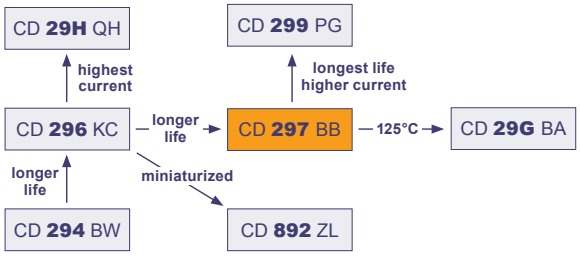
7 000h at 105°C

- Extended Lifetime at 105°C
- High Ripple Current
- High Professional Switch Mode Power Supplies
- Frequency Converters



Item	Characteristics	
Operating Temperature Range (°C)	-40 ~ +105	-25 ~ +105
Voltage Range (V)	10 ~ 100	160 ~ 500
Capacitance Range (µF)	47 ~ 56 000	
Capacitance Tolerance (20°C, 120Hz)	± 20%	
Leakage Current (µA)	After 5 minutes at 20°C application of rated voltage, leakage current is not more than 0,01CV or 1,5mA, whichever is smaller C: Nominal Capacitance (µF) V: Rated Voltage (V)	

Dissipation Factor (20°C, 120Hz)

Rated Voltage (V)	10	16	25	35	50	63	80	100	160~400	450~500
Tan δ (max)	0,55	0,50	0,45	0,40	0,35	0,30	0,25	0,20	0,15	0,20

Stability at Low Temperature (Impedance Ratio at 120Hz)

Rated Voltage (V)	10 ~ 100	160 ~ 250	315 ~ 500
$Z_{-25°C} / Z_{+20°C}$	4	3	8
$Z_{-40°C} / Z_{+20°C}$	15	-	-

	Useful Life		Load Life	Endurance Test	Shelf Life
Lifetime	**7 000h**	>200 000h	5 000h	5 000h	1 000h
Leakage Current	Not more than specified value		Not more than specified value	Not more than specified value	Not more than specified value
Capacitance Change	Within ± 30% of initial value		Within ± 20% of initial value	Within ± 20% of initial value	Within ± 20% of initial value
Dissipation Factor	Not more than 300% of specified value		Not more than 200% of specified value	Not more than 200% of specified value	Not more than 200% of specified value
Condition:					
Applied Voltage	U_R	U_R	U_R	U_R	U_R = 0
Applied Current	I_R	1,6 x I_R	I_R	I_R = 0	I_R = 0
Applied Temperature	105°C	40°C	105°C	105°C	105°C
Outlier Percentage	≤ 1%	≤ 1%	0%	IEC 60384	0%

After test: U_R to be applied for 30min >24h before measurement

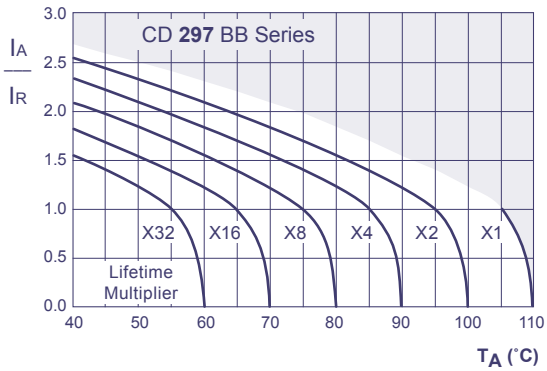
Multiplier for Ripple Current

Frequency Coefficient

Rated Voltage (V) \ Frequency	50Hz	120Hz	500Hz	1kHz	10kHz	≥50kHz
10 ~ 100	0,90	1,00	1,10	1,15	1,15	1,15
160 ~ 250	0,80	1,00	1,20	1,30	1,45	1,50
≥ 315	0,80	1,00	1,20	1,30	1,42	1,45

Multiplier for Lifetime

Lifetime Diagram



I_A = actual ripple current at 120Hz, I_R = rated ripple current at 120Hz, 105°C
Multiplier of Useful Life as a function of ambient temperature and ripple current load

Snap-In

Ratings for CD **297** BB Series

$U_{R.DC}$ (Surge Voltage) Code	Rated Capa-citance	Max ESR 20°C, 120Hz	Typ ESR 20°C, 120Hz	Max Ripple Current 105°C, 120Hz	Size Ø D x L
(V)	(µF)	(mΩ)	(mΩ)	(Arms)	(mm)
10 (13) 1A	8200	89	63	1,36	22 x 25
	10000	73	52	1,65	22 x 30
	12000	61	43	1,85	22 x 35
		61	43	1,82	25 x 25
	15000	49	35	2,12	22 x 40
		49	35	2,11	25 x 30
		49	35	2,14	30 x 25
	18000	41	29	2,40	22 x 45
		41	29	2,32	25 x 35
	22000	34	24	2,59	25 x 40
		34	24	2,73	30 x 30
	27000	27	19	3,01	25 x 45
		27	19	3,13	30 x 35
		27	19	3,05	35 x 30
	33000	23	16	3,43	25 x 50
		23	16	3,53	30 x 40
		23	16	3,49	35 x 35
	39000	19	14	3,78	30 x 45
		19	14	3,96	35 x 40
	47000	16	11	4,58	30 x 50
		16	11	4,60	35 x 45
	56000	14	10	5,06	35 x 50
16 (20) 1C	5600	119	83	1,44	22 x 25
	6800	98	69	1,66	22 x 30
	8200	81	57	1,67	25 x 25
	10000	67	47	2,08	22 x 35
		67	47	2,07	25 x 30
	12000	56	39	2,36	22 x 40
		56	39	2,37	25 x 35
		56	39	2,33	30 x 25
	15000	45	31	2,69	22 x 45
		45	31	2,72	25 x 40
		45	31	2,54	30 x 30
	18000	37	26	3,06	25 x 45
		37	26	3,02	30 x 35
		37	26	3,09	35 x 30
	22000	31	22	3,39	25 x 50
		31	22	3,46	30 x 40
	27000	25	18	3,88	30 x 45
		25	18	3,85	35 x 35
	33000	21	15	4,33	30 x 50
		21	15	4,33	35 x 40
	39000	18	12	4,96	35 x 45
	47000	15	10	5,49	35 x 50
25 (32) 1E	3900	154	108	1,31	22 x 25
	4700	127	89	1,55	22 x 30
	5600	107	75	1,77	22 x 35
		107	75	1,76	25 x 25
	6800	88	62	2,02	22 x 40
		88	62	1,88	25 x 30
	8200	73	51	2,27	22 x 45
		73	51	2,18	25 x 35
		73	51	2,19	30 x 25
	10000	60	42	2,56	22 x 50
		60	42	2,53	25 x 40
		60	42	2,38	30 x 30
	12000	50	35	2,79	25 x 45
		50	35	2,70	30 x 35
		50	35	2,76	35 x 30
	15000	40	28	3,13	30 x 40
	18000	34	24	3,52	30 x 45
		34	24	3,50	35 x 35
	22000	28	19	3,92	30 x 50
		28	19	3,95	35 x 40
	27000	23	16	4,72	35 x 50
35 (44) 1V	2700	197	138	1,29	22 x 25
	3300	161	113	1,54	22 x 30
	3900	137	96	1,77	22 x 35
		137	96	1,75	25 x 25
	4700	113	80	2,01	22 x 40
		113	80	1,97	25 x 30
	5600	95	67	2,25	22 x 45
		95	67	2,18	25 x 35
		95	67	2,08	30 x 25
	6800	79	55	2,49	22 x 50
		79	55	2,45	25 x 40
		79	55	2,28	30 x 30
	8200	65	46	2,80	25 x 45
		65	46	2,69	30 x 35
	10000	54	38	3,04	30 x 40
		54	38	2,78	35 x 30
	12000	45	31	3,38	30 x 45
		45	31	3,30	35 x 35
	15000	36	25	3,98	35 x 40
	18000	30	21	4,40	35 x 45
50 (63) 1H	1500	310	217	1,21	22 x 25
	2200	212	148	1,52	22 x 30
		212	148	1,46	25 x 25
	2700	172	121	1,77	22 x 35
		172	121	1,76	25 x 30
	3300	141	99	2,02	22 x 40
		141	99	1,92	30 x 25
	3900	120	84	2,27	22 x 45
		120	84	2,20	25 x 35
		120	84	2,19	30 x 30
	4700	99	70	2,43	25 x 40
	5600	83	59	2,72	25 x 45
		83	59	2,58	30 x 35
		83	59	2,35	35 x 30

$U_{R.DC}$ (Surge Voltage) Code	Rated Capa-citance	Max ESR 20°C, 120Hz	Typ ESR 20°C, 120Hz	Max Ripple Current 105°C, 120Hz	Size Ø D x L
(V)	(µF)	(mΩ)	(mΩ)	(Arms)	(mm)
50 (63) 1H	6800	69	48	3,01	30 x 40
		69	48	2,91	35 x 35
	8200	57	40	3,63	30 x 50
		57	40	3,36	35 x 40
	10000	47	33	3,79	35 x 45
	12000	39	28	4,06	35 x 50
63 (79) 1J	1000	398	279	1,10	22 x 25
	1500	266	186	1,41	22 x 30
		266	186	1,38	25 x 25
	1800	222	155	1,62	22 x 35
		222	155	1,63	25 x 30
	2200	181	127	1,85	22 x 40
		181	127	1,80	30 x 25
	2700	148	104	2,10	22 x 45
		148	104	2,03	25 x 35
		148	104	2,01	30 x 30
	3300	121	85	2,33	25 x 40
	3900	103	72	2,58	25 x 45
		103	72	2,46	30 x 35
		103	72	2,31	35 x 30
	4700	85	60	2,82	30 x 40
		85	60	2,77	35 x 35
	5600	72	50	3,22	30 x 45
		72	50	3,20	35 x 40
	6800	59	41	3,61	35 x 45
	8200	49	34	3,94	35 x 50
80 (100) 1K	820	405	284	1,09	22 x 25
	1000	332	233	1,29	22 x 30
	1200	277	194	1,48	22 x 35
		277	194	1,38	25 x 25
	1500	222	155	1,70	22 x 40
		222	155	1,74	25 x 30
		222	155	1,75	30 x 25
	1800	185	129	1,91	22 x 45
		185	129	1,86	25 x 35
	2200	151	106	2,22	25 x 45
		151	106	2,02	30 x 30
	2700	123	86	2,50	30 x 35
		123	86	2,45	35 x 30
	3300	101	71	2,69	30 x 40
		101	71	2,60	35 x 35
	3900	86	60	2,94	30 x 45
		86	60	3,00	35 x 40
	4700	71	50	3,44	35 x 45
	5600	60	42	3,72	35 x 50
100 (125) 2A	560	474	332	1,01	22 x 25
	680	391	274	1,19	22 x 30
	820	324	227	1,33	22 x 35
		324	227	1,26	25 x 25
	1000	266	186	1,56	22 x 40
		266	186	1,52	25 x 30
		266	186	1,47	30 x 25
	1200	222	155	1,76	22 x 45
		222	155	1,76	25 x 35
		222	155	1,76	30 x 30
	1500	177	124	2,00	22 x 50
		177	124	2,03	25 x 40
	1800	148	104	2,29	25 x 45
		148	104	2,19	30 x 35
		148	104	2,15	35 x 30
	2200	121	85	2,52	30 x 40
		121	85	2,48	35 x 35
	2700	99	69	2,86	30 x 45
		99	69	2,87	35 x 40
	3300	81	57	3,25	35 x 45
	3900	68	48	3,56	35 x 50
160 (200) 2C	220	905	634	0,63	22 x 25
	270	737	516	0,76	22 x 30
	330	603	423	0,90	22 x 35
		603	423	0,84	25 x 25
	390	511	358	0,97	25 x 30
		511	358	1,00	30 x 25
	470	424	297	1,11	22 x 40
		424	297	1,14	25 x 35
		424	297	1,17	30 x 30
	560	356	249	1,26	22 x 45
	680	293	205	1,44	22 x 50
		293	205	1,43	25 x 40
		293	205	1,50	30 x 35
	820	243	170	1,63	25 x 45
		243	170	1,66	30 x 40
		243	170	1,63	35 x 30
	1000	199	140	1,89	30 x 45
		199	140	1,89	35 x 35
	1200	166	117	2,16	30 x 50
		166	117	2,23	35 x 40
	1500	133	93	2,61	35 x 45
	1800	111	78	2,97	35 x 50

Customer specific products and adaptions on request.

Ratings for CD **297** BB Series

$U_{R.DC}$ (Surge Voltage) Code	Rated Capa-citance	Max ESR 20°C, 120Hz	Typ ESR 20°C, 120Hz	Max Ripple Current 105°C, 120Hz	Size Ø D x L
(V)	(µF)	(mΩ)	(mΩ)	(Arms)	(mm)
180 (225) 2K	220	905	634	0,63	22 x 25
	270	737	516	0,76	22 x 30
		737	516	0,76	25 x 25
	330	603	423	0,90	22 x 35
		603	423	0,90	25 x 30
	390	511	358	1,03	22 x 40
		511	358	1,06	25 x 35
		511	358	1,02	30 x 25
	470	424	297	1,17	22 x 45
		424	297	1,17	30 x 30
	560	356	249	1,32	22 x 50
		356	249	1,32	25 x 40
		356	249	1,33	30 x 35
	680	293	205	1,51	25 x 45
		293	205	1,49	35 x 30
	820	243	170	1,71	25 x 50
		243	170	1,74	30 x 40
		243	170	1,75	35 x 35
	1000	199	140	2,01	30 x 45
		199	140	2,07	35 x 40
	1200	166	117	2,25	30 x 50
		166	117	2,23	35 x 45
	1500	133	93	2,76	35 x 50
200 (250) 2D	180	1106	774	0,57	22 x 25
	220	905	634	0,70	22 x 30
	270	737	516	0,83	22 x 35
		737	516	0,76	25 x 25
	330	603	423	0,96	22 x 40
		603	423	0,90	25 x 30
	390	511	358	1,06	25 x 35
		511	358	1,02	30 x 25
	470	424	297	1,17	22 x 45
		424	297	1,22	25 x 40
		424	297	1,17	30 x 30
	560	356	249	1,39	25 x 45
		356	249	1,38	30 x 35
	680	293	205	1,58	25 x 50
		293	205	1,61	30 x 40
		293	205	1,49	35 x 30
	820	243	170	1,85	30 x 45
		243	170	1,75	35 x 35
	1000	199	140	2,11	30 x 50
		199	140	2,07	35 x 40
	1200	166	117	2,38	35 x 45
	1500	133	93	2,76	35 x 50
250 (300) 2E	150	1327	929	0,52	22 x 25
	180	1106	774	0,64	22 x 30
		1106	774	0,62	25 x 25
	220	905	634	0,76	22 x 35
		905	634	0,76	25 x 30
	270	737	516	0,88	22 x 40
		737	516	0,90	25 x 35
		737	516	0,85	30 x 25
	330	603	423	1,01	22 x 45
		603	423	1,00	30 x 30
	390	511	358	1,13	22 x 50
		511	358	1,13	25 x 40
		511	358	1,15	30 x 35
	470	424	297	1,29	25 x 45
		424	297	1,24	35 x 30
	560	356	249	1,45	25 x 50
		356	249	1,48	30 x 40
		356	249	1,49	35 x 35
	680	293	205	1,71	30 x 45
		293	205	1,74	35 x 40
	820	243	170	1,94	30 x 50
	1000	199	140	2,20	35 x 45
315 (365) 2F	68	3901	2731	0,32	22 x 25
	82	3235	2265	0,38	22 x 30
	100	2653	1857	0,41	25 x 25
	120	2211	1548	0,48	22 x 35
		2211	1548	0,49	25 x 30
	150	1769	1238	0,56	22 x 40
		1769	1238	0,51	30 x 25
	180	1474	1032	0,63	22 x 45
		1474	1032	0,62	25 x 35
		1474	1032	0,63	30 x 30
	220	1206	845	0,72	22 x 50
		1206	845	0,71	25 x 40
		1206	845	0,74	30 x 35
	270	983	688	0,81	25 x 45
		983	688	0,85	30 x 40
		983	688	0,82	35 x 30
	330	804	563	0,92	25 x 50
		804	563	0,90	35 x 35
	390	681	477	1,04	30 x 45
		681	477	1,05	35 x 40
	470	565	396	1,15	30 x 50
		565	396	1,18	35 x 45
	560	474	332	1,34	35 x 50

$U_{R.DC}$ (Surge Voltage) Code	Rated Capa-citance	Max ESR 20°C, 120Hz	Typ ESR 20°C, 120Hz	Max Ripple Current 105°C, 120Hz	Size Ø D x L
(V)	(µF)	(mΩ)	(mΩ)	(Arms)	(mm)
350 (400) 2V	68	3901	2731	0,34	22 x 25
	82	3235	2265	0,40	22 x 30
	100	2653	1857	0,47	25 x 25
	120	2211	1548	0,52	22 x 35
		2211	1548	0,53	25 x 30
		2211	1548	0,53	30 x 25
	150	1769	1238	0,59	22 x 40
		1769	1238	0,60	25 x 35
	180	1474	1032	0,68	22 x 45
		1474	1032	0,70	25 x 40
		1474	1032	0,71	30 x 30
	220	1206	845	0,78	22 x 50
		1206	845	0,82	25 x 45
		1206	845	0,82	30 x 35
	270	983	688	0,94	25 x 50
		983	688	0,93	30 x 40
		983	688	0,90	35 x 30
	330	804	563	1,05	30 x 45
		804	563	1,01	35 x 35
	390	681	477	1,18	30 x 50
		681	477	1,13	35 x 40
	470	565	396	1,26	35 x 45
	560	474	332	1,39	35 x 50
400 (450) 2G	68	3901	2731	0,38	22 x 30
	82	3235	2265	0,41	25 x 25
	100	2653	1857	0,46	22 x 35
		2653	1857	0,48	25 x 30
		2653	1857	0,48	30 x 25
	120	2211	1548	0,53	22 x 40
		2211	1548	0,55	25 x 35
		2211	1548	0,56	30 x 30
	150	1769	1238	0,63	22 x 50
		1769	1238	0,65	25 x 40
	180	1474	1032	0,72	25 x 45
		1474	1032	0,74	30 x 35
	220	1206	845	0,79	25 x 50
		1206	845	0,85	30 x 40
		1206	845	0,89	35 x 30
	270	983	688	0,98	30 x 45
		983	688	0,96	35 x 35
	330	804	563	1,12	30 x 50
		804	563	1,12	35 x 40
	390	681	477	1,27	35 x 45
	470	565	396	1,33	35 x 50
450 (500) 2W	68	3903	2732	0,38	22 x 30
	82	3237	2266	0,44	22 x 35
		3237	2266	0,45	25 x 30
		3237	2266	0,46	30 x 25
	100	2654	1858	0,50	22 x 40
		2654	1858	0,52	25 x 35
	120	2212	1548	0,58	22 x 50
		2212	1548	0,58	25 x 40
		2212	1548	0,58	30 x 30
	150	1769	1239	0,66	25 x 45
		1769	1239	0,68	30 x 35
	180	1474	1032	0,74	25 x 50
		1474	1032	0,77	30 x 40
		1474	1032	0,77	35 x 30
	220	1206	844	0,88	30 x 45
		1206	844	0,88	35 x 35
	270	983	688	0,99	30 x 50
		983	688	1,01	35 x 40
	330	804	563	1,15	35 x 45
	390	681	476	1,28	35 x 50
500 (550) 2H	47	5647	2823	0,41	22 x 30
	56	4739	2370	0,47	22 x 30
	68	3903	1951	0,54	22 x 35
		3903	1951	0,54	25 x 30
	82	3237	1618	0,62	22 x 40
		3237	1618	0,62	25 x 35
	100	2654	1327	0,67	22 x 45
		2654	1327	0,67	25 x 40
		2654	1327	0,67	30 x 30
	120	2212	1106	0,77	22 x 50
		2212	1106	0,74	25 x 40
		2212	1106	0,77	30 x 35
		2212	1106	0,8	35 x 30
	150	1769	885	0,82	25 x 45
		1769	885	0,85	30 x 40
		1769	885	0,67	35 x 30
		1769	885	0,85	35 x 35
	180	1474	737	0,98	25 x 50
		1474	737	1,01	30 x 45
	220	1206	603	1,12	30 x 50
		1206	603	0,94	35 x 35
		1206	603	1,12	35 x 40
	270	983	492	1,25	30 x 50
		983	492	1,25	35 x 40
	330	804	402	1,36	35 x 45
	390	681	340	1,54	35 x 50
	470	565	282	1,69	35 x 60

Snap-In

Customer specific products and adaptions on request.

Part Number System

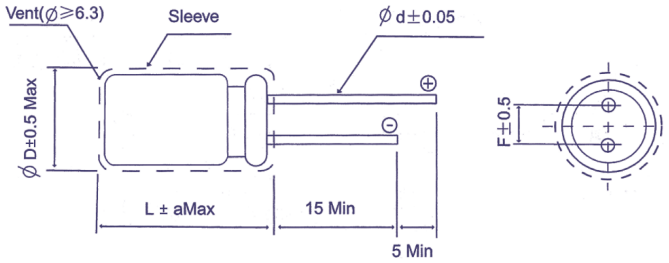
Order Code **SMD, Radial, Snap-In**

EC	R	1C	PT	101	M	FF	25	0611			JExxxxx
Technology	Terminal Type	Rated Voltage Code	Series Code	Capacitance Code (in µF)	Capacitance Tolerance	Lead Form	Terminal/ Pitch Size	Size Ø D x L	Material Code	Rubber Type	for Specials only
EC = Electrolytric Capacitor	SMD = V	2,5V = 0E	CD **110** = PT	0,47 = R47	**±20%** = M	SMD:		4x7 = 0407	- = Standard	- = Standard	
	Radial = R	4V = 0G	CD **11GL** = GL	1,0 = 010	±10% = K	**Taped** = **FF**	Terminal = T2	5x11,5 = 0511	V = PCV Sleeve	F = Flat Rubber	
PC = Polymer Capacitor	Snap-In = S	6,3V = 0J	CD **261** = LK	2,2 = 2R2	+20 / -0% = R	Radial:		6,3x11,5 = 0611	E = PET Sleeve	S = Stand-Off	
		10V = 1A	CD **261X** = QX	10 = 100	+20 / -10% = V	**Taped** = **FF**	2,0mm = 20	35x80 = 3580			
		16V = 1C	CD **262** = QM	100 = 101	+30 / -10% = Q	**Long Lead** = **LL**	2,5mm = 25	45x100 = 45100			
		20V = 1D	CD **263** = BK	1000 = 102	+50 / -10% = T	Cut 5,0mm = CB	3,5mm = 35				
		25V = 1E	CD **269** = PH	10000 = 103		**Cut 4,5mm** = **CC**	5,0mm = 50				
		35V = 1V	CD **269L** = HL			Cut 4,0mm = CD	7,5mm = 75				
		40V = 1G	CD **281** = LL			Cut 3,5mm = CE	10,0mm = 10				
		50V = 1H	CD **281L** = LH			Cut 3,0mm = CF	12,5mm = 12				
		63V = 1J	CD **287** = GC			on request: alternative lead forms (Keyed Polarity, axial, 90° - angle, others)					
		80V = 1K	CD **28L** = QL			**Snap-In:**					
		100V = 2A	CD **293** = BZ			4,0mm Pin Length = T/L4	2 Pin = P2				
		160V = 2C	CD **294** = BW			**6,3mm Pin Length** = **T/L6**	3 Pin = P3				
		180V = 2K	CD **295** = BC			Soldering Pin = S4	4 Pin = P4				
		200V = 2D	CD **296** = KC			on request: alternative pin types	5 Pin = P5				
		250V = 2E	CD **297** = BB								
		315V = 2F	CD **299** = PG								
		350V = 2V	CD **29D** = HR								
		385V = 2J	CD **29G** = BA								
		400V = 26	CD **29H** = QH								
		415V = 2P	CD **29L** = QL								
		420V = 2X	CD **29U** = CU								
		450V = 2W	CD **801** = ZP								
		500V = 2H	CD **804** = ZM								
		550V = 2Y	CD **811** = ZN								
		575V = 2Z	CD **840** = ZQ								
		600V = 2S	CD **891** = ZJ								
		630V = J2	CD **892** = ZL								
			CD **895** = ZK								
			Polymer on request								

preferred

Technical Specification **Radial Type**

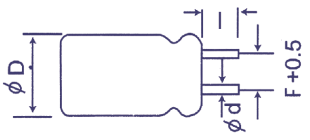
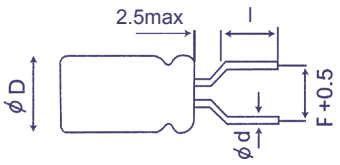
Dimensions for loose, long-lead type (bulk)
Order Code: LL



L	L ≤ 7					L ≥ 11									
Ø D	3	4	5	6,3	8	5	6,3	8	10	12,5	16	18	20	22	25
F	1	1,5	2,0	2,5	3,5	2,0	2,5	3,5	5,0		7,5		10,0		12,5
Ø d	0,4	0,45				0,5		0,6			0,8		1,0		
a_{Max}	1,0					2,0							2,5		

For diameter 20 pitch 7,5 on request. in mm

Dimensions for loose, short cut leads (bulk)
Order Code: CC (CB, CD, CE, CF)

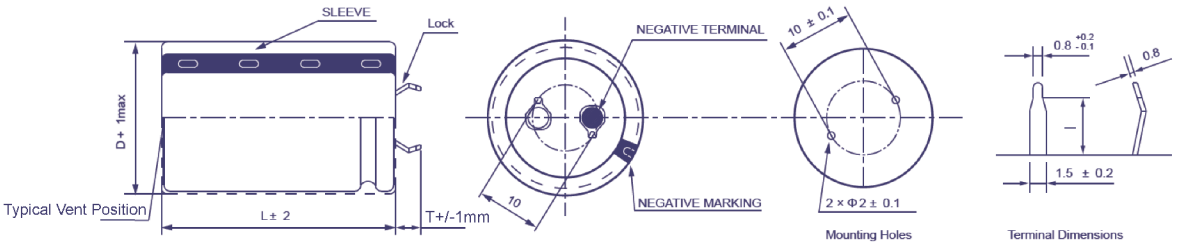
Straight Lead	Bended Lead
	

Code	CB	CC	CD	CE	CF
l	5,0 ± 0,5	**4,5 ± 0,5**	4,0 ± 0,5	3,5 ± 0,5	3,0 ± 0,5

preferred in mm

Technical Specification **Snap-In Type**

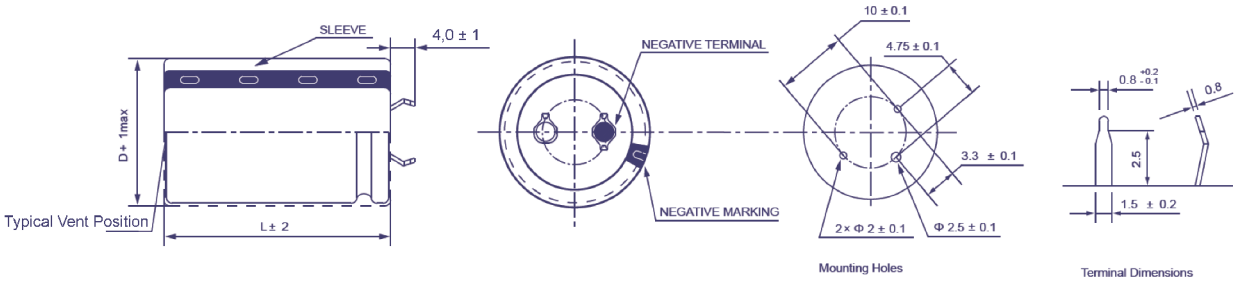
2 Pin Type: T6P2 / T4P2 Standard



Standard Version: Self-Lock Terminal.
Other terminal types and styles on request.
For diameter øD ≥ 45 mm the safety vent is typically placed at the side of the housing.

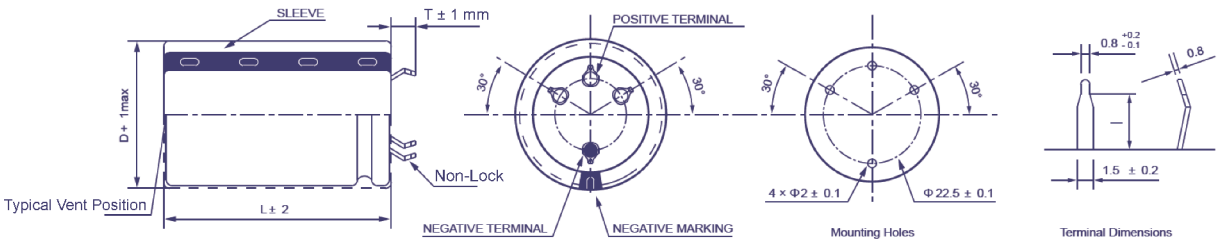
Terminal	**T6**	T4
Pin Length T	**6,3 mm** preferred	4,0 mm
Pin Detail I	**3,5 mm** preferred	2,5 mm

3 Pin Type: T4P3



For diameter øD ≥ 45 mm the safety vent is typically placed at the side of the housing.

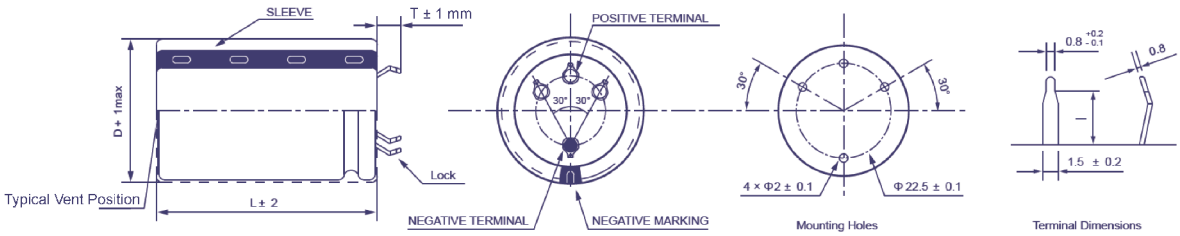
4 Pin Type: T6P4 / T4P4 Standard



Standard Version: Non-Lock Terminal
For øD ≥ 30 mm only.
Other terminal types and styles on request.
For diameter øD ≥ 45 mm the safety vent is typically placed at the side of the housing.

Terminal	**T6**	T4
Pin Length T	**6,3 mm** preferred	4,0 mm
Pin Detail I	**3,5 mm** preferred	2,5 mm

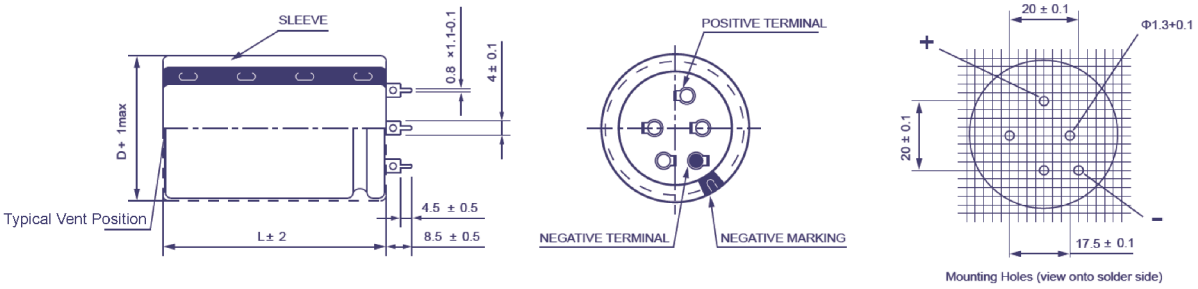
4 Pin Type: L6P4 / L4P4 Self-Lock Terminal



For øD ≥ 30 mm only.
Other terminal types and styles on request.
For Diameter øD ≥ 45 mm the safety vent is typically placed at the side of the housing.

Terminal	**L6**	L4
Pin Length T	**6,3 mm** preferred	4,0 mm
Pin Detail l	**3,5 mm** preferred	2,5 mm

5 Pin Type: S4P5 Soldering Pin



For øD ≥ 30 mm only.
For diameter øD ≥ 45 mm the safety vent is typically placed at the side of the housing.

Lifetime Estimation of Aluminum Electrolytic Capacitors from Jianghai

To estimate the Lifetime of a non-solid Aluminum Electrolytic Capacitor from **Jianghai**, the following formulas can be utilized. The Lifetime depends mainly on the ambient temperature, the ripple current and, within certain limits, the operating voltage applied. Other parameters may also affect the Lifetime. Moreover, L_0 can be interpreted in many different ways, which has a fundamental influence on the numerical result. **Jianghai** offers a high transparency by publishing the different typical definitions of Lifetimes in each datasheet. Lifetime estimations are approximations by nature.

Please let **JIANGHAI EUROPE** confirm any result before using it. The formulas given here do not constitute part of a contract nor of a specification. The formulas do not cover additional aging effects of certain electrolytic systems or other chemical effects. Please contact us should you need Lifetime estimates for Solid Electrolyte Polymer Capacitors. Also the dimensions of the components may have an effect. Forced cooling or other additional cooling-methods have a strong impact on the Lifetime and are not covered by the formulas.

For the estimation and interpretation of Lifetime, a close collaboration with **JIANGHAI EUROPE** is strongly advised.

Structural formula:

$$L = L_0 \cdot K_T \cdot K_R \cdot K_V$$

Where:

L	Total Lifetime
L_0	Lifetime under Rated Ripple Current at Upper Category Temperature (see catalogue)
K_T	Temperature Factor
K_R	Ripple Current Factor
K_V	Voltage Factor

1. K_T **Temperature Factor:**
Aluminum Electrolytic Capacitors follow roughly the 10 K rule of Arrhenius. It is possible to estimate the Lifetime by rule of thumb: When the operational temperature is reduced by 10 K, the Lifetime will double. The formula for K_T in detail is:

$$K_T = 2^{\frac{T_0 - T_A}{10K}}$$

Where:

T_0	Rated Temperature
T_A	Ambient Temperature, Upper Category Temperature

2. K_R **Ripple Current Factor:** The influence of ripple current on Lifetime can be estimated according to the following formula:

$$K_R = K_i^{A\frac{\Delta T_0}{10K}}$$

With:

$$A = 1 - \left(\frac{I_A}{I_R}\right)^2$$

Where:

I_A	Actual Rated Ripple Current
I_R	Ripple Current at Upper Category Temperature (databook value)
ΔT_0	Core Temperature Rise of the capacitor (typically 5K for T_0 = 105°C and 10K for T_0 = 85°C)
K_i	Basis, defined as

T_0 = 105°C: $I_A > I_R$: $K_i = 4$; $I_A \leq I_R$: $K_i = 2$

T_0 = 85°C: $K_i = 2$

Assistance needed? Please contact JIANGHAI EUROPE GmbH +49 (0) 2151 652088-72 or info@jianghai-europe.com

3. K_V **Voltage Factor:** For Radial Electrolytic Capacitors, this part of the formula has no impact ($K_V = 1$). But for some bigger capacitors like Snap-In and Screw-Terminal types with rated voltages above 350V, the operating voltage will affect their Lifetime. It is expressed as follows:

$$K_V = \left(\frac{U_A}{U_R}\right)^{-n}$$

Where:

U_R Rated Voltage
U_A Actual Operating Voltage
n Exponent, defined as:

$$0{,}5 \leq \frac{U_A}{U_R} \leq 1 \quad \rightarrow n = 2{,}5$$

$$0 < \frac{U_A}{U_R} < 0{,}5 \quad \rightarrow n = 0$$

4. **Frequency Correction Factors:** If the actual Ripple Currents are not given at the same frequency like I_0, weighing factors need to be applied.

$$I_A = \sqrt{\left(\frac{I_{f1}}{F_{f1}}\right)^2 + \left(\frac{I_{f2}}{F_{f2}}\right)^2 + \cdots \left(\frac{I_{fn}}{F_{fn}}\right)^2}$$

I_A Actual Rated Ripple Current (normalized)
$I_{f1} \ldots I_{fn}$ Ripple Currents at different frequencies
$F_{f1} \ldots F_{fn}$ Frequency Correction Factors for different frequencies

5. **JIANGHAI Electrolytic Capacitor Lifetime Estimation Formula**

$$L = L_0 \cdot K_T \cdot K_R \cdot K_V$$

$$= L_0 \cdot 2^{\frac{T_0 - T_A}{10K}} \cdot K_i^{\left[1-\left(\frac{I_A}{I_R}\right)^2\right] \cdot \frac{\Delta T_0}{10K}} \cdot \left(\frac{U_A}{U_R}\right)^{-n}$$

$T_0 = 105°C$ $I_A > I_R \rightarrow K_i = 4$
$I_A \leq I_R \rightarrow K_i = 2$
$T_0 = 85°C$ $\rightarrow K_i = 2$

$$0{,}5 \leq \frac{U_A}{U_R} \leq 1 \quad \rightarrow n = 2{,}5$$

$$0 < \frac{U_A}{U_R} < 0{,}5 \quad \rightarrow n = 0$$

Jianghai Electrolytic Capacitors

Warranty: The information contained in this catalogue does not form part of any quotation or contract, is believed to be accurate, reliable and up to date. Quality data are based on the statistical evaluations of a large quantity of parts and do not constitute a guarantee in a legal sense. However, agreement on these specifications does not mean that the customer may not claim for replacement of individual defective capacitors within the terms of delivery. We cannot assume any liability beyond the replacement of defective components. This applies in particular to any further consequences of component failure. Furthermore it must be taken into consideration that the figures stated for lifetime, failure rates and outlier percentages refer to the average production status and are therefore to be understood as mean values (statistic expectations) for a large number of delivery lots of identical capacitors. These figures are based on application experience and data obtained from preceding tests under normal conditions, or – for purpose of accelerated aging – more severe conditions. JIANGHAI reserves the right to change these specifications without prior notice. Any application information given is advisory and does not form part of any specification. The products are not primarily designed for use in life support applications, devices or systems where malfunction of these products can reasonably be expected to result in personal injury. JIANGHAI customers using or selling these products for use in such applications without prior written consent of JIANGHAI do so at their own risk and agree fully to indemnify JIANGHAI for any damage resulting from such improper use or sale. This version of the catalogue supersedes all previous versions. Latest versions of datasheets can be found on our homepage: www.jianghai-europe.com

For more details on precautions and guidelines for aluminum electrolytic capacitors, please refer to CENELEC Technical Report CLC/TR 50454:2008 E, “Guide for the application of aluminum electrolytic capacitors”.

Polarity: Electrolytic capacitors are polar and shall never be used with incorrect polarity, as there is a possible danger of shorting or destruction.

Rated Voltage Ur: The Rated Voltage is marked on the capacitor and defined in the datasheets as Ur. This voltage should never be exceeded and is the maximum peak voltage including any ripple voltages allowed to avoid a shortening of the lifetime or damage of the capacitor. When a ripple current is applied to the capacitor, the sum of the peak ripple voltage and bias DC voltage shall never exceed the Rated Voltage. It might be necessary to lower the maximum allowed bias DC voltage, when certain ripple currents are applied to the capacitor.

Surge Voltage: Maximum Voltage, which may be applied to the capacitor for short periods of time: max. 1000 cycles of 30 sec. per 6 min., max. 5 pulses per hour. Capacitance drift +/- 15% max.

Reverse Voltage: Reverse voltages or voltages < 0 V are not allowed.

Recovery Voltage: After charging and discharging a capacitor there might still be a voltage between the terminals, which is built up internally due to dielectric absorption. Please take action that this load does not damage other devices or scare the workers during production (sparks possible).

Temperature Range: Use electrolytic capacitors only within the specified operating temperature range.

Over-Current: Currents exceeding the rated ripple currents should be avoided.

Ripple Current/Voltage: The combined value of DC voltage and peak AC voltage (due to ripple current) shall not exceed the rated voltage and shall never be < 0 V. Use of aluminum electrolytic capacitors under ripple current with wide amplitudes is equivalent to quick charge-discharge operation.

Rapid Charging/Discharging: Rapid Charging/Discharging generates severe heat and gas may be emitted which may lead to explosion. Consult JIANGHAI about specially designed capacitors suitable for such kind of applications.

Balancing resistors: Balancing resistors should be utilized if capacitors are used in serial connection. Please choose low-tolerance resistors to limit voltage drift.

Charge-Discharge Proof: JIANGHAI capacitors are charge-discharge proof, which means that 10^6 switching cycles will cause capacitance reduction of less than 10%.

Lifetime: There are many different lifetime definitions known without any true standard definition. Take special care when capacitors are compared that the capacitors fulfill the needed requirements. JIANGHAI publishes all conditions to be as transparent as possible. In the case of lifetime tests with additional ripple currents, the bias DC voltage must be reduced, so that the sum of bias DC voltage and the peak of the ripple voltage does not exceed the Rated Voltage Ur.

- **Load Life:** Period of time, during which the technical parameters of all capacitors stay within the given limits. JIANGHAI defines this without allowing for outliers.
- **Useful Life:** defined like load life, but a given percentage of components may be outside the defined limits. Useful life data are usually calculated within a confidence level of 60%. See further details in specifications and data sheets. Outlier percentage: ≤ 1%.
- **Endurance Test:** IEC 60384-4 defines the acceptable drift criteria of electrical parameters after the endurance tests (continuous voltage test).
- **Shelf Life:** Definition of time with acceptable drift of capacitor parameters after storage at upper category temperature without load. JIS-C-5102-1994

Vibration and mechanical stress: Capacitors are sensitive to vibration and mechanical forces applied on the leads. Do not use capacitors, which have been dropped onto a rigid surface.

Insulation: If any defect of the sleeve is visible, the component should not be used – same for any kind of visible damage. A capacitor should be electrically isolated from the following parts: Aluminum case, cathode lead wire, anode lead wire and circuit pattern, and auxiliary terminal of snap-in type. The PVC sleeve is not recognized as an isolator and therefore the standard capacitor should not be used in a place where insulation function is needed. Please contact JIANGHAI if higher grade of insulation is required.

Environmental Conditions:
- Avoid direct contact with water, salt solution, oil, dewing conditions
- Halogens generally, especially fumigation treatment with bromides and flame retardent agents containing halogens must be avoided.
- Avoid exposing to direct sunshine, ozone, ultraviolet rays and x-ray radiation.
- Air Pressure: Max. 150kPa, min. 8kPa.
- No heavy air pressure changes are allowed.
- Do not use or store in an environment containing any hazardous gas (e.g., hydrogen sulphide, sulphurous acid, nitrous acid, chlorine, ammonia, bromine, methyl bromide, other halogens) or acidic or alkaline solutions.

Storage:
- Temperature 5 to 30°C, Humidity below 75%.
- Electrolytic capacitors may accumulate charge naturally during storage. In this case discharge through a 1kOhm resistor before use (Recovery Voltage).
- Leakage current may be increased after long storage time. In this case the capacitor should be subjected to the rated voltage treatment through a 1kOhm resistor before use for 1 hour, then it should be discharged through a resistor of about 1 Ohm/Volt.
- Storage times above 1 year should be avoided or rated voltage treatment may be necessary.
- In accordance to IEC 60384-4 electrolytic capacitors are subject to a reforming process before acceptance testing. Rated voltage is applied via a series resistance (100Ω: Ur ≤ 100VDC, 1kΩ: Ur > 100VDC).

Soldering: Soldering conditions (temperature, times) should be within specified conditions, especially for SMD components. Avoid high soldering temperatures as this may reduce lifetime or damage the capacitor. Do never dip the capacitor body into molten solder. Flux should not be adhered to the capacitor’s body but only to its terminals.
For details and different methods please contact us.

Cleaning and Coating: Do not use fixing agents or cleaning substances containing halogens and the epoxy resin coating materials. Also never use solvents containing: Halogenated hydrocarbons, alkali, petroleum, trichloroethylene/-ethane, xylene, acetones, trichlorotrifluoroethane, tetrachloroethylene, methylenechloride, chloroform, acetates, ketones, esters, chlorides and bromides. In case of questions see detailed instructions.

Mounting: Other devices, which are mounted near the capacitor, should not touch the capacitor. Additional heat coming from other components near the capacitor may reduce the lifetime of the capacitor. Do never bend or twist the capacitor after soldering to avoid stress on the leads. Radial capacitors are not protected against mechanical forces on the leads. Forces on the pins might damage the capacitor. No printed circuit board tracks are allowed between the lead pads of the capacitor. Screw Terminal capacitors should only be mounted in an upright position.

Transport: Avoid fumigation and spraying insecticides (especially with bromides) in the import or export procedures which can cause corrosion. This applies also to the finished devices.

Maintenance: Periodical inspection should be carried out for the capacitor: visual inspection to check pressure relief open or leakage of electrolyte, electrical characteristics as leakage current, capacitance, and dissipation factor.

Electrolyte and Separator paper: Electrolyte and separator paper used in Aluminum Capacitors may be flammable. Also electrolyte is electrically conductive. Therefore in case electrolyte gets in contact with PC board it may cause corrosion of circuit pattern or cause short circuit between patterns, and may lead to smoke generation or ignition in worst case.

Caution during Use of Capacitors: Do not touch the terminals of capacitors. Keep the capacitor free from conductive solution, such as acids, alkali and so on. Ensure that the operating environment of the equipment into which the capacitor has been built is within the specified conditions mentioned in the catalogue or specification sheets.

Safety Vent: The safety vent needs some free space to open properly. Allow for free headroom of at least 2mm for diameter ≤16mm, more than 3mm for diameter 18-35mm, more than 5mm for case diameter 40mm and larger.

Emergency Actions: When the pressure relief vent is open and some gas blows out from the capacitor, please turn the main switch of the equipment off or pull out the plug from the power outlet immediately. During safety vent operation, extremely hot gas (>100°C) may blow out of the capacitors. Do not stand close to the capacitors. In case of eye contact, rinse the open eye(s) with clean water immediately. In case of ingestion, gargle with water immediately, do not swallow. Do not touch electrolyte but wash skin with soap and water in case of skin contact.

Definition of electrical parameters: Separate documents as application notes, equivalent circuit diagrams and so on are available on request.

Packaging: Please refer to the data book for details. Further information is available on request.

Jianghai Europe Electronic Components GmbH

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