

FELSIK 85

CO 54 - CO 53

15 000 h / 85°C

10 V ... 630 V	68 µF ... 680 000 µF	∅ 36 mm ... ∅ 90 mm	- 55°C +85°C	Long Life Time
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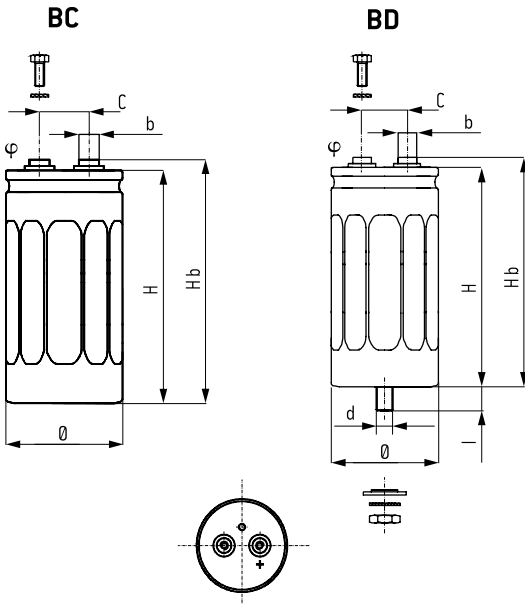


APPLICATIONS

- Power electronics : converters, current inverters
- Switch mode power supplies
- Magnetization, welding machines, flash
- Circuit with high impulse current
- 360 V and 480 V series are mainly designed for repetitive fast discharges working.

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

Tolerance on capacitance at 20°C : -10 +30 %
Operating temperature : - 55°C + 85°C



DIMENSIONS (mm)

∅ ±1	H ±2	Hb ±2	C ±0,5	∅	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

BC

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

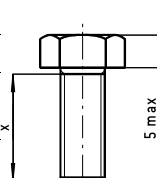
BD

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

∅	d	l	Max. nut torque
36	M8	12 ^{±1}	4 Nm
≥ 51	M12	16 ^{±1,5}	10 Nm

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/s ²	20 g - 196 m/s ²
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 ≤ 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

CO 54 - CO 53

15 000 h / 85°C

Capacitance (μF)	Case		ESR		Z 10 kHz +20°C max. ($\text{m}\Omega$)	II +20°C 5 min max. (mA)	I~ 100 Hz		Code	
	\emptyset (mm)	H (mm)	Typic ($\text{m}\Omega$)	100 Hz +20°C ($\text{m}\Omega$)			+40°C max. (A)	+85°C (A)	CO 54 (BC)	CO 53 (BD)
Rated voltage 10 V										
33000	36	52	16	24	25	1,8	22	6,6	A 744020	A 745020
68000	36	104	7	11	13	4	22	13,5	A 744021	A 745021
330000	66	104	4	8	7	5	50	25	A 744023	A 745023
Rated voltage 16 V										
22000	36	52	16	24	25	2	22	6,6	A 744040	A 745040
47000	36	80	11	16	15	4	22	8,8	A 744041	A 745041
100000	51	81	8	12	10	5	25	13,7	A 744042	A 745042
150000	51	104	7	11	8	5	25	16,4	A 744043	A 745043
220000	66	104	5	8	6	5	50	22,3	A 744044	A 745044
330000	77	104	3	5	6	6	55	31,5	A 744045	A 745045
470000	77	144	3	5	6	6	55	36	A 744046	A 745046
680000	77	220	3	5	6	7	55	43	A 744047	A 745047
Rated voltage 25 V										
15000	36	52	18	27	26	2	22	6,2	A 744060	A 745060
22000	36	52	17	25	24	3	22	6,5	A 744069	A 745069
33000	36	80	15	23	18	4	22	8,2	A 744061	A 745061
47000	36	104	12	18	15	5	25	10,3	A 744070	A 745070
47000	51	81	9	14	10	5	25	12,9	A 744062	A 745062
68000	51	81	8	14	10	5	25	13,7	A 744063	A 745063
100000	51	104	8	14	8	5	25	15,3	A 744064	A 745064
150000	66	104	7	11	7	5	50	18,9	A 744065	A 745065
220000	77	104	4	6	7	6	55	26	A 744066	A 745066
330000	77	144	3	5	6	7	55	36	A 744067	A 745067
Rated voltage 40 V										
10000	36	52	20	30	28	2	21	5,9	A 744080	A 745080
15000	36	80	18	27	23	3	22	7,5	A 744081	A 745081
22000	36	104	15	22	19	5	22	9,2	A 744082	A 745082
33000	51	81	10	15	13	5	25	12	A 744091	A 745091
47000	51	81	9	14	9	5	25	12,9	A 744083	A 745083
68000	51	104	8	12	8	6	25	14,4	A 744092	A 745092
100000	66	104	7	11	7	6	50	18,9	A 744084	A 745084
150000	77	104	5	8	7	8	55	24,5	A 744085	A 745085
220000	77	144	4	6	6	9	55	31,5	A 744086	A 745086
470000	90	200	3	5	5	15	80	46	A 744088	A 745088
Rated voltage 63 V										
4700	36	52	40	60	48	1,6	15	4,2	A 744100	A 745100
6800	36	52	35	50	39	2,5	15	4,4	A 744112	A 745112
10000	36	80	23	34	28	3	22	7	A 744101	A 745101
15000	51	81	13	20	18	5	25	10,7	A 744102	A 745102
22000	51	81	12	18	15	5	25	11,1	A 744103	A 745103
33000	51	104	10	15	14	5	25	13,7	A 744113	A 745113
33000	66	104	10	15	14	5	50	15,8	A 744104	A 745104
47000	66	104	8	12	11	6	50	17,7	A 744105	A 745105
68000	77	104	5	8	8	8	55	24,5	A 744106	A 745106
100000	77	144	3	8	8	9	55	36	A 744107	A 745107
150000	77	220	3	8	8	11	55	43	A 744109	A 745109
220000	90	200	3	5	4	15	80	46	A 744110	A 745110
Rated voltage 80 V										
3300	36	52	60	90	70	1,5	12	3,4	A 744360	A 745360
10000	51	81	19	29	23	5	25	8,9	A 744363	A 745363
15000	51	81	17	25	20	5	25	9,4	A 744364	A 745364
22000	51	104	14	21	17	6	25	12	A 744365	A 745365
33000	66	104	12	18	15	6	49	14	A 744366	A 745366
47000	77	104	8	12	10	8	55	19	A 744367	A 745367
68000	77	144	6	9	8	9	55	26	A 744368	A 745368
Rated voltage 100 V										
2200	36	52	70	105	90	1,1	11	3,1	A 744120	A 745120
4700	36	80	45	68	54	2,5	16	4,7	A 744121	A 745121
6800	51	81	24	36	27	4	25	7,9	A 744122	A 745122
10000	51	81	20	30	21	5	25	8,7	A 744123	A 745123
15000	51	104	17	26	18	6	25	10,5	A 744124	A 745124
22000	66	104	13	19	15	6	49	13,9	A 744125	A 745125
33000	77	104	10	15	13	8	55	17,5	A 744126	A 745126
47000	77	144	7	11	10	9	55	23	A 744127	A 745127
100000	90	200	5	8	6	11	80	35	A 744130	A 745130

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Capacitance (μ F)	Case		ESR		Z 10 kHz +20°C max. (m Ω)	I +20°C 5 min max. (mA)	I _r ~ 100 Hz		Code	
	\emptyset (mm)	H (mm)	Typic (m Ω)	100 Hz +20°C (m Ω)			+40°C max. (A)	+85°C (A)	CO 54 (BC)	CO 53 (BD)
Rated voltage 160 V										
1000	36	52	85	130	80	0,9	10	2,8	A 744140	A 745140
1500	36	80	55	85	70	1,3	15	4,3	A 744141	A 745141
2200	36	104	48	73	53	2	18	5,2	A 744142	A 745142
3300	51	81	28	42	34	3	25	7,3	A 744143	A 745143
4700	51	104	20	30	28	4	25	9,7	A 744144	A 745144
6800	66	104	17	25	21	5	43	12,3	A 744145	A 745145
10000	77	104	12	18	16	6	55	15,8	A 744146	A 745146
15000	77	144	10	14	13	8	55	20	A 744147	A 745147
22000	77	220	10	15	13	10	55	24	A 744148	A 745148
33000	90	200	8	12	11	14	80	28	A 744150	A 745150
Rated voltage 250 V										
470	36	52	110	170	100	0,7	9	2,5	A 744160	A 745160
1000	36	80	70	105	70	1,5	13	3,8	A 744161	A 745161
1500	51	81	50	75	50	2	19	5,5	A 744162	A 745162
2200	51	81	48	72	48	3	20	5,6	A 744163	A 745163
3300	51	104	35	50	35	4	25	7,6	A 744164	A 745164
4700	66	104	21	32	20	6	38	10,9	A 744165	A 745165
6800	77	104	16	24	15	8	46	13	A 744166	A 745166
10000	77	144	14	21	13	9	55	16,8	A 744167	A 745167
15000	77	220	12	18	12	10	55	22	A 744168	A 745168
22000	90	200	10	15	12	14	80	25	A 744170	A 745170
Rated voltage 350 V										
330	36	52	240	360	190	0,7	5,9	1,7	A 744180	A 745180
470	36	80	150	230	140	0,9	9	2,6	A 744181	A 745181
680	36	104	100	150	100	1,4	13	3,6	A 744182	A 745182
1000	51	81	75	110	65	2	16	4,5	A 744183	A 745183
1500	51	104	55	75	55	3	20	5,8	A 744184	A 745184
2200	66	104	30	45	32	4	32	9,1	A 744185	A 745185
3300	77	104	25	38	27	6	38	10,9	A 744186	A 745186
4700	77	104	20	30	18	7	43	12,2	A 744191	A 745191
6800	77	144	17	25	15	7	53	15,2	A 744187	A 745187
8200	77	220	12	18	15	8	55	22	A 744188	A 745188
10000	77	220	11	16	14	9	55	23	A 744189	A 745189
15000	90	200	10	15	13	14	80	25	A 744190	A 745190
Rated voltage 360 V										
910	36	80	160	200	130	3,4	9,8	2,8	A 744341	A 745341
1200	36	104	120	180	120	3,9	11	3,3	A 744342	A 745342
4700	66	104	80	120	80	7	20	5,6	A 744345	A 745345
10000	77	144	35	50	35	10	39	11	A 744347	A 745347
20000	90	200	9	14	12	16	80	26	A 744349	A 745349
Rated voltage 385 V										
220	36	52	380	570	360	0,5	4,6	1,3	A 744200	A 745200
1000	51	81	90	135	100	2,3	14	4,1	A 744202	A 745202
1500	51	104	70	110	80	3,4	18	5	A 744203	A 745203
2200	66	104	50	75	50	5	25	7,1	A 744204	A 745204
3300	77	104	29	45	30	6	35	10,1	A 744205	A 745205
4700	77	144	22	35	25	7	47	13,4	A 744206	A 745206
6800	77	220	17	25	15	8	55	18,4	A 744207	A 745207
Rated voltage 400 V										
220	36	52	400	600	500	1,7	4,6	1,3	A 744220	A 745220
330	36	80	280	420	300	2,0	6,6	1,9	A 744221	A 745221
470	36	104	200	300	200	2,5	9	2,5	A 744222	A 745222
1000	51	81	90	135	100	3,5	14	4,1	A 744223	A 745223
1500	66	104	60	90	60	4,0	22	6,4	A 744224	A 745224
2200	66	104	40	70	50	5,0	28	7,9	A 744225	A 745225
3300	77	104	29	50	35	6,0	35	10,1	A 744226	A 745226
4700	77	144	22	35	25	7,0	47	13,4	A 744227	A 745227
6800	90	144	16	25	15	9,0	64	18,4	A 744229	A 745229
10000	90	200	11	18	15	12,0	80	24,0	A 744230	A 745230

15 000 h / 85°C

Capacitance (μF)	Case		ESR		Z 10 kHz +20°C max. ($\text{m}\Omega$)	II +20°C 5 min max. (mA)	I ~ 100 Hz		Code	
	\emptyset (mm)	H (mm)	Typic ($\text{m}\Omega$)	100 Hz +20°C ($\text{m}\Omega$)			+40°C max. (A)	+85°C (A)	CO 54 (BC)	CO 53 (BD)
Rated voltage 450 V										
150	36	52	590	890	700	1,5	3,9	1,1	A 744240	A 745240
220	36	60	400	600	480	1,8	4,9	1,4	A 744241	A 745241
330	36	80	260	400	370	2,3	7	2,0	A 744242	A 745242
470	36	104	170	260	240	2,7	9,5	2,7	A 744243	A 745243
680	51	81	130	190	130	3,3	12	3,3	A 744244	A 745244
1000	51	104	85	130	90	4,0	16	4,7	A 744245	A 745245
1500	66	104	65	100	85	5,0	22	6,2	A 744246	A 745246
2200	66	104	50	85	70	6,0	25	7,0	A 744250	A 745250
2200	77	104	38	70	60	6,0	31	8,8	A 744247	A 745247
3300	77	144	25	50	40	7,3	44	12,6	A 744248	A 745248
4700	77	144	22	40	35	8,7	47	13,4	A 744252	A 745252
5600	77	220	20	40	30	9,5	55	17,0	A 744249	A 745249
6000	90	144	20	40	30	9,9	60	17,0	A 744253	A 745253
6800	90	200	15	30	20	10,0	72	20,0	A 744251	A 745251
8000	90	200	12	20	18	11,0	80	23,0	A 744255	A 745255
10000	90	200	11	18	16	13,0	80	24,0	A 744256	A 745256
Rated voltage 480 V										
150	36	52	550	820	600	1,6	3,9	1,1	A 744260	A 745260
220	36	60	450	680	500	2,0	4,6	1,3	A 744261	A 745261
330	36	80	290	440	400	2,4	6,7	1,9	A 744262	A 745262
470	36	104	200	300	300	2,9	8,8	2,5	A 744263	A 745263
680	51	81	150	220	150	3,8	11	3,2	A 744264	A 745264
1000	51	104	100	150	100	4,2	15	4,3	A 744265	A 745265
1500	66	104	65	100	85	5,0	22	6,2	A 744266	A 745266
2200	77	104	38	70	60	6,2	31	8,8	A 744267	A 745267
3300	77	144	25	50	40	7,5	44	12,6	A 744268	A 745268
4700	77	220	20	30	20	9,0	55	17,0	A 744269	A 745269
6800	90	200	15	25	15	11,0	74	21,0	A 744270	A 745270
Rated voltage 500 V										
68	36	52	700	1050	750	1,1	3,5	1,0	A 744280	A 745280
100	36	52	520	800	550	1,3	4	1,2	A 744381	A 745381
150	36	60	400	700	500	1,6	4,9	1,4	A 744382	A 745382
220	36	80	280	420	300	2,0	6,6	1,9	A 744383	A 745383
330	36	104	240	360	260	2,4	8	2,3	A 744384	A 745384
470	51	81	170	260	180	2,9	10	3,0	A 744385	A 745385
680	51	104	120	180	130	3,5	14	3,9	A 744386	A 745386
1000	66	104	80	120	80	4,2	20	5,6	A 744387	A 745387
1500	77	104	70	105	70	5,2	23	6,5	A 744388	A 745388
2200	77	144	50	75	50	6,2	31	8,9	A 744389	A 745389
3300	77	220	30	45	35	7,7	49	14,0	A 744390	A 745390
4700	90	200	20	35	25	9,2	62	18,0	A 744391	A 745391
Rated voltage 550 V										
68	36	52	850	1300	900	1,5	3,2	0,9	A 744302	A 745302
100	36	52	600	1000	700	1,9	3,8	1,1	A 744303	A 745303
150	36	80	500	800	600	2,3	5	1,4	A 744304	A 745304
220	36	104	400	600	450	2,8	6,3	1,8	A 744305	A 745305
330	51	81	300	450	330	3,4	7,8	2,2	A 744306	A 745306
470	51	104	200	300	230	4,1	11	3,1	A 744307	A 745307
680	66	104	130	200	150	4,9	15	4,4	A 744308	A 745308
1000	77	104	100	150	110	5,9	19	5,5	A 744309	A 745309
1500	77	144	80	120	80	7,3	25	7,0	A 744310	A 745310
2200	90	144	40	70	55	8,8	38	11,0	A 744311	A 745311
3300	90	200	25	45	35	11,0	56	16,0	A 744301	A 745301
4700	90	200	20	35	30	13,0	62	18,0	A 744313	A 745313
Rated voltage 630 V										
68	36	52	2400	3600	3000	2,0	1,9	0,5	A 744400	A 745400
100	36	52	2000	3000	2800	2,5	2,1	0,6	A 744411	A 745411
150	36	80	1100	1650	1200	3,1	3,3	1,0	A 744401	A 745401
220	36	104	750	1150	850	3,7	4,6	1,3	A 744402	A 745402
330	51	81	500	750	550	4,6	6	1,7	A 744403	A 745403
470	51	104	350	520	400	5,4	8	2,3	A 744404	A 745404
680	66	104	230	350	270	6,5	12	3,3	A 744405	A 745405
1000	77	104	200	300	250	7,9	14	3,9	A 744406	A 745406
1500	77	144	180	270	200	9,7	16	4,7	A 744407	A 745407
2200	90	144	120	180	120	12,0	22	6,3	A 744408	A 745408
3300	90	200	80	120	80	15,0	31	8,9	A 744409	A 745409

FELIC 85

CO 54 - CO 53

15 000 h / 85°C

PEAK VOLTAGE (V)

1000 cycles, without ripple current

Up : Repetitive standard peak voltage (30 s)

Us : Repetitive surge voltage (0,1 s)

Do not overstep this value without damage.

U _R	10 V	16 V	25 V	40 V	63 V	80 V	100 V	160 V	250 V
Up	11,5	18	29	46	72	92	115	184	288
Us								200	290

U _R	350 V	360 V	385 V	400 V	450 V	480 V	500 V	550 V	630 V
Up	385	390	424	440	495	500	550	605	695
Us	405	405	430	450	500	540	600	650	700

PERMISSIBLE REPETITIVE PEAK CURRENT I_p :

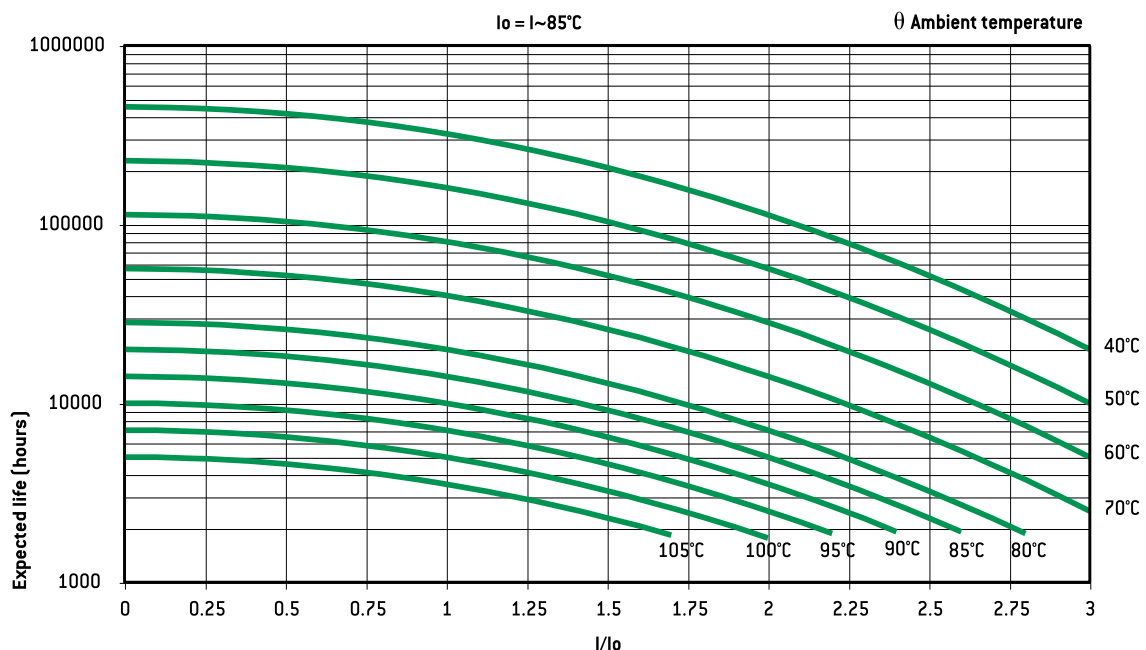
If given corresponding max r.m.s. currents are not exceeded, peak current values are as follows :

Dimensions (mm)		I _p (A)		I _{rms} 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

EXPECTED LIFE

as a function of temperature and ripple current

For UR = 360 V and 480 V do not overstep 0.95 UR



EXPECTED LIFE WITH ID :

• 1 to 5 discharges per minute For I = I_d 48 000 000 cycles

In order to have the highest value of stored energy use preferably FELIC 85 360 V.

• 10 discharges per minute For I = I_d 36 000 000 cycles

• 15 discharges per minute For I = I_d 18 000 000 cycles

$$I = I_d/2 > 1 \times 10^9 \text{ cycles}$$

• 15 to 60 discharges per minute

To have the highest dissipated power, use preferably FELIC 85 480 V, 500 V and 550 V and calculate r.m.s. current (general technical data § 6.4.2.).

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

versus frequency f :

I_{rms} : permissible r.m.s. current at 100 Hz

f (Hz)	50	100	300	600	1 000	10 000	50 000
I	0,8 x I _{rms}	I _{rms}	1,2 x I _{rms}	1,3 x I _{rms}	1,35 x I _{rms}	1,5 x I _{rms}	1,6 x I _{rms}

FAST DISCHARGES WORKING (ID)

Discharge current I_d = peak current of 3 ms per cycle of 1 to 60 s, at 40°C.

I_d as a function of case

Dimensions (mm)		I _d
Ø	H	(A)
36	52	230
36	60	300
36	80	440
36	104	580
51	81	740
51	104	990
66	104	1400
77	104	2000
77	144	2800
77	220	3700
90	144	3900
90	200	4800

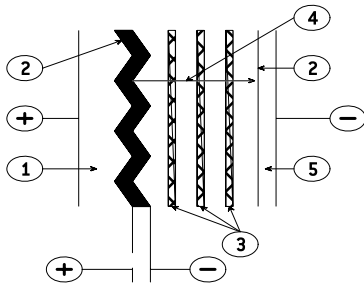
CONNECTIONS IN SERIES :

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 (see FELIC in bank.).

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.

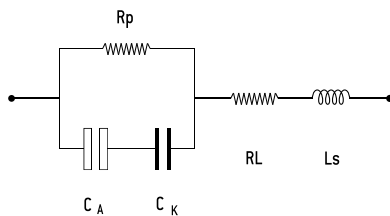
The negative plate is constituted by a second aluminum foil which serves as a current supply, and by electrolyte-impregnated papers layers.

The metal used for anode is a $\geq 99,98\%$ grade aluminum.

The dielectric has a thickness of $13 \text{ \AA} / \text{V}$.

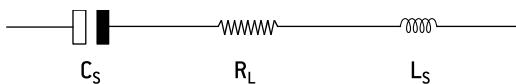
The aluminum used for the cathode is a $\geq 98\%$ grade aluminum covered with a dielectric layer with a thickness of about 40 \AA .

2. DIAGRAM OF THE EQUIVALENT CIRCUIT



- C_A = Capacitance of the anode
- C_K = Capacitance of the cathode
- R_p = Parallel resistance due to the aluminum oxide film.
- R_L = Series resistance of connections, plates and impregnated spacer.
- L_s = Inductance of winding and connections.

A standard simplified diagram is.



C_s is the series capacitance of both anode and cathode capacitances. Electrolytic aluminum capacitors are naturally polarized because of the insulating film 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

U_p 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.

$$U_p \geq 1,15 U_R (U_R \leq 315 \text{ V})$$

$$U_p \geq 1,10 U_R (U_R > 315 \text{ V})$$

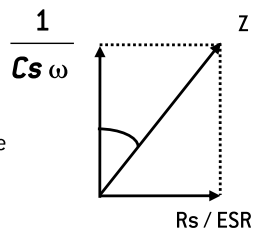
General technical data

4.4. DISSIPATION FACTOR TANδ

The dissipation or loss factor is defined by its tangent $\text{Tan}\delta$

$$\text{Tg}\delta = R_s C_s \omega$$

$$(\omega = 2\pi F)$$



ESR Capacitor Equivalent Series Resistance

Cs Capacitor capacitance

F Frequency [100 Hz]

Z Capacitor impedance

4.5. EQUIVALENT SERIES RESISTANCE ESR

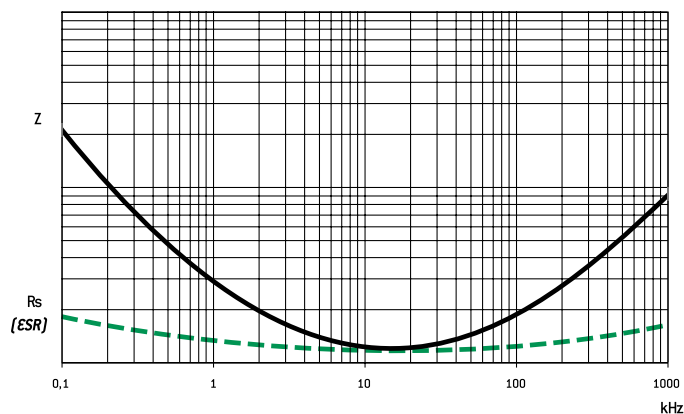
The relation between ESR and dissipation factor $\text{Tan}\delta$ is given in § 4.4.

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 to 3 I_0 .

4.8. LEAKAGE CURRENT II

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

For C_R in μF and U_R in V :

$$I \leq 0,01 C_R U_R \text{ or } 1 \mu\text{A}^*$$

when $C_R U_R \leq 1000 \mu\text{C}$

$$I \leq 0,006 C_R U_R + 4 \mu\text{A}$$

when $C_R U_R > 1000 \mu\text{C}$

For $U_R > 350 \text{ V}_{\text{DC}}$ it can be specified :

with $K = 4, 6 \text{ or } 8$

or

$$I \leq 0,3 (C_R U_R)^{0,7} + 4 \mu\text{A} \text{ (CECC 30 300)}$$

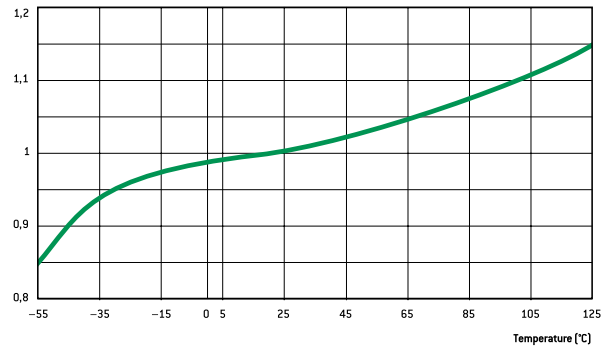
* Whichever is the greater

4.9. CHARACTERISTICS

Versus temperature (typical values).

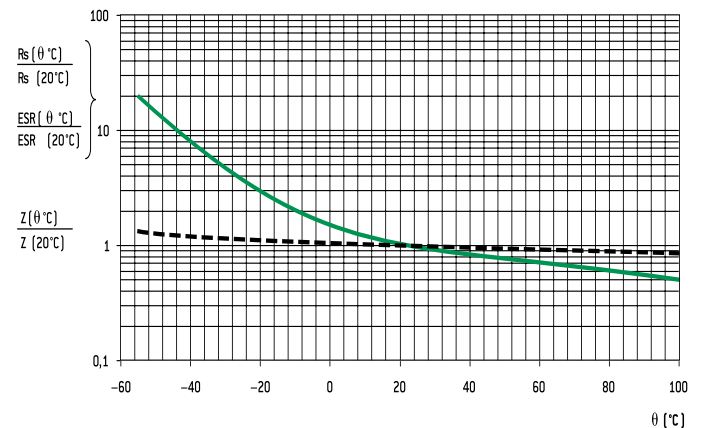
4.9.1. Capacitance drift

Versus temperature



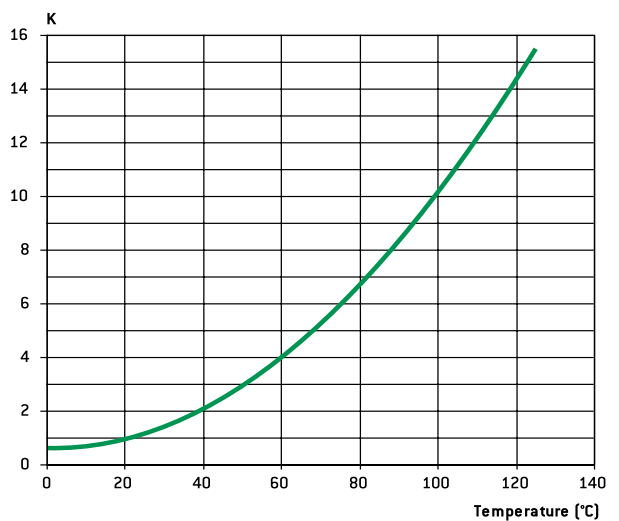
4.9.2. ESR and Z drifts at 100 Hz

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 II specification - Electrolytic aluminum capacitors with non solid electrolyte /	UTE 83 110	CECC 30 301	IEC 60 384 - 4 -1 QC 300 301
Blank deta II 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 $\tan\delta$, ESR, Z and II 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
$\tan\delta$ or ESR (1)	1,5	1,3	1,3	1,5
Z (2)	3	2	2	3
II	Standard values			

(1) $\tan\delta$ 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).
- $\tan\delta$ or ESR : 3 times standard max initial values.
- Z : 3 times standard max initial values.
- II : 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 Θ_i 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 boiling point electrolytes (§ 8.6)

$\Theta_i \text{ max} = 125 \text{ to } 185^\circ\text{C}$ 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 :

- Θ_i = Internal hot spot temperature
- Θ_a = Ambient temperature
- Θ_c = Case temperature
- K = Parameter depending upon case diameter and cooling
 - $\Theta \geq 51 \text{ k} = 2^{\pm 0,5}$
 - $\Theta < 51 \text{ k} = 1,5^{\pm 0,5}$ (air cooling - 0,2 m/s)

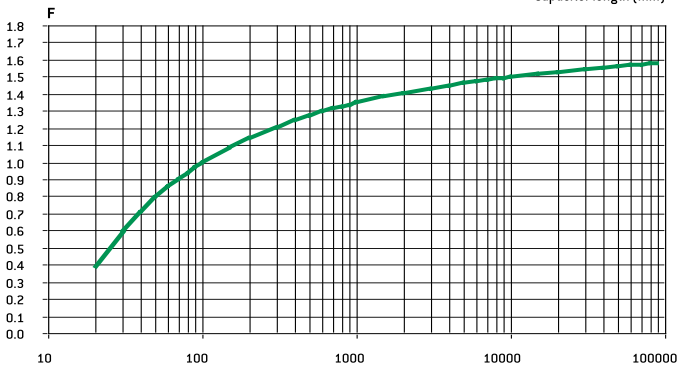
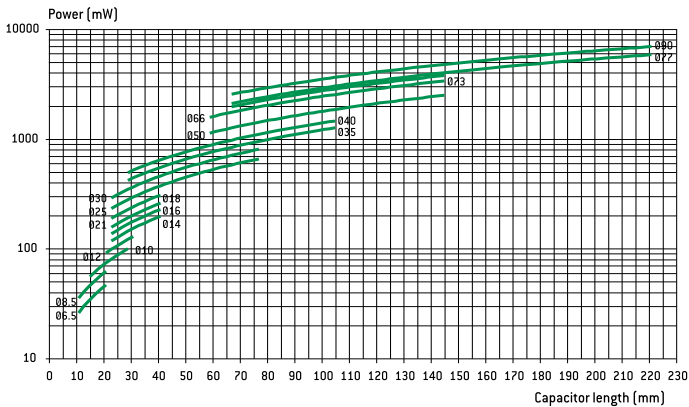
General technical data

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

Function	Mean value	R.m.s. value	Function	Mean value	R.m.s. value	Function	Mean value	R.m.s. value
	$A (t_0/T)$	$A \sqrt{t_0/T}$		$A/2$	$A \sqrt{3}$		$2A/\pi$	$A / \sqrt{2}$
	$A (t_1/T)$	$A \sqrt{2t_1/3T}$		$2A/\pi (t_0/T)$	$A \sqrt{t_0/2T}$		$A/2$	$A / \sqrt{3}$
	$A/2 (t_0/T)$	$A \sqrt{t_0/3T}$		$A/2 (t_0/T)$	$A \sqrt{t_0/3T}$		0	A

6.4.3. Dissipated power versus case dimension

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



$P = ESR \cdot I^2$

P = Dissipated power (mW)

($\Theta_i - \Theta_a = 10^\circ\text{C}$)

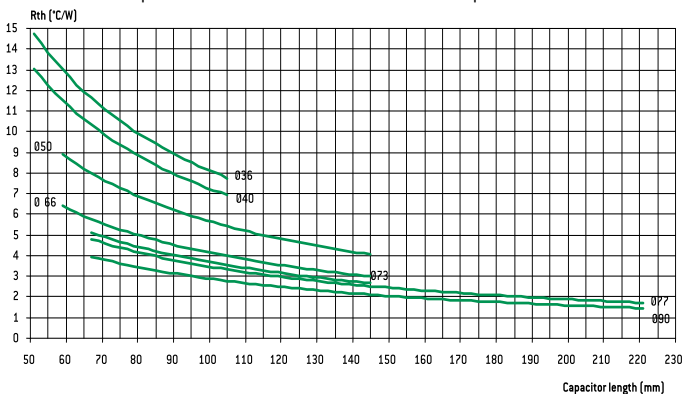
ESR : Equivalent series resistance (100 Hz 20°C)

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 :

\emptyset (mm)	$\leq 0,5$ m/s	1 m/s	2 m/s	3 m/s	≥ 4 m/s
66 - 90	1~	1,1 1~	1,2 1~	1,25 1~	1,3 1~
36 - 51	1~	1,2 1~	1,4 1~	1,45 1~	1,5 1~

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.

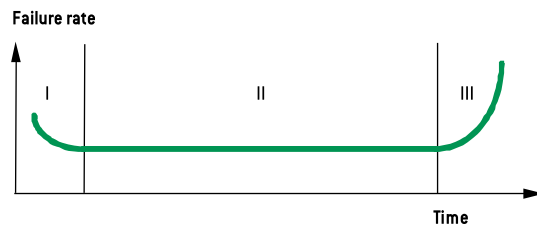
Guaranty is not applicable for damages occurred by surge voltage, irregular use, polarity inversion or maintenance default.

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 :

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



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 measured in years

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

Multiplying factor of FR with voltage and temperature

Factor	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

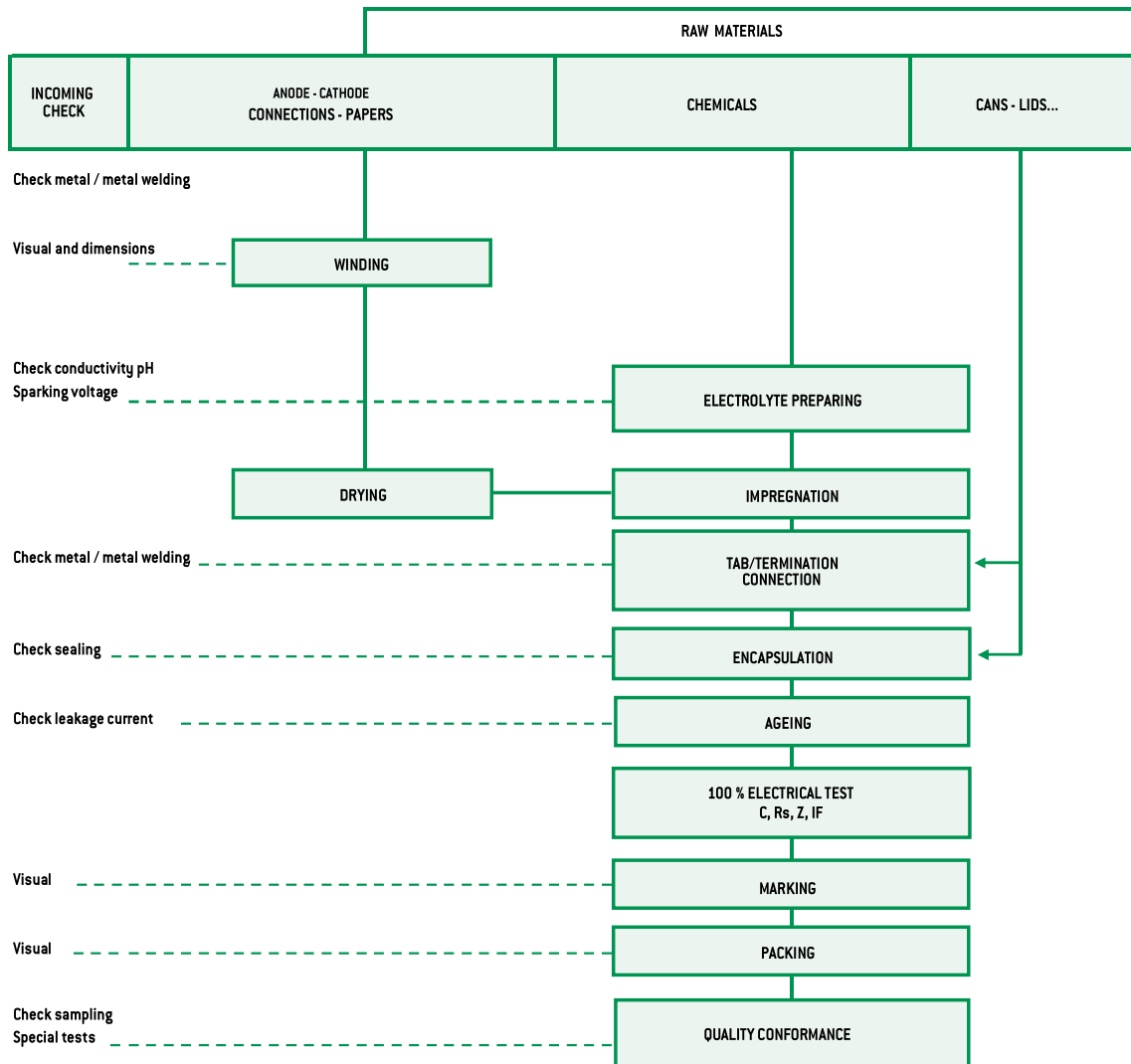
Factor	Percentage of rated voltage (2)		
	100 %	80 %	50 %
Factor	1	0,8	0,5

(2) This voltage has to be constant

Environment	Without vibration		Ground with vibrations or mob ile			
	Ground, fix Controlled air	Ground, fix	PRORELSIC SNAPCIC 20 g FELCIC 20 g	FELCIC 10 g PROMISIC SICAL Ø ≤14	CI FRS - SNAPCIC 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 diluted solutions. Avoid incompatible solvents (halogenous for example).

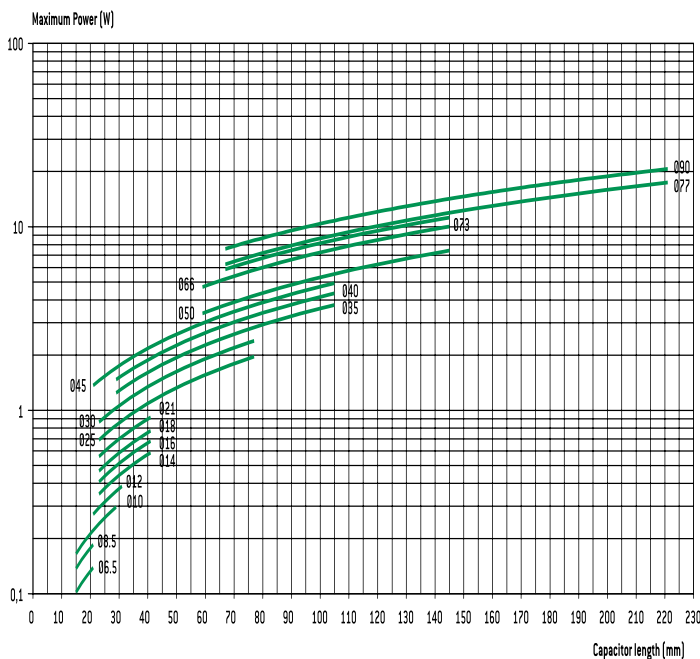
8.2. SHELF LIFE

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 $+50^{\circ}\text{C}$ without reforming for the following periods of time :

- For $U_R \leq 100\text{ V}$, storage time : 5 years
(up to 10 years under specific conditions)
- For $100\text{ V} < U_R \leq 360\text{ V}$ storage time : 3 years
- For $360\text{ V} < U_R < 500\text{ V}$ storage time : 1 year
- For $U_R \leq 500\text{ V}$, 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 available power through capacitor during first seconds or minutes after storage or transport, according to the following chart :



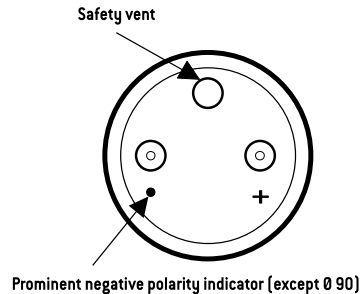
8.3. LOW PRESSURE RESISTANCE

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



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 boiling point solvents. Ionic conductive salts in electrolyte induce a very weak acidity (pH 5 to 7).

8.7. ENVIRONMENT.

- There is no possibility to produce gaseous emissions of nitrogen oxides or liquid emissions of nitrites or nitrates during the manufacture process.
- There is no possibility 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.

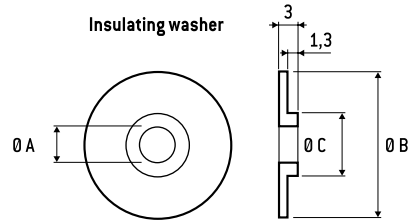
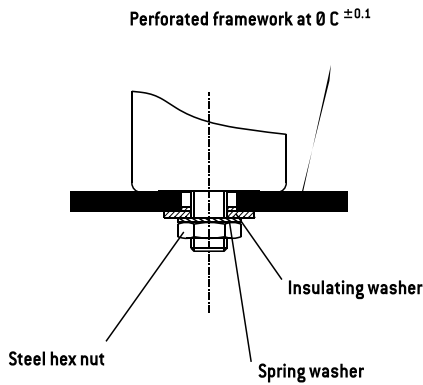
Mounting and insulating parts

STUD FIXING : FELSIC BD

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

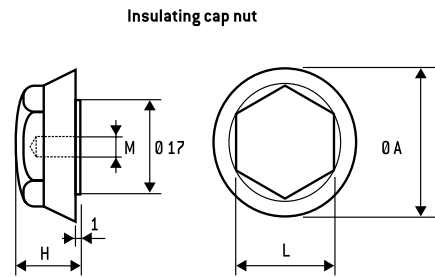
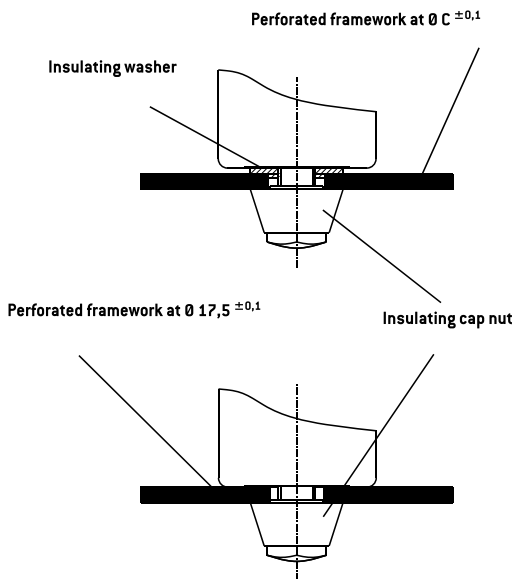
STANDARD MOUNTING WITH :

Insulating washer and steel nut



Ø Capacitor	Dimension (mm)				Code
	M	Ø A	Ø B	Ø C	
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

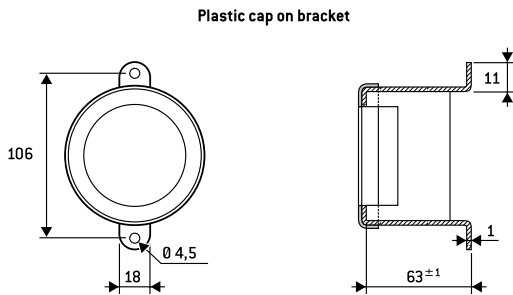


M	Dimension (mm)				Max. torque	Code
	Ø A	H	L			
8	25	15	17	3 Nm	A 691070	
12	30	20	19	7 Nm	A 691071	

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

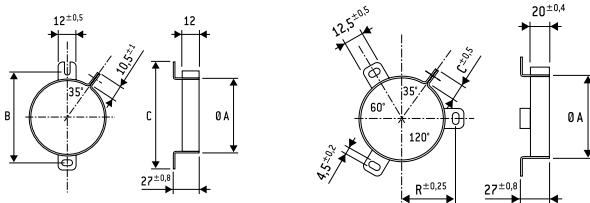
General technical data

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	Ø A Cap.	B	C	Code
36	54	63	A 691901	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

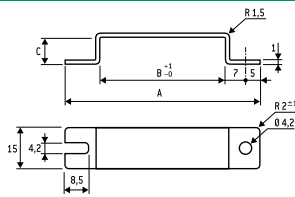
Stirrup mounting : CUBISIC LP

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

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

1.2. Radial solder types

Case dimensions		ALSIC	SNAPSIC	Case dimensions		ALSIC	SNAPSIC
Ø (mm)	H (mm)	Weight* (g)	Weight* (g)	Ø (mm)	H (mm)	Weight* (g)	Weight* (g)
10	16	1,8		35	30		50
				35	40		50
12,5	21	4,5		35	45		52
12,5	24	5		35	50		60
				35	75		95
16	25	8,2		35	100		125
22	25		15	40	40		65
22	30		17	40	50		100
22	40		18	40	75		130
				40	100		170
25	25		17	45	21		50
25	30		20	45	25		60
25	35		22	45	30		73
25	40		25	45	35		85
25	45		28	45	45		110
25	50		30	45	75		180
				45	100		240
30	25		28				
30	30		30				
30	35		30				
30	40		40				
30	45		45				
30	50		50				

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

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

1.3. Axial types

Case dimensions		PRORELSIC	PRORELSIC	SICAL CO 42
Ø (mm)	H (mm)	Unit weight * (g)	PROMISIC (g)	SICAL (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

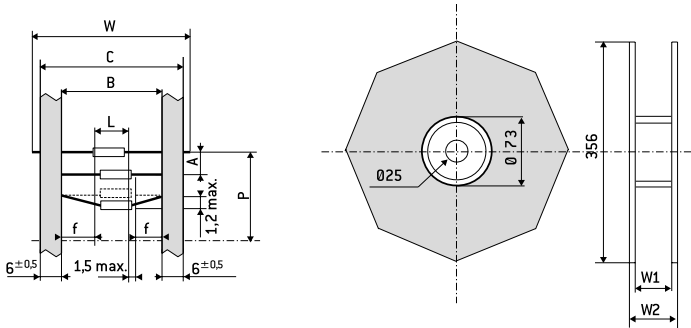
Possible variations of = ± 25 % according to different voltage and capacitance.

General technical data

2. PACKAGING ON TAPE

2.1. Axial types

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



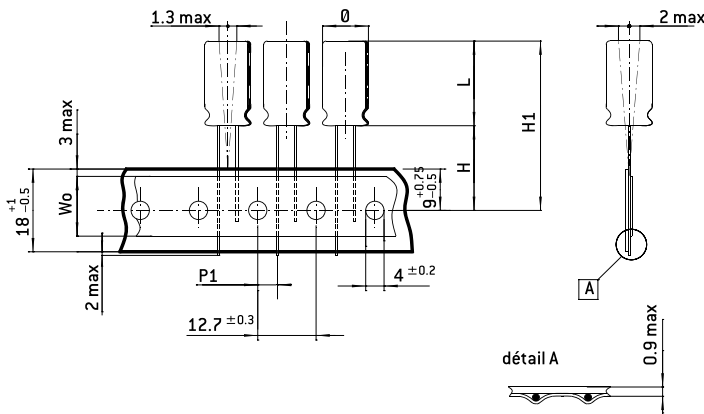
Dimensions									
D	L max.	B	A	P	C max.	W ₁	W ₂ max.	W	n ⁽²⁾
6,5	20	73±1,5	10±1,5	± 2	87,5	93	106	85±1,5	1000
8,5 ⁽¹⁾									750
10 ⁽¹⁾									400
12 ⁽¹⁾	32	73±1,5	15±1,5	± 3	87,5	93	106	85±1,5	400
14 ⁽¹⁾									200

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

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

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

