

# SICAL CO42 - SICAL

CO 42

2 500 h / 105°C

10 V ... 630 V	2,2 $\mu$ F ... 47 000 $\mu$ F	$\varnothing$ 6,5 mm ... $\varnothing$ 25 mm	- 55°C + 105°C	Long Life Time
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## APPLICATIONS

- Coupling/decoupling
- Filtering
- Circuits with time constant
- Switch mode power supplies

Insulating aluminum case

Axial tin-coated copper leads

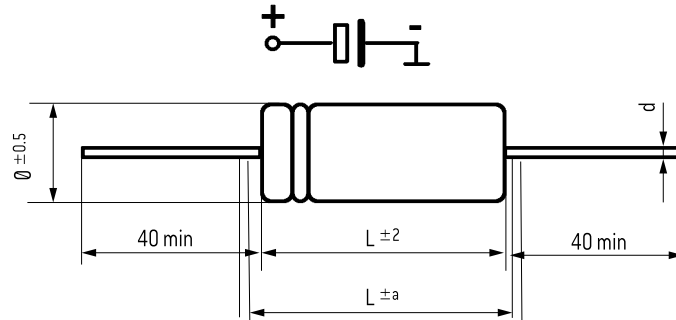
Welded chain providing perfect continuity of the circuit.

Tolerance on capacitance at 20°C :

- 10 + 50 % (SICAL CO 42)

- 20 + 20 % (SICAL)

Operating temperature : - 55°C + 105°C



$\varnothing$ (mm)	d	a
6,5 - 21	0,8	4
25	1	8

## RESISTANCE TO VIBRATIONS

Hb (mm)	Standard	On request
f (Hz)	10 - 55 Hz	10 - 2000 Hz
Amplitude	0,75 mm	1,5 mm
Acceleration	10 g - 98 m/s <sup>2</sup>	20 g - 196 m/s <sup>2</sup>
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 30 301-019 (SICAL CO 42)

CECC 30 300 (SICAL)

IEC 60 384.4 - Long life

Standard endurance test  $U_R$  : 5000 h / 85°C

## WITHSTAND STRENGTH OF INSULATING SLEEVE

Insulating resistance at 20°C between leads and mounting hardware : 100 M $\Omega$

Test voltage at 50 Hz 1 min. between leads and mounting hardware : 1000 V

Fire resistance : self extinguish 30 s (IEC 60 695-2-2) without PVC

## SICAL C042 - SICAL

C0 42

2 500 h / 105°C

Capacitance [ $\mu$ F]	Case		Tan $\delta$ 100 Hz +20°C max. [%]	ESR 100 Hz Typic [ $\Omega$ ]	Z F(1) +20°C max. [ $\Omega$ ]	II +20°C 5 min. max. [ $\mu$ A]	I~ 100 Hz +85°C max. [A]	Code
	Ø [mm]	L [mm]						
<b>Rated voltage / Peak voltage: 10/12 V</b>								
100	6,5	19	13	1,5	1,1	10	0,2	A 748201
220	8,5	19	15	0,75	0,5	17	0,33	A 748203
270	6,5	19	13	0,60	0,5	18	0,26	A 748208
330	10	19	17	0,45	0,4	24	0,48	A 748204
470	10	19	17	0,35	0,3	32	0,54	A 748205
510	8,5	19	15	0,36	0,4	31	0,39	A 748209
730	10	19	17	0,30	0,3	44	0,47	A 748210
1000	10	25	17	0,18	0,2	60	0,85	A 748207
2200	16	30	17	0,07	0,09	135	1,9	A 749000
3300	18	30	17	0,05	0,07	200	2,4	A 749001
4700	16	30	17	0,07	0,09	285	1,9	A 749003
4700	18	40	17	0,04	0,05	285	3,1	A 749002
6300	18	30	17	0,05	0,07	370	2,4	A 749004
9400	18	40	17	0,04	0,05	560	3,1	A 749005
4700	14	30	23	0,05	0,06	285	2,1	A 749500
6800	16	30	24	0,04	0,05	410	2,5	A 749502
10000	18	40	26	0,03	0,04	600	3,5	A 749501
<b>Rated voltage / Peak voltage: 16/18 V</b>								
47	6,5	19	9	1,5	1,1	8	0,2	A 748219
68	6,5	19	12	1,3	0,8	10	0,22	A 748222
100	6,5	19	12	1	0,75	14	0,25	A 748220
150	6,5	19	12	1,3	0,8	18	0,22	A 748229
150	8,5	19	12	0,8	0,7	18	0,32	A 748223
220	6,5	19	12	1	0,75	25	0,25	A 748230
220	8,5	19	14	0,55	0,6	25	0,39	A 748224
280	8,5	19	12	0,8	0,7	27	0,32	A 748231
330	10	19	15	0,5	0,5	35	0,45	A 748225
420	8,5	19	14	0,55	0,6	40	0,39	A 748232
470	10	19	15	0,4	0,45	49	0,5	A 748226
590	10	19	15	0,4	0,45	57	0,5	A 748233
680	10	25	15	0,17	0,22	65	0,87	A 748227
840	10	25	15	0,17	0,22	81	0,87	A 748234
1000	12	30	15	0,13	0,13	100	1,2	A 748228
1500	16	30	15	0,11	0,11	145	1,5	A 749021
1700	12	30	15	0,13	0,13	160	1,2	A 748235
2200	18	30	15	0,05	0,05	215	2,4	A 749022
3800	16	30	15	0,11	0,11	365	1,5	A 749024
4700	21	40	15	0,03	0,04	455	3,9	A 749023
5100	18	30	15	0,05	0,05	490	2,4	A 749025
7900	21	40	15	0,03	0,04	760	3,9	A 749026
2200	14	30	16	0,08	0,11	215	1,7	A 749508
3300	16	30	16	0,06	0,08	320	2,1	A 749509
4700	18	30	16	0,04	0,05	455	2,7	A 749510
10000	21	40	29	0,03	0,03	960	3,9	A 749511
22000	25	40	36	0,02	0,02	2100	5,2	A 749513
47000	25	75	50	0,013	0,015	4500	8,6	A 749514

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CO 42

2 500 h / 105°C

Capacitance [ $\mu$ F]	Case		Tan $\delta$ 100 Hz +20°C max. [%]	ESR 100 Hz Typic [ $\Omega$ ]	Z F(1) +20°C max. [ $\Omega$ ]	I +20°C 5 min. max. [ $\mu$ A]	I $\sim$ 100 Hz +85°C max. [A]	Code
	$\emptyset$ [mm]	L [mm]						
<b>Rated voltage / Peak voltage: 25/30 V</b>								
22	6,5	19	8	2,2	1,6	6	0,15	A 748239
47	6,5	19	12	1,9	1,5	11	0,16	A 748242
100	8,5	19	12	1	0,9	19	0,29	A 748243
140	6,5	19	12	1,9	1,5	21	0,16	A 748249
150	8,5	19	12	0,8	0,7	27	0,32	A 748246
220	10	19	11	0,6	0,6	37	0,41	A 748244
270	8,5	19	12	0,8	0,7	41	0,32	A 748250
330	10	19	11	0,4	0,4	54	0,5	A 748247
380	10	19	11	0,4	0,4	57	0,5	A 748251
470	10	25	10	0,2	0,25	75	0,8	A 748245
540	10	25	10	0,2	0,25	81	0,8	A 748252
680	12	30	10	0,13	0,15	105	1,2	A 748248
1000	16	30	10	0,09	0,08	150	1,7	A 749041
1100	12	30	10	0,13	0,15	165	1,2	A 748253
1500	18	30	10	0,06	0,06	225	2,2	A 749042
2200	18	40	10	0,04	0,04	330	3,1	A 749043
2500	16	30	10	0,09	0,08	375	1,7	A 749044
3300	18	30	10	0,06	0,06	495	2,2	A 749045
4700	25	40	10	0,02	0,03	700	5,2	A 749047
5000	18	40	10	0,04	0,04	750	3,1	A 749046
5100	25	40	10	0,02	0,03	765	5,2	A 749048
1500	14	30	12	0,09	0,09	225	1,6	A 749520
2200	16	30	12	0,06	0,06	330	2,1	A 749521
3300	18	30	12	0,05	0,05	495	2,4	A 749522
4700	18	40	12	0,04	0,04	700	3,1	A 749523
6800	21	40	18	0,03	0,04	1020	3,9	A 749524
10000	25	40	21	0,02	0,03	1500	5,2	A 749515
15000	25	75	24	0,02	0,02	2250	6,9	A 749516
22000	25	75	36	0,02	0,02	3300	6,9	A 749517
<b>Rated voltage / Peak voltage: 40/48 V</b>								
33	6,5	19	10	2,2	2	11	0,17	A 748262
47	8,5	19	9	2	1,6	15	0,2	A 748263
63	6,5	19	10	2,2	2	15	0,17	A 748269
68	8,5	19	10	1,5	1,2	20	0,24	A 748261
100	10	19	10	0,85	0,8	28	0,35	A 748264
120	8,5	19	10	1,5	1,2	29	0,24	A 748270
170	10	19	10	0,85	0,8	41	0,35	A 748271
220	10	25	9	0,35	0,3	55	0,61	A 748266
330	10	25	10	0,27	0,25	83	0,69	A 748267
470	12	30	10	0,2	0,15	115	0,96	A 748268
680	16	30	8	0,08	0,07	165	1,8	A 749061
1000	18	30	9	0,07	0,07	240	2	A 749062
1100	16	30	8	0,08	0,07	264	1,8	A 749064
1500	18	30	9	0,07	0,07	360	2	A 749065
2200	21	40	10	0,04	0,04	530	3,4	A 749063
2900	21	40	10	0,04	0,04	700	3,4	A 749066
1000	14	30	10	0,08	0,08	240	1,7	A 749530
1500	16	30	10	0,08	0,08	360	1,8	A 749533
2200	18	40	10	0,04	0,04	530	3,1	A 749531
3300	18	40	12	0,03	0,03	800	3,5	A 749534
4700	21	40	13	0,025	0,03	1130	4,2	A 749532
10000	25	50	16	0,02	0,02	2400	5,8	A 749535
15000	25	75	23	0,02	0,02	3600	6,9	A 749537

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C0 42

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Capacitance [ $\mu$ F]	Case		Tan $\delta$ 100 Hz +20°C max. [%]	ESR 100 Hz Typic [ $\Omega$ ]	Z F(1) +20°C max. [ $\Omega$ ]	II +20°C 5 min. max. [ $\mu$ A]	I $\sim$ 100 Hz +85°C max. [A]	Code
	0 [mm]	L [mm]						
<b>Rated voltage / Peak voltage: 63/75 V</b>								
10	6,5	19	8	4,1	4	6	0,12	A 748279
15	6,5	19	8	3,8	3,2	10	0,13	A 748286
22	8,5	19	7	2,8	2	12	0,17	A 748287
26	6,5	19	8	4,1	4	6	0,12	A 748280
33	8,5	19	8	2	1,3	16	0,2	A 748288
39	6,5	19	8	3,8	3,2	10	0,13	A 748281
47	8,5	19	7	2,8	2	22	0,17	A 748282
47	10	19	8	1,4	1,1	22	0,27	A 748289
68	10	19	8	1,2	0,9	30	0,29	A 748290
73	8,5	19	8	2	1,3	16	0,2	A 748283
100	10	19	8	1,2	0,9	40	0,29	A 748284
100	10	25	8	0,8	0,6	40	0,4	A 748291
150	10	25	8	0,8	0,6	50	0,4	A 748285
150	12	30	8	0,4	0,35	50	0,68	A 748292
220	12	30	10	0,4	0,35	85	0,68	A 748293
290	12	30	10	0,4	0,35	85	0,68	A 748294
330	16	30	8	0,17	0,15	125	1,2	A 749081
470	18	30	8	0,11	0,1	180	1,6	A 749082
660	16	30	8	0,17	0,15	125	1,2	A 748290
1000	21	40	6	0,06	0,07	380	2,7	A 749083
2100	21	40	6	0,06	0,07	380	2,7	A 748292
2200	25	50	8	0,04	0,04	835	4,1	A 749086
4100	25	50	8	0,04	0,04	835	4,1	A 748293
4700	25	75	12	0,025	0,03	1780	5,6	A 749087
6700	25	75	12	0,025	0,03	1780	5,6	A 748294
680	14	30	8	0,14	0,12	260	1,3	A 749544
1000	16	30	9	0,12	0,11	380	1,5	A 749540
1500	18	40	9	0,09	0,08	570	2	A 749541
2200	21	40	9	0,05	0,04	835	3	A 749545
3300	25	40	11	0,04	0,03	1250	3,7	A 749546
4700	25	50	12	0,03	0,03	1780	4,7	A 749543
6800	25	75	12	0,02	0,02	2570	6,9	A 749547
<b>Rated voltage / Peak voltage: 100/115 V</b>								
4,7	6,5	19	7	9,4	5	5	0,08	A 748299
6,8	6,5	19	7	7,8	4,3	8	0,09	A 748301
10	6,5	19	7	6	3,8	10	0,1	A 748302
15	6,5	19	7	4,2	3,1	13	0,12	A 748303
22	8,5	19	7	2,6	2	17	0,18	A 748304
33	10	19	7	1,8	1,3	24	0,24	A 748307
47	10	25	7	1,2	0,7	32	0,33	A 748306
68	12	30	7	0,8	0,6	45	0,48	A 748309
100	14	30	5	0,35	0,3	60	0,74	A 749100
150	14	30	7	0,3	0,25	94	0,86	A 749105
220	18	30	5	0,18	0,16	135	1,3	A 749101
470	21	40	7	0,1	0,1	285	2,1	A 749102
1000	25	50	7	0,05	0,04	600	3,6	A 749104
220	14	30	6	0,3	0,25	135	0,86	A 749550
330	16	30	7	0,25	0,2	200	1	A 749554
470	18	30	7	0,12	0,11	285	1,6	A 749551
680	21	40	8	0,1	0,1	400	2,1	A 749555
1000	21	40	8	0,07	0,07	600	2,5	A 749552
1500	25	50	8	0,06	0,06	900	3,3	A 749557
1800	25	50	8	0,05	0,05	1080	3,6	A 749558
2200	25	75	8	0,035	0,035	1320	5,2	A 749559
3300	25	75	8	0,03	0,03	1980	5,6	A 749556

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CO 42

2 500 h / 105°C

Capacitance [ $\mu$ F]	Case		Tan $\delta$ 100 Hz +20°C max. [%]	ESR 100 Hz Typic [ $\Omega$ ]	Z F(1) +20°C max. [ $\Omega$ ]	I +20°C 5 min. max. [ $\mu$ A]	I $\sim$ 100 Hz +85°C max. [A]	Code
	$\emptyset$ [mm]	L [mm]						
<b>Rated voltage / Peak voltage: 160/180 V</b>								
2,2	6,5	19	7	26	27	5	0,05	A 748320
4,1	6,5	19	7	26	27	8	0,05	A 748325
4,7	8,5	19	7	12	13	8	0,08	A 748321
8,1	8,5	19	7	12	13	8	0,08	A 748326
10	10	19	8	9	8	14	0,11	A 748322
22	12	25	7	2,1	2,1	25	0,28	A 748323
33	12	30	7	1,8	1,8	35	0,32	A 748324
47	16	30	7	1,4	1,3	49	0,43	A 749121
75	16	30	7	1,4	1,3	72	0,43	A 749125
100	18	40	7	0,45	0,6	100	0,92	A 749122
150	18	40	7	0,45	0,6	140	0,92	A 749126
220	25	40	7	0,25	0,3	215	1,5	A 749124
350	25	40	7	0,25	0,3	340	1,5	A 749127
47	14	30	10	1,3	1,2	49	0,41	A 749563
100	18	40	10	0,7	0,7	100	0,61	A 749560
150	18	30	10	0,6	0,6	148	0,7	A 749568
220	18	40	10	0,5	0,5	215	0,87	A 749561
330	21	40	10	0,3	0,3	321	1,2	A 749564
470	25	40	8	0,2	0,2	450	1,7	A 749565
1000	25	75	8	0,1	0,1	960	3,1	A 749567
<b>Rated voltage / Peak voltage: 250/275 V</b>								
10	10	19	8	11	10	19	0,1	A 748342
15	10	25	10	8,5	8,5	27	0,12	A 748343
22	14	30	6	2,5	2,3	37	0,3	A 749140
33	16	30	6	1,7	1,6	54	0,39	A 749141
47	18	30	6	1,1	1,1	74	0,52	A 749142
100	21	40	6	0,5	0,5	154	0,95	A 749143
22	12	25	7	3,4	3,8	37	0,22	A 748344
33	12	30	7	2	2,2	54	0,3	A 748345
47	14	30	7	1,5	1,5	74	0,38	A 749570
68	16	30	7	1,1	1,1	106	0,48	A 749573
100	18	30	7	0,7	0,7	154	0,64	A 749571
150	18	40	7	0,7	0,7	229	0,73	A 749574
220	21	40	7	0,5	0,50	334	0,95	A 749572
330	25	40	7	0,5	0,5	499	1	A 749575
470	25	75	7	0,1	0,1	709	3,1	A 749576
680	25	75	7	0,08	0,08	1020	3,50	A 749577
1000	25	75	7	0,07	0,07	1500	3,7	A 749578
<b>Rated voltage / Peak voltage: 350/385 V</b>								
6,8	10	19	7	10	10	18	0,1	A 748362
10	10	25	7	6	6	25	0,15	A 748363
15	14	30	6	3,2	3,2	36	0,26	A 749160
22	16	30	6	2,3	2,3	50	0,33	A 749161
33	18	30	6	1,2	1,2	73	0,49	A 749162
47	18	40	6	0,9	0,8	103	0,64	A 749163
15	12	25	6	3,8	3,8	36	0,2	A 748364
22	12	30	6	2,7	2,8	50	0,26	A 748365
33	14	30	6	2	2	73	0,33	A 749580
47	16	30	6	1,2	1,2	103	0,46	A 749581
100	21	40	6	0,5	0,5	214	0,94	A 749582
220	25	40	9	0,4	0,4	466	1,2	A 749585
470	25	75	9	0,3	0,3	991	1,8	A 749586

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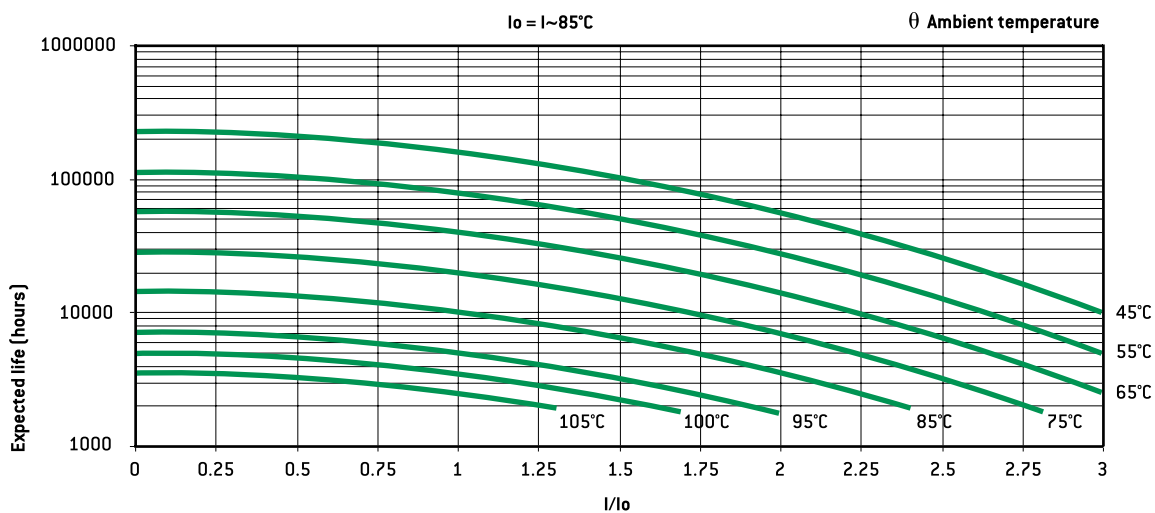
C0 42

2 500 h / 105°C

Capacitance [ $\mu$ F]	Case		Tan $\delta$ 100 Hz +20°C max. [%]	ESR 100 Hz Typic [ $\Omega$ ]	Z F(1) +20°C max. [ $\Omega$ ]	II +20°C 5 min. max. [ $\mu$ A]	I ~ 100 Hz +85°C max. [A]	Code
	$\emptyset$ [mm]	L [mm]						
Rated voltage / Peak voltage: 385/420 V								
6,8	10	19	10	20	22	20	0,07	A 748382
10	10	25	10	10,5	13	27	0,11	A 748383
15	12	25	10	4,5	5,5	39	0,19	A 748384
22	14	30	10	3,5	3,5	55	0,25	A 749590
33	16	30	10	1,9	1,9	80	0,37	A 749591
47	18	30	10	1,7	2	113	0,42	A 749592
100	21	40	10	0,8	1,1	235	0,75	A 749593
150	25	40	10	0,7	0,9	351	0,88	A 749597
220	25	50	10	0,5	0,9	512	1,2	A 749598
330	25	75	10	0,4	0,8	766	1,5	A 749599
Rated voltage / Peak voltage: 450/500 V								
6,8	10	19	13	24	26	330	0,07	A 748402
10	12	25	8	4,7	5,7	400	0,18	A 748403
10	14	30	8	5,5	4,5	400	0,2	A 749606
15	12	30	8	4	5	490	0,22	A 748405
15	14	30	8	4	3,5	490	0,24	A 749607
22	14	30	8	3,5	3,5	600	0,25	A 749600
33	16	30	9	3	3	730	0,29	A 749601
47	18	30	8	1,8	1,8	870	0,4	A 749602
100	21	40	9	0,9	0,9	1300	0,71	A 749603
150	25	40	10	0,7	0,7	1600	0,88	A 749608
220	25	50	10	0,5	0,5	1900	1,2	A 749609
330	25	75	10	0,4	0,4	2350	1,5	A 749610
Rated voltage / Peak voltage: 550/605 V								
15	18	40	7	3,5	3,5	540	0,33	A 749620
22	21	40	7	2,3	2,3	660	0,44	A 749621
33	25	40	7	1,5	1,5	810	0,6	A 749623
Rated voltage / Peak voltage: 630/695 V								
15	18	40	20	11	9	780	0,19	A 749640
22	21	40	20	7,5	5,8	940	0,24	A 749641
33	25	40	20	5,1	5,3	1150	0,33	A 749643

## EXPECTED LIFE

as a function of temperature and ripple current  
For  $\emptyset = 6,5$  mm half life time values are applicable.



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

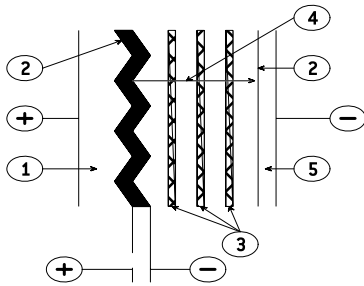
versus frequency  $f$  : $I \sim$  : permissible r.m.s. current at 100 Hz

f [Hz]	50	100	300	600	1 000	10 000	$\geq 50 000$
I	$0,8 \times I \sim$	$I \sim$	$1,2 \times I \sim$	$1,3 \times I \sim$	$1,35 \times I \sim$	$1,5 \times I \sim$	$1,6 \times I \sim$

# 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.

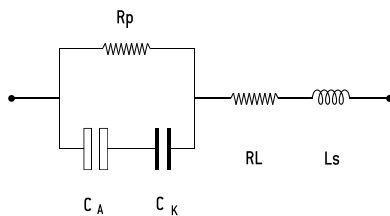
The negative plate is constituted by a second aluminum foil which serves as a current supply, and by electrolyte-impregnated papers layers.

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

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

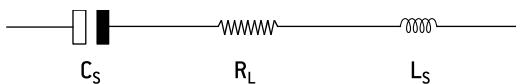
The aluminum used for the cathode is a  $\geq 98\%$  grade aluminum covered with a dielectric layer with a thickness of about  $40 \text{ \AA}$ .

## 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.

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

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

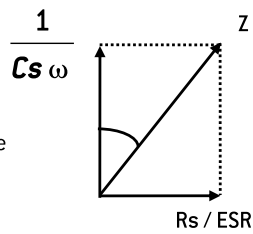
# General technical data

## 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

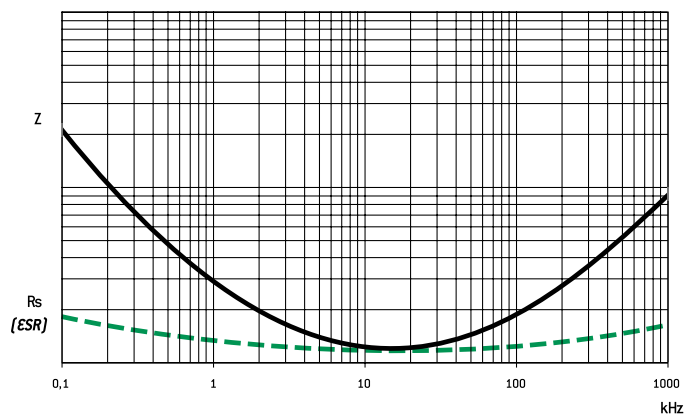
The relation between ESR and dissipation factor  $\text{Tan}\delta$  is given in § 4.4.

## 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  $\mu\text{F}$  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

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

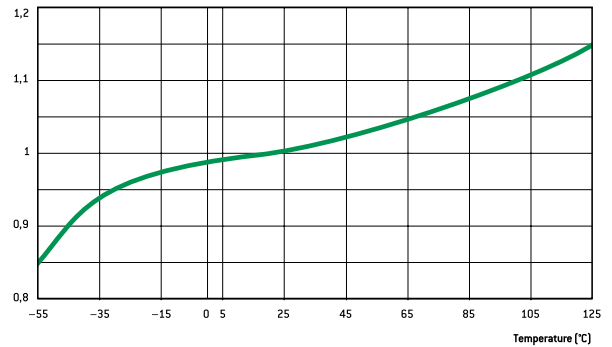
\* Whichever is the greater

## 4.9. CHARACTERISTICS

Versus temperature (typical values).

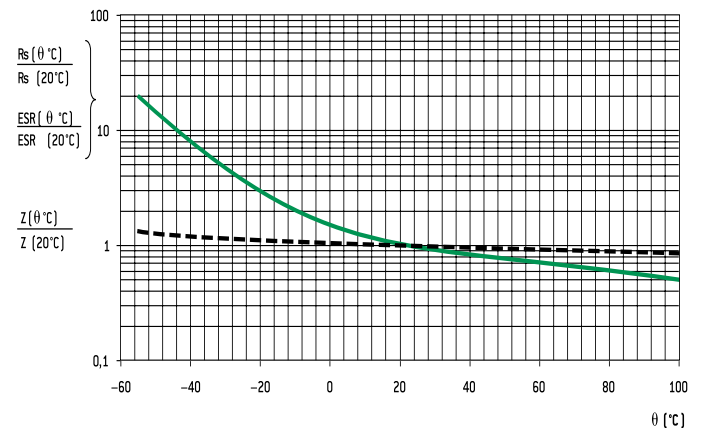
### 4.9.1. Capacitance drift

Versus temperature



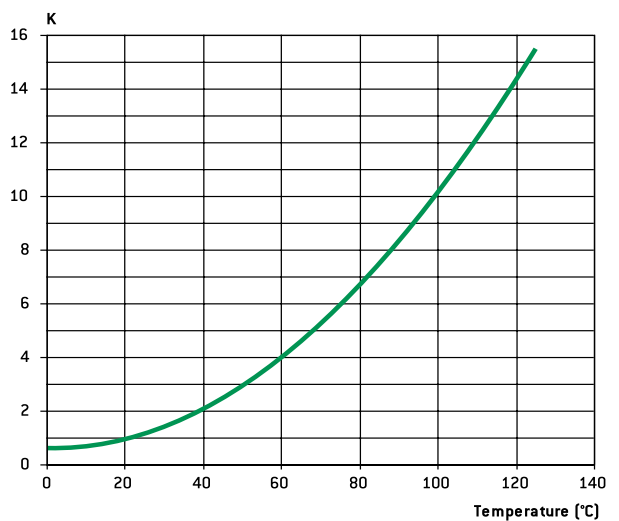
### 4.9.2. ESR and Z drifts at 100 Hz

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<sup>SIC SAFCO</sup> 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  $\Theta_i$  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 :

- $\Theta_i$  = Internal hot spot temperature
- $\Theta_a$  = Ambient temperature
- $\Theta_c$  = 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)

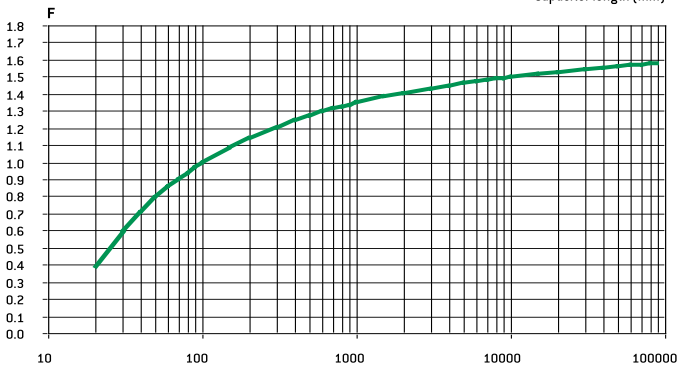
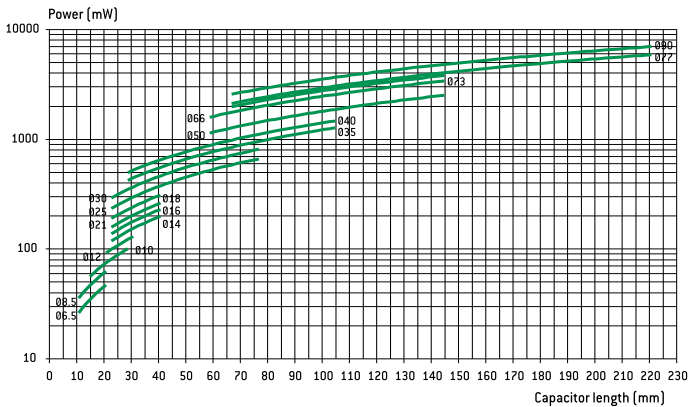
# General technical data

### 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)

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

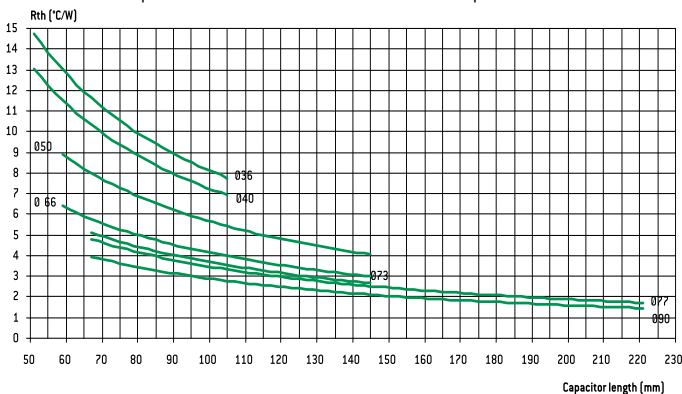
ESR : Equivalent series resistance (100 Hz 20°C)

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	$\geq 4$ 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.

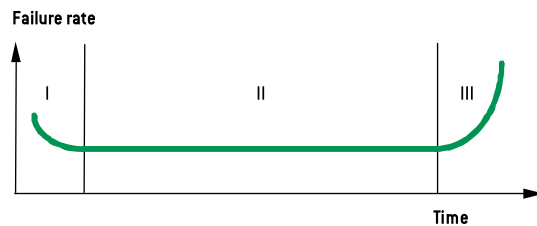
Guaranty is not applicable for damages occurred by surge voltage, irregular use, polarity inversion or maintenance default.

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

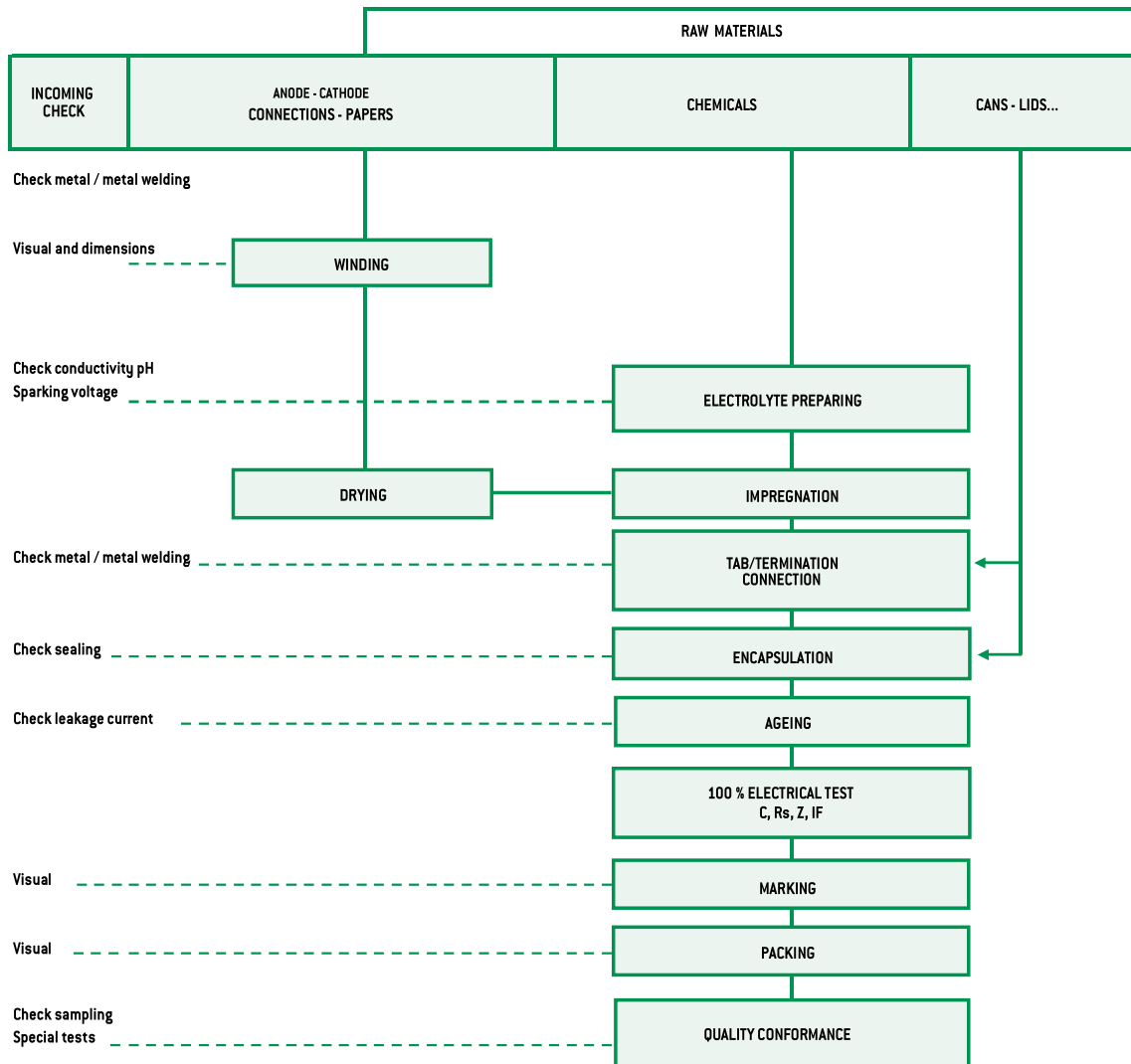
Factor	Percentage of rated voltage (2)		
	100 %	80 %	50 %
Factor	1	0,8	0,5

(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).

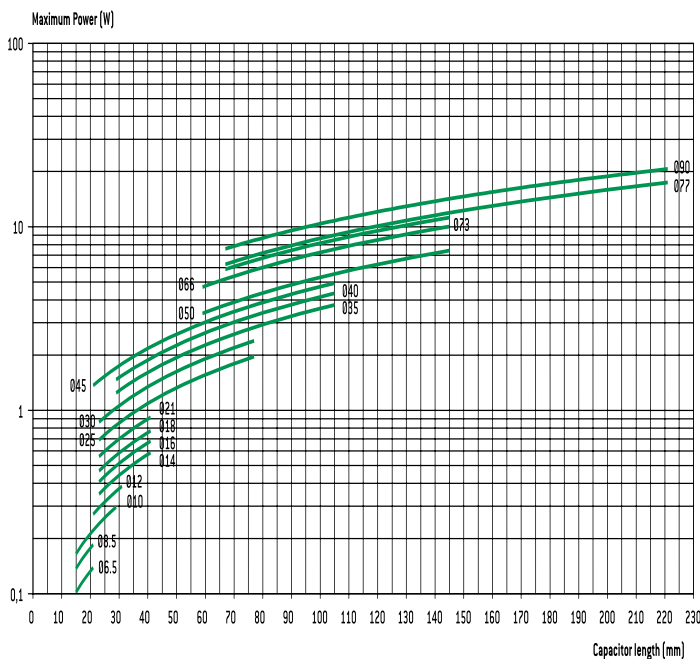
### 8.2. SHELF LIFE

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  $-5^{\circ}$  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 :



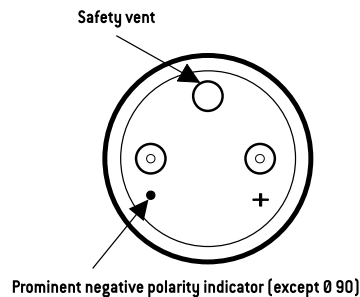
### 8.3. LOW PRESSURE RESISTANCE

EXXELIA<sup>SIC SAFCO</sup> 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<sup>SIC SAFCO</sup> capacitors are manufactured by EXXELIA<sup>SIC SAFCO</sup>. Main solvents are generally  $\gamma$  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<sup>SIC SAFCO</sup> 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<sup>SIC SAFCO</sup>, 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<sup>SIC SAFCO</sup> since 1991, can be scrapped or used in raw materials recycling processes with-out special care.

EXXELIA<sup>SIC SAFCO</sup> 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<sup>SIC SAFCO</sup> capacitors including every solder type, manufactured with pure tin coated pins or wires, since at least January 2006.

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

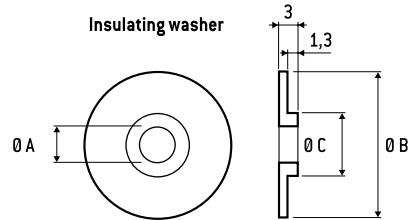
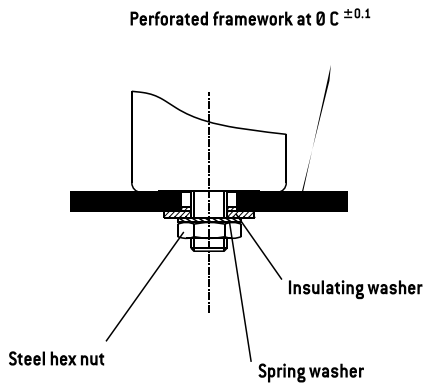
# Mounting and insulating parts

## STUD FIXING : FELSIC BD

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

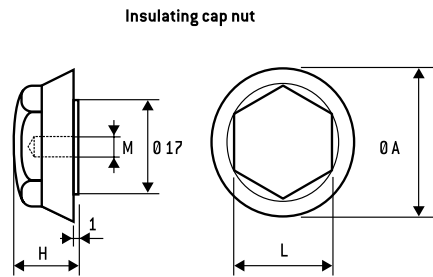
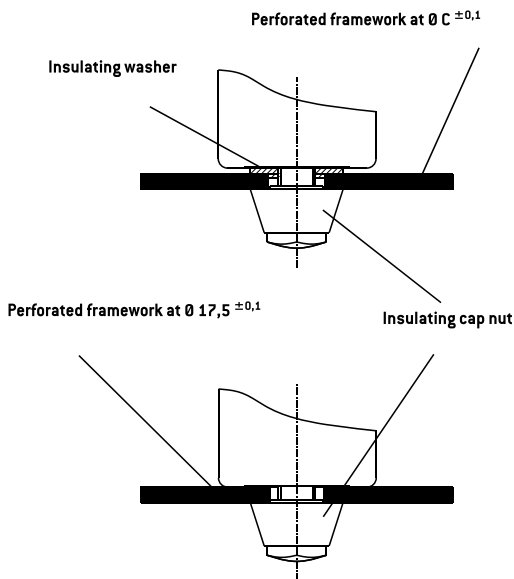
### STANDARD MOUNTING WITH :

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

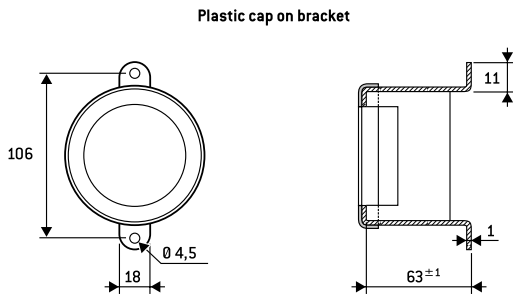


M	Dimension (mm)				Max. torque	Code
	Ø A	H	L			
8	25	15	17	3 Nm	A 691070	
12	30	20	19	7 Nm	A 691071	

## 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

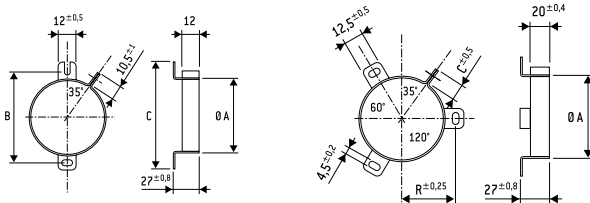
# General technical data

## 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

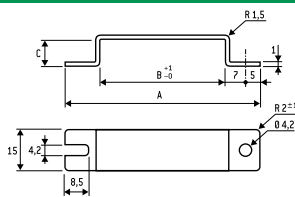
## Stirrup mounting : CUBISIC LP

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

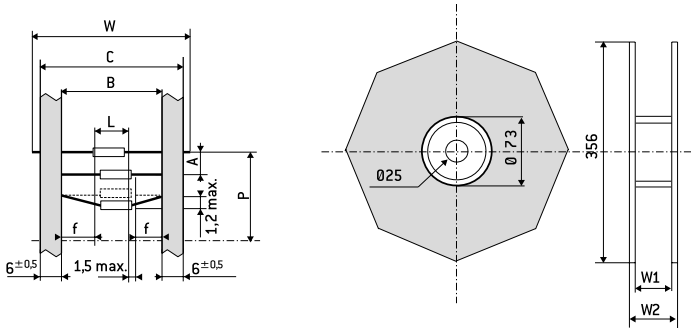
Possible variations of = ± 25 % according to different voltage and capacitance.

# General technical data

## 2. PACKAGING ON TAPE

### 2.1. Axial types

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



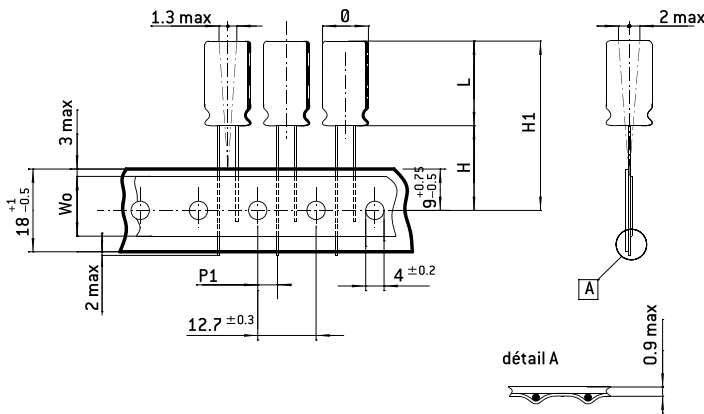
Dimensions									
D	L max.	B	A	P	C max.	W <sub>1</sub>	W <sub>2</sub> max.	W	n <sup>(2)</sup>
6,5	20	73±1,5	10±1,5	± 2	87,5	93	106	85±1,5	1000
8,5 <sup>(1)</sup>									750
10 <sup>(1)</sup>	32	73±1,5	15±1,5	± 3	87,5	93	106	85±1,5	400
12 <sup>(1)</sup>									400
14 <sup>(1)</sup>									200

- (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 <sub>1</sub> max.	W <sub>0</sub>	P <sub>1</sub>	H
10	16	46,5	13	3,85	19±1

Fan fold packaging (Ammopack)  
Number of capacitors : 1000

