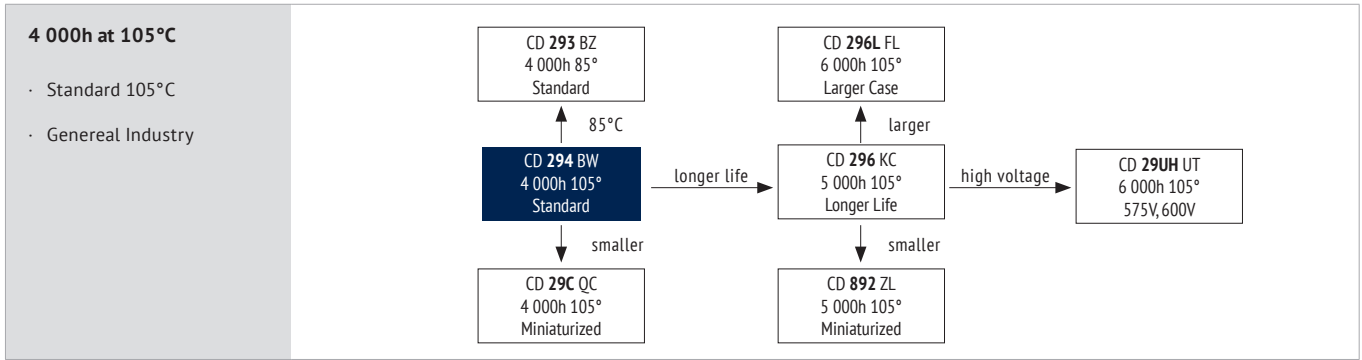


ALUMINUM ELECTROLYTIC CAPACITORS · SNAP-IN TYPE

# CD 294 BW SERIES



**ITEM CHARACTERISTICS**

Operating Temperature Range (°C)	-40 ~ +105	-25 ~ +105
Voltage Range (V)	16 ~ 100	160 ~ 550
Capacitance Range (µF)	39 ~ 47 000	
Capacitance Tolerance (20°C, 120Hz)	± 20%	

**!** The usage at lower temperatures than indicated may be possible. Please contact the Jianghai Europe sales office for approval.

Leakage Current: After 5 minutes at 20°C application of rated voltage, leakage current is not more than specified in table.

Stability at Low Temperature (Impedance Ratio at 120Hz)	Rated Voltage (V)	16 ~ 100	160 ~ 200	250 ~ 550
	$Z_{-25°C} / Z_{+20°C}$	4		
	$Z_{-40°C} / Z_{+20°C}$	15	-	

Fast Charge-Discharge: **!** Please contact Jianghai for an appropriate choice of the capacitor or possible technical adaptations, esp. for applications like: Welding, Photoflash, Servo motors, X-Ray

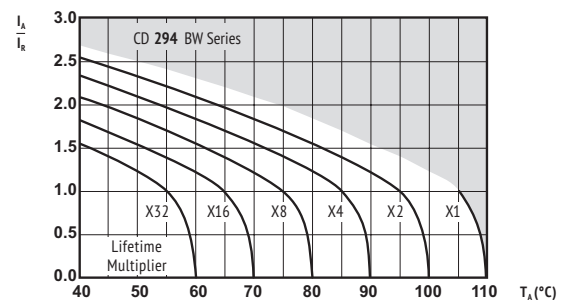
ITEM	USEFUL LIFE		LOAD LIFE	ENDURANCE TEST	SHELF LIFE	
Lifetime	4 000h	> 180 000h	2 000h	3 000h	1 000h	
Leakage Current	Not more than specified value		Not more than specified value	Not more than specified value	Not more than specified value	
Capacitance Change	Within ± 30% of initial value		Within ± 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:	$U_R$	$U_R$	$U_R$	$U_R$	$U_R = 0$	After test:
Applied Voltage	$I_R$	$1,4 \times I_R$	$I_R$	$I_R = 0$	$I_R = 0$	$U_R$ to be applied
Applied Current	105°C	40°C	105°C	105°C	105°C	for 30 min > 24h
Applied Temperature				IEC 60384		before measurement

**MULTIPLIER FOR RIPPLE CURRENT (FREQUENCY COEFFICIENT)**

Frequency \ Rated Voltage (V)	50Hz	120Hz	300Hz	1kHz	10kHz	≥ 50 kHz
≤ 100	0,95	1,00	1,07	1,13	1,19	1,20
160 ~ 250	0,87	1,00	1,17	1,32	1,45	1,50
≥ 315	0,80	1,00	1,16	1,30	1,41	1,43

Multipliers for typical operating conditions.

**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 & ripple current load

**!** Max. Current Snap-In Terminal: 15A. For more current use Lug-Terminals.

**ENVIRONMENTAL**

The products are RoHS, WEEE and REAcH compliant. The detailed version please see separate "Environmental Certificates" document or [www.jianghai-europe.com](http://www.jianghai-europe.com)

**! SAFETY FACTOR**

This diagram includes a safety margin. In many cases the allowed current capability/lifetime may be increased. For details and approvals please contact the Jianghai Europe sales office.



U <sub>RDC</sub> (Surge Voltage) Code	C <sub>R</sub> Rated Capacitance	ESR <sub>max</sub> Equivalent Series Resistance 20°C 120Hz	ESR <sub>typ</sub> Equivalent Series Resistance 20°C 120Hz	tanδ Dissipation Factor	I <sub>leak</sub> Leakage Current	I <sub>RAC</sub> Rated Ripple Current 105°C 120Hz	Size øD x L (mm)	ORDER CODE ◇ = pin style & length △ = pin number Details: Page 6
(V)	(µF)	(mΩ)	(mΩ)		(mA)	(Arms)	(mm)	
<b>16 (20) 1C</b>	12 000	56	39	0,50	1,5	2,30	25x30	ECS1CBW123M◇△△2530
	15 000	45	31	0,50	1,5	2,68	25x35	ECS1CBW153M◇△△2535
		37	26	0,50	1,5	3,04	25x40	ECS1CBW183M◇△△2540
	18 000	37	26	0,50	1,5	3,00	30x30	ECS1CBW183M◇△△3030
		31	21	0,50	1,5	3,40	25x45	ECS1CBW223M◇△△2545
	22 000	31	21	0,50	1,5	3,39	30x35	ECS1CBW223M◇△△3035
		25	17	0,50	1,5	3,83	30x40	ECS1CBW273M◇△△3040
	27 000	25	17	0,50	1,5	3,74	35x30	ECS1CBW273M◇△△3530
		21	14	0,50	1,5	4,30	30x45	ECS1CBW333M◇△△3045
	33 000	21	14	0,50	1,5	4,24	35x35	ECS1CBW333M◇△△3535
39 000		18	12	0,50	1,5	4,74	30x50	ECS1CBW393M◇△△3050
		18	12	0,50	1,5	4,72	35x40	ECS1CBW393M◇△△3540
47 000	15	10	0,50	1,5	5,27	35x45	ECS1CBW473M◇△△3545	
<b>25 (32) 1E</b>	8 200	65	45	0,40	1,5	2,16	25x30	ECS1EBW822M◇△△2530
	10 000	54	37	0,40	1,5	2,44	25x35	ECS1EBW103M◇△△2535
		45	31	0,40	1,5	2,74	25x40	ECS1EBW123M◇△△2540
	12 000	45	31	0,40	1,5	2,70	30x30	ECS1EBW123M◇△△3030
		36	25	0,40	1,5	3,15	25x45	ECS1EBW153M◇△△2545
	15 000	36	25	0,40	1,5	3,13	30x35	ECS1EBW153M◇△△3035
		30	21	0,40	1,5	3,54	25x50	ECS1EBW183M◇△△2550
	18 000	30	21	0,40	1,5	3,54	30x40	ECS1EBW183M◇△△3040
		25	17	0,40	1,5	4,24	30x45	ECS1EBW223M◇△△3045
	22 000	25	17	0,40	1,5	3,96	35x35	ECS1EBW223M◇△△3535
27 000		20	14	0,40	1,5	4,75	35x45	ECS1EBW273M◇△△3545
33 000	17	11	0,40	1,5	5,39	35x50	ECS1EBW333M◇△△3550	
<b>35 (44) 1V</b>	5 600	83	58	0,35	1,5	2,04	25x30	ECS1VBW562M◇△△2530
	6 800	69	48	0,35	1,5	2,31	25x35	ECS1VBW682M◇△△2535
		57	40	0,35	1,5	2,60	25x40	ECS1VBW822M◇△△2540
	8 200	57	40	0,35	1,5	2,56	30x30	ECS1VBW822M◇△△3030
		47	33	0,35	1,5	2,92	25x45	ECS1VBW103M◇△△2545
	10 000	47	33	0,35	1,5	2,92	30x35	ECS1VBW103M◇△△3035
		39	27	0,35	1,5	3,28	30x40	ECS1VBW123M◇△△3040
	12 000	39	27	0,35	1,5	3,20	35x30	ECS1VBW123M◇△△3530
		31	22	0,35	1,5	3,74	30x45	ECS1VBW153M◇△△3045
	15 000	31	22	0,35	1,5	3,69	35x35	ECS1VBW153M◇△△3535
18 000		26	18	0,35	1,5	4,16	35x40	ECS1VBW183M◇△△3540
22 000	22	15	0,35	1,5	4,92	35x50	ECS1VBW223M◇△△3550	
<b>50 (63) 1H</b>	3 300	121	84	0,30	1,5	2,00	25x25	ECS1HBW332M◇△△2525
	3 900	103	72	0,30	1,5	2,28	25x30	ECS1HBW392M◇△△2530
		85	59	0,30	1,5	2,58	25x30	ECS1HBW472M◇△△2530
	5 600	72	50	0,30	1,5	2,81	25x35	ECS1HBW562M◇△△2535
		59	41	0,30	1,5	3,37	25x40	ECS1HBW682M◇△△2540
	6 800	59	41	0,30	1,5	3,39	30x35	ECS1HBW682M◇△△3035
		49	34	0,30	1,5	3,71	30x40	ECS1HBW822M◇△△3040
	8 200	49	34	0,30	1,5	3,66	35x35	ECS1HBW822M◇△△3535
		40	28	0,30	1,5	4,09	30x45	ECS1HBW103M◇△△3045
	10 000	40	28	0,30	1,5	4,07	35x40	ECS1HBW103M◇△△3540
34		23	0,30	1,5	4,50	35x45	ECS1HBW123M◇△△3545	
<b>63 (79) 1J</b>	2 200	121	84	0,20	1,4	1,75	25x30	ECS1JBW222M◇△△2530
	2 700	99	69	0,20	1,5	1,99	25x35	ECS1JBW272M◇△△2535
		81	56	0,20	1,5	2,27	25x40	ECS1JBW332M◇△△2540
	3 300	81	56	0,20	1,5	2,24	30x30	ECS1JBW332M◇△△3030
		69	48	0,20	1,5	2,54	25x45	ECS1JBW392M◇△△2545
	3 900	69	48	0,20	1,5	2,55	30x35	ECS1JBW392M◇△△3035
		57	40	0,20	1,5	2,88	25x50	ECS1JBW472M◇△△2550
	4 700	57	40	0,20	1,5	2,90	30x40	ECS1JBW472M◇△△3040
		48	33	0,20	1,5	3,28	30x45	ECS1JBW562M◇△△3045
	5 600	48	33	0,20	1,5	3,24	35x35	ECS1JBW562M◇△△3535
40		27	0,20	1,5	3,73	30x50	ECS1JBW682M◇△△3050	
6 800	40	27	0,20	1,5	3,71	35x40	ECS1JBW682M◇△△3540	
	8 200	33	23	0,20	1,5	4,16	35x45	ECS1JBW822M◇△△3545
10 000	27	19	0,20	1,5	4,69	35x50	ECS1JBW103M◇△△3550	

U <sub>RDC</sub> (Surge Voltage) Code	C <sub>R</sub> Rated Capacitance	ESR <sub>max</sub> Equivalent Series Resistance 20°C 120Hz	ESR <sub>typ</sub> Equivalent Series Resistance 20°C 120Hz	tanδ Dissipation Factor	I <sub>leak</sub> Leakage Current	I <sub>RAC</sub> Rated Ripple Current 105°C 120Hz	Size øD x L (mm)	ORDER CODE ◇ = pin style & length △ = pin number Details: Page 6
(V)	(µF)	(mΩ)	(mΩ)		(mA)	(Arms)	(mm)	
<b>80 (100) 1K</b>	1 500	177	124	0,20	1,2	1,62	25x30	ECS1KBW152M◇△△2530
	1 800	148	103	0,20	1,4	1,81	25x30	ECS1KBW182M◇△△2530
		121	84	0,20	1,5	2,09	22x45	ECS1KBW222M◇△△2245
	2 200	121	84	0,20	1,5	2,01	25x35	ECS1KBW222M◇△△2535
		99	69	0,20	1,5	2,43	30x35	ECS1KBW272M◇△△3035
	2 700	99	69	0,20	1,5	2,43	30x40	ECS1KBW332M◇△△3040
		81	56	0,20	1,5	2,78	30x45	ECS1KBW392M◇△△3045
	3 300	69	48	0,20	1,5	3,12	30x45	ECS1KBW392M◇△△3045
		57	40	0,20	1,5	3,50	35x40	ECS1KBW472M◇△△3540
	4 700	57	40	0,20	1,5	3,87	35x45	ECS1KBW562M◇△△3545
6 800		40	27	0,20	1,5	4,19	35x50	ECS1KBW682M◇△△3550
<b>100 (125) 2A</b>	1 000	266	186	0,20	1,0	1,56	25x30	ECS2ABW102M◇△△2530
	1 200	222	155	0,20	1,2	1,76	25x35	ECS2ABW122M◇△△2535
		177	124	0,20	1,5	2,03	25x40	ECS2ABW152M◇△△2540
	1 500	177	124	0,20	1,5	2,00	30x30	ECS2ABW152M◇△△3030
		148	103	0,20	1,5	2,28	25x45	ECS2ABW182M◇△△2545
	1 800	148	103	0,20	1,5	2,27	30x35	ECS2ABW182M◇△△3035
		121	84	0,20	1,5	2,57	25x50	ECS2ABW222M◇△△2550
	2 200	121	84	0,20	1,5	2,59	30x40	ECS2ABW222M◇△△3040
		99	69	0,20	1,5	2,94	30x45	ECS2ABW272M◇△△3045
	2 700	81	56	0,20	1,5	3,32	30x50	ECS2ABW332M◇△△3050
81		56	0,20	1,5	3,31	35x40	ECS2ABW332M◇△△3540	
3 300	81	56	0,20	1,5	3,69	35x45	ECS2ABW392M◇△△3545	
	69	48	0,20	1,5	4,14	35x50	ECS2ABW472M◇△△3550	
<b>160 (200) 2C</b>	560	356	249	0,15	0,9	1,62	22x40	ECS2CBW561M◇△△2240
		356	249	0,15	0,9	1,73	25x30	ECS2CBW561M◇△△2530
	680	293	205	0,15	1,1	1,70	22x45	ECS2CBW681M◇△△2245
		293	205	0,15	1,1	1,81	25x35	ECS2CBW681M◇△△2535
	820	243	170	0,15	1,3	1,98	25x40	ECS2CBW821M◇△△2540
		243	170	0,15	1,3	1,98	30x30	ECS2CBW821M◇△△3030
	1 000	199	139	0,15	1,5	2,04	25x45	ECS2CBW102M◇△△2545
		199	139	0,15	1,5	2,14	30x35	ECS2CBW102M◇△△3035
	1 200	166	116	0,15	1,5	2,12	25x50	ECS2CBW122M◇△△2550
		166	116	0,15	1,5	2,22	30x40	ECS2CBW122M◇△△3040
1 500	133	93	0,15	1,5	2,46	30x45	ECS2CBW152M◇△△3045	
	133	93	0,15	1,5	2,53	35x35	ECS2CBW152M◇△△3535	
1 800	111	77	0,15	1,5	2,98	35x45	ECS2CBW182M◇△△3545	
	91	63	0,15	1,5	3,10	35x50	ECS2CBW222M◇△△3550	
2 200	74	51	0,15	1,5	3,77	35x55	ECS2CBW272M◇△△3555	
	3 300	61	42	0,15	1,5	4,33	35x60	ECS2CBW332M◇△△3560
<b>180 (225) 2K</b>	470	424	296	0,15	0,8	1,50	22x35	ECS2KBW471M◇△△2235
		424	296	0,15	0,8	1,62	25x30	ECS2KBW471M◇△△2530
	560	356	249	0,15	1,0	1,62	22x40	ECS2KBW561M◇△△2240
		356	249	0,15	1,0	1,69	25x35	ECS2KBW561M◇△△2535
	680	293	205	0,15	1,2	1,72	25x40	ECS2KBW681M◇△△2540
		293	205	0,15	1,2	1,74	30x30	ECS2KBW681M◇△△3030
	820	243	170	0,15	1,5	1,78	25x45	ECS2KBW821M◇△△2545
		243	170	0,15	1,5	1,85	30x35	ECS2KBW821M◇△△3035
	1 000	199	139	0,15	1,5	1,91	25x50	ECS2KBW102M◇△△2550
		199	139	0,15	1,5	2,01	30x40	ECS2KBW102M◇△△3040
1 200	166	116	0,15	1,5	2,19	30x45	ECS2KBW122M◇△△3045	
1 500	133	93	0,15	1,5	2,36	30x50	ECS2KBW152M◇△△3050	
1 800	111	77	0,15	1,5	2,67	35x45	ECS2KBW182M◇△△3545	
2 200	91	63	0,15	1,5	3,27	35x50	ECS2KBW222M◇△△3550	
2 700	74	52	0,15	1,5	3,92	35x60	ECS2KBW272M◇△△3560	
<b>200 (250) 2D</b>	470	424	296	0,15	0,9	1,47	25x30	ECS2DBW471M◇△△2530
		424	296	0,15	0,9	1,56	30x25	ECS2DBW471M◇△△3025
	560	356	249	0,15	1,1	1,58	25x35	ECS2DBW561M◇△△2535
		356	249	0,15	1,1	1,65	30x30	ECS2DBW561M◇△△3030
	680	293	205	0,15	1,4	1,80	25x40	ECS2DBW681M◇△△2540
		293	205	0,15	1,4	1,82	30x30	ECS2DBW681M◇△△3030
	820	243	170	0,15	1,5	1,99	30x35	ECS2DBW821M◇△△3035
		199	139	0,15	1,5	2,17	22x50	ECS2DBW102M◇△△2250





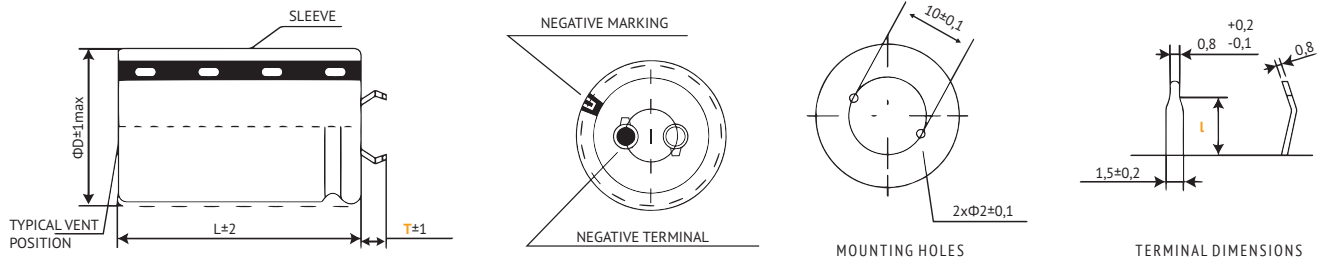
$U_{RDC}$ (Surge Voltage) Code	$C_R$ Rated Capacitance	$ESR_{max}$ Equivalent Series Resistance 20°C 120Hz	$ESR_{typ}$ Equivalent Series Resistance 20°C 120Hz	$\tan\delta$ Dissipation Factor 20°C 120Hz	$I_{leak}$ Leakage Current	$I_{RAC}$ Rated Ripple Current 105°C 120Hz	Size $\varnothing D \times L$	ORDER CODE  ◇◇ = pin style & length △△ = pin number  Details: Page 6
(V)	( $\mu F$ )	(m $\Omega$ )	(m $\Omega$ )		(mA)	(Arms)	(mm)	
<b>500 (550) 2H</b>	270	983	472	0,20	1,4	1,29	30x40	ECS2HBW271M◇◇△△3040
		983	472	0,20	1,4	1,34	35x35	ECS2HBW271M◇◇△△3535
	330	804	402	0,20	1,5	1,40	35x45	ECS2HBW331M◇◇△△3545
		390	681	340	0,20	1,5	1,60	35x50
	470	565	282	0,20	1,5	1,80	35x50	ECS2HBW471M◇◇△△3550
		565	282	0,20	1,5	1,80	35x60	ECS2HBW471M◇◇△△3560
	560	474	237	0,20	1,5	1,90	35x60	ECS2HBW561M◇◇△△3560
	680	391	196	0,20	1,5	2,20	35x70	ECS2HBW681M◇◇△△3570
<b>550 (600) 2Y</b>	150	1769	885	0,20	1,5	0,86	30x35	ECS2YBW151M◇◇△△3035
		1474	737	0,20	1,5	1,06	30x40	ECS2YBW181M◇◇△△3040
	180	1474	737	0,20	1,5	1,11	35x30	ECS2YBW181M◇◇△△3530
		220	1206	603	0,20	1,5	1,18	30x50
	270	1206	603	0,20	1,5	1,23	35x35	ECS2YBW221M◇◇△△3535
		330	983	492	0,20	1,5	1,31	35x45
	390	804	402	0,20	1,5	1,50	35x50	ECS2YBW331M◇◇△△3550
	470	681	340	0,20	1,5	1,67	35x60	ECS2YBW391M◇◇△△3560
		565	282	0,20	1,5	1,90	35x60	ECS2YBW471M◇◇△△3560
	560	565	282	0,20	1,5	1,95	35x70	ECS2YBW471M◇◇△△3570
		560	474	237	0,20	1,5	2,10	35x80

**ORDER CODE SNAP-IN TYPE**

EC	S	2G	QC	221	M	T6	P2	2535	-	JExxxxx
Techno- logy	Terminal Type	Rated Voltage Code	Series Code	Capacitance Code	Capacitance Tolerance	Terminal Style	Terminal / Pitch	Dimension (mm)	Material Code	for Specials only
EC = Electrolytic Capacitor	Snap-In S	6,3V 0J	CD 293 BZ	0,1 0R1	±20% M	4,0mm Pin Length T/L4	2 Pin P2	22x40 2240	Standard -	
		10V 1A	CD 294 BW	0,47 R47	±10% K	6,3mm Pin Length T/L6	3 Pin P3	30x45 3045	PVC V	
		16V 1C	CD 295 BC	1,0 010	+30/-10% Q	Soldering Pin S4	4 Pin P4	35x80 3580	PET E	
		20V 1D	CD 295S BS	2,2 2R2	+20/-0% R	on request: alternative pin types  ■ = preferred	5 Pin P5	45x100 45100		
		25V 1E	CD 296 KC	100 101	±15% L		6 Pin P6	50x105 50105		
		35V 1V	CD 296L FL	1 000 102	+20/-10% V					
		40V 1G	CD 297 BB	10 000 103						
		50V 1H	CD 299 PG							
		63V 1J	CD 29C QC							
		80V 1K	CD 29D HR							
		100V 2A	CD 29H QH							
		125V 2B	CD 29HD QF							
		160V 2C	CD 29L QL							
		180V 2K	CD 29U CU							
		200V 2D	CD 29UH UT							
		250V 2E	CD 840 ZQ							
		315V 2F	CD 891 ZJ							
		350V 2V	CD 892 ZL							
		385V 2J	CD 895 ZK							
		400V 2G								
		415V 2P								
		420V 2X								
		450V 2W								
		500V 2H								
550V 2Y										
575V 2Z										
600V 2S										
630V J2										



## 2 PIN TYPE: T6P2 / T4P2 STANDARD



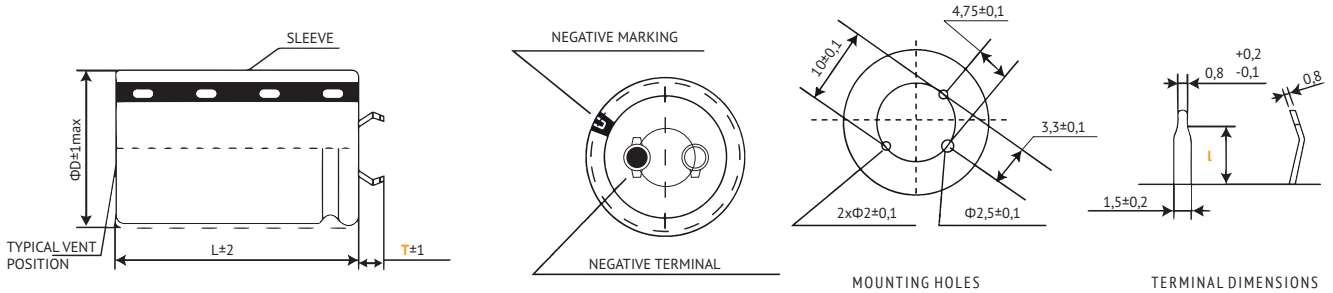
Standard Version: Self-Lock Terminal. Other terminal types and styles on request.  
For diameter  $\phi D \geq 45\text{mm}$  the safety vent is typically placed at the side of the housing.

Terminal	T6 (preferred)	T4
Pin Length <b>T</b>	6,3 mm	4,0 mm
Pin Detail <b>l</b>	3,5 mm	2,5 mm

**!** Max. Current Snap-In Terminal: 15A  
For more current please ask for Lug-Terminals.

in mm

## 3 PIN TYPE: T4P3



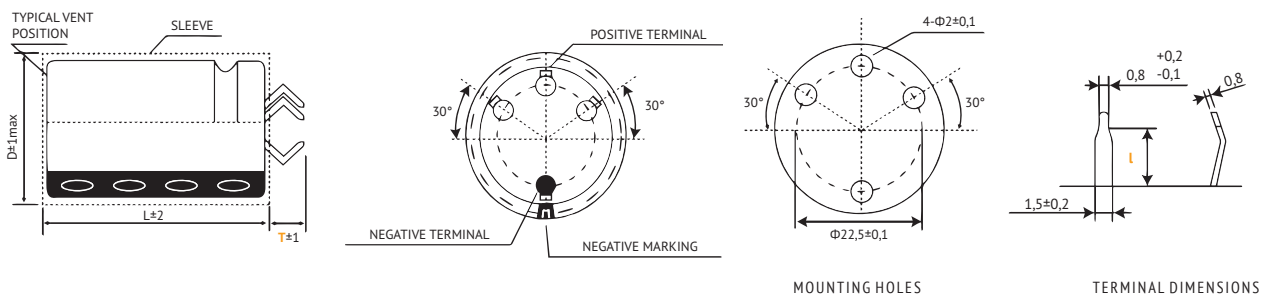
For diameter  $\phi D \geq 45\text{mm}$  the safety vent is typically placed at the side of the housing.

Terminal	T6	T4
Pin Length <b>T</b>	-	4,0 mm
Pin Detail <b>l</b>	-	2,5 mm

**!** Max. Current Snap-In Terminal: 15A  
For more current please ask for Lug-Terminals.

in mm

## 4 PIN TYPE: T6P4/T4P4 STANDARD



Standard Version: Non-Lock-Terminal. Other terminal types and styles on request.  
For  $\phi D \geq 30\text{mm}$  only.  
For diameter  $\phi D \geq 45\text{mm}$  the safety vent is typically placed at the side of the housing.

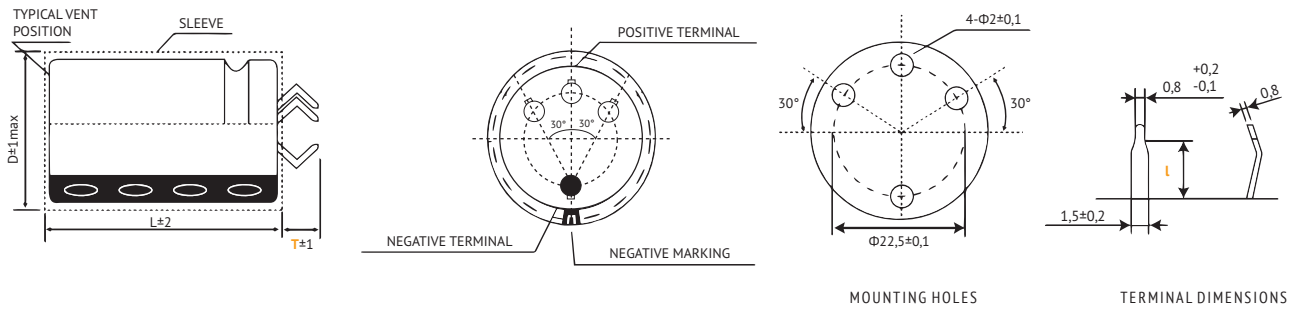
Terminal	T6 (preferred)	T4
Pin Length <b>T</b>	6,3 mm	4,0 mm
Pin Detail <b>l</b>	3,5 mm	2,5 mm

**!** Max. Current Snap-In Terminal: 15A  
For more current please ask for Lug-Terminals.

in mm



## 4 PIN TYPE: L6P4/L4P4 SELF-LOCK TERMINAL



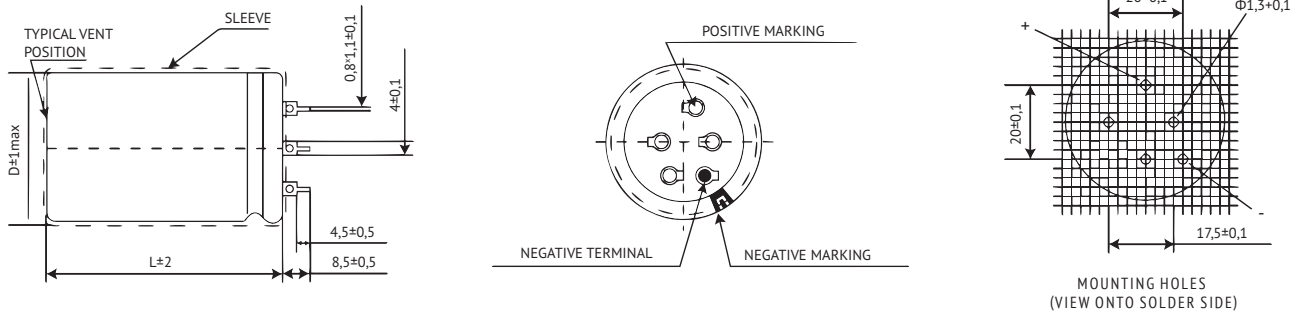
For  $\varnothing D \geq 30\text{mm}$  only. Other terminal types and styles on request.  
For diameter  $\varnothing D \geq 45\text{mm}$  the safety vent is typically placed at the side of the housing.

Terminal	T6 (preferred)	T4
Pin Length $T$	6,3 mm	4,0 mm
Pin Detail $l$	3,5 mm	2,5 mm

**!** Max. Current Snap-In Terminal: 15A  
For more current please ask for Lug-Terminals.

in mm

## 5 PIN TYPE: S4P5 SOLDERING PIN

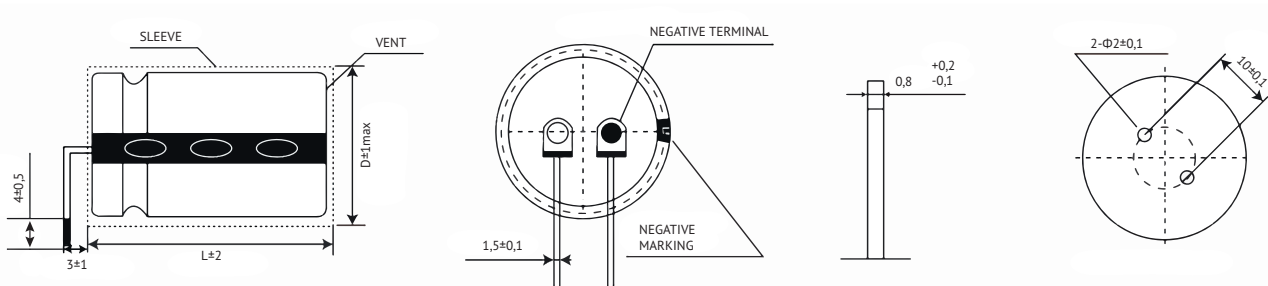


For  $\varnothing D \geq 30\text{mm}$  only.  
For diameter  $\varnothing D \geq 45\text{mm}$  the safety vent is typically placed at the side of the housing.

**!** Max. Current Snap-In Terminal: 15A  
For more current please ask for Lug-Terminals.

in mm

## EXAMPLE: AXIAL MOUNTING



For  $\varnothing D \geq 25\text{mm}$  only.  
Available also for high vibration usage.

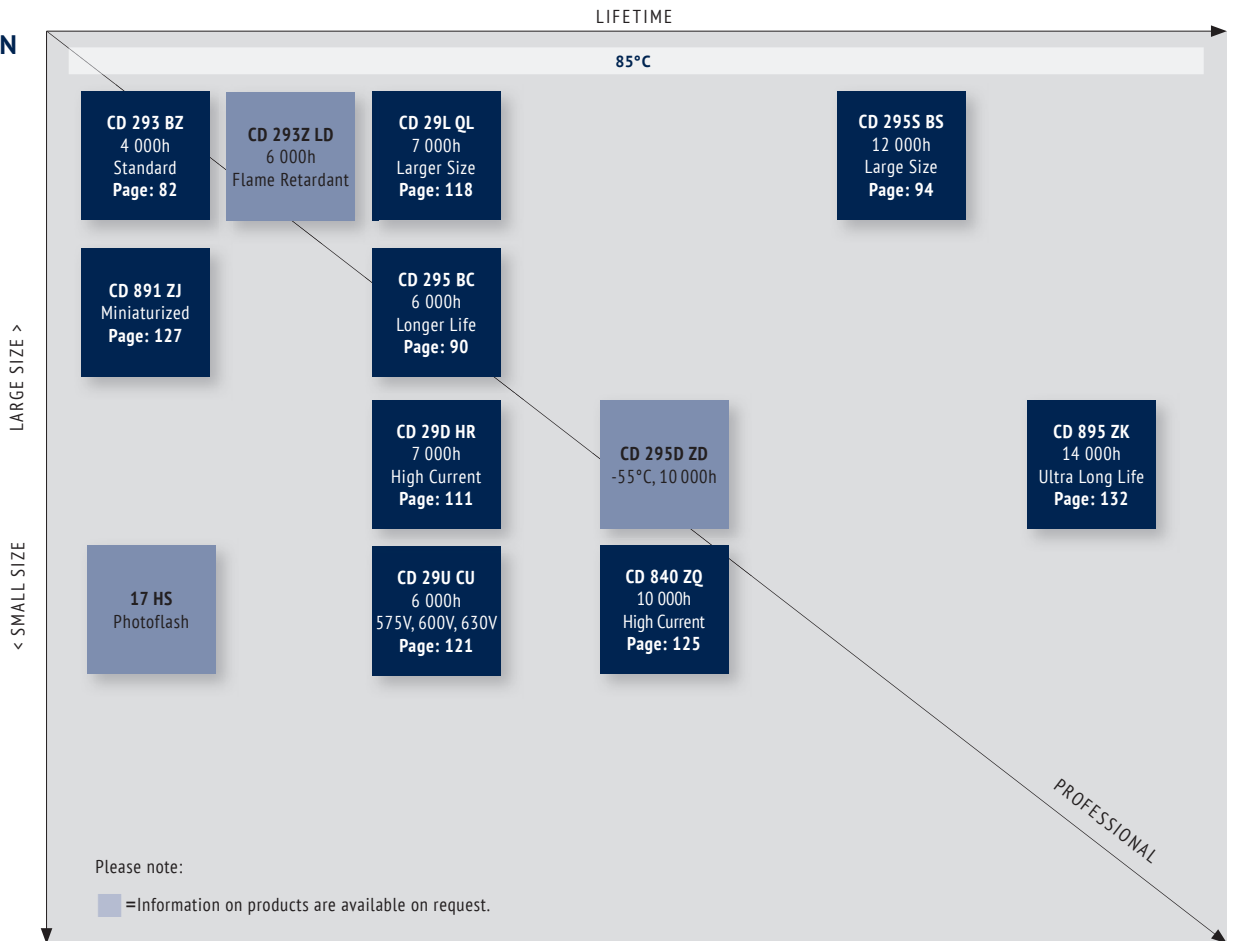
**!** Max. Current Snap-In Terminal: 15A  
For more current please ask for Lug-Terminals.

in mm

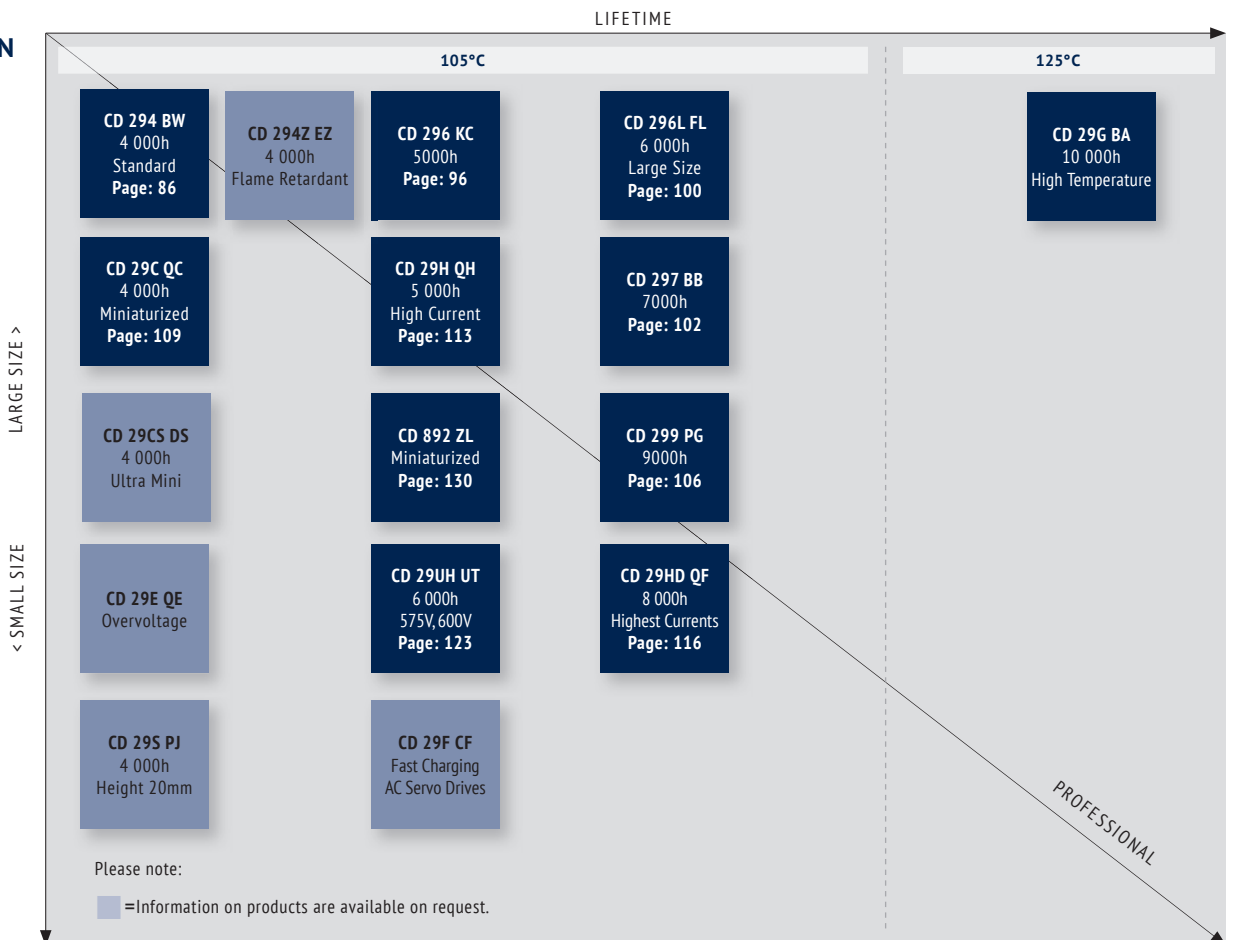
Other Terminal Styles on request.



**SNAP-IN  
85°C**



**SNAP-IN  
105°C/  
125°C**



## 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. 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 as defined. 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 Nominal Load at Upper Category Temperature (see catalogue)
- $K_T$  Temperature Factor
- $K_R$  Ripple Current Factor
- $K_V$  Voltage Factor

### $K_T$ 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

### $K_R$ RIPPLE CURRENT FACTOR

To estimate the influence of ripple current on lifetime, Jianghai uses a safety factor  $K_i$ . Under certain conditions this value can be set to  $K_i=2$ , which is prolonging the lifetime. Please contact Jianghai Europe for details and approval.

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

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)
- $\Delta T_0$  Core Temperature Rise of the capacitor (typically 3,5 ~ 5 K for  $T_0 = 105^\circ\text{C}$  and 3,5 ~ 10K for  $T_0 = 85^\circ\text{C}$ , see databook value)
- $K_i$  Basis, typically defined as
 

$T_0 = 105^\circ\text{C}$	$I_A > I_R$ :	$K_i=4$
	$I_A \leq I_R$ :	$K_i=2$
$T_0 = 85^\circ\text{C}$		$K_i=2$



*Remark: Safety Factor  $K_i$  may be set as  $K_i=2$  under certain defined conditions. Please contact Jianghai Europe for approval.*

### $K_V$ 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 160V, the operating voltage will affect their Lifetime. It is expressed as follows:

FOR:

$$0,6 \leq \frac{U_A}{U_R} \leq 1$$

$$K_V = \left( \frac{U_A}{U_R} \right)^{-2,5}$$

WHERE:

- $U_A$  Actual Operating Voltage
- $U_R$  Rated Voltage

FOR:

$$0 < \frac{U_A}{U_R} < 0,6$$

$$K_V = 3,59$$

FOR:

$$\frac{U_A}{U_R} > 1 \text{ not allowed}$$

$$K_V = 1$$

FOR: Radial Capacitors or  $U_R \leq 160V$

$$K_V = 1$$

### FREQUENCY CORRECTION FACTORS:

If the actual Ripple Currents are not given at the same frequency like  $I_{\sigma}$ , correction factors need to be applied.

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

### JIANGHAI ELECTROLYTIC CAPACITOR LIFETIME

#### ESTIMATION FORMULA (incl. Safety Factors):

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

WITH TYPICAL VALUES:

$$T_0 = 105^\circ\text{C} \quad I_A > I_R : K_i = 4$$

$$I_A \leq I_R : K_i = 2$$

$$T_0 = 85^\circ\text{C} \quad K_i = 2$$

$\Delta T_0$  = depending on the series: 3,5~10K,  
see databook value

$$0,6 \leq \frac{U_A}{U_R} \leq 1 \rightarrow n = 2,5$$

$$0 < \frac{U_A}{U_R} < 0,6 \rightarrow K_V = \left(\frac{U_A}{U_R}\right)^{-n} = 3,59$$

For  $U_R \leq 160V$ , Radial and

$$\frac{U_A}{U_R} > 1 \rightarrow K_V = 1$$

## HANDLING PRECAUTIONS FOR ALUMINUM ELECTROLYTIC CAPACITORS FROM JIANGHAI

### WARNING

JIANGHAI is not liable for any extent of possible injuries or damages to persons or things, of any kind, caused by the improper application of and/or operating conditions harmful to electrolytic capacitors. Misapplications which may cause failures include, but are not limited to: ripple current or peak current or voltage above specification, operating voltage above surge voltage specified, temperature exposure outside the specified operating temperature range. Examples of harmful operating conditions comprise, but are not limited to: unusual storage or transport temperatures, excessive and/or rapid changes of ambient temperature or humidity, heavy mechanical shock or vibration, corrosive and abrasive particles in the ambient (cooling) air, conducting dust in the ambient (cooling) air, oil or water vapor or corrosive substances, explosive gas or dust, operation under extremely high or low ambient pressure conditions (below or above sea level), superimposed radio frequency voltages, radioactivity. In case of doubt about the impact of operating conditions on capacitor performance, please contact JIANGHAI.

### PERSONAL SAFETY

Electrical or mechanical misapplication of electrolytic capacitors may be hazardous. Personal injury or property damage may result from explosion of a capacitor or from the expulsion of electrolyte due to mechanical disruption or the release of a safety vent of a capacitor. In case of injury or skin or eye exposure to electrolyte, immediately seek professional medical advice. Before using electrolytic capacitors in any application, please read these Handling Precautions, familiarizing thoroughly with the information contained herein. Please check before using any of our electrolytic capacitors if these components fulfill the requirements of your application and that warnings and instructions for use are followed.

### 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 mean that the customer may claim for replacement of individual defective capacitors within the terms of delivery. We will not assume any liability beyond the replacement of defective components. This applies in particular to any consequential damage caused by 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](http://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 $U_R$

The rated voltage is marked on the capacitor and defined in the datasheets as  $U_R$ . 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 < 0V are not allowed.

## RECOVERY VOLTAGE

Electric potential between the positive and negative terminal may exist as a result of dielectric absorption. Please take action that this load does not damage other devices or scare workers during the production process (sparks possible). If needed please discharge the capacitor through a 1kΩ resistor.

## 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 < 0V. Use of aluminum electrolytic capacitors under ripple current with wide amplitudes is equivalent to rapid 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. Example: Servo Drive Application

## 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<sup>6</sup> 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  $U_R$ .

**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 with a larger range of parameter change.

**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.

## 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 – the same holds 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 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 a 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 retardant agents containing halogens must be avoided. Avoid exposing to direct sunshine, ozone, ultraviolet rays and x-ray radiation. Air Pressure: Max. 150kPa, min. 8kPa. For usage >2000m altitude above sea level current deratings might be necessary. 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 35°C, relative 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:  $U_R \leq 100VDC$ , 1kΩ:  $U_R > 100VDC$ ).

## 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.

## GLUEING, CLEANING AND COATING

Do not use fixing agents or cleaning substances containing halogens. Do not use coating and moulding components that completely seal the capacitor from the environment. Also, never use solvents containing: halogenated hydrocarbons, alkali, petroleum, trichloroethylene/-ethane, xylene, acetones, trichlorotrifluoroethane, tetrachloroethylene, methylenechloride, chloroform, acetates, ketones, esters, chlorides and bromides.

## 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.

## DISPOSAL

Scrapped capacitors are classified as scrapped metal. For disposal they are handled as controllable industrial waste because of the nature of the contents (electrolyte). Most of the material is aluminum and cannot be completely burned.

*Jianghai Europe Electronic Components GmbH*

*VERSION 10/2021*