Capacitance (C)

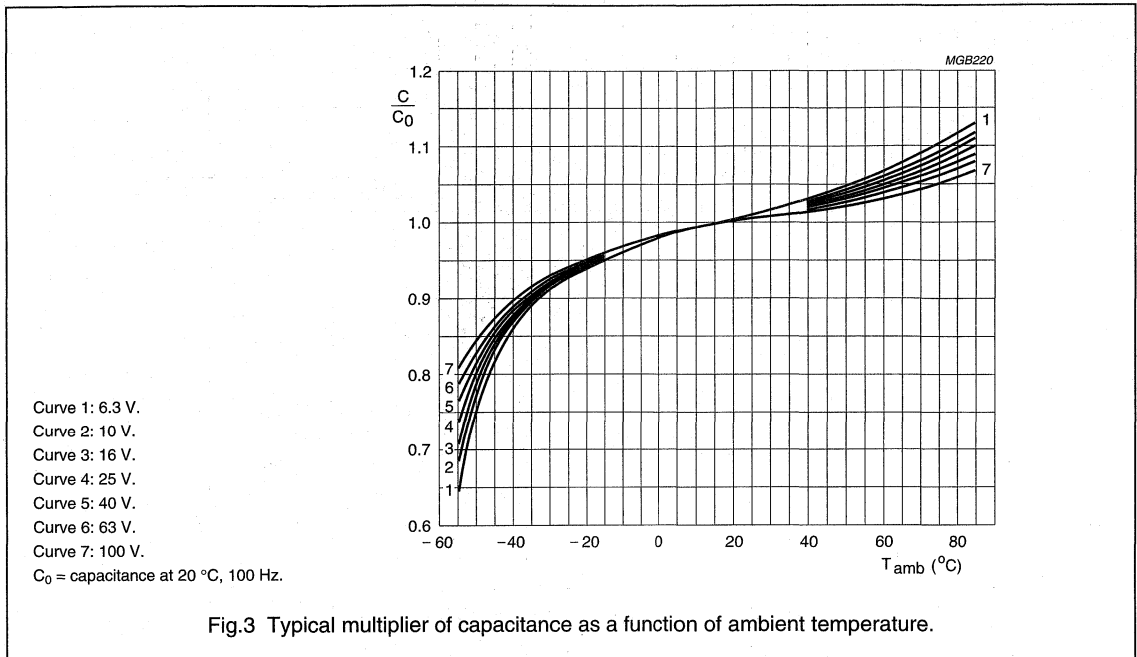


Fig.3 Typical multiplier of capacitance as a function of ambient temperature.

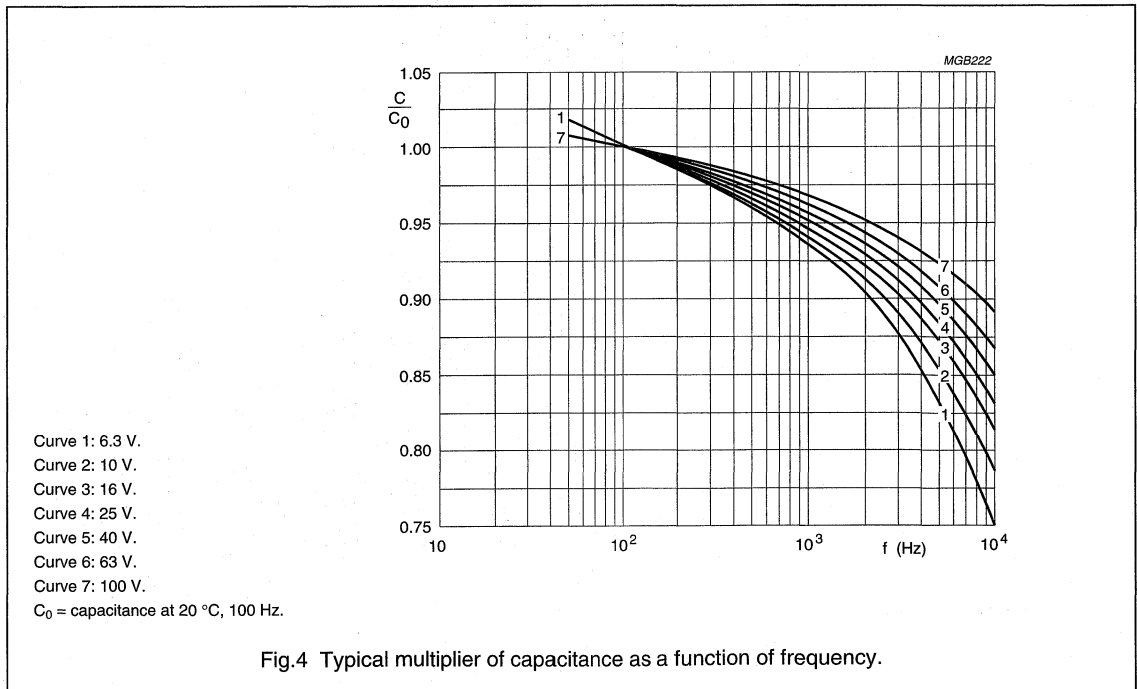
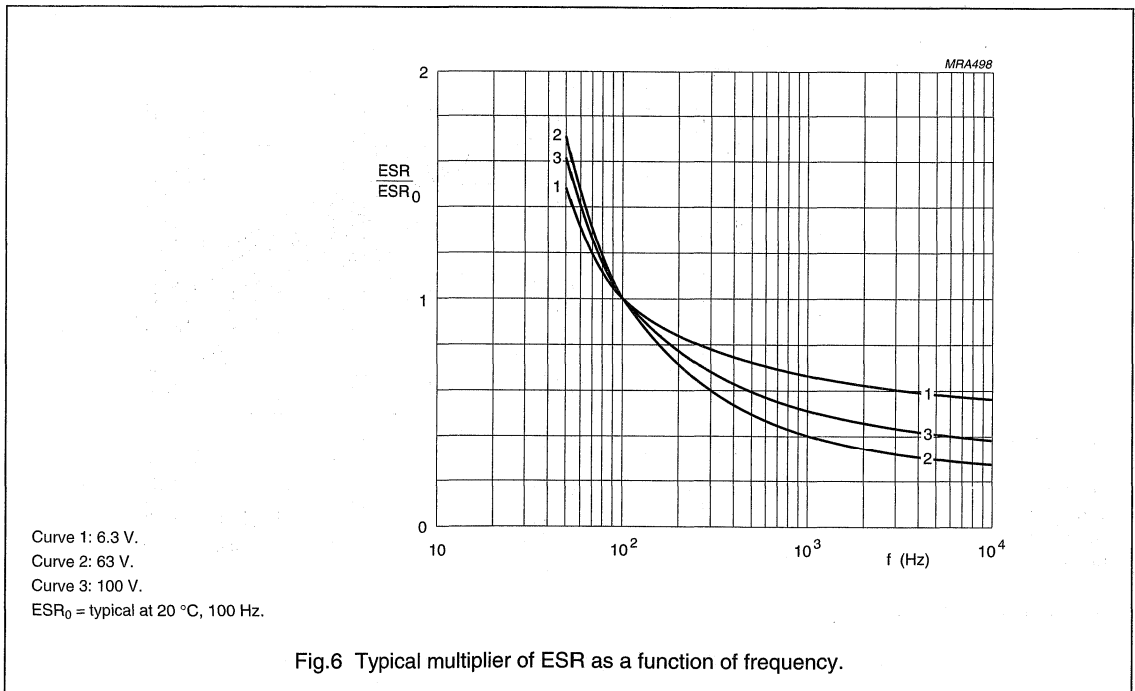
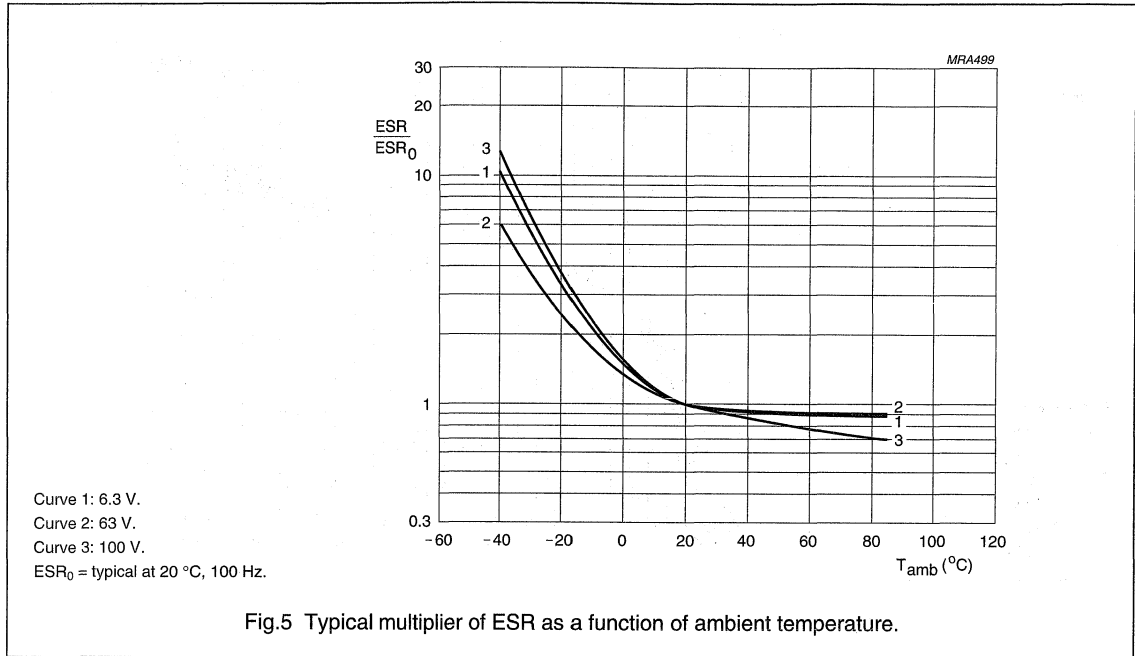


Fig.4 Typical multiplier of capacitance as a function of frequency.

Aluminum electrolytic capacitors Axial Standard

030/031 AS

Equivalent series resistance (ESR)



Aluminum electrolytic capacitors

Axial Standard

030/031 AS

Impedance (Z)

Table 3 Impedance × capacitance values at 10 kHz

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	≤200	≤160	≤120	≤90	≤70	≤55	≤45
-25 °C	≤1200	≤750	≤560	≤400	≤300	≤180	≤130
-40 °C	≤3200	≤2000	≤1500	≤1100	≤900	≤500	≤350

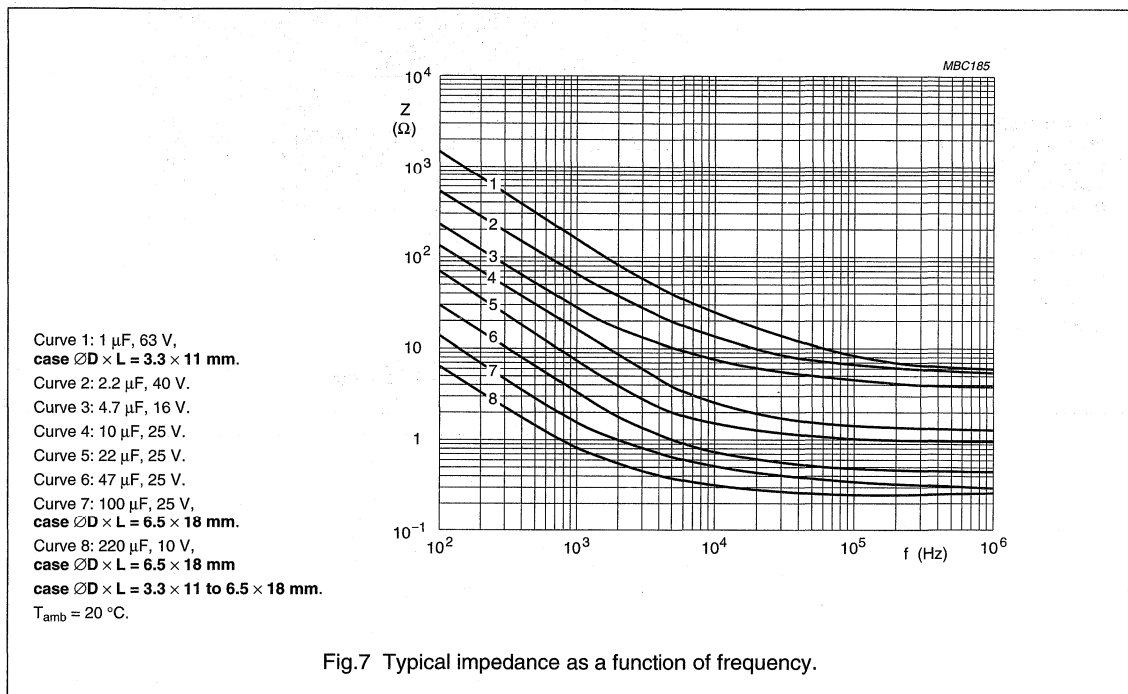


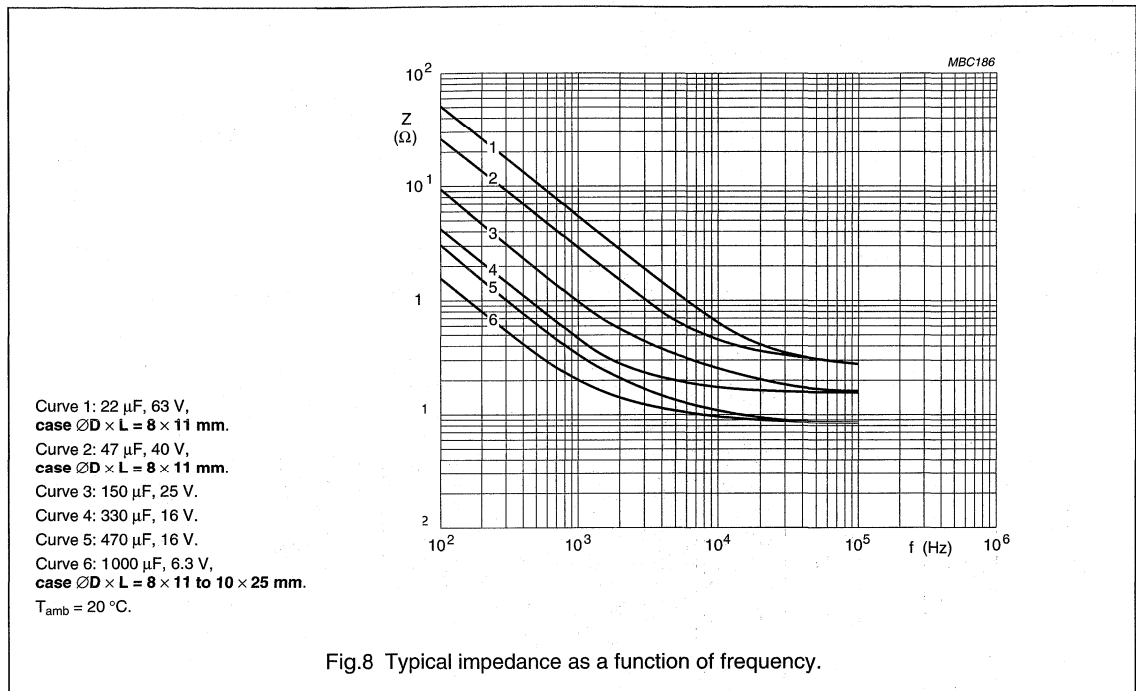
Fig.7 Typical impedance as a function of frequency.



Aluminum electrolytic capacitors

Axial Standard

030/031 AS



Aluminum electrolytic capacitors

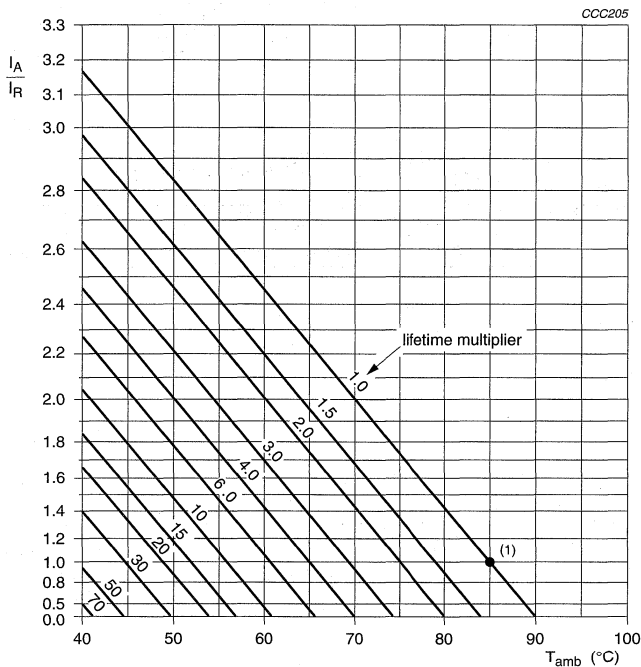
Axial Standard

030/031 AS

RIPPLE CURRENT AND USEFUL LIFE

Table 4 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	0.9	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 $\varnothing D \times L = 3.3 \times 11$ mm: 1500 hours
 case $\varnothing D \times L = 4.5 \times 10$ to 10×25 mm: 3000 hours.

Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Axial Standard

030/031 AS

SPECIFIC TESTS AND REQUIREMENTS

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

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Case $\varnothing D \times L = 3.3 \times 11$ mm			
Endurance	IEC 384-4/ EN130300 subclause 4.13	$T_{amb} = 85$ °C; U_R applied; 1000 hours	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85$ °C; U_R and I_R applied; 1500 hours	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 384-4/ 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	$\Delta C/C, \tan \delta, Z:$ for requirements see 'Endurance test' above $I_{L5} \leq 2 \times$ spec. limit
Case $\varnothing D \times L = 4.5 \times 10$ to 10×25 mm			
Endurance	IEC 384-4/ EN130300 subclause 4.13	$T_{amb} = 85$ °C; U_R applied; 2000 hours	$U_R \leq 6.3$ V; $\Delta C/C: +15/-30\%$ $U_R > 6.3$ V; $\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times$ spec. limit $Z \leq 2 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85$ °C; U_R and I_R applied; 3000 hours	$U_R \leq 6.3$ V; $\Delta C/C: +45/-50\%$ $U_R > 6.3$ V; $\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 384-4/ 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	$\Delta C/C, \tan \delta, Z:$ for requirements see 'Endurance test' above $I_{L5} \leq 2 \times$ spec. limit

Aluminum electrolytic capacitors

Axial Standard, High Voltage

041-043 ASH

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Mounting ring version (single ended) not insulated
- Taped versions up to case $\varnothing 15 \times 30$ mm available for automatic insertion
- Charge and discharge proof
- Useful life: 5000 to 15000 hours at 85 °C
- High rated voltage: up to 450 V.

APPLICATIONS

- General purpose, industrial, power supply, audio-video and lighting
- Smoothing, filtering, buffering at high voltages
- Boards with restricted mounting height, vibration and shock resistant.

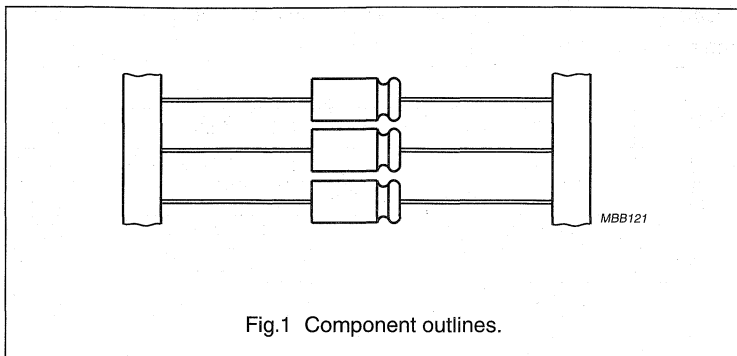
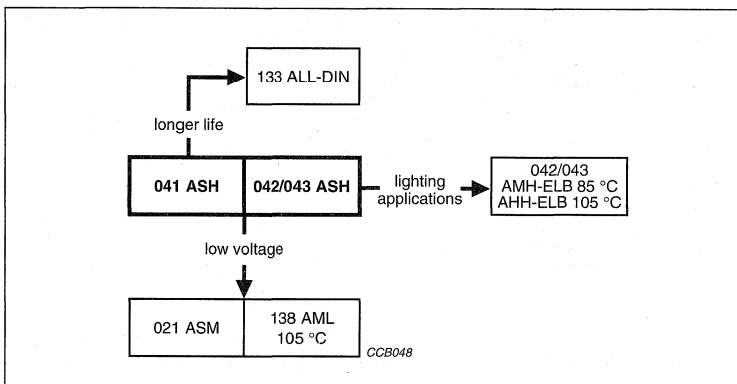


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	6.5 × 18 to 10 × 25	10 × 30 to 21 × 40
Rated capacitance range, C_R	1 to 220 μF	
Tolerance on C_R	-10 to +50%	
Rated voltage range, U_R	160 to 450 V	
Category temperature range	-40 to +85 °C (450 V: -25 to +85 °C)	
Endurance test at 85 °C	2000 hours	8000 hours (450 V: 5000 hours)
Useful life at 85 °C	5000 hours	15000 hours (450 V: 10000 hours)
Useful life at 40 °C	1.4 × I_R applied: 120000 hours	1.8 × I_R applied: 240000 hours (450 V: 160000 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 (450 V: 25/085/56)	

A

Aluminum electrolytic capacitors

Axial Standard, High Voltage

041-043 ASH

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	160	250	350	385	400	450
1.0	–	–	–	6.5 × 18	–	–
2.2	–	6.5 × 18	–	8 × 18	–	–
4.7	6.5 × 18	8 × 18	10 × 18	10 × 25	–	–
6.8	–	–	10 × 30	10 × 30	10 × 30	10 × 30
10	8 × 18	10 × 25	12.5 × 30	12.5 × 30	12.5 × 30	12.5 × 30
	–	10 × 30	–	–	–	–
15	–	12.5 × 30	12.5 × 30	15 × 30	15 × 30	12.5 × 30
22	10 × 25	12.5 × 30	15 × 30	18 × 30	18 × 30	15 × 30
	10 × 30	–	–	–	–	–
33	12.5 × 30	15 × 30	18 × 30	18 × 40	18 × 40	18 × 30
47	15 × 30	18 × 30	18 × 40	18 × 40	18 × 40	18 × 40
68	15 × 30	18 × 40	21 × 40	21 × 40	21 × 40	21 × 40
100	18 × 30	21 × 40	–	–	–	–
150	18 × 40	–	–	–	–	–
220	21 × 40	–	–	–	–	–

MARKING

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

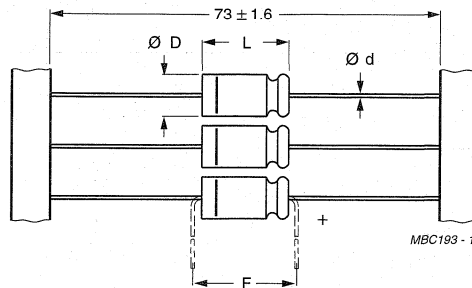
- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062"
- Rated voltage (in V)
- Group number (041, 042 or 043)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to identify the negative terminal
- '+' sign to indicate the positive terminal.

Aluminum electrolytic capacitors

Axial Standard, High Voltage

041-043 ASH

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.

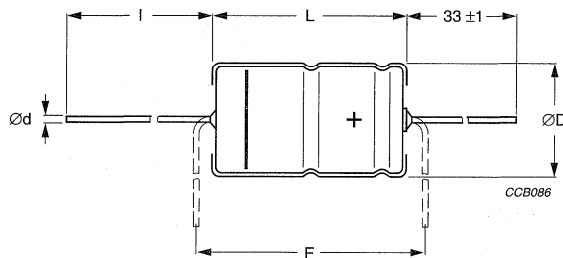
Form BR: Taped on reel,
case $\text{Ø}D \times L = 6.5 \times 18$ to 15×30 mm.

Form BA: Taped in box (ammopack),
case $\text{Ø}D \times L = 6.5 \times 18$ 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 $\text{Ø}D \times L = 10 \times 30$ to 21×40 mm

For dimensions see Table 1.

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

Fig.3 Dimensional outline; Form AA.

Aluminum electrolytic capacitors

Axial Standard, High Voltage

041-043 ASH

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

NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	AXIAL: FORM AA, BA, and BR					MASS (g)	PACKAGING QUANTITIES		
		Ød (mm)	l (mm)	ØD _{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	–	–

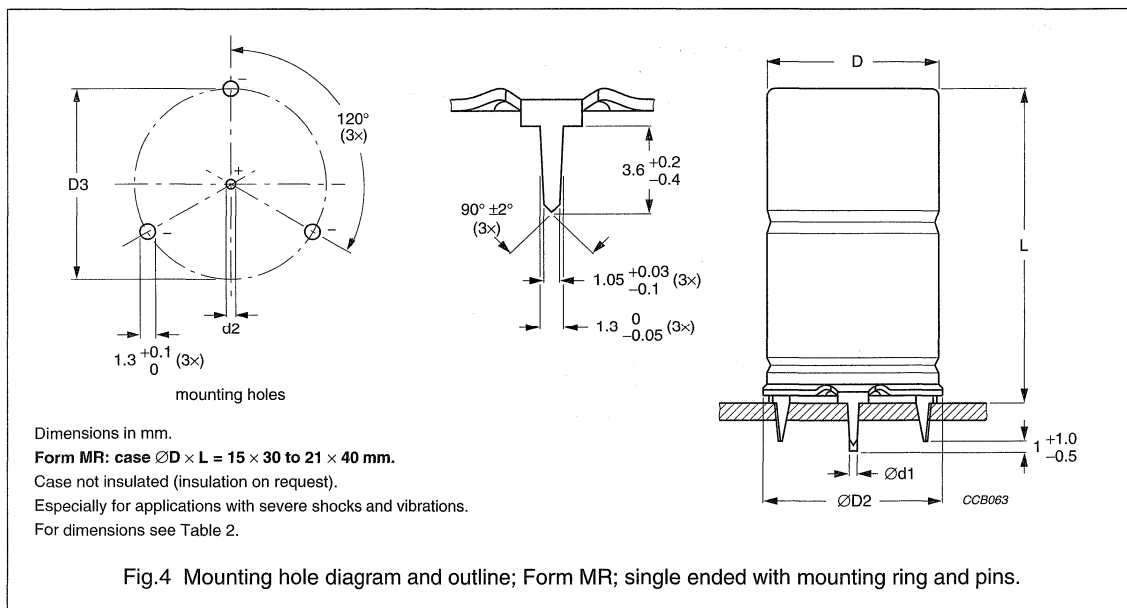


Table 2 Single ended; physical dimensions, mass and packaging information; see Fig.4

NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	SINGLE ENDED WITH MOUNTING RING: FORM MR						MASS (g)	PACKAGING QUANTITIES
		Ød1 (mm)	Ød2 (mm)	ØD _{max} (mm)	ØD2 _{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

Aluminum electrolytic capacitors Axial Standard, High Voltage

041-043 ASH

Ordering example

Electrolytic capacitor 041 series

10 μ F/250 V; -10/+50%

Nominal case size: \varnothing 10 x 25 mm; Form BA

Catalogue number: 2222 041 33109.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 3 apply at $T_{amb} = 20^\circ C$,

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

Table 3 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	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	4.7	6.5 x 18	4	50	38	8	0.15	51	26	-	041 21478	041 31478	-
	10	8 x 18	5	70	68	14	0.15	24	12	-	041 21109	041 31109	-
	22	10 x 25	7	150	130	25	0.15	11	5.5	-	041 21229	041 31229	-
	22	10 x 30	00	190	42	25	0.10	6.8	5.5	042 11229	042 21229	-	-
	33	12.5 x 30	01	270	58	36	0.10	4.5	3.1	042 11339	042 21339	-	-
	47	15 x 30	02	350	78	49	0.10	3.2	2.1	042 11479	042 21479	-	042 41479
	68	15 x 30	02	420	110	69	0.10	2.2	1.4	042 11689	042 21689	-	042 41689
	100	18 x 30	03	580	150	100	0.10	1.5	1.0	042 11101	-	-	042 41101
	150	18 x 40	04	760	230	150	0.10	1.0	0.7	043 11151	-	-	043 41151
	220	21 x 40	05	940	330	220	0.10	0.7	0.5	043 11221	-	-	043 41221
250	2.2	6.5 x 18	4	35	28	6	0.10	72	50	-	041 23228	041 33228	-
	4.7	8 x 18	5	55	55	11	0.10	34	23	-	041 23478	041 33478	-
	10	10 x 25	7	90	95	19	0.10	16	11	-	041 23109	041 33109	-
	10	10 x 30	00	130	33	19	0.10	15	11	042 13109	042 23109	-	-



Aluminum electrolytic capacitors
Axial Standard, High Voltage

041-043 ASH

CATALOGUE NUMBER 2222				Z 10 kHz (Ω)	ESR 100 Hz (Ω)	Tan δ 100 Hz	I _{L5} 5 min (μA)	I _{L1} 1 min (μA)	I _R 100 Hz 85 °C (mA)	CASE CODE	NOMINAL CASE SIZE ∅D × L (mm)	C _R 100 Hz (μF)	U _R (V)	AXIAL			SINGLE ENDED
IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR														
250	15	12.5 × 30	01	180	44	27	0.10	10	7.4	042 13159	042 23159	-	-	-	-	-	
	22	12.5 × 30	01	220	60	37	0.10	6.8	5.0	042 13229	042 23229	-	-	-	-	-	
	33	15 × 30	02	290	84	54	0.10	4.5	3.4	042 13339	042 23339	-	-	-	-	042 43339	
	47	18 × 30	03	400	120	75	0.10	3.2	2.3	042 13479	-	-	-	-	-	042 43479	
	68	18 × 40	04	520	160	110	0.10	2.2	1.7	043 13689	-	-	-	-	-	043 43689	
	100	21 × 40	05	650	240	150	0.10	1.5	1.1	043 13101	-	-	-	-	-	043 43101	
350	4.7	10 × 18	6	60	69	14	0.10	34	22	-	041 25478	041 35478	-	-	-	-	
	6.8	10 × 30	00	110	32	18	0.10	22	14	042 15688	042 25688	-	-	-	-	-	
	10	12.5 × 30	01	150	42	25	0.10	15	10	042 15109	042 25109	-	-	-	-	-	
	15	12.5 × 30	01	180	57	36	0.10	10	6.7	042 15159	042 25159	-	-	-	-	-	
	22	15 × 30	02	250	79	50	0.10	6.8	4.5	042 15229	042 25229	-	-	-	-	042 45229	
	33	18 × 30	03	350	110	73	0.10	4.5	3.1	042 15339	-	-	-	-	-	042 45339	
	47	18 × 40	04	450	160	100	0.10	3.2	2.1	043 15479	-	-	-	-	-	043 45479	
	68	21 × 40	05	560	220	150	0.10	2.2	1.4	043 15689	-	-	-	-	-	043 45689	
385	1	6.5 × 18	4	20	19	4	0.10	160	100	-	041 28108	041 38108	-	-	-	-	
	2.2	8 × 18	5	40	42	8	0.10	72	45	-	041 28228	041 38228	-	-	-	-	
	4.7	10 × 25	7	70	71	15	0.10	34	22	-	041 28478	041 38478	-	-	-	-	
	6.8	10 × 30	00	110	34	20	0.10	22	14	042 18688	042 28688	-	-	-	-	-	
	10	12.5 × 30	01	150	45	27	0.10	15	10	042 18109	042 28109	-	-	-	-	-	
	15	15 × 30	02	210	62	39	0.10	10	6.0	042 18159	042 28159	-	-	-	-	042 48159	
	22	18 × 30	03	290	86	55	0.10	6.8	4.1	042 18229	-	-	-	-	-	042 48229	
	33	18 × 40	04	380	120	80	0.10	4.5	2.7	043 18339	-	-	-	-	-	043 48339	
	47	18 × 40	04	450	170	110	0.10	3.2	2.1	043 18479	-	-	-	-	-	043 48479	
	68	21 × 40	05	570	250	160	0.10	2.2	1.4	043 18689	-	-	-	-	-	043 48689	

Aluminum electrolytic capacitors
Axial Standard, High Voltage

041-043 ASH

CATALOGUE NUMBER 2222													
U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	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)	AXIAL			
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	SINGLE ENDED MOUNTING RING FORM MR
400	6.8	10 × 30	00	110	220	110	0.055	11.5	7.3	042 16688	042 26688	-	-
	10	12.5 × 30	01	150	240	110	0.055	7.5	4.6	042 16109	042 26109	-	-
	15	15 × 30	02	210	250	110	0.055	5.0	3.1	042 16159	042 26159	-	042 46159
	22	18 × 30	03	290	280	120	0.055	3.5	2.1	042 16229	-	-	042 46229
	33	18 × 40	04	380	320	130	0.055	2.3	1.4	043 16339	-	-	043 46339
450	47	18 × 40	04	450	370	140	0.055	1.7	1.1	043 16479	-	-	043 46479
	68	21 × 40	05	560	440	150	0.055	1.2	0.7	043 16689	-	-	043 46689
	6.8	10 × 30	00	110	230	110	0.10	22	14	042 17688	042 27688	-	-
	10	12.5 × 30	01	150	240	110	0.10	15	10	042 17109	042 27109	-	-
	15	12.5 × 30	01	180	260	110	0.10	10	6	042 17159	042 27159	-	-
47	22	15 × 30	02	240	290	120	0.10	6.8	4.1	042 17229	042 27229	-	042 47229
	33	18 × 30	03	350	330	130	0.10	4.5	2.7	042 17339	-	-	042 47339
	47	18 × 40	04	440	390	140	0.10	3.2	2.1	043 17479	-	-	043 47479
	68	21 × 40	05	550	460	160	0.10	2.2	1.4	043 17689	-	-	043 47689



Aluminum electrolytic capacitors

Axial Standard, High Voltage

041-043 ASH

Additional electrical data

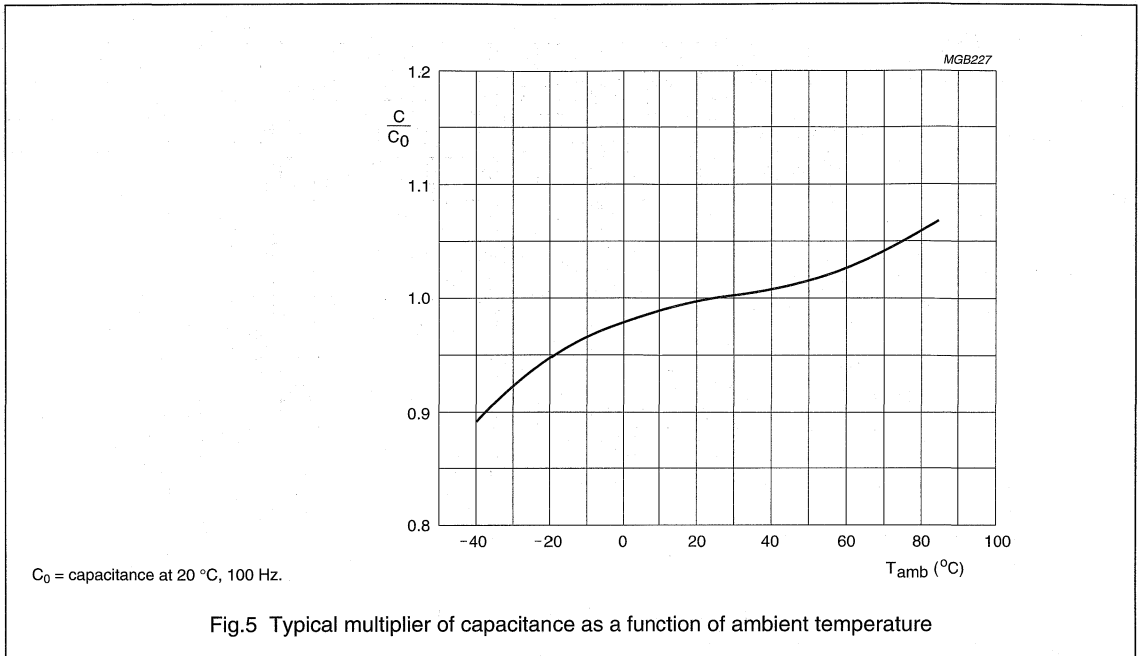
PARAMETER	CONDITIONS	VALUE	
		AXIAL	SINGLE ENDED
Voltage			
Surge voltage	$U_R = 160$ to 250 V	$U_s \leq 1.15 \times U_R$	
	$U_R = 350$ to 450 V	$U_s \leq 1.1 \times U_R$	
Reverse voltage		$U_{rev} \leq 1$ V	
Current			
Leakage current	after 1 minute: case $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: $CV \leq 1000 \mu C$ $CV > 1000 \mu C$ case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: $U_R = 160$ to 385 V $U_R = 400$ and 450 V	$I_{L1} \leq 0.05C_R \times U_R$ or $5 \mu A$, whichever is greater $I_{L1} \leq 0.03C_R \times U_R + 20 \mu A$ $I_{L1} \leq 0.009C_R \times U_R + 10 \mu A$ $I_{L1} \leq 0.009C_R \times U_R + 200 \mu A$	
	after 5 minutes: $U_R = 160$ to 385 V: $CV \leq 1000 \mu C$ $CV > 1000 \mu C$ $U_R = 400$ and 450 V	$I_{L5} \leq 0.01C_R \times U_R$ or $1 \mu A$, whichever is greater $I_{L5} \leq 0.006C_R \times U_R + 4 \mu A$ $I_{L5} \leq 0.002C_R \times U_R + 100 \mu A$	
Inductance			
Equivalent series inductance (ESL)	case $\varnothing D \times L$ 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

Aluminum electrolytic capacitors

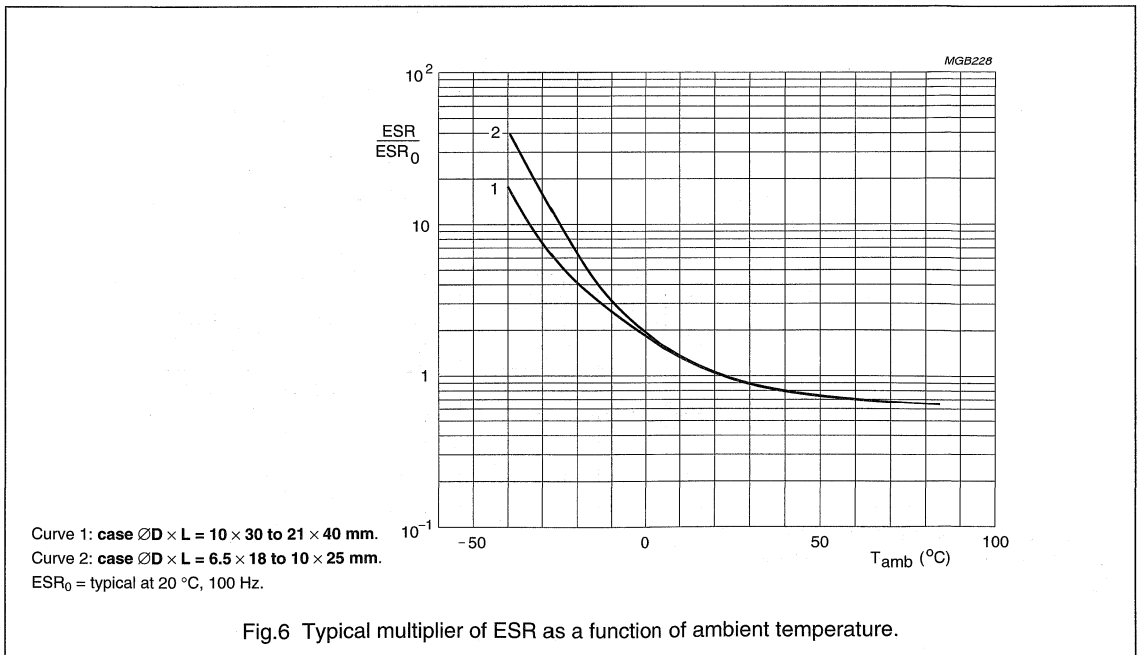
Axial Standard, High Voltage

041-043 ASH

Capacitance (C)

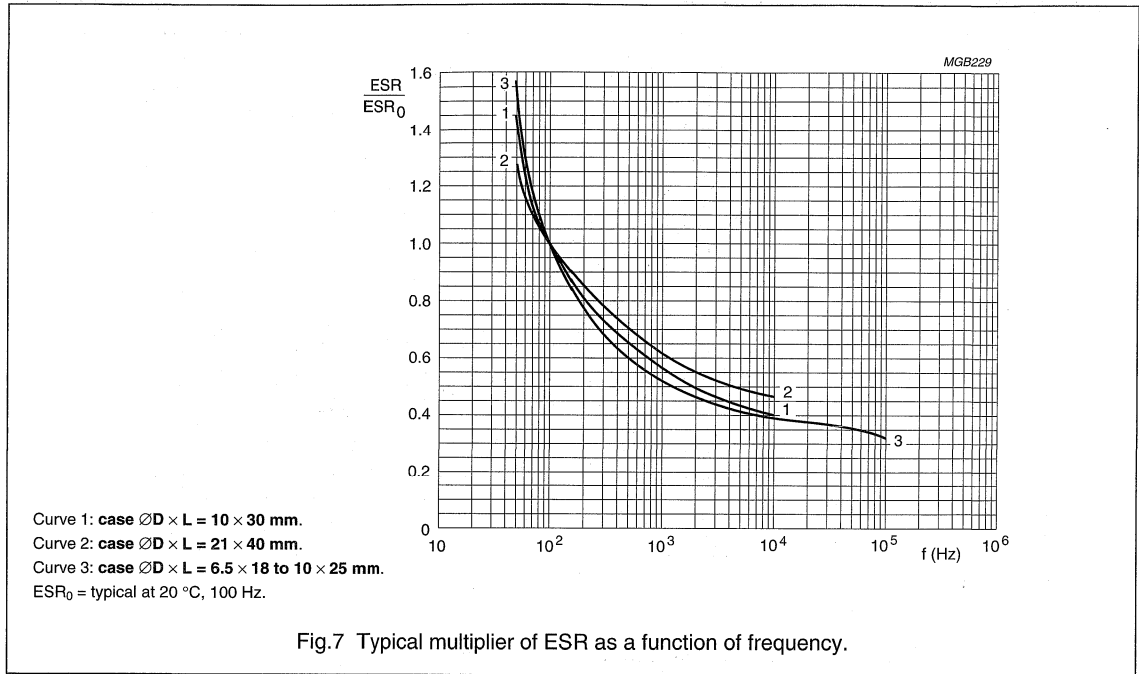


Equivalent series resistance (ESR)

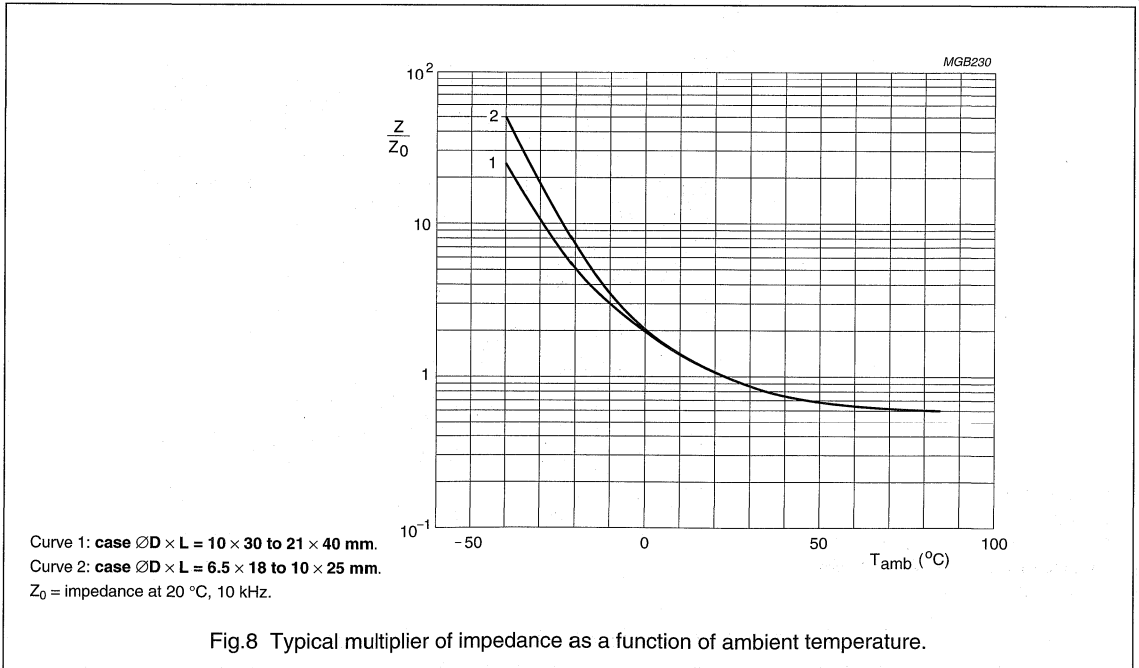


Aluminum electrolytic capacitors Axial Standard, High Voltage

041-043 ASH

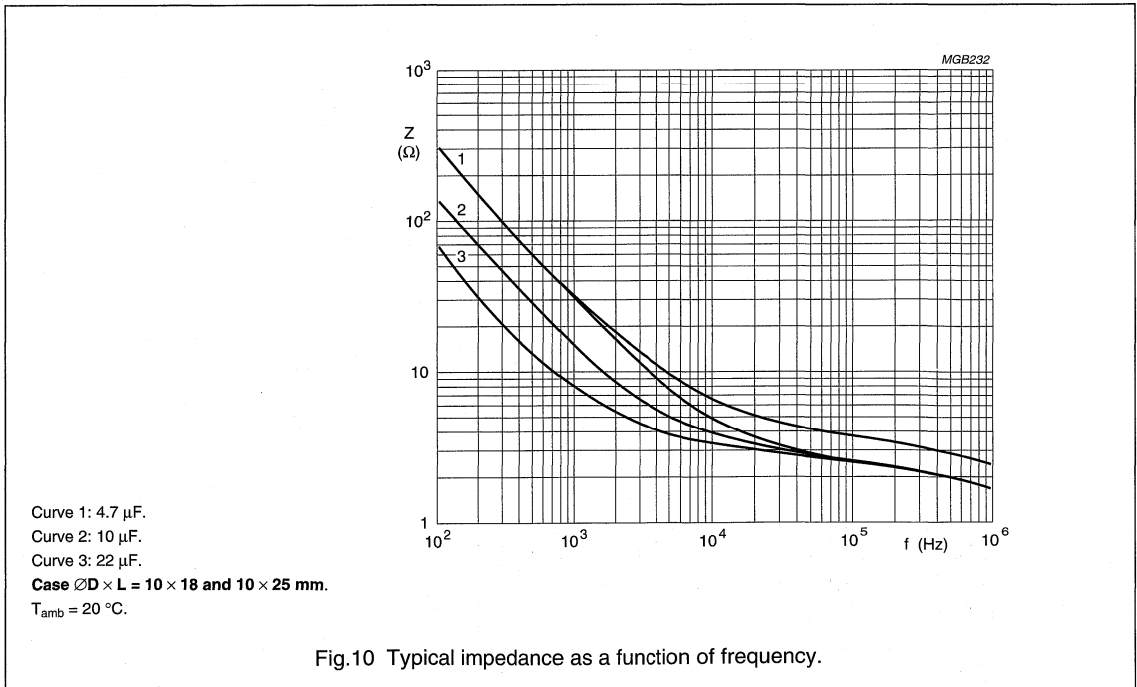
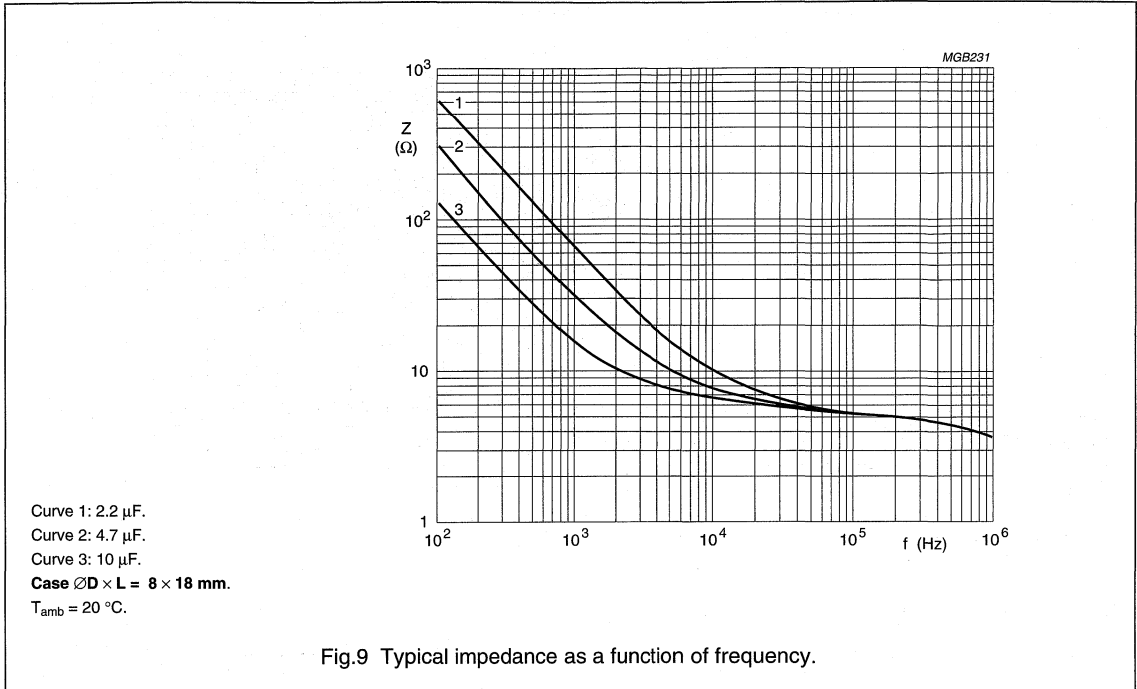


Impedance (Z)



Aluminum electrolytic capacitors
Axial Standard, High Voltage

041-043 ASH

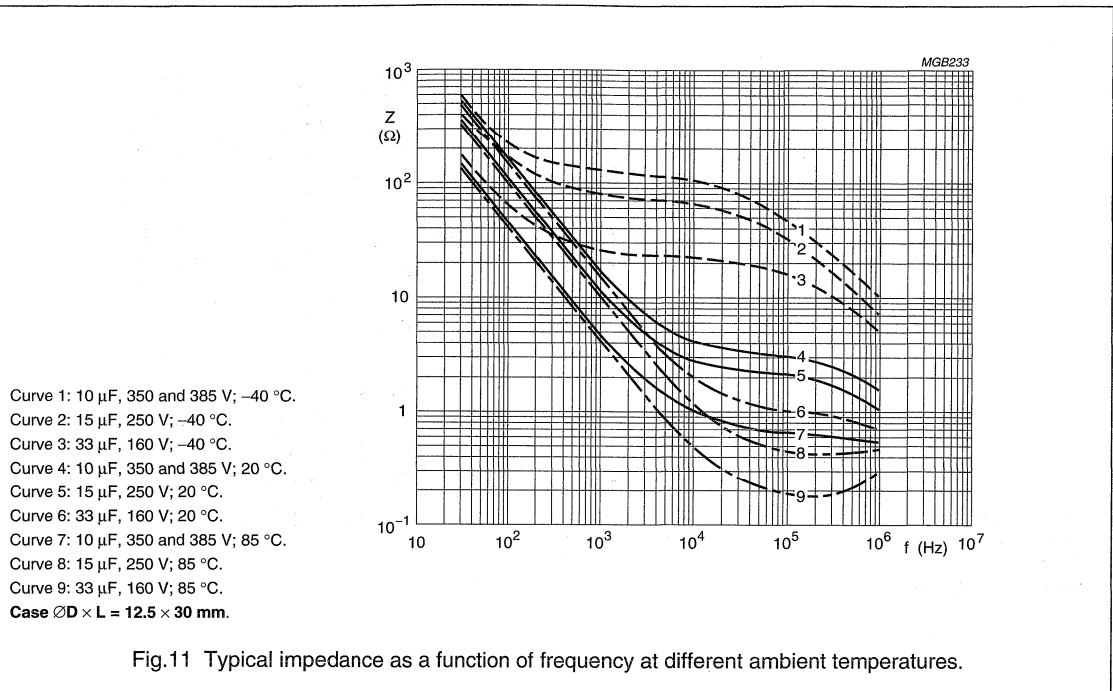


A

Aluminum electrolytic capacitors

Axial Standard, High Voltage

041-043 ASH



Aluminum electrolytic capacitors

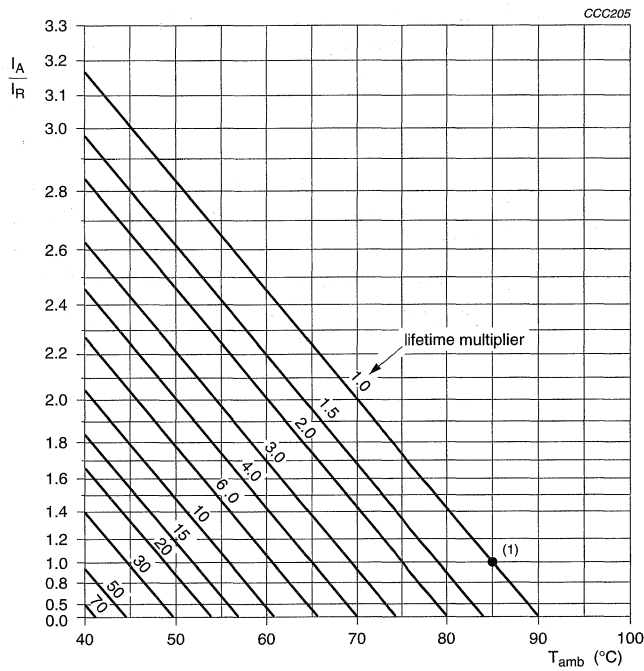
Axial Standard, High Voltage

041-043 ASH

RIPPLE CURRENT AND USEFUL LIFE

Table 4 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.75
100	1.0
300	1.15
1000	1.3
3000	1.4
≥ 10000	1.5



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 $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: 5000 hours

case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 15000 hours (450 V: 10000 hours).

Fig.12 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Axial Standard, High Voltage

041-043 ASH

SPECIFIC TESTS AND REQUIREMENTS

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

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; case $\varnothing D \times L$: 6.5 × 18 to 10 × 25 mm: 2000 hours; 10 × 30 to 21 × 40 mm: 8000 hours (450 V: 5000 hours)	$U_R = 160\text{ V}$; $\Delta C/C$: $\pm 15\%$ $U_R = 250$ to 450 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	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; case $\varnothing D \times L$: 6.5 × 18 to 10 × 25 mm: 5000 hours; 10 × 30 to 21 × 40 mm: 15000 hours (450 V: 10000 hours)	$U_R = 160\text{ V}$; $\Delta C/C$: $\pm 45\%$ $U_R = 250$ to 450 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: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors, Axial Miniature, High Voltage for Electronic Lighting Ballast

042/043 AMH-ELB

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Taped versions up to case $\varnothing 15 \times 30$ mm available for automatic insertion
- Charge and discharge proof
- Useful life: 20000 hours
- Stable under overvoltage conditions:
550 V for 24 hours at 85 °C
- High ripple current capability
- Smallest dimensions.

APPLICATIONS

- Electronic lighting ballast, power supply
- Smoothing, filtering, buffering at high voltages
- Boards with restricted mounting height, vibration and shock resistant.

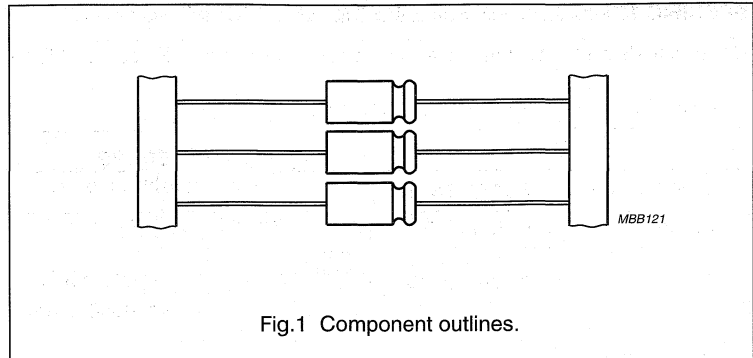
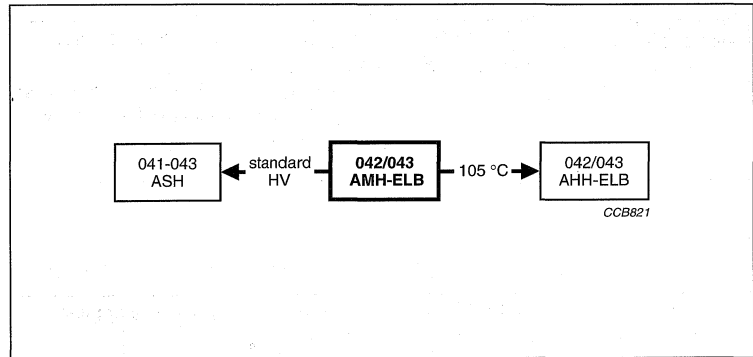


Fig.1 Component outlines.



QUICK REFERENCE DATA

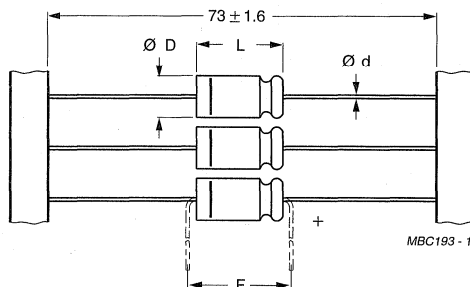
DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	12.5 × 30 to 18 × 40
Rated capacitance range, C_R	10 to 33 μ F
Tolerance on C_R	-10 to +50%
Rated voltage, U_R	450 V
Category temperature range	-25 to +85 °C
Endurance test at 85 °C	8000 hours
Useful life at 85 °C	20000 hours
Useful life at 70 °C, I_R applied	100000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	25/085/56

A

Aluminum electrolytic capacitors, Axial Miniature, High Voltage for Electronic Lighting Ballast

042/043
AMH-ELB

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.

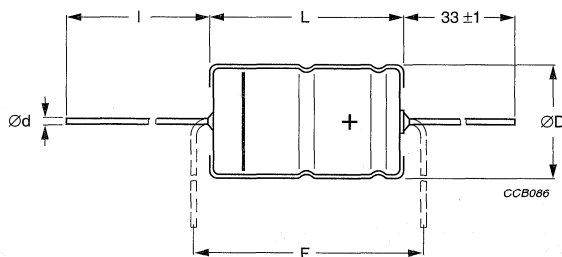
Form BR: Taped on reel.

Case $\varnothing D \times L = 12.5 \times 30$ and 15×30 mm.

For dimensions see Table 1.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.2 Dimensional outline; Form BR.



Dimensions in mm.

Form AA: Axial in box.

Case $\varnothing D \times L = 12.5 \times 30$ to 18×40 mm.

For dimensions see Table 1.

For case $\varnothing D \times L = 18 \times 40$, the stated L may be exceeded by 0.7 mm.

Fig.3 Dimensional outline; Form AA.

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

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	AXIAL: FORM AA and BR					MASS (g)	PACKAGING QUANTITIES	
		$\varnothing d$ (mm)	l (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F_{min} (mm)		FORM AA	FORM BR
12.5 × 30	01	0.8	55 ± 1	13.0	30.5	35	≈ 6.1	200	400
15 × 30	02	0.8	55 ± 1	15.5	30.5	35	≈ 8.3	200	250
18 × 30	03	0.8	55 ± 1	18.5	30.5	35	≈ 11.6	200	–
18 × 40	04	0.8	34 ± 1	18.5	41.5	45	≈ 16.2	100	–

Aluminum electrolytic capacitors, Axial Miniature, High Voltage for Electronic Lighting Ballast

042/043
AMH-ELB

Ordering example

Electrolytic capacitor 042 series

10 μ F/450 V; -10/+50%

Nominal case size: \varnothing 12.5 x 30 mm; Form BR

Catalogue number: 2222 042 82109.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{amb} = 20\text{ }^{\circ}\text{C}$,
P = 86 to 106 kPa, RH = 45 to 75%.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz; tolerance -10/+50%
I_R	rated RMS ripple current at 10 kHz, 85 $^{\circ}\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ/max. equivalent series resistance at 100 Hz
Z	typ/max. impedance at 10 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 10 kHz 85 $^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	ESR TYP. 100 Hz (Ω)	ESR MAX. 100 Hz (Ω)	Z TYP. 10 kHz (Ω)	Z MAX. 10 kHz (Ω)	CATALOGUE NUMBER	
										CASE CODE	IN BOX FORM AA
450	10	12.5 x 30	710	240	110	2.6	5.6	1.8	3.1	042 81109	042 82109
	15	15 x 30	910	260	115	1.7	3.7	1.2	2.1	042 81159	042 82159
	22	18 x 30	1190	290	120	1.1	2.4	0.9	1.4	042 81229	-
	33	18 x 40	1610	330	130	0.8	1.7	0.6	1.0	043 81339	-



Aluminum electrolytic capacitors, Axial Miniature, High Voltage for Electronic Lighting Ballast

042/043
AMH-ELB

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	$U_R = 450 \text{ V}$	$U_S \leq 550 \text{ V}$
Overvoltage test	24 hours at 85 °C	550 V; note 1
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute	$I_{L1} \leq 0.009 \times C_R \times U_R + 200 \mu\text{A}$
	after 5 minutes	$I_{L5} \leq 0.002 \times C_R \times U_R + 100 \mu\text{A}$
Inductance		
Equivalent series inductance	case $\varnothing D \times L$ in mm:	
	12.5 × 30	typ. 46 nH
	15 × 30	typ. 48 nH
	18 × 30	typ. 50 nH
	18 × 40	typ. 54 nH

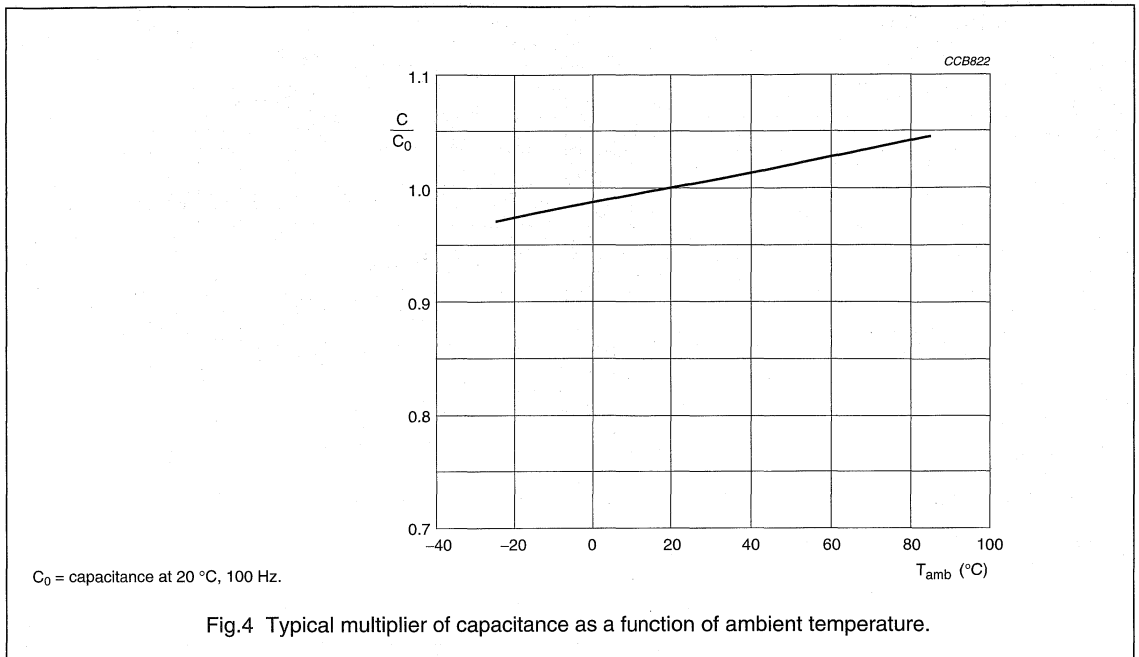
Note

- For 10, 15 and 22 μF types.

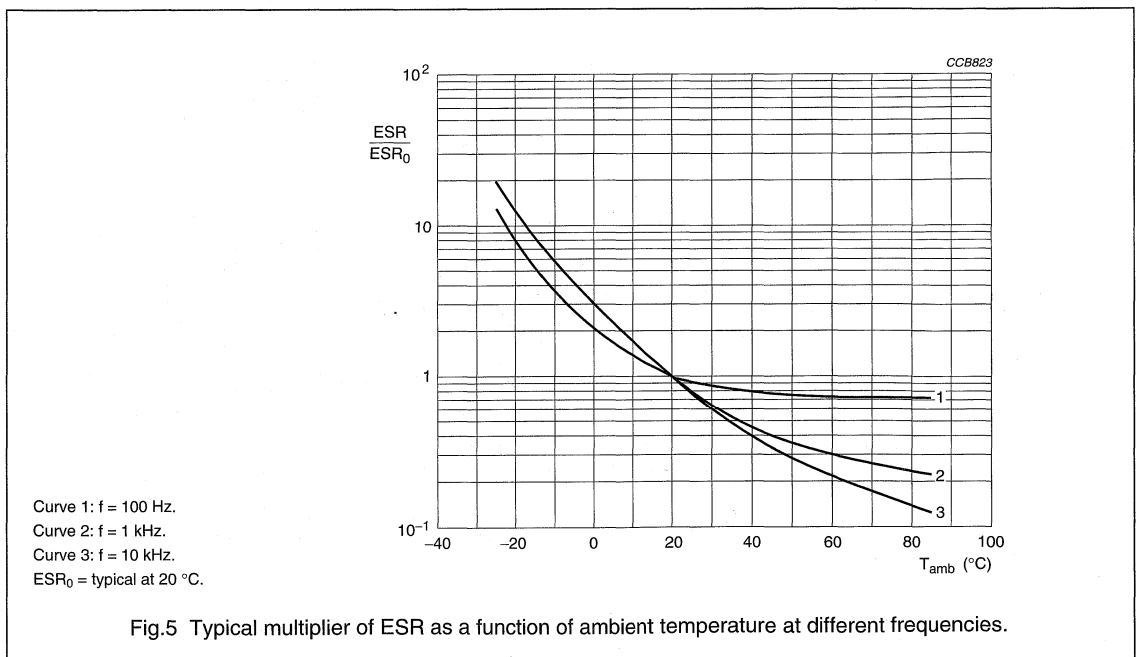
Aluminum electrolytic capacitors, Axial Miniature,
High Voltage for Electronic Lighting Ballast

042/043
AMH-ELB

Capacitance (C)



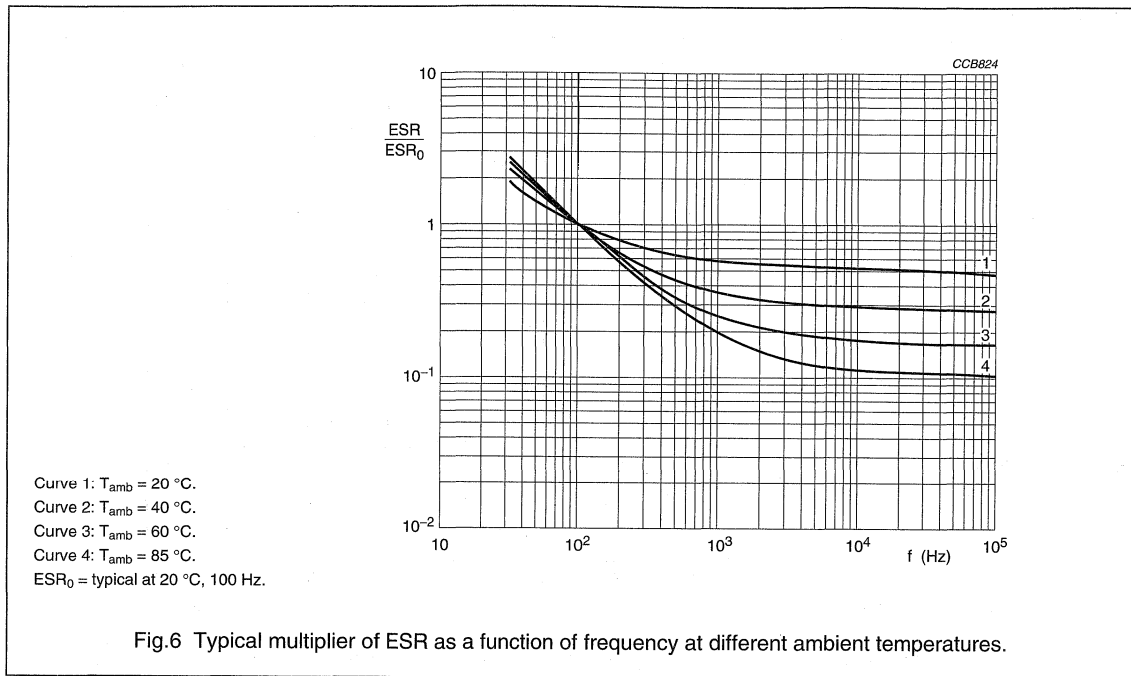
Equivalent series resistance (ESR)



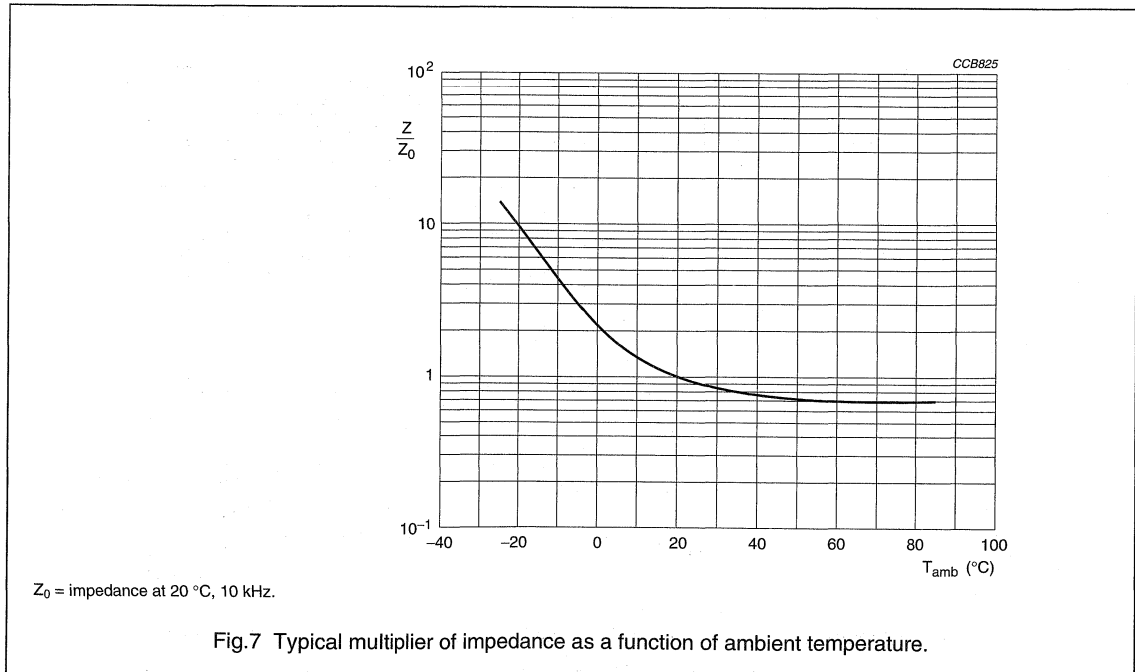
A

Aluminum electrolytic capacitors, Axial Miniature,
High Voltage for Electronic Lighting Ballast

042/043
AMH-ELB



Impedance (Z)



Aluminum electrolytic capacitors, Axial Miniature, High Voltage for Electronic Lighting Ballast

042/043
AMH-ELB

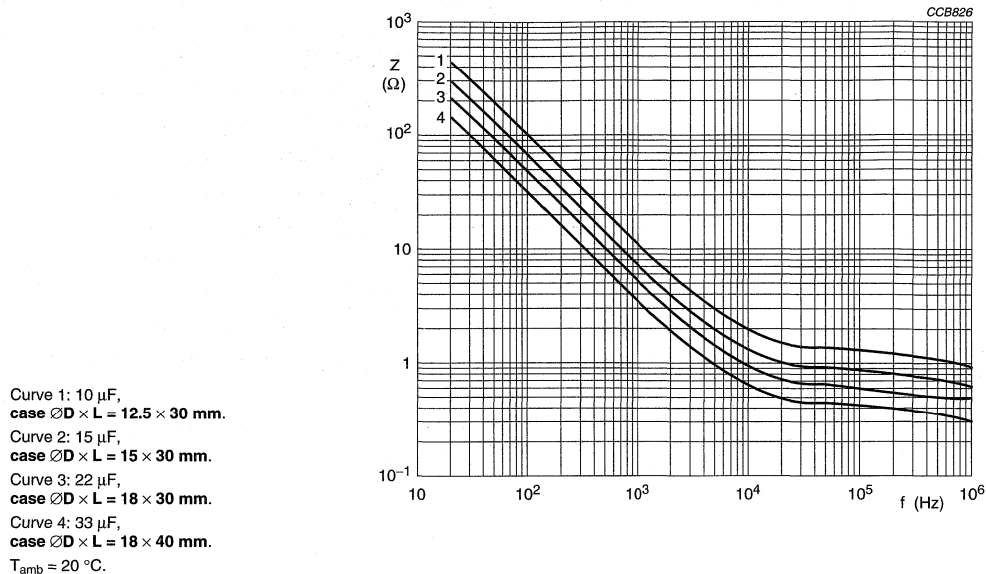


Fig.8 Typical impedance as a function of frequency.

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"
- Rated voltage (in V)
- Catalogue number (last 8 digits)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to identify the negative terminal
- '+' sign to indicate the positive terminal.

Aluminum electrolytic capacitors, Axial Miniature,
High Voltage for Electronic Lighting Ballast

042/043
AMH-ELB

RIPPLE CURRENT AND USEFUL LIFE

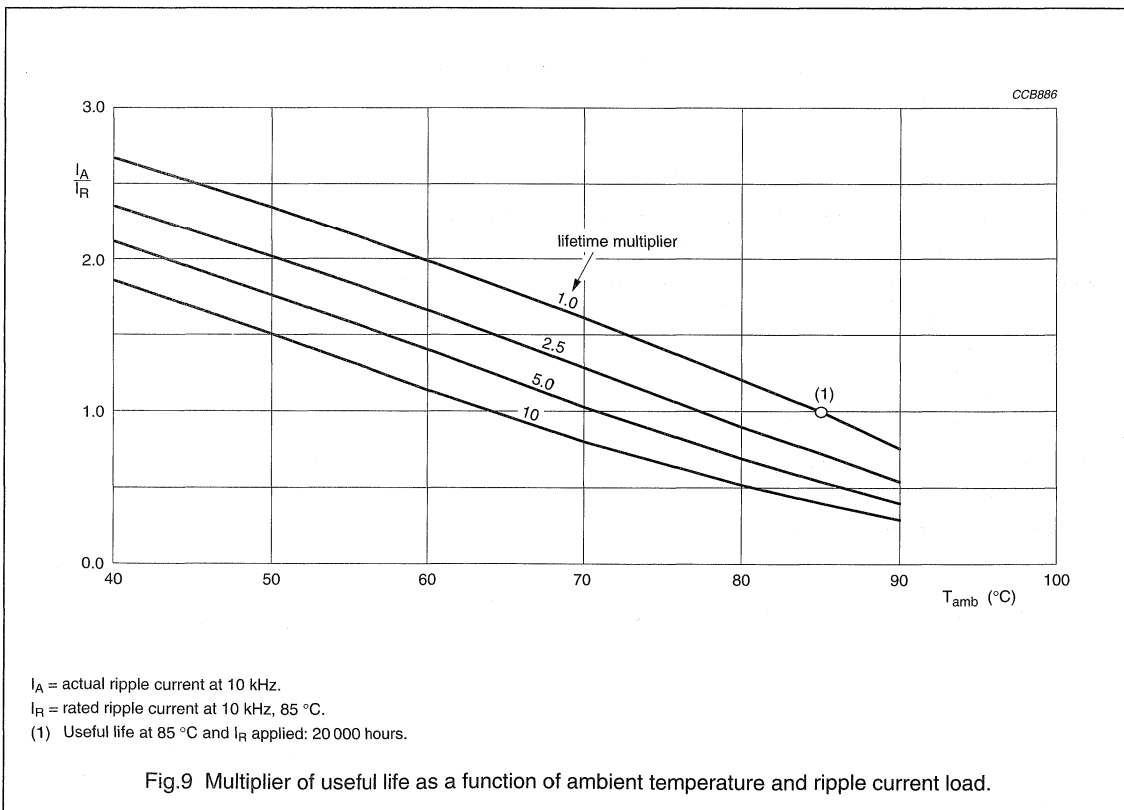
Table 3 Multiplier of ripple current (I_R) as a function of frequency; note 1

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.22
100	0.30
300	0.49
1000	0.72
3000	0.89
≥ 10000	1.00

Note

- Formula (1) should be used to calculate the actual ripple current at 10 kHz (see Fig.9) when multiple frequencies are present. For an example of the values 100 Hz and 50 kHz:

$$I_A = \sqrt{\left(\frac{I(100 \text{ Hz})}{0.30}\right)^2 + \left(\frac{I(50 \text{ kHz})}{1.0}\right)^2} \tag{1}$$



Aluminum electrolytic capacitors, Axial Miniature, High Voltage for Electronic Lighting Ballast

042/043
AMH-ELB

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 8000 hours	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 20000 hours	$\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$



Aluminum electrolytic capacitors, Axial High Temperature, High Voltage for Electronic Lighting Ballast

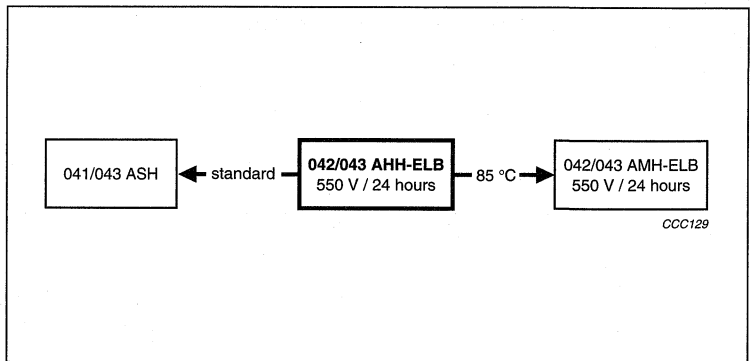
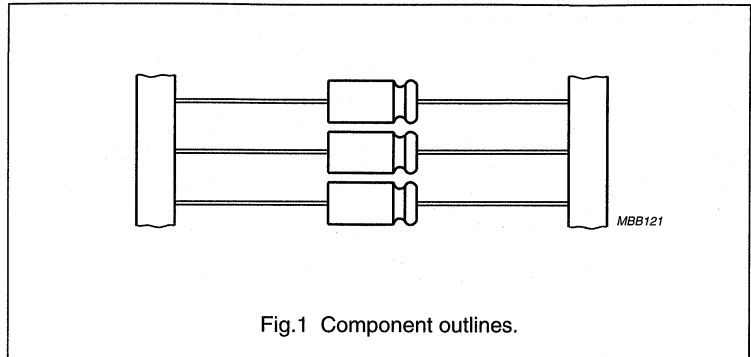
042/043 AHH-ELB

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Taped versions up to case $\varnothing 15 \times 30$ mm available for automatic insertion
- Charge and discharge proof
- Useful life: 10000 hours at 105 °C
- Stable under overvoltage conditions:
550 V for 24 hours at 85 °C
- High ripple current capability
- Smallest dimensions.

APPLICATIONS

- Electronic lighting ballast, power supply
- Smoothing, filtering, buffering at high voltages
- Boards with restricted mounting height, vibration and shock resistant.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	12.5 × 30 to 18 × 40
Rated capacitance range, C_R	10 to 33 μ F
Tolerance on C_R	-10 to +50%
Rated voltage, U_R	450 V
Category temperature range	-25 to +105 °C
Endurance test at 105 °C	5000 hours
Useful life at 105 °C	10000 hours
Useful life at 85 °C, I_R applied	100000 hours
Shelf life at 0 V, 105 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	25/105/56

Aluminum electrolytic capacitors, Axial High Temperature, High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

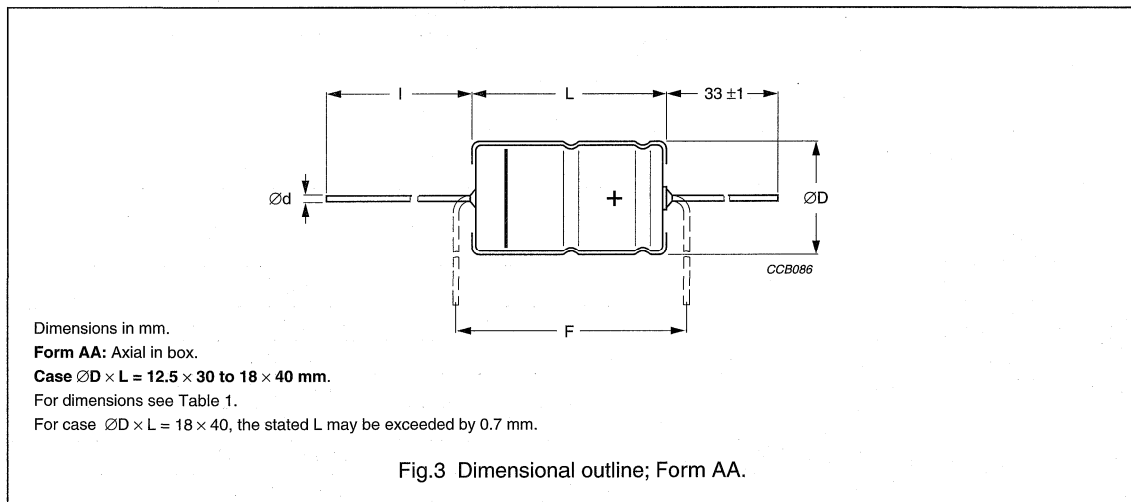
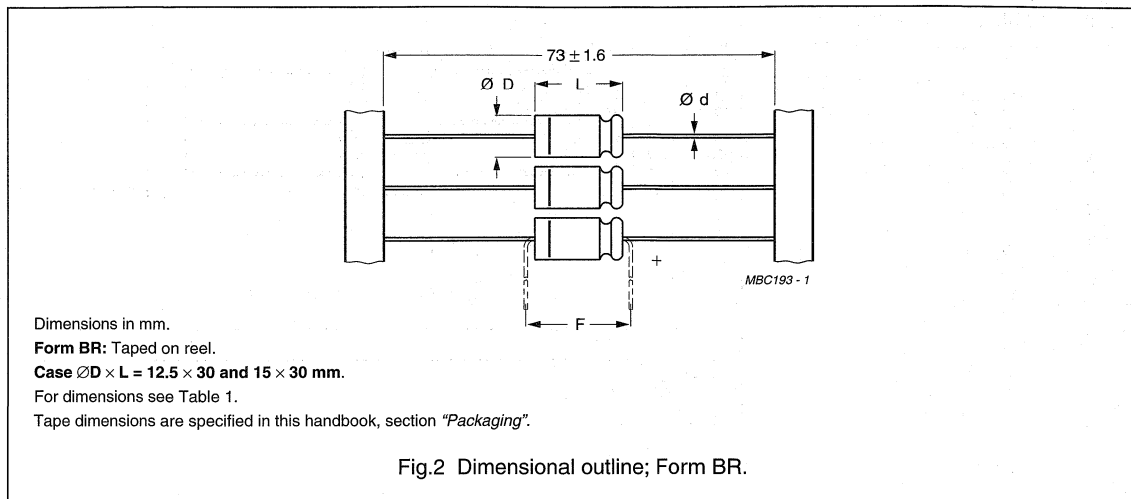


Table 1 Axial; physical dimensions, mass and packaging quantities; see Figs 2 and 3

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	AXIAL: FORM AA and BR					MASS (g)	PACKAGING QUANTITIES	
		$\varnothing d$ (mm)	l (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F_{min} (mm)		FORM AA	FORM BR
12.5 × 30	01	0.8	55 ± 1	13.0	30.5	35	≈ 6.1	200	400
15 × 30	02	0.8	55 ± 1	15.5	30.5	35	≈ 8.3	200	250
18 × 30	03	0.8	55 ± 1	18.5	30.5	35	≈ 11.6	200	–
18 × 40	04	0.8	34 ± 1	18.5	41.5	45	≈ 16.2	100	–



Aluminum electrolytic capacitors, Axial High Temperature, High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB

Ordering example

Electrolytic capacitor 042 series

10 μ F/450 V, -10/+50%

Nominal case size: \varnothing 12.5 x 30 mm; Form BR

Catalogue number: 2222 042 72109.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{amb} = 20\text{ }^{\circ}\text{C}$, $P = 86$ to 106 kPa, $RH = 45$ to 75%.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz; tolerance -10/+50%
I_R	rated RMS ripple current at 10 kHz, 105 $^{\circ}\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ/max. equivalent series resistance at 100 Hz
Z	typ/max. impedance at 10 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 10 kHz 105 $^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	ESR TYP. 100 Hz (Ω)	ESR MAX. 100 Hz (Ω)	Z TYP. 10 kHz (Ω)	Z MAX. 10 kHz (Ω)	CATALOGUE NUMBER	
											IN BOX FORM AA	TAPED ON REEL FORM BR
450	10	12.5 x 30	01	470	240	110	2.9	5.9	2.0	3.3	042 71109	042 72109
	15	15 x 30	02	600	260	115	1.9	3.9	1.3	2.3	042 71159	042 72159
	22	18 x 30	03	750	290	120	1.2	2.5	1.0	1.5	042 71229	-
	33	18 x 40	04	1020	330	130	0.9	1.8	0.7	1.1	043 71339	-

Aluminum electrolytic capacitors, Axial High Temperature, High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	$U_R = 450 \text{ V}$	$U_S \leq 550 \text{ V}$
Overvoltage test	24 hours at $85 \text{ }^\circ\text{C}$	550 V; note 1
Reverse voltage		$U_{\text{rev}} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute	$I_{L1} \leq 0.009 \times C_R \times U_R + 200 \text{ } \mu\text{A}$
	after 5 minutes	$I_{L5} \leq 0.002 \times C_R \times U_R + 100 \text{ } \mu\text{A}$
Inductance		
Equivalent series inductance	case $\varnothing D \times L$ in mm:	
	12.5 × 30	typ. 46 nH
	15 × 30	typ. 48 nH
	18 × 30	typ. 50 nH
	18 × 40	typ. 54 nH

Note

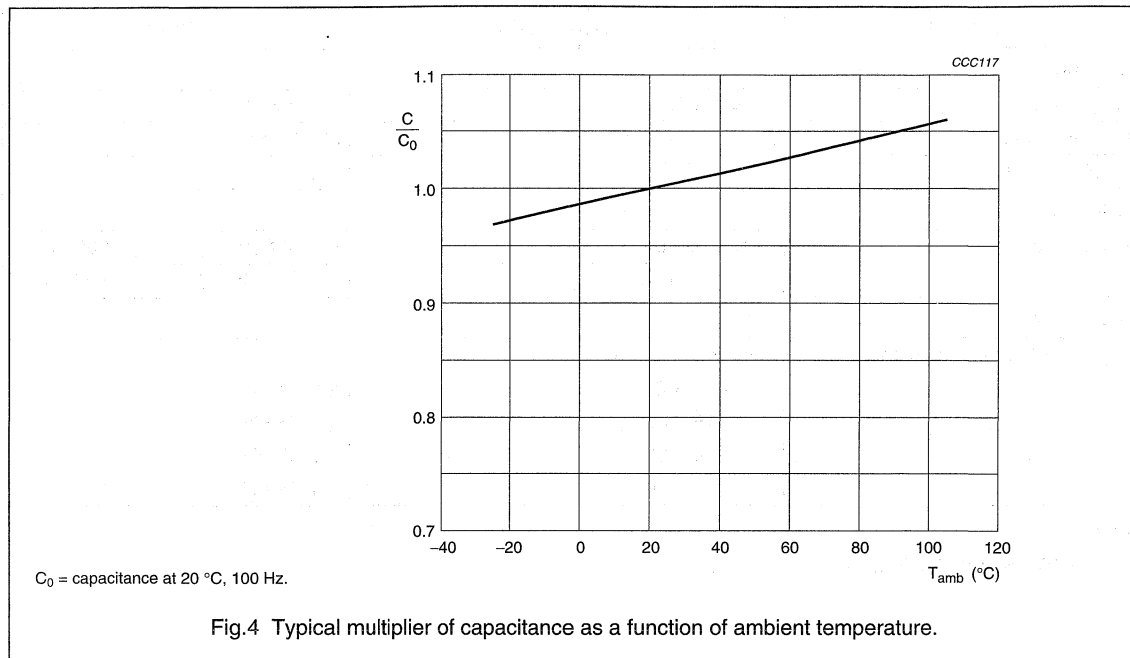
- For 10, 15 and 22 μF types.

A

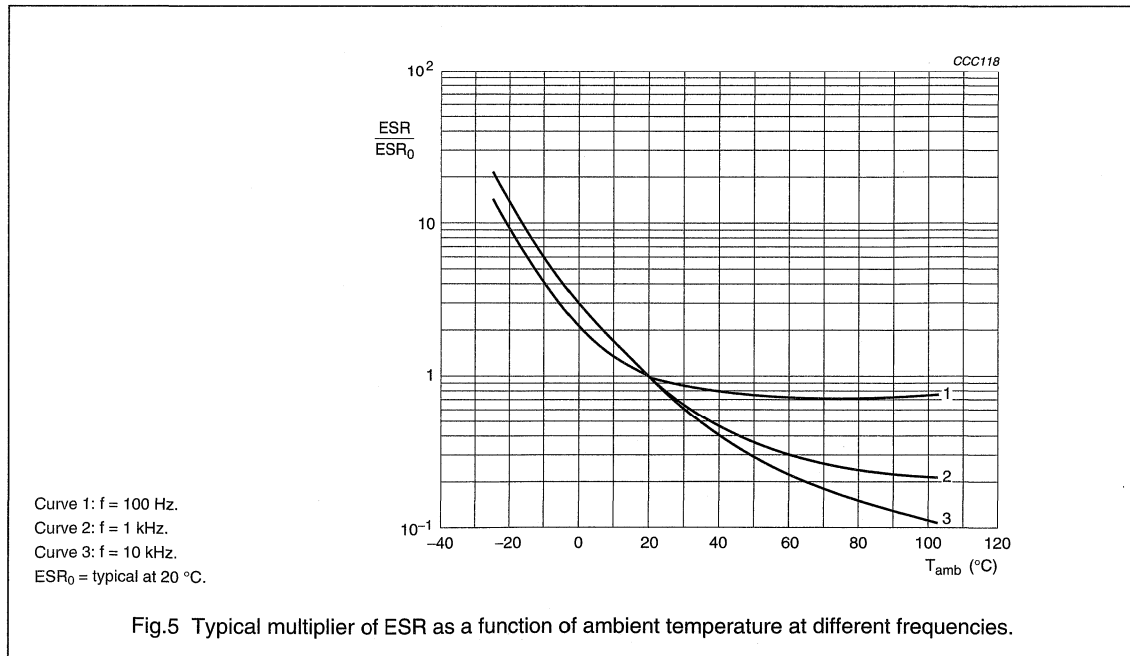
Aluminum electrolytic capacitors, Axial High Temperature,
High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB

Capacitance (C)

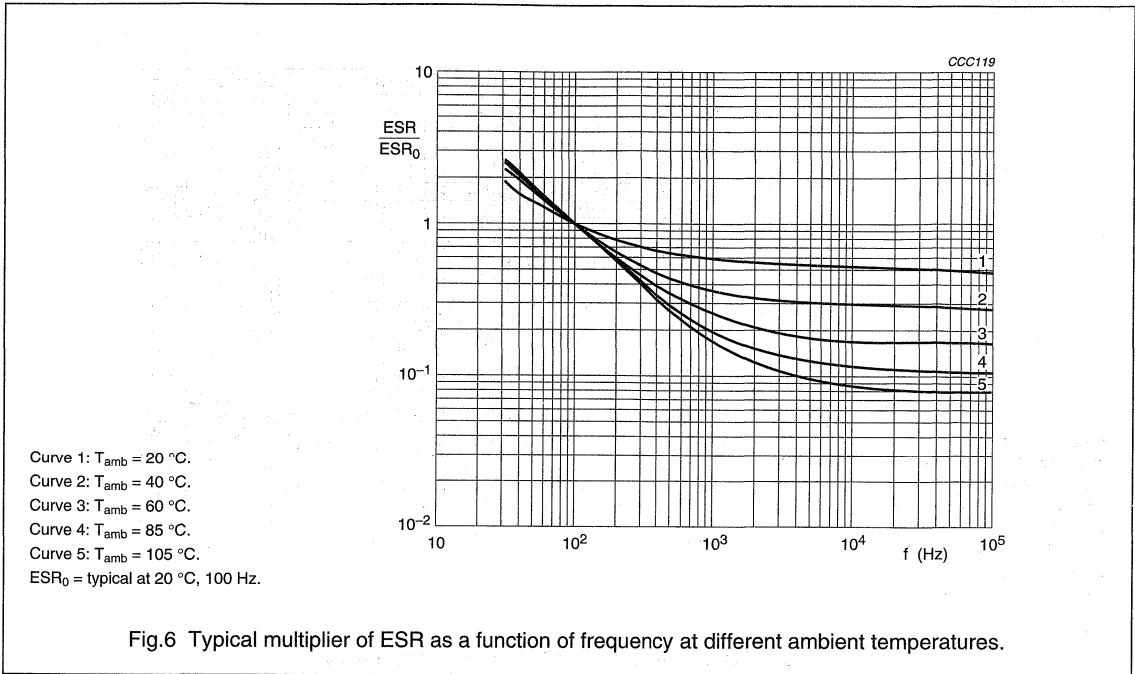


Equivalent series resistance (ESR)

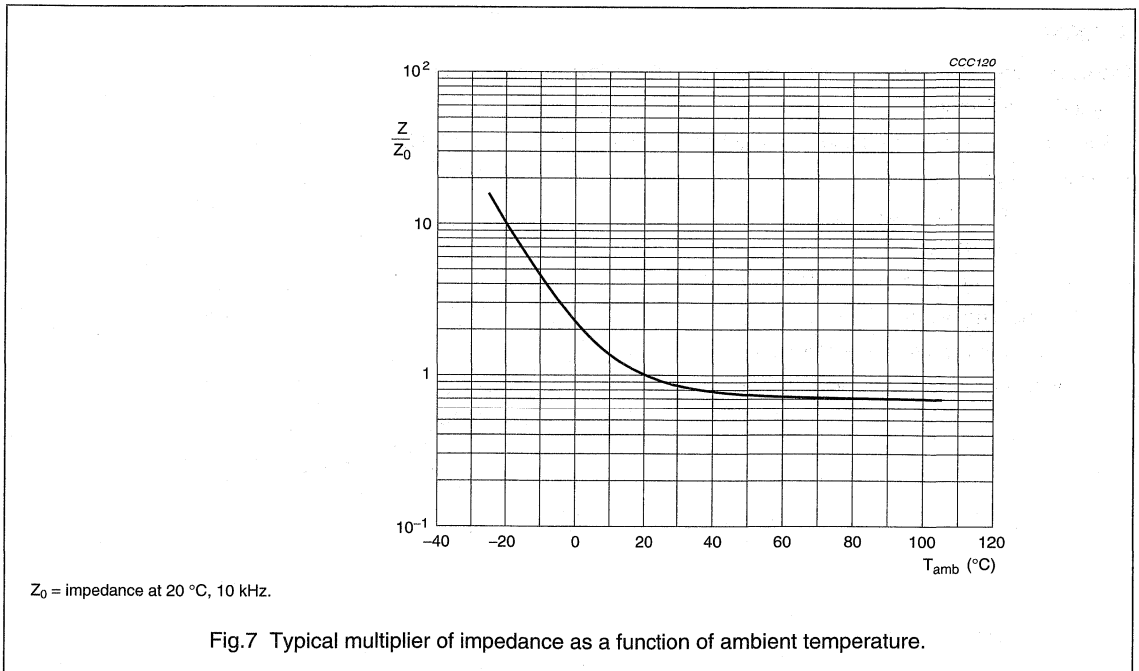


Aluminum electrolytic capacitors, Axial High Temperature,
High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB

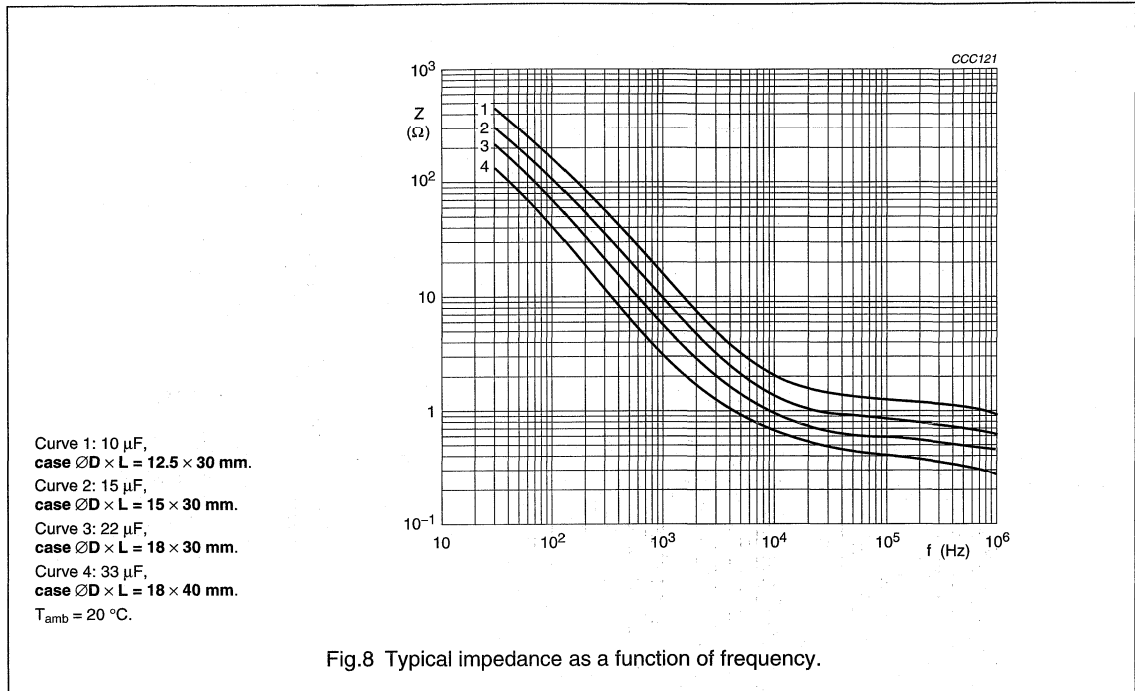


Impedance (Z)



Aluminum electrolytic capacitors, Axial High Temperature, High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB



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"
- Rated voltage (in V)
- Catalogue number (last 8 digits)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to identify the negative terminal
- '+' sign to indicate the positive terminal.

Aluminum electrolytic capacitors, Axial High Temperature,
High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB

RIPPLE CURRENT AND USEFUL LIFE

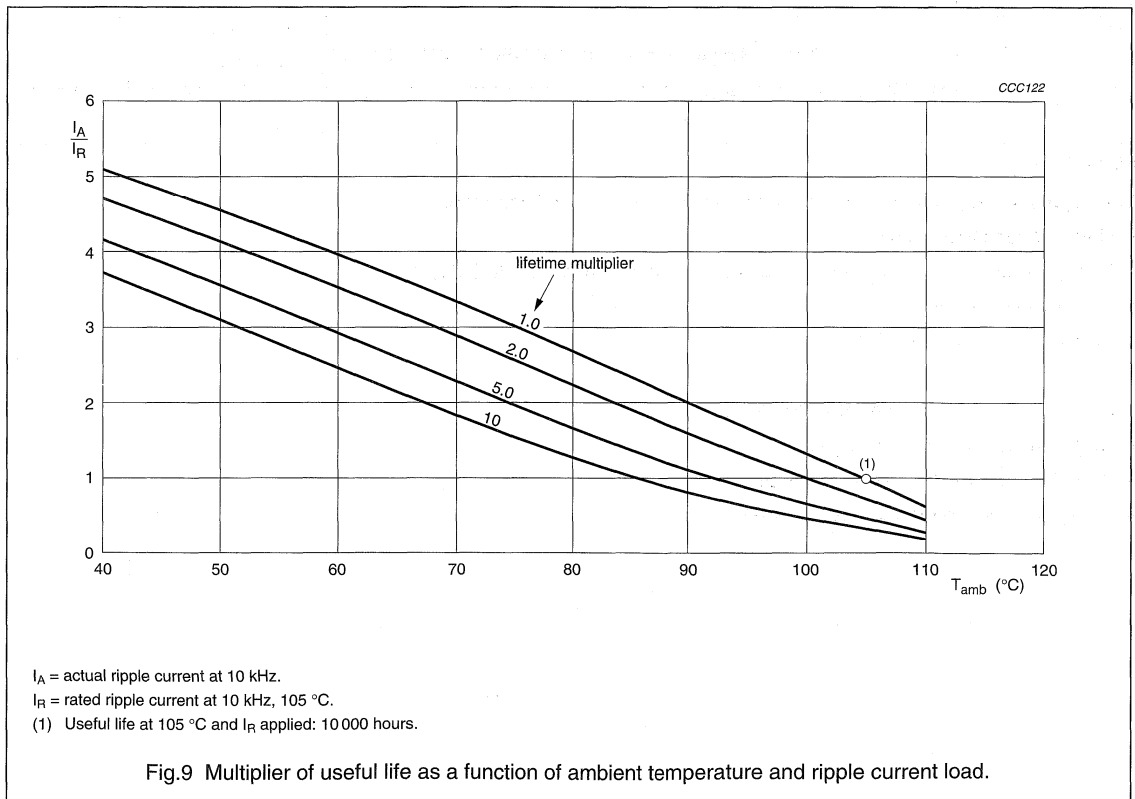
Table 3 Multiplier of ripple current (I_R) as a function of frequency; note 1

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.20
100	0.27
300	0.45
1000	0.68
3000	0.82
≥10000	1.00

Note

- Formula (1) should be used to calculate the actual ripple current at 10 kHz (see Fig.9) when multiple frequencies are present. For an example of the values 100 Hz and 50 kHz:

$$I_A = \sqrt{\left(\frac{I(100 \text{ Hz})}{0.27}\right)^2 + \left(\frac{I(50 \text{ kHz})}{1.0}\right)^2} \tag{1}$$



I_A = actual ripple current at 10 kHz.
 I_R = rated ripple current at 10 kHz, 105 °C.
 (1) Useful life at 105 °C and I_R applied: 10000 hours.

Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors, Axial High Temperature, High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ °C}$; U_R applied; 5000 hours	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; 10000 hours	$\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ °C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors, Axial High Temperature,
High Voltage for Electronic Lighting Ballast

042/043
AHH-ELB

NOTES



Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve (case $\varnothing 6.3 \times 12.7$ and 7.7×12.7 mm are moulded with flame retardant plastic material)
- Mounting ring version (single ended) not insulated
- Taped versions up to case $\varnothing 15 \times 30$ mm available for automatic insertion
- Charge and discharge proof
- Long useful life: 2000 to 10000 hours at 105 °C, high reliability
- High ripple current capability
- Miniaturized, high CV-product per unit volume.

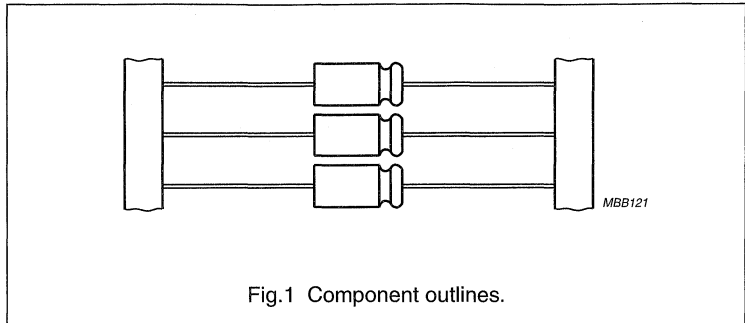
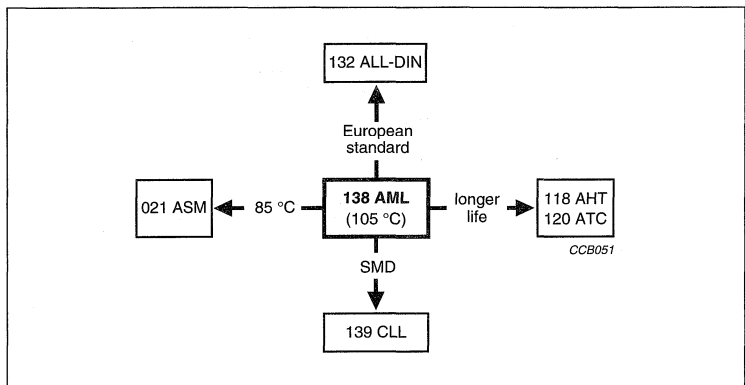


Fig.1 Component outlines.

APPLICATIONS

- Industrial, automotive, EDP and telecommunication
- Smoothing, filtering, buffering in SMPS; coupling, decoupling, timing



- Portable and mobile equipment (small size, low mass)
- Standby applications
- Low mounting height boards
- Vibration and shock resistant.

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	6.3 × 2.7 to 10 × 25	10 × 30 to 21 × 40
Rated capacitance range, C_R	1.0 to 15000 μ F	
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	5 000 hours
Useful life at 105 °C	2000 hours	10000 hours
Useful life at 40 °C, I_R applied	$1.3 \times I_R$ applied: 200000 hours	$1.8 \times I_R$ applied: 500000 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	

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	6.3	10	16	25	40	50	63	100
1.0	-	-	-	-	-	-	-	6.3 × 12.7
2.2	-	-	-	-	-	-	-	6.3 × 12.7
4.7	-	-	-	-	-	-	6.3 × 12.7	7.7 × 12.7
10	-	-	-	6.3 × 12.7	-	6.3 × 12.7	7.7 × 12.7	6.5 × 18
22	-	-	6.3 × 12.7	6.3 × 12.7	-	7.7 × 12.7	6.5 × 18	8 × 18
33	-	-	-	6.3 × 12.7	7.7 × 12.7	-	-	-
47	-	-	6.3 × 12.7	7.7 × 12.7	6.5 × 18	-	8 × 18	10 × 25
68	-	-	-	-	-	-	-	10 × 30
100	6.3 × 12.7	-	7.7 × 12.7	6.5 × 18	8 × 18	10 × 18	10 × 25	12.5 × 30
150	-	7.7 × 12.7	-	-	-	-	10 × 30	15 × 30
220	7.7 × 12.7	6.5 × 18	8 × 18	10 × 18	10 × 25	-	12.5 × 30	15 × 30
330	-	-	-	-	10 × 30	-	12.5 × 30	18 × 30
470	6.5 × 18	8 × 18	10 × 18	10 × 25	12.5 × 30	-	15 × 30	18 × 40
680	-	-	-	10 × 30	12.5 × 30	-	18 × 30	21 × 40
1000	10 × 18	10 × 25	10 × 30	12.5 × 30	15 × 30	-	18 × 40	-
1500	-	10 × 30	12.5 × 30	15 × 30	18 × 30	-	21 × 40	-
2200	10 × 25	12.5 × 30	15 × 30	18 × 30	18 × 40	-	-	-
3300	-	15 × 30	18 × 30	18 × 40	21 × 40	-	-	-
4700	-	18 × 30	18 × 30	18 × 40	-	-	-	-
6800	-	18 × 40	18 × 40	21 × 40	-	-	-	-
10000	-	18 × 40	21 × 40	-	-	-	-	-
15000	-	21 × 40	-	-	-	-	-	-

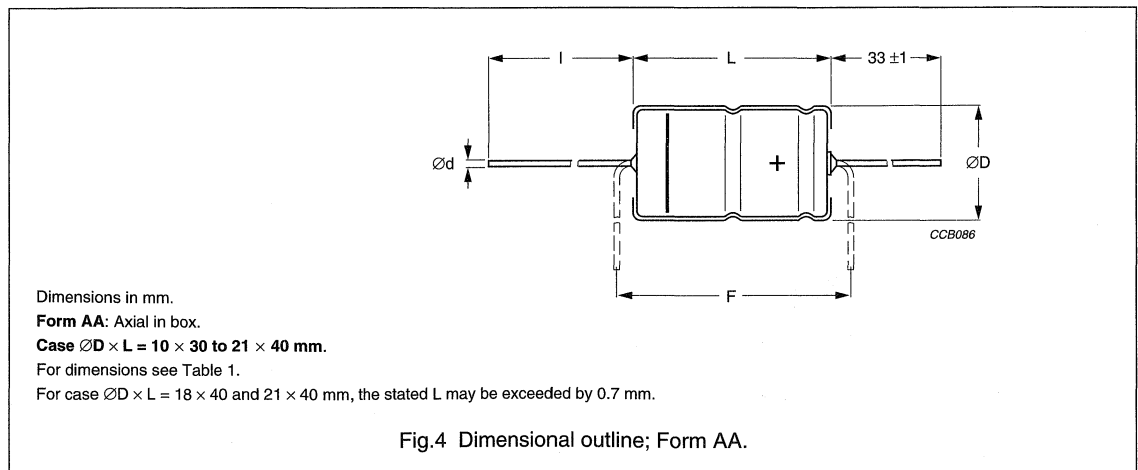
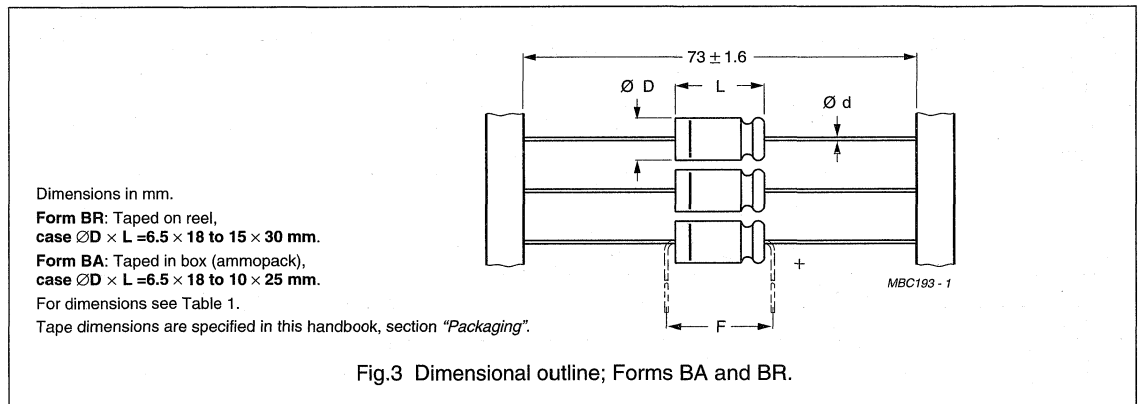
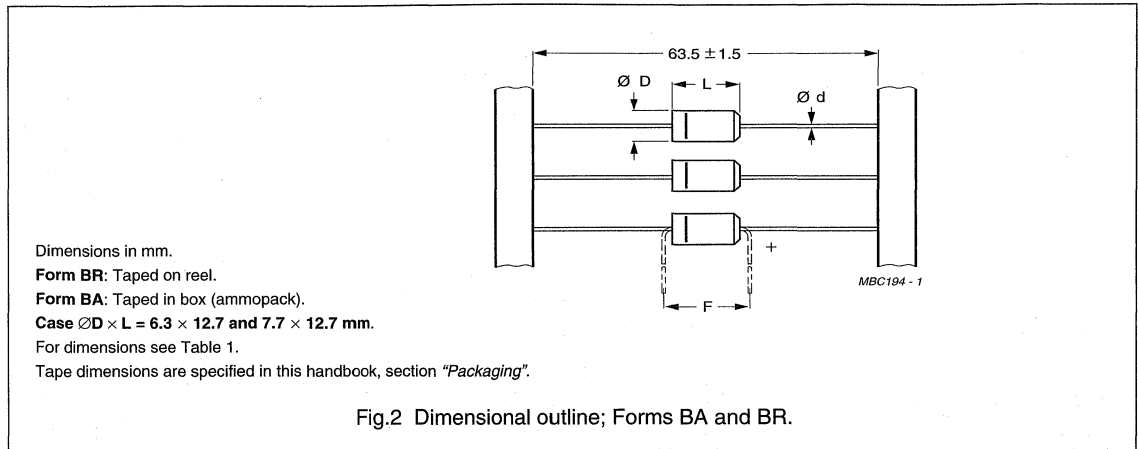
A

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

Table 1 Axial; physical dimensions, mass and packaging quantities; see Figs 2, 3 and 4

NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	AXIAL: FORM AA, BA, and BR					MASS (g)	PACKAGING QUANTITIES		
		Ød (mm)	l (mm)	ØD _{max} (mm)	L _{max} (mm)	F _{min} (mm)		FORM AA	FORM BA	FORM BR
6.3 × 12.7	(2)	0.6	–	6.5	12.9	17.5	≈1.1	–	1000	1000
7.7 × 12.7	(3)	0.6	–	7.9	12.9	17.5	≈1.3	–	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	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	–	–

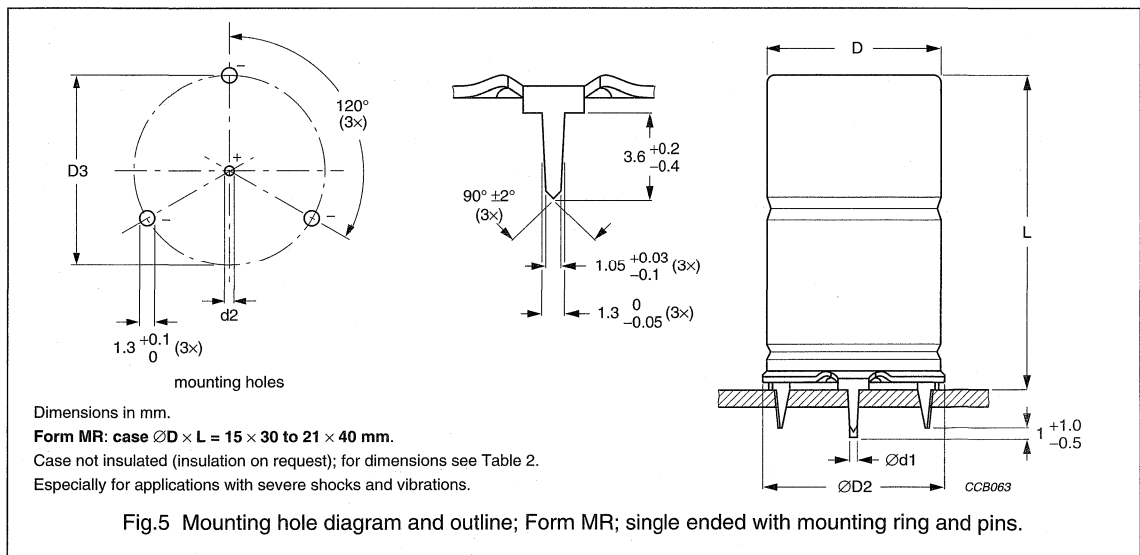


Table 2 Single ended; physical dimensions, mass and packaging quantities; see Fig.5

NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	SINGLE ENDED WITH MOUNTING RING: FORM MR						MASS (g)	PACKAGING QUANTITIES
		Ød1 (mm)	Ød2 (mm)	ØD _{max} (mm)	ØD2 _{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

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

ELECTRICAL DATA

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

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, $105\text{ }^{\circ}\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\tan \delta$	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 or 100 kHz

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

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 $^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)
6.3	100	6.3 \times 12.7	99	16	5.3	0.24	3.8	3.0	1.8
	220	7.7 \times 12.7	160	31	6.8	0.24	1.7	1.4	0.95
	470	6.5 \times 18	250	22	9.9	0.24	0.81	0.64	0.5
	1000	10 \times 18	430	42	17	0.24	0.38	0.30	0.24
	2200	10 \times 25	640	87	32	0.29	0.21	0.18	0.15
10	150	7.7 \times 12.7	140	33	7.0	0.2	2.1	1.3	0.95
	220	6.5 \times 18	190	17	8.4	0.2	1.4	0.91	0.5
	470	8 \times 18	300	32	13	0.2	0.68	0.43	0.35
	1000	10 \times 25	520	64	24	0.2	0.32	0.20	0.16
	1500	10 \times 30	670	94	34	0.26	0.27	0.20	0.18
	2200	12.5 \times 30	890	140	48	0.27	0.19	0.14	0.13
	3300	15 \times 30	1140	200	70	0.28	0.135	0.1	0.1
	4700	18 \times 30	1450	290	98	0.31	0.105	0.083	0.088
	6800	18 \times 40	1880	410	140	0.32	0.075	0.056	0.069
	10000	18 \times 40	1980	600	200	0.37	0.059	0.048	0.065
15000	21 \times 40	2200	900	300	0.51	0.054	0.044	0.063	
16	22	6.3 \times 12.7	58	10	4.7	0.12	8.7	7.3	2.7
	47	6.3 \times 12.7	83	18	5.5	0.16	5.4	3.4	1.9
	100	7.7 \times 12.7	130	35	7.2	0.16	2.5	1.6	1.0
	220	8 \times 18	230	25	11	0.16	1.2	0.73	0.35
	470	10 \times 18	360	49	19	0.16	0.54	0.34	0.25
	1000	10 \times 30	630	100	36	0.19	0.29	0.20	0.18
	1500	12.5 \times 30	860	150	52	0.19	0.20	0.14	0.13
	2200	15 \times 30	1090	210	74	0.21	0.15	0.105	0.103
	3300	18 \times 30	1420	320	110	0.23	0.11	0.083	0.088

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 138 series

470 $\mu\text{F}/10\text{ V}; \pm 20\%$ Nominal case size: $\varnothing 8 \times 18\text{ mm}$; Form BA

Catalogue number: 2222 138 34471.

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

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (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
6.3	100	6.3 × 12.7	(2)	–	138 23101	138 33101	–
	220	7.7 × 12.7	(3)	–	138 23221	138 33221	–
	470	6.5 × 18	4	–	138 23471	138 33471	–
	1000	10 × 18	6	–	138 23102	138 33102	–
	2200	10 × 25	7	–	138 23222	138 33222	–
10	150	7.7 × 12.7	(3)	–	138 24151	138 34151	–
	220	6.5 × 18	4	–	138 24221	138 34221	–
	470	8 × 18	5	–	138 24471	138 34471	–
	1000	10 × 25	7	–	138 24102	138 34102	–
	1500	10 × 30	00	138 14152	138 24152	–	–
	2200	12.5 × 30	01	138 14222	138 24222	–	–
	3300	15 × 30	02	138 14332	138 24332	–	138 44332
	4700	18 × 30	03	138 14472	–	–	138 44472
	6800	18 × 40	04	138 14682	–	–	138 44682
	10000	18 × 40	04	138 14103	–	–	138 44103
15000	21 × 40	05	138 14153	–	–	138 44153	
16	22	6.3 × 12.7	(2)	–	138 25229	138 35229	–
	47	6.3 × 12.7	(2)	–	138 25479	138 35479	–
	100	7.7 × 12.7	(3)	–	138 25101	138 35101	–
	220	8 × 18	5	–	138 25221	138 35221	–
	470	10 × 18	6	–	138 25471	138 35471	–
	1000	10 × 30	00	138 15102	138 25102	–	–
	1500	12.5 × 30	01	138 15152	138 25152	–	–
	2200	15 × 30	02	138 15222	138 25222	–	138 45222
	3300	18 × 30	03	138 15332	–	–	138 45332

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

ELECTRICAL DATA (continued)**Table 5** Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	
16	4700	18 × 30	1480	450	150	0.28	0.093	0.073	0.082	
	6800	18 × 40	1930	660	220	0.28	0.062	0.048	0.065	
	10000	21 × 40	2100	960	320	0.35	0.055	0.044	0.063	
25	10	6.3 × 12.7	46	8	4.5	0.09	14	12	2.8	
	22	6.3 × 12.7	61	14	5.1	0.14	10	5.5	2.5	
	33	6.3 × 12.7	74	20	5.7	0.14	6.8	3.6	1.9	
	47	7.7 × 12.7	96	27	6.4	0.14	4.7	2.6	1.0	
	100	6.5 × 18	160	19	9.0	0.13	2.1	1.2	0.55	
	220	10 × 18	270	37	15	0.13	0.94	0.55	0.27	
	470	10 × 25	440	75	28	0.13	0.44	0.26	0.17	
	680	10 × 30	580	110	38	0.14	0.32	0.20	0.18	
	1000	12.5 × 30	790	150	54	0.14	0.22	0.14	0.13	
	1500	15 × 30	1020	230	79	0.15	0.16	0.105	0.105	
	2200	18 × 30	1320	330	110	0.16	0.12	0.083	0.088	
	3300	18 × 40	1720	500	170	0.17	0.08	0.055	0.069	
	4700	18 × 40	1840	710	240	0.20	0.067	0.049	0.065	
6800	21 × 40	2100	1000	340	0.26	0.059	0.045	0.064		
40	33	7.7 × 12.7	91	29	6.6	0.11	5.3	2.7	1.0	
	47	6.5 × 18	120	15	7.8	0.10	3.4	1.9	0.65	
	100	8 × 18	180	28	12	0.10	1.6	0.9	0.40	
	220	10 × 25	350	57	22	0.10	0.72	0.41	0.20	
	330	10 × 30	490	83	30	0.10	0.45	0.25	0.21	
	470	12.5 × 30	650	120	42	0.10	0.33	0.18	0.16	
	680	12.5 × 30	750	170	58	0.11	0.25	0.145	0.13	
	1000	15 × 30	970	240	84	0.11	0.17	0.105	0.097	
	1500	18 × 30	1250	360	120	0.12	0.13	0.085	0.087	
	2200	18 × 40	1640	530	180	0.13	0.09	0.055	0.070	
	3300	21 × 40	1810	800	270	0.15	0.075	0.052	0.069	
	50	10	6.3 × 12.7	51	13	5.0	0.09	14	7	2.7
		22	7.7 × 12.7	82	25	6.2	0.09	6.5	3.2	1.1
100		10 × 18	230	34	14	0.08	1.3	0.7	0.30	

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

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
16	4700	18 × 30	03	138 15472	–	–	138 45472
	6800	18 × 40	04	138 15682	–	–	138 45682
	10000	21 × 40	05	138 15103	–	–	138 45103
25	10	6.3 × 12.7	(2)	–	138 26109	138 36109	–
	22	6.3 × 12.7	(2)	–	138 26229	138 36229	–
	33	6.3 × 12.7	(2)	–	138 26339	138 36339	–
	47	7.7 × 12.7	(3)	–	138 26479	138 36479	–
	100	6.5 × 18	4	–	138 26101	138 36101	–
	220	10 × 18	6	–	138 26221	138 36221	–
	470	10 × 25	7	–	138 26471	138 36471	–
	680	10 × 30	00	138 16681	138 26681	–	–
	1000	12.5 × 30	01	138 16102	138 26102	–	–
	1500	15 × 30	02	138 16152	138 26152	–	138 46152
	2200	18 × 30	03	138 16222	–	–	138 46222
	3300	18 × 40	04	138 16332	–	–	138 46332
	4700	18 × 40	04	138 16472	–	–	138 46472
	6800	21 × 40	05	138 16682	–	–	138 46682
40	33	7.7 × 12.7	(3)	–	138 27339	138 37339	–
	47	6.5 × 18	4	–	138 27479	138 37479	–
	100	8 × 18	5	–	138 27101	138 37101	–
	220	10 × 25	7	–	138 27221	138 37221	–
	330	10 × 30	00	138 17331	138 27331	–	–
	470	12.5 × 30	01	138 17471	138 27471	–	–
	680	12.5 × 30	01	138 17681	138 27681	–	–
	1000	15 × 30	02	138 17102	138 27102	–	138 47102
	1500	18 × 30	03	138 17152	–	–	138 47152
	2200	18 × 40	04	138 17222	–	–	138 47222
	3300	21 × 40	05	138 17332	–	–	138 47332
50	10	6.3 × 12.7	(2)	–	138 21109	138 31109	–
	22	7.7 × 12.7	(3)	–	138 21229	138 31229	–
	100	10 × 18	6	–	138 21101	138 31101	–

A

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

ELECTRICAL DATA (continued)

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

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °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	6.3 × 12.7	35	9	4.6	0.09	30	17	5
	10	7.7 × 12.7	59	16	5.3	0.08	13	8	1.8
	22	6.5 × 18	100	12	6.8	0.07	5.1	3.6	0.85
	47	8 × 18	150	22	9.9	0.07	2.4	1.7	0.50
	100	10 × 25	280	42	17	0.07	1.1	0.8	0.27
	150	10 × 30	410	61	23	0.11	0.73	0.41	0.31
	220	12.5 × 30	560	88	32	0.11	0.50	0.28	0.22
	330	12.5 × 30	660	130	46	0.12	0.37	0.22	0.18
	470	15 × 30	860	180	63	0.12	0.26	0.15	0.14
	680	18 × 30	1130	260	90	0.12	0.19	0.12	0.11
	1000	18 × 40	1460	380	130	0.12	0.13	0.08	0.09
1500	21 × 40	1680	570	190	0.13	0.10	0.07	0.08	
100	1.0	6.3 × 12.7	16	5	4.2	0.09	140	55	10
	2.2	6.3 × 12.7	24	7	4.4	0.09	65	25	8
	4.7	7.7 × 12.7	40	12	4.9	0.08	27	17	5
	10	6.5 × 18	67	10	6.0	0.07	11	8	2.4
	22	8 × 18	100	17	8.4	0.07	5.1	3.6	1.4
	47	10 × 25	190	32	13	0.07	2.4	1.7	0.67
	68	10 × 30	300	45	18	0.07	1.7	1.1	0.97
	100	12.5 × 30	410	64	24	0.07	1.1	0.77	0.67
	150	15 × 30	550	94	34	0.07	0.78	0.52	0.46
	220	15 × 30	650	140	48	0.07	0.54	0.37	0.33
	330	18 × 30	880	200	70	0.08	0.38	0.27	0.24
	470	18 × 40	1130	290	98	0.08	0.27	0.19	0.17
	680	21 × 40	1330	410	140	0.09	0.21	0.14	0.14

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

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	6.3 × 12.7	(2)	–	138 28478	138 38478	–
	10	7.7 × 12.7	(3)	–	138 28109	138 38109	–
	22	6.5 × 18	4	–	138 28229	138 38229	–
	47	8 × 18	5	–	138 28479	138 38479	–
	100	10 × 25	7	–	138 28101	138 38101	–
	150	10 × 30	00	138 18151	138 28151	–	–
	220	12.5 × 30	01	138 18221	138 28221	–	–
	330	12.5 × 30	01	138 18331	138 28331	–	–
	470	15 × 30	02	138 18471	138 28471	–	138 48471
	680	18 × 30	03	138 18681	–	–	138 48681
	1000	18 × 40	04	138 18102	–	–	138 48102
	1500	21 × 40	05	138 18152	–	–	138 48152
100	1.0	6.3 × 12.7	(2)	–	138 29108	138 39108	–
	2.2	6.3 × 12.7	(2)	–	138 29228	138 39228	–
	4.7	7.7 × 12.7	(3)	–	138 29478	138 39478	–
	10	6.5 × 18	4	–	138 29109	138 39109	–
	22	8 × 18	5	–	138 29229	138 39229	–
	47	10 × 25	7	–	138 29479	138 39479	–
	68	10 × 30	00	138 19689	138 29689	–	–
	100	12.5 × 30	01	138 19101	138 29101	–	–
	150	15 × 30	02	138 19151	138 29151	–	138 49151
	220	15 × 30	02	138 19221	138 29221	–	138 49221
	330	18 × 30	03	138 19331	–	–	138 49331
	470	18 × 40	04	138 19471	–	–	138 49471
680	21 × 40	05	138 19681	–	–	138 49681	

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

ELECTRICAL DATA (continued)**Additional electrical data**

PARAMETER	CONDITIONS	VALUE	
		AXIAL	SINGLE ENDED
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 $\varnothing D \times L = 6.3 \times 12.7$ and 7.7×12.7 mm case $\varnothing D \times L = 6.5 \times 18$ to 21×40 mm	$I_{L1} \leq 0.02C_R \times U_R + 3 \mu A$ $I_{L1} \leq 0.006C_R \times U_R + 4 \mu A$	
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu A$	
Inductance			
Equivalent series inductance (ESL)	case $\varnothing D \times L$ mm:		
	6.3 × 12.7	typ. 20 nH	–
	7.7 × 12.7	typ. 30 nH	–
	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	

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"
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (138)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to indicate the negative terminal
- '+' sign to identify the positive terminal (not for case sizes $L < 18$ mm).

Aluminum electrolytic capacitors Axial Miniature Long-Life

138 AML

ELECTRICAL DATA (continued)

Capacitance (C)

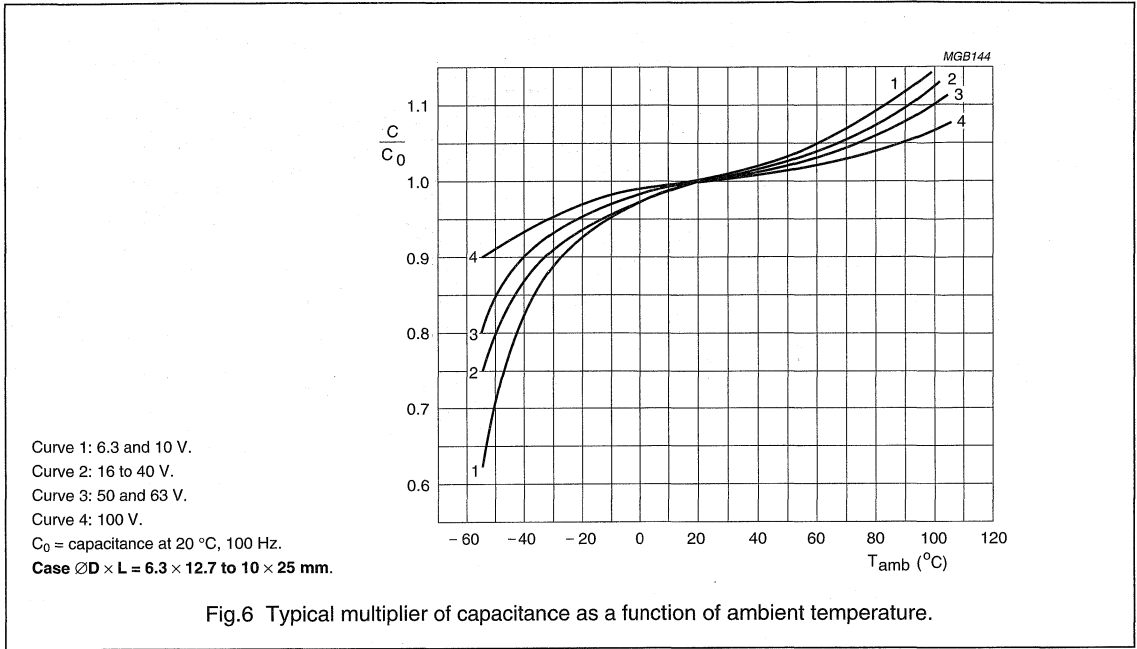


Fig.6 Typical multiplier of capacitance as a function of ambient temperature.

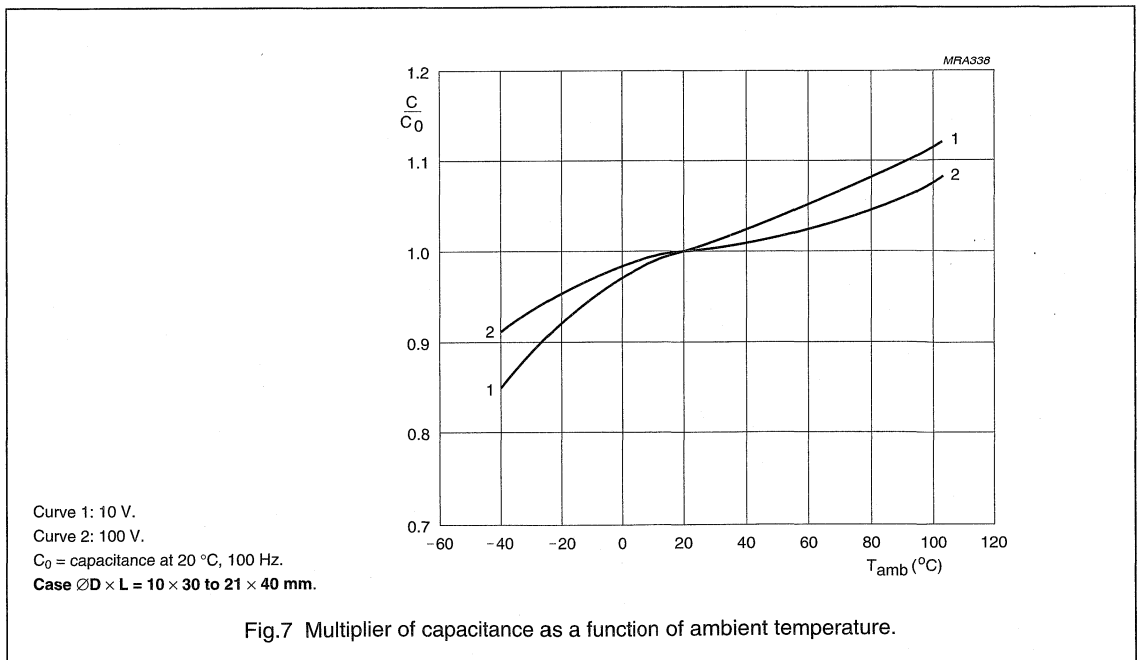


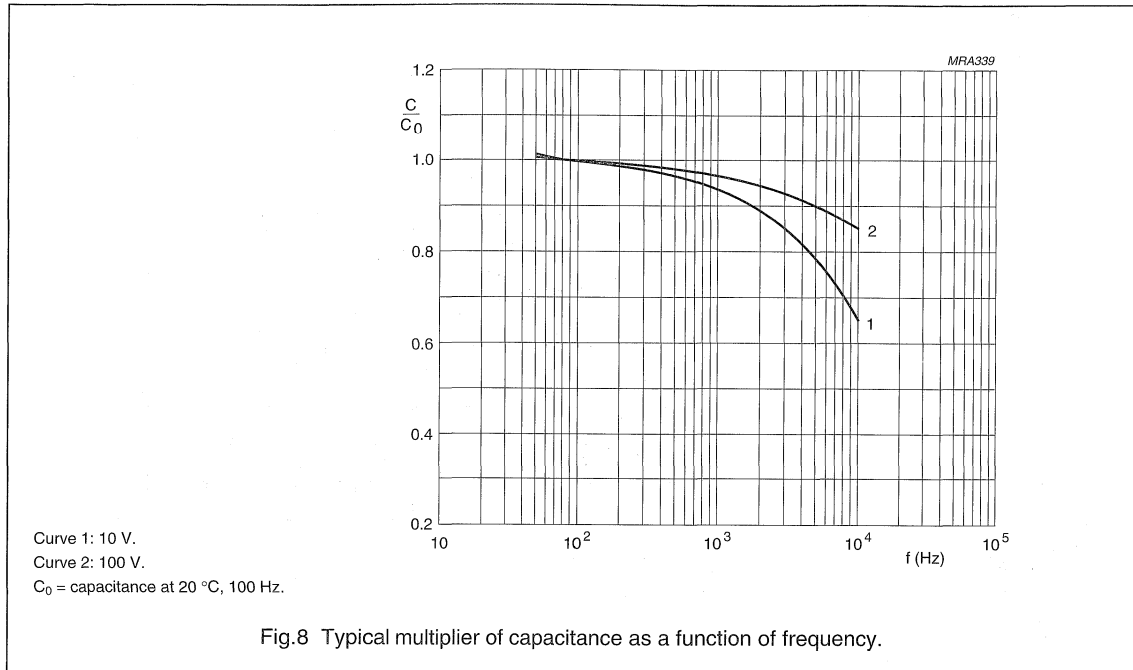
Fig.7 Multiplier of capacitance as a function of ambient temperature.

A

Aluminum electrolytic capacitors

Axial Miniature Long-Life

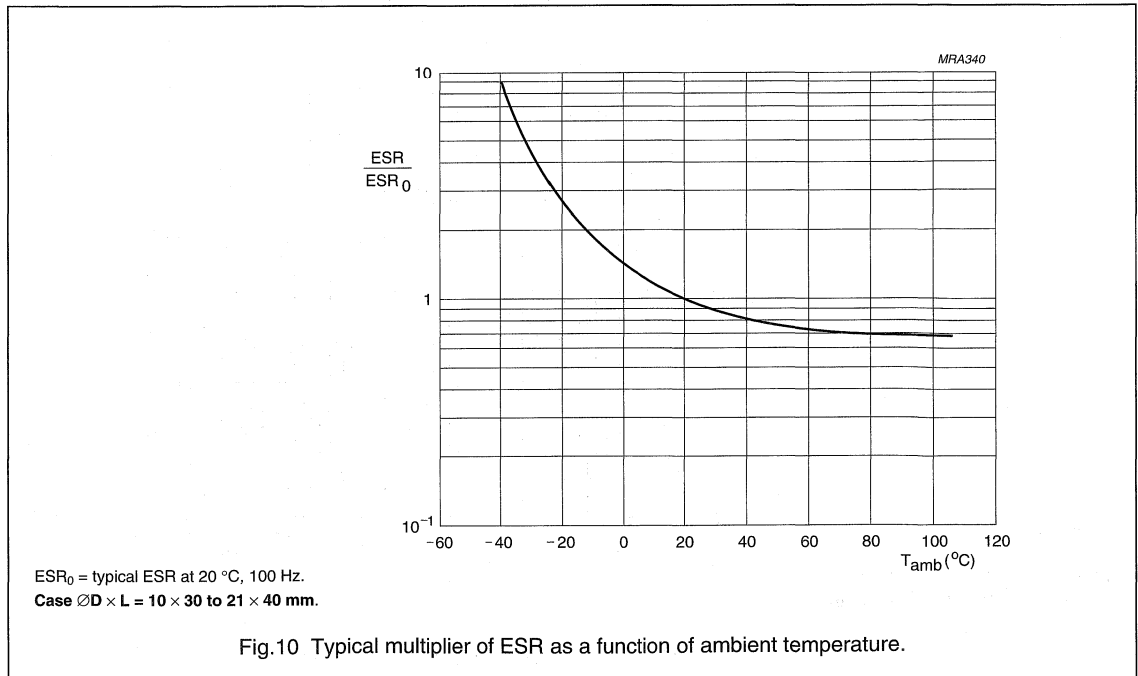
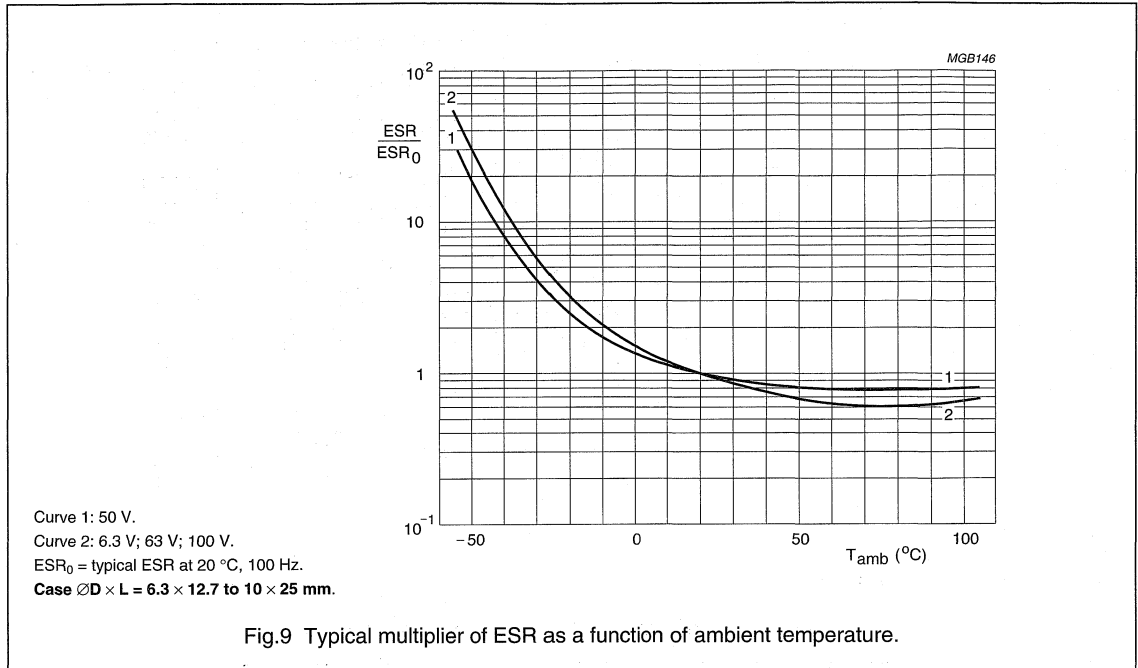
138 AML



Aluminum electrolytic capacitors Axial Miniature Long-Life

138 AML

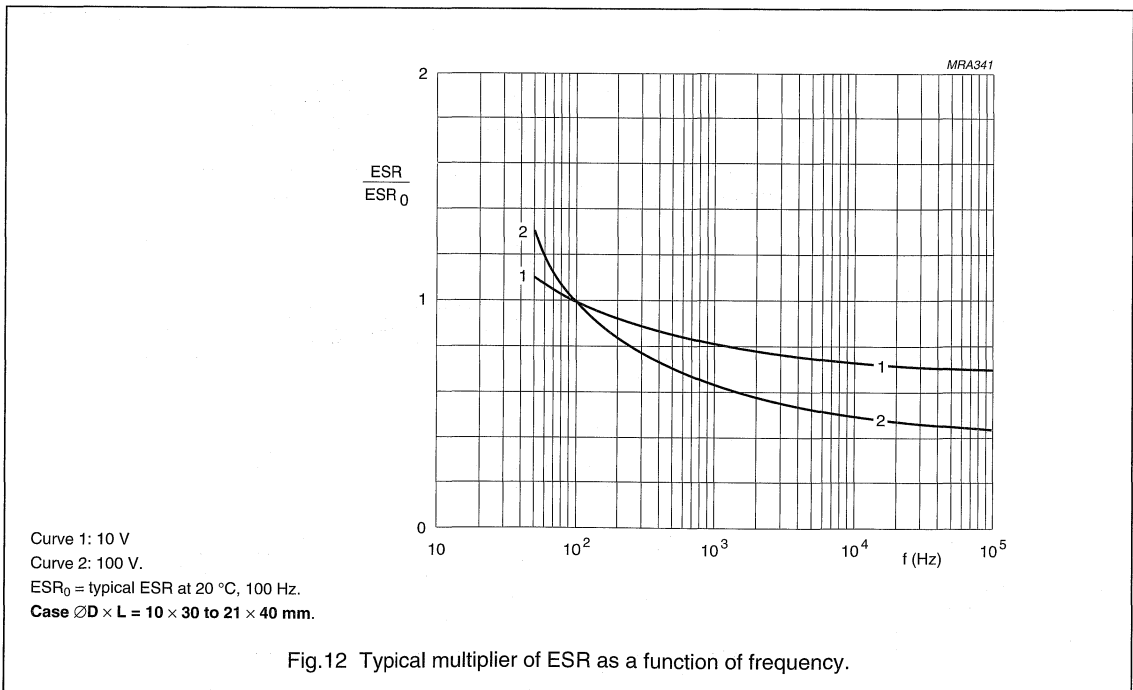
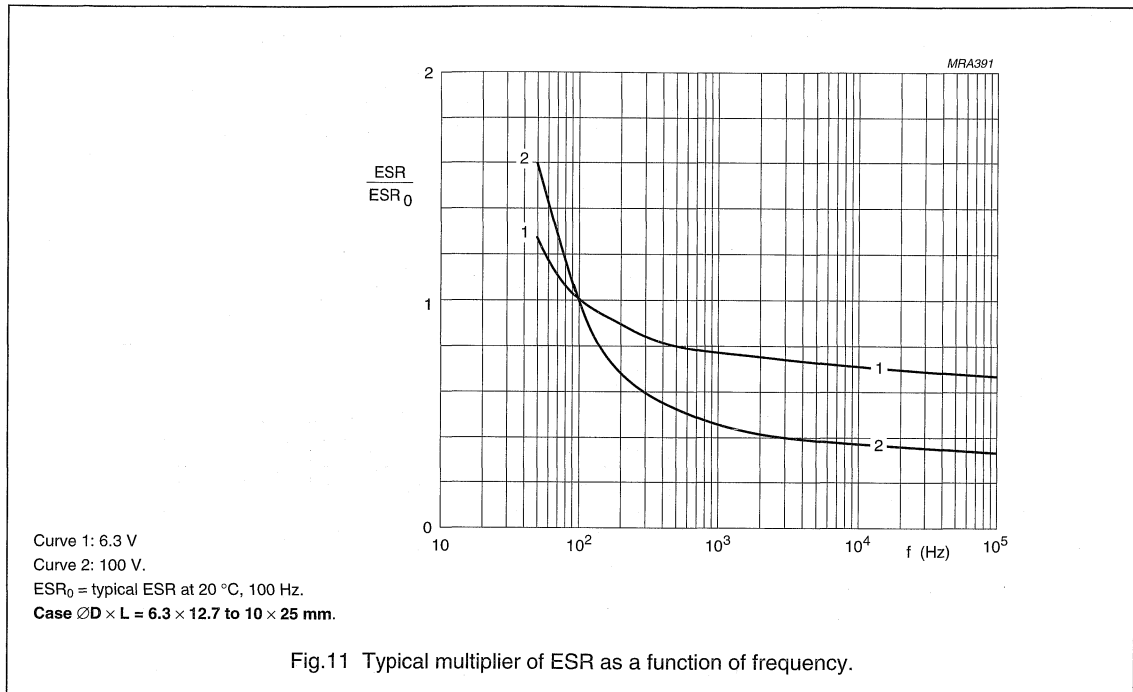
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML



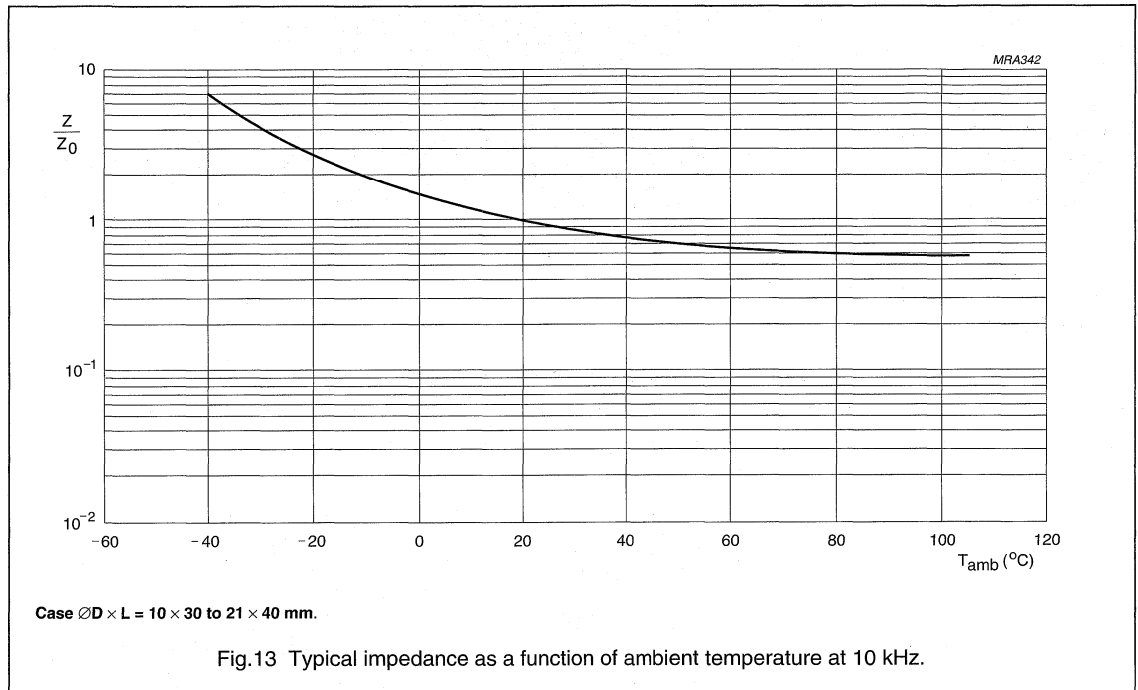
Aluminum electrolytic capacitors Axial Miniature Long-Life

138 AML

Impedance (Z)

Table 9 Impedance × capacitance values (case $\varnothing D \times L = 6.3 \times 12.7$ to 10×25 mm)

T_{amb}	$Z \times C_R (\Omega \times \mu F)$ 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

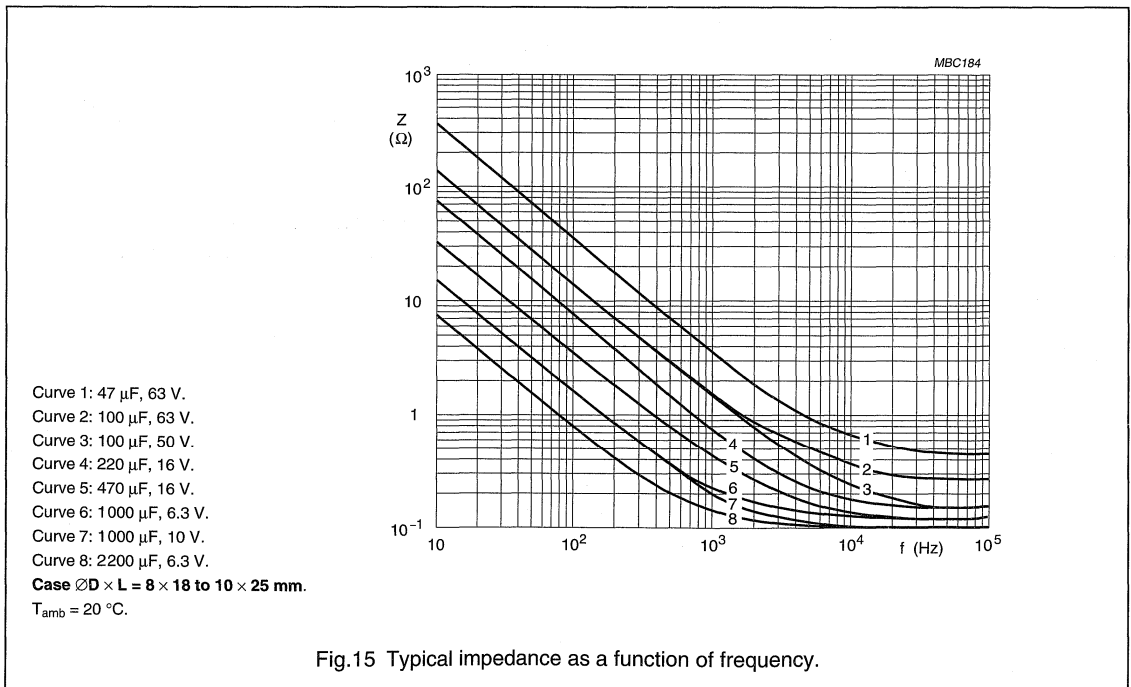
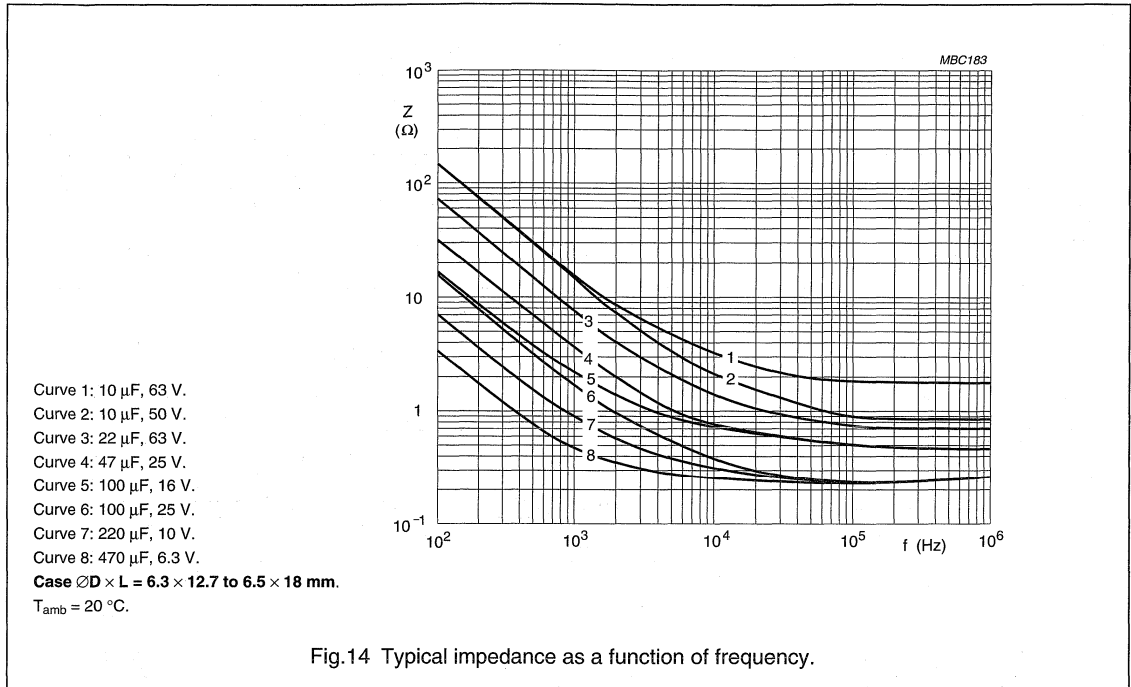


A

Aluminum electrolytic capacitors

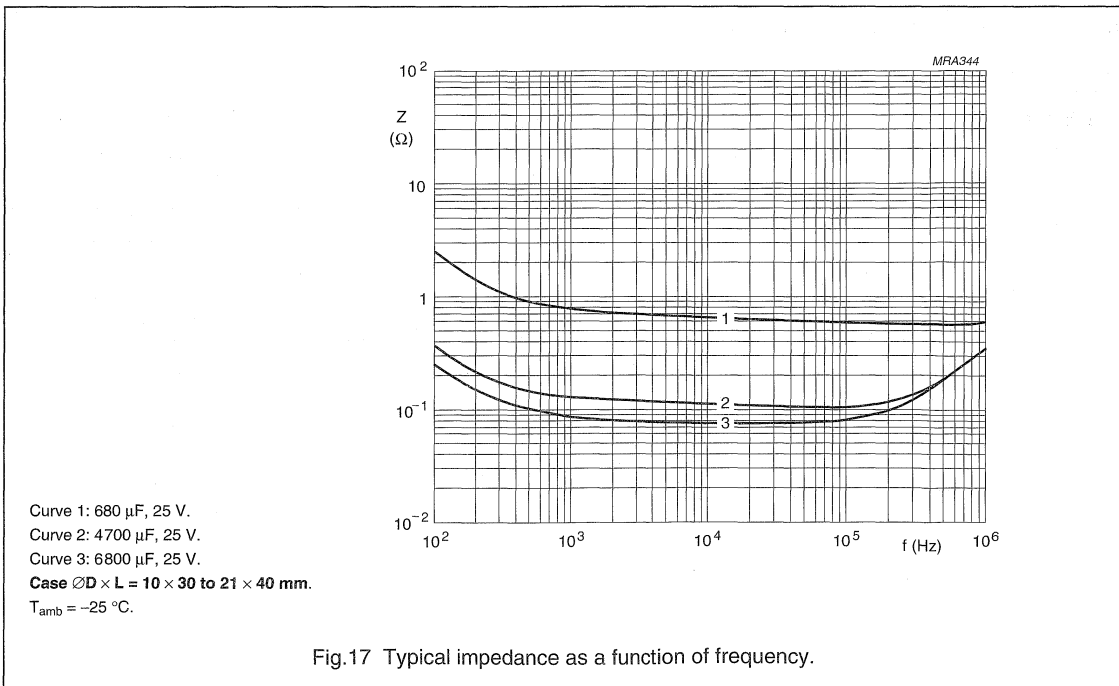
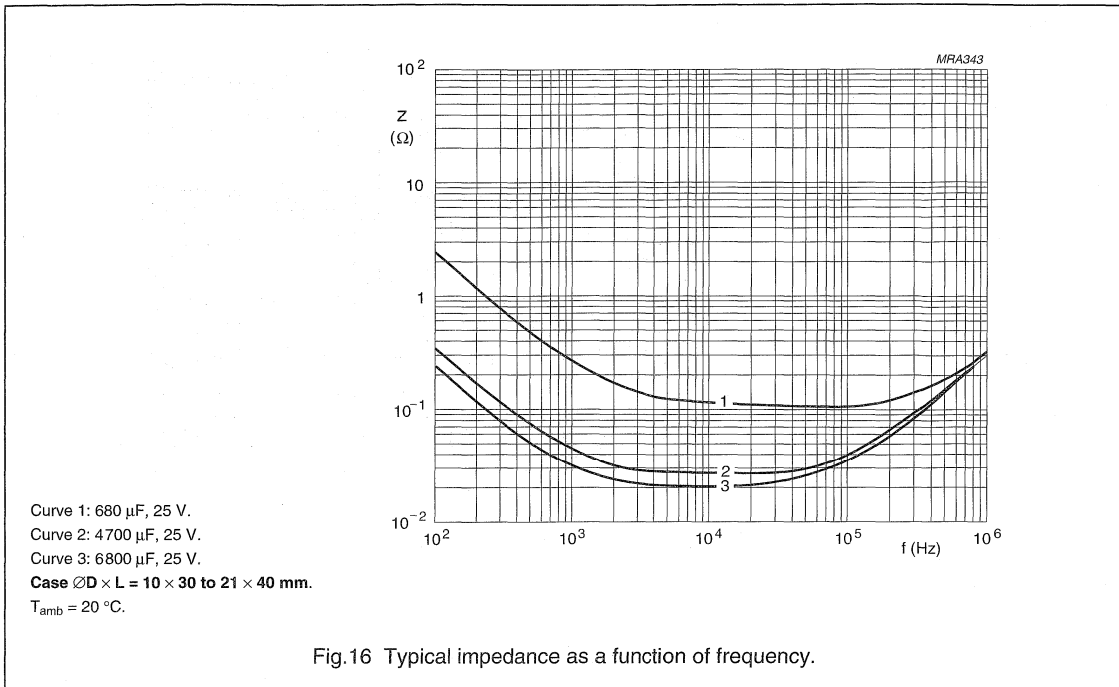
Axial Miniature Long-Life

138 AML



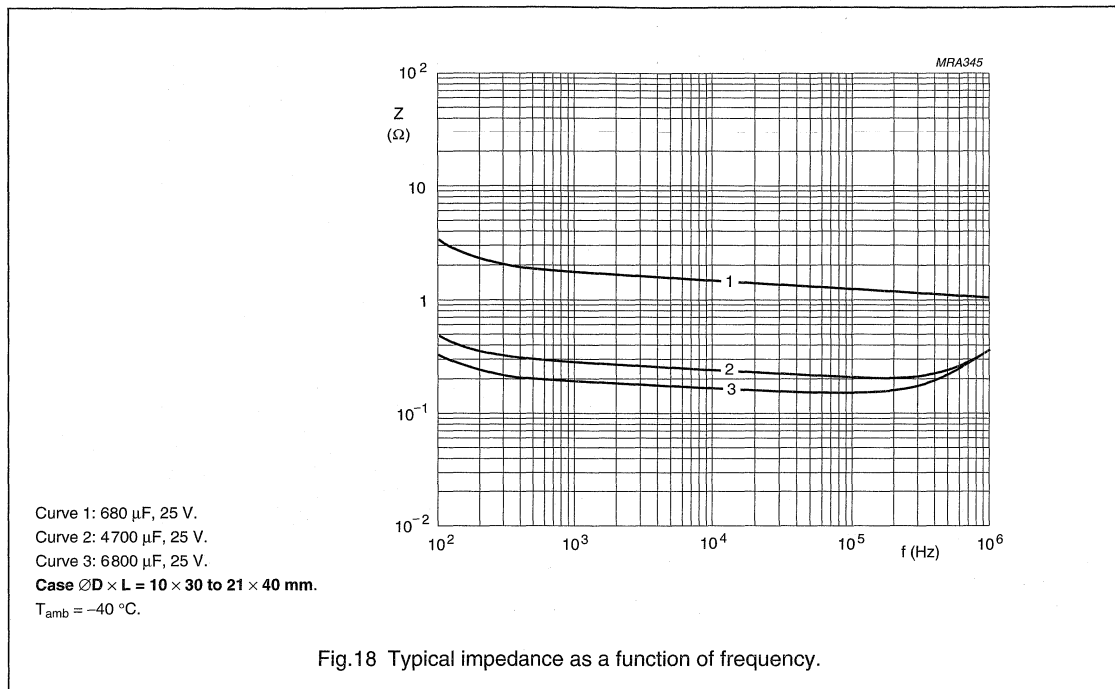
Aluminum electrolytic capacitors
Axial Miniature Long-Life

138 AML



Aluminum electrolytic capacitors
Axial Miniature Long-Life

138 AML



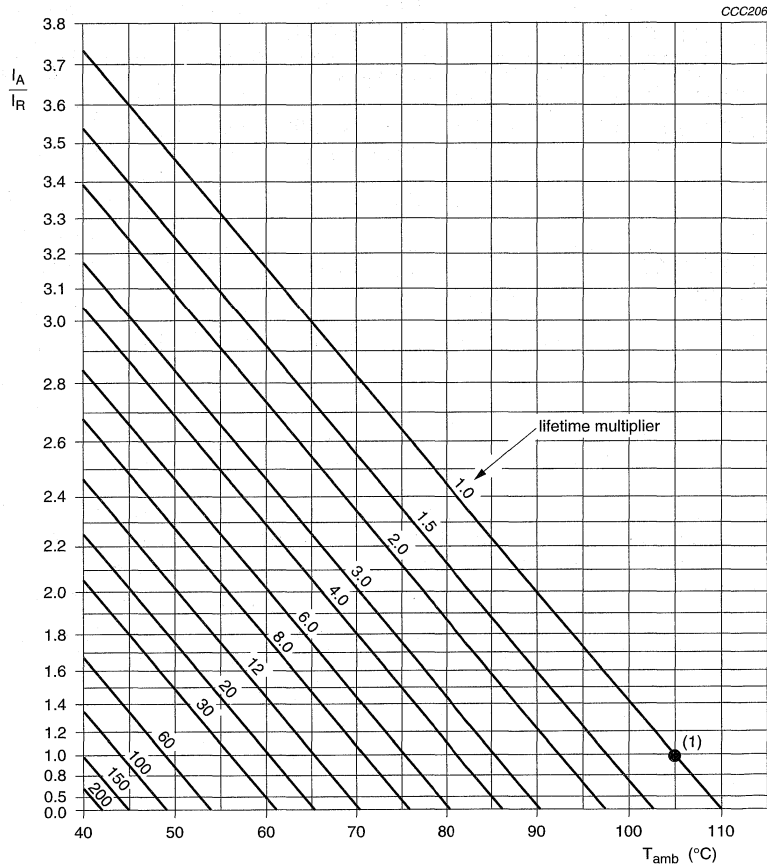
RIPPLE CURRENT AND USEFUL LIFE

Table 10 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	0.9	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

Aluminum electrolytic capacitors
Axial Miniature Long-Life

138 AML



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 $\varnothing D \times L = 6.3 \times 12.7$ to 10×25 mm: 2000 hours

case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 10000 hours.

Fig.19 Multiplier of useful life as a function of ambient temperature and ripple current load; see Table 10.

Aluminum electrolytic capacitors

Axial Miniature Long-Life

138 AML

SPECIFIC TESTS AND REQUIREMENTS

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

Table 11 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; case $\varnothing D \times L$: 6.3×12.7 to 10×25 mm: 1000 hours; 10×30 to 21×40 mm: 5000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +15/-30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; case $\varnothing D \times L$: 6.3×12.7 to 10×25 mm: 2000 hours; 10×30 to 21×40 mm: 10000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +45/-50% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300, subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors
Axial Miniature Long-Life

138 AML

NOTES

A

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Mounting ring version (single ended) not insulated
- Taped versions up to $\varnothing 15 \times 30$ 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.

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.

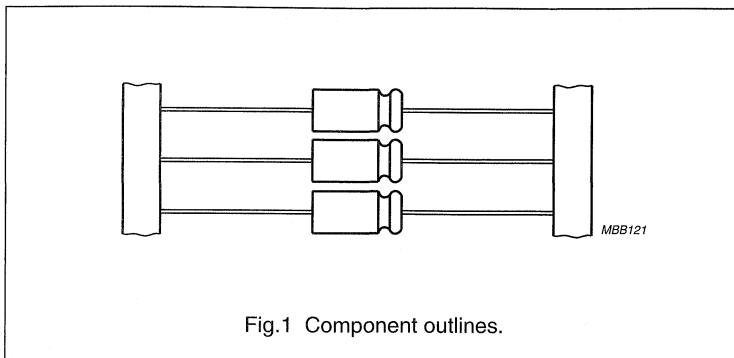
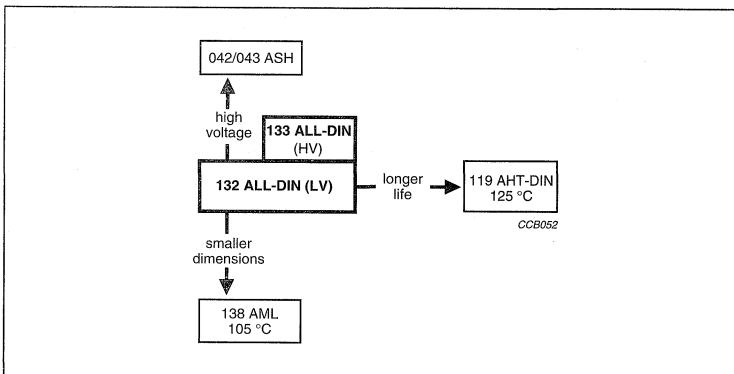


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE		
Case sizes ($\varnothing D_{nom} \times L_{nom}$ 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 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	10000 hours	15000 hours	15000 hours
Useful life at 40 °C, $1.8 \times I_R$ applied	160000 hours	240000 hours	240000 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		

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

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

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

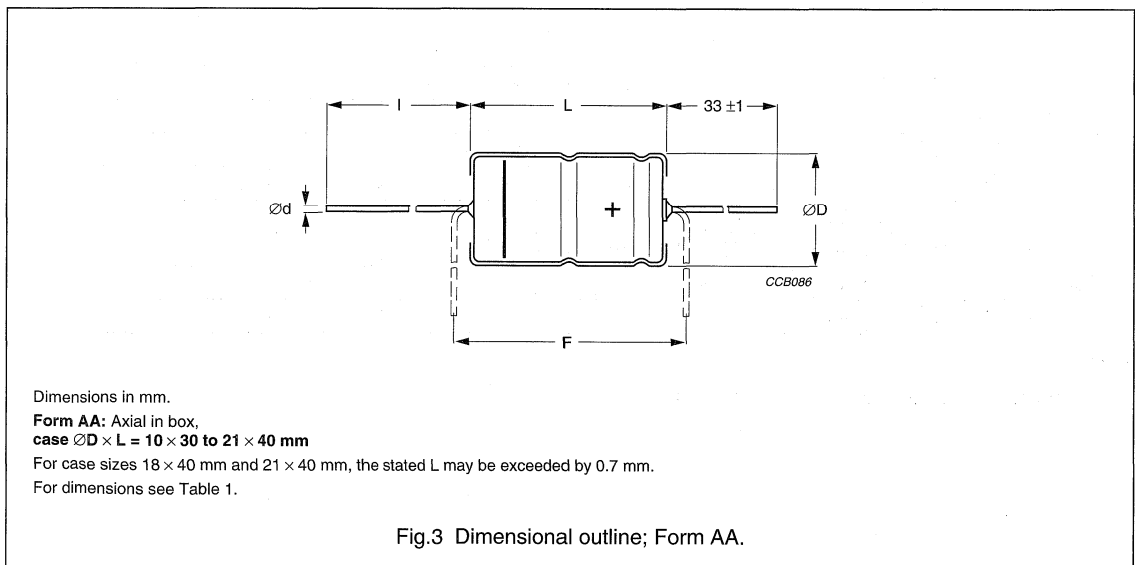
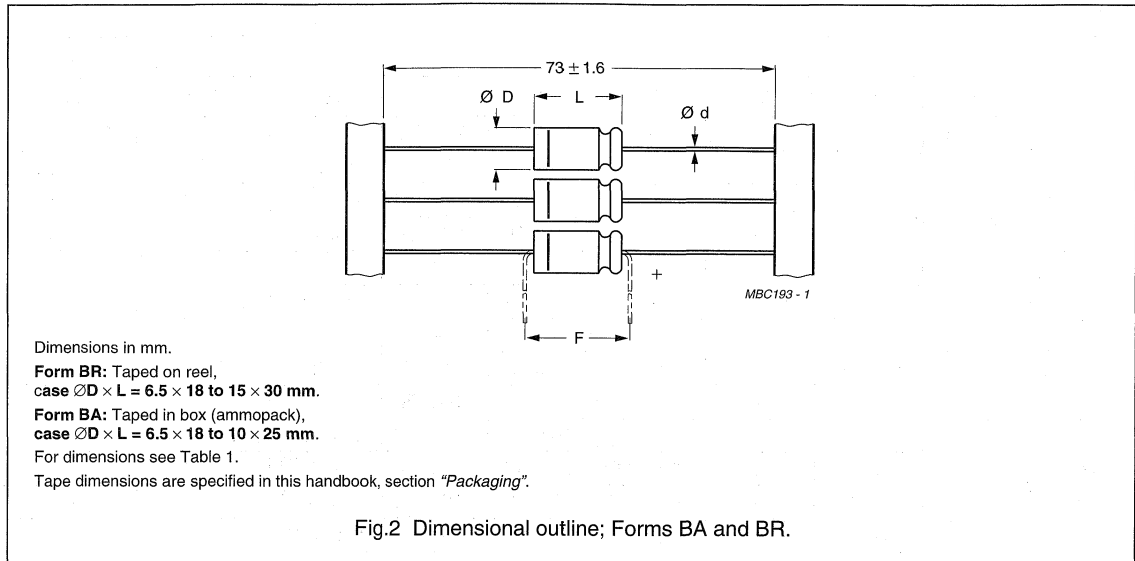
A

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



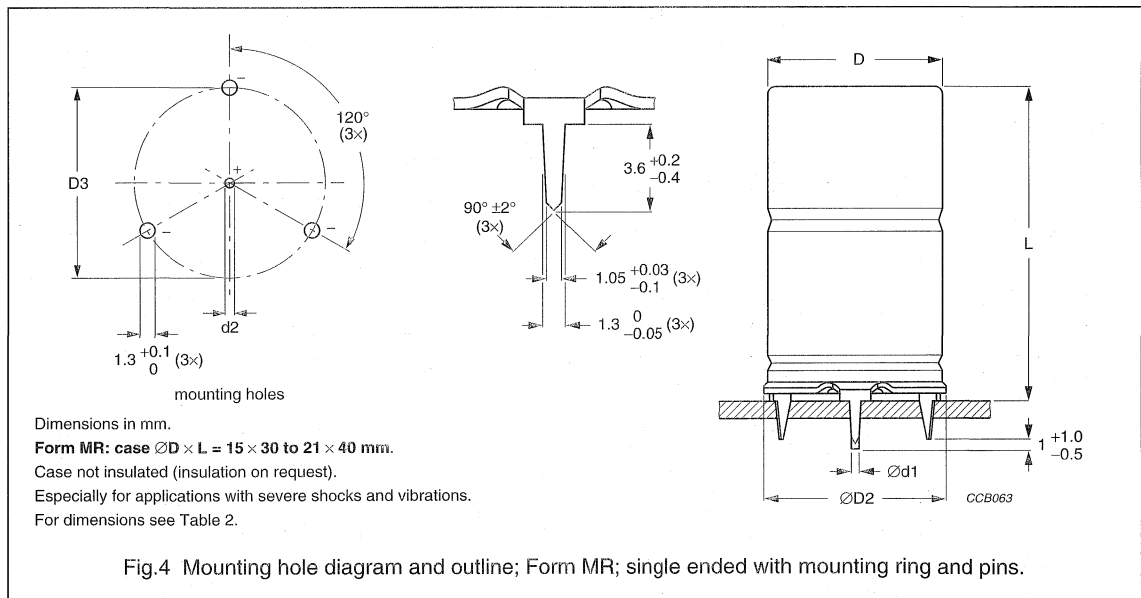
Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

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

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	AXIAL: FORM AA, BA, and BR					MASS (g)	PACKAGING QUANTITIES		
		$\varnothing d$ (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	–	–

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

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	SINGLE ENDED WITH MOUNTING RING: FORM MR						MASS (g)	PACKAGING QUANTITIES
		$\varnothing d1$ (mm)	$\varnothing d2$ (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

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 3, 5 and 7 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ 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
$\tan \delta$	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 or 100 kHz

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

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 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	–

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 132 series

100 $\mu\text{F}/40\text{ V}$; $-10/+50\%$ Nominal case size: $\varnothing 10 \times 18\text{ mm}$; 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 $\varnothing D \times L$ (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

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

ELECTRICAL DATA (continued)

Table 5 Electrical data continued; preferred types in bold

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (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	–
	63	4.7	6.5 × 18	38	6.0	4.6	0.07	24	12
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	–

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

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
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

Aluminum electrolytic capacitors
Axial Long Life, DIN-based

132/133 ALL-DIN

ELECTRICAL DATA (continued)

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

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)
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	–	
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

Aluminum electrolytic capacitors
Axial Long Life, DIN-based

132/133 ALL-DIN

ORDERING INFORMATION (continued)

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

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ØD × 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
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	
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	–

A

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

ELECTRICAL DATA (continued)**Additional electrical data**

PARAMETER	CONDITIONS	VALUE	
		AXIAL	SINGLE ENDED
Voltage			
Surge voltage	$U_R = 10$ 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 $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: $U_R = 10$ to 100 V	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu A$	
	$U_R = 160$ to 350 V	$I_{L1} \leq 50 \mu A$	
	case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: $U_R = 10$ to 100 V	$I_{L1} \leq 0.006 C_R \times U_R + 3 \mu A$	
Leakage current	after 5 minutes:		
	case $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: $U_R = 10$ to 100 V	$I_{L5} \leq 0.002 C_R \times U_R + 4 \mu A$	
	$U_R = 160$ to 350 V	$I_{L5} \leq 20 \mu A$	
	case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: $U_R = 10$ to 100 V	$I_{L5} \leq 0.002 C_R \times U_R + 4 \mu A$	
Inductance			
Equivalent series inductance (ESL)	case $\varnothing D \times L$ 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	

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"
- Rated voltage (in V)
- Upper category temperature (85 °C)
- Group number (132 or 133)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to identify the negative terminal.

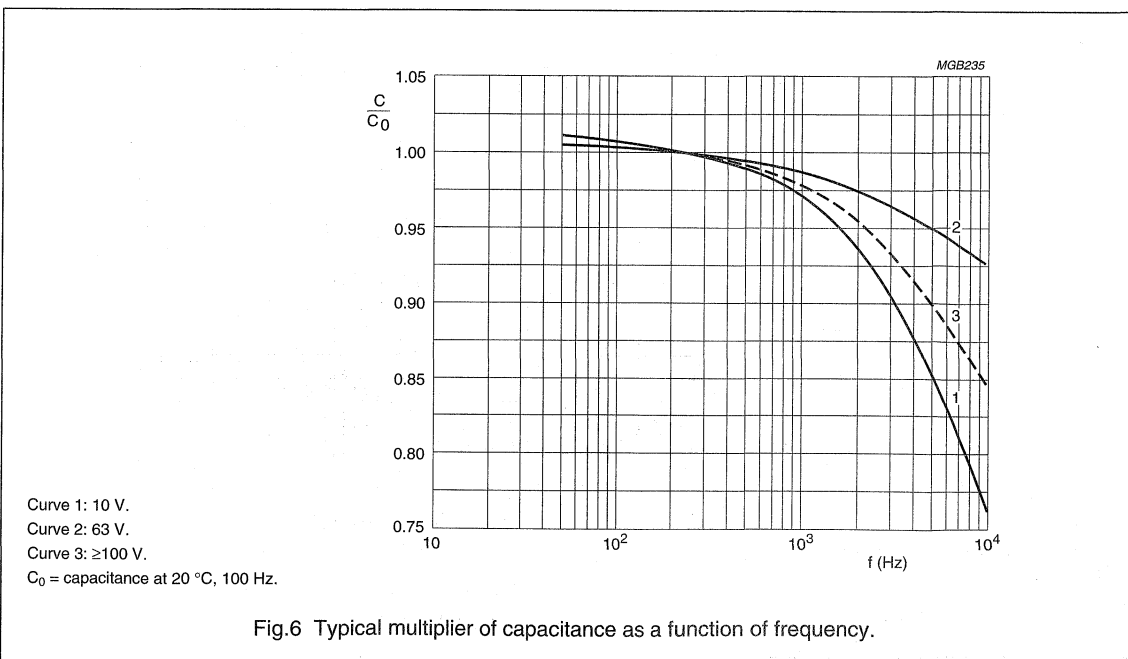
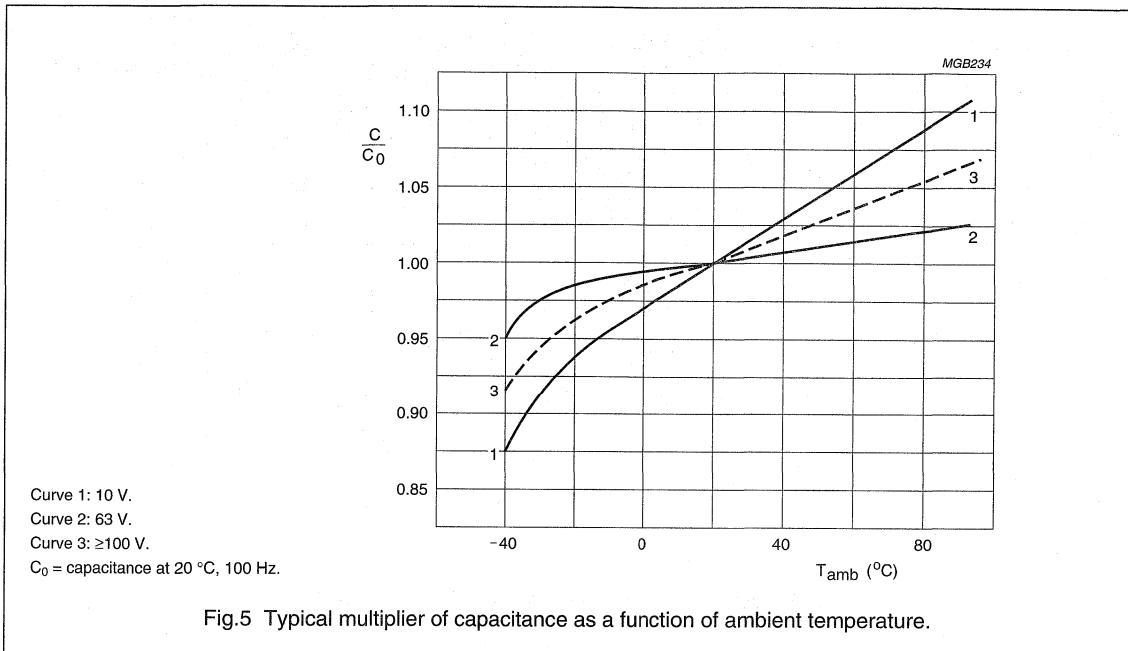
Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

ELECTRICAL DATA (continued)

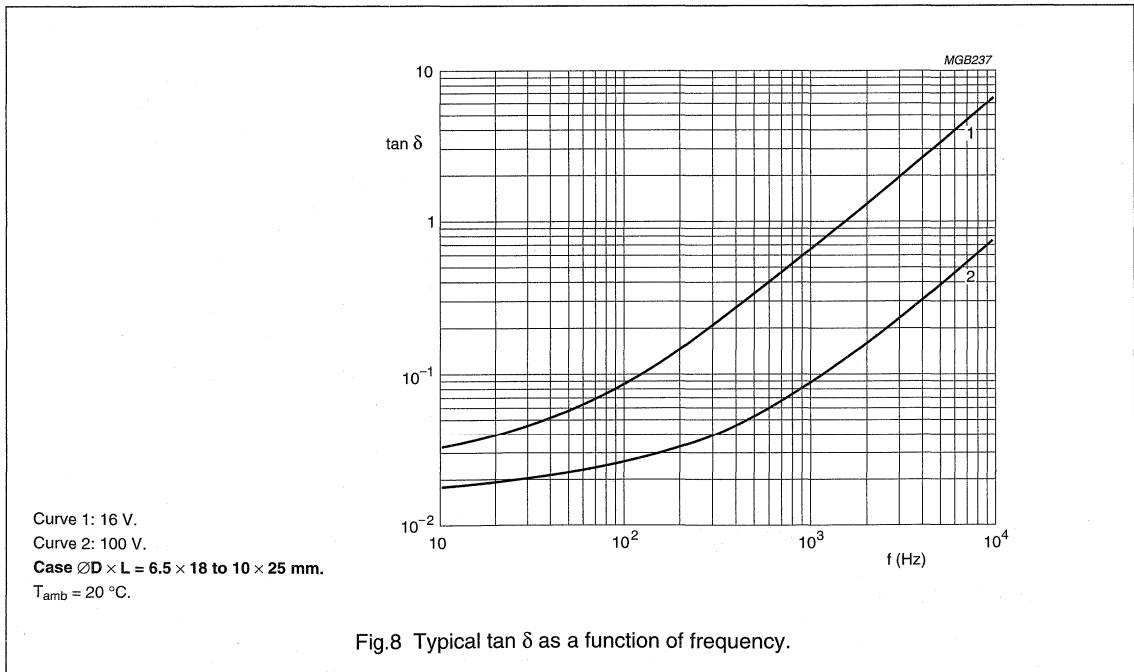
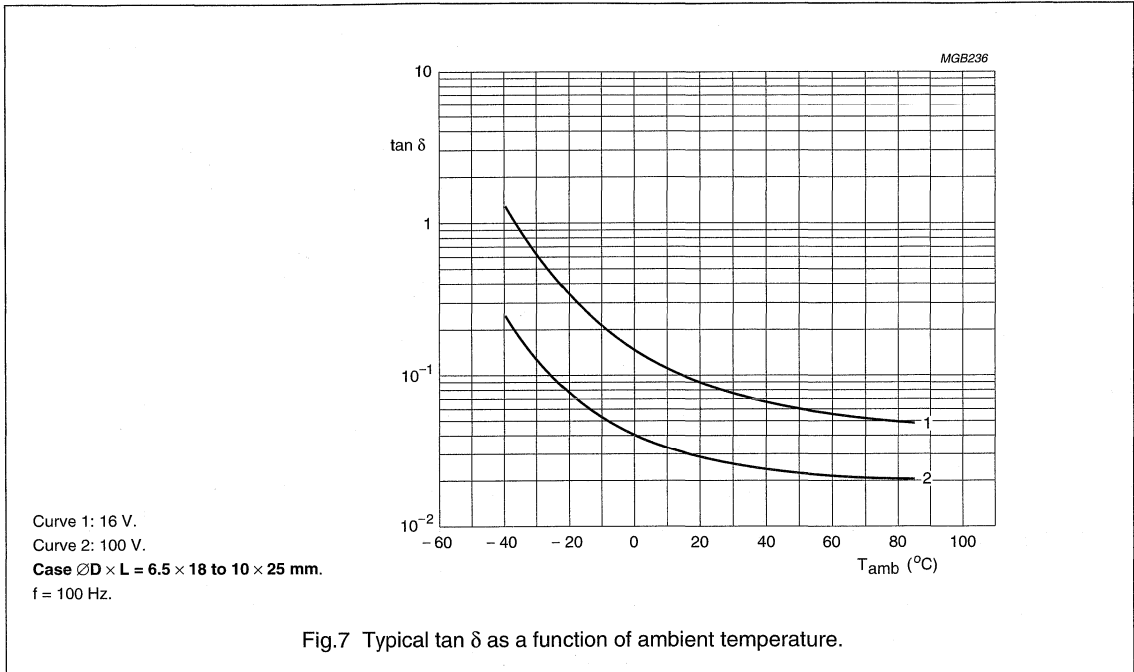
Capacitance (C)



Aluminum electrolytic capacitors
Axial Long Life, DIN-based

132/133 ALL-DIN

Dissipation factor ($\tan \delta$)



Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

Impedance (Z)

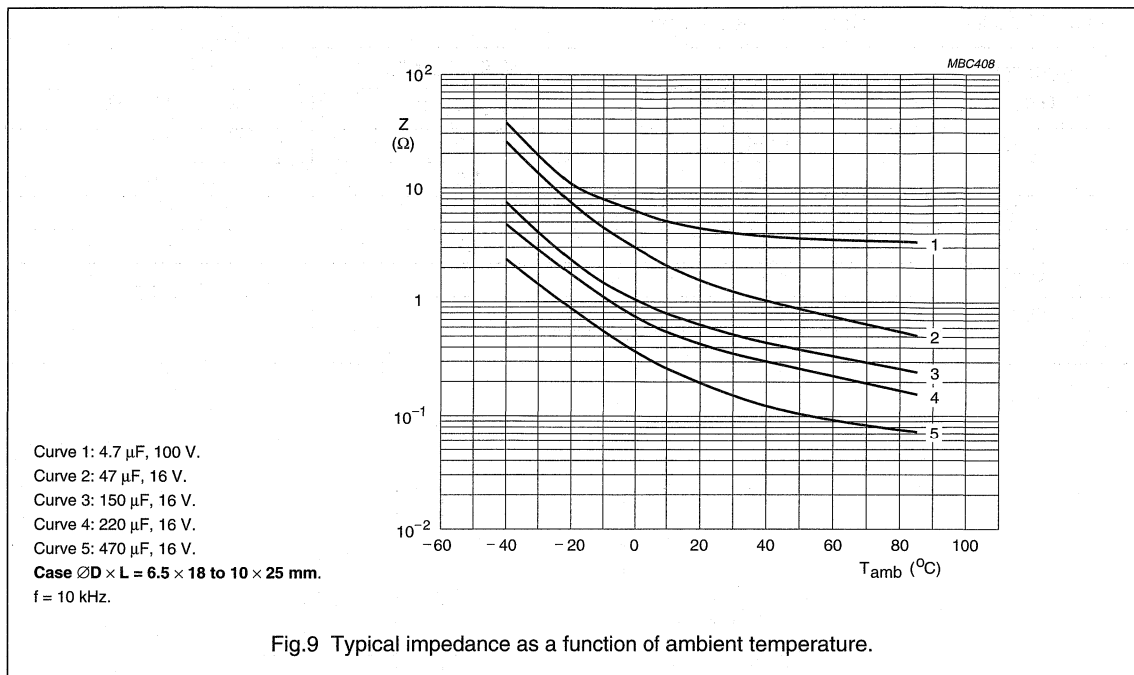


Fig.9 Typical impedance as a function of ambient temperature.

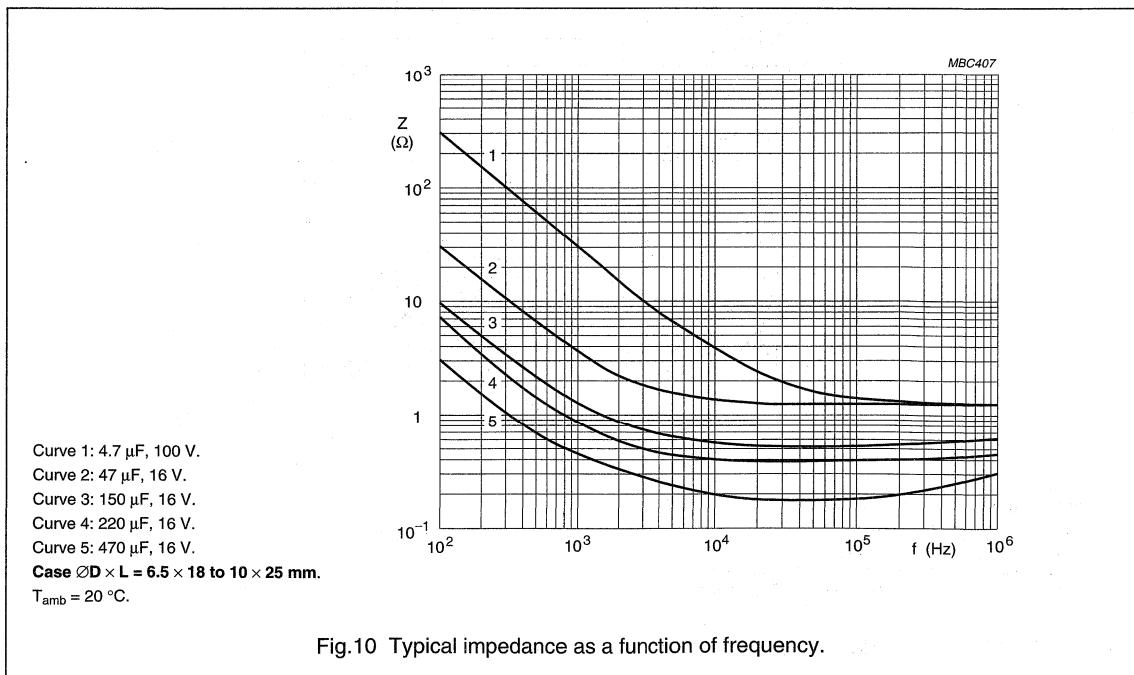


Fig.10 Typical impedance as a function of frequency.

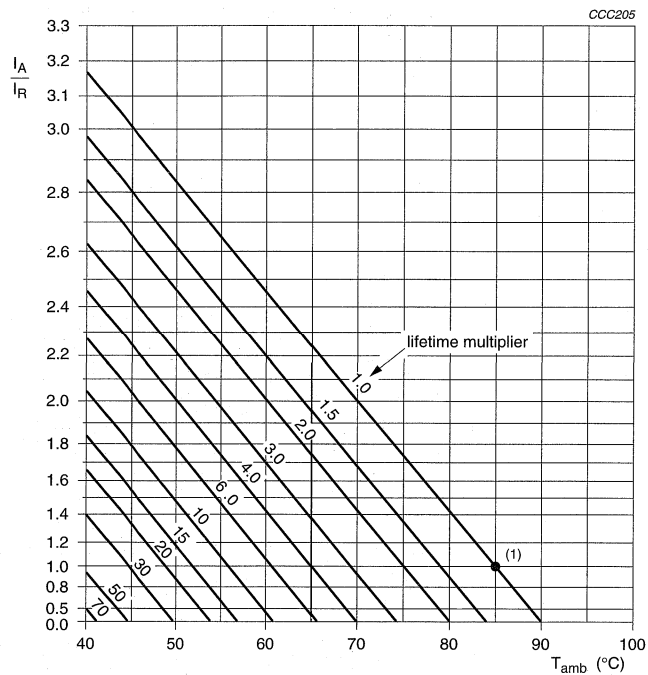
Aluminum electrolytic capacitors Axial Long Life, DIN-based

132/133 ALL-DIN

RIPPLE CURRENT AND USEFUL LIFE

Table 9 Multiplier of ripple current (I_R) as a function of frequency

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 $\varnothing D \times L = 6.5 \times 18$ and 8×18 mm: 10000 hours
 - case $\varnothing D \times L = 10 \times 18$ to 21×40 mm: 15000 hours.

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

Aluminum electrolytic capacitors

Axial Long Life, DIN-based

132/133 ALL-DIN

SPECIFIC TESTS AND REQUIREMENTS

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

Table 10 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300, subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; case $\varnothing D \times L = 6.5 \times 18$ and 8×18 mm: 6000 hours; case $\varnothing D \times L = 10 \times 18$ to 21×40 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	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; case $\varnothing D \times L = 6.5 \times 18$ and 8×18 mm: 10000 hours; case $\varnothing D \times L = 10 \times 18$ to 21×40 mm: 15000 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	$T_{amb} = 85\text{ °C}$; 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 $I_{L5} \leq 2 \times \text{spec. limit}$

A

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminium case, insulated with a blue sleeve
- Mounting ring version (single ended) not insulated
- Case $\varnothing 10 \times 30$ mm to $\varnothing 21 \times 40$ mm with pressure relief
- Taped versions up to case $\varnothing 15 \times 30$ 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.

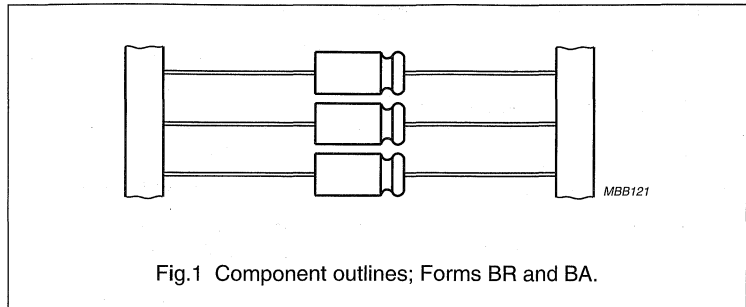
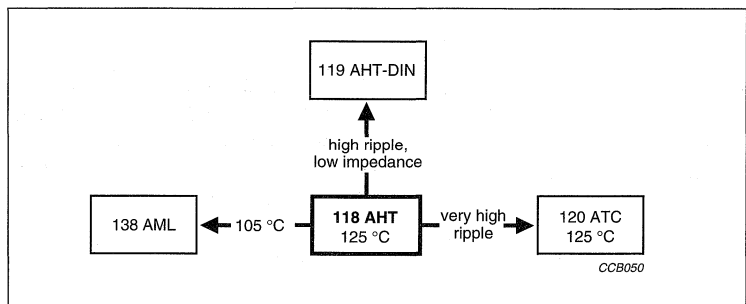


Fig.1 Component outlines; Forms BR and BA.



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.

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	6.5 × 18 to 10 × 25	10 × 30 to 21 × 40
Rated capacitance range, C_R	1 to 10000 μF	
Tolerance on C_R	±20%	
Rated voltage range, U_R	6.3 to 200 V	
Category temperature range	-40 to +125 °C	-55 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, $1.8 \times I_R$ applied	500000 hours	1000000 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

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	6.3	10	16	25	40	63	100	200
1.0	–	–	–	–	–	6.5 × 18	–	–
2.2	–	–	–	–	–	6.5 × 18	–	–
4.7	–	–	–	–	–	6.5 × 18	6.5 × 18	8 × 18
10	–	–	–	–	–	6.5 × 18	6.5 × 18	10 × 25
15	–	–	–	–	–	–	–	10 × 30
22	–	–	–	–	–	6.5 × 18	8 × 18	12.5 × 30
33	–	–	–	–	–	–	10 × 25	15 × 30
47	–	–	–	–	6.5 × 18	–	10 × 25	18 × 30
	–	–	–	–	–	–	10 × 30	–
68	–	–	–	–	–	–	12.5 × 30	–
100	–	–	–	6.5 × 18	8 × 18	10 × 25	12.5 × 30	21 × 40
	–	–	–	–	–	10 × 30	–	–
150	–	–	–	–	10 × 18	12.5 × 30	–	–
220	–	6.5 × 18	8 × 18	10 × 18	10 × 25	12.5 × 30	18 × 30	–
	–	–	–	–	10 × 30	–	–	–
330	–	8 × 18	–	–	12.5 × 30	–	–	–
470	–	8 × 18	10 × 18	10 × 25	12.5 × 30	18 × 30	21 × 40	–
	–	–	–	10 × 30	–	–	–	–
680	–	–	–	12.5 × 30	–	–	–	–
1000	10 × 18	10 × 25	12.5 × 30	12.5 × 30	18 × 30	21 × 40	–	–
	–	10 × 30	–	–	–	–	–	–
1500	10 × 25	12.5 × 30	12.5 × 30	15 × 30	18 × 40	–	–	–
2200	–	12.5 × 30	15 × 30	18 × 30	21 × 40	–	–	–
3300	–	15 × 30	18 × 30	18 × 40	–	–	–	–
4700	–	18 × 30	18 × 40	21 × 40	–	–	–	–
6800	–	18 × 40	21 × 40	–	–	–	–	–
10000	–	21 × 40	–	–	–	–	–	–

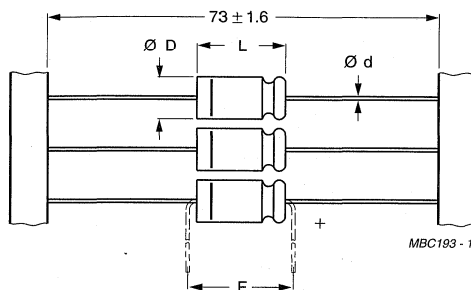
A

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.

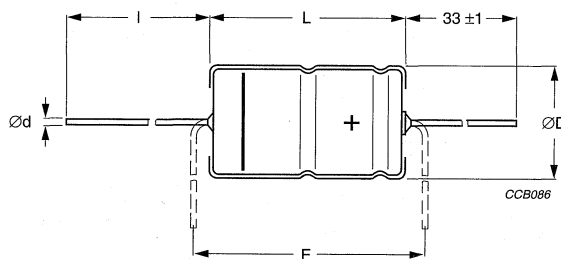
Form BR: Taped on reel,
case $\varnothing D \times L = 6.5 \times 18$ to 15×30 mm.

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

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 $\varnothing D \times L = 10 \times 30$ to 21×40 mm.

For case $\varnothing D \times L = 18 \times 40$ and 21×40 mm, the stated limit may be exceeded by 0.7 mm.

For dimensions see Table 1.

Fig.3 Dimensional outline; Form AA.

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

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)	∅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	–	–

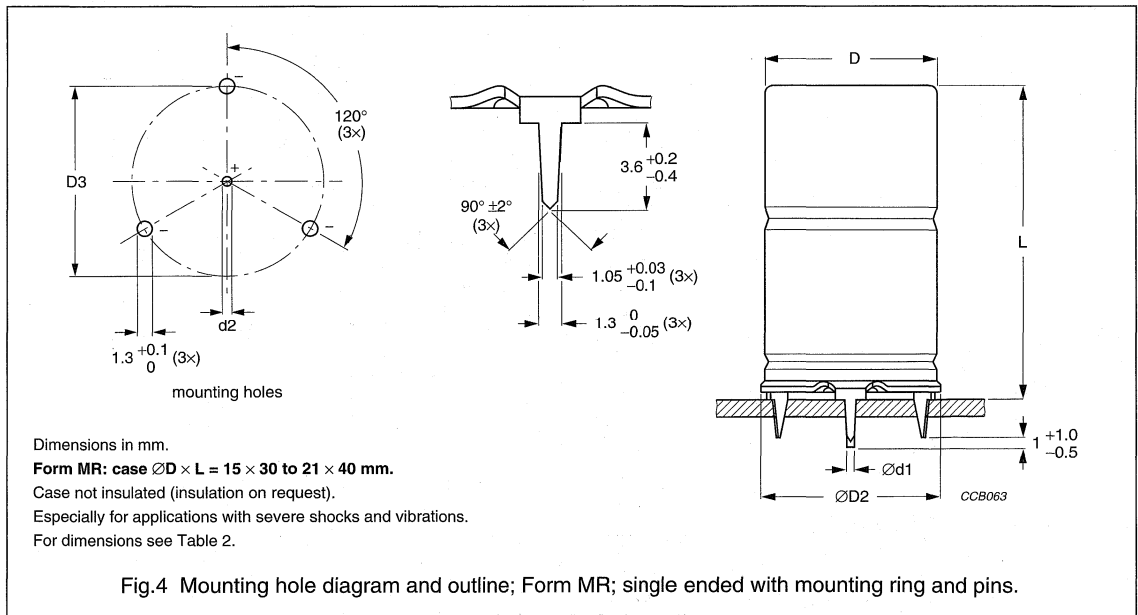


Table 2 Single ended; physical dimensions, mass and packaging quantities; see Fig. 4

NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	SINGLE ENDED WITH MOUNTING RING: FORM MR					MASS (g)	PACKAGING QUANTITIES	
		∅d1 (mm)	∅d2 (mm)	∅D _{max} (mm)	∅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	≈8.6	200
18 × 30	03	0.8	1.0 +0.4	18.5	19.5	18.5 ±0.2	33	≈11.5	200
18 × 40	04	0.8	1.0 +0.4	18.5	19.5	18.5 ±0.2	45	≈14.5	100
21 × 40	05	0.8	1.0 +0.4	21.5	22.5	21.5 ±0.2	45	≈19.7	100

Aluminum electrolytic capacitors Axial High Temperature

118 AHT

Ordering example

Electrolytic capacitor 118 series

1000 μ F/10 V; \pm 20%

Nominal case size: \varnothing 10 x 30 mm; Form BR

Catalogue number: 2222 118 24102.

ELECTRICAL DATA AND ORDERING INFORMATION

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

C_R	rated capacitance at 100 Hz, tolerance \pm 20%
I_R	rated RMS ripple current at 100 Hz, 125 $^{\circ}\text{C}$
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

Table 3 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 125 $^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222				
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	SINGLE ENDED MOUNTING RING FORM MR	
6.3	1000	10 x 18	6	251	42	17	0.50	0.79	0.8	-	118 23102	118 33102	-	-
	1500	10 x 25	7	352	61	23	0.50	0.53	0.53	-	118 90502	118 90503	-	-
10	220	6.5 x 18	4	109	20	8,4	0.35	2.53	2.1	-	118 24221	118 34221	-	-
	330	8 x 18	5	150	24	11	0.35	1.69	1.4	-	118 24331	118 34331	-	-
	470	8 x 18	5	179	32	13	0.35	1.19	1.0	-	118 24471	118 34471	-	-
	1000	10 x 25	7	343	64	24	0.35	0.56	0.55	-	118 90504	118 90505	-	-
	1000	10 x 30	00	550	64	24	0.32	0.505	0.45	-	118 14102	118 24102	-	-
	1500	12.5 x 30	01	740	94	34	0.32	0.340	0.28	-	118 14152	118 24152	-	-
	2200	12.5 x 30	01	830	136	48	0.40	0.290	0.27	-	118 14222	118 24222	-	-
	3300	15 x 30	02	1070	202	70	0.40	0.190	0.18	-	118 14332	118 24332	-	-
	4700	18 x 30	03	1350	286	98	0.46	0.155	0.15	-	118 14472	-	-	118 44332
	6800	18 x 40	04	1730	412	140	0.53	0.100	0.10	-	118 14682	-	-	118 44472
	10000	21 x 40	05	1860	604	200	0.53	0.084	0.10	-	118 14103	-	-	118 44682
										-	-	-	-	118 44103

Aluminum electrolytic capacitors
Axial High Temperature

118 AHT

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × 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)	CATALOGUE NUMBER 2222				SINGLE ENDED MOUNTING RING FORM MR	
										AXIAL			TAPED IN BOX FORM BA		
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED ON REEL BOX FORM BA			
40	47	6.5 × 18	4	89.8	20	7.8	0.11	3.72	2.8	-	118 27479	118 37479	-	-	
	100	8 × 18	5	147	28	12	0.11	1.75	1.3	-	118 27101	118 37101	-	-	
	150	10 × 18	6	207	40	16	0.11	1.17	1.0	-	118 27151	118 37151	-	-	
	220	10 × 25	7	287	57	22	0.11	0.80	0.68	-	118 90511	118 90512	-	-	
	220	10 × 30	00	390	57	22	0.10	0.70	0.55	118 17221	118 27221	-	-		
	330	12.5 × 30	01	570	83	30	0.10	0.43	0.33	118 17331	118 27331	-	-		
	470	12.5 × 30	01	620	117	42	0.11	0.38	0.30	118 17471	118 27471	-	-		
	680	15 × 30	02	810	167	58	0.11	0.255	0.23	118 17681	118 27681	-	118 47681		
	1000	18 × 30	03	1070	244	84	0.13	0.205	0.18	118 17102	-	-	118 47102		
	1500	18 × 40	04	1390	364	120	0.13	0.13	0.11	118 17152	-	-	118 47152		
	2200	21 × 40	05	1540	532	180	0.15	0.105	0.10	118 17222	-	-	118 47222		
	63	1.0	6.5 × 18	4	16.4	20	4.1	0.07	110	22	-	118 28108	118 38108	-	-
		2.2	6.5 × 18	4	24.3	20	4.3	0.07	51	15	-	118 28228	118 38228	-	-
		4.7	6.5 × 18	4	35.6	20	4.6	0.07	24	8.9	-	118 28478	118 38478	-	-
		10	6.5 × 18	4	51.9	20	5.3	0.07	11	5.6	-	118 28109	118 38109	-	-
		22	6.5 × 18	4	77.0	20	6.8	0.07	5.1	3.2	-	118 28229	118 38229	-	-
		47	8 × 18	5	126	22	9.9	0.07	2.4	1.5	-	118 28479	118 38479	-	-
		100	10 × 25	7	243	42	17	0.07	1.1	0.7	-	118 90513	118 90514	-	-
		100	10 × 30	00	340	42	17	0.07	1.1	1.0	118 18101	118 28101	-	-	
		150	12.5 × 30	01	490	61	23	0.07	0.65	0.61	118 18151	118 28151	-	-	
220		12.5 × 30	01	550	87	32	0.08	0.61	0.56	118 18221	118 28221	-	-		
330	15 × 30	02	730	129	46	0.09	0.42	0.40	118 18331	118 28331	-	118 48331			
470	18 × 30	03	970	182	63	0.09	0.31	0.29	118 18471	-	-	118 48471			
680	18 × 40	04	1230	261	90	0.09	0.2	0.18	118 18681	-	-	118 48681			
1000	21 × 40	05	1400	383	130	0.10	0.16	0.15	118 18102	-	-	118 48102			

Aluminum electrolytic capacitors
Axial High Temperature

118 AHT

CATALOGUE NUMBER 2222				Z 10 kHz (Ω)	ESR 100 Hz (Ω)	Tan δ 100 Hz	I _{L5} 5 min (μA)	I _{L1} 1 min (μA)	I _R 100 Hz 125 °C (mA)	CASE CODE	NOMINAL CASE SIZE ∅D × L (mm)	C _R 100 Hz (μF)	U _R (V)	AXIAL				SINGLE ENDED
IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR															
100	4.7	6.5 × 18	4	36	20	4.9	0.07	24	19	24	0.07	11	9.0	118 29478	118 39478	-	-	-
	10	6.5 × 18	4	52	20	6.0	0.07	11	9.0	11	0.07	5.1	4.0	118 29109	118 39109	-	-	-
	22	8 × 18	5	91	20	8.4	0.07	5.1	4.0	5.1	0.07	3.4	2.7	118 29229	118 39229	-	-	-
	33	10 × 25	7	140	24	11	0.07	3.4	2.7	3.4	0.07	2.6	2.0	118 29339	118 39339	-	-	-
	47	10 × 25	7	170	33	13	0.07	2.6	2.0	2.6	0.07	2.0	2.0	118 90535	118 90536	-	-	-
	47	10 × 30	00	240	33	13	0.08	2.6	2.0	2.6	0.08	1.8	1.2	118 19689	118 29689	-	-	-
	68	12.5 × 30	01	320	45	18	0.08	1.8	1.2	1.8	0.08	1.4	1.15	118 19101	118 29101	-	-	-
	100	12.5 × 30	01	380	64	24	0.09	1.4	1.15	1.4	0.09	0.94	0.78	118 19151	118 29151	-	-	118 49151
	150	15 × 30	02	500	94	34	0.10	0.94	0.78	0.94	0.10	0.66	0.55	118 19221	-	-	-	118 49221
	220	18 × 30	03	690	136	48	0.10	0.66	0.55	0.66	0.10	0.45	0.37	118 19331	-	-	-	118 49331
	330	18 × 40	04	890	202	70	0.10	0.45	0.37	0.45	0.10	0.33	0.28	118 19471	-	-	-	118 49471
	470	21 × 40	05	1050	286	98	0.10	0.33	0.28	0.33	0.10	0.06	0.23	118 90537	118 90538	-	-	-
200	2.2	6.5 × 18	4	27	20	4.9	0.06	44	23	44	0.06	21	11	118 90539	118 90541	-	-	-
	4.7	8 × 18	5	46	20	5.9	0.06	21	11	21	0.06	9.4	5.0	118 90542	118 90543	-	-	-
	10	10 × 25	7	85	20	8.0	0.06	9.4	5.0	9.4	0.06	4.76	3.75	118 92159	-	-	-	-
	15	10 × 30	00	150	22	10	0.046	4.76	3.75	4.76	0.046	3.17	2.22	118 90012	-	-	-	-
	22	12.5 × 30	01	210	31	13	0.046	3.17	2.22	3.17	0.046	2.11	1.11	118 92229	118 90013	-	-	-
	33	15 × 30	02	290	44	17	0.046	2.11	1.11	2.11	0.046	1.48	0.60	118 92339	118 90014	-	-	118 90002
	47	18 × 30	03	390	61	23	0.046	1.48	0.60	1.48	0.046	1.02	0.42	118 92479	-	-	-	118 90003
	68	18 × 40	04	500	86	31	0.046	1.02	0.42	1.02	0.046	0.96	0.39	118 92689	-	-	-	118 90004
	100	21 × 40	05	610	124	44	0.046	0.96	0.39	0.96	0.046	0.39	0.23	118 92101	-	-	-	118 90005

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

Additional electrical data

PARAMETER	CONDITIONS	VALUE	
		AXIAL	SINGLE ENDED
Voltage			
Surge voltage		$U_s \leq 1.15 \times U_R$	
Reverse voltage		$U_{rev} \leq 1 \text{ V}$	
Current			
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$ or $20 \mu\text{A}$ (whichever is greater)	
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$	
Inductance			
Equivalent series inductance (ESL)	case $\varnothing D \times L$ 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	

Table 4 Uprating values at reduced ambient temperature; note 1

SYMBOL	CONDITIONS	VALUES								UNIT
		6.3	10	16	25	40	63	100	200	
U_R	$T_{amb} > 85$ to $125 \text{ }^\circ\text{C}$	6.3	10	16	25	40	63	100	200	V
U_{R2}	$T_{amb} \leq 85 \text{ }^\circ\text{C}$	10	16	25	40	63	100	125	250	V

Note

- For applications at ambient temperatures of $\leq 85 \text{ }^\circ\text{C}$, the rated voltage (U_R) may be raised to U_{R2} .

MARKING

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

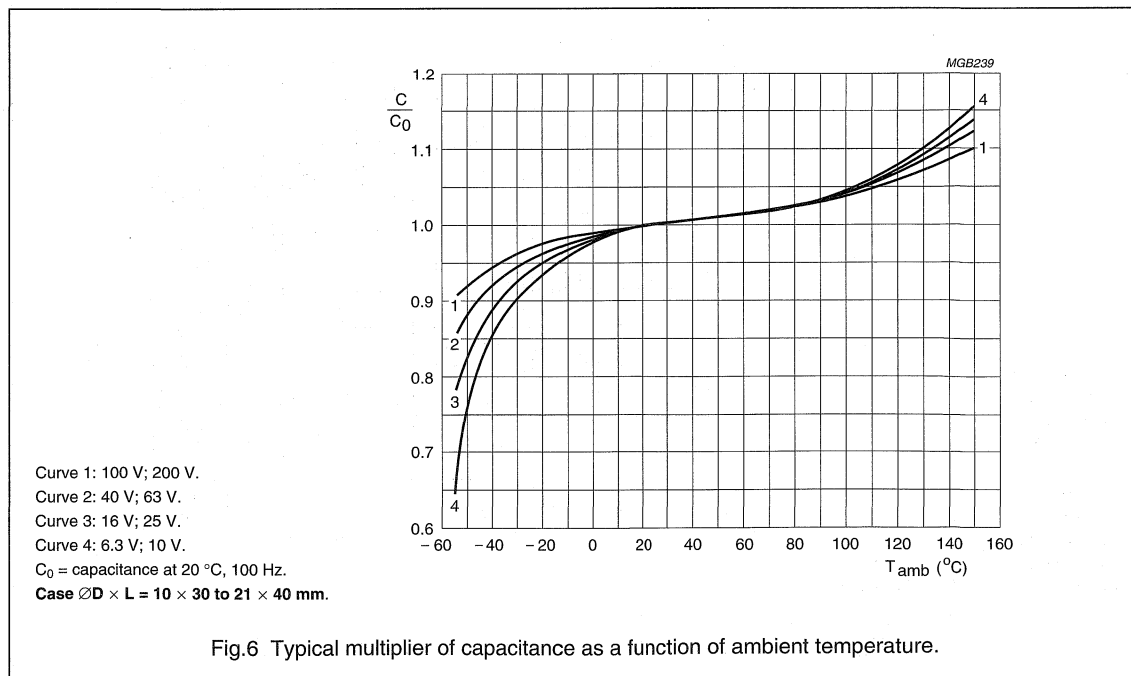
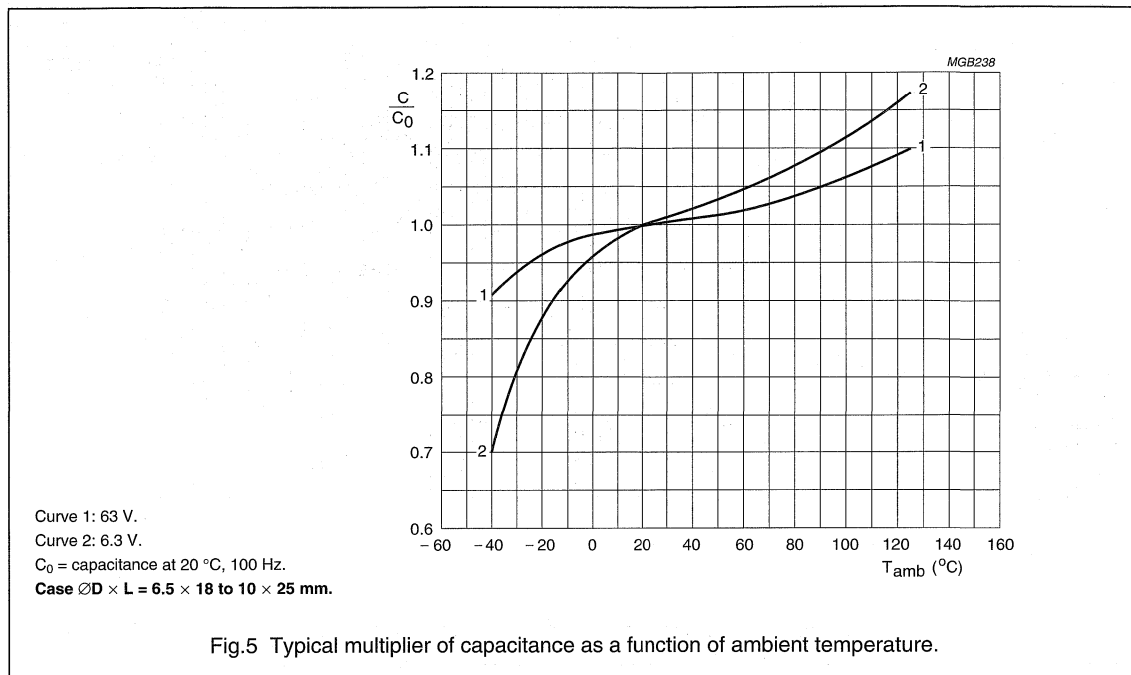
- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062"
- Rated voltage (in V) at $125 \text{ }^\circ\text{C}$ and $85 \text{ }^\circ\text{C}$
- Group number (118)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to identify the negative terminal
- '+' sign to identify the positive terminal.

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

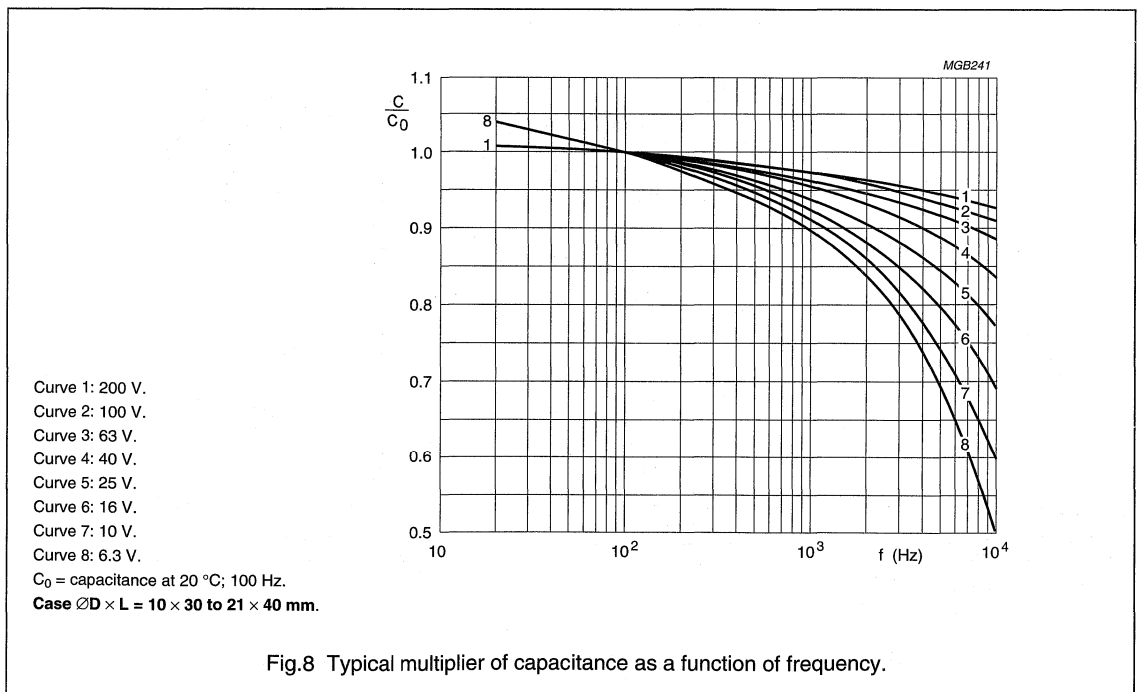
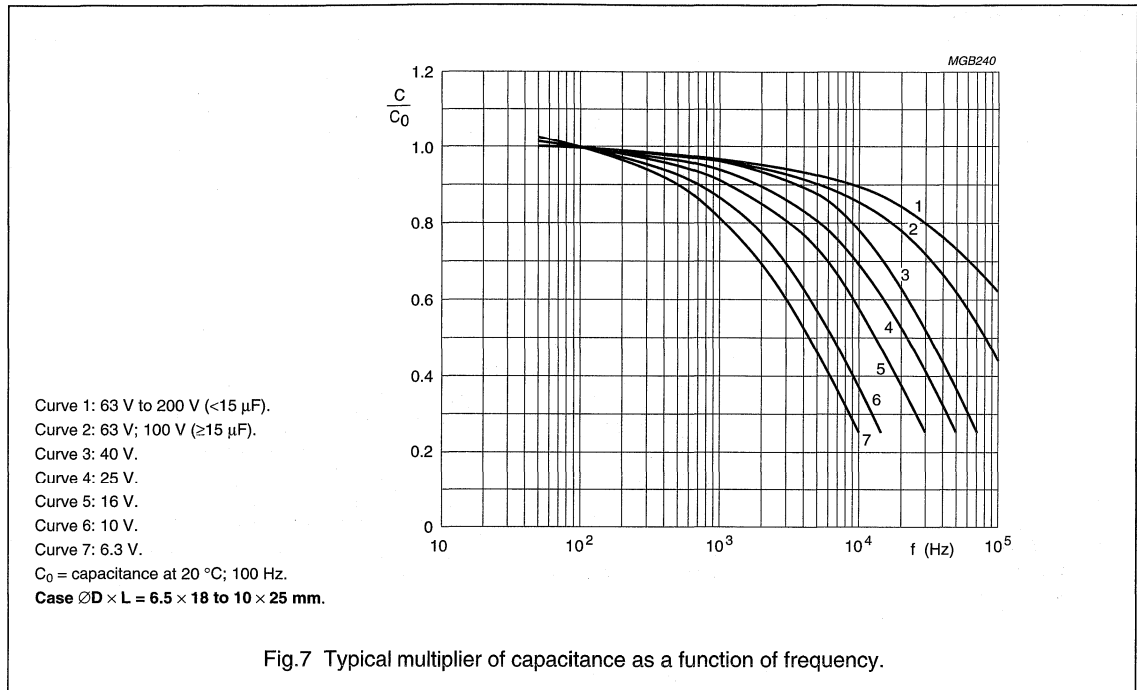
Capacitance (C)



Aluminum electrolytic capacitors

Axial High Temperature

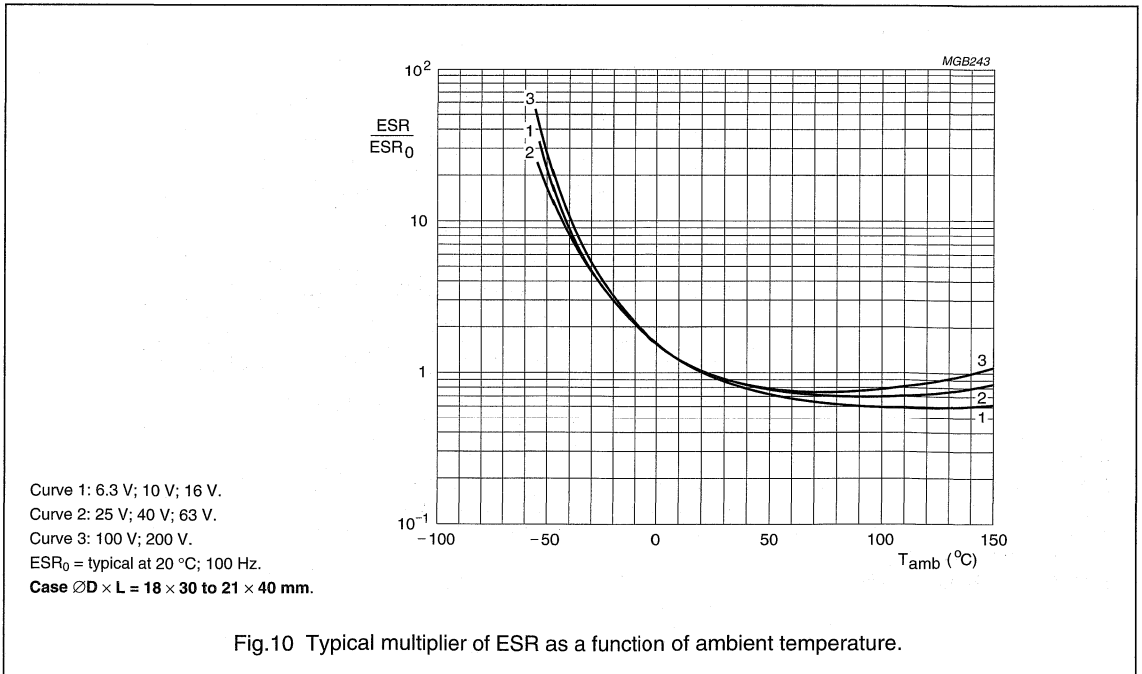
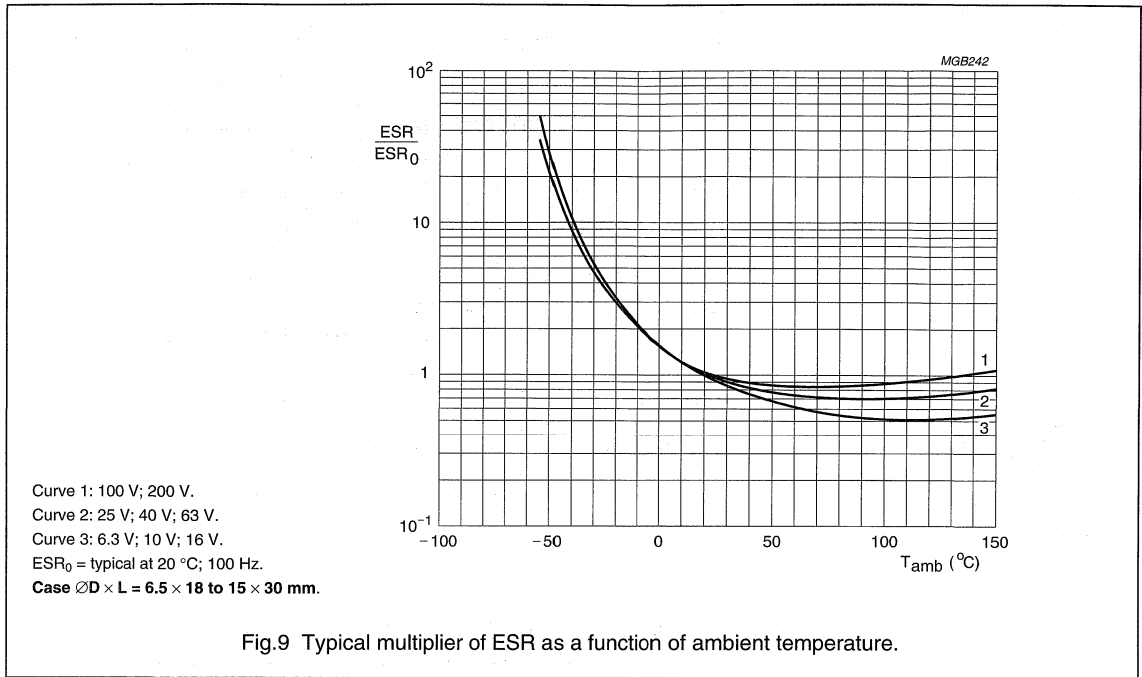
118 AHT



Aluminum electrolytic capacitors Axial High Temperature

118 AHT

Equivalent series resistance (ESR)



A

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

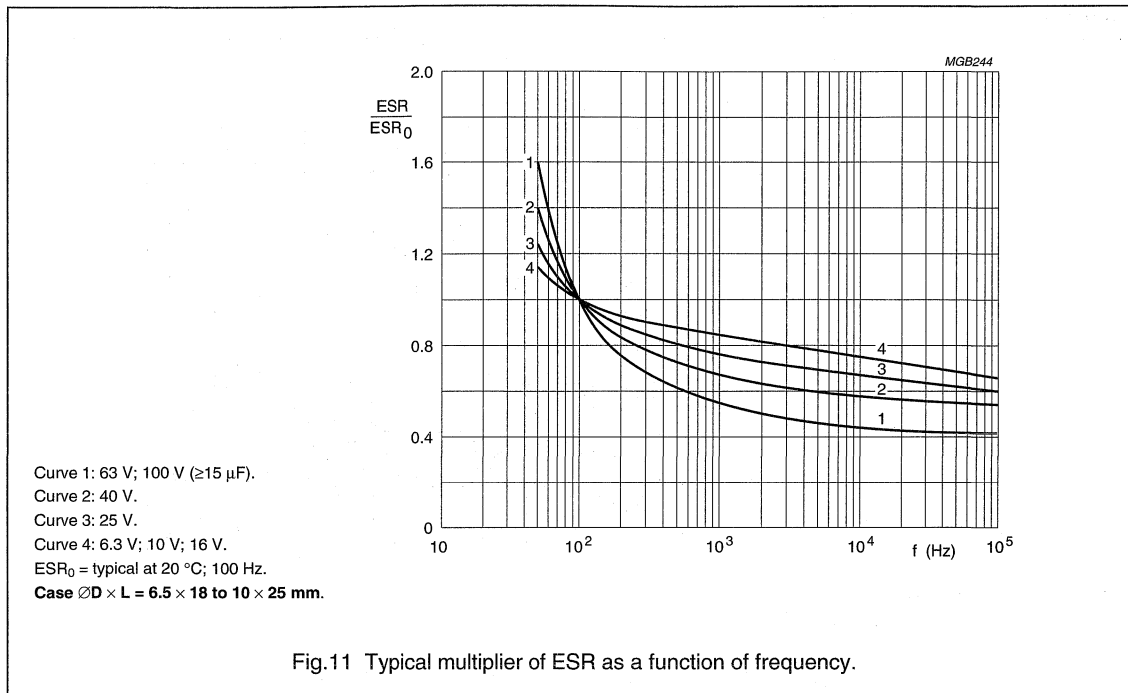


Fig.11 Typical multiplier of ESR as a function of frequency.

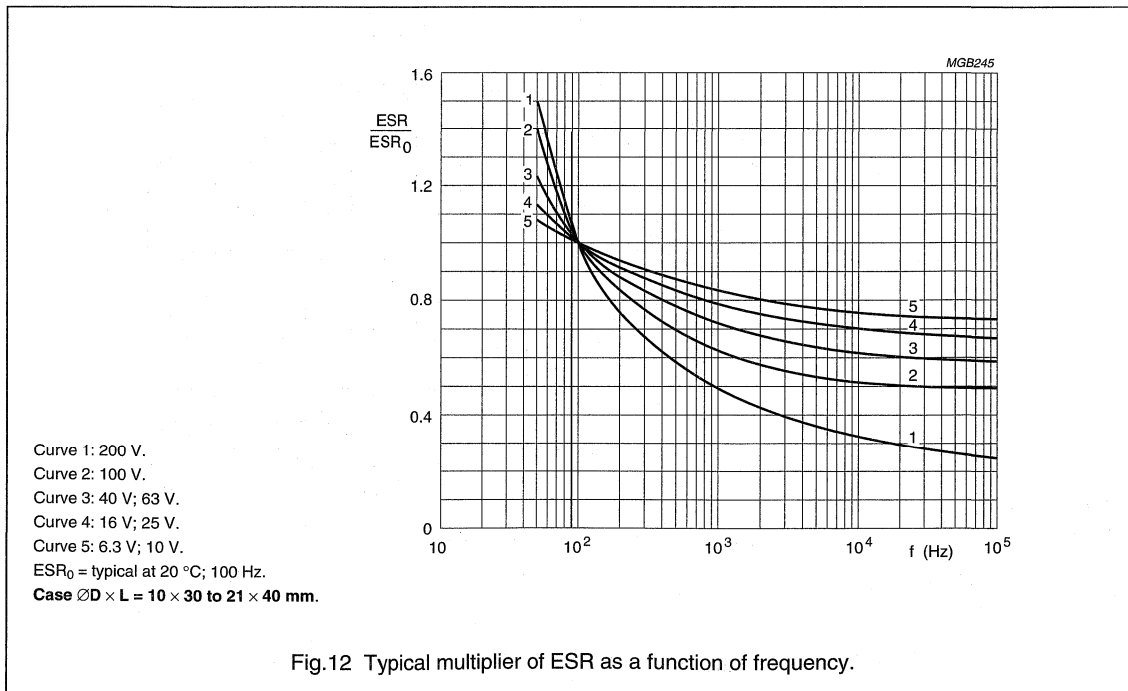


Fig.12 Typical multiplier of ESR as a function of frequency.

Aluminum electrolytic capacitors Axial High Temperature

118 AHT

Impedance (Z)

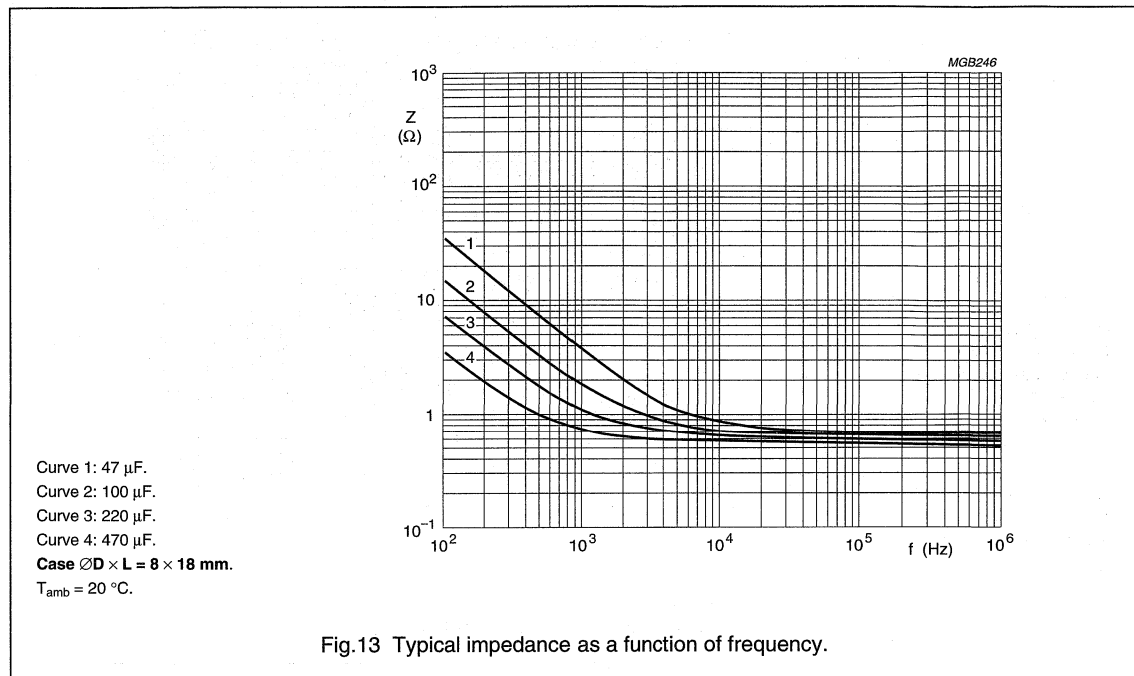


Fig.13 Typical impedance as a function of frequency.

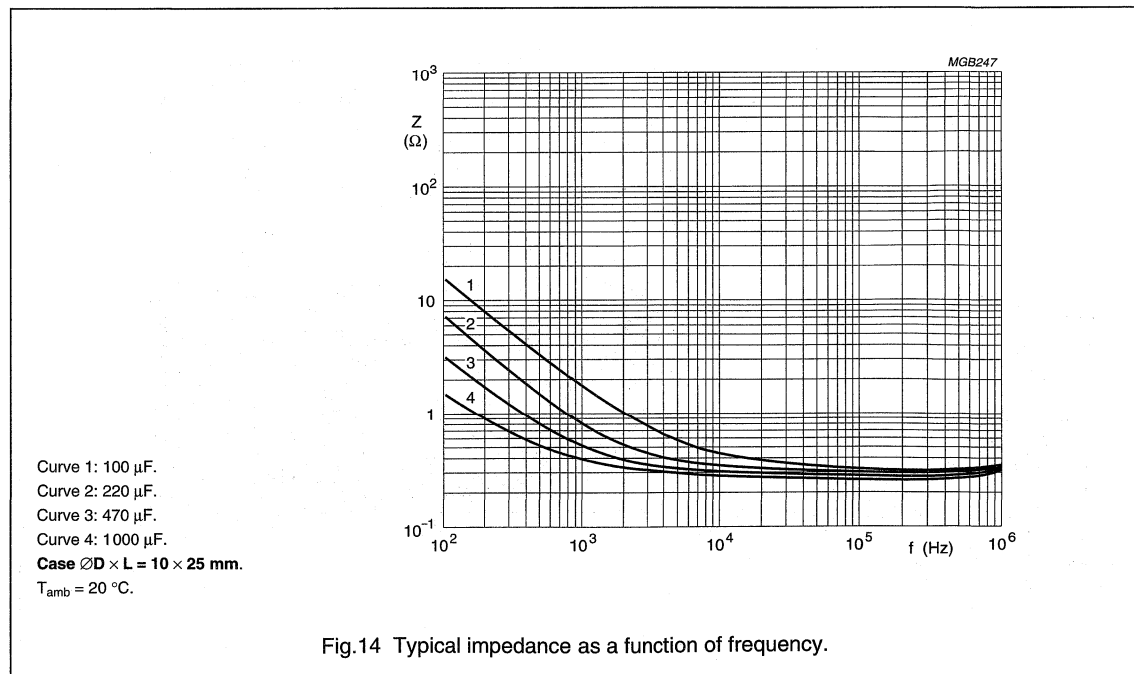


Fig.14 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

Curve 1: 22 μ F, 200 V.
 Curve 2: 68 μ F, 100 V.
 Curve 3: 150 μ F, 63 V.
 Curve 4: 220 μ F, 63 V.
 Curve 5: 330 μ F, 40 V.
 Curve 6: 470 μ F, 40 V.
 Curve 7: 680 μ F, 25 V.
 Curve 8: 1000 μ F, 25 V and 1000 μ F, 16 V.
 Curve 9: 1500 μ F, 16 V and 1500 μ F, 10 V.
 Curve 10: 2200 μ F, 10 V and 2200 μ F, 6.3 V.
 Curve 11: 3300 μ F, 6.3 V.
Case $\varnothing D \times L = 12.5 \times 30$ mm.
 $T_{amb} = -40$ °C.

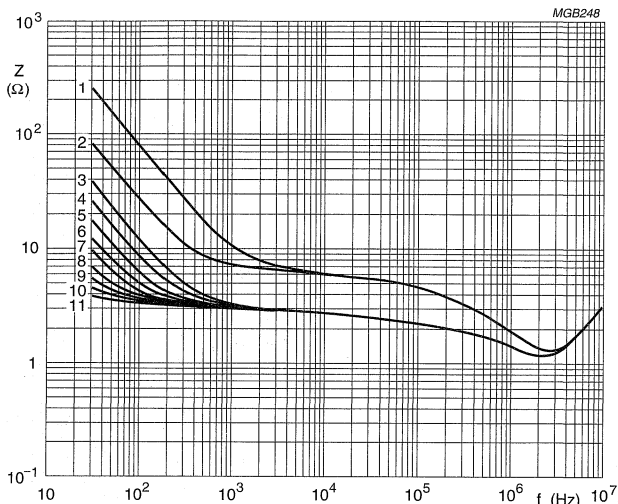


Fig.15 Typical impedance as a function of frequency.

Curve 1: 22 μ F, 200 V.
 Curve 2: 68 μ F, 100 V.
 Curve 3: 150 μ F, 63 V.
 Curve 4: 220 μ F, 63 V.
 Curve 5: 330 μ F, 40 V.
 Curve 6: 470 μ F, 40 V.
 Curve 7: 680 μ F, 25 V.
 Curve 8: 1000 μ F, 25 V and 1000 μ F, 16 V.
 Curve 9: 1500 μ F, 16 V and 1500 μ F, 10 V.
 Curve 10: 2200 μ F, 10 V and 2200 μ F, 6.3 V.
 Curve 11: 3300 μ F, 6.3 V.
Case $\varnothing D \times L = 12.5 \times 30$ mm.
 $T_{amb} = 20$ °C.

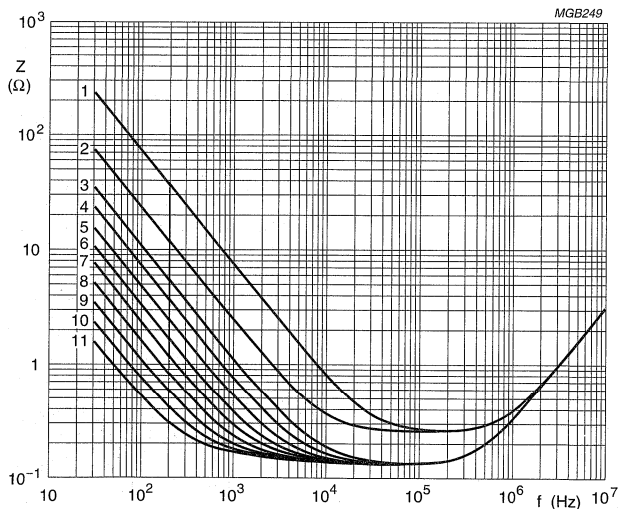


Fig.16 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors
Axial High Temperature

118 AHT

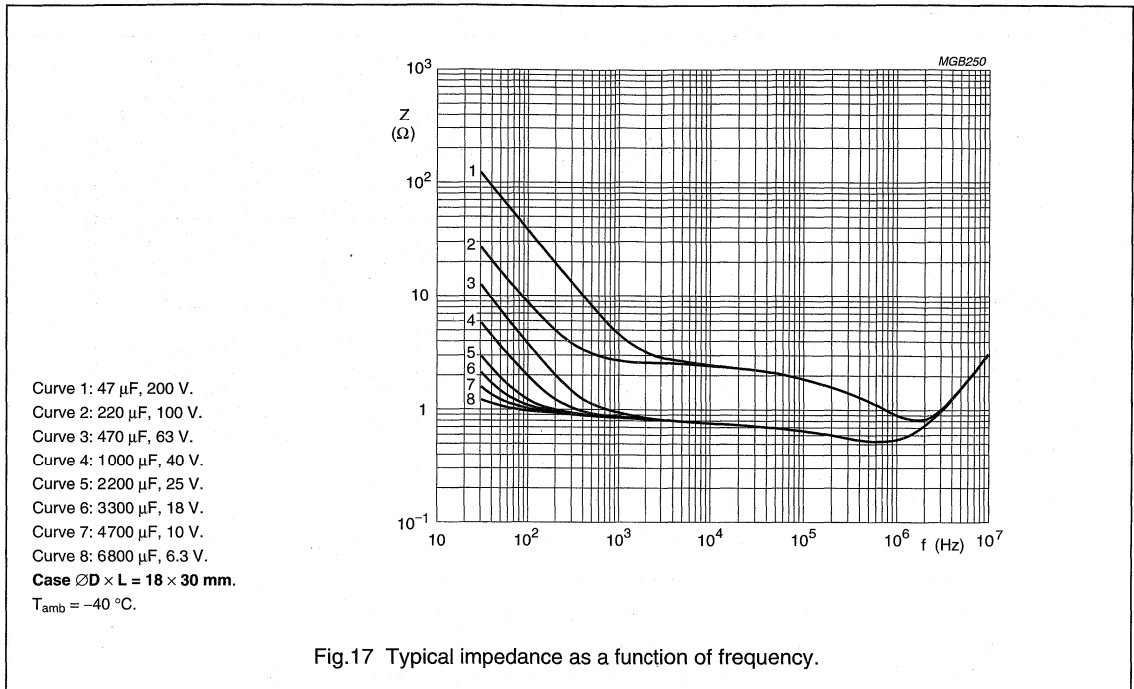


Fig.17 Typical impedance as a function of frequency.

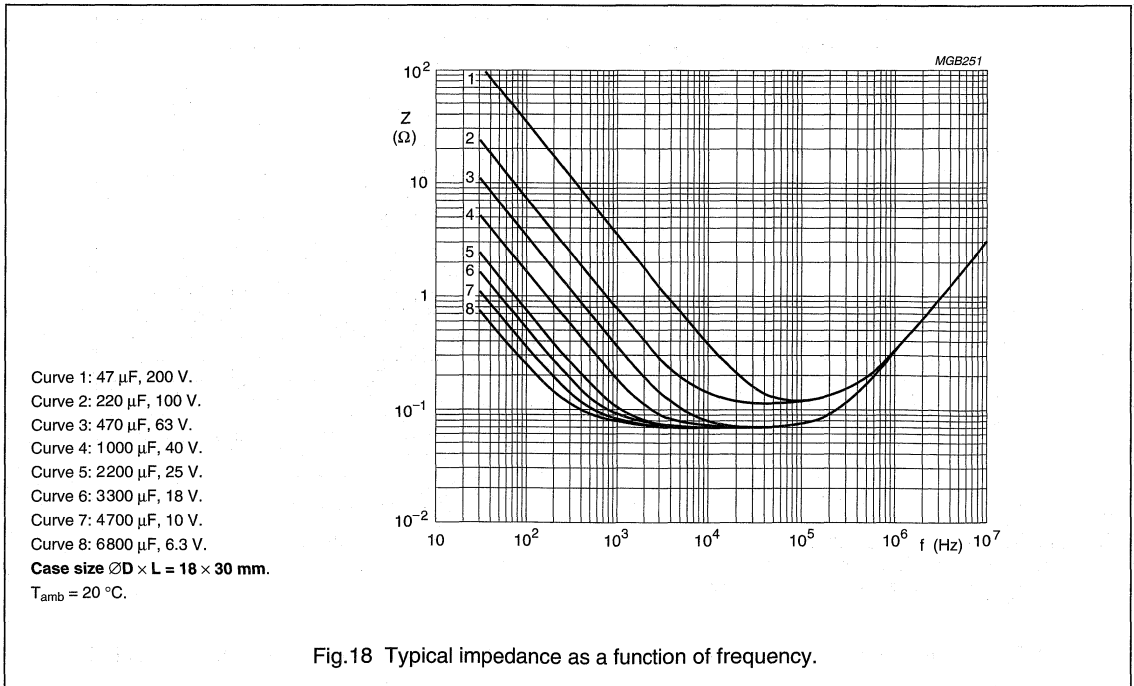


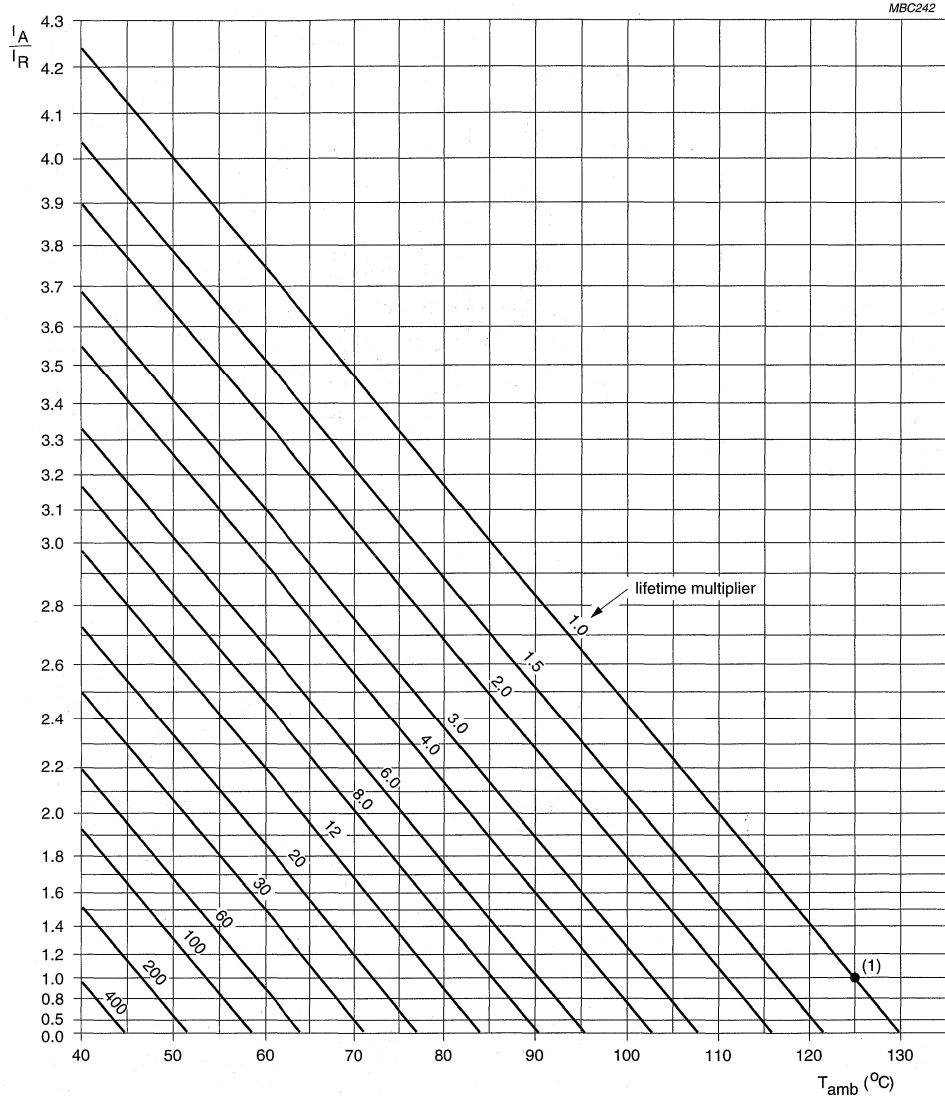
Fig.18 Typical impedance as a function of frequency.



Aluminum electrolytic capacitors Axial High Temperature

118 AHT

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 $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: 4000 hours

case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 8000 hours.

Fig.19 Multiplier of useful life as a function of ambient temperature and ripple current load; see Table 5.

Aluminum electrolytic capacitors

Axial High Temperature

118 AHT

Table 5 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 6.3$ to 25 V	$U_R = 40$ to 63 V	$U_R = 100$ to 200 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

SPECIFIC TESTS AND REQUIREMENTS

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

Table 6 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125$ °C; U_R applied; case sizes: 6.5×18 to 10×25 mm: 2000 hours; 10×30 to 21×40 mm: 3000 hours	$U_R \leq 6.3$ V; $\Delta C/C$: +15/-30% $U_R > 6.3$ V; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times$ spec. limit $Z \leq 2 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 125$ °C; U_R and I_R applied; case $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: 4000 hours; case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 8000 hours	$U_R \leq 6.3$ V; $\Delta C/C$: +45/-50% $U_R > 6.3$ V; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit no short or open circuit total failure percentage: $\leq 1\%$ (200 V $\leq 3\%$)
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125$ °C; no voltage applied; $U_R = 6.3$ to 63 V: 500 hours; $U_R = 100$ and 200 V: 100 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 $I_{L5} \leq 2 \times$ 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	$\Delta C/C$: $\pm 20\%$ $\tan \delta \leq$ spec. limit $I_{L5} \leq$ spec. limit

A

Aluminum electrolytic capacitors Axial High Temperature, DIN-based

119 AHT-DIN

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminium case, insulated with a blue sleeve
- Mounting ring version (single ended) not insulated
- Taped versions up to case $\varnothing 15 \times 30$ mm available for automatic insertion
- Charge and discharge proof
- Extra long useful life: up to 8000 hours at 125 °C, high stability, high reliability
- Extended temperature range: 125 °C (usable up to 150 °C)
- High ripple current capability.

APPLICATIONS

- Military, industrial control, EDP and telecommunication
- Smoothing, filtering, buffering in SMPS; coupling, decoupling
- For use where low mounting height is important; vibration and shock resistant.

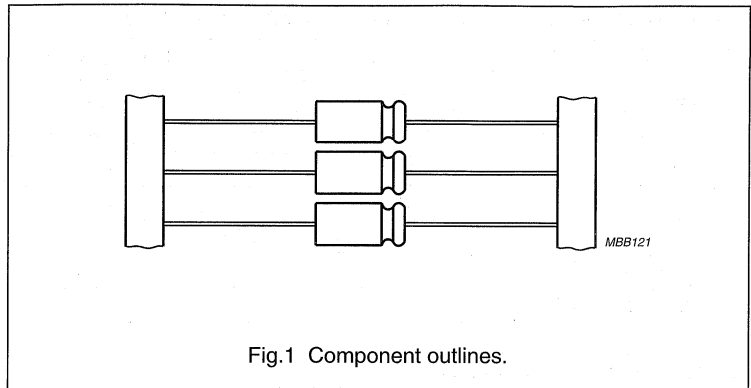
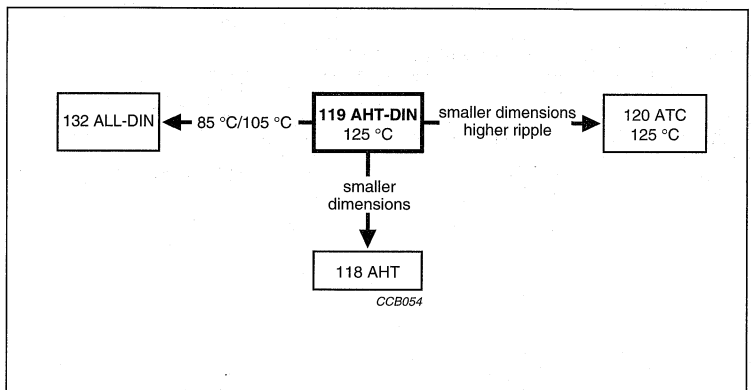


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	6.5 × 18 to 10 × 25	10 × 30 to 21 × 40
Rated capacitance range, C_R	4.7 to 4700 μ F	
Tolerance on C_R	-10/+50%	
Rated voltage range, U_R	10 to 200 V	
Category temperature range	-55 to +125 °C	
Endurance test at 150 °C	500 hours	500 hours
Endurance test at 125 °C	2000 hours	4000 hours
Useful life at 125 °C	4000 hours	8000 hours
Useful life at 40 °C, 1.8 I_R applied	500000 hours	1000000 hours
Shelf life at 0 V, 125 °C:		
$U_R = 10$ 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	55/125/56	

Aluminum electrolytic capacitors

Axial High Temperature, DIN-based

119 AHT-DIN

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)						
	10	16	25	40	63	100	200
4.7	–	–	–	–	–	6.5 × 18	10 × 18
10	–	–	–	–	6.5 × 18	8 × 18	10 × 25
22	–	–	6.5 × 18	–	8 × 18	10 × 18	–
47	–	6.5 × 18	–	8 × 18	10 × 18	10 × 25	–
	–	–	–	–	–	10 × 30	–
68	–	–	–	–	10 × 30	12.5 × 30	–
100	6.5 × 18	8 × 18	10 × 18	10 × 25	10 × 30	15 × 30	–
150	–	–	–	12.5 × 30	15 × 30	15 × 30	–
220	10 × 18	10 × 25	10 × 25	12.5 × 30	15 × 30	18 × 30	–
	–	–	12.5 × 30	–	–	–	–
330	–	12.5 × 30	12.5 × 30	15 × 30	18 × 30	18 × 40	–
470	10 × 25	12.5 × 30	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	–	–	–	–	–

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"
- Rated voltage (in V) at 125 °C and 85 °C
- Group number (119)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to indicate the negative terminal
- '+' sign to identify the positive terminal.

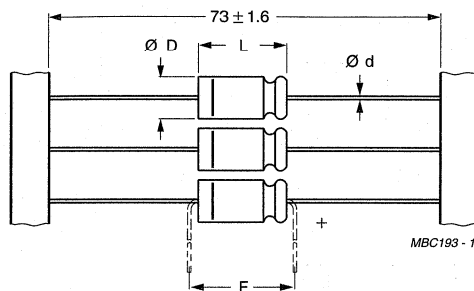
A

Aluminum electrolytic capacitors

Axial High Temperature, DIN-based

119 AHT-DIN

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.

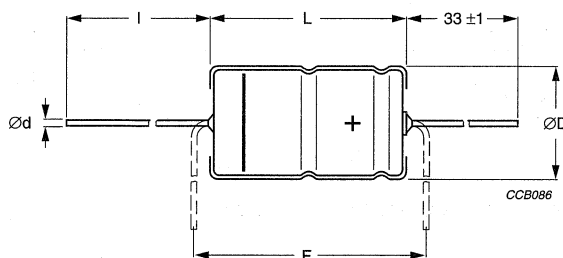
Form BR: Taped on reel,
case $\varnothing D \times L = 6.5 \times 18$ to 15×30 mm.

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

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 $\varnothing D \times L = 10 \times 30$ to 21×40 mm.

For case sizes 18×30 and 21×40 mm, the stated L_{max} may be exceeded by 0.7 mm.

For dimensions see Table 1.

Fig.3 Dimensional outline; Form AA.

Aluminum electrolytic capacitors

Axial High Temperature, DIN-based

119 AHT-DIN

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

NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	AXIAL FORM AA, BA, and BR					MASS (g)	PACKAGING QUANTITIES		
		Ød	l (mm)	ØD _{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	–	–

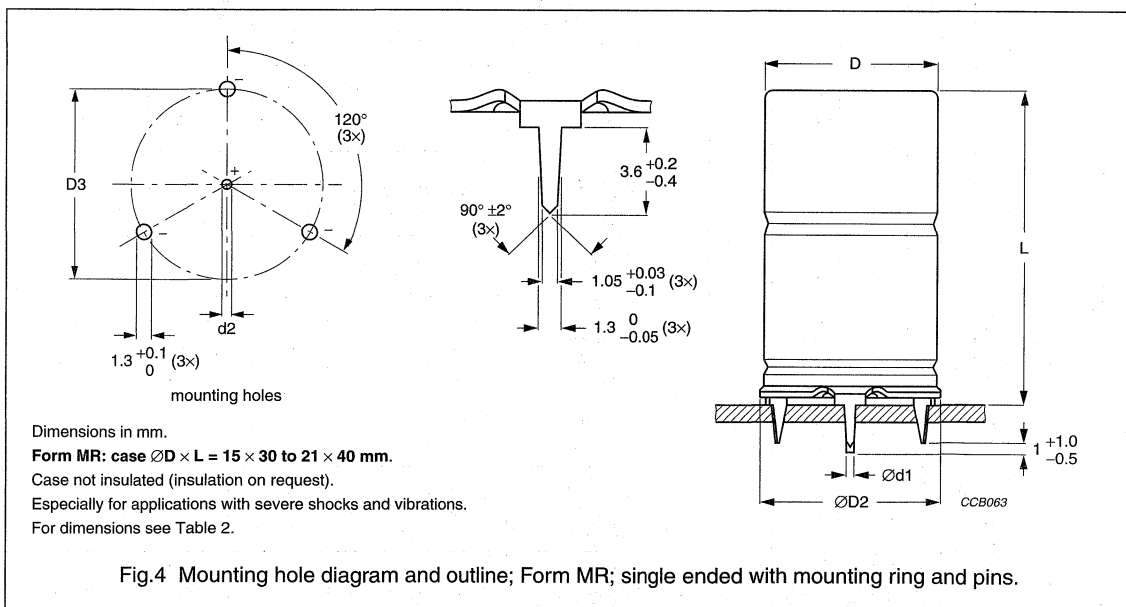


Table 2 Single ended; mass and packaging quantities; see Fig. 4

NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	SINGLE ENDED WITH MOUNTING RING: FORM MR						MASS (g)	PACKAGING QUANTITIES
		Ød1 (mm)	Ød2 (mm)	ØD _{max} (mm)	ØD2 _{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	≈8.6	200
18 × 30	03	0.8	1.0 +0.4	18.5	19.5	18.5 ±0.2	33	≈11.5	200
18 × 40	04	0.8	1.0 +0.4	18.5	19.5	18.5 ±0.2	45	≈14.5	100
21 × 40	05	0.8	1.0 +0.4	21.5	22.5	21.5 ±0.2	45	≈19.7	100

Aluminum electrolytic capacitors
Axial High Temperature, DIN-based

119 AHT-DIN

Ordering example

Electrolytic capacitor 119 series
470 $\mu\text{F}/16\text{ V}$; $-10/+50\%$
Nominal case size: $\varnothing 12.5 \times 30\text{ mm}$; Form BR
Catalogue number: 2222 119 25471.

ELECTRICAL DATA AND ORDERING INFORMATION

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

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance $-10/+50\%$
I_R	rated RMS ripple current at 100 Hz, 125 $^\circ\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\text{Tan } \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\text{tan } \delta_{\text{max}}$ and C_R)
Z	max. impedance at 10 kHz

Table 3 Electrical data and ordering information; preferred types in bold

U_R 100 Hz (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 125 $^\circ\text{C}$ (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\text{Tan } \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	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	100	6.5 x 18	4	130	10	6	0.2	3.5	2.2	-	119 24101	119 34101	-
	220	10 x 18	6	240	17	8.4	0.18	1.3	1.0	-	119 24221	119 34221	-
	470	10 x 25	7	380	32	13	0.18	0.61	0.49	-	119 90501	119 90502	-
	470	12.5 x 30	01	550	32	13	0.16	0.54	0.38	119 14471	119 24471	-	-
	680	12.5 x 30	01	640	45	18	0.20	0.47	0.38	119 14681	119 24681	-	-
	1000	15 x 30	02	830	64	24	0.20	0.32	0.24	119 14102	119 24102	-	119 44102
	1500	18 x 30	03	1100	94	34	0.22	0.23	0.17	119 14152	-	-	119 44152
	2200	18 x 30	03	1190	136	48	0.26	0.19	0.17	119 14222	-	-	119 44222
	3300	18 x 40	04	1550	202	70	0.27	0.13	0.10	119 14332	-	-	119 44332
	4700	21 x 40	05	1700	286	90	0.30	0.10	0.09	119 14472	-	-	119 44472
16	47	6.5 x 18	4	110	10	5.5	0.13	4.4	2.2	-	119 25479	119 35479	-
	100	8 x 18	5	170	14	7.2	0.13	2.1	1.3	-	119 25101	119 35101	-
	220	10 x 25	7	300	25	11	0.13	0.94	0.55	-	119 25221	119 35221	-
	330	12.5 x 30	01	560	36	15	0.13	0.63	0.38	119 15331	119 25331	-	-
	470	12.5 x 30	01	570	50	19	0.15	0.51	0.38	119 15471	119 25471	-	-

Aluminum electrolytic capacitors
Axial High Temperature, DIN-based

119 AHT-DIN

CATALOGUE NUMBER 2222				Z 10 kHz (Ω)	ESR 100 Hz (Ω)	Tan δ 100 Hz	I _{L5} 5 min (μ A)	I _{L1} 1 min (μ A)	I _R 100 Hz 125 °C (mA)	CASE CODE	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	C _R 100 Hz (μ F)	U _R (V)	AXIAL			SINGLE ENDED					
IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR																			
16	680	15 × 30	02	750	69	26	0.15	0.35	0.24	0.24	0.35	0.15	0.24	0.24	0.17	0.10	0.09	0.09	119 15681	119 25681	119 36229	119 45681
	1000	15 × 30	02	850	100	36	0.19	0.30	0.24	0.30	0.19	0.10	0.24	0.30	0.21	0.10	0.09	0.09	119 15102	119 25102	119 36101	119 45102
	1500	18 × 30	03	1120	148	52	0.20	0.21	0.17	0.21	0.20	0.10	0.17	0.21	0.14	0.10	0.09	0.09	119 15152	-	-	119 45152
	2200	18 × 40	04	1440	215	74	0.20	0.14	0.38	0.14	0.20	0.13	0.10	0.14	0.11	0.10	0.09	0.09	119 15222	-	-	119 45222
	3300	21 × 40	05	1650	321	110	0.22	0.11	0.38	0.11	0.22	0.13	0.10	0.11	0.14	0.10	0.09	0.09	119 15332	-	-	119 45332
	4700	21 × 40	05	1710	455	154	0.28	0.09	0.38	0.09	0.28	0.13	0.10	0.11	0.14	0.10	0.09	0.09	119 15472	-	-	119 45472
25	22	6.5 × 18	4	85	10	5.1	0.10	7.2	3.2	7.2	0.10	0.10	3.2	7.2	0.58	0.09	0.09	0.09	-	119 26229	119 36229	-
	100	10 × 18	6	210	19	9	0.10	1.6	1.0	1.6	0.10	0.10	1.0	1.6	0.72	0.10	0.09	0.09	-	119 26101	119 36101	-
	220	10 × 25	7	350	37	15	0.10	0.72	0.58	0.72	0.10	0.10	0.58	0.72	0.65	0.10	0.09	0.09	-	119 90503	119 90504	-
	220	12.5 × 30	01	500	37	15	0.09	0.65	0.38	0.65	0.09	0.09	0.38	0.65	0.53	0.09	0.09	0.09	119 16221	119 26221	-	-
	330	12.5 × 30	01	580	54	21	0.11	0.53	0.38	0.53	0.11	0.11	0.38	0.53	0.44	0.11	0.10	0.10	119 16331	119 26331	-	-
	470	12.5 × 30	01	630	75	28	0.13	0.44	0.38	0.44	0.13	0.13	0.38	0.44	0.30	0.13	0.10	0.10	119 16471	119 26471	-	-
	680	18 × 30	03	990	106	38	0.13	0.30	0.17	0.30	0.13	0.13	0.17	0.30	0.21	0.13	0.10	0.10	119 16681	-	-	119 46681
	1000	18 × 30	03	1090	154	54	0.13	0.21	0.38	0.21	0.13	0.13	0.17	0.21	0.14	0.13	0.10	0.10	119 16102	-	-	119 46102
	1500	18 × 40	04	1420	229	79	0.13	0.14	0.38	0.14	0.13	0.13	0.10	0.14	0.14	0.10	0.09	0.09	119 16152	-	-	119 46152
	2200	21 × 40	05	1550	334	114	0.13	0.11	0.38	0.11	0.13	0.13	0.09	0.11	0.14	0.10	0.09	0.09	119 16222	-	-	119 46222
40	47	8 × 18	5	150	15	7.8	0.08	2.7	1.5	2.7	0.08	0.08	1.5	2.7	0.85	0.08	0.08	0.08	-	119 27479	119 37479	-
	100	10 × 25	7	260	28	12	0.08	1.3	0.7	1.3	0.08	0.08	0.7	1.3	0.85	0.08	0.08	0.08	-	119 27101	119 37101	-
	150	12.5 × 30	01	440	40	16	0.08	0.85	0.51	0.85	0.08	0.08	0.51	0.85	0.65	0.08	0.08	0.08	119 17151	119 27151	-	-
	220	12.5 × 30	01	500	57	22	0.09	0.65	0.48	0.65	0.09	0.09	0.48	0.65	0.43	0.09	0.08	0.08	119 17221	119 27221	-	-
	330	15 × 30	02	630	83	30	0.09	0.43	0.37	0.43	0.09	0.09	0.37	0.43	0.41	0.09	0.08	0.08	119 17331	119 27331	-	119 47331
	470	15 × 30	02	720	117	42	0.12	0.41	0.37	0.41	0.12	0.12	0.37	0.41	0.28	0.12	0.10	0.10	119 17471	119 27471	-	119 47471
	680	18 × 30	03	970	167	58	0.12	0.28	0.22	0.28	0.12	0.12	0.22	0.28	0.19	0.12	0.10	0.10	119 17681	-	-	119 47681
	1000	18 × 40	04	1250	244	84	0.12	0.19	0.14	0.19	0.12	0.12	0.14	0.19	0.15	0.12	0.10	0.10	119 17102	-	-	119 47102
	1500	21 × 40	05	1410	364	124	0.14	0.15	0.12	0.15	0.14	0.14	0.12	0.15	0.15	0.12	0.10	0.10	119 17152	-	-	119 47152
	2200	21 × 40	05	1550	532	180	0.18	0.13	0.11	0.13	0.18	0.18	0.11	0.13	0.13	0.11	0.10	0.10	119 17222	-	-	119 47222

Aluminum electrolytic capacitors
Axial High Temperature, DIN-based

119 AHT-DIN

CATALOGUE NUMBER 2222															
UR (V)	CR 100 Hz (µF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	IR 100 Hz 125 °C (mA)	IL1 1 min (µA)	IL5 5 min (µA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	AXIAL			SINGLE ENDED		
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA		MOUNTING RING FORM MR	
63	10	6.5 × 18	4	68	20	5.3	0.07	11	5.6	-	119 28109	119 38109	-	-	
	22	8 × 18	5	110	20	6.7	0.07	5.1	2.8	-	119 28229	119 38229	-	-	
	47	10 × 18	6	180	22	9.9	0.07	2.4	1.3	-	119 28479	119 38479	-	-	
	68	10 × 25	7	230	30	13	0.07	1.6	1.0	-	119 90505	119 90506	-	-	
	68	10 × 30	00	300	30	13	0.07	1.6	0.92	119 18689	119 28689	-	-	-	
	100	10 × 30	00	360	42	17	0.08	1.3	0.75	119 18101	119 28101	-	-	-	
	150	15 × 30	02	560	61	23	0.08	0.85	0.37	119 18151	119 28151	-	-	119 48151	
	220	15 × 30	02	640	87	32	0.08	0.58	0.37	119 18221	119 28221	-	-	119 48221	
	330	18 × 30	03	880	129	46	0.09	0.43	0.23	119 18331	-	-	-	119 48331	
	470	18 × 40	04	1130	182	63	0.09	0.30	0.15	119 18471	-	-	-	119 48471	
	680	21 × 40	05	1290	261	90	0.09	0.21	0.12	119 18681	-	-	-	119 48681	
	1000	21 × 40	05	1430	382	130	0.10	0.16	0.11	119 18102	-	-	-	119 48102	
	100	4.7	6.5 × 18	4	44	20	10	0.08	27	10	-	119 29478	119 39478	-	-
		10	8 × 18	5	70	20	10	0.08	13	6.0	-	119 29109	119 39109	-	-
		22	10 × 18	6	112	20	10	0.08	5.8	3.5	-	119 29229	119 39229	-	-
47		10 × 25	7	178	32	13	0.08	2.7	2.0	-	119 90518	119 90519	-	-	
47		10 × 30	00	240	32	13	0.08	2.7	2.0	119 19479	119 29479	-	-	-	
68		12.5 × 30	01	330	45	18	0.08	1.9	1.2	119 19689	119 29689	-	-	-	
100		15 × 30	02	440	64	24	0.09	1.4	0.96	119 19101	119 29101	-	-	119 49101	
150		15 × 30	02	520	94	34	0.10	1.1	0.78	119 19151	119 29151	-	-	119 49151	
220		18 × 30	03	710	136	48	0.10	0.72	0.55	119 19221	-	-	-	119 49221	
330		18 × 40	04	920	202	70	0.10	0.48	0.37	119 19331	-	-	-	119 49331	
470		21 × 40	05	1070	286	98	0.10	0.34	0.28	119 19471	-	-	-	119 49471	
200		4.7	10 × 18	6	52	20	10	0.08	27	10	-	119 90507	119 90508	-	-
		10	10 × 25	7	82	20	10	0.08	13	5.0	-	119 90509	119 90511	-	-

Aluminum electrolytic capacitors

Axial High Temperature, DIN-based

119 AHT-DIN

Additional electrical data

PARAMETER	CONDITIONS	VALUE	
		AXIAL	SINGLE ENDED
Voltage			
Surge voltage		$U_s \leq 1.15 \times U_R$	
Reverse voltage		$U_{rev} \leq 1 \text{ V}$	
Current			
Leakage current	after 1 minute: $U_R = 10 \text{ to } 40 \text{ V}$	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$, or $10 \mu\text{A}$ (whichever is greater)	
	$U_R = 63 \text{ V to } 200 \text{ V}$	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$, or $20 \mu\text{A}$ (whichever is greater)	
Leakage current	after 5 minutes: $U_R = 10 \text{ to } 63 \text{ V}$	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$	
	$U_R = 100 \text{ and } 200 \text{ V}$	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$, or $10 \mu\text{A}$ (whichever is greater)	
Inductance			
Equivalent series inductance (ESL)	case $\varnothing D \times L$ 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	

Table 4 Up-rating values at reduced ambient temperature; note 1

SYMBOL	CONDITIONS	VALUES							UNIT
U_R	$T_{amb} > 85 \text{ to } 125 \text{ }^\circ\text{C}$	10	16	25	40	63	100	200	V
U_{R2}	$T_{amb} \leq 85 \text{ }^\circ\text{C}$	16	25	40	63	100	125	250	V

Note

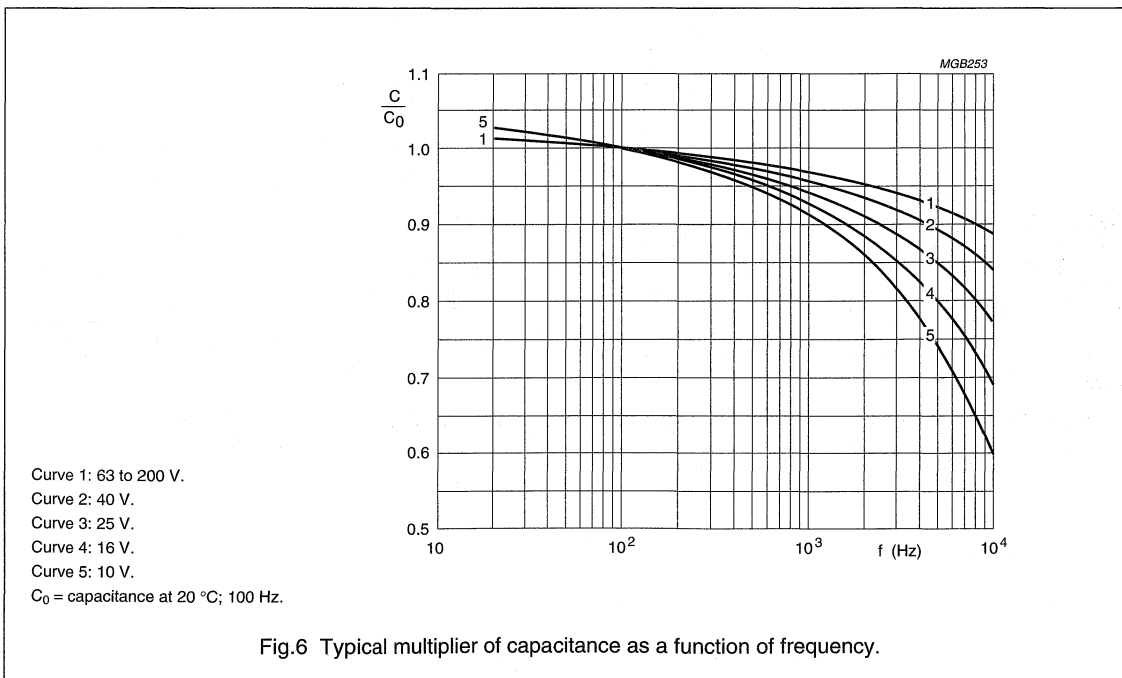
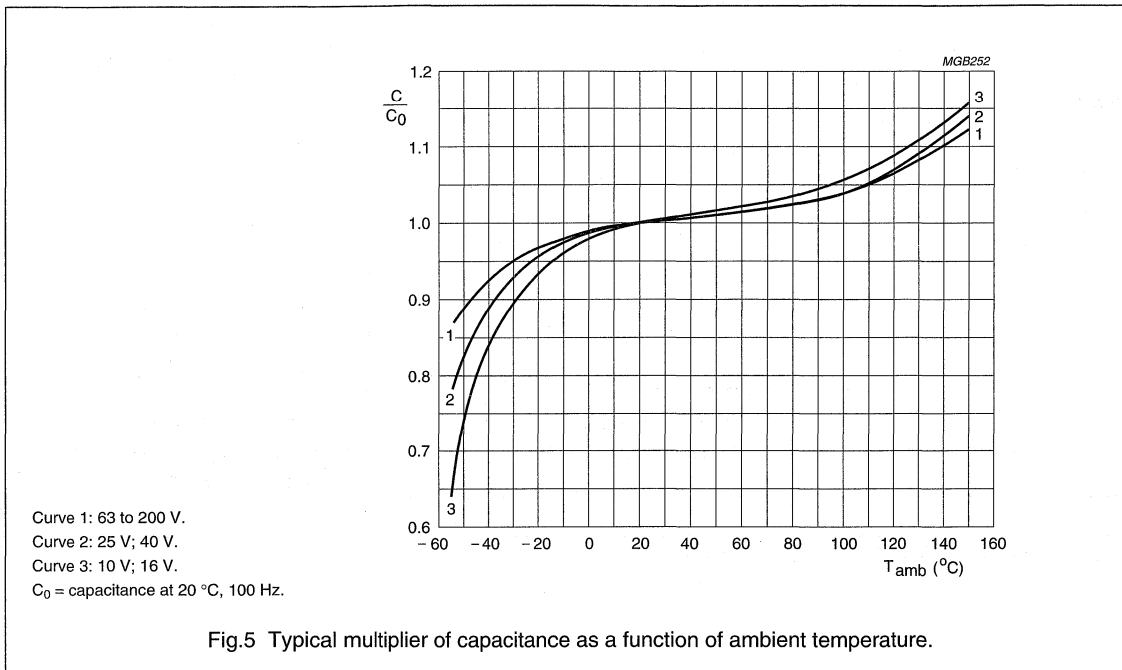
- For applications at ambient temperatures of $\leq 85 \text{ }^\circ\text{C}$, the rated voltage (U_R) may be raised to U_{R2} .

Aluminum electrolytic capacitors

Axial High Temperature, DIN-based

119 AHT-DIN

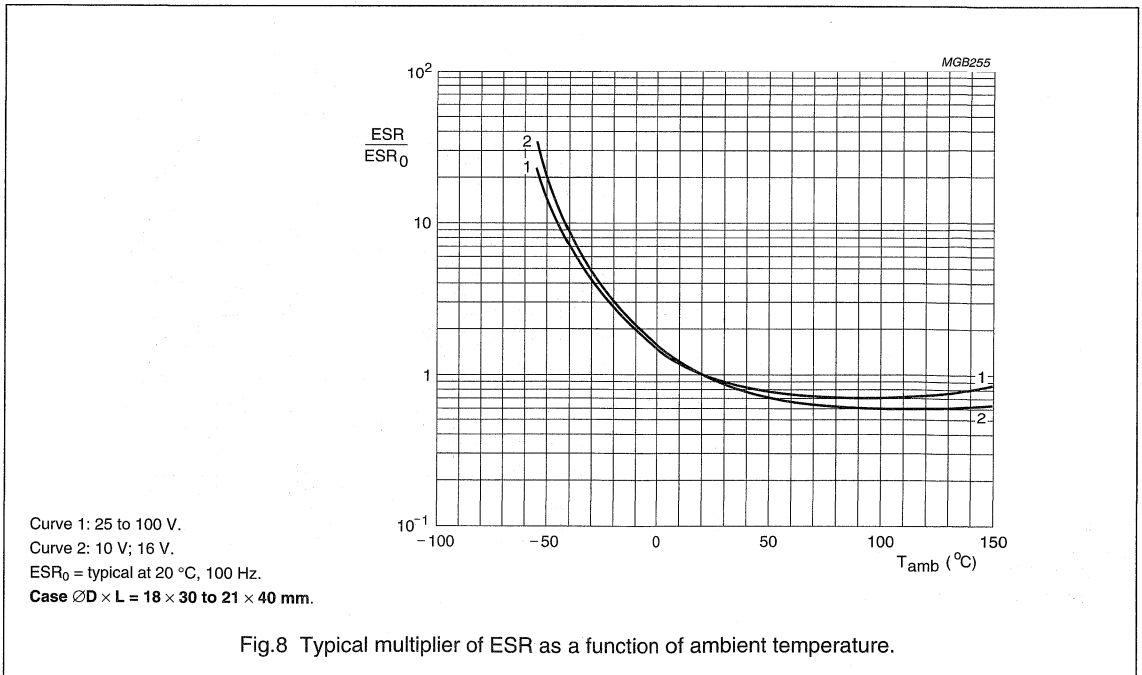
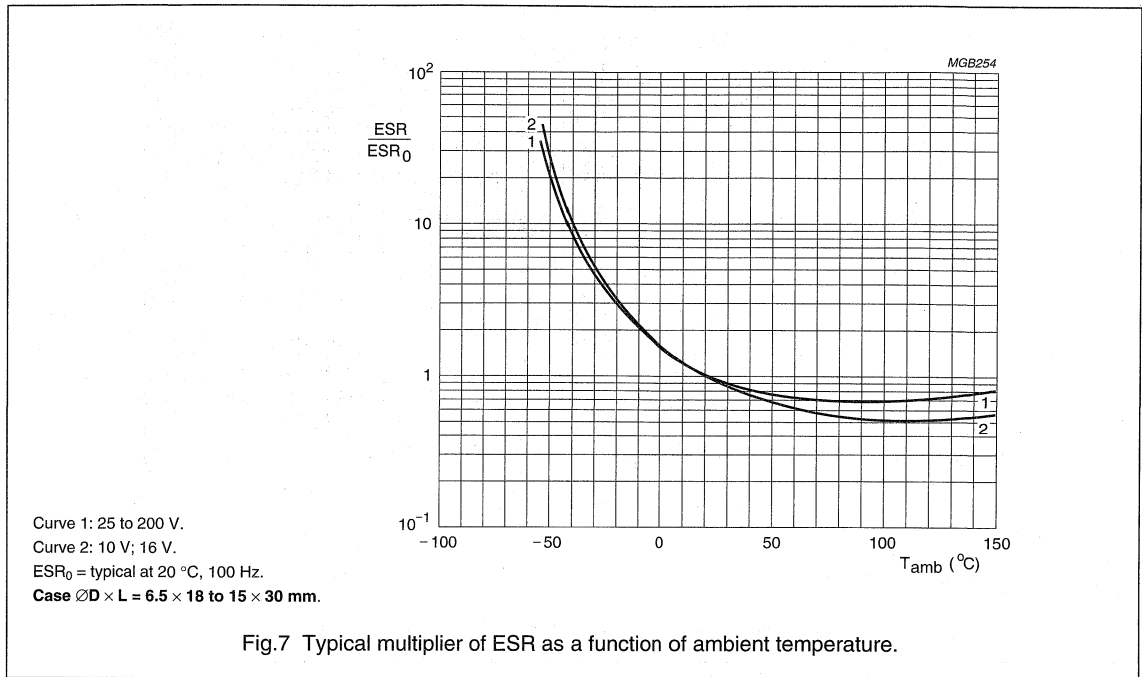
Capacitance (C)



Aluminum electrolytic capacitors Axial High Temperature, DIN-based

119 AHT-DIN

Equivalent series resistance (ESR)

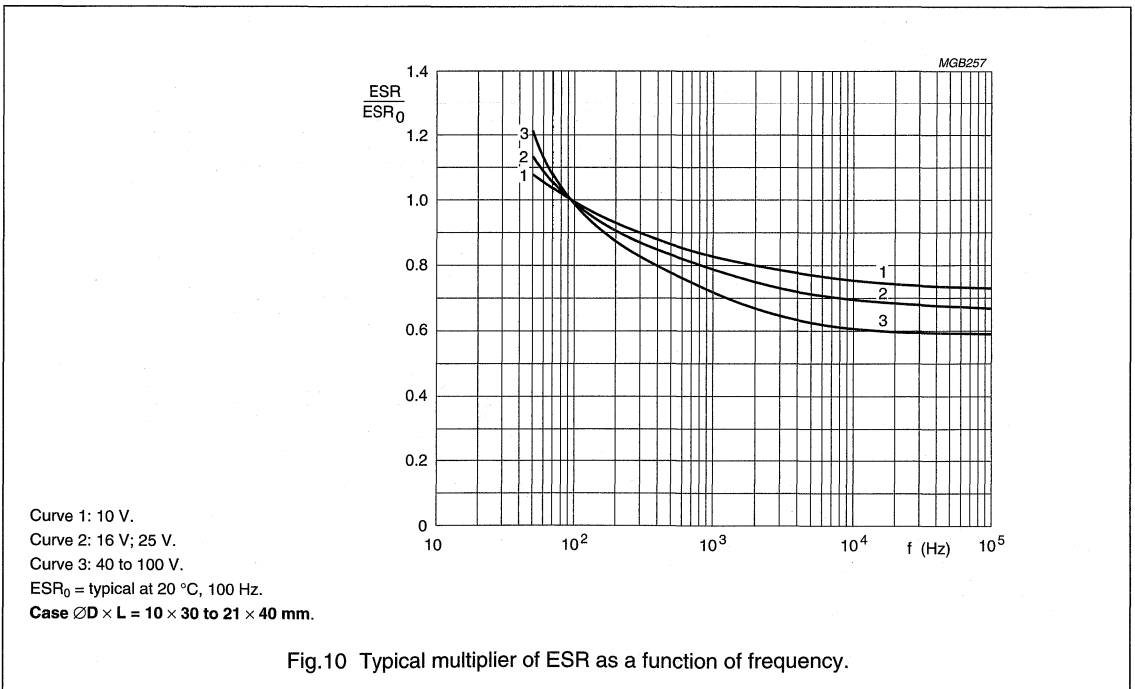
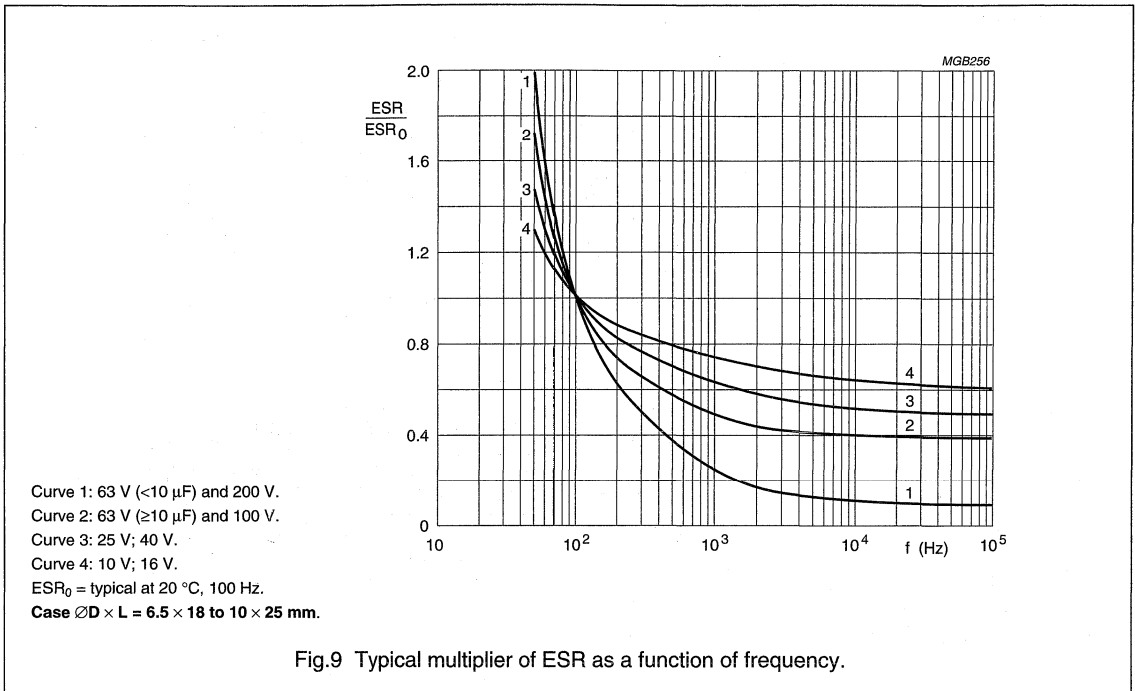


A

Aluminum electrolytic capacitors

Axial High Temperature, DIN-based

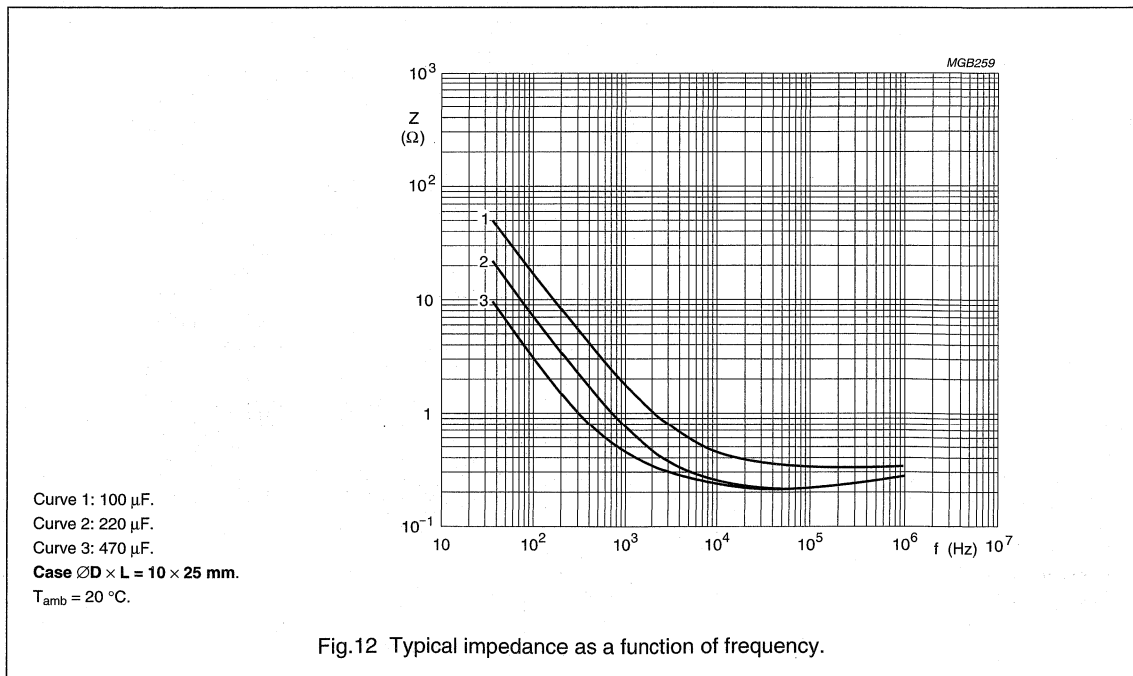
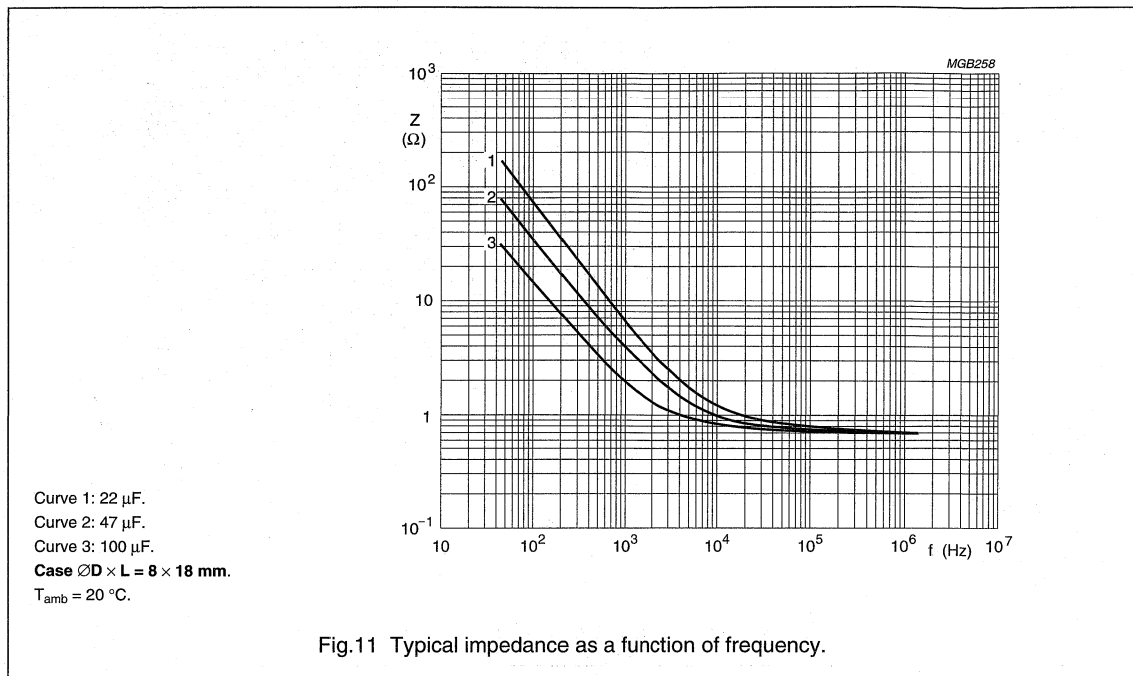
119 AHT-DIN



Aluminum electrolytic capacitors Axial High Temperature, DIN-based

119 AHT-DIN

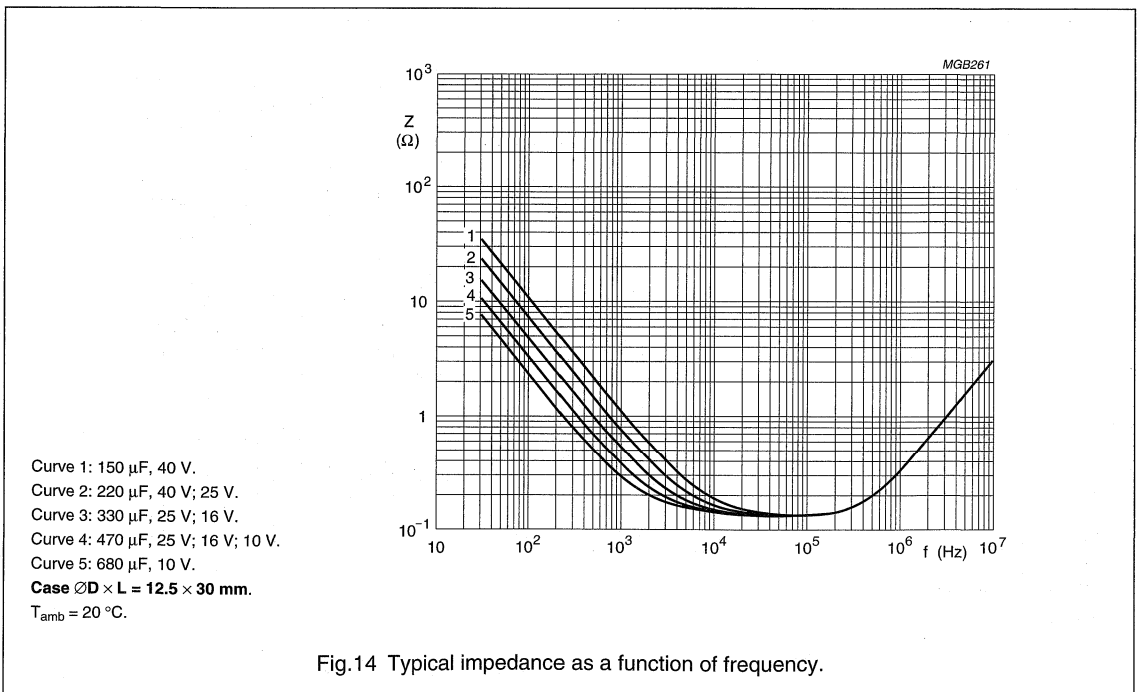
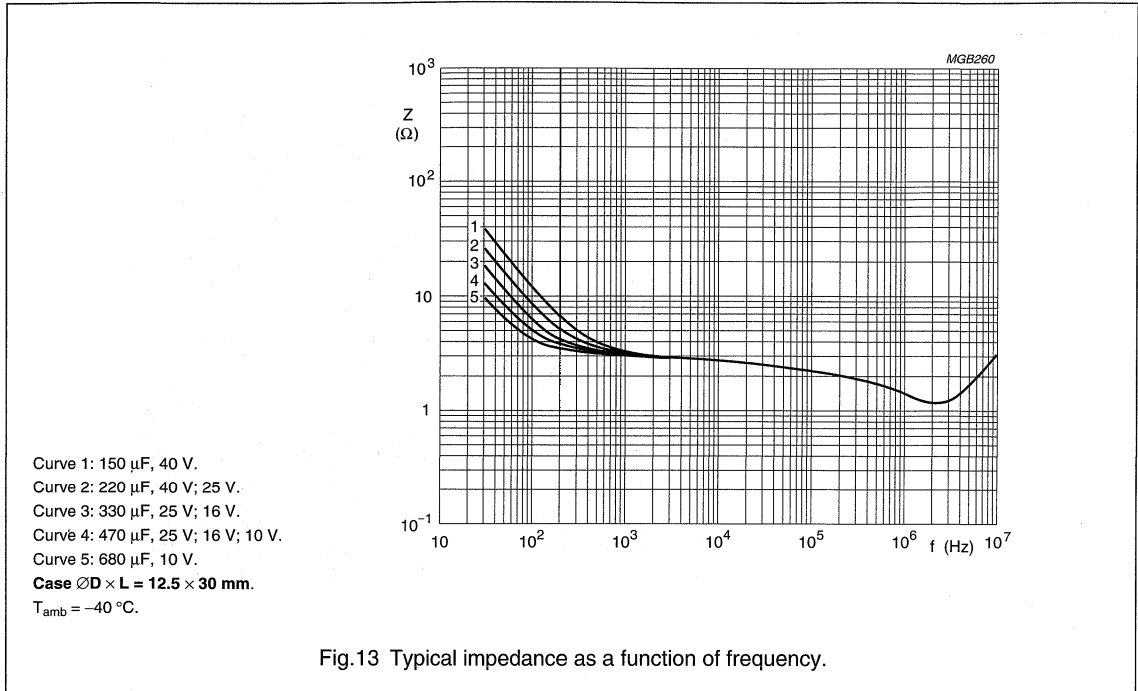
Impedance (Z)



Aluminum electrolytic capacitors

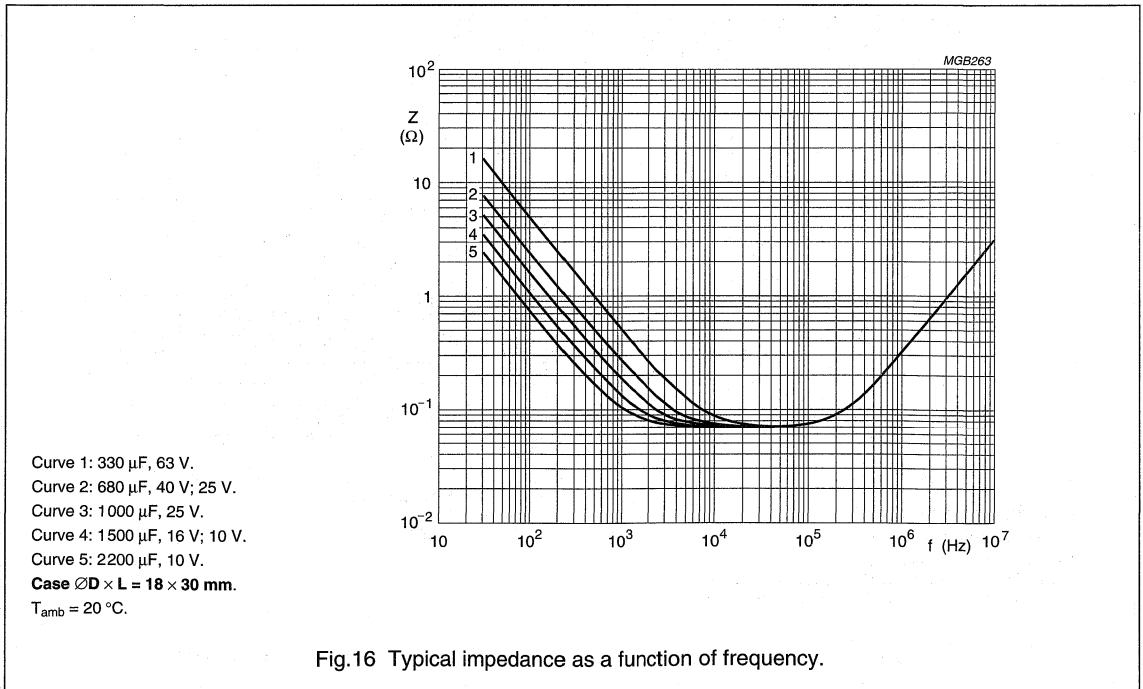
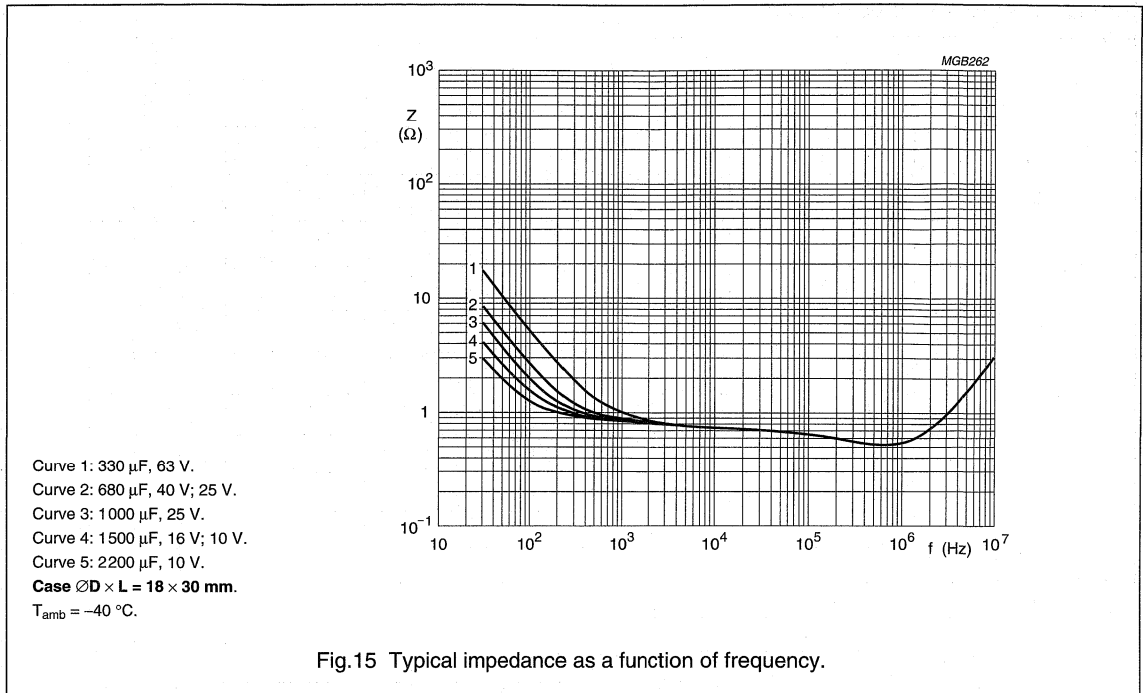
Axial High Temperature, DIN-based

119 AHT-DIN



Aluminum electrolytic capacitors
Axial High Temperature, DIN-based

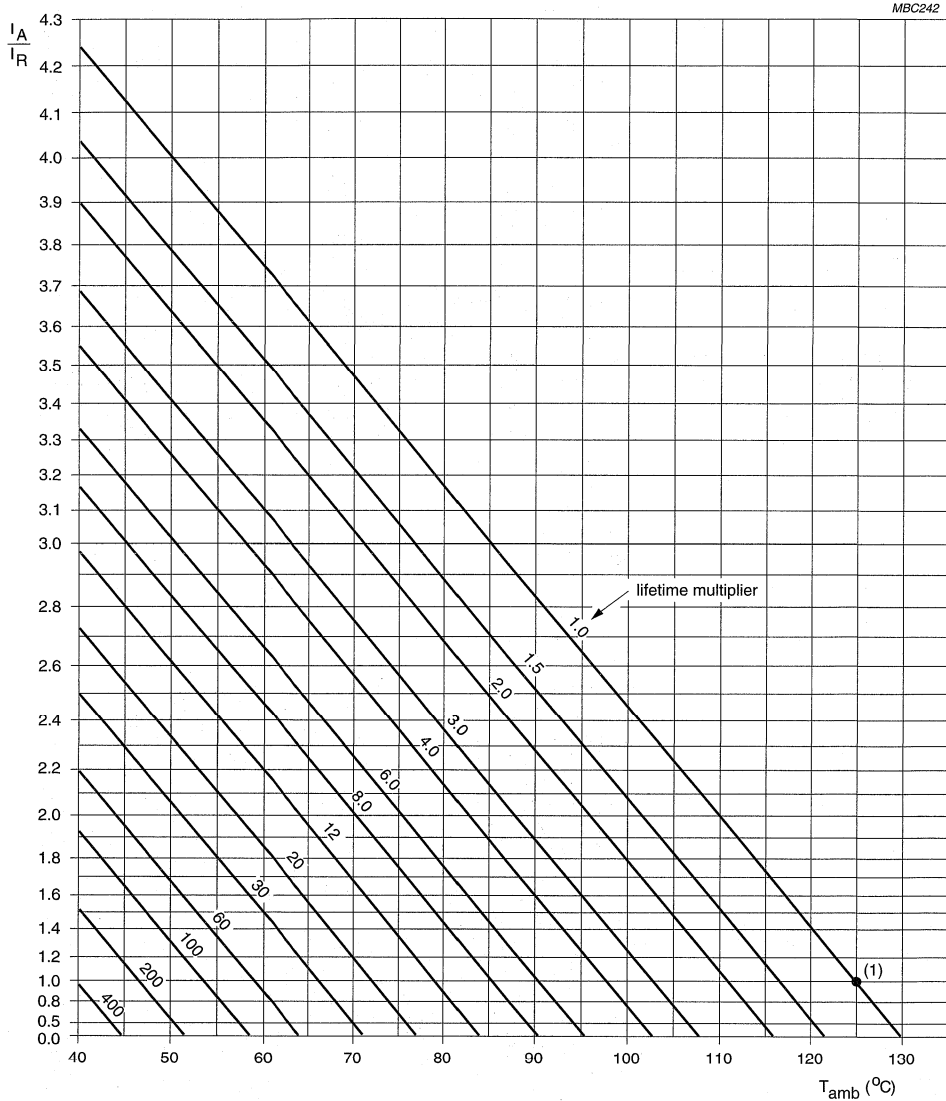
119 AHT-DIN



Aluminum electrolytic capacitors Axial High Temperature, DIN-based

119 AHT-DIN

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 $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: 4000 hours

case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 8000 hours.

Fig.17 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Axial High Temperature, DIN-based

119 AHT-DIN

Table 5 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 40 V	$U_R = 63$ to 200 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

SPECIFIC TESTS AND REQUIREMENTS

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

Table 6 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125$ °C; U_R applied; case $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: 2000 hours; case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 4000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 125$ °C; U_R and I_R applied; case $\varnothing D \times L = 6.5 \times 18$ to 10×25 mm: 4000 hours; case $\varnothing D \times L = 10 \times 30$ to 21×40 mm: 8000 hours	$\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$ (200 V $\leq 3\%$)
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125$ °C; no voltage applied; $U_R = 10$ to 63 V: 500 hours; $U_R = 100$ and 200 V: 100 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 $I_{L5} \leq 2 \times \text{spec. limit}$
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	$\Delta C/C: \pm 20\%$ $\tan \delta \leq \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$

A

Aluminum electrolytic capacitors

Axial High Temperature High Ripple Current

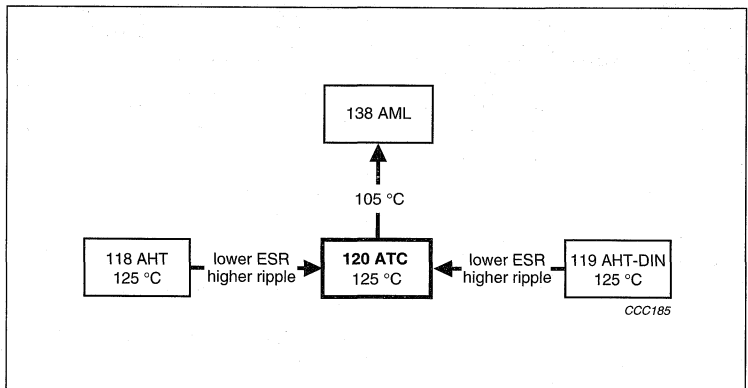
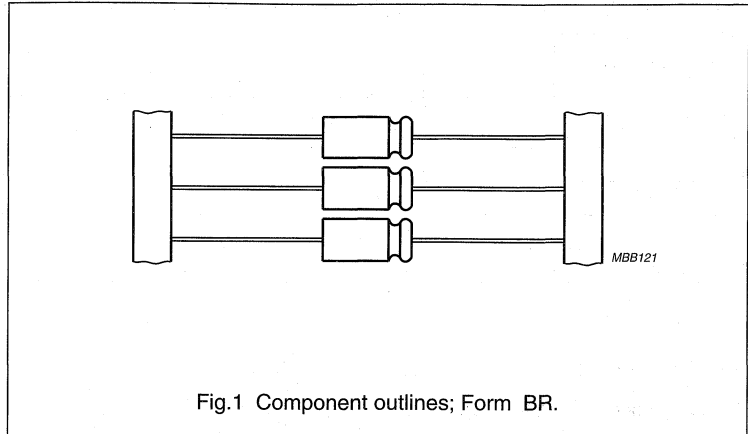
120 ATC

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminium case, insulated with a blue sleeve
- Taped versions available for automatic insertion
- Charge and discharge proof
- Extra long useful life: up to 8000 hours at 125 °C, high reliability
- Lowest ESR levels providing very high ripple current capability
- Extended temperature range: usable up to 150 °C
- Miniaturized, high CV-product per unit volume
- Lead diameter $\varnothing d = 1.0$ mm, available on request.

APPLICATIONS

- Automotive, industrial and telecommunication
- Smoothing, filtering, buffering
- Low mounting height applications, vibration and shock resistant
- SMPS and standard power supplies.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 30 to 21 × 40
Rated capacitance range, C_R	47 to 6800 μ F
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	16 to 100 V
Category temperature range	-40 to +125 °C
Endurance test at 150 °C	1000 hours (100 V: 500 hours)
Endurance test at 125 °C	4000 hours (100 V: 3000 hours)
Useful life at 125 °C	8000 hours
Useful life at 85 °C, $1.7 \times I_R$ applied	40000 hours
Shelf life at 0 V, 125 °C	1000 hours (100 V: 100 hours)
Shelf life at 0 V, 150 °C	≤ 63 V: 500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/125/56

Aluminum electrolytic capacitors

Axial High Temperature High Ripple Current

120 ATC

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm); note 1

Preferred types in **bold**.

C_R (μF)	U_R (V)				
	16	25	40	63	100
47	–	–	–	–	10 × 30
68	–	–	–	–	12.5 × 30
100	–	–	–	10 × 30	12.5 × 30
150	–	–	–	12.5 × 30	15 × 30
220	–	–	10 × 30	12.5 × 30	18 × 30
330	–	–	12.5 × 30	15 × 30	18 × 40
470	–	10 × 30	12.5 × 30	18 × 30	21 × 40
680	10 × 30	12.5 × 30	15 × 30	18 × 40	–
1000	12.5 × 30	12.5 × 30	18 × 30	21 × 40	–
1500	12.5 × 30	15 × 30	18 × 40	–	–
2200	15 × 30	18 × 30	21 × 40	–	–
3300	18 × 30	18 × 40	–	–	–
4700	18 × 40	21 × 40	–	–	–
6800	21 × 40	–	–	–	–

Note

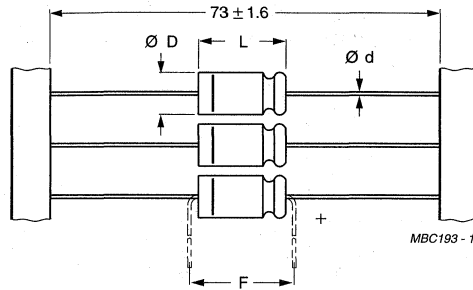
1. Smaller CV-values are available on request.

Aluminum electrolytic capacitors

Axial High Temperature High Ripple Current

120 ATC

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



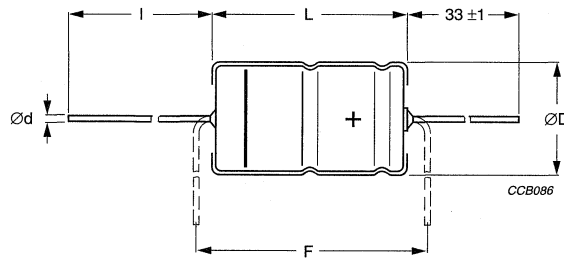
Dimensions in mm.

Form BR: Taped on reel,
case $\varnothing D \times L = 10 \times 30$ to 15×30 mm.

For dimensions see Table 1.

Tape dimensions are specified in this handbook, section "Packaging".

Fig.2 Dimensional outline; Form BR.



Dimensions in mm.

Form AA: Axial in box,
case $\varnothing D \times L = 10 \times 30$ to 21×40 mm.

For case $\varnothing D \times L = 18 \times 40$ and 21×40 mm, the stated limit may be exceeded by 0.7 mm.

For dimensions see Table 1.

Fig.3 Dimensional outline; Form AA.

Aluminum electrolytic capacitors

Axial High Temperature High Ripple Current

120 ATC

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

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	AXIAL: FORM AA and BR					MASS (g)	PACKAGING QUANTITIES	
	$\varnothing d^{(1)}$ (mm)	l (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F_{min} (mm)		FORM AA	FORM BR
10 × 30	0.8	55 ±1	10.5	30.5	35	≈4.8	200	500
12.5 × 30	0.8	55 ±1	13.0	30.5	35	≈7.4	200	400
15 × 30	0.8	55 ±1	15.5	30.5	35	≈11.7	200	250
18 × 30	0.8	55 ±1	18.5	30.5	35	≈12.9	200	–
18 × 40	0.8	34 ±1	18.5	41.5	45	≈19.4	100	–
21 × 40	0.8	34 ±1	21.5	41.5	45	≈24.7	100	–

Note

1. Lead diameter $\varnothing d = 1.0$ mm, available on request.

Aluminum electrolytic capacitors

Axial High Temperature High Ripple Current

120 ATC

Ordering example

Electrolytic capacitor 120 series

1000 μ F/16 V; \pm 20%

Nominal case size: \varnothing 12.5 x 30 mm; Form BR

Catalogue number: 2222 120 25102.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{amb} = 20\text{ }^{\circ}\text{C}$,
 P = 86 to 106 kPa, RH = 45 to 75%.

C_R	rated capacitance at 100 Hz; tolerance \pm 20%
I_R	rated RMS ripple current at 10 kHz; 125 $^{\circ}\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	equivalent series resistance at 100 Hz (calculated from $\tan \delta_{max}$ and C_R)
Z	max. impedance at 10 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 10 kHz 125 $^{\circ}\text{C}$ (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	TYP. ESR 100 Hz (m Ω)	MAX. ESR 100 Hz (m Ω)	TYP. ESR 10 kHz (m Ω)	MAX. ESR 10 kHz (m Ω)	Z MAX. 10 kHz (m Ω)	CATALOGUE NUMBER 2222		
											AXIAL		
											IN BOX FORM AA	TAPED ON REEL FORM BR	
16	680	10 x 30	2100	85	46	106	177	44	74	78	120 15681	120 25681	
	1000	12.5 x 30	2550	116	52	77	128	35	58	61	120 15102	120 25102	
	1500	12.5 x 30	2650	164	68	60	100	32	53	53	120 15152	120 25152	
	2200	15 x 30	2940	231	90	48	79	28	46	46	120 15222	120 25222	
	3300	18 x 30	3430	337	126	41	68	26	43	43	120 15332	-	
	4700	18 x 40	4350	471	166	27	45	18	29	29	120 15472	-	
	6800	21 x 40	4590	673	236	26	43	18	29	29	120 15682	-	
	25	470	10 x 30	2100	91	44	112	187	45	74	84	120 16471	120 26471
		680	12.5 x 30	2550	122	54	81	136	35	59	64	120 16681	120 26681
		1000	12.5 x 30	2600	170	70	64	107	32	53	55	120 16102	120 26102
1500		15 x 30	2890	245	95	49	82	28	46	46	120 16152	120 26152	
3300	2200	18 x 30	3310	350	126	43	71	27	44	44	120 16222	-	
	3300	18 x 40	4350	515	186	28	47	18	29	29	120 16332	-	
	4700	21 x 40	4470	725	256	27	44	18	29	29	120 16472	-	

Aluminum electrolytic capacitors

Axial High Temperature High Ripple Current

120 ATC

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 10 kHz 125 °C (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	TYP. ESR 100 Hz (m Ω)	MAX. ESR 100 Hz (m Ω)	TYP. ESR 10 kHz (m Ω)	MAX. ESR 10 kHz (m Ω)	Z MAX. 10 kHz (m Ω)	CATALOGUE NUMBER 2222	
											AXIAL	
											IN BOX FORM AA	TAPED ON REEL FORM BR
40	220	10 × 30	1990	73	38	192	320	52	87	124	120 17221	120 27221
	330	12.5 × 30	2430	99	46	130	216	37	62	83	120 17331	120 27331
	470	12.5 × 30	2550	133	58	101	169	35	58	70	120 17471	120 27471
	680	15 × 30	2840	183	74	75	125	30	50	55	120 17681	120 27681
	1000	18 × 30	3150	260	100	59	99	28	47	49	120 17102	-
	1500	18 × 40	4130	380	136	39	65	19	31	32	120 17152	-
	2200	21 × 40	4170	548	196	34	56	19	31	31	120 17222	-
	100	10 × 30	1560	58	33	297	495	92	154	249	120 18101	120 28101
	150	12.5 × 30	2050	77	39	195	325	61	102	162	120 18151	120 28151
	220	12.5 × 30	2150	103	48	149	249	55	92	126	120 18221	120 28221
100	330	15 × 30	2510	145	62	105	175	44	73	91	120 18331	120 28331
	470	18 × 30	2860	198	79	81	135	38	64	74	120 18471	-
	680	18 × 40	3720	277	106	55	92	26	43	49	120 18681	-
	1000	21 × 40	3780	399	146	44	74	25	41	43	120 18102	-
	47	10 × 30	760	49	29	760	1269	349	581	720	120 19479	120 29479
	68	12.5 × 30	1030	61	34	531	885	246	410	503	120 19689	120 29689
	100	12.5 × 30	1140	80	40	389	648	196	327	381	120 19101	120 29101
	150	15 × 30	1480	110	50	266	443	137	229	262	120 19151	120 29151
	220	18 × 30	1960	152	64	181	302	95	158	179	120 19221	-
	330	18 × 40	2550	218	86	120	200	62	104	117	120 19331	-
470	21 × 40	2800	302	114	92	154	52	86	94	120 19471	-	

A

Aluminum electrolytic capacitors

Axial High Temperature High Ripple

120 ATC

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 20 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 20 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \times L$ mm:	
	10 × 30	typ. 38 nH
	12.5 × 30	typ. 46 nH
	15 × 30	typ. 48 nH
	18 × 30	typ. 50 nH
	18 × 40	typ. 54 nH
	21 × 40	typ. 59 nH

MARKING

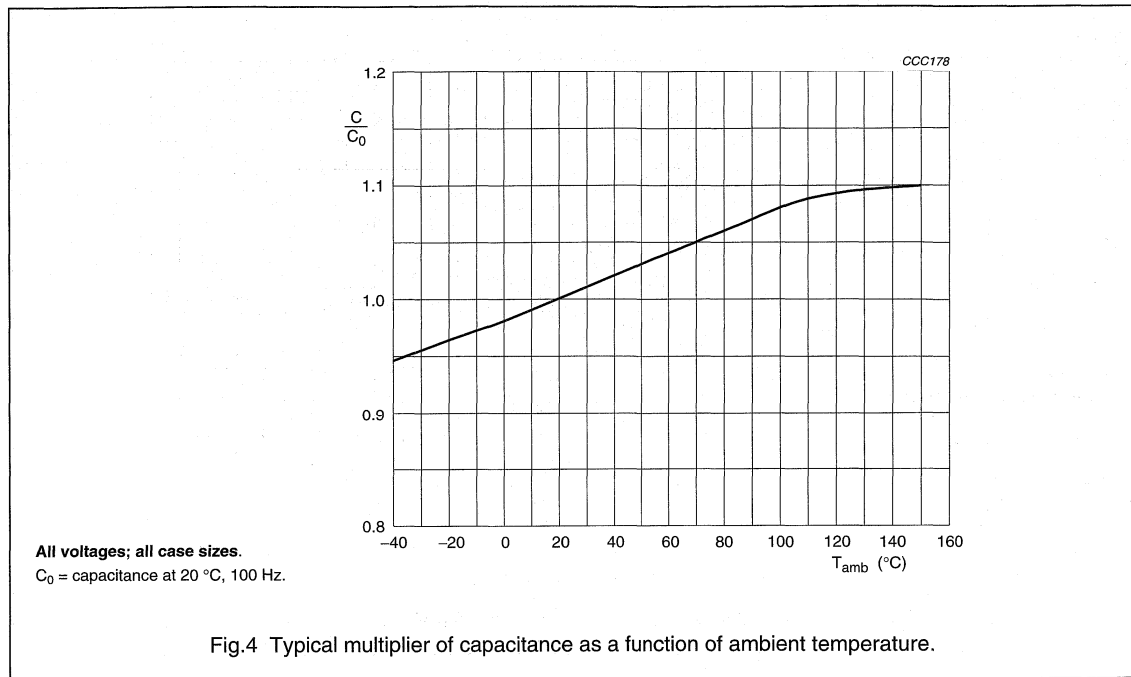
The capacitors are marked (where possible) with the following information:

- Rated capacitance (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062"
- Rated voltage (in V) at 125 °C
- Group number (120)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Code indicating factory of origin
- Band to identify the negative terminal
- '+' sign to identify the positive terminal.

Aluminum electrolytic capacitors Axial High Temperature High Ripple Current

120 ATC

Capacitance (C)



Aluminum electrolytic capacitors Axial High Temperature High Ripple

120 ATC

Equivalent series resistance (ESR)

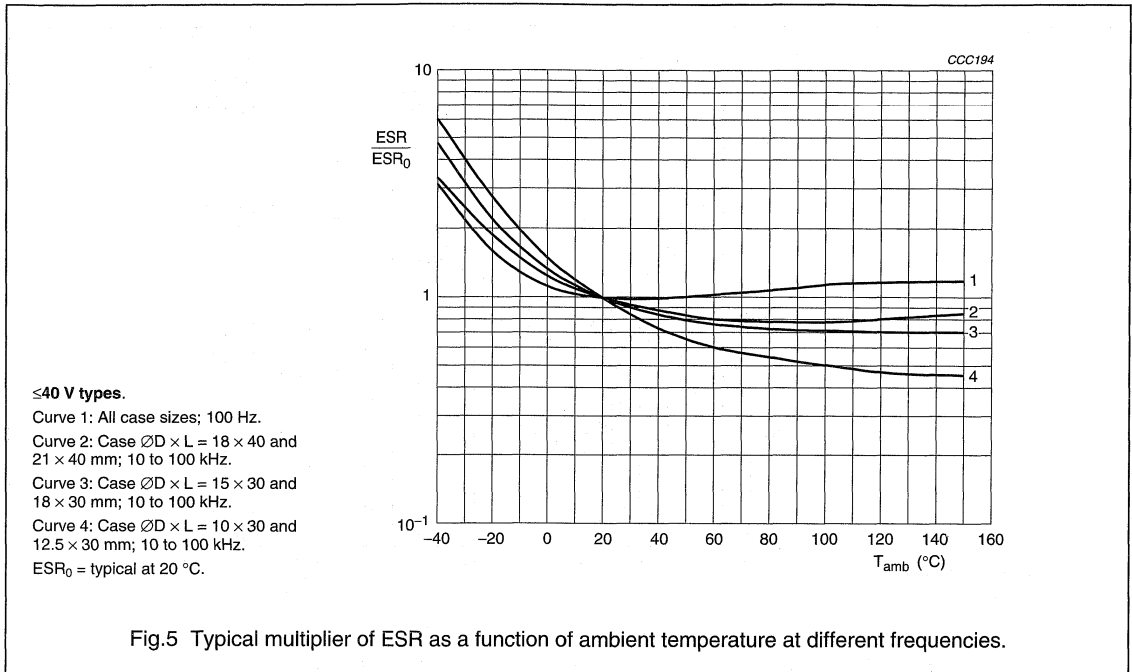


Fig.5 Typical multiplier of ESR as a function of ambient temperature at different frequencies.

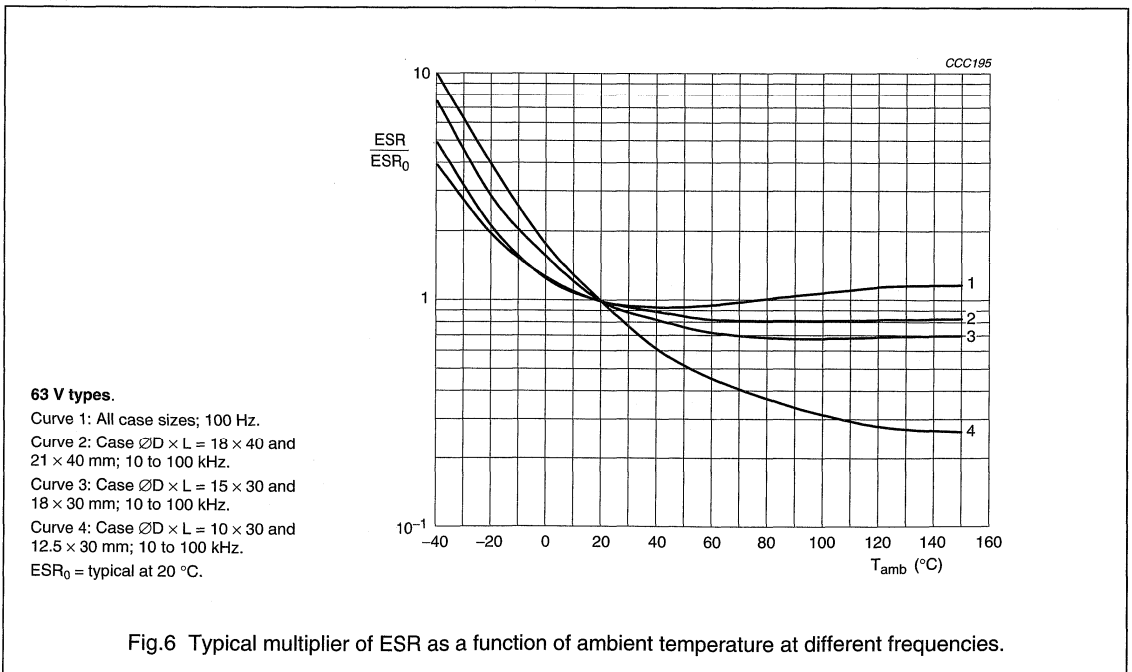
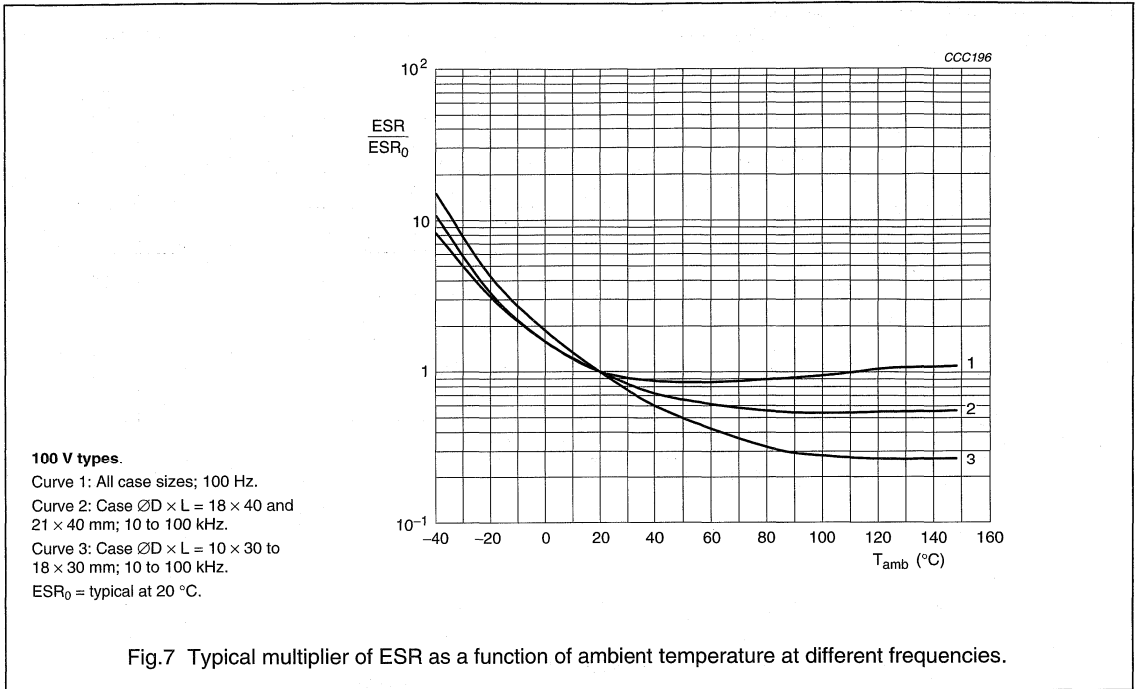


Fig.6 Typical multiplier of ESR as a function of ambient temperature at different frequencies.

Aluminum electrolytic capacitors
Axial High Temperature High Ripple Current

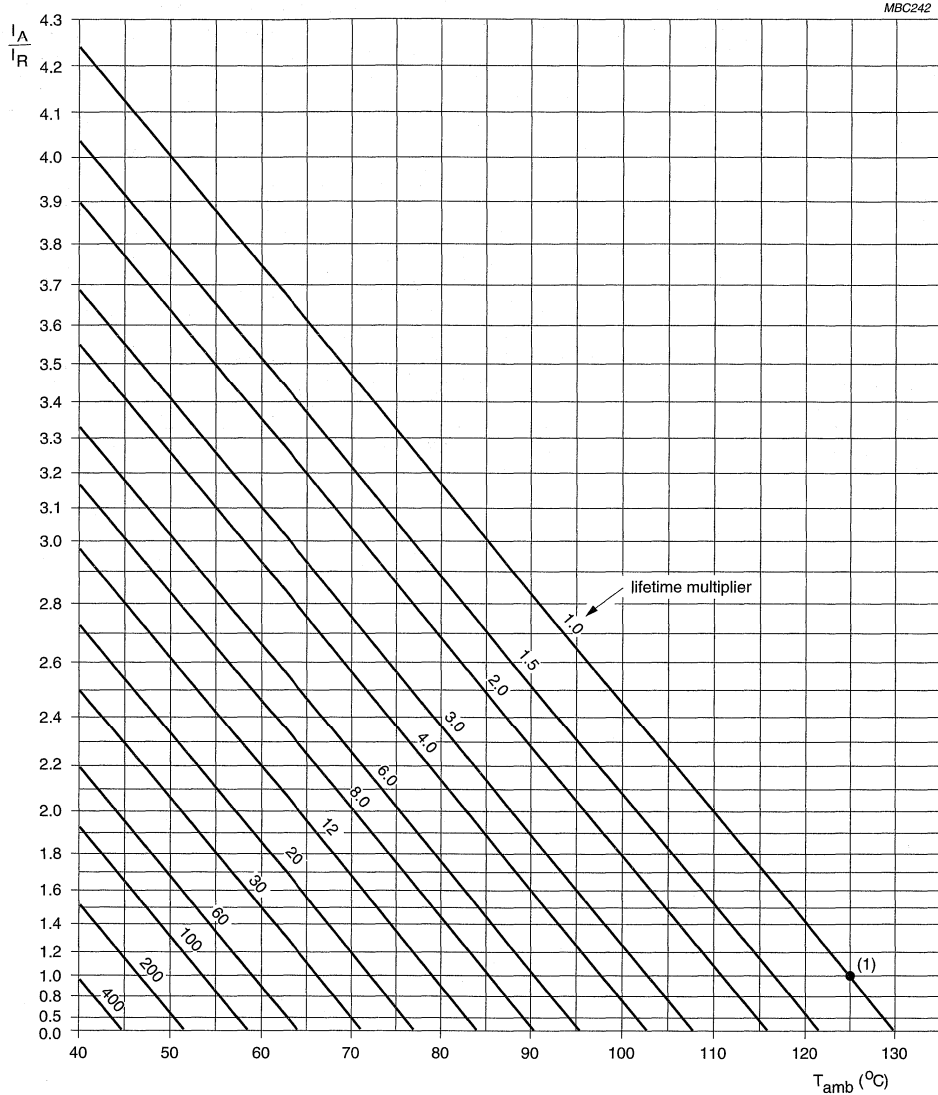
120 ATC



Aluminum electrolytic capacitors Axial High Temperature High Ripple

120 ATC

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 10 kHz.

I_R = rated ripple current at 10 kHz, 125 °C.

(1) Useful life at 125 °C and I_R applied: 8000 hours.

A nomogram extension for temperatures from 130 to 150 °C is in preparation.

Fig.8 Multiplier of useful life as a function of ambient temperature and ripple current load; see Table 3.

Aluminum electrolytic capacitors

Axial High Temperature High Ripple Current

120 ATC

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER			
	$U_R = 16$ to 40 V case sizes 10×30 to 15×30 mm	$U_R = 16$ to 40 V case sizes 18×30 to 21×40 mm	$U_R = 63$ and 100 V case sizes 10×30 to 15×30 mm	$U_R = 63$ and 100 V case sizes 18×30 to 21×40 mm
	50	0.37	0.54	0.23
100	0.48	0.63	0.32	0.56
300	0.69	0.75	0.53	0.76
1000	0.86	0.81	0.77	0.88
3000	0.96	0.87	0.93	0.94
≥ 10000	1.0	1.0	1.0	1.0

Aluminum electrolytic capacitors

Axial High Temperature High Ripple

120 ATC


SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125\text{ °C}$; U_R applied; 4000 hours (100 V: 3000 hours)	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 125\text{ °C}$; U_R and I_R applied; 8000 hours	$\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125\text{ °C}$; no voltage applied; 1000 hours (100 V: 100 hours) $T_{amb} = 150\text{ °C}$; no voltage applied; 500 hours for voltages: $\leq 63\text{ V}$ 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 $I_{L5} \leq 2 \times \text{spec. limit}$
Reverse voltage	IEC 60384-4/ EN130300 subclause 4.15	$T_{amb} = 125\text{ °C}$: 125 hours at $U = -1\text{ V}$ followed by 125 hours at U_R	$\Delta C/C: \pm 20\%$ $\tan \delta \leq \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Vibration	IEC 60068-2 subclause 4.15 test method Fc	case size 10×30 to 18×30 : 10 to 2000 Hz; 1.5 mm or 20 g (whichever is less severe); in 3 directions; 2.5 hours per direction case size 18×40 and 21×40 : 10 to 500 Hz; 0.75 mm or 10 g (whichever is less severe); in 3 directions; 2 hours per direction	no visible damage; no leakage of electrolyte; markings legible $\Delta C/C: \pm 5\%$ with respect to initial measurement

SNAP-IN/DIN-PW CAPACITORS

	ECONOMY	LONG-LIFE	LONG-LIFE HIGH TEMPERATURE
	2500 to 12000 hours 85 °C	15000 hours 85 °C	3000 to 10000 hours 105 °C
<p>smaller dimensions ↓ higher CV per volume</p> 	051-053 PEC-PW page 615	050-052 PED-PW page 633	162/163 PLL-PW page 654
	166/167 PSM-4TSl page 591		168/169 PLL-4TSl page 598
	056/057 PSM-SI page 554		058/059 PLL-SI page 573
	157 PUM-SI page 532	198 PHR-SI page 605	159 PUL-SI page 543

CCB097



Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

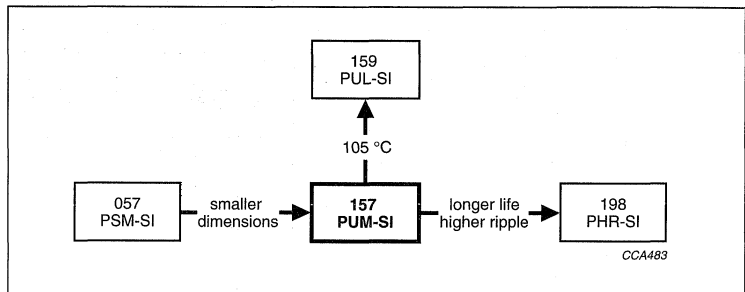
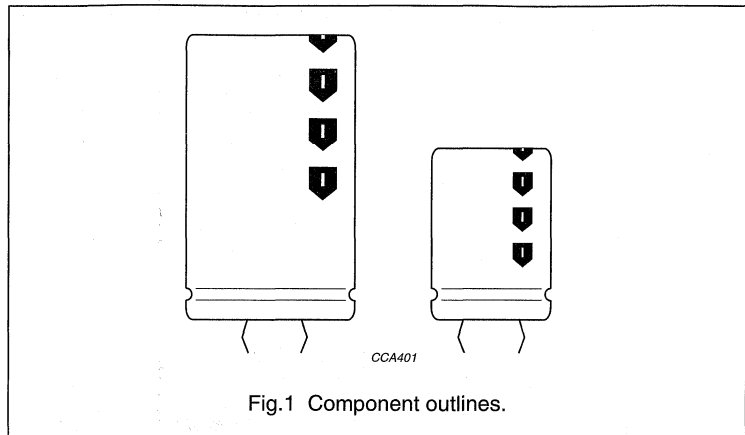
157 PUM-SI

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case
- Charge and discharge proof
- Useful life: 2500 hours at 85 °C
- Keyed polarity version available.

APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	22 × 25 to 35 × 60	
Rated capacitance range (E6/E12 series), C_R	56 to 2200 μF	
Tolerance on C_R	±20%	
Rated voltage range, U_R ; note 1	200 V, 250 V	400 V, 450 V
Category temperature range	-40 to +85 °C	-25 to +85 °C
Endurance test at 85 °C	2000 hours	
Load life at 85 °C	2000 hours	
Useful life at 85 °C	2500 hours	
Useful life at 40 °C and $1.4 \times I_R$ applied	45000 hours	
Shelf life at 0 V, 85 °C	1000 hours	
Based on sectional specification	IEC 60384-4-1/EN130300	
Climatic category IEC 60068	40/085/56	25/085/56

Note

1. 160 volt and 420 V ranges are available on request.

Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

157 PUM-SI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm); preferred types in bold

C_R (μF)	U_R (V)			
	200	250	400	450
56	–	–	–	22 × 25
68	–	–	22 × 25	22 × 30
82	–	–	22 × 25	22 × 30
	–	–	–	25 × 25
100	–	–	22 × 30	22 × 35
	–	–	–	25 × 30
120	–	–	22 × 30	22 × 40
	–	–	–	25 × 30
	–	–	–	30 × 25
150	–	–	22 × 35	25 × 35
	–	–	25 × 30	25 × 40
	–	–	–	30 × 30
180	–	–	22 × 40	25 × 40
	–	–	25 × 35	30 × 35
	–	–	–	35 × 25
220	–	22 × 30	25 × 40	25 × 50
	–	–	30 × 30	30 × 40
	–	–	35 × 25	35 × 30
270	22 × 25	22 × 30	25 × 45	30 × 45
	–	25 × 25	30 × 35	35 × 35
	–	–	35 × 30	–
330	22 × 30	22 × 35	30 × 40	30 × 50
	–	25 × 30	35 × 30	35 × 40
390	22 × 30	22 × 40	30 × 45	35 × 45
	–	30 × 25	35 × 35	–
470	22 × 35	25 × 35	30 × 50	35 × 50
	25 × 30	30 × 30	35 × 40	–
560	22 × 40	25 × 40	35 × 45	–
	25 × 35	30 × 30	–	–
	30 × 25	35 × 25	–	–
680	25 × 40	25 × 45	35 × 50	35 × 60
	30 × 30	30 × 35	–	–
	35 × 25	35 × 30	–	–
820	25 × 45	30 × 40	35 × 60	–
	30 × 35	35 × 35	–	–
	35 × 30	–	–	–
1000	30 × 40	30 × 45	–	–
	35 × 30	35 × 40	–	–
1200	30 × 45	35 × 45	–	–
	35 × 35	–	–	–
1500	30 × 50	35 × 50	–	–
	35 × 40	–	–	–
1800	35 × 45	–	–	–
2200	35 × 50	–	–	–

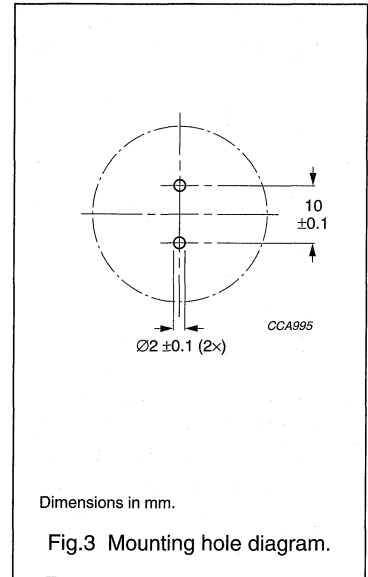
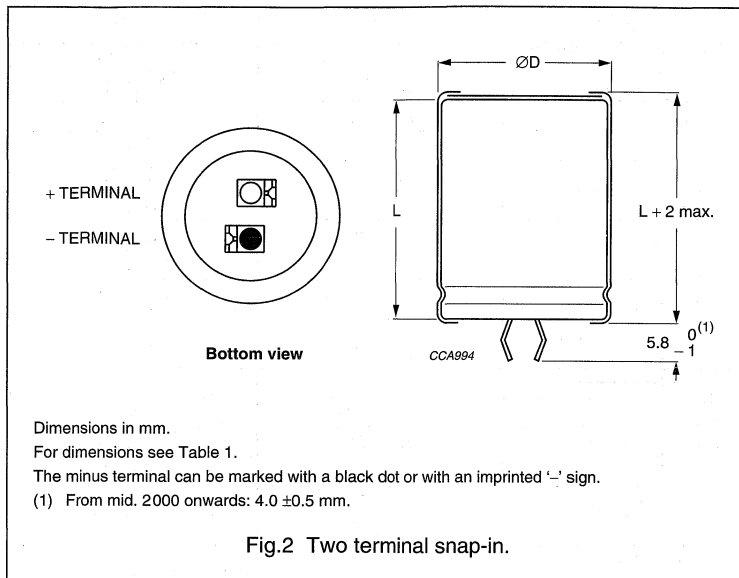
Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

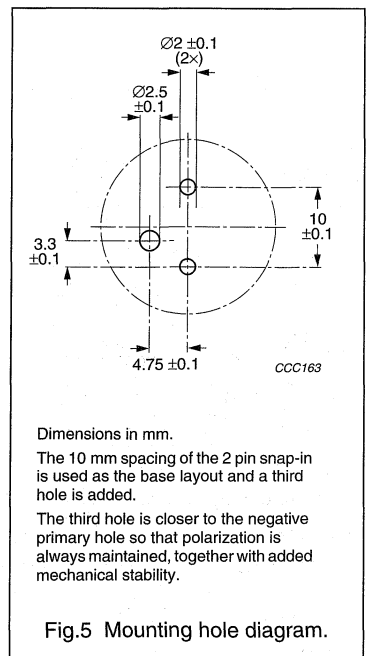
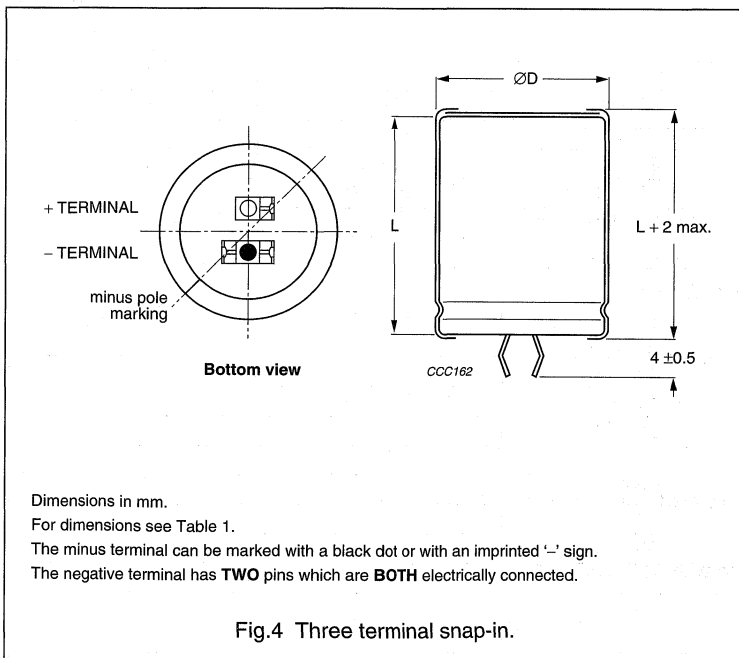
157 PUM-SI

MECHANICAL DATA AND PACKAGING QUANTITIES

Two terminal snap-in



Three terminal snap-in (available on request)



Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

157 PUM-SI

Table 1 Physical dimensions, mass and packaging information; see Figs 2 and 4

NOMINAL CASE SIZE ØD × L (mm)	ØD _{max} (mm)	L _{max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
22 × 25	23	27	≈12	100	260 × 250 × 39
22 × 30	23	32	≈16	100	260 × 250 × 44
22 × 35	23	37	≈20	100	260 × 250 × 49
22 × 40	23	42	≈23	100	260 × 250 × 54
25 × 25	26	27	≈20	100	290 × 280 × 39
25 × 30	26	32	≈22	100	290 × 280 × 44
25 × 35	26	37	≈24	100	290 × 280 × 49
25 × 40	26	42	≈27	100	290 × 280 × 54
25 × 45	26	47	≈32	100	290 × 280 × 59
25 × 50	26	52	≈38	100	290 × 280 × 64
30 × 25	31	27	≈25	100	340 × 330 × 39
30 × 30	31	32	≈30	100	340 × 330 × 44
30 × 35	31	37	≈35	100	340 × 330 × 49
30 × 40	31	42	≈40	100	340 × 330 × 54
30 × 45	31	47	≈45	100	340 × 330 × 59
30 × 50	31	52	≈50	100	340 × 330 × 64
35 × 25	36	27	≈33	50	390 × 198 × 39
35 × 30	36	32	≈40	50	390 × 198 × 44
35 × 35	36	37	≈48	50	390 × 198 × 49
35 × 40	36	42	≈55	50	390 × 198 × 54
35 × 45	36	47	≈63	50	390 × 198 × 59
35 × 50	36	52	≈72	50	390 × 198 × 64
35 × 60	36	62	≈82	50	390 × 198 × 74

MARKING

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

- Rated capacitance (in µF)
- Tolerance code on rated capacitance (M for ±20%)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- '-' sign to indicate the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

157 PUM-SI

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100/120 Hz
I_R	rated RMS ripple current at 120 Hz, 85 °C
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ./max. equivalent series resistance at 100 Hz; note 1
Z	typ./max. impedance at 10 kHz

Note

- ESR at 120 Hz is approximately $0.95 \times$ ESR 100 Hz.

Ordering example

Electrolytic capacitor 157 series

1000 $\mu\text{F}/200\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 30 \times 40\text{ mm}$
2-terminal snap-in

Catalogue number: 2222 157 52102.

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (m Ω)	MAX. ESR 100 Hz ⁽¹⁾ (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽²⁾⁽³⁾ 2222
200	270	22 × 25	1.15	0.54	550	880	420	700	157 52271
	330	22 × 30	1.36	0.66	430	720	300	500	157 52331
	390	22 × 30	1.46	0.78	390	650	295	490	157 52391
	470	22 × 35	1.68	0.94	350	580	240	400	157 32471
		25 × 30	1.67	0.94	350	580	240	400	157 52471
	560	22 × 40	1.91	1.12	255	425	235	390	157 42561
		25 × 35	1.91	1.12	255	425	235	390	157 32561
		30 × 25	1.89	1.12	255	425	235	390	157 52561
	680	25 × 40	2.18	1.36	210	350	205	340	157 42681
		30 × 30	2.04	1.36	210	350	205	340	157 52681
		35 × 25	2.06	1.36	210	350	205	340	157 62681
	820	25 × 45	2.46	1.64	170	290	145	240	157 62821
		30 × 35	2.35	1.64	170	290	145	240	157 32821
		35 × 30	2.29	1.64	170	290	145	240	157 52821
1000	30 × 40	2.66	2.00	140	235	135	225	157 52102	
	35 × 30	2.33	2.00	140	235	135	225	157 62102	
	1200	30 × 45	2.98	2.40	120	200	110	190	157 32122
		35 × 35	2.69	2.40	120	200	110	190	157 62122
1500	30 × 50	3.31	3.00	110	180	95	155	157 42152	
	35 × 40	3.04	3.00	110	180	95	155	157 52152	
	1800	35 × 45	3.36	3.60	100	160	80	130	157 42182
2200	35 × 50	3.68	4.40	90	150	65	105	157 52222	

Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

157 PUM-SI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (m Ω)	MAX. ESR 100 Hz ⁽¹⁾ (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽²⁾⁽³⁾ 2222
250	220	22 × 30	1.23	0.55	600	1080	420	700	157 53221
	270	22 × 30	1.32	0.67	490	880	335	560	157 43271
		25 × 25	1.23	0.67	490	880	335	560	157 53271
	330	22 × 35	1.53	0.82	400	720	255	430	157 33331
		25 × 30	1.56	0.82	400	720	255	430	157 53331
	390	22 × 40	1.74	0.97	330	610	250	425	157 43391
		30 × 25	1.58	0.97	330	610	250	425	157 53391
	470	25 × 35	1.87	1.17	280	505	190	320	157 33471
		30 × 30	1.89	1.17	280	505	190	320	157 53471
	560	25 × 40	2.12	1.40	240	425	185	310	157 43561
		30 × 30	1.97	1.40	240	425	185	310	157 53561
		35 × 25	1.80	1.40	240	425	185	310	157 63561
	680	25 × 45	2.29	1.70	200	350	155	260	157 63681
		30 × 35	2.28	1.70	200	350	155	260	157 33681
		35 × 30	2.20	1.70	200	350	155	260	157 53681
	820	30 × 40	2.57	2.05	160	290	125	210	157 53821
		35 × 35	2.54	2.05	160	290	125	210	157 63821
	1000	30 × 45	2.88	2.50	140	235	105	180	157 33102
		35 × 40	2.86	2.50	140	235	105	180	157 53102
	1200	35 × 45	3.17	3.00	120	200	95	160	157 43122
1500	35 × 50	3.49	3.75	90	160	85	140	157 53152	

Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

157 PUM-SI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (m Ω)	MAX. ESR 100 Hz ⁽¹⁾ (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽²⁾⁽³⁾ 2222
400	68	22 × 25	0.71	0.27	1400	2800	1170	1950	157 56689
	82	22 × 25	0.77	0.33	1250	2500	970	1620	157 56829
	100	22 × 30	0.94	0.40	1125	2250	750	1220	157 56101
	120	22 × 30	0.97	0.48	990	1980	700	1140	157 56121
	150	22 × 35	1.13	0.60	750	1500	540	900	157 36151
		25 × 30	1.16	0.60	750	1500	540	900	157 56151
	180	22 × 40	1.29	0.72	630	1260	435	725	157 46181
		25 × 35	1.35	0.72	630	1260	435	725	157 36181
	220	25 × 40	1.54	0.88	520	1040	355	590	157 46221
		30 × 30	1.50	0.88	520	1040	355	590	157 56221
		35 × 25	1.42	0.88	520	1040	355	590	157 66221
	270	25 × 45	1.72	1.08	430	860	335	560	157 66271
		30 × 35	1.74	1.08	430	860	335	560	157 36271
		35 × 30	1.71	1.08	430	860	335	560	157 56271
	330	30 × 40	1.97	1.32	350	700	315	525	157 56331
		35 × 30	1.76	1.32	350	700	315	525	157 66331
	390	30 × 45	2.19	1.56	300	610	250	420	157 56391
		35 × 35	2.04	1.56	300	610	250	420	157 36391
	470	30 × 50	2.40	1.88	250	505	210	350	157 46471
		35 × 40	2.30	1.88	250	505	210	350	157 56471
560	35 × 45	2.55	2.24	210	425	180	305	157 46561	
680	35 × 50	2.79	2.72	190	380	160	265	157 56681	
820	35 × 60	3.33	3.28	155	315	115	215	157 56821	

Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

157 PUM-SI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (m Ω)	MAX. ESR 100 Hz ⁽¹⁾ (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽²⁾⁽³⁾ 2222
450	56	22 × 25	0.68	0.25	1650	3300	1120	1880	157 57569
	68	22 × 30	0.80	0.30	1400	2800	920	1530	157 57689
	82	22 × 30	0.87	0.36	1200	2400	780	1290	157 47829
		25 × 25	0.85	0.36	1200	2400	780	1290	157 57829
	100	22 × 35	1.00	0.45	1000	2000	630	1050	157 37101
		25 × 30	1.02	0.45	1000	2000	630	1050	157 57101
120		22 × 40	1.15	0.54	800	1600	530	885	157 47121
		25 × 30	1.09	0.54	800	1600	530	885	157 57121
		30 × 25	1.10	0.54	800	1600	530	885	157 67121
	150	25 × 40	1.35	0.67	650	1300	420	705	157 47151
		25 × 35	1.27	0.67	650	1300	420	705	157 67151
		30 × 30	1.32	0.67	650	1300	420	705	157 57151
180		25 × 40	1.45	0.81	570	1150	360	605	157 47181
		30 × 35	1.49	0.81	570	1150	360	605	157 57181
		35 × 25	1.35	0.81	570	1150	360	605	157 67181
	220	25 × 50	1.73	0.99	450	900	315	525	157 47221
		30 × 40	1.72	0.99	450	900	315	525	157 57221
		35 × 30	1.61	0.99	450	900	315	525	157 67221
270		30 × 45	1.95	1.21	380	770	270	450	157 37271
		35 × 35	1.86	1.21	380	770	270	450	157 67271
	330	30 × 50	2.19	1.48	300	600	230	390	157 47331
		35 × 40	2.10	1.48	300	600	230	390	157 57331
390		35 × 45	2.34	1.75	250	500	190	340	157 47391
	470	35 × 50	2.60	2.11	210	420	170	290	157 57471
	680	35 × 60	3.15	3.06	150	300	110	200	157 57681

Notes

- ESR at 120 Hz is approximately $0.95 \times \text{ESR } 100 \text{ Hz}$.
- All catalogue numbers refer to 2-terminal snap-in products.
- 3-terminal snap-ins are available on request.



Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

157 PUM-SI

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥400 V versions	$U_s = 1.1 \times U_R$
	≤250 V versions	$U_s = 1.15 \times U_R$
Reverse voltage		≤1 V
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.01C_R \times U_R$
Inductance		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH

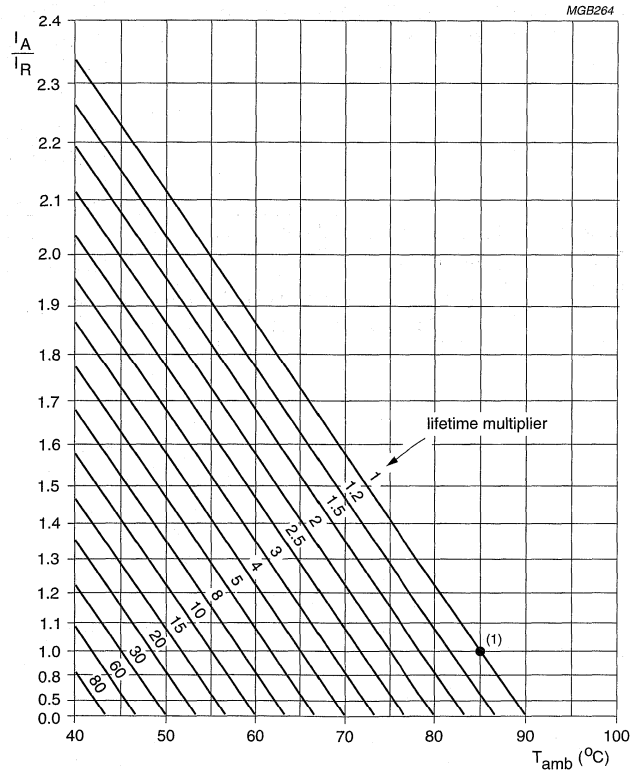
Aluminum electrolytic capacitors Power Ultra Miniature Snap-in

157 PUM-SI

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.9
100	0.95
120	1.0
200	1.15
1000	1.3
≥ 10000	1.4



I_A = actual ripple current at 120 Hz and 85 °C.
 I_R = rated ripple current at 120 Hz and 85 °C.
 (1) Useful life at 85 °C and I_R applied: 2500 hours.

Fig.6 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power Ultra Miniature Snap-in

157 PUM-SI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 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; 2000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Load life		$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 2000 hours	$\Delta C/C: \pm 20\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 2500 hours	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ }^{\circ}\text{C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq 1 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power Ultra Long Life Snap-in

159 PUL-SI

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case
- Charge and discharge proof
- Low ESR, high ripple current capability
- Useful life: 5 000 hours at 105 °C
- Keyed polarity version available.

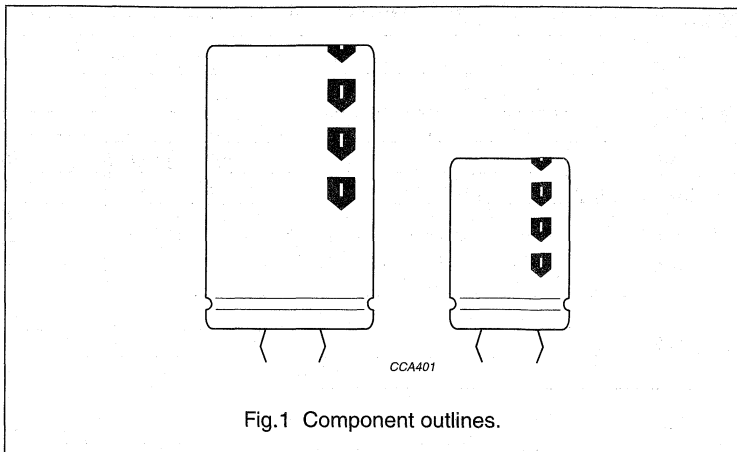
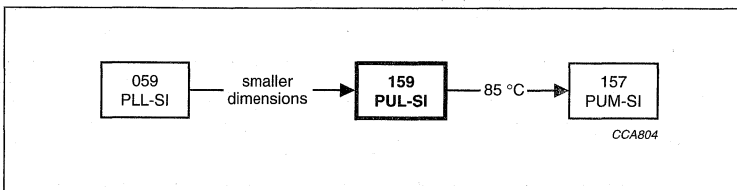


Fig.1 Component outlines.

APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	22 × 25 to 35 × 60	
Rated capacitance range (E6/E12 series), C_R	56 to 1800 μF	
Tolerance on C_R	±20%	
Rated voltage range, U_R ; note 1	200 V, 250 V	400 V, 450 V
Category temperature range	-40 to +105 °C	-25 to +105 °C
Endurance test at 105 °C	2000 hours	
Load life at 105 °C	2000 hours	
Useful life at 105 °C	5000 hours	
Useful life at 40 °C and $1.6 \times I_R$ applied	500000 hours	
Shelf life at 0 V, 105 °C	1000 hours	
Based on sectional specification	IEC 60384-4-1/EN130300	
Climatic category IEC 60068	40/105/56	25/105/56

Note

1. A 160 volt range is available on request.

Aluminum electrolytic capacitors

Power Ultra Long Life Snap-in

159 PUL-SI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm); preferred types in bold

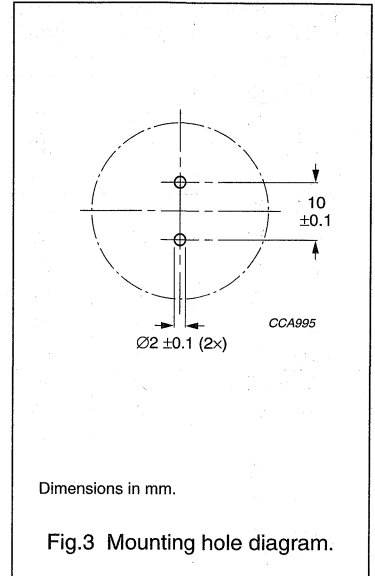
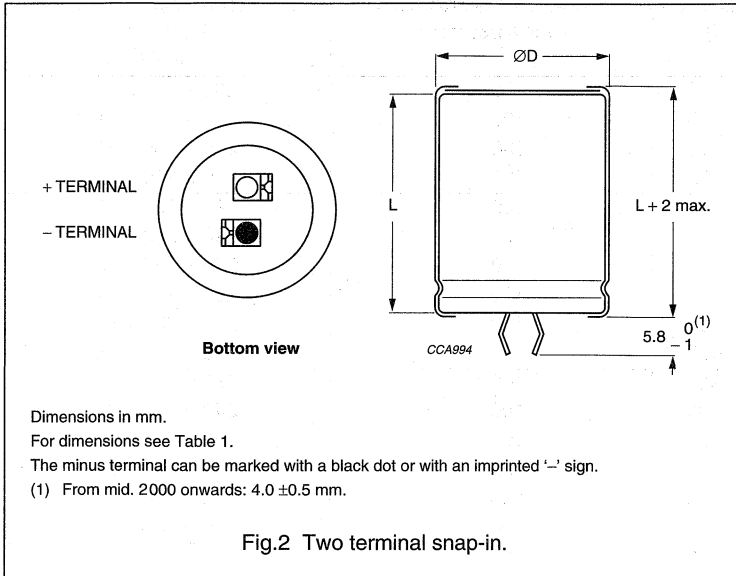
C_R (μF)	U_R (V)			
	200	250	400	450
56	–	–	–	22 × 25
68	–	–	22 × 25	22 × 30/25 × 25
82	–	–	22 × 30	22 × 35
	–	–	25 × 25	–
100	–	–	22 × 35	22 × 40
	–	–	25 × 30	25 × 30/30 × 25
120	–	–	22 × 35	–
	–	–	25 × 30	25 × 35
	–	–	30 × 25	–
150	–	–	22 × 40	25 × 40
	–	–	25 × 35	30 × 30
	–	–	30 × 30	35 × 25
180	–	–	25 × 40	25 × 45
	–	–	30 × 30	30 × 35
	–	–	35 × 25	–
220	–	22 × 30	25 × 45	30 × 40
	–	25 × 25	30 × 35	35 × 30
	–	–	35 × 30	–
270	–	22 × 35	25 × 50	30 × 45
	–	25 × 30	30 × 40	35 × 35
	–	30 × 25	35 × 30	–
330	22 × 30	22 × 40	30 × 45	30 × 50
	–	25 × 30/30 × 25	35 × 35	35 × 40
390	22 × 35	25 × 35	30 × 50	35 × 45
	25 × 30	30 × 30	35 × 40	–
470	22 × 40	25 × 40	35 × 45	35 × 50
	30 × 25	30 × 30/35 × 25	–	–
560	–	25 × 45	35 × 50	35 × 60
	25 × 35	30 × 35	–	–
	30 × 30	35 × 30	–	–
680	25 × 45	30 × 40	35 × 60	–
	30 × 30	35 × 35	–	–
	35 × 25	–	–	–
820	25 × 50	30 × 45	–	–
	30 × 35	35 × 35	–	–
	35 × 30	35 × 40	–	–
1000	30 × 45	35 × 40	–	–
	35 × 35	35 × 45	–	–
1200	30 × 50	35 × 45	–	–
	35 × 35	35 × 50	–	–
1500	35 × 45	–	–	–
1800	35 × 50	–	–	–

Aluminum electrolytic capacitors Power Ultra Long Life Snap-in

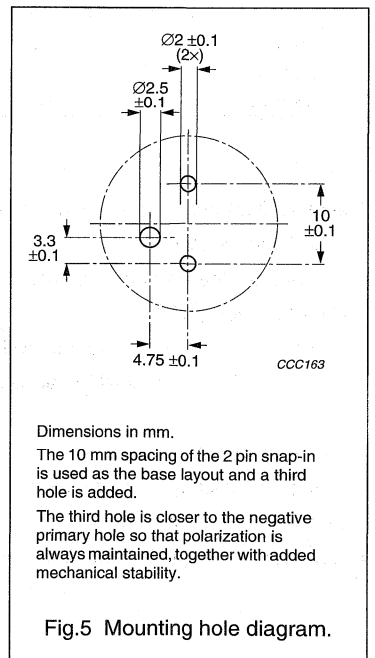
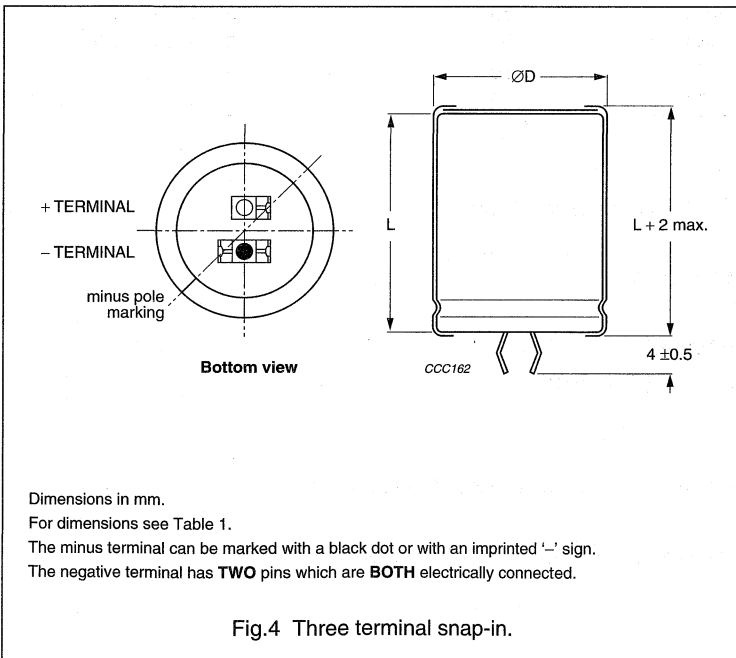
159 PUL-SI

MECHANICAL DATA AND PACKAGING QUANTITIES

Two terminal snap-in



Three terminal snap-in (available on request)



Aluminum electrolytic capacitors

Power Ultra Long Life Snap-in

159 PUL-SI

Table 1 Physical dimensions, mass and packaging information; see Figs 2 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{\max}$ (mm)	L_{\max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
22 × 25	23	27	≈12	100	260 × 250 × 39
22 × 30	23	32	≈16	100	260 × 250 × 44
22 × 35	23	37	≈20	100	260 × 250 × 49
22 × 40	23	42	≈23	100	260 × 250 × 54
25 × 25	26	27	≈20	100	290 × 280 × 39
25 × 30	26	32	≈22	100	290 × 280 × 44
25 × 35	26	37	≈24	100	290 × 280 × 49
25 × 40	26	42	≈27	100	290 × 280 × 54
25 × 45	26	47	≈32	100	290 × 280 × 59
25 × 50	26	52	≈38	100	290 × 280 × 64
30 × 25	31	27	≈25	100	340 × 330 × 39
30 × 30	31	32	≈30	100	340 × 330 × 44
30 × 35	31	37	≈35	100	340 × 330 × 49
30 × 40	31	42	≈40	100	340 × 330 × 54
30 × 45	31	47	≈45	100	340 × 330 × 59
30 × 50	31	52	≈50	100	340 × 330 × 64
35 × 25	36	27	≈33	50	390 × 198 × 39
35 × 30	36	32	≈40	50	390 × 198 × 44
35 × 35	36	37	≈48	50	390 × 198 × 49
35 × 40	36	42	≈55	50	390 × 198 × 54
35 × 45	36	47	≈63	50	390 × 198 × 59
35 × 50	36	52	≈72	50	390 × 198 × 64
35 × 60	36	62	≈84	50	390 × 198 × 74

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- '-' sign to indicate the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors

Power Ultra Long Life Snap-in

159 PUL-SI

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 120 Hz, 105 °C
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ./max. equivalent series resistance at 100 Hz; note 1
Z	typ./max. impedance at 10 kHz

Note

- ESR at 120 Hz is approximately $0.95 \times \text{ESR } 100\text{ Hz}$.

Ordering example

Electrolytic capacitor 159 series

1000 μF /200 V; $\pm 20\%$ Nominal case size: $\varnothing 30 \times 45\text{ mm}$
2-terminal snap-in

Catalogue number: 2222 159 42102.

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 105 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (m Ω)	MAX. ESR 100 Hz ⁽¹⁾ (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽²⁾⁽³⁾ 2222
200	330	22 × 30	1.08	0.66	450	730	300	500	159 52331
	390	22 × 35	1.23	0.78	380	610	280	470	159 42391
	390	25 × 30	1.23	0.78	380	610	280	470	159 52391
	470	22 × 40	1.37	0.94	300	505	240	400	159 32471
	470	30 × 25	1.27	0.94	300	505	240	400	159 52471
	560	25 × 35	1.50	1.12	260	425	235	390	159 42561
	560	30 × 30	1.52	1.12	260	425	235	390	159 52561
	680	25 × 45	1.82	1.36	210	350	205	340	159 42681
	680	30 × 30	1.59	1.36	210	350	205	340	159 52681
	680	35 × 25	1.44	1.36	210	350	205	340	159 62681
	820	25 × 50	2.04	1.64	180	290	145	240	159 32821
	820	30 × 35	1.83	1.64	180	290	145	240	159 42821
	820	35 × 30	1.77	1.64	180	290	145	240	159 52821
	1000	30 × 45	2.23	2.00	150	235	135	225	159 42102
	1000	35 × 35	2.04	2.00	150	235	135	225	159 52102
	1200	30 × 50	2.47	2.40	130	210	115	190	159 42122
1200	35 × 35	2.07	2.40	130	210	115	190	159 52122	
1500	35 × 45	2.56	3.00	100	170	95	155	159 52152	
1800	35 × 50	2.80	3.60	90	150	80	130	159 52182	

Aluminum electrolytic capacitors
Power Ultra Long Life Snap-in

159 PUL-SI

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 105 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (m Ω)	MAX. ESR 100 Hz ⁽¹⁾ (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽²⁾⁽³⁾ 2222
250	220	22 × 30	1.00	0.55	540	1080	420	700	159 43221
	220	25 × 25	1.00	0.55	540	1080	420	700	159 53221
	270	22 × 35	1.07	0.67	440	880	335	560	159 43271
	270	25 × 30	1.08	0.67	440	880	335	560	159 53271
	270	30 × 25	1.08	0.67	440	880	335	560	159 63271
	330	22 × 40	1.20	0.82	360	720	255	430	159 33331
	330	25 × 30	1.21	0.82	360	720	255	430	159 43331
	330	30 × 25	1.19	0.82	360	720	255	430	159 53331
	390	25 × 35	1.39	0.97	330	610	245	410	159 43391
	390	30 × 30	1.41	0.97	330	610	245	410	159 53391
	470	25 × 40	1.58	1.17	270	505	240	400	159 33471
	470	30 × 30	1.57	1.17	270	505	240	400	159 43471
	470	35 × 25	1.37	1.17	270	505	240	400	159 53471
	560	25 × 45	1.78	1.40	230	425	185	310	159 43561
	560	30 × 35	1.71	1.40	230	425	185	310	159 53561
	560	35 × 30	1.67	1.40	230	425	185	310	159 63561
	680	30 × 40	1.93	1.70	210	350	155	260	159 43681
	680	35 × 35	1.92	1.70	210	350	155	260	159 53681
	820	30 × 45	2.16	2.05	180	290	125	210	159 43821
	820	35 × 35	1.97	2.05	180	290	125	210	159 53821
820	35 × 40	2.16	2.05	180	290	125	210	159 63821	
1000	35 × 40	2.22	2.50	140	235	105	180	159 53102	
1000	35 × 45	2.41	2.50	140	235	105	180	159 63102	
1200	35 × 45	2.46	3.00	130	200	95	160	159 43122	
1200	35 × 50	2.65	3.00	130	200	95	160	159 53122	

Aluminum electrolytic capacitors

Power Ultra Long Life Snap-in

159 PUL-SI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 105 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (m Ω)	MAX. ESR 100 Hz ⁽¹⁾ (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽²⁾⁽³⁾ 2222
400	68	22 × 25	0.51	0.27	1600	3200	1170	1950	159 56689
	82	22 × 30	0.60	0.33	1200	2400	910	1520	159 46829
	82	25 × 25	0.60	0.33	1200	2400	910	1520	159 56829
	100	22 × 35	0.69	0.40	990	1980	740	1240	159 46101
	100	25 × 30	0.70	0.40	990	1980	740	1240	159 56101
	120	22 × 35	0.76	0.48	800	1600	660	1100	159 46121
	120	25 × 30	0.76	0.48	800	1600	660	1100	159 56121
	120	30 × 25	0.77	0.48	800	1600	660	1100	159 66121
	150	22 × 40	0.86	0.60	700	1400	510	860	159 36151
	150	25 × 35	0.89	0.60	700	1400	510	860	159 46151
	150	30 × 30	0.92	0.60	700	1400	510	860	159 56151
	180	25 × 40	1.01	0.72	590	1170	420	700	159 36181
	180	30 × 30	0.99	0.72	590	1170	420	700	159 46181
	180	35 × 25	0.96	0.72	590	1170	420	700	159 56181
	220	25 × 45	1.15	0.88	470	940	350	590	159 46221
	220	30 × 35	1.15	0.88	470	940	350	590	159 56221
	220	35 × 30	1.14	0.88	470	940	350	590	159 66221
	270	25 × 50	1.31	1.08	380	760	330	550	159 46271
	270	30 × 40	1.30	1.08	380	760	330	550	159 56271
	270	35 × 30	1.21	1.08	380	760	330	550	159 66271
	330	30 × 45	1.47	1.32	320	640	270	450	159 56331
	330	35 × 35	1.40	1.32	320	640	270	450	159 66331
	390	30 × 50	1.63	1.56	270	540	240	410	159 46391
	390	35 × 40	1.57	1.56	270	540	240	410	159 56391
	470	35 × 45	1.72	1.88	230	450	200	330	159 56471
	560	35 × 50	1.84	2.24	210	420	170	280	159 56561
	680	35 × 60	2.24	2.72	180	350	130	230	159 56681

Aluminum electrolytic capacitors

Power Ultra Long Life Snap-in

159 PUL-SI

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	I _R 120 Hz 105 °C (A)	I _{L5} 5 min (mA)	TYP. ESR 100 Hz ⁽¹⁾ (mΩ)	MAX. ESR 100 Hz ⁽¹⁾ (mΩ)	TYP. Z 10 kHz (mΩ)	MAX. Z 10 kHz (mΩ)	CATALOGUE NUMBER ⁽²⁾⁽³⁾ 2222
450	56	22 × 25	0.48	0.25	1600	3200	1120	1880	159 57569
	68	22 × 30	0.56	0.30	1200	2400	910	1530	159 47689
	68	25 × 25	0.56	0.30	1200	2400	910	1530	159 57689
	82	22 × 35	0.64	0.36	1100	2200	770	1290	159 57829
	100	22 × 40	0.74	0.45	900	1800	630	1050	159 37101
	100	25 × 30	0.71	0.45	900	1800	630	1050	159 47101
	100	30 × 25	0.73	0.45	900	1800	630	1050	159 57101
	120	25 × 35	0.82	0.54	750	1500	530	885	159 57121
	150	25 × 40	0.95	0.67	600	1200	420	705	159 47151
	150	30 × 30	0.93	0.67	600	1200	420	705	159 57151
	150	35 × 25	0.91	0.67	600	1200	420	705	159 67151
	180	25 × 45	1.07	0.81	500	1000	360	605	159 47181
	180	30 × 35	1.06	0.81	500	1000	360	605	159 57181
	220	30 × 40	1.21	0.99	370	740	310	525	159 47221
	220	35 × 30	1.14	0.99	370	740	310	525	159 57221
	270	30 × 45	1.37	1.21	350	700	270	450	159 47271
	270	35 × 35	1.32	1.21	350	700	270	450	159 57271
	330	30 × 50	1.54	1.48	300	600	230	390	159 47331
	330	35 × 40	1.49	1.48	300	600	230	390	159 57331
390	35 × 45	1.61	1.75	250	500	200	340	159 57391	
470	35 × 50	1.72	2.11	210	420	170	290	159 57471	
560	35 × 60	2.11	2.52	190	380	140	240	159 57561	

Notes

1. ESR at 120 Hz is approximately 0.95 × ESR 100 Hz.
2. All catalogue numbers refer to 2-terminal snap-in products.
3. 3-terminal snap-ins are available on request.

Aluminum electrolytic capacitors

Power Ultra Long Life Snap-in

159 PUL-SI

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥400 V versions	$U_s = 1.1 \times U_R$
	≤250 V versions	$U_s = 1.15 \times U_R$
Reverse voltage		≤1 V
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.01 C_R \times U_R$
Inductance		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH



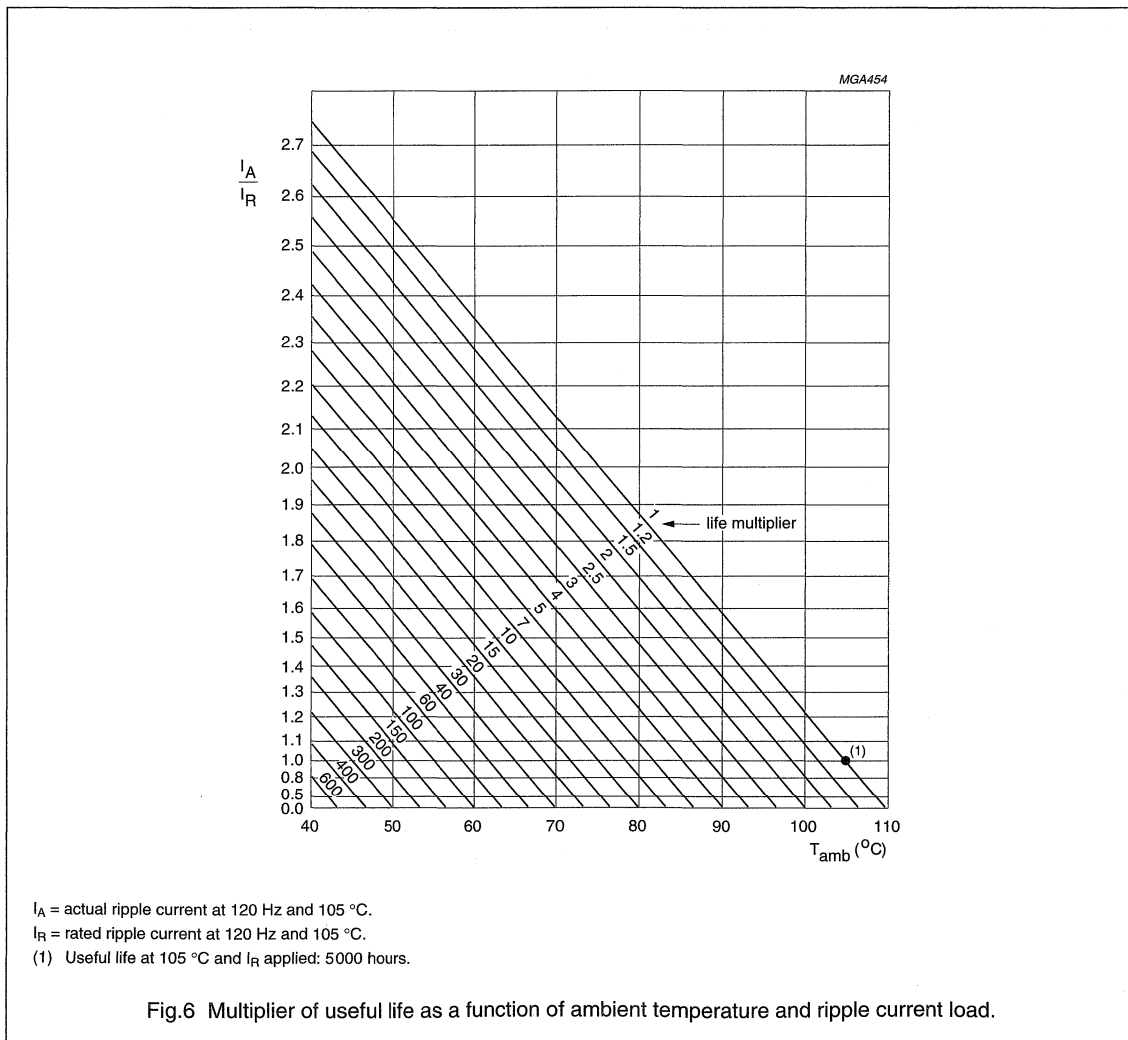
Aluminum electrolytic capacitors Power Ultra Long Life Snap-in

159 PUL-SI

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.9
100	0.95
120	1.0
200	1.15
1000	1.3
≥ 10000	1.4



Aluminum electrolytic capacitors

Power Ultra Long Life Snap-in

159 PUL-SI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

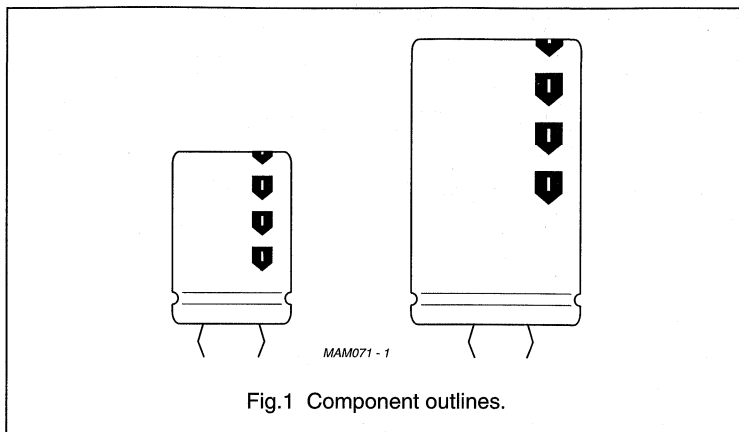
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ °C}$; U_R applied; 2000 hours	$\Delta C/C: \pm 15\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Load life		$T_{amb} = 105\text{ °C}$; U_R and I_R applied; 2000 hours	$\Delta C/C: \pm 20\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; 5000 hours	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ °C}$; no voltage applied; 1000 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$

Aluminum electrolytic capacitors Power Standard Miniature Snap-in

056/057 PSM-SI

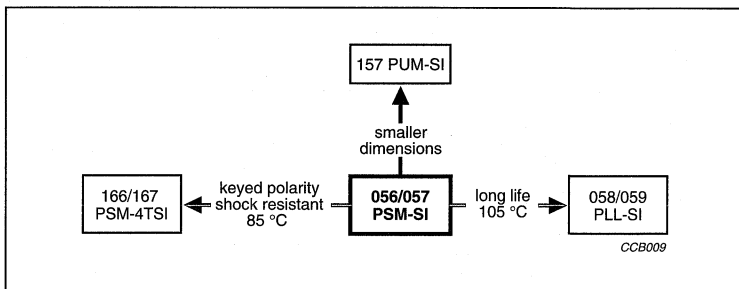
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case
- Charge and discharge proof
- Long useful life:
12000 hours at 85 °C
- High ripple current capability; see Table 3 for ripple current optimized types, 385 V and 400 V
- Keyed polarity version available with three or four terminals.



APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	056	057
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	22 × 25 to 35 × 50	
Rated capacitance range (E6 series), C_R	470 to 68000 μF	47 to 1500 μF
Tolerance on C_R	±20%	
Rated voltage range, U_R ; note 1	10 to 100 V	200 to 450 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	5000 hours (450 V: 2000 hours)	
Useful life at 85 °C	12000 hours (450 V: 5000 hours)	
Useful life at 40 °C and $1.4 \times I_R$ applied	210000 hours (450 V: 90000 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	

Note

1. A 420 V range is available on request.

Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 056 series

Preferred types in **bold**.

C_R (μF)	U_R (V)						
	10	16	25	40	50	63	100
470	–	–	–	–	–	–	22 × 25
680	–	–	–	–	–	–	22 × 30
1000	–	–	–	–	–	22 × 25	25 × 30
	–	–	–	–	–	–	22 × 40
1500	–	–	–	–	22 × 25	22 × 30	30 × 30
	–	–	–	–	–	–	25 × 40
2200	–	–	–	22 × 25	22 × 30	25 × 30	30 × 40
	–	–	–	–	–	22 × 40	25 × 50
3300	–	–	22 × 25	22 × 30	25 × 30	30 × 30	35 × 40
	–	–	–	–	22 × 40	25 × 40	30 × 50
4700	–	22 × 25	22 × 30	25 × 30	30 × 30	30 × 40	35 × 50
	–	–	–	22 × 40	25 × 40	25 × 50	–
6800	22 × 25	22 × 30	25 × 30	30 × 30	30 × 40	35 × 40	–
	–	–	22 × 40	25 × 40	25 × 50	30 × 50	–
10000	22 × 30	25 × 30	30 × 30	30 × 40	35 × 40	35 × 50	–
	–	22 × 40	25 × 40	25 × 50	30 × 50	–	–
15000	25 × 30	30 × 30	30 × 40	35 × 40	35 × 50	–	–
	22 × 40	25 × 40	25 × 50	30 × 50	–	–	–
22000	30 × 30	30 × 40	35 × 40	35 × 50	–	–	–
	25 × 40	25 × 50	30 × 50	–	–	–	–
33000	30 × 40	35 × 40	35 × 50	–	–	–	–
	25 × 50	30 × 50	–	–	–	–	–
47000	35 × 40	35 × 50	–	–	–	–	–
	30 × 50	–	–	–	–	–	–
68000	35 × 50	–	–	–	–	–	–

L

Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 057 series

Preferred types in **bold**.

C_R (μF)	U_R (V)				
	200	250	385	400	450
47	–	–	22 × 30 ⁽¹⁾	22 × 30 ⁽¹⁾	22 × 30
	–	–	22 × 25	22 × 25	–
68	–	–	25 × 30 ⁽¹⁾	25 × 30 ⁽¹⁾	22 × 30
	–	–	22 × 40 ⁽¹⁾	22 × 35 ⁽¹⁾	–
	–	–	22 × 35 ⁽¹⁾	22 × 30	–
	–	–	22 × 30	–	–
100	–	22 × 25	30 × 30 ⁽¹⁾	30 × 30 ⁽¹⁾	30 × 30
	–	–	25 × 40 ⁽¹⁾	25 × 40 ⁽¹⁾	–
	–	–	25 × 30	25 × 30	–
	–	–	22 × 40	22 × 35	–
	–	–	22 × 35	–	25 × 35
150	22 × 25	22 × 30	30 × 40 ⁽¹⁾	30 × 35 ⁽¹⁾	25 × 50
	–	–	30 × 35 ⁽¹⁾	30 × 30	–
	–	–	30 × 30	25 × 50 ⁽¹⁾	–
	–	–	25 × 50 ⁽¹⁾	25 × 40	–
	–	–	25 × 40	–	30 × 35
220	22 × 30	25 × 30	35 × 35 ⁽¹⁾	35 × 40 ⁽¹⁾	35 × 40
	–	22 × 40	30 × 45 ⁽¹⁾	30 × 50 ⁽¹⁾	30 × 45
	–	–	30 × 40	30 × 35	–
	–	–	30 × 35	25 × 50	–
	–	–	25 × 50	–	–
330	25 × 30	30 × 30	35 × 50 ⁽¹⁾	35 × 50 ⁽¹⁾	35 × 50
	22 × 40	25 × 40	35 × 45 ⁽¹⁾	35 × 40	35 × 45
	–	–	35 × 35	30 × 50	–
	–	–	30 × 45	–	–
470	30 × 30	30 × 40	35 × 50	35 × 50	–
	25 × 40	25 × 50	35 × 45	–	–
680	30 × 40	35 × 40	–	–	–
	25 × 50	30 × 50	–	–	–
1000	35 × 40	35 × 50	–	–	–
	30 × 50	–	–	–	–
1500	35 × 50	–	–	–	–

Note

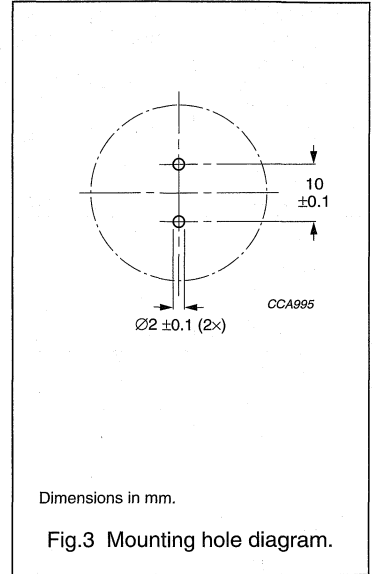
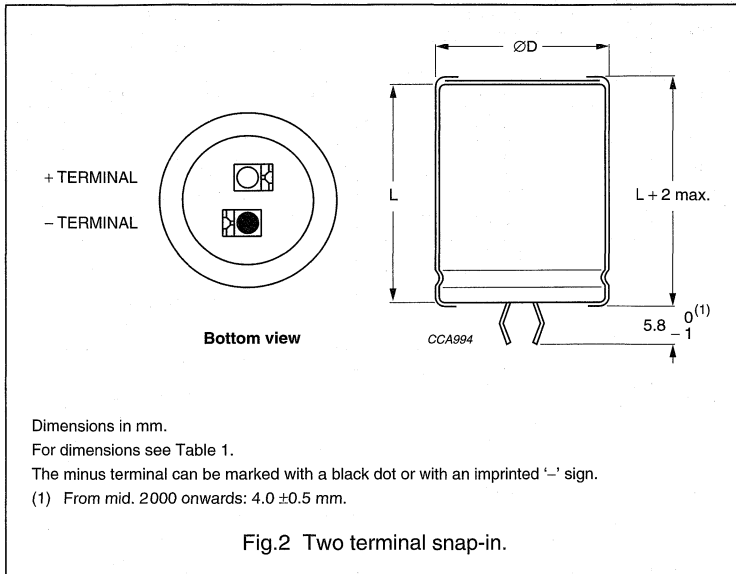
1. Ripple current optimized types.

Aluminum electrolytic capacitors Power Standard Miniature Snap-in

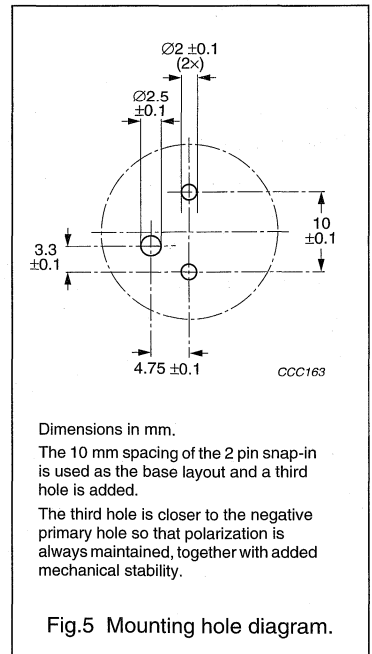
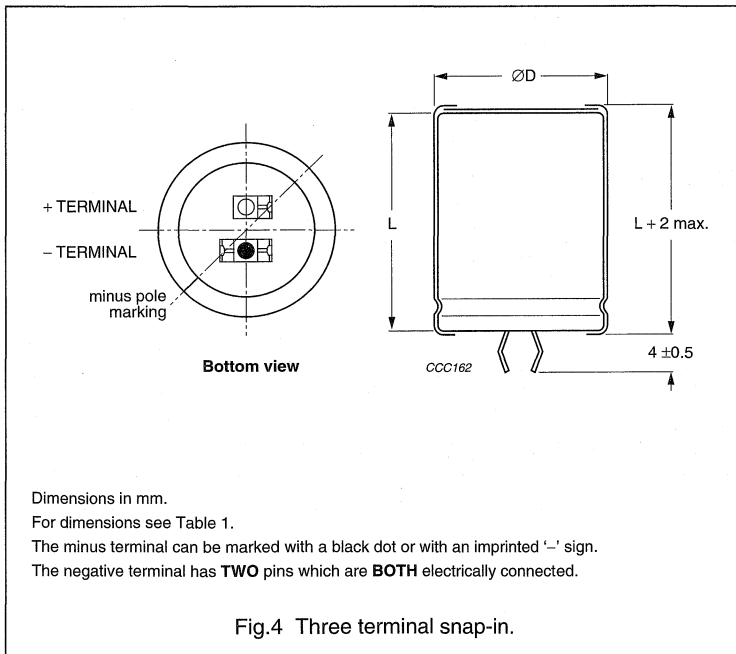
056/057 PSM-SI

MECHANICAL DATA AND PACKAGING QUANTITIES

Two terminal snap-in



Three terminal snap-in (available on request)



Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

Table 1 Physical dimensions, mass and packaging information; see Figs 2 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{\max}$ (mm)	L_{\max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
22 × 25	23	27	≈12	100	260 × 250 × 39
22 × 30	23	32	≈16	100	260 × 250 × 44
22 × 35	23	37	≈20	100	260 × 250 × 49
22 × 40	23	42	≈23	100	260 × 250 × 54
25 × 30	26	32	≈22	100	290 × 280 × 44
25 × 35	26	37	≈24	100	290 × 280 × 49
25 × 40	26	42	≈27	100	290 × 280 × 54
25 × 50	26	52	≈38	100	290 × 280 × 64
30 × 30	31	32	≈30	100	340 × 330 × 44
30 × 35	31	37	≈35	100	340 × 330 × 49
30 × 40	31	42	≈40	100	340 × 330 × 54
30 × 45	31	47	≈45	100	340 × 330 × 59
30 × 50	31	52	≈50	100	340 × 330 × 64
35 × 35	36	37	≈48	50	390 × 198 × 49
35 × 40	36	42	≈55	50	390 × 198 × 54
35 × 45	36	47	≈63	50	390 × 198 × 59
35 × 50	36	52	≈72	50	390 × 198 × 64

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- '-' sign to indicate the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 2, 3 and 4 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 100 Hz or $\geq 10\text{ kHz}$ and 85 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 100 Hz
Z	max. impedance at 10 kHz

Ordering example

Electrolytic capacitor 056 series

10000 $\mu\text{F}/25\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 25 \times 40\text{ mm}$
2-terminal snap-in

Catalogue number: 2222 056 46103.

Table 2 Electrical data and ordering information for **056** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R $\geq 10\text{ kHz}$ 85 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
10	6800	22 × 25	2.04	2.40	412	140	76	62	056 54682
	10000	22 × 30	2.56	3.02	608	205	56	45	056 54103
	15000	25 × 30	3.12	3.68	904	304	44	39	056 54153
	15000	22 × 40	3.39	4.00	904	304	41	34	056 44153
	22000	30 × 30	3.47	4.09	1324	444	44	37	056 54223
	22000	25 × 40	4.12	4.86	1324	444	34	28	056 44223
	33000	30 × 40	4.58	5.40	1984	664	32	28	056 54333
	33000	25 × 50	4.70	5.55	1984	664	30	27	056 44333
	47000	35 × 40	5.10	6.02	2824	944	31	26	056 54473
	47000	30 × 50	5.39	6.36	2824	944	28	24	056 44473
	68000	35 × 50	5.88	6.94	4084	1364	28	23	056 54683
16	4700	22 × 25	2.01	2.37	455	154	79	62	056 55472
	6800	22 × 30	2.54	3.00	657	222	57	45	056 55682
	10000	25 × 30	3.02	3.56	964	324	47	39	056 55103
	10000	22 × 40	3.28	3.87	964	324	44	34	056 45103
	15000	30 × 30	3.36	3.96	1444	484	47	37	056 55153
	15000	25 × 40	4.00	4.72	1444	484	34	28	056 45153
	22000	30 × 40	4.51	5.32	2116	708	33	28	056 55223
	22000	25 × 50	3.97	4.68	2116	708	42	41	056 45223
	33000	35 × 40	5.02	5.92	3172	1060	32	28	056 55333
	33000	30 × 50	4.75	5.61	3172	1060	36	34	056 45333
	47000	35 × 50	5.34	6.30	4516	1508	34	32	056 55473

Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R ≥ 10 kHz 85 °C (A)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
25	3300	22 × 25	1.88	2.22	499	169	89	61	056 56332
	4700	22 × 30	2.37	2.80	709	239	65	45	056 56472
	6800	25 × 30	2.81	3.32	1024	344	54	41	056 56682
	6800	22 × 40	3.16	3.73	1024	344	47	38	056 46682
	10000	30 × 30	3.25	3.84	1504	504	50	38	056 56103
	10000	25 × 40	3.73	4.40	1504	504	39	30	056 46103
	15000	30 × 40	4.73	5.58	2254	754	30	28	056 56153
	15000	25 × 50	3.92	4.63	2254	754	43	39	056 46153
	22000	35 × 40	4.48	5.29	3304	1104	40	28	056 56223
	22000	30 × 50	4.96	5.85	3304	1104	36	23	056 46223
33000	35 × 50	4.98	5.88	4954	1654	39	33	056 56333	
40	2200	22 × 25	1.85	2.26	532	180	92	61	056 57222
	3300	22 × 30	2.09	2.55	796	260	67	45	056 57332
	4700	25 × 30	2.28	2.78	1132	380	82	70	056 57472
	4700	22 × 40	3.10	3.78	1132	380	49	38	056 47472
	6800	30 × 30	3.16	3.85	1636	548	53	38	056 57682
	6800	25 × 40	3.06	3.73	1636	548	58	50	056 47682
	10000	30 × 40	4.20	5.12	2404	804	38	28	056 57103
	10000	25 × 50	3.88	4.73	2404	804	44	39	056 47103
	15000	35 × 40	4.05	4.94	3604	1204	49	41	056 57153
	15000	30 × 50	4.45	5.43	3604	1204	41	34	056 47153
	22000	35 × 50	4.86	5.93	5284	1764	40	33	056 57223
	50	1500	22 × 25	1.36	1.66	454	154	170	130
2200		22 × 30	1.75	2.14	664	224	120	91	056 51222
3300		25 × 30	2.17	2.65	994	334	90	72	056 51332
3300		22 × 40	2.42	2.95	994	334	80	63	056 41332
4700		30 × 30	2.65	3.23	1414	474	75	63	056 51472
4700		25 × 40	2.89	3.53	1414	474	65	52	056 41472
6800		30 × 40	3.56	4.34	2044	684	53	45	056 51682
6800		25 × 50	3.75	4.58	2044	684	50	43	056 41682
10000		35 × 40	4.05	4.94	3004	1004	49	42	056 51103
10000		30 × 50	4.50	5.49	3004	1004	40	35	056 41103
15000		35 × 50	4.98	6.08	4504	1504	39	33	056 51153

Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R ≥ 10 kHz 85 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
63	1000	22 × 25	1.46	1.78	382	130	148	104	056 58102
	1500	22 × 30	1.87	2.28	571	193	105	72	056 58152
	2200	25 × 30	2.32	2.83	836	281	79	59	056 58222
	2200	22 × 40	2.54	3.10	836	281	73	53	056 48222
	3300	30 × 30	2.87	3.50	1251	420	64	50	056 58332
	3300	25 × 40	3.14	3.83	1251	420	55	44	056 48332
	4700	30 × 40	3.67	4.48	1780	596	50	38	056 58472
	4700	25 × 50	3.71	4.53	1780	596	48	38	056 48472
	6800	35 × 40	4.33	5.28	2574	861	43	38	056 58682
	6800	30 × 50	4.75	5.80	2574	861	42	37	056 48682
	10000	35 × 50	5.26	6.42	3784	1264	35	30	056 58103
100	470	22 × 25	0.77	0.94	286	98	535	470	056 59471
	680	22 × 30	0.99	1.21	412	160	375	328	056 59681
	1000	25 × 30	1.27	1.55	604	204	265	235	056 59102
	1000	22 × 40	1.35	1.65	604	204	260	225	056 49102
	1500	30 × 30	1.67	2.04	904	304	190	170	056 59152
	1500	25 × 40	1.75	2.14	904	304	180	160	056 49152
	2200	30 × 40	2.27	2.77	1324	444	130	120	056 59222
	2200	25 × 50	2.30	2.80	1324	444	125	110	056 49222
	3300	35 × 40	2.84	3.46	1984	664	100	95	056 59332
	3300	30 × 50	2.97	3.62	1984	664	92	85	056 49332
	4700	35 × 50	3.59	4.38	2824	677	75	70	056 59472

Notes

1. All catalogue numbers refer to 2 terminal snap-in products.
2. 3 terminal snap-ins are available on request.

Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

Table 3 Electrical data and ordering information for **057** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
200	150	22 × 25	0.77	184	64	950	620	057 52151
	220	22 × 30	1.00	268	92	650	435	057 52221
	330	25 × 30	1.36	400	136	430	310	057 52331
	330	22 × 40	1.36	400	136	430	310	057 42331
	470	30 × 30	1.80	568	192	310	230	057 52471
	470	25 × 40	1.80	568	192	310	230	057 42471
	680	30 × 40	2.39	820	276	210	180	057 52681
	680	25 × 50	2.39	820	276	210	180	057 42681
	1000	35 × 40	2.85	1204	404	160	135	057 52102
	1000	30 × 50	2.85	1204	404	160	135	057 42102
1500	35 × 50	3.66	1804	604	120	105	057 52152	
250	100	22 × 25	0.63	154	54	1440	770	057 53101
	150	22 × 30	0.83	229	79	960	520	057 53151
	220	25 × 30	1.10	334	114	660	365	057 53221
	220	22 × 40	1.10	334	114	660	365	057 43221
	330	30 × 30	1.49	499	169	440	265	057 53331
	330	25 × 40	1.49	499	169	440	265	057 43331
	470	30 × 40	1.98	709	239	310	185	057 53471
	470	25 × 50	1.98	709	239	310	185	057 43471
	680	35 × 40	2.60	1024	344	240	145	057 53681
	680	30 × 50	2.60	1024	344	240	145	057 43681
	1000	35 × 50	3.12	1504	504	160	105	057 53102
	385	47	22 × 30	0.59	112	40	3000	1400
47		22 × 25	0.50	112	40	3000	1400	057 58479
68		25 × 30	0.82	161	56	2100	1100	057 78689 ⁽³⁾
68		22 × 40	0.81	161	56	2100	1100	057 28689 ⁽³⁾
68		22 × 35	0.79	161	56	2100	1100	057 18689 ⁽³⁾
68		22 × 30	0.63	161	56	2100	1000	057 58689
100		30 × 30	1.13	235	81	1400	750	057 28101 ⁽³⁾
100		25 × 40	1.13	235	81	1400	750	057 18101 ⁽³⁾
100		25 × 30	0.86	235	81	1400	780	057 58101
100		22 × 40	0.86	235	81	1400	780	057 48101
100		22 × 35	0.84	235	81	1400	780	057 38101
150		30 × 40	1.54	350	119	1000	500	057 38151 ⁽³⁾
150		30 × 35	1.41	350	119	1000	500	057 28151 ⁽³⁾
150		30 × 30	1.16	350	119	950	520	057 58151
150		25 × 50	1.48	350	119	1000	500	057 18151 ⁽³⁾

Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
385	150	25 × 40	1.16	350	119	950	520	057 48151
	220	35 × 35	1.61	512	173	700	460	057 28221 ⁽³⁾
	220	30 × 45	1.63	512	173	700	460	057 18221 ⁽³⁾
	220	30 × 40	1.57	512	173	650	400	057 58221
	220	30 × 35	1.50	512	173	650	400	057 38221
	220	25 × 50	1.57	512	173	650	400	057 48221
	330	35 × 50	2.31	766	258	450	280	057 28331 ⁽³⁾
	330	35 × 45	2.20	766	258	450	280	057 18331 ⁽³⁾
	330	35 × 35	1.73	766	258	480	280	057 68331
	330	30 × 45	1.75	766	258	480	280	057 38331
	470	35 × 50	2.40	1089	366	340	220	057 58471
	470	35 × 45	2.29	1089	366	340	220	057 48471
400	47	22 × 30	0.59	117	42	3000	1400	057 16479 ⁽³⁾
	47	22 × 25	0.50	117	42	3000	1400	057 56479
	68	25 × 30	0.82	167	58	2100	1100	057 26689 ⁽³⁾
	68	22 × 35	0.79	167	58	2100	1100	057 16689 ⁽³⁾
	68	22 × 30	0.63	167	58	2100	1000	057 56689
	100	30 × 30	1.13	244	84	1400	750	057 26101 ⁽³⁾
	100	25 × 40	1.13	244	84	1400	750	057 16101 ⁽³⁾
	100	25 × 30	0.86	244	84	1400	780	057 56101
	100	22 × 35	0.84	240	84	1400	780	057 36101
	150	30 × 35	1.41	364	124	1000	520	057 26151 ⁽³⁾
	150	30 × 30	1.16	364	124	950	520	057 56151
	150	25 × 50	1.50	364	124	1000	520	057 16151 ⁽³⁾
	150	25 × 40	1.16	364	124	950	520	057 46151
	220	35 × 40	1.74	532	180	700	460	057 26221 ⁽³⁾
	220	30 × 50	1.75	532	180	700	460	057 16221 ⁽³⁾
	220	30 × 35	1.50	532	180	650	400	057 36221
	220	25 × 50	1.57	532	180	650	400	057 46221
	330	35 × 50	2.31	796	268	450	300	057 16331 ⁽³⁾
	330	35 × 40	1.85	796	268	480	280	057 56331
	330	30 × 50	1.85	796	268	480	280	057 46331
	470	35 × 50	2.40	1132	380	340	220	057 56471

Notes

1. All catalogue numbers refer to 2 terminal snap-in products.
2. 3 terminal snap-ins are available on request.
3. Ripple current optimized types.

Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

Table 4 Electrical data and ordering information (continued) for **057** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
450	47	22 × 30	0.26	131	45	5600	4400	057 67479
	68	22 × 30	0.33	188	65	3900	3100	057 57689
	100	30 × 30	0.48	274	94	2600	2100	057 57101
	100	25 × 35	0.46	274	94	2600	2100	057 37101
	150	30 × 35	0.66	409	140	1600	1300	057 37151
	150	25 × 50	0.70	409	140	1600	1300	057 47151
	220	35 × 40	0.92	598	202	1100	900	057 57221
	220	30 × 45	0.73	598	202	1100	900	057 37221
	330	35 × 50	1.26	895	301	700	600	057 57331
	330	35 × 45	1.20	895	301	700	600	057 47331

Notes

1. All catalogue numbers refer to 2 terminal snap-in products.
2. 3 terminal snap-ins are available on request.

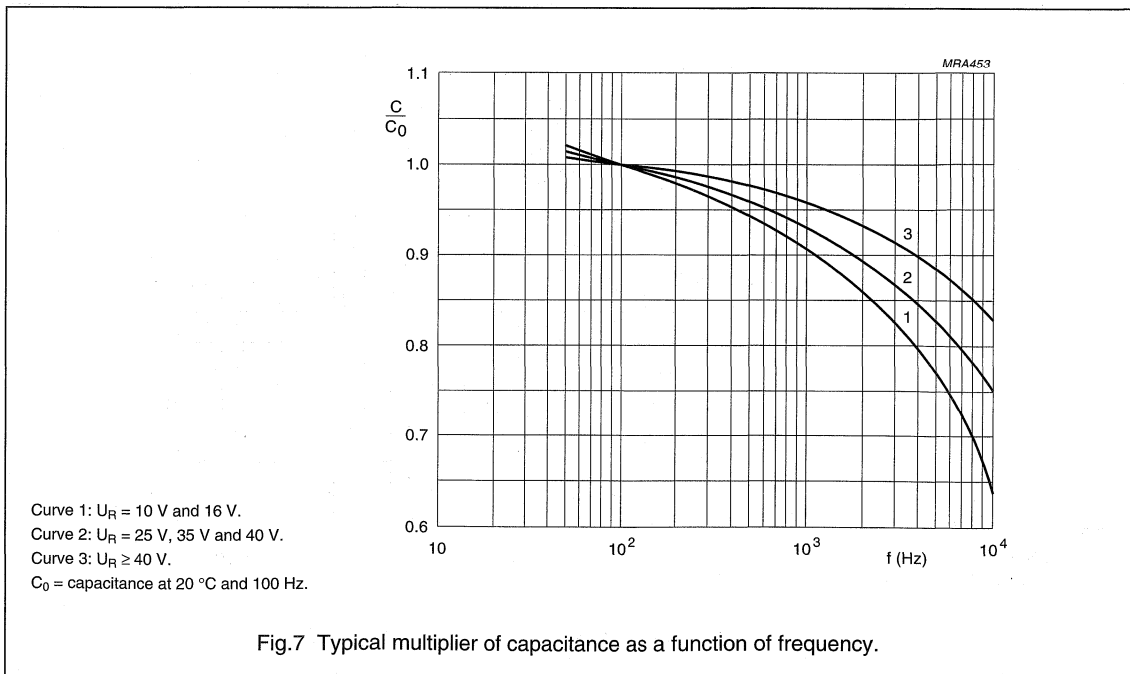
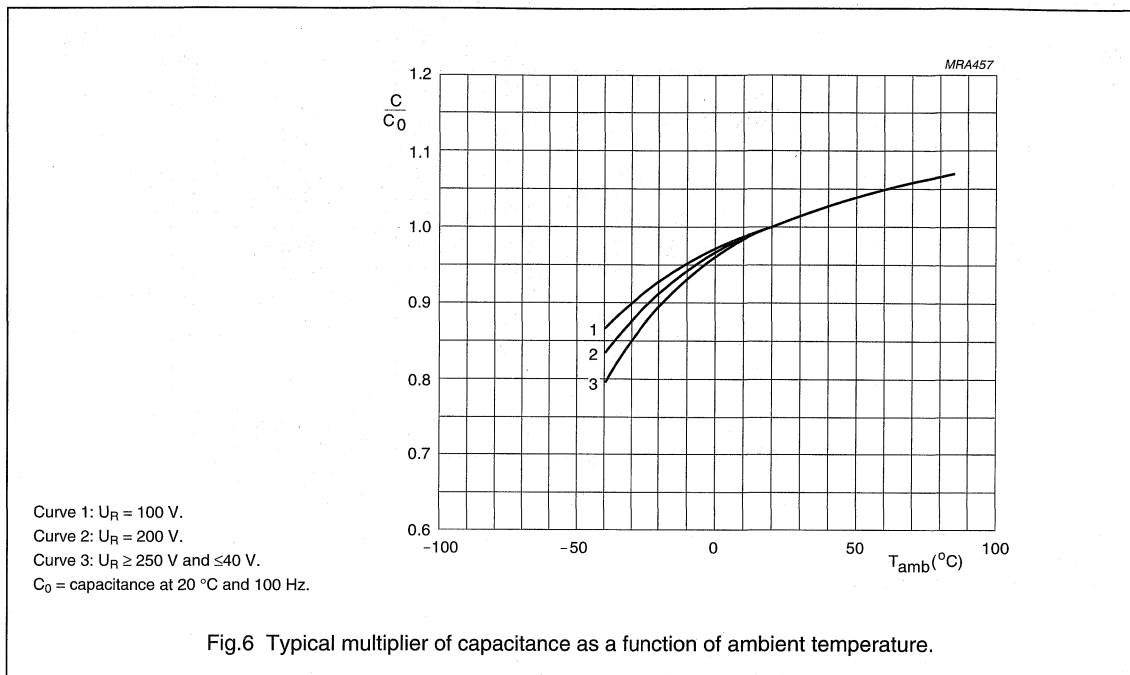
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.15 \times U_R$
	≥385 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH

Aluminum electrolytic capacitors
Power Standard Miniature Snap-in

056/057 PSM-SI

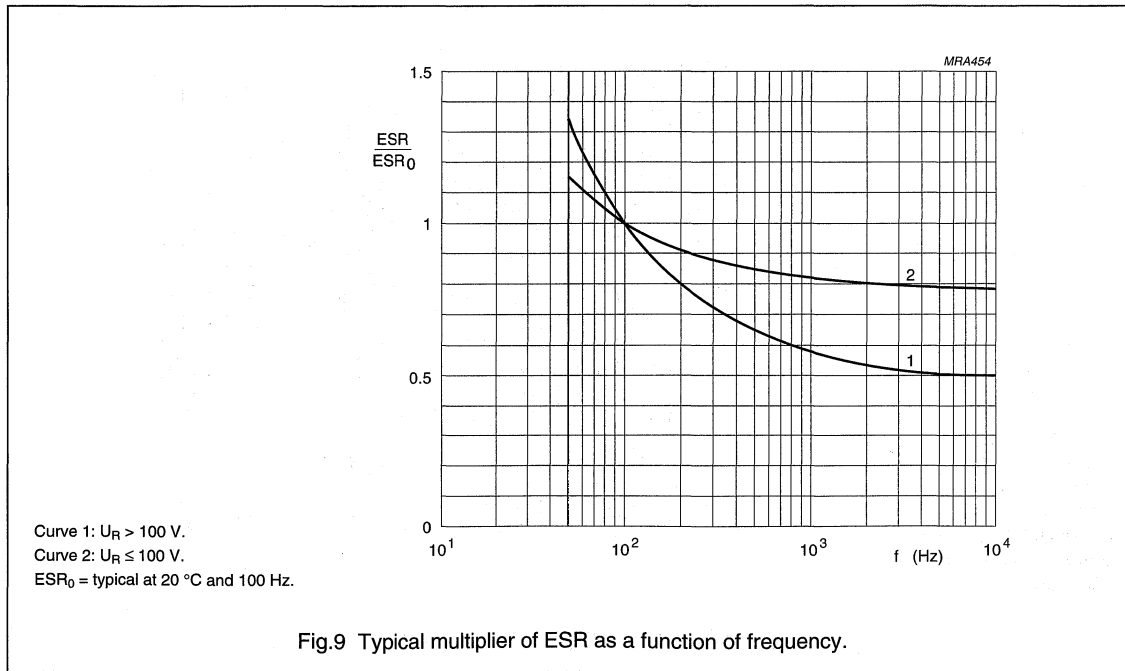
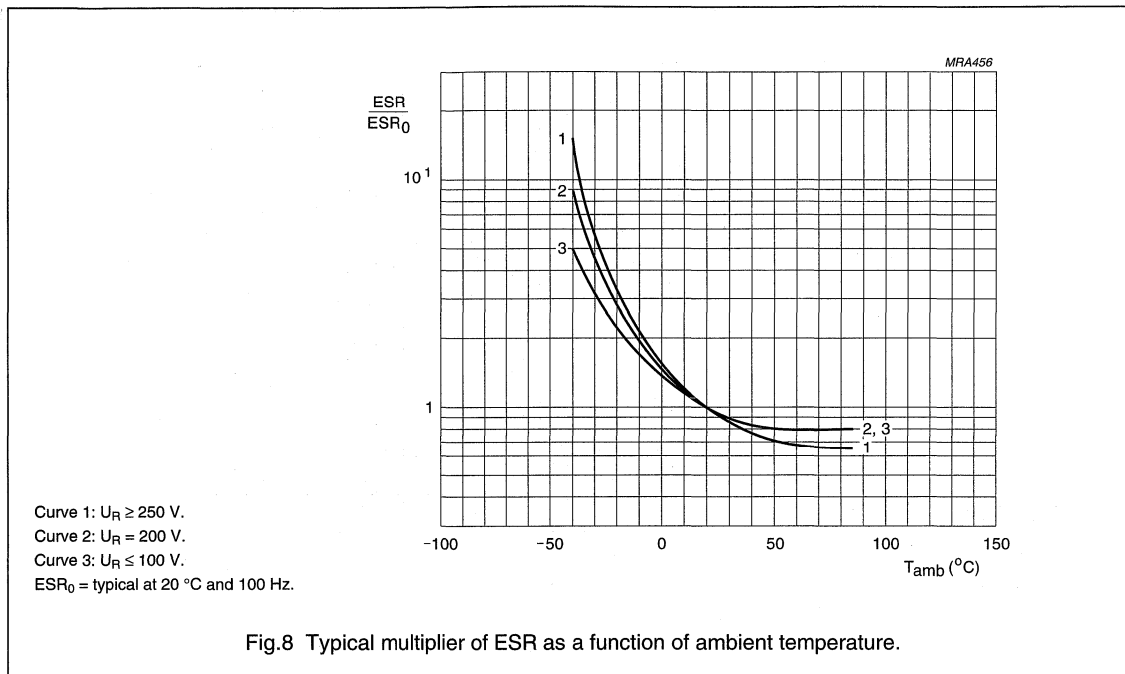
Capacitance (C)



Aluminum electrolytic capacitors
Power Standard Miniature Snap-in

056/057 PSM-SI

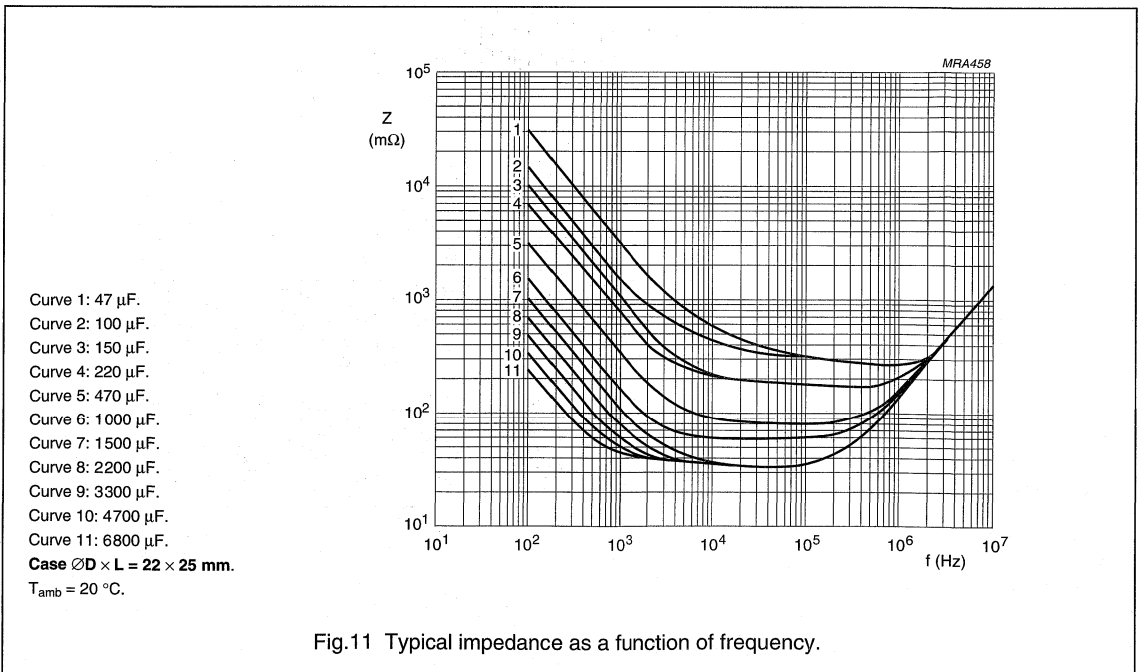
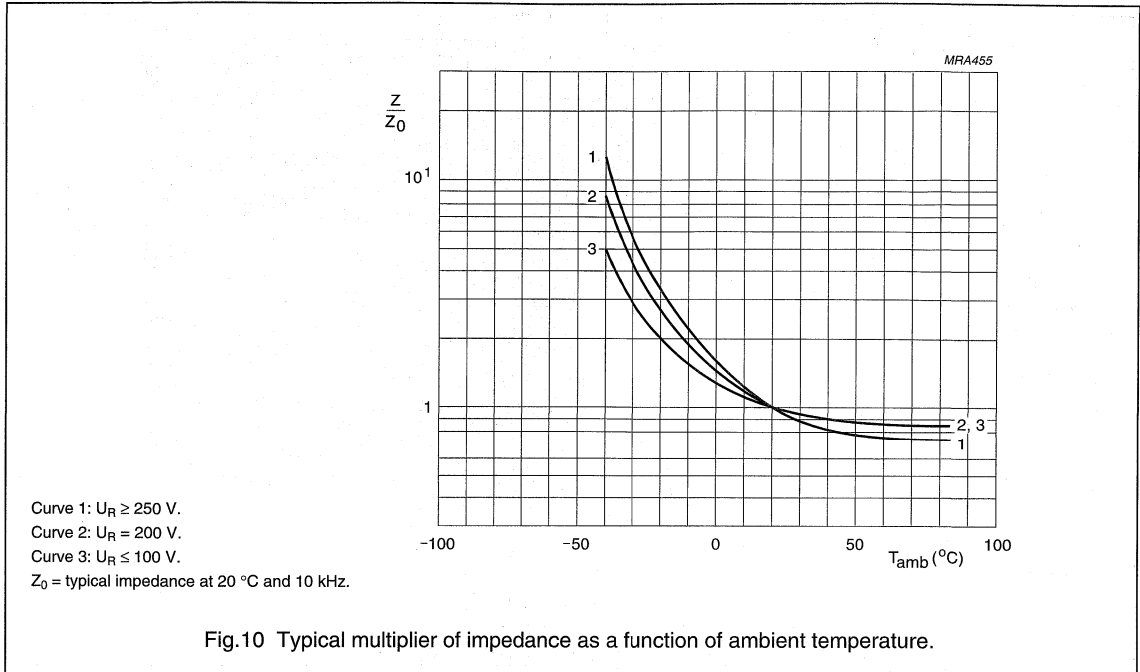
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors
Power Standard Miniature Snap-in

056/057 PSM-SI

Impedance (Z)



Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

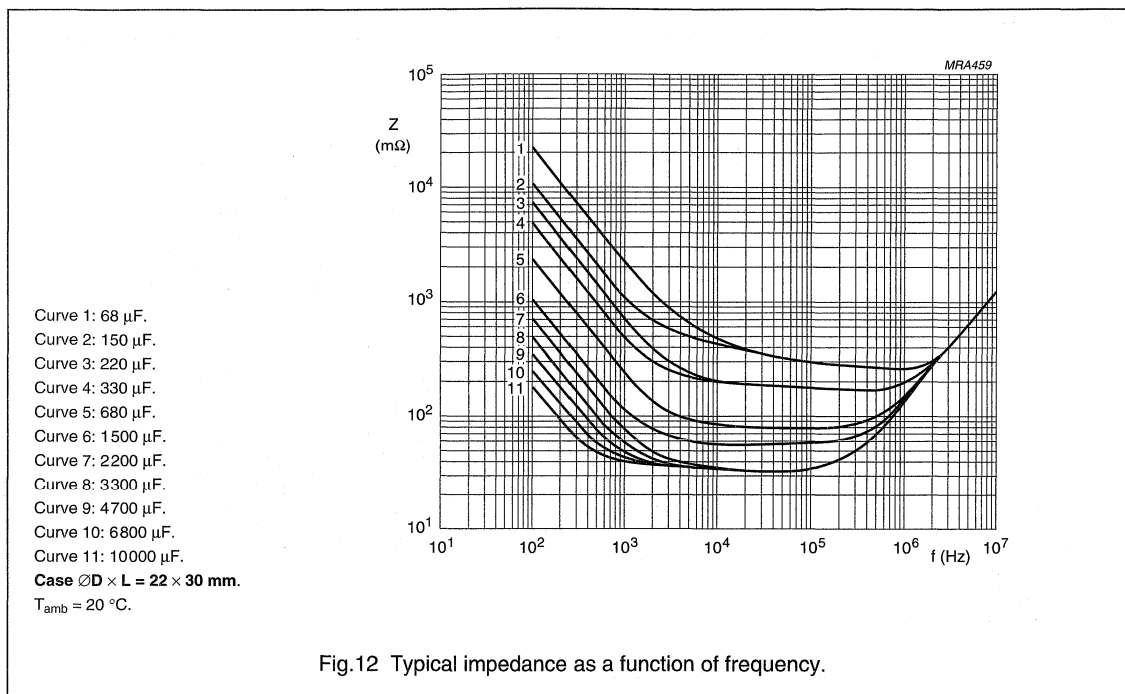


Fig.12 Typical impedance as a function of frequency.

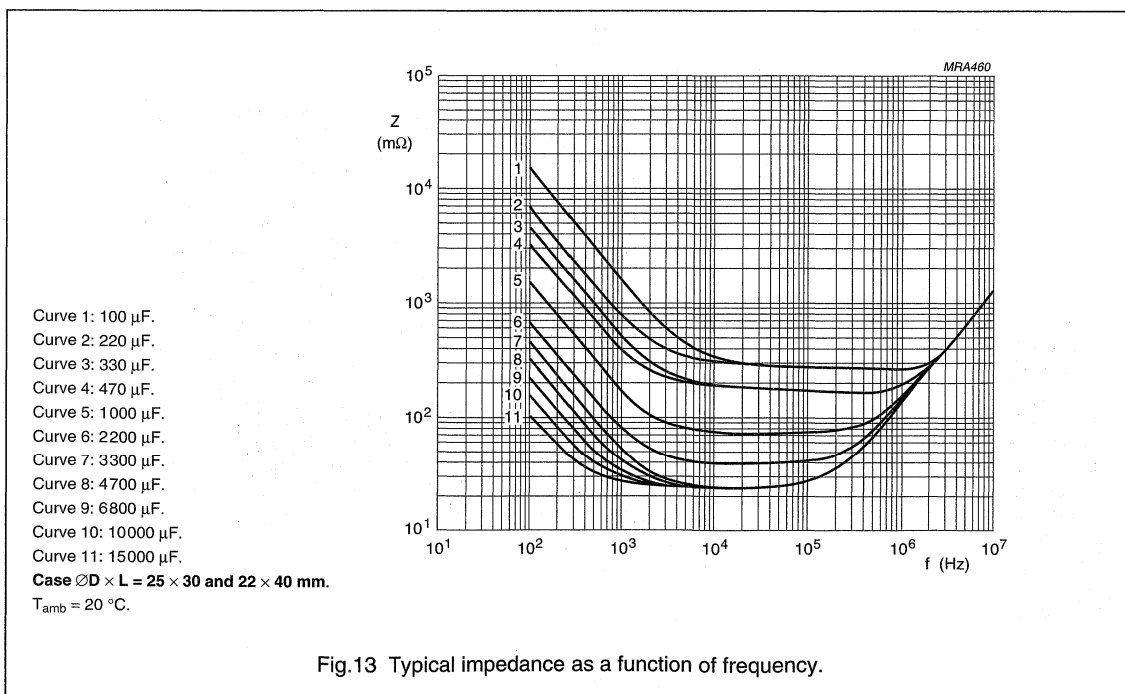
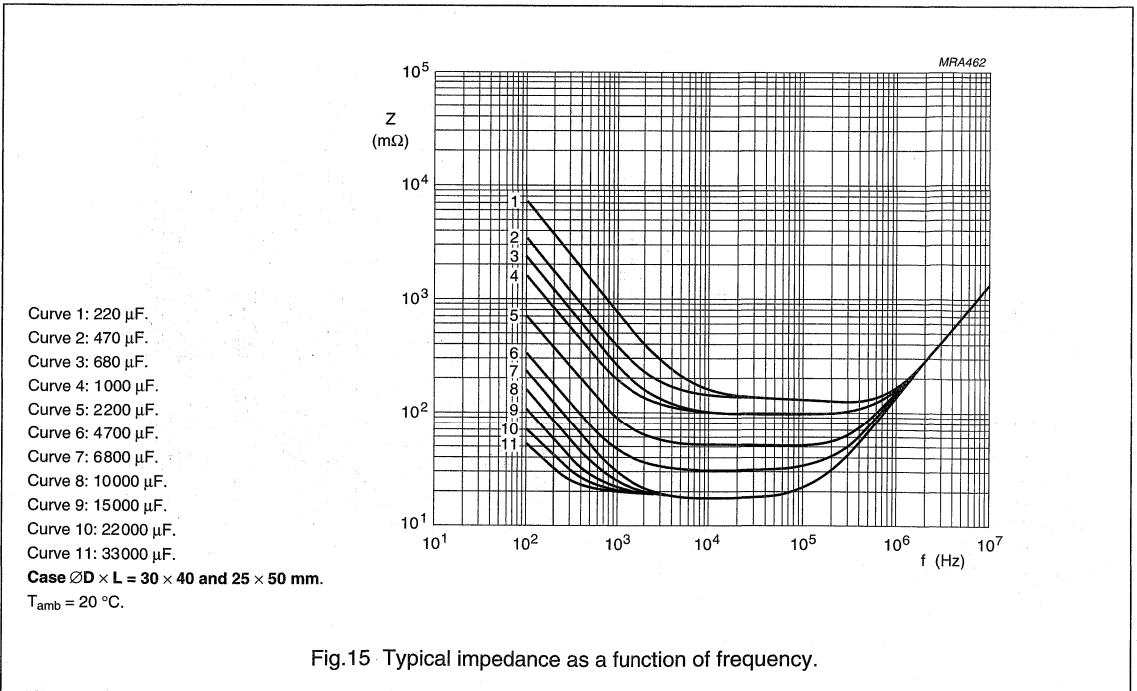
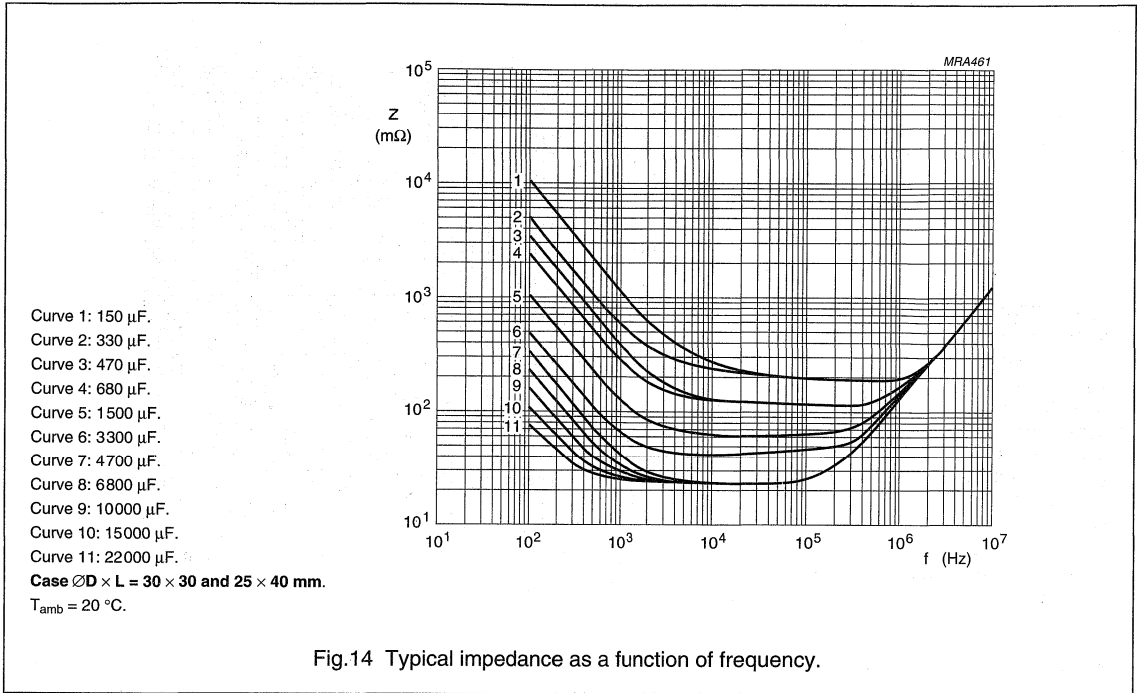


Fig.13 Typical impedance as a function of frequency.

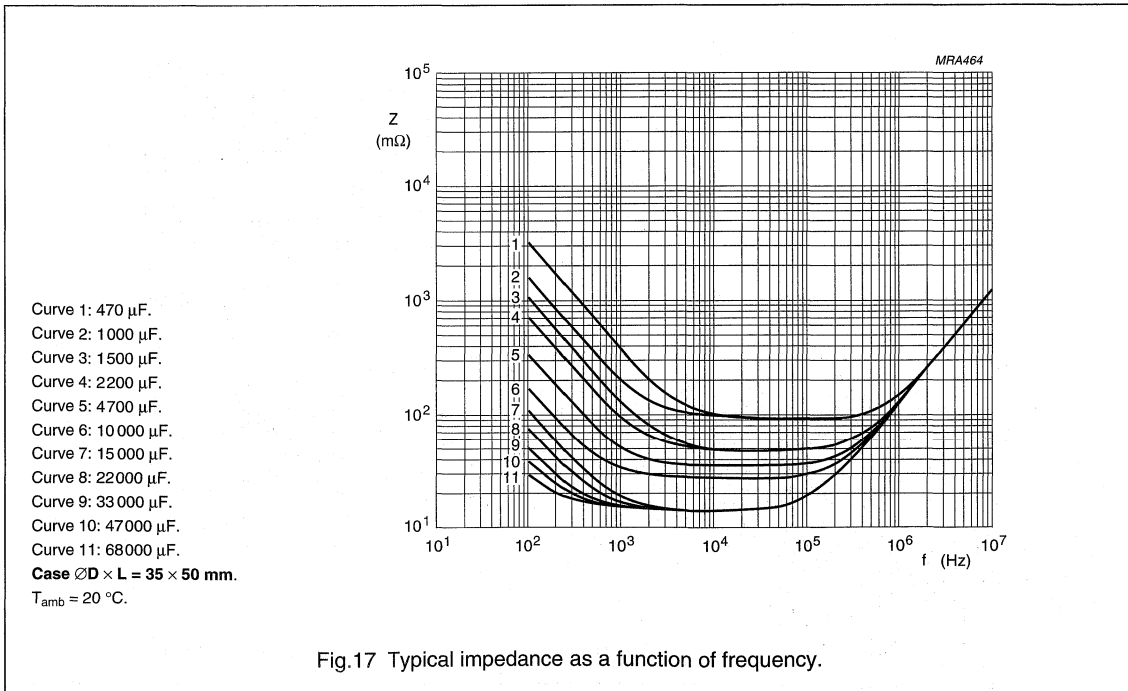
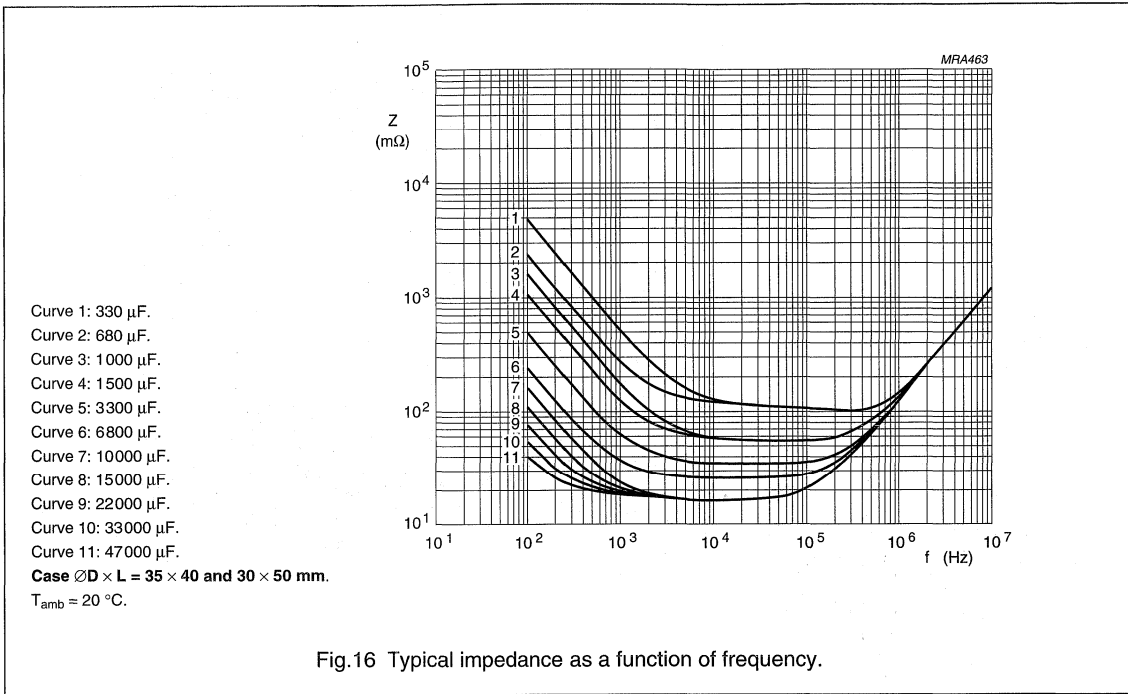
Aluminum electrolytic capacitors
Power Standard Miniature Snap-in

056/057 PSM-SI



Aluminum electrolytic capacitors
Power Standard Miniature Snap-in

056/057 PSM-SI



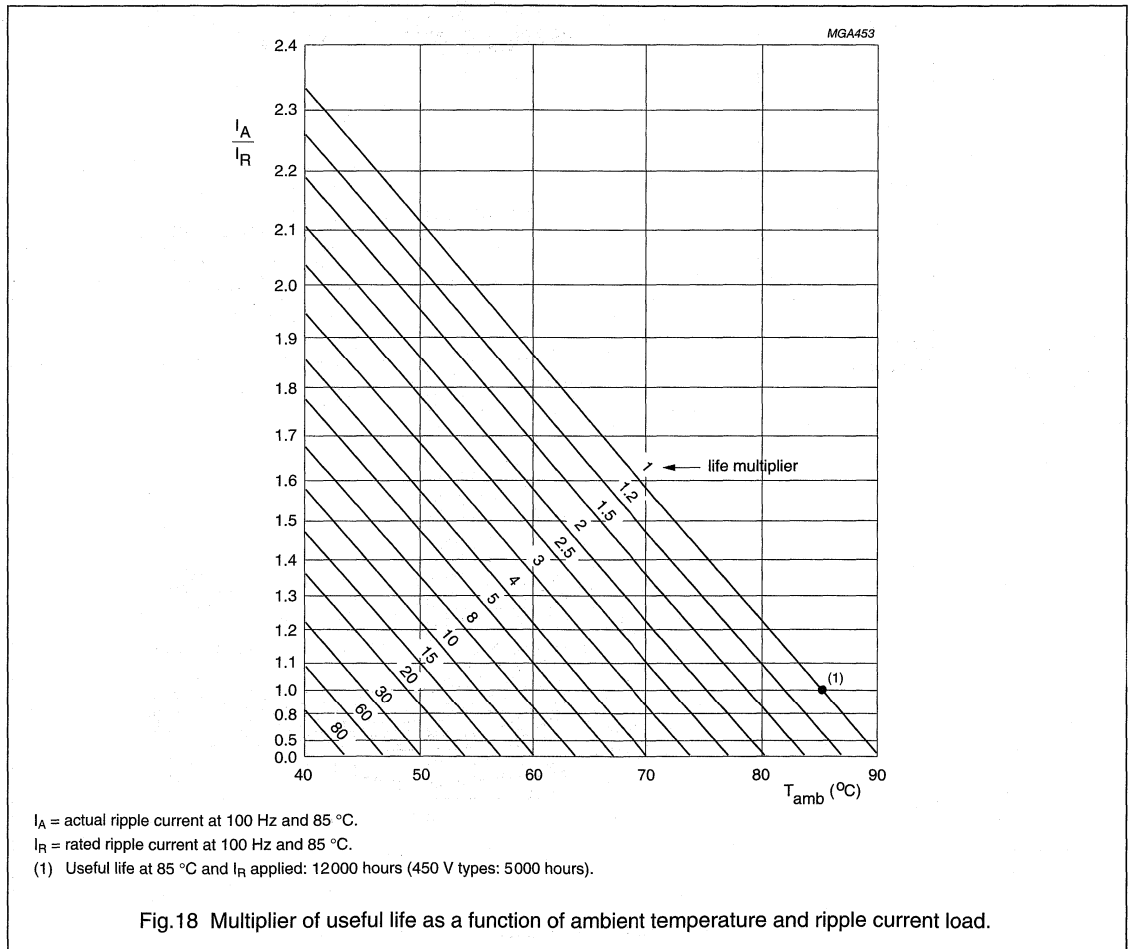
Aluminum electrolytic capacitors Power Standard Miniature Snap-in

056/057 PSM-SI

RIPPLE CURRENT AND USEFUL LIFE

Table 5 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 40$ to 100 V	$U_R > 100$ V
50	0.93	0.91	0.86
100	1.00	1.00	1.00
200	1.04	1.05	1.13
400	1.07	1.09	1.21
1000	1.11	1.13	1.29
2000	1.13	1.15	1.32
4000	1.15	1.18	1.35
≥ 10000	1.18	1.22	1.40



Aluminum electrolytic capacitors

Power Standard Miniature Snap-in

056/057 PSM-SI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 6 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied; 5000 hours (450 V types: 2000 hours)	$U_R \leq 100\text{ V}$; $\Delta C/C$: $\pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C$: $\pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 12000 hours (450 V types: 5000 hours)	$U_R \leq 100\text{ V}$; $\Delta C/C$: $\pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C$: $\pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}$: $\leq 1\%$; $U_R > 100\text{ V}$: $\leq 3\%$
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	$\Delta C/C$: $\pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power Long Life Snap-in

058/059 PLL-SI

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case
- Charge and discharge proof
- Very long useful life: up to 10000 hours at 105 °C
- Extended temperature range: 105 °C
- Low ESR, high ripple current capability
- Keyed polarity version available.

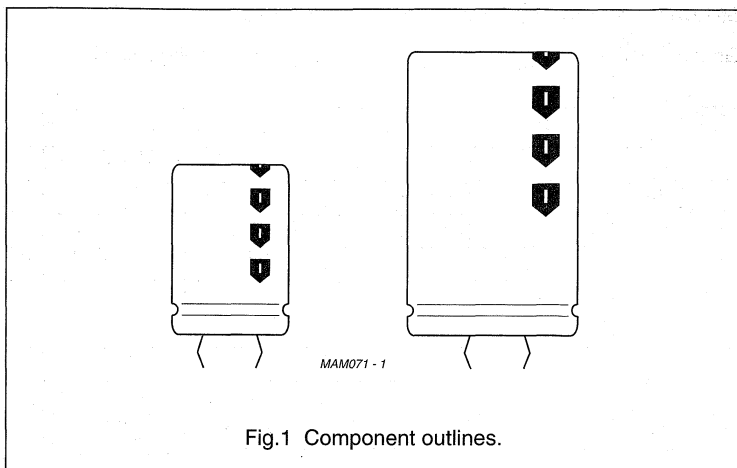
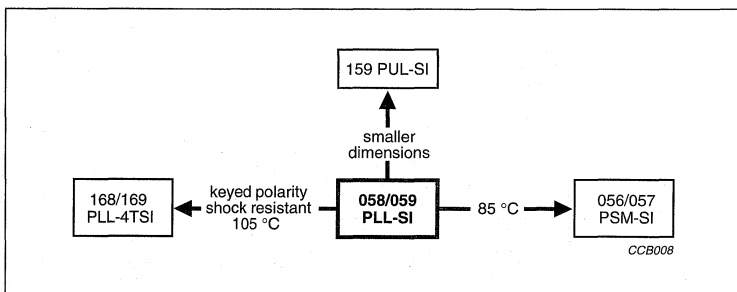


Fig.1 Component outlines.

APPLICATIONS

- Computer, telecommunication and industrial systems
- Smoothing and filtering applications
- Standard and switched mode power supplies
- Energy storage in pulse systems.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	058	059
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	22 × 25 to 35 × 50	
Rated capacitance range (E6 series), C_R	33 to 47000 μF	
Tolerance on C_R	±20%	
Rated voltage range, U_R	10 to 100 V	200 to 400 V
Category temperature range	-40 to +105 °C	
Endurance test at 105 °C	≤50 V: 2000 hours; ≥63 V: 5000 hours	
Useful life at 105 °C	≤50 V: 5000 hours; ≥63 V: 10000 hours	
Useful life at 40 °C and $1.9 \times I_R$ applied	≤50 V: 125000 hours; ≥63 V: 250000 hours	
Shelf life at 0 V, 105 °C	500 hours	
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	40/105/56	

Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 058 series

Preferred types in **bold**.

C_R (μF)	U_R (V)						
	10	16	25	40	50	63	100
330	–	–	–	–	–	–	22 × 25
470	–	–	–	–	–	–	22 × 30
680	–	–	–	–	–	22 × 25	25 × 30
	–	–	–	–	–	–	22 × 40
1000	–	–	–	–	22 × 25	22 × 30	30 × 30
	–	–	–	–	–	–	25 × 40
1500	–	–	–	22 × 25	22 × 30	25 × 30	30 × 40
	–	–	–	–	–	22 × 40	25 × 50
2200	–	–	22 × 25	22 × 30	25 × 30	30 × 30	35 × 40
	–	–	–	–	22 × 40	25 × 40	30 × 50
3300	–	22 × 25	22 × 30	25 × 30	30 × 30	30 × 40	35 × 50
	–	–	–	22 × 40	25 × 40	25 × 50	–
4700	22 × 25	22 × 30	25 × 30	30 × 30	30 × 40	35 × 40	–
	–	–	22 × 40	25 × 40	25 × 50	30 × 50	–
6800	22 × 30	25 × 30	30 × 30	30 × 40	35 × 40	35 × 50	–
	–	22 × 40	25 × 40	25 × 50	30 × 50	–	–
10000	25 × 30	30 × 30	30 × 40	35 × 40	35 × 50	–	–
	22 × 40	25 × 40	25 × 50	30 × 50	–	–	–
15000	30 × 30	30 × 40	35 × 40	35 × 50	–	–	–
	25 × 40	25 × 50	30 × 50	–	–	–	–
22000	30 × 40	35 × 40	35 × 50	–	–	–	–
	25 × 50	30 × 50	–	–	–	–	–
33000	35 × 40	35 × 50	–	–	–	–	–
	30 × 50	–	–	–	–	–	–
47000	35 × 50	–	–	–	–	–	–

Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 059 series

Preferred types in **bold**.

C_R (μF)	U_R (V)			
	200	250	385	400
33	–	–	22 × 25	–
47	–	–	22 × 30	22 × 30
68	–	22 × 25	22 × 35	22 × 35
	–	–	25 × 30	25 × 30
100	22 × 25	22 × 30	30 × 30	30 × 30
	–	–	25 × 40	25 × 40
150	22 × 30	22 × 35	25 × 50	30 × 35
	–	25 × 30	30 × 40	25 × 50
220	22 × 35	30 × 30	35 × 40	35 × 40
	25 × 30	25 × 35	30 × 50	30 × 50
330	30 × 30	30 × 35	35 × 50	35 × 50
	25 × 40	25 × 50	–	–
470	30 × 35	35 × 35	–	–
	25 × 50	30 × 45	–	–
680	35 × 35	35 × 45	–	–
	30 × 45	–	–	–
1000	35 × 50	–	–	–

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- Minus-sign to indicate the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".



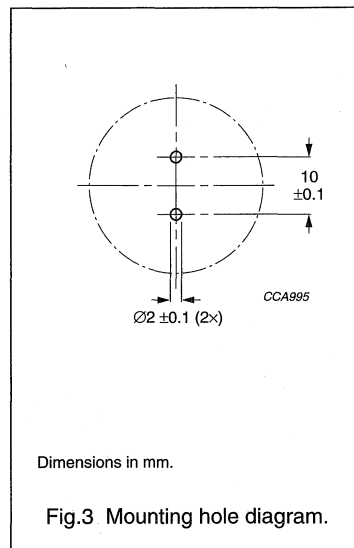
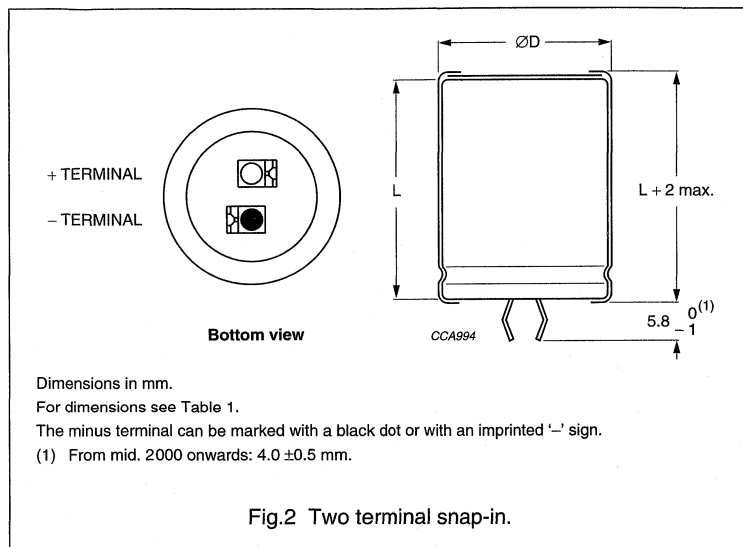
Aluminum electrolytic capacitors

Power Long Life Snap-in

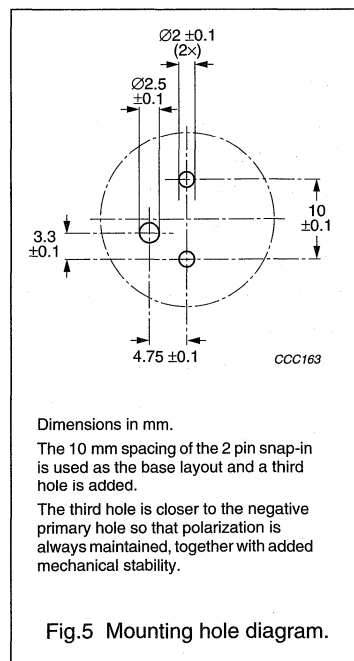
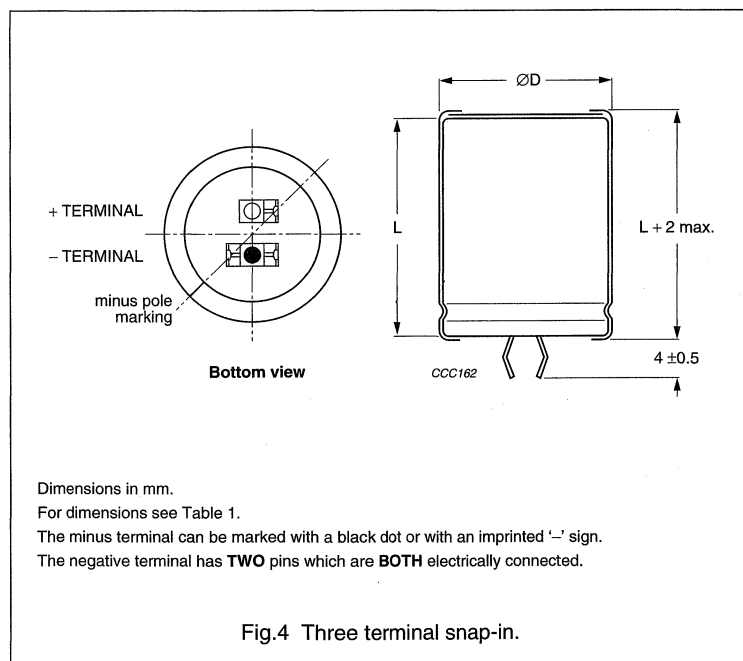
058/059 PLL-SI

MECHANICAL DATA AND PACKAGING QUANTITIES

Two terminal snap-in



Three terminal snap-in (available on request)



Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

Table 1 Physical dimensions, mass and packaging information; see Figs 2 and 4

NOMINAL CASE SIZE ∅D × L (mm)	∅D_{max} (mm)	L_{max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
22 × 25	23	27	≈12	100	260 × 250 × 39
22 × 30	23	32	≈16	100	260 × 250 × 44
22 × 35	23	37	≈20	100	260 × 250 × 49
22 × 40	23	42	≈23	100	260 × 250 × 54
25 × 30	26	32	≈22	100	290 × 280 × 44
25 × 35	26	37	≈24	100	290 × 280 × 49
25 × 40	26	42	≈27	100	290 × 280 × 54
25 × 50	26	52	≈38	100	290 × 280 × 64
30 × 30	31	32	≈30	100	340 × 330 × 44
30 × 35	31	37	≈35	100	340 × 330 × 49
30 × 40	31	42	≈40	100	340 × 330 × 54
30 × 45	31	47	≈45	100	340 × 330 × 59
30 × 50	31	52	≈50	100	340 × 330 × 64
35 × 35	36	37	≈48	50	390 × 198 × 49
35 × 40	36	42	≈55	50	390 × 198 × 54
35 × 45	36	47	≈63	50	390 × 198 × 59
35 × 50	36	52	≈72	50	390 × 198 × 64

Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 2 and 3 apply at $T_{amb} = 20\text{ °C}$, $P = 86\text{ to }106\text{ kPa}$, $RH = 45\text{ to }75\%$.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 100 Hz or $\geq 10\text{ kHz}$ and 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 100 Hz
Z	max. impedance at 10 kHz

Ordering example

Electrolytic capacitor 058 series

10000 $\mu\text{F}/25\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 30 \times 40\text{ mm}$
2-terminal snap-in

Catalogue number: 2222 058 56103.

Table 2 Electrical data and ordering information for **058** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_R $\geq 10\text{ kHz}$ 105 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
10	4700	22 × 25	1.95	2.30	286	98	82	57	058 54472
	6800	22 × 30	2.44	2.88	412	140	61	44	058 54682
	10000	25 × 30	2.81	3.32	604	204	54	42	058 54103
	10000	22 × 40	3.29	3.88	604	204	43	32	058 44103
	15000	30 × 30	3.53	4.17	904	304	42	34	058 54153
	15000	25 × 40	3.78	4.46	904	304	38	30	058 44153
	22000	30 × 40	4.62	5.45	1324	444	31	25	058 54223
	22000	25 × 50	4.68	5.52	1324	444	31	24	058 44223
	33000	35 × 40	5.15	6.08	1984	664	30	24	058 54333
	33000	30 × 50	5.70	6.73	1984	664	24	21	058 44333
	47000	35 × 50	6.23	7.35	2824	944	24	21	058 54473
16	3300	22 × 25	1.90	2.24	321	110	86	57	058 55332
	4700	22 × 30	2.36	2.78	455	154	65	44	058 55472
	6800	25 × 30	2.75	3.25	657	222	56	42	058 55682
	6800	22 × 40	3.18	3.75	657	222	46	32	058 45682
	10000	30 × 30	3.44	4.06	964	324	44	34	058 55103
	10000	25 × 40	3.66	4.32	964	324	40	30	058 45103
	15000	30 × 40	4.55	5.37	1444	484	32	25	058 55153
	15000	25 × 50	4.55	5.37	1444	484	32	24	058 45153
	22000	35 × 40	5.07	5.98	2116	708	31	24	058 55223
	22000	30 × 50	5.67	6.69	2116	708	25	21	058 45223
	33000	35 × 50	6.23	7.35	3172	1060	25	21	058 55333

Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_R ≥ 10 kHz 105 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
25	2200	22 × 25	1.76	2.08	334	114	100	57	058 56222
	3300	22 × 30	2.23	2.63	499	169	73	44	058 56332
	4700	25 × 30	2.60	3.07	709	239	62	42	058 56472
	4700	22 × 40	3.00	3.54	709	239	52	32	058 46472
	6800	30 × 30	3.26	3.85	1024	344	49	34	058 56682
	6800	25 × 40	3.49	4.12	1024	344	44	30	058 46682
	10000	30 × 40	4.37	5.16	1504	504	35	25	058 56103
	10000	25 × 50	4.37	5.16	1504	504	35	24	058 46103
	15000	35 × 40	4.91	5.79	2254	754	33	24	058 56153
	15000	30 × 50	5.43	6.41	2254	754	27	21	058 46153
	22000	35 × 50	6.07	7.16	3304	1104	27	21	058 56223
40	1500	22 × 25	1.65	2.01	364	124	114	65	058 57152
	2200	22 × 30	2.04	2.49	532	180	87	50	058 57222
	3300	25 × 30	2.43	2.99	796	268	71	45	058 57332
	3300	22 × 40	2.78	3.39	796	268	60	37	058 47332
	4700	30 × 30	2.96	3.61	1132	380	59	40	058 57472
	4700	25 × 40	3.26	3.90	1132	380	51	32	058 47472
	6800	30 × 40	3.94	4.81	1636	548	42	29	058 57682
	6800	25 × 50	4.10	5.00	1636	548	39	26	058 47682
	10000	35 × 40	4.18	5.10	2404	804	46	29	058 57103
	10000	30 × 50	4.98	6.08	2404	804	36	24	058 47103
	15000	35 × 50	5.21	6.36	3604	1204	36	24	058 57153



Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_R ≥ 10 kHz 105 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
50	1000	22 × 25	1.50	1.83	304	104	138	69	058 51102
	1500	22 × 30	1.88	2.29	454	154	102	54	058 51152
	2200	25 × 30	2.27	2.77	664	124	82	47	058 51222
	2200	22 × 40	2.55	3.11	664	124	71	38	058 41222
	3300	30 × 30	2.81	3.43	994	334	66	41	058 51332
	3300	25 × 40	3.07	3.75	994	334	57	33	058 41332
	4700	30 × 40	3.77	4.60	1414	474	47	30	058 51472
	4700	25 × 50	3.85	4.70	1414	474	43	27	058 41472
	6800	35 × 40	4.01	4.89	2044	684	49	30	058 51682
	6800	30 × 50	4.74	5.78	2044	684	38	24	058 41682
10000	35 × 50	5.04	6.15	3004	1004	38	24	058 51103	
63	680	22 × 25	1.17	1.43	261	90	228	150	058 58681
	1000	22 × 30	1.46	1.78	382	130	170	115	058 58102
	1500	25 × 30	1.76	2.15	571	193	137	85	058 58152
	1500	22 × 40	2.00	2.44	571	193	115	85	058 48152
	2200	30 × 30	2.27	2.77	836	281	101	70	058 58222
	2200	25 × 40	2.40	2.93	836	281	94	70	058 48222
	3300	30 × 40	3.07	3.75	1251	420	70	50	058 58332
	3300	25 × 50	3.07	3.75	1251	420	70	50	058 48332
	4700	35 × 40	3.65	4.45	1781	596	60	45	058 58472
	4700	30 × 50	3.88	4.73	1781	596	53	45	058 48472
6800	35 × 50	4.58	5.59	2574	861	46	35	058 58682	
100	330	22 × 25	0.92	1.12	202	70	370	250	058 59331
	470	22 × 30	1.14	1.39	286	98	280	190	058 59471
	680	25 × 30	1.35	1.65	412	140	232	140	058 59681
	680	22 × 40	1.57	1.92	412	140	190	140	058 49681
	1000	30 × 30	1.79	2.40	604	204	163	115	058 59102
	1000	25 × 40	1.85	2.26	604	204	158	115	058 49102
	1500	30 × 40	2.45	2.99	904	304	111	85	058 59152
	1500	25 × 50	2.38	2.90	904	304	116	85	058 49152
	2200	35 × 40	3.05	3.72	1324	444	86	65	058 59222
	2200	30 × 50	3.13	3.82	1324	444	82	65	058 49222
3300	35 × 50	3.84	4.68	1984	664	64	50	058 59332	

Notes

1. All catalogue numbers refer to 2-terminal snap-in products.
2. 3-terminal snap-ins are available on request.

Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

Table 3 Electrical data and ordering information for **059** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
200	100	22 × 25	0.53	124	44	1280	730	059 52101
	150	22 × 30	0.67	184	64	850	540	059 52151
	220	22 × 35	0.86	268	92	610	430	059 32221
	220	25 × 30	0.87	268	92	610	430	059 52221
	330	30 × 30	1.12	400	136	435	300	059 52331
	330	25 × 40	1.12	400	136	435	300	059 42331
	470	30 × 35	1.46	568	192	335	225	059 32471
	470	25 × 50	1.25	568	192	335	225	059 42471
	680	30 × 45	1.87	820	276	235	155	059 32681
	680	35 × 35	1.85	820	276	235	155	059 62681
	1000	35 × 50	2.45	1204	404	160	125	059 52102
250	68	22 × 25	0.49	106	38	1640	760	059 53689
	100	22 × 30	0.62	154	54	1110	570	059 53101
	150	22 × 35	0.82	229	79	795	440	059 33151
	150	25 × 30	0.82	229	79	795	440	059 53151
	220	25 × 35	1.03	334	114	540	300	059 33221
	220	30 × 30	1.06	334	114	540	300	059 53221
	330	30 × 35	1.43	499	169	385	225	059 33331
	330	25 × 50	1.40	499	169	385	225	059 43331
	470	30 × 45	1.79	709	239	270	155	059 33471
	470	35 × 35	1.79	709	239	270	155	059 63471
	680	35 × 45	2.25	1024	344	190	125	059 43681
385	33	22 × 25	0.32	80	29	3860	3000	059 58339
	47	22 × 30	0.41	113	40	2710	2100	059 58479
	68	22 × 35	0.53	161	56	1870	1460	059 38689
	68	25 × 30	0.52	161	56	1870	1460	059 58689
	100	30 × 30	0.72	235	81	1270	1010	059 58101
	100	25 × 40	0.72	235	81	1270	1010	059 48101
	150	30 × 40	0.99	351	119	850	675	059 58151
	150	25 × 50	0.99	351	119	850	675	059 48151
	220	35 × 40	1.31	512	173	580	465	059 58221
	220	30 × 50	1.31	512	173	580	465	059 48221
	330	35 × 50	1.75	766	258	390	320	059 58331

Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
400	47	22 × 30	0.30	117	42	4260	3490	059 56479
	68	22 × 35	0.38	167	58	2950	2420	059 36689
	68	25 × 30	0.41	167	58	2950	2420	059 56689
	100	30 × 30	0.55	244	84	2020	1660	059 56101
	100	25 × 40	0.55	244	84	2020	1660	059 46101
	150	30 × 35	0.68	364	124	1350	1110	059 36151
	150	25 × 50	0.78	364	124	1350	1110	059 46151
	220	35 × 40	0.94	532	180	930	760	059 56221
	220	30 × 50	0.94	532	180	930	760	059 46221
	330	35 × 50	1.25	796	260	620	510	059 56331

Notes

- All catalogue numbers refer to 2-terminal snap-in products.
- 3-terminal snap-ins are available on request.

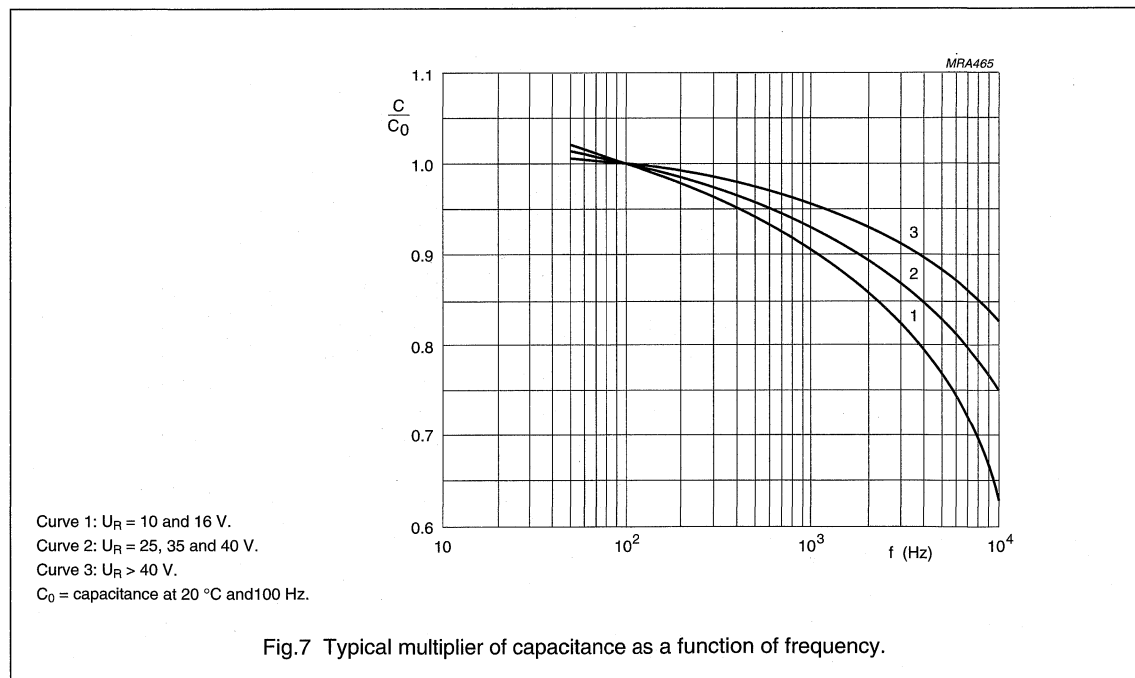
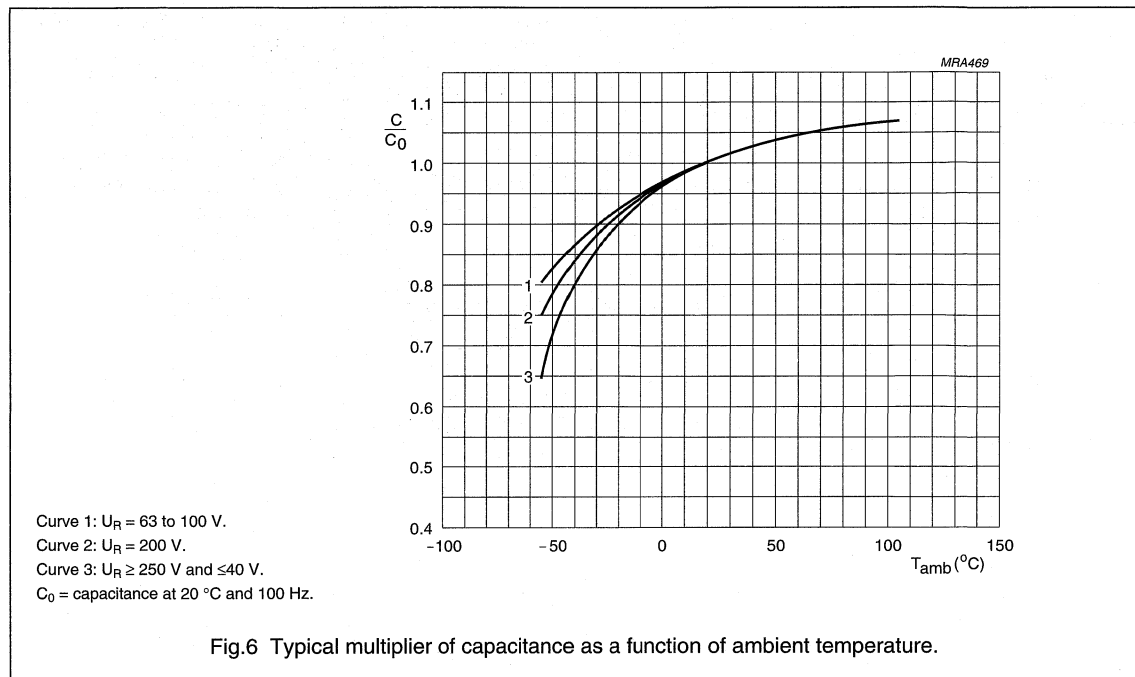
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.15 \times U_R$
	≥385 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH

Aluminum electrolytic capacitors
Power Long Life Snap-in

058/059 PLL-SI

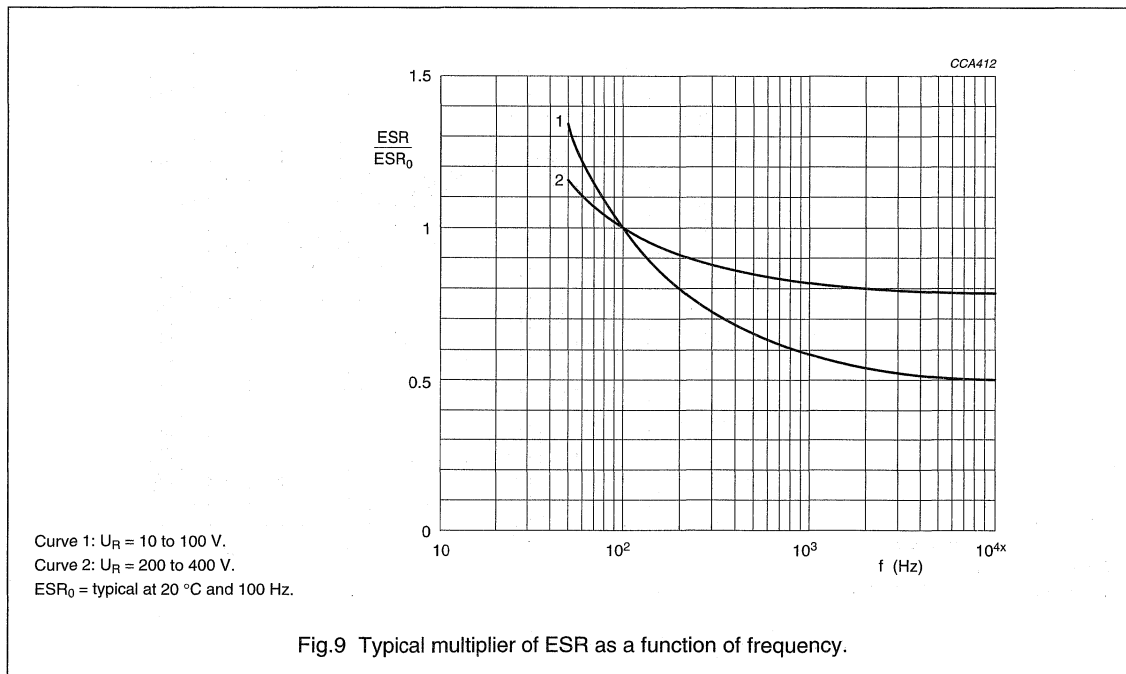
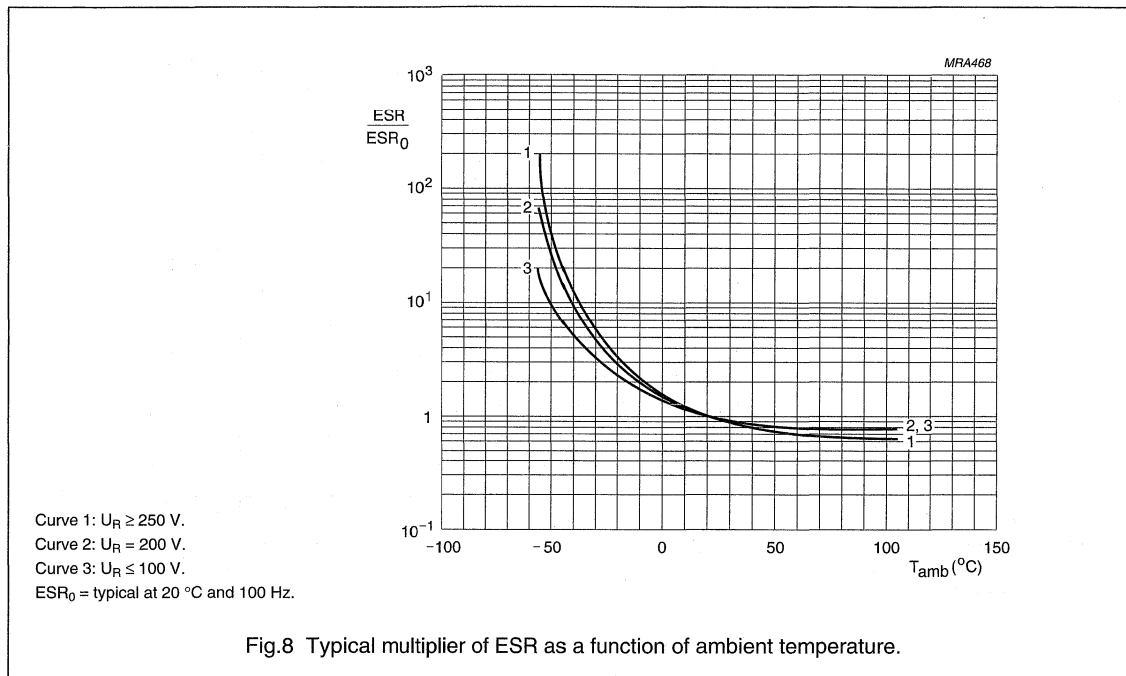
Capacitance (C)



Aluminum electrolytic capacitors Power Long Life Snap-in

058/059 PLL-SI

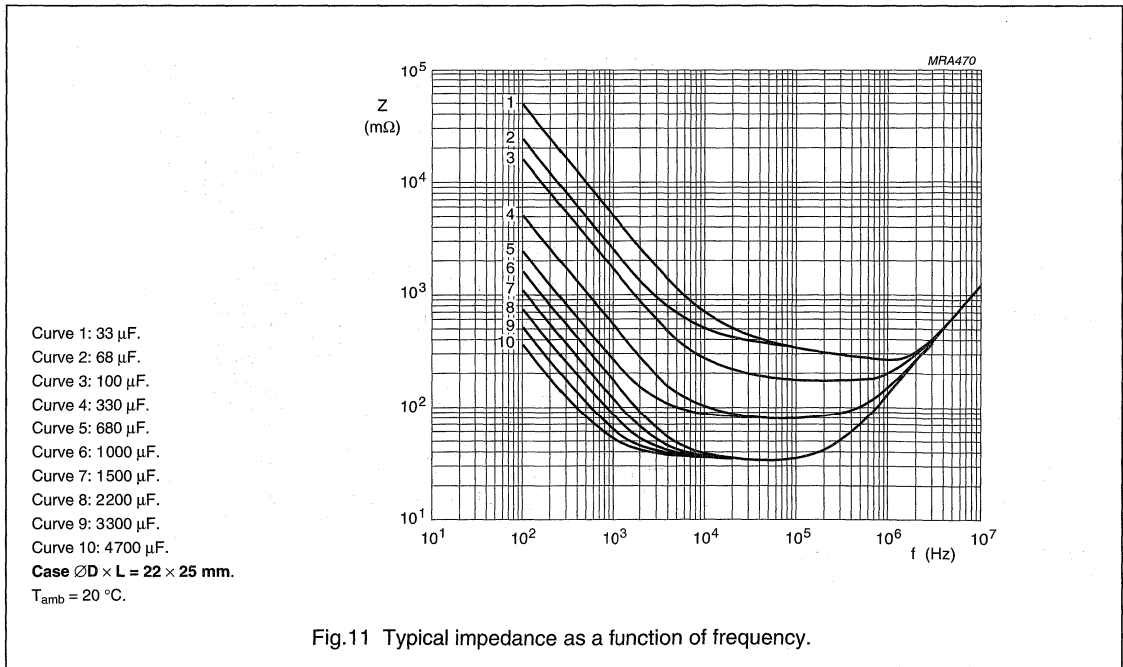
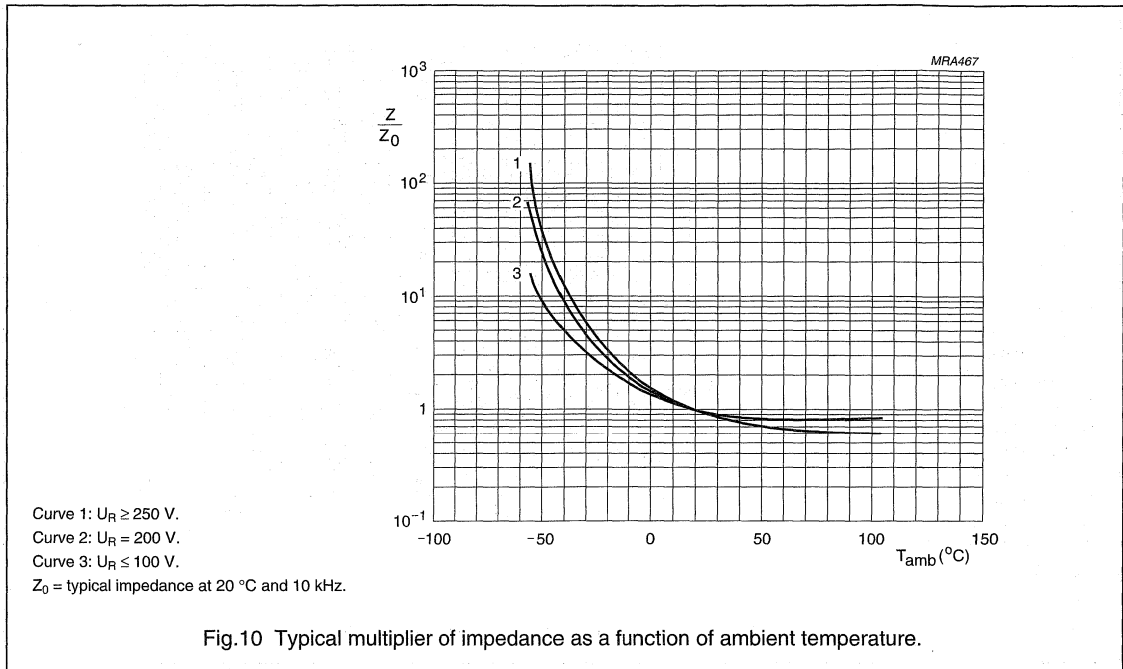
Equivalent series resistance (ESR)



Aluminum electrolytic capacitors
Power Long Life Snap-in

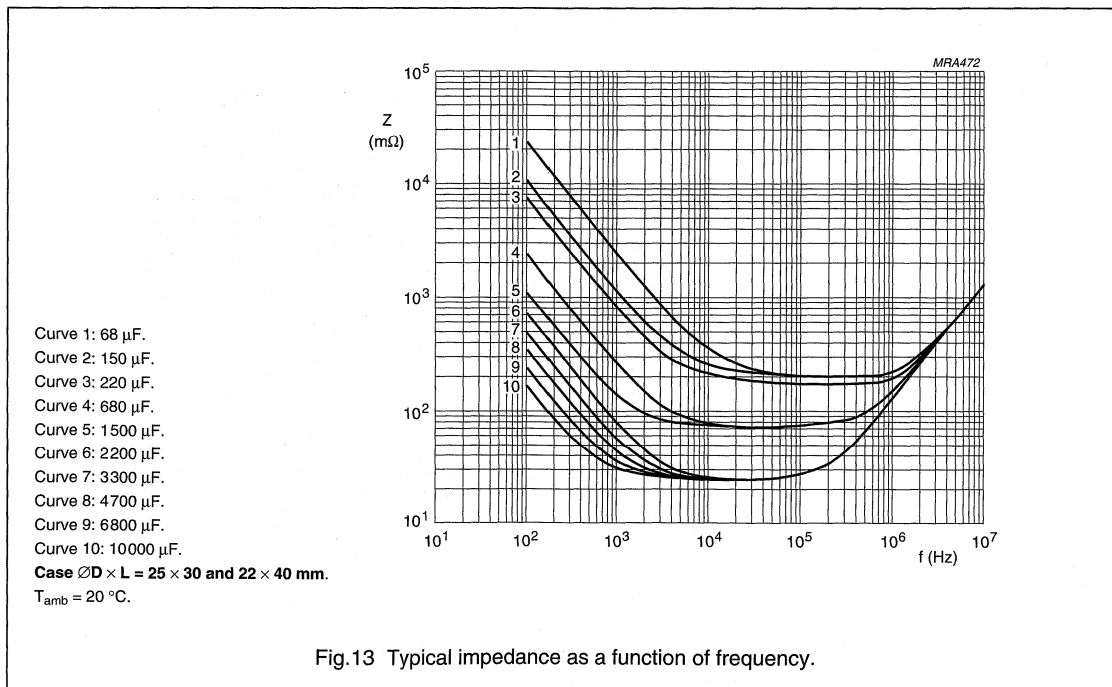
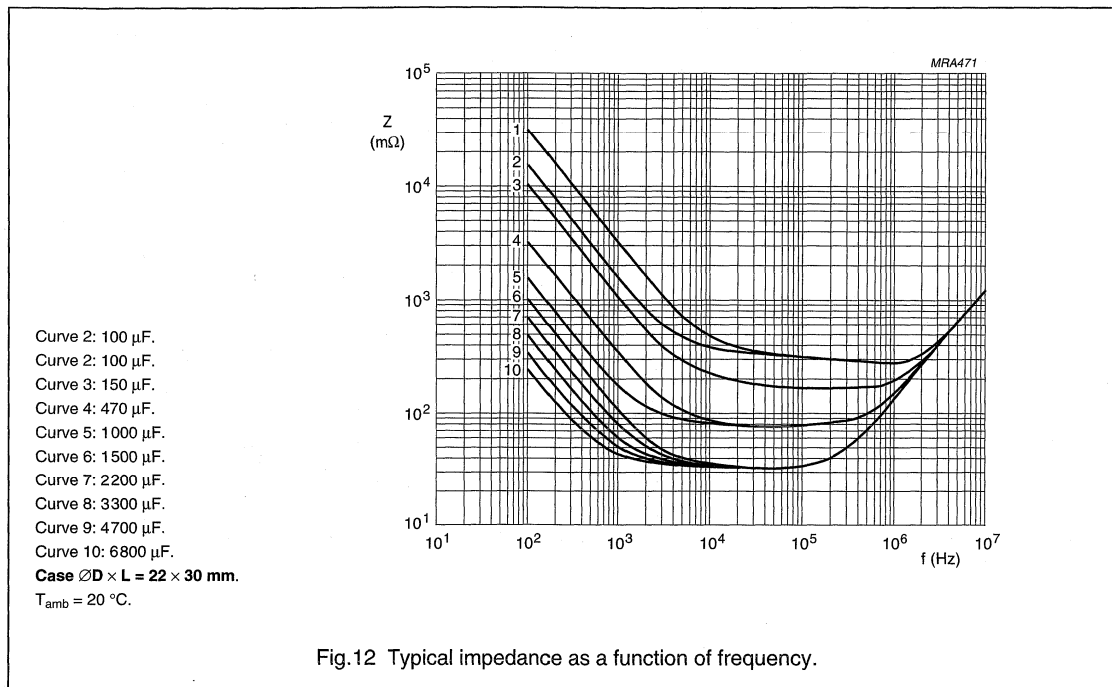
058/059 PLL-SI

Impedance (Z)



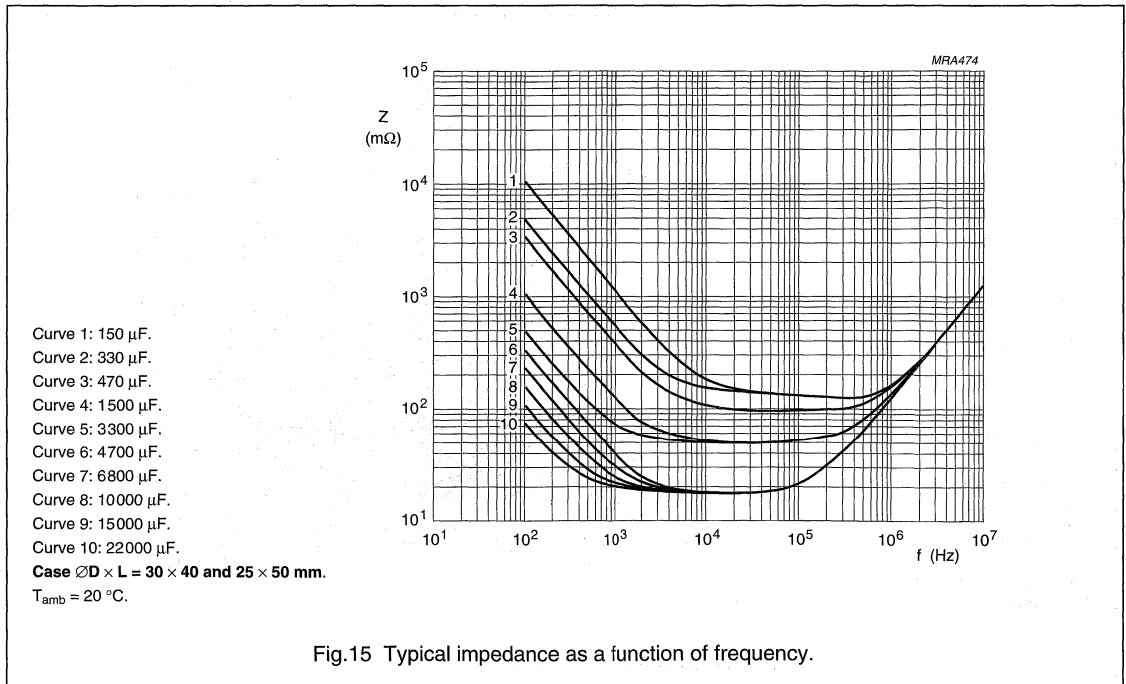
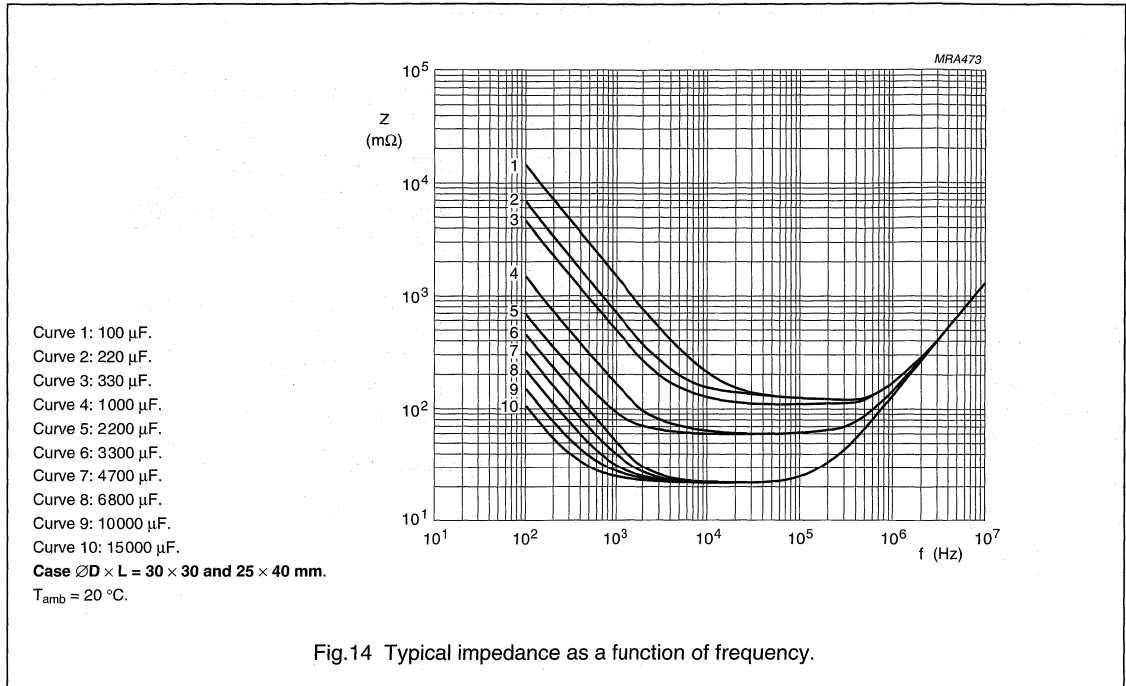
Aluminum electrolytic capacitors
Power Long Life Snap-in

058/059 PLL-SI



Aluminum electrolytic capacitors
Power Long Life Snap-in

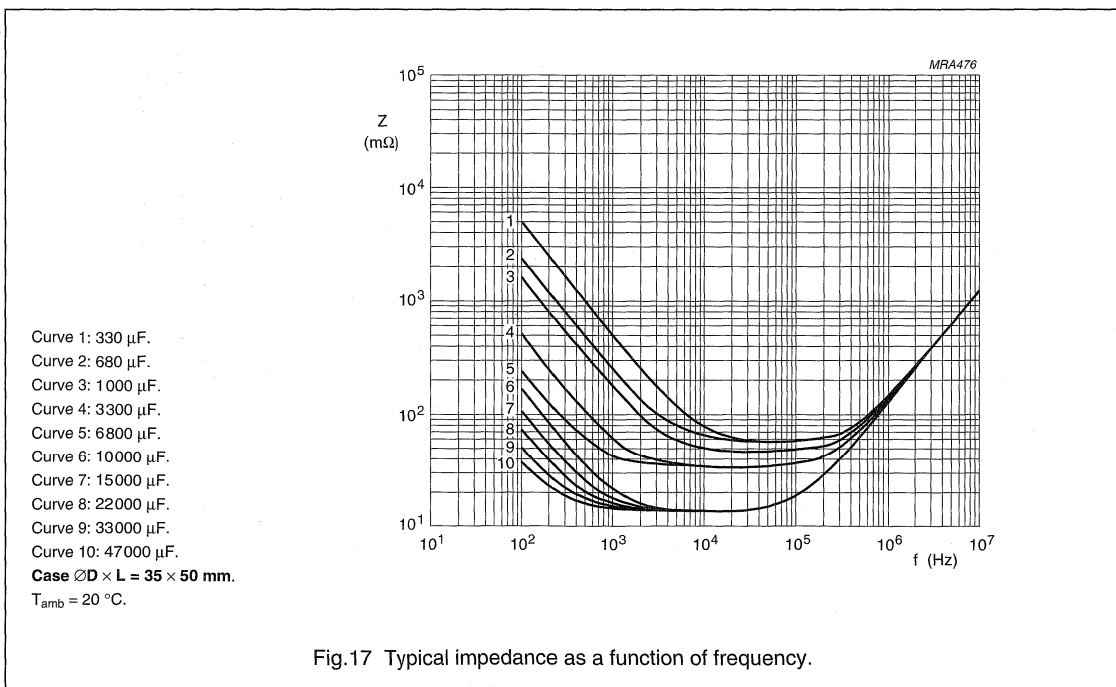
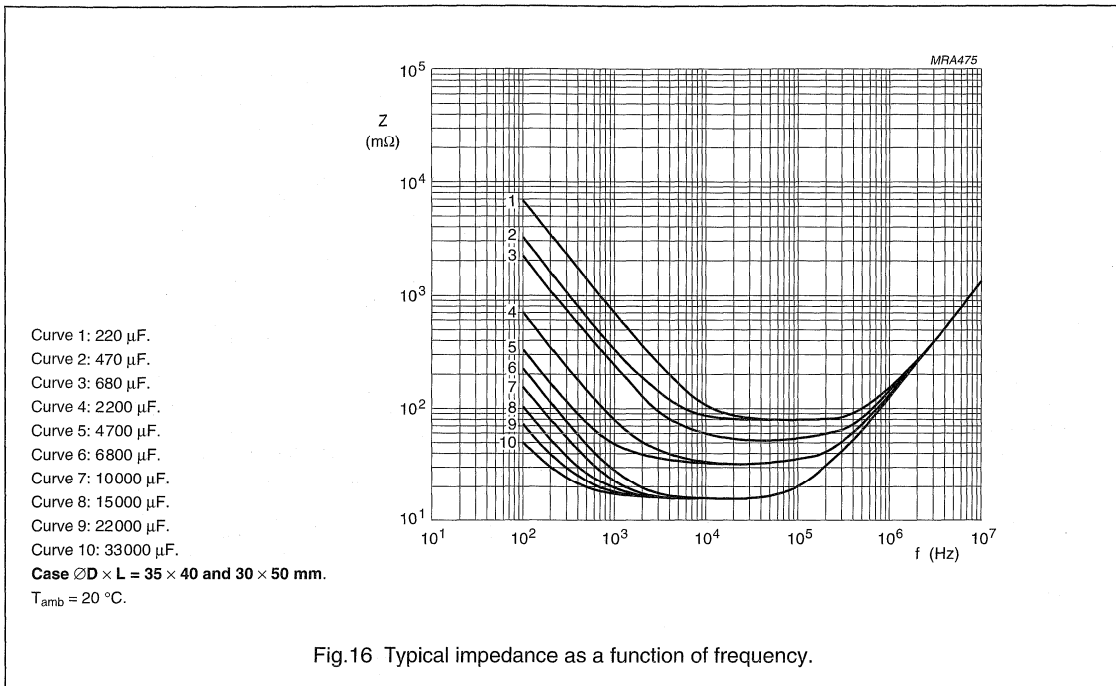
058/059 PLL-SI



Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI



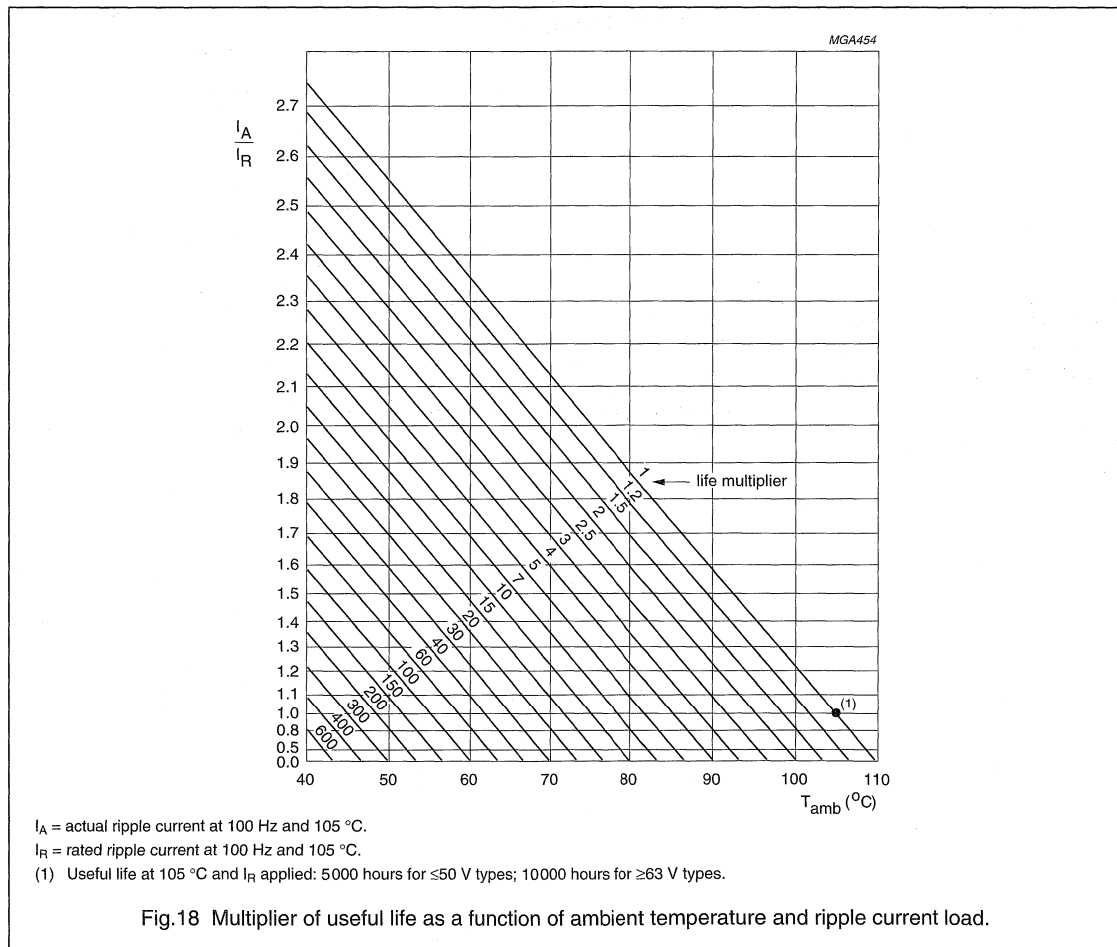
Aluminum electrolytic capacitors Power Long Life Snap-in

058/059 PLL-SI

RIPPLE CURRENT AND USEFUL LIFE

Table 4 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 40$ to 100 V	$U_R > 100$ V
50	0.93	0.91	0.86
100	1.00	1.00	1.00
200	1.04	1.05	1.13
400	1.07	1.09	1.21
1000	1.11	1.13	1.29
2000	1.13	1.15	1.32
4000	1.15	1.18	1.35
≥ 10000	1.18	1.22	1.40



Aluminum electrolytic capacitors

Power Long Life Snap-in

058/059 PLL-SI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; $\leq 50\text{ V}$ types: 2000 hours; $\geq 63\text{ V}$ types: 5000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C$: $\pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C$: $\pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; $\leq 50\text{ V}$ types: 5000 hours; $\geq 63\text{ V}$ types: 10000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C$: $\pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C$: $\pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}$: $\leq 1\%$; $U_R > 100\text{ V}$: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C$: $\pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power Standard Miniature 4-Terminal Snap-in

166/167 PSM-4TSI

FEATURES

- Keyed polarity obtained by 4 snap-in terminals
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case
- Charge and discharge proof
- Long useful life: 10000 hours at 85 °C
- High ripple current capability.

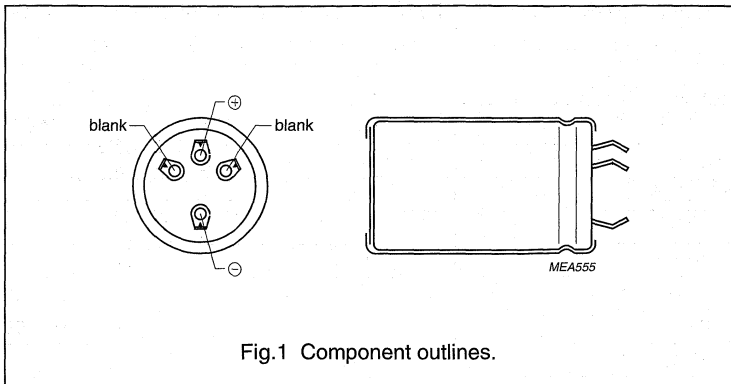
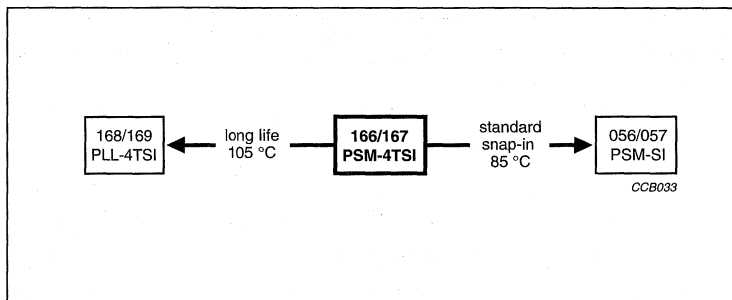


Fig.1 Component outlines.

APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems
- For excellent mounting stability.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	166	167
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	35 × 40; 35 × 50	35 × 40; 35 × 45; 35 × 50
Rated capacitance range (E6/E12 series), C_R	3300 to 68000 μF	330 to 1500 μF
Tolerance on C_R	±20%	
Rated voltage range, U_R	10 to 100 V	200 to 400 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	5000 hours	
Useful life at 85 °C	10000 hours	
Useful life at 40 °C and $1.4 \times I_R$ applied	175000 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	

Aluminum electrolytic capacitors

Power Standard Miniature 4-Terminal Snap-in

166/167 PSM-4TSI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 166 series

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	40	63	100
3300	–	–	–	–	–	35 × 40
4700	–	–	–	–	–	35 × 50
6800	–	–	–	–	35 × 40	–
10000	–	–	–	–	35 × 50	–
15000	–	–	–	35 × 40	–	–
22000	–	–	35 × 40	35 × 50	–	–
33000	–	35 × 40	35 × 50	–	–	–
47000	35 × 40	35 × 50	–	–	–	–
68000	35 × 50	–	–	–	–	–

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 167 series

Preferred types in **bold**.

C_R (μF)	U_R (V)			
	200	250	385	400
330	–	–	35 × 40	35 × 40
390	–	–	–	35 × 45
470	–	–	35 × 45	35 × 50
	–	–	35 × 50	–
680	–	35 × 40	–	–
820	–	35 × 45	–	–
1000	35 × 40	35 × 50	–	–
1200	35 × 45	–	–	–
1500	35 × 50	–	–	–

Aluminum electrolytic capacitors

Power Standard Miniature 4-Terminal Snap-in

166/167 PSM-4TSl

MECHANICAL DATA AND PACKAGING QUANTITIES

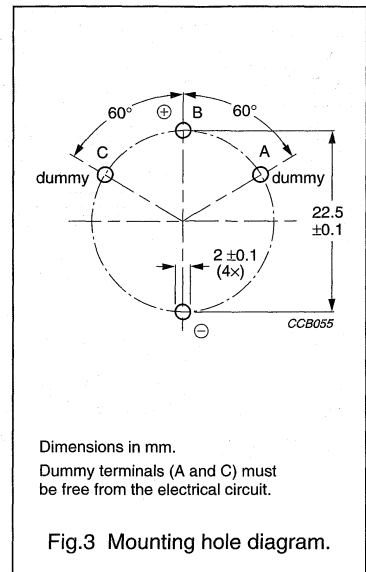
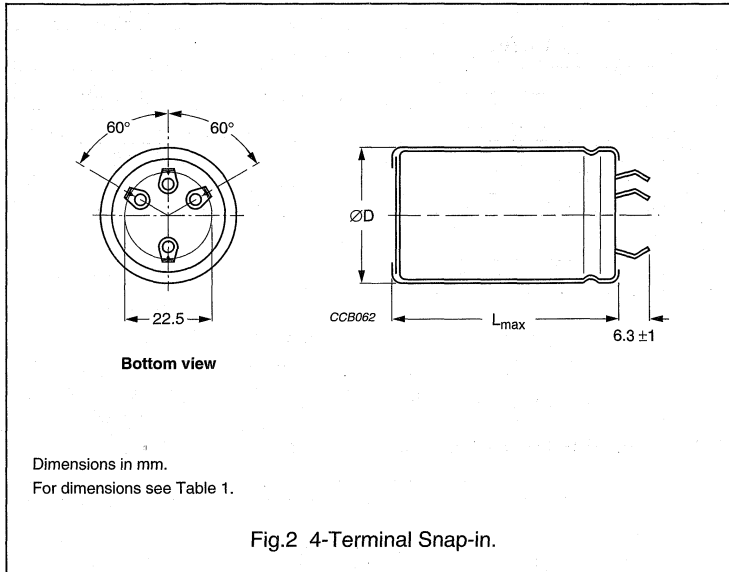


Table 1 Physical dimensions, mass and packaging information; see Fig.2

NOMINAL CASE SIZE ØD × L (mm)	ØD _{max} (mm)	L _{max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
35 × 40	36	42	≈55	50	390 × 198 × 54
35 × 45	36	47	≈63	50	390 × 198 × 59
35 × 50	36	52	≈72	50	390 × 198 × 64

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- '-' sign to indicate the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors

Power Standard Miniature 4-Terminal Snap-in

166/167 PSM-4TSI

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 100 Hz and 85 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 100 Hz
Z	max. impedance at 10 kHz

Ordering example

Electrolytic capacitor 166 series

15000 $\mu\text{F}/40\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 35 \times 40\text{ mm}$

Catalogue number: 2222 166 57153.

Table 2 Electrical data and ordering information for 166/167 series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
10	47000	35 × 40	5.10	2824	944	31	26	166 54473
	68000	35 × 50	5.88	4084	1364	28	23	166 54683
16	33000	35 × 40	5.02	3172	1060	32	28	166 55333
	47000	35 × 50	5.34	4516	1508	34	32	166 55473
25	22000	35 × 40	4.48	3304	1104	40	28	166 56223
	33000	35 × 50	4.98	4954	1654	39	33	166 56333
40	15000	35 × 40	4.05	3604	1204	49	41	166 57153
	22000	35 × 50	4.86	5284	1764	40	33	166 57223
63	6800	35 × 40	4.01	2574	861	50	42	166 58682
	10000	35 × 50	5.00	3784	1264	39	33	166 58103
100	3300	35 × 40	2.84	1984	664	100	95	166 59332
	4700	35 × 50	3.59	2824	677	75	70	166 59472
200	1000	35 × 40	2.85	1204	404	160	135	167 52102
	1200	35 × 45	2.98	1444	484	150	130	167 42122
	1500	35 × 50	3.66	1804	604	120	105	167 52152
250	680	35 × 40	2.60	1024	344	240	145	167 53681
	820	35 × 45	2.70	1234	414	195	128	167 43821
	1000	35 × 50	3.12	1504	504	160	105	167 53102
385	330	35 × 40	2.11	766	258	480	280	167 58331
	470	35 × 45	2.29	1089	366	340	220	167 48471
	470	35 × 50	2.76	1089	366	340	220	167 58471
400	330	35 × 40	1.85	796	268	480	280	167 56331
	390	35 × 45	2.08	940	316	410	265	167 46391
	470	35 × 50	2.76	1132	380	340	220	167 56471

Aluminum electrolytic capacitors
Power Standard Miniature 4-Terminal Snap-in

166/167 PSM-4TSI

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.15 \times U_R$
	≥385 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH



Aluminum electrolytic capacitors
Power Standard Miniature 4-Terminal Snap-in

166/167 PSM-4TSI

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 40$ to 100 V	$U_R > 100$ V
50	0.93	0.91	0.86
100	1.00	1.00	1.00
200	1.04	1.05	1.13
400	1.07	1.09	1.21
1000	1.11	1.13	1.29
2000	1.13	1.15	1.32
4000	1.15	1.18	1.35
≥ 10000	1.18	1.22	1.40

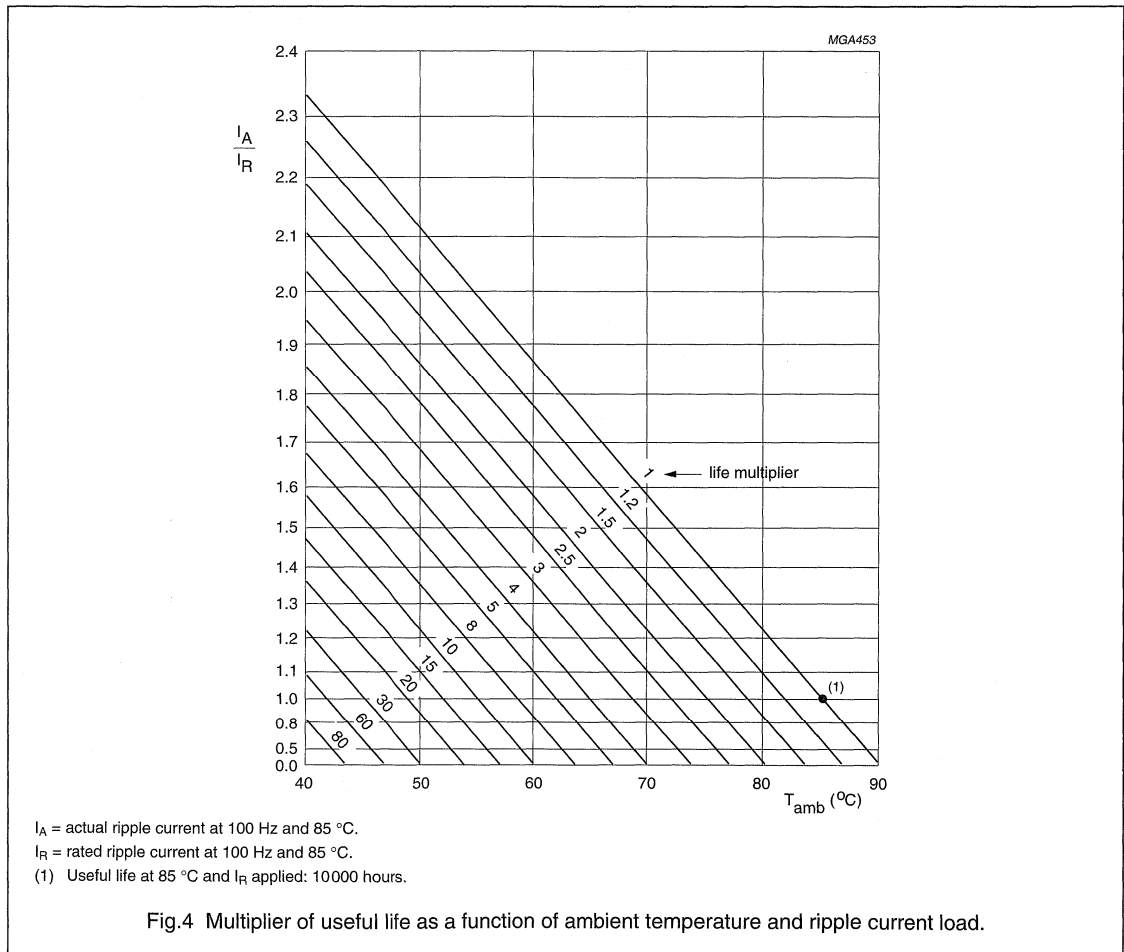


Fig.4 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power Standard Miniature 4-Terminal Snap-in

166/167 PSM-4TSI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 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; 5000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 10000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}: \leq 1\%$; $U_R > 100\text{ V}: \leq 3\%$
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	$\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

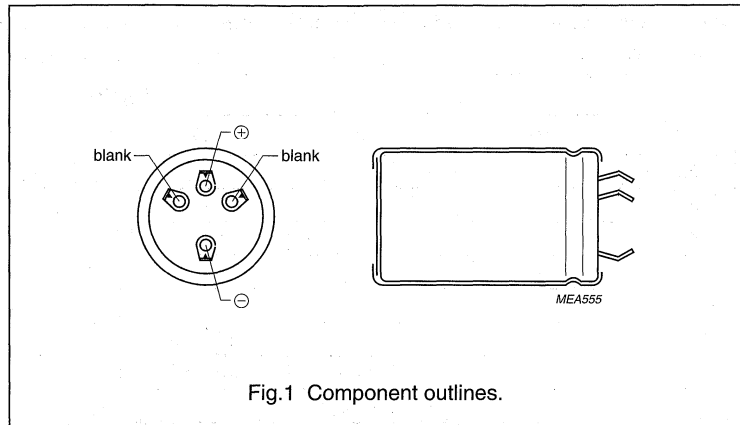
Aluminum electrolytic capacitors

Power Long Life 4-Terminal Snap-in

168/169 PLL-4TSI

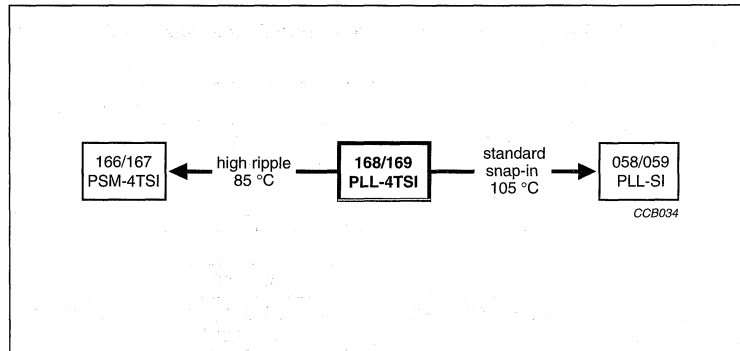
FEATURES

- Keyed polarity obtained by 4 snap-in terminals
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case
- Charge and discharge proof
- Very long useful life: 5000 hours at 105 °C
- Temperature range up to 105 °C
- Low ESR, high ripple current capability.



APPLICATIONS

- Computer, telecommunication and industrial systems
- Smoothing and filtering applications
- Standard and switched mode power supplies
- Energy storage in pulse systems
- For excellent mounting stability.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	168	169
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	35 × 40; 35 × 50	35 × 40; 35 × 45; 35 × 50
Rated capacitance range (E6/E12 series), C_R	2200 to 47000 μF	220 to 1000 μF
Tolerance on C_R	±20%	
Rated voltage range, U_R	10 to 100 V	200 to 400 V
Category temperature range	-40 to +105 °C	
Endurance test at 105 °C	2000 hours	
Useful life at 105 °C	5000 hours	
Useful life at 40 °C and $1.9 \times I_R$ applied	125000 hours	
Shelf life at 0 V, 105 °C	500 hours	
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	40/105/56	

Aluminum electrolytic capacitors

Power Long Life 4-Terminal Snap-in

168/169 PLL-4TSI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 168 series

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	40	63	100
2200	–	–	–	–	–	35 × 40
3300	–	–	–	–	–	35 × 50
4700	–	–	–	–	35 × 40	–
6800	–	–	–	–	35 × 50	–
10000	–	–	–	35 × 40	–	–
15000	–	–	35 × 40	35 × 50	–	–
22000	–	35 × 40	35 × 50	–	–	–
33000	35 × 40	35 × 50	–	–	–	–
47000	35 × 50	–	–	–	–	–

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 169 series

Preferred types in **bold**.

C_R (μF)	U_R (V)			
	200	250	385	400
220	–	–	35 × 40	35 × 40
270	–	–	35 × 45	35 × 45
330	–	–	35 × 50	35 × 50
470	–	35 × 40	–	–
680	35 × 40	35 × 45	–	–
	–	35 × 50	–	–
820	35 × 45	–	–	–
1000	35 × 50	–	–	–

Aluminum electrolytic capacitors

Power Long Life 4-Terminal Snap-in

168/169 PLL-4TSI

MECHANICAL DATA AND PACKAGING QUANTITIES

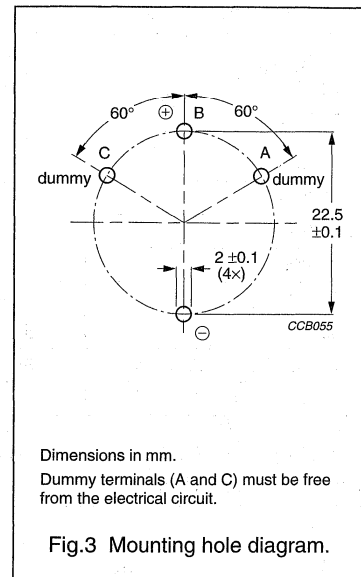
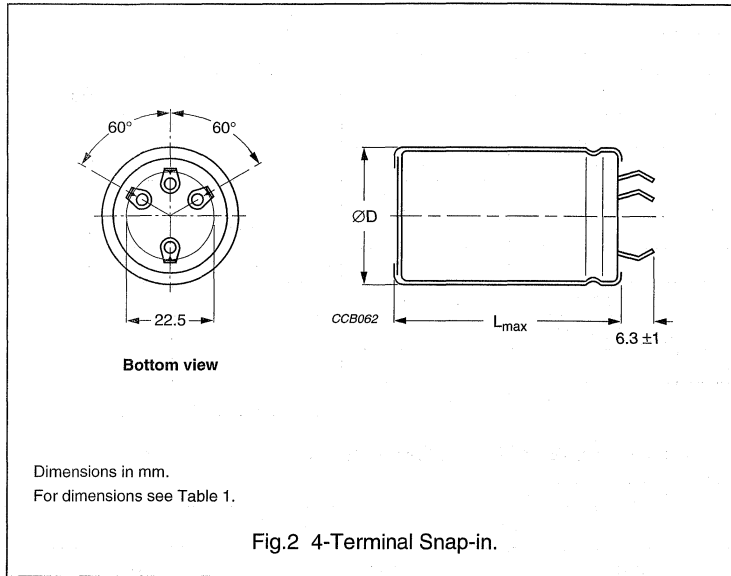


Table 1 Physical dimensions, mass and packaging information; see Fig.2

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
35 × 40	36	42	≈55	50	390 × 198 × 54
35 × 45	36	47	≈63	50	390 × 198 × 59
35 × 50	36	52	≈72	50	390 × 198 × 64

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- '-' sign to indicate the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors

Power Long Life 4-Terminal Snap-in

168/169 PLL-4TSI

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 100 Hz and 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 100 Hz
Z	max. impedance at 10 kHz

Ordering example

Electrolytic capacitor 168 series

15 000 $\mu\text{F}/25\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 35 \times 40\text{ mm}$

Catalogue number: 2222 168 56153.

Table 2 Electrical data and ordering information for 168/169 series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
10	33000	35 × 40	5.15	1984	664	30	24	168 54333
	47000	35 × 50	6.23	2824	944	24	21	168 54473
16	22000	35 × 40	5.07	2116	708	31	24	168 55223
	33000	35 × 50	6.23	3172	1060	25	21	168 55333
25	15000	35 × 40	4.91	2254	754	33	24	168 56153
	22000	35 × 50	6.07	3304	1104	27	21	168 56223
40	10000	35 × 40	4.18	2404	804	46	29	168 57103
	15000	35 × 50	5.21	3604	1204	36	24	168 57153
63	4700	35 × 40	3.65	1781	596	60	45	168 58472
	6800	35 × 50	4.58	2574	861	46	35	168 58682
100	2200	35 × 40	3.05	1324	444	86	65	168 59222
	3300	35 × 50	3.84	1984	664	64	50	168 59332
200	680	35 × 40	1.91	820	276	235	155	169 52681
	820	35 × 45	2.18	988	332	195	150	169 42821
	1000	35 × 50	2.45	1204	404	160	125	169 52102
250	470	35 × 40	1.82	709	239	270	155	169 53471
	680	35 × 45	2.25	1024	344	190	125	169 43681
	680	35 × 50	2.30	1024	344	190	125	169 53681
385	220	35 × 40	1.31	512	173	580	465	169 58221
	270	35 × 45	1.52	627	212	475	385	169 48271
	330	35 × 50	1.75	766	258	390	320	169 58331
400	220	35 × 40	0.94	532	180	930	760	169 56221
	270	35 × 45	1.07	652	220	770	630	169 46271
	330	35 × 50	1.25	796	260	620	510	169 56331

Aluminum electrolytic capacitors

Power Long Life 4-Terminal Snap-in

168/169 PLL-4TSI

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.15 \times U_R$
	≥385 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH

Aluminum electrolytic capacitors Power Long Life 4-Terminal Snap-in

168/169 PLL-4TSI

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 40$ to 100 V	$U_R > 100$ V
50	0.93	0.91	0.86
100	1.00	1.00	1.00
200	1.04	1.05	1.13
400	1.07	1.09	1.21
1000	1.11	1.13	1.29
2000	1.13	1.15	1.32
4000	1.15	1.18	1.35
≥ 10000	1.18	1.22	1.40

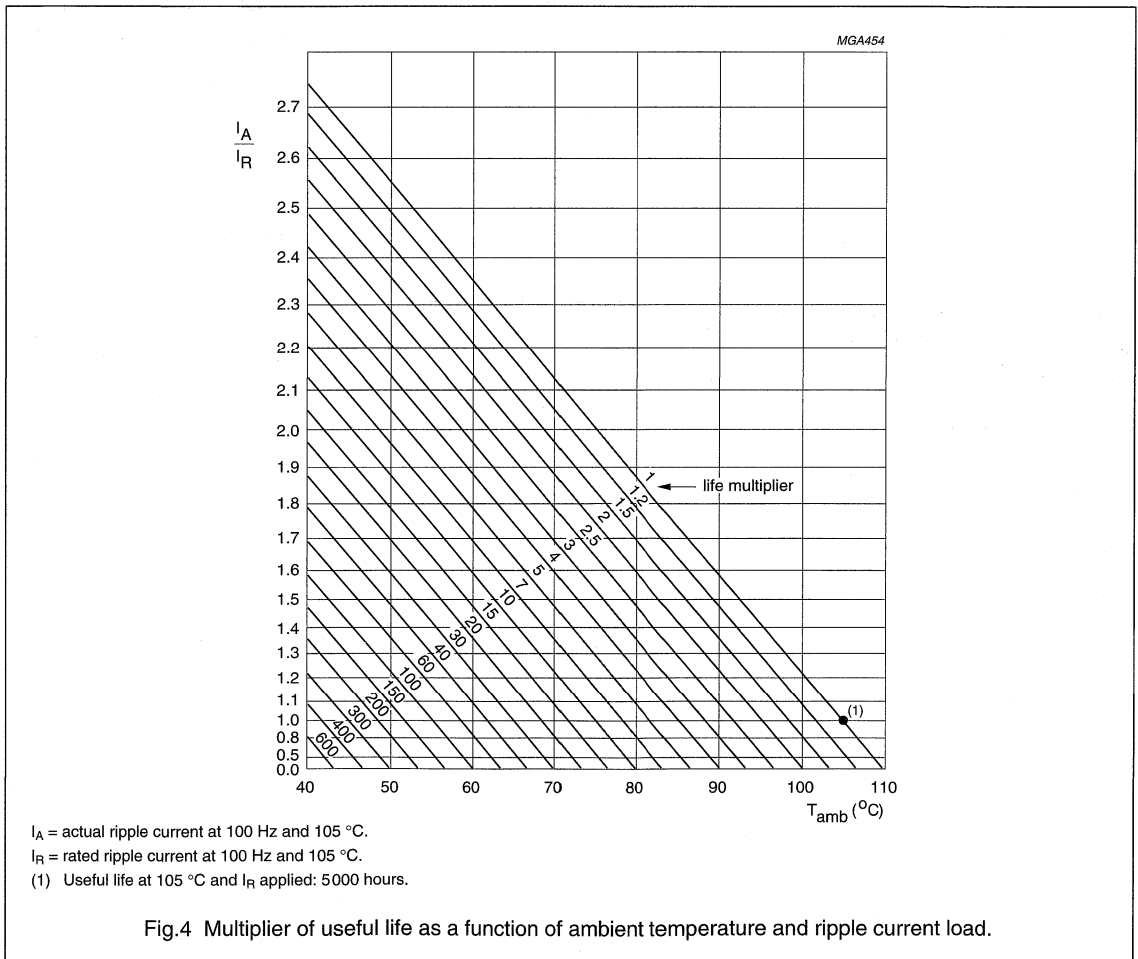


Fig.4 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power Long Life 4-Terminal Snap-in

168/169 PLL-4TSI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; 2000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; 5000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}$: $\leq 1\%$; $U_R > 100\text{ V}$: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power High Ripple Current Snap-in

198 PHR-SI

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, miniaturized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the side of the aluminum case
- Charge and discharge proof
- Very high ripple current capability
- Keyed polarity version available.

APPLICATIONS

- Motor control and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.

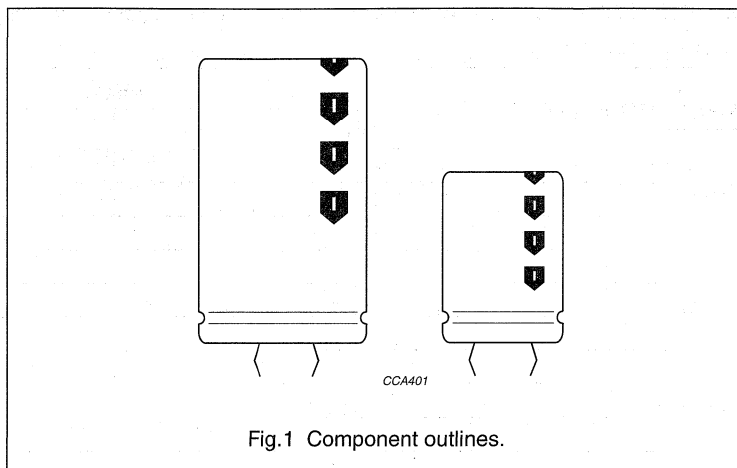
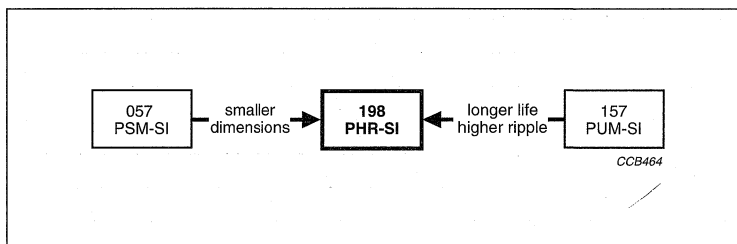


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	22 × 25 to 35 × 60
Rated capacitance range (E6/E12 series), C_R	56 to 680 μ F
Tolerance on C_R	±20%
Rated voltage range, U_R	400 and 450 V
Category temperature range	-25 to +85 °C
Endurance test at 85 °C	7000 hours
Useful life at 85 °C	15000 hours
Shelf life at 0 V, 85 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	25/085/56

Aluminum electrolytic capacitors

Power High Ripple Current Snap-in

198 PHR-SI

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

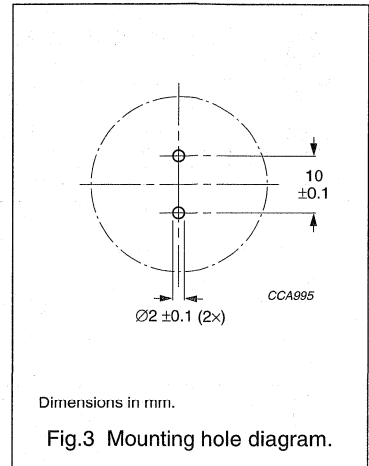
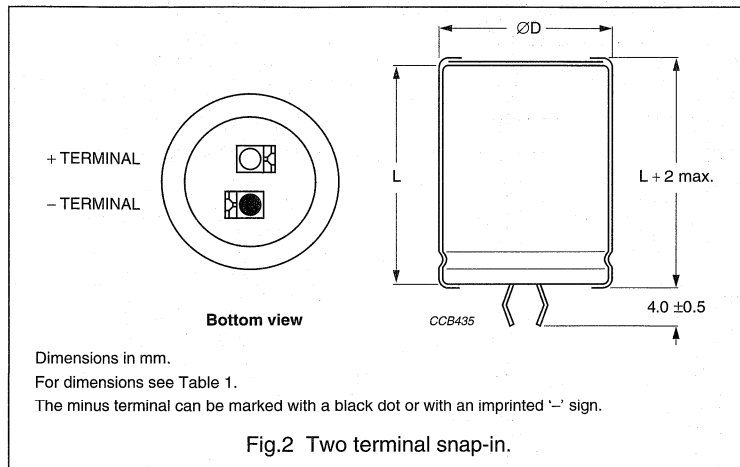
C_R (μF)	U_R (V)	
	400	450
56	22 × 25	22 × 25
68	22 × 25	22 × 30
82	–	22 × 30
	–	25 × 25
100	22 × 30	22 × 35
	–	25 × 30
120	22 × 35	22 × 40
	25 × 30	25 × 30
	–	30 × 25
150	22 × 40	25 × 40
	25 × 35	30 × 30
180	25 × 40	25 × 40
	30 × 30	30 × 35
	35 × 25	35 × 25
220	25 × 45	25 × 50
	30 × 35	30 × 40
	35 × 30	35 × 30
270	30 × 40	30 × 45
	35 × 30	35 × 35
330	30 × 45	30 × 50
	35 × 35	35 × 40
390	30 × 50	35 × 45
	35 × 40	–
470	35 × 45	35 × 50
560	35 × 50	35 × 60
680	35 × 60	35 × 60

Aluminum electrolytic capacitors Power High Ripple Current Snap-in

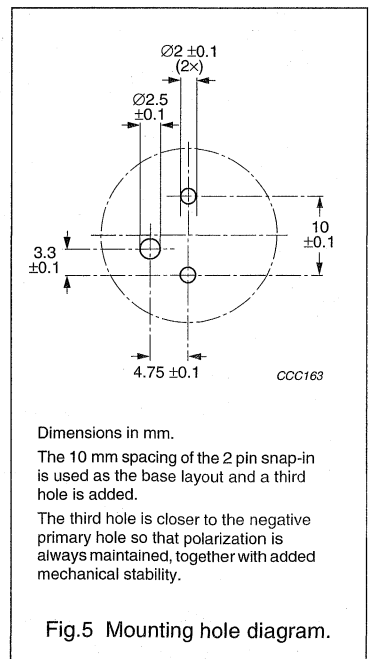
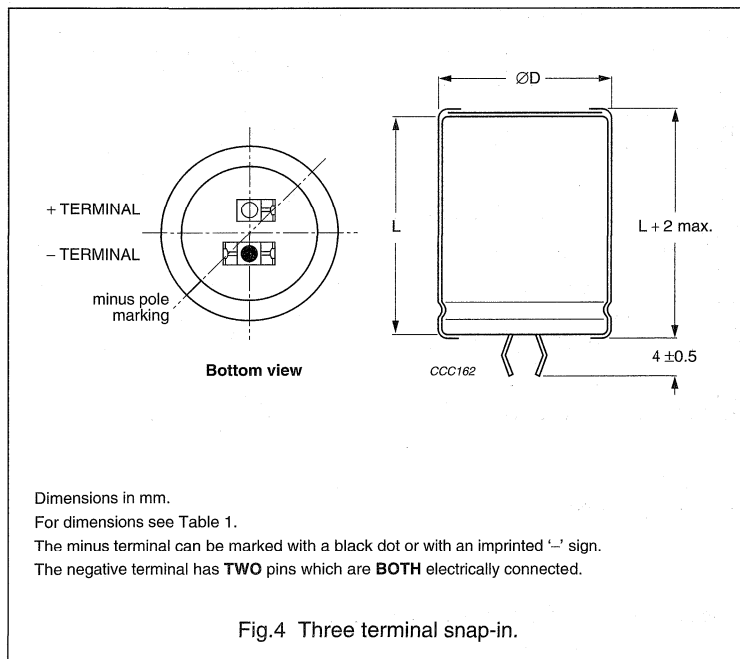
198 PHR-SI

MECHANICAL DATA AND PACKAGING QUANTITIES

Two terminal snap-in



Three terminal snap-in (available on request)



Aluminum electrolytic capacitors

Power High Ripple Current Snap-in

198 PHR-SI

Table 1 Physical dimensions, mass and packaging information; see Figs 2 and 4

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{\max}$ (mm)	L_{\max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
22 × 25	23	27	≈12	100	260 × 250 × 39
22 × 30	23	32	≈16	100	260 × 250 × 44
22 × 35	23	37	≈20	100	260 × 250 × 49
22 × 40	23	42	≈23	100	260 × 250 × 54
25 × 25	26	27	≈20	100	290 × 280 × 39
25 × 30	26	32	≈22	100	290 × 280 × 44
25 × 35	26	37	≈24	100	290 × 280 × 49
25 × 40	26	42	≈27	100	290 × 280 × 54
25 × 45	26	47	≈32	100	290 × 280 × 59
25 × 50	26	52	≈38	100	290 × 280 × 64
30 × 25	31	27	≈25	100	340 × 330 × 39
30 × 30	31	32	≈30	100	340 × 330 × 44
30 × 35	31	37	≈35	100	340 × 330 × 49
30 × 40	31	42	≈40	100	340 × 330 × 54
30 × 45	31	47	≈45	100	340 × 330 × 59
30 × 50	31	52	≈50	100	340 × 330 × 64
35 × 25	36	27	≈33	50	390 × 198 × 39
35 × 30	36	32	≈40	50	390 × 198 × 44
35 × 35	36	37	≈48	50	390 × 198 × 49
35 × 40	36	42	≈55	50	390 × 198 × 54
35 × 45	36	47	≈63	50	390 × 198 × 59
35 × 50	36	52	≈72	50	390 × 198 × 64
35 × 60	36	62	≈87	50	390 × 198 × 74

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- '−' sign to indicate the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Code for specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors

Power High Ripple Current Snap-in

198 PHR-SI

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
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
ESR	typ./max. equivalent series resistance at 100 Hz
Z	typ./max. impedance at 10 kHz

Ordering example

Electrolytic capacitor 198 PHR-SI

470 $\mu\text{F}/450\text{ V}$; $\pm 20\%$

Nominal case size: $\varnothing 35 \times 50\text{ mm}$
 2-terminal snap-in

Catalogue number: 2222 198 57471.

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	TYP. ESR 100 Hz (m Ω)	MAX. ESR 100 Hz (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
400	56	22 × 25	0.72	138	49	1530	4265	869	2170	198 56569
	68	22 × 25	0.79	167	59	1270	3513	724	1810	198 56689
	100	22 × 30	1.00	244	84	866	2389	495	1220	198 56101
	120	22 × 35	1.14	292	100	722	1990	412	900	198 46121
		25 × 30	1.14	292	100	730	1990	420	900	198 36121
	150	22 × 40	1.33	364	124	580	1592	332	725	198 66151
		25 × 35	1.33	364	124	585	1592	337	725	198 36151
		180	25 × 40	1.51	436	148	489	1327	282	590
	220	30 × 30	1.49	436	148	508	1327	300	590	198 66181
		35 × 25	1.56	436	148	545	1327	334	590	198 26181
		25 × 45	1.75	532	180	402	1086	232	560	198 36221
		30 × 35	1.56	532	180	416	1086	245	560	198 26221
270	35 × 30	1.81	532	180	431	1086	259	560	198 16221	
	30 × 40	1.95	652	220	341	885	202	525	198 36271	
	35 × 30	1.93	652	220	370	885	229	525	198 66271	
330	30 × 45	2.22	796	268	282	724	168	420	198 36331	
	35 × 35	2.18	796	268	302	724	187	420	198 66331	
	390	30 × 50	2.50	940	316	241	612	144	350	198 36391
470	35 × 40	2.44	940	316	256	612	158	350	198 66391	
	35 × 45	2.72	1132	380	215	508	134	305	198 36471	
560	35 × 50	3.03	1348	452	184	427	116	265	198 46561	
680	35 × 60	3.53	1636	548	151	351	95	220	198 46681	

Aluminum electrolytic capacitors

Power High Ripple Current Snap-in

198 PHR-SI

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	TYP. ESR 100 Hz (m Ω)	MAX. ESR 100 Hz (m Ω)	TYP. Z 10 kHz (m Ω)	MAX. Z 10 kHz (m Ω)	CATALOGUE NUMBER ⁽¹⁾⁽²⁾ 2222
450	56	22 × 25	0.71	155	54.4	1441	4265	799	1880	198 57569
	68	22 × 30	0.82	188	65.2	1182	3513	654	1530	198 57689
	82	22 × 30	0.89	225	77.8	987	2913	548	1290	198 47829
	100	25 × 25	0.91	225	77.8	1006	2913	565	1290	198 57829
25 × 30		1.02	274	94	809	2389	450	1050	198 47101	
	120	25 × 30	1.05	274	94	818	2389	457	1050	198 57101
		22 × 40	1.14	328	112	676	1990	375	885	198 47121
	150	25 × 30	1.13	328	112	691	1990	389	885	198 57121
		30 × 25	1.16	328	112	718	1990	414	885	198 67121
	180	25 × 40	1.36	409	139	547	1592	306	705	198 47151
		30 × 30	1.36	409	139	566	1592	323	705	198 57151
	220	25 × 40	1.47	490	166	462	1327	261	605	198 47181
		30 × 35	1.54	490	166	470	1327	268	605	198 57181
	270	35 × 25	1.46	490	166	527	1327	319	605	198 67181
		25 × 50	1.71	598	202	377	1086	212	525	198 47221
	330	30 × 40	1.75	598	202	387	1086	221	525	198 57221
		35 × 30	1.72	598	202	414	1086	246	525	198 67221
	390	30 × 45	1.98	733	247	318	885	183	450	198 47271
		35 × 35	1.96	733	247	337	885	200	450	198 57271
	470	30 × 50	2.22	895	301	264	724	152	390	198 47331
		35 × 40	2.22	895	301	278	724	166	390	198 57331
	560	35 × 45	2.46	1057	355	237	612	142	340	198 57391
		35 × 50	2.73	1273	427	200	508	121	290	198 57471
	680	35 × 60	3.10	1516	508	167	427	100	240	198 57561
		35 × 60	3.30	1840	616	147	351	91	220	198 57681

Notes

1. All catalogue numbers refer to 2-terminal snap-in products.
2. 3-terminal snap-ins are available on request.

Customized products

If you are unable to find the capacitor you require, please contact your local BC Components sales organization; we are able to design and manufacture customized capacitors to meet your specific requirements.

Aluminum electrolytic capacitors

Power High Ripple Current Snap-in

198 PHR-SI

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥400 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		≤1 V
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu A$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu A$
Inductance		
Equivalent series inductance (ESL)	all case sizes	typ. 19 nH
		max. 25 nH



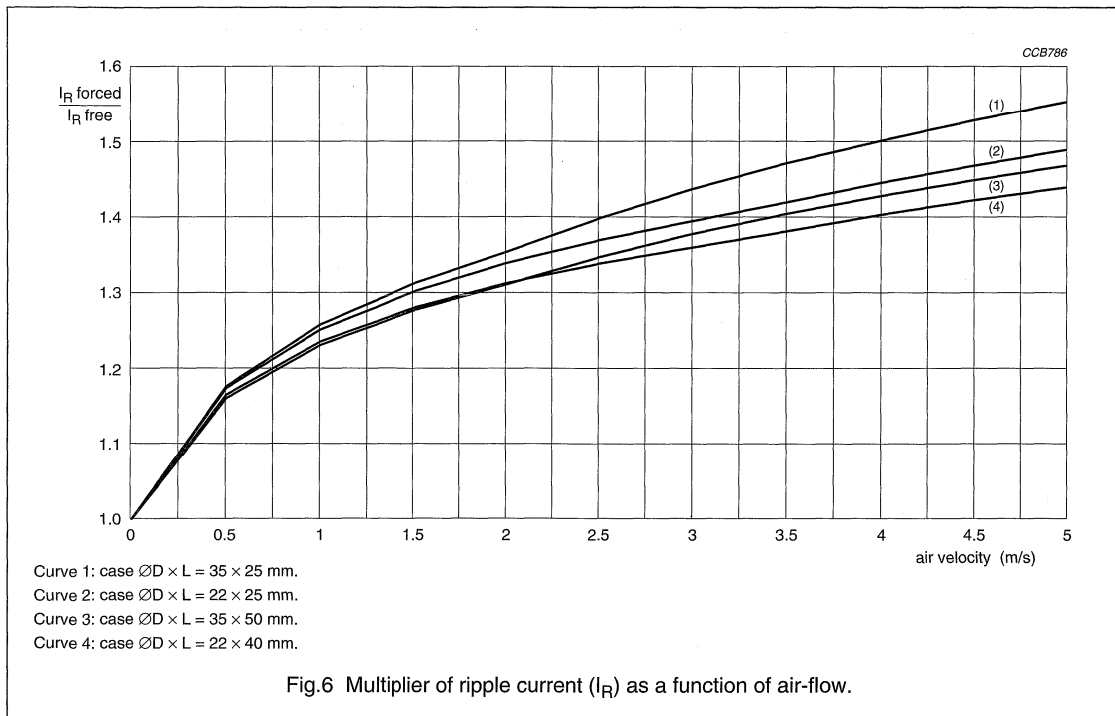
Aluminum electrolytic capacitors Power High Ripple Current Snap-in

198 PHR-SI

RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.86
100	1.00
300	1.17
600	1.24
1000	1.29
≥ 10000	1.40



Maximum ripple current multiplier

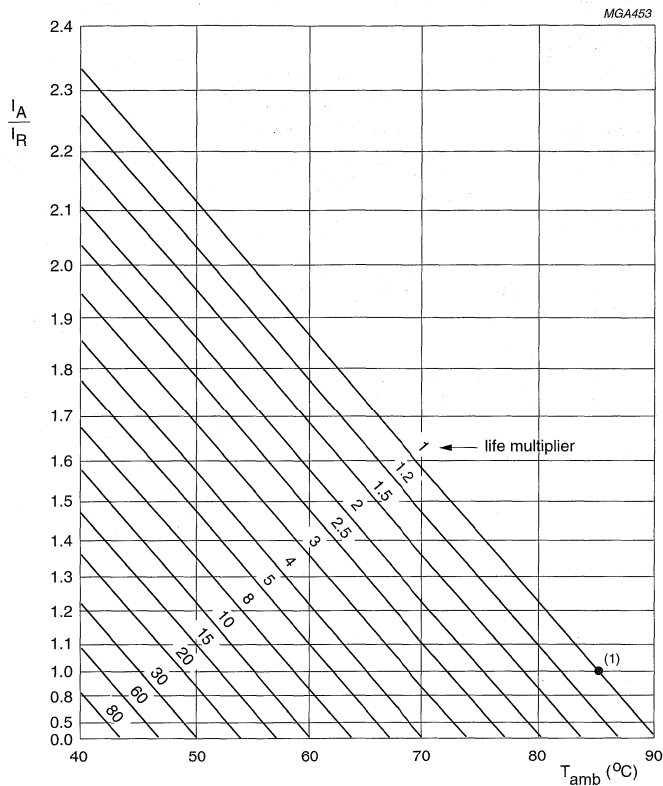
CALCULATION EXAMPLE FOR CASE $\varnothing D \times L = 35 \times 25$ mm

PARAMETER	CONDITION	MAXIMUM RIPPLE CURRENT MULTIPLIER	VALUE
Ambient temperature (T_{amb})	70 °C	from nomogram; see Fig.7	1.57
Operating frequency (f)	300 Hz	from frequency table; see Table 3	1.17
Air-flow	2 m/s	from air-flow; see Fig.6	1.35

Therefore the maximum ripple current multiplier at 70 °C, 300 Hz and 2 m/s air-flow = $1.57 \times 1.17 \times 1.35 = 2.48$.

Aluminum electrolytic capacitors
Power High Ripple Current Snap-in

198 PHR-SI



I_A = actual ripple current at 100 Hz and 85 °C.
 I_R = rated ripple current at 100 Hz and 85 °C.
 (1) Useful life at 85 °C and U_R applied: 15000 hours.

Fig.7 Multiplier of useful life as a function of ambient temperature and ripple current load.



Aluminum electrolytic capacitors

Power High Ripple Current Snap-in

198 PHR-SI

SPECIFIC TESTS AND REQUIREMENTS

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

Table 4 Test procedures and requirements

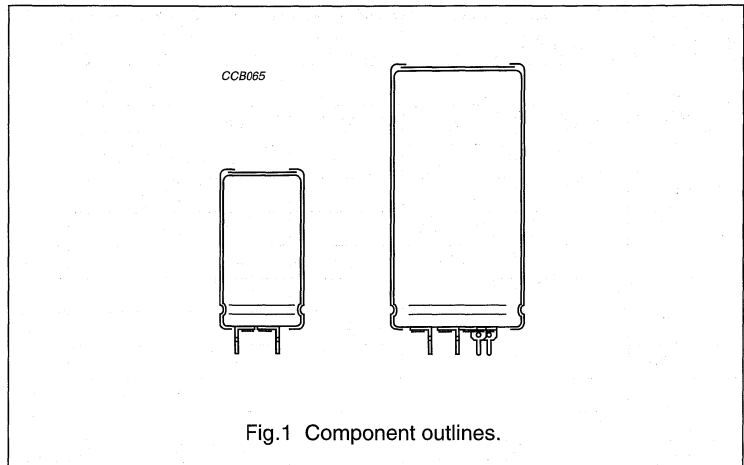
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied; 7000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 15000 hours	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
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	$\Delta C/C: \pm 15\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW

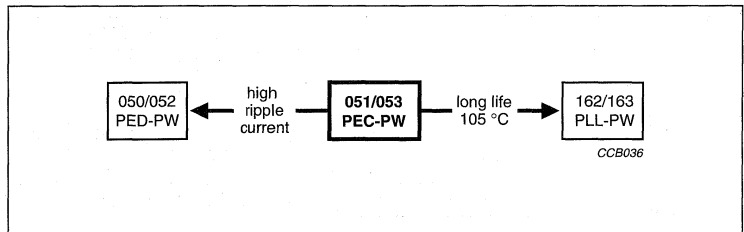
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types with reduced dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Provided with keyed polarity
- Pressure relief on the top of the aluminium case
- Charge and discharge proof
- Long useful life:
12000 hours at 85 °C
- High ripple current capability
- High resistance to shock and vibration.



APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	051	053
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	25 × 30 to 40 × 100	
Rated capacitance range (E6 series), C_R	680 to 150000 μF	68 to 2200 μF
Tolerance on C_R	±20%	
Rated voltage range, U_R	10 to 100 V	200 to 400 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	5000 hours	
Useful life at 85 °C	12000 hours	
Useful life at 40 °C, $1.4 \times I_R$ applied	200000 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	

Aluminum electrolytic capacitors

Power Economic Printed Wiring

051/053 PEC-PW

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

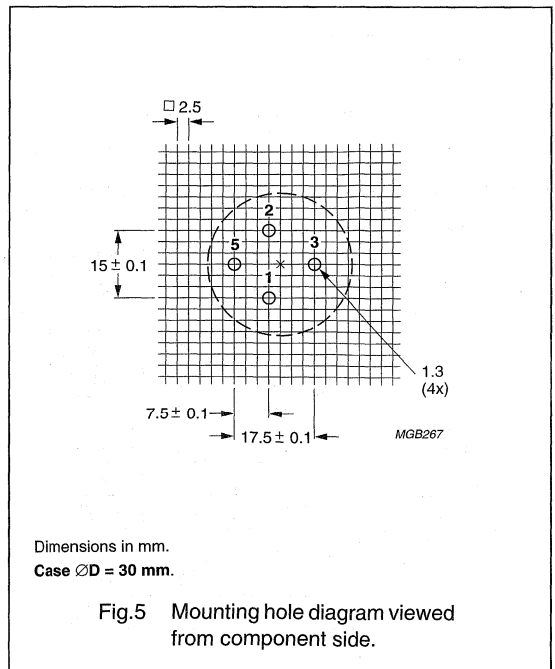
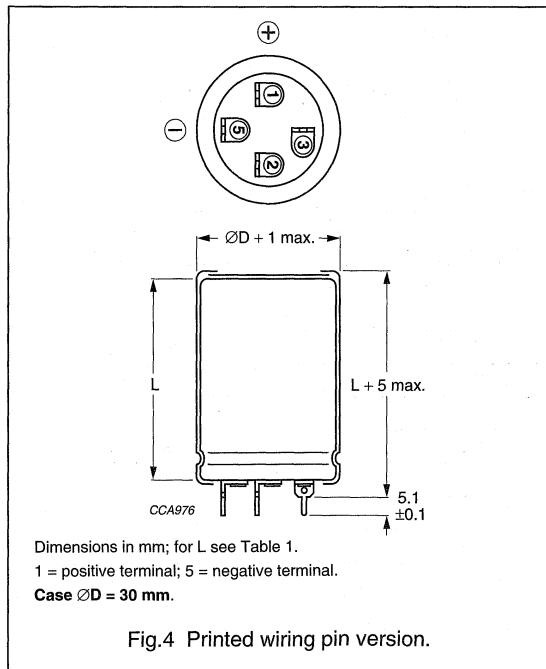
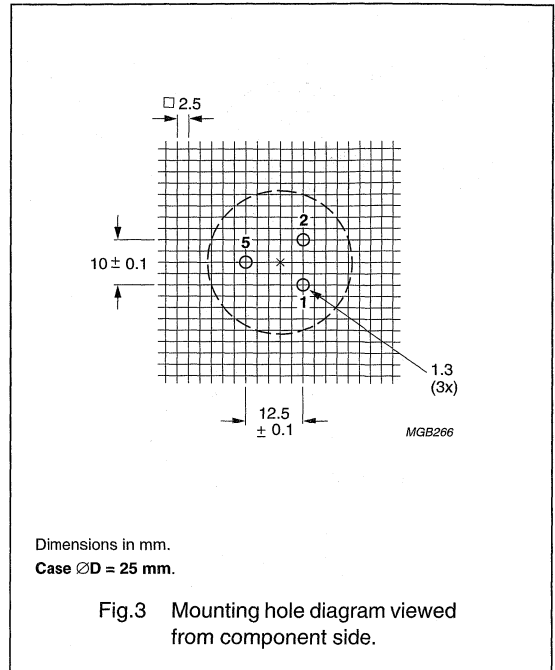
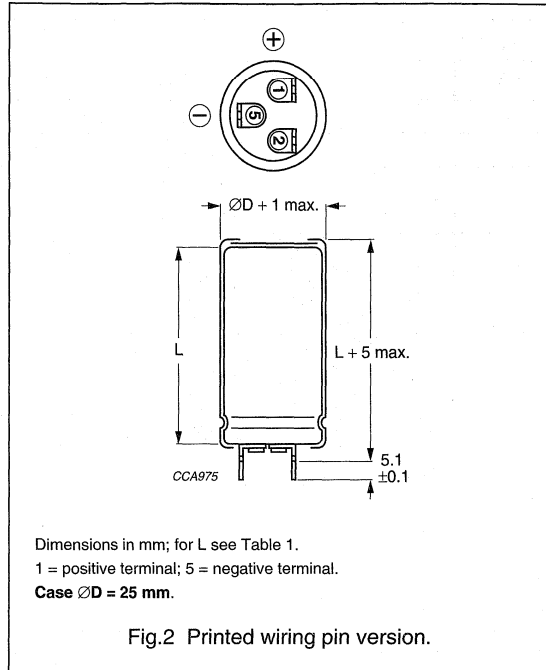
Preferred types in **bold**

C_R (μF)	U_R (V)								
	10	16	25	40	63	100	200	385	400
68	-	-	-	-	-	-	-	25 × 30	25 × 30
100	-	-	-	-	-	-	-	25 × 40	25 × 40
150	-	-	-	-	-	-	25 × 30	30 × 40	30 × 40
220	-	-	-	-	-	-	25 × 40	35 × 40	35 × 40
330	-	-	-	-	-	-	30 × 40	35 × 50	35 × 50
	-	-	-	-	-	-	-	40 × 40	40 × 40
470	-	-	-	-	-	-	35 × 40	40 × 50	40 × 50
680	-	-	-	-	-	25 × 30	35 × 50	40 × 70	40 × 70
	-	-	-	-	-	-	40 × 40	-	-
1000	-	-	-	-	-	25 × 40	40 × 50	40 × 100	40 × 100
1500	-	-	-	-	-	30 × 40	40 × 70	-	-
2200	-	-	-	-	25 × 30	35 × 40	40 × 100	-	-
3300	-	-	-	25 × 30	25 × 40	35 × 50	-	-	-
	-	-	-	-	-	40 × 40	-	-	-
4700	-	-	25 × 30	25 × 40	30 × 40	40 × 50	-	-	-
6800	-	25 × 30	25 × 40	30 × 40	35 × 40	40 × 70	-	-	-
10000	25 × 30	25 × 40	30 × 40	35 × 40	35 × 50	40 × 100	-	-	-
	-	-	-	-	40 × 40	-	-	-	-
15000	25 × 40	30 × 40	35 × 40	35 × 50	40 × 70	-	-	-	-
	-	-	-	40 × 40	-	-	-	-	-
22000	30 × 40	35 × 40	35 × 50	40 × 50	40 × 100	-	-	-	-
	-	-	40 × 40	-	-	-	-	-	-
33000	35 × 40	35 × 50	40 × 50	40 × 70	-	-	-	-	-
	-	40 × 40	-	-	-	-	-	-	-
47000	35 × 50	40 × 50	40 × 70	40 × 100	-	-	-	-	-
	40 × 40	-	-	-	-	-	-	-	-
68000	40 × 50	40 × 70	40 × 100	-	-	-	-	-	-
100000	40 × 70	40 × 100	-	-	-	-	-	-	-
150000	40 × 100	-	-	-	-	-	-	-	-

Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW

MECHANICAL DATA AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW

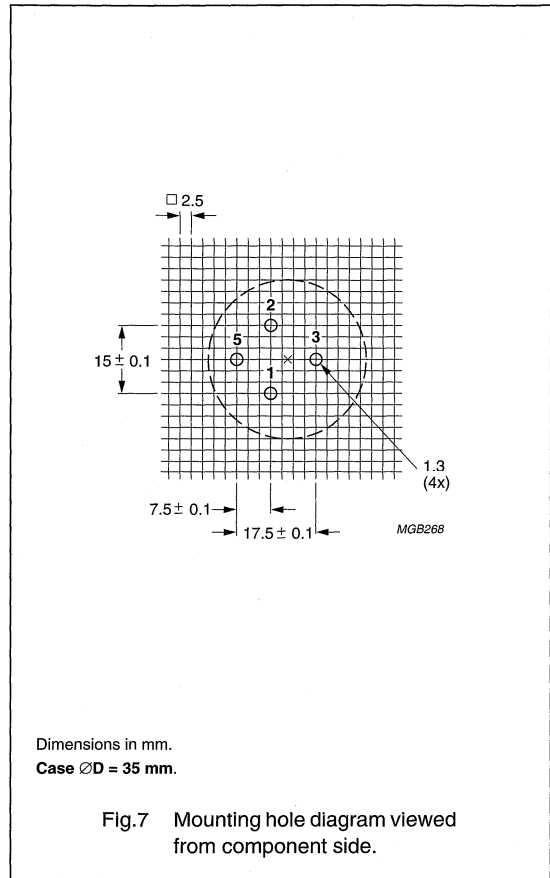
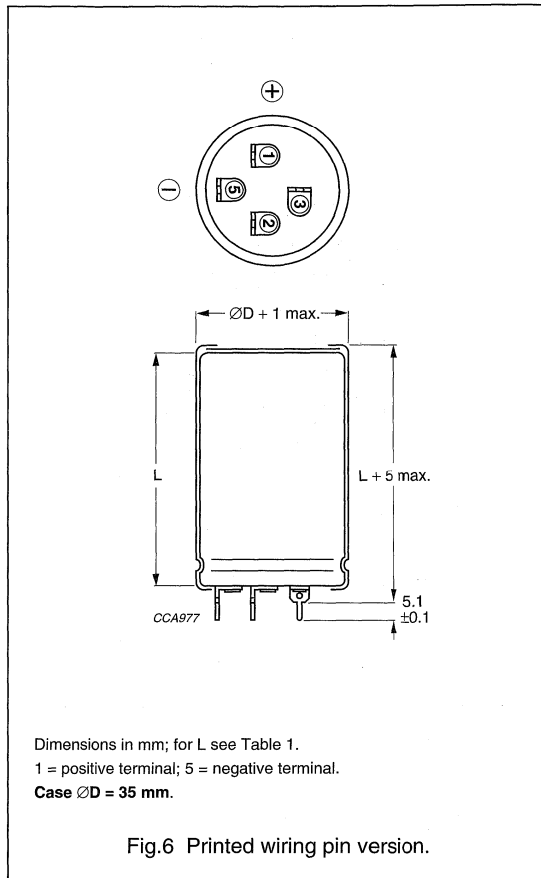
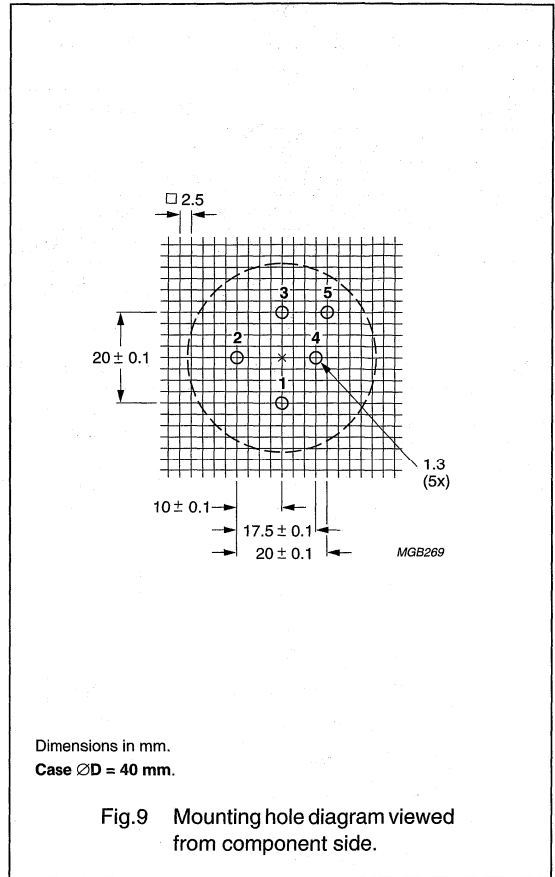
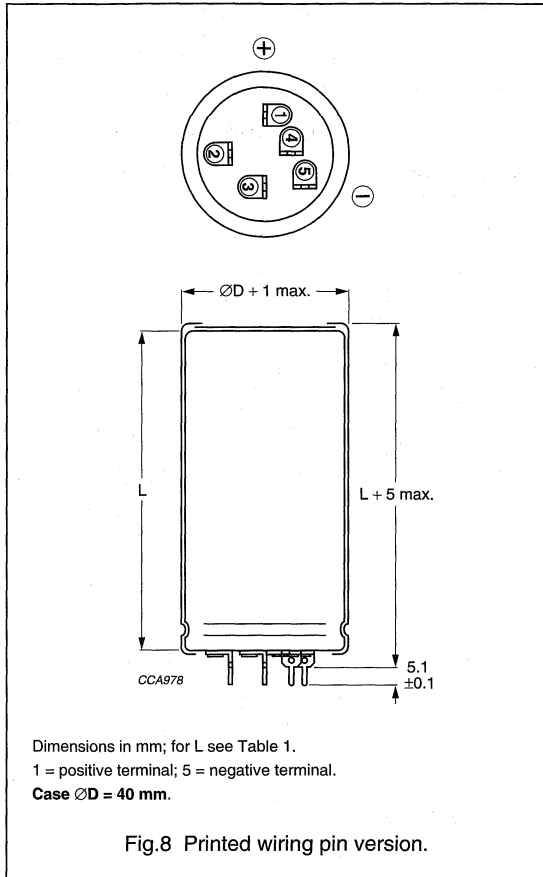


Table 1 Physical dimensions, mass and packaging information; see Figs 2, 4, 6 and 8

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
25 × 30	26	35	≈24	100	290 × 280 × 50
25 × 40	26	45	≈28	100	290 × 280 × 60
30 × 40	31	45	≈38	100	340 × 330 × 60
35 × 40	36	45	≈51	50	390 × 198 × 60
35 × 50	36	55	≈66	50	390 × 198 × 70
40 × 40	41	45	≈78	50	440 × 223 × 60
40 × 50	41	55	≈82	50	440 × 223 × 70
40 × 70	41	75	≈110	50	440 × 223 × 90
40 × 100	41	105	≈176	50	440 × 223 × 120

Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW



Mounting

When a number of capacitors are connected in a bank, they must not be closer together than 15 mm, when no derating of ripple current and/or temperature is applied.

Pin numbers 2, 3 and 4 (if present) must be free from the electrical circuit.

MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance (M for $\pm 20\%$)

- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- Polarity of the terminals and '-' sign to indicate the negative terminal, visible from the top and/or side of the capacitor
- Code number
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors

Power Economic Printed Wiring

051/053 PEC-PW

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 2 and 3 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 100 Hz, 85 °C or at 20 kHz, 70 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 100 Hz
Z	max. impedance at 10 kHz

Ordering example

Electrolytic capacitor 051 series

10000 $\mu\text{F}/25\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 30 \times 40\text{ mm}$

Catalogue number: 2222 051 56103.

Table 2 Electrical data and ordering information for **051** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
10	10000	25 × 30	3.1	5.9	0.60	0.20	51	40	051 54103
	15000	25 × 40	4.1	7.8	0.90	0.30	37	30	051 54153
	22000	30 × 40	5.0	9.5	1.32	0.44	30	25	051 54223
	33000	35 × 40	5.5	10.4	1.98	0.66	28	24	051 54333
	47000	35 × 50	6.8	12.9	2.82	0.94	23	20	051 54473
	47000	40 × 40	5.8	10.4	2.82	0.94	29	22	051 44473
	68000	40 × 50	7.1	13.5	4.08	1.36	24	20	051 54683
	100000	40 × 70	9.2	17.4	6.00	2.00	19	16	051 54104
150000	40 × 100	12.0	22.7	9.00	3.00	16	14	051 54154	
16	6800	25 × 30	3.1	5.9	0.65	0.22	53	42	051 55682
	10000	25 × 40	4.0	7.6	0.96	0.32	39	34	051 55103
	15000	30 × 40	5.0	9.5	1.44	0.48	31	27	051 55153
	22000	35 × 40	5.5	10.4	2.12	0.71	29	26	051 55223
	33000	35 × 50	6.7	12.7	3.17	1.06	23	21	051 55333
	33000	40 × 40	5.7	10.8	3.17	1.06	30	24	051 45333
	47000	40 × 50	7.0	13.3	4.52	1.51	24	20	051 55473
	68000	40 × 70	9.2	17.4	6.53	2.18	19	16	051 55683
	100000	40 × 100	12.0	22.7	9.60	3.20	16	14	051 55104
	25	4700	25 × 30	2.9	5.5	0.71	0.24	60	42
6800		25 × 40	3.9	7.4	1.02	0.34	42	34	051 56682
10000		30 × 40	4.8	9.1	1.50	0.50	34	27	051 56103
15000		35 × 40	5.3	10.0	2.25	0.75	30	26	051 56153
22000		35 × 50	6.5	12.3	3.30	1.10	24	21	051 56223
22000		40 × 40	5.7	10.8	3.30	1.10	31	24	051 46223
33000		40 × 50	7.0	13.3	4.95	1.65	25	20	051 56333
47000		40 × 70	9.2	17.4	7.05	2.35	19	16	051 56473
68000		40 × 100	12.0	22.7	10.20	3.40	16	14	051 56683

Aluminum electrolytic capacitors

Power Economic Printed Wiring

051/053 PEC-PW

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
40	3300	25 × 30	2.9	5.5	0.80	0.27	87	63	051 57332
	4700	25 × 40	3.8	7.2	1.13	0.38	62	47	051 57472
	6800	30 × 40	4.7	8.9	1.64	0.55	49	38	051 57682
	10000	35 × 40	5.2	9.8	2.40	0.80	48	37	051 57103
	15000	35 × 50	6.3	11.9	3.60	1.20	37	28	051 57153
	15000	40 × 40	5.6	10.6	3.60	1.20	50	35	051 47153
	22000	40 × 50	5.8	11.0	5.28	1.76	39	28	051 57223
	33000	40 × 70	7.8	14.8	7.92	2.64	28	21	051 57333
	47000	40 × 100	10.4	19.7	11.28	3.76	22	17	051 57473
63	2200	25 × 30	2.5	4.7	0.84	0.28	83	62	051 58222
	3300	25 × 40	3.3	6.2	1.25	0.42	58	42	051 58332
	4700	30 × 40	4.1	7.8	1.78	0.60	49	38	051 58472
	6800	35 × 40	4.5	8.5	2.57	0.86	48	37	051 58682
	10000	35 × 50	5.4	10.2	3.78	1.26	37	28	051 58103
	10000	40 × 40	4.6	8.7	3.78	1.26	52	37	051 48103
	15000	40 × 70	7.5	14.2	5.67	1.89	29	24	051 58153
	22000	40 × 100	10.0	19.0	8.32	2.77	22	19	051 58223
100	680	25 × 30	1.74	3.30	0.41	0.14	190	130	051 59681
	1000	25 × 40	2.34	4.44	0.60	0.20	130	90	051 59102
	1500	30 × 40	2.95	5.59	0.90	0.30	95	67	051 59152
	2200	35 × 40	3.69	7.00	1.32	0.44	71	53	051 59222
	3300	35 × 50	4.37	8.29	1.98	0.66	55	41	051 59332
	3300	40 × 40	4.16	7.89	1.98	0.66	64	48	051 49332
	4700	40 × 50	5.21	9.88	2.82	0.94	49	38	051 59472
	6800	40 × 70	6.97	13.22	4.08	1.36	35	28	051 59682
	10000	40 × 100	9.50	18.00	6.00	2.00	26	21	051 59103

Aluminum electrolytic capacitors

Power Economic Printed Wiring

051/053 PEC-PW

Table 3 Electrical data and ordering information for **053** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
200	150	25 × 30	0.70	1.33	0.18	0.06	1000	770	053 52151
	220	25 × 40	0.94	1.78	0.26	0.09	680	525	053 52221
	330	30 × 40	1.27	2.41	0.40	0.14	460	360	053 52331
	470	35 × 40	1.66	3.15	0.57	0.19	320	250	053 52471
	680	35 × 50	2.19	4.15	0.82	0.28	220	170	053 52681
	680	40 × 40	2.17	4.11	0.82	0.28	220	170	053 42681
	1000	40 × 50	2.86	5.42	1.20	0.40	150	115	053 52102
	1500	40 × 70	3.81	7.22	1.80	0.60	110	85	053 52152
	2200	40 × 100	5.20	9.86	2.64	0.88	80	60	053 52222
385	68	25 × 30	0.47	0.89	0.16	0.06	2200	1480	053 58689
	100	25 × 40	0.64	1.21	0.23	0.08	1500	1020	053 58101
	150	30 × 40	0.90	1.71	0.35	0.12	1000	700	053 58151
	220	35 × 40	1.15	2.18	0.51	0.17	680	480	053 58221
	330	35 × 50	1.53	2.90	0.77	0.26	450	340	053 58331
	330	40 × 40	1.52	2.88	0.77	0.26	450	340	053 48331
	470	40 × 50	1.96	3.72	1.09	0.36	320	260	053 58471
	680	40 × 70	2.70	5.12	1.58	0.53	220	190	053 58681
	1000	40 × 100	3.70	7.02	2.31	0.78	180	140	053 58102
400	68	25 × 30	0.54	1.02	0.16	0.06	2100	1000	053 56689
	100	25 × 40	0.73	1.38	0.24	0.08	1400	780	053 56101
	150	30 × 40	0.98	1.86	0.36	0.12	950	520	053 56151
	220	35 × 40	1.28	2.43	0.52	0.17	650	400	053 56221
	330	35 × 50	1.67	3.17	0.79	0.26	480	280	053 56331
	330	40 × 40	1.67	3.17	0.79	0.26	480	280	053 46331
	470	40 × 50	2.12	4.02	1.12	0.37	340	220	053 56471
	680	40 × 70	2.90	5.50	1.63	0.54	235	155	053 56681
	1000	40 × 100	4.05	7.68	2.40	0.80	160	110	053 56102

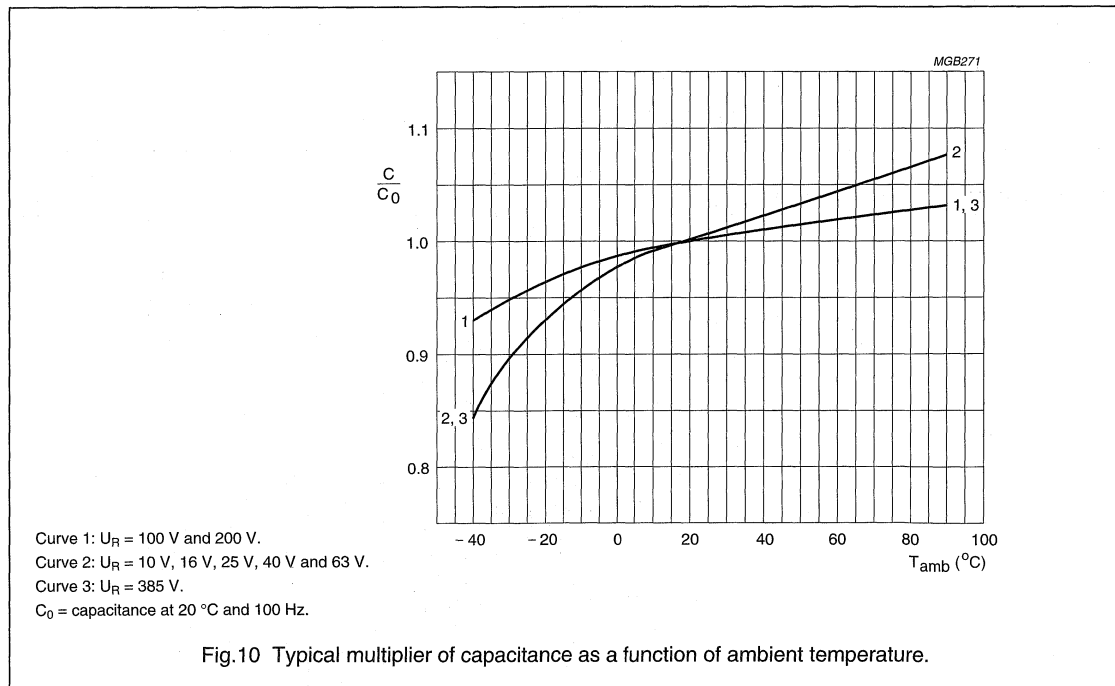
Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.15 \times U_R$
	≥385 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 25 \text{ mm}$	max. 25 nH
	case $\varnothing D = 30 \text{ and } 35 \text{ mm}$	max. 30 nH
	case $\varnothing D = 40 \text{ mm}$	max. 35 nH

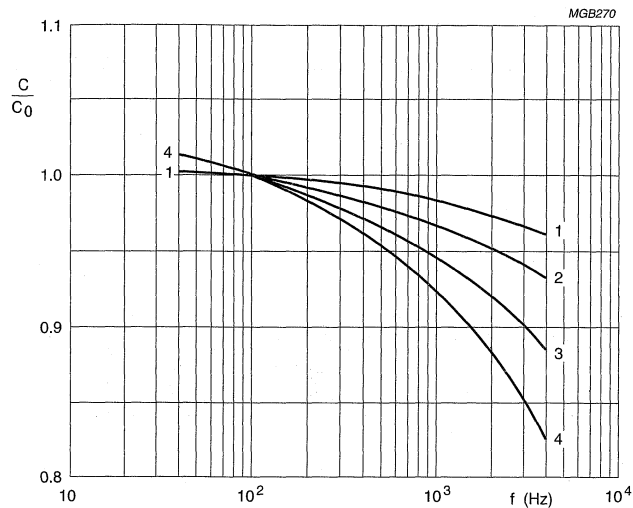
Capacitance (C)



Aluminum electrolytic capacitors

Power Economic Printed Wiring

051/053 PEC-PW



Curve 1: $U_R = 100$ V and 200 V.

Curve 2: $U_R = 40$ V and 63 V.

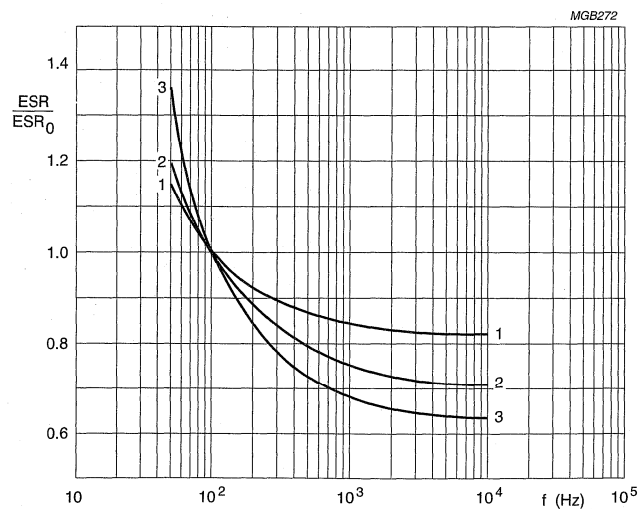
Curve 3: $U_R = 25$ V and 385 V.

Curve 4: $U_R = 10$ V and 16 V.

C_0 = capacitance at 20 °C and 100 Hz.

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

Equivalent series resistance (ESR)



Curve 1: $U_R = 10$ V, 16 V and 25 V.

Curve 2: $U_R = 40$ V, 63 V and 385 V.

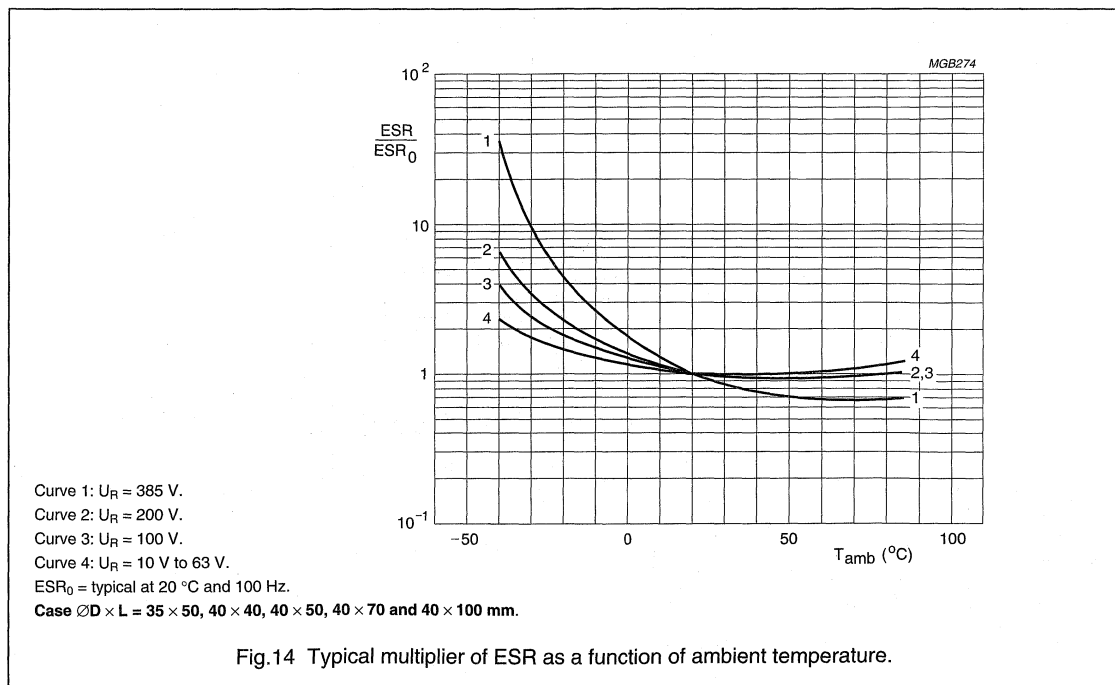
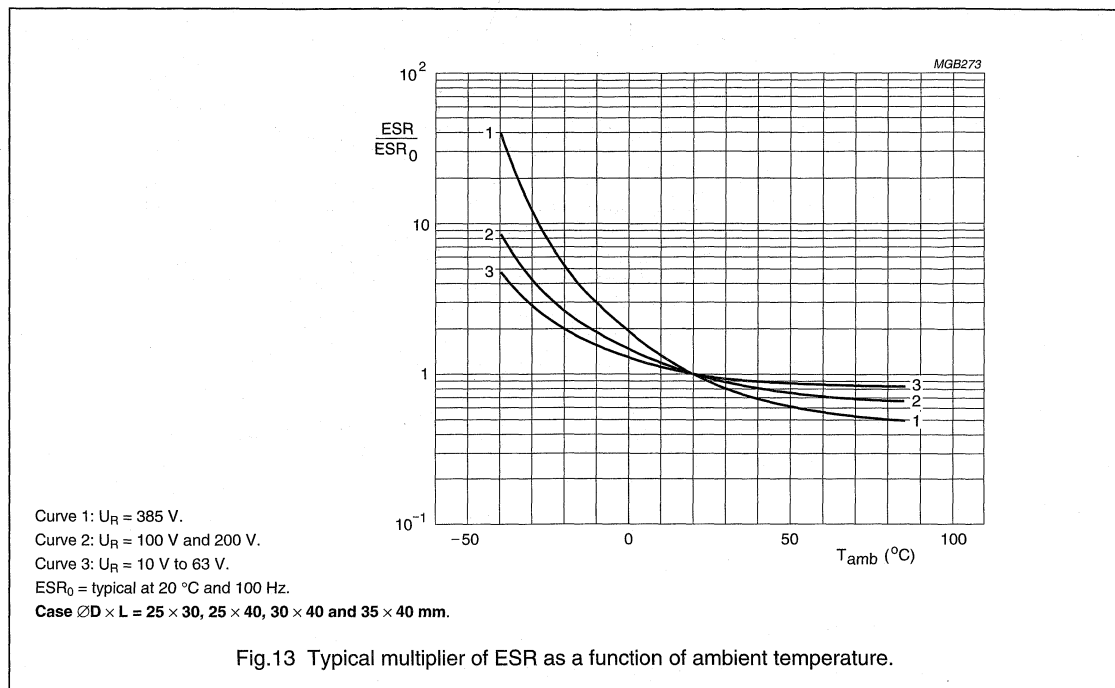
Curve 3: $U_R = 100$ V and 200 V.

ESR_0 = typical at 20 °C and 100 Hz.

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

Aluminum electrolytic capacitors
Power Economic Printed Wiring

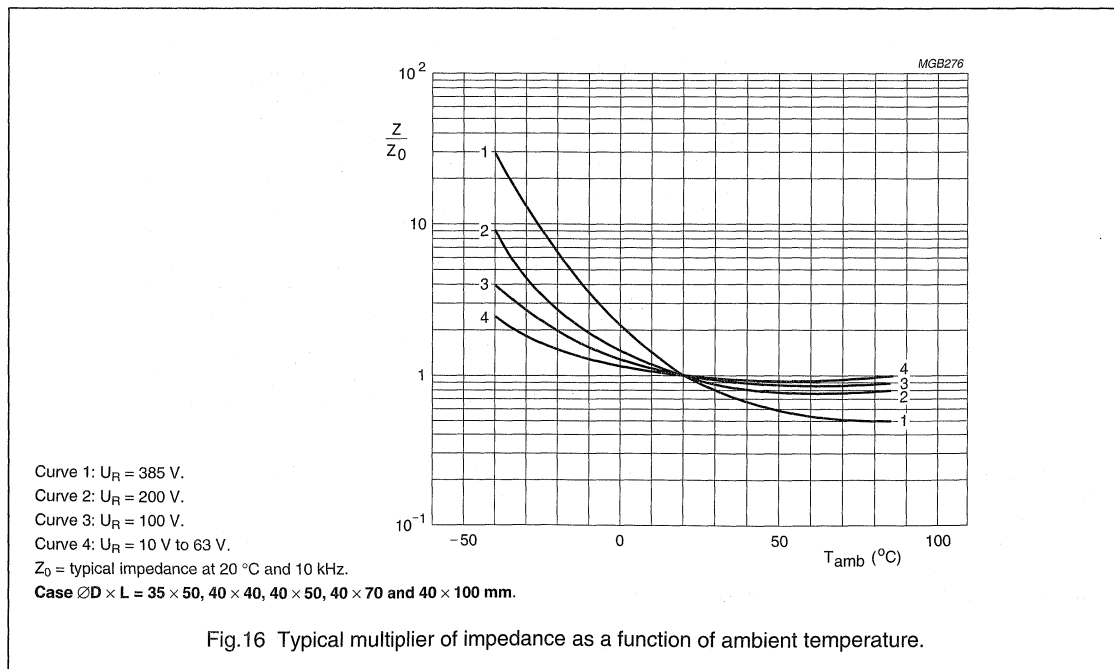
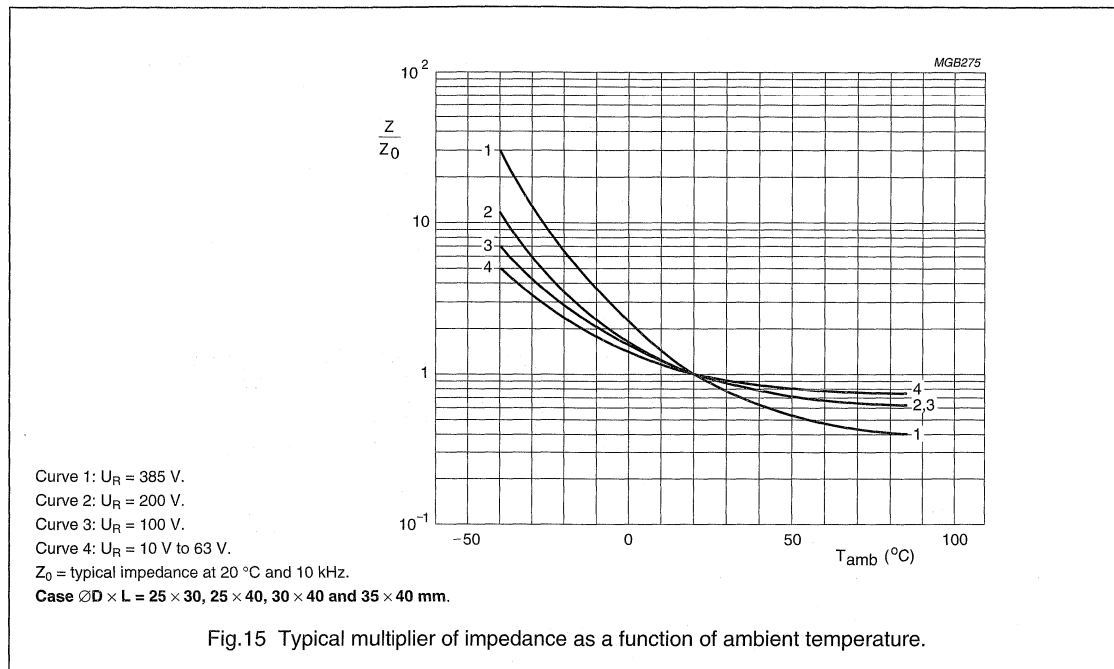
051/053 PEC-PW



Aluminum electrolytic capacitors Power Economic Printed Wiring

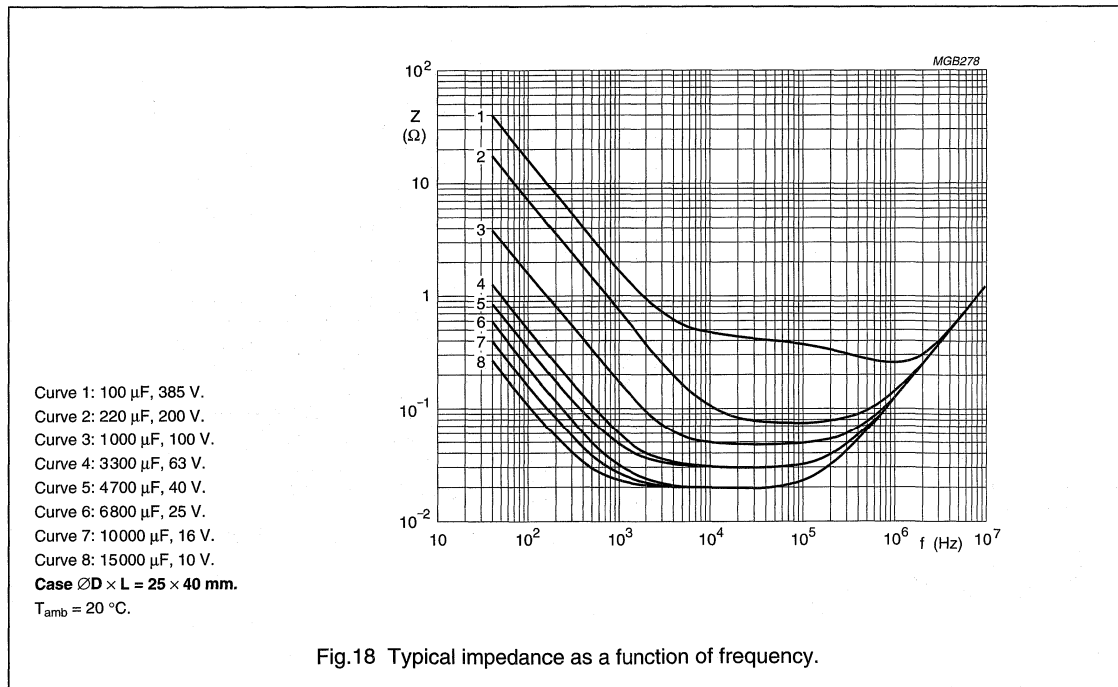
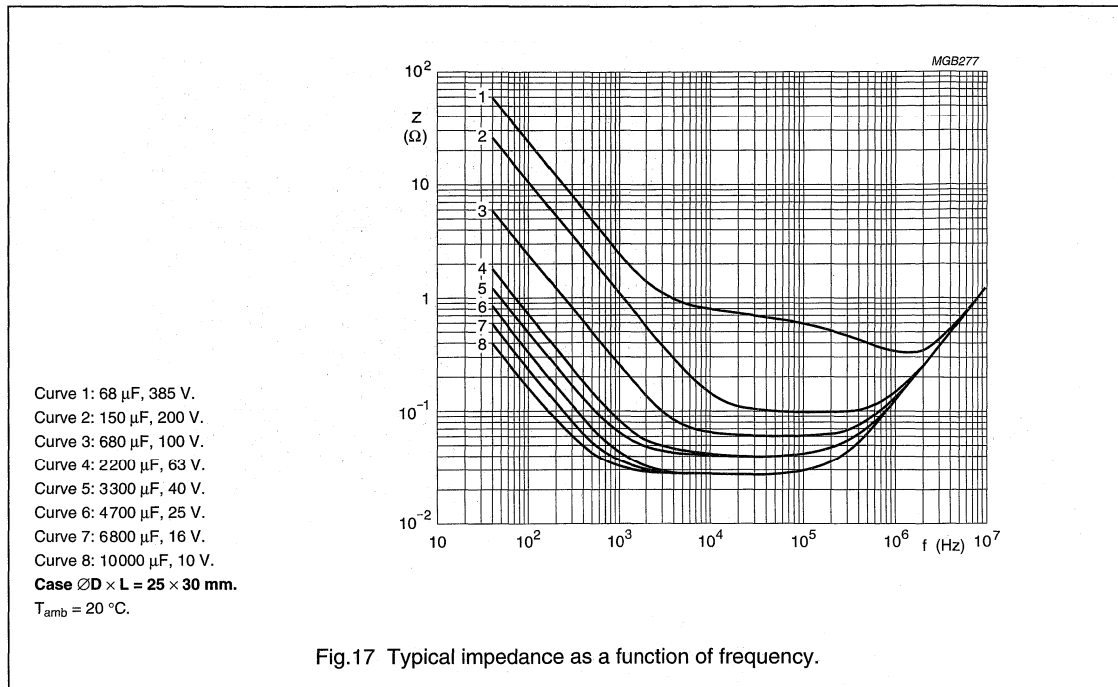
051/053 PEC-PW

Impedance (Z)



Aluminum electrolytic capacitors
Power Economic Printed Wiring

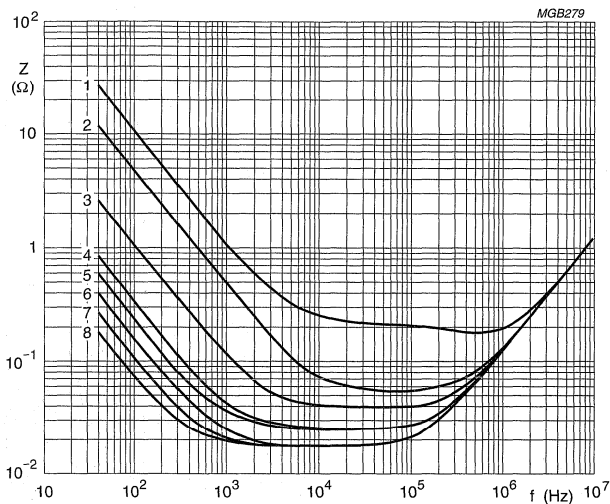
051/053 PEC-PW



Aluminum electrolytic capacitors

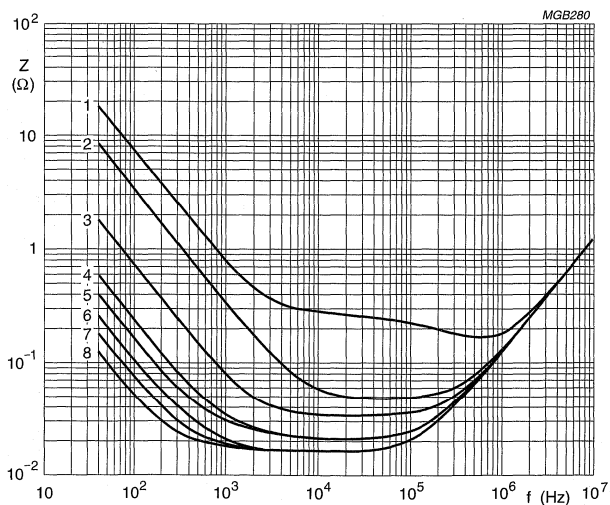
Power Economic Printed Wiring

051/053 PEC-PW



Curve 1: 150 μF , 385 V.
 Curve 2: 330 μF , 200 V.
 Curve 3: 1500 μF , 100 V.
 Curve 4: 4700 μF , 63 V.
 Curve 5: 6800 μF , 40 V.
 Curve 6: 10000 μF , 25 V.
 Curve 7: 15000 μF , 16 V.
 Curve 8: 22000 μF , 10 V.
Case $\varnothing\text{D} \times \text{L} = 30 \times 40 \text{ mm}$.
 $T_{\text{amb}} = 20 \text{ }^\circ\text{C}$.

Fig.19 Typical impedance as a function of frequency.

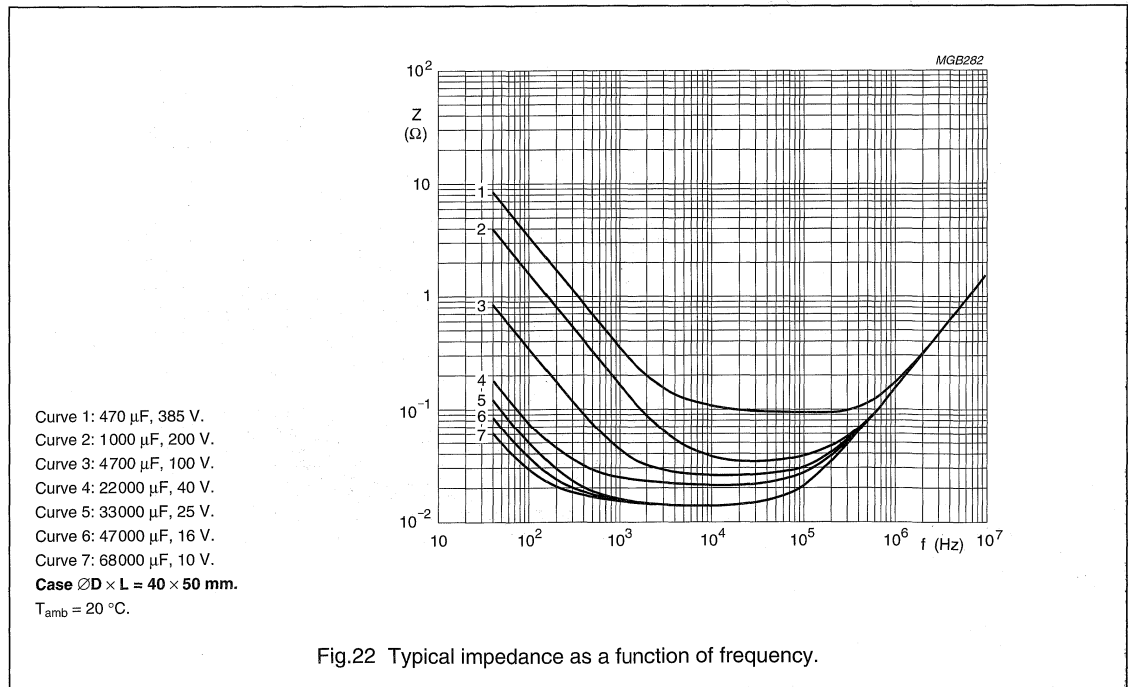
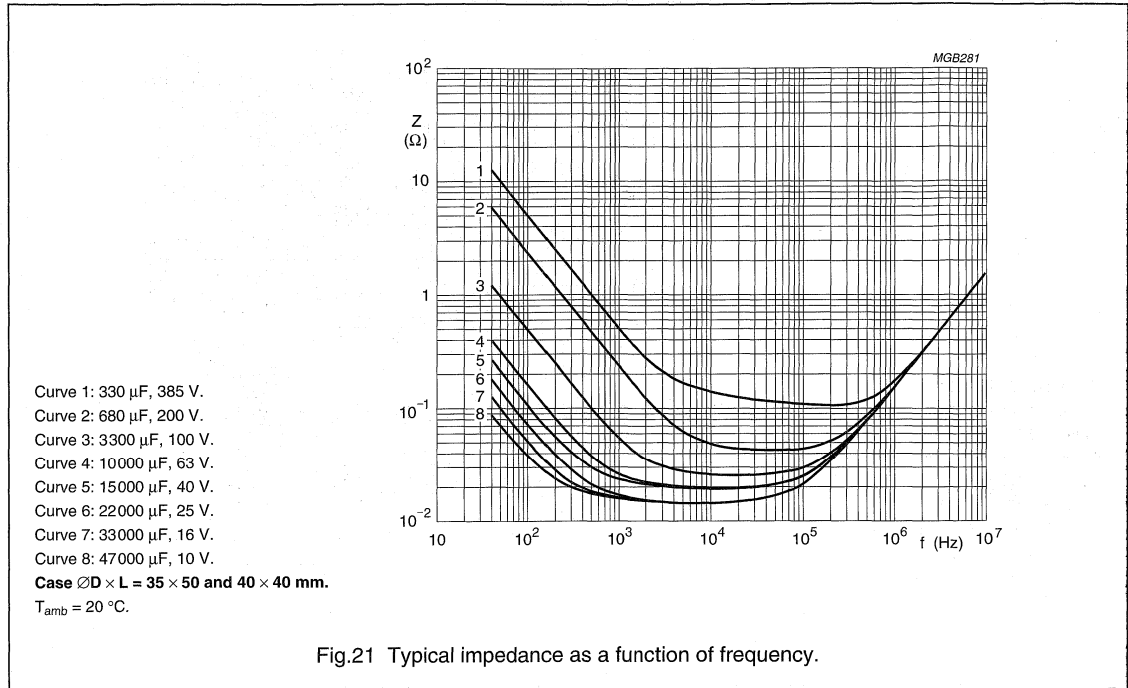


Curve 1: 220 μF , 385 V.
 Curve 2: 470 μF , 200 V.
 Curve 3: 2200 μF , 100 V.
 Curve 4: 6800 μF , 63 V.
 Curve 5: 10000 μF , 40 V.
 Curve 6: 15000 μF , 25 V.
 Curve 7: 22000 μF , 16 V.
 Curve 8: 33000 μF , 10 V.
Case $\varnothing\text{D} \times \text{L} = 35 \times 40 \text{ mm}$.
 $T_{\text{amb}} = 20 \text{ }^\circ\text{C}$.

Fig.20 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors
Power Economic Printed Wiring

051/053 PEC-PW



Aluminum electrolytic capacitors

Power Economic Printed Wiring

051/053 PEC-PW

Curve 1: 680 μ F, 385 V.
 Curve 2: 1500 μ F, 200 V.
 Curve 3: 6800 μ F, 100 V.
 Curve 4: 15000 μ F, 63 V.
 Curve 5: 33000 μ F, 40 V.
 Curve 6: 47000 μ F, 25 V.
 Curve 7: 68000 μ F, 16 V.
 Curve 8: 100000 μ F, 10 V.
Case $\varnothing D \times L = 40 \times 70$ mm.
 $T_{amb} = 20$ °C.

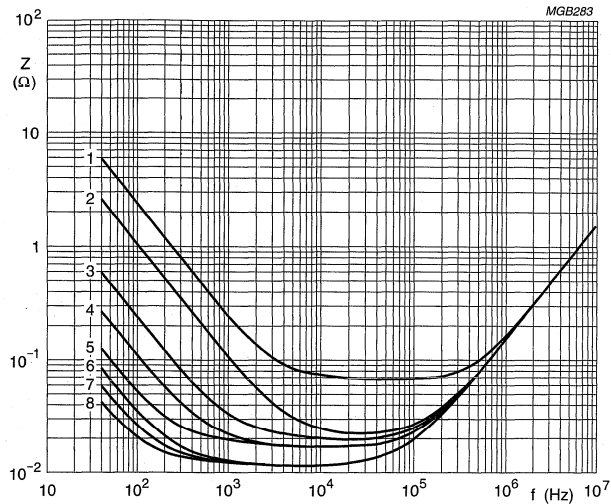


Fig.23 Typical impedance as a function of frequency.

Curve 1: 1000 μ F, 385 V.
 Curve 2: 2200 μ F, 200 V.
 Curve 3: 10000 μ F, 100 V.
 Curve 4: 22000 μ F, 63 V.
 Curve 5: 47000 μ F, 40 V.
 Curve 6: 68000 μ F, 25 V.
 Curve 7: 100000 μ F, 16 V.
 Curve 8: 150000 μ F, 10 V.
Case $\varnothing D \times L = 40 \times 100$ mm.
 $T_{amb} = 20$ °C.

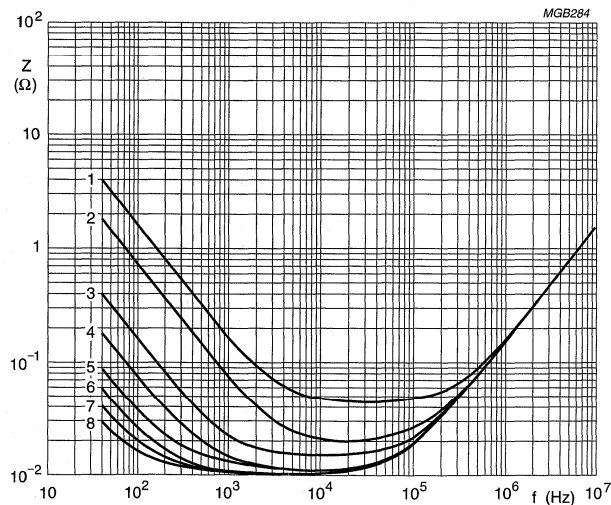


Fig.24 Typical impedance as a function of frequency.

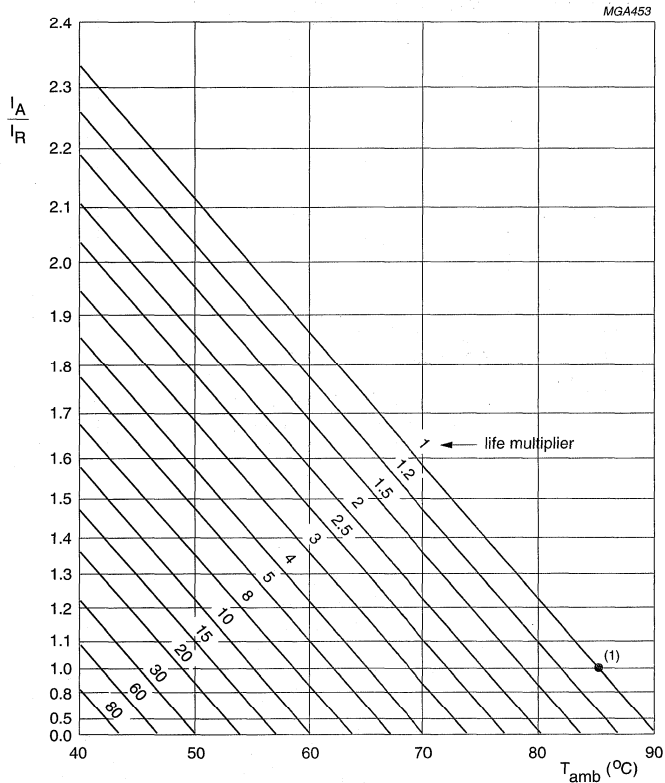
Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW

RIPPLE CURRENT AND USEFUL LIFE

Table 4 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.83
100	1.00
200	1.10
400	1.15
1000	1.19
≥ 2000	1.20



I_A = actual ripple current at 100 Hz and 85 °C.

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

(1) Useful life at 85 °C and I_R applied: 12000 hours.

Fig.25 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power Economic Printed Wiring

051/053 PEC-PW

SPECIFIC TESTS AND REQUIREMENTS

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

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 5000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 12000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}$: $\leq 1\%$; $U_R > 100\text{ V}$: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

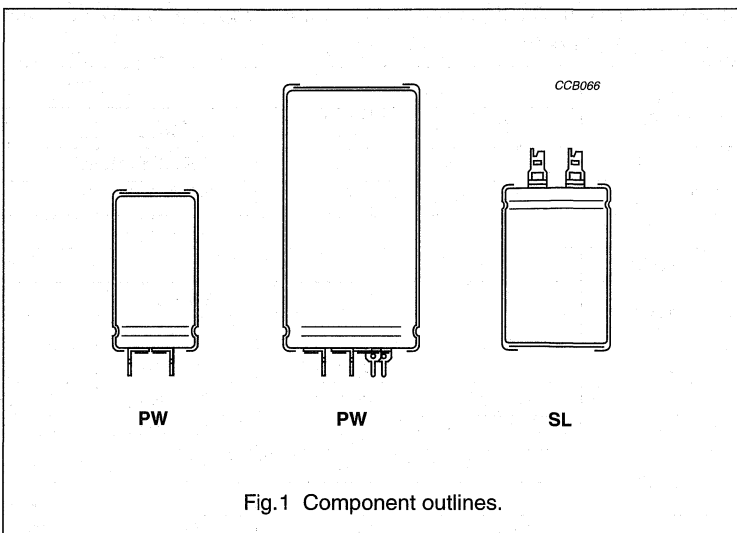
Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW

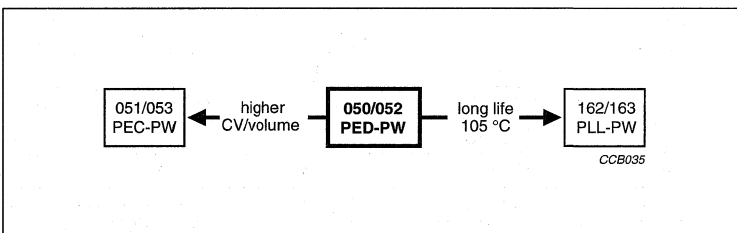
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, cylindrical aluminum case, insulated with a blue sleeve
- Provided with keyed polarity
- 050 series also available in solder-lug (SL) versions
- Pressure relief on the top of the aluminium case
- Charge and discharge proof
- Very long useful life: 15000 hours at 85 °C
- Low ESR, high ripple current capability
- High resistance to shock and vibration.



APPLICATIONS

- Computer, telecommunication and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	050	052
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	25 × 30 to 40 × 100	
Rated capacitance range (E6 series), C_R	470 to 68000 μF	47 to 1000 μF
Tolerance on C_R	-10 to +30%	
Rated voltage range, U_R	10 to 100 V	250 to 400 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	5000 hours	
Useful life at 85 °C	15000 hours	
Useful life at 40 °C and $1.4 \times I_R$ applied	250000 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	

Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 050 series

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	40	63	100
470	–	–	–	–	–	25 × 30
680	–	–	–	–	–	25 × 40
1000	–	–	–	–	25 × 30	30 × 40
1500	–	–	–	25 × 30	25 × 40	35 × 40
2200	–	–	25 × 30	25 × 40	30 × 40	35 × 50
	–	–	–	–	–	40 × 40
3300	–	25 × 30	25 × 40	30 × 40	35 × 40	40 × 50
4700	25 × 30	25 × 40	30 × 40	35 × 40	35 × 50	40 × 70
	–	–	–	–	40 × 40	–
6800	25 × 40	30 × 40	35 × 40	35 × 50	40 × 50	40 × 100
	–	–	–	40 × 40	–	–
10000	30 × 40	35 × 40	35 × 50	40 × 50	40 × 70	–
	–	–	40 × 40	–	–	–
15000	35 × 40	35 × 50	40 × 50	40 × 70	40 × 100	–
	–	40 × 40	–	–	–	–
22000	35 × 50	40 × 50	40 × 70	40 × 100	–	–
	40 × 40	–	–	–	–	–
33000	40 × 50	40 × 70	40 × 100	–	–	–
47000	40 × 70	40 × 100	–	–	–	–
68000	40 × 100	–	–	–	–	–

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 052 series

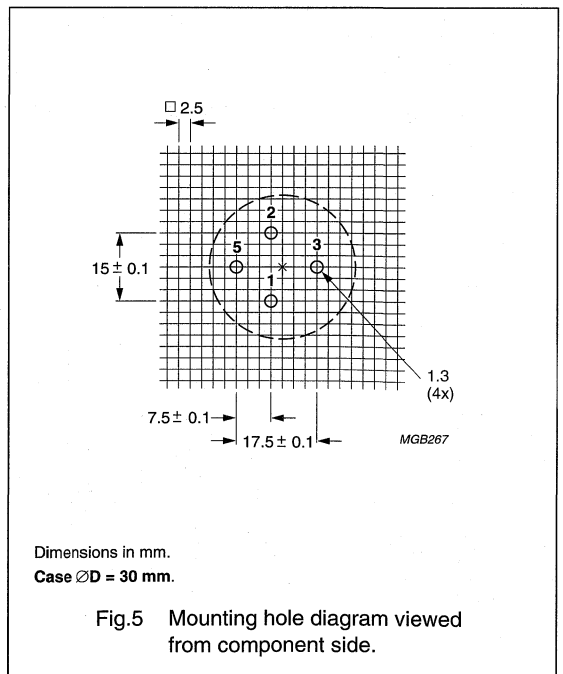
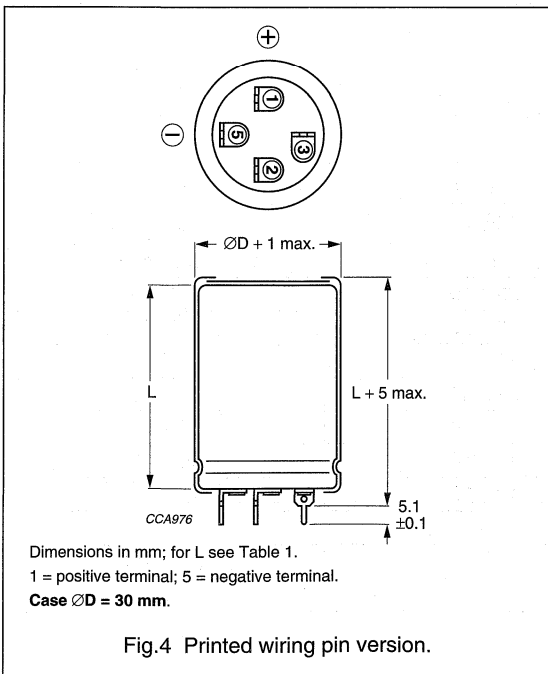
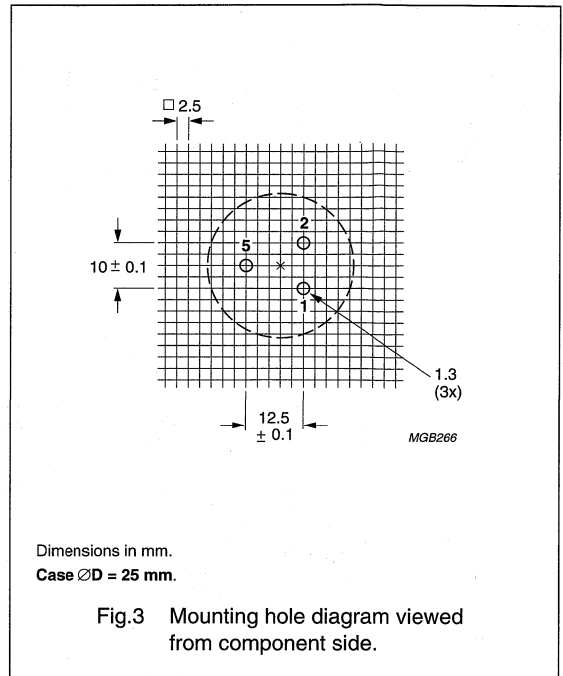
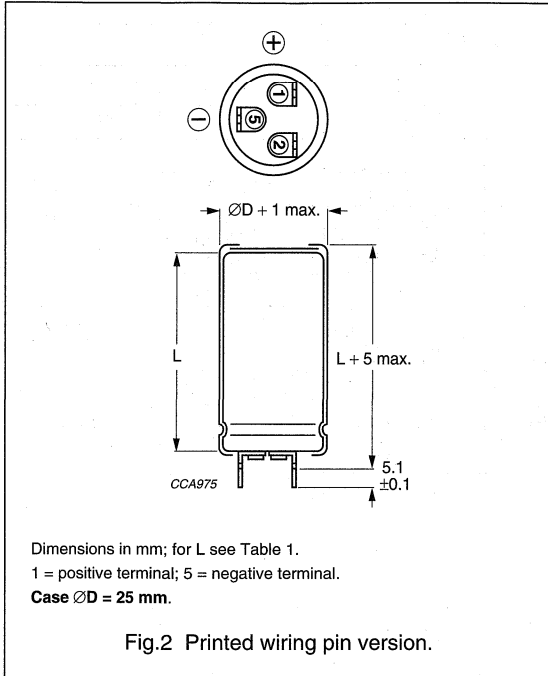
Preferred types in **bold**.

C_R (μF)	U_R (V)		
	250	385	400
47	–	25 × 30	25 × 30
68	–	25 × 40	25 × 40
100	25 × 30	30 × 40	30 × 40
150	25 × 40	35 × 40	35 × 40
220	30 × 40	35 × 50	35 × 50
	–	40 × 40	40 × 40
330	35 × 40	40 × 50	40 × 50
470	35 × 50	40 × 70	40 × 70
	40 × 40	–	–
680	40 × 50	–	40 × 100
1000	40 × 70	–	–

Aluminum electrolytic capacitors Power Eurodin Printed Wiring

050/052 PED-PW

MECHANICAL DATA AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors
Power Eurodin Printed Wiring

050/052 PED-PW

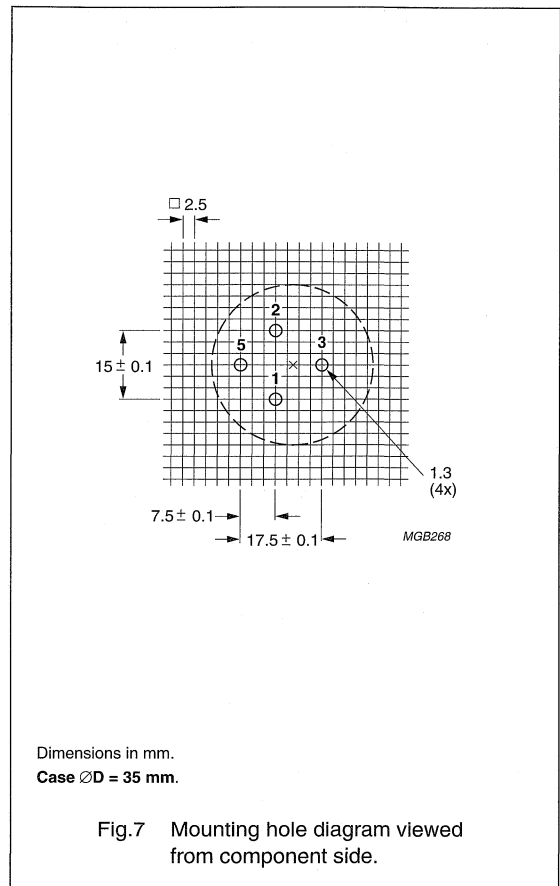
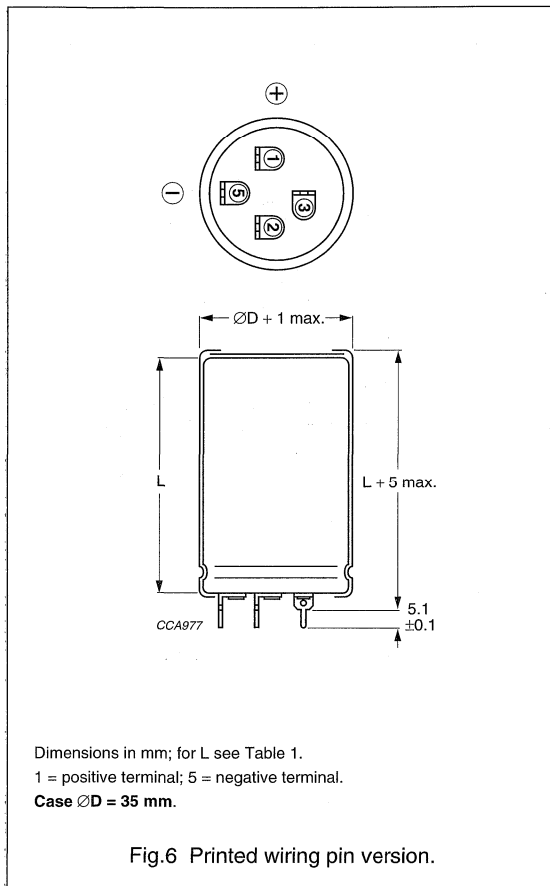
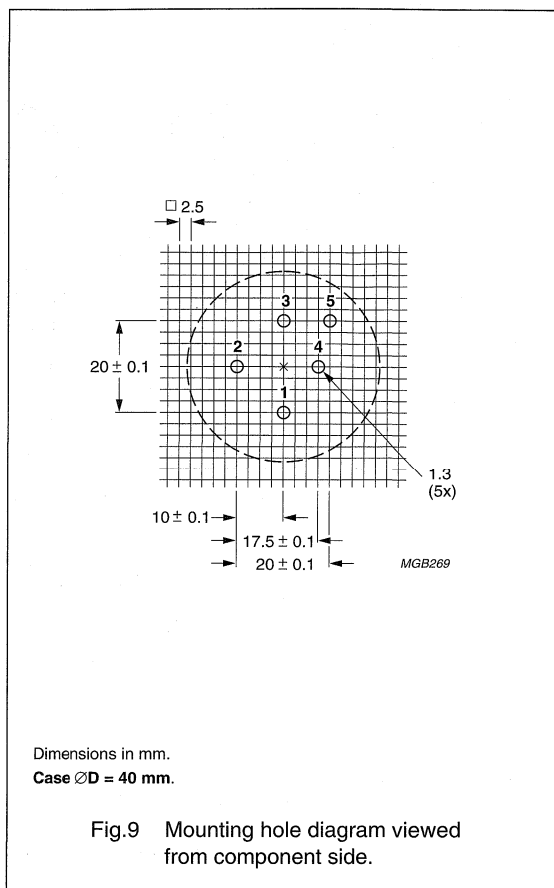
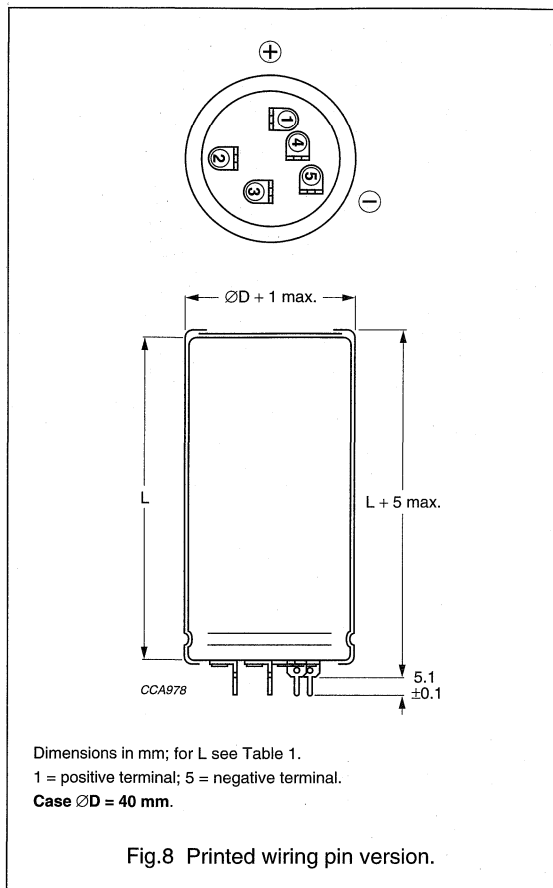


Table 1 PW versions; physical dimensions, mass and packaging information; see Figs 2, 4, 6 and 8

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
25 × 30	26	35	≈24	100	290 × 280 × 50
25 × 40	26	45	≈28	100	290 × 280 × 60
30 × 40	31	45	≈38	100	340 × 330 × 60
35 × 40	36	45	≈51	50	390 × 198 × 60
35 × 50	36	55	≈66	50	390 × 198 × 70
40 × 40	41	45	≈78	50	440 × 223 × 60
40 × 50	41	55	≈82	50	440 × 223 × 70
40 × 70	41	75	≈110	50	440 × 223 × 90
40 × 100	41	105	≈176	50	440 × 223 × 120

Aluminum electrolytic capacitors Power Eurodin Printed Wiring

050/052 PED-PW



Mounting

When a number of capacitors are connected in a bank, they must not be closer together than 15 mm, when no derating of ripple current and/or temperature is applied.

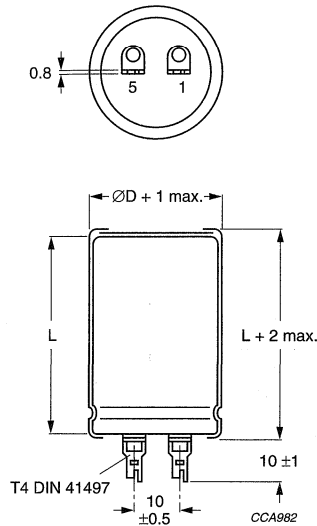
Pin numbers 2, 3 and 4 (if present) must be free from the electrical circuit.



Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW



Dimensions in mm; for L see Table 2.

1 = positive terminal; 5 = negative terminal.

See this handbook, section "Mounting Accessories".

Fig.10 Solder-lug version (SL); only available in 050 series.

Table 2 SL versions (050 series only); physical dimensions, mass and packaging information; see Fig.10

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{\max}$ (mm)	L_{\max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
25 × 30	26	32	≈24	100	290 × 280 × 50
25 × 40	26	42	≈28	100	290 × 280 × 60
30 × 40	31	42	≈38	100	340 × 330 × 60
35 × 40	36	42	≈51	50	390 × 198 × 60
35 × 50	36	52	≈66	50	390 × 198 × 70
40 × 50	41	52	≈82	50	440 × 223 × 70
40 × 70	41	72	≈110	50	440 × 223 × 90
40 × 100	41	102	≈176	50	440 × 223 × 120

Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 3 and 4 apply at $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 100 Hz, 85 °C or at 20 kHz, 70 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 100 Hz
Z	max. impedance at 10 kHz

Ordering example

Electrolytic capacitor 050 series

10000 $\mu\text{F}/25\text{ V}$; $-10/+30\%$ Nominal case size: $\varnothing 35 \times 50\text{ mm}$;
PW version

Catalogue number: 2222 050 56103.

Table 3 Electrical data and ordering information for **050** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER (note 1) 2222
10	4700	25 × 30	2.4	4.6	0.28	0.10	74	50	050 54472
	6800	25 × 40	3.2	6.1	0.41	0.14	51	37	050 54682
	10000	30 × 40	3.8	7.2	0.60	0.20	39	29	050 54103
	15000	35 × 40	4.1	7.8	0.90	0.30	35	26	050 54153
	22000	35 × 50	5.0	9.5	1.32	0.44	27	21	050 54223
	22000	40 × 40	4.2	8.0	1.32	0.44	36	27	050 44223
	33000	40 × 50	5.0	9.5	1.98	0.66	29	22	050 54333
	47000	40 × 70	6.8	12.9	2.82	0.94	20	17	050 54473
16	68000	40 × 100	9.2	17.5	4.08	1.36	15	14	050 54683
	3300	25 × 30	2.4	4.6	0.32	0.11	75	50	050 55332
	4700	25 × 40	3.1	5.9	0.45	0.15	52	37	050 55472
	6800	30 × 40	3.7	7.0	0.65	0.22	40	30	050 55682
	10000	35 × 40	4.1	7.8	0.96	0.32	36	27	050 55103
	15000	35 × 50	5.0	9.5	1.44	0.48	28	21	050 55153
	15000	40 × 40	4.2	8.0	1.44	0.48	36	27	050 45153
	22000	40 × 50	5.0	9.5	2.12	0.71	29	22	050 55223
25	33000	40 × 70	6.7	12.7	3.17	1.06	20	17	050 55333
	47000	40 × 100	9.1	17.3	4.51	1.51	15	14	050 55473
	2200	25 × 30	2.3	4.4	0.33	0.11	78	52	050 56222
	3300	25 × 40	3.1	5.9	0.49	0.17	53	38	050 56332
	4700	30 × 40	3.7	7.0	0.70	0.24	42	31	050 56472
	6800	35 × 40	4.1	7.8	1.02	0.34	37	28	050 56682
	10000	35 × 50	5.0	9.5	1.50	0.50	28	21	050 56103
	10000	40 × 40	4.2	8.0	1.50	0.50	36	27	050 46103
25	15000	40 × 50	5.0	9.5	2.25	0.75	29	22	050 56153
	22000	40 × 70	6.8	12.9	3.30	1.10	20	17	050 56223
	33000	40 × 100	9.2	17.5	4.95	1.65	15	14	050 56333

Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER (note 1) 2222
40	1500	25 × 30	2.0	3.8	0.36	0.12	112	68	050 57152
	2200	25 × 40	2.7	5.1	0.53	0.18	76	51	050 57222
	3300	30 × 40	3.3	6.3	0.79	0.27	57	41	050 57332
	4700	35 × 40	3.8	7.2	1.13	0.38	48	35	050 57472
	6800	35 × 50	4.7	8.9	1.64	0.55	36	27	050 57682
	6800	40 × 40	4.1	7.8	1.64	0.55	45	33	050 47682
	10000	40 × 50	4.9	9.3	2.40	0.80	35	27	050 57103
	15000	40 × 70	6.6	12.5	3.60	1.20	25	20	050 57153
	22000	40 × 100	9.0	17.1	5.28	1.76	18	16	050 57223
63	1000	25 × 30	1.8	3.4	0.38	0.13	122	74	050 58102
	1500	25 × 40	2.5	4.7	0.57	0.19	83	54	050 58152
	2200	30 × 40	3.1	5.9	0.83	0.28	57	41	050 58222
	3300	35 × 40	3.6	6.8	1.25	0.42	48	35	050 58332
	4700	35 × 50	4.4	8.3	1.78	0.60	36	27	050 58472
	4700	40 × 40	3.8	7.2	1.78	0.60	45	33	050 48472
	6800	40 × 50	4.7	8.9	2.57	0.86	35	27	050 58682
	10000	40 × 70	6.2	11.8	3.78	1.26	25	20	050 58103
	15000	40 × 100	8.5	16.1	5.67	1.89	18	16	050 58153
100	470	25 × 30	1.4	2.7	0.28	0.10	247	172	050 59471
	680	25 × 40	1.9	3.6	0.41	0.14	170	116	050 59681
	1000	30 × 40	2.5	4.7	0.60	0.20	123	88	050 59102
	1500	35 × 40	3.1	5.8	0.90	0.30	94	71	050 59152
	2200	35 × 50	3.9	7.4	1.32	0.44	69	55	050 59222
	2200	40 × 40	3.6	6.8	1.32	0.44	81	65	050 49222
	3300	40 × 50	4.6	8.7	1.98	0.66	59	48	050 59332
	4700	40 × 70	6.2	11.7	2.82	0.94	42	36	050 59472
	6800	40 × 100	8.2	15.5	4.08	1.36	32	28	050 59682

Note

1. Catalogue number applies to the PW versions; for SL versions (not preferred) available in 050 series only (case size $\varnothing 40 \times 40$ mm not available) replace the 8th digit by '1': SL versions: 2222 050 1....

Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW

Table 4 Electrical data and ordering information for **052** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
250	100	25 × 30	0.6	1.15	0.15	0.05	1800	1300	052 53101
	150	25 × 40	0.8	1.5	0.23	0.08	1100	850	052 53151
	220	30 × 40	1.0	1.9	0.33	0.11	750	550	052 53221
	330	35 × 40	1.4	2.65	0.49	0.17	500	400	052 53331
	470	35 × 50	1.8	3.4	0.70	0.24	360	290	052 53471
	470	40 × 40	1.8	3.4	0.70	0.24	420	350	052 43471
	680	40 × 50	2.3	4.4	1.02	0.34	250	190	052 53681
	1000	40 × 70	3.0	5.7	1.50	0.50	170	140	052 53102
385	47	25 × 30	0.5	0.94	0.11	0.04	2370	1550	052 58479
	68	25 × 40	0.67	1.27	0.16	0.06	1640	1100	052 58689
	100	30 × 40	0.84	1.59	0.23	0.08	1275	950	052 58101
	150	35 × 40	1.13	2.14	0.34	0.11	850	635	052 58151
	220	35 × 50	1.48	2.8	0.50	0.17	580	430	052 58221
	220	40 × 40	1.48	2.8	0.50	0.17	580	430	052 48221
	330	40 × 50	1.97	3.73	0.75	0.25	385	300	052 58331
	470	40 × 70	2.7	5.11	1.06	0.36	270	215	052 58471
400	47	25 × 30	0.47	0.89	0.11	0.04	2700	2125	052 56479
	68	25 × 40	0.63	1.29	0.16	0.06	1875	1470	052 56689
	100	30 × 40	0.84	1.59	0.24	0.08	1275	1000	052 56101
	150	35 × 40	1.13	2.14	0.36	0.12	850	665	052 56151
	220	35 × 50	1.41	2.67	0.52	0.17	650	450	052 56221
	220	40 × 40	1.41	2.67	0.52	0.17	650	450	052 46221
	330	40 × 50	1.86	3.52	0.79	0.26	435	315	052 56331
	470	40 × 70	2.54	4.81	1.12	0.37	305	225	052 56471
680	40 × 100	3.56	6.75	1.63	0.54	210	155	052 56681	

Aluminum electrolytic capacitors
Power Eurodin Printed Wiring

050/052 PED-PW

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.15 \times U_R$
	≥385 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 25 \text{ mm}$	max. 25 nH
	case $\varnothing D = 30 \text{ and } 35 \text{ mm}$	max. 30 nH
	case $\varnothing D = 40 \text{ mm}$	max. 35 nH

Capacitance (C)

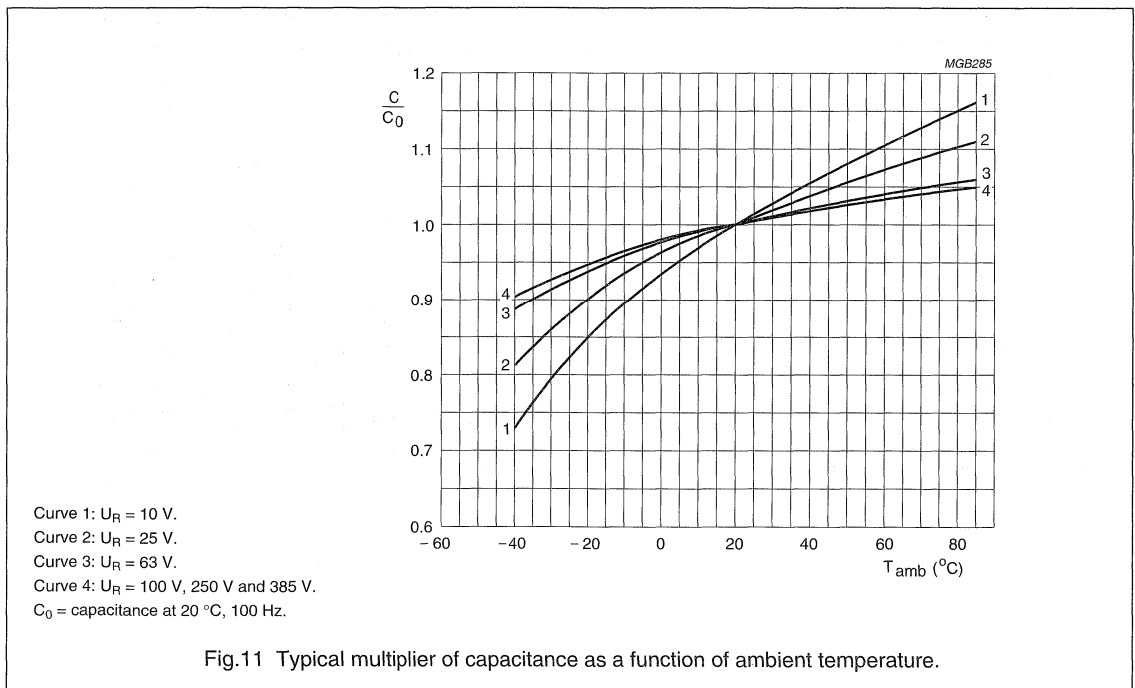
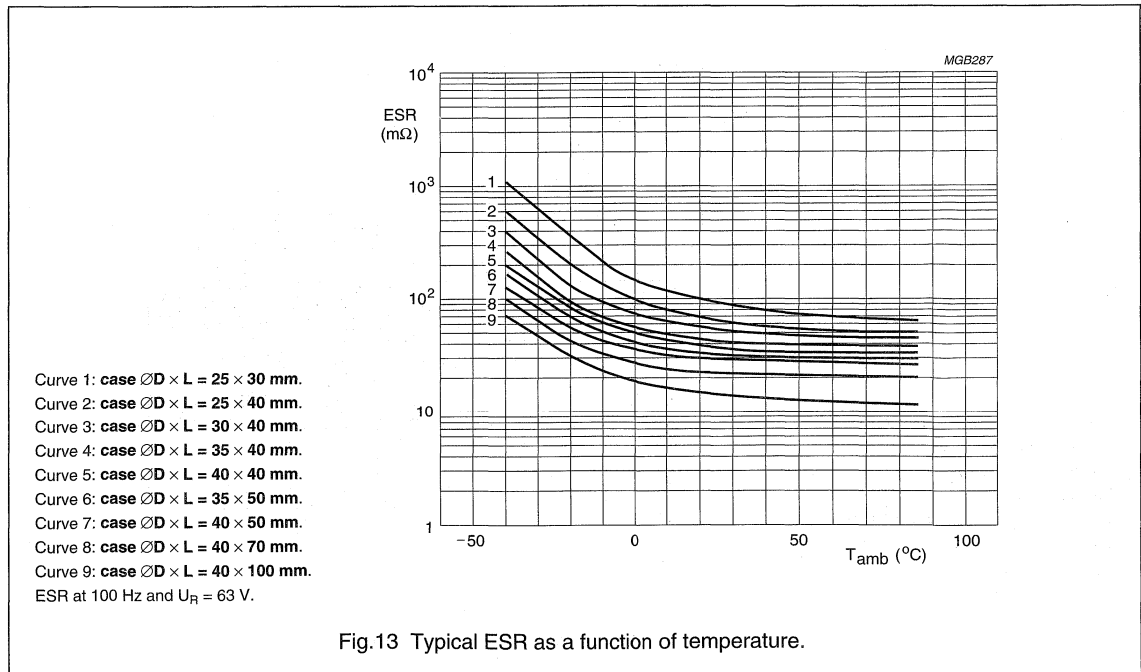
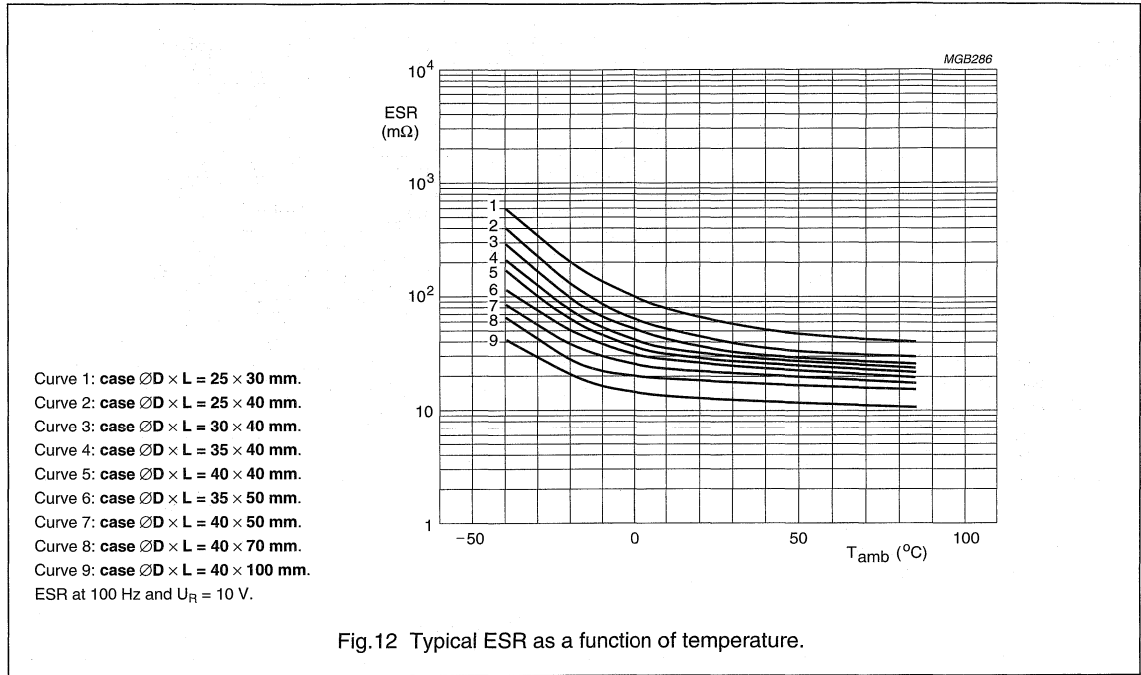


Fig.11 Typical multiplier of capacitance as a function of ambient temperature.

Aluminum electrolytic capacitors Power Eurodin Printed Wiring

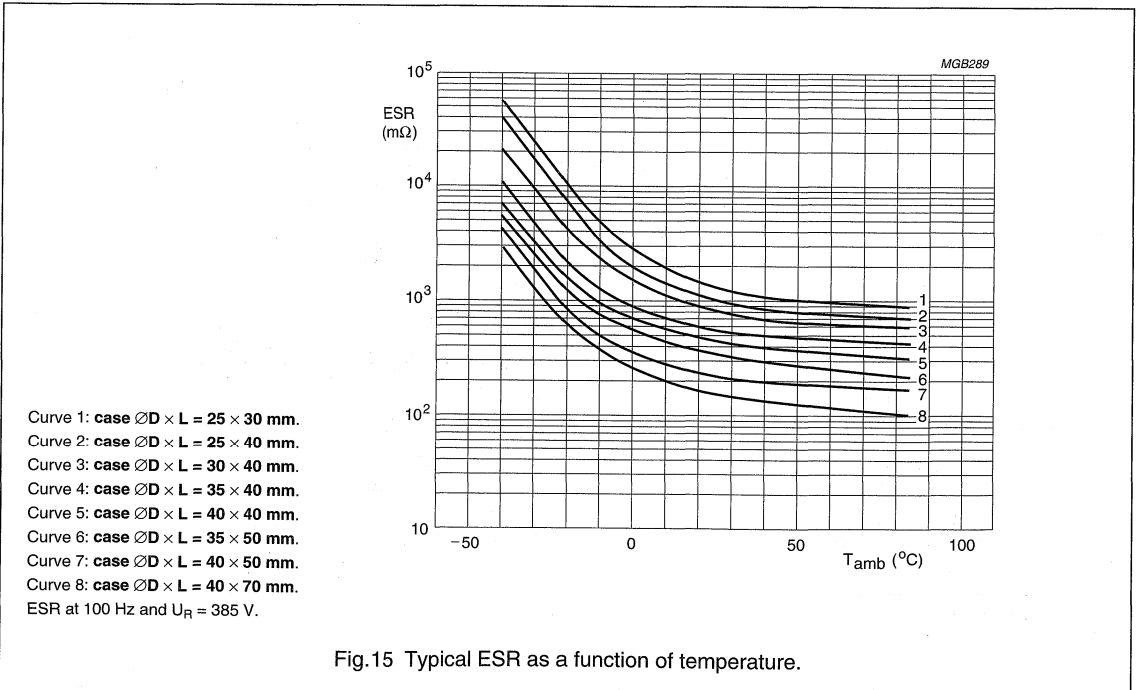
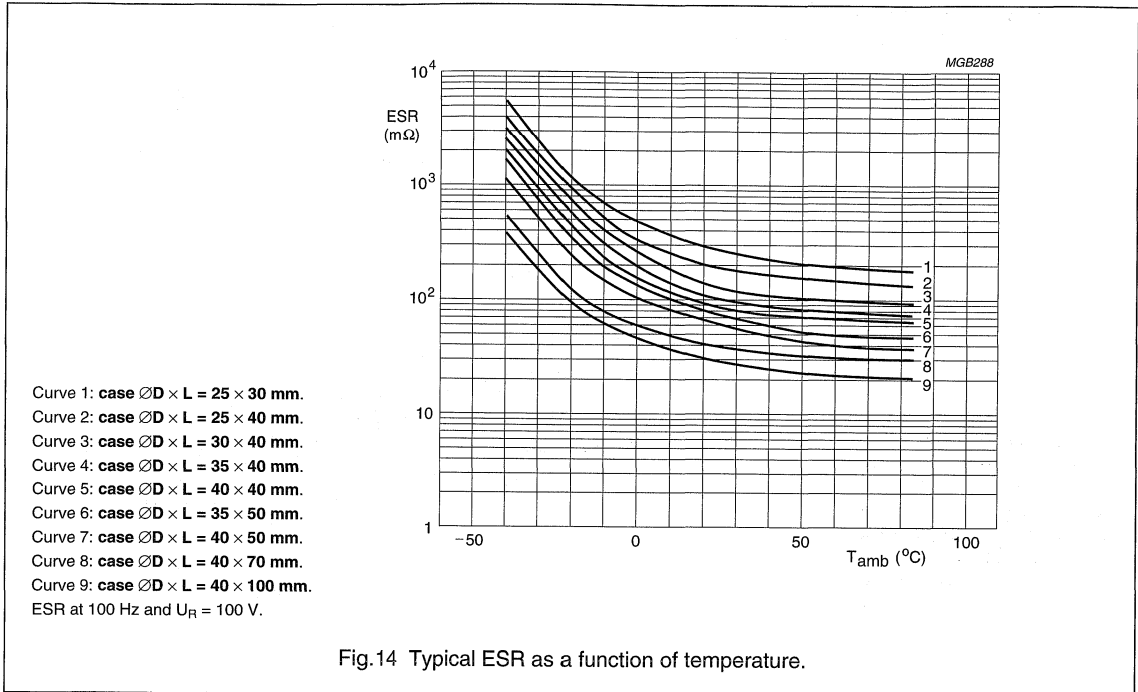
050/052 PED-PW

Equivalent series resistance (ESR)



Aluminum electrolytic capacitors
Power Eurodin Printed Wiring

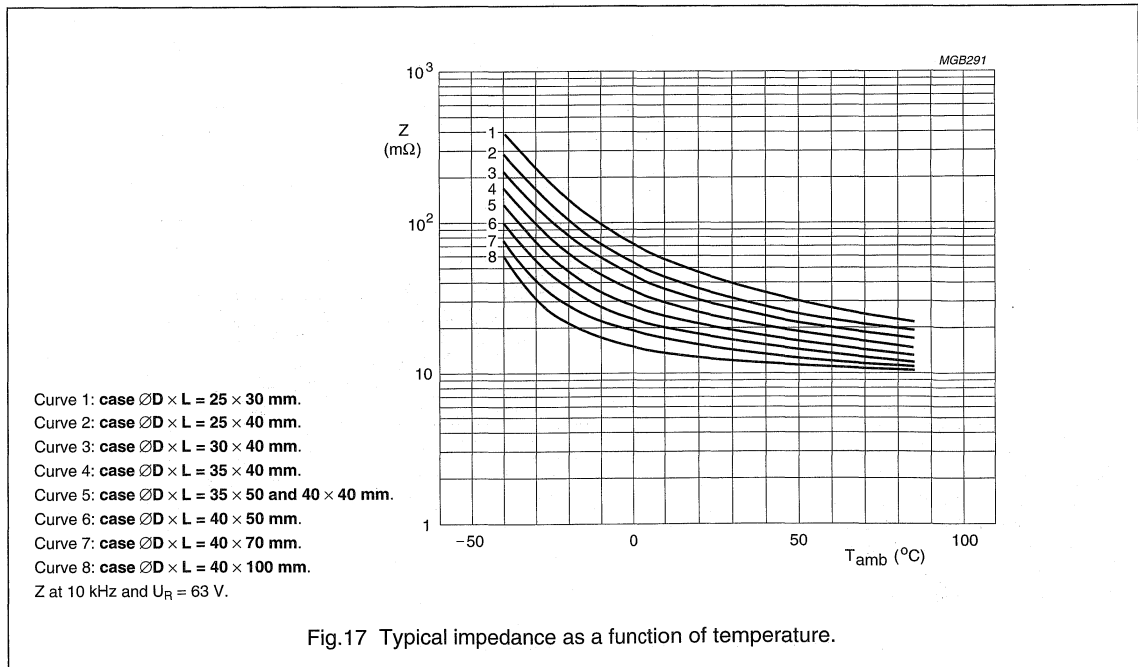
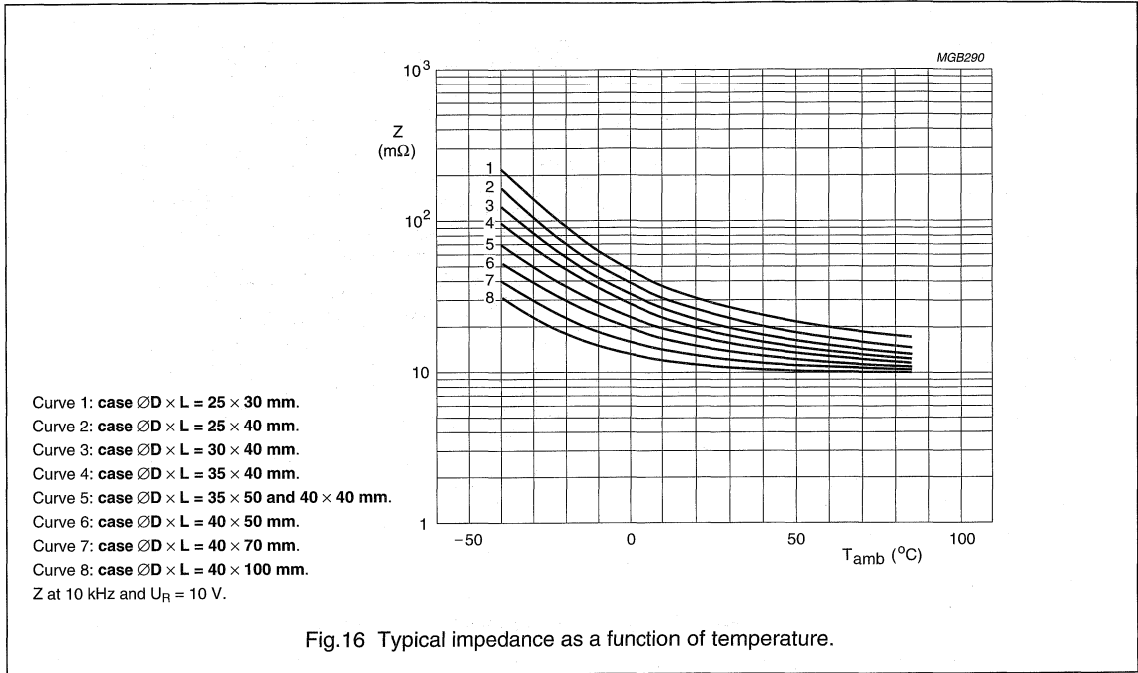
050/052 PED-PW



Aluminum electrolytic capacitors
Power Eurodin Printed Wiring

050/052 PED-PW

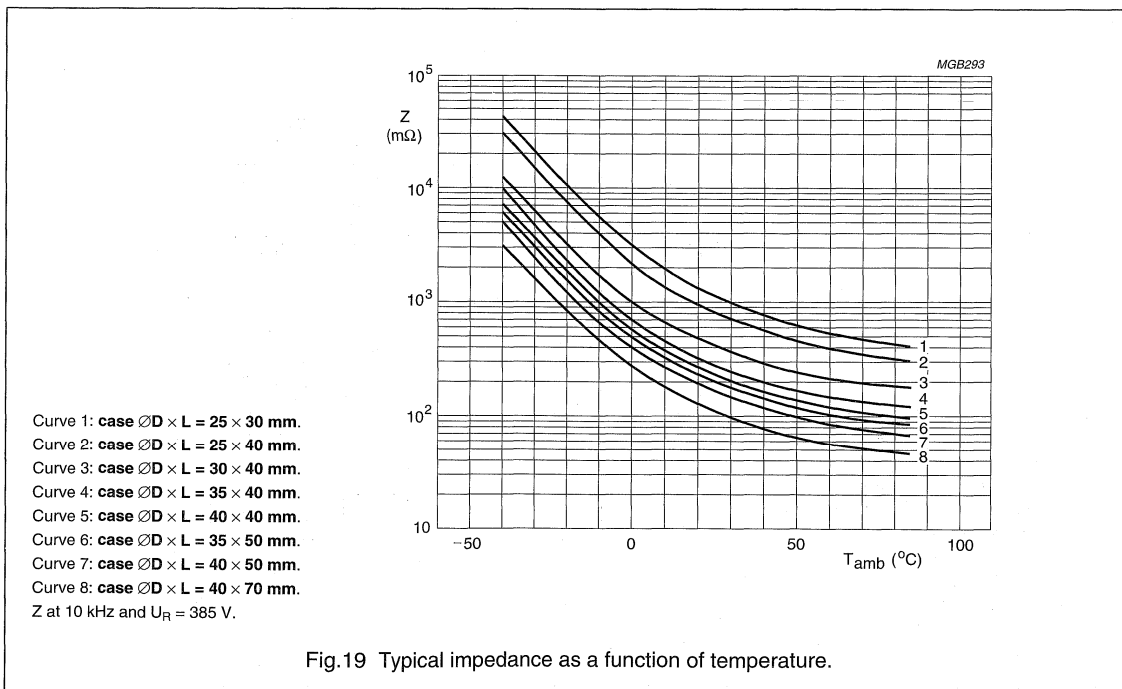
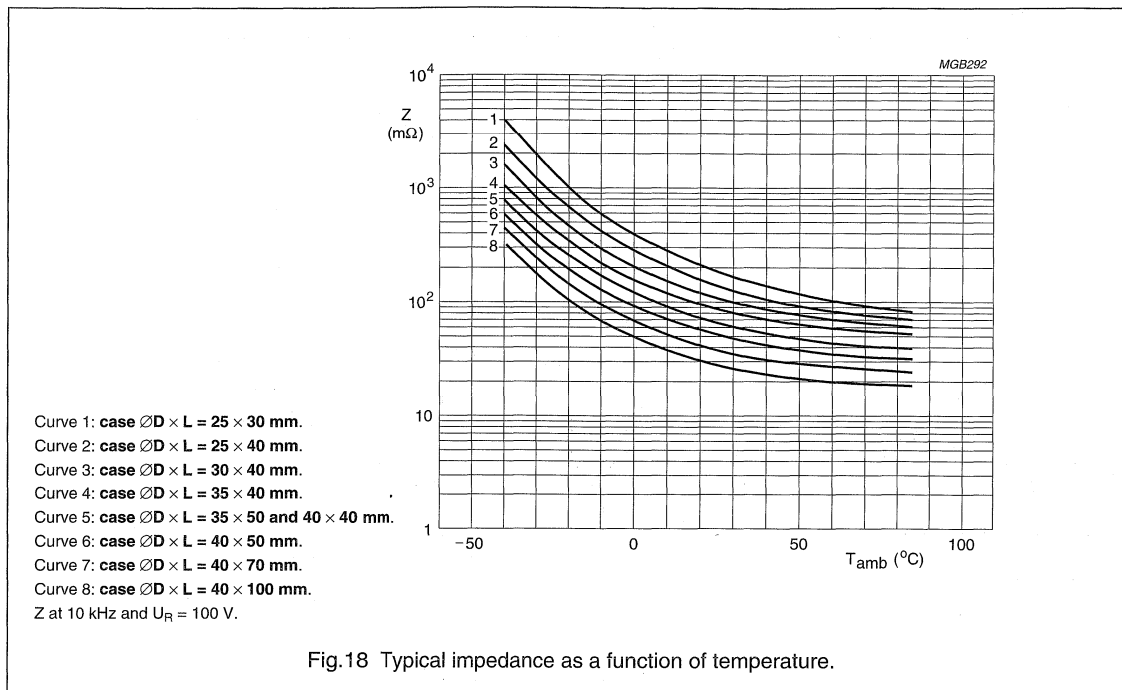
Impedance (Z)



Aluminum electrolytic capacitors

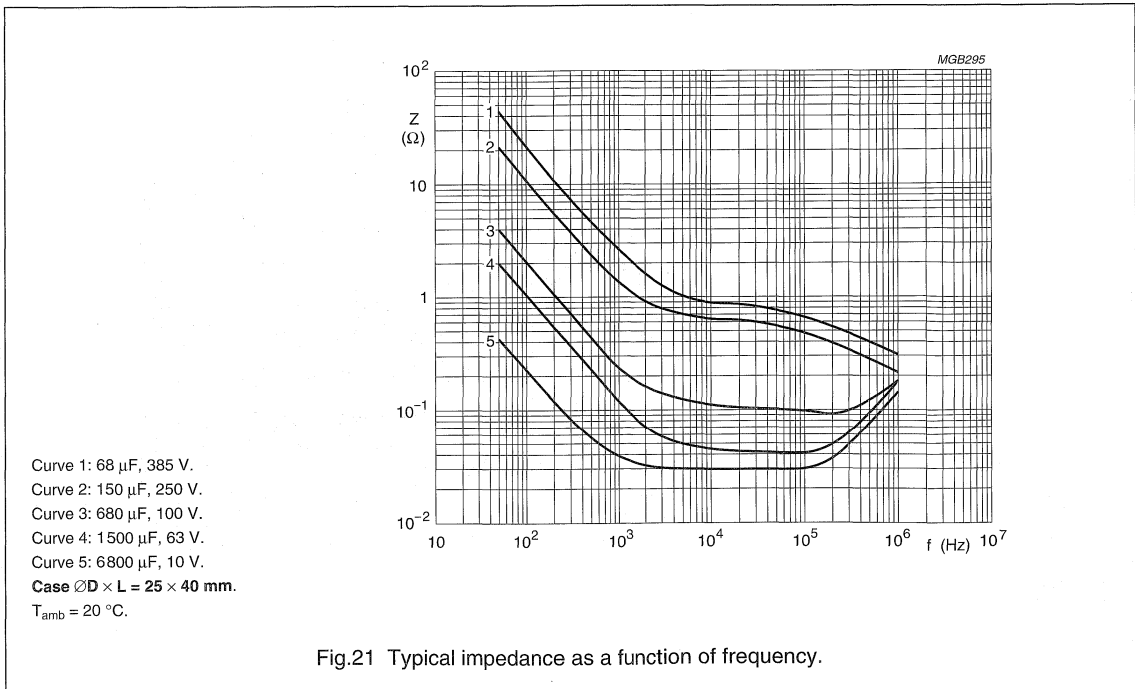
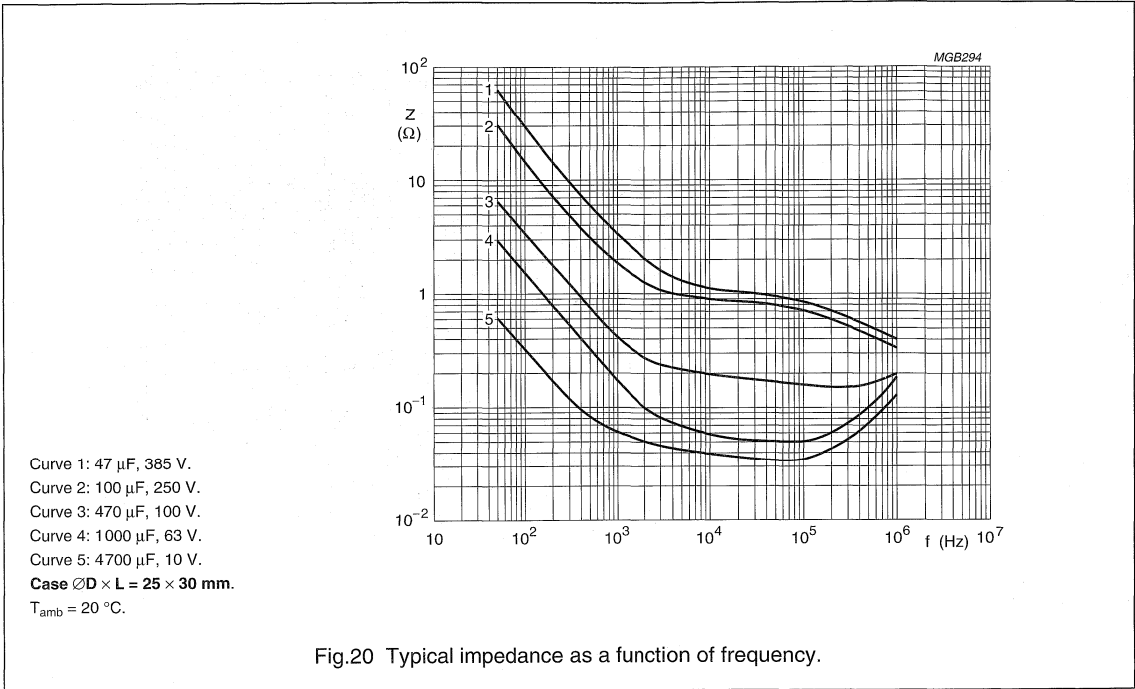
Power Eurodin Printed Wiring

050/052 PED-PW



Aluminum electrolytic capacitors
Power Eurodin Printed Wiring

050/052 PED-PW



Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW

Curve 1: 100 μF , 385 V.
 Curve 2: 220 μF , 250 V.
 Curve 3: 1000 μF , 100 V.
 Curve 4: 2200 μF , 63 V.
 Curve 5: 10000 μF , 10 V.
Case $\varnothing\text{D} \times \text{L} = 30 \times 40 \text{ mm}$.
 $T_{\text{amb}} = 20 \text{ }^\circ\text{C}$.

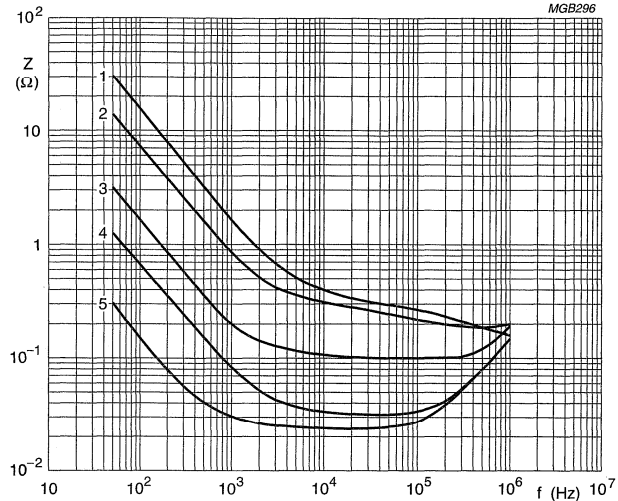


Fig.22 Typical impedance as a function of frequency.

Curve 1: 150 μF , 385 V.
 Curve 2: 330 μF , 250 V.
 Curve 3: 1500 μF , 100 V.
 Curve 4: 3300 μF , 63 V.
 Curve 5: 15000 μF , 10 V.
Case $\varnothing\text{D} \times \text{L} = 35 \times 40 \text{ mm}$.
 $T_{\text{amb}} = 20 \text{ }^\circ\text{C}$.

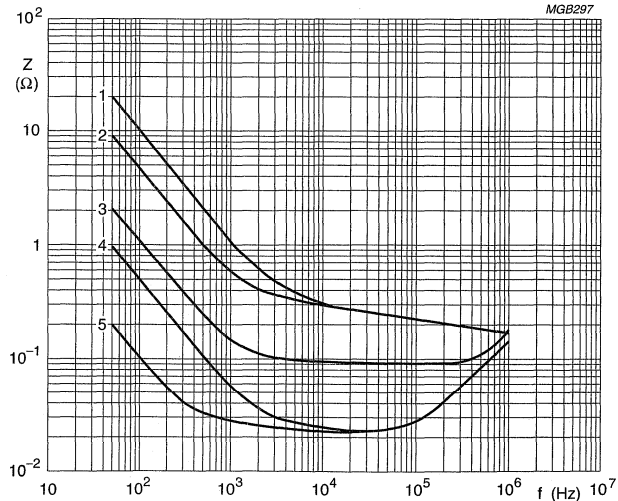


Fig.23 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors
Power Eurodin Printed Wiring

050/052 PED-PW

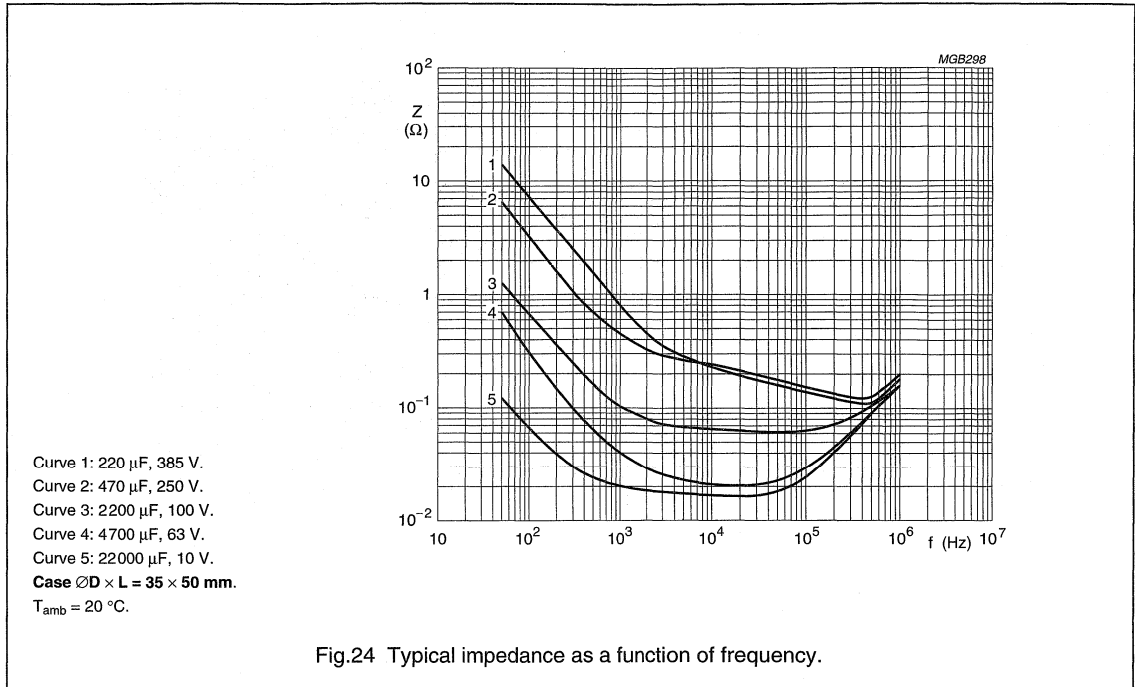


Fig.24 Typical impedance as a function of frequency.

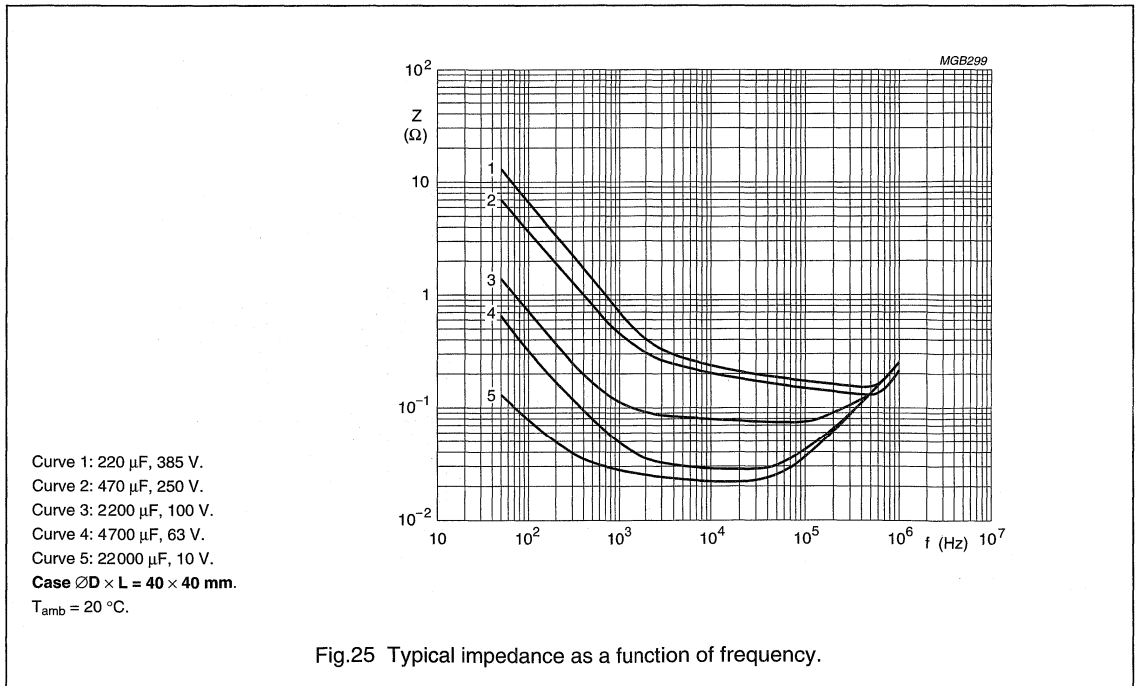
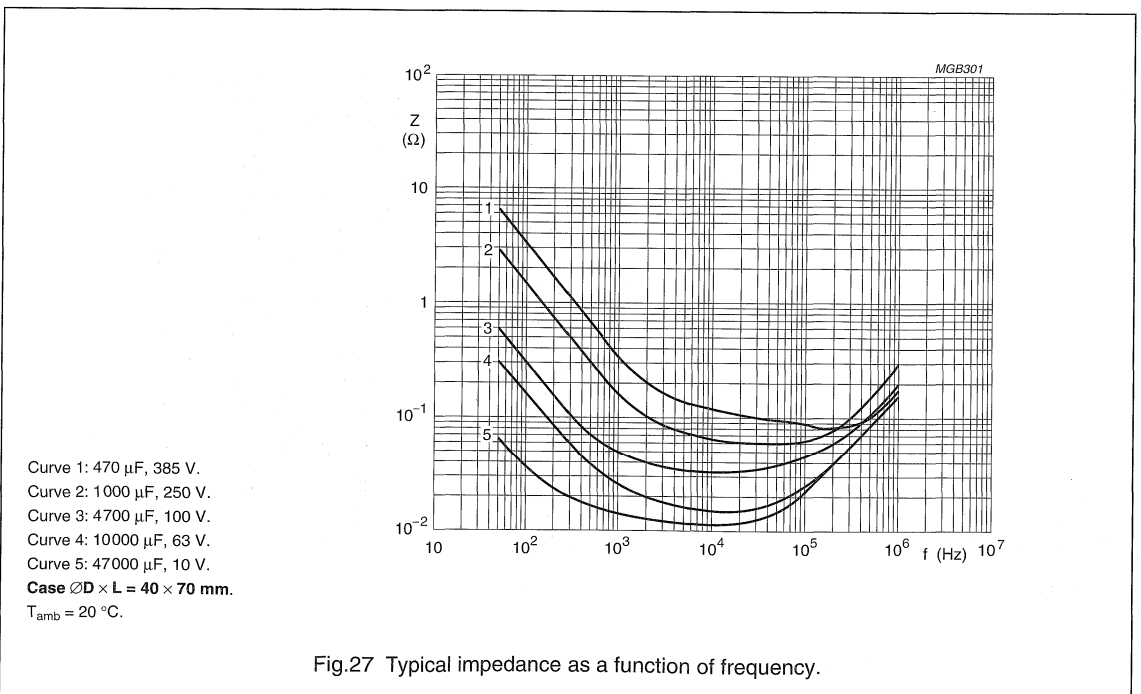
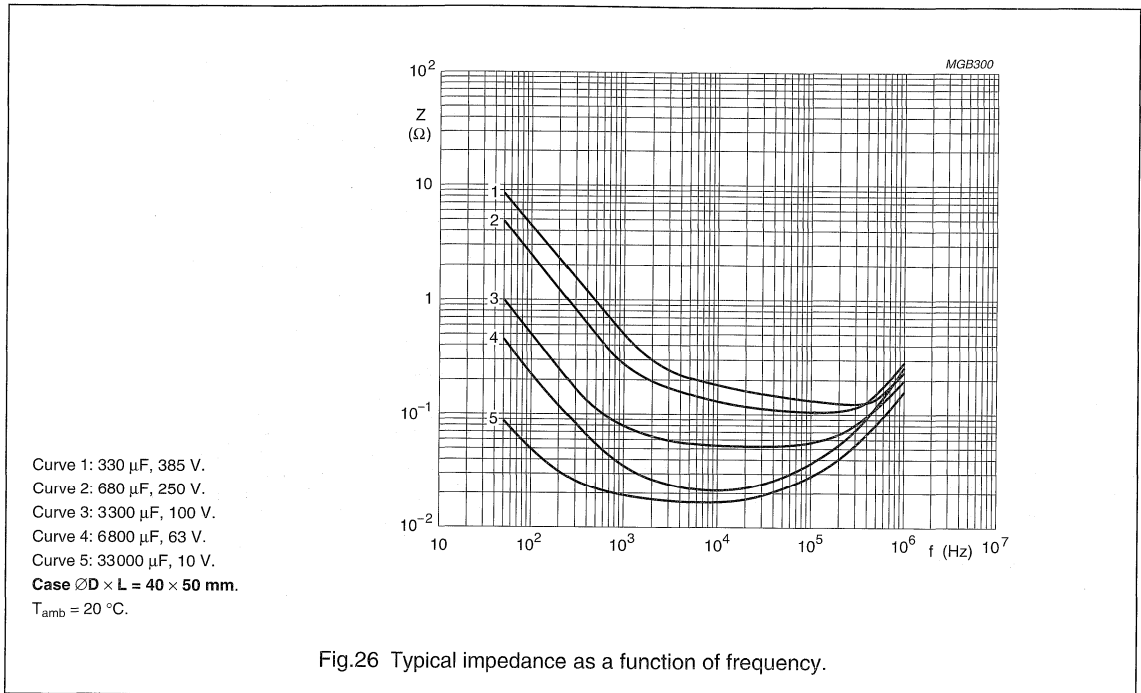


Fig.25 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

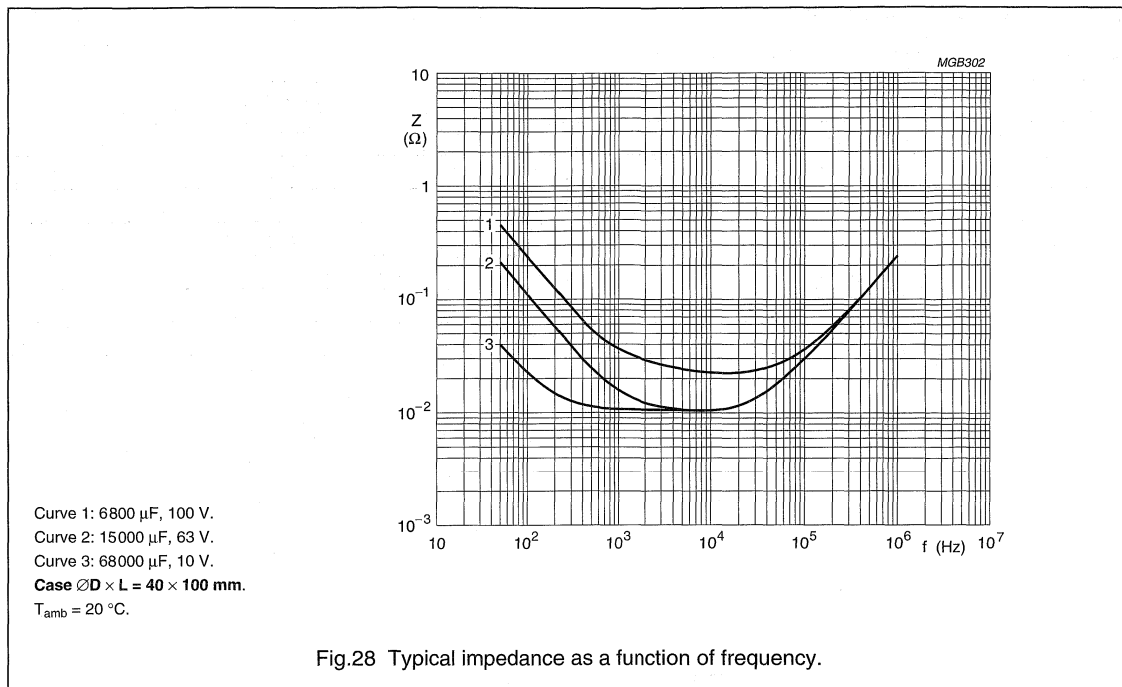
050/052 PED-PW



Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW



MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance (Q for $-10/+30\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- Polarity of the terminals and '-' sign to indicate the negative terminal, visible from the top and/or side of the capacitor
- Code number
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".



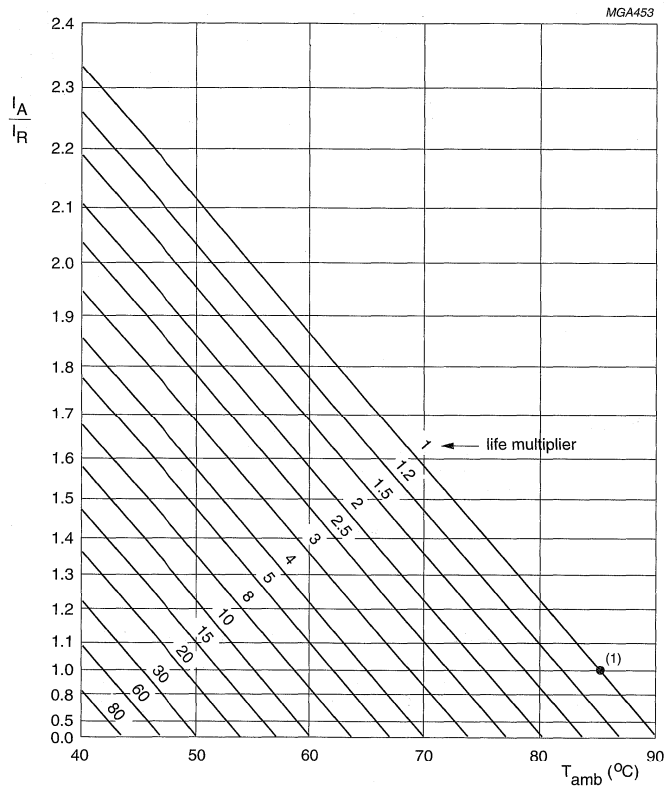
Aluminum electrolytic capacitors Power Eurodin Printed Wiring

050/052 PED-PW

RIPPLE CURRENT AND USEFUL LIFE

Table 5 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.83
100	1.00
200	1.10
400	1.15
1000	1.19
≥ 2000	1.20



I_A = actual ripple current at 100 Hz and 85 °C.
 I_R = rated ripple current at 100 Hz and 85 °C.
 (1) Useful life at 85 °C and I_R applied: 15000 hours.

Fig.29 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power Eurodin Printed Wiring

050/052 PED-PW

SPECIFIC TESTS AND REQUIREMENTS

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

Table 6 Test procedures and requirements

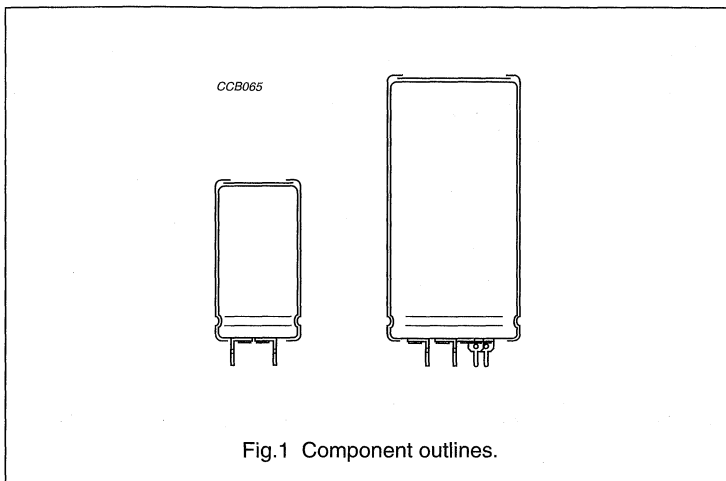
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied; 5000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 15000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}$: $\leq 1\%$; $U_R > 100\text{ V}$: $\leq 3\%$
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	$\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power Long Life Printed Wiring

162/163 PLL-PW

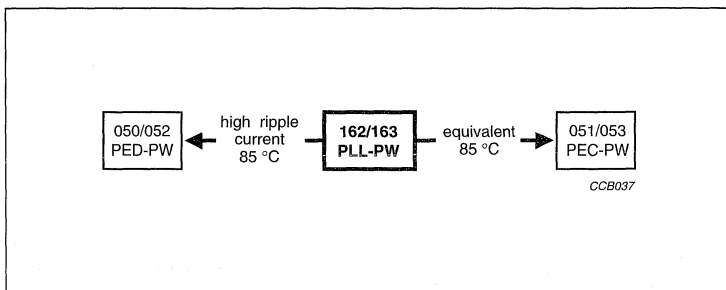
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Provided with keyed polarity
- Pressure relief on the top of the aluminium case
- Charge and discharge proof
- Very long useful life: 5000 hours at 105 °C
- Low ESR, high ripple current capability
- Temperature range up to 105 °C
- High resistance to shock and vibration.



APPLICATIONS

- Computer, telecommunication and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	162	163
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	25 × 30 to 40 × 100	
Rated capacitance range (E6 series), C_R	470 to 150000 μF	68 to 3300 μF
Tolerance on C_R	±20%	
Rated voltage range, U_R	10 to 100 V	200 to 400 V
Category temperature range	-40 to +105 °C	
Endurance test at 105 °C	2000 hours	
Useful life at 105 °C	5000 hours	
Useful life at 40 °C, $1.9 \times I_R$ applied	150000 hours	
Shelf life at 0 V, 105 °C	500 hours	
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	40/105/56	

Aluminum electrolytic capacitors

Power Long Life Printed Wiring

162/163 PLL-PW

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 162 series

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	40	63	100
470	–	–	–	–	–	25 × 30
680	–	–	–	–	–	25 × 40
1000	–	–	–	–	25 × 30	30 × 40
1500	–	–	–	–	25 × 40	35 × 40
2200	–	–	–	25 × 30	30 × 40	35 × 50
	–	–	–	–	–	40 × 40
3300	–	–	–	25 × 40	35 × 40	40 × 50
4700	–	–	25 × 30	30 × 40	35 × 50	40 × 70
	–	–	–	–	40 × 40	–
6800	–	25 × 30	25 × 40	35 × 40	40 × 50	40 × 100
10000	25 × 30	25 × 40	30 × 40	35 × 50	40 × 70	–
	–	–	–	40 × 40	–	–
15000	25 × 40	30 × 40	35 × 40	40 × 50	40 × 100	–
22000	30 × 40	35 × 40	35 × 50	40 × 70	–	–
	–	–	40 × 40	–	–	–
33000	35 × 40	35 × 50	40 × 50	40 × 100	–	–
	–	40 × 40	–	–	–	–
47000	35 × 50	40 × 50	40 × 70	–	–	–
	40 × 40	–	–	–	–	–
68000	40 × 50	40 × 70	40 × 100	–	–	–
100000	40 × 70	40 × 100	–	–	–	–
150000	40 × 100	–	–	–	–	–

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 163 series

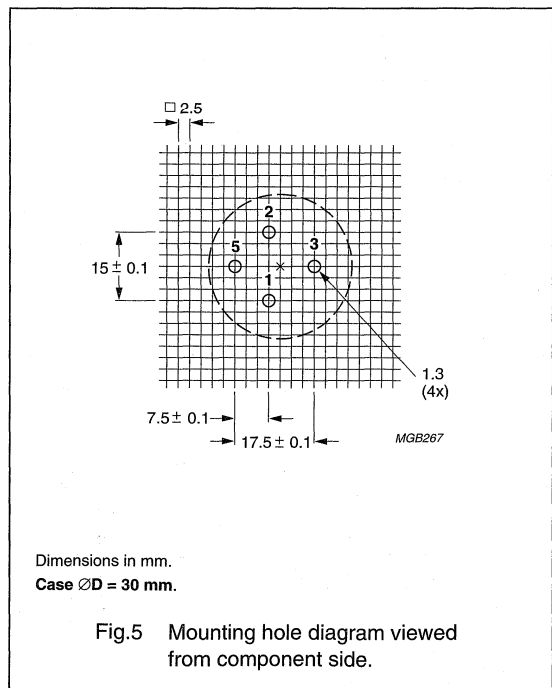
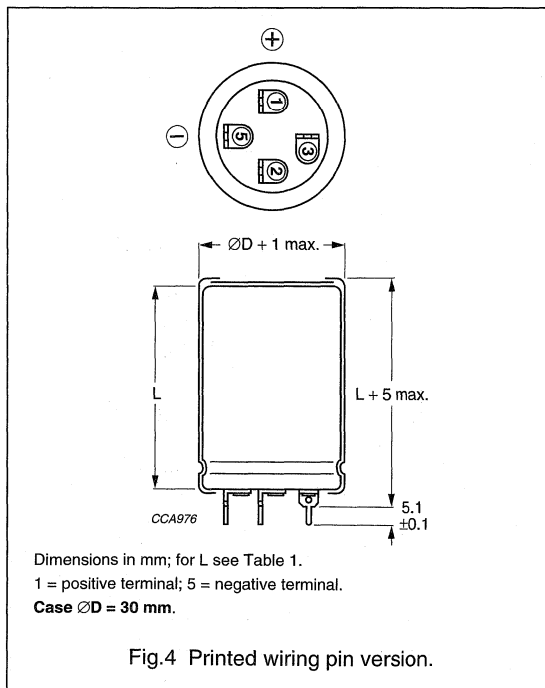
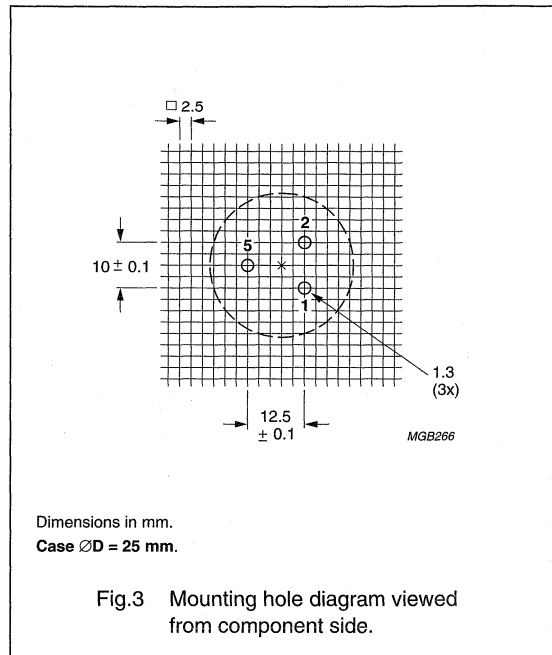
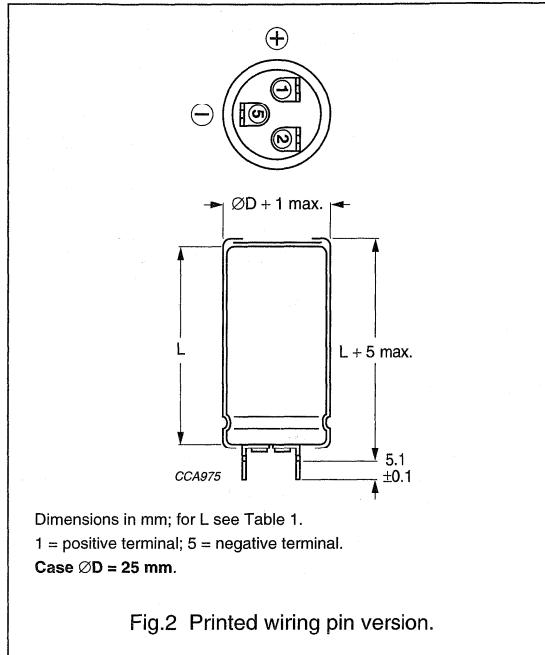
Preferred types in **bold**.

C_R (μF)	U_R (V)			
	200	250	385	400
68	–	–	25 × 30	25 × 30
100	–	25 × 30	25 × 40	25 × 40
150	25 × 30	25 × 40	30 × 40	30 × 40
220	25 × 40	30 × 40	35 × 40	35 × 40
330	30 × 40	35 × 40	35 × 50	35 × 50
	–	–	40 × 40	40 × 40
470	35 × 40	35 × 50	40 × 50	40 × 50
	–	40 × 40	–	–
680	35 × 50	40 × 50	40 × 70	40 × 70
	40 × 50	–	–	–
1000	40 × 50	40 × 70	40 × 100	40 × 100
1500	40 × 70	40 × 100	–	–
2200	40 × 100	–	–	–

Aluminum electrolytic capacitors Power Long Life Printed Wiring

162/163 PLL-PW

MECHANICAL DATA AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors Power Long Life Printed Wiring

162/163 PLL-PW

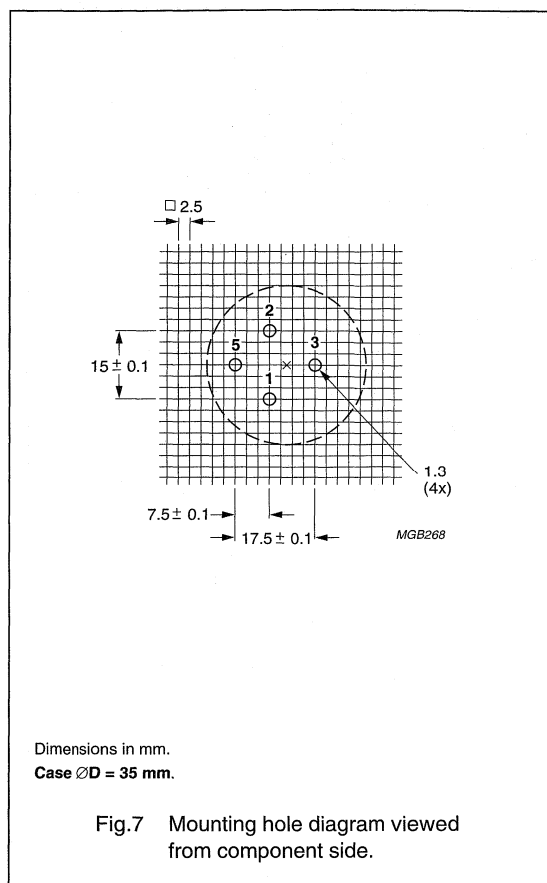
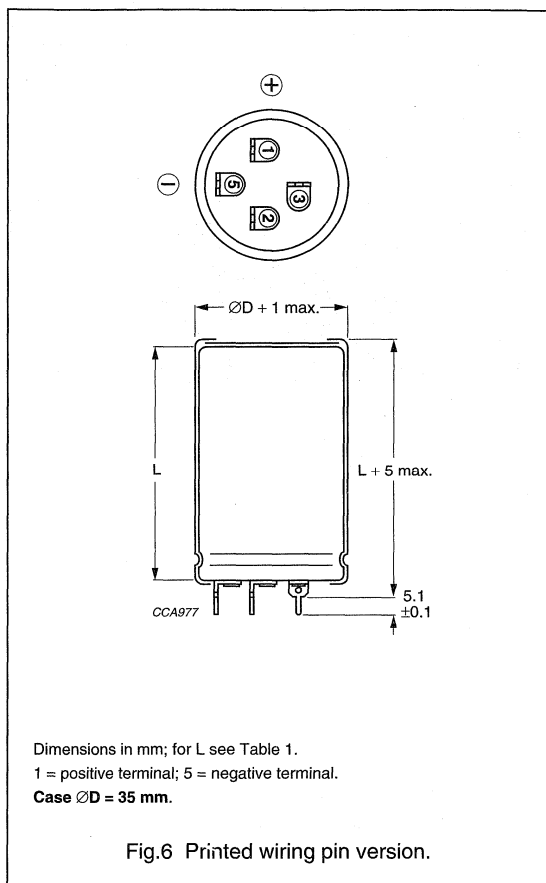
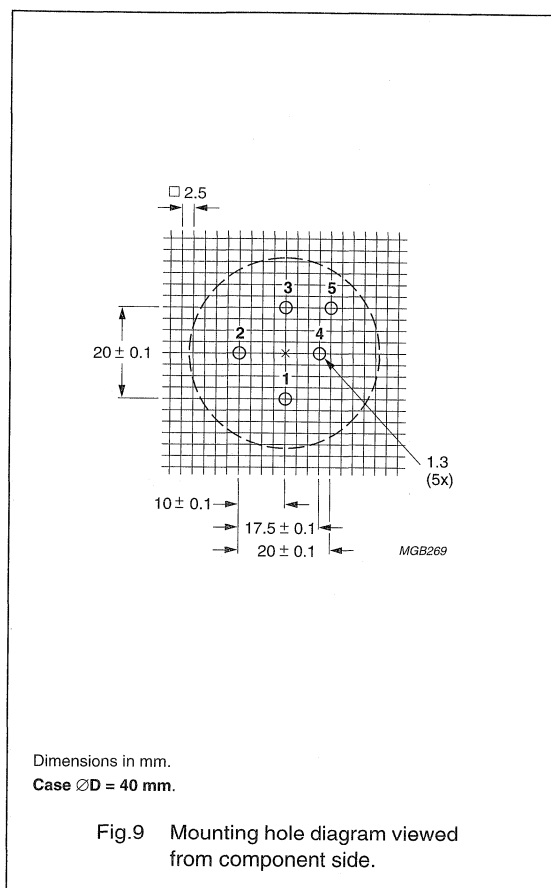
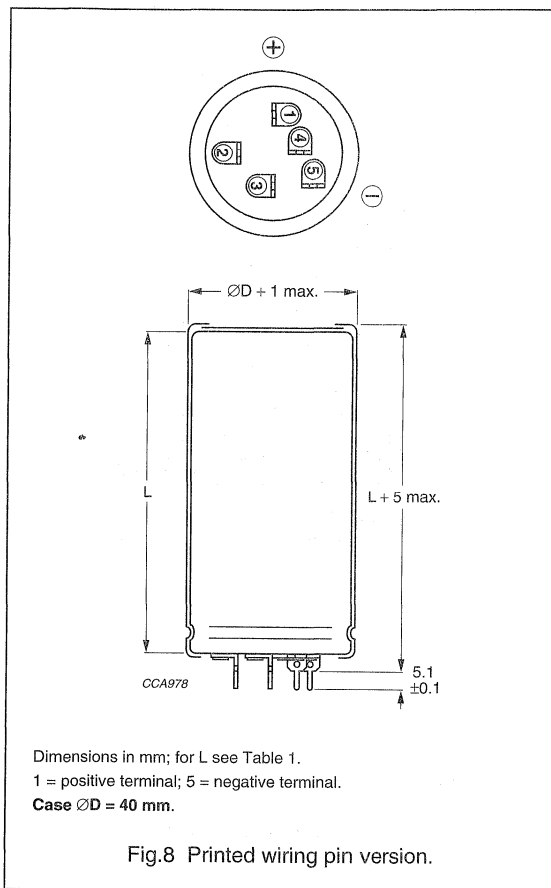


Table 1 Physical dimensions, mass and packaging information; see Figs 2, 4, 6 and 8

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
25 × 30	26	35	≈24	100	290 × 280 × 50
25 × 40	26	45	≈28	100	290 × 280 × 60
30 × 40	31	45	≈38	100	340 × 330 × 60
35 × 40	36	45	≈51	50	390 × 198 × 60
35 × 50	36	55	≈66	50	390 × 198 × 70
40 × 40	41	45	≈78	50	440 × 223 × 60
40 × 50	41	55	≈82	50	440 × 223 × 70
40 × 70	41	75	≈110	50	440 × 223 × 90
40 × 100	41	105	≈176	50	440 × 223 × 120

Aluminum electrolytic capacitors Power Long Life Printed Wiring

162/163 PLL-PW



Mounting

When a number of capacitors are connected in a bank, they must not be closer together than 15 mm, when no derating of ripple current and/or temperature is applied.

Pin numbers 2, 3 and 4 (if present) must be free from the electrical circuit.

Aluminum electrolytic capacitors

Power Long Life Printed Wiring

162/163 PLL-PW

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 2 and 3 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 100 Hz and 105 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 100 Hz
Z	max. impedance at 10 kHz

Ordering example

Electrolytic capacitor 162 series

10000 $\mu\text{F}/25\text{ V}$; $\pm 20\%$ Nominal case size: $\varnothing 30 \times 40\text{ mm}$

Catalogue number: 2222 162 56103.

Table 2 Electrical data and ordering information for 162 series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
10	10000	25 × 30	3.17	0.60	0.20	48	37	162 54103
	15000	25 × 40	4.21	0.90	0.30	34	27	162 54153
	22000	30 × 40	5.05	1.32	0.44	29	23	162 54223
	33000	35 × 40	5.63	1.98	0.66	27	22	162 54333
	47000	35 × 50	6.19	2.82	0.94	26	21	162 54473
	47000	40 × 40	6.19	2.82	0.94	26	21	162 44473
	68000	40 × 50	7.64	4.08	1.36	21	18	162 54683
	100000	40 × 70	10.0	6.00	2.00	16	15	162 54104
150000	40 × 100	12.9	9.00	3.00	13	12	162 54154	
16	6800	25 × 30	3.11	0.65	0.22	50	37	162 55682
	10000	25 × 40	4.09	0.96	0.32	36	27	162 55103
	15000	30 × 40	4.97	1.44	0.48	30	23	162 55153
	22000	35 × 40	5.53	2.12	0.71	29	22	162 55223
	33000	35 × 50	6.08	3.17	1.06	28	21	162 55333
	33000	40 × 40	6.08	3.17	1.06	28	21	162 45333
	47000	40 × 50	7.46	4.52	1.51	22	18	162 55473
	68000	40 × 70	9.70	6.53	2.18	17	15	162 55683
100000	40 × 100	12.90	9.60	3.20	13	12	162 55104	

Aluminum electrolytic capacitors

Power Long Life Printed Wiring

162/163 PLL-PW

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
25	4700	25 × 30	2.94	0.71	0.24	56	37	162 56472
	6800	25 × 40	3.93	1.02	0.34	39	27	162 56682
	10000	30 × 40	4.81	1.50	0.50	32	23	162 56103
	15000	35 × 40	5.43	2.25	0.75	30	22	162 56153
	22000	35 × 50	5.98	3.30	1.10	29	21	162 56223
	22000	40 × 40	5.98	3.30	1.10	29	21	162 46223
	33000	40 × 50	7.30	4.95	1.65	23	18	162 56333
	47000	40 × 70	9.43	7.05	2.35	18	15	162 56473
68000	40 × 100	12.44	10.20	3.40	14	12	162 56683	
40	2200	25 × 30	2.36	0.53	0.18	87	54	162 57222
	3300	25 × 40	3.17	0.79	0.27	60	38	162 57332
	4700	30 × 40	3.93	1.13	0.38	48	33	162 57472
	6800	35 × 40	4.59	1.63	0.55	42	31	162 57682
	10000	35 × 50	5.03	2.40	0.80	41	29	162 57103
	10000	40 × 40	5.03	2.40	0.80	41	29	162 47103
	15000	40 × 50	6.09	3.60	1.20	33	24	162 57153
	22000	40 × 70	8.34	5.28	1.76	23	18	162 57223
	33000	40 × 100	10.97	7.92	2.64	18	15	162 57333
	63	1000	25 × 30	1.55	0.38	0.13	202	155
1500		25 × 40	2.10	0.57	0.19	137	109	162 58152
2200		30 × 40	2.72	0.83	0.28	100	79	162 58222
3300		35 × 40	3.44	1.25	0.42	75	61	162 58332
4700		35 × 50	4.09	1.78	0.60	62	53	162 58472
4700		40 × 40	4.09	1.78	0.60	62	53	162 48472
6800		40 × 50	5.10	2.57	0.86	47	40	162 58682
10000		40 × 70	6.86	3.78	1.26	34	29	162 58103
15000		40 × 100	9.31	5.67	1.89	25	21	162 58153
100	470	25 × 30	1.42	0.28	0.10	240	155	162 59471
	680	25 × 40	1.90	0.41	0.14	167	109	162 59681
	1000	30 × 40	2.48	0.60	0.20	120	79	162 59102
	1500	35 × 40	3.17	0.90	0.30	88	61	162 59152
	2200	35 × 50	3.79	1.32	0.44	72	53	162 59222
	2200	40 × 40	3.79	1.32	0.44	72	53	162 49222
	3300	40 × 50	4.81	1.98	0.66	53	40	162 59332
	4700	40 × 70	6.49	2.82	0.94	38	29	162 59472
	6800	40 × 100	8.80	4.08	1.36	28	21	162 59682

Aluminum electrolytic capacitors

Power Long Life Printed Wiring

162/163 PLL-PW

Table 3 Electrical data and ordering information for **163** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 105 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR 100 Hz (m Ω)	Z 10 kHz (m Ω)	CATALOGUE NUMBER 2222
200	150	25 × 30	0.72	0.18	0.06	950	710	163 52151
	220	25 × 40	0.96	0.26	0.09	650	485	163 52221
	330	30 × 40	1.29	0.40	0.14	442	330	163 52331
	470	35 × 40	1.66	0.57	0.19	321	240	163 52471
	680	35 × 50	2.09	0.82	0.28	237	185	163 52681
	680	40 × 40	2.09	0.82	0.28	237	185	163 42681
	1000	40 × 50	2.71	1.20	0.40	167	133	163 52102
	1500	40 × 70	3.75	1.80	0.60	114	90	163 52152
	2200	40 × 100	5.24	2.64	0.88	79	62	163 52222
250	100	25 × 30	0.67	0.15	0.05	1060	710	163 53101
	150	25 × 40	0.92	0.22	0.08	710	485	163 53151
	220	30 × 40	1.28	0.33	0.11	492	330	163 53221
	330	35 × 40	1.65	0.49	0.17	325	240	163 53331
	470	35 × 50	2.01	0.70	0.24	256	185	163 53471
	470	40 × 40	2.01	0.70	0.24	256	185	163 43471
	680	40 × 50	2.59	1.02	0.34	182	133	163 53681
	1000	40 × 70	3.58	1.50	0.50	125	90	163 53102
	1500	40 × 100	5.05	2.25	0.75	85	62	163 53152
385	68	25 × 30	0.61	0.16	0.06	1650	1260	163 58689
	100	25 × 40	0.82	0.23	0.08	1120	855	163 58101
	150	30 × 40	1.10	0.35	0.12	755	580	163 58151
	220	35 × 40	1.44	0.51	0.17	525	405	163 58221
	330	35 × 50	1.84	0.77	0.26	360	280	163 58331
	330	40 × 40	1.84	0.77	0.26	360	280	163 48331
	470	40 × 50	2.37	1.09	0.36	260	205	163 58471
	680	40 × 70	3.24	1.58	0.53	180	140	163 58681
	1000	40 × 100	4.54	2.31	0.78	125	100	163 58102
400	68	25 × 30	0.39	0.16	0.06	3200	2660	163 56689
	100	25 × 40	0.53	0.24	0.08	2180	1810	163 56101
	150	30 × 40	0.72	0.36	0.12	1460	1210	163 56151
	220	35 × 40	0.94	0.52	0.17	1010	830	163 56221
	330	35 × 50	1.24	0.79	0.26	680	570	163 56331
	330	40 × 40	1.24	0.79	0.26	680	570	163 46331
	470	40 × 50	1.59	1.12	0.37	485	407	163 56471
	680	40 × 70	2.18	1.63	0.54	336	282	163 56681
	1000	40 × 100	3.07	2.40	0.80	230	193	163 56102

Aluminum electrolytic capacitors

Power Long Life Printed Wiring

162/163 PLL-PW

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤200 V versions	$U_s = 1.15 \times U_R$
	≥385 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 25 \text{ mm}$	max. 25 nH
	case $\varnothing D = 30 \text{ and } 35 \text{ mm}$	max. 30 nH
	case $\varnothing D = 40 \text{ mm}$	max. 35 nH

MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- Polarity of the terminals and '−' sign to indicate the negative terminal, visible from the top and/or side of the capacitor
- Code number
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

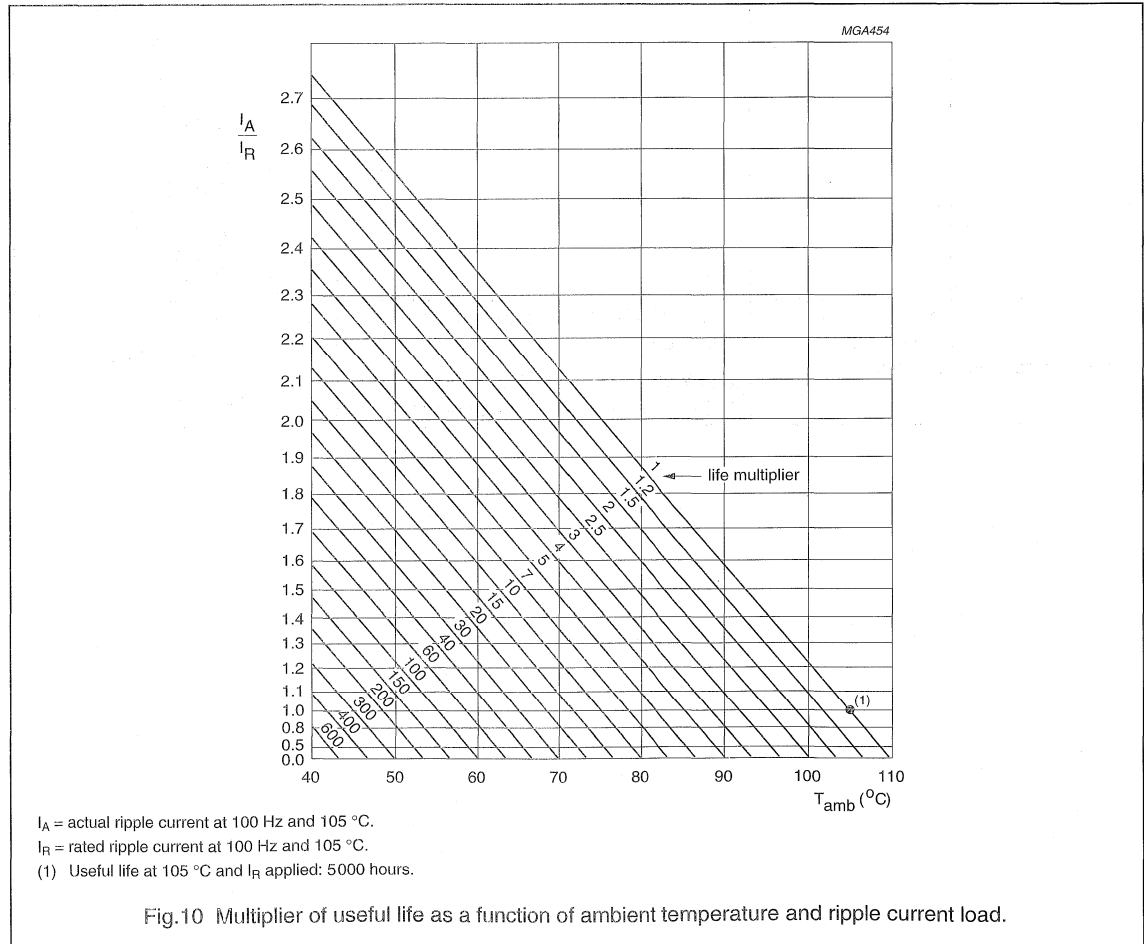
Aluminum electrolytic capacitors Power Long Life Printed Wiring

162/163 PLL-PW

RIPPLE CURRENT AND USEFUL LIFE

Table 4 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 10$ to 25 V	$U_R = 40$ to 100 V	$U_R = 200$ to 400 V
50	0.93	0.91	0.86
100	1.00	1.00	1.00
200	1.04	1.05	1.13
400	1.07	1.09	1.21
1000	1.11	1.13	1.29
2000	1.13	1.15	1.32
4000	1.15	1.18	1.35
≥ 10000	1.18	1.22	1.40



Aluminum electrolytic capacitors

Power Long Life Printed Wiring

162/163 PLL-PW


SPECIFIC TESTS AND REQUIREMENTS

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

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; 2000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; 5000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}: \leq 1\%$; $U_R > 100\text{ V}: \leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

SCREW TERMINAL CAPACITORS

	STANDARD	LONG-LIFE	HIGH TEMPERATURE LONG-LIFE	ECONOMY/ EURO-DIN
 <p style="font-size: small; margin-top: 5px;">480C432-1</p>	2000 to 5000 hours 85 °C	4000 to 6000 hours 85 °C	5000 hours 105 °C	5000 to 20000 hours 85 °C
	NAFTA 002 2222 002 PHRC-ST <i>page 693</i>			
	NAFTA 3191 2251 004 9.... POC-ST <i>page 682</i>	NAFTA 3188 2222 088/089 PHC-ST <i>page 713</i>	NAFTA 3198 2222 005 9.... PLV-ST <i>page 728</i>	114/115 PED-ST/ PED-STB <i>page 750</i>
	NAFTA 3186 2222 086/087 PS-ST <i>page 666</i>	NAFTA 3199 2251 006 PPS-ST <i>page 700</i>		154/155 PEC-ST/ PEC-STB <i>page 741</i>

CCB098



Aluminum electrolytic capacitors Power Standard, Screw Terminals

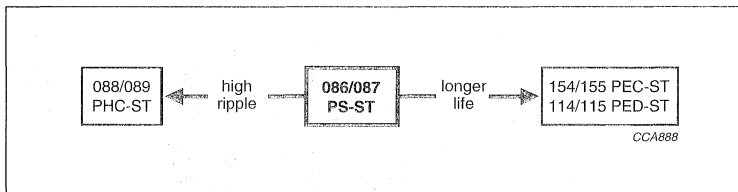
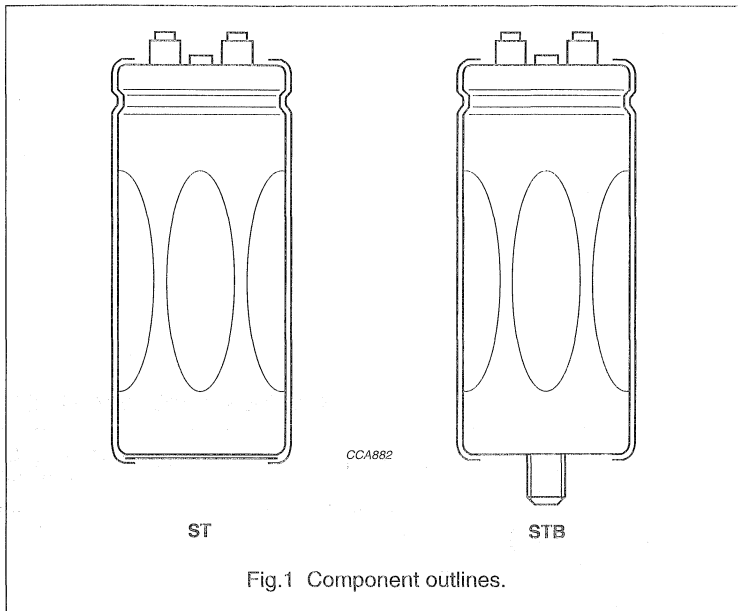
NAFTA 3186, 086/087 PS-ST

FEATURES

- Polarized aluminium electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Bolt version available for case $\varnothing D = 50, 65$ and 75 mm ($\varnothing D = 2", 2.5"$ and $3"$)
- Pressure relief in the sealing
- Charge and discharge proof
- High ripple current capability
- High resistance to shock and vibration.

APPLICATIONS

- General purpose, computer and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Welding
- Energy storage in pulse systems
- Motor control devices
- Uninterruptable power supplies (UPS).



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	086	087
Case size (in millimetres and inches)	BA 35 × 54 mm (1.375" × 2.125") to GN 76 × 220 mm (3.000" × 8.625")	
Rated capacitance range, C _R	220 to 820 000 μF	
Tolerance on C _R	-10 to +30%; -10 to +50%; ±20%	
Rated voltage range, U _R	16 to 100 V	200 to 500 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	1 000 hours	
Useful life at 85 °C	5 000 hours (≥100 V: 3 000 hours)	
Useful life at 40 °C, 1.3 × I _R applied	120 000 hours (≥100 V: 72 000 hours)	
Shelf life at 0 V, 85 °C	500 hours	
Based on sectional specification	IEC 60384-4	
Climatic category IEC 60068	40/085/56	

Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm); NAFTA 3186, 086 PS-ST

Preferred types in **bold**. Other values available on request.

C_R (μF)	U_R (V)						
	16	25	40	50	63	75	100
2700	–	–	–	–	–	–	35 × 54
3300	–	–	–	–	–	–	35 × 80
3900	–	–	–	–	–	35 × 54	–
4700	–	–	–	–	35 × 54	–	–
5600	–	–	–	–	–	–	35 × 105
6800	–	–	–	–	–	35 × 80	–
8200	–	–	–	35 × 54	35 × 80	–	–
10000	–	–	35 × 54	–	–	35 × 105	50 × 80
12000	–	–	–	35 × 80	35 × 105	–	–
15000	–	–	35 × 80	–	–	50 × 80	50 × 105
18000	–	35 × 54	–	35 × 105	50 × 80	–	50 × 130
22000	35 × 54	–	35 × 105	–	–	50 × 105	50 × 143
	–	–	–	–	–	–	65 × 105
27000	–	35 × 80	–	50 × 80	50 × 105	50 × 118	65 × 130
33000	–	–	–	–	50 × 118	50 × 143	65 × 143
	–	–	–	–	–	65 × 105	76 × 105
39000	35 × 80	35 × 105	50 × 80	–	50 × 143	65 × 118	76 × 118
47000	–	–	–	50 × 105	65 × 105	76 × 105	–
56000	35 × 105	–	50 × 105	50 × 118	65 × 118	65 × 143	76 × 143
	–	–	–	–	–	76 × 118	–
68000	–	50 × 80	50 × 118	50 × 143	65 × 143	–	–
	–	–	–	65 × 105	76 × 105	–	–
82000	50 × 80	–	50 × 143	65 × 118	76 × 118	76 × 143	76 × 220
100000	–	50 × 105	65 × 105	65 × 143	76 × 143	–	–
	–	–	–	76 × 105	–	–	–
120000	50 × 105	50 × 118	65 × 118	76 × 118	–	76 × 220	–
150000	50 × 118	50 × 143	65 × 143	76 × 143	76 × 220	–	–
	–	65 × 105	76 × 105	–	–	–	–
180000	50 × 143	65 × 118	76 × 118	–	–	–	–
220000	65 × 105	65 × 143	76 × 143	76 × 220	–	–	–
	–	76 × 105	–	–	–	–	–
270000	65 × 118	76 × 118	–	–	–	–	–
330000	65 × 143	76 × 143	76 × 220	–	–	–	–
	76 × 105	–	–	–	–	–	–
390000	76 × 118	–	–	–	–	–	–
470000	76 × 143	–	–	–	–	–	–
560000	–	76 × 220	–	–	–	–	–
820000	76 × 220	–	–	–	–	–	–

Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm); NAFTA 3186, 087 PS-ST

Preferred types in **bold**. Other values available on request.

C_R (μF)	U_R (V)					
	200	250	350	400	450	500 ⁽¹⁾
180	–	–	–	–	–	–
220	–	–	–	–	35 × 54	–
270	–	–	–	–	–	–
330	–	–	–	35 × 54	–	–
390	–	–	35 × 54	–	35 × 80	–
470	–	–	–	–	–	–
560	–	–	–	35 × 80	35 × 105	–
680	–	35 × 54	35 × 80	–	–	–
820	–	–	–	35 × 105	50 × 80	50 × 105
1000	35 × 54	–	35 × 105	–	–	–
1200	–	35 × 80	–	50 × 80	50 × 105	50 × 130
1500	35 × 80	–	50 × 80	–	50 × 130	–
1800	–	35 × 105	–	50 × 105	50 × 143	–
2200	35 × 105	–	50 × 105	50 × 130	65 × 105	65 × 130
2700	–	50 × 80	50 × 130	50 × 143	65 × 130	–
3300	–	–	50 × 143	65 × 130	65 × 143	–
3900	50 × 80	50 × 105	65 × 130	65 × 143	76 × 118	–
4700	–	–	65 × 143	76 × 118	76 × 143	–
5600	50 × 105	50 × 143	76 × 118	76 × 143	–	–
6800	50 × 130	65 × 105	76 × 143	–	–	–
8200	50 × 143	65 × 130	–	–	76 × 220	–
10000	65 × 105	65 × 143	–	76 × 220	–	–
12000	65 × 130	76 × 118	76 × 220	–	–	–
15000	65 × 143	76 × 143	–	–	–	–
18000	–	–	–	–	–	–
22000	76 × 143	76 × 220	–	–	–	–
27000	–	–	–	–	–	–
33000	76 × 220	–	–	–	–	–

Note

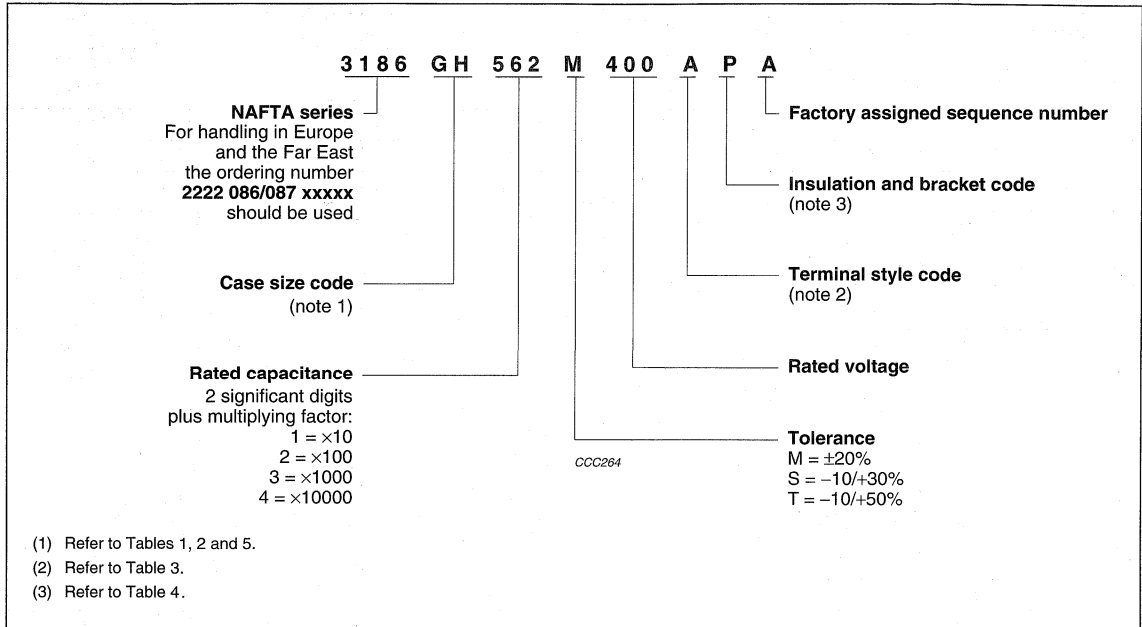
1. For additional values and sizes, please contact your local BC Components sales organization.

Aluminum electrolytic capacitors Power Standard, Screw Terminals

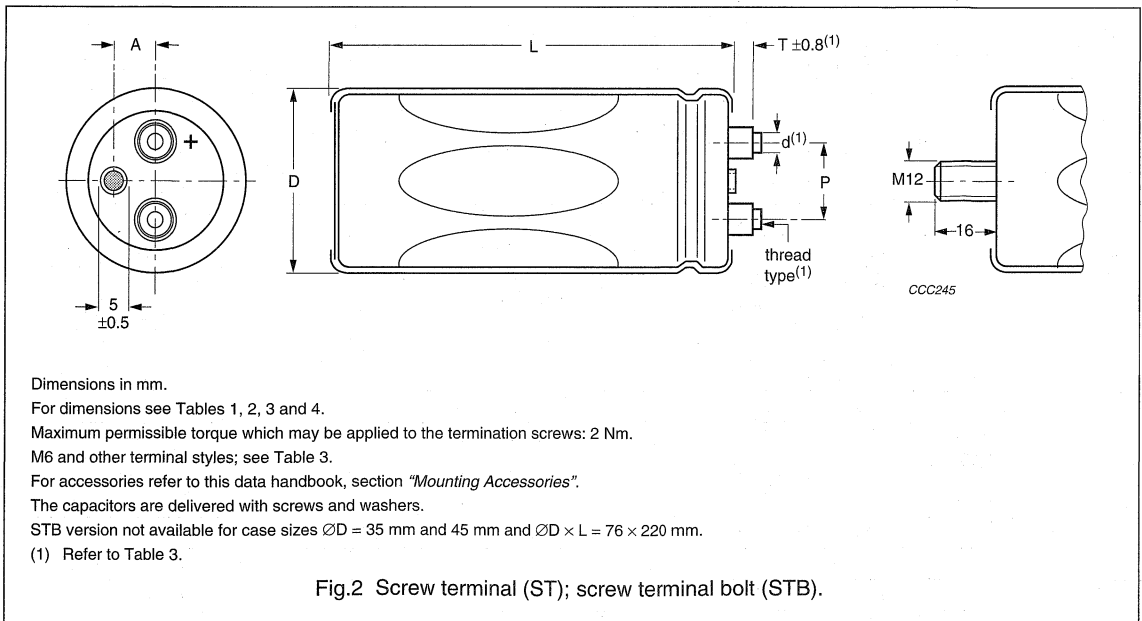
NAFTA 3186, 086/087 PS-ST

ORDERING INFORMATION

NAFTA part numbering system



MECHANICAL DATA



Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

Table 1 Physical dimensions in millimetres (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (mm)	L _{max} (mm)	P ±0.4 (mm)	A (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
Dimensions in millimetres							
BA	34.9	54.0	12.7	8.0	≈72	150	402 × 200 × 258
BB	34.9	66.7	12.7	8.0	≈90	150	402 × 200 × 258
BC	34.9	79.4	12.7	8.0	≈105	150	402 × 200 × 283
BD	34.9	92.1	12.7	8.0	≈120	100	402 × 200 × 258
BE	34.9	104.8	12.7	8.0	≈135	100	402 × 200 × 258
BF	34.9	117.5	12.7	8.0	≈170	100	402 × 200 × 258
BG	34.9	130.2	12.7	8.0	≈220	100	402 × 200 × 283
BH	34.9	142.9	12.7	8.0	≈270	100	402 × 200 × 315
DA	44.5	54.0	19.1	11.5	≈160	96	324 × 216 × 289
DB	44.5	66.7	19.1	11.5	≈175	72	332 × 221 × 278
DC	44.5	79.4	19.1	11.5	≈180	72	332 × 221 × 278
DD	44.5	92.1	19.1	11.5	≈205	48	324 × 216 × 289
DE	44.5	104.8	19.1	11.5	≈220	48	324 × 216 × 289
DF	44.5	117.5	19.1	11.5	≈235	48	324 × 216 × 289
DG	44.5	130.2	19.1	11.5	≈250	48	324 × 216 × 289
DH	44.5	142.9	19.1	11.5	≈270	24	324 × 216 × 315
EA	50.8	54.0	22.2	12.7	≈170	96	324 × 216 × 289
EB	50.8	66.7	22.2	12.7	≈180	72	332 × 221 × 278
EC	50.8	79.4	22.2	12.7	≈190	72	332 × 221 × 278
ED	50.8	92.1	22.2	12.7	≈220	48	324 × 216 × 289
EE	50.8	104.8	22.2	12.7	≈255	48	324 × 216 × 289
EF	50.8	117.5	22.2	12.7	≈290	48	324 × 216 × 289
EG	50.8	130.2	22.2	12.7	≈320	48	324 × 216 × 289
EH	50.8	142.9	22.2	12.7	≈350	48	324 × 216 × 315
FB	63.5	66.7	28.6	15.9	≈300	40	343 × 275 × 240
FC	63.5	79.4	28.6	15.9	≈370	40	343 × 275 × 240
FD	63.5	92.1	28.6	15.9	≈400	40	343 × 275 × 240
FE	63.5	104.8	28.6	15.9	≈445	40	343 × 275 × 240
FF	63.5	117.5	28.6	15.9	≈600	40	343 × 275 × 315
FG	63.5	130.2	28.6	15.9	≈650	40	343 × 275 × 315
FH	63.5	142.9	28.6	15.9	≈600	20	343 × 275 × 240
GC	76.2	79.4	31.8	19.0	≈520	60	397 × 320 × 292
GD	76.2	92.1	31.8	19.0	≈570	20	397 × 320 × 121
GE	76.2	104.8	31.8	19.0	≈600	20	397 × 320 × 121
GF	76.2	117.5	31.8	19.0	≈720	20	397 × 320 × 147
GG	76.2	130.2	31.8	19.0	≈850	20	397 × 320 × 147
GH	76.2	142.9	31.8	19.0	≈970	20	397 × 320 × 178
GJ	76.2	149.2	31.8	19.0	≈1050	20	397 × 320 × 178
GN	76.2	219.1	31.8	19.0	≈1460	16	426 × 410 × 237

Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

Table 2 Physical dimensions in inches (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (inches)	L _{max} (inches)	P ±0.014 (inches)	A (inches)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (inches)
Dimensions in inches							
BA	1.375	2.125	0.5	0.39	≈72	150	15.825 × 7.875 × 10.125
BB	1.375	2.625	0.5	0.39	≈90	150	15.825 × 7.875 × 10.125
BC	1.375	3.125	0.5	0.39	≈105	150	15.825 × 7.875 × 11.125
BD	1.375	3.625	0.5	0.39	≈120	100	15.825 × 7.875 × 10.125
BE	1.375	4.125	0.5	0.39	≈135	100	15.825 × 7.875 × 10.125
BF	1.375	4.625	0.5	0.39	≈170	100	15.825 × 7.875 × 10.125
BG	1.375	5.125	0.5	0.39	≈220	100	15.825 × 7.875 × 11.125
BH	1.375	5.625	0.5	0.39	≈270	100	15.825 × 7.875 × 12.400
DA	1.75	2.125	0.75	0.453	≈160	96	12.750 × 8.500 × 11.375
DB	1.75	2.625	0.75	0.453	≈175	72	13.700 × 8.700 × 11.000
DC	1.75	3.125	0.75	0.453	≈180	72	13.700 × 8.700 × 11.000
DD	1.75	3.625	0.75	0.453	≈205	48	12.750 × 8.500 × 11.375
DE	1.75	4.125	0.75	0.453	≈220	48	12.750 × 8.500 × 11.375
DF	1.75	4.625	0.75	0.453	≈235	48	12.750 × 8.500 × 11.375
DG	1.75	5.125	0.75	0.453	≈250	48	12.750 × 8.500 × 11.375
DH	1.75	5.625	0.75	0.453	≈270	24	12.750 × 8.500 × 12.400
EA	2	2.125	0.875	0.5	≈170	96	12.750 × 8.500 × 11.375
EB	2	2.625	0.875	0.5	≈180	72	13.750 × 8.700 × 11.000
EC	2	3.125	0.875	0.5	≈190	72	13.750 × 8.700 × 11.000
ED	2	3.625	0.875	0.5	≈220	48	12.750 × 8.500 × 11.375
EE	2	4.125	0.875	0.5	≈255	48	12.750 × 8.500 × 11.375
EF	2	4.625	0.875	0.5	≈290	48	12.750 × 8.500 × 11.375
EG	2	5.125	0.875	0.5	≈320	48	12.750 × 8.500 × 11.375
EH	2	5.625	0.875	0.5	≈350	48	12.750 × 8.500 × 12.400
FB	2.5	2.625	1.125	0.625	≈300	40	13.500 × 10.825 × 9.500
FC	2.5	3.125	1.125	0.625	≈370	40	13.500 × 10.825 × 9.500
FD	2.5	3.625	1.125	0.625	≈400	40	13.500 × 10.825 × 9.500
FE	2.5	4.125	1.125	0.625	≈445	40	13.500 × 10.825 × 9.500
FF	2.5	4.625	1.125	0.625	≈600	40	13.500 × 10.825 × 12.400
FG	2.5	5.125	1.125	0.625	≈650	40	13.500 × 10.825 × 12.400
FH	2.5	5.625	1.125	0.625	≈600	20	13.500 × 10.825 × 9.500
GC	3	3.125	1.25	0.75	≈520	60	15.630 × 12.600 × 11.500
GD	3	3.625	1.25	0.75	≈570	20	15.630 × 12.600 × 4.750
GE	3	4.125	1.25	0.75	≈600	20	15.630 × 12.600 × 4.750
GF	3	4.625	1.25	0.75	≈720	20	15.630 × 12.600 × 5.750
GG	3	5.125	1.25	0.75	≈850	20	15.630 × 12.600 × 5.750
GH	3	5.625	1.25	0.75	≈970	20	15.630 × 12.600 × 7.000
GJ	3	5.825	1.25	0.75	≈1050	20	15.630 × 12.600 × 7.000
GN	3	8.625	1.25	0.75	≈1460	16	16.775 × 16.125 × 9.250

Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

Table 3 NAFTA terminal style code

CODE	TERMINAL STYLE	THREAD TYPE	d (mm)	T (mm)	d (inches)	T (inches)
A	high post	10-32	8	6.4	.315	0.250
B	low post	10-32	8	1.6	.315	0.063
D	high current; see note 1	¹ / ₄ -28	17	3.2	.670	0.125
J	high current; see note 1	M6	17	3.2	.670	0.125
M	high post	M5	8	6.4	.315	0.250
K	high current; see note 1	¹ / ₄ -28	17	6.4	.670	0.250

Note

- Case $\varnothing D = 65$ mm (2.5") and $\varnothing D = 76$ mm (3.0") cans only; for 30 A and up.

Table 4 NAFTA insulation and clamp/bracket codes; see note 1

CODE	CLAMP/BRACKET	INSULATION TYPE	DIMENSION ADDERS		
			D	L	H
			Dimensions in mm		
P	no	0.2 mm polymeric	+0.51	+0.81	+0.61
H	no	0.6 mm polymeric	+0.63	+1.58	+1.14
N	no	none	–	–	–
R	yes	0.2 mm polymeric	+0.51	+0.81	+0.61
J	yes	0.6 mm polymeric	+0.63	+1.58	+1.14
X	yes	none	–	–	–
			Dimensions in inches		
P	no	0.008" polymeric	+0.020	+0.032	+0.024
H	no	0.012" polymeric	+0.030	+0.062	+0.045
N	no	none	–	–	–
R	yes	0.008" polymeric	+0.020	+0.032	+0.024
J	yes	0.012" polymeric	+0.030	+0.062	+0.045
X	yes	none	–	–	–

Note

- For clamp/bracket dimensions see section "Mounting Accessories" in this data handbook.

MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance
- Rated voltage (in V)
- Date code in "yyww" (year, week) format
- Name of manufacturer
- NAFTA code number 17 digits
- Code number 12 digits (12NC; NAFTA customers will not see the 12NC).

Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 5 and 6 apply at
 $T_{amb} = 25\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz
I_R	rated RMS ripple current at 85 °C
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 120 Hz
Z	impedance at 20 kHz on request
$\tan \delta$	max. dissipation factor at 120 Hz

Ordering example

Electrolytic capacitor 087 series

10000 μF /200 V; $\pm 20\%$ High post code "M", insulation type
"H", 0.6 mm polymeric

Nominal case size:

 $\varnothing 65 \times 105\text{ mm}$, ST version

Catalogue number: 2222 087 12103.

Table 5 Electrical data and ordering information for **086** series; preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	$\tan \delta$ MAX. 120 Hz	CATALOGUE NUMBER (see Table 6, note 1) 2222
16	22000	35 × 54	BA	5.4	3.56	25	0.45	086 15223
	39000	35 × 80	BC	7.6	4.74	18	0.57	086 15393
	56000	35 × 105	BE	9.7	5.68	14	0.64	086 15563
	82000	50 × 80	EC	17	6.87	6	0.40	086 15823
	120000	50 × 105	EE	21	8.31	5	0.49	086 15124
	150000	50 × 118	EF	23	9.30	4	0.49	086 15154
	150000	50 × 143	EH	25	10.18	4	0.59	086 25154
	220000	65 × 105	FE	27	11.26	4	0.72	086 15224
	270000	65 × 118	FF	29	12.47	4	0.88	086 15274
	330000	65 × 143	FH	34	13.79	3	0.81	086 15334
	330000	76 × 105	GE	32	13.79	4	1.08	086 25334
25	390000	76 × 118	GF	35	14.99	3	0.96	086 15394
	470000	76 × 143	GH	40	16.45	3	1.15	086 15474
	820000	76 × 220	GN	50	21.73	3	2.01	086 15824
	18000	35 × 54	BA	5.4	4.02	25	0.37	086 16183
	27000	35 × 80	BC	7.5	4.93	18	0.40	086 16273
	39000	35 × 105	BE	9	5.92	14	0.45	086 16393
	68000	50 × 80	EC	17	7.82	6	0.33	086 16683
	100000	50 × 105	EE	21	9.49	5	0.41	086 16104
	120000	50 × 118	EF	23	10.39	4	0.39	086 16124
	150000	50 × 143	EH	26	11.62	4	0.49	086 16154
	150000	65 × 105	FE	27	11.62	4	0.49	086 26154
180000	65 × 118	FF	29	12.73	4	0.59	086 16184	
220000	65 × 143	FH	31	14.07	3	0.54	086 16224	
220000	76 × 105	GE	32	14.07	4	0.72	086 26224	
270000	76 × 118	GF	35	15.59	3	0.66	086 16274	

Aluminum electrolytic capacitors
Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (see Table 6, note 1) 2222
25	330000	76 × 143	GH	38	17.23	3	0.81	086 16334
	560000	76 × 220	GN	50	22.45	3	1.37	086 16564
40	10000	35 × 54	BA	4.8	3.79	33	0.27	086 17103
	15000	35 × 80	BC	7.4	4.65	19	0.23	086 17153
	22000	35 × 105	BE	9.4	5.63	14	0.25	086 17223
	39000	50 × 80	EC	15	7.49	7	0.22	086 17393
	56000	50 × 105	EE	19	8.98	6	0.27	086 17563
	68000	50 × 118	EF	21	9.90	5	0.28	086 17683
	82000	50 × 143	EH	23	10.87	5	0.33	086 17823
	100000	65 × 105	FE	24	12.00	5	0.41	086 17104
	120000	65 × 118	FF	27	13.15	4	0.39	086 17124
	150000	65 × 143	FH	31	14.70	4	0.49	086 17154
	150000	76 × 105	GE	29	14.70	4	0.49	086 27154
	180000	76 × 118	GF	35	16.10	4	0.59	086 17184
	220000	76 × 143	GH	37	17.80	3	0.54	086 17224
	330000	76 × 220	GN	50	21.80	3	0.81	086 17334
50	8200	35 × 54	BA	4.2	3.84	41	0.27	086 11822
	12000	35 × 80	BC	6	4.65	28	0.27	086 11123
	18000	35 × 105	BE	7.8	5.69	21	0.31	086 11183
	27000	50 × 80	EC	10	6.97	15	0.33	086 11273
	47000	50 × 105	EE	13	9.20	11	0.42	086 11473
	56000	50 × 118	EF	15	10.04	10	0.46	086 11563
	68000	50 × 143	EH	17	11.06	9	0.50	086 11683
	68000	65 × 105	FE	18	11.06	8	0.44	086 21683
	82000	65 × 118	FF	20	12.15	7	0.47	086 11823
	100000	65 × 143	FH	24	13.42	6	0.49	086 11104
	100000	76 × 105	GE	23	13.42	6	0.49	086 21104
	120000	76 × 118	GF	25	14.70	6	0.59	086 11124
	150000	76 × 143	GH	30	16.43	5	0.61	086 11154
	220000	76 × 220	GN	40	19.90	4	0.72	086 11224
63	4700	35 × 54	BA	4.2	3.26	42	0.16	086 18472
	8200	35 × 80	BC	6	4.31	28	0.19	086 18822
	12000	35 × 105	BE	8	5.22	21	0.21	086 18123
	18000	50 × 80	EC	10	6.39	15	0.22	086 18183
	27000	50 × 105	EE	13	7.83	11	0.24	086 18273
	33000	50 × 118	EF	15	8.65	10	0.27	086 18333
	39000	50 × 143	EH	16	9.40	9	0.29	086 18393
	47000	65 × 105	FE	18	10.32	8	0.31	086 18473

Aluminum electrolytic capacitors
Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (see Table 6, note 1) 2222
63	56000	65 × 118	FF	20	11.27	7	0.32	086 18563
	68000	65 × 143	FH	24	12.42	6	0.33	086 18683
	68000	76 × 105	GE	23	12.42	6	0.33	086 28683
	82000	76 × 118	GF	25	13.64	6	0.40	086 18823
	100000	76 × 143	GH	30	15.06	5	0.41	086 18104
	150000	76 × 220	GN	40	16.44	4	0.49	086 18154
75	3900	35 × 54	BA	4.1	3.24	43	0.14	086 12392
	6800	35 × 80	BC	5.9	4.28	29	0.16	086 12682
	10000	35 × 105	BE	7.8	5.20	21	0.17	086 12103
	15000	50 × 80	EC	10	6.36	15	0.18	086 12153
	22000	50 × 105	EE	13	7.71	11	0.20	086 12223
	27000	50 × 118	EF	15	8.54	10	0.22	086 12273
	33000	50 × 143	EH	17	9.44	9	0.24	086 12333
	33000	65 × 105	FE	18	9.44	8	0.22	086 22333
	39000	65 × 118	FF	20	10.26	7	0.22	086 12393
	56000	65 × 143	FH	23	12.30	6	0.27	086 12563
	47000	76 × 105	GE	23	11.26	7	0.27	086 22473
	56000	76 × 118	GF	25	12.30	6	0.27	086 12563
	82000	76 × 143	GH	29	14.88	5	0.33	086 12823
	120000	76 × 220	GN	40	18.00	4	0.39	086 12104
	100	2700	35 × 54	BA	3.3	3.12	65	0.14
3900		35 × 80	BC	4.3	3.75	50	0.16	086 19392
5600		35 × 105	BE	5.9	4.49	32	0.15	086 19562
10000		50 × 80	EC	5.5	6.00	52	0.42	086 19103
15000		50 × 105	EE	7.3	7.35	37	0.45	086 19153
18000		50 × 130	EG	9	8.05	27	0.40	086 19183
22000		50 × 143	EH	15	8.90	11	0.20	086 19223
22000		65 × 105	FE	11	8.90	19	0.34	086 29223
27000		65 × 118	FF	13	9.86	16	0.35	086 19273
33000		65 × 143	FH	14	10.90	14	0.38	086 19333
33000		76 × 105	GE	14	10.90	14	0.38	086 29333
39000		76 × 118	GF	17	11.85	11	0.35	086 19393
56000		76 × 143	GH	22	14.20	8	0.37	086 19563
82000		76 × 220	GN	25	17.18	7	0.47	086 19823

Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

Table 6 Electrical data and ordering information for **087** series; preferred types in **bold**

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (note 1) 2222
200	1000	35 × 54	BA	2.6	2.68	109	0.09	087 12102
	1500	35 × 80	BC	3.4	3.29	77	0.09	087 12152
	2200	35 × 105	BE	4.6	3.98	52	0.09	087 12222
	3900	50 × 80	EC	4.8	5.30	73	0.23	087 12392
	5600	50 × 105	EE	8.6	6.35	24	0.11	087 12562
	6800	50 × 130	EG	9.9	7.00	21	0.12	087 12682
	8200	50 × 143	EH	12	7.68	17	0.11	087 12822
	10000	65 × 105	FE	11	8.49	22	0.18	087 12103
	12000	65 × 130	FG	12	9.30	17	0.17	087 12123
	15000	65 × 143	FH	14	10.39	16	0.20	087 12153
	12000	76 × 105	GE	11	9.30	26	0.25	087 22123
	15000	76 × 118	GF	12	10.39	23	0.28	087 22153
	22000	76 × 143	GH	15	12.59	17	0.31	087 12223
	33000	76 × 220	GN	17	15.41	15	0.40	087 12333
250	680	35 × 54	BA	2.6	2.47	120	0.07	087 13681
	1200	35 × 80	BC	3.6	3.29	76	0.07	087 13122
	1800	35 × 105	BE	4.9	4.02	53	0.08	087 13182
	2700	50 × 80	EC	4.4	4.93	67	0.15	087 13272
	3900	50 × 105	EE	7.9	5.92	27	0.09	087 13392
	4700	50 × 130	EG	9	6.50	23	0.09	087 13472
	5600	50 × 143	EH	10	7.10	20	0.09	087 13562
	6800	65 × 105	FE	10	7.82	24	0.13	087 13682
	8200	65 × 130	FG	11	8.59	19	0.13	087 13822
	10000	65 × 143	FH	14	9.49	17	0.14	087 13103
	10000	76 × 105	GE	11	9.49	25	0.20	087 23103
	12000	76 × 118	GF	12	10.39	22	0.22	087 13123
	15000	76 × 143	GH	14	11.62	19	0.23	087 13153
	22000	76 × 220	GN	17	14.07	16	0.29	087 13223

Aluminum electrolytic capacitors
Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (note 1) 2222
350	390	35 × 54	BA	1.3	2.22	270	0.09	087 15391
	680	35 × 80	BC	2.5	2.93	163	0.09	087 15681
	1000	35 × 105	BE	3.3	3.55	112	0.09	087 15102
	1500	50 × 80	EC	3.9	4.35	105	0.13	087 15152
	2200	50 × 105	EE	5.6	5.26	55	0.10	087 15222
	2700	50 × 130	EG	7	5.83	44	0.10	087 15272
	3300	50 × 143	EH	8	6.45	37	0.10	087 15332
	2700	65 × 105	FE	6.6	5.83	54	0.12	087 25272
	3900	65 × 130	FG	8.7	7.01	37	0.12	087 15392
	4700	65 × 143	FH	9.6	7.70	33	0.13	087 15472
	4700	76 × 105	GE	9.6	7.70	33	0.13	087 25472
	5600	76 × 118	GF	10	8.40	33	0.15	087 15562
	6800	76 × 143	GH	11	9.26	28	0.16	087 15682
	12000	76 × 220	GN	18	12.30	18	0.18	087 15123
400	330	35 × 54	BA	1.3	2.18	290	0.08	087 16331
	560	35 × 80	BC	2.1	2.84	190	0.09	087 16561
	820	35 × 105	BE	3	3.44	129	0.09	087 16821
	1200	50 × 80	EC	3.7	4.16	95	0.09	087 16152
	1800	50 × 105	EE	5.5	5.09	59	0.09	087 16182
	2200	50 × 130	EG	6.4	5.63	50	0.09	087 16222
	2700	50 × 143	EH	7.9	6.24	39	0.09	087 16272
	2700	65 × 105	FE	7.3	6.24	48	0.11	087 26272
	3300	65 × 130	FG	8.5	6.89	39	0.11	087 16332
	3900	65 × 143	FH	9.4	7.49	37	0.12	087 16392
	3900	76 × 105	GE	9.4	7.49	37	0.12	087 26392
	4700	76 × 118	GF	10	8.23	34	0.13	087 16472
	5600	76 × 143	GH	11	8.98	28	0.13	087 16562
	10000	76 × 220	GN	18	12.00	18	0.15	087 16103

Aluminum electrolytic capacitors
Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (note 1) 2222
450	220	35 × 54	BA	1	1.89	430	0.08	087 17221
	390	35 × 80	BC	1.8	2.51	310	0.10	087 17391
	560	35 × 105	BE	2.6	3.01	180	0.08	087 17561
	820	50 × 80	EC	3	3.64	145	0.10	087 17821
	1200	50 × 105	EE	4.6	4.41	85	0.08	087 17122
	1500	50 × 130	EG	5.3	4.93	71	0.09	087 17152
	1800	50 × 143	EH	5.9	5.40	60	0.09	087 17182
	2200	65 × 105	FE	6.7	5.97	53	0.10	087 17222
	2700	65 × 130	FG	7.7	6.61	45	0.10	087 17272
	3300	65 × 143	FH	9.5	7.31	35	0.09	087 17332
	3300	76 × 105	GE	9.5	7.31	35	0.09	087 27332
	3900	76 × 118	GF	9.8	7.95	36	0.11	087 17392
	4700	76 × 143	GH	11	8.73	31	0.12	087 17472
8200	76 × 220	GN	14	11.53	23	0.15	087 17822	
500 ⁽²⁾	820	50 × 105	EE	3.4	3.8	132	0.06	087 18821
	1200	50 × 130	EG	4.6	4.6	90	0.06	087 18122
	2200	65 × 130	FG	6.6	6.3	59	0.06	087 18222
	3300	76 × 143	GH	8.6	7.7	43	0.06	087 18332

Notes

- Catalogue type applies to the terminal style "M", high post (see Table 3); the insulation type "H", 0.6 mm polymeric (see Table 4); tolerance $\pm 20\%$ and to the ST version; for STB version (not preferred) replace 8th digit by '5' if ST version is '1' (2222 086/087 5....) or replace 8th digit by '6' if ST version is '2' (2222 086/087 6....). STB version is not available for $\varnothing D = 35$ mm and 45 mm and for case size $\varnothing 76 \times 220$ mm.
- For additional values and sizes, please contact your local BC Components sales organization.

Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods	≤250 V versions	$U_s = 1.3 \times U_R$
	≥350 V versions	$U_s = 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.006 \times \sqrt{C \times V} \text{ (mA)}$
Inductance		
Equivalent series inductance (ESL)	case ØD = 35 mm, (1.375")	typ. 18 nH
	case ØD = 45 mm, (1.75")	typ. 23 nH
	case ØD = 50 mm, (2.0")	typ. 25 nH
	case ØD = 65 mm, (2.5")	typ. 27 nH
	case ØD = 76 mm, (3.0")	typ. 29 nH



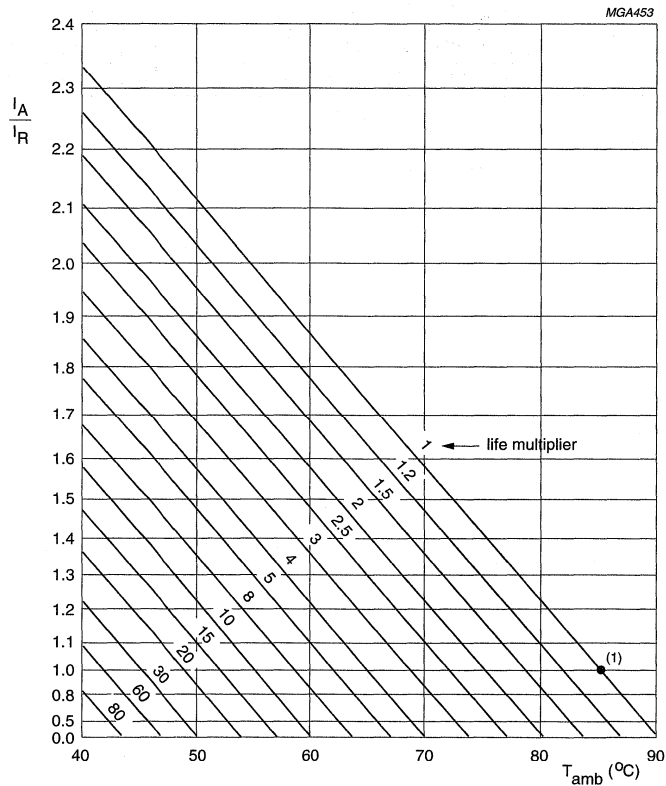
Aluminum electrolytic capacitors
Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

RIPPLE CURRENT AND USEFUL LIFE

Table 7 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER	
	086	087
60	0.9	0.9
120	1.00	1.00
300	1.15	1.25
1000	1.25	1.40
≥ 10000	1.30	1.50



J_A = actual ripple current at 120 Hz and 85 °C.

I_R = rated ripple current at 120 Hz and 85 °C.

With an absolute maximum of 50 A at 85 °C.

(1) Useful life at 85 °C and I_R applied: 5000 hours (3000 hours for ≥ 100 V types).

Fig.3 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power Standard, Screw Terminals

NAFTA 3186, 086/087 PS-ST

SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this data handbook, section "Tests and Requirements".

Table 8 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 1000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 5000 hours ($\geq 100\text{ V}$ types: 3000 hours)	$\Delta C/C: \pm 15\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4 subclause 4.17	$T_{amb} = 85\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 10\%$ $I_{L5} \leq 2 \times \text{spec. limit}$ $ESR \leq 1.75 \times \text{spec. limit}$

Aluminum electrolytic capacitors

Power, Output (filter) Current, Screw Terminals

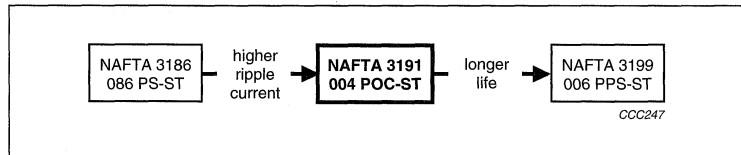
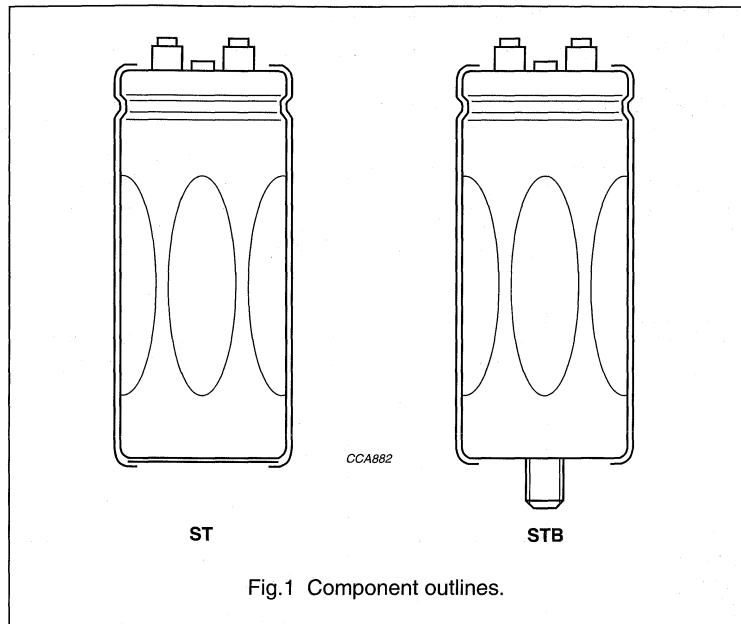
NAFTA 3191, 004 POC-ST

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Bolt version available for case $\varnothing D = 50 \text{ mm}$ ($\varnothing D = 2''$)
- Pressure relief in the sealing disk
- Charge and discharge proof
- High ripple current capability
- High resistance to shock and vibration.

APPLICATIONS

- Industrial systems
- Smoothing and filtering
- Audio Power Supplies



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case size (in millimetres and inches)	BA 35 × 54 mm (1.375" × 2.125") to EG 76 × 220 mm (2.000" × 5.125")
Rated capacitance range, C_R	2700 to 150000 μF
Tolerance on C_R	-10 to +30%; -10 to +50%; $\pm 20\%$
Rated voltage range, U_R	7.5 to 55 V_{DC}
Category temperature range	-40 to +85 $^{\circ}\text{C}$
Endurance test at 85 $^{\circ}\text{C}$	1500 hours
Useful life at 85 $^{\circ}\text{C}$	2000 hours
Useful life at 40 $^{\circ}\text{C}$ and $1.2 \times I_R$ applied	60000 hours
Shelf life at 0 V, 85 $^{\circ}\text{C}$	500 hours
Based on sectional specification	IEC 60384-4
Climatic category IEC 60068	40/085/56

Aluminum electrolytic capacitors

Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
004 POC-ST

Selection chart for C_R , U_R and relevant nominal case code sizes

Preferred types in **bold**.

C_R (μF)	U_R (V)						
	7.5	10	16	20	28	35	55
2700	-	-	-	-	-	-	BA
3900	-	-	-	-	-	BA	BB
4700	-	-	-	-	BA	BB	BC
5600	-	-	-	-	BB	BB	BD
6800	-	-	-	-	BB	BC	BE/EA
8200	-	-	-	BA	BB	BD	BF/EB
10000	-	-	BA	BB	BC	BD/EA	BH/EC
12000	-	-	BB	BB	BD	BF/EB	ED
15000	BA	BA	BC	BC	BE/EA	BG/EC	EE
18000	BB	BB	BC	BD	BF/EB	ED	EF
22000	BC	BC	BD/EA	BE/EA	BG/EC	ED	EG
27000	BC	BD	BF/EB	BF/EB	ED	EF	-
33000	BD	BE/EA	BG/EC	BH/EC	EE	EG	-
39000	BE	BE/EB	EC	ED	EF	EH	-
47000	BG/EA	BG/EC	ED	EE	EG	-	-
56000	BH/EB	BH/EC	EE	EF	-	-	-
68000	EC	ED	EF	EG	-	-	-
82000	ED	EE	EG	EH	-	-	-
100000	EE	EF	-	-	-	-	-
120000	EF	EE	-	-	-	-	-
150000	EG	-	-	-	-	-	-
180000	-	-	-	-	-	-	-
220000	-	-	-	-	-	-	-
270000	-	-	-	-	-	-	-
330000	-	-	-	-	-	-	-
390000	-	-	-	-	-	-	-
470000	-	-	-	-	-	-	-
820000	-	-	-	-	-	-	-

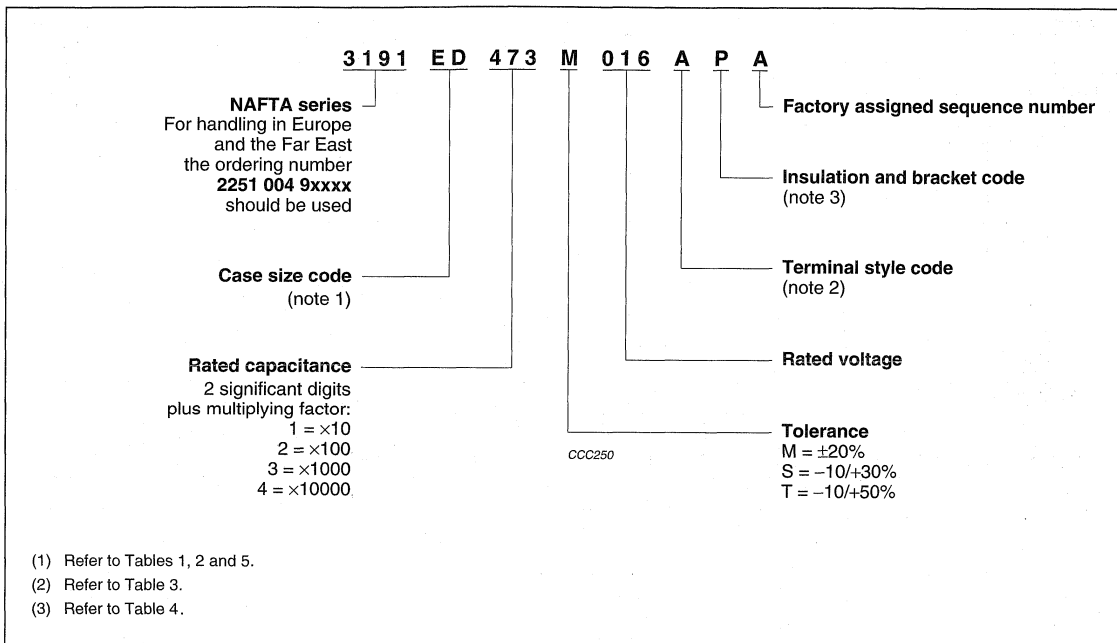


Aluminum electrolytic capacitors Power, Output (filter) Current, Screw Terminals

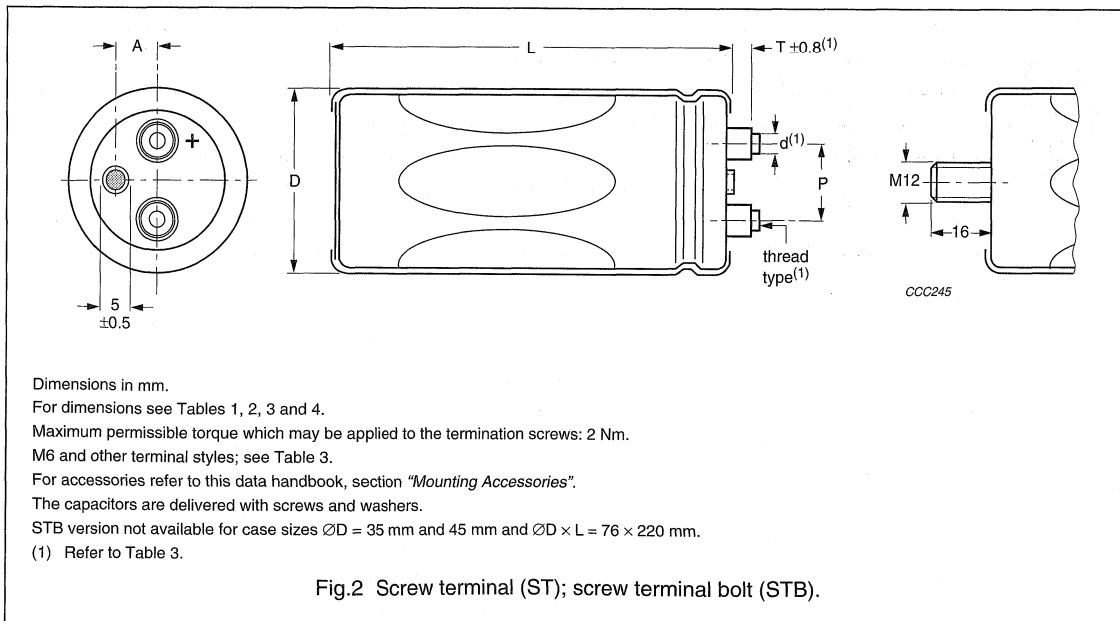
NAFTA 3191,
004 POC-ST

ORDERING INFORMATION

NAFTA part numbering system



MECHANICAL DATA



Aluminum electrolytic capacitors
Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
004 POC-ST

Table 1 Physical dimensions in millimetres (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (mm)	L _{max} (mm)	P ±0.4 (mm)	A (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
Dimensions in millimetres							
BA	34.9	54.0	12.7	8.0	≈72	150	402 × 200 × 258
BB	34.9	66.7	12.7	8.0	≈90	150	402 × 200 × 258
BC	34.9	79.4	12.7	8.0	≈105	150	402 × 200 × 283
BD	34.9	92.1	12.7	8.0	≈120	100	402 × 200 × 258
BE	34.9	104.8	12.7	8.0	≈135	100	402 × 200 × 258
BF	34.9	117.5	12.7	8.0	≈170	100	402 × 200 × 258
BG	34.9	130.2	12.7	8.0	≈220	100	402 × 200 × 283
BH	34.9	142.9	12.7	8.0	≈270	100	402 × 200 × 315
EA	50.8	54.0	22.2	12.7	≈170	96	324 × 216 × 289
EB	50.8	66.7	22.2	12.7	≈180	72	332 × 221 × 278
EC	50.8	79.4	22.2	12.7	≈190	72	332 × 221 × 278
ED	50.8	92.1	22.2	12.7	≈220	48	324 × 216 × 289
EE	50.8	104.8	22.2	12.7	≈255	48	324 × 216 × 289
EF	50.8	117.5	22.2	12.7	≈290	48	324 × 216 × 289
EG	50.8	130.2	22.2	12.7	≈320	48	324 × 216 × 289
EH	50.8	142.9	22.2	12.7	≈350	48	324 × 216 × 315

Aluminum electrolytic capacitors

Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
004 POC-ST

Table 2 Physical dimensions in inches (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (inches)	L _{max} (inches)	P ±0.014 (inches)	A (inches)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (inches)
Dimensions in inches							
BA	1.375	2.125	0.5	0.39	≈72	150	15.825 × 7.875 × 10.125
BB	1.375	2.625	0.5	0.39	≈90	150	15.825 × 7.875 × 10.125
BC	1.375	3.125	0.5	0.39	≈105	150	15.825 × 7.875 × 11.125
BD	1.375	3.625	0.5	0.39	≈120	100	15.825 × 7.875 × 10.125
BE	1.375	4.125	0.5	0.39	≈135	100	15.825 × 7.875 × 10.125
BF	1.375	4.625	0.5	0.39	≈170	100	15.825 × 7.875 × 10.125
BG	1.375	5.125	0.5	0.39	≈220	100	15.825 × 7.875 × 11.125
BH	1.375	5.625	0.5	0.39	≈270	100	15.825 × 7.875 × 12.400
EA	2	2.125	0.875	0.5	≈170	96	12.750 × 8.500 × 11.375
EB	2	2.625	0.875	0.5	≈180	72	13.750 × 8.700 × 11.000
EC	2	3.125	0.875	0.5	≈190	72	13.750 × 8.700 × 11.000
ED	2	3.625	0.875	0.5	≈220	48	12.750 × 8.500 × 11.375
EE	2	4.125	0.875	0.5	≈255	48	12.750 × 8.500 × 11.375
EF	2	4.625	0.875	0.5	≈290	48	12.750 × 8.500 × 11.375
EG	2	5.125	0.875	0.5	≈320	48	12.750 × 8.500 × 11.375
EH	2	5.625	0.875	0.5	≈350	48	12.750 × 8.500 × 12.400

Table 3 NAFTA terminal style code

CODE	TERMINAL STYLE	THREAD TYPE	d (mm)	T (mm)	d (inches)	T (inches)
A	high post	10-32	8	6.4	.315	0.250
B	low post	10-32	8	1.6	.315	0.063
D	high current; see note 1	1/4-28	17	3.2	.670	0.125
J	high current; see note 1	M6	17	3.2	.670	0.125
M	high post	M5	8	6.4	.315	0.250
K	high current; see note 1	1/4-28	17	6.4	.670	0.250

Note

1. Case $\varnothing D = 65$ mm (2.5") and $\varnothing D = 76$ mm (3.0") cans only; for 30 A and up.

Aluminum electrolytic capacitors

Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
004 POC-ST

Table 4 NAFTA insulation and clamp/bracket codes; see note 1

CODE	CLAMP/BRACKET	INSULATION TYPE	DIMENSION ADDERS		
			D	L	H
			Dimensions in mm		
P	no	0.2 mm polymeric	+0.51	+0.81	+0.61
H	no	0.6 mm polymeric	+0.63	+1.58	+1.14
N	no	none	–	–	–
R	yes	0.2 mm polymeric	+0.51	+0.81	+0.61
J	yes	0.6 mm polymeric	+0.63	+1.58	+1.14
X	yes	none	–	–	–
			Dimensions in inches		
P	no	0.008" polymeric	+0.020	+0.032	+0.024
H	no	0.012" polymeric	+0.030	+0.062	+0.045
N	no	none	–	–	–
R	yes	0.008" polymeric	+0.020	+0.032	+0.024
J	yes	0.012" polymeric	+0.030	+0.062	+0.045
X	yes	none	–	–	–

Note

1. For clamp/bracket dimensions see section "Mounting Accessories" in this data handbook.

MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance
- Rated voltage (in V)
- Date code in "yyww" (year, week) format
- Name of manufacturer
- NAFTA code number 17 digits
- Code number 12 digits (12NC; NAFTA customers will not see the 12NC).



Aluminum electrolytic capacitors

Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
004 POC-ST

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Table 5 apply at $T_{amb} = 25\text{ }^{\circ}\text{C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz
I_R	rated RMS ripple current at $85\text{ }^{\circ}\text{C}$, 120 Hz
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ. equivalent series resistance at 120 Hz
Z	impedance at 20 kHz on request
Tan δ	typ. dissipation factor at 120 Hz

Table 5 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz $85\text{ }^{\circ}\text{C}$ (A)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	CATALOGUE NUMBER 2251 004 9....
7.5	15000	35 × 54	BA	9.4	2.01	15.8	on request
	18000	35 × 65	BB	10.4	2.20	13.9	on request
	22000	35 × 80	BC	11.5	2.44	11.8	on request
	27000	35 × 80	BC	12.7	2.70	10.8	on request
	33000	35 × 90	BD	14.2	2.98	9.4	on request
	39000	35 × 105	BE	15.5	3.24	8.6	on request
	47000	35 × 130/50 × 54	BG/EA	17.7	3.56	7.3	on request
	56000	35 × 143/50 × 65	BH/EB	19.5	3.89	7.0	on request
	68000	50 × 80	EC	17.7	4.28	9.2	on request
	82000	50 × 90	ED	19.5	4.71	7.9	on request
	100000	50 × 105	EE	22.1	5.20	6.9	on request
	120000	50 × 118	EF	23.9	5.69	6.4	on request
	150000	50 × 130	EG	26.1	6.36	5.7	on request
10	15000	35 × 54	BA	9.5	2.32	15.6	on request
	18000	35 × 65	BB	10.9	2.55	13.6	on request
	22000	35 × 80	BC	12.2	2.81	11.1	on request
	27000	35 × 90	BD	13.9	3.12	10.1	on request
	33000	35 × 105/50 × 54	BE/EA	15.5	3.45	9.1	on request
	39000	35 × 105/50 × 65	BE/EB	15.7	3.75	8.6	on request
	47000	35 × 130/50 × 80	BG/EC	18.1	4.11	7.4	on request
	56000	35 × 143/50 × 80	BH/EC	19.5	4.49	7.1	on request
	68000	50 × 90	ED	19.6	4.95	7.7	on request
	82000	50 × 105	EE	22.3	5.43	6.9	on request
	100000	50 × 118	EF	24.3	6.00	6.0	on request
	120000	50 × 105	EE	26.0	6.57	5.7	on request

Aluminum electrolytic capacitors
Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
004 POC-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	CATALOGUE NUMBER 2251 004 9....
16	10000	35 × 54	BA	9.3	2.40	16.7	on request
	12000	35 × 65	BB	10.4	2.63	14.2	on request
	15000	35 × 80	BC	12.1	2.94	11.7	on request
	18000	35 × 80	BC	13.5	3.22	11.3	on request
	22000	35 × 90/50 × 54	BD/EA	14.2	3.56	9.8	on request
	27000	35 × 118/50 × 65	BF/EB	16.8	3.94	8.4	on request
	33000	35 × 130/50 × 80	BG/EC	18.4	4.36	7.6	on request
	39000	50 × 80	EC	17.9	4.74	9.1	on request
	47000	50 × 90	ED	19.7	5.20	7.8	on request
	56000	50 × 105	EE	21.5	5.68	7.1	on request
	68000	50 × 118	EF	23.5	6.26	6.4	on request
82000	50 × 130	EG	25.3	6.87	5.9	on request	
20	8200	35 × 54	BA	8.9	2.43	18.2	on request
	10000	35 × 65	BB	10.1	2.68	15.1	on request
	12000	35 × 65	BB	10.8	2.94	14.2	on request
	15000	35 × 80	BC	12.4	3.29	11.9	on request
	18000	35 × 90	BD	13.9	3.60	11.0	on request
	22000	35 × 105/50 × 54	BE/EA	15.4	3.98	9.3	on request
	27000	35 × 118/50 × 65	BF/EB	17.4	4.41	8.0	on request
	33000	35 × 145/50 × 80	BH/EC	19.4	4.87	7.3	on request
	39000	50 × 90	ED	18.9	5.30	7.9	on request
	47000	50 × 105	EE	21.7	5.82	7.0	on request
	56000	50 × 118	EF	23.9	6.35	6.4	on request
	68000	50 × 130	EG	24.8	7.00	5.9	on request
	82000	50 × 143	EH	27.1	7.68	5.6	on request
28	4700	35 × 54	BA	7.5	2.18	23.4	on request
	5600	35 × 65	BB	7.9	2.38	22.5	on request
	6800	35 × 65	BB	8.5	2.62	19.0	on request
	8200	35 × 65	BB	9.4	2.87	17.5	on request
	10000	35 × 80	BC	11.3	3.17	15.0	on request
	12000	35 × 90	BD	12.7	3.48	12.7	on request
	15000	35 × 105/50 × 54	BE/EA	14.1	3.89	11.2	on request
	18000	35 × 118/50 × 65	BF/EB	15.9	4.26	9.9	on request
	22000	35 × 130/50 × 80	BG/EC	17.5	4.71	8.6	on request
	27000	50 × 90	ED	19.1	5.22	8.1	on request
	33000	50 × 105	EE	21.7	5.77	7.3	on request
	39000	50 × 118	EF	23.9	6.27	6.6	on request
	47000	50 × 130	EG	25.3	6.88	6.0	on request

Aluminum electrolytic capacitors

Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
004 POC-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	CATALOGUE NUMBER 2251 004 9....
35	3900	35 × 54	BA	7.7	2.22	25.4	on request
	4700	35 × 65	BB	8.9	2.43	21.2	on request
	5600	35 × 65	BB	9.3	2.66	19.1	on request
	6800	35 × 80	BC	9.9	2.93	17.2	on request
	8200	35 × 90	BD	11.9	3.21	14.7	on request
	10000	35 × 90/50 × 54	BD/EA	13.0	3.55	12.9	on request
	12000	35 × 118/50 × 65	BF/EB	14.3	3.89	11.4	on request
	15000	35 × 130/50 × 80	BG/EC	15.8	4.35	9.6	on request
	18000	50 × 90	ED	18.9	4.76	8.8	on request
	22000	50 × 90	ED	20.2	5.26	8.1	on request
	27000	50 × 118	EF	22.8	5.83	6.9	on request
	33000	50 × 130	EG	24.6	6.45	6.4	on request
	39000	50 × 143	EH	26.8	7.01	6.0	on request
55	2700	35 × 54	BA	7.2	2.31	33.2	on request
	3900	35 × 65	BB	9.0	2.78	23.3	on request
	4700	35 × 80	BC	10.2	3.05	19.4	on request
	5600	35 × 90	BD	11.6	3.33	16.4	on request
	6800	35 × 105/50 × 54	BE/EA	12.9	3.67	15.2	on request
	8200	35 × 118/50 × 65	BF/EB	14.7	4.03	12.7	on request
	10000	35 × 143/50 × 80	BH/EC	17.2	4.45	10.9	on request
	12000	50 × 90	ED	18.6	4.87	9.9	on request
	15000	50 × 105	EE	20.3	5.45	8.9	on request
	18000	50 × 118	EF	21.8	5.97	7.8	on request
	22000	50 × 130	EG	24.1	6.60	7.1	on request

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.3 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.006 \times \sqrt{C \times V}$ (mA)
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 35 \text{ mm}$, (1.375")	typ. 18 nH
	case $\varnothing D = 50 \text{ mm}$, (2.0")	typ. 25 nH

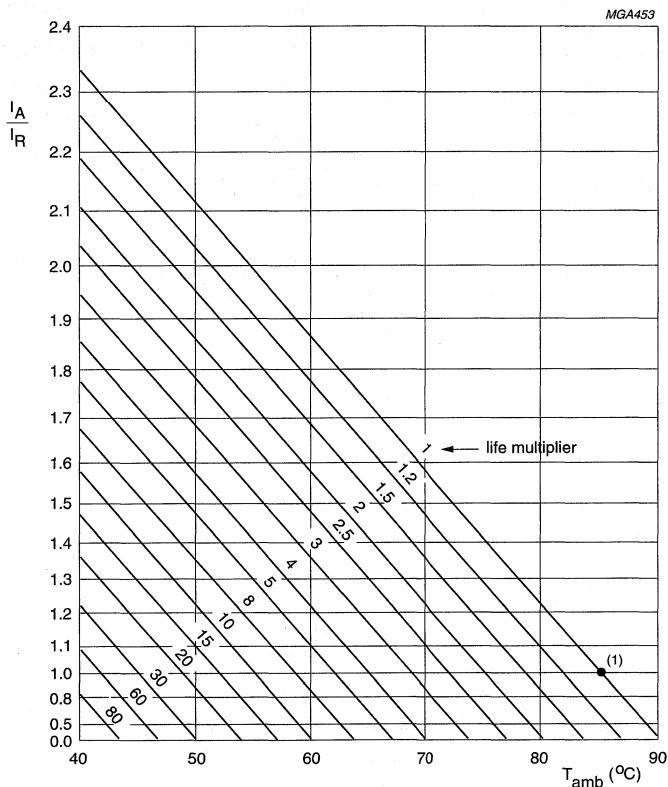
Aluminum electrolytic capacitors
 Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
 004 POC-ST

RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
60	0.9
120	1.00
300	1.05
1000	1.1
≥ 10000	1.15



I_A = actual ripple current at 120 Hz and 85 °C.
 I_R = rated ripple current at 120 Hz and 85 °C.
 With an absolute maximum of 50 A at 85 °C.
 (1) Useful life at 85 °C and I_R applied: 2000 hours.

Fig.3 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power, Output (filter) Current, Screw Terminals

NAFTA 3191,
004 POC-ST

SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this data handbook, section "Tests and Requirements".

Table 7 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied; 1500 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 2000 hours	$\Delta C/C: \pm 15\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4 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	$\Delta C/C: \pm 10\%$ $I_{L5} \leq 2 \times \text{spec. limit}$ $ESR \leq 1.75 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power, High Ripple Current, Screw Terminals

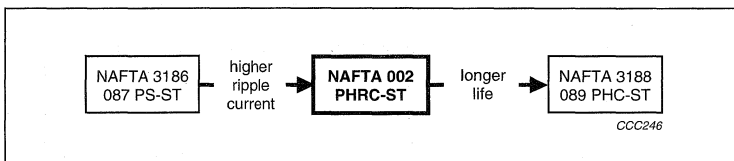
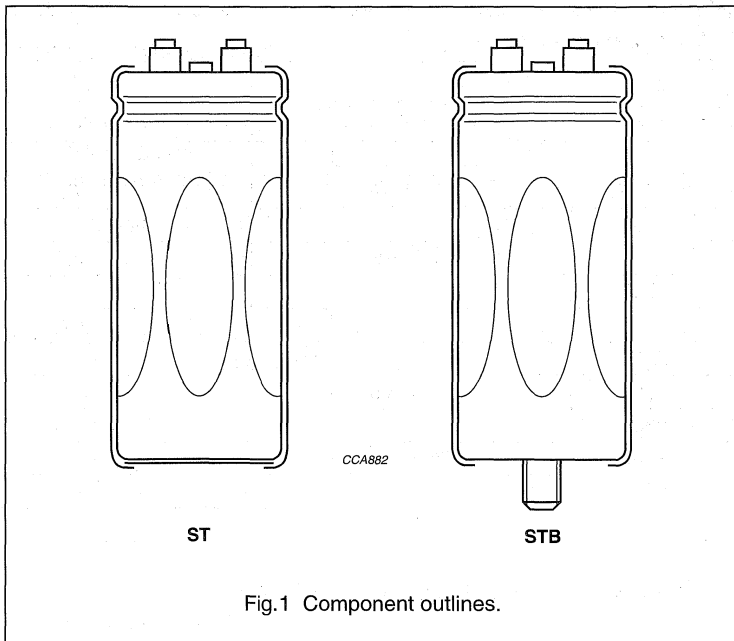
NAFTA 002 PHRC-ST

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Also available in bolt version: PHRC-STB
- Pressure relief in the sealing disk
- Charge and discharge proof
- Very high ripple current capability
- High resistance to shock and vibration.

APPLICATIONS

- General purpose, computer and Industrial systems
- Smoothing and filtering
- Standard switched mode power supplies
- Welding
- Energy storage in pulse systems
- Motor control devices
- Uninterruptable power supplies (UPS).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	50 × 80 mm to 76 × 143 mm
Rated capacitance range, C_R	680 to 5600 μF
Tolerance on C_R	-10 to +30%
Rated voltage range, U_R	400 to 500 V_{DC}
Category temperature range	-40 to +85 °C
Endurance test at 85 °C	1 000 hours
Useful life at 85 °C	3000 hours
Useful life at 40 °C and $1.2 \times I_R$ applied	90000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 60384-4
Climatic category IEC 60068	40/085/56

Aluminum electrolytic capacitors

Power, High Ripple Current, Screw Terminals

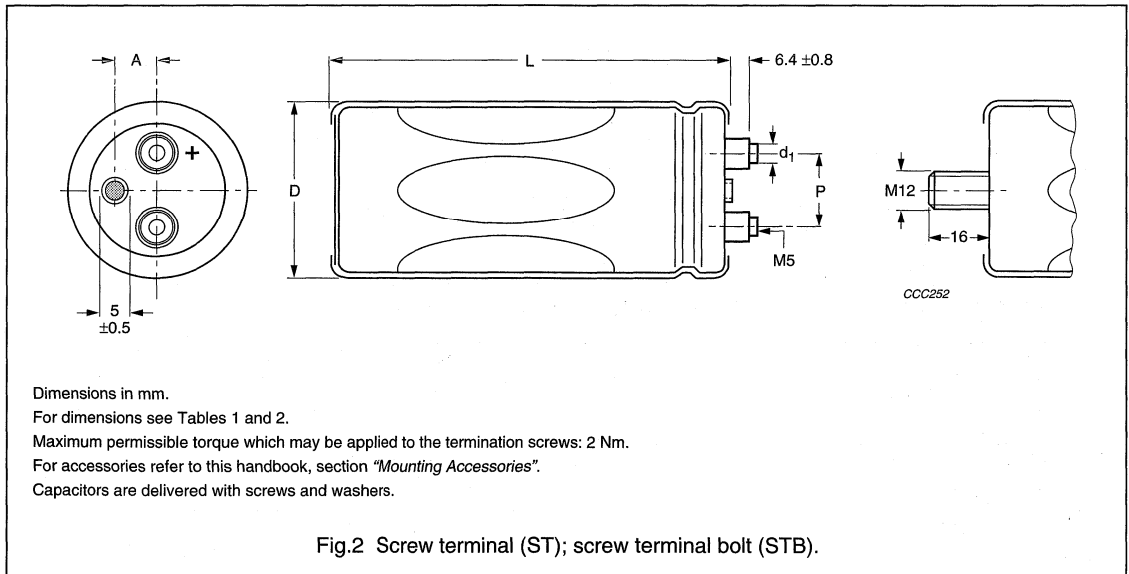
NAFTA 002 PHRC-ST

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)		
	400	450	500
680	–	–	50 × 80
820	–	50 × 80	–
1000	–	–	50 × 105
1200	50 × 80	50 × 105	–
1500	–	–	65 × 105
1800	50 × 105	65 × 105	–
2200	–	–	76 × 105
2700	65 × 105	–	–
3300	–	76 × 105	76 × 143
3900	76 × 105	–	–
4700	–	76 × 143	–
5600	76 × 143	–	–

MECHANICAL DATA AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors

Power, High Ripple Current, Screw Terminals

NAFTA 002 PHRC-ST

Table 1 Physical dimensions in millimetres, mass and packaging information; see Fig.2 and note 1

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	P (mm)	A (mm)	d_1 ± 0.2 (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
50 × 80	52.9	81.8	22.2 ± 0.4	12.7	8.0	≈190	72	324 × 216 × 278
50 × 105	52.9	107.2	22.2 ± 0.4	12.7	8.0	≈255	48	324 × 216 × 289
65 × 105	65.6	107.2	28.5 ± 0.4	15.9	8.0	≈445	40	343 × 275 × 240
76 × 105	78.3	107.2	31.8 ± 0.4	19.0	8.0	≈600	20	397 × 320 × 121
76 × 143	78.3	145.3	31.8 ± 0.4	19.0	8.0	≈970	20	397 × 320 × 178

Note

- Note that all screws and bolts (STB) are metric thread; this applies also to the NAFTA market products.

Table 2 Physical dimensions in inches, mass and packaging information; see Fig.2 and note 1

NOMINAL CASE SIZE $\varnothing D \times L$ (inches)	$\varnothing D_{max}$ (inches)	L_{max} (inches)	P (inches)	A (inches)	d_1 ± 0.2 (inches)	MASS (lb)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (inches)
2.000 × 3.125	2.083	3.225	.875 ± .016	.500	0.315	.42	72	12 ³ / ₄ × 8 ¹ / ₂ × 11
2.000 × 4.125	2.083	4.225	.875 ± .016	.500	0.315	.56	48	12 ³ / ₄ × 8 ¹ / ₂ × 11 ³ / ₈
2.500 × 4.125	2.583	4.225	1.125 ± .016	.625	0.315	.98	40	13 ¹ / ₂ × 10 ¹³ / ₁₆ × 9 ¹ / ₂
3.000 × 4.125	3.083	4.225	1.250 ± .016	.750	0.315	1.33	20	15 ⁵ / ₈ × 12 ⁵ / ₈ × 4 ³ / ₄
3.000 × 5.625	3.083	5.725	1.250 ± .016	.750	0.315	2.15	20	15 ⁵ / ₈ × 12 ⁵ / ₈ × 5 ¹³ / ₁₆

Note

- Note that all screws and bolts (STB) are metric thread; this applies also to the NAFTA market products.

MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance
- Rated voltage (in V)
- Date code in "yyww" (year, week) format
- Name of manufacturer
- Code number 12 digits.

Aluminum electrolytic capacitors

Power, High Ripple Current, Screw Terminals

NAFTA 002 PHRC-ST

ELECTRICAL DATA AND ORDERING INFORMATION

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

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz
I_R	rated RMS ripple current at 85 °C
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ. equivalent series resistance at 120 Hz
Z	impedance at 20 kHz on request
Tan δ	typ. dissipation factor at 120 Hz

Ordering information

Electrolytic capacitor 002 PHRC-ST:
 1000 $\mu\text{F}/500\text{ V}$; $\pm 20\%$

Nominal case size: $\varnothing 50 \times 105\text{ mm}$,
 ST version

Catalogue number:
 2222 002 18102⁽¹⁾

(1) This series does not have a NAFTA
 part number.

Table 3 Electrical data and ordering information for 002 series

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 120 Hz 85 °C (mA)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	Tan δ 120 Hz	CATALOGUE NUMBER (note 1) 2222
400	1200	50 × 80	5.6	4.16	95	0.09	002 16102
	1800	50 × 105	8.8	5.09	59	0.09	002 16182
	2700	65 × 105	10.1	6.24	39	0.09	002 16272
	3900	76 × 105	13	7.49	37	0.12	002 16392
	5600	76 × 143	14.6	8.98	28	0.13	002 16472
450	820	50 × 80	5	3.64	145	0.10	002 17102
	1200	50 × 105	7.4	4.41	85	0.10	002 17152
	2200	65 × 105	9.8	5.97	63	0.10	002 17222
	3300	76 × 105	12.7	7.31	35	0.10	002 17332
	4700	76 × 143	14.2	8.73	31	0.12	002 17472
500	680	50 × 80	5.1	3.50	132	0.09	002 18681
	1000	50 × 105	6.7	4.24	90	0.09	002 18102
	1500	65 × 105	9	5.20	59	0.09	002 18152
	2200	76 × 105	11.1	6.21	43	0.10	002 18222
	3300	76 × 143	14.4	7.71	30	0.10	002 18332

Note

- Catalogue number applies to the ST version; for STB version (not preferred) replace 8th digit by '5' if ST version is '1' (2222 002 5....).

Aluminum electrolytic capacitors
Power, High Ripple Current, Screw Terminals

NAFTA 002 PHRC-ST

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥400 V versions	$U_S = 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.006 \times \sqrt{C \times V} \text{ (mA)}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 50 \text{ mm}$	typ. 25 nH
	case $\varnothing D = 65 \text{ mm}$	typ. 27 nH
	case $\varnothing D = 76 \text{ mm}$	typ. 29 nH

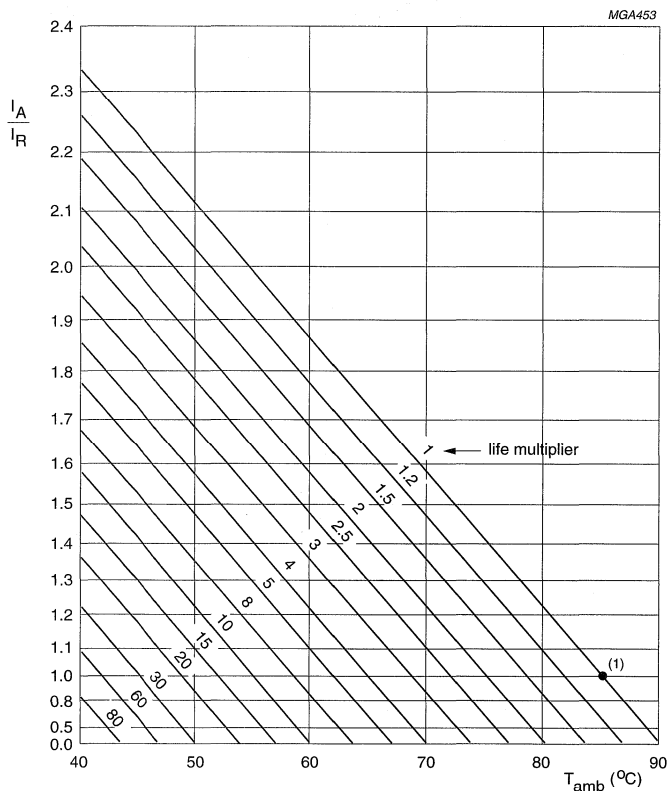
Aluminum electrolytic capacitors Power, High Ripple Current, Screw Terminals

NAFTA 002 PHRC-ST

RIPPLE CURRENT AND USEFUL LIFE

Table 4 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
60	0.9
120	1.00
300	1.05
1000	1.1
≥ 10000	1.15



I_A = actual ripple current at 120 Hz and 85 °C.
 I_R = rated ripple current at 120 Hz and 85 °C.
 With an absolute maximum of 50 A at 85 °C.
 (1) Useful life at 85 °C and I_R applied: 3000 hours.

Fig.3 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power, High Ripple Current, Screw Terminals

NAFTA 002 PHRC-ST

SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this data handbook, section "Tests and Requirements".

Table 5 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; 1000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; 3000 hours	$\Delta C/C: \pm 15\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 10\%$ $I_{L5} \leq 2 \times \text{spec. limit}$ $ESR \leq 1.75 \times \text{spec. limit}$

Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Bolt version available for case $\varnothing D = 50, 65$ and 75 mm ($\varnothing D = 2", 2.5"$ and $3"$)
- Pressure relief in the sealing disk
- Charge and discharge proof
- High ripple current capability
- High resistance to shock and vibration.

APPLICATIONS

- Industrial systems
- Smoothing and filtering
- Audio Power Supplies

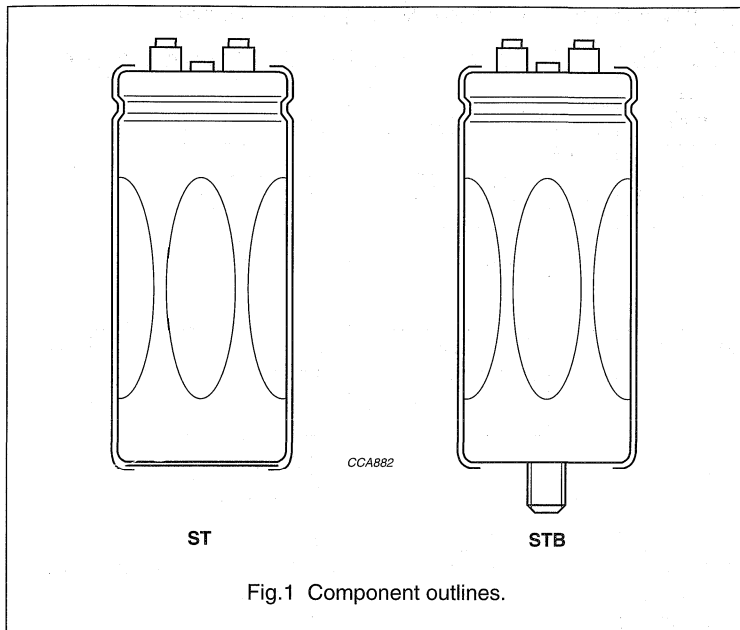
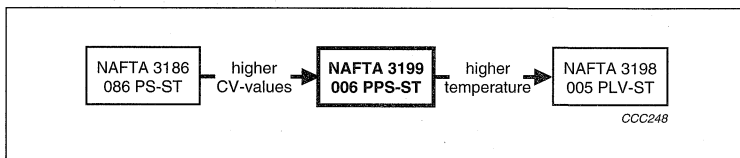


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case size (in millimetres and inches)	BA 35 × 54 mm (1.375" × 2.125") to GN 76 × 220 mm (3.000" × 8.625")
Rated capacitance range, C _R	3900 μF to 1.2 F
Tolerance on C _R	-10 to +30%; -10 to +50%; ± 20%
Rated voltage range, U _R	7.5 to 75 V _{DC}
Category temperature range	-55 to +85 °C
Endurance test at 85 °C	5000 hours
Useful life at 85 °C	6000 hours
Useful life at 40 °C and 1.2 × I _R applied	180000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 60384-4
Climatic category IEC 60068	55/085/56

Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

Selection chart for C_R , U_R and relevant nominal case code sizes

Preferred types in **bold**.

C_R (μF)	U_R (V)							
	7.5	10	16	25	40	50	63	75
3900	-	-	-	-	-	-	-	BA
4700	-	-	-	-	-	-	BA	BB
5600	-	-	-	-	-	-	BB	BB
6800	-	-	-	-	-	-	BB	BC
8200	-	-	-	-	-	BA	BC	BD
10000	-	-	-	-	BA	BB	BD	BE
12000	-	-	-	-	BB	BC	BE	BG
15000	-	-	-	-	BC	BD	BG	DD
18000	-	-	-	BA	BD	BE	BH	DE
22000	-	-	BA	-	BE	BF	DE	DG
27000	-	-	BB	BC	BF	BH	DG	EF
33000	-	BA	-	BD	BH	DE	DH	EH
39000	BA	BB	BC	BE	DD	DF	EG	FF
47000	BB	BC	BD	BG	DE	DG	FE	FG
56000	BC	BC	BE	BH	DG	EF	FF	FH
68000	BD	BD	BG	DE	DH	EH	FH	GG
82000	BD	BE	BH	DF	EG	FF	GF	GH
100000	BF	BG	DE	DG	FE	FH	GH	-
120000	BG	DD	DF	EF	FF	GF	-	GN
150000	DD	DE	DH	EH	FH	GH	GN	-
180000	DE	DG	EG	FF	GG	-	-	-
220000	DG	DH	FE	FG	GH	GN	-	-
270000	EF	EG	FF	GF	-	-	-	-
330000	EH	FE	GE	GG	GN	-	-	-
390000	FE	FF	GF	-	-	-	-	-
470000	FG	FH	GH	-	-	-	-	-
560000	FH	GF	-	GN	-	-	-	-
680000	GF	GH	-	-	-	-	-	-
820000	GH	-	GN	-	-	-	-	-
1000000	-	-	-	-	-	-	-	-
1200000	GN	GN	-	-	-	-	-	-

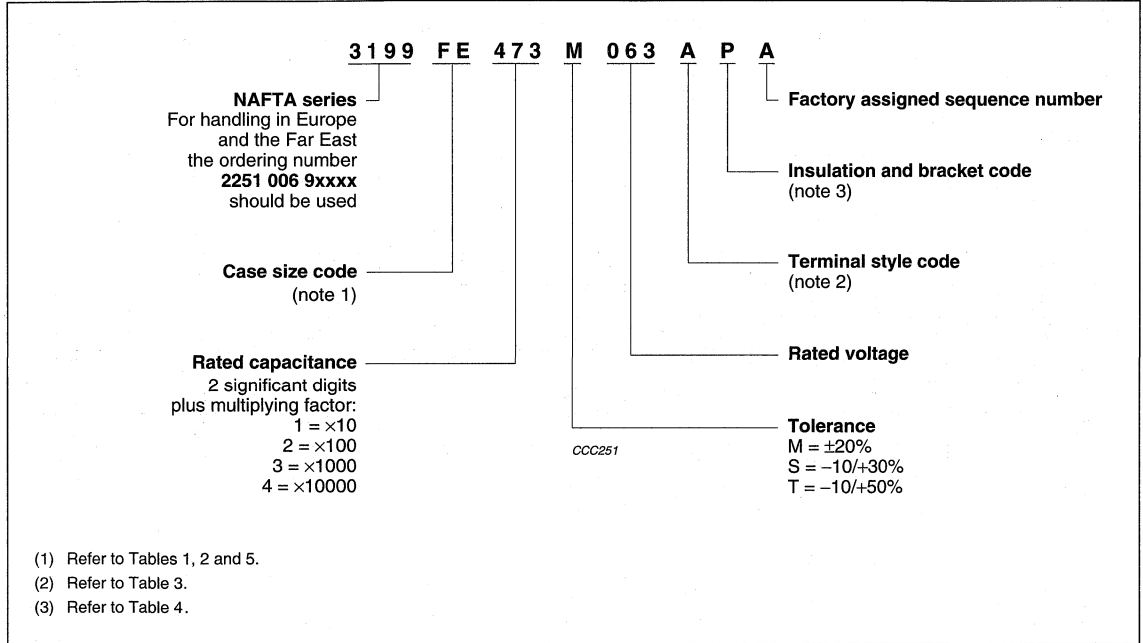
Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

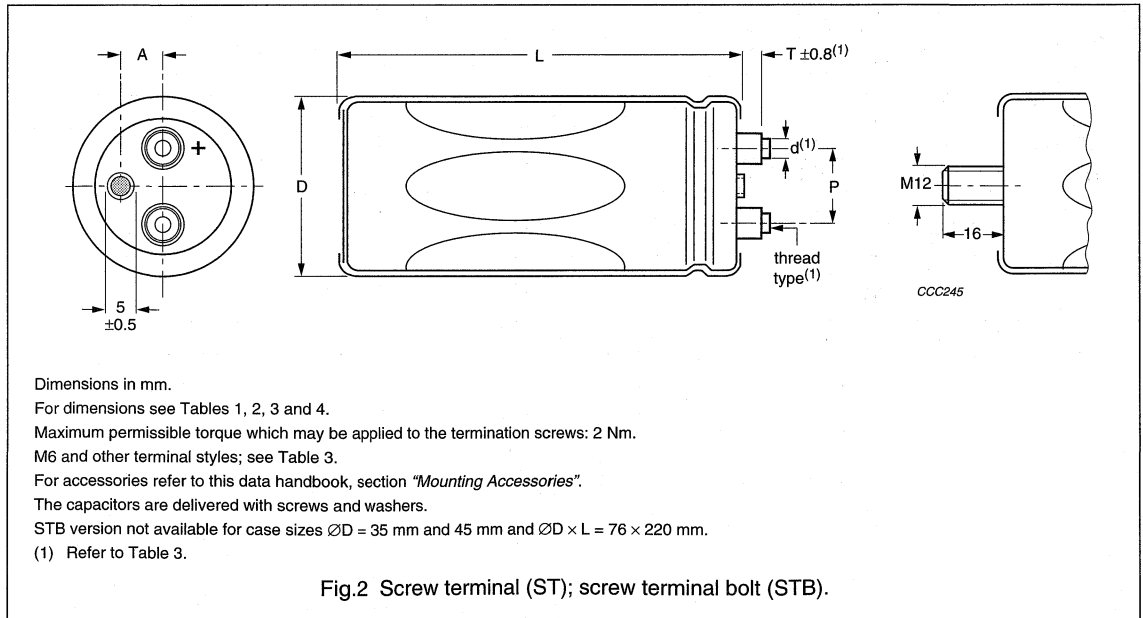
NAFTA 3199, 006 PPS-ST

ORDERING INFORMATION

NAFTA part numbering system



MECHANICAL DATA



Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

Table 1 Physical dimensions in millimetres (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (mm)	L _{max} (mm)	P ±0.4 (mm)	A (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
Dimensions in millimetres							
BA	34.9	54.0	12.7	8.0	≈72	150	402 × 200 × 258
BB	34.9	66.7	12.7	8.0	≈90	150	402 × 200 × 258
BC	34.9	79.4	12.7	8.0	≈105	150	402 × 200 × 283
BD	34.9	92.1	12.7	8.0	≈120	100	402 × 200 × 258
BE	34.9	104.8	12.7	8.0	≈135	100	402 × 200 × 258
BF	34.9	117.5	12.7	8.0	≈170	100	402 × 200 × 258
BG	34.9	130.2	12.7	8.0	≈220	100	402 × 200 × 283
BH	34.9	142.9	12.7	8.0	≈270	100	402 × 200 × 315
DA	44.5	54.0	19.1	11.5	≈160	96	324 × 216 × 289
DB	44.5	66.7	19.1	11.5	≈175	72	332 × 221 × 278
DC	44.5	79.4	19.1	11.5	≈180	72	332 × 221 × 278
DD	44.5	92.1	19.1	11.5	≈205	48	324 × 216 × 289
DE	44.5	104.8	19.1	11.5	≈220	48	324 × 216 × 289
DF	44.5	117.5	19.1	11.5	≈235	48	324 × 216 × 289
DG	44.5	130.2	19.1	11.5	≈250	48	324 × 216 × 289
DH	44.5	142.9	19.1	11.5	≈270	24	324 × 216 × 315
EA	50.8	54.0	22.2	12.7	≈170	96	324 × 216 × 289
EB	50.8	66.7	22.2	12.7	≈180	72	332 × 221 × 278
EC	50.8	79.4	22.2	12.7	≈190	72	332 × 221 × 278
ED	50.8	92.1	22.2	12.7	≈220	48	324 × 216 × 289
EE	50.8	104.8	22.2	12.7	≈255	48	324 × 216 × 289
EF	50.8	117.5	22.2	12.7	≈290	48	324 × 216 × 289
EG	50.8	130.2	22.2	12.7	≈320	48	324 × 216 × 289
EH	50.8	142.9	22.2	12.7	≈350	48	324 × 216 × 315
FB	63.5	66.7	28.6	15.9	≈300	40	343 × 275 × 240
FC	63.5	79.4	28.6	15.9	≈370	40	343 × 275 × 240
FD	63.5	92.1	28.6	15.9	≈400	40	343 × 275 × 240
FE	63.5	104.8	28.6	15.9	≈445	40	343 × 275 × 240
FF	63.5	117.5	28.6	15.9	≈600	40	343 × 275 × 315
FG	63.5	130.2	28.6	15.9	≈650	40	343 × 275 × 315
FH	63.5	142.9	28.6	15.9	≈600	20	343 × 275 × 240
GC	76.2	79.4	31.8	19.0	≈520	60	397 × 320 × 292
GD	76.2	92.1	31.8	19.0	≈570	20	397 × 320 × 121
GE	76.2	104.8	31.8	19.0	≈600	20	397 × 320 × 121
GF	76.2	117.5	31.8	19.0	≈720	20	397 × 320 × 147
GG	76.2	130.2	31.8	19.0	≈850	20	397 × 320 × 147
GH	76.2	142.9	31.8	19.0	≈970	20	397 × 320 × 178
GJ	76.2	149.2	31.8	19.0	≈1050	20	397 × 320 × 178
GN	76.2	219.1	31.8	19.0	≈1460	16	426 × 410 × 237

Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

Table 2 Physical dimensions in inches (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (inches)	L _{max} (inches)	P ±0.014 (inches)	A (inches)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (inches)
Dimensions in inches							
BA	1.375	2.125	0.5	0.39	≈72	150	15.825 × 7.875 × 10.125
BB	1.375	2.625	0.5	0.39	≈90	150	15.825 × 7.875 × 10.125
BC	1.375	3.125	0.5	0.39	≈105	150	15.825 × 7.875 × 11.125
BD	1.375	3.625	0.5	0.39	≈120	100	15.825 × 7.875 × 10.125
BE	1.375	4.125	0.5	0.39	≈135	100	15.825 × 7.875 × 10.125
BF	1.375	4.625	0.5	0.39	≈170	100	15.825 × 7.875 × 10.125
BG	1.375	5.125	0.5	0.39	≈220	100	15.825 × 7.875 × 11.125
BH	1.375	5.625	0.5	0.39	≈270	100	15.825 × 7.875 × 12.400
DA	1.75	2.125	0.75	0.453	≈160	96	12.750 × 8.500 × 11.375
DB	1.75	2.625	0.75	0.453	≈175	72	13.700 × 8.700 × 11.000
DC	1.75	3.125	0.75	0.453	≈180	72	13.700 × 8.700 × 11.000
DD	1.75	3.625	0.75	0.453	≈205	48	12.750 × 8.500 × 11.375
DE	1.75	4.125	0.75	0.453	≈220	48	12.750 × 8.500 × 11.375
DF	1.75	4.625	0.75	0.453	≈235	48	12.750 × 8.500 × 11.375
DG	1.75	5.125	0.75	0.453	≈250	48	12.750 × 8.500 × 11.375
DH	1.75	5.625	0.75	0.453	≈270	24	12.750 × 8.500 × 12.400
EA	2	2.125	0.875	0.5	≈170	96	12.750 × 8.500 × 11.375
EB	2	2.625	0.875	0.5	≈180	72	13.750 × 8.700 × 11.000
EC	2	3.125	0.875	0.5	≈190	72	13.750 × 8.700 × 11.000
ED	2	3.625	0.875	0.5	≈220	48	12.750 × 8.500 × 11.375
EE	2	4.125	0.875	0.5	≈255	48	12.750 × 8.500 × 11.375
EF	2	4.625	0.875	0.5	≈290	48	12.750 × 8.500 × 11.375
EG	2	5.125	0.875	0.5	≈320	48	12.750 × 8.500 × 11.375
EH	2	5.625	0.875	0.5	≈350	48	12.750 × 8.500 × 12.400
FB	2.5	2.625	1.125	0.625	≈300	40	13.500 × 10.825 × 9.500
FC	2.5	3.125	1.125	0.625	≈370	40	13.500 × 10.825 × 9.500
FD	2.5	3.625	1.125	0.625	≈400	40	13.500 × 10.825 × 9.500
FE	2.5	4.125	1.125	0.625	≈445	40	13.500 × 10.825 × 9.500
FF	2.5	4.625	1.125	0.625	≈600	40	13.500 × 10.825 × 12.400
FG	2.5	5.125	1.125	0.625	≈650	40	13.500 × 10.825 × 12.400
FH	2.5	5.625	1.125	0.625	≈600	20	13.500 × 10.825 × 9.500
GC	3	3.125	1.25	0.75	≈520	60	15.630 × 12.600 × 11.500
GD	3	3.625	1.25	0.75	≈570	20	15.630 × 12.600 × 4.750
GE	3	4.125	1.25	0.75	≈600	20	15.630 × 12.600 × 4.750
GF	3	4.625	1.25	0.75	≈720	20	15.630 × 12.600 × 5.750
GG	3	5.125	1.25	0.75	≈850	20	15.630 × 12.600 × 5.750
GH	3	5.625	1.25	0.75	≈970	20	15.630 × 12.600 × 7.000
GJ	3	5.825	1.25	0.75	≈1050	20	15.630 × 12.600 × 7.000
GN	3	8.625	1.25	0.75	≈1460	16	16.775 × 16.125 × 9.250

Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

Table 3 NAFTA terminal style code

CODE	TERMINAL STYLE	THREAD TYPE	d (mm)	T (mm)	d (inches)	T (inches)
A	high post	10-32	8	6.4	.315	0.250
B	low post	10-32	8	1.6	.315	0.063
D	high current; see note 1	1/4-28	17	3.2	.670	0.125
J	high current; see note 1	M6	17	3.2	.670	0.125
M	high post	M5	8	6.4	.315	0.250
K	high current; see note 1	1/4-28	17	6.4	.670	0.250

Note

- Case $\varnothing D = 65$ mm (2.5") and $\varnothing D = 76$ mm (3.0") cans only; for 30 A and up.

Table 4 NAFTA insulation and clamp/bracket codes; see note 1

CODE	CLAMP/BRACKET	INSULATION TYPE	DIMENSION ADDERS		
			D	L	H
Dimensions in mm					
P	no	0.2 mm polymeric	+0.51	+0.81	+0.61
H	no	0.6 mm polymeric	+0.63	+1.58	+1.14
N	no	none	—	—	—
R	yes	0.2 mm polymeric	+0.51	+0.81	+0.61
J	yes	0.6 mm polymeric	+0.63	+1.58	+1.14
X	yes	none	—	—	—
Dimensions in inches					
P	no	0.008" polymeric	+0.020	+0.032	+0.024
H	no	0.012" polymeric	+0.030	+0.062	+0.045
N	no	none	—	—	—
R	yes	0.008" polymeric	+0.020	+0.032	+0.024
J	yes	0.012" polymeric	+0.030	+0.062	+0.045
X	yes	none	—	—	—

Note

- For clamp/bracket dimensions see section "Mounting Accessories" in this data handbook.

MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance
- Rated voltage (in V)
- Date code in "yyww" (year, week) format
- Name of manufacturer
- NAFTA code number 17 digits
- Code number 12 digits (12NC; NAFTA customers will not see the 12NC).

Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Table 5 apply at $T_{amb} = 25\text{ }^{\circ}\text{C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz
I_R	rated RMS ripple current at $85\text{ }^{\circ}\text{C}$, 120 Hz
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ. equivalent series resistance at 120 Hz
Z	impedance at 20 kHz on request

Table 5 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz $85\text{ }^{\circ}\text{C}$ (A)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	CATALOGUE NUMBER 2251 006 9....
7.5	39000	35 × 54	BA	8.8	3.24	9.4	on request
	47000	35 × 65	BB	9.5	3.56	9.6	on request
	56000	35 × 80	BC	11.2	3.89	7.9	on request
	68000	35 × 90	BD	12.7	4.28	6.8	on request
	82000	35 × 90	BD	13.7	4.71	6.0	on request
	100000	35 × 118	BF	16.3	5.20	5.2	on request
	120000	35 × 130	BG	18.5	5.69	4.4	on request
	150000	45 × 90	DD	18.1	6.36	4.6	on request
	180000	45 × 105	DE	20.0	6.97	4.2	on request
	220000	45 × 130	DG	24.4	7.71	3.4	on request
	270000	50 × 118	EF	23.6	8.54	3.8	on request
	330000	50 × 143	EH	25.5	9.44	3.9	on request
	390000	65 × 105	FE	31.7	10.26	2.6	on request
	470000	65 × 130	FG	34.7	11.26	2.5	on request
	560000	65 × 143	FH	39.2	12.30	2.2	on request
	680000	76 × 118	GF	40.5	13.55	2.2	on request
820000	76 × 143	GH	43.3	14.88	2.2	on request	
1200000	76 × 220	GN	50.0	18.00	1.9	on request	

Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	CATALOGUE NUMBER 2251 006 9....
10	33000	35 × 54	BA	8.8	3.45	9.6	on request
	39000	35 × 65	BB	10.2	3.75	8.4	on request
	47000	35 × 80	BC	11.1	4.11	7.5	on request
	56000	35 × 80	BC	12.0	4.49	6.9	on request
	68000	35 × 90	BD	13.6	4.95	6.1	on request
	82000	35 × 105	BE	15.1	5.43	5.5	on request
	100000	35 × 130	BG	18.5	6.00	4.5	on request
	120000	45 × 90	DD	18.0	6.57	4.6	on request
	150000	45 × 105	DE	19.9	7.35	4.2	on request
	180000	45 × 130	DG	23.1	8.05	3.8	on request
	220000	45 × 143	DH	26.0	8.90	3.2	on request
	270000	50 × 130	EG	25.4	9.86	3.6	on request
	330000	65 × 105	FE	31.6	10.90	2.6	on request
	390000	65 × 118	FF	34.3	11.85	2.4	on request
	470000	65 × 143	FH	37.0	13.01	2.4	on request
	560000	76 × 105	GF	40.4	14.20	2.2	on request
	680000	76 × 143	GH	43.2	15.65	2.2	on request
1200000	76 × 220	GN	50.0	20.78	1.7	on request	
16	22000	35 × 54	BA	5.4	3.61	24.6	on request
	27000	35 × 65	BB	6.4	4.00	21.3	on request
	39000	35 × 80	BC	7.6	4.81	17.1	on request
	47000	35 × 90	BD	8.7	5.28	14.8	on request
	56000	35 × 105	BE	9.7	5.77	13.3	on request
	68000	35 × 130	BG	12.1	6.36	10.3	on request
	82000	35 × 143	BH	13.0	6.98	9.8	on request
	100000	45 × 105	DE	15.4	7.71	7.0	on request
	120000	45 × 118	DF	17.7	8.44	5.8	on request
	150000	45 × 143	DH	20.4	9.44	5.2	on request
	180000	50 × 130	EG	25.2	10.34	3.7	on request
	220000	65 × 105	FE	27.1	11.43	3.5	on request
	270000	65 × 118	FF	29.6	12.66	3.2	on request
	330000	76 × 105	GE	32.5	14.00	3.1	on request
	390000	76 × 118	GF	35.5	15.22	2.8	on request
	470000	76 × 143	GH	40.6	16.71	2.5	on request
	820000	76 × 220	GN	50.0	22.07	2.2	on request

Aluminum electrolytic capacitors
Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	CATALOGUE NUMBER 2251 006 9...
25	18000	35 × 54	BA	5.4	4.02	24.8	on request
	27000	35 × 80	BC	7.5	4.93	17.4	on request
	33000	35 × 90	BD	8.6	5.45	15.0	on request
	39000	35 × 105	BE	9.6	5.92	13.5	on request
	47000	35 × 135	BG	12.0	6.50	10.5	on request
	56000	35 × 143	BH	12.9	7.10	9.9	on request
	68000	45 × 105	DE	15.3	7.82	7.1	on request
	82000	45 × 118	DF	17.5	8.59	5.9	on request
	100000	45 × 130	DG	19.0	9.49	5.5	on request
	120000	50 × 118	EF	23.3	10.39	4.0	on request
	150000	50 × 143	EH	26.7	11.62	3.5	on request
	180000	65 × 118	FF	29.3	12.73	3.3	on request
	220000	65 × 130	FG	31.6	14.07	3.0	on request
	270000	76 × 118	GF	35.2	15.59	2.8	on request
	330000	76 × 130	GG	38.0	17.23	2.6	on request
560000	76 × 220	GN	50.0	22.46	2.2	on request	
40	10000	35 × 54	BA	4.8	3.79	32.0	on request
	12000	35 × 65	BB	5.6	4.16	27.4	on request
	15000	35 × 80	BC	7.4	4.65	18.2	on request
	18000	35 × 90	BD	8.5	5.09	15.7	on request
	22000	35 × 105	BE	9.4	5.63	14.0	on request
	27000	35 × 118	BF	10.1	6.24	13.5	on request
	33000	35 × 143	BH	11.8	6.89	11.8	on request
	39000	45 × 90	DD	12.6	7.49	9.4	on request
	47000	45 × 105	DE	14.1	8.23	8.4	on request
	56000	45 × 130	DG	17.4	8.98	6.6	on request
	68000	45 × 143	DH	18.8	9.90	6.1	on request
	82000	50 × 130	EG	23.2	10.87	4.3	on request
	100000	65 × 105	FE	24.6	12.00	4.3	on request
	120000	65 × 118	FF	27.0	13.15	3.9	on request
	150000	65 × 143	FH	31.2	14.70	3.4	on request
	180000	76 × 130	GG	34.8	16.10	3.1	on request
	220000	76 × 143	GH	37.3	17.80	2.9	on request
	330000	76 × 220	GN	50.0	21.80	2.2	on request

Aluminum electrolytic capacitors
Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	CATALOGUE NUMBER 2251 006 9....
50	8200	35 × 54	BA	4.2	3.84	41.0	on request
	10000	35 × 65	BB	5.0	4.24	34.9	on request
	12000	35 × 80	BC	6.0	4.65	27.6	on request
	15000	35 × 90	BD	6.9	5.20	23.2	on request
	18000	35 × 105	BE	7.8	5.69	20.3	on request
	22000	35 × 118	BF	9.1	6.29	16.6	on request
	27000	35 × 143	BH	10.7	6.97	14.2	on request
	33000	45 × 105	DE	13.0	7.71	9.8	on request
	39000	45 × 118	DF	14.9	8.38	8.2	on request
	47000	45 × 130	DG	16.3	9.20	7.5	on request
	56000	50 × 118	EF	14.9	10.04	9.6	on request
	68000	50 × 143	EH	17.6	11.06	8.1	on request
	82000	65 × 118	FF	20.6	12.15	6.6	on request
	100000	65 × 143	FH	24.1	13.42	5.6	on request
	120000	76 × 118	GF	25.7	14.70	5.3	on request
150000	76 × 143	GH	30.1	16.43	4.5	on request	
220000	76 × 220	GN	40.6	19.90	3.5	on request	
63	4700	35 × 54	BA	4.2	3.26	41.5	on request
	5600	35 × 65	BB	4.9	3.56	35.4	on request
	6800	35 × 65	BB	5.4	3.93	32.4	on request
	8200	35 × 80	BC	6.0	4.31	27.5	on request
	10000	35 × 90	BD	7.0	4.76	23.2	on request
	12000	35 × 105	BE	7.9	5.22	20.3	on request
	15000	35 × 130	BG	9.9	5.83	15.5	on request
	18000	35 × 143	BH	10.7	6.39	14.3	on request
	22000	45 × 105	DE	12.9	7.06	10.0	on request
	27000	45 × 130	DG	16.0	7.83	7.8	on request
	33000	45 × 143	DH	17.3	8.65	7.2	on request
	39000	50 × 130	EG	16.4	9.40	8.6	on request
	47000	65 × 105	FE	18.4	10.32	7.5	on request
	56000	65 × 118	FF	20.4	11.27	6.7	on request
	68000	65 × 143	FH	23.9	12.42	5.7	on request
82000	76 × 118	GF	25.6	13.64	5.3	on request	
100000	76 × 143	GH	29.9	15.06	4.5	on request	
150000	76 × 220	GN	40.3	18.44	3.6	on request	

Aluminum electrolytic capacitors
Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	TYP. ESR 120 Hz (m Ω)	CATALOGUE NUMBER 2251 006 9....
75	3900	35 × 54	BA	4.1	3.24	42.5	on request
	4700	35 × 65	BB	4.9	3.56	36.2	on request
	5600	35 × 65	BB	5.4	3.89	32.6	on request
	6800	35 × 80	BC	5.9	4.28	28.1	on request
	8200	35 × 90	BD	6.9	4.71	23.7	on request
	10000	35 × 105	BE	7.8	5.20	20.7	on request
	12000	35 × 130	BG	9.8	5.69	15.8	on request
	15000	45 × 90	DD	11.3	6.36	11.6	on request
	18000	45 × 105	DE	12.7	6.97	10.2	on request
	22000	45 × 130	DG	15.8	7.71	8.0	on request
	27000	50 × 118	EF	14.9	8.54	9.6	on request
	33000	50 × 143	EH	17.5	9.44	8.2	on request
	39000	65 × 118	FF	20.1	10.26	6.9	on request
	47000	65 × 130	FG	21.9	11.26	6.3	on request
	56000	65 × 143	FH	23.7	12.30	5.8	on request
68000	76 × 130	GG	27.5	13.55	5.0	on request	
82000	76 × 143	GH	29.7	14.88	4.6	on request	
120000	76 × 220	GN	40.1	20.12	3.6	on request	

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.3 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.006 \times \sqrt{C \times V}$ (mA)
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 35 \text{ mm}$, (1.375")	typ. 18 nH
	case $\varnothing D = 45 \text{ mm}$, (1.75")	typ. 23 nH
	case $\varnothing D = 50 \text{ mm}$, (2.0")	typ. 25 nH
	case $\varnothing D = 65 \text{ mm}$, (2.5")	typ. 27 nH
	case $\varnothing D = 75 \text{ mm}$, (3.0")	typ. 29 nH

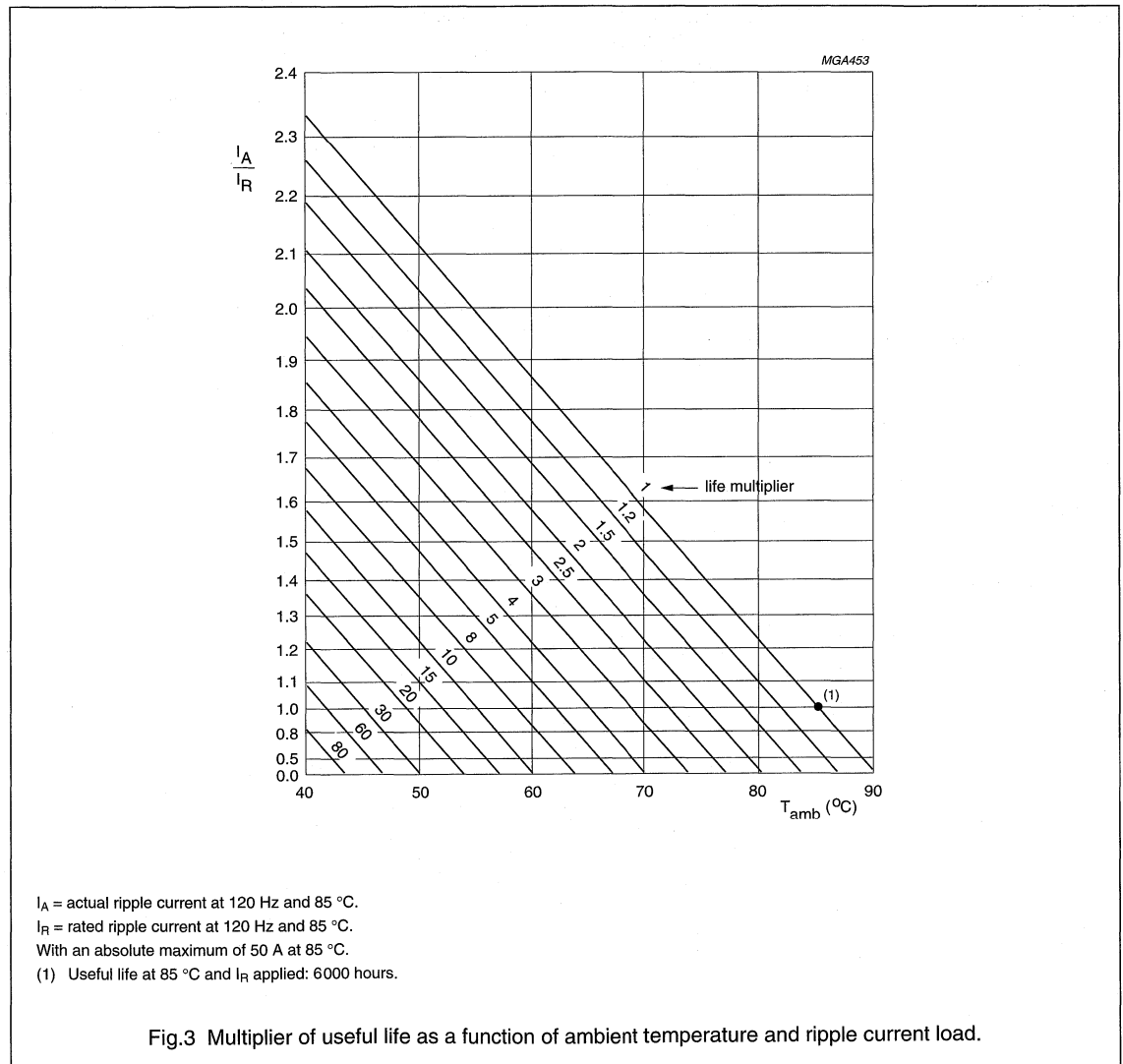
Aluminum electrolytic capacitors
Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
60	0.9
120	1.00
300	1.05
1000	1.1
≥ 10000	1.15



Aluminum electrolytic capacitors

Power, Performance Style, Screw Terminals

NAFTA 3199, 006 PPS-ST

SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this data handbook, section "Tests and Requirements".

Table 7 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied; 5000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 6000 hours	$\Delta C/C: \pm 15\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4 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	$\Delta C/C: \pm 10\%$ $I_{L5} \leq 2 \times \text{spec. limit}$ $ESR \leq 1.75 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Bolt version available for case $\varnothing D = 50, 65$ and 75 mm ($\varnothing D = 2", 2.5"$ and $3"$)
- Pressure relief in the sealing disk
- Charge and discharge proof
- High ripple current capability
- High resistance to shock and vibration
- $105\text{ }^{\circ}\text{C}$ types on request.

APPLICATIONS

- General purpose, computer and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Welding
- Energy storage in pulse systems
- Motor control devices
- Uninterruptable power supplies (UPS).

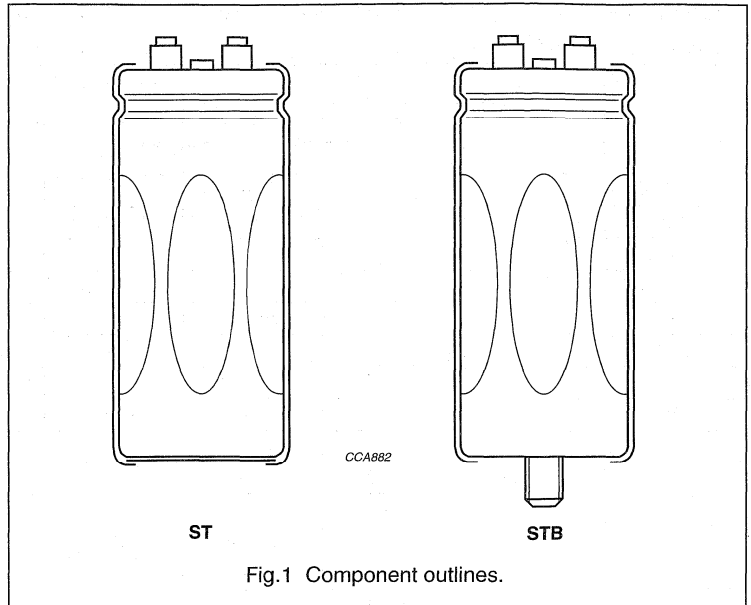
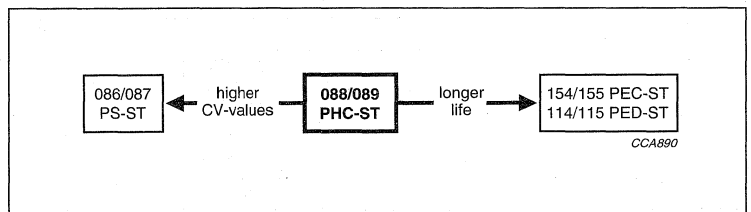


Fig.1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	088	089
Case size (in millimetres and inches)	BA 35 × 54 mm (1.375" × 2.125") to GN 76 × 220 mm (3.000" × 8.625")	
Rated capacitance range, C _R	270 to 820000 μF	
Tolerance on C _R	-10 to +30%; -10 to +50%; ±20%	
Rated voltage range, U _R	16 to 100 V	200 to 450 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	2000 hours	
Useful life at 85 °C	5000 hours (≥100 V: 4000 hours)	
Useful life at 40 °C and 1.2 × I _R applied	150000 hours (≥100 V: 120000 hours)	
Shelf life at 0 V, 85 °C	500 hours	
Based on sectional specification	IEC 60384-4	
Climatic category IEC 60068	40/085/56	

Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm); NAFTA 3188, 088 PHC-ST

Preferred types in **bold**.

C_R (μF)	U_R (V)						
	16	25	40	50	63	75	100
1800	–	–	–	–	–	–	35 × 54
2700	–	–	–	–	–	35 × 54	35 × 80
3900	–	–	–	–	–	–	35 × 105
4700	–	–	–	–	35 × 54	35 × 80	–
6800	–	–	–	35 × 54	35 × 80	35 × 105	50 × 80
8200	–	–	35 × 54	–	–	–	–
10000	–	–	–	35 × 80	35 × 105	–	50 × 105
12000	–	35 × 54	35 × 80	–	–	50 × 80	50 × 118
15000	–	–	–	35 × 105	–	–	50 × 143
18000	–	–	35 × 105	–	50 × 80	50 × 105	65 × 105
22000	35 × 54	35 × 80	–	–	–	50 × 130	65 × 130
	–	–	–	–	–	–	76 × 105
27000	–	–	50 × 80	50 × 80	50 × 105	50 × 143	65 × 143
	–	–	–	–	–	65 × 105	76 × 118
33000	–	35 × 105	–	–	50 × 130	65 × 118	–
39000	35 × 80	–	–	50 × 105	50 × 143	65 × 143	76 × 143
	–	–	–	–	65 × 105	76 × 105	–
47000	–	–	50 × 105	50 × 130	65 × 118	76 × 118	–
56000	35 × 105	50 × 80	50 × 130	50 × 143	65 × 143	76 × 143	76 × 220
	–	–	–	65 × 105	76 × 105	–	–
68000	–	–	50 × 143	65 × 118	76 × 118	–	–
	–	–	65 × 105	–	–	–	–
82000	50 × 80	50 × 105	65 × 118	65 × 143	76 × 143	–	–
	–	–	–	76 × 105	–	–	–
100000	–	50 × 130	65 × 143	76 × 118	–	76 × 220	–
	–	–	76 × 105	–	–	–	–
120000	50 × 105	50 × 143	76 × 118	76 × 143	–	–	–
	–	65 × 105	–	–	–	–	–
150000	50 × 130	65 × 118	76 × 143	–	76 × 220	–	–
	50 × 143	–	–	–	–	–	–
180000	–	65 × 143	–	–	–	–	–
	–	76 × 105	–	–	–	–	–
220000	65 × 105	76 × 118	–	76 × 220	–	–	–
270000	65 × 118	76 × 143	76 × 220	–	–	–	–
330000	65 × 143	–	–	–	–	–	–
	76 × 105	–	–	–	–	–	–
390000	76 × 118	–	–	–	–	–	–
470000	76 × 143	76 × 220	–	–	–	–	–
820000	76 × 220	–	–	–	–	–	–

Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm); NAFTA 3188, 089 PHC-ST

Preferred types in **bold**.

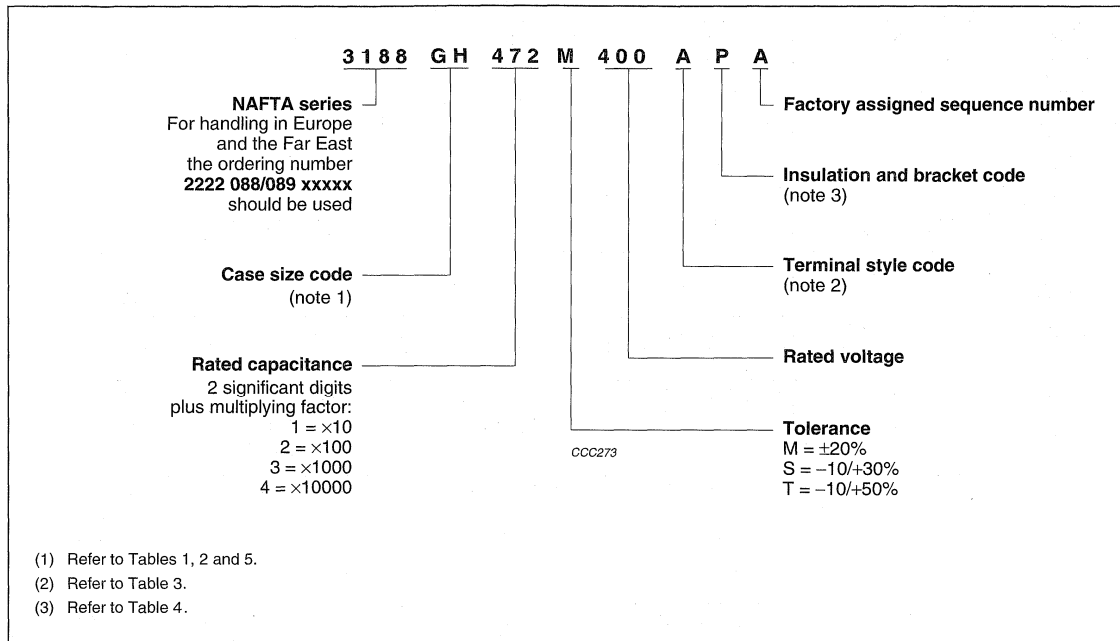
C_R (μF)	U_R (V)				
	200	250	350	400	450
270	-	-	-	35 × 54	-
330	-	-	35 × 54	-	-
390	-	-	-	-	-
470	-	35 × 54	-	35 × 80	-
560	-	-	35 × 80	-	-
680	35 × 54	-	-	35 × 105	-
820	-	35 × 80	35 × 105	-	-
1000	-	-	-	50 × 80	50 × 105
1200	35 × 80	35 × 105	50 × 80	-	-
1500	-	-	-	50 × 105	50 × 130
1800	35 × 105	50 × 80	50 × 105	50 × 118	-
2200	-	-	50 × 118	50 × 143	76 × 118
	-	-	-	65 × 105	-
2700	50 × 80	50 × 105	50 × 143	65 × 130	-
	-	-	65 × 105	-	-
3300	-	50 × 118	65 × 130	65 × 143	-
	-	-	-	76 × 105	76 × 118
3900	50 × 105	50 × 143	65 × 143	76 × 118	76 × 143
	-	-	76 × 105	-	-
4700	50 × 118	65 × 105	76 × 118	76 × 143	-
5600	50 × 143	65 × 130	76 × 143	-	-
6800	65 × 105	65 × 143	-	-	-
	-	76 × 105	-	-	-
8200	65 × 130	76 × 118	-	76 × 220	-
10000	65 × 143	76 × 143	76 × 220	-	-
	76 × 105	-	-	-	-
12000	76 × 118	-	-	-	-
	-	76 × 220	-	-	-
15000	76 × 143	-	-	-	-
22000	76 × 220	-	-	-	-

Aluminum electrolytic capacitors Power High Current, Screw Terminals

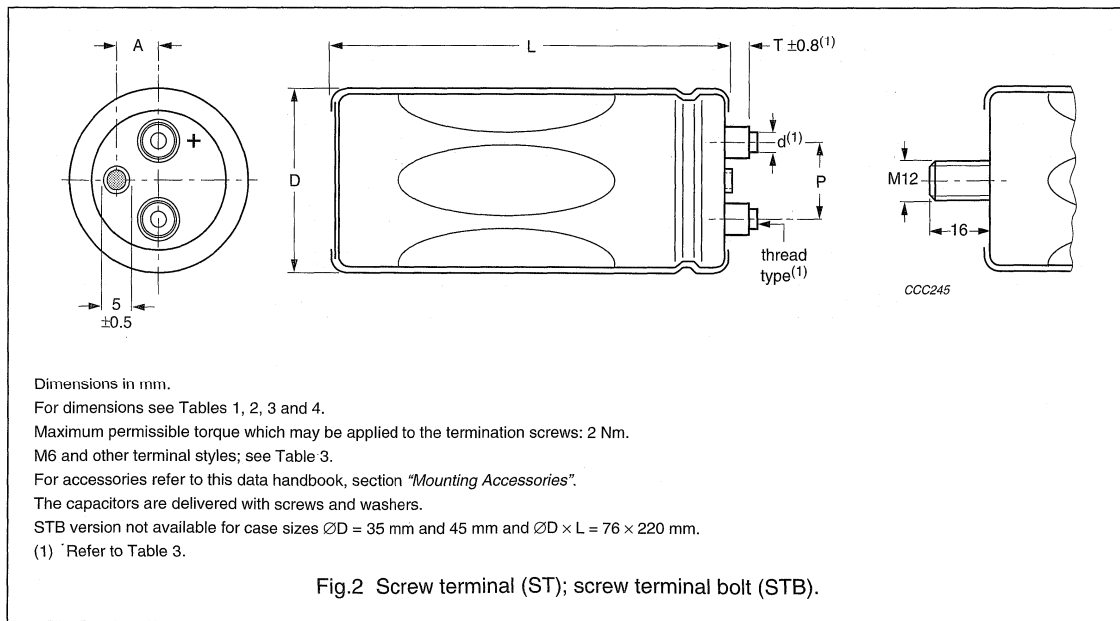
NAFTA 3188, 088/089 PHC-ST

ORDERING INFORMATION

NAFTA part numbering system



MECHANICAL DATA



Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

Table 1 Physical dimensions in millimetres (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (mm)	L _{max} (mm)	P ±0.4 (mm)	A (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
Dimensions in millimetres							
BA	34.9	54.0	12.7	8.0	≈72	150	402 × 200 × 258
BB	34.9	66.7	12.7	8.0	≈90	150	402 × 200 × 258
BC	34.9	79.4	12.7	8.0	≈105	150	402 × 200 × 283
BD	34.9	92.1	12.7	8.0	≈120	100	402 × 200 × 258
BE	34.9	104.8	12.7	8.0	≈135	100	402 × 200 × 258
BF	34.9	117.5	12.7	8.0	≈170	100	402 × 200 × 258
BG	34.9	130.2	12.7	8.0	≈220	100	402 × 200 × 283
BH	34.9	142.9	12.7	8.0	≈270	100	402 × 200 × 315
DA	44.5	54.0	19.1	11.5	≈160	96	324 × 216 × 289
DB	44.5	66.7	19.1	11.5	≈175	72	332 × 221 × 278
DC	44.5	79.4	19.1	11.5	≈180	72	332 × 221 × 278
DD	44.5	92.1	19.1	11.5	≈205	48	324 × 216 × 289
DE	44.5	104.8	19.1	11.5	≈220	48	324 × 216 × 289
DF	44.5	117.5	19.1	11.5	≈235	48	324 × 216 × 289
DG	44.5	130.2	19.1	11.5	≈250	48	324 × 216 × 289
DH	44.5	142.9	19.1	11.5	≈270	24	324 × 216 × 315
EA	50.8	54.0	22.2	12.7	≈170	96	324 × 216 × 289
EB	50.8	66.7	22.2	12.7	≈180	72	332 × 221 × 278
EC	50.8	79.4	22.2	12.7	≈190	72	332 × 221 × 278
ED	50.8	92.1	22.2	12.7	≈220	48	324 × 216 × 289
EE	50.8	104.8	22.2	12.7	≈255	48	324 × 216 × 289
EF	50.8	117.5	22.2	12.7	≈290	48	324 × 216 × 289
EG	50.8	130.2	22.2	12.7	≈320	48	324 × 216 × 289
EH	50.8	142.9	22.2	12.7	≈350	48	324 × 216 × 315
FB	63.5	66.7	28.6	15.9	≈300	40	343 × 275 × 240
FC	63.5	79.4	28.6	15.9	≈370	40	343 × 275 × 240
FD	63.5	92.1	28.6	15.9	≈400	40	343 × 275 × 240
FE	63.5	104.8	28.6	15.9	≈445	40	343 × 275 × 240
FF	63.5	117.5	28.6	15.9	≈600	40	343 × 275 × 315
FG	63.5	130.2	28.6	15.9	≈650	40	343 × 275 × 315
FH	63.5	142.9	28.6	15.9	≈600	20	343 × 275 × 240
GC	76.2	79.4	31.8	19.0	≈520	60	397 × 320 × 292
GD	76.2	92.1	31.8	19.0	≈570	20	397 × 320 × 121
GE	76.2	104.8	31.8	19.0	≈600	20	397 × 320 × 121
GF	76.2	117.5	31.8	19.0	≈720	20	397 × 320 × 147
GG	76.2	130.2	31.8	19.0	≈850	20	397 × 320 × 147
GH	76.2	142.9	31.8	19.0	≈970	20	397 × 320 × 178
GJ	76.2	149.2	31.8	19.0	≈1050	20	397 × 320 × 178
GN	76.2	219.1	31.8	19.0	≈1460	16	426 × 410 × 237

Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

Table 2 Physical dimensions in inches (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (inches)	L _{max} (inches)	P ±0.014 (inches)	A (inches)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (inches)
Dimensions in inches							
BA	1.375	2.125	0.5	0.39	≈72	150	15.825 × 7.875 × 10.125
BB	1.375	2.625	0.5	0.39	≈90	150	15.825 × 7.875 × 10.125
BC	1.375	3.125	0.5	0.39	≈105	150	15.825 × 7.875 × 11.125
BD	1.375	3.625	0.5	0.39	≈120	100	15.825 × 7.875 × 10.125
BE	1.375	4.125	0.5	0.39	≈135	100	15.825 × 7.875 × 10.125
BF	1.375	4.625	0.5	0.39	≈170	100	15.825 × 7.875 × 10.125
BG	1.375	5.125	0.5	0.39	≈220	100	15.825 × 7.875 × 11.125
BH	1.375	5.625	0.5	0.39	≈270	100	15.825 × 7.875 × 12.400
DA	1.75	2.125	0.75	0.453	≈160	96	12.750 × 8.500 × 11.375
DB	1.75	2.625	0.75	0.453	≈175	72	13.700 × 8.700 × 11.000
DC	1.75	3.125	0.75	0.453	≈180	72	13.700 × 8.700 × 11.000
DD	1.75	3.625	0.75	0.453	≈205	48	12.750 × 8.500 × 11.375
DE	1.75	4.125	0.75	0.453	≈220	48	12.750 × 8.500 × 11.375
DF	1.75	4.625	0.75	0.453	≈235	48	12.750 × 8.500 × 11.375
DG	1.75	5.125	0.75	0.453	≈250	48	12.750 × 8.500 × 11.375
DH	1.75	5.625	0.75	0.453	≈270	24	12.750 × 8.500 × 12.400
EA	2	2.125	0.875	0.5	≈170	96	12.750 × 8.500 × 11.375
EB	2	2.625	0.875	0.5	≈180	72	13.750 × 8.700 × 11.000
EC	2	3.125	0.875	0.5	≈190	72	13.750 × 8.700 × 11.000
ED	2	3.625	0.875	0.5	≈220	48	12.750 × 8.500 × 11.375
EE	2	4.125	0.875	0.5	≈255	48	12.750 × 8.500 × 11.375
EF	2	4.625	0.875	0.5	≈290	48	12.750 × 8.500 × 11.375
EG	2	5.125	0.875	0.5	≈320	48	12.750 × 8.500 × 11.375
EH	2	5.625	0.875	0.5	≈350	48	12.750 × 8.500 × 12.400
FB	2.5	2.625	1.125	0.625	≈300	40	13.500 × 10.825 × 9.500
FC	2.5	3.125	1.125	0.625	≈370	40	13.500 × 10.825 × 9.500
FD	2.5	3.625	1.125	0.625	≈400	40	13.500 × 10.825 × 9.500
FE	2.5	4.125	1.125	0.625	≈445	40	13.500 × 10.825 × 9.500
FF	2.5	4.625	1.125	0.625	≈600	40	13.500 × 10.825 × 12.400
FG	2.5	5.125	1.125	0.625	≈650	40	13.500 × 10.825 × 12.400
FH	2.5	5.625	1.125	0.625	≈600	20	13.500 × 10.825 × 9.500
GC	3	3.125	1.25	0.75	≈520	60	15.630 × 12.600 × 11.500
GD	3	3.625	1.25	0.75	≈570	20	15.630 × 12.600 × 4.750
GE	3	4.125	1.25	0.75	≈600	20	15.630 × 12.600 × 4.750
GF	3	4.625	1.25	0.75	≈720	20	15.630 × 12.600 × 5.750
GG	3	5.125	1.25	0.75	≈850	20	15.630 × 12.600 × 5.750
GH	3	5.625	1.25	0.75	≈970	20	15.630 × 12.600 × 7.000
GJ	3	5.825	1.25	0.75	≈1050	20	15.630 × 12.600 × 7.000
GN	3	8.625	1.25	0.75	≈1460	16	16.775 × 16.125 × 9.250

Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

Table 3 NAFTA terminal style code

CODE	TERMINAL STYLE	THREAD TYPE	d (mm)	T (mm)	d (inches)	T (inches)
A	high post	10-32	8	6.4	.315	0.250
B	low post	10-32	8	1.6	.315	0.063
D	high current; see note 1	1/4-28	17	3.2	.670	0.125
J	high current; see note 1	M6	17	3.2	.670	0.125
M	high post	M5	8	6.4	.315	0.250
K	high current; see note 1	1/4-28	17	6.4	.670	0.250

Note

1. Case $\varnothing D = 65$ mm (2.5") and $\varnothing D = 76$ mm (3.0") cans only; for 30 A and up.

Table 4 NAFTA insulation and clamp/bracket codes; see note 1

CODE	CLAMP/BRACKET	INSULATION TYPE	DIMENSION ADDERS		
			D	L	H
			Dimensions in mm		
P	no	0.2 mm polymeric	+0.51	+0.81	+0.61
H	no	0.6 mm polymeric	+0.63	+1.58	+1.14
N	no	none	–	–	–
R	yes	0.2 mm polymeric	+0.51	+0.81	+0.61
J	yes	0.6 mm polymeric	+0.63	+1.58	+1.14
X	yes	none	–	–	–
			Dimensions in inches		
P	no	0.008" polymeric	+0.020	+0.032	+0.024
H	no	0.012" polymeric	+0.030	+0.062	+0.045
N	no	none	–	–	–
R	yes	0.008" polymeric	+0.020	+0.032	+0.024
J	yes	0.012" polymeric	+0.030	+0.062	+0.045
X	yes	none	–	–	–

Note

1. For clamp/bracket dimensions see section "Mounting Accessories" in this data handbook.

MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance
- Rated voltage (in V)
- Date code in "yyww" (year, week) format
- Name of manufacturer
- NAFTA code number 17 digits
- Code number 12 digits (12NC; NAFTA customers will not see the 12NC).

Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 5 and 6 apply at
 $T_{amb} = 25\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz
I_R	rated RMS ripple current at 85 °C
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	max. equivalent series resistance at 120 Hz
Z	impedance at 20 kHz on request
Tan δ	max. dissipation factor at 120 Hz

Ordering example

Electrolytic capacitor 089 series

10000 $\mu\text{F}/200\text{ V}$; $\pm 20\%$ High post code "M", insulation type
"H", 0.6 mm polymericNominal case size:
 $\varnothing 65 \times 143\text{ mm}$, ST version

Catalogue number: 2222 089 12103.

Table 5 Electrical data and ordering information for **088 PHC-ST** preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (see Table 6, note 1) 2222
16	22000	35 × 54	BA	12	1.78	10	0.18	088 15223
	39000	35 × 80	BC	17	2.37	7	0.22	088 15393
	56000	35 × 105	BE	21	2.84	6	0.27	088 15563
	82000	50 × 80	EC	24	3.44	6	0.40	088 15823
	120000	50 × 105	EE	30	4.16	6	0.49	088 15124
	150000	50 × 130	EG	30	4.65	4	0.49	088 15154
	150000	50 × 143	EH	30	4.65	4	0.49	088 25154
	220000	65 × 105	FE	44	5.63	3	0.54	088 15224
	270000	65 × 118	FF	48	6.24	3	0.66	088 15274
	330000	65 × 143	FH	50	6.89	3	0.81	088 15334
	330000	76 × 105	GE	50	6.89	3	0.81	088 25334
	390000	76 × 118	GF	50	7.49	3	0.96	088 15394
	470000	76 × 143	GH	50	8.23	2	0.77	088 15474
820000	76 × 220	GN	50	10.87	2	1.34	088 15824	
25	12000	35 × 54	BA	6.8	1.64	32	0.31	088 16123
	22000	35 × 80	BC	9.6	2.22	22	0.40	088 16223
	33000	35 × 105	BE	12	2.72	17	0.46	088 16333
	56000	50 × 80	EC	21	3.55	7	0.32	088 16563
	82000	50 × 105	EE	28	4.30	5	0.33	088 16823
	100000	50 × 130	EG	30	4.74	5	0.41	088 16104
	120000	50 × 143	EH	30	5.20	4	0.39	088 16124
	120000	65 × 105	FE	35	5.20	5	0.49	088 26124
	150000	65 × 118	FF	38	5.81	4	0.49	088 16154
	180000	65 × 143	FH	41	6.36	4	0.59	088 16184
	180000	76 × 105	GE	42	6.36	4	0.59	088 26184

Aluminum electrolytic capacitors
Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (see Table 6, note 1) 2222
25	220000	76 × 118	GF	46	7.04	4	0.72	088 16224
	270000	76 × 143	GH	49	7.79	4	0.88	088 16274
	470000	76 × 220	GN	50	10.28	3	1.15	088 16474
40	8200	35 × 54	BA	6.1	1.72	39	0.26	088 17822
	12000	35 × 80	BC	8.7	2.08	27	0.26	088 17123
	18000	35 × 105	BE	11	2.55	20	0.29	088 17183
	27000	50 × 80	EC	19	3.12	9	0.20	088 17273
	47000	50 × 105	EE	25	4.11	6	0.23	088 17473
	56000	50 × 130	EG	30	4.49	5	0.23	088 17563
	68000	50 × 143	EH	30	4.95	5	0.28	088 17683
	68000	65 × 105	FE	32	4.95	5	0.28	088 27683
	82000	65 × 118	FF	35	5.43	5	0.33	088 17823
	100000	65 × 143	FH	38	6.00	5	0.41	088 17104
	100000	76 × 105	GE	38	6.00	5	0.41	088 27104
	120000	76 × 118	GF	42	6.57	4	0.39	088 17124
	150000	76 × 143	GH	46	7.35	4	0.49	088 17154
270000	76 × 220	GN	50	9.86	3	0.66	088 17274	
50	6800	35 × 54	BA	5.9	1.75	42	0.23	088 11682
	10000	35 × 80	BC	8.4	2.12	28	0.23	088 11103
	15000	35 × 105	BE	11	2.60	21	0.26	088 11153
	27000	50 × 80	EC	14	3.49	15	0.33	088 11273
	39000	50 × 105	EE	19	4.19	11	0.35	088 11393
	47000	50 × 130	EG	21	4.60	10	0.38	088 11473
	56000	50 × 143	EH	24	5.02	9	0.41	088 11563
	56000	65 × 105	FE	26	5.02	8	0.37	088 21563
	68000	65 × 118	FF	29	5.53	7	0.39	088 11683
	82000	65 × 143	FH	34	6.07	6	0.40	088 11823
	82000	76 × 105	GE	32	6.07	6	0.40	088 21823
	100000	76 × 118	GF	36	6.71	6	0.49	088 11104
	120000	76 × 143	GH	39	7.35	5	0.49	088 11124
	220000	76 × 220	GN	50	9.95	4	0.72	088 11224
63	4700	35 × 54	BA	5.9	1.63	42	0.16	088 18472
	6800	35 × 80	BC	8.4	1.96	29	0.16	088 18682
	10000	35 × 105	BE	11	2.38	21	0.17	088 18103
	18000	50 × 80	EC	14	3.19	15	0.22	088 18183
	27000	50 × 105	EE	19	3.91	11	0.24	088 18273
	33000	50 × 130	EG	23	4.33	9	0.24	088 18333
	39000	50 × 143	EH	25	4.70	9	0.29	088 18393

Aluminum electrolytic capacitors
Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (see Table 6, note 1) 2222
63	39000	65 × 105	FE	26	4.70	8	0.25	088 28393
	47000	65 × 118	FF	28	5.16	7	0.27	088 18473
	56000	65 × 143	FH	31	5.63	7	0.32	088 18563
	56000	76 × 105	GE	32	5.63	7	0.32	088 28563
	68000	76 × 118	GF	36	6.21	6	0.33	088 18683
	82000	76 × 143	GH	39	6.82	5	0.33	088 18823
	150000	76 × 220	GN	50	9.22	4	0.49	088 18154
75	2700	35 × 54	BA	5.7	1.35	46	0.10	088 12272
	4700	35 × 80	BC	8.2	1.78	30	0.12	088 12472
	6800	35 × 105	BE	10	2.14	22	0.12	088 12682
	12000	50 × 80	EC	14	2.85	16	0.16	088 12123
	18000	50 × 105	EE	18	3.49	12	0.18	088 12183
	22000	50 × 130	EG	22	3.85	10	0.18	088 12223
	27000	50 × 143	EH	24	4.27	9	0.20	088 12273
	27000	65 × 105	FE	25	4.27	8	0.18	088 22273
	33000	65 × 118	FF	28	4.72	7	0.19	088 12333
	39000	65 × 143	FH	33	5.13	6	0.19	088 12393
	39000	76 × 105	GE	33	5.13	6	0.19	088 22393
	47000	76 × 118	GF	35	5.63	6	0.23	088 12473
	56000	76 × 143	GH	41	6.15	5	0.23	088 12563
	100000	76 × 220	GN	50	8.22	4	0.33	088 12104
	100	1800	35 × 54	BA	4	1.27	79	0.12
2700		35 × 80	BC	5.9	1.56	51	0.11	088 19272
4700		35 × 105	BE	8.9	2.06	32	0.12	088 19472
6800		50 × 80	EC	6.8	2.47	64	0.36	088 19682
10000		50 × 105	EE	10	3.00	38	0.31	088 19103
12000		50 × 130	EG	11	3.29	34	0.33	088 19123
15000		50 × 143	EH	13	3.67	28	0.34	088 19153
18000		65 × 105	FE	17	4.02	18	0.26	088 19183
22000		65 × 118	FF	20	4.45	14	0.26	088 19223
22000		65 × 143	FH	15	4.45	25	0.45	088 29223
27000		76 × 105	GE	22	4.93	13	0.29	088 19273
27000		76 × 118	GF	18	4.93	20	0.44	088 29273
39000		76 × 143	GH	21	5.92	16	0.51	088 19393
56000		76 × 220	GN	25	7.10	14	0.64	088 19563

Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

Table 6 Electrical data and ordering information for **089 PHC-ST**; preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (note 1) 2222
200	680	35 × 54	BA	2.9	1.11	130	0.07	089 12681
	1200	35 × 80	BC	4.1	1.47	76	0.07	089 12122
	1800	35 × 105	BE	6.9	1.80	53	0.08	089 12182
	2700	50 × 80	EC	6.2	2.20	76	0.17	089 12272
	3900	50 × 105	EE	8.5	2.65	51	0.16	089 12392
	4700	50 × 130	EG	11	2.91	36	0.14	089 12472
	5600	50 × 143	EH	15	3.17	20	0.09	089 12562
	6800	65 × 105	FE	14	3.50	24	0.13	089 12682
	8200	65 × 118	FF	16	3.64	21	0.14	089 12822
	10000	65 × 143	FH	20	4.24	17	0.14	089 12103
	10000	76 × 105	GE	16	4.24	25	0.20	089 22103
	12000	76 × 118	GF	18	4.65	22	0.22	089 12123
	15000	76 × 143	GH	21	6.20	19	0.23	089 12153
	22000	76 × 220	GN	25	6.29	15	0.27	089 12223
250	470	35 × 54	BA	2.9	1.03	130	0.05	089 13471
	820	35 × 80	BC	4.7	1.36	86	0.06	089 13821
	1200	35 × 105	BE	6.8	1.64	54	0.05	089 13122
	1800	50 × 80	EC	6.9	2.01	76	0.11	089 13182
	2700	50 × 105	EE	8.4	2.46	52	0.11	089 13272
	3300	50 × 130	EG	14	2.72	22	0.06	089 13332
	3900	50 × 143	EH	16	2.96	19	0.06	089 13392
	4700	65 × 105	FE	14	3.25	25	0.10	089 13472
	5600	65 × 118	FF	16	3.55	20	0.09	089 13562
	6800	65 × 143	FH	18	3.91	17	0.09	089 13682
	6800	76 × 105	GE	18	3.91	17	0.09	089 23682
	8200	76 × 118	GF	16	4.30	24	0.16	089 13822
	10000	76 × 143	GH	21	4.74	18	0.15	089 13103
	12000	76 × 220	GN	25	5.20	16	0.16	089 13123

Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR MAX. 120 Hz (m Ω)	Tan δ MAX. 120 Hz	CATALOGUE NUMBER (note 1) 2222
350	330	35 × 54	BA	1.9	1.02	290	0.08	089 15331
	560	35 × 80	BC	2.9	1.33	191	0.09	089 15561
	820	35 × 105	BE	4.2	1.61	129	0.09	089 15821
	1200	50 × 80	EC	5	1.94	122	0.12	089 15122
	1800	50 × 105	EE	7.3	2.38	74	0.11	089 15182
	2200	50 × 130	EG	9.1	2.63	49	0.09	089 15222
	2700	50 × 143	EH	10	2.92	39	0.09	089 15272
	2700	65 × 105	FE	10	2.92	47	0.10	089 25272
	3300	65 × 118	FF	12	3.22	39	0.11	089 15332
	3900	65 × 143	FH	13	3.50	34	0.11	089 15392
	3900	76 × 105	GE	13	3.50	34	0.11	089 25392
	4700	76 × 118	GF	14	3.85	34	0.13	089 15472
	5600	76 × 143	GH	16	4.20	28	0.13	089 15562
	10000	76 × 220	GN	25	5.61	18	0.15	089 15103
	400	270	35 × 54	BA	1.7	0.99	333	0.07
470		35 × 80	BC	2.9	1.30	224	0.09	089 16471
680		35 × 105	BE	4.1	1.56	134	0.07	089 16681
1000		50 × 80	EC	4.8	1.90	127	0.10	089 16102
1500		50 × 105	EE	7.8	2.32	63	0.08	089 16152
1800		50 × 130	EG	8.8	2.55	53	0.08	089 16182
2200		50 × 143	EH	9.8	2.81	45	0.08	089 16222
2200		65 × 105	FE	9.8	2.81	45	0.08	089 26222
2700		65 × 118	FF	10.7	3.12	47	0.10	089 16272
3300		65 × 143	FH	13	3.45	35	0.09	089 16332
3300		76 × 105	GE	13	3.45	35	0.09	089 26332
3900		76 × 118	GF	13	3.75	37	0.12	089 16392
4700		76 × 143	GH	15	4.11	31	0.12	089 16472
8200	76 × 220	GN	22	5.43	24	0.16	089 16822	
450	1000	50 × 105	EE	5.5	2.0	102	0.05	089 17102
	1500	50 × 130	EG	7.4	2.5	70	0.05	089 17152
	2200	65 × 118	FF	10.5	3.0	46	0.05	089 17222
	3300	76 × 118	GF	13.8	3.65	34	0.05	089 17332
	3900	76 × 143	GH	19.1	4.0	22	0.06	089 17392

Note

1. Catalogue type applies to the terminal style "M", high post (see Table 3); the insulation type "H", 0.6 mm polymeric (see Table 4); tolerance $\pm 20\%$ and to the ST version; for STB version (not preferred) replace 8th digit by '5' if ST version is '1' (2222 088/089 5....) or replace 8th digit by '6' if ST version is '2' (2222 088/089 6....). STB version is not available for $\varnothing D = 35$ mm and 45 mm and for case size $\varnothing 76 \times 220$ mm.

Aluminum electrolytic capacitors
Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods	≤250 V versions	$U_s = 1.3 \times U_R$
	≥350 V versions	$U_s = 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.003 \times \sqrt{C \times V} \text{ (mA)}$
Inductance		
Equivalent series inductance (ESL)	case ØD = 35 mm, (1.375")	typ. 18 nH
	case ØD = 45 mm, (1.75")	typ. 23 nH
	case ØD = 50 mm, (2.0")	typ. 25 nH
	case ØD = 65 mm, (2.5")	typ. 27 nH
	case ØD = 76 mm, (3.0")	typ. 29 nH

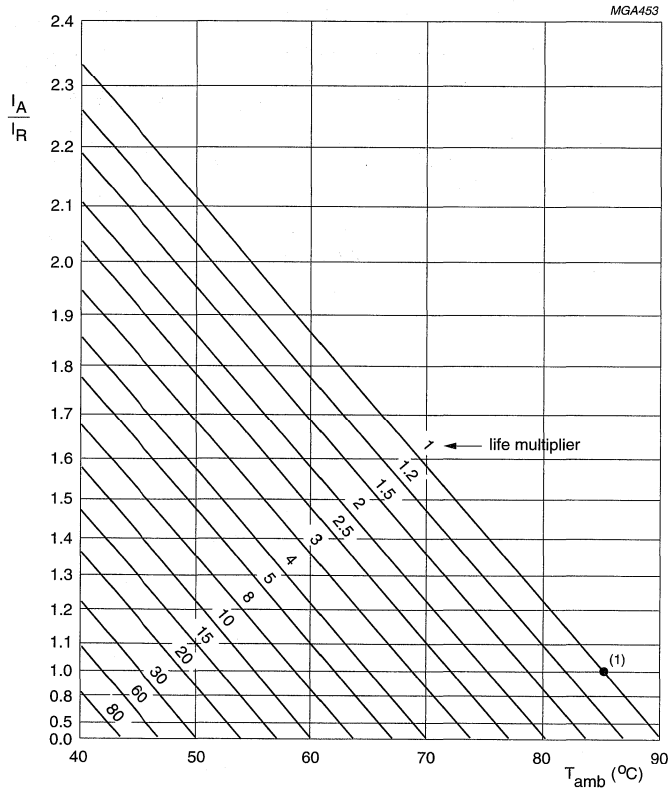
Aluminum electrolytic capacitors
Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

RIPPLE CURRENT AND USEFUL LIFE

Table 7 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER	
	088	089
60	0.9	0.9
120	1.00	1.00
300	1.15	1.25
1000	1.25	1.40
≥ 10000	1.30	1.50



I_A = actual ripple current at 120 Hz and 85 °C.
 I_R = rated ripple current at 120 Hz and 85 °C.
 With an absolute maximum of 50 A at 85 °C.

(1) Useful life at 85 °C and I_R applied: 5000 hours (4000 hours for ≥ 100 V types).

Fig.3 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power High Current, Screw Terminals

NAFTA 3188, 088/089 PHC-ST

SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this data handbook, section "Tests and Requirements".

Table 8 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied; 2000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 5000 hours ($\geq 100\text{ V}$ types: 4000 hours)	$\Delta C/C: \pm 15\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4 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	$\Delta C/C: \pm 10\%$ $I_{L5} \leq 2 \times \text{spec. limit}$ $ESR \leq 1.75 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power, Low Voltage, Screw Terminals

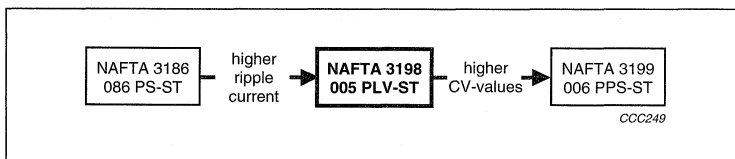
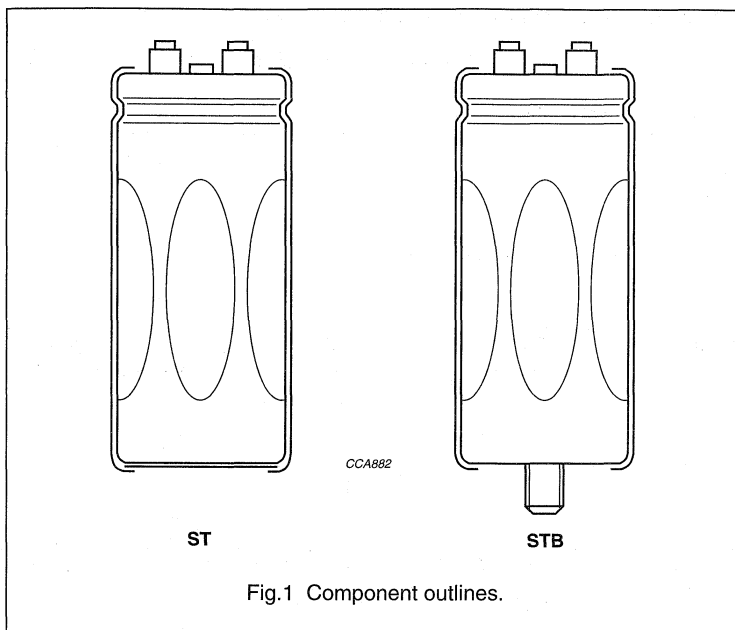
NAFTA 3198, 005 PLV-ST

VFEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Bolt version available for case $\varnothing D = 50, 65$ and 75 mm ($\varnothing D = 2", 2.5"$ and $3"$).
- Pressure relief in the sealing disk
- Charge and discharge proof
- High ripple current capability
- High resistance to shock and vibration.

APPLICATIONS

- Industrial systems
- Smoothing and filtering
- Audio Power Supplies



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case size (in millimetres and inches)	BA 35 × 54 mm (1.375" × 2.125") to GN 76 × 220 mm (3.000" × 8.625")
Rated capacitance range, C _R	2700 μF to 1.2 F
Tolerance on C _R	-10 to +30%; -10 to +50%; ±20%
Rated voltage range, U _R	7.5 to 75 V _{DC}
Category temperature range	-55 to +105 °C
Endurance test at 105 °C	3000 hours
Useful life at 105 °C	5000 hours
Useful life at 40 °C and 1.9 × I _R applied	125000 hours
Shelf life at 0 V, 105 °C	500 hours
Based on sectional specification	IEC 60384-4
Climatic category IEC 60068	55/105/56

Aluminum electrolytic capacitors

Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

Selection chart for C_R , U_R and relevant nominal case code sizes

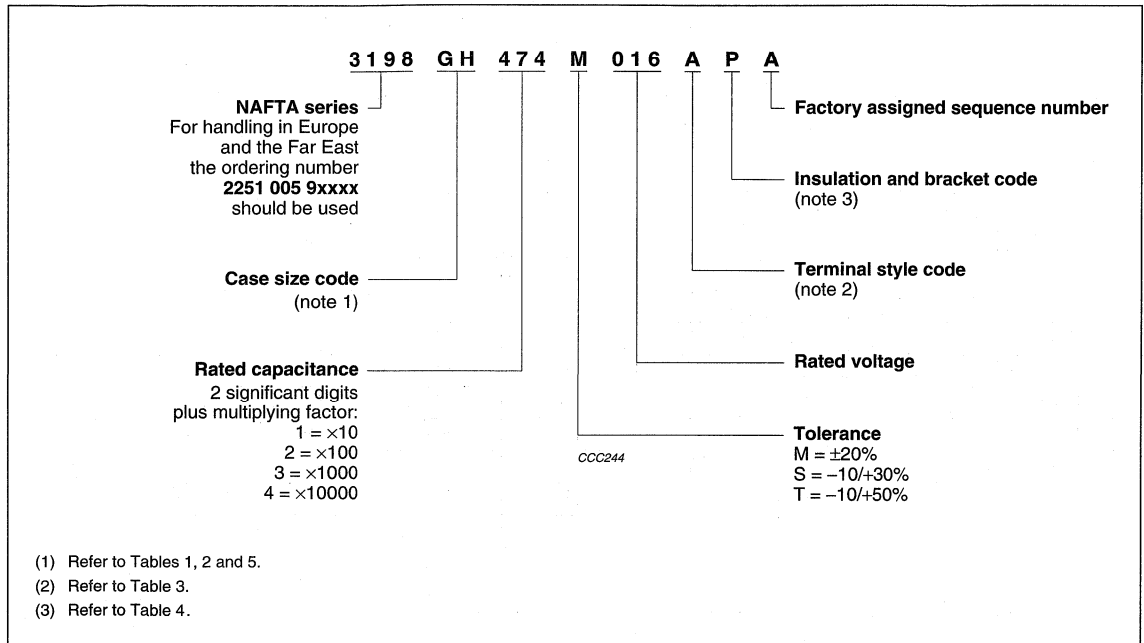
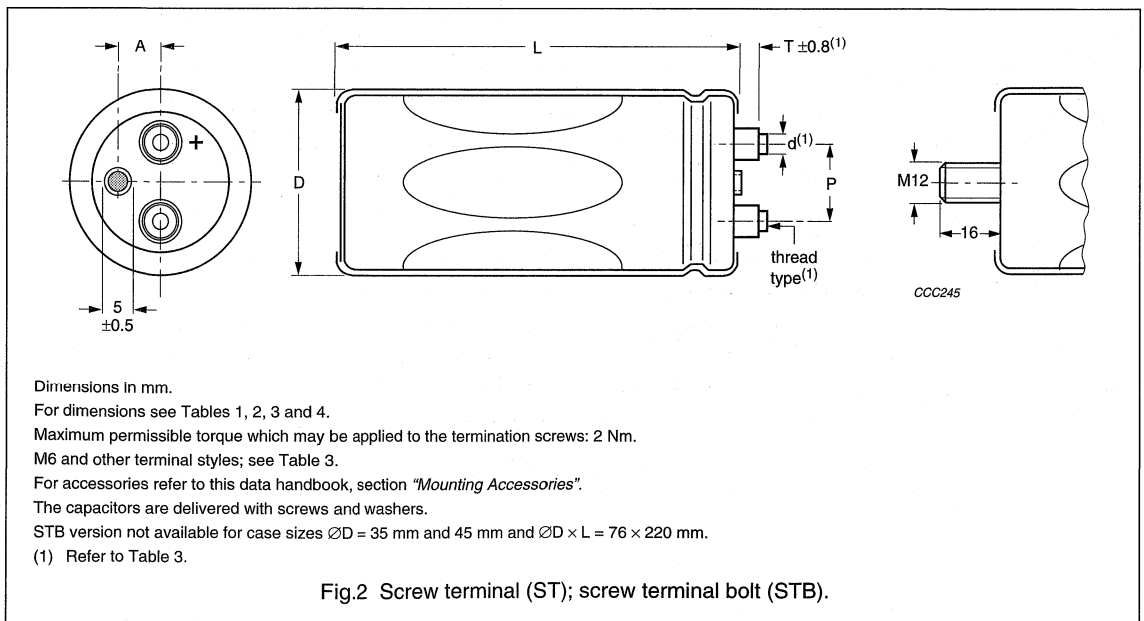
Preferred types in **bold**.

C_R (μF)	U_R (V)							
	7.5	10	16	25	40	50	63	75
2700	-	-	-	-	-	-	-	BA
3300	-	-	-	-	-	-	BA	BB
3900	-	-	-	-	-	-	-	BB
4700	-	-	-	-	-	-	BB	BC
5600	-	-	-	-	-	-	-	BD
6800	-	-	-	-	-	BA	BC	BE
8200	-	-	-	-	BA	BB	BD	BF
10000	-	-	-	-	BB	BC	BE	BH
12000	-	-	-	BA	BC	BD	BF	DE
15000	-	-	-	BB	BD	BE	BH	DF
18000	-	-	-	-	BE	BF	DE	DH
22000	-	-	BA	BC	BG	BH	DF	EG
27000	-	BA	BB	BD	BH	DE	DH	EH
33000	BA	BB	-	BE	DE	DF	EG	FF
39000	BB	-	BC	BG	DF	DG	FF	FH
47000	-	BC	BD	BH	DG	EF	FG	GF
56000	BC	BD	BE	DE	EG	EH	GF	GH
68000	BD	BE	BG	DF	EH	FF	GG	-
82000	BE	BG	DD	DG	FF	FH	-	-
100000	BG	BH	DE	EG	FG	GF	-	GN
120000	DD	DE	DF	EH	GF	GG	GN	-
150000	DE	DF	DH	FF	GG	-	GN	-
180000	DG	DH	EG	FG	-	-	-	-
220000	DH	EG	FE	GF	-	GN	-	-
270000	EG	EH	FF	GG	GN	-	-	-
330000	FE	FF	FH	-	-	-	-	-
390000	FF	FG	GF	-	-	-	-	-
470000	FH	GF	GH	GN	-	-	-	-
560000	-	GG	-	-	-	-	-	-
680000	-	-	GN	-	-	-	-	-
820000	-	-	GN	-	-	-	-	-
1000000	-	GN	-	-	-	-	-	-
1200000	GN	-	-	-	-	-	-	-

Aluminum electrolytic capacitors

Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

ORDERING INFORMATION**NAFTA part numbering system****MECHANICAL DATA**

Aluminum electrolytic capacitors

Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

Table 1 Physical dimensions in millimetres (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (mm)	L _{max} (mm)	P ±0.4 (mm)	A (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
Dimensions in millimetres							
BA	34.9	54.0	12.7	8.0	≈72	150	402 × 200 × 258
BB	34.9	66.7	12.7	8.0	≈90	150	402 × 200 × 258
BC	34.9	79.4	12.7	8.0	≈105	150	402 × 200 × 283
BD	34.9	92.1	12.7	8.0	≈120	100	402 × 200 × 258
BE	34.9	104.8	12.7	8.0	≈135	100	402 × 200 × 258
BF	34.9	117.5	12.7	8.0	≈170	100	402 × 200 × 258
BG	34.9	130.2	12.7	8.0	≈220	100	402 × 200 × 283
BH	34.9	142.9	12.7	8.0	≈270	100	402 × 200 × 315
DA	44.5	54.0	19.1	11.5	≈160	96	324 × 216 × 289
DB	44.5	66.7	19.1	11.5	≈175	72	332 × 221 × 278
DC	44.5	79.4	19.1	11.5	≈180	72	332 × 221 × 278
DD	44.5	92.1	19.1	11.5	≈205	48	324 × 216 × 289
DE	44.5	104.8	19.1	11.5	≈220	48	324 × 216 × 289
DF	44.5	117.5	19.1	11.5	≈235	48	324 × 216 × 289
DG	44.5	130.2	19.1	11.5	≈250	48	324 × 216 × 289
DH	44.5	142.9	19.1	11.5	≈270	24	324 × 216 × 315
EA	50.8	54.0	22.2	12.7	≈170	96	324 × 216 × 289
EB	50.8	66.7	22.2	12.7	≈180	72	332 × 221 × 278
EC	50.8	79.4	22.2	12.7	≈190	72	332 × 221 × 278
ED	50.8	92.1	22.2	12.7	≈220	48	324 × 216 × 289
EE	50.8	104.8	22.2	12.7	≈255	48	324 × 216 × 289
EF	50.8	117.5	22.2	12.7	≈290	48	324 × 216 × 289
EG	50.8	130.2	22.2	12.7	≈320	48	324 × 216 × 289
EH	50.8	142.9	22.2	12.7	≈350	48	324 × 216 × 315
FB	63.5	66.7	28.6	15.9	≈300	40	343 × 275 × 240
FC	63.5	79.4	28.6	15.9	≈370	40	343 × 275 × 240
FD	63.5	92.1	28.6	15.9	≈400	40	343 × 275 × 240
FE	63.5	104.8	28.6	15.9	≈445	40	343 × 275 × 240
FF	63.5	117.5	28.6	15.9	≈600	40	343 × 275 × 315
FG	63.5	130.2	28.6	15.9	≈650	40	343 × 275 × 315
FH	63.5	142.9	28.6	15.9	≈600	20	343 × 275 × 240
GC	76.2	79.4	31.8	19.0	≈520	60	397 × 320 × 292
GD	76.2	92.1	31.8	19.0	≈570	20	397 × 320 × 121
GE	76.2	104.8	31.8	19.0	≈600	20	397 × 320 × 121
GF	76.2	117.5	31.8	19.0	≈720	20	397 × 320 × 147
GG	76.2	130.2	31.8	19.0	≈850	20	397 × 320 × 147
GH	76.2	142.9	31.8	19.0	≈970	20	397 × 320 × 178
GJ	76.2	149.2	31.8	19.0	≈1050	20	397 × 320 × 178
GN	76.2	219.1	31.8	19.0	≈1460	16	426 × 410 × 237

Aluminum electrolytic capacitors

Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

Table 2 Physical dimensions in inches (uninsulated case), mass and packaging information; see Fig.2

CASE CODE	D _{max} (inches)	L _{max} (inches)	P ±0.014 (inches)	A (inches)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS l × w × h (inches)
Dimensions in inches							
BA	1.375	2.125	0.5	0.39	≈72	150	15.825 × 7.875 × 10.125
BB	1.375	2.625	0.5	0.39	≈90	150	15.825 × 7.875 × 10.125
BC	1.375	3.125	0.5	0.39	≈105	150	15.825 × 7.875 × 11.125
BD	1.375	3.625	0.5	0.39	≈120	100	15.825 × 7.875 × 10.125
BE	1.375	4.125	0.5	0.39	≈135	100	15.825 × 7.875 × 10.125
BF	1.375	4.625	0.5	0.39	≈170	100	15.825 × 7.875 × 10.125
BG	1.375	5.125	0.5	0.39	≈220	100	15.825 × 7.875 × 11.125
BH	1.375	5.625	0.5	0.39	≈270	100	15.825 × 7.875 × 12.400
DA	1.75	2.125	0.75	0.453	≈160	96	12.750 × 8.500 × 11.375
DB	1.75	2.625	0.75	0.453	≈175	72	13.700 × 8.700 × 11.000
DC	1.75	3.125	0.75	0.453	≈180	72	13.700 × 8.700 × 11.000
DD	1.75	3.625	0.75	0.453	≈205	48	12.750 × 8.500 × 11.375
DE	1.75	4.125	0.75	0.453	≈220	48	12.750 × 8.500 × 11.375
DF	1.75	4.625	0.75	0.453	≈235	48	12.750 × 8.500 × 11.375
DG	1.75	5.125	0.75	0.453	≈250	48	12.750 × 8.500 × 11.375
DH	1.75	5.625	0.75	0.453	≈270	24	12.750 × 8.500 × 12.400
EA	2	2.125	0.875	0.5	≈170	96	12.750 × 8.500 × 11.375
EB	2	2.625	0.875	0.5	≈180	72	13.750 × 8.700 × 11.000
EC	2	3.125	0.875	0.5	≈190	72	13.750 × 8.700 × 11.000
ED	2	3.625	0.875	0.5	≈220	48	12.750 × 8.500 × 11.375
EE	2	4.125	0.875	0.5	≈255	48	12.750 × 8.500 × 11.375
EF	2	4.625	0.875	0.5	≈290	48	12.750 × 8.500 × 11.375
EG	2	5.125	0.875	0.5	≈320	48	12.750 × 8.500 × 11.375
EH	2	5.625	0.875	0.5	≈350	48	12.750 × 8.500 × 12.400
FB	2.5	2.625	1.125	0.625	≈300	40	13.500 × 10.825 × 9.500
FC	2.5	3.125	1.125	0.625	≈370	40	13.500 × 10.825 × 9.500
FD	2.5	3.625	1.125	0.625	≈400	40	13.500 × 10.825 × 9.500
FE	2.5	4.125	1.125	0.625	≈445	40	13.500 × 10.825 × 9.500
FF	2.5	4.625	1.125	0.625	≈600	40	13.500 × 10.825 × 12.400
FG	2.5	5.125	1.125	0.625	≈650	40	13.500 × 10.825 × 12.400
FH	2.5	5.625	1.125	0.625	≈600	20	13.500 × 10.825 × 9.500
GC	3	3.125	1.25	0.75	≈520	60	15.630 × 12.600 × 11.500
GD	3	3.625	1.25	0.75	≈570	20	15.630 × 12.600 × 4.750
GE	3	4.125	1.25	0.75	≈600	20	15.630 × 12.600 × 4.750
GF	3	4.625	1.25	0.75	≈720	20	15.630 × 12.600 × 5.750
GG	3	5.125	1.25	0.75	≈850	20	15.630 × 12.600 × 5.750
GH	3	5.625	1.25	0.75	≈970	20	15.630 × 12.600 × 7.000
GJ	3	5.825	1.25	0.75	≈1050	20	15.630 × 12.600 × 7.000
GN	3	8.625	1.25	0.75	≈1460	16	16.775 × 16.125 × 9.250

Aluminum electrolytic capacitors

Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

Table 3 NAFTA terminal style code

CODE	TERMINAL STYLE	THREAD TYPE	d (mm)	T (mm)	d (inches)	T (inches)
A	high post	10-32	8	6.4	.315	0.250
B	low post	10-32	8	1.6	.315	0.063
D	high current; see note 1	1/4-28	17	3.2	.670	0.125
J	high current; see note 1	M6	17	3.2	.670	0.125
M	high post	M5	8	6.4	.315	0.250
K	high current; see note 1	1/4-28	17	6.4	.670	0.250

Note

- Case $\varnothing D = 63.5$ mm (2.5") and $\varnothing D = 76.2$ mm (3.0") cans only; for 30 A and up.

Table 4 NAFTA insulation and clamp/bracket codes; see note 1

CODE	CLAMP/BRACKET	INSULATION TYPE	DIMENSION ADDERS		
			D	L	H
			Dimensions in mm		
P	no	0.2 mm polymeric	+0.51	+0.81	+0.61
H	no	0.6 mm polymeric	+0.63	+1.58	+1.14
N	no	none	–	–	–
R	yes	0.2 mm polymeric	+0.51	+0.81	+0.61
J	yes	0.6 mm polymeric	+0.63	+1.58	+1.14
X	yes	none	–	–	–
			Dimensions in inches		
P	no	0.008" polymeric	+0.020	+0.032	+0.024
H	no	0.012" polymeric	+0.030	+0.062	+0.045
N	no	none	–	–	–
R	yes	0.008" polymeric	+0.020	+0.032	+0.024
J	yes	0.012" polymeric	+0.030	+0.062	+0.045
X	yes	none	–	–	–

Note

- For clamp/bracket dimensions see section "Mounting Accessories" in this data handbook.

MARKING

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

- Rated capacitance (in μF)
- Tolerance on rated capacitance
- Rated voltage (in V)
- Date code in "yyww" (year, week) format
- Name of manufacturer
- NAFTA code number 17 digits
- Code number 12 digits (12NC; NAFTA customers will not see the 12NC).

Aluminum electrolytic capacitors

Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Table 5 apply at $T_{amb} = 25\text{ °C}$, $P = 86$ to 106 kPa , $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 120 Hz
I_R	rated RMS ripple current at 85 °C, 120 Hz
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typ. equivalent series resistance at 120 Hz
Z	impedance at 20 kHz on request

Table 5 Electrical data and ordering information for **3198** series; preferred types in **bold**

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR TYP. 120 Hz (m Ω)	CATALOGUE NUMBER 2251 005 9....
7.5	33000	35 × 54	BA	11.4	1.49	11.2	on request
	39000	35 × 65	BB	13.3	1.62	9.7	on request
	56000	35 × 80	BC	17.0	1.94	8.9	on request
	68000	35 × 90	BD	19.3	2.14	6.1	on request
	82000	35 × 105	BE	21.3	2.35	5.5	on request
	100000	35 × 130	BG	26.1	2.60	4.5	on request
	120000	45 × 90	DD	25.4	2.85	4.7	on request
	150000	45 × 105	DE	28.1	3.18	4.2	on request
	180000	45 × 130	DG	30.0	3.49	3.8	on request
	220000	45 × 143	DH	30.0	3.85	3.2	on request
	270000	50 × 130	EG	30.0	4.27	3.6	on request
	330000	65 × 105	FE	44.6	4.72	2.6	on request
	390000	65 × 118	FF	48.6	5.13	2.4	on request
	470000	65 × 143	FH	50.0	5.63	2.4	on request
1200000	76 × 220	GN	50.0	9.00	1.7	on request	

Aluminum electrolytic capacitors

Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR TYP. 120 Hz (m Ω)	CATALOGUE NUMBER 2251 005 9....
10	27000	35 × 54	BA	11.4	1.56	11.4	on request
	33000	35 × 65	BB	13.2	1.72	9.8	on request
	47000	35 × 80	BC	16.9	2.06	7.0	on request
	56000	35 × 90	BD	19.2	2.24	6.1	on request
	68000	35 × 105	BE	21.2	2.47	5.6	on request
	82000	35 × 130	BG	25.9	2.72	4.5	on request
	100000	35 × 143	BH	27.7	3.00	4.3	on request
	120000	45 × 105	DE	28.0	3.29	4.3	on request
	150000	45 × 118	DF	30.0	3.67	3.6	on request
	180000	45 × 143	DH	30.0	4.02	3.3	on request
	220000	50 × 130	EG	30.0	4.45	3.7	on request
	270000	50 × 143	EH	30.0	4.93	3.5	on request
	330000	65 × 118	FF	48.4	5.45	2.4	on request
	390000	65 × 130	FG	50.0	5.92	2.3	on request
	470000	76 × 118	GF	50.0	6.50	2.2	on request
	560000	76 × 130	GG	50.0	7.10	2.1	on request
1000000	76 × 220	GN	50.0	9.49	1.7	on request	
16	22000	35 × 54	BA	12.2	1.78	9.9	on request
	27000	35 × 65	BB	14.1	1.97	8.6	on request
	39000	35 × 80	BC	16.8	2.37	7.0	on request
	47000	35 × 90	BD	19.1	2.60	6.2	on request
	56000	35 × 105	BE	21.1	2.84	5.7	on request
	68000	35 × 130	BG	25.8	3.13	4.6	on request
	82000	45 × 90	DD	25.2	3.44	4.7	on request
	100000	45 × 105	DE	27.9	3.79	4.3	on request
	120000	45 × 118	DF	30.0	4.16	3.6	on request
	150000	45 × 143	DH	30.0	4.65	3.3	on request
	180000	50 × 130	EG	30.0	5.09	3.7	on request
	220000	65 × 105	FE	44.3	5.63	2.6	on request
	270000	65 × 118	FF	48.3	6.24	2.4	on request
	330000	65 × 143	FH	50.0	6.89	2.2	on request
	390000	76 × 118	GF	50.0	7.49	2.2	on request
	470000	76 × 143	GH	50.0	8.23	2.0	on request
680000	76 × 220	GN	50.0	9.90	1.7	on request	
820000	76 × 220	GN	50.0	10.87	1.8	on request	

Aluminum electrolytic capacitors
Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR TYP. 120 Hz (m Ω)	CATALOGUE NUMBER 2251 005 9....
25	12000	35 × 54	BA	6.8	1.64	31.6	on request
	15000	35 × 65	BB	8.0	1.84	27.0	on request
	22000	35 × 80	BC	9.6	2.22	21.4	on request
	27000	35 × 90	BD	11.1	2.46	18.2	on request
	33000	35 × 105	BE	12.4	2.72	16.1	on request
	39000	35 × 130	BG	15.6	2.96	12.4	on request
	47000	35 × 143	BH	16.9	3.25	11.6	on request
	56000	45 × 105	DE	20.0	3.55	8.3	on request
	68000	45 × 118	DF	22.9	3.91	6.9	on request
	82000	45 × 130	DG	24.9	4.30	6.4	on request
	100000	50 × 130	EG	30.0	4.74	4.3	on request
	120000	50 × 143	EH	30.0	5.20	4.0	on request
	150000	65 × 118	FF	38.3	5.81	3.8	on request
	180000	65 × 130	FG	41.5	6.36	3.5	on request
	220000	76 × 118	GF	45.8	7.04	3.3	on request
270000	76 × 130	GG	49.6	7.79	3.1	on request	
470000	76 × 220	GN	50.0	10.28	2.4	on request	
40	8200	35 × 54	BA	6.1	1.72	38.8	on request
	10000	35 × 65	BB	7.2	1.90	33.0	on request
	12000	35 × 80	BC	8.7	2.08	26.3	on request
	15000	35 × 90	BD	10.1	2.32	22.1	on request
	18000	35 × 105	BE	11.4	2.55	19.4	on request
	22000	35 × 130	BG	14.3	2.81	14.7	on request
	27000	35 × 143	BH	15.5	3.12	13.6	on request
	33000	45 × 105	DE	18.4	3.45	9.8	on request
	39000	45 × 118	DF	21.1	3.75	8.2	on request
	47000	45 × 130	DG	23.0	4.11	7.5	on request
	56000	50 × 130	EG	30.0	4.49	5.0	on request
	68000	50 × 143	EH	30.0	4.95	4.7	on request
	82000	65 × 118	FF	35.2	5.43	4.5	on request
	100000	65 × 130	FG	38.4	6.00	4.1	on request
	120000	76 × 118	GF	42.1	6.57	4.0	on request
150000	76 × 130	GG	45.9	7.35	3.6	on request	
270000	76 × 220	GN	50.0	9.86	2.7	on request	

Aluminum electrolytic capacitors
Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR TYP. 120 Hz (m Ω)	CATALOGUE NUMBER 2251 005 9....
50	6800	35 × 54	BA	5.9	1.75	41.6	on request
	8200	35 × 65	BB	7.0	1.92	35.4	on request
	10000	35 × 80	BC	8.4	2.12	28.0	on request
	12000	35 × 90	BD	9.7	2.32	23.6	on request
	15000	35 × 105	BE	11.0	2.60	20.6	on request
	18000	35 × 118	BF	12.8	2.85	16.9	on request
	22000	35 × 143	BH	15.1	3.15	14.4	on request
	27000	45 × 105	DE	18.2	3.49	10.0	on request
	33000	45 × 118	DF	20.9	3.85	8.3	on request
	39000	45 × 130	DG	22.9	4.19	7.6	on request
	47000	50 × 118	EF	21.0	4.60	9.6	on request
	56000	50 × 143	EH	24.7	5.02	8.2	on request
	68000	65 × 118	FF	29.0	5.53	6.6	on request
	82000	65 × 143	FH	34.0	6.07	5.7	on request
	100000	76 × 118	GF	36.0	6.71	5.3	on request
	120000	76 × 130	GG	39.5	7.35	4.9	on request
220000	76 × 220	GN	50.0	9.95	3.5	on request	
63	3300	35 × 54	BA	5.9	1.37	41.5	on request
	4700	35 × 65	BB	7.0	1.63	35.4	on request
	6800	35 × 80	BC	8.4	1.96	28.1	on request
	8200	35 × 90	BD	9.7	2.16	23.7	on request
	10000	35 × 105	BE	11.0	2.38	20.7	on request
	12000	35 × 118	BF	12.7	2.61	17.1	on request
	15000	35 × 143	BH	15.0	2.92	14.5	on request
	18000	45 × 105	DE	18.0	3.19	10.2	on request
	22000	45 × 118	DF	20.7	3.53	8.5	on request
	27000	45 × 143	DH	24.2	3.91	7.3	on request
	33000	50 × 130	EG	23.0	4.33	8.8	on request
	39000	65 × 118	FF	25.9	4.70	7.6	on request
	47000	65 × 130	FG	28.6	5.16	6.8	on request
	56000	76 × 118	GF	32.5	5.63	6.1	on request
	68000	76 × 130	GG	36.0	6.21	5.4	on request
	120000	76 × 220	GN	47.0	8.25	4.4	on request
150000	76 × 220	GN	47.0	9.22	4.4	on request	

Aluminum electrolytic capacitors
Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

U_R (V)	C_R 120 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 120 Hz 85 °C (A)	I_{L5} 5 min (mA)	ESR TYP. 120 Hz (m Ω)	CATALOGUE NUMBER 2251 005 9....
75	2700	35 × 54	BA	5.7	1.35	45.4	on request
	3300	35 × 65	BB	6.3	1.49	42.2	on request
	3900	35 × 65	BB	6.8	1.62	37.2	on request
	4700	35 × 80	BC	8.2	1.78	29.7	on request
	5600	35 × 90	BD	9.5	1.94	25.1	on request
	6800	35 × 105	BE	10.7	2.14	21.8	on request
	8200	35 × 118	BF	12.4	2.35	18.0	on request
	10000	35 × 143	BH	14.6	2.60	15.3	on request
	12000	45 × 105	DE	17.4	2.85	10.9	on request
	15000	45 × 118	DF	20.1	3.18	9.0	on request
	18000	45 × 143	DH	23.5	3.49	7.8	on request
	22000	50 × 130	EG	22.6	3.85	9.1	on request
	27000	50 × 143	EH	24.5	4.27	8.4	on request
	33000	65 × 118	FF	28.2	4.72	7.0	on request
	39000	65 × 143	FH	33.0	5.13	6.0	on request
	47000	76 × 118	GF	35.4	5.63	5.6	on request
56000	76 × 143	GH	41.4	6.15	4.7	on request	
100000	76 × 220	GN	50.0	8.22	3.6	on request	

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤ 250 V versions	$U_s = 1.3 \times U_R$
Reverse voltage		$U_{rev} \leq 1$ V
Current		
Leakage current	after 5 minutes at U_R	$I_{L5} \leq 0.003 \times \sqrt{C \times V}$ (mA)
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 35$ mm, (1.375")	typ. 18 nH
	case $\varnothing D = 45$ mm, (1.75")	typ. 23 nH
	case $\varnothing D = 50$ mm, (2.0")	typ. 25 nH
	case $\varnothing D = 65$ mm, (2.5")	typ. 27 nH
	case $\varnothing D = 75$ mm, (3.0")	typ. 29 nH

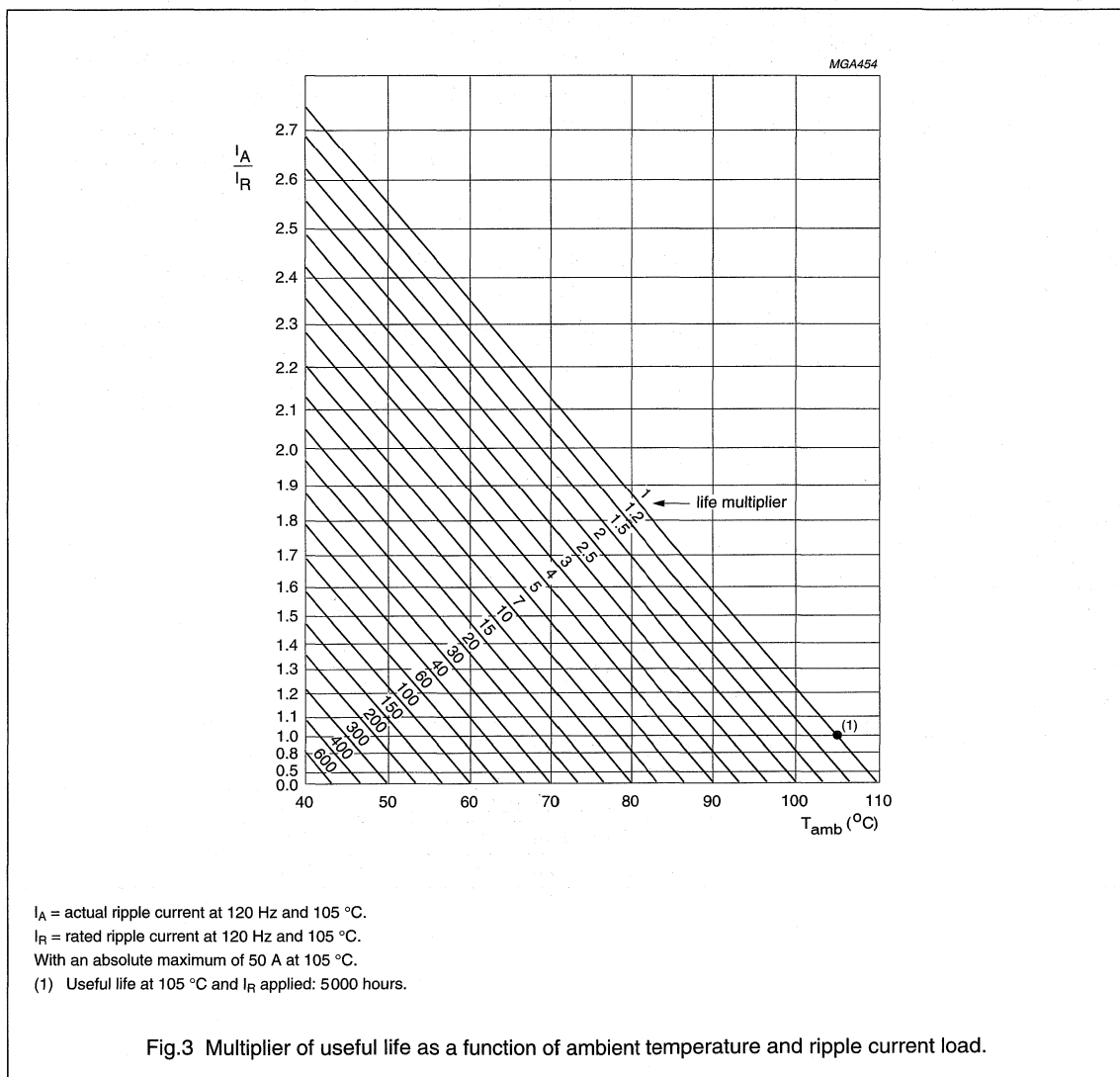
Aluminum electrolytic capacitors Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
60	0.9
120	1.00
300	1.05
1000	1.1
≥ 10000	1.15



Aluminum electrolytic capacitors

Power, Low Voltage, Screw Terminals

NAFTA 3198, 005 PLV-ST

SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this data handbook, section "Tests and Requirements".

Table 7 Test procedures and requirements

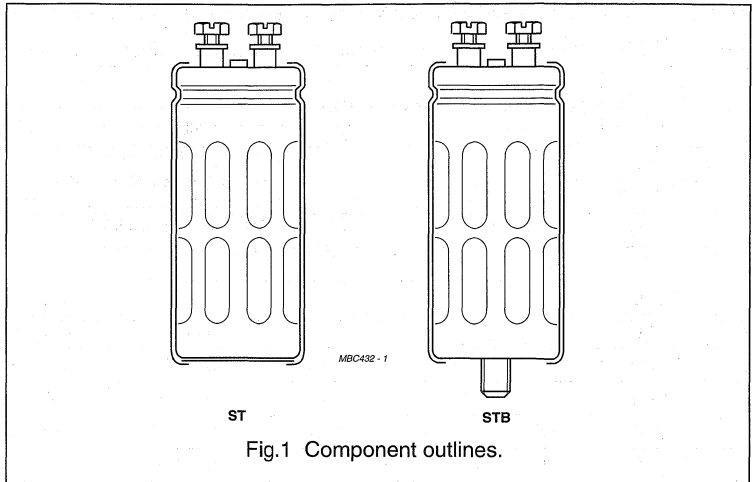
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 subclause 4.13	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R applied; 3000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ }^{\circ}\text{C}$; U_R and I_R applied; 5000 hours	$\Delta C/C: \pm 15\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4 subclause 4.17	$T_{amb} = 105\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 10\%$ $I_{L5} \leq 2 \times \text{spec. limit}$ $ESR \leq 1.75 \times \text{spec. limit}$

Aluminum electrolytic capacitors Power Economic Screw Terminals

154/155 PEC-ST

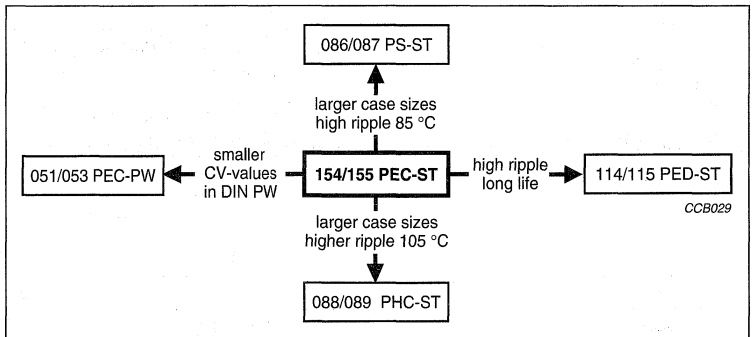
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Also available in bolt version (PEC-STB)
- Pressure relief in the sealing
- Charge and discharge proof
- Long useful life:
12000 hours at 85 °C
- High ripple current capability
- High resistance to shock and vibration achieved by longitudinal rills and special internal construction.



APPLICATIONS

- General purpose, computer and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	154	155
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	35 × 60 to 75 × 105	
Rated capacitance range (E6 series), C_R	220 to 470000 μF	
Tolerance on C_R	±20%	
Rated voltage range, U_R	10 to 100 V	250 to 400 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	5000 hours	
Useful life at 85 °C	12000 hours	
Useful life at 40 °C, $1.4 \times I_R$ applied	200000 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	

Aluminum electrolytic capacitors

Power Economic Screw Terminals

154/155 PEC-ST

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 154 series

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	40	63	100
3300	–	–	–	–	–	35 × 60
4700	–	–	–	–	–	35 × 80
6800	–	–	–	–	35 × 60	35 × 105
10000	–	–	–	–	35 × 80	50 × 80
15000	–	–	–	35 × 60	35 × 105	50 × 105
22000	–	–	35 × 60	35 × 80	50 × 80	65 × 105
33000	–	35 × 60	35 × 80	50 × 80	50 × 105	75 × 105
47000	35 × 60	35 × 80	35 × 105	50 × 80	65 × 105	–
68000	35 × 80	35 × 105	50 × 80	50 × 105	75 × 105	–
100000	35 × 105	50 × 80	50 × 105	65 × 105	–	–
150000	50 × 80	50 × 105	65 × 105	75 × 105	–	–
220000	50 × 105	65 × 105	75 × 105	–	–	–
330000	65 × 105	75 × 105	–	–	–	–
470000	75 × 105	–	–	–	–	–

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 155 series

Preferred types in **bold**.

C_R (μF)	U_R (V)			
	250	350	385	400
220	–	–	35 × 60	35 × 60
330	–	35 × 60	35 × 80	35 × 80
470	35 × 60	35 × 80	35 × 80	35 × 80
680	35 × 80	35 × 105	35 × 105	35 × 105
1000	35 × 105	50 × 80	50 × 80	50 × 80
1500	50 × 80	50 × 105	50 × 105	50 × 105
2200	50 × 105	65 × 105	65 × 105	65 × 105
3300	65 × 105	65 × 105	75 × 105	75 × 105
4700	65 × 105	–	–	–
6800	75 × 105	–	–	–

Aluminum electrolytic capacitors

Power Economic Screw Terminals

154/155 PEC-ST

MECHANICAL DATA AND PACKAGING QUANTITIES

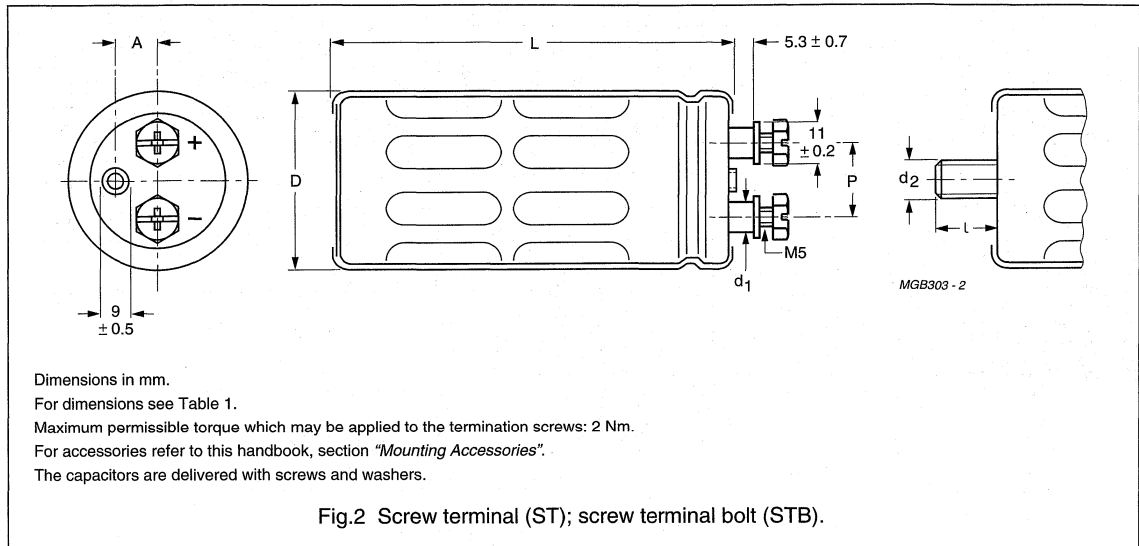


Table 1 Physical dimensions, mass and packaging information; see Fig.2

NOMINAL CASE SIZE ∅D × L (mm)	∅D _{max} (mm)	L _{max} (mm)	P ±0.1 (mm)	A (mm)	d ₁ ±0.2 (mm)	d ₂ × l	MASS (g)	PACKAGING QUANTITIES (per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
35 × 60	36.5	63	13.0	8.4	8.0	M8 × 12	≈55	25	196 × 192 × 110
35 × 80	36.5	83	13.0	8.4	8.0	M8 × 12	≈80	25	196 × 192 × 115
35 × 105	36.5	108	13.0	8.4	8.0	M8 × 12	≈110	25	196 × 192 × 140
50 × 80	51.5	83	22.0	14.3	8.0	M12 × 16	≈160	25	293 × 273 × 115
50 × 105	51.5	108	22.0	14.3	8.0	M12 × 16	≈210	25	293 × 273 × 140
65 × 105	66.5	108	28.5	19.0	9.6	M12 × 16	≈370	10	368 × 151 × 140
75 × 105	76.5	108	32.0	21.0	9.6	M12 × 16	≈535	10	418 × 173 × 140

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors
Power Economic Screw Terminals

154/155 PEC-ST

Ordering example

Electrolytic capacitor 154 series

10000 μ F/63 V; \pm 20%

Nominal case size: \varnothing 35 x 80 mm; ST version

Catalogue number: 2222 154 18103.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 2 and 3 apply at $T_{amb} = 20\text{ }^{\circ}\text{C}$,
P = 86 to 106 kPa, RH = 45 to 75%.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	rated RMS ripple current at 100 Hz, 85 $^{\circ}\text{C}$ and 20 kHz, 70 $^{\circ}\text{C}$
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
ESR	typical equivalent series resistance at 100 Hz
Tan δ	max. dissipation factor at 100 Hz
Z	impedance at 20 kHz

Table 2 Electrical data and ordering information for **154** series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 $^{\circ}\text{C}$ (A)	I_R 20 kHz 70 $^{\circ}\text{C}$ (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR TYP. 100 Hz (m Ω)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (m Ω)	Z MAX. 20 kHz (m Ω)	CATALOGUE NUMBER (see Table 3, note 1) 2222
10	47000	35 x 60	8.4	15.9	2.82	0.94	14	0.48	11	16.5	154 14473
	68000	35 x 80	8.7	16.5	4.08	1.36	11	0.88	9	13.5	154 14683
	100000	35 x 105	10.7	20.3	6.00	2.00	10.5	0.92	8	12	154 14104
	150000	50 x 80	13.2	25.0	9.00	3.00	8	1.03	8	12	154 14154
	220000	50 x 105	16.5	31.4	13.20	4.40	6.5	1.26	7	10.5	154 14224
	330000	65 x 105	20.8	39.5	19.80	6.60	5.5	1.59	7	10.5	154 14334
16	470000	75 x 105	22.6	42.9	28.20	9.40	5.5	2.21	7	10.5	154 14474
	33000	35 x 60	8.4	15.9	3.17	1.06	14	0.32	10	15	154 15333
	47000	35 x 80	8.7	16.5	4.51	1.51	11	0.32	9	13.5	154 15473
	68000	35 x 105	12.2	23.2	6.53	2.18	8	0.45	8	12	154 15683
	100000	50 x 80	13.2	25.0	9.60	3.20	8	0.70	8	12	154 15104
	150000	50 x 105	14.9	28.3	14.40	4.80	8	0.88	7	10.5	154 15154
220000	65 x 105	20.8	39.5	21.10	7.04	5.5	1.07	7	10.5	154 15224	
330000	75 x 105	22.6	42.9	31.70	10.60	5.5	1.58	7	10.5	154 15334	

Aluminum electrolytic capacitors

Power Economic Screw Terminals

154/155 PEC-ST

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR TYP. 100 Hz (m Ω)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (m Ω)	Z MAX. 20 kHz (m Ω)	CATALOGUE NUMBER (see Table 3, note 1) 2222... ..	
25	22000	35 × 60	8.1	15.4	3.30	1.10	12	0.23	10	15	154 16223	
	33000	35 × 80	9.6	18.2	4.95	1.65	10	0.28	9	13.5	154 16333	
	47000	35 × 105	12.2	23.2	7.05	2.35	8	0.33	8	12	154 16473	
	68000	50 × 80	13.2	25.0	10.20	3.40	8	0.49	8	12	154 16683	
	100000	50 × 105	15.9	30.2	15.00	5.00	7	0.60	8	12	154 16104	
	150000	65 × 105	19.7	37.4	22.50	7.50	7	0.93	8	12	154 16154	
	220000	75 × 105	22.6	42.9	33.00	11.00	5.5	1.07	7	10.5	154 16224	
	15000	35 × 60	7.7	14.6	3.60	1.20	13	0.17	10	15	154 17153	
	22000	35 × 80	9.8	18.6	5.28	1.76	11	0.20	9	13.5	154 17223	
	33000	50 × 80	11.8	22.4	7.92	2.64	10	0.29	9	13.5	154 17333	
40	47000	50 × 80	11.8	22.4	11.30	3.76	10	0.42	9	13.5	154 17473	
	68000	50 × 105	14.1	26.8	16.30	5.44	9	0.45	8	12	154 17683	
	100000	65 × 105	17.3	32.9	24.00	8.00	9	0.80	8	12	154 17104	
	150000	75 × 105	20.8	39.5	36.00	12.00	6.5	0.83	7	10.5	154 17154	
	6800	35 × 60	6.6	12.5	2.57	0.86	17	0.10	13	19	154 18682	
	10000	35 × 80	8.6	16.3	3.78	1.26	12.5	0.11	10	15	154 18103	
	15000	35 × 105	10.9	20.7	5.67	1.89	10	0.13	9	13.5	154 18153	
	22000	50 × 80	11.8	22.4	8.32	2.77	10	0.20	9	13.5	154 18223	
	33000	50 × 105	14.1	26.8	12.50	4.16	9	0.24	8	12	154 18333	
	47000	65 × 105	17.3	32.9	17.80	5.92	9	0.36	8	12	154 18473	
63	68000	75 × 105	17.7	33.6	25.70	8.57	9	0.58	8	12	154 18683	
	3300	35 × 60	3.8	7.2	1.98	0.66	50	0.13	35	55	154 19332	
	4700	35 × 80	5.3	10.0	2.82	0.94	35	0.13	25	40	154 19472	
	6800	35 × 105	7.1	13.5	4.08	1.36	25	0.14	18	28	154 19682	
	10000	50 × 80	8.9	16.9	6.00	2.00	18	0.14	13	20	154 19103	
	15000	50 × 105	11.5	21.8	9.00	3.00	14	0.16	10	16	154 19153	
	22000	65 × 105	18.2	34.5	13.20	4.40	7.5	0.13	6	9	154 19223	
	33000	75 × 105	24.1	45.7	19.80	6.60	5.0	0.13	4	6	154 19333	
	100	3300	35 × 60	3.8	7.2	1.98	0.66	50	0.13	35	55	154 19332
		4700	35 × 80	5.3	10.0	2.82	0.94	35	0.13	25	40	154 19472
6800		35 × 105	7.1	13.5	4.08	1.36	25	0.14	18	28	154 19682	
10000		50 × 80	8.9	16.9	6.00	2.00	18	0.14	13	20	154 19103	
15000		50 × 105	11.5	21.8	9.00	3.00	14	0.16	10	16	154 19153	
22000		65 × 105	18.2	34.5	13.20	4.40	7.5	0.13	6	9	154 19223	
33000		75 × 105	24.1	45.7	19.80	6.60	5.0	0.13	4	6	154 19333	

Aluminum electrolytic capacitors

Power Economic Screw Terminals

154/155 PEC-ST

Table 3 Electrical data and ordering information for 155 series; preferred types in **bold**

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR TYP. 100 Hz (m Ω)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (m Ω)	Z MAX. 20 kHz (m Ω)	CATALOGUE NUMBER (note 1) 2222	
250	470	35 × 60	1.6	3.0	0.70	0.24	360	0.16	300	450	155 13471	
	680	35 × 80	2.2	4.2	1.02	0.34	250	0.16	216	325	155 13681	
	1000	35 × 105	2.9	5.5	1.50	0.50	175	0.16	140	210	155 13102	
	1500	50 × 80	3.9	7.4	2.25	0.75	115	0.16	100	150	155 13152	
	2200	50 × 105	5.3	10.1	3.30	1.10	80	0.17	70	105	155 13222	
	3300	65 × 105	7.7	14.6	4.95	1.65	50	0.17	43	65	155 13332	
	4700	65 × 105	8.2	15.6	7.05	2.35	44	0.19	40	60	155 13472	
	6800	75 × 105	10	19	10.20	3.40	35	0.22	33	50	155 13682	
	350	330	35 × 60	1.5	2.9	0.69	0.23	370	0.12	313	470	155 15331
		470	35 × 80	2.1	4.0	0.99	0.33	260	0.12	223	335	155 15471
680		35 × 105	2.9	5.5	1.43	0.48	180	0.12	146	220	155 15681	
1000		50 × 80	3.7	7.0	2.10	0.70	125	0.12	113	170	155 15102	
1500		50 × 105	4.3	8.2	3.15	1.05	120	0.18	106	160	155 15152	
2200		65 × 105	6.5	12.6	4.62	1.54	70	0.18	63	95	155 15222	
3300		65 × 105	7.1	13.5	6.93	2.31	60	0.19	63	95	155 15332	
385		220	35 × 60	1.0	2.0	0.51	0.17	650	0.15	475	955	155 18221
		330	35 × 80	1.5	2.9	0.76	0.25	430	0.15	326	635	155 18331
		470	35 × 80	1.8	3.4	1.08	0.36	300	0.15	220	445	155 18471
	680	35 × 105	2.4	4.6	1.57	0.52	210	0.15	150	310	155 18681	
	1000	50 × 80	3.4	6.5	2.31	0.77	125	0.15	90	210	155 18102	
	1500	50 × 105	4.7	8.9	3.46	1.15	85	0.15	60	140	155 18152	
	2200	65 × 105	6.5	12.4	5.08	1.69	58	0.15	40	95	155 18222	
	3300	75 × 105	7.6	14.5	7.62	2.54	50	0.15	35	70	155 18332	

Aluminum electrolytic capacitors

Power Economic Screw Terminals

154/155 PEC-ST

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR TYP. 100 Hz (m Ω)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (m Ω)	Z MAX. 20 kHz (m Ω)	CATALOGUE NUMBER (note 1) 2222
400	220	35 × 60	1.0	2.0	0.53	0.18	650	0.15	475	955	155 16221
	330	35 × 80	1.5	2.9	0.79	0.27	430	0.15	320	635	155 16331
	470	35 × 80	1.8	3.4	1.13	0.38	300	0.15	220	445	155 16471
	680	35 × 105	2.4	4.6	1.63	0.54	210	0.15	150	310	155 16681
	1000	50 × 80	3.4	6.5	2.40	0.80	125	0.15	90	210	155 16102
	1500	50 × 105	4.7	8.9	3.60	1.20	85	0.15	60	140	155 16152
	2200	65 × 105	6.5	12.4	5.28	1.76	58	0.15	40	95	155 16222
	3300	75 × 105	7.6	14.5	7.92	2.64	50	0.15	35	70	155 16332

Note

1. Catalogue number applies to the ST version; for STB version (not preferred) replace 8th digit by '5' (2222 154/155 5....).

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_S = 1.15 \times U_R$
	≥350 V versions	$U_S = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006 C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 35 \text{ mm}$	typ. 18 nH
	case $\varnothing D = 50 \text{ mm}$	typ. 25 nH
	case $\varnothing D = 65 \text{ mm}$	typ. 27 nH
	case $\varnothing D = 75 \text{ mm}$	typ. 29 nH

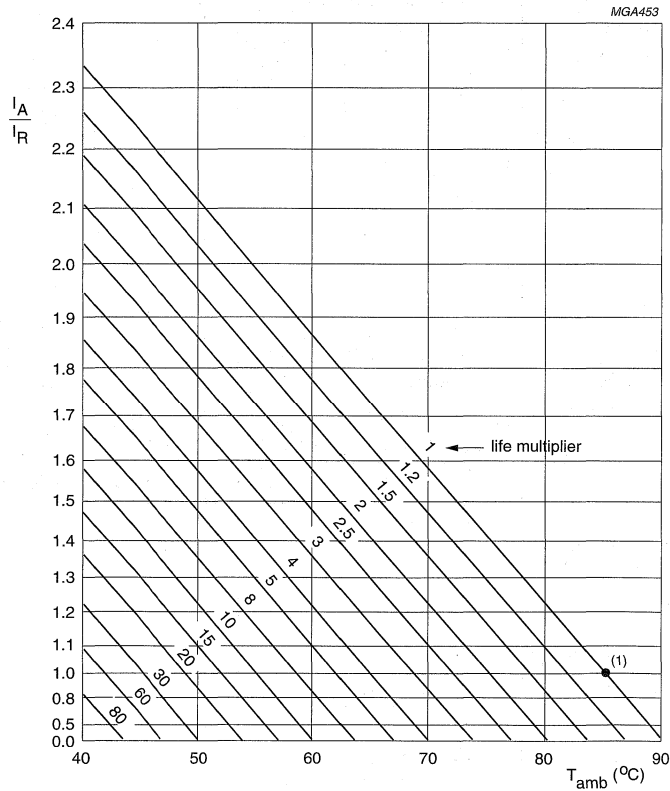
Aluminum electrolytic capacitors Power Economic Screw Terminals

154/155 PEC-ST

RIPPLE CURRENT AND USEFUL LIFE

Table 4 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.83
100	1.00
200	1.10
400	1.15
1000	1.19
≥ 2000	1.20



I_A = actual ripple current at 100 Hz and 85 °C.

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

With an absolute maximum of 50 A at 85 °C.

(1) Useful life at 85 °C and I_R applied: 12000 hours.

Fig.3 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power Economic Screw Terminals

154/155 PEC-ST

SPECIFIC TESTS AND REQUIREMENTS

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

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; 5000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 12000 hours	$U_R \leq 100\text{ V}$; $\Delta C/C: \pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C: \pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}: \leq 1\%$; $U_R > 100\text{ V}: \leq 3\%$
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	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, cylindrical aluminum case, insulated with a blue sleeve
- Also available in bolt version (PED-STB)
- Pressure relief in the sealing
- Charge and discharge proof
- Extremely low ESR and ESL allowing very high ripple current load, achieved by a special construction with multiple internal anode and cathode connections
- Very long useful life: 20000 hours at 85 °C
- High resistance to shock and vibration achieved by longitudinal rills and special internal construction.

APPLICATIONS

- Computer, telecommunications and industrial systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.

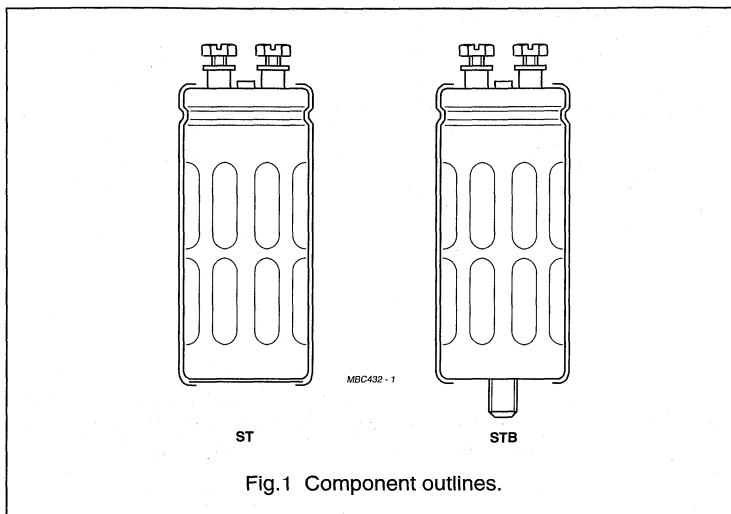
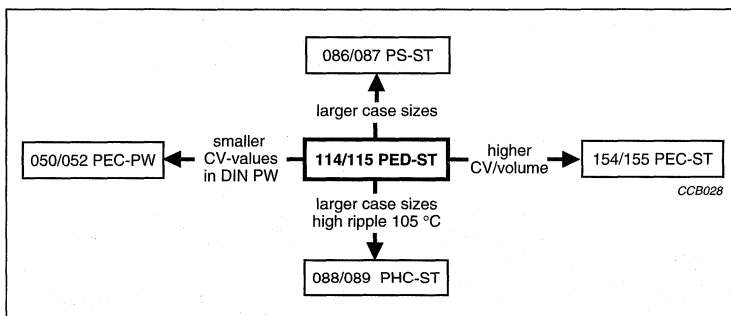


Fig. 1 Component outlines.



QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	114	115
Case size ($\varnothing D_{nom} \times L_{nom}$ in mm)	35 × 60 to 75 × 105	
Rated capacitance range (E6 series), C_R	150 to 220000 μF	
Tolerance on C_R	-10 to +30%	
Rated voltage range, U_R	10 to 100 V	250 to 400 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	8000 hours (400 V: 5000 hours)	
Useful life at 85 °C	20000 hours (400 V: 12000 hours)	
Useful life at 40 °C, $1.4 \times I_R$ applied	350000 hours (400 V: 220000 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	

Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 114 series

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	10	16	25	40	63	100
1000	–	–	–	–	–	35 × 60
1500	–	–	–	–	–	35 × 60
2200	–	–	–	–	35 × 60	35 × 80
3300	–	–	–	35 × 60	35 × 60	35 × 105
4700	–	–	35 × 60	35 × 60	35 × 80	50 × 80
6800	–	–	35 × 60	35 × 80	35 × 105	50 × 105
10000	–	35 × 60	35 × 80	35 × 105	50 × 80	65 × 105
15000	35 × 60	35 × 80	35 × 105	50 × 80	50 × 105	65 × 105
22000	35 × 80	35 × 105	50 × 80	50 × 105	65 × 105	75 × 105
33000	35 × 105	50 × 80	50 × 105	65 × 105	65 × 105	–
47000	50 × 80	50 × 105	65 × 105	65 × 105	75 × 105	–
68000	50 × 105	65 × 105	65 × 105	75 × 105	–	–
100000	65 × 105	65 × 105	75 × 105	–	–	–
150000	65 × 105	75 × 105	–	–	–	–
220000	75 × 105	–	–	–	–	–

Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm) for 115 series

Preferred types in **bold**.

C_R (μF)	U_R (V)			
	250	350	385	400
150	–	–	35 × 60	35 × 60
220	–	35 × 60	35 × 80	35 × 80
330	35 × 60	35 × 80	35 × 105	35 × 105
470	35 × 80	35 × 105	50 × 80	50 × 80
680	35 × 105	50 × 80	50 × 105	50 × 105
1000	50 × 80	50 × 105	65 × 105	65 × 105
1500	50 × 105	65 × 105	65 × 105	65 × 105
2200	65 × 105	65 × 105	75 × 105	75 × 105
3300	65 × 105	75 × 105	–	–
4700	75 × 105	–	–	–

Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST

MECHANICAL DATA AND PACKAGING QUANTITIES

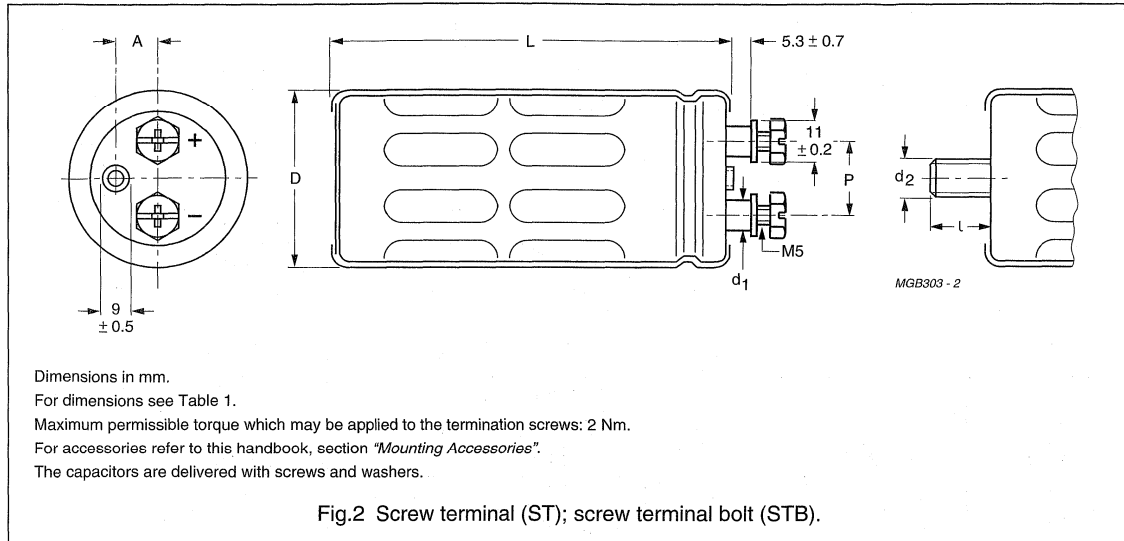


Table 1 Physical dimensions, mass and packaging information; see Fig.2

NOMINAL CASE SIZE ∅D × L (mm)	∅D _{max} (mm)	L _{max} (mm)	P ±0.1 (mm)	A (mm)	d ₁ ±0.2 (mm)	d ₂ × l	MASS (g)	PACKAGING QUANTITIES (per box)	CARDBOARD BOX DIMENSIONS l × w × h (mm)
35 × 60	36.5	63	13.0	8.4	8.0	M8 × 12	≈55	25	196 × 192 × 110
35 × 80	36.5	83	13.0	8.4	8.0	M8 × 12	≈80	25	196 × 192 × 115
35 × 105	36.5	108	13.0	8.4	8.0	M8 × 12	≈110	25	196 × 192 × 140
50 × 80	51.5	83	22.0	14.3	8.0	M12 × 16	≈160	25	293 × 273 × 115
50 × 105	51.5	108	22.0	14.3	8.0	M12 × 16	≈210	25	293 × 273 × 140
65 × 105	66.5	108	28.5	19.0	9.6	M12 × 16	≈370	10	368 × 151 × 140
75 × 105	76.5	108	32.0	21.0	9.6	M12 × 16	≈535	10	418 × 173 × 140

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for ±20%)
- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- Code number (last 8 digits)
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST

Ordering example

Electrolytic capacitor 114 series

10000 µF/25 V; -10/+30%

Nominal case size: Ø35 × 80 mm; ST version

Catalogue number: 2222 114 16103.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 2 and 3 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 +30%
I _R	rated RMS ripple current at 100 Hz, 85 °C and 20 kHz, 70 °C
I _{L1}	max. leakage current after 1 minute at U _R
I _{L5}	max. leakage current after 5 minutes at U _R
ESR	typical equivalent series resistance at 100 Hz
Z	impedance at 20 kHz
Tan δ	max. dissipation factor at 100 Hz

Table 2 Electrical data and ordering information for the 114 series; preferred types in bold

U _R (V)	C _R 100 Hz (µF)	NOMINAL CASE SIZE ØD × L (mm)	I _R 100 Hz 85 °C (A)	I _R 20 kHz 70 °C (A)	I _{L1} 1 min (mA)	I _{L5} 5 min (mA)	ESR TYP. 100 Hz (mΩ)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (mΩ)	Z MAX. 20 kHz (mΩ)	CATALOGUE NUMBER (see Table 3, note 1) 2222	
10	15000	35 × 60	6	11.4	0.90	0.30	20	0.32	13	20	114 14153	
	22000	35 × 80	7.5	14.2	1.32	0.43	14	0.33	9.5	14	114 14223	
	33000	35 × 105	10	19	1.98	0.66	10	0.35	7.5	10	114 14333	
	47000	50 × 80	14	26.5	2.82	0.94	7.5	0.36	5.0	9.5	114 14473	
	68000	50 × 105	18	34	4.08	1.36	5.5	0.38	4.0	8.0	114 14683	
	100000	65 × 105	30	50	6.00	2.00	3.5	0.34	3.0	5.0	114 14104	
	150000	65 × 105	30	50	9.00	3.00	3.0	0.45	3.0	5.0	114 14154	
	220000	75 × 105	37	50	13.20	4.40	2.0	0.45	2.5	4.0	114 14224	
	16	10000	35 × 60	6	11.4	0.96	0.32	22	0.22	13	20	114 15103
		15000	35 × 80	7.5	14.2	1.44	0.40	15	0.23	9.5	14	114 15153
22000		35 × 105	10	19	2.12	0.71	11	0.25	7.0	10	114 15223	
33000		50 × 80	13	24.6	3.17	1.06	7.5	0.26	5.0	9.5	114 15333	
47000		50 × 105	18	34	4.52	1.51	5.5	0.27	4.0	8.0	114 15473	
68000		65 × 105	28	50	6.53	2.18	3.5	0.24	3.0	5.0	114 15683	
100000	65 × 105	28	50	9.60	3.20	3.0	0.31	3.0	5.0	114 15104		
150000	75 × 105	37	50	14.40	4.80	2.0	0.31	2.5	4.0	114 15154		

Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR TYP. 100 Hz (m Ω)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (m Ω)	Z MAX. 20 kHz (m Ω)	CATALOGUE NUMBER (see Table 3, note 1) 2222
25	4700	35 × 60	5.2	10	0.71	0.24	30	0.14	15	23	114 16472
	6800	35 × 60	5.2	10	1.02	0.34	25	0.18	14	21	114 16682
	10000	35 × 80	6.7	12.7	1.50	0.50	18	0.18	10	15	114 16103
	15000	35 × 105	9.7	18.4	2.25	0.75	12	0.19	7.5	11	114 16153
	22000	50 × 80	12.5	23.7	3.30	1.10	8.5	0.19	5.5	9.5	114 16223
	33000	50 × 105	18	34	4.95	1.65	6.0	0.21	4.0	8.0	114 16333
	47000	65 × 105	27	50	7.05	2.35	4.0	0.18	3.0	5.0	114 16473
	68000	65 × 105	27	50	10.20	3.40	3.5	0.23	3.0	5.0	114 16683
	100000	75 × 105	37	50	15.00	5.0	2.5	0.23	2.5	4.0	114 16104
	40	3300	35 × 60	4.5	8.5	0.80	0.27	37	0.13	21	32
	4700	35 × 60	4.5	8.5	1.13	0.38	35	0.17	22	33	114 17472
	6800	35 × 80	6	11.4	1.64	0.55	25	0.17	15	23	114 17682
	10000	35 × 105	7.5	14.2	2.40	0.80	17	0.18	11	17	114 17103
	15000	50 × 80	10	19	3.60	1.20	11	0.17	7.5	13	114 17153
	22000	50 × 105	15	28.5	5.28	1.76	8.0	0.18	5.5	10.5	114 17223
	33000	65 × 105	21	40	7.92	2.64	5.0	0.16	3.5	6.0	114 17333
	47000	65 × 105	22	42	11.28	3.76	4.5	0.21	3.5	6.0	114 17473
	68000	75 × 105	30	50	16.32	5.44	3.0	0.21	3.0	4.5	114 17683
63	2200	35 × 60	3.7	7	0.84	0.28	39	0.09	22	33	114 18222
	3300	35 × 60	3.7	7	1.25	0.42	32	0.11	20	30	114 18332
	4700	35 × 80	5.2	10	1.78	0.66	23	0.11	14	21	114 18472
	6800	35 × 105	7.5	14.2	2.57	0.86	17	0.11	10	15	114 18682
	10000	50 × 80	9.5	18	3.78	1.26	12	0.12	7.5	14	114 18103
	15000	50 × 105	13.5	25.6	5.67	1.89	8.5	0.13	5.5	10.5	114 18153
	22000	65 × 105	21	40	8.32	2.77	5.0	0.11	3.5	6.0	114 18223
	33000	65 × 105	22	42	12.48	4.16	4.5	0.14	3.5	6.0	114 18333
	47000	75 × 105	30	50	17.77	5.92	3.0	0.14	3.0	4.5	114 18473

Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR TYP. 100 Hz (m Ω)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (m Ω)	Z MAX. 20 kHz (m Ω)	CATALOGUE NUMBER (see Table 3, note 1) 2222
100	1000	35 × 60	3.0	5.7	0.60	0.20	85	0.09	45	67	114 19102
	1500	35 × 60	3.3	6.3	0.90	0.30	65	0.10	40	60	114 19152
	2200	35 × 80	4.6	8.7	1.32	0.41	45	0.10	28	42	114 19222
	3300	35 × 105	6.5	12.3	1.98	0.66	30	0.10	19	28	114 19332
	4700	50 × 80	7.4	14.0	2.82	0.94	27	0.11	17	25	114 19472
	6800	50 × 105	9.9	18.8	4.08	1.36	19	0.11	12	18	114 19682
	10000	65 × 105	15.0	28.5	6.00	2.00	11	0.11	7	11	114 19103
	15000	65 × 105	15.8	30.0	9.00	3.00	10	0.12	6	10	114 19153
	22000	75 × 105	20.5	38.9	13.20	4.40	7	0.12	5	8	114 19223

Table 3 Electrical data and ordering information for the 115 series; preferred types in bold

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR TYP. 100 Hz (m Ω)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (m Ω)	Z MAX. 20 kHz (m Ω)	CATALOGUE NUMBER (see note 1) 2222	
250	330	35 × 60	1.8	3.4	0.50	0.17	300	0.15	275	500	115 13331	
	470	35 × 80	2.5	4.7	0.71	0.24	250	0.15	140	375	115 13471	
	680	35 × 105	3.5	6.6	1.02	0.34	180	0.15	125	300	115 13681	
	1000	50 × 80	4.2	8	1.50	0.50	110	0.15	60	130	115 13102	
	1500	50 × 105	6.3	12	2.25	0.75	60	0.15	40	100	115 13152	
	2200	65 × 105	8.8	16.7	3.30	1.10	45	0.15	30	60	115 13222	
	3300	65 × 105	10.5	20	4.95	1.65	30	0.15	25	50	115 13332	
	4700	75 × 105	14	26.5	7.05	2.35	25	0.15	20	40	115 13472	
	350	220	35 × 60	1.9	3.6	0.47	0.16	360	0.10	220	480	115 15221
		330	35 × 80	2.5	4.8	0.70	0.23	245	0.10	150	320	115 15331
470		35 × 105	3.2	6.1	0.99	0.33	175	0.10	105	230	115 15471	
680		50 × 80	3.9	7.0	1.47	0.48	140	0.10	60	130	115 15681	
1000		50 × 105	5.4	9.7	2.14	0.71	65	0.10	50	100	115 15102	



Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 85 °C (A)	I_R 20 kHz 70 °C (A)	I_{L1} 1 min (mA)	I_{L5} 5 min (mA)	ESR TYP. 100 Hz (m Ω)	Tan δ MAX. 100 Hz	Z TYP. 20 kHz (m Ω)	Z MAX. 20 kHz (m Ω)	CATALOGUE NUMBER (see note 1) 2222
350	1500	65 × 105	7.7	14.8	3.15	1.05	55	0.10	30	70	115 15152
	2200	65 × 105	9.1	17.5	4.62	1.54	35	0.10	22	50	115 15222
	3300	75 × 105	10.8	19.4	6.93	2.31	30	0.12	20	45	115 15332
385	150	35 × 60	1.0	1.8	0.34	0.12	730	0.12	450	935	115 18151
	220	35 × 80	1.4	2.6	0.50	0.17	520	0.12	310	630	115 18221
	330	35 × 105	1.9	3.6	0.75	0.25	340	0.12	210	425	115 18331
	470	50 × 80	2.7	5.1	1.06	0.36	200	0.12	140	300	115 18471
	680	50 × 105	3.6	6.9	1.53	0.51	140	0.12	100	205	115 18681
	1000	65 × 105	5.1	9.7	2.25	0.75	95	0.12	65	125	115 18102
	1500	65 × 105	5.7	10.6	3.38	1.13	80	0.12	45	95	115 18152
400	2200	75 × 105	7.3	13.8	4.95	1.65	55	0.12	40	75	115 18222
	150	35 × 60	1.0	1.8	0.36	0.12	730	0.12	450	935	115 16151
	220	35 × 80	1.4	2.6	0.53	0.18	520	0.12	310	630	115 16221
	330	35 × 105	1.9	3.6	0.79	0.26	340	0.12	210	425	115 16331
	470	50 × 80	2.7	5.1	1.13	0.38	200	0.12	140	300	115 16471
450	680	50 × 105	3.6	6.9	1.63	0.54	140	0.12	100	205	115 16681
	1000	65 × 105	5.1	9.7	2.40	0.80	95	0.12	65	125	115 16102
	1500	65 × 105	5.7	10.6	3.60	1.20	80	0.12	45	95	115 16152
450	2200	75 × 105	7.3	13.8	5.28	1.76	55	0.12	40	75	115 16222

Note

- Catalogue number applies to the ST version; for STB version (not preferred) replace 8th digit by '5' (2222 114/115 5....).

Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≤250 V versions	$U_s = 1.15 \times U_R$
	≥350 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 35 \text{ mm}$	typ. 13 nH
	case $\varnothing D = 50 \text{ mm}$	typ. 16 nH
	case $\varnothing D = 65 \text{ mm}$	typ. 19 nH
	case $\varnothing D = 75 \text{ mm}$	typ. 20 nH

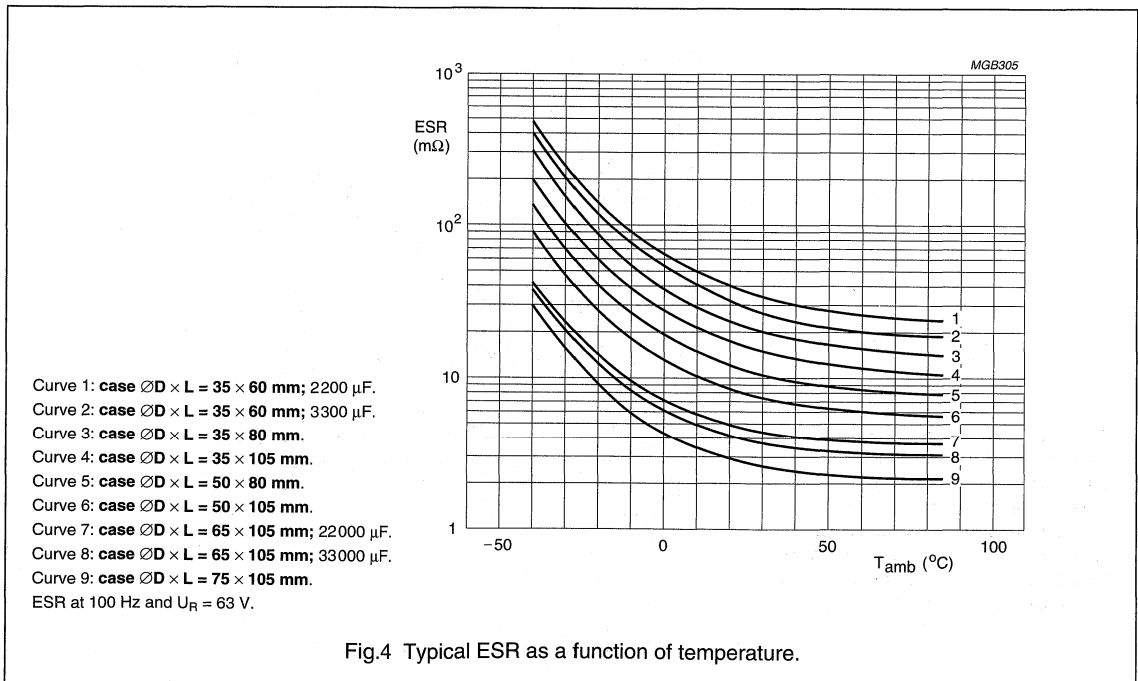
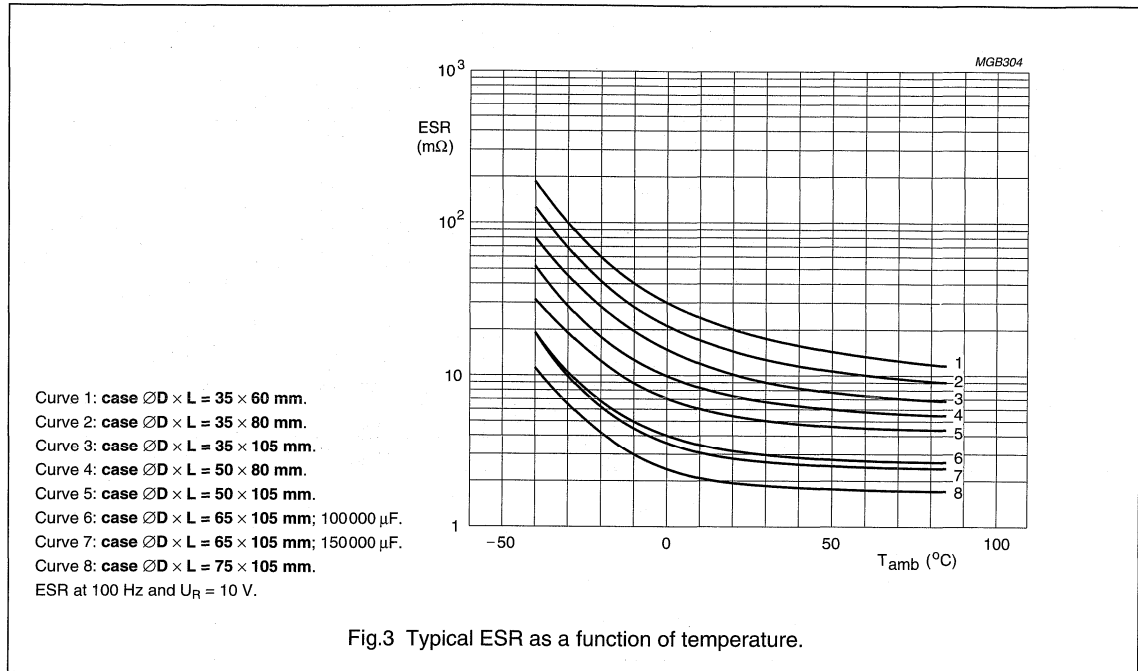


Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST

Equivalent series resistance (ESR)



Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST

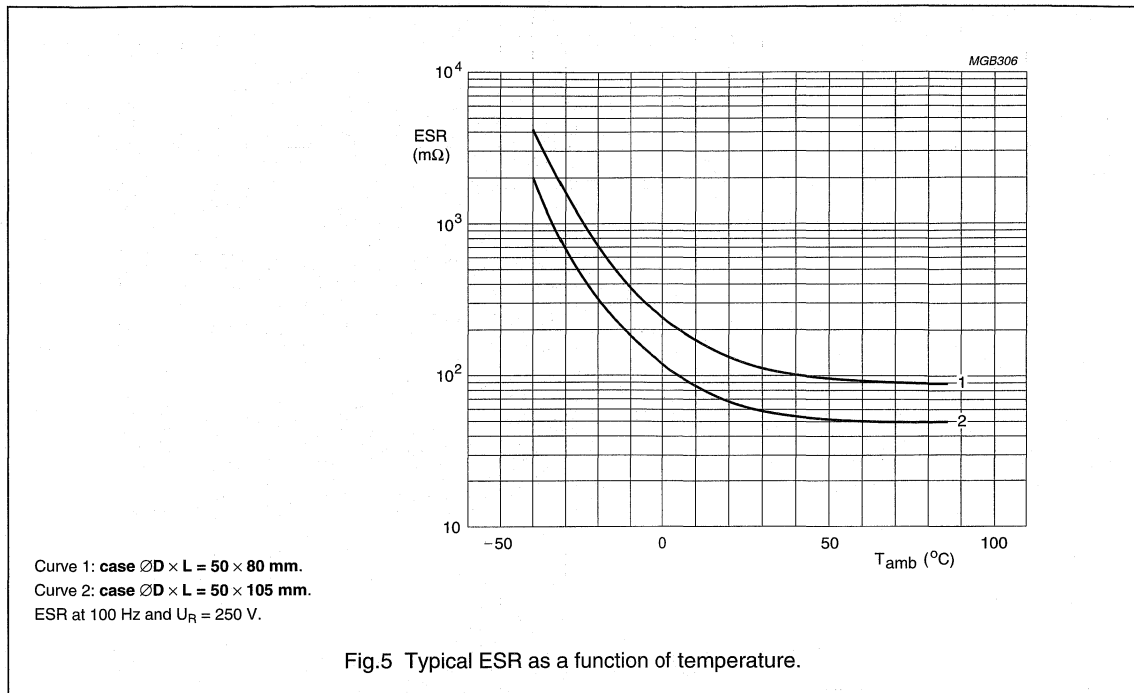


Fig.5 Typical ESR as a function of temperature.

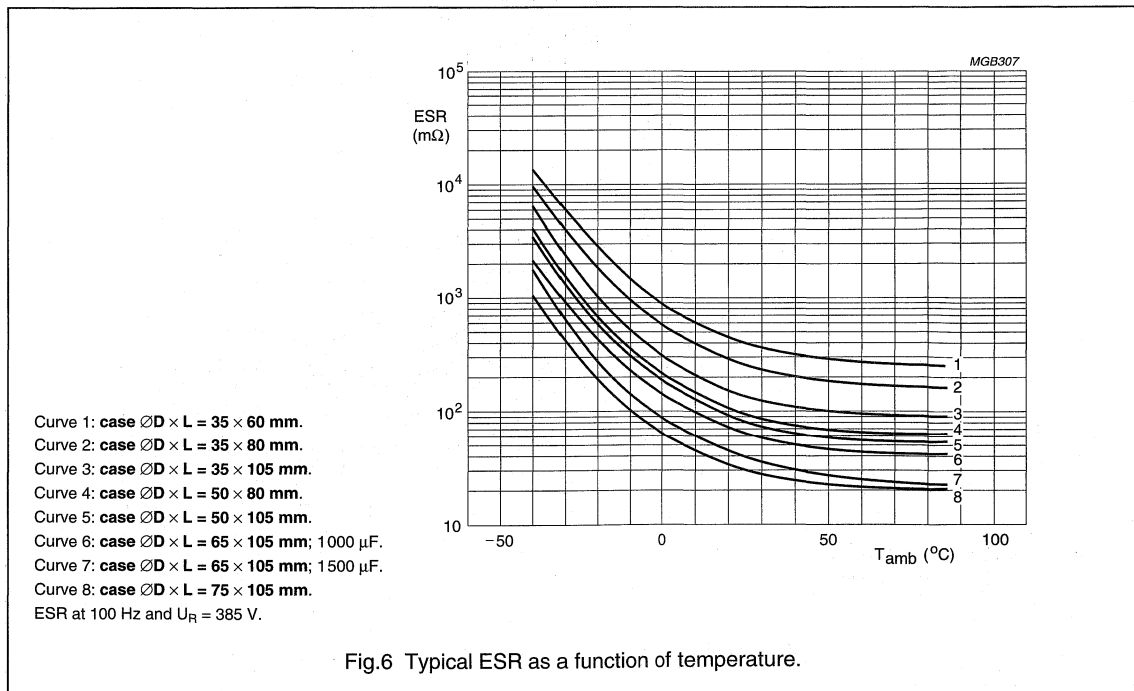


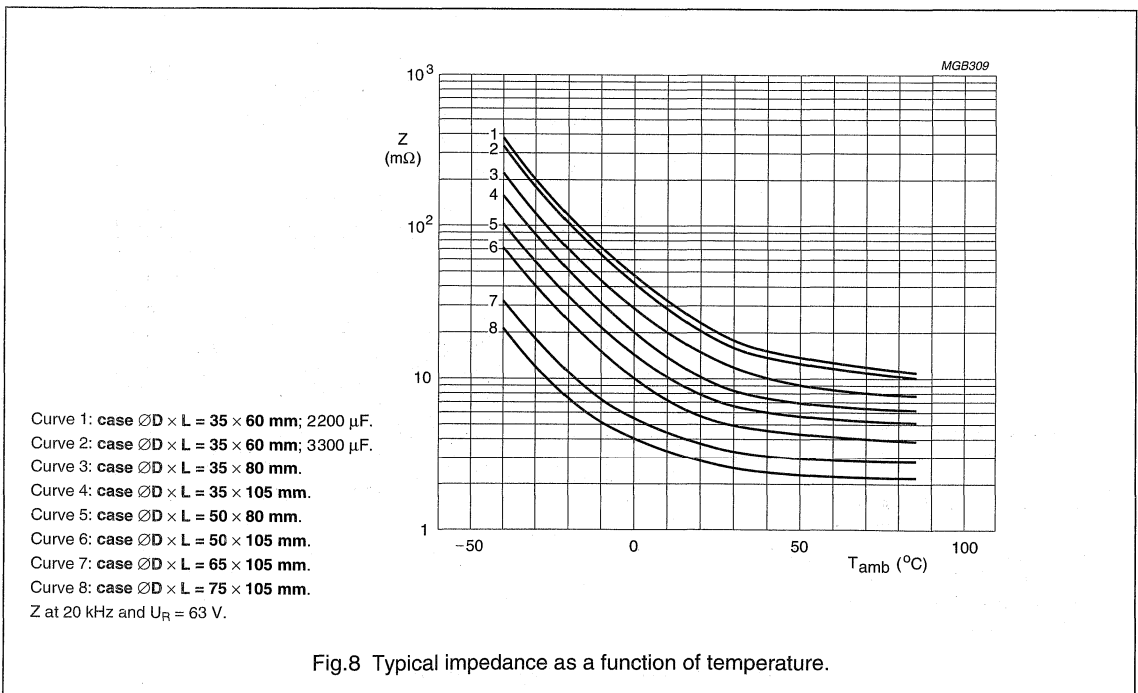
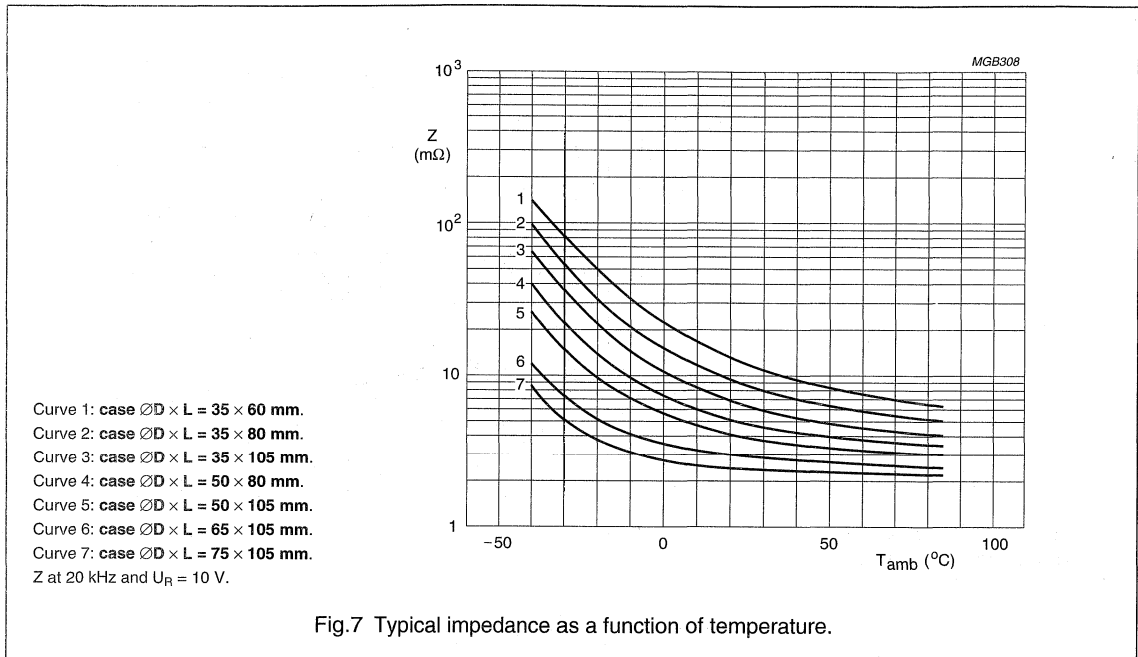
Fig.6 Typical ESR as a function of temperature.

Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

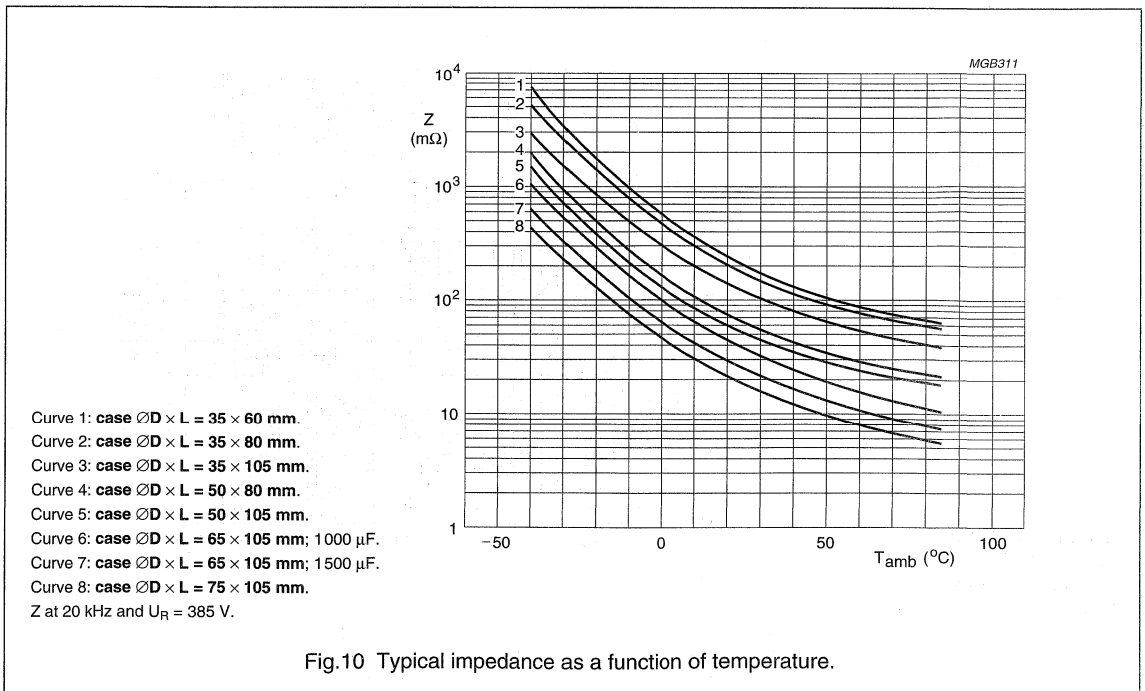
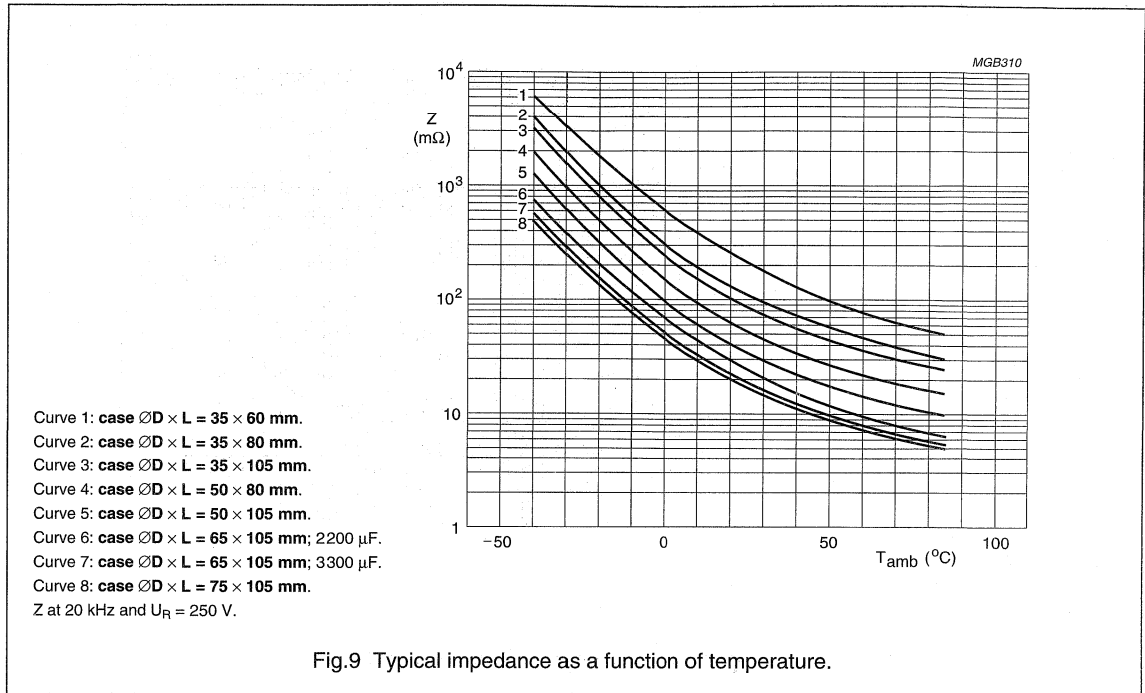
114/115 PED-ST

Impedance (Z)



Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST



Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST

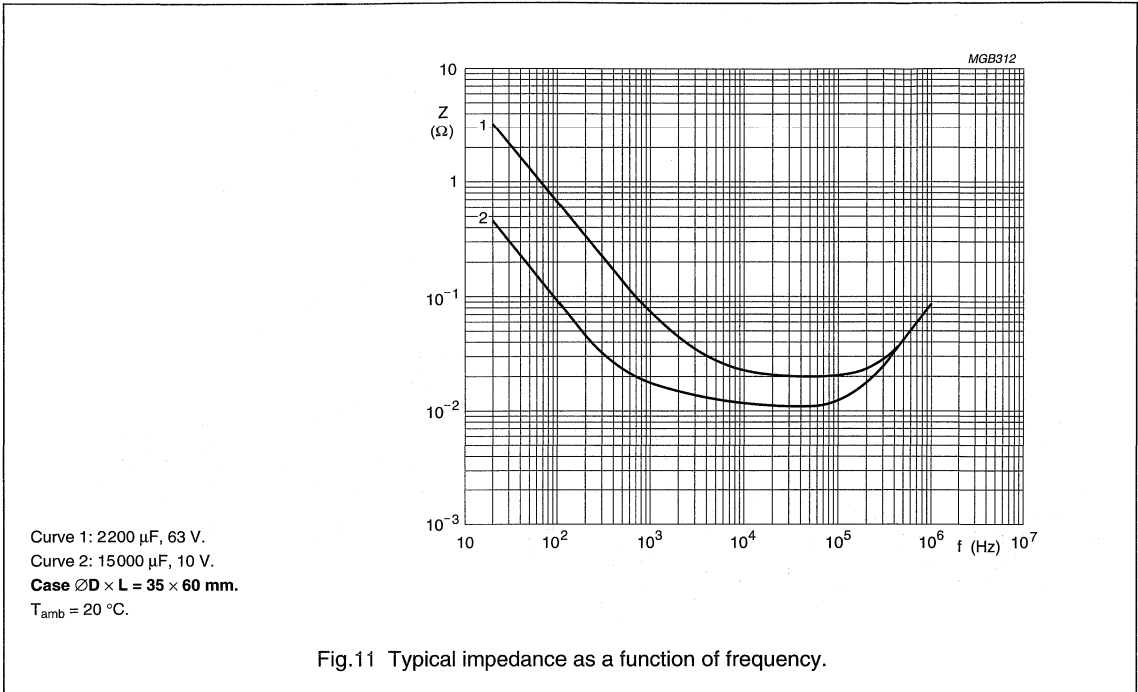


Fig.11 Typical impedance as a function of frequency.

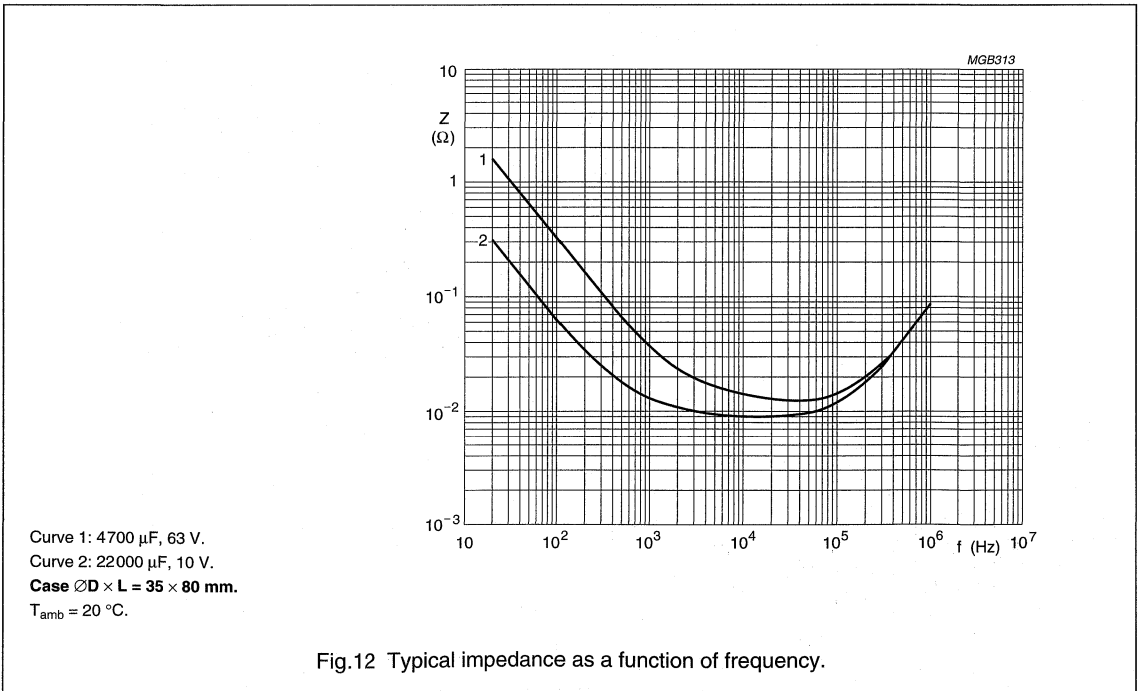


Fig.12 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST

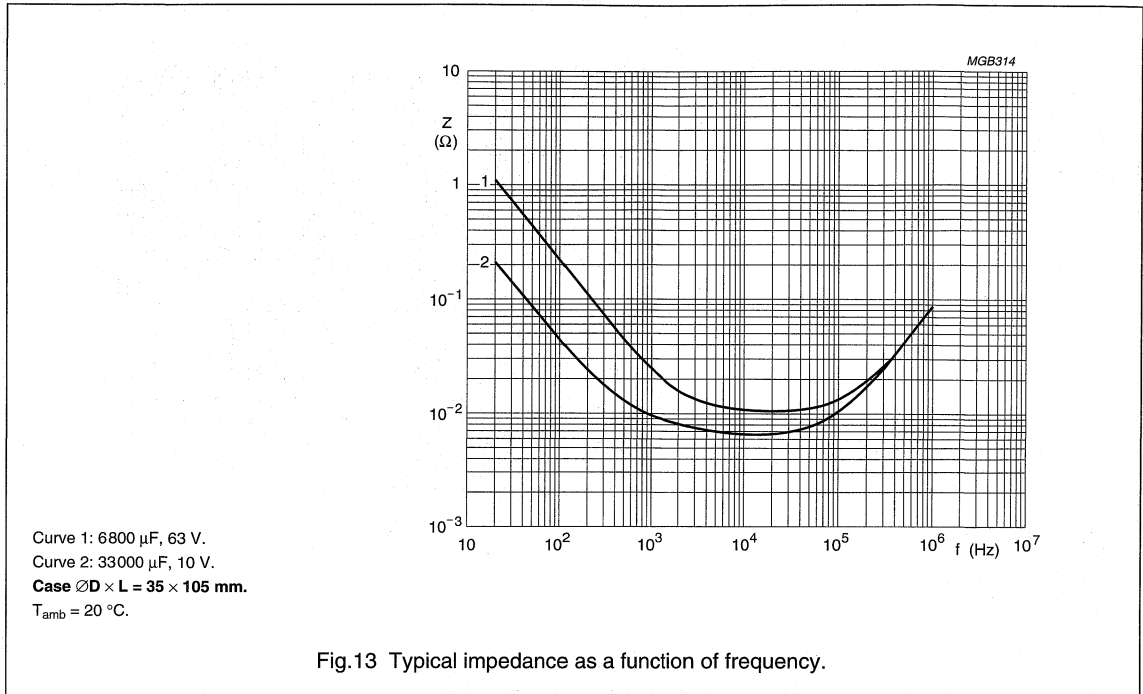


Fig.13 Typical impedance as a function of frequency.

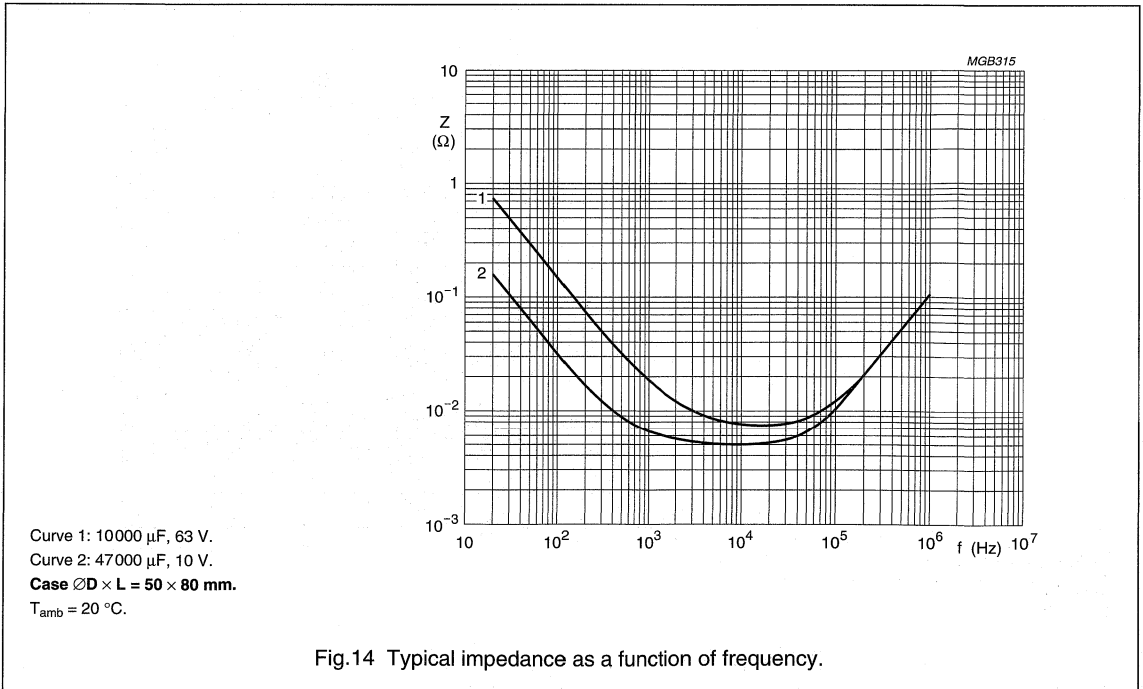
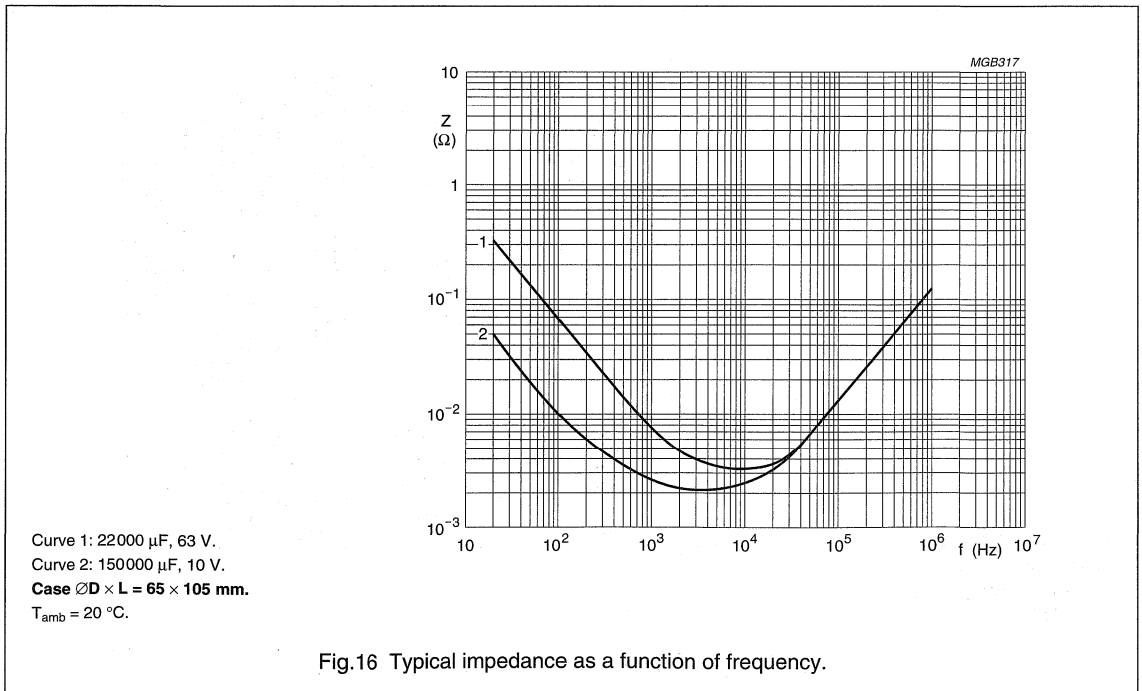
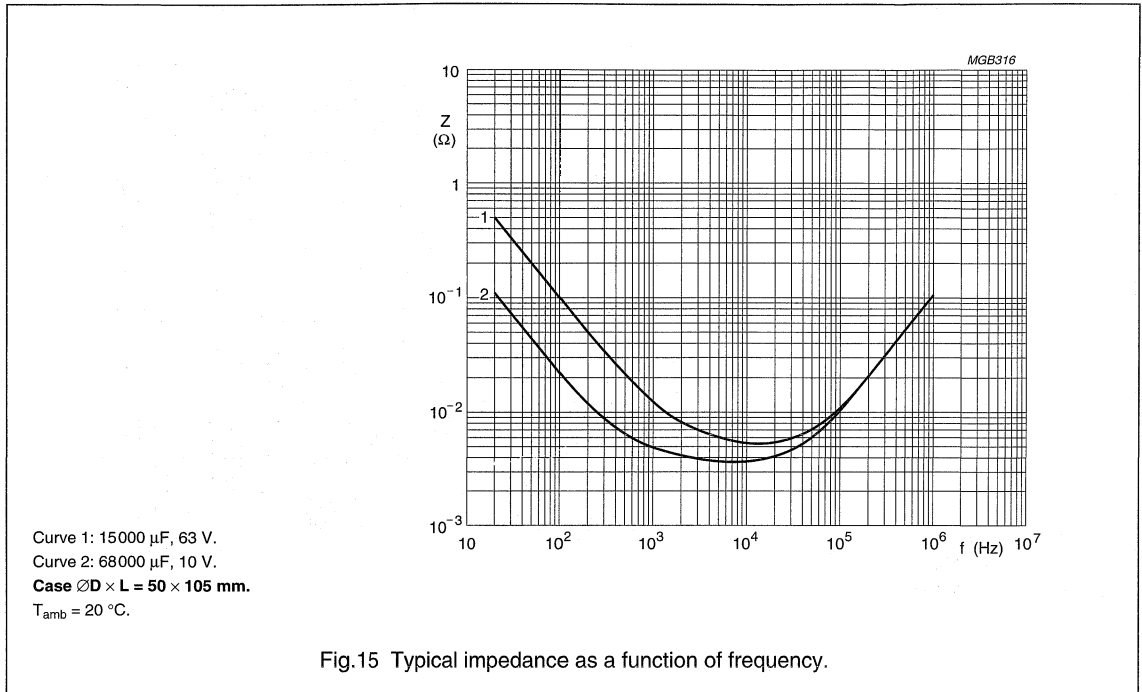


Fig.14 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST



Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST

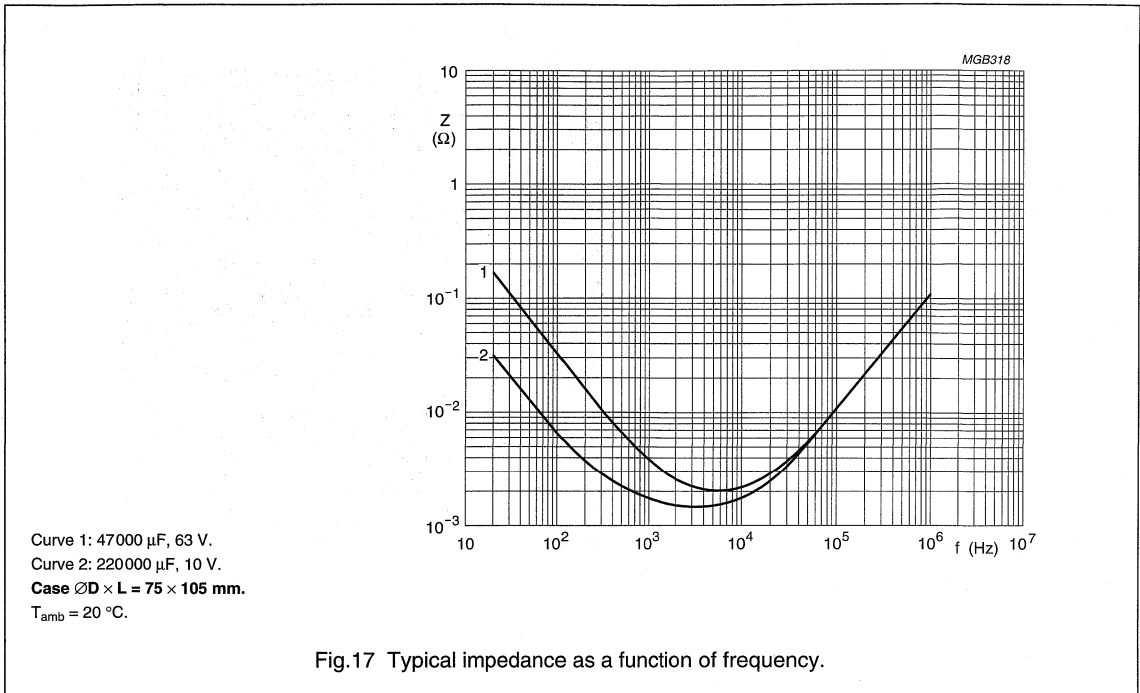


Fig.17 Typical impedance as a function of frequency.

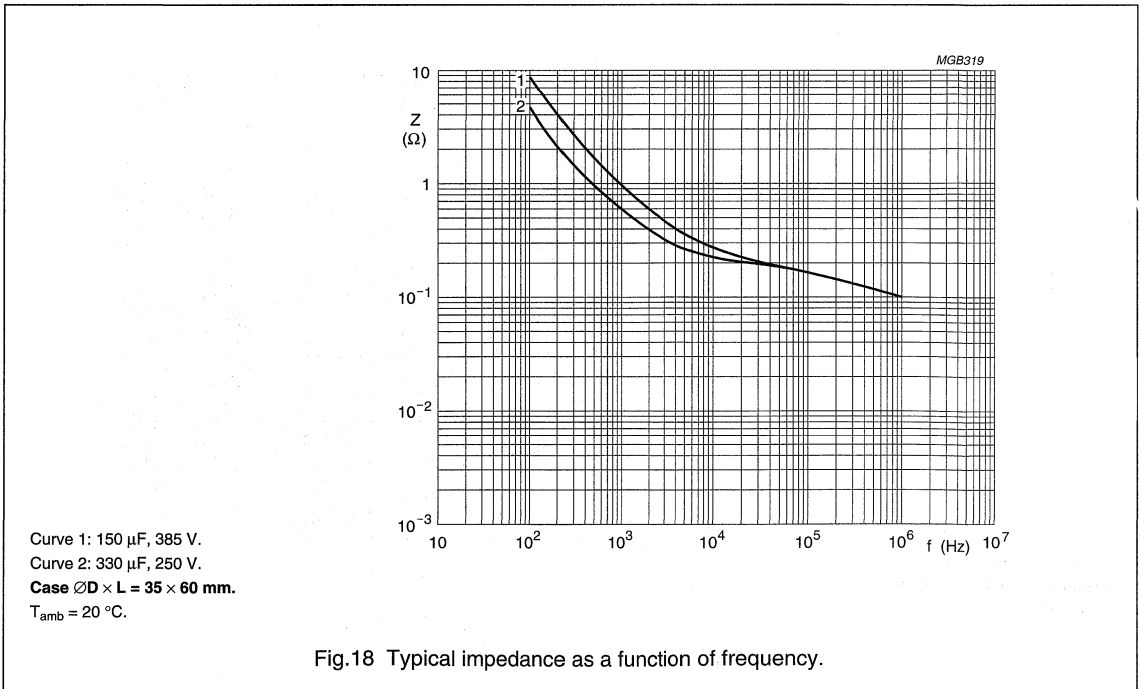


Fig.18 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

114/115 PED-ST

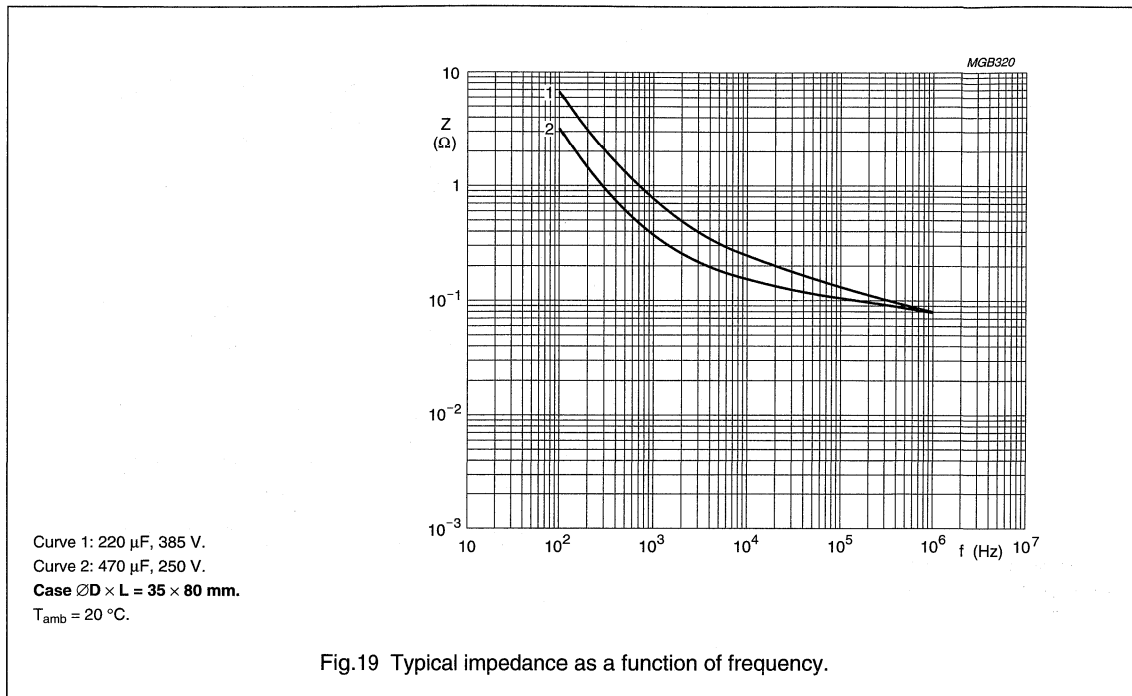


Fig.19 Typical impedance as a function of frequency.

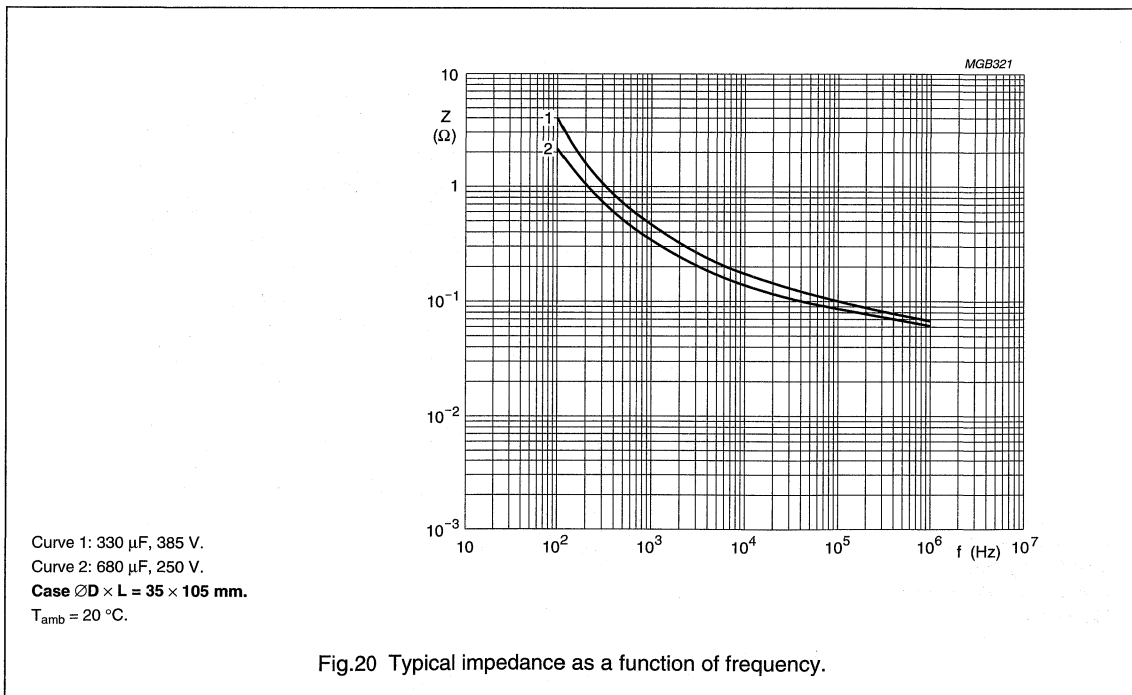
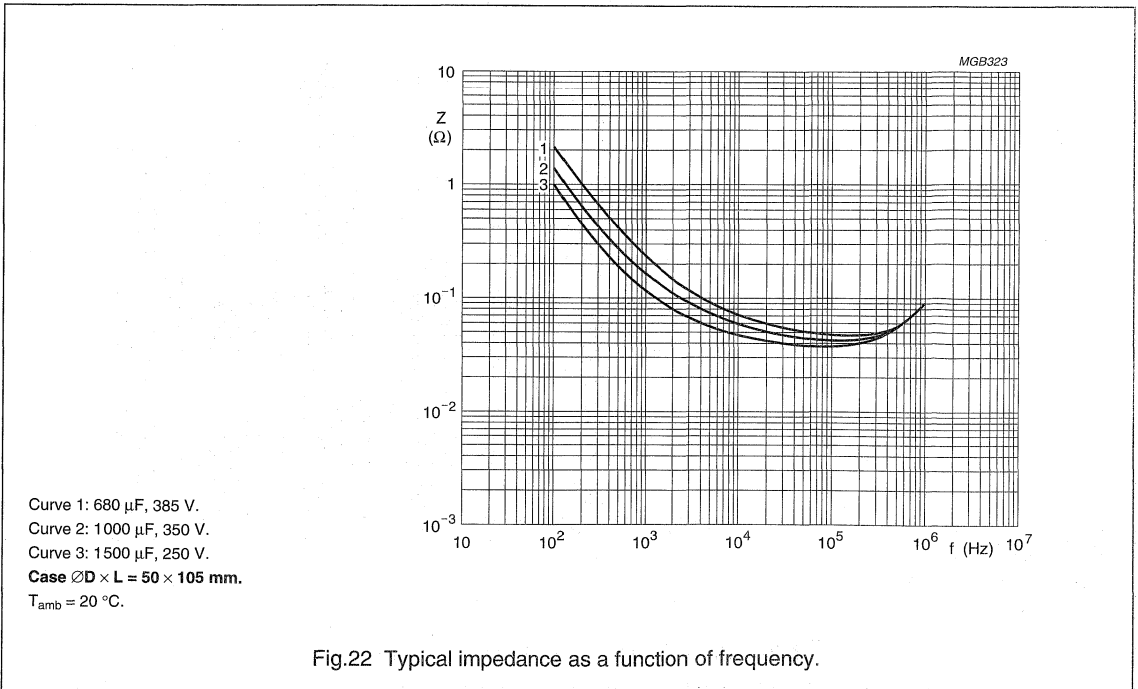
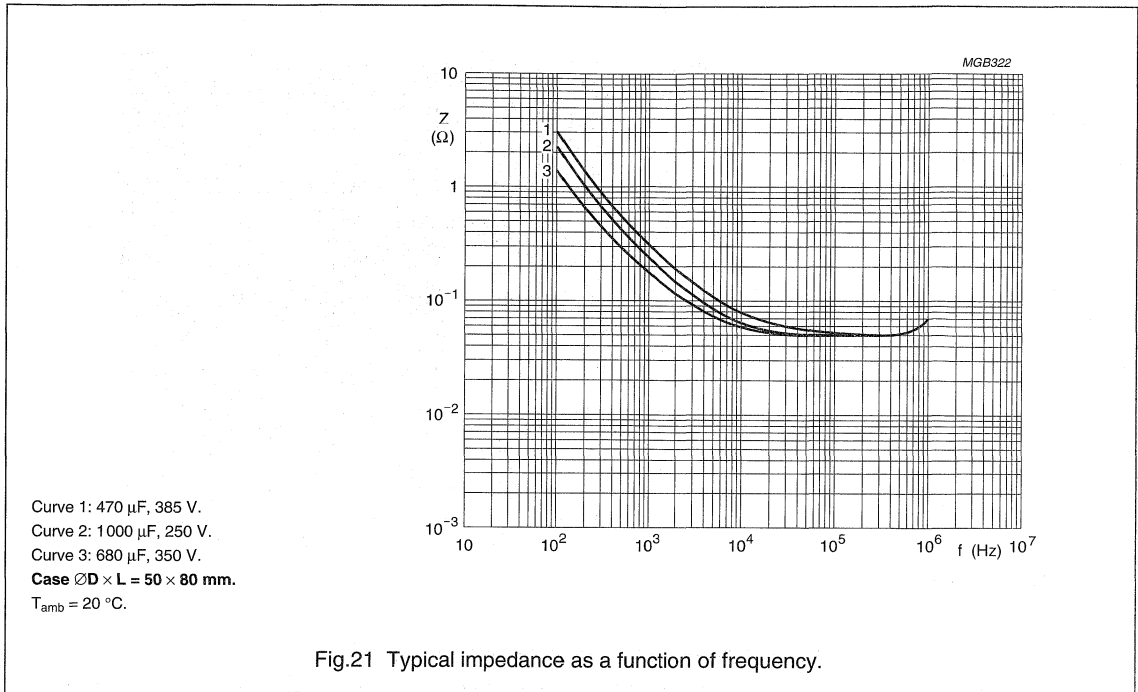


Fig.20 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors
Power Eurodin Screw Terminals

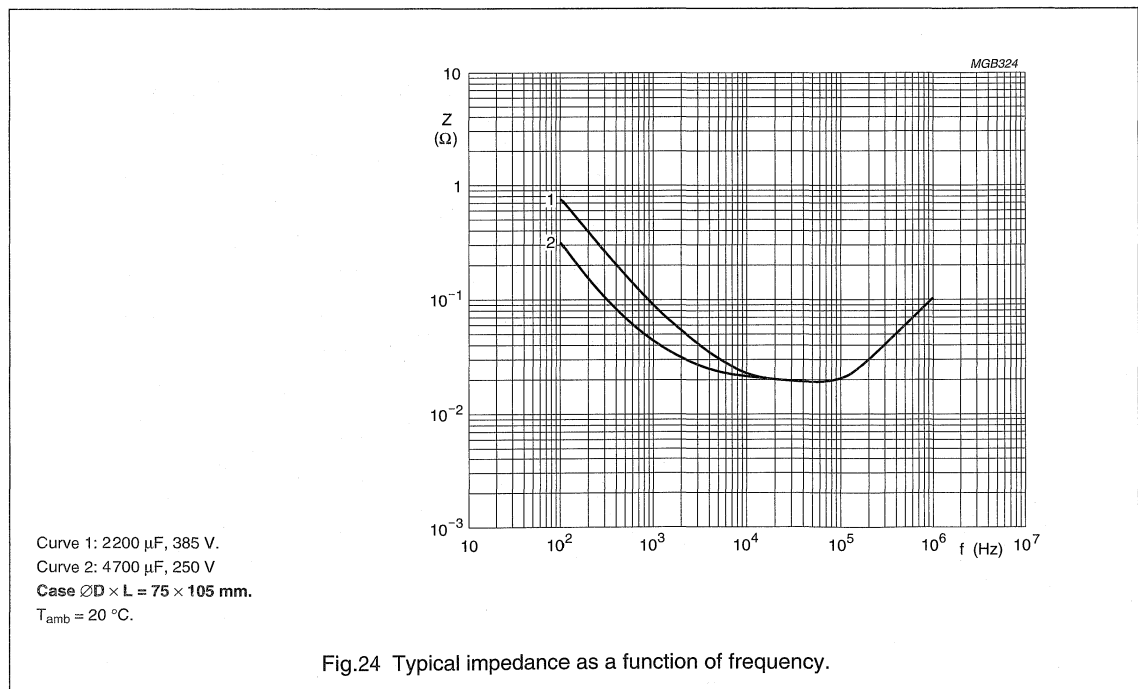
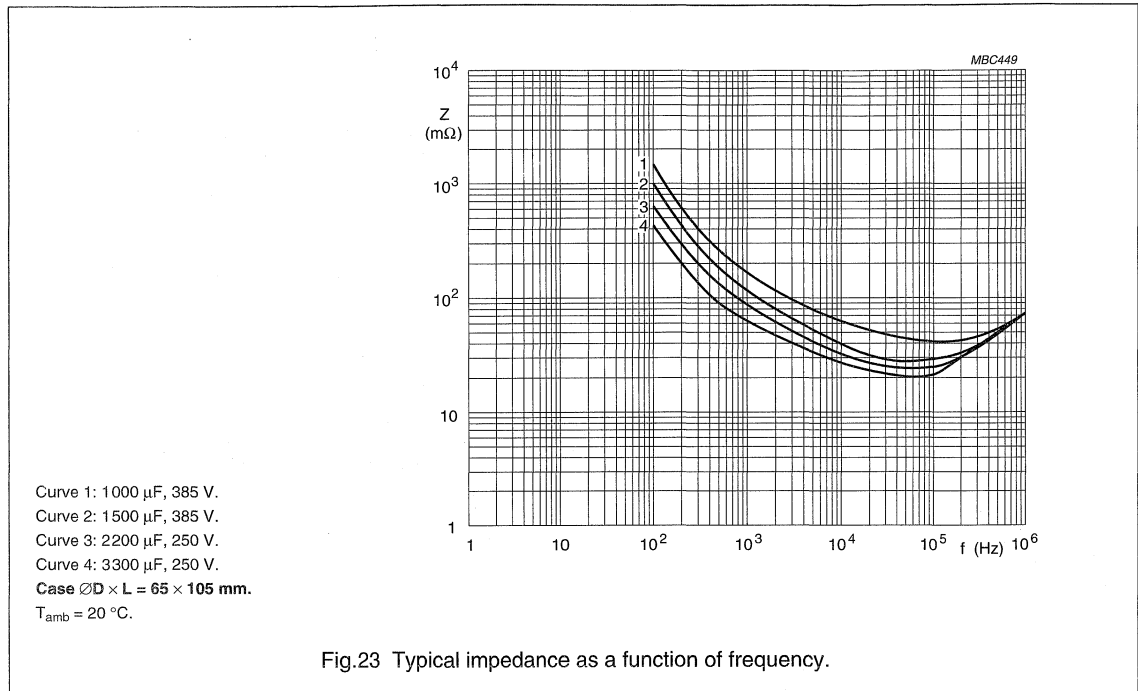
114/115 PED-ST



Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST



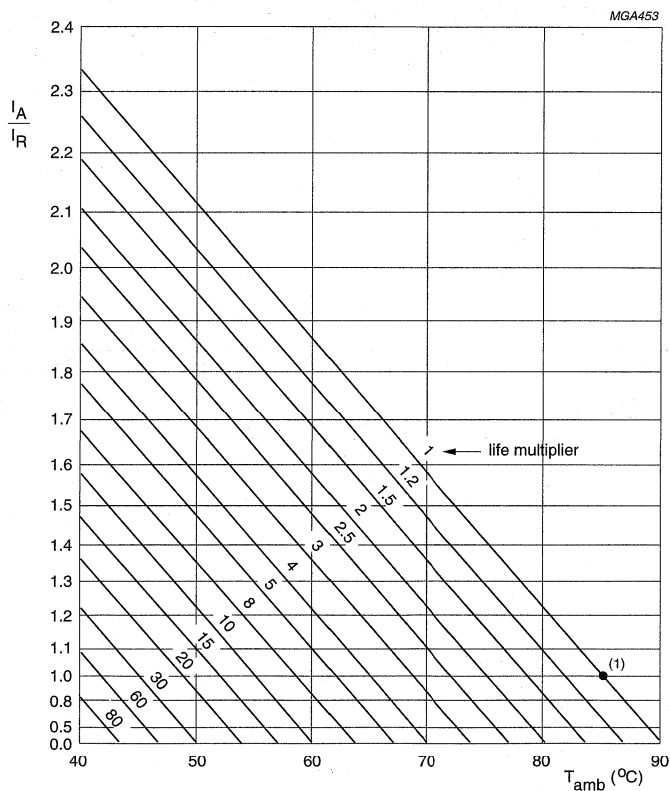
Aluminum electrolytic capacitors Power Eurodin Screw Terminals

114/115 PED-ST

RIPPLE CURRENT AND USEFUL LIFE

Table 4 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER
50	0.83
100	1.00
200	1.10
400	1.15
1000	1.19
≥ 2000	1.20



I_A = actual ripple current at 100 Hz and 85 °C.

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

With an absolute maximum of 50 A at 85 °C

(1) Useful life at 85 °C and I_R applied: 20000 hours (12000 hours for 400 V types).

Fig.25 Multiplier of useful life as a function of ambient temperature and ripple current load.

Aluminum electrolytic capacitors

Power Eurodin Screw Terminals

114/115 PED-ST

SPECIFIC TESTS AND REQUIREMENTS

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

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; 8000 hours (400 V types: 5000 hours)	$U_R \leq 100\text{ V}$; $\Delta C/C$: $\pm 15\%$ $U_R > 100\text{ V}$; $\Delta C/C$: $\pm 10\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied; 20000 hours (400 V types: 12000 hours)	$U_R \leq 100\text{ V}$; $\Delta C/C$: $\pm 45\%$ $U_R > 100\text{ V}$; $\Delta C/C$: $\pm 30\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}$: $\leq 1\%$; $U_R > 100\text{ V}$: $\leq 3\%$
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	$\Delta C/C$: $\pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$

Electrolytic capacitors

Mounting accessories

MECHANICAL DATA

Clamps for ST-types: 086/087 PS-ST; 088/089 PHC-ST

To facilitate vertical mounting, a series of rigid clamps made of zinc plated steel are available.

The clamps have either two or three mounting lugs, may be easily slipped over the capacitor and then clamped with

a nut and bolt. Five types of clamps are available, one for each case diameter.

They are delivered without nuts or bolts.

To avoid damaging the insulation sleeve, do not overtighten the clamp screw.

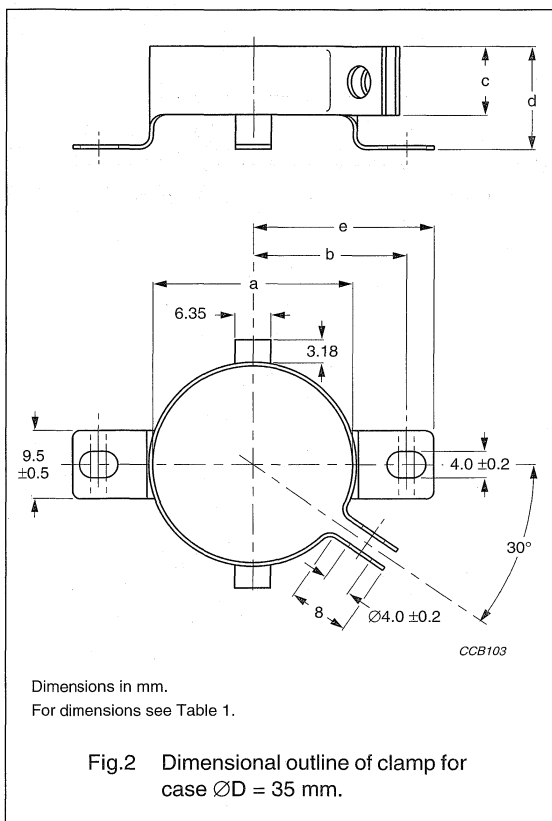
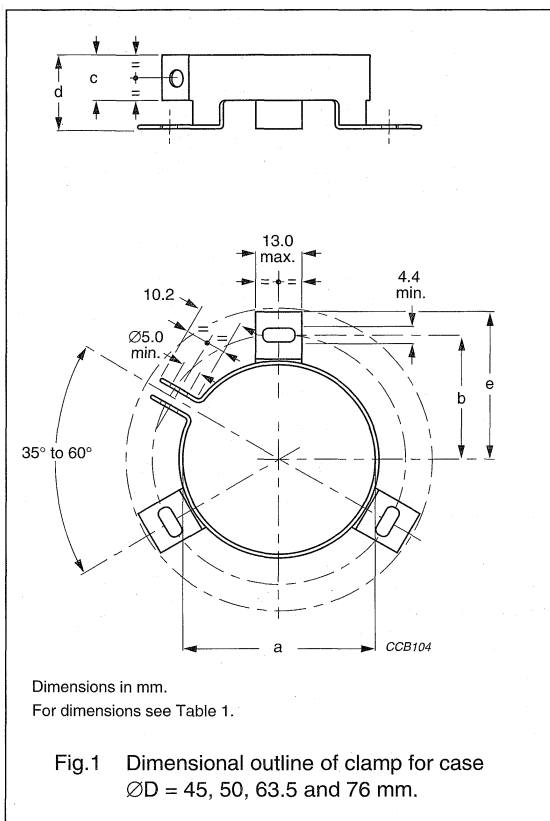


Table 1 Clamp dimensions; see Figs 1 and 2

CASE DIAMETER (mm)	a (mm)	b (mm)	c (mm)	d (mm)	e (mm)	CATALOGUE NUMBER
35	34.92 ±0.13	23.01 ±0.79	14.25 ±0.40	19.05 ±0.79	29.36 ±0.79	4322 043 17521
45	44.45 ±0.13	28.57 ±0.79	19.05 ±0.40	28.57 ±0.79	33.35 ±0.79	4322 043 17481
50	50.80 ±0.13	31.75 ±0.79	19.05 ±0.40	28.57 ±0.79	36.51 ±0.79	4322 043 17491
63.5	63.50 ±0.13	38.10 ±0.79	19.05 ±0.40	28.57 ±0.79	42.87 ±0.79	4322 043 17501
76	76.20 ±0.13	44.45 ±0.79	19.05 ±0.40	28.57 ±0.79	49.22 ±0.79	4322 043 17511

Electrolytic capacitors

Mounting accessories

Clamps for ST types:**154/155 PEC-ST; 114/115 PED-ST**

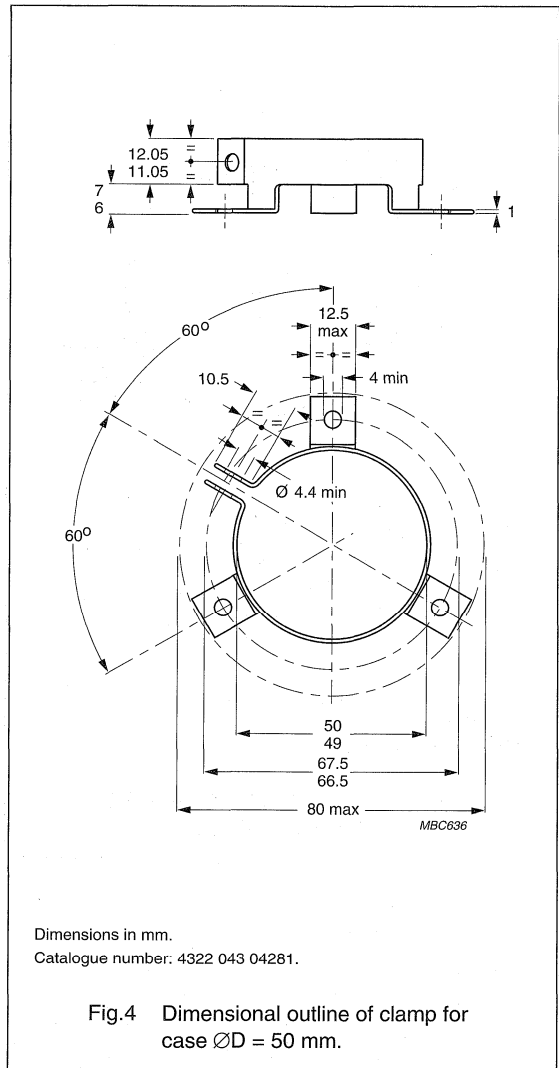
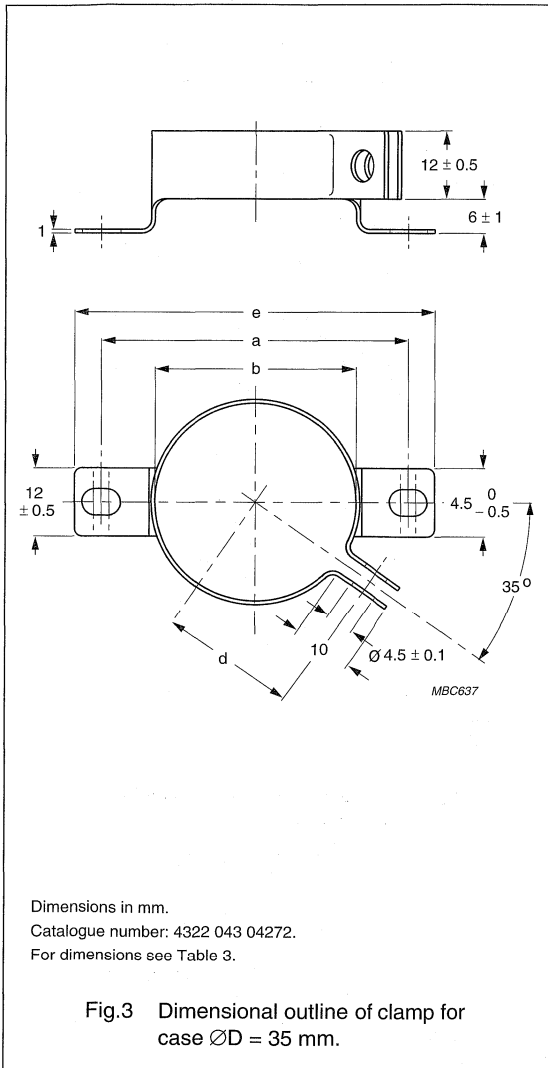
To facilitate vertical mounting, a series of rigid clamps made of zinc plated steel are available.

The clamps have either two or three mounting lugs, may be easily slipped over the capacitor and then clamped with

a nut and bolt. Four types of clamps are available, one for each case diameter.

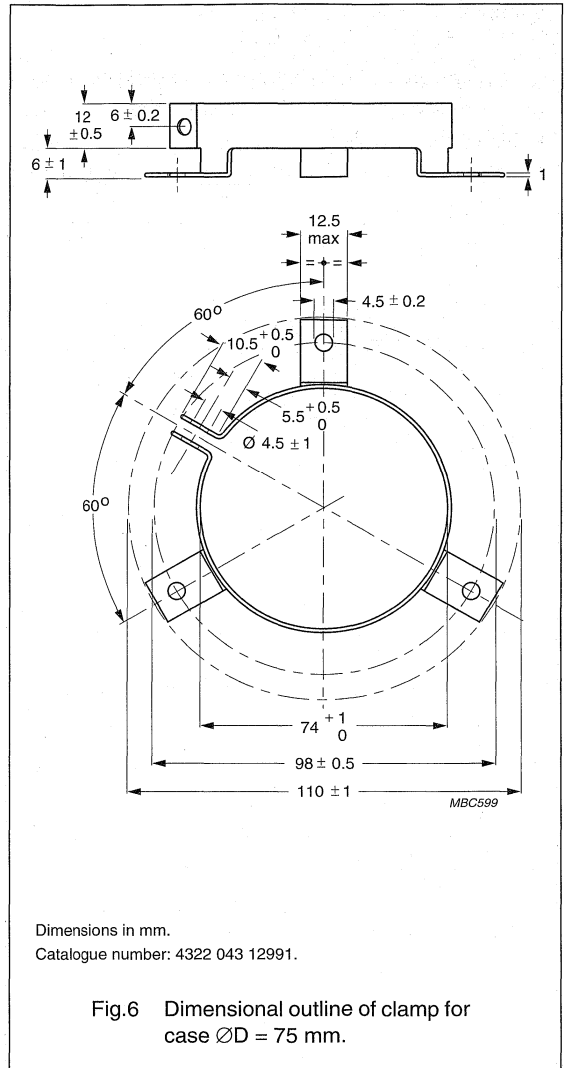
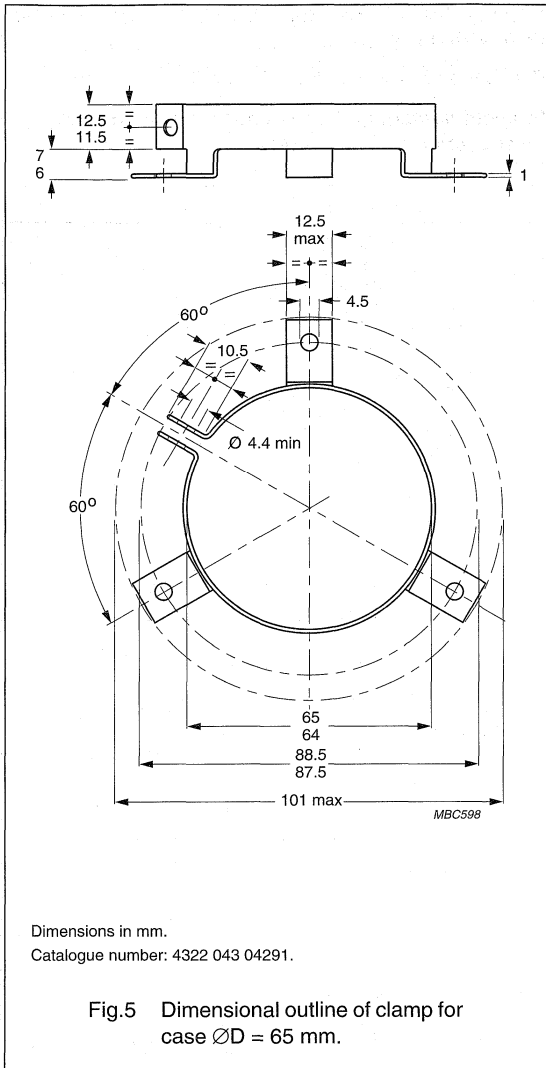
They are delivered without nuts or bolts.

To avoid damaging the insulation sleeve, do not overtighten the clamp screw.



Electrolytic capacitors

Mounting accessories



Electrolytic capacitors

Mounting accessories

Nuts and washers for STB-versions

When mounting with the bolt, which is an integral part of the case, standard metal M8 and M12 nuts and washers may be used; the maximum permissible torque is 4 Nm for M8 nuts and 10 Nm for M12 nuts.

If insulated mounting is required, synthetic nuts and rubber washers are available; for these nuts the maximum permissible torque is 2 Nm (M8) and 4 Nm (M12).

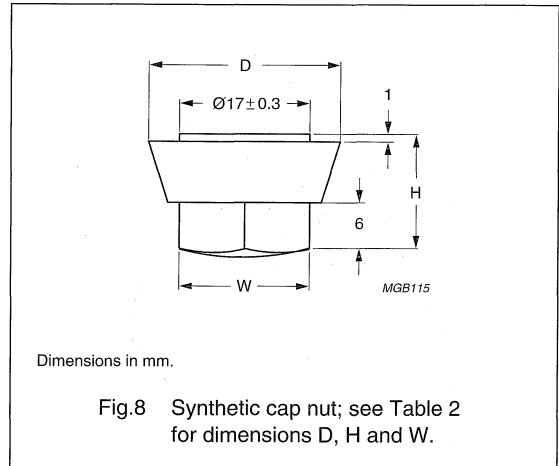
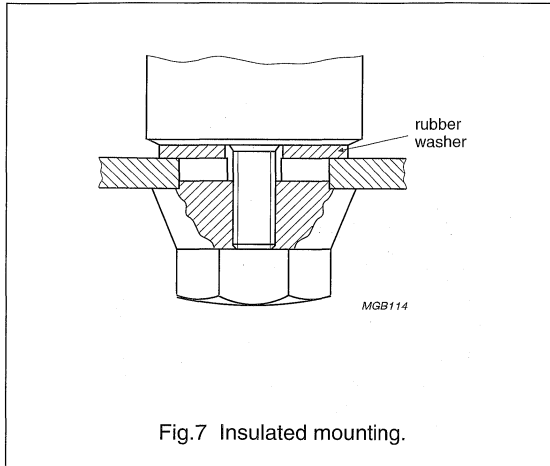
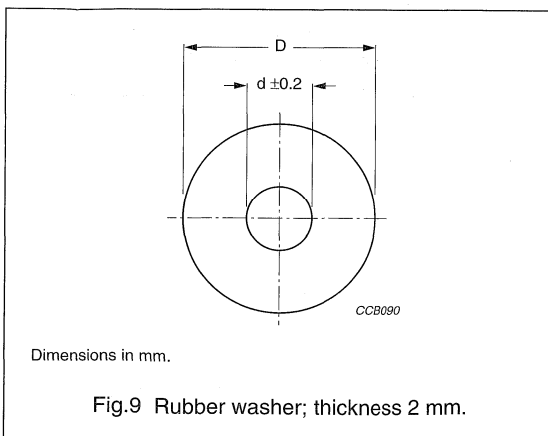


Table 2 Dimensions of synthetic cap nut; see Fig.8

CASE DIAMETER (mm)	THREAD	D (mm)	H (mm)	W ⁽¹⁾ (mm)	MIN. THREADED DEPTH (mm)	CATALOGUE NUMBER
35	M8	25	15	17	11.5	4322 043 05561
≥50	M12	30	20	19	15.5	4322 043 05571

Note

1. Dimension W is measured across flats.



Rubber washer ordering codes

D (mm)	d (mm)	CATALOGUE NUMBER
34	8.4	4322 043 05591
49	13.0	4322 043 05531
64	13.0	4322 043 05521
74	13.0	4322 043 13001

Electrolytic capacitors

Mounting accessories

Clamps for SL-versions, ØD = 25, 30, 35 and 40 mm

To facilitate vertical mounting, a series of rigid clamps made of zinc plated steel are available.

The clamps have two mounting lugs, may be easily slipped over the capacitor and then clamped with a nut and bolt.

Four types of clamps are available, one for each case diameter.

They are delivered without nuts or bolts.

To avoid damaging the insulation sleeve, do not overtighten the clamp screw.

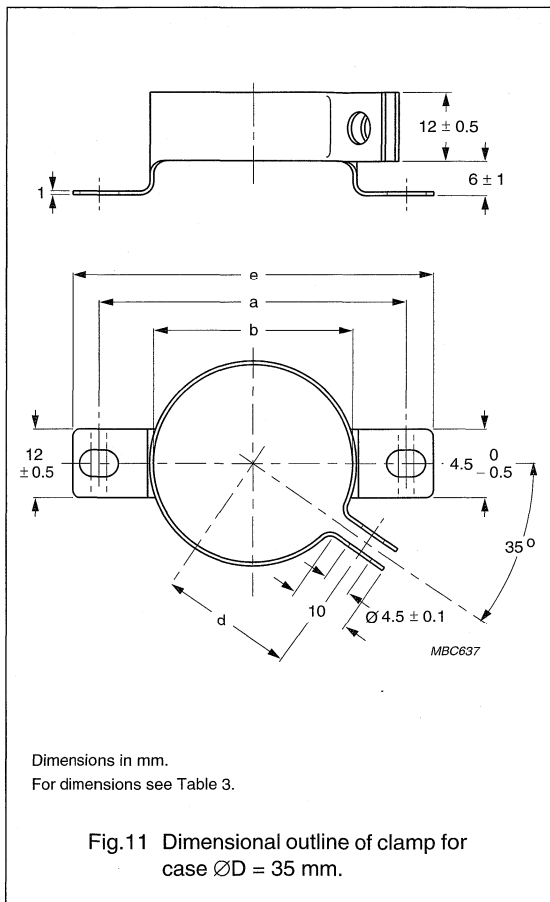
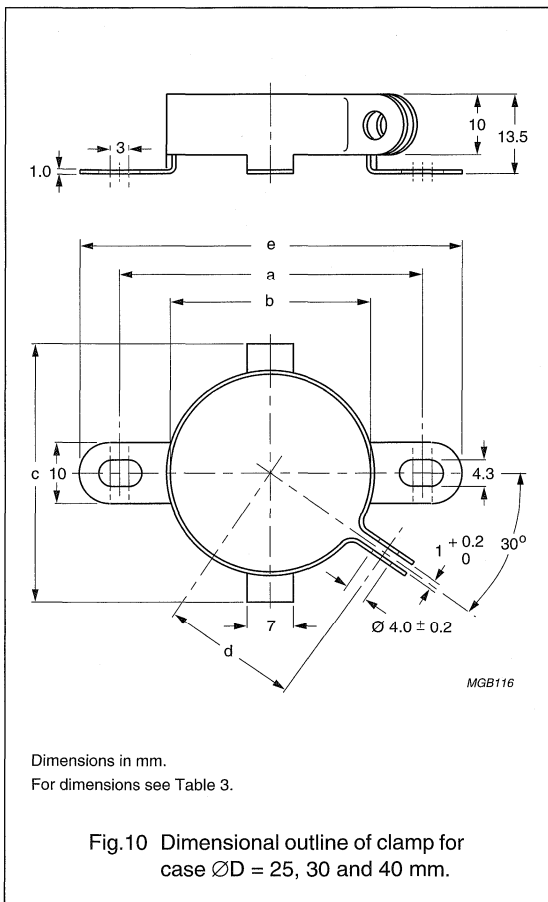
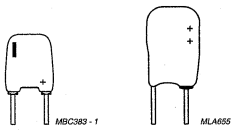


Table 3 Clamp dimensions; see Figs 3, 10 and 11

CASE DIAMETER (mm)	a (mm)	b (mm)	c (mm)	d (mm)	e (mm)	CATALOGUE NUMBER
25	41.5 ± 0.2	25	35	18.5	56	4322 043 03301
30	46.5 ± 0.2	30	40	21	61	4322 043 03311
35	51.5 ± 0.2	35	—	23.5	63	4322 043 04272
40	56.5 ± 0.2	40	50	26	71	4322 043 03331

SOLID ALUMINUM (SAL) ELECTROLYTIC CAPACITORS

**RADIAL
(pearl)**

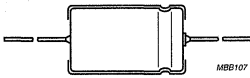


MBC283-1 MLA655

PROFESSIONAL
20000 hours / 125 °C

128 SAL-RPM H: 9 mm page 778	122 SAL-RP H: 12 mm page 797
-------------------------------------------	-------------------------------------------

AXIAL



MBB107

123 SAL-A page 815

CCB110

Aluminum electrolytic capacitors

Solid Al, Radial Pearl Miniature

128 SAL-RPM

FEATURES

- Polarized aluminum electrolytic capacitors, solid electrolyte MnO_2
- Radial leads, max. height 9.5 mm, resin dipped, orange coloured
- Extremely long useful life, 20000 hours/125 °C
- Extended usable temperature range up to 175 °C
- Excellent low temperature, impedance and ESR behaviour
- Charge and discharge proof, application with 0 Ω resistance allowed
- Reverse DC voltage up to $0.3 \times U_R$ allowed
- AC voltage up to $0.8 \times U_R$ allowed
- Advanced technology to achieve high reliability and high stability.

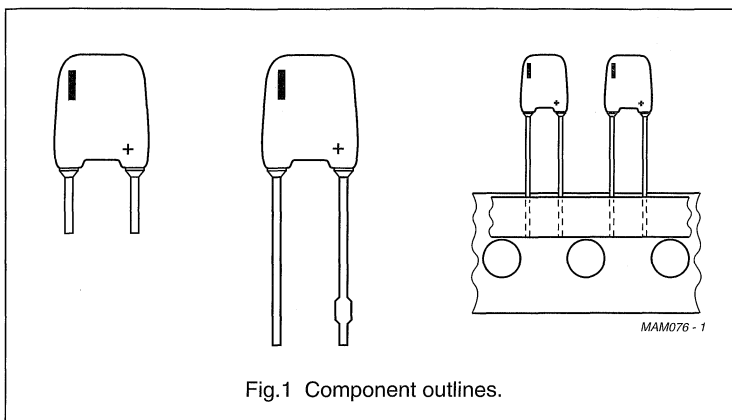
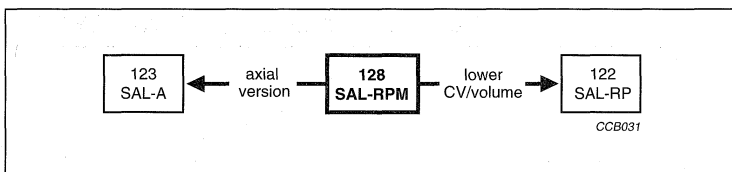


Fig.1 Component outlines.



APPLICATIONS

- EDP, telecommunication, general industrial, automotive and audio-video
- Smoothing, filtering and buffering
- For small power supplies, DC/DC converters.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($H_{\max} \times W_{\max} \times T_{\max}$ in mm)	$9.5 \times 7 \times 3$ to $9.5 \times 8 \times 6$
Rated capacitance range (E6 series), C_R	0.1 to 68 μF
Tolerance on C_R	$\pm 20\%$
Rated voltage range, U_R	6.3 to 40 V
Category temperature range: $U_R = 6.3$ to 40 V $U_C = 6.3$ to 25 V	-55 to $+85$ °C -55 to $+125$ °C
Endurance test at 125 °C	10000 hours
Useful life at 125 °C	20000 hours
Useful life at 175 °C	2000 hours
Useful life at 40 °C, I_R applied	>300000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/125/56

Aluminum electrolytic capacitors

Solid Al, Radial Pearl Miniature

128 SAL-RPM

Selection chart for C_R , U_R , U_C and relevant maximum case sizes ($H \times W \times T$ in mm)

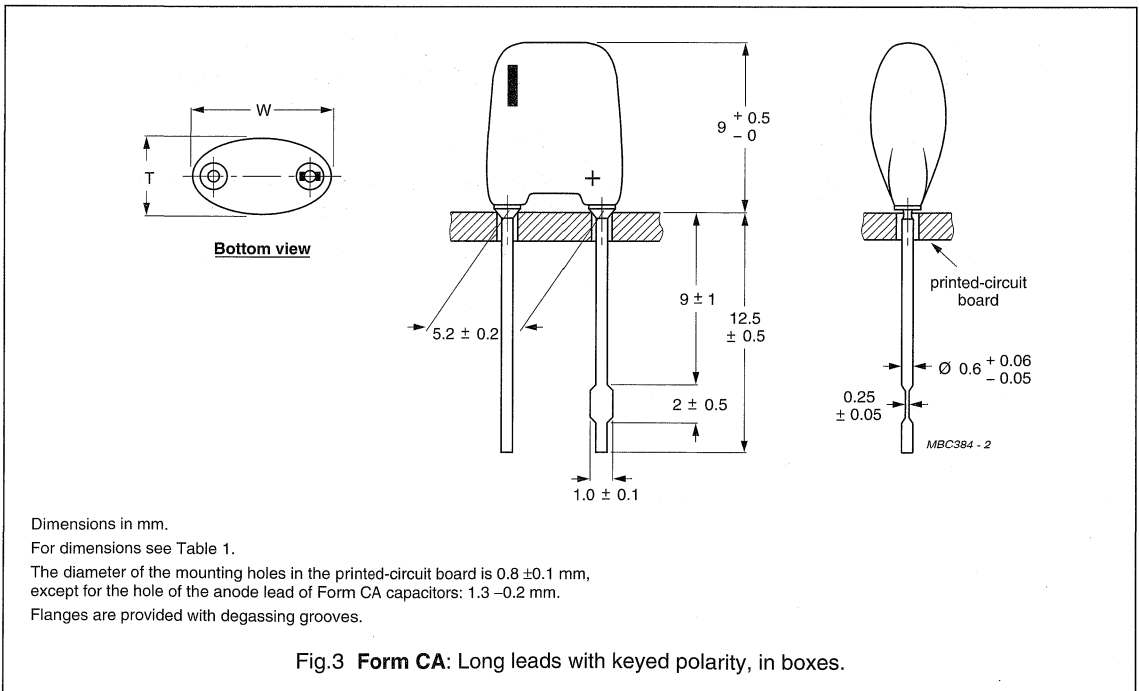
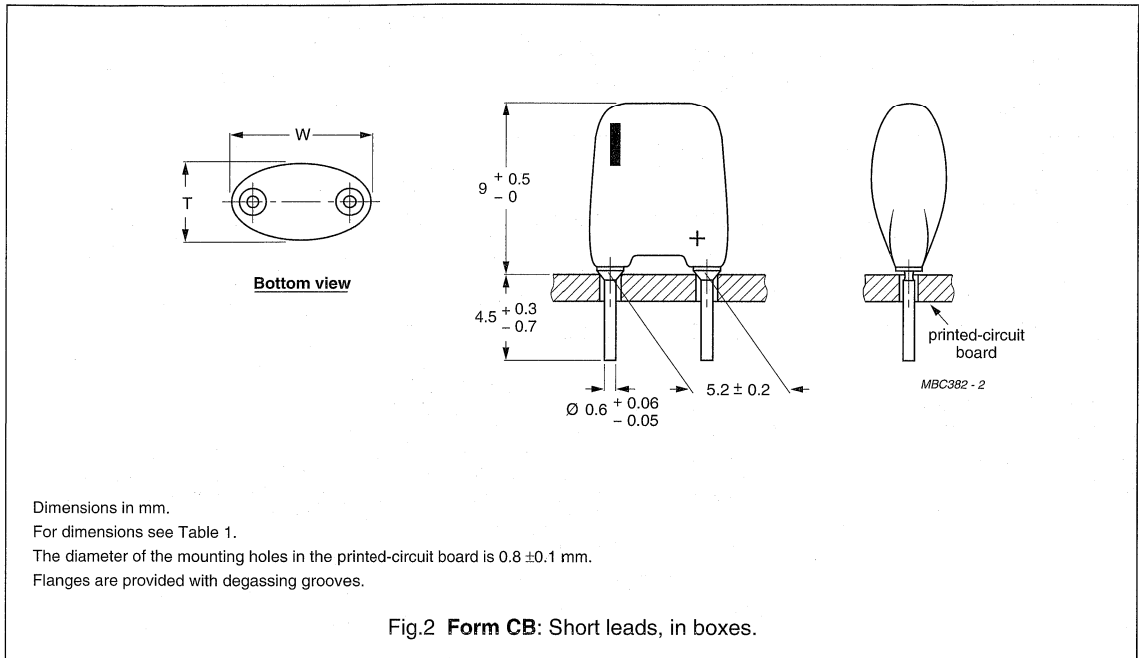
Preferred types in **bold**.

C_R (μF)	U_R (V) at $T_{amb} = 85^\circ C$					
	6.3	10	16	25	35	40
	U_C (V) at $T_{amb} = 125^\circ C$					
	6.3	10	16	25	25	25
0.1	–	–	–	–	–	9.5 × 7 × 3
0.15	–	–	–	–	–	9.5 × 7 × 3
0.22	–	–	–	–	–	9.5 × 7 × 3.5
0.33	–	–	–	–	9.5 × 7 × 3.5	9.5 × 7 × 4
0.47	–	–	–	–	9.5 × 7 × 4	9.5 × 7 × 5
0.68	–	–	–	9.5 × 7 × 3.5	9.5 × 7 × 4	9.5 × 7 × 5
1	–	–	–	9.5 × 7 × 3.5	9.5 × 7 × 5	9.5 × 8 × 5
1.5	–	–	–	9.5 × 7 × 3.5	9.5 × 8 × 5	9.5 × 8 × 6
2.2	–	–	9.5 × 7 × 3.5	9.5 × 7 × 4	9.5 × 8 × 6	9.5 × 8 × 6
3.3	–	–	9.5 × 7 × 3.5	9.5 × 7 × 5	9.5 × 8 × 6	–
4.7	–	9.5 × 7 × 3.5	9.5 × 7 × 4	9.5 × 8 × 5	–	–
6.8	–	9.5 × 7 × 3.5	9.5 × 7 × 4	9.5 × 8 × 6	–	–
10	9.5 × 7 × 3.5	9.5 × 7 × 4	9.5 × 7 × 5	9.5 × 8 × 6	–	–
15	–	9.5 × 7 × 4	9.5 × 8 × 5	–	–	–
22	9.5 × 7 × 4	9.5 × 7 × 5	9.5 × 8 × 6	–	–	–
33	9.5 × 7 × 5	9.5 × 8 × 5	–	–	–	–
47	9.5 × 8 × 5	9.5 × 8 × 6	–	–	–	–
68	9.5 × 8 × 6	–	–	–	–	–

Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

128 SAL-RPM

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors

Solid Al, Radial Pearl Miniature

128 SAL-RPM

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

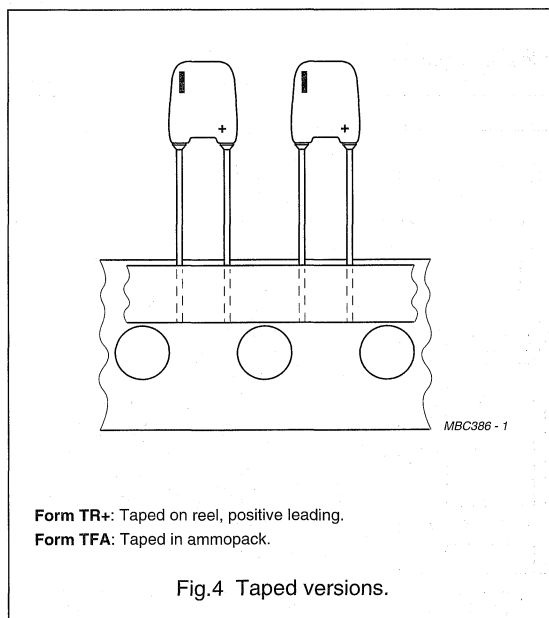
MAXIMUM CASE SIZE H × W × T (mm)	CASE CODE	MASS (g)	PACKAGING QUANTITIES			
			FORM CA (note 1)	FORM CB (note 1)	FORM TR+	FORM TFA
9.5 × 7 × 3	10	≈0.22	1000	1000	2000	1000
9.5 × 7 × 3.5	20	≈0.25	1000	1000	2000	1000
9.5 × 7 × 4	30	≈0.30	1000	1000	2000	1000
9.5 × 7 × 5	40	≈0.35	1000	1000	1000	1000
9.5 × 8 × 5	50	≈0.50	1000	1000	1000	1000
9.5 × 8 × 6	60	≈0.60	1000	1000	1000	1000

Note

1. In plastic bags of 200 units each.

TAPED PRODUCTS

Tape dimensions are specified in this handbook, section "Packaging".

**MARKING**

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for $\pm 20\%$)
- Rated voltage (in V) and category voltage if applicable
- Date code in accordance with "IEC 60062"
- Name of manufacturer
- '+' sign to indicate the anode terminal
- 'I' sign to indicate the cathode terminal.

MOUNTING

When bending, cutting or straightening the leads, ensure that the capacitor body is relieved of stress.

Bending after soldering must be avoided.

SAL

Aluminum electrolytic capacitors Solid Al, Radial Pearl Miniature

128 SAL-RPM

Ordering example

Electrolytic capacitors 128 series

10 $\mu\text{F}/16 \text{ V}$; $\pm 20\%$

Maximum case size: $9.5 \times 7 \times 5 \text{ mm}$; Form CB

Catalogue number: 2222 128 55109.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at $T_{\text{amb}} = 20$ to $25 \text{ }^\circ\text{C}$, $P = 86$ to 106 kPa , $\text{RH} = 45$ to 75% .

C_R	rated capacitance at 100 Hz, tolerance $\pm 20\%$
I_R	max. RMS ripple current no necessary DC applied
I_{L5}	max. leakage current after 5 minutes at U_R
$\text{Tan } \delta$	max. dissipation factor at 100 Hz; note 1
ESR	max. typ. equivalent series resistance at 100 Hz
Z	max. impedance at 100 kHz

Table 2 Electrical data and ordering information 128 series; preferred types in bold

U_C (V)	U_R (V)	C_R 100 Hz (μF)	MAXIMUM CASE SIZE $H \times W \times T$ (mm)	CASE CODE	I_R 100 Hz $125 \text{ }^\circ\text{C}$ (mA)	I_R 10 kHz $85 \text{ }^\circ\text{C}$ (mA)	I_R 100 kHz $40 \text{ }^\circ\text{C}$ (mA)	I_{L5} 5 min (μA)	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222 128....			
												FORM CB	FORM CA	FORM TR+ REEL	FORM TFA AMMO
10	6.3	10	$9.5 \times 7 \times 3.5$	20	22.4	320	595	2	20	8	2.0	53109	73109	23109	33109
		22	$9.5 \times 7 \times 4$	30	32.9	470	870	4	9	3.5	1.0	53229	73229	23229	33229
		33	$9.5 \times 7 \times 5$	40	65.4	595	1100	5	6.1	2	0.70	53339	73339	23339	33339
		47	$9.5 \times 8 \times 5$	50	118.4	740	1360	7	4.3	2	0.50	53479	73479	23479	33479
		68	$9.5 \times 8 \times 6$	60	153.0	800	1650	11	3.0	1.5	0.40	53689	73689	23689	33689
		4.7	$9.5 \times 7 \times 3.5$	20	16.1	230	425	2	43	16	3.00	54478	74478	24478	34478
16	10	6.8	$9.5 \times 7 \times 3.5$	20	18.9	270	500	2	30	12	2.20	54688	74688	24688	34688
		10	$9.5 \times 7 \times 4$	30	21.7	310	573	3	20	9	1.70	54109	74109	24109	34109
		15	$9.5 \times 7 \times 4$	30	27.3	390	720	4	14	7	1.20	54159	74159	24159	34159
		22	$9.5 \times 7 \times 5$	40	51.7	470	870	6	9	3.5	0.90	54229	74229	24229	34229
		33	$9.5 \times 8 \times 5$	50	81.6	510	940	8	6.1	2	0.60	54339	74339	24339	34339
		47	$9.5 \times 8 \times 6$	60	105.4	620	1140	12	4.3	1.5	0.40	54479	74479	24479	34479
16	16	2.2	$9.5 \times 7 \times 3.5$	20	14.0	200	370	2	91	25	4.50	55228	75228	25228	35228
		3.3	$9.5 \times 7 \times 3.5$	20	16.1	230	425	2	61	26	3.30	55338	75338	25338	35338
		4.7	$9.5 \times 7 \times 4$	30	18.9	270	500	2	43	14	2.30	55478	75478	25478	35478
		6.8	$9.5 \times 7 \times 4$	30	22.4	320	590	3	30	11	1.65	55688	75688	25688	35688
		10	$9.5 \times 7 \times 5$	40	42.9	390	720	4	20	6	1.10	55109	75109	25109	35109
		15	$9.5 \times 8 \times 5$	50	71.2	445	820	6	14	5	0.85	55159	75159	25159	35159
16	16	22	$9.5 \times 8 \times 6$	60	86.7	510	940	9	9	3.5	0.65	55229	75229	25229	35229

Aluminum electrolytic capacitors

Solid Al, Radial Pearl Miniature

128 SAL-RPM

U _C (V)	U _R (V)	C _R 100 Hz (μF)	MAXIMUM CASE SIZE H × W × T (mm)	CASE CODE	I _R 100 Hz 125 °C (mA)	I _R 10 kHz 85 °C (mA)	I _R 100 kHz 40 °C (mA)	I _{L5} 5 min (μA)	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222 128.....			
												FORM CB	FORM CA	FORM TR+	FORM TFA
												AMMO	REEL	REEL	AMMO
25	25	0.68	9.5 × 7 × 3.5	20	7.7	110	200	2	295	85	17.00	56887	76687	26687	36687
		1	9.5 × 7 × 3.5	20	9.1	130	240	2	200	71	12.50	56108	76108	26108	36108
		1.5	9.5 × 7 × 3.5	20	10.8	155	285	2	135	48	9.50	56158	76158	26158	36158
		2.2	9.5 × 7 × 4	30	13.6	195	360	2	91	34	7.00	56228	76228	26228	36228
		3.3	9.5 × 7 × 5	40	16.1	230	425	2	61	19	5.20	56338	76338	26338	36338
		4.7	9.5 × 8 × 5	50	25.3	270	500	3	43	14	3.50	56478	76478	26478	36478
		6.8	9.5 × 8 × 6	60	52.7	310	570	4	30	11	2.70	56688	76688	26688	36688
		10	9.5 × 8 × 6	60	64.8	360	660	6	20	9	2.00	56109	76109	26109	36109
25	35	0.33	9.5 × 7 × 3.5	20	5.6	80	145	2	610	185	27.00	50337	70337	20337	30337
		0.47	9.5 × 7 × 4	30	6.3	90	165	2	430	130	20.00	50477	70477	20477	30477
		0.68	9.5 × 7 × 4	30	7.7	110	205	2	295	89	15.00	50687	70687	20687	30687
		1	9.5 × 7 × 5	40	13.7	125	230	2	200	49	10.00	50108	70108	20108	30108
		1.5	9.5 × 8 × 5	50	24.8	155	285	2	135	41	7.00	50158	70158	20158	30158
		2.2	9.5 × 8 × 6	60	33.1	195	360	2	91	28	4.50	50228	70228	20228	30228
		3.3	9.5 × 8 × 6	60	39.9	235	435	3	61	28	3.50	50338	70338	20338	30338
25	40	0.1	9.5 × 7 × 3	10	2.0	40	75	2	1990	950	45.00	57107	77107	27107	37107
		0.15	9.5 × 7 × 3	10	2.5	50	95	2	1330	400	35.00	57157	77157	27157	37157
		0.22	9.5 × 7 × 3.5	20	4.2	60	115	2	910	275	27.00	57227	77227	27227	37227
		0.33	9.5 × 7 × 4	30	5.3	75	140	2	610	172	20.00	57337	77337	27337	37337
		0.47	9.5 × 7 × 5	40	10.4	95	175	2	430	114	15.00	57477	77477	27477	37477
		0.68	9.5 × 7 × 5	40	12.1	110	205	2	295	89	10.00	57687	77687	27687	37687
		1	9.5 × 8 × 5	50	20.0	125	230	2	200	45	7.00	57108	77108	27108	37108
		1.5	9.5 × 8 × 6	60	25.5	150	280	2	135	35	5.50	57158	77158	27158	37158
		2.2	9.5 × 8 × 6	60	33.1	195	360	2	91	28	4.20	57228	77228	27228	37228

Note

1. Tan δ at 100 Hz for all types < 0.10.

SAL

Aluminum electrolytic capacitors

Solid Al, Radial Pearl Miniature

128 SAL-RPM

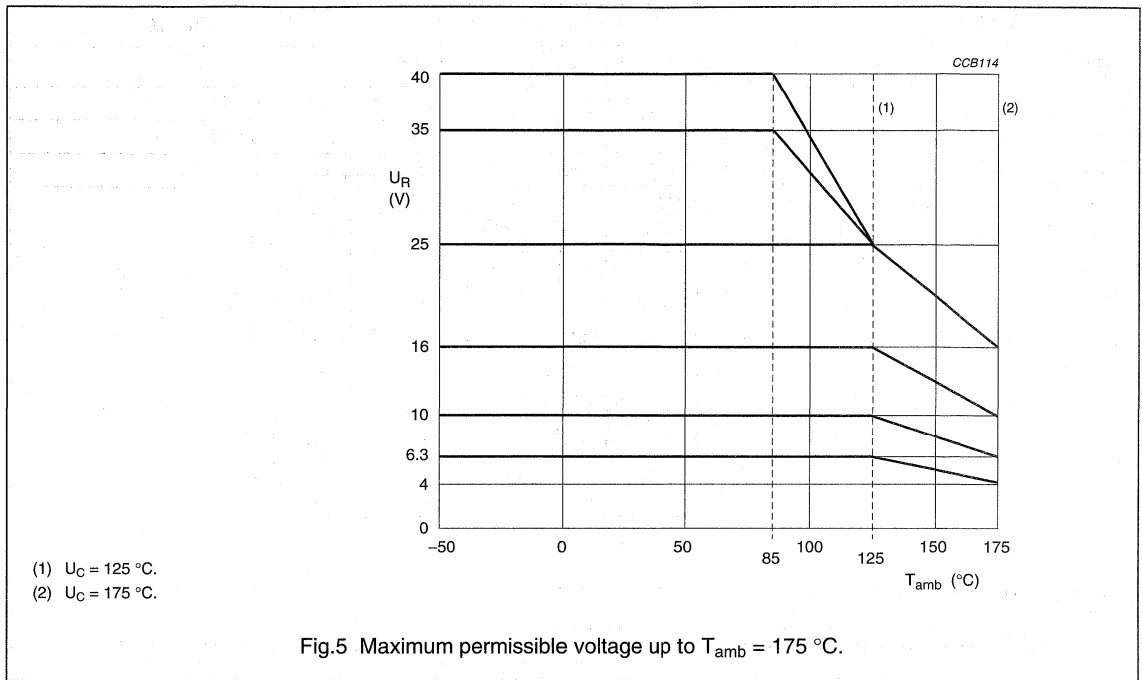
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} < 0.3 \times U_R$
Maximum peak AC voltage	reverse voltage applied	$\leq 2 V$
Maximum peak AC voltage, without reverse voltage applied	$T_{amb} \leq 85 \text{ }^\circ\text{C}$: at $f \leq 0.1 \text{ Hz}$ at $0.1 \text{ Hz} < f \leq 1 \text{ Hz}$ at $1 \text{ Hz} < f \leq 10 \text{ Hz}$ at $10 \text{ Hz} < f \leq 50 \text{ Hz}$ at $f > 50 \text{ Hz}$ $85 \text{ }^\circ\text{C} < T_{amb} \leq 125 \text{ }^\circ\text{C}$: at $f \leq 0.1 \text{ Hz}$ at $0.1 \text{ Hz} < f \leq 1 \text{ Hz}$ at $1 \text{ Hz} < f \leq 10 \text{ Hz}$ at $10 \text{ Hz} < f \leq 50 \text{ Hz}$ at $f > 50 \text{ Hz}$	$0.30 \times U_R$ $0.45 \times U_R$ $0.60 \times U_R$ $0.65 \times U_R$ $0.80 \times U_R$ $0.15 \times U_R$ $0.22 \times U_R$ $0.30 \times U_R$ $0.32 \times U_R$ $0.40 \times U_R$
Inductance		
Equivalent series inductance (ESL)	case sizes $9.5 \times 7 \times 3$ to $9.5 \times 7 \times 5 \text{ mm}$	typ. 9 to 14 nH
	case sizes $9.5 \times 8 \times 5$ and $9.5 \times 8 \times 6 \text{ mm}$	typ. 11 to 16 nH
	all case sizes	max. 20 nH
Dissipation		
Maximum power dissipation	case sizes $9.5 \times 7 \times 3$ to $9.5 \times 7 \times 5 \text{ mm}$	$P_{125} = 88 \text{ mW}$
	case sizes $9.5 \times 8 \times 5$ and $9.5 \times 8 \times 6 \text{ mm}$	$P_{125} = 104 \text{ mW}$
Current		
Maximum leakage current	after 5 minutes at U_R and $T_{amb} = 25 \text{ }^\circ\text{C}$	$I_{L5} \leq 0.025C_R \times U_R$ or $2 \text{ } \mu\text{A}$ whichever is greater; see Table 2
Typical leakage current	15 s at U_R and $T_{amb} = 25 \text{ }^\circ\text{C}$: $U_R = 6.3$ to 16 V $U_R = 25$ to 40 V	$\approx 0.2 \times$ value stated in Table 2 $\approx 0.1 \times$ value stated in Table 2

Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

128 SAL-RPM

Voltage



Ripple current (I_R)

Applying the maximum RMS ripple current given in Table 2 will cause a device temperature of $138\text{ }^\circ\text{C}$.
The 100 kHz values in Table 2 for other temperatures are to be calculated with the following I_R multipliers:

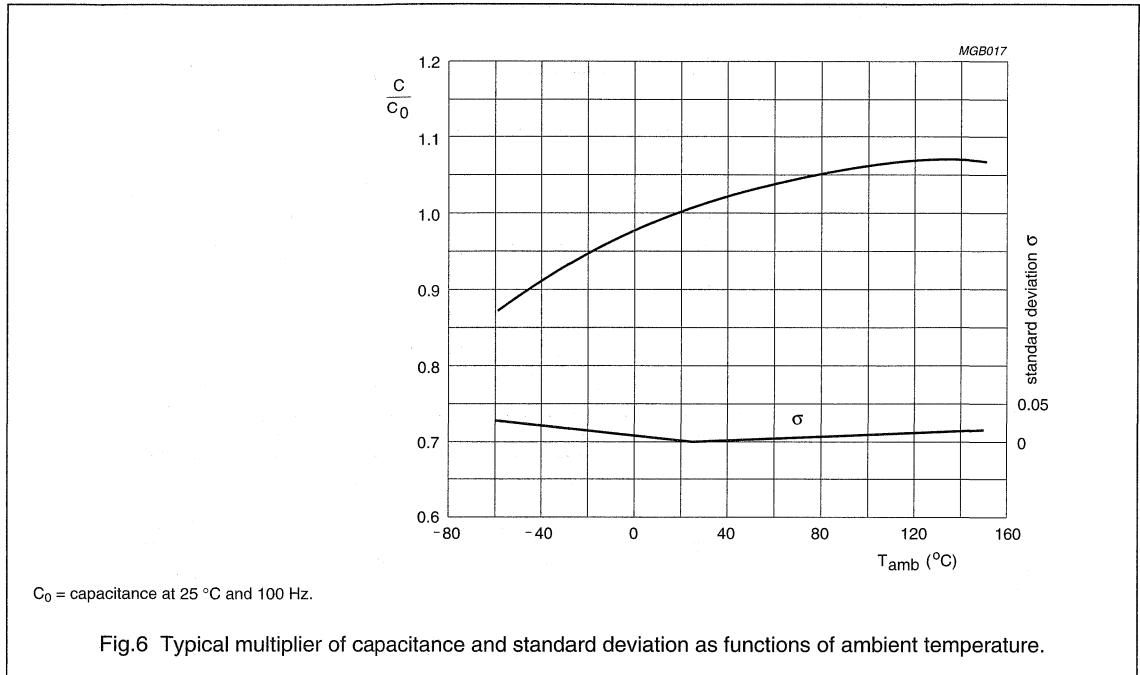
PARAMETER	T_{amb}					
	25 °C	40 °C	65 °C	85 °C	105 °C	125 °C
I_R multiplier	1.1	1.0	0.88	0.75	0.59	0.37



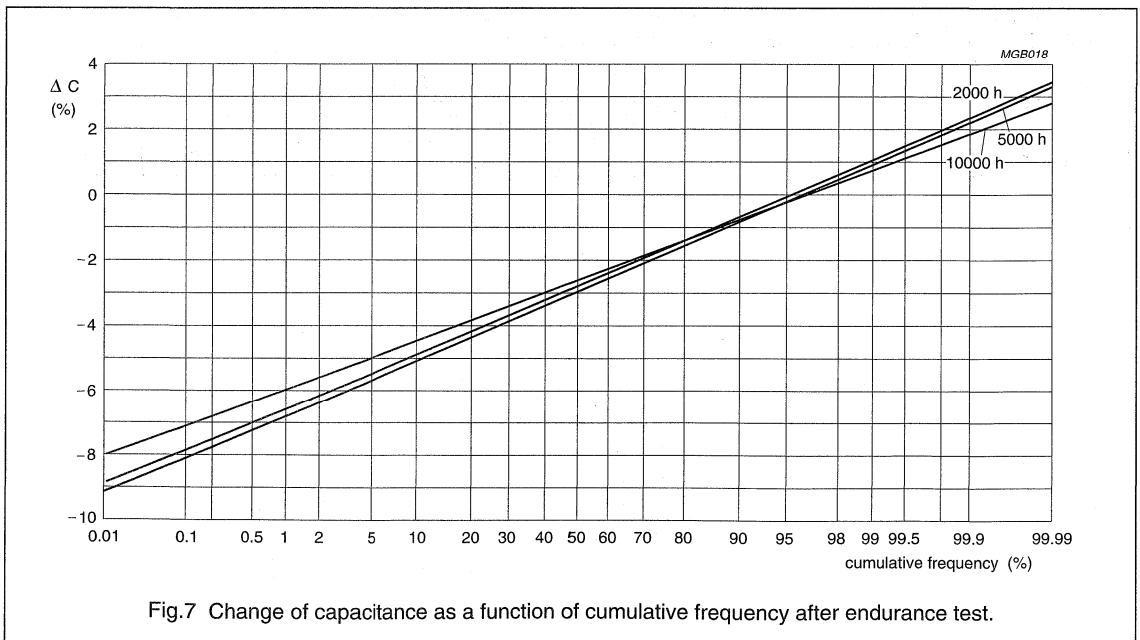
Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

128 SAL-RPM

Capacitance (C)



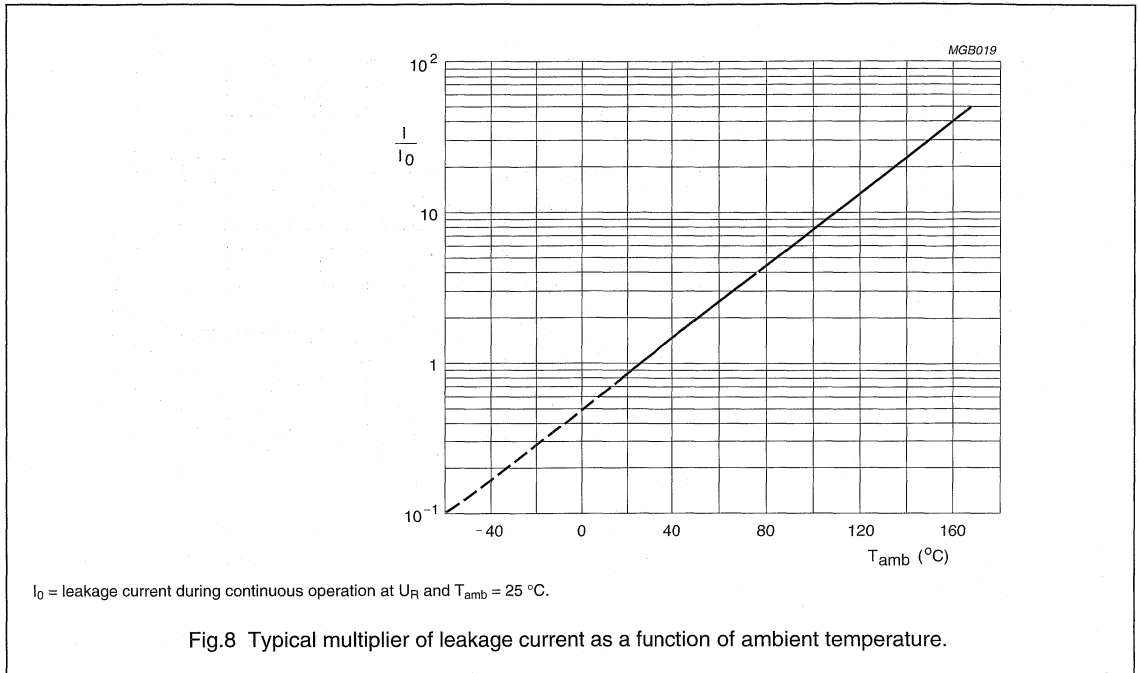
Typical capacitance change after endurance test at $T_{amb} = 125$ °C



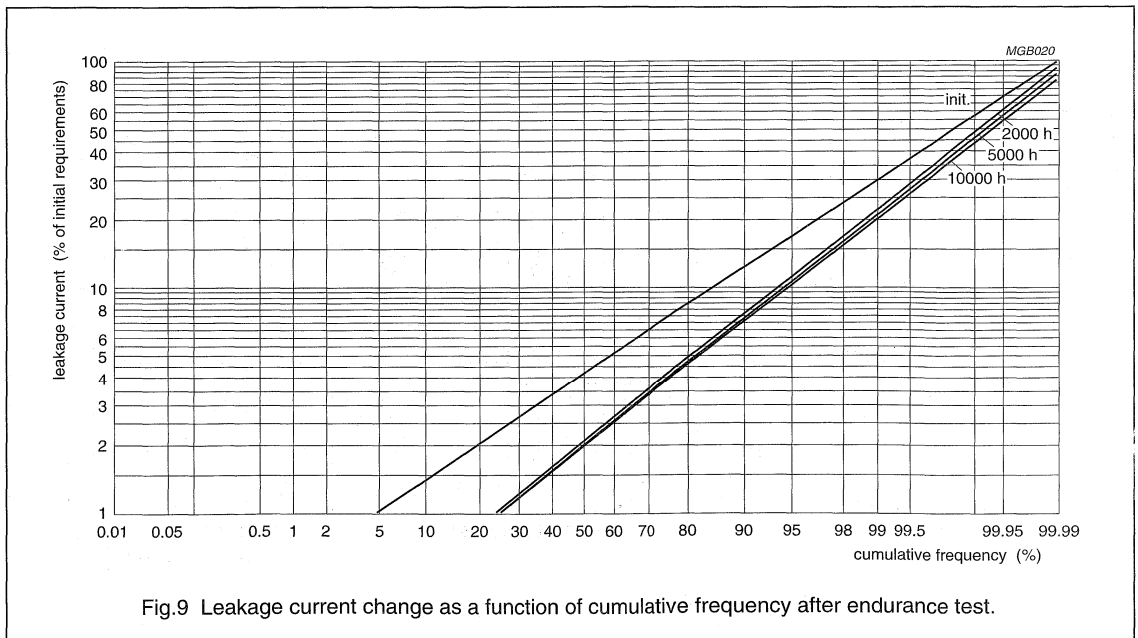
Aluminum electrolytic capacitors Solid Al, Radial Pearl Miniature

128 SAL-RPM

Leakage current



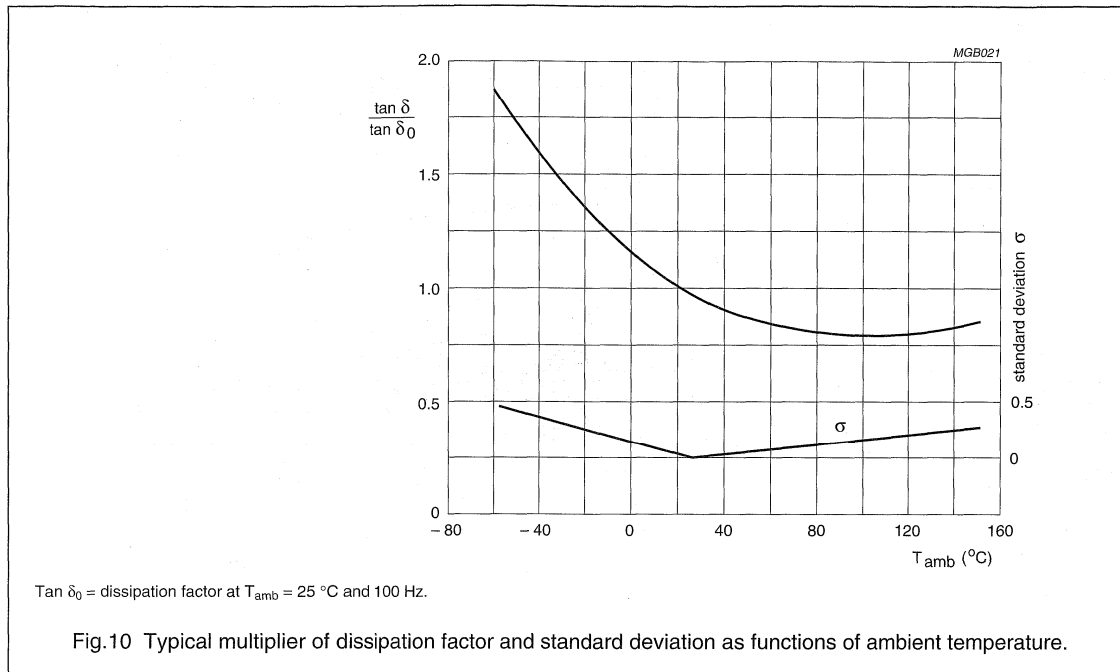
Typical leakage current change after endurance test at $T_{amb} = 125^\circ\text{C}$



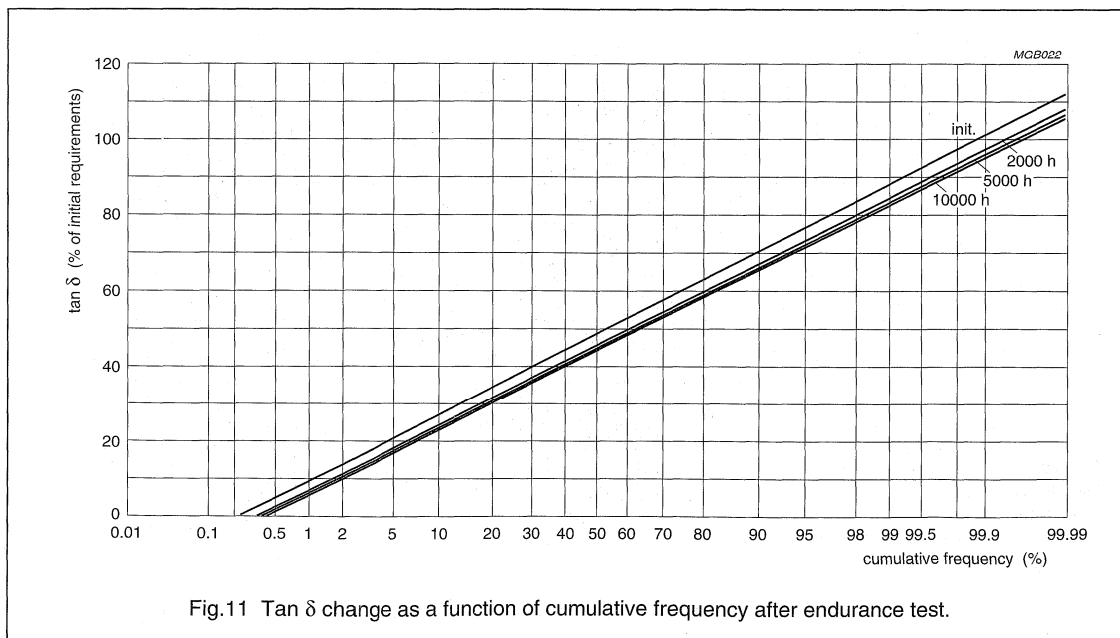
Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

128 SAL-RPM

Dissipation factor ($\tan \delta$)



Typical $\tan \delta$ change after endurance test at $T_{amb} = 125^{\circ}C$



Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

128 SAL-RPM

Equivalent series resistance (ESR)

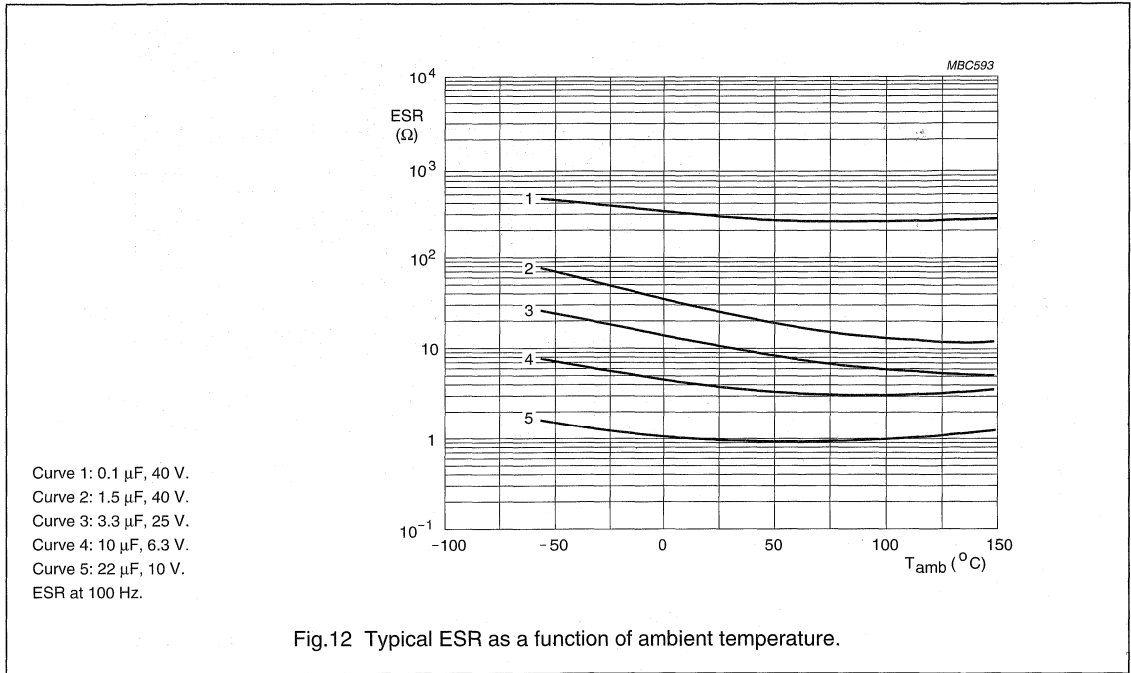


Fig.12 Typical ESR as a function of ambient temperature.

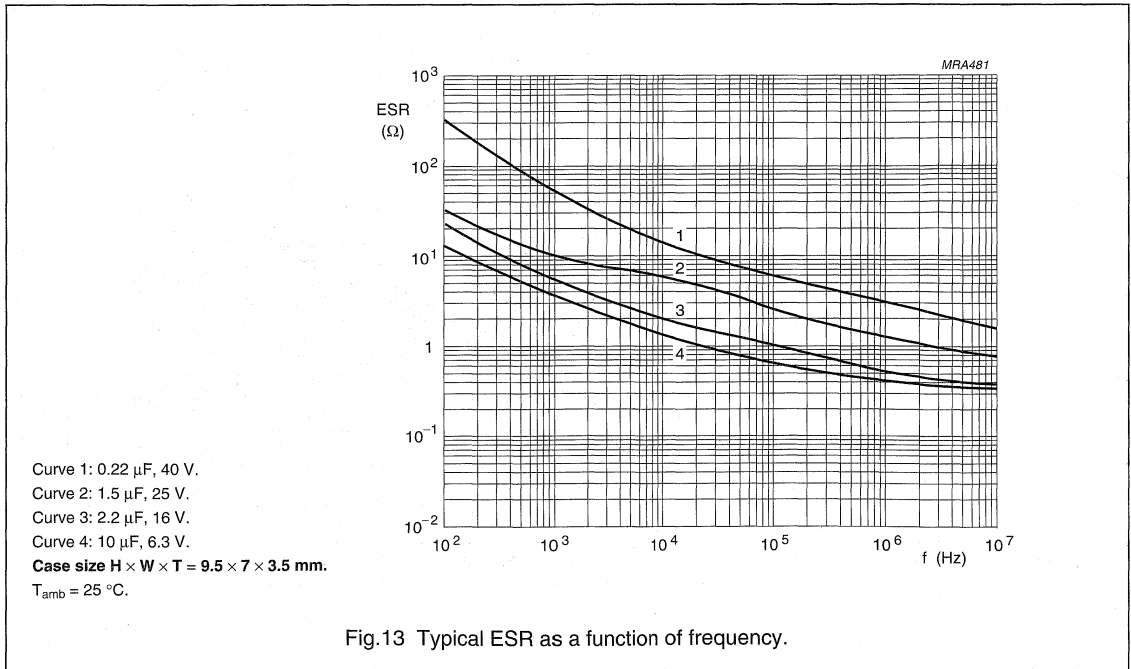


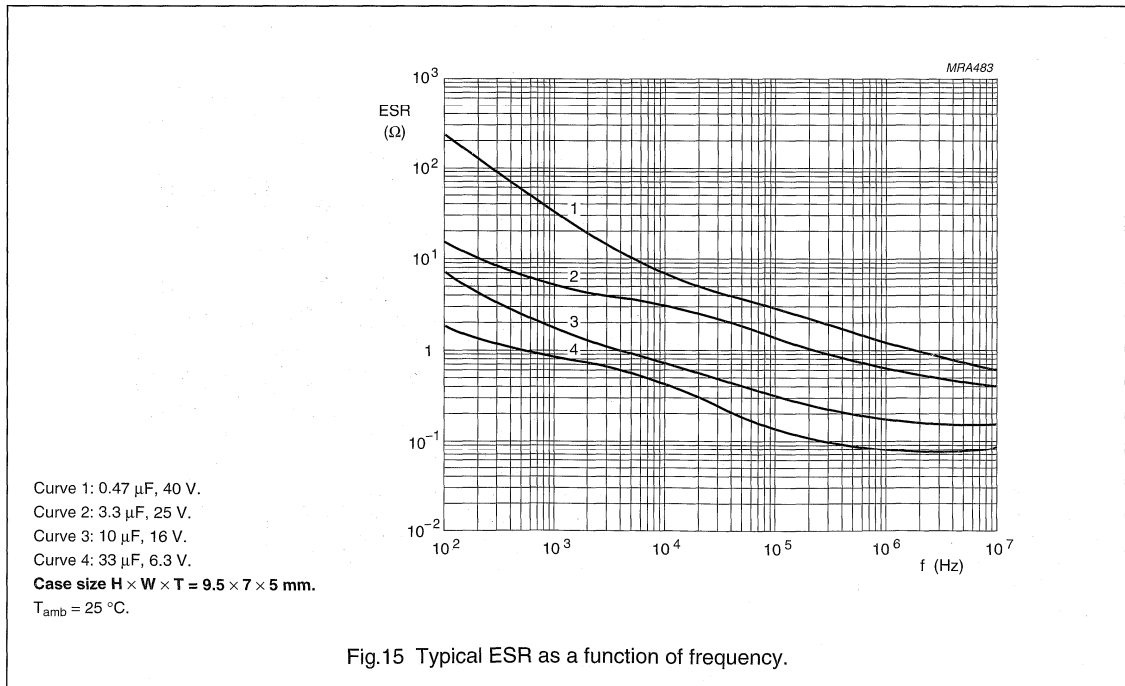
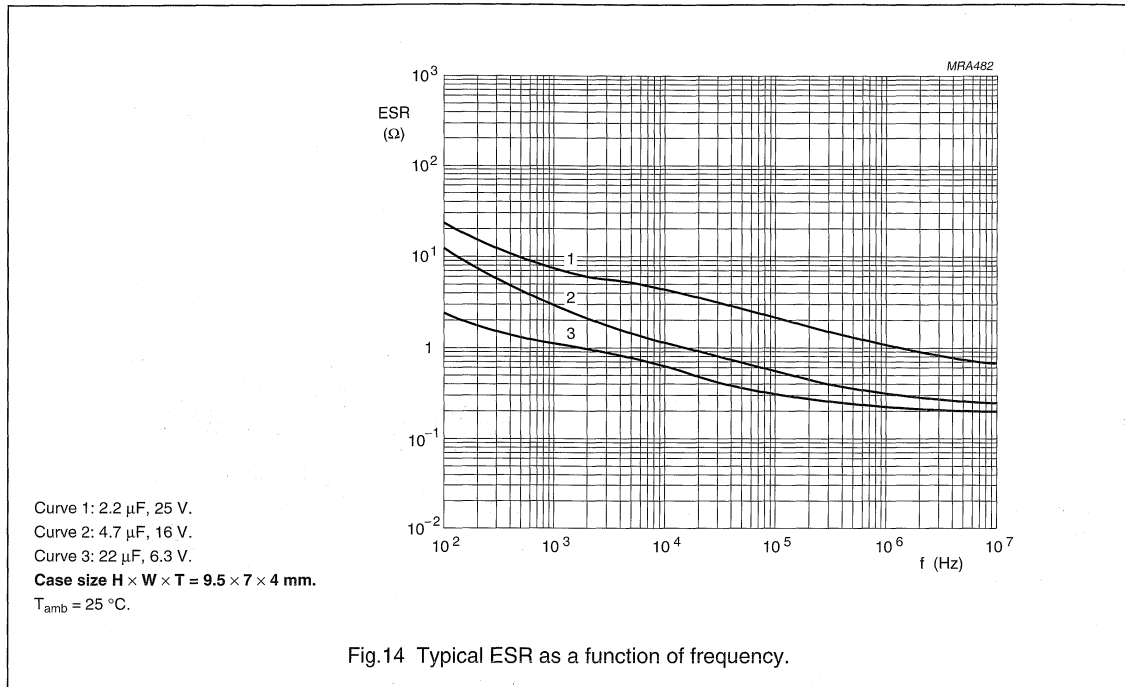
Fig.13 Typical ESR as a function of frequency.



Aluminum electrolytic capacitors

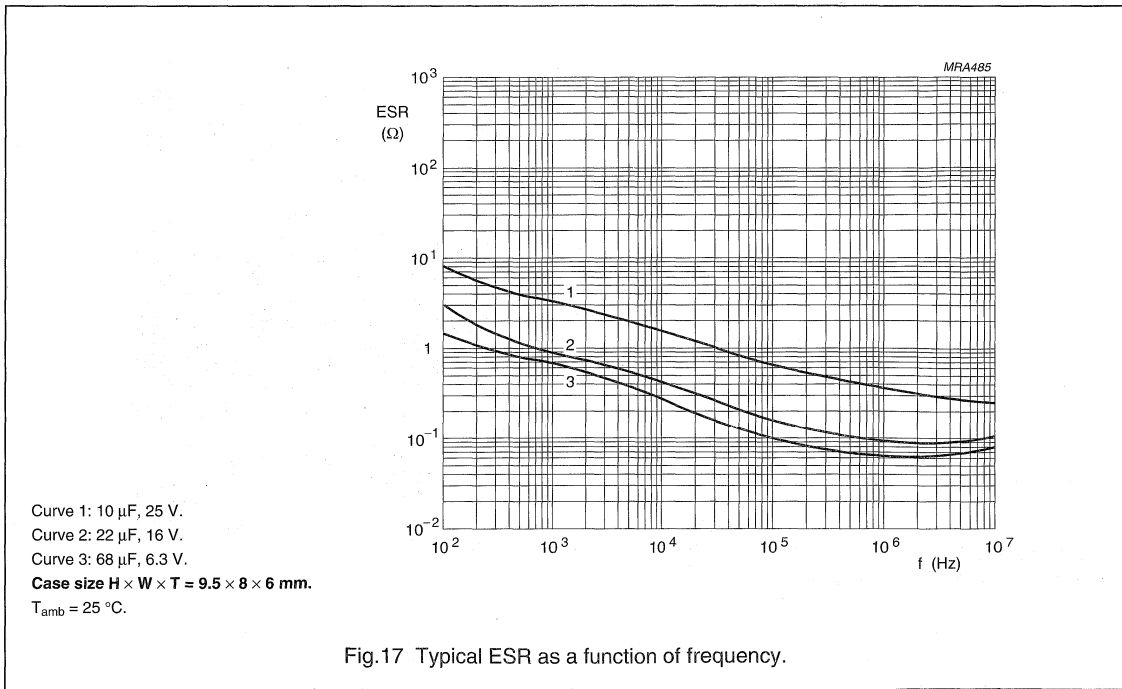
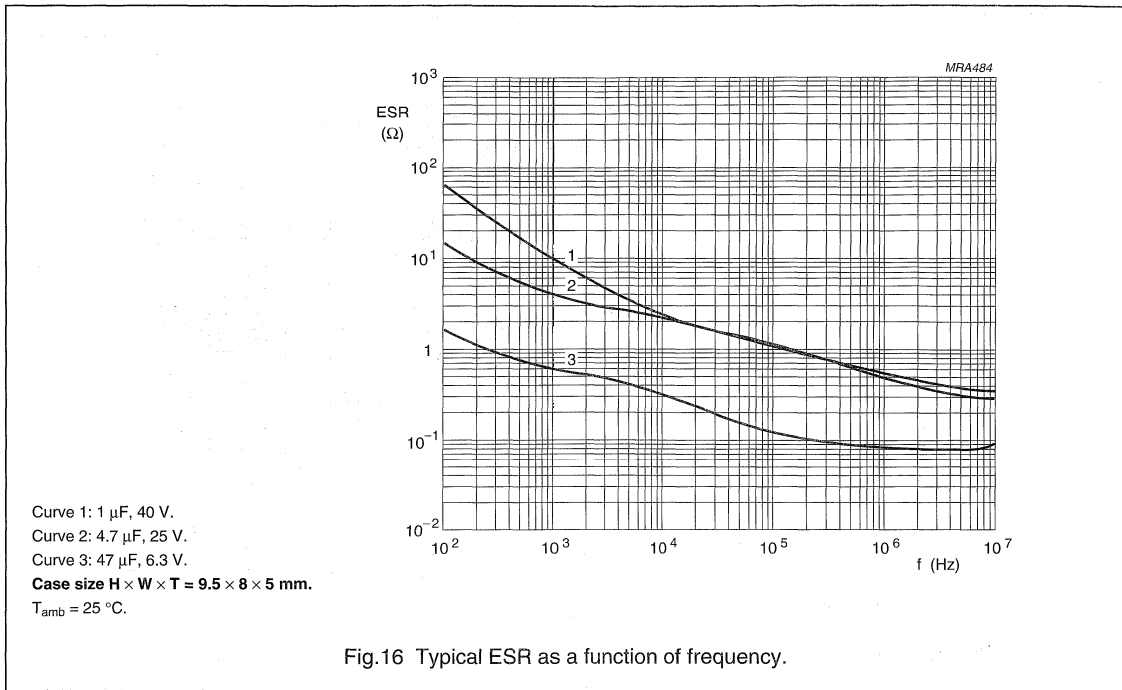
Solid Al, Radial Pearl Miniature

128 SAL-RPM



Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

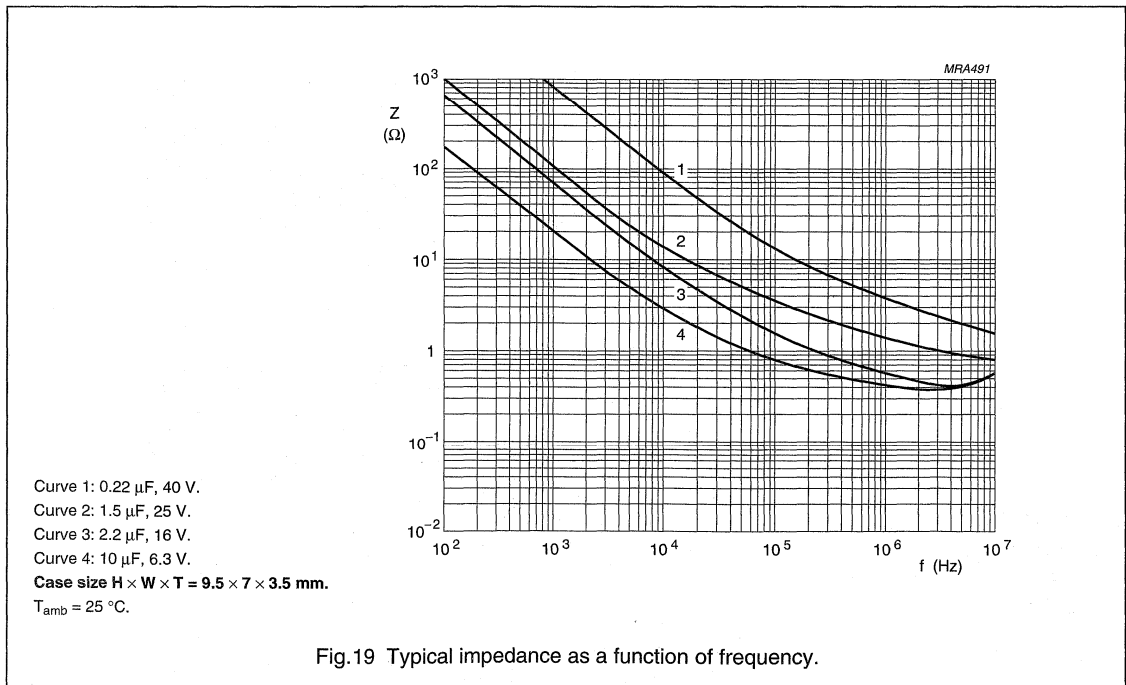
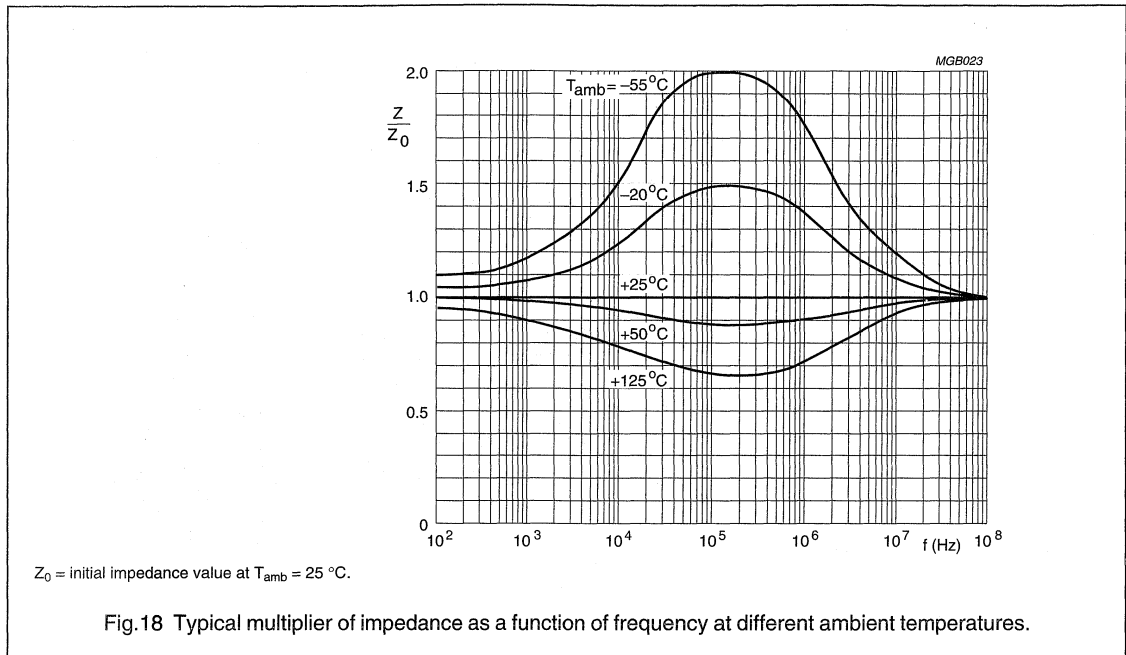
128 SAL-RPM



Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

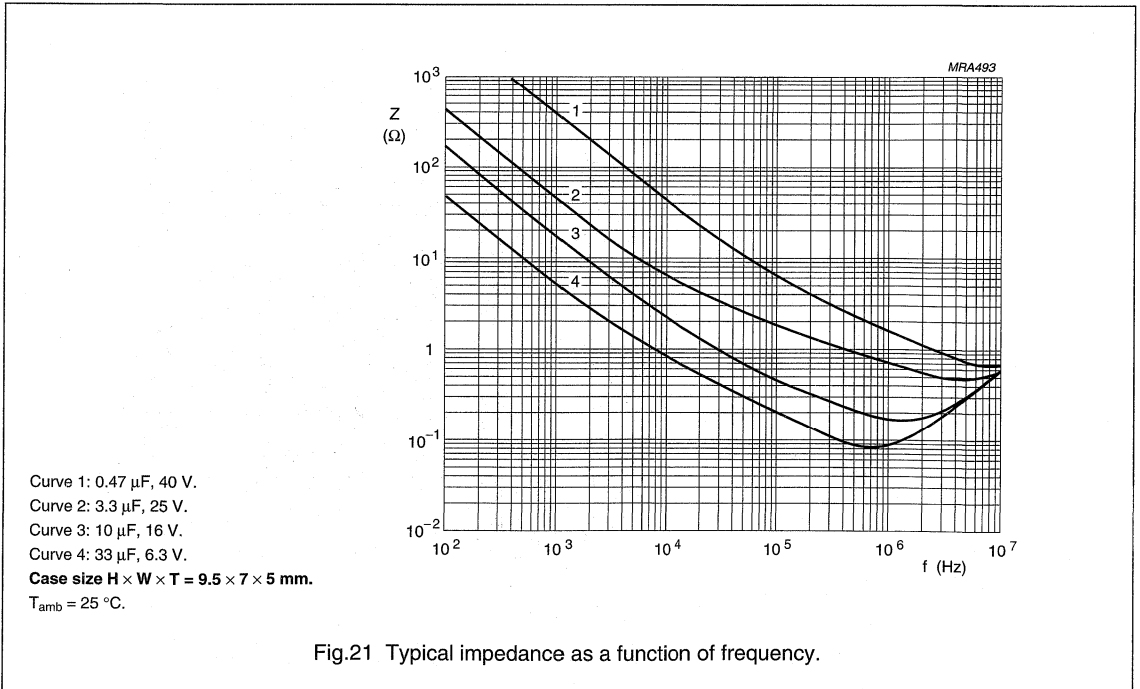
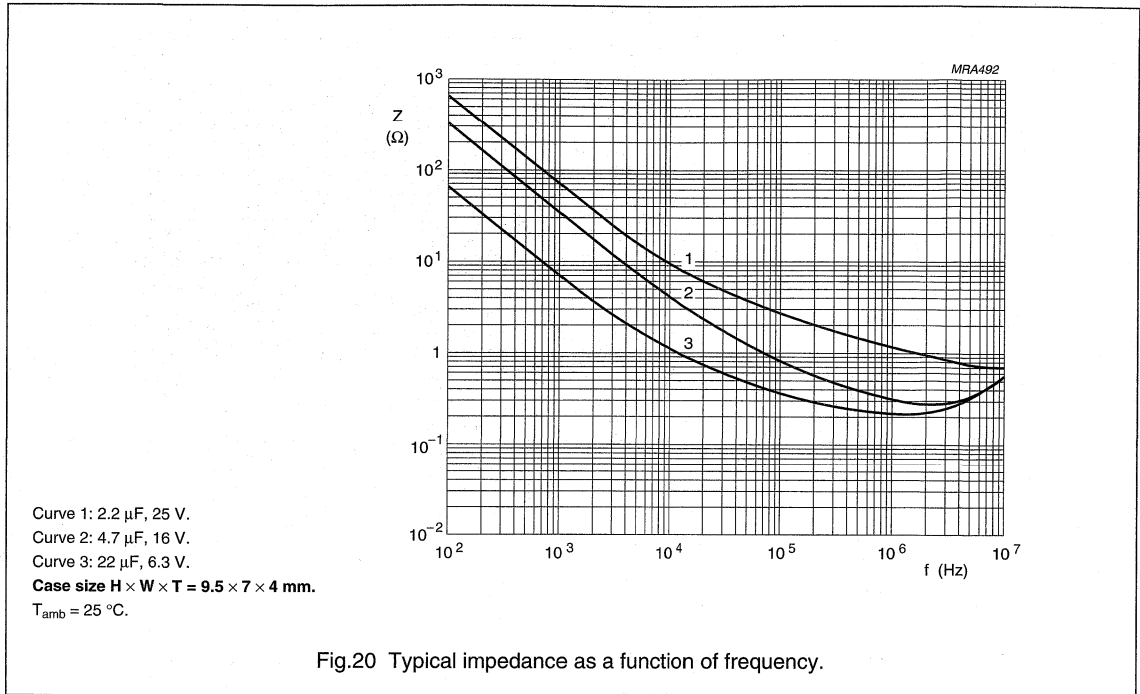
128 SAL-RPM

Impedance (Z)



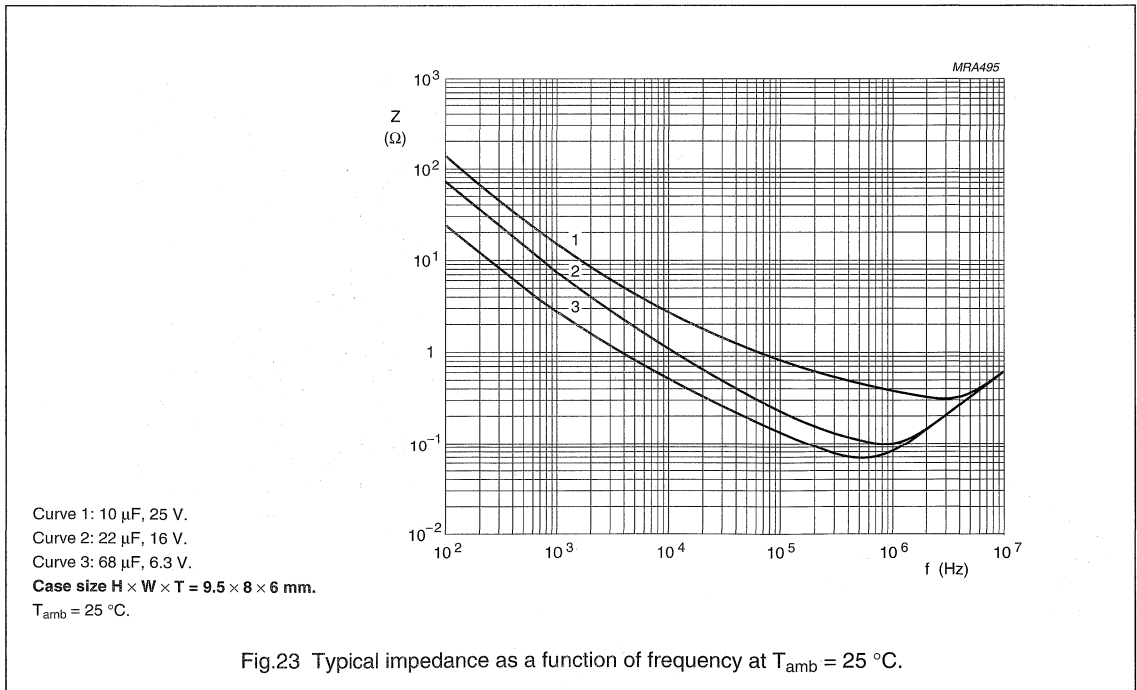
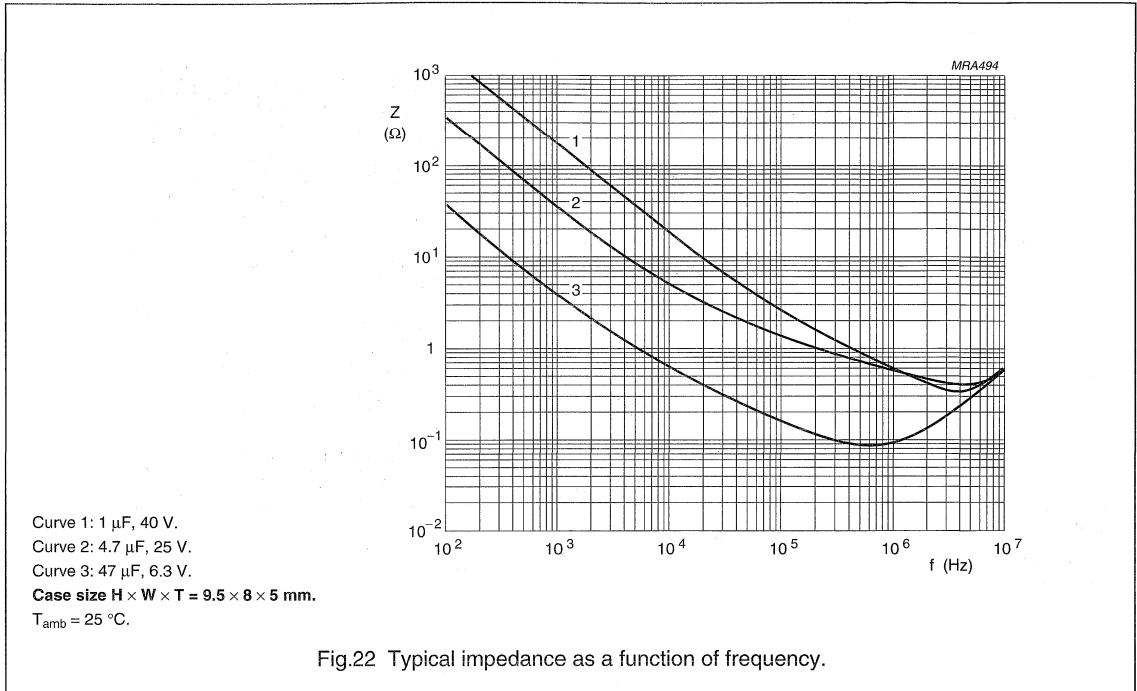
Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

128 SAL-RPM



Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

128 SAL-RPM



Aluminum electrolytic capacitors

Solid Al, Radial Pearl Miniature

128 SAL-RPM

SPECIFIC TESTS AND REQUIREMENTS

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

Table 3 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125\text{ }^{\circ}\text{C}$; $U_R = 6.3$ to 25 V with U_R applied; $U_R = 35$ and 40 V with U_C applied; 10000 hours	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30302 subclause 1.8.1	$T_{amb} = 125\text{ }^{\circ}\text{C}$; I_R applied and: $U_R = 6.3$ to 25 V with U_R applied; $U_R = 35$ and 40 V with U_C applied; 20000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: <1%
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1 \times \text{spec. limit}$
Charge and discharge	IEC 60384-4-2 subclause 9.21	10^6 cycles without series resistance: 0.5 s to U_R ; 0.5 s to ground	$\Delta C/C: \pm 5\%$ no short or open circuit, no visible damage
Solvent resistance	IEC 60068-2-45, test XA IEC 60653	immersion: 5 ± 0.5 minutes with or without ultrasonic at $55 \pm 5\text{ }^{\circ}\text{C}$ solvents: demineralized water and/or calgonite solution (20 g/l)	visual appearance not affected

Aluminum electrolytic capacitors

Solid Al, Radial Pearl Miniature

128 SAL-RPM

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Extended vibration	IEC 60068-2-6 test Fc	10 to 2000 Hz; 1.5 mm or 20 g; 1 octave/minute; 3 directions; 1 sweep per direction; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C: \pm 5\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1.5 \times \text{spec. limit}$
Shock	IEC 60068-2-27 test Ea	half-sine or sawtooth pulse shape; 50 g; 11 ms; 3 successive shocks in each direction of 3 mutually perpendicular axes; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C: \pm 5\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1.5 \times \text{spec. limit}$
Passive flammability	IEC 60695-2-2	capacitor mounted to a vertical printed-circuit board, one flame on capacitor body; $T_{\text{amb}} = 20 \text{ to } 25 \text{ }^\circ\text{C}$; test duration = 20 s	after removing the test flame from the capacitor, the capacitor must not continue to burn for more than 15 s; no burning particles must drop from the sample

Aluminum electrolytic capacitors

Solid Al, Radial Pearl

122 SAL-RP

FEATURES

- Polarized aluminum electrolytic capacitors, solid electrolyte MnO_2
- Radial leads, max. height 12.5 mm, resin dipped, orange coloured
- Extremely long useful life: 20000 hours at 125 °C
- Extended usable temperature range up to 175 °C
- Excellent low temperature, impedance and ESR behaviour
- Charge and discharge proof, application with 0 Ω resistance allowed
- Reverse DC voltage up to $0.3 \times U_R$ allowed
- AC voltage up to $0.8 \times U_R$ allowed
- Advanced technology to achieve high reliability and high stability.

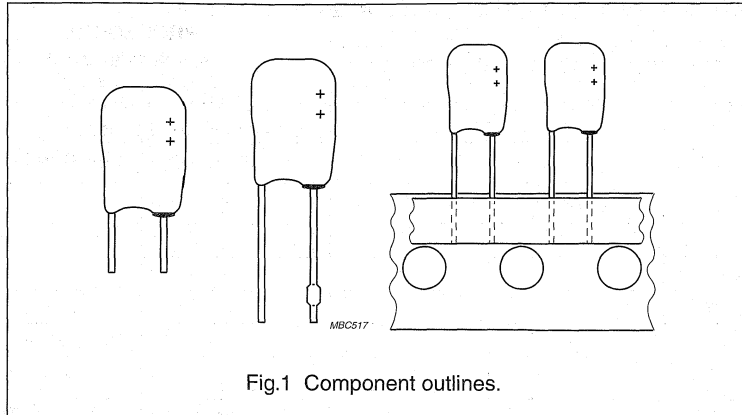
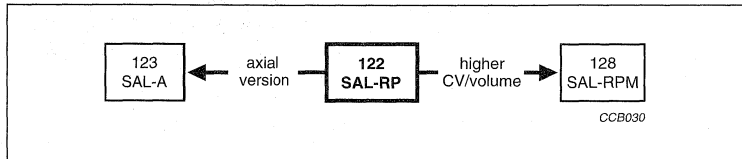


Fig.1 Component outlines.



APPLICATIONS

- EDP, telecommunication, general industrial
- Automotive and audio-video
- For small power supplies, DC/DC converters.
- Smoothing, filtering and buffering

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($H_{\max} \times W_{\max} \times T_{\max}$ in mm)	12.5 × 8 × 3.5 to 12.5 × 8 × 6
Rated capacitance range (E6 series), C_R	0.33 to 68 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	6.3 to 40 V
Category temperature range:	
$U_R = 6.3$ to 40 V	-55 to +85 °C
$U_C = 6.3$ to 25 V	-55 to +125 °C
Endurance test at 125 °C	10000 hours
Useful life at 125 °C	20000 hours
Useful life at 175 °C	2000 hours
Useful life at 40 °C, I_R applied	>300000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/125/56

SAL

Aluminum electrolytic capacitors

Solid Al, Radial Pearl

122 SAL-RP

Selection chart for C_R , U_R , U_C and relevant maximum case sizes (H × W × T in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V) at $T_{\text{amb}} = 85^\circ\text{C}$					
	6.3	10	16	25	35	40
	U_C (V) at $T_{\text{amb}} = 125^\circ\text{C}$					
	6.3	10	16	25	25	25
0.33	–	–	–	–	–	12.5 × 8 × 3.5
0.47	–	–	–	–	–	12.5 × 8 × 4.5
0.68	–	–	–	12.5 × 8 × 3.5	–	12.5 × 8 × 4.5
1.0	–	–	–	12.5 × 8 × 3.5	12.5 × 8 × 4.5	12.5 × 8 × 5
1.5	–	–	–	12.5 × 8 × 3.5	–	12.5 × 8 × 6
2.2	–	–	12.5 × 8 × 3.5	12.5 × 8 × 4.5	–	12.5 × 8 × 6
3.3	–	–	12.5 × 8 × 3.5	12.5 × 8 × 4.5	12.5 × 8 × 6	–
4.7	–	12.5 × 8 × 3.5	12.5 × 8 × 4.5	12.5 × 8 × 5	12.5 × 8 × 6 ⁽¹⁾	–
6.8	–	12.5 × 8 × 3.5	12.5 × 8 × 4.5	12.5 × 8 × 6	–	–
10	12.5 × 8 × 3.5	12.5 × 8 × 4.5	12.5 × 8 × 5	12.5 × 8 × 6	–	–
15	12.5 × 8 × 4.5	12.5 × 8 × 4.5	12.5 × 8 × 6	–	–	–
22	12.5 × 8 × 4.5	12.5 × 8 × 5	–	–	–	–
33	12.5 × 8 × 5	12.5 × 8 × 6	–	–	–	–
47	12.5 × 8 × 6	–	–	–	–	–
68	12.5 × 8 × 6	–	–	–	–	–

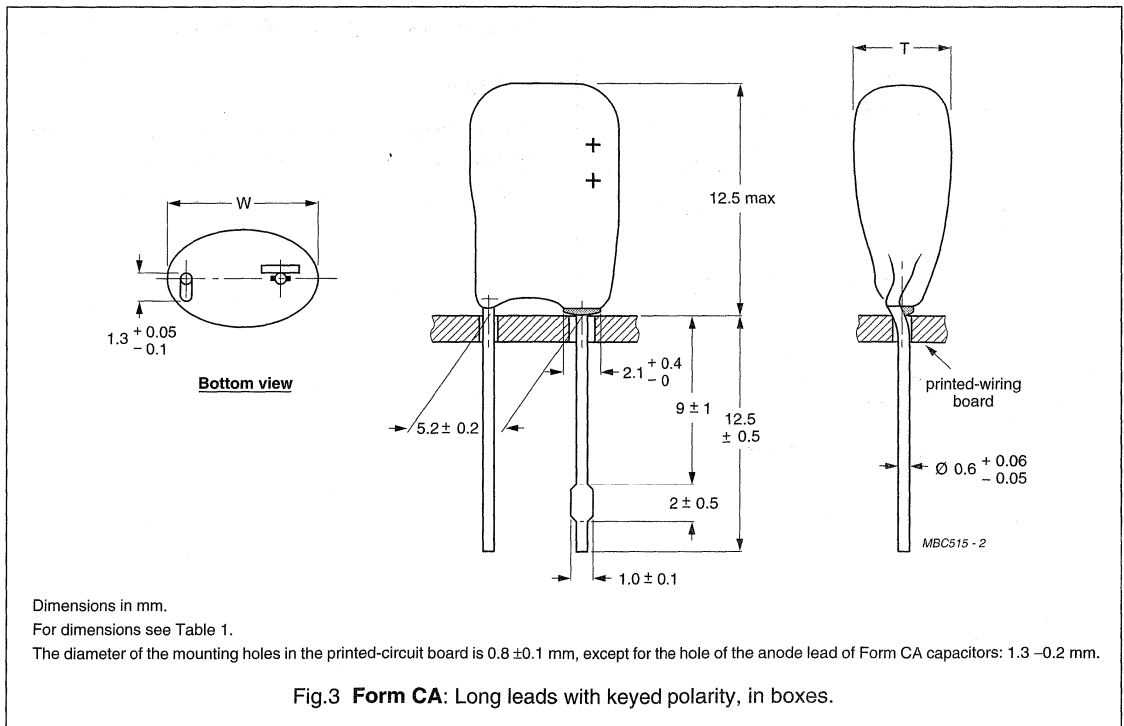
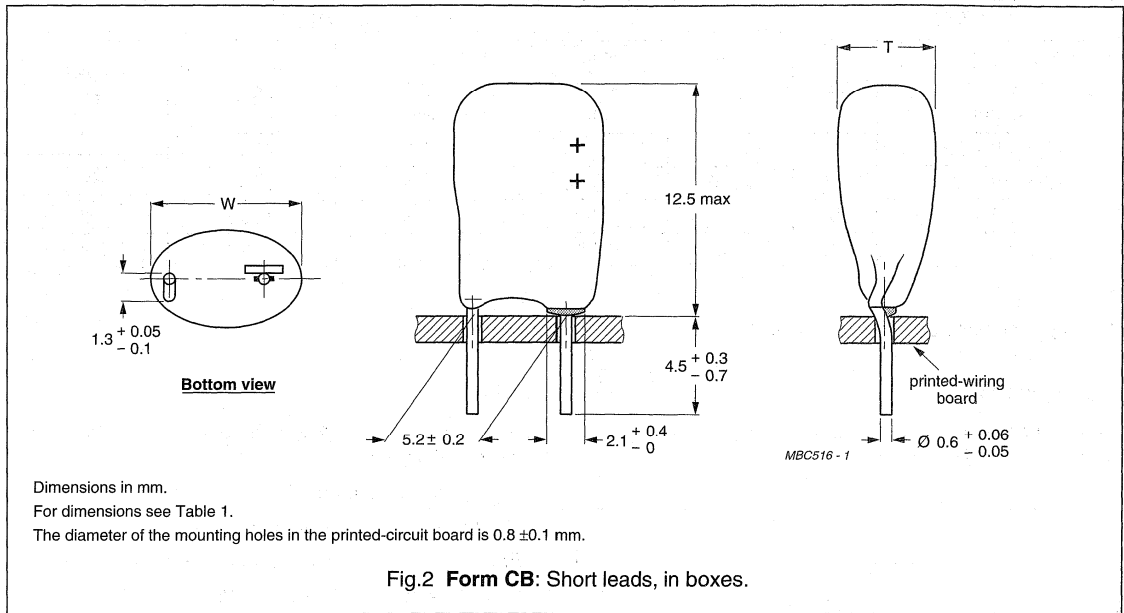
Note

1. 4.7 $\mu\text{F}/35\text{ V}$ in development.

Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

MECHANICAL DATA AVAILABLE FORMS AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors

Solid Al, Radial Pearl

122 SAL-RP

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

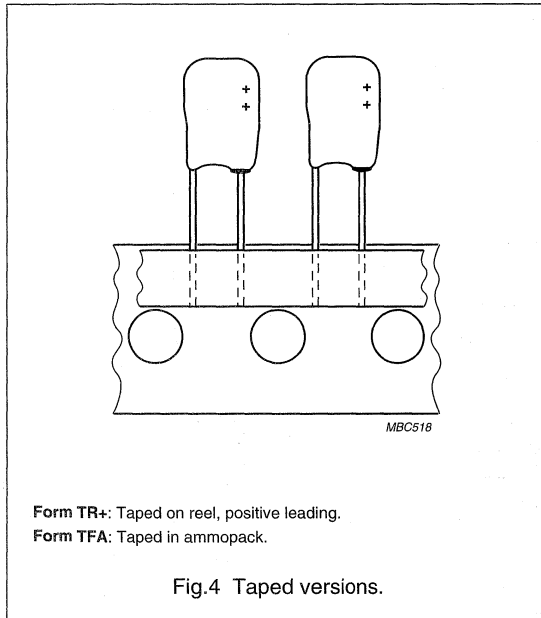
CASE		MASS (g)	PACKAGING QUANTITIES			
MAXIMUM SIZE H × W × T (mm)	CODE		FORM CA (note 1)	FORM CB (note 1)	FORM TR+	FORM TFA
12.5 × 8 × 3.5	1	≈0.35	1000	1000	2000	1000
12.5 × 8 × 4.5	2	≈0.38	1000	1000	2000	1000
12.5 × 8 × 5	3	≈0.45	1000	1000	1000	1000
12.5 × 8 × 6	4	≈0.58	800	1000	1000	1000

Note

1. In plastic bags of 200 units each.

Taped products

Tape dimensions are specified in this handbook, section "Packaging".

**MARKING**

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance ($M = \pm 20\%$)
- Rated voltage (in V) and category voltage if applicable
- Date code in accordance with "IEC 60062"
- Name of manufacturer
- '+' signs to identify the anode terminal.

MOUNTING

When bending, cutting or straightening the leads, ensure that the capacitor body is relieved of stress.

Bending after soldering must be avoided.

Aluminum electrolytic capacitors Solid Al, Radial Pearl

122 SAL-RP

Ordering example

Electrolytic capacitors 122 series

10 µF/16 V; ±20%

Maximum case size: 12.5 × 8 × 5 mm; Form TFA

Catalogue number: 2222 122 35109.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at T_{amb} = 20 to 25 °C, P = 86 to 106 kPa, RH = 45 to 75%.

C _R	rated capacitance at 100 Hz, tolerance ±20%
I _R	max. RMS ripple current, no necessary DC voltage applied
I _{L5}	max. leakage current after 5 minutes at U _R
Tan δ	max. dissipation factor at 100 Hz; note 1
ESR	max./typ. equivalent series resistance at 100 Hz
Z	max. impedance at 100 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U _C (V)	U _R (V)	C _R 100 Hz (µF)	MAXIMUM CASE SIZE H × W × T (mm)	CASE CODE	I _R 100 Hz 125 °C (mA)	I _R 10 kHz 85 °C (mA)	I _R 100 kHz 40 °C (mA)	I _{L5} 5 min (µA)	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222 122			
												FORM CB	FORM CA	FORM TR+ REEL	FORM TFA AMMO
6.3	6.3	10	12.5 × 8 × 3.5	1	9	156	211	3	30	14	5	53109	73109	23109	33109
		15	12.5 × 8 × 4.5	2	13	195	264	5	20	8	3	53159	73159	23159	33159
		22	12.5 × 8 × 4.5	2	20	234	317	7	14	6	1.3	53229	73229	23229	33229
		33	12.5 × 8 × 5	3	30	293	396	11	9	4	0.9	53339	73339	23339	33339
		47	12.5 × 8 × 6	4	42	371	502	15	6.4	2.5	0.7	53479	73479	23479	33479
		68	12.5 × 8 × 6	4	61	449	607	22	4.4	2.5	0.5	53689	73689	23689	33689
10	10	4.7	12.5 × 8 × 3.5	1	7	117	158	3	64	27	7	54478	74478	24478	34478
		6.8	12.5 × 8 × 3.5	1	10	137	185	4	44	18	5	54688	74688	24688	34688
		10	12.5 × 8 × 4.5	2	14	156	211	5	30	9	1.5	54109	74109	24109	34109
		15	12.5 × 8 × 4.5	2	21	195	264	8	20	9	1	54159	74159	24159	34159
		22	12.5 × 8 × 5	3	31	234	317	11	14	5	0.7	54229	74229	24229	34229
		33	12.5 × 8 × 6	4	47	312	422	17	9	3	0.5	54339	74339	24339	34339
16	16	2.2	12.5 × 8 × 3.5	1	5	98	132	2	91	40	10	55228	75228	25228	35228
		3.3	12.5 × 8 × 3.5	1	8	117	158	3	61	30	7	55338	75338	25338	35338
		4.7	12.5 × 8 × 4.5	2	11	137	185	4	43	17	2	55478	75478	25478	35478
		6.8	12.5 × 8 × 4.5	2	16	156	211	6	29.5	11	1.5	55688	75688	25688	35688
		10	12.5 × 8 × 5	3	23	195	264	8	20	10	1	55109	75109	25109	35109
		15	12.5 × 8 × 6	4	34	254	343	12	13.5	6	0.7	55159	75159	25159	35159



Aluminum electrolytic capacitors

Solid Al, Radial Pearl

122 SAL-RP

U _C (V)	U _R (V)	C _R 100 Hz (μF)	MAXIMUM CASE SIZE H × W × T (mm)	CASE CODE	I _R 100 Hz 125 °C (mA)	I _R 10 kHz 85 °C (mA)	I _R 100 kHz 40 °C (mA)	I _{L5} 5 min (μA)	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222 122			
												FORM CB	FORM CA	FORM TR+ FEEL	FORM TFA AMMO
25	25	0.68	12.5 × 8 × 3.5	1	2	55	74	2	295	135	30	56687	76687	26687	36687
		1.0	12.5 × 8 × 3.5	1	4	62	85	2	200	90	20	56108	76108	26108	36108
		1.5	12.5 × 8 × 3.5	1	5	78	106	2	135	62	15	56158	76158	26158	36158
		2.2	12.5 × 8 × 4.5	2	8	98	132	3	91	37	10	56228	76228	26228	36228
		3.3	12.5 × 8 × 4.5	2	12	117	158	4	61	30	7	56338	76338	26338	36338
		4.7	12.5 × 8 × 5	3	17	137	185	6	43	25	5	56478	76478	26478	36478
		6.8	12.5 × 8 × 6	4	24	176	238	9	29.5	14	3	56688	76688	26688	36688
		10	12.5 × 8 × 6	4	35	200	238	13	20	12	2	56109	76109	26109	36109
25	35	1.0	12.5 × 8 × 4.5	2	3	62	85	2	200	80	15	50108	70108	20108	30108
		3.3	12.5 × 8 × 6	4	12	117	132	6	61	23	5	50338	70338	20338	30338
		4.7 ⁽²⁾	12.5 × 8 × 6	4	18	135	180	8	47	17.5	3.2	50478	70478	20478	30478
25	40	0.33	12.5 × 8 × 3.5	1	1	39	53	2	610	170	30	57337	77337	27337	37337
		0.47	12.5 × 8 × 4.5	2	2	47	63	2	430	130	20	57477	77477	27477	37477
		0.68	12.5 × 8 × 4.5	2	2	55	74	2	295	90	15	57687	77687	27687	37687
		1.0	12.5 × 8 × 5	3	4	62	85	2	200	65	10	57108	77108	27108	37108
		1.5	12.5 × 8 × 6	4	5	78	106	3	135	38	7	57158	77158	27158	37158
		2.2	12.5 × 8 × 6	4	8	98	132	5	91	37	5	57228	77228	27228	37228

Notes

1. Tan δ at 100 Hz for 6.3 V and 10 V types ≤ 0.15.
Tan δ at 100 Hz for 16 V to 40 V types ≤ 0.10.
2. In development.

Aluminum electrolytic capacitors

Solid Al, Radial Pearl

122 SAL-RP

Additional electrical data

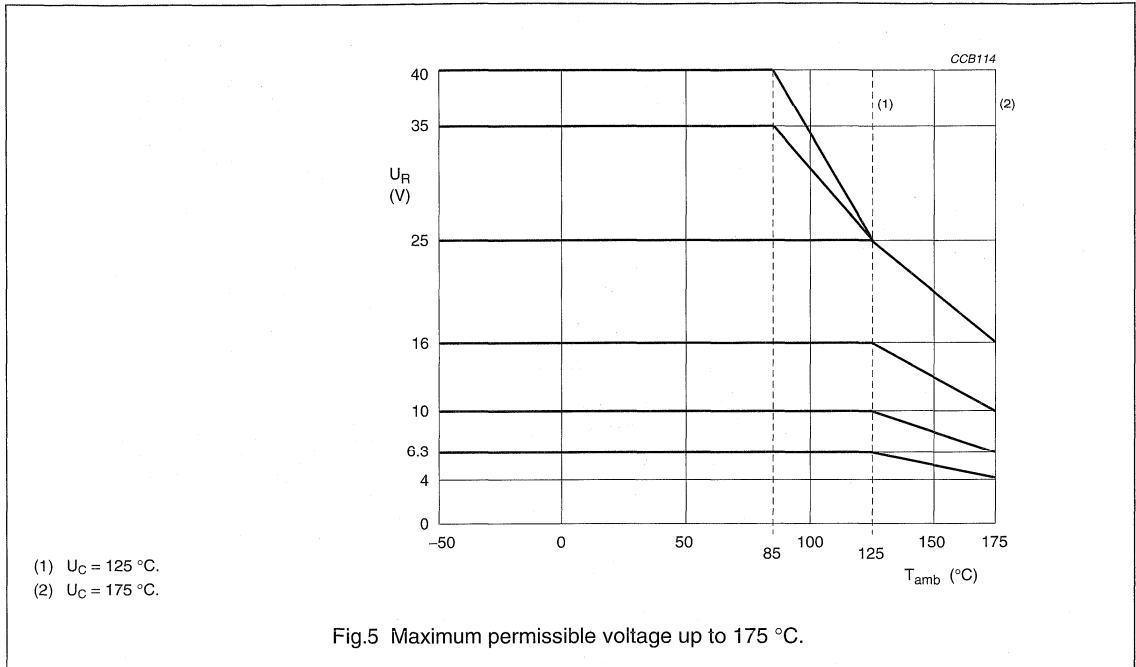
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} < 0.3 \times U_R$
Maximum peak AC voltage, reverse voltage applied		$\leq 2 \text{ V}$
Maximum peak AC voltage, without reverse voltage applied	$T_{amb} \leq 85 \text{ }^\circ\text{C}$: at $f \leq 0.1 \text{ Hz}$ at $0.1 \text{ Hz} < f \leq 1 \text{ Hz}$ at $1 \text{ Hz} < f \leq 10 \text{ Hz}$ at $10 \text{ Hz} < f \leq 50 \text{ Hz}$ at $f > 50 \text{ Hz}$ $85 \text{ }^\circ\text{C} < T_{amb} \leq 125 \text{ }^\circ\text{C}$: at $f \leq 0.1 \text{ Hz}$ at $0.1 \text{ Hz} < f \leq 1 \text{ Hz}$ at $1 \text{ Hz} < f \leq 10 \text{ Hz}$ at $10 \text{ Hz} < f \leq 50 \text{ Hz}$ at $f > 50 \text{ Hz}$	$0.30 \times U_R$ $0.45 \times U_R$ $0.60 \times U_R$ $0.65 \times U_R$ $0.80 \times U_R$ $0.15 \times U_R$ $0.22 \times U_R$ $0.30 \times U_R$ $0.32 \times U_R$ $0.40 \times U_R$
Inductance		
Equivalent series inductance (ESL)	case size $12.5 \times 8 \times 3.5$ to $12.5 \times 8 \times 4.5 \text{ mm}$	typ. 9 to 14 nH
	case size $12.5 \times 8 \times 5$ and $12.5 \times 8 \times 6 \text{ mm}$	typ. 11 to 16 nH
	all case sizes	max. 20 nH
Dissipation		
Maximum power dissipation	case sizes $12.5 \times 8 \times 3.5$ to $12.5 \times 8 \times 5 \text{ mm}$	$P_{125} = 88 \text{ mW}$
	case size $12.5 \times 8 \times 6 \text{ mm}$	$P_{125} = 104 \text{ mW}$
Current		
Maximum leakage current	after 5 minutes at U_R and $T_{amb} = 25 \text{ }^\circ\text{C}$	$I_{L5} \leq 0.05C_R \times U_R$ or $2 \text{ } \mu\text{A}$ whichever is greater; see Table 2
Typical leakage current	after 15 s at U_R and $T_{amb} = 25 \text{ }^\circ\text{C}$: $U_R = 6.3$ to 16 V $U_R = 25$ to 40 V	$\approx 0.2 \times$ value stated in Table 2 $\approx 0.1 \times$ value stated in Table 2

SAL

Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

Voltage



Ripple current (I_R)

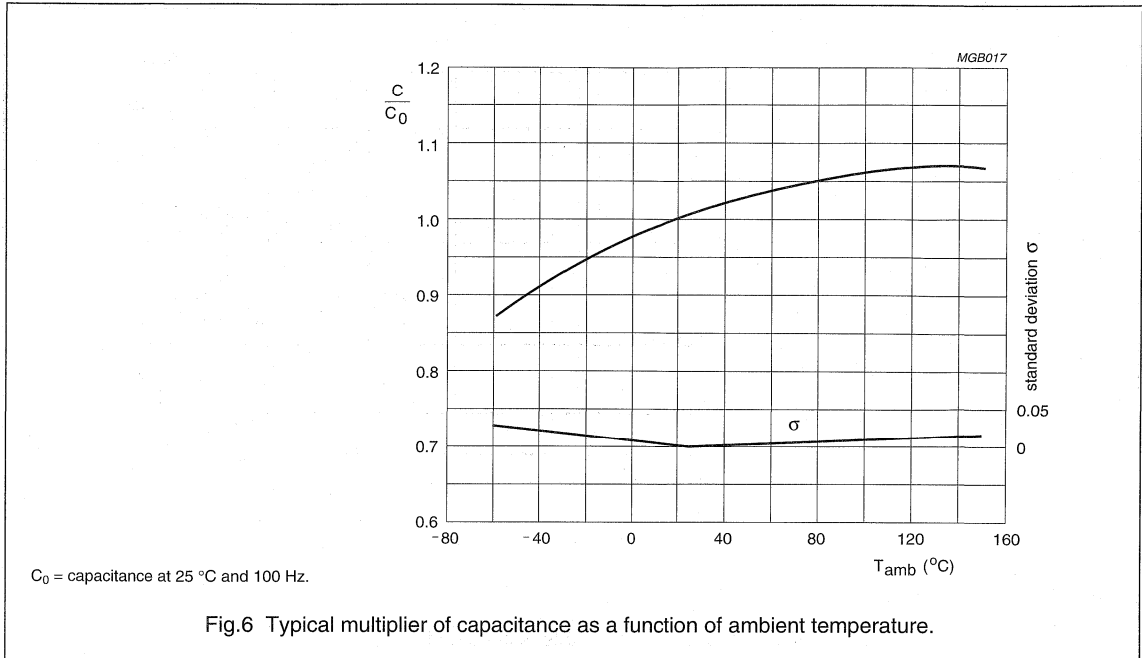
Applying the maximum RMS ripple current given in Table 2 will cause a device temperature of 138 °C. The 100 kHz values in Table 2 for other temperatures are to be calculated with the following I_R multipliers:

PARAMETER	T_{amb}					
	25 °C	40 °C	65 °C	85 °C	105 °C	125 °C
I_R multiplier	1.1	1.0	0.88	0.75	0.59	0.37

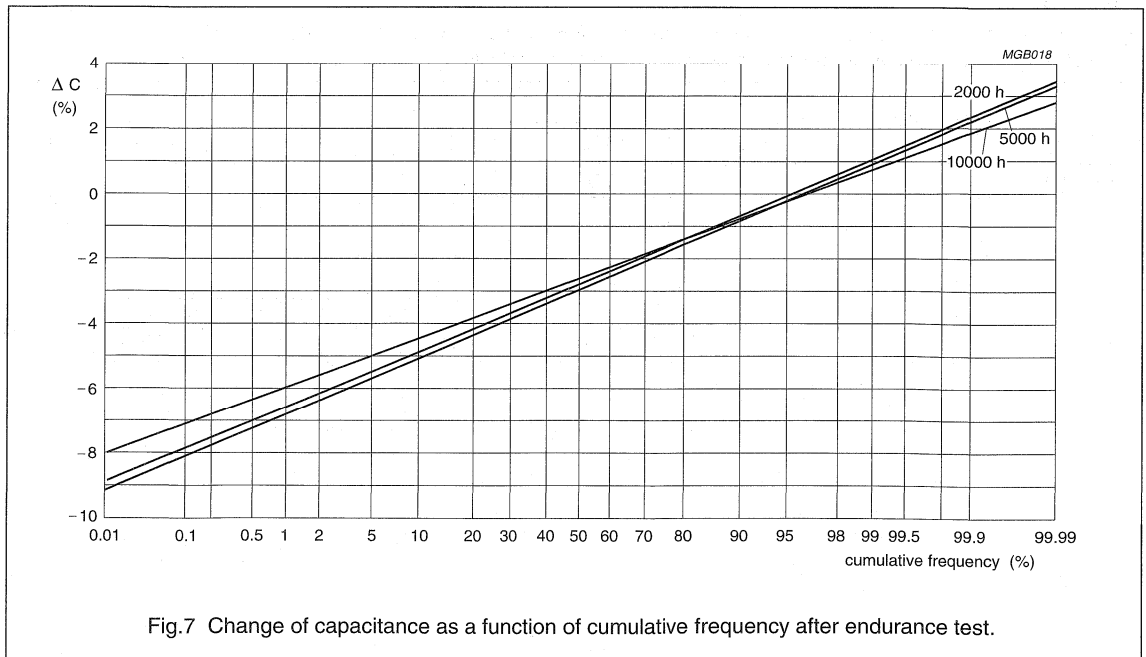
Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

Capacitance (C)



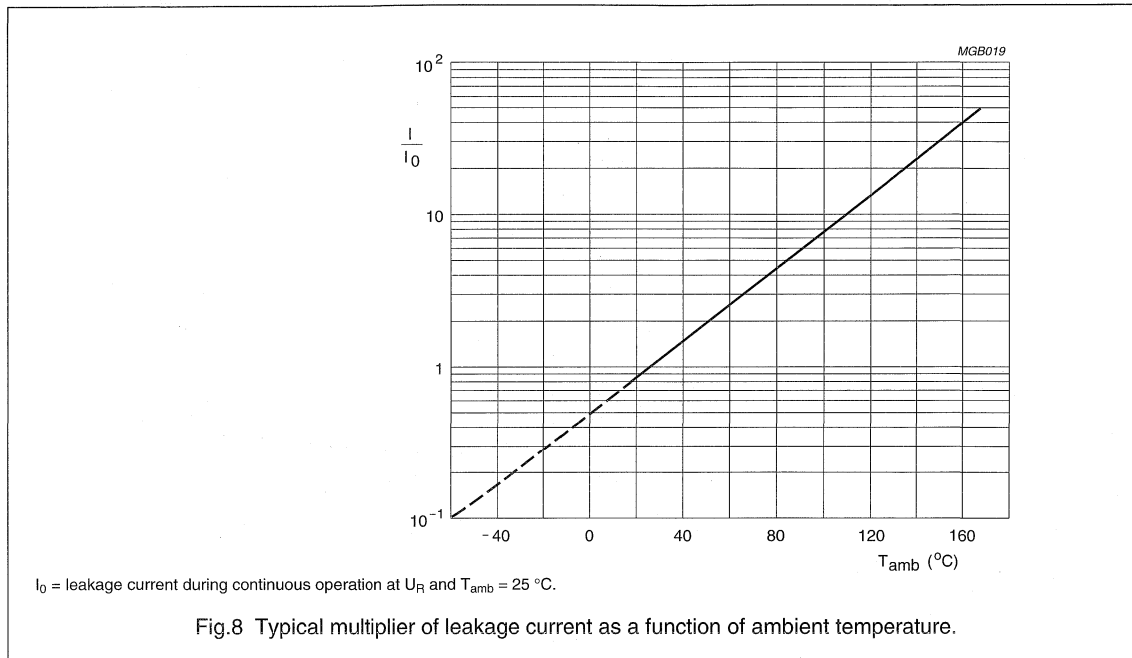
Typical capacitance change after endurance test at $T_{amb} = 125\text{ °C}$



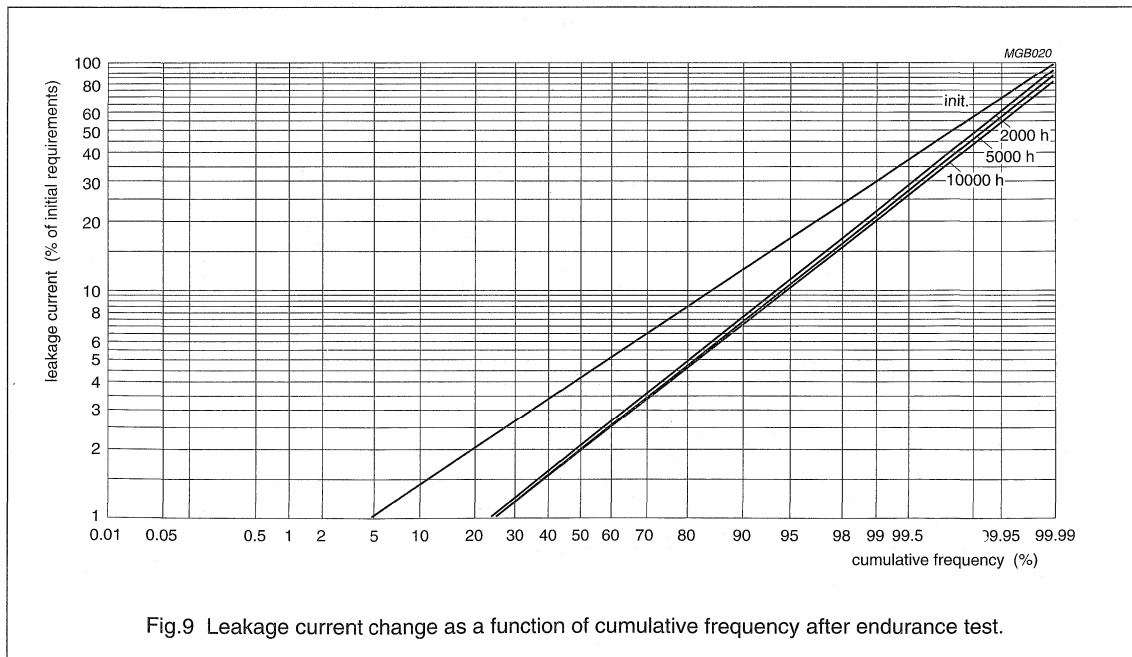
Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

Leakage current



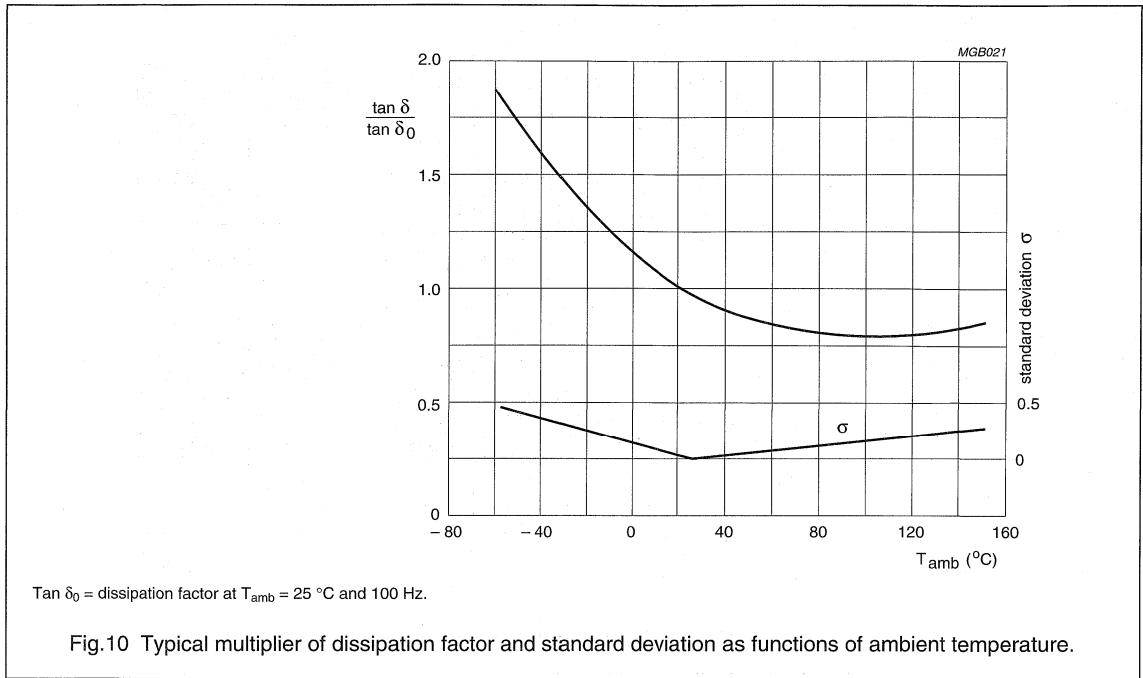
Typical leakage current change after endurance test at $T_{amb} = 125^\circ C$



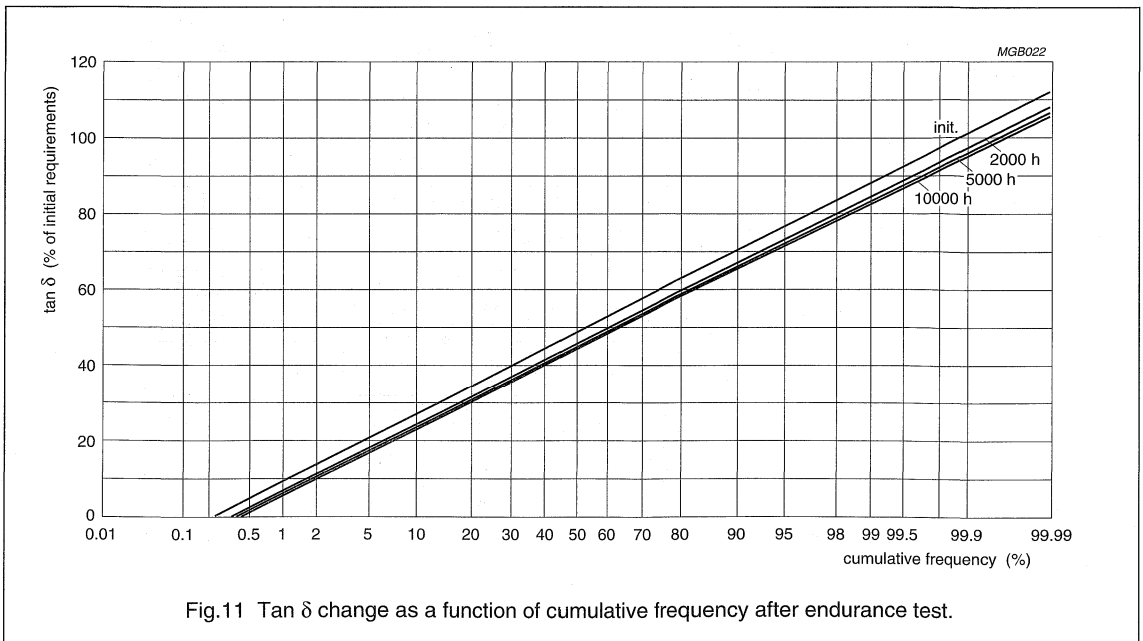
Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

Dissipation factor ($\tan \delta$)



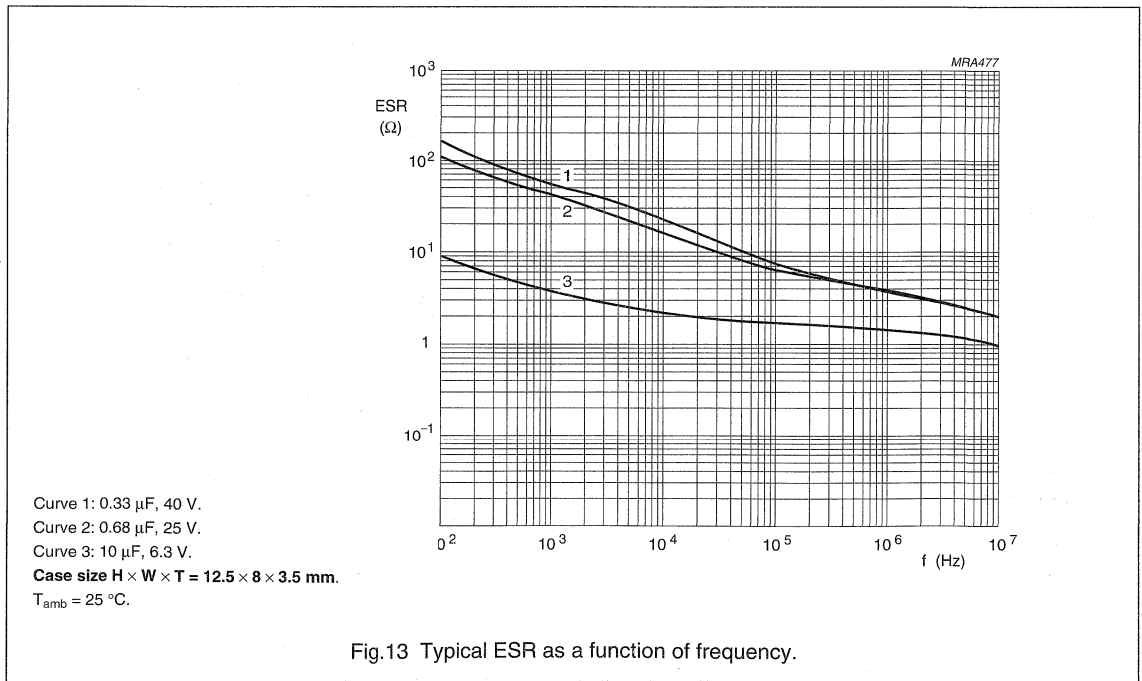
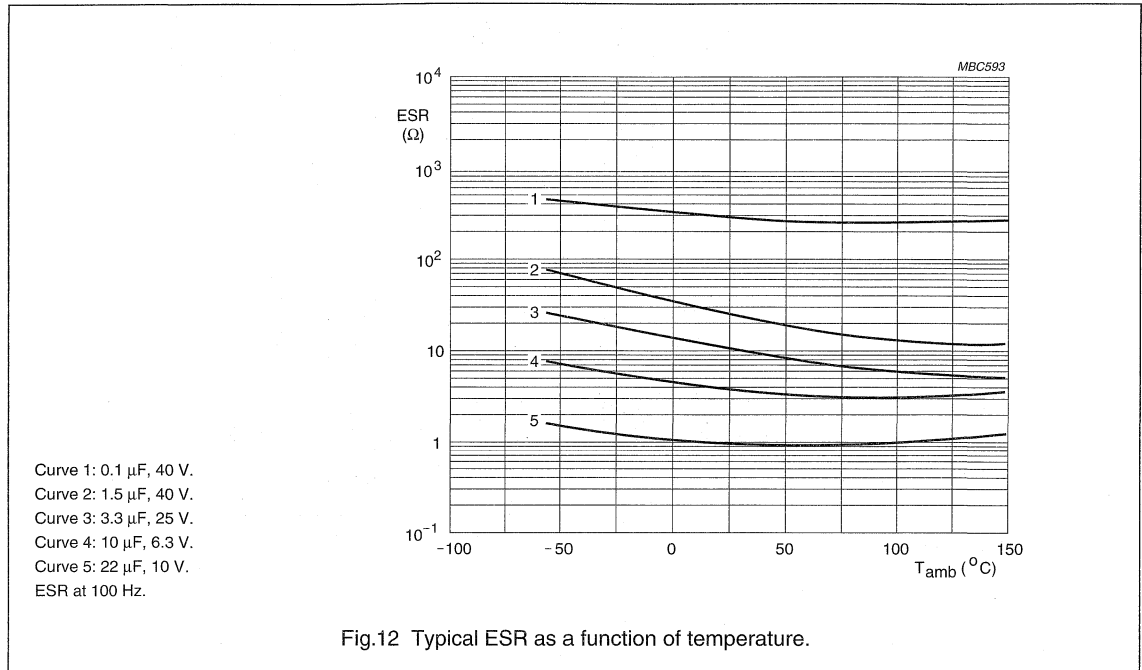
Typical $\tan \delta$ change after endurance test at $T_{amb} = 125^{\circ}\text{C}$



Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

Equivalent series resistance (ESR)



Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

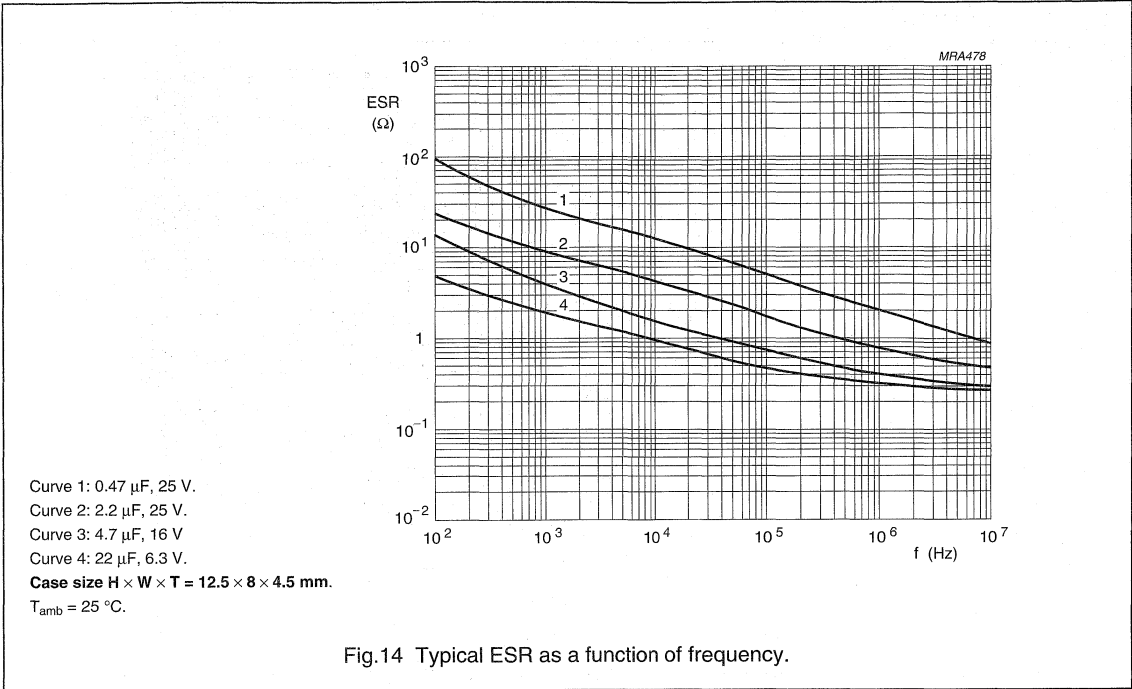


Fig.14 Typical ESR as a function of frequency.

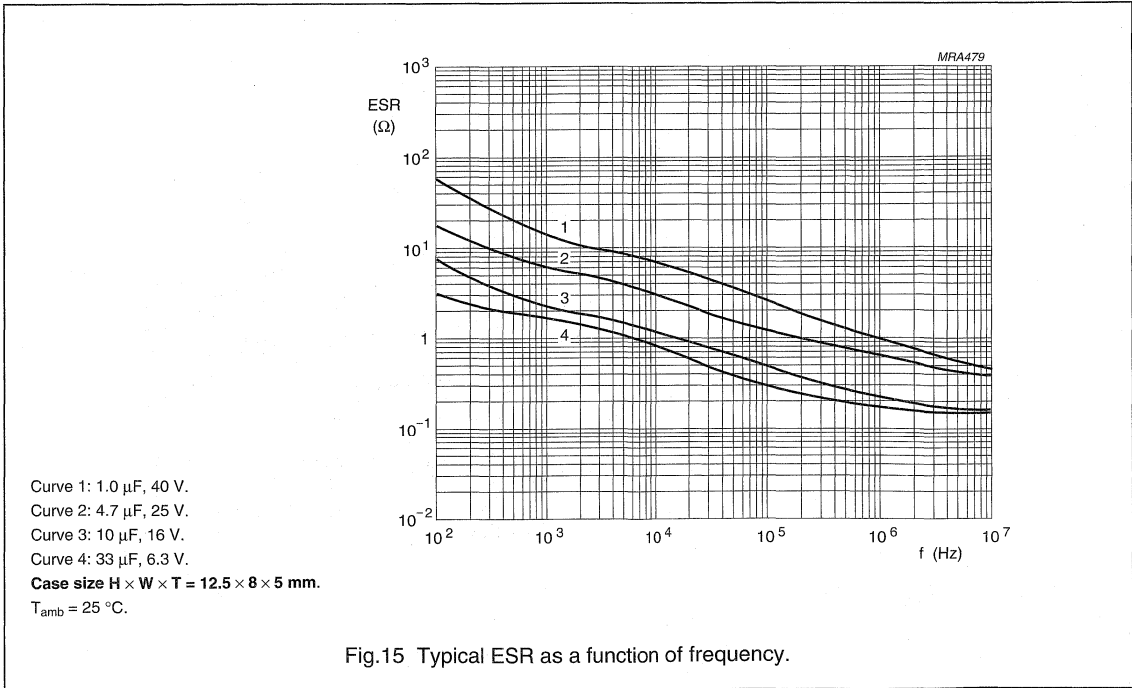


Fig.15 Typical ESR as a function of frequency.

SAL

Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

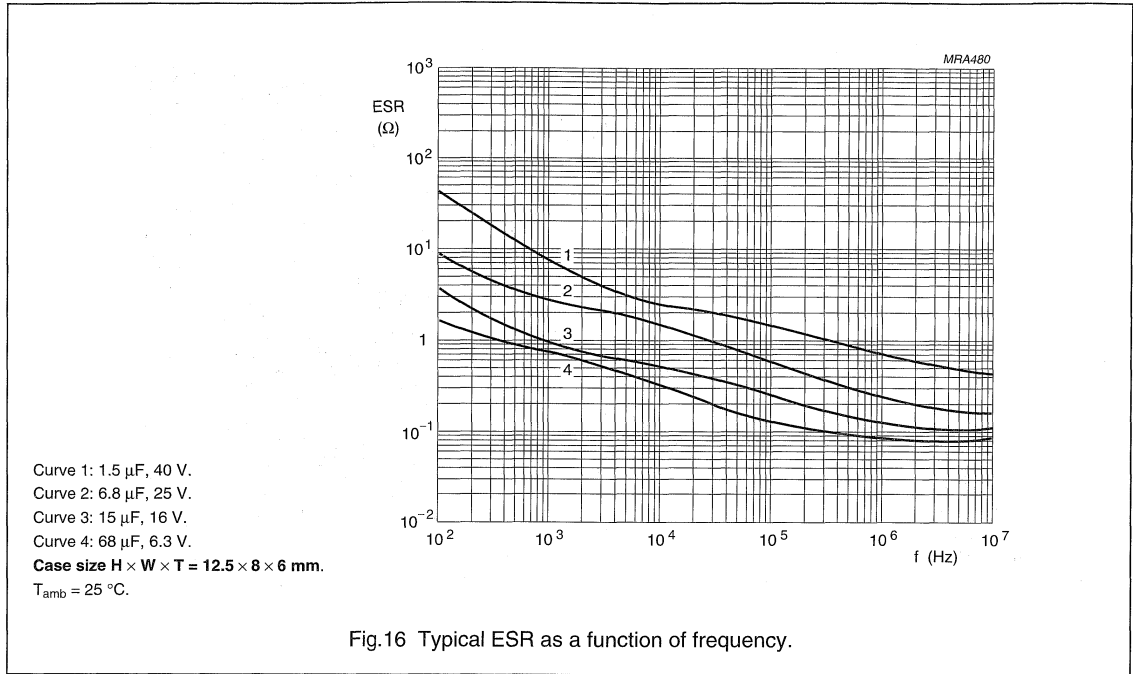
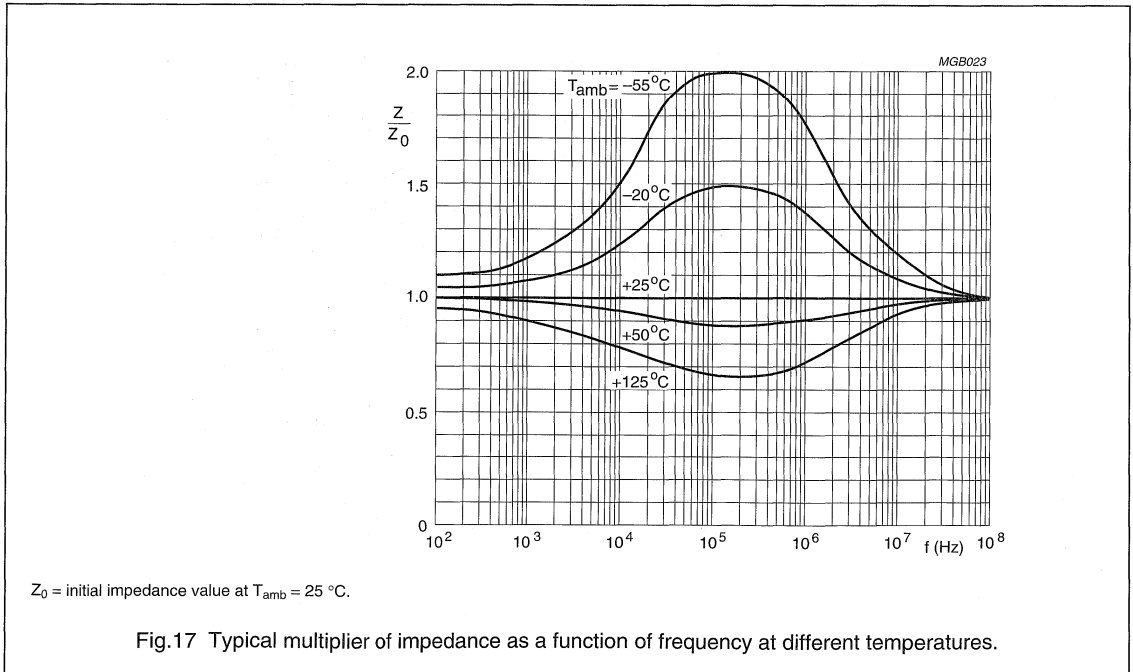


Fig.16 Typical ESR as a function of frequency.

Impedance (Z)



Z₀ = initial impedance value at T_{amb} = 25 °C.

Fig.17 Typical multiplier of impedance as a function of frequency at different temperatures.

Aluminum electrolytic capacitors
Solid Al, Radial Pearl

122 SAL-RP

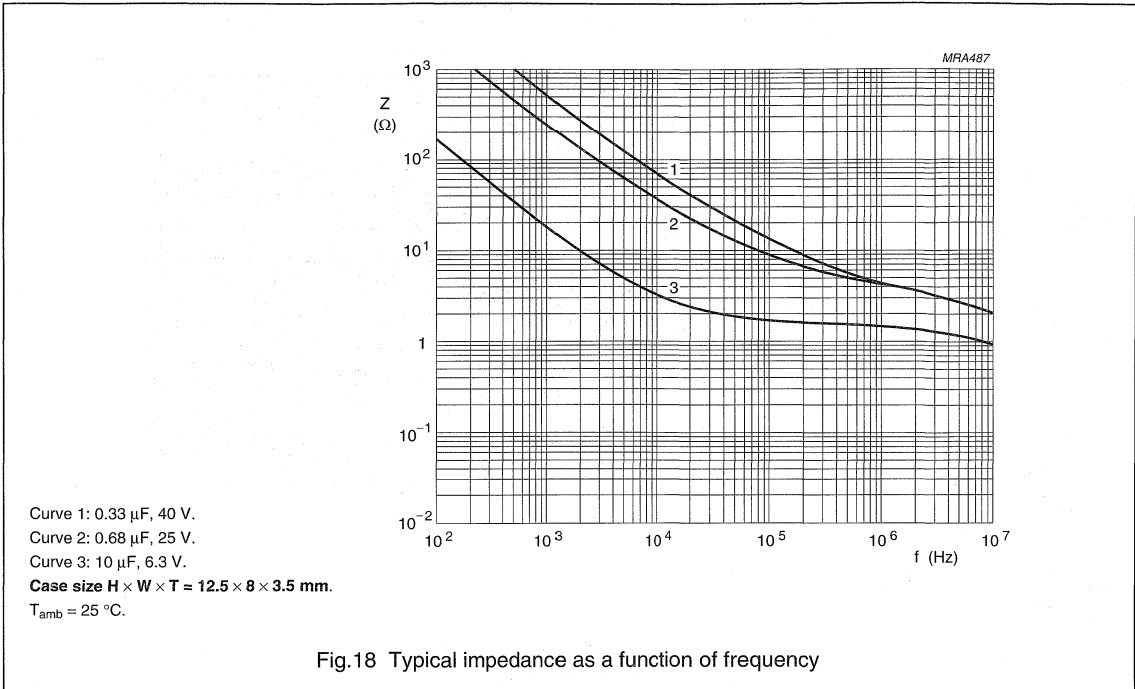


Fig.18 Typical impedance as a function of frequency

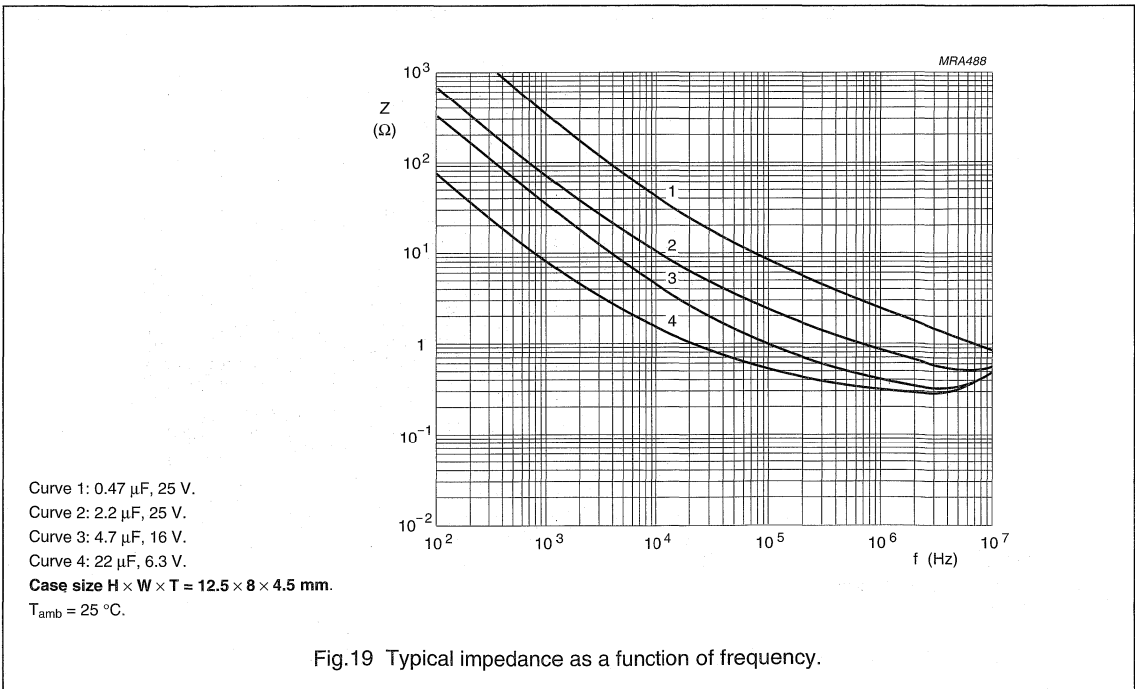


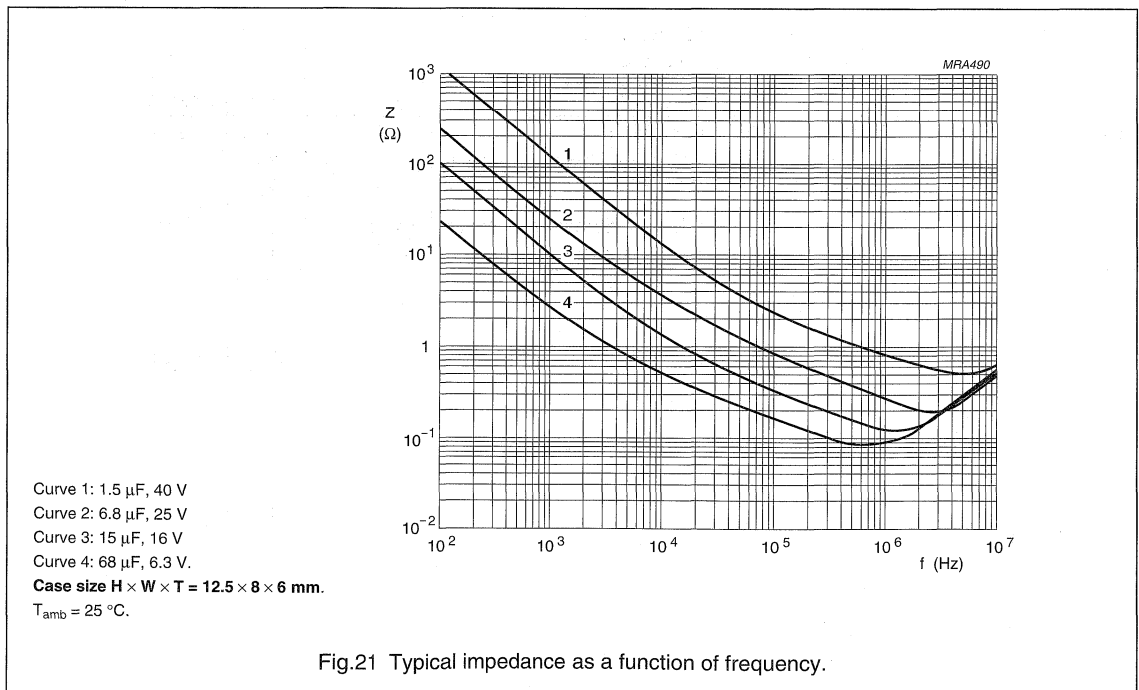
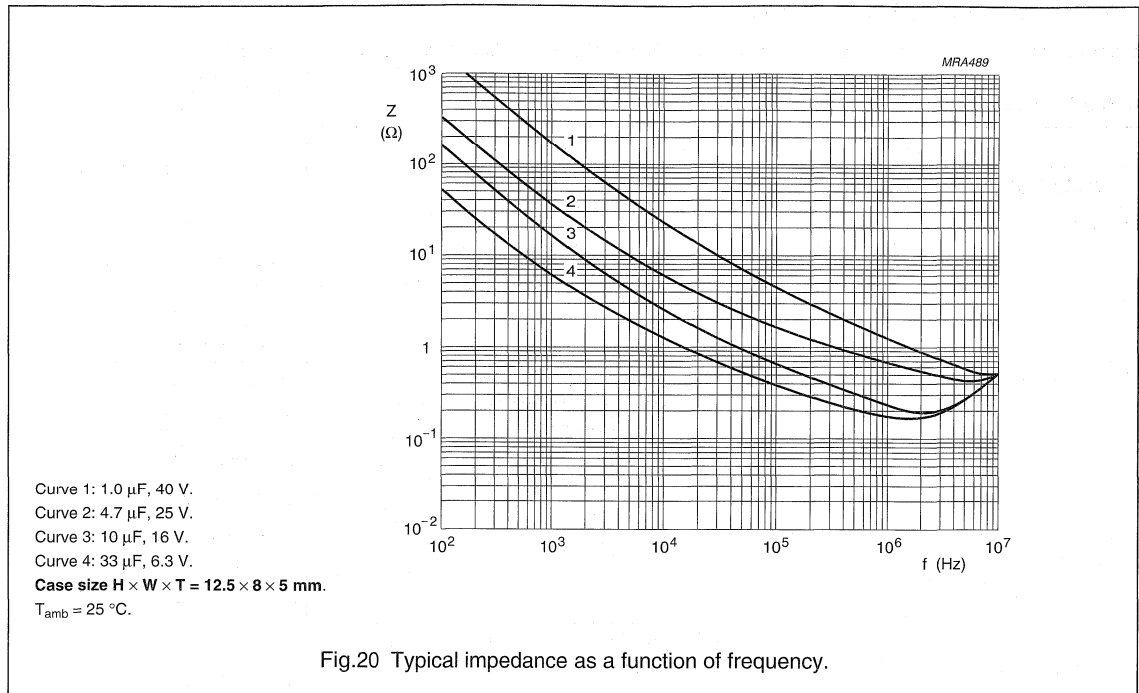
Fig.19 Typical impedance as a function of frequency.



Aluminum electrolytic capacitors

Solid Al, Radial Pearl

122 SAL-RP



Aluminum electrolytic capacitors

Solid Al, Radial Pearl

122 SAL-RP

SPECIFIC TESTS AND REQUIREMENTS

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

Table 3 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125\text{ }^{\circ}\text{C}$; $U_R = 6.3$ to 25 V with U_R applied; $U_R = 35$ and 40 V with U_C applied; 10000 hours	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30302 subclause 1.8.1	$T_{amb} = 125\text{ }^{\circ}\text{C}$; I_R applied and $U_R = 6.3$ to 25 V with U_R applied; $U_R = 35$ and 40 V with U_C applied; 20000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $< 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125\text{ }^{\circ}\text{C}$; no voltage applied; 500 hours	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1 \times \text{spec. limit}$
Charge and discharge	IEC 60384-4-2 subclause 9.21	10^6 cycles without series resistance: 0.5 s to U_R ; 0.5 s to ground	$\Delta C/C: \pm 5\%$ no short or open circuit, no visible damage
Solvent resistance	IEC 60068-2-45, test XA IEC 60653	immersion: 5 ± 0.5 minutes with or without ultrasonic at $55 \pm 5\text{ }^{\circ}\text{C}$ solvents: demineralized water and/or calgonite solution (20 g/l)	visual appearance not affected



Aluminum electrolytic capacitors

Solid Al, Radial Pearl

122 SAL-RP

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Extended vibration	IEC 60068-2-6 test Fc	10 to 2000 Hz; 1.5 mm or 20 g; 1 octave/minute; 3 directions; 1 sweep per direction; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C: \pm 5\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1.5 \times \text{spec. limit}$
Shock	IEC 60068-2-27 test Ea	half-sine or saw tooth pulse shape; 50 g; 11 ms; 3 successive shocks in each direction of 3 mutually perpendicular axes; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C: \pm 5\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1.5 \times \text{spec. limit}$
Passive flammability	IEC 60695-2-2	capacitor mounted to a vertical printed-circuit board; one flame on capacitor body; $T_{\text{amb}} = 20$ to 25 °C; test duration = 20 s	after removing the test flame from the capacitor, the capacitor must not continue to burn for more than 15 s; no burning particles must drop from the sample

Aluminum electrolytic capacitors

Solid Al, Axial



123 SAL-A

FEATURES

- Polarized aluminum electrolytic capacitors, solid electrolyte MnO₂
- Axial leads, aluminum case, ceramic seal, blue insulation sleeve
- SAL-A: standard version
- SAL-AG: epoxy filled shock-proof version up to 10000 g
- Extremely long useful life: 20000 hours at 125 °C
- Extended usable temperature range up to 200 °C
- Excellent low temperature impedance and ESR behaviour
- Charge and discharge proof, application with 0 Ω resistance allowed
- Reverse DC voltage up to 0.3 × U_R allowed
- AC voltage up to 0.8 × U_R allowed
- Advanced technology to achieve high reliability and high stability.

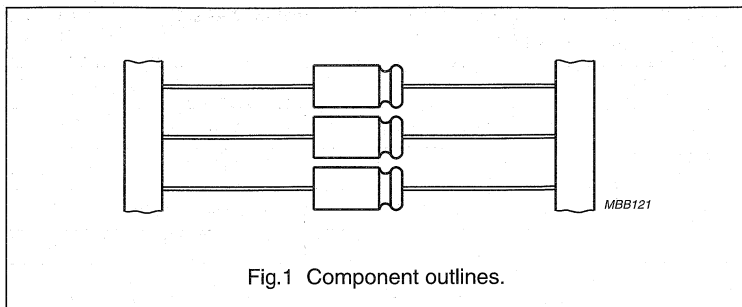
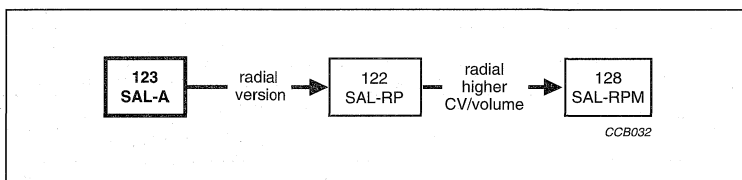


Fig.1 Component outlines.



APPLICATIONS

- EDP, telecommunications, general industrial, automotive, military and space
- Smoothing, filtering, buffering, timing
- For power supplies, DC/DC converters.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case size (∅D _{max} × L _{max} in mm)	6.7 × 15.3 to 12.9 × 32.0
Rated capacitance range (E6 series), C _R	1.0 to 1500 μF
Tolerance on C _R	±20%; ±10% on request
Rated voltage range, U _R	6.3 to 40 V
Category temperature range	-55 to +125 °C
Usable temperature range	-80 to +200 °C
Endurance test at 155 and 125 °C	5000 and 8000 hours
Useful life at 125 °C	20000 hours
Useful life at 40 °C, I _R applied	450000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Detail specification	IEC 60384-4-2/CECC 30302
Approvals	CECC 30302-003 (excl. 40 V)
Climatic category IEC 60068	55/125/56

SAL

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

Selection chart for C_R , U_R and relevant maximum case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V) at $T_{amb} = 85^\circ C$					
	6.3	10	16	25	35	40 ⁽¹⁾
	U_C (V) at $T_{amb} = 125^\circ C$					
	6.3	10	16	25	25	25
1.0	–	–	–	–	6.7 × 15.3	–
1.5	–	–	–	–	6.7 × 15.3	–
2.2	–	–	–	–	6.7 × 15.3	6.7 × 15.3
3.3	–	–	–	–	6.7 × 15.3	6.7 × 15.3
4.7	–	–	–	–	6.7 × 15.3	6.7 × 15.3
6.8	–	–	–	–	6.7 × 15.3	6.7 × 15.3
10	–	–	6.7 × 15.3	6.7 × 15.3	7.6 × 20.4	7.6 × 20.4
15	–	–	6.7 × 15.3	6.7 × 15.3	7.6 × 20.4	7.6 × 20.4
22	–	–	6.7 × 15.3	7.6 × 20.4	7.6 × 20.4	9.4 × 23.3
33	–	6.7 × 15.3	7.6 × 20.4	7.6 × 20.4	9.4 × 23.3	9.4 × 23.3
47	6.7 × 15.3	6.7 × 15.3	7.6 × 20.4	7.6 × 20.4	9.4 × 23.3	10.3 × 32.0
68	6.7 × 15.3	7.6 × 20.4	7.6 × 20.4	9.4 × 23.3	10.3 × 32.0	10.3 × 32.0
100	–	7.6 × 20.4	9.4 × 23.3	9.4 × 23.3	12.9 × 32.0	12.9 × 32.0
150	7.6 × 20.4	9.4 × 23.3	9.4 × 23.3	10.3 × 32.0	12.9 × 32.0	–
220	–	9.4 × 23.3	10.3 × 32.0	12.9 × 32.0	–	–
330	9.4 × 23.3	10.3 × 32.0	10.3 × 32.0	12.9 × 32.0	–	–
470	–	10.3 × 32.0	12.9 × 32.0	–	–	–
680	10.3 × 32.0	12.9 × 32.0	12.9 × 32.0	–	–	–
1000	12.9 × 32.0	12.9 × 32.0	–	–	–	–
1500	12.9 × 32.0	–	–	–	–	–

Note

1. 40 V type not CECC approved.

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M = $\pm 20\%$, K = $\pm 10\%$, in accordance with "IEC 60062")
- Rated voltage (in V) at corresponding maximum temperature
- Date code in accordance with "IEC 60062"
- Name of manufacturer
- Group number (123)
- Code for factory of origin
- Code for basic specification (in accordance with "IEC 60384-4")
- '+' sign to indicate the positive terminal
- A band to identify the negative terminal.

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

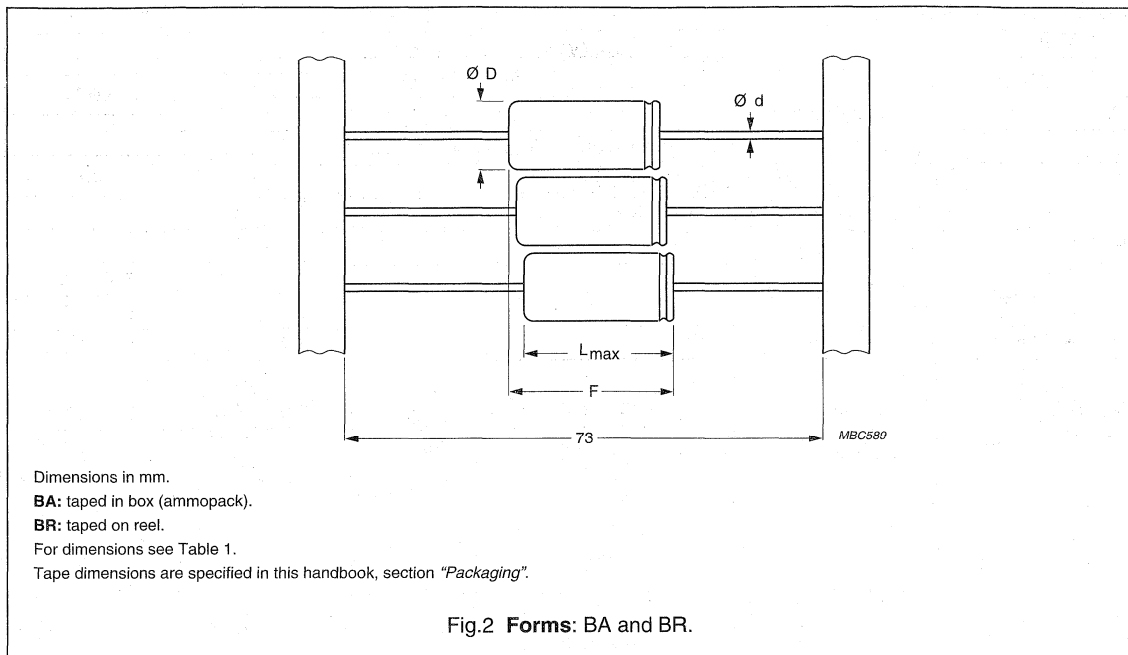


Table 1 Physical dimensions, mass and packaging quantities; see Fig.2

CASE		F _{max} (mm)	Ød (mm)	MASS ⁽²⁾ (g)	PACKAGING QUANTITIES	
MAXIMUM SIZE ØD × L ⁽¹⁾ (mm)	CODE				FORM BA	FORM BR
6.7 × 15.3	1	20.0	0.6	≈1.05	100	800
7.6 × 20.4	2A	22.5	0.6	≈1.55	100	800
9.4 × 23.3	4	25.0	0.6	≈2.6	100	500
10.3 × 32.0	5	35.0	0.8	≈4.2	100	500
12.9 × 32.0	6	35.0	0.8	≈7	100	400

Notes

- For epoxy-filled versions add 1 mm to stated L_{max}.
- Add 10% for SAL-AG epoxy-filled versions.

SAL

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2, 4 and 6 apply at $T_{amb} = 20$ to 25 °C, $P = 86$ to 106 kPa, $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz
I_R	max. RMS ripple current, no necessary DC voltage applied
I_{L5}	max. leakage current after 5 minutes at U_R
$\tan \delta$	max. dissipation factor at 100 Hz
ESR	max./typ. equivalent series resistance at 100 Hz
Z	max. impedance at 100 kHz

Table 2 Electrical data for 123 series; preferred types in **bold**

U_C (V)	U_R (V)	C_R 100 Hz (μF)	MAXIMUM CASE SIZE $\varnothing D \times L$ (mm)	I_R 100 Hz 125 °C (mA)	I_R 10 kHz 85 °C (mA)	I_R 100 kHz 40 °C (mA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)
6.3	6.3	47	6.7 × 15.3	58	440	640	15	0.18	7.6	3.0	1.2
		68	6.7 × 15.3	83	520	760	21	0.18	5.3	2.6	1.2
		150	7.6 × 20.4	160	870	1270	47	0.18	2.4	1.5	1.0
		330	9.4 × 23.3	330	1470	2140	104	0.18	1.1	0.55	0.4
		680	10.3 × 32.0	680	2340	3410	214	0.18	0.55	0.28	0.3
		1000	12.9 × 32.0	940	3180	4640	315	0.18	0.36	0.19	0.2
		1500	12.9 × 32.0	1220	4140	6020	473	0.18	0.24	0.13	0.2
10	10	33	6.7 × 15.3	63	360	530	17	0.18	11	3.8	1.2
		47	6.7 × 15.3	83	440	640	24	0.18	7.6	4.0	1.2
		68	7.6 × 20.4	110	590	850	34	0.18	5.3	2.5	1.0
		100	7.6 × 20.4	160	710	1040	50	0.18	3.6	1.8	1.0
		150	9.4 × 23.3	240	990	1450	75	0.18	2.4	0.9	0.4
		220	9.4 × 23.3	350	1180	1720	110	0.18	1.7	0.6	0.4
		330	10.3 × 32.0	490	1650	2410	165	0.18	1.1	0.45	0.3
		470	10.3 × 32.0	570	1940	2830	235	0.18	0.8	0.35	0.3
		680	12.9 × 32.0	760	2580	3750	340	0.18	0.55	0.25	0.2
		1000	12.9 × 32.0	1000	3380	4920	500	0.18	0.36	0.18	0.2

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

ORDERING INFORMATION**Ordering example**

Electrolytic capacitors 123 series

10 μ F/16 V; \pm 20%Maximum case size: \varnothing 6.7 \times 15.3 mm; Form BR

Catalogue number: 2222 123 25109.

Table 3 Ordering information for 123 series; preferred types in **bold**

U _C (V)	U _R (V)	C _R 100 Hz (μ F)	MAXIMUM CASE SIZE \varnothing D \times L (mm)	CATALOGUE NUMBER 2222			
				SAL-A FORM BA tol. \pm 20%	SAL-A FORM BR tol. \pm 20%	SAL-AG ⁽¹⁾ FORM BA tol. \pm 10% level S	SAL-AG ⁽¹⁾ FORM BA tol. \pm 20%
6.3	6.3	47	6.7 \times 15.3	123 13479	123 23479	123 83479	123 63479
		68	6.7 \times 15.3	123 13689	123 23689	123 83689	123 63689
		150	7.6 \times 20.4	123 13151	123 23151	123 83151	123 63151
		330	9.4 \times 23.3	123 13331	123 23331	123 83331	123 63331
		680	10.3 \times 32.0	123 13681	123 23681	123 83681	123 63681
		1000	12.9 \times 32.0	123 13102	123 23102	123 83102	123 63102
		1500	12.9 \times 32.0	123 13152	123 23152	123 83152	123 63152
		10	10	33	6.7 \times 15.3	123 14339	123 24339
47	6.7 \times 15.3			123 14479	123 24479	123 84479	123 64479
68	7.6 \times 20.4			123 14689	123 24689	123 84689	123 64689
100	7.6 \times 20.4			123 14101	123 24101	123 84101	123 64101
150	9.4 \times 23.3			123 14151	123 24151	123 84151	123 64151
220	9.4 \times 23.3			123 14221	123 24221	123 84221	123 64221
330	10.3 \times 32.0			123 14331	123 24331	123 84331	123 64331
470	10.3 \times 32.0			123 14471	123 24471	123 84471	123 64471
680	12.9 \times 32.0			123 14681	123 24681	123 84681	123 64681
1000	12.9 \times 32.0			123 14102	123 24102	123 84102	123 64102

Note

1. SAL-AG types are epoxy-filled.

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

ELECTRICAL DATA (continued)**Table 4** Electrical data for 123 series continued; preferred types in **bold**

U _C (V)	U _R (V)	C _R 100 Hz (μF)	MAXIMUM CASE SIZE ∅D × L (mm)	I _R 100 Hz 125 °C (mA)	I _R 10 kHz 85 °C (mA)	I _R 100 kHz 40 °C (mA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)	
16	16	10	6.7 × 15.3	31	230	330	16	0.14	28	8.0	2.5	
		15	6.7 × 15.3	47	280	400	24	0.14	19	5.5	2.5	
		22	6.7 × 15.3	63	340	490	35	0.14	13	5.5	2.5	
		33	7.6 × 20.4	89	470	680	55	0.14	8.4	3.0	2.0	
		47	7.6 × 20.4	120	560	810	75	0.14	5.9	2.6	2.0	
		68	7.6 × 20.4	180	670	970	110	0.14	4.1	2.5	2.0	
		100	9.4 × 23.3	260	920	1340	160	0.14	2.8	1.5	0.8	
		150	9.4 × 23.3	310	1060	1550	240	0.16	2.1	0.7	0.8	
		220	10.3 × 32.0	420	1420	2060	350	0.16	1.5	0.55	0.6	
		330	10.3 × 32.0	510	1740	2530	500	0.16	1.0	0.35	0.6	
		470	12.9 × 32.0	680	2280	3330	750	0.16	0.7	0.25	0.4	
	680	12.9 × 32.0	850	2870	4170	870	0.16	0.5	0.18	0.4		
25	25	10	6.7 × 15.3	43	230	330	25	0.14	28	13.0	5	
		15	6.7 × 15.3	60	280	400	35	0.14	19	10.0	5.0	
		22	7.6 × 20.4	88	370	550	55	0.14	13	7	2.5	
		33	7.6 × 20.4	130	470	680	85	0.14	8.4	5	2.5	
		47	7.6 × 20.4	160	560	810	100	0.14	5.9	3.5	2.5	
		68	9.4 × 23.3	230	760	1110	170	0.14	4.1	1.8	1.0	
		100	9.4 × 23.3	250	860	1250	250	0.16	3.2	1.0	1.0	
		150	10.3 × 32.0	350	1200	1740	400	0.16	2.1	1.2	0.8	
		220	12.9 × 32.0	460	1560	2270	550	0.16	1.5	0.85	0.6	
			330	12.9 × 32.0	600	2030	2950	800	0.16	1.0	0.60	0.6
		25	35	1.5	6.7 × 15.3	7	68	98	5	0.12	160	40.60
2.2	6.7 × 15.3			10	82	120	5	0.12	109	30	7.5	
3.3	6.7 × 15.3			14	100	150	7	0.12	73	28	7.5	
4.7	6.7 × 15.3			20	120	170	10	0.12	51	20	7.5	
6.8	6.7 × 15.3			27	140	210	15	0.12	35	16	7.5	
10	7.6 × 20.4			37	200	280	20	0.12	24	10	2.5	
15	7.6 × 20.4			53	240	350	30	0.12	16	8	2.5	
22	7.6 × 20.4			78	290	420	45	0.12	11	7	2.5	
33	9.4 × 23.3			120	410	590	65	0.12	7.2	3	1.0	
47	9.4 × 23.3			140	480	700	95	0.12	5.1	2.9	1.0	
68	10.3 × 32.0			170	570	820	135	0.16	4.7	2.1	0.8	
100	12.9 × 32.0			220	760	1100	200	0.16	3.2	1.7	0.6	
	150			12.9 × 32.0	290	990	1440	300	0.16	2.1	1.0	0.6

Aluminum electrolytic capacitors
Solid Al, Axial

123 SAL-A

ORDERING INFORMATION (continued)

Table 5 Ordering information for 123 series continued; preferred types in bold

U _C (V)	U _R (V)	C _R 100 Hz (µF)	MAXIMUM CASE SIZE ØD × L (mm)	CATALOGUE NUMBER 2222			
				SAL-A FORM BA tol ±20%	SAL-A FORM BR tol ±20%	SAL-AG ⁽¹⁾ FORM BA tol. ±10% level S	SAL-AG ⁽¹⁾ FORM BA tol. ±20%
16	16	10	6.7 × 15.3	123 15109	123 25109	123 85109	123 65109
		15	6.7 × 15.3	123 15159	123 25159	123 85159	123 65159
		22	6.7 × 15.3	123 15229	123 25229	123 85229	123 65229
		33	7.6 × 20.4	123 15339	123 25339	123 85339	123 65339
		47	7.6 × 20.4	123 15479	123 25479	123 85479	123 65479
		68	7.6 × 20.4	123 15689	123 25689	123 85689	123 65689
		100	9.4 × 23.3	123 15101	123 25101	123 85101	123 65101
		150	9.4 × 23.3	123 15151	123 25151	123 85151	123 65151
		220	10.3 × 32.0	123 15221	123 25221	123 85221	123 65221
		330	10.3 × 32.0	123 15331	123 25331	123 85331	123 65331
		470	12.9 × 32.0	123 15471	123 25471	123 85471	123 65471
		680	12.9 × 32.0	123 15681	123 25681	123 85681	123 65681
		25	25	10	6.7 × 15.3	123 16109	123 26109
15	6.7 × 15.3			123 16159	123 26159	123 86159	123 66159
22	7.6 × 20.4			123 16229	123 26229	123 86229	123 66229
33	7.6 × 20.4			123 16339	123 26339	123 86339	123 66339
47	7.6 × 20.4			123 16479	123 26479	123 86479	123 66479
68	9.4 × 23.3			123 16689	123 26689	123 86689	123 66689
100	9.4 × 23.3			123 16101	123 26101	123 86101	123 66101
150	10.3 × 32.0			123 16151	123 26151	123 86151	123 66151
220	12.9 × 32.0			123 16221	123 26221	123 86221	123 66221
330	12.9 × 32.0			123 16331	123 26331	123 86331	123 66331
25	35	1.5	6.7 × 15.3	123 10158	123 20158	123 80158	123 60158
		2.2	6.7 × 15.3	123 10228	123 20228	123 80228	123 60228
		3.3	6.7 × 15.3	123 10338	123 20338	123 80338	123 60338
		4.7	6.7 × 15.3	123 10478	123 20478	123 80478	123 60478
		6.8	6.7 × 15.3	123 10688	123 20688	123 80688	123 60688
		10	7.6 × 20.4	123 10109	123 20109	123 80109	123 60109
		15	7.6 × 20.4	123 10159	123 20159	123 80159	123 60159
		22	7.6 × 20.4	123 10229	123 20229	123 80229	123 60229
		33	9.4 × 23.3	123 10339	123 20339	123 80339	123 60339
		47	9.4 × 23.3	123 10479	123 20479	123 80479	123 60479
		68	10.3 × 32.0	123 10689	123 20689	123 80689	123 60689
		100	12.9 × 32.0	123 10101	123 20101	123 80101	123 60101
		150	12.9 × 32.0	123 10151	123 20151	123 80151	123 60151

SAL

Note

1. SAL-AG types are epoxy-filled.

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

ELECTRICAL DATA (continued)**Table 6** Electrical data for 123 series continued; preferred types in **bold**

U _C (V)	U _R (V)	C _R 100 Hz (μ F)	MAXIMUM CASE SIZE $\varnothing D \times L$ (mm)	I _R 100 Hz 125 °C (mA)	I _R 10 kHz 85 °C (mA)	I _R 100 kHz 40 °C (mA)	I _{L5} 5 min (μ A)	Tan δ 100 Hz	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)
25	40	2.2	6.7 × 15.3	11	82	120	9	0.12	109	38	7.5
		3.3	6.7 × 15.3	16	100	150	13	0.12	73	25	7.5
		4.7	6.7 × 15.3	22	120	170	19	0.12	51	20	7.5
		6.8	6.7 × 15.3	28	140	210	27	0.12	35	15	7.5
		10	7.6 × 20.4	41	200	280	40	0.12	24	11	2.5
		15	7.6 × 20.4	61	240	350	60	0.12	16	7	2.5
		22	9.4 × 23.3	89	330	480	90	0.12	11	4	1.5
		33	9.4 × 23.3	120	410	590	130	0.12	7.2	2.9	1.0
		47	10.3 × 32.0	160	540	790	190	0.12	5.1	2.7	1.0
		68	10.3 × 32.0	170	570	820	270	0.16	4.7	2.3	0.8
		100	12.9 × 32.0	220	760	1100	400	0.16	3.2	1.6	0.6

ORDERING INFORMATION (continued)**Table 7** Ordering information for 123 series continued; preferred types in **bold**

U _C (V)	U _R (V)	C _R 100 Hz (μ F)	MAXIMUM CASE SIZE $\varnothing D \times L$ (mm)	CATALOGUE NUMBER 2222			
				SAL-A FORM BA tol $\pm 20\%$	SAL-A FORM BR tol $\pm 20\%$	SAL-AG ⁽¹⁾ FORM BA tol. $\pm 10\%$ level S	SAL-AG ⁽¹⁾ FORM BA tol. $\pm 20\%$
25	40	2.2	6.7 × 15.3	123 17228	123 27228	123 87228	123 67228
		3.3	6.7 × 15.3	123 17338	123 27338	123 87338	123 67338
		4.7	6.7 × 15.3	123 17478	123 27478	123 87478	123 67478
		6.8	6.7 × 15.3	123 17688	123 27688	123 87688	123 67688
		10	7.6 × 20.4	123 17109	123 27109	123 87109	123 67109
		15	7.6 × 20.4	123 17159	123 27159	123 87159	123 67159
		22	9.4 × 23.3	123 17229	123 27229	123 87229	123 67229
		33	9.4 × 23.3	123 17339	123 27339	123 87339	123 67339
		47	10.3 × 32.0	123 17479	123 27479	123 87479	123 67479
		68	10.3 × 32.0	123 17689	123 27689	123 87689	123 67689
		100	12.9 × 32.0	123 17101	123 27101	123 87101	123 67101

Note

- SAL-AG types are epoxy-filled.

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

ELECTRICAL DATA (continued)**Additional electrical data**

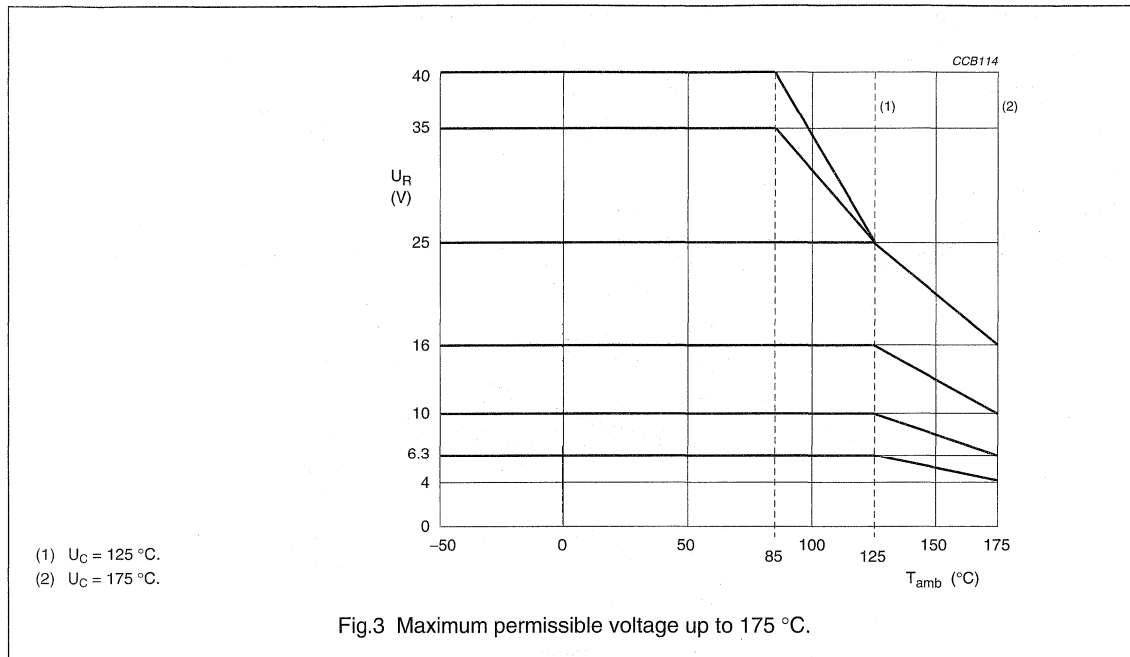
PARAMETER	CONDITIONS	VALUE
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} < 0.3 \times U_R$
Maximum peak AC voltage, reverse voltage applied		$\leq 2 V$
Maximum peak AC voltage, without reverse voltage applied	$T_{amb} \leq 85\text{ °C}$: at $f \leq 0.1\text{ Hz}$ at $0.1\text{ Hz} < f \leq 1\text{ Hz}$ at $1\text{ Hz} < f \leq 10\text{ Hz}$ at $10\text{ Hz} < f \leq 50\text{ Hz}$ at $f > 50\text{ Hz}$ $85\text{ °C} < T_{amb} \leq 125\text{ °C}$: at $f \leq 0.1\text{ Hz}$ at $0.1\text{ Hz} < f \leq 1\text{ Hz}$ at $1\text{ Hz} < f \leq 10\text{ Hz}$ at $10\text{ Hz} < f \leq 50\text{ Hz}$ at $f > 50\text{ Hz}$	$0.30 \times U_R$ $0.45 \times U_R$ $0.60 \times U_R$ $0.65 \times U_R$ $0.80 \times U_R$ $0.15 \times U_R$ $0.22 \times U_R$ $0.30 \times U_R$ $0.32 \times U_R$ $0.40 \times U_R$
Current		
Maximum leakage current	after 5 minutes at U_R and $T_{amb} = 25\text{ °C}$	$I_{L5} \leq 0.05C_R \times U_R$ or $2\text{ }\mu\text{A}$, whichever is greater; see Tables 2, 4 and 6
Typical leakage current	after 15 s at U_R and $T_{amb} = 25\text{ °C}$: $U_R = 6.3$ to 16 V $U_R = 25$ to 40 V	$\approx 0.2 \times$ value stated in Tables 2, 4 and 6 $\approx 0.1 \times$ value stated in Tables 2, 4 and 6

SAL

Aluminum electrolytic capacitors
Solid Al, Axial

123 SAL-A

Voltage



Ripple current (I_R)

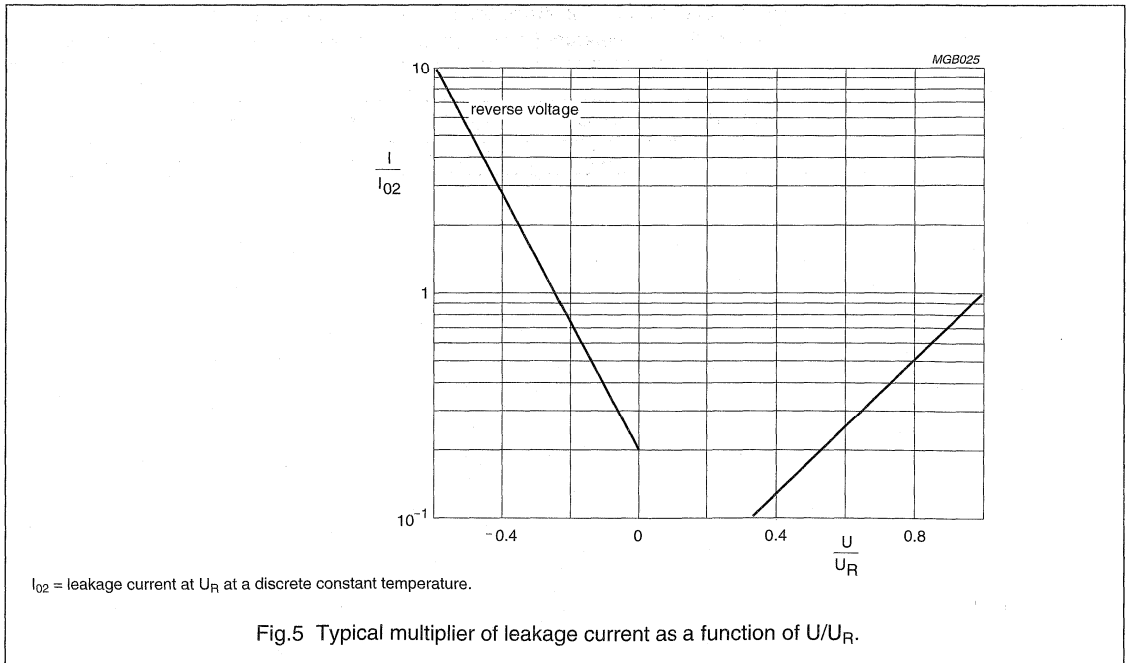
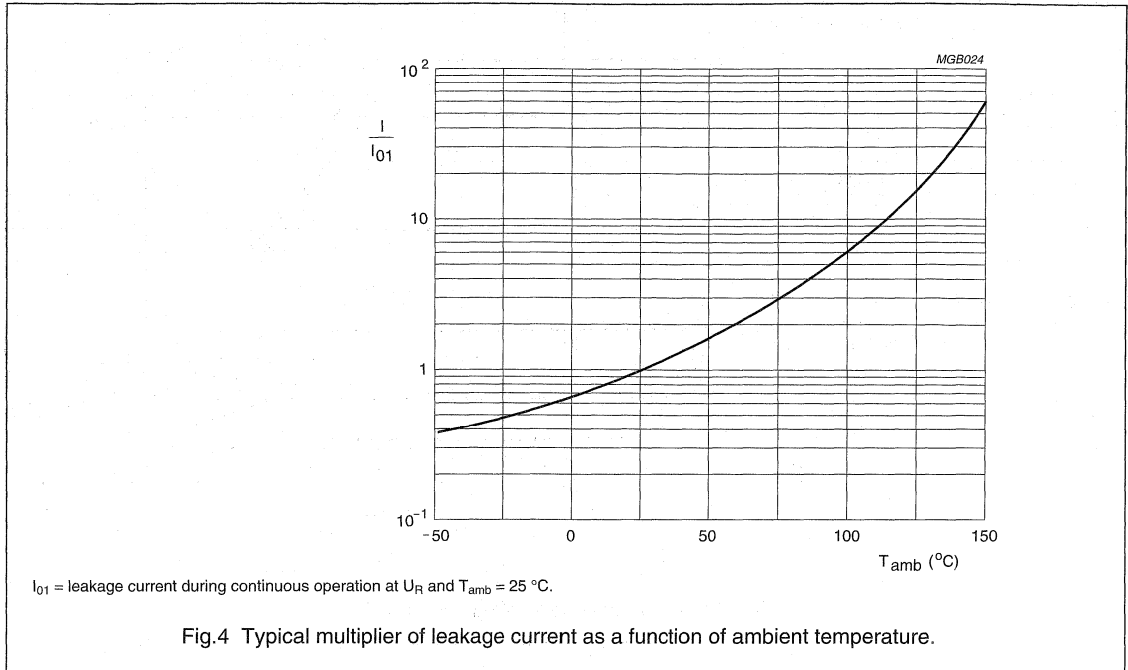
Applying the maximum RMS ripple current given in Tables 2, 4 and 6 will cause a device temperature of 138 °C. The 100 kHz values in Tables 2, 4 and 6 for other temperatures are to be calculated with the following I_R multipliers:

PARAMETER	T_{amb}					
	25 °C	40 °C	65 °C	85 °C	105 °C	125 °C
I_R multiplier	1.1	1.0	0.88	0.75	0.59	0.37

Aluminum electrolytic capacitors
Solid Al, Axial

123 SAL-A

Leakage current



Aluminum electrolytic capacitors
Solid Al, Axial

123 SAL-A

Maximum power dissipation

MAXIMUM CASE SIZE $\varnothing D \times L$ (mm)	$P_{\max} = P_{125}$ (W)
6.7 × 15.3	0.13
7.6 × 20.4	0.16
9.4 × 23.3	0.21
10.3 × 32.0	0.26
12.9 × 32.0	0.32

Equivalent series inductance (ESL), $f = 10$ MHz

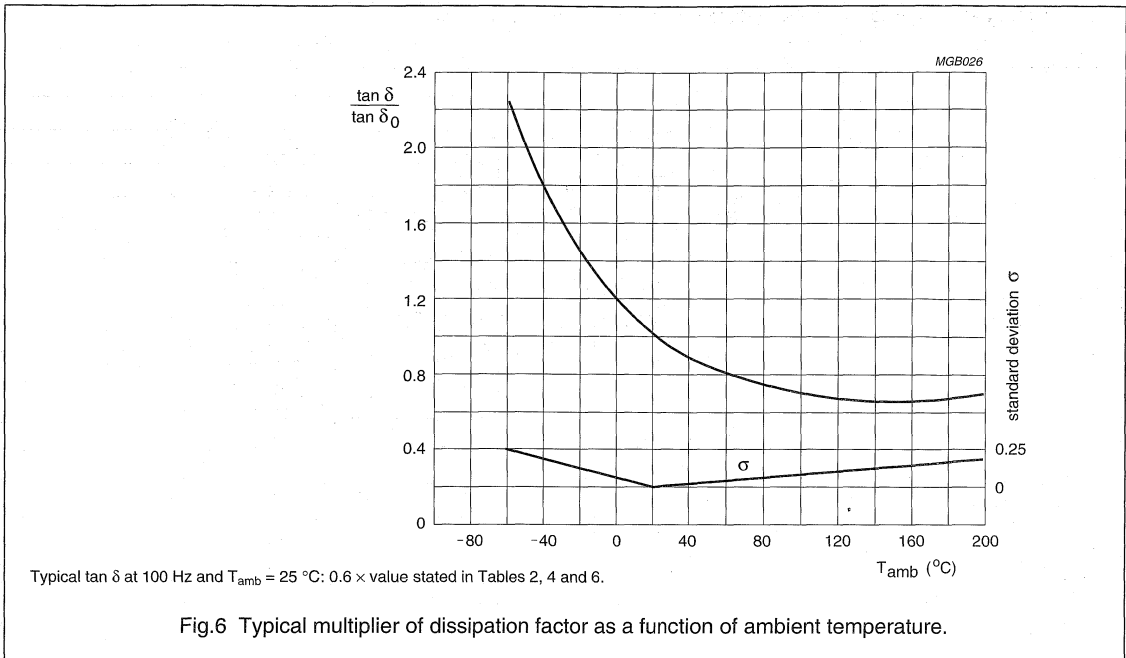
MAXIMUM CASE SIZE $\varnothing D \times L$ (mm)	PITCH (mm)	MAX. ESL (nH)	TYP. ESL (nH)
6.7 × 15.3	20.3	30	15 to 23
7.6 × 20.4	25.4	30	16 to 24
9.4 × 23.3	27.9	35	20 to 27
10.3 × 32.0	35.6	40	26 to 33
12.9 × 32.0	35.6	55	32 to 49

Aluminum electrolytic capacitors

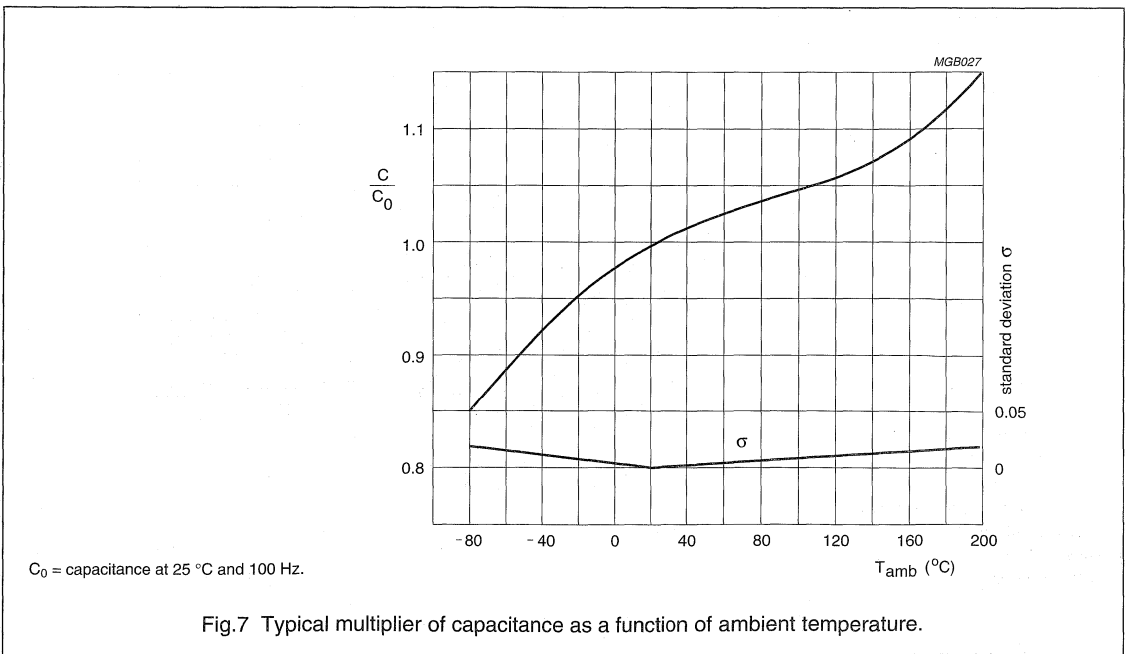
Solid Al, Axial

123 SAL-A

Dissipation factor (tan δ)



Capacitance (C)



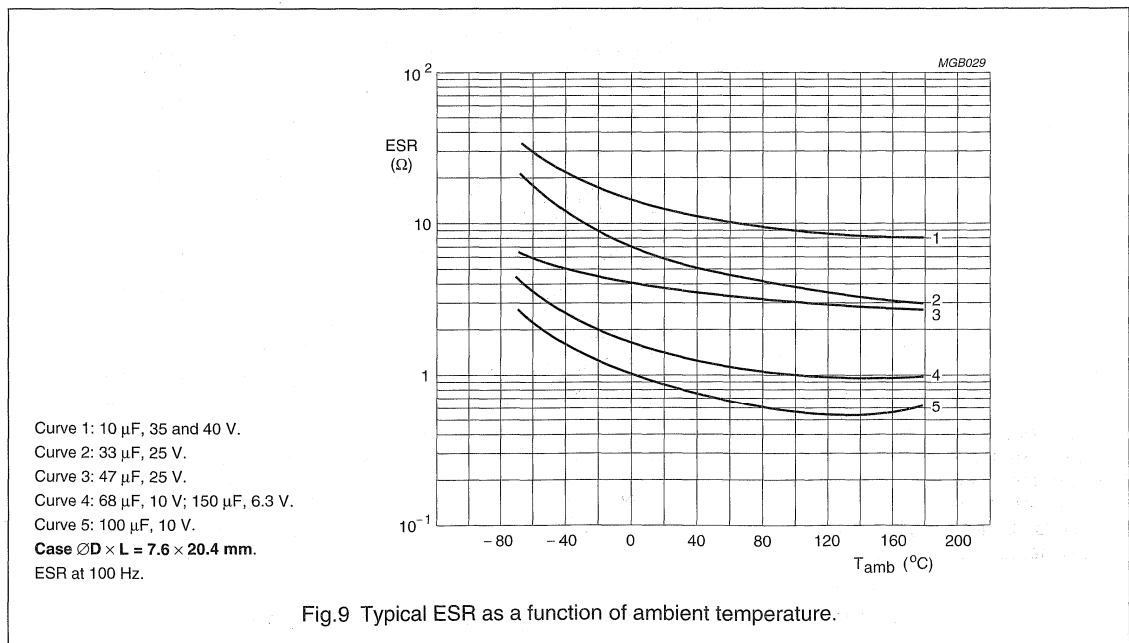
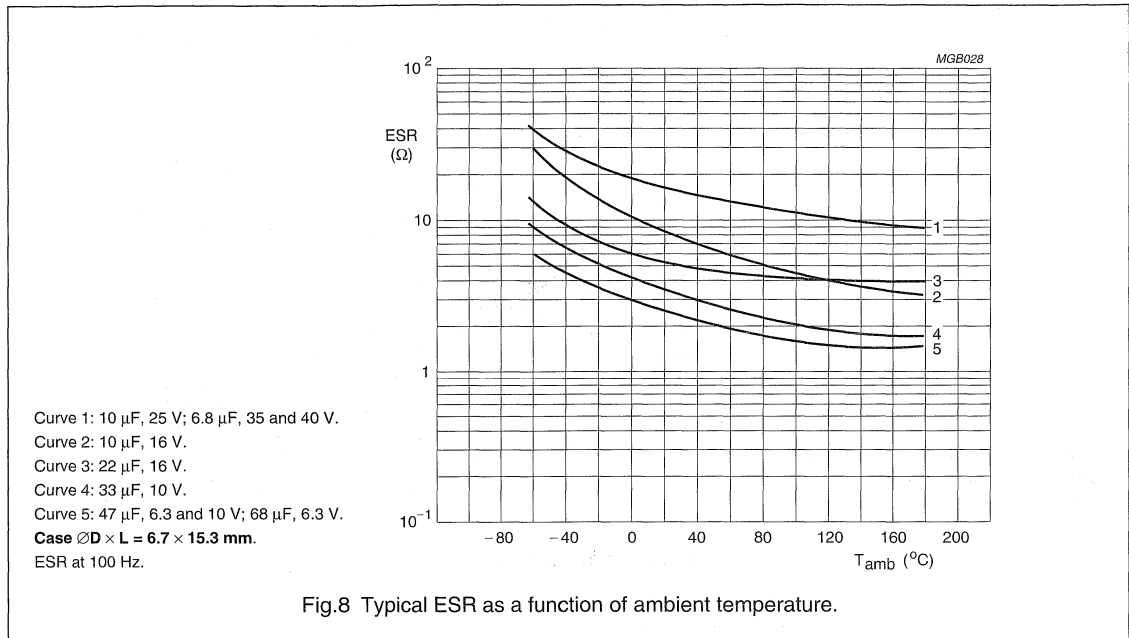
Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

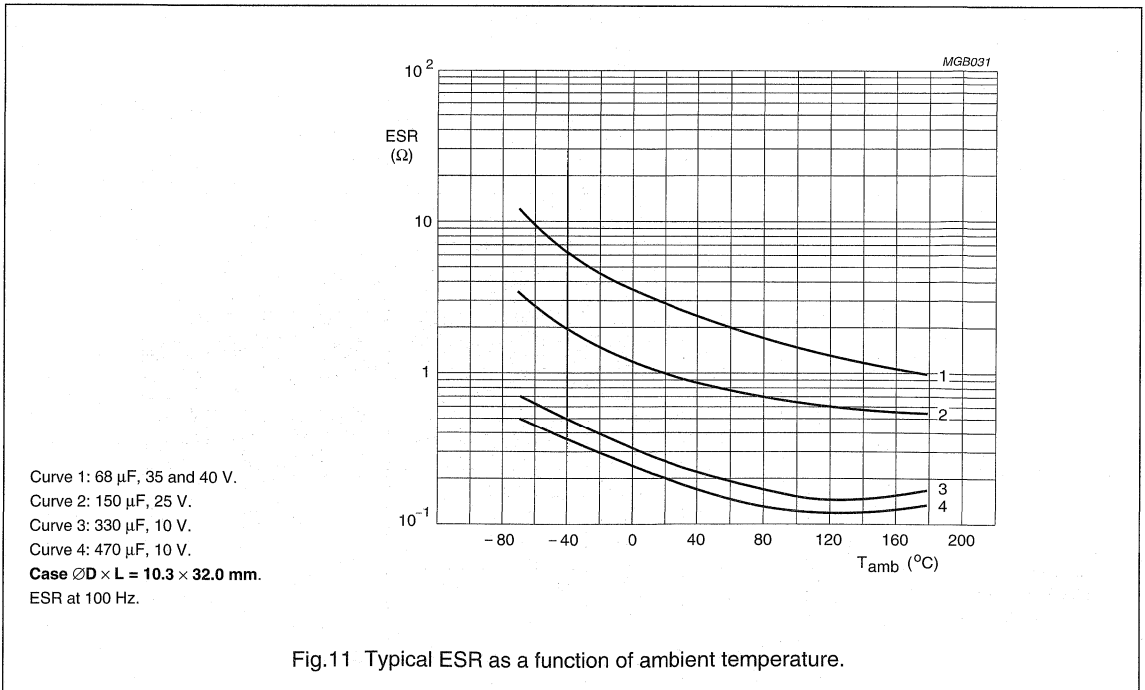
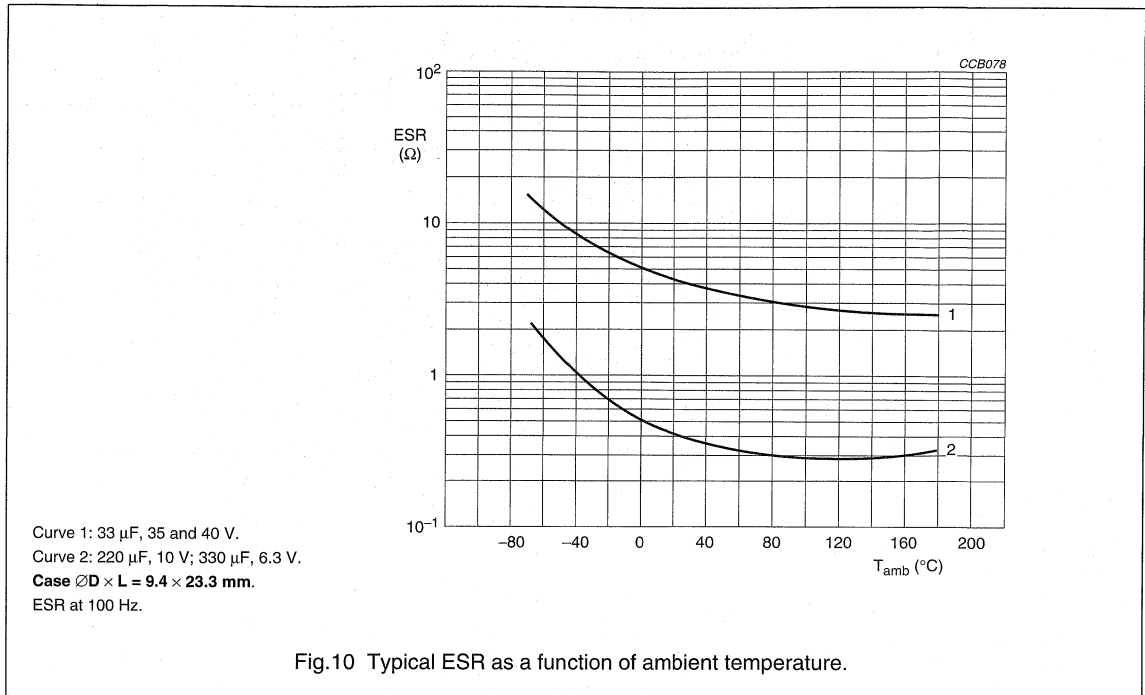
Equivalent series resistance (ESR)

Typical ESR: see Figs 8 to 17; the standard deviation is 20% of each value.



Aluminum electrolytic capacitors
Solid Al, Axial

123 SAL-A



Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

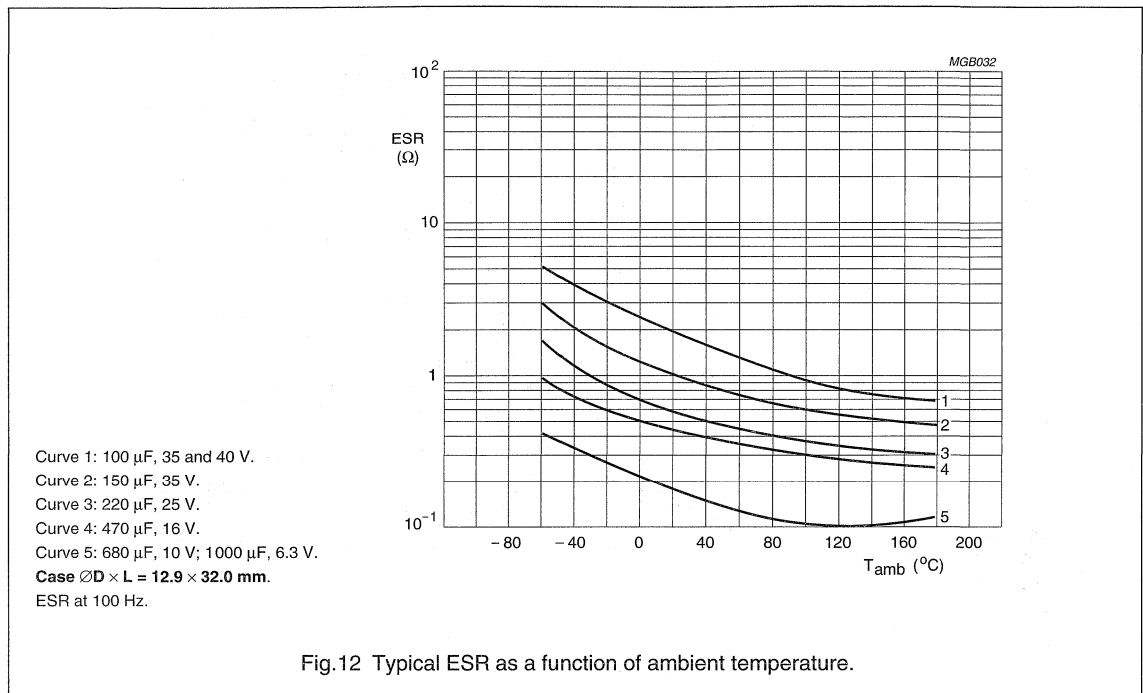


Fig.12 Typical ESR as a function of ambient temperature.

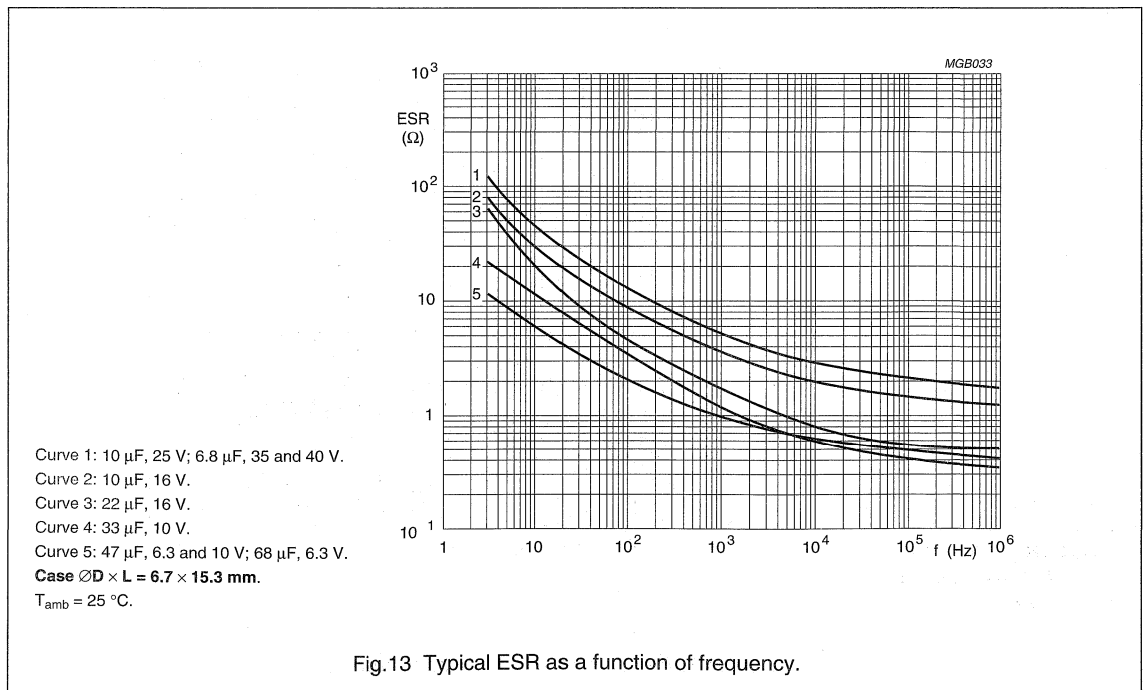
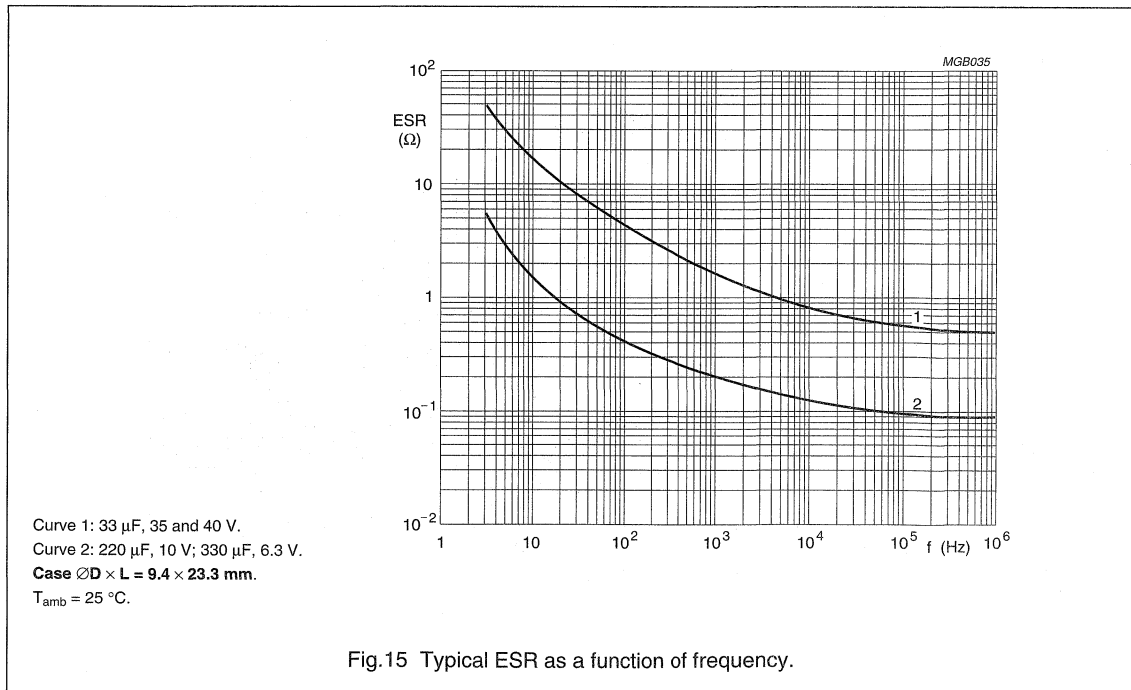
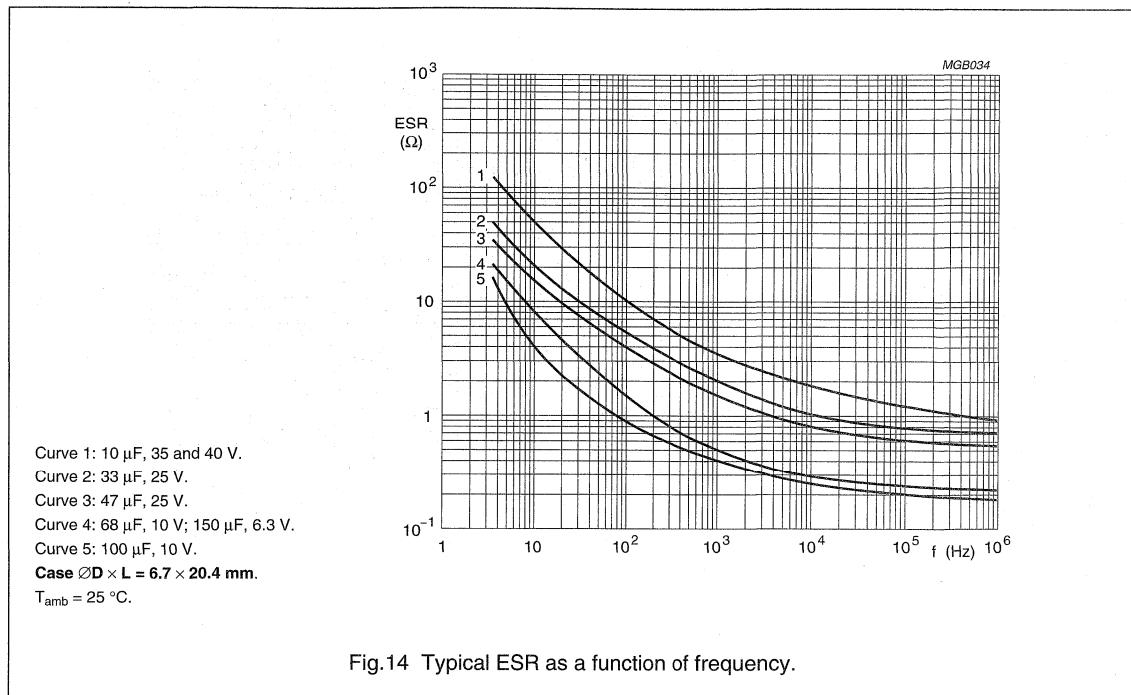


Fig.13 Typical ESR as a function of frequency.

Aluminum electrolytic capacitors
Solid Al, Axial

123 SAL-A



Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

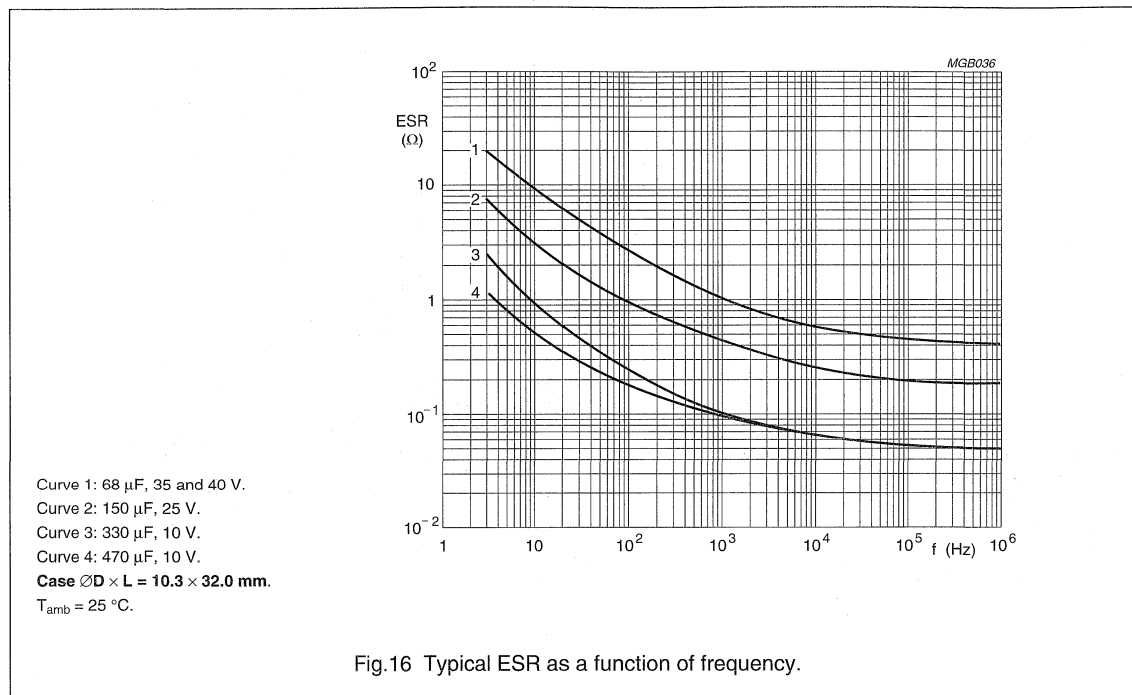


Fig.16 Typical ESR as a function of frequency.

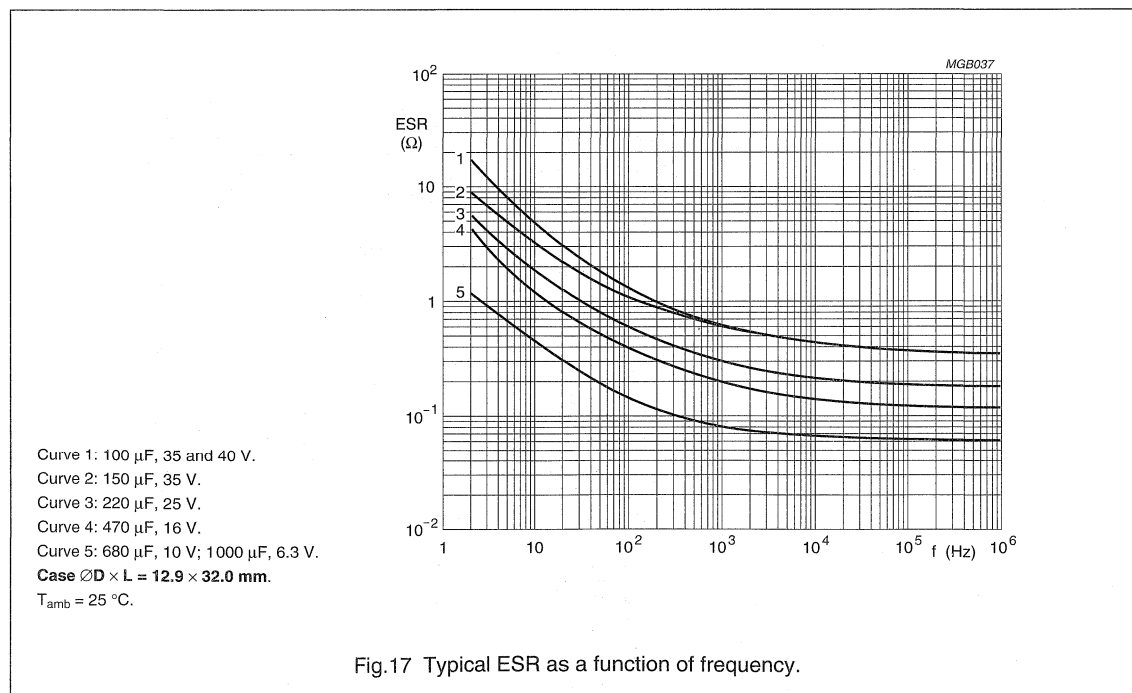


Fig.17 Typical ESR as a function of frequency.

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

Impedance (Z)

Typical impedance at 100 kHz and $T_{amb} = 25\text{ }^{\circ}\text{C}$: $0.5 \times$ value stated in Tables 2, 4 and 6.

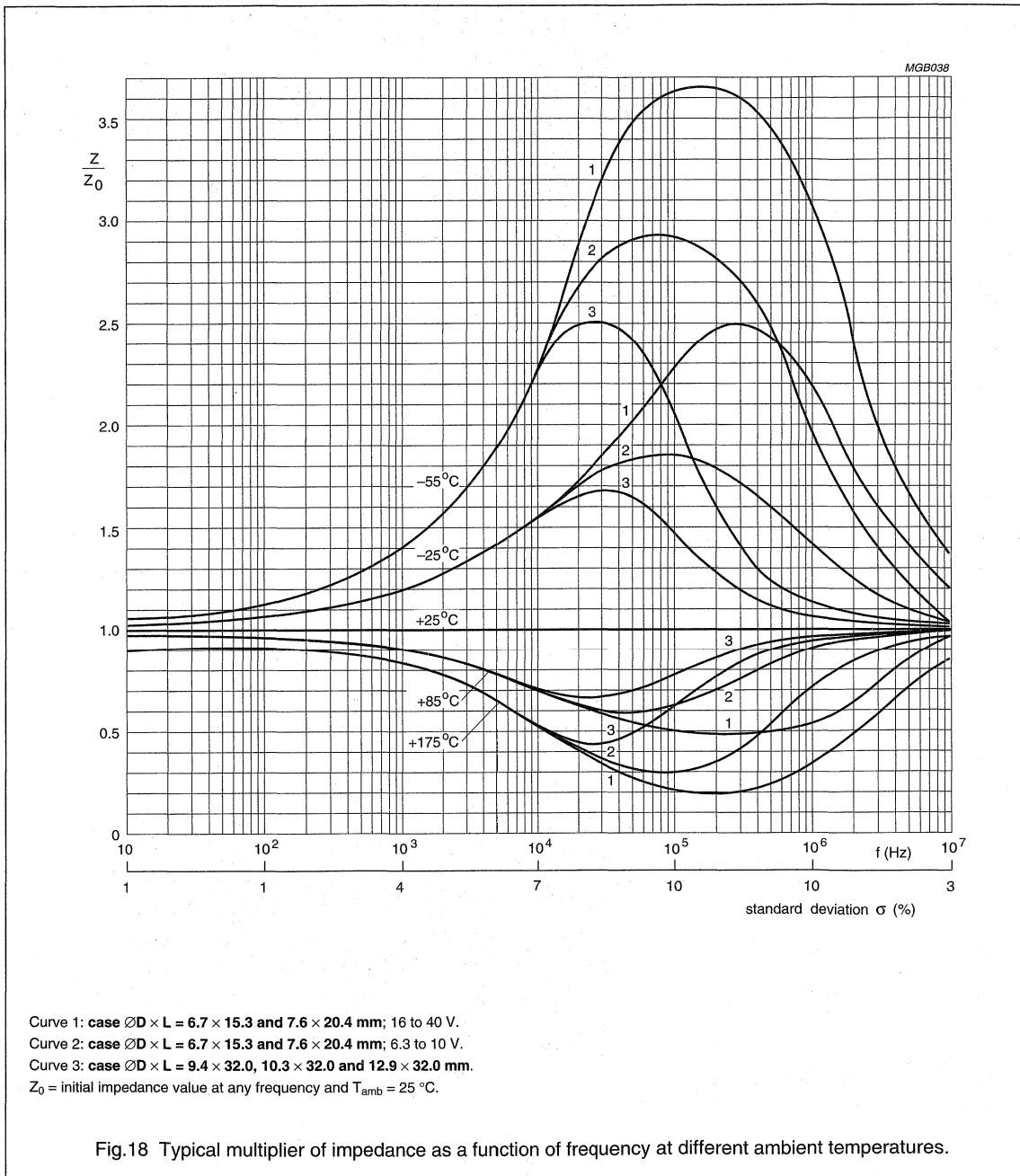


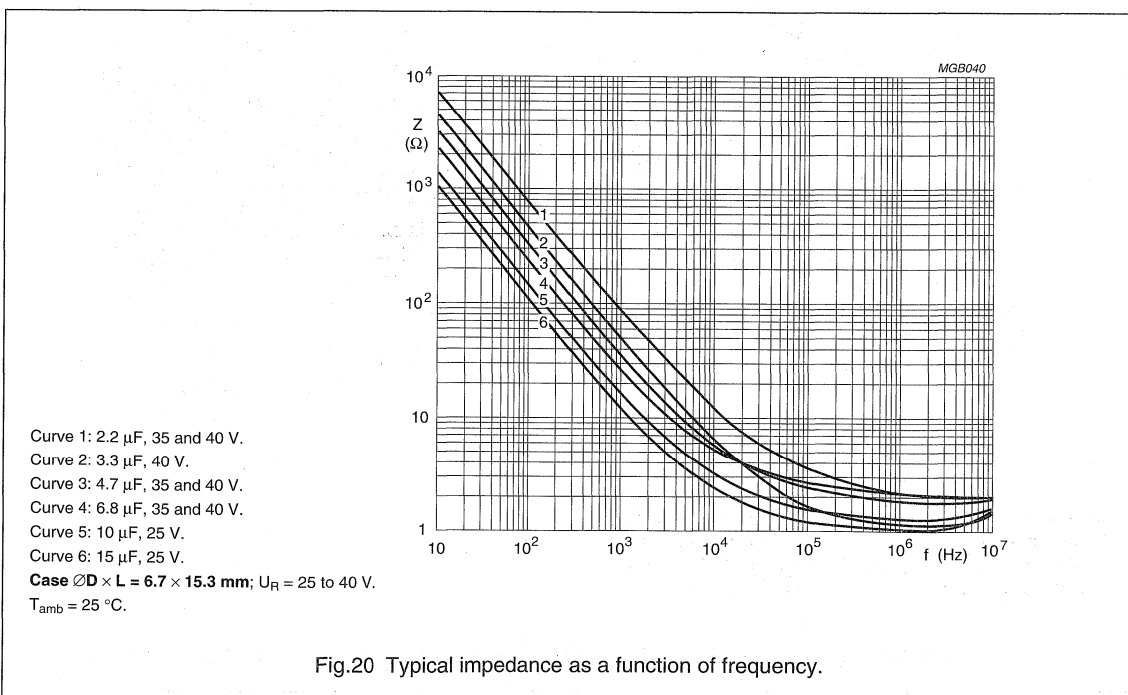
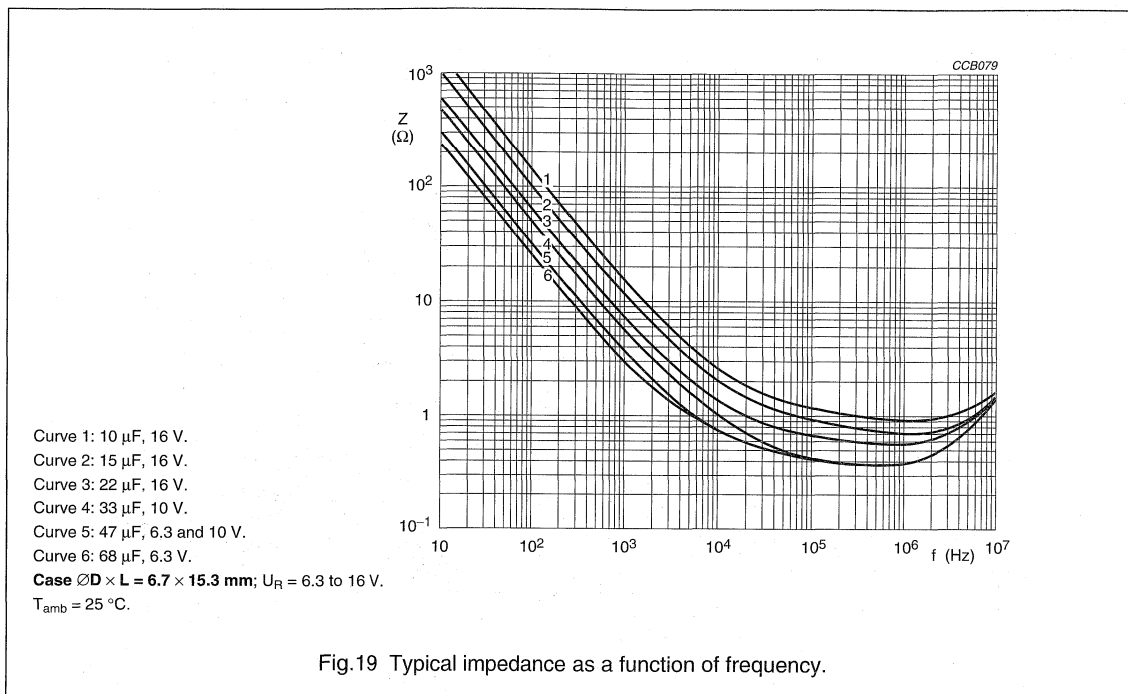
Fig.18 Typical multiplier of impedance as a function of frequency at different ambient temperatures.

SAL

Aluminum electrolytic capacitors

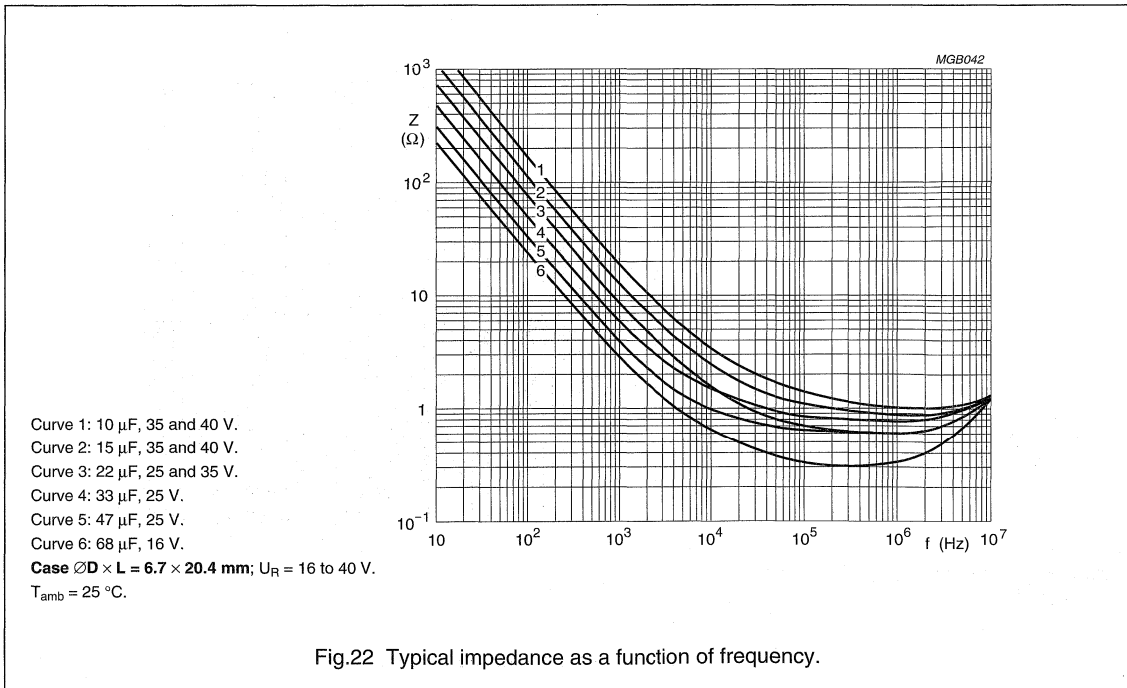
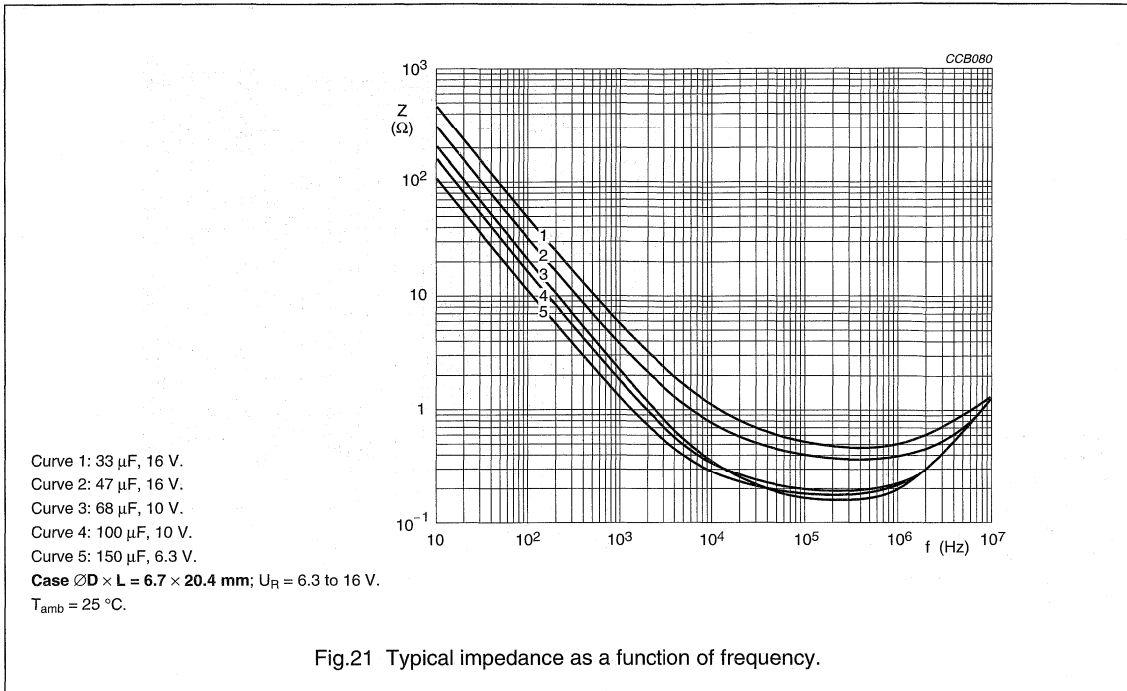
Solid Al, Axial

123 SAL-A



Aluminum electrolytic capacitors
Solid Al, Axial

123 SAL-A



SAL

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

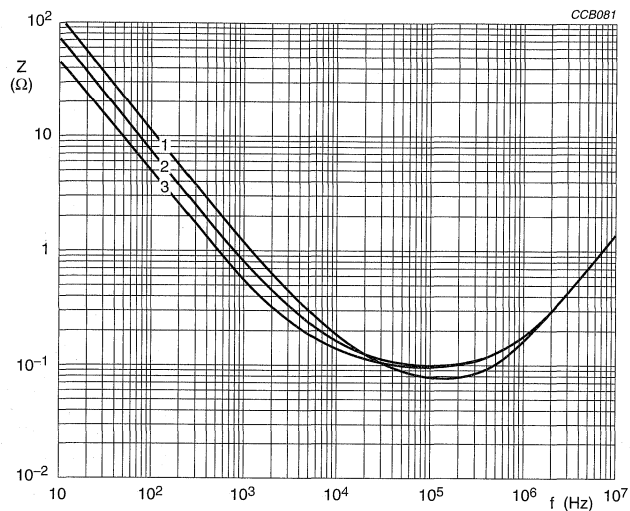
Curve 1: 150 μF , 10 V.Curve 2: 220 μF , 10 V.Curve 3: 330 μF , 6.3 V.Case $\varnothing\text{D} \times \text{L} = 9.4 \times 23.3$ mm; $U_R = 6.3$ to 10 V. $T_{\text{amb}} = 25$ °C.

Fig.23 Typical impedance as a function of frequency.

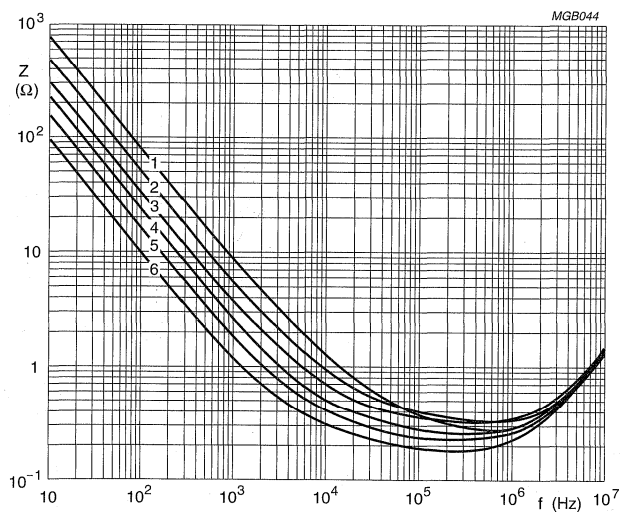
Curve 1: 22 μF , 40 V.Curve 2: 33 μF , 35 and 40 V.Curve 3: 47 μF , 35 V.Curve 4: 68 μF , 25 V.Curve 5: 100 μF , 16, 25 V.Curve 6: 150 μF , 16 V.Case $\varnothing\text{D} \times \text{L} = 9.4 \times 23.3$ mm; $U_R = 16$ to 40 V. $T_{\text{amb}} = 25$ °C.

Fig.24 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors
Solid Al, Axial

123 SAL-A

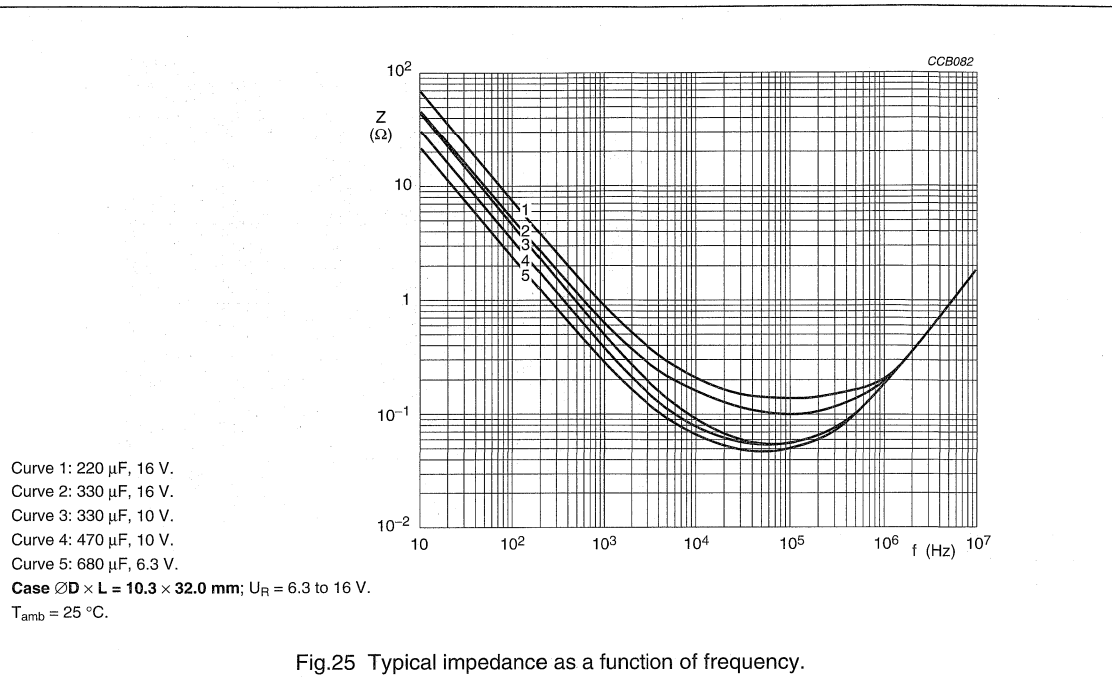


Fig.25 Typical impedance as a function of frequency.

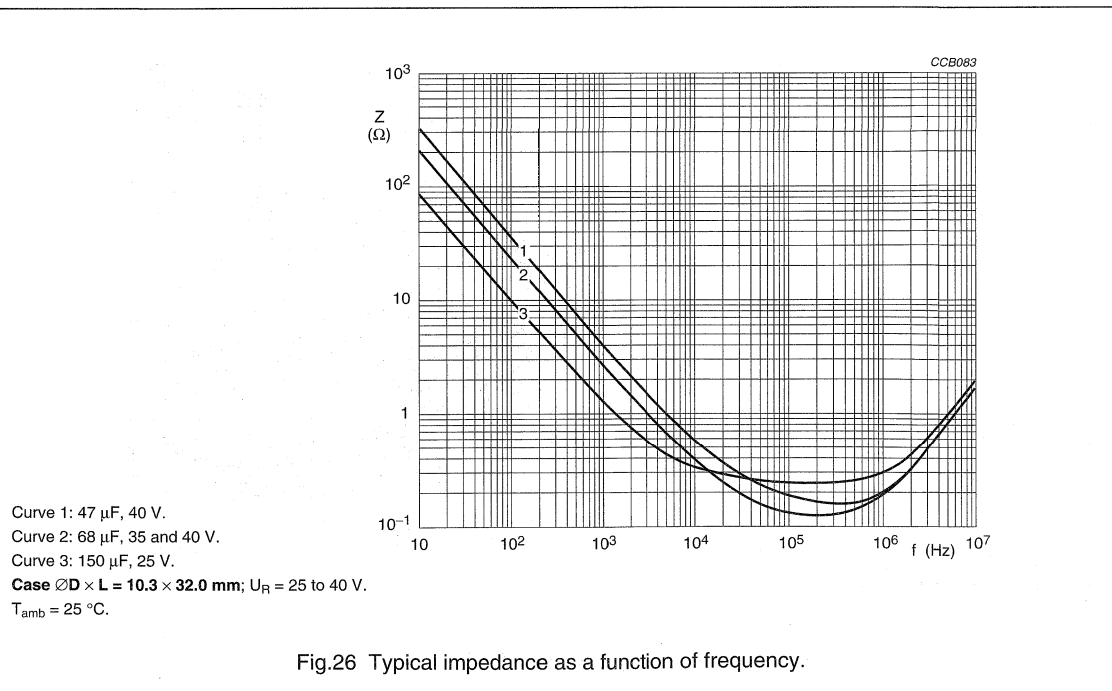


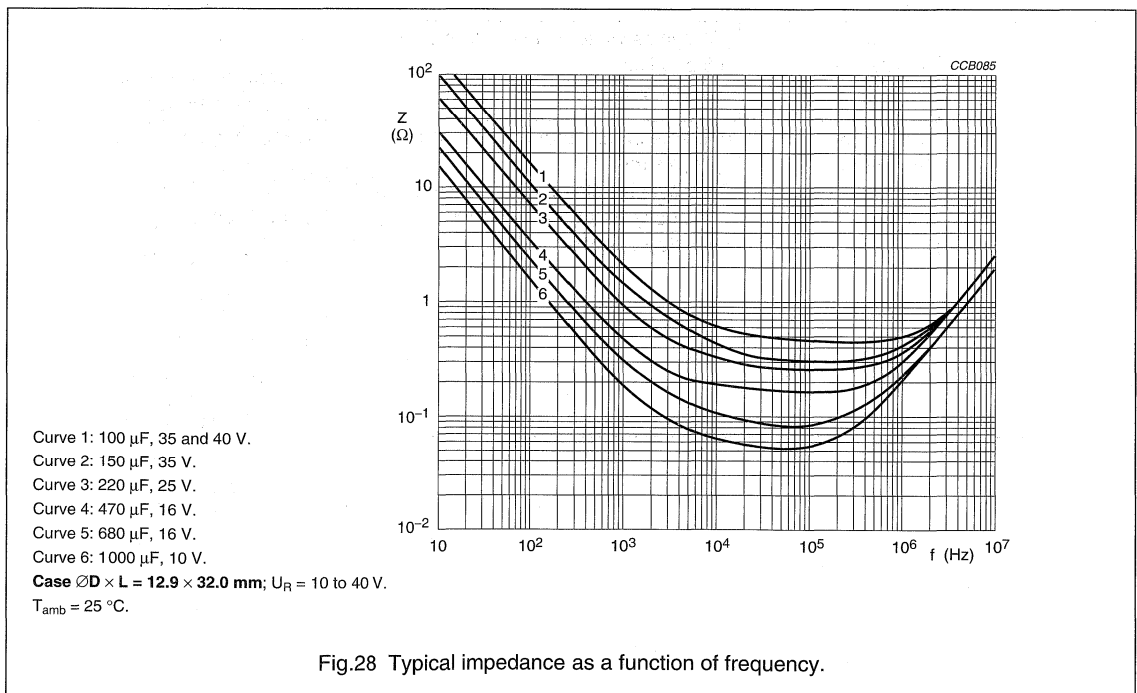
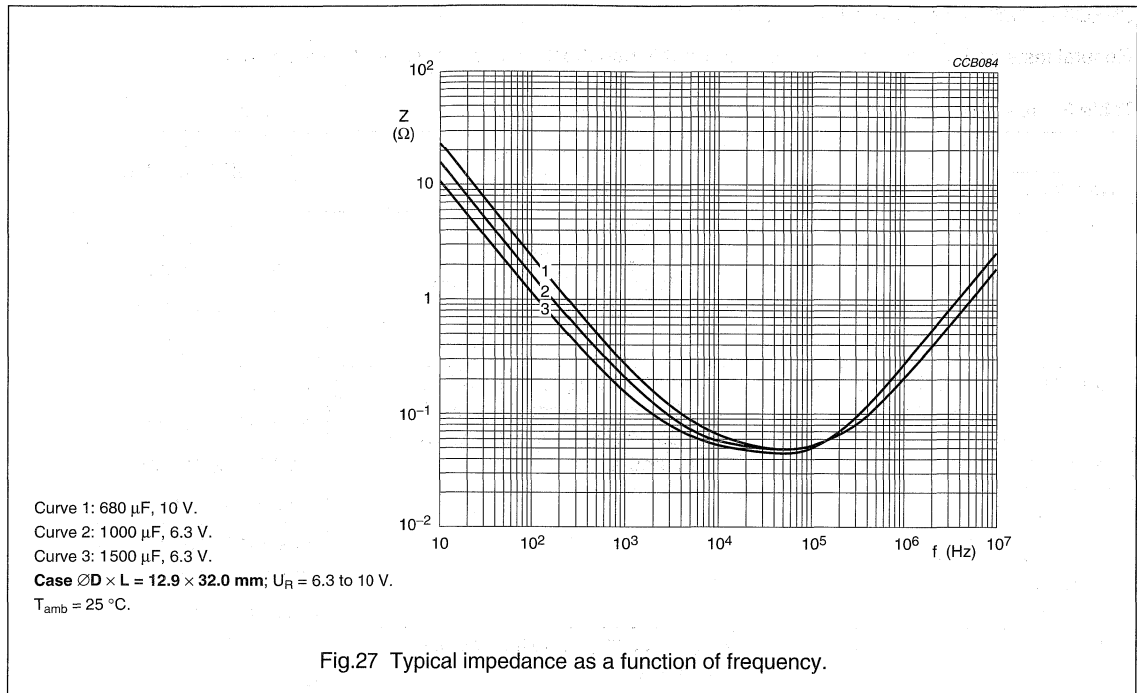
Fig.26 Typical impedance as a function of frequency.



Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A



Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

SPECIFIC TESTS AND REQUIREMENTS

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

Table 8 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 125\text{ °C}$; $U_R = 6.3$ to 25 V with U_R applied; $U_R = 35$ and 40 V with U_C applied; 10000 hours	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30302 subclause 1.8.1	$T_{amb} = 125\text{ °C}$; I_R applied and $U_R = 6.3$ to 25 V with U_R applied; $U_R = 35$ and 40 V with U_C applied; 20000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $< 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 125\text{ °C}$; no voltage applied; 500 hours	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1 \times \text{spec. limit}$
Charge and discharge	IEC 60384-4-2 subclause 9.21	10^6 cycles without series resistance: 0.5 s to U_R ; 0.5 s to ground	$\Delta C/C: \pm 5\%$ no short or open circuit, no visible damage
Shock	IEC 60068-2-27 test Ea	half-sine or saw tooth pulse shape; 50 g; 11 ms; 3 successive shocks in each direction of 3 mutually perpendicular axes; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C: \pm 5\%$ $\tan \delta \leq 1.2 \times \text{spec. limit}$ $Z \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 1.5 \times \text{spec. limit}$

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Severe rapid change of temperature		100 cycles of 1 hour duration, each with 30 minutes at $-40\text{ }^{\circ}\text{C}$ and $+125\text{ }^{\circ}\text{C}$	$\Delta C/C: \pm 25\%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $Z \leq 2.0 \times \text{spec. limit}$ $I_{L5} \leq 1 \times \text{spec. limit}$
Solvent resistance	IEC 60068-2-45, test XA IEC 60653	immersion: 5 ± 0.5 minutes with or without ultrasonic at $55 \pm 5\text{ }^{\circ}\text{C}$ solvents: demineralized water and/or calgonite solution (20 g/l)	visual appearance not affected
Passive flammability	IEC 60695-2-2	capacitor mounted to a vertical printed-circuit board, one flame on capacitor body; $T_{\text{amb}} = 20$ to $25\text{ }^{\circ}\text{C}$; test duration = 20 s	after removing the test flame from the capacitor, the capacitor must not continue to burn for more than 15 s; no burning particles must drop from the sample

Aluminum electrolytic capacitors

Solid Al, Axial

123 SAL-A

ADDITIONAL TESTS AND REQUIREMENTS FOR EPOXY-FILLED VERSIONS SAL-AG

2222 123 6.... Form BA $\pm 20\%$ 2222 123 8.... Form BA $\pm 10\%$, level S

Table 9 Test procedures and requirements

TEST	PROCEDURE	REQUIREMENTS
Severe vibration tests in accordance with "IEC 60068-2-6" and "MIL STD-202", method 204, letter E, with the following details and additions		
Method of mounting: severity 1	clamping both body and leads frequency range temperature 10 to 3000 Hz; 20-25 °C	$\Delta C/C: \pm 10\%$ $\tan \delta \leq 1.2 \times$ stated limit
severity 2	frequency range temperature 50 to 2000 Hz; 125 °C	$Z \leq 1.4 \times$ stated limit
severity 1 and 2	vibration amplitude: 50 g or 3.5 mm, whichever is less	DC leakage current: \leq stated limit no intermittent contacts no indication of breakdown
Direction and duration of motion: severity 1	1 octave/minute; 3 directions (mutually perpendicular); 20 sweeps per direction (total 60 sweeps or 18 hours)	no open circuiting no evidence of mechanical damage
severity 2	1 octave/minute; 2 directions (longitudinal and transversal); 3 sweeps per direction (total 6 sweeps or 1 hour)	
Functioning: severity 1	rated voltage applied	
severity 2	no voltage applied	
Typical capability	>80 g at 10 to 3000 Hz (also at 125 °C)	
Severe shock tests in accordance with "IEC 60068-2-27" and "MIL STD-202", method 213, letter F, with the following details and additions:		
Method of mounting	clamping both body and leads	$\Delta C/C: \pm 10\%$
Pulse shape: severity 1	half-sine or sawtooth 1500 g; 0.5 ms ("MIL STD-202", method 213, letter F)	$\tan \delta \leq 1.2 \times$ stated limit $Z \leq 1.4 \times$ stated limit
severity 2	3000 g; 0.2 ms	DC leakage current: \leq stated limit
severity 3	10000 g; 0.1 ms	no intermittent contacts
Direction and number of shocks: severity 1 and 2	3 successive shocks in each direction of 3 mutually perpendicular axes (total 18 shocks)	no indication of breakdown no open circuiting
severity 3	1 shock in any direction	no evidence of mechanical damage
Functioning	rated voltage applied	

SAL

ENERGY STORAGE CAPACITORS (DOUBLE LAYER)

Double layer capacitors

196 DLC

FEATURES

- Polarized capacitor with high charge density, alternative product to rechargeable backup batteries
- Dielectric: electric double layer
- Radial leads, cylindrical case, insulated with a blue vinyl sleeve
- Available in both vertical and low-profile versions
- Unlimited charge and discharge cycle numbers
- No charge-discharge control circuitry and no series resistor necessary
- Maintenance-free, no periodic replacement or service necessary
- Ecologically beneficial (no Cd, no Li).

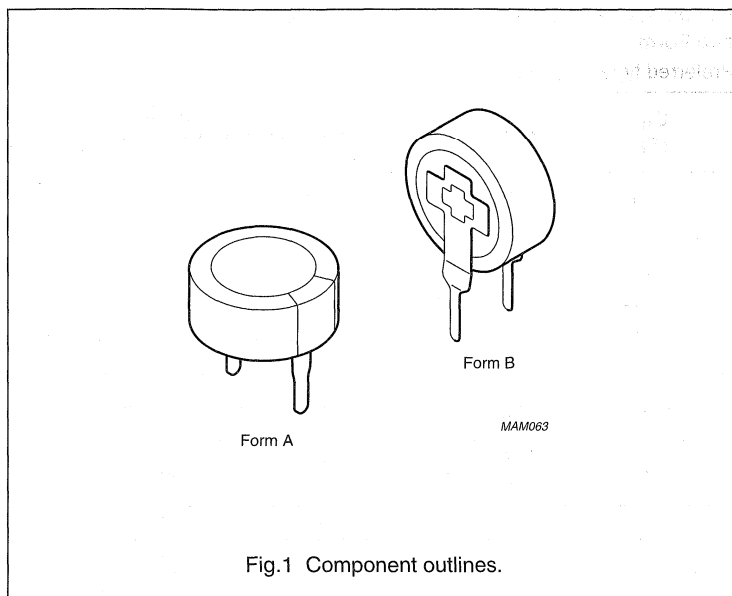


Fig.1 Component outlines.

APPLICATIONS

- Energy storage, for backup of semiconductor memories (CMOS) in all fields of electronics
- Telecommunication, audio-video, EDP
- General industrial, clock and timer systems.

QUICK REFERENCE DATA

DESCRIPTION	VALUE			
	STANDARD FORM A	HIGH VOLTAGE FORM A	HIGH TEMPERATURE FORM A	VERTICAL, MINIATURIZED FORM B
Case sizes ($\varnothing D \times L$ in mm)	13 × 7 and 21 × 7.5	13 × 9 and 21 × 9	13 × 9 and 21 × 9	11.5 × 13 (vertical)
Rated capacitance range, C_R	0.047 to 1.0 F	0.047 to 0.68 F	0.047 to 0.68 F	0.047 to 1.0 F
Tolerance on C_R at 20 °C	-20 to +80%			
Rated voltage, U_R	5.5 V	6.3 V	5.5 V	5.5 V
Maximum surge voltage, U_S	6.3 V	7.0 V	6.3 V	6.3 V
Category temperature range	-25 to +70 °C	-25 to +70 °C	-25 to +85 °C	-25 to +70 °C
Useful life at U_R :				
at 85 °C	–	–	1000 hours	–
at 70 °C	1000 hours	1000 hours	2800 hours	1000 hours
at 40 °C	8000 hours	8000 hours	23000 hours	8000 hours
at 25 °C	23000 hours	23000 hours	64000 hours	23000 hours
Shelf life at 0 V	1000 hours at upper category temperature			
Climatic category IEC 60068	25/070/21	25/070/21	25/085/21	25/070/21

Double layer capacitors

196 DLC

Selection chart for C_R , U_R , upper category temperature (UCT), relevant nominal case sizes ($\varnothing D \times L$ in mm) and FormPreferred types in **bold**.

C_R (F)	FORM	$U_R = 5.5 \text{ V}$		$U_R = 6.3 \text{ V}$
		UCT = 85 °C	UCT = 70 °C	UCT = 70 °C
0.047	A	13 × 9	13 × 7	13 × 9
	B	–	11.5 × 13	–
0.1	A	13 × 9	13 × 7	13 × 9
	B	–	11.5 × 13	–
0.22	A	–	13 × 7	–
	B	–	11.5 × 13	–
0.33	A	–	13 × 7	–
	B	–	11.5 × 13	–
0.47	A	21 × 9	21 × 7.5	21 × 9
	B	–	–	–
0.68	A	21 × 9	–	21 × 9
	B	–	–	–
1.0	A	–	21 × 7.5	–
	B	–	19 × 20.5	–

MARKING

The capacitors are marked with the following information:

- Rated capacitance (in F)
- Rated voltage (in V)
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification
- Upper category temperature (at 85 °C types only).

Double layer capacitors

196 DLC

MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

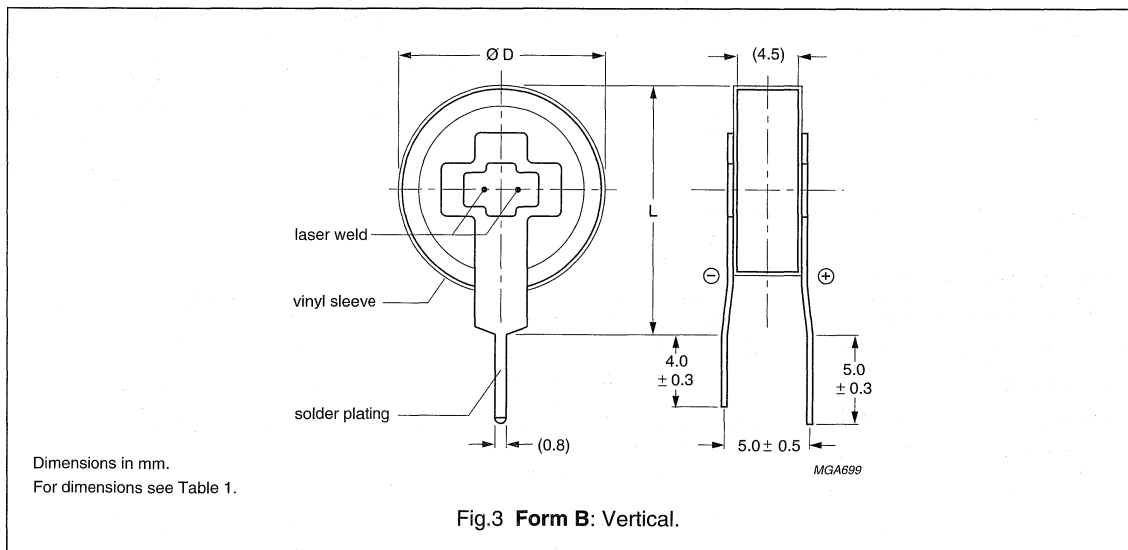
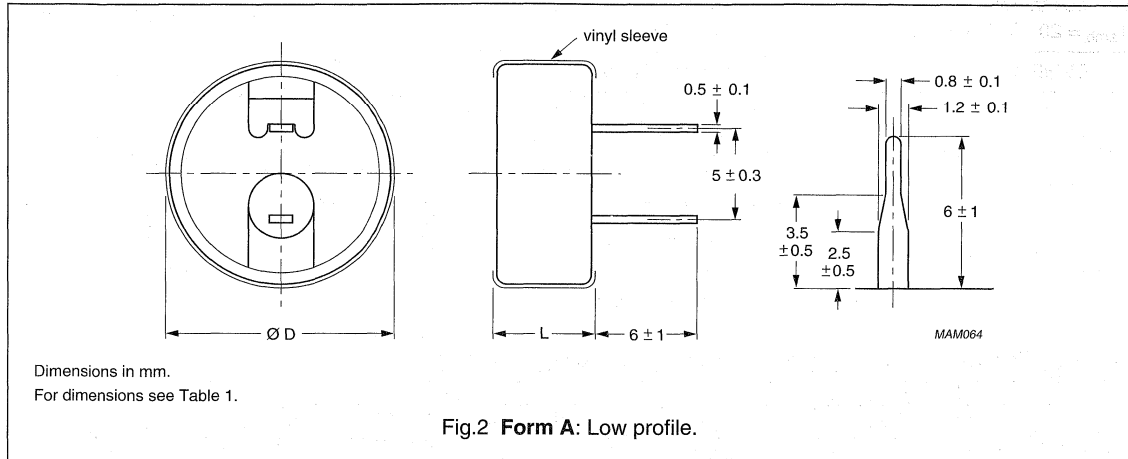


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	FORM	$\varnothing D_{\max}$ (mm)	L_{\max} (mm)	MASS (g)	PACKAGING QUANTITIES
11.5 × 13	1	B	11.8	13.5	≈1.5	2000
13 × 7	2	A	13.5	7.5	≈2.8	1000
13 × 9	3	A	13.5	9.5	≈3.4	1000
21 × 7.5	4	A	21.5	8.0	≈7.1	500
21 × 9	5	A	21.5	9.5	≈8.8	500
19 × 20.5	6	B	19.3	211.0	≈8.0	500

Double layer capacitors

196 DLC

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at
 $T_{amb} = 20\text{ °C}$, $P = 86$ to 106 kPa and $RH = 45$ to 75% .

SYMBOL	DESCRIPTION
C_R	rated capacitance, tolerance $-20/+80\%$, measured by constant current discharge method
UCT	upper category temperature
I_L	max. leakage current after 30 minutes at U_R
R_I	max. internal resistance at 1 kHz

Ordering example

Double layer capacitor 196 series

1.0 F/5.5 V

Nominal case size: $\varnothing 21 \times 7.5\text{ mm}$;
Form A

Catalogue number: 2222 196 12105.

For test methods see chapter "Measuring of characteristics".

Table 2 Electrical data and ordering information; preferred types in **bold**

U_R (V)	C_R (F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	Form	UCT (°C)	I_L 30 min (μA)	R_I 1 kHz (Ω)	CATALOGUE NUMBER
Standard series								
5.5	0.047	13 × 7	2	A	70	69	120	2222 196 12473
	0.1	13 × 7	2	A	70	100	75	2222 196 12104
	0.22	13 × 7	2	A	70	135	75	2222 196 12224
	0.33	13 × 7	2	A	70	182	75	2222 196 12334
	0.47	21 × 7.5	4	A	70	216	30	2222 196 12474
	1.0	21 × 7.5	4	A	70	315	30	2222 196 12105
High temperature series								
5.5	0.047	13 × 9	3	A	85	69	300	2222 196 22473
	0.1	13 × 9	3	A	85	100	200	2222 196 22104
	0.47	21 × 9	5	A	85	216	50	2222 196 22474
	0.68	21 × 9	5	A	85	260	50	2222 196 22684
Vertical, miniaturized series								
5.5	0.047	11.5 × 13	1	B	70	69	120	2222 196 32473
	0.1	11.5 × 13	1	B	70	100	75	2222 196 32104
	0.22	11.5 × 13	1	B	70	135	75	2222 196 32224
	0.33	11.5 × 13	1	B	70	182	75	2222 196 32334
	1.0	19 × 20.5	6	B	70	315	30	2222 196 32105
High voltage series								
6.3	0.047	13 × 9	3	A	70	69	300	2222 196 13473
	0.1	13 × 9	3	A	70	100	200	2222 196 13104
	0.47	21 × 9	5	A	70	216	50	2222 196 13474
	0.68	21 × 9	5	A	70	260	50	2222 196 13684

Double layer capacitors

196 DLC

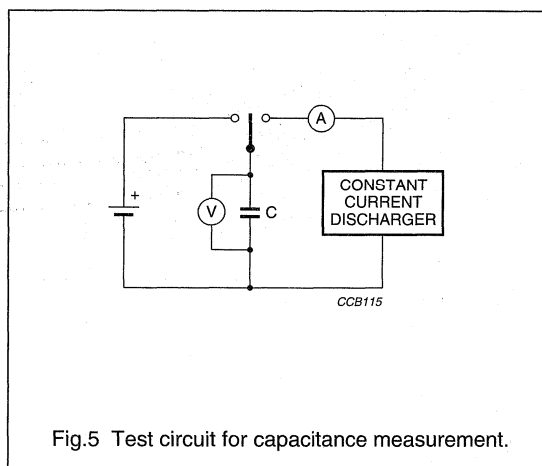
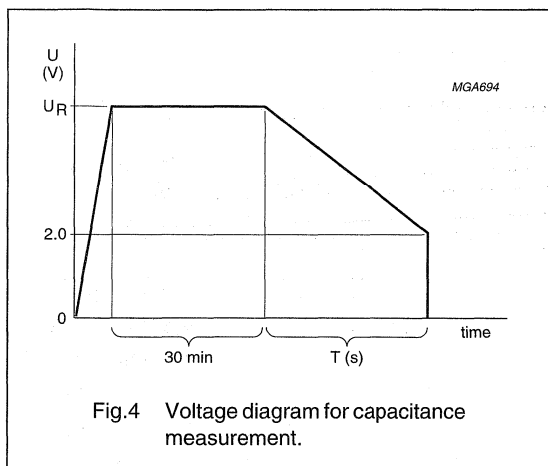
MEASURING OF CHARACTERISTICS

Capacitance (C)

Capacitance shall be measured by constant current discharge method.

Discharge current as a function of rated capacitance

PARAMETER	VALUE							UNIT
	0.047	0.1	0.22	0.33	0.47	0.68	1.0	
Rated capacitance, C_R	0.047	0.1	0.22	0.33	0.47	0.68	1.0	F
Discharge current, I_D	0.1			1.0				mA

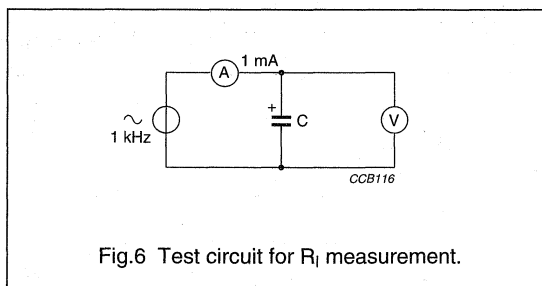


Capacitance value C_R is given by discharge current I_D , time T and rated voltage U_R , according to the following equation:

$$C(F) = \frac{I_D(\text{mA}) \times 10^{-3} \times T(\text{s})}{U_R(\text{V}) - 2}$$

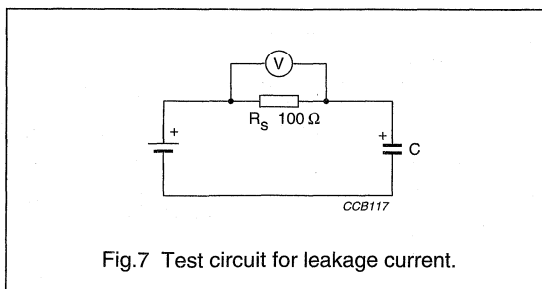
Internal resistance (R_I) at 1 kHz

$$R_I(\Omega) = \frac{V_C(\text{V})}{10^{-3}}$$

Leakage current (I_L)

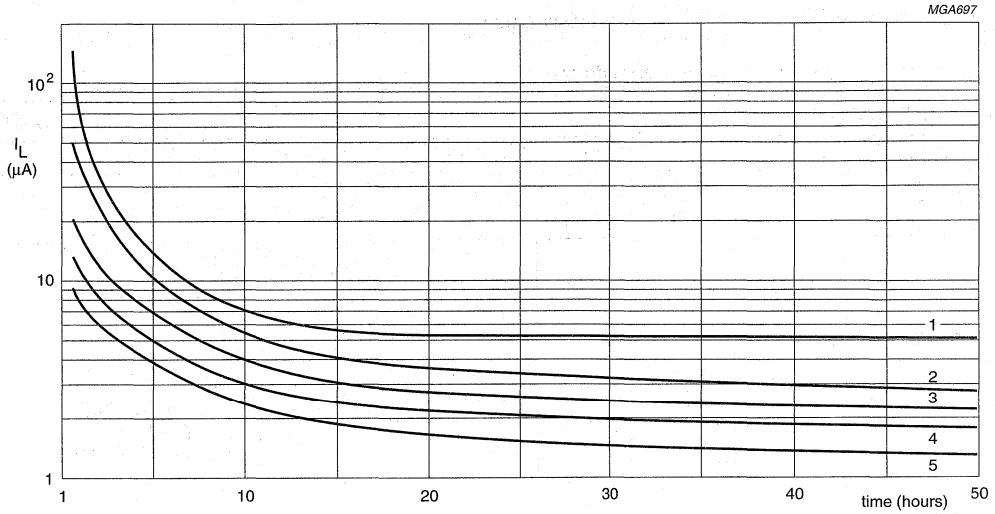
Leakage current shall be measured after 30 minutes application of rated voltage U_R :

$$I_L(\mu\text{A}) = \frac{V(\text{V})}{10^{-4}}$$



Double layer capacitors

196 DLC



Curve 1: 1.0 F, 5.5 V.
Curve 2: 0.47 F, 5.5 V.
Curve 3: 0.22 F, 5.5 V.
Curve 4: 0.1 F, 5.5 V.
Curve 5: 0.047 F, 5.5 V.
 $R_s = 100 \Omega$.

Fig.8 Typical leakage current as a function of time.

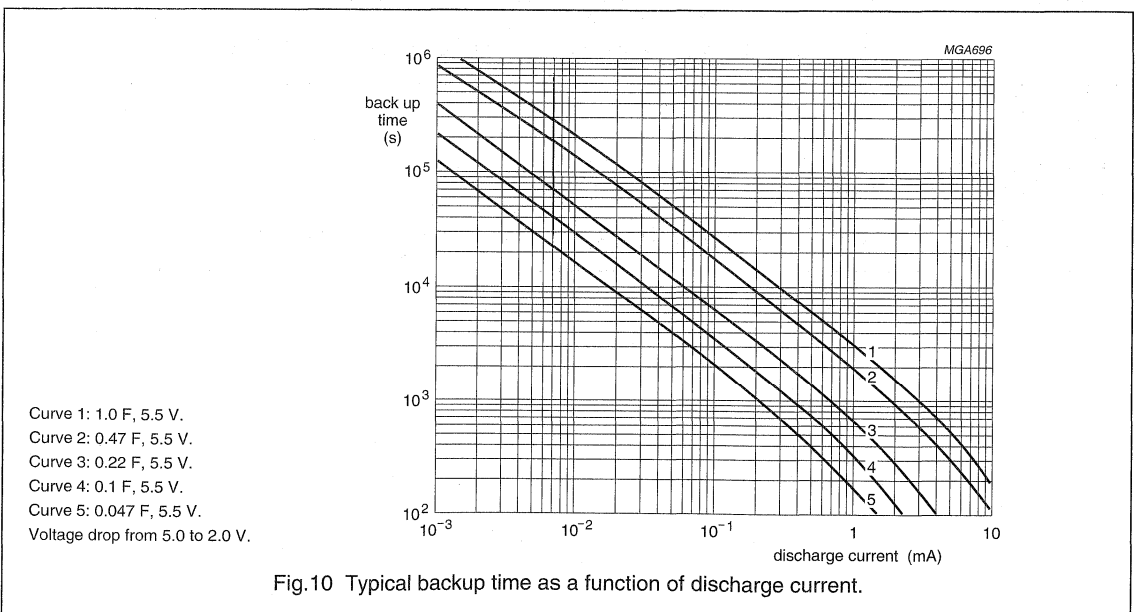
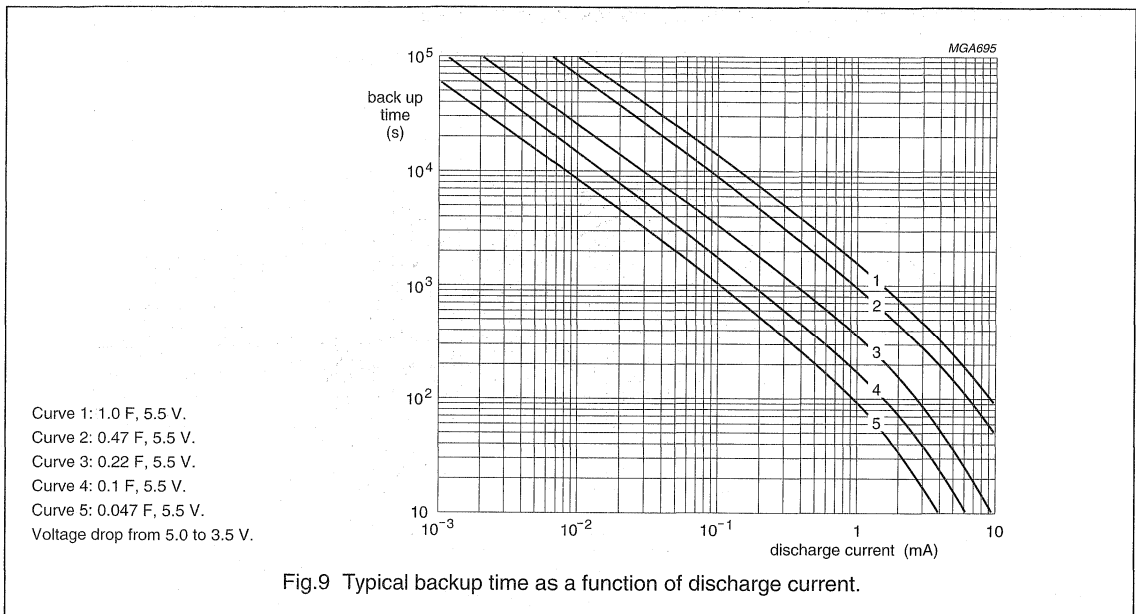
Double layer capacitors

196 DLC

DISCHARGE CHARACTERISTICS

Backup time of 196 DLC series capacitors depends on minimum memory holding voltage and discharge current (corresponding with the current consumption of the load).

For minimum backup times of standard and vertical miniaturized series see Figs 9 and 10 (charging time ≥ 24 hours).



Double layer capacitors

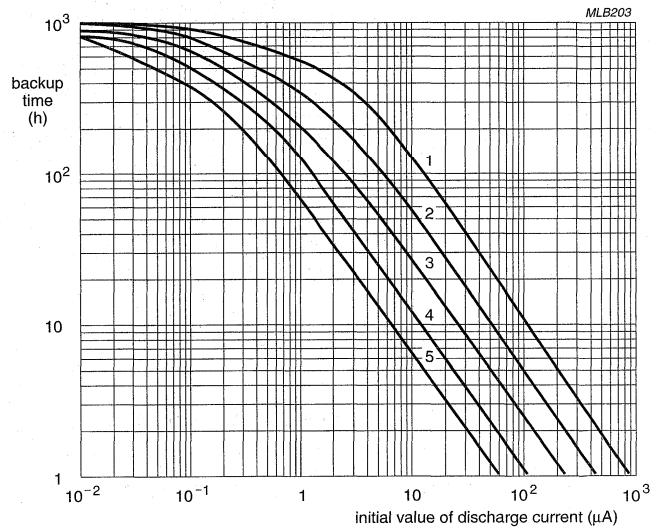
196 DLC

Figure 11 shows the backup time when a 196 DLC capacitor is discharged by a constant resistance (charging time ≥ 24 hours).

The horizontal axis shows the initial value of discharge current if 5 V is connected to the capacitor via a fixed series resistor.

Example: 1 μA corresponds to 5 M Ω and 0.1 μA corresponds to 50 M Ω

The vertical axis shows that period of time during which the voltage drops from 5 to 2 V.



Curve 1: 1.0 F, 5.5 V.

Curve 2: 0.47 F, 5.5 V.

Curve 3: 0.22 F, 5.5 V.

Curve 4: 0.1 F, 5.5 V.

Curve 5: 0.047 F, 5.5 V.

Discharge from 5.0 to 2.0 V by means of a fixed resistor.

Fig.11 Typical backup time as a function of initial discharge current.

Double layer capacitors

196 DLC

TESTS AND REQUIREMENTS

Standard and vertical miniaturized series (5.5 V; 70 °C)

Table 3 Test procedures and requirements

NAME OF TEST	IEC 60384-4/ EN130300 subclause	PROCEDURE (quick reference)	REQUIREMENTS
Robustness of terminations	4.4	tensile strength; application of loading force for 10 seconds: 20 N (standard series) 5 N (vertical miniaturized series)	no breaks
Resistance to soldering heat	4.5	solder bath; 260 °C; 5 seconds	$\Delta C/C: \pm 10\%$ R_I and $I_L \leq$ spec. limit
Solderability	4.6	solder bath; 235 °C; 2 seconds	$\geq 75\%$ tinning
Vibration	4.8	10 to 55 Hz; 1.5 mm; 3 directions; 2 hours per direction	$\Delta C/C: \pm 10\%$ R_I and $I_L \leq$ spec. limit
Damp heat, steady state	4.12	500 hours at 55 °C; RH 90 to 95%; no voltage applied	$\Delta C/C: \pm 30\%$ $R_I \leq 4 \times$ spec. limit $I_L \leq 2 \times$ spec. limit
Endurance	4.13	$T_{amb} = 70$ °C; 5.5 V applied; 1000 hours	$\Delta C/C: \pm 30\%$ $R_I \leq 4 \times$ spec. limit $I_L \leq 2 \times$ spec. limit
Storage at upper category temperature	4.17	$T_{amb} = 70$ °C; no voltage applied; 1000 hours	$\Delta C/C: \pm 30\%$ $R_I \leq 4 \times$ spec. limit $I_L \leq 2 \times$ spec. limit
Self discharge	–	24 hours storage at room temperature after application of 5 V for 1 hour	remaining voltage: ≥ 4 V
Characteristics at high and low temperature	4.19	step 1: reference measurement at +20 °C of C, R_I and I_L step 2: measurement at -25 °C step 3: measurement at +20 °C step 4: measurement at +70 °C step 5: measurement at +20 °C	$\Delta C/C: \pm 30\%$ of +20 °C value $R_I \leq 5 \times$ the +20 °C value $I_L \leq 4 \times$ the +20 °C value

DATA HANDBOOK SYSTEM

DATA HANDBOOK SYSTEM

BC Components data handbooks are available for selected product ranges and contain all relevant data available at the time of publication and each is revised and updated regularly.

Loose data sheets are sent to subscribers to keep them up-to-date on additions or alterations made during the lifetime of each edition.

Our data handbook titles are listed here.

<i>New</i>	<i>Old</i>	<i>Title</i>
BC01	PA01	Electrolytic Capacitors
BC02	PA02	Varistors, Thermistors and Sensors
BC03	PA03	Potentiometers
BC04	PA04	Variable Capacitors
BC05	PA05	Film Capacitors
BC06	PA06b	Ceramic Capacitors
BC08	PA08	Fixed Resistors
BC10	PA10	Quartz Crystals
BC11	PA11	Quartz Oscillators

MORE INFORMATION FROM BC COMPONENTS?

For more information about BC Components data handbooks, catalogues and subscriptions, please contact your nearest BC Components sales organization (**see address list on the back cover of this handbook**).

BCcomponents - Quality components and excellent service... worldwide

Argentina: IEROD, BUENOS AIRES,

Tel. +5411 4786 7635, Fax. +5411 4786 9367

Australia: Philips Components Pty Ltd., NORTH RYDE,

Tel. +61 2 9704 8151, Fax. +61 2 9704 8139

Austria: BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 0, Fax. +49 40 2489 1400

Belarus: BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 0, Fax. +49 40 2489 1400

Benelux: BCcomponents B.V., EINDHOVEN, NL,

Tel. +31 40 25 90 767, Fax. +31 40 25 90 777

Brasil: Phoenix do Brasil Ltd., SÃO PAULO,

Tel. +55 11 321 2375, Fax. +55 11 829 1849

China: BCcomponents ASO, Offices:

BEIJING, Tel. +86 10 6517 2288/+86 137 0108 1940,
Fax. +86 10 6518 1192

GUANGDONG, Tel. +86 752 3355 373, Fax. +86 752 3356 842
SHANGHAI, Tel. +86 21 6391 6088, Fax. +86 21 6391 5060

Denmark: Sales Organization Nordic,

BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 1247, Fax. +49 40 2489 1413

Finland: Sales Organization Nordic,

BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 1247, Fax. +49 40 2489 1413

France: BCcomponents S.A.S., NANTERRE,

Tel. +33 1 4119 1950, Fax. +33 1 4119 1960

Germany: BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 0, Fax. +49 40 2489 1400

Hong Kong: BCcomponents Hong Kong Ltd., KOWLOON BAY,

Tel. +852 2753 3542, Fax. +852 2799 0525

India: BCcomponents India Pvt. Ltd., NEAR PUNE,

Tel. +91 20 813 737/636, Fax. +91 20 813 741

Indonesia: BCcomponents Singapore Pte Ltd., SINGAPORE,

Tel. +65 483 8300, Fax. +65 482 5521

Israel: Rapac Electronics Ltd., TEL AVIV,

Tel. +972 3 6450 444, Fax. +972 3 6491 007

Italy: BCcomponents South Europe S.r.l., MONZA,

Tel. +39 039 2035 932, Fax. +39 039 2036 625

Japan: Nihon LCR Co. Ltd., TOKYO,

Poland: BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 0, Fax. +49 40 2489 1400

Portugal: Euroinger S.L., MADRID,

Tel. +34 91 6201 425, Fax. +34 91 6200 612

Russia: BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 0, Fax. +49 40 2489 1400

Singapore: BCcomponents Singapore Pte Ltd., SINGAPORE,

Tel. +65 483 8301, Fax. +65 482 5521

Spain: Euroinger S.L., MADRID,

Tel. +34 91 6201 425, Fax. +34 91 6200 612

Sweden: Sales Organization Nordic,

BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 1247, Fax. +49 40 2489 1413

Switzerland: BCcomponents Vertriebs-GmbH, HAMBURG,

Tel. +49 40 2489 0, Fax. +49 40 2489 1400

Taiwan: BCcomponents Taiwan Ltd., CHUNGLI,

Tel. +886 3 4379 766, Fax. +886 3 4379 715/771

Thailand: BCcomponents, BANGKOK,

Tel. +662 361 2057, Fax. +662 361 2081

Turkey: Omega Electronic Ltd., IZMIR,

Tel. +90 232 2515 715, Fax. +90 232 2515 717

United Kingdom: BCcomponents UK Ltd., GUILDFORD,

Tel. +44 1483 467 000, Fax. +44 1483 467 010

United States: BCcomponents Inc., ALPHARETTA,

Tel. +1 678 366 9970, Fax. +1 678 366 9930

• West Region: BCcomponents Inc., ADDISON,

Tel. +1 972 406 9739, Fax. +1 972 406 9793

• Central Region: BCcomponents Inc., ROSEMONT,

Tel. +1 847 296 9988, Fax. +1 847 296 7828

For all other countries apply to:

BCcomponents, P.O. Box 8777,
5605 LT EINDHOVEN, The Netherlands,
Fax. +31 40 25 90 701

**For the most recent contact details please visit
our internet site:**

www.bccomponents.com

BCD10

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

TEL.: +31-535733333, FAX: +31-535733888

Printed in The Netherlands

Document order number: 2000 3359 001-1

Date of release: March 2000

