FELSIC 85 M

CO 54 - CO 53

15 000 h / 85°C

10 V ... 630 V	68 µF ... 330 000 µF	Ø 36 mm ... Ø 90 mm	– 55°C + 85°C	Long Life Time

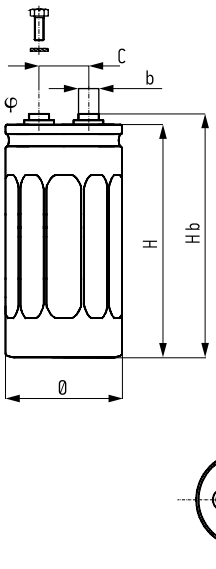
APPLICATIONS

- Power electronics : converters, current inverters
- Switch mode power supplies
- Magnetization, welding machines, flash
- Circuit with high impulse current

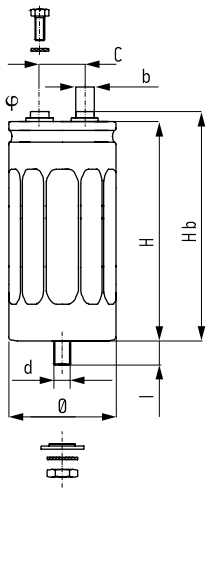
Fixing : Clip or stud fixing
Screw terminals : M5 or M6

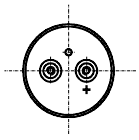
Tolerance on capacitance at 20°C : –20 +20 %
Operating temperature : – 55°C + 85°C

BC



BD





DIMENSIONS (mm)

Ø ±1	H ±2	Hb ±2	C ±0,5	φ	b
36	52	58	12,7	M5	8
36	60	66	12,7	M5	8
36	80	86	12,7	M5	8
36	104	110	12,7	M5	8
51	81	87	22,2	M5	13
51	104	110	22,2	M5	13
66	104	110	28,5	M5	13
77	104	110	31,7	M5	13
77	144	150	31,7	M5	13
77	220	226	31,7	M5	13
90	144	151	31,7	M6	13
90	200	207	31,7	M6	13

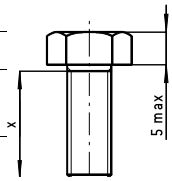
Ø	d	l	Max. nut torque
36	M8	$12^{\pm 1}$	4 Nm
≥ 51	M12	$16^{\pm 1,5}$	10 Nm

BC
Insulated aluminum case
Hexagonal screws
Spring washers
Fixing clip must be ordered separately

BD
Aluminum case with sleeve
Hexagonal screws
Spring washers
Stud fixing delivered with capacitor
(steel hex nut, spring washer)

HEXAGONAL SCREWS

Screwing height between screws and terminals : 3,5 mm max	
Max. screw torque :	M5 : 3 Nm (x min 8 mm)
	M6 : 6 Nm (x min 10 mm)



RESISTANCE TO VIBRATIONS

Hb (mm)	>150	≤150
(Hz)	10 –55 Hz	10 - 2000 Hz
Amplitude	0,75 mm	1,5 mm
Acceleration	10 g - 98 m/s²	20 g - 196 m/s²
t (h)	3 x 2 h	3 x 2 h

SPECIFICATIONS

NFC 83 110 - Long life
DIN 41 240 - Climatic category GPF – 55°C + 85°C / 56 days
CECC 30301-059 Issue 3
CECC 30 301-810
IEC 60 384.4 long life
Standard endurance test at U_R : $U_R \leq 350$ V : 5000 h / 85°C
$U_R > 350$ V : 2000 h / 85°C

WITHSTAND STRENGTH OF INSULATING SLEEVE

Insulation resistance at 20°C between terminals
and mounting hardware : 100 MΩ
Test voltage at 50 Hz 1 min. between terminals
and mounting hardware : 2000 V
Fire resistance : self extinguish 15 s (IEC 60 695-2-2)

FELSIC 85 M

CO 54 - CO 53

15 000 h / 85°C

Capacitance	Case		ESR		Z 10 kHz +20°C max.	II +20°C 5 min max.	I ~ 100 Hz		Code	
	Ø	H	Typic	100 Hz +20°C			+40°C max.	+85°C	CO 54 (M)	CO 53 (M)
(µF)	(mm)	(mm)	(mΩ)	(mΩ)	(mΩ)	(mA)	(A)	(A)	(BC)	(BD)
Rated voltage 10 V										
33000	36	52	16	24	25	1,8	22	6,6	A 746020	A 747020
Rated voltage 16 V										
22000	36	52	16	24	25	2	22	6,6	A 746040	A 747040
47000	36	80	11	16	15	4	22	8,8	A 746041	A 747041
100000	51	81	8	12	10	5	25	13,7	A 746042	A 747042
150000	51	104	7	11	8	5	25	16,4	A 746043	A 747043
220000	66	104	5	8	6	5	50	22,3	A 746044	A 747044
Rated voltage 25 V										
15000	36	52	18	27	26	2	22	6,2	A 746060	A 747060
22000	36	52	17	25	24	3	22	6,5	A 746069	A 747069
33000	36	80	15	23	18	4	22	8,2	A 746061	A 747061
47000	36	104	12	18	15	5	25	10,3	A 746070	A 747070
47000	51	81	9	14	10	5	25	12,9	A 746062	A 747062
68000	51	81	8	14	10	5	25	13,7	A 746063	A 747063
100000	51	104	8	14	8	5	25	15,3	A 746064	A 747064
220000	77	104	4	6	7	6	55	26	A 746066	A 747066
330000	77	144	3	5	6	7	55	36	A 746067	A 747067
Rated voltage 40 V										
10000	36	52	20	30	28	2	21	5,9	A 746080	A 747080
15000	36	80	18	27	23	3	22	7,5	A 746081	A 747081
22000	36	104	15	22	19	5	22	9,2	A 746082	A 747082
33000	51	81	10	15	13	5	25	12	A 746091	A 747091
47000	51	81	9	14	9	5	25	12,9	A 746083	A 747083
68000	51	104	8	12	8	6	25	14,4	A 746092	A 747092
100000	66	104	7	11	7	6	50	18,9	A 746084	A 747084
150000	77	104	5	8	7	8	55	24,5	A 746085	A 747085
220000	77	144	4	6	6	9	55	31,5	A 746086	A 747086
Rated voltage 63 V										
4700	36	52	40	60	48	1,6	15	4,2	A 746100	A 747100
6800	36	52	35	50	39	2,5	15	4,4	A 746112	A 747112
10000	36	80	23	34	28	3	22	7	A 746101	A 747101
15000	51	81	13	20	18	5	25	10,7	A 746102	A 747102
22000	51	81	12	18	15	5	25	11,1	A 746103	A 747103
33000	51	104	10	15	14	5	25	13,7	A 746113	A 747113
33000	66	104	10	15	14	5	50	15,8	A 746104	A 747104
47000	66	104	8	12	11	6	50	17,7	A 746105	A 747105
68000	77	104	5	8	8	8	55	24,5	A 746106	A 747106
100000	77	144	3	8	8	9	55	36	A 746107	A 747107
150000	77	220	3	8	8	11	55	43	A 746109	A 747109
220000	90	200	3	5	4	15	80	46	A 746110	A 747110
Rated voltage 80 V										
10000	51	81	19	29	23	5	25	8,9	A 746363	A 747363
15000	51	81	17	25	20	5	25	9,4	A 746364	A 747364
22000	51	104	14	21	17	6	25	12	A 746365	A 747365
33000	66	104	12	18	15	6	49	14	A 746366	A 747366
Rated voltage 100 V										
2200	36	52	70	105	90	1,1	11	3,1	A 746120	A 747120
4700	36	80	45	68	54	2,5	16	4,7	A 746121	A 747121
6800	51	81	24	36	27	4	25	7,9	A 746122	A 747122
10000	51	81	20	30	21	5	25	8,7	A 746123	A 747123
15000	51	104	17	26	18	6	25	10,5	A 746124	A 747124
22000	66	104	13	19	15	6	49	13,9	A 746125	A 747125
33000	77	104	10	15	13	8	55	17,5	A 746126	A 747126
47000	77	144	7	11	10	9	55	23	A 746127	A 747127
Rated voltage 160 V										
1000	36	52	85	130	80	0,9	10	2,8	A 746140	A 747140
1500	36	80	55	85	70	1,3	15	4,3	A 746141	A 747141
2200	36	104	48	73	53	2	18	5,2	A 746142	A 747142
3300	51	81	28	42	34	3	25	7,3	A 746143	A 747143
4700	51	104	20	30	28	4	25	9,7	A 746144	A 747144
6800	66	104	17	25	21	5	43	12,3	A 746145	A 747145
10000	77	104	12	18	16	6	55	15,8	A 746146	A 747146
15000	77	144	10	14	13	8	55	20	A 746147	A 747147
22000	77	220	10	15	13	10	55	24	A 746148	A 747148
33000	90	200	8	12	11	14	80	28	A 746150	A 747150

FELSIC 85 M

CO 54 - CO 53

15 000 h / 85°C

Capacitance	Case		ESR		Z 10 kHz +20°C max.	II +20°C 5 min max.	I ~ 100 Hz		Code	
	Ø	H	Typic	100 Hz +20°C			+40°C max.	+85°C	CO 54 (M)	CO 53 (M)
(µF)	(mm)	(mm)	(mΩ)	(mΩ)	(mΩ)	(mA)	(A)	(A)	(BC)	(BD)
Rated voltage 250 V										
470	36	52	110	170	100	0,7	9	2,5	A 746160	A 747160
1000	36	80	70	105	70	1,5	13	3,8	A 746161	A 747161
1500	51	81	50	75	50	2	19	5,5	A 746162	A 747162
2200	51	81	48	72	48	3	20	5,6	A 746163	A 747163
3300	51	104	35	50	35	4	25	7,6	A 746164	A 747164
4700	66	104	21	32	20	6	38	10,9	A 746165	A 747165
6800	77	104	16	24	15	8	46	13	A 746166	A 747166
10000	77	144	14	21	13	9	55	16,8	A 746167	A 747167
22000	90	200	10	15	12	14	80	25	A 746170	A 747170
Rated voltage 350 V										
330	36	52	240	360	190	0,7	5,9	1,7	A 746180	A 747180
470	36	80	150	230	140	0,9	9	2,6	A 746181	A 747181
680	36	104	100	150	100	1,4	13	3,6	A 746182	A 747182
1000	51	81	75	110	65	2	16	4,5	A 746183	A 747183
1500	51	104	55	75	55	3	20	5,8	A 746184	A 747184
2200	66	104	30	45	32	4	32	9,1	A 746185	A 747185
3300	77	104	25	38	27	6	38	10,9	A 746186	A 747186
4700	77	104	20	30	18	7	43	12,2	A 746191	A 747191
6800	77	144	17	25	15	7	53	15,2	A 746187	A 747187
Rated voltage 385 V										
220	36	52	380	570	360	0,5	4,6	1,3	A 746200	A 747200
1000	51	81	90	135	100	2,3	14	4,1	A 746202	A 747202
1500	51	104	70	110	80	3,4	18	5	A 746203	A 747203
2200	66	104	50	75	50	5	25	7,1	A 746204	A 747204
3300	77	104	29	45	30	6	35	10,1	A 746205	A 747205
4700	77	144	22	35	25	7	47	13,4	A 746206	A 747206
6800	77	220	17	25	15	8	55	18,4	A 746207	A 747207
Rated voltage 400 V										
220	36	52	400	600	500	1,7	4,6	1,3	A 746220	A 747220
330	36	80	280	420	300	2,0	6,6	1,9	A 746221	A 747221
470	36	104	200	300	200	2,5	9	2,5	A 746222	A 747222
1000	51	81	90	135	100	3,5	14	4,1	A 746223	A 747223
1500	66	104	60	90	60	4,0	22	6,4	A 746224	A 747224
2200	66	104	40	70	50	5,0	28	7,9	A 746225	A 747225
3300	77	104	29	50	35	6,0	35	10,1	A 746226	A 747226
4700	77	144	22	35	25	7,0	47	13,4	A 746227	A 747227
6800	90	144	16	25	15	9,0	64	18,4	A 746229	A 747229
10000	90	200	11	18	15	12,0	80	24,0	A 746230	A 747230
Rated voltage 450 V										
150	36	52	590	890	700	1,5	3,9	1,1	A 746240	A 747240
330	36	80	260	400	370	2,3	7	2,0	A 746242	A 747242
470	36	104	170	260	240	2,7	9,5	2,7	A 746243	A 747243
680	51	81	130	190	130	3,3	12	3,3	A 746244	A 747244
1000	51	104	85	130	90	4,0	16	4,7	A 746245	A 747245
1500	66	104	65	100	85	5,0	22	6,2	A 746246	A 747246
2200	66	104	50	85	70	6,0	25	7,0	A 746250	A 747250
2200	77	104	38	70	60	6,0	31	8,8	A 746247	A 747247
3300	77	144	25	50	40	7,3	44	12,6	A 746248	A 747248
4700	77	144	22	40	35	8,7	47	13,4	A 746252	A 747252
5600	77	220	20	40	30	9,5	55	17,0	A 746249	A 747249
6000	90	144	20	40	30	9,9	60	17,0	A 746253	A 747253
6800	90	200	15	30	20	10,0	72	20,0	A 746251	A 747251
8000	90	200	12	20	18	11,0	80	23,0	A 746255	A 747255
10000	90	200	11	18	16	13,0	80	24,0	A 746256	A 747256
Rated voltage 500 V										
68	36	52	700	1050	750	1,1	3,5	1,0	A 746280	A 747280
100	36	52	520	800	550	1,3	4	1,2	A 746381	A 747381
150	36	60	400	700	500	1,6	4,9	1,4	A 746382	A 747382
220	36	80	280	420	300	2,0	6,6	1,9	A 746383	A 747383
330	36	104	240	360	260	2,4	8	2,3	A 746384	A 747384
470	51	81	170	260	180	2,9	10	3,0	A 746385	A 747385
680	51	104	120	180	130	3,5	14	3,9	A 746386	A 747386
1000	66	104	80	120	80	4,2	20	5,6	A 746387	A 747387
1500	77	104	70	105	70	5,2	23	6,5	A 746388	A 747388
3300	77	220	30	45	35	7,7	49	14,0	A 746390	A 747390

FELSIC 85 M

CO 54 - CO 53

15 000 h / 85°C

Capacitance	Case		ESR		Z 10 kHz +20°C max.	II +20°C 5 min max.	I ~ 100 Hz		Code	
	Ø	H	Typic	100 Hz +20°C			+40°C max.	+85°C	CO 54 (M) (BC)	CO 53 (M) (BD)
(µF)	(mm)	(mm)	(mΩ)	(mΩ)	(mΩ)	(mA)	(A)	(A)		
Rated voltage 550 V										
68	36	52	850	1300	900	1,5	3,2	0,9	A 746302	A 747302
100	36	52	600	1000	700	1,9	3,8	1,1	A 746303	A 747303
150	36	80	500	800	600	2,3	5	1,4	A 746304	A 747304
220	36	104	400	600	450	2,8	6,3	1,8	A 746305	A 747305
330	51	81	300	450	330	3,4	7,8	2,2	A 746306	A 747306
470	51	104	200	300	230	4,1	11	3,1	A 746307	A 747307
680	66	104	130	200	150	4,9	15	4,4	A 746308	A 747308
1000	77	104	100	150	110	5,9	19	5,5	A 746309	A 747309
1500	77	144	80	120	80	7,3	25	7,0	A 746310	A 747310
2200	90	144	40	70	55	8,8	38	11,0	A 746311	A 747311
3300	90	200	25	45	35	11,0	56	16,0	A 746301	A 747301
4700	90	200	20	35	30	13,0	62	18,0	A 746313	A 747313
Rated voltage 630 V										
68	36	52	2400	3600	3000	2,0	1,9	0,5	A 746400	A 747400
100	36	52	2000	3000	2800	2,5	2,1	0,6	A 746411	A 747411
150	36	80	1100	1650	1200	3,1	3,3	1,0	A 746401	A 747401
220	36	104	750	1150	850	3,7	4,6	1,3	A 746402	A 747402
330	51	81	500	750	550	4,6	6	1,7	A 746403	A 747403
470	51	104	350	520	400	5,4	8	2,3	A 746404	A 747404
680	66	104	230	350	270	6,5	12	3,3	A 746405	A 747405
1000	77	104	200	300	250	7,9	14	3,9	A 746406	A 747406
1500	77	144	180	270	200	9,7	16	4,7	A 746407	A 747407
2200	90	144	120	180	120	12,0	22	6,3	A 746408	A 747408
3300	90	200	80	120	80	15,0	31	8,9	A 746409	A 747409

PERMISSIBLE REPETITIVE PEAK CURRENT Ip :

If given corresponding max r.m.s. currents are not exceeded, peak current values are as follows :

Dimensions (mm)		Ip (A)		I~ max.
Ø	H	40°C	85°C	(A)
36	52	400	200	22
36	60	450	220	22
36	80	600	300	22
36	104	700	400	22
51	81	800	400	25
51	104	1100	500	25
66	104	1900	800	50
77	104	3100	1200	55
77	144	4200	1800	55
77	220	5700	2400	55
90	144	5700	2400	80
90	200	7700	3200	80

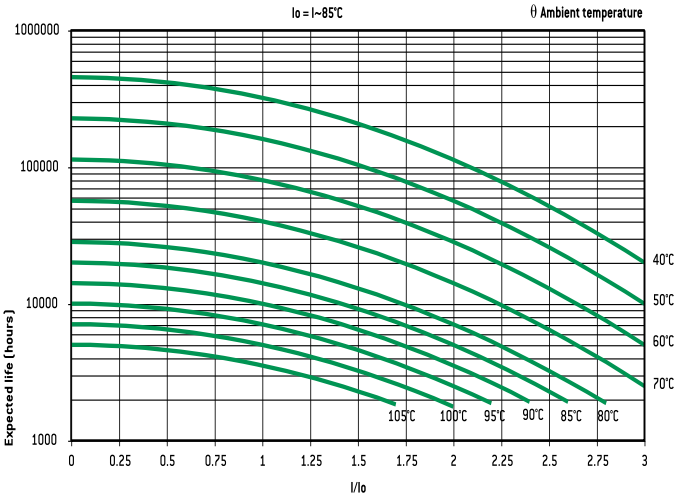
PERMISSIBLE RIPPLE CURRENT I (R.M.S. VALUE)

versus frequency ƒ :
I ~ : permissible r.m.s. current at 100 Hz

(Hz)	50	100	300	600	1 000	10 000	50 000
I	0,8 x I~	I~	1,2 x I~	1,3 x I~	1,35 x I~	1,5 x I~	1,6 x I~

EXPECTED LIFE

As a function of temperature and ripple current



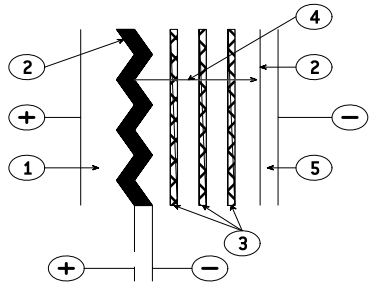
CONNECTIONS IN SERIES :

Operating voltages exceeding 500 V up to 20000 V will be reached by connecting capacitors with rated voltages higher or equal to 350 V in series.

General technical data

1. BASIC CONSTRUCTION

Structure of an electrolytic aluminum capacitor is shown hereunder :



1. Anode : aluminum foil
2. Dielectric : aluminum oxide
3. Papers spacers impregnated with electrolyte
4. Ionic conduction assumed by electrolyte
5. Cathode : aluminum foil

The positive plate is an etched aluminum foil covered with alumina which is the dielectric of the capacitor.

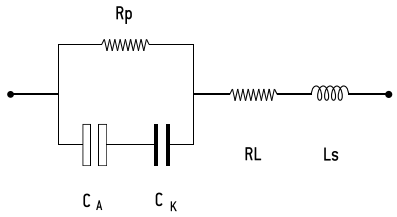
The negative plate is constituted by a second aluminum foil which serves as a current supply, and by electrolyte-impregnated papers layers.

The metal used for anode is a ≥ 99,98 % grade aluminum.

The dielectric has a thickness of 13 Å / V.

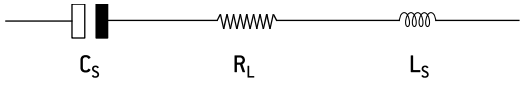
The aluminum used for the cathode is a ≥ 98 % grade aluminum covered with a dielectric layer with a thickness of about 40 Å.

2. DIAGRAM OF THE EQUIVALENT CIRCUIT



CA = Capacitance of the anode
CK = Capacitance of the cathode
Rp = Parallel resistance due to the aluminum oxide f llms.
RL = Series resistance of connections, plates and impregnated spacer.
Ls = Inductance of winding and connections.

A standard simplified diagram is.



Cs is the series capacitance of both anode and cathode capacitances.
Electrolytic aluminum capacitors are naturally polarized because of the insulating f llm on the anode. Given the very thin aluminum oxide layer, a reversed voltage should not exceed 1.5 V when there is energy supply.

Short duration reverse voltages can be absorbed by special construction, second anode replacing the former cathode.

3. CAPACITORS MARKING

3.1. ARTICLE CODE (ON EACH PACKAGING)

A followed by 6 figures number. First 3 positions are specific of the range. (Ex. A 745xxx for a FELSIC 85 BD)

140	FELSIC en batterie / in bank	741	FELSIC 125 FRS BD (ex 731)
701	PRORELSIC 125	742	PRORELSIC 105 TFRS
703	PRORELSIC 125	743	PRORELSIC 105 TFRS
704	SNAPSIC	744	FELSIC 85 BC / FELSIC 85 LP
705	SNAPSIC 105	745	FELSIC 85 BD
706	FELSIC HP BC – BD	746	FELSIC 85 M BC
708	PRORELSIC 145	747	FELSIC 85 M BD
710	CUBISIC	748	SICAL CO 42 - SICAL
711	PROMISIC 031	749	SICAL CO 42 - SICAL
712	CUBISIC LP	750	CUBISIC 125
713	SNAPSIC 105 LP	756	FELSIC 105 BC / FELSIC 105 LP
714	SNAPSIC 4P	757	FELSIC 105 BD
715	SNAPSIC 105 4P	760	FELSIC CAPAX BC
716	SNAPSIC HV	761	FELSIC CAPAX BD
717	SNAPSIC CAPAX	762	FELSIC 105 TFRS BC
718	SNAPSIC 125	763	FELSIC 105 TFRS BD
721	RELSIC 033	764	FELSIC HV BC
722	CI FRS	765	FELSIC HV BD
723	CI FRS	775	VACSIC
728	FELSIC 039 (ex 727) - FELSIC DI	774	VACSIC 150
738	FELSIC 037 (ex 737)	776	ALSIC 20G / ALSIC 145 20G
740	FELSIC 125 FRS BC (ex 731)		

In FELSIC ranges, article code without first letter A, is printed on each capacitor.
a Figure 9 in fourth position shows a special product.

3.2. BATCH (ON EACH CAPACITOR).

3 figures or 6 figures

3.3. DATE (ON EACH CAPACITOR IF APPLICABLE)

4 figures (year-week)

4. ELECTRICAL CHARACTERISTICS

4.1. RATED CAPACITANCE C_R

The rated capacitance is defined at 100 Hz and at ambient temperature.

4.2. RATED VOLTAGE U_R

U_R is the maximum DC voltage which may be applied in continuous operation.
When applying a superimposed alternating voltage, the peak value of the resulting waveform should not exceed the rated voltage.

4.3. PEAK VOLTAGE U_P

Up is the maximum repetitive voltage which can be applied within short periods.
Defined in CECC 30 300 and IEC 60 384-4 :

1000 cycles of 30 s charge followed by a no load period of 5 min. 30 s with upper category temperature.

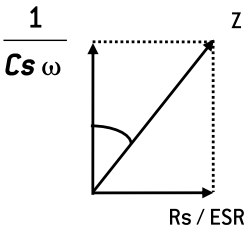
$Up \geq 1{,}15\ U_R$ ($U_R \leq 315$ V)
$Up \geq 1{,}10\ U_R$ ($U_R > 315$ V)

General technical data

4.4. DISSIPATION FACTOR TANδ

The dissipation or loss factor is defined by its tangent Tanδ

$$Tg\delta = Rs \quad Cs\,\omega \qquad (\omega = 2\pi F)$$



ESR Capacitor Equivalent Series Resistance
Cs Capacitor capacitance
F Frequency (100 Hz)
Z Capacitor impedance

4.5. EQUIVALENT SERIES RESISTANCE ESR

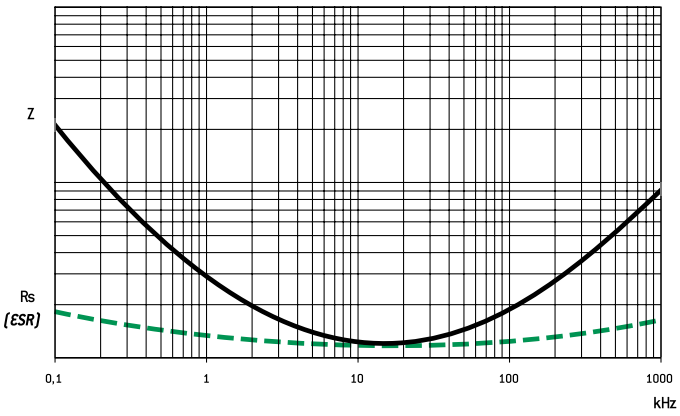
The relation between ESR and dissipation factor Tanδ is given in § 4.4.

4.6. IMPEDANCE Z - INDUCTANCE L

The impedance is given by :

$$Z = \sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}$$

L inductance. Generally L = 5 to 20 nH



Z and ESR as function of frequency typically follows the chart :

4.7. PERMISSIBLE RIPPLE CURRENT (I r.m.s.) I~

The current is defined at the maximum climatic category and at 100 Hz. It is the root mean square value r.m.s. The value I_0 is the rated value for calculations of expected life up to3 I_0.

4.8. LEAKAGE CURRENT Il

Il is measured at 20°C after a 5 min. polarization under rated voltage.

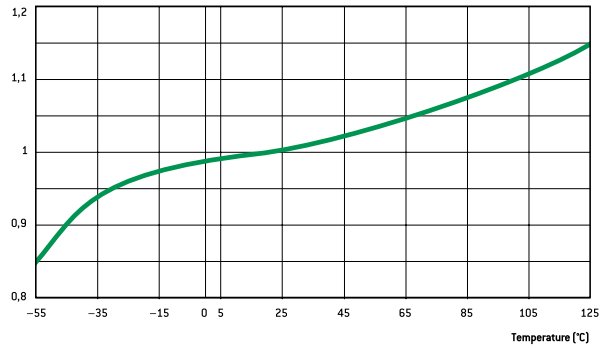
For C_R in µF and U_R in V :
$Il \leq 0{,}01\ C_R\ U_R$ or 1 µA*
when $C_R\ U_R \leq 1000$ µC
$Il \leq 0{,}006\ C_R\ U_R + 4$ µA
when $C_R\ U_R > 1000$ µC
For $U_R > 350\ V_{DC}$ it can be specified :
with K = 4, 6 or 8
or
$Il \leq 0{,}3\ (C_R\ U_R)^{0,7} + 4$ µA (CECC 30 300)
* Whichever is the greater

4.9. CHARACTERISTICS

Versus temperature (typical values).

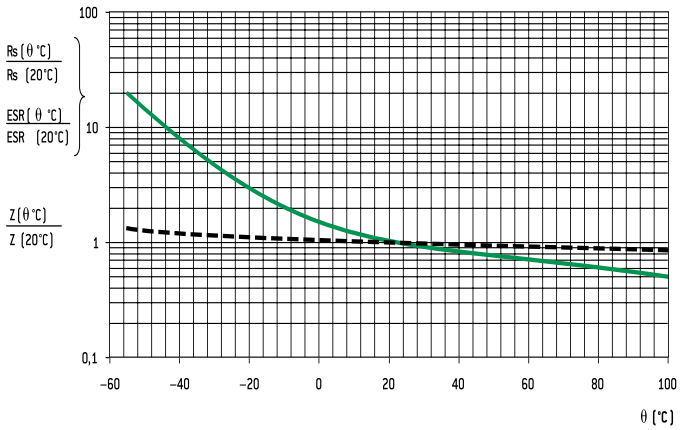
4.9.1. Capacitance drift

Versus temperature



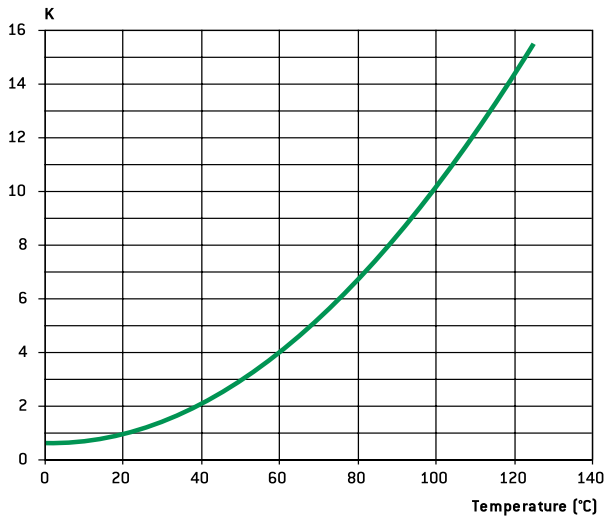
4.9.2. ESR and Z drifts at 100 Hz

Versus temperature



4.9.3 Leakage current drift

Versus temperature



General technical data

5. SPECIFICATION TO APPLY

Electrolytic aluminum capacitors are defined in :

- NF and UTE French national standard
- CECC European specifications
- IEC international specifications

Quality insurance procedures are described in these specifications.

	French	European	International
Generic specification Fixed capacitors	NF C 83 100	CECC 30 000 EN 130 000	IEC 60 384 -1 QC 300 000
Sectional specification Electrolytic aluminum capacitors	NF C 83 110	CECC 30 300	IEC 60 384 - 4 C 300 300
Blank deta ll specification - Electrolytic aluminum capacitors with non solid electrolyte /	UTE 83 110	CECC 30 301	IEC 60 384 - 4 -1 QC 300 301
Blank deta ll specifications	CECC 30 301- 017 to CECC 30 301- 062 CO 31 to CO 55	CECC 30 301- 017 to CECC 30 301- 062 CECC 30 301- 802 to CECC 30 301- 811	

6. ENDURANCE TESTS / LIFE TIME

6.1. STANDARD ENDURANCE TEST

at max category temperature :

Temperature	Endurance test			
	Grade I - Long life			Grade II - General purpose
	10 000 h	5 000 h	2 000 h	1 000 h
125°C			•	
105°C		•	•	•
85°C	•	•	•	•

Standard endurance tests do not exceed 2000 hours at 125°C. However, present EXXELIA SIC SAFCO technologies concerning liquid electrolytes have led to endurance tests up to 5000 hours at 125°C (PRORELSIC 125 - FELSIC 125 RS) and even 20000 hours at 125°C (PRORELSIC 145 - ALSIC 145)

6.2. PERFORMANCE REQUIREMENTS ON STANDARD ENDURANCE TESTS.

Permissible capacitance drift $\Delta C/C$ (%)

Permissible increase factors on Tanδ, ESR, Z and ll initial values

U_R	Endurance test			
	Grade I			Grade II
	10 000 h	5 000 h	2 000 h	1 000 h
6,3 V			+15 –30	+25 –40
10 V - 35 V	+15 –20	±15	±15	±30
40 V - 160 V	±15	±15	±15	±30
> 160 V	±15	±10	±10	±15

	Endurance test			
	Grade I			Grade II
	10 000 h	5 000 h	2 000 h	1 000 h
Tanδ or ESR (1)	1,5	1,3	1,3	1,5
Z (2)	3	2	2	3
ll	Standard values			

(1) Tanδ or ESR : for initial value, take standard value.

(2) Z : for initial value, take specified value (see data sheet).

Specific requirements can be taken into consideration with regards to initial values of dissipation factor or equivalent series resistance and impedance.

6.3. FAILURE CRITERIA FOR ELECTROLYTIC CAPACITORS.

Failure criteria are defined in CECC 30 301

- Non measurable defaults leading to complete failure.
- Measurable defaults leading to adjustment losses of the load circuit (failure due to variations).

6.3.1. Non measurable defaults.

They might be summed up as :

- Open circuit
- Short circuit
- Operation of pressure relief device
- Severely damaged insulation
- Unusable terminations

6.3.2. Measurable defaults.

Variations exceeding the values given below characterize a default.

- Capacitance drift $\Delta C/C$ (%) : 3 times the limit for standard endurance testing or 50 % (whichever is the smallest).
- Tanδ or ESR : 3 times standard max initial values.
- Z : 3 times standard max initial values.
- ll : initial limit (under load conditions).

Specific requirements can be taken into consideration with regards to lower drifts.

6.4. INFLUENCE OF MAIN PARAMETER ON OPERATIONAL LIFE.

6.4.1. Temperature.

The capacitors operational life is highly dependent upon its internal temperature Θi and therefore upon the ambient temperature and the ripple current.

Knowing ESR and dissipated power values (§ 6.4.3.) one can figure out, the internal temperature rise and then determine the capacitors expected life.

With present high bo lling point electrolytes (§ 8.6)

Θi max = 125 to 185°C depending on styles.

6.4.2. Ripple current.

The ripple current flowing through the capacitor increase the internal temperature through power dissipation.

Standards define the permissible current at 100 Hz and generally consider a temperature rise of 5 to 10°C of max category temperature.

Current waveforms and frequencies make it difficult to clearly determine the capacitors internal temperature rise, which defines the operationally life.

Experiments confirm following relationship :

$$\Theta i = \Theta a + (\Theta c - \Theta a)\, K$$

Where :

- Θi = Internal hot spot temperature
- Θa = Ambient temperature
- Θc = Case temperature
- K = Parameter depending upon case diameter and cooling

  $\varnothing \geq 51$ k = $2^{\pm 0,5}$

  $\varnothing < 51$ k = $1,5^{\pm 0,5}$ (air cooling - 0,2 m/s)

General technical data

r.m.s. value according to current waveform.

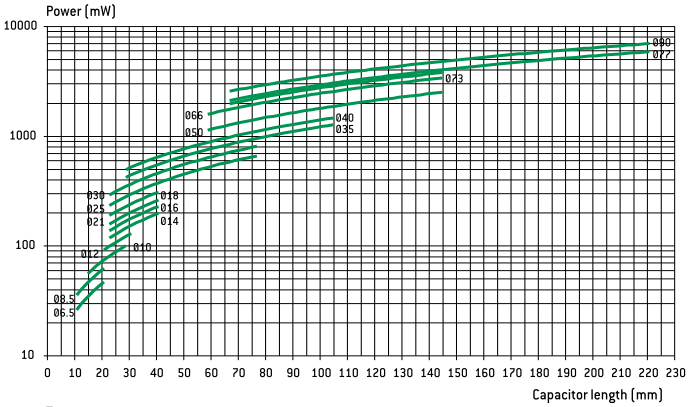
Function	Mean value	R.m.s. value
	A (t0/T)	$A\sqrt{t_0/T}$
	A (t1/T)	$A\sqrt{2t_1/3T}$
	A/2 (t0/T)	$A\sqrt{t_0/3T}$

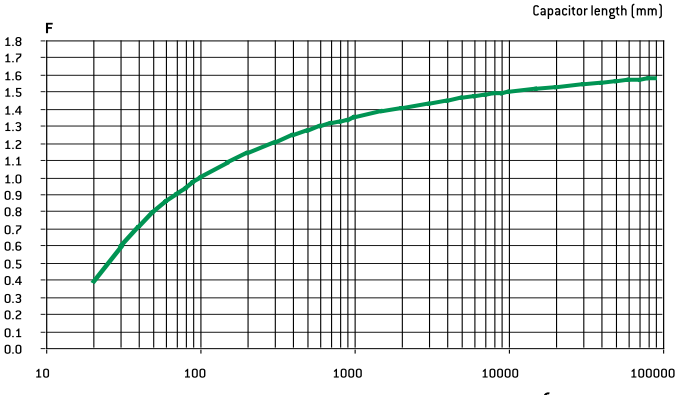
Function	Mean value	R.m.s. value
	A/2	$A\sqrt{3}$
	2A/π (t0/T)	$A\sqrt{t_0/2T}$
	A/2 (t0/T)	$A\sqrt{t_0/3T}$

Function	Mean value	R.m.s. value
	2A/π	$A/\sqrt{2}$
	A/2	$A/\sqrt{3}$
	0	A

6.4.3. Dissipated power versus case dimension

For calculations of ripple currents, considering an internal temperature rise of 10°C





$P = ESR.I^2$

P = Dissipated power (mW)

($\Theta i - \Theta a = 10°C$)

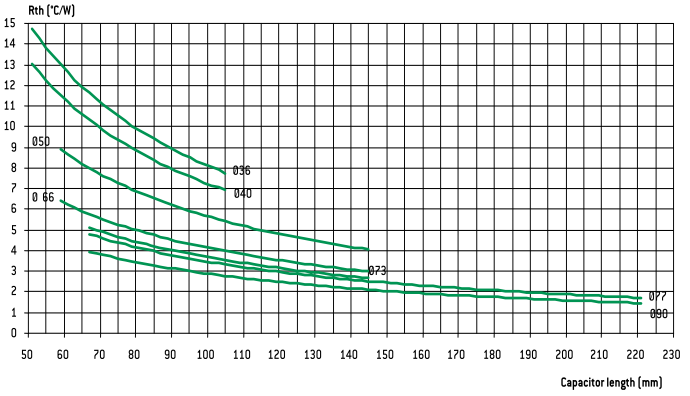
ESR : Equivalent series resistance (100 Hz 20°C)

I : Ripple current (r.m.s. value at 100 Hz)

For different frequencies from 100 Hz, I must be multiplied by the factor F, according to above chart. :

6.4.4. Thermal resistance Rth and air cooling

Rth is static thermal resistance (without cooling) between capacitor central hot spot and ambient temperature measured at a distance of one capacitor diameter



Forced or not cooling air can lead to a significant decrease of these values.

Consequently, r.m.s. ripple current can be increased as a function of air cooling speed :

Ø (mm)	≤ 0,5 m/s	1 m/s	2 m/s	3 m/s	≥ 4 m/s
66 - 90	I~	1,1 I~	1,2 I~	1,25 I~	1,3 I~
36 - 51	I~	1,2 I~	1,4 I~	1,45 I~	1,5 I~

This parameter shall be applied to one capacitor alone.

For capacitors in bank, ambient temperature must be strictly equal around all capacitors.

6.4.5. Quality guaranty

We guarantee products manufactured during 2 years from the data of shipment against defaults of material and assembly.

This guaranty can be involved by the buyer only if our products are used within normal conditions, always according to the state of the art and taking in account storage conditions.

The equipment design should take into consideration possible failures of our capacitors and related effects in order to avoid them.

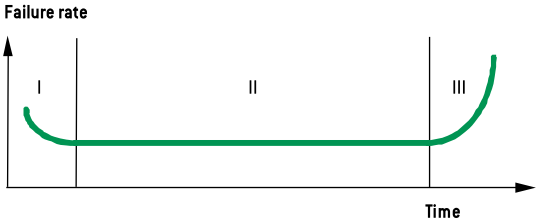
Guaranty is not applicable for damages occurred by surge voltage, irregular use, polarity inversion or maintenance default.

Guaranty is exclusively limited to the replacement of individual defective capacitors within the terms of delivery. This rule applied to all cases and particularly to any further consequence of failures.

6.4.6. Reliability

Failure rate :

$$FR = \frac{\text{Number of components tested x test duration}}{\text{Number of failures}}$$



Failure rate is measured in FIT (failure in time = 10^{-9} / hour).

The failure rate is set up during the life time of the capacitor (phase II)

I. Early failure phase (generally excluded during ageing process).

II. Operational life time of the capacitors

III. End of life

General technical data

Mean time between failures MTBF = 1/FR mesured in years

Range	Failure rate for a failure percentage not exceeding 1% with a confidence level of 60 %
FELSIC 85 >350 V FELSIC CAPAX > 350 V SNAPSIC - SNAPSIC CAPAX > 350 V SNAPSIC 4P > 350 V PROMISIC 031 Ø = 6,5 SICAL CO 42 - SICAL > 350 V	50 FIT - (MTBF = 2280)
FELSIC 037 - 039 FELSIC 85 ≤ 350 V FELSIC CAPAX ≤ 350 V CUBISIC CI FRS SNAPSIC 105 - SNAPSIC 105 4P SNAPSIC 105 LP - SNAPSIC HV SNAPSIC - SNAPSIC 4P ≤ 350 V SNAPSIC CAPAX ≤ 350 V ALSIC IR - ALSIC 145 - ALSIC HV - VACSIC 150 - VACSIC SICAL CO 42 - SICAL ≤ 350 V PRORELSIC 125 Ø = 6,5 RELSIC 033 PROMISIC 031 Ø > 6,5	25 FIT - (MTBF = 4560)
FELSIC 125 FRS - SNAPSIC 125 FELSIC HV - FELSIC 105	10 FIT - (MTBF = 11410)
PRORELSIC 125 Ø > 6,5 PRORELSIC 145	5 FIT - (MTBF = 22820)

Multiplying factor of FR with voltage and temperature

	Temperature (°C)							
	≤ 40	50	60	70	85	105 (1)	125 (1)	145 (1)
Factor	1	1,5	2,3	3,4	6,3	14	32	72

(1) Only for permitted capacitors

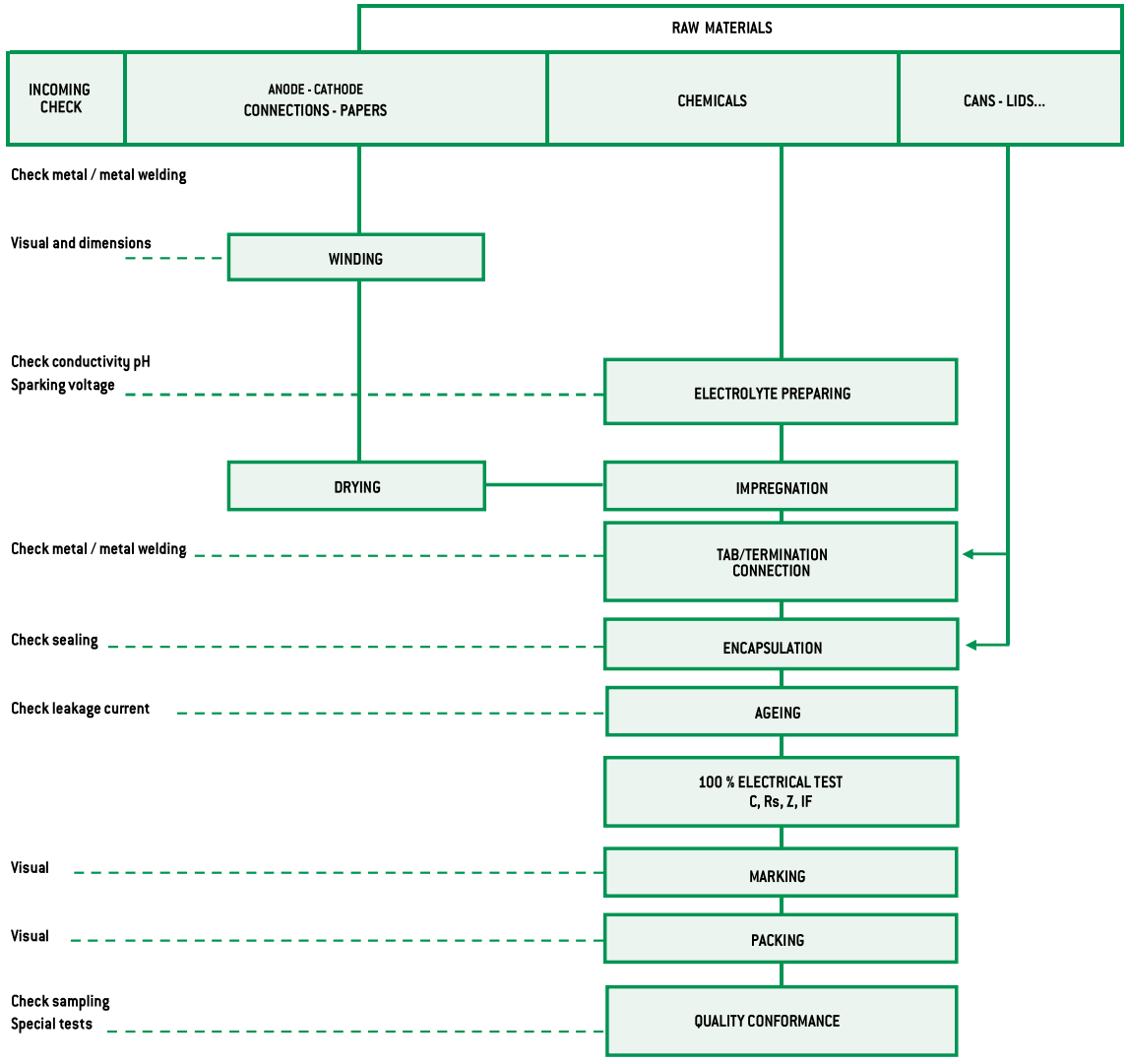
	Percentage of rated voltage (2)		
	100 %	80 %	50 %
Factor	1	0,8	0,5

(2) This voltage has to be constant

Environment	Without vibration		Ground with vibrations or mob lle			
	Ground, fix Controlled air	Ground, fix	PRORELSIC SNAPSIC 20 g FELSIC 20 g	FELSIC 10 g PROMISIC SICAL Ø ≤14	CI FRS - SNAPSIC RELSIC SICAL Ø >14	ALSIC
Factor	1	2	2	4	6	12

7. MANUFACTURING FLOW CHART

Process controls



General technical data

8. INFORMATION ON APPLICATION

8.1. CLEANING SOLVENTS

Use aliphatic alcohols, such as denatured ethyl alcohol, isopropanol, or butylacetate, or else alkaline d lluted solutions. Avoid incompatible solvents (halogenous for example).

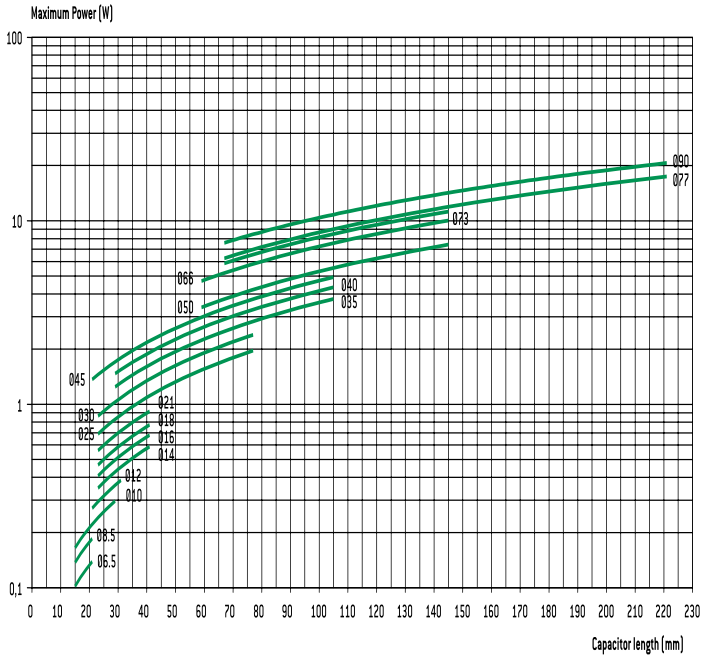
8.2. SHELF LIFE

There is no electrical characteristics variation for long periods of storage except leakage current which can increase.

It is caused by chemical reactions between the dielectric alumina and the electrolyte. These reactions are reversible when switched on. Capacitors can generally be stored at temperature between –5° and +50°C without reforming for the following periods of time :

- For $U_R \leq 100$ V, storage time : ..... 5 years (up to 10 years under specific conditions)
- For 100 V < $U_R \leq 360$ V storage time : ..... 3 years
- For 360 V < $U_R < 500$ V storage time : ..... 1 year
- For $U_R \leq 500$ V, storage time : ..... 6 months

Generally when these periods are overstepped, one hour at rated voltage causes the decrease of leakage current under the specified limits. An other way to avoid this leakage current increase problem is to always limit ava llable power through capacitor during first seconds or minutes after storage or transport, according to the following chart :



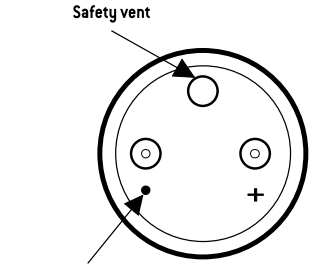
8.3. LOW PRESSURE RESISTANCE

EXXELIA SIC SAFCO capacitors can be used with ambient low pressure decreasing up to 10 mbar (altitude 28000 m – 92000 feet).

8.4. MOUNTING SCREW TERMINALS CAPACITORS (FELSIC)

Capacitors may be used vertically (terminals on top) or horizontally. When used horizontally, the following position in relation to the safety vent, is recommended :

Mounting capacitors in series may be used for operating voltage exceeding U_R. See FELSIC in bank



Prominent negative polarity indicator (except Ø 90)

8.5. MOUNTING SOLDER TYPE CAPACITORS.

They may be used in any position. During mounting, avoid applying excessive force to capacitor pins or wires. There is a risk of damaging internal connections.
After soldering and for the same reasons, do not try to move the capacitor's body.

8.6. ELECTROLYTES : SAFETY RULES.

Electrolytes used in EXXELIA SIC SAFCO capacitors are manufactured by EXXELIA SIC SAFCO. Main solvents are generally γ butyrolactone and ethylene glycol, very stable high bo lling point solvents. Ionic conductive salts in electrolyte induce a very weak acidity (pH 5 to 7).

8.7. ENVIRONMENT.

- There is no possib llity to produce gaseous emissions of nitrogen oxides or liquid emissions of nitrites or nitrates during the manufacture process.
- There is no possib llity to produce liquid emissions or salts coming from dangerous metals such as mercury, hexavalent chromium or cadmium and from poisons such as arsenic or cyanides.

Accessories not made in aluminum, ring, screw, are also plated in anticorrosion processes without cadmium.

EXXELIA SIC SAFCO is always involved in this security field particularly in using whenever it's possible chemicals for electrolyte, without well-known risks.

- Dimethylformamide (DMF) dangerous solvent forbidden in several uses is completely excluded by EXXELIA SIC SAFCO, since 1990.
- There is no halogen compound such as chlorofluorocarbon (CFC or FCKW in german) or polychlorobiphenyl (PCB-Pyralene) or pentabromodiphenylether or octabromodiphenylether.

There is neither benzene, toluene or phenyl compound nor explosive such as picric acid, nor asbestos in plastic covers.

All the capacitors made by EXXELIA SIC SAFCO since 1991, can be scrapped or used in raw materials recycling processes with-out special care.

EXXELIA SIC SAFCO aluminum capacitors with non solid electrolyte are particularly suitable for different kinds of environment taking in account severity increasing laws.

European directives 2003/11/EC, 2002/96/EC (WEEE) and 2002/95/EC (RoHS) applies to all EXXELIA SIC SAFCO capacitors including every solder type, manufactured with pure tin coated pins or wires, since at least January 2006.

EXXELIA SIC SAFCO capacitors do not contain any carcinogen, mutagen and substance toxic for reproduction in accordance with 1907/2006/EC (REACH) European directive target.

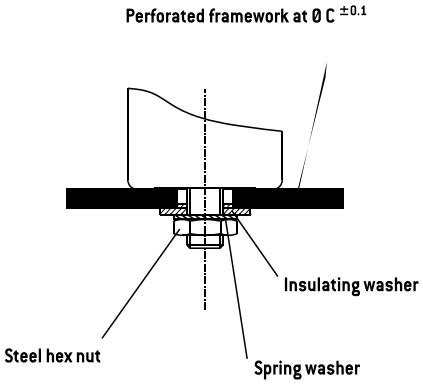
Mounting and insulating parts

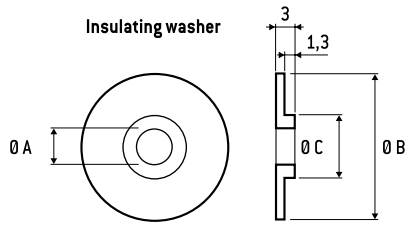
STUD FIXING : FELSIC BD

Steel nut, spring washer and insulating washer are delivered loosely with the capacitor.

STANDARD MOUNTING WITH :

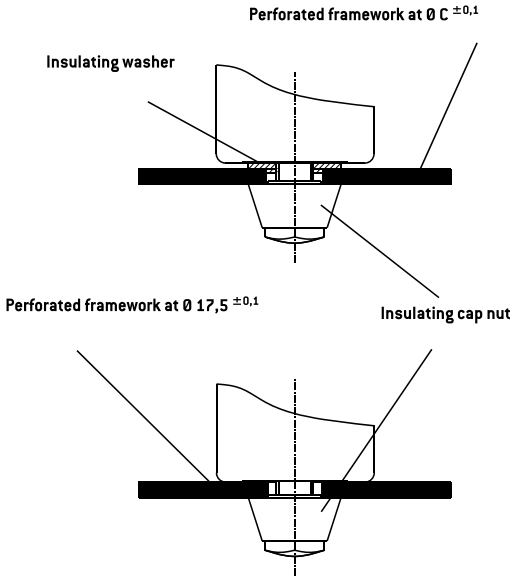
Insulating washer and steel nut

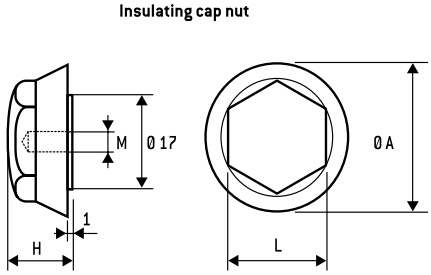




Ø Capacitor	Dimension (mm)				
	M	Ø A	Ø B	Ø C	Code
36	8	8,4	25	18,5	A 691060
51 - 77	12	12,5	30	21,5	A 691061
90	12	12,5	35	21,5	A 691062

Insulating plastic nut with or without insulating washer

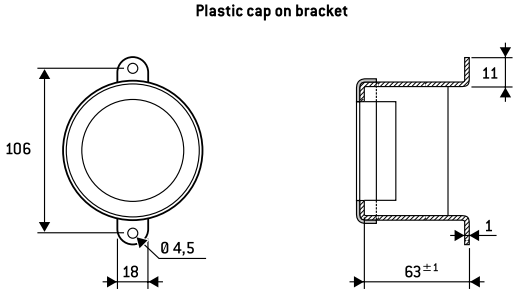




Dimension (mm)					
M	Ø A	H	L	Max. torque	Code
8	25	15	17	3 Nm	A 691070
12	30	20	19	7 Nm	A 691071

Ring - clip mounting : FELSIC LP

Ring clips shall be ordered separately.
Tightening screws and nuts are supplied loosely.



FELSIC 85 LP FELSIC 105 LP	Code
Metal bracket	A691055
Plastic cap	A691065

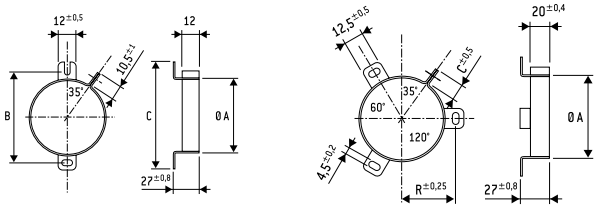
General technical data

Ring - clip mounting : FELSIC BC

Ring clips shall be ordered separately.

Tightening screws and nuts are supplied loosely.

FELSIC BC - Metal ring-clips



Ø A Cap.	B	C	Code
36	54	63	A 691901

Ø A Cap.	B	C	Code
51	33,5	11,8	A 691905
66	39	10,5	A 691913
73	44	10,5	A 691914
77	44,5	10,5	A 691907
90	53,3	11,8	A 691915

Stirrup mounting : CUBISIC LP

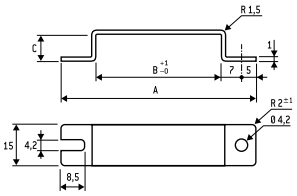
Stirrups shall be ordered separately.

Tightening screws and nuts are supplied loosely

Salt mist endurance of screws and mounting accessories :

minimum 96 h (IEC 600 68-2-11)

CUBISIC /CUBISIC LP - Metal bracket



Ø A Cap.	A	B	C	Code
45x12	69	45	10	A 691057
35x16	59	35	14	A 691059

PACKAGING

1. PACKAGING AND WEIGHT UNITS.

1.1. Capacitor with screw terminals

Case dimensions				Unit weight *
Ø	H			(g)
36	47	52	53	70
36	60			79
36	80	81		100
36	104	105		120
51	47			80
51	62	63		105
51	81	82		190
51	104	105		260
51	112			270
51	144			370
66	104	105		430
66	112			460
73	104	112		600
73	144			680
77	104	105		620
77	144	145		860
77	200			1300
77	220	221		1400
90	67			600
90	144	145		1400
90	200			1800

* Unit weight = typical values

Possibles variations of = ± 25 % according to different voltage and capacitance.

1.2. Radial solder types

Case dimensions		ALSIC	SNAPSIC
Ø (mm)	H (mm)	Weight* (g)	Weight* (g)
10	16	1,8	
12,5	21	4,5	
12,5	24	5	
16	25	8,2	
22	25		15
22	30		17
22	40		18
25	25		17
25	30		20
25	35		22
25	40		25
25	45		28
25	50		30
30	25		28
30	30		30
30	35		30
30	40		40
30	45		45
30	50		50

Case dimensions		ALSIC	SNAPSIC
Ø (mm)	H (mm)	Weight* (g)	Weight* (g)
35	30		50
35	40		50
35	45		52
35	50		60
35	75		95
35	100		125
40	40		65
40	50		100
40	75		130
40	100		170
45	21		50
45	25		60
45	30		73
45	35		85
45	45		110
45	75		180
45	100		240

Case dimensions			CUBISIC
I	L	H	weight (g)
35	35	16	30
35	50	16	40
45	35	12	30
45	50	12	45
45	75	12	60

* Unit weight = typical values

Possibles variations of = ± 25 % according to different voltage and capacitance.

1.3. Axial types

Case dimensions		PRORELSIC RELSIC	PRORELSIC PROMISIC	SICAL CO 42 SICAL
Ø (mm)	H (mm)	Unit weight * (g)	Unit weight * (g)	Unit weight * (g)
6,5	15		1,6	
6,5	19		1,8	1,8
8,5	19		2,3	2,3
10	19		2,8	2,8
10	25		3,5	3,5
10	28		3,8	
12	25		5	
12	30		5,4	5,4
14	30		6,9	6,9
14	41		9,5	
16	30	7,7		7,7
18	35	13,6		
18	40	15,3		15,3
21	40	19,5		19,5
25	40	28		28
25	50	35		35
25	75	56		56

* Unit weight = typical values

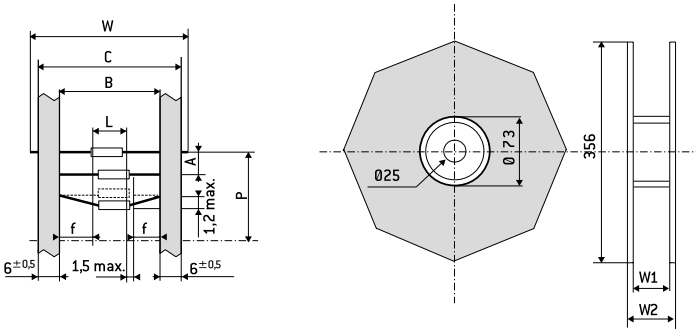
Possibles variations of = ± 25 % according to different voltage and capacitance.

General technical data

2. PACKAGING ON TAPE

2.1. Axial types

Dimensions and tolerance (in mm) in accordance with IEC 60 286-1



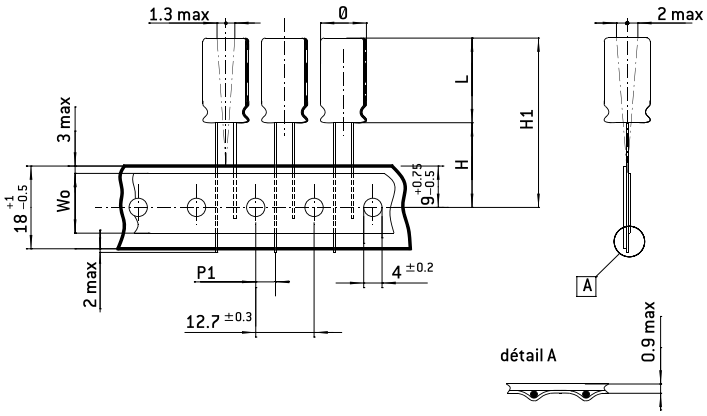
Dimensions									
D	L max.	B	A	P	C max.	W_1	W_2 max.	W	n [2]
6,5 8,5 [1]	20	7,3±1,5	10±1,5	± 2	87,5	93	106	85±1,5	1000 750
10 [1] 12 [1] 14 [1]	32	7,3±1,5	15±1,5	± 3	87,5	93	106	85±1,5	400 400 200

White positive tape ƒ: > 20 mm
P: 10 space

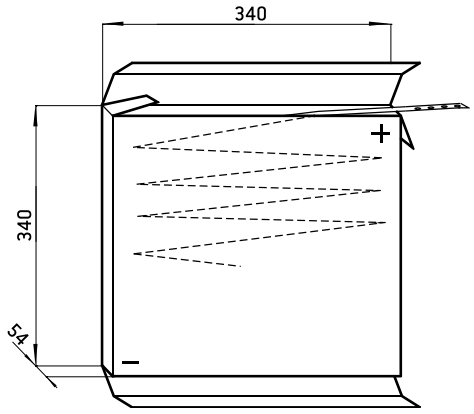
(1) On tape only on request
(2) n = number of capacitors per reel.

2.2. ALSIC IR - ALSIC 145

Dimensions and tolerance (in mm) in accordance with IEC 60 286-2.



Dimensions (mm)					
Ø	L	H_1 max.	W_0	P_1	H
10	16	46,5	13	3,85	19±1



Fan fold packaging (Ammopack)
Number of capacitors : 1000