Digitalization empowers the spirit of craftsmanship

Mes

Automation

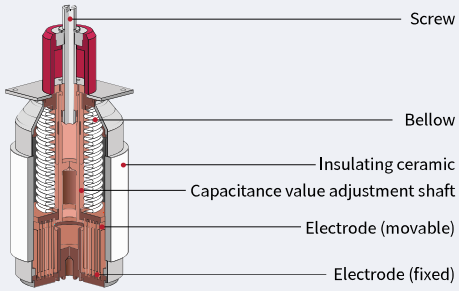
Informatization

PRODUCT INTRODUCTION

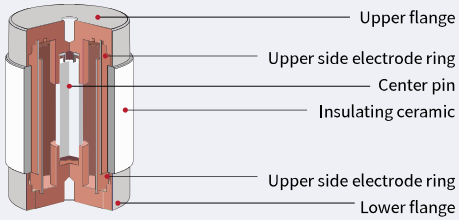
A vacuum capacitor is a type of capacitor using ceramic or glass as insulated envelope,vacuum as a dielectric medium and OFHC copper as material electrode. Compared with other capacitors, it has features of high voltage withstand, high current carrying, low high-frequency loss, self-healing under instantaneous overload. It is especially suitable for being used in high frequency and high voltage fields.

INTERNAL CONSTRUCTION

Variable



Fixed



PRODUCT CHARACTERISTICS

Low RF Loss
It is determined by the selected nonmagnetic and low dielectric loss materials, OFHC copper electrodes, ceramic envelope and copper alloy bellows. Vacuum capacitors'loss can be expressed by tanδ. This value is between 10^{-3}~10^{-4} at 1MHz.

Self-recovering After Instantaneous Overload

Higher Dielectric Strength
Vacuum capacitor's electrode gap can withstand 15kVp~20kVp/mm.

Low Temperature Coefficient
The Vacuum capacitor's temperature coefficient is less than 50ppm/℃ .

Space Saving
For a given capacitance and rated voltage, vacuum capacitors occupy the smallest envelope space.

Wide Adjustable Range
The ratio of maximum capacitance to minimum capacitance is as high as 100 : 1, from several pF to thousands pF, it is an ideal component for wide tuning range.

Work In High Altitude
Vacuum sealing allows vacuum capacitors to work in high altitude without performance degradation.

With all of the above dielectric advantages of vacuum, Vacuum capacitors have excellent performance in RF and high voltage applications.

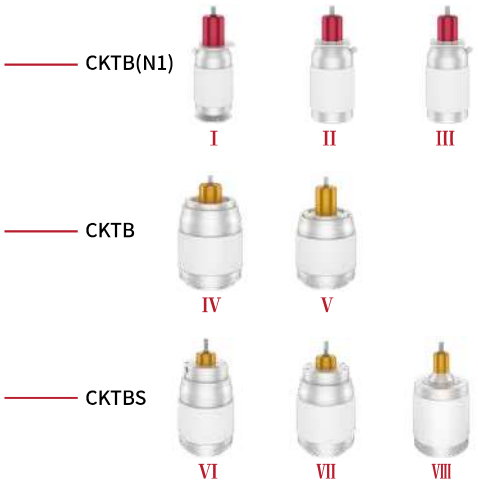
Variable Vacuum Capacitors

PRODUCT NAMING RULES

C K T B S XX / XX / XX

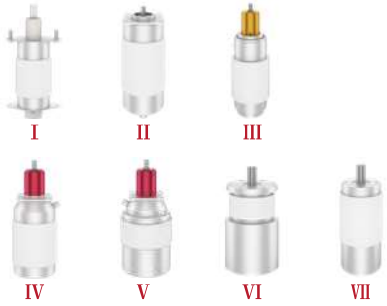
- Maximum current(A)
- Peak test(working) voltage
- Capacitance
- Water cooling
- Variable capacitor
- Ceramic envelope
- Vacuum dielectric
- Capacitor

- Designed for typical semiconductor applications.
- Optimized bellows design for high power operations
- Optimized drive system for fast tuning
- High current capability relative to small size.
- Interchangeable due to uniform size
- Standardized 42 mm quadratic mounting flange
- Available as a motorized and non-motorized Vacuum Capacitor
- CKTBS is large current （150A） and lower torque

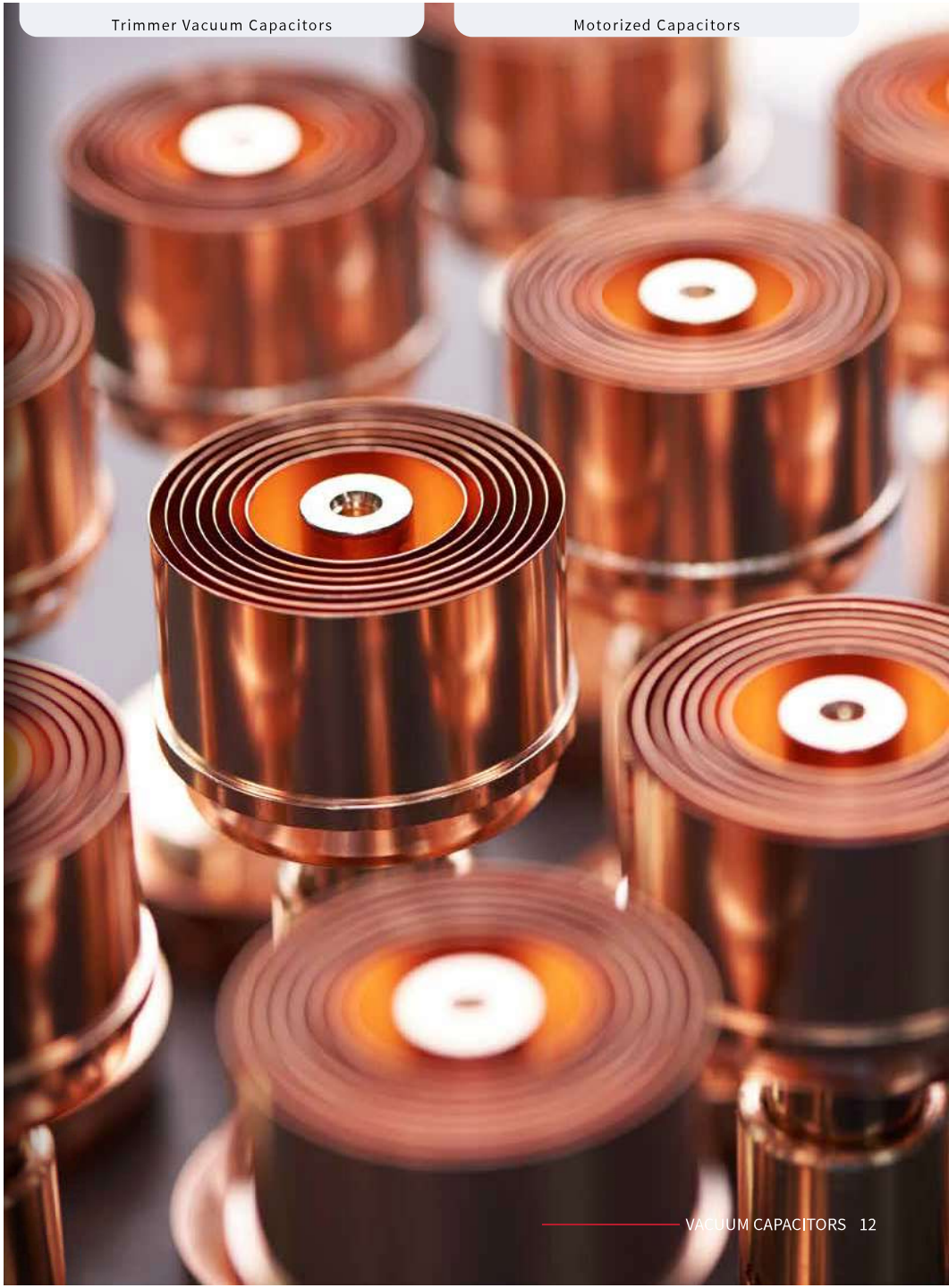


SERIES	TYPE	Capacitance (pF)	Cmin (pF)	Voltage (Peak test) (kVp)	Voltage (RF working) (kVp)	Current (Arms)	Diameter (mm)	Length (mm)	Turns (N)	Torque (N.m)
I	CKTB250/15/94N1	250	25	15	9	94	55	133.5	11.5	0.2
	CKTB500/8/92N1	500	50	8	4.8	92	55	133.5	11.5	0.2
	CKTB1000/5/89N1	1000	100	5	3	89	55	133.5	11.5	0.2
	CKTB1400/3/63N1	1400	8	3	1.8	63	55	141.5	21.5	0.2
	CKTB1500/4/85N1	1500	150	4	2.4	85	55	133.5	11.5	0.2
II	CKTB450/12/94N1	450	7	12	7.2	94	64	133.5	11.5	0.2
	CKTB500/12/94N1	500	50	12	7.2	94	64	133.5	11.5	0.2
	CKTB1000/10/94N1	1000	100	10	6	91	64	133.5	11.5	0.2
	CKTB1400/4/94N1	1400	50	4	2.4	94	64	133.5	11.5	0.2
	CKTB1500/4/94N1	1500	150	4	2.4	94	64	133.5	11.5	0.2
	CKTB2000/3/86N1	2000	500	3	1.8	86	64	133.5	11.5	0.2
III	CKTB500/8/57N1	500	200	8	4.8	57	55	148.8	22	0.15
IV	CKTB500/15/123	500	50	15	9	123	86	141.5	22	0.2
V	CKTB1000/5/150	1000	100	5	3	150	86	132.8	16	0.2
	CKTB1500/5/127	1500	150	5	3	127	86	130.1	15.5	0.2
VI	CKTBS300/15/150	300	30	15	9	150	86	158.4	15	0.2
	CKTBS500/15/150	500	50	15	9	150	86	158.4	22	0.2
VII	CKTBS1000/5/150	1000	100	5	3	150	86	147	17.5	0.2
	CKTBS1500/5/150	1500	30	5	3	150	86	147	17	0.2
VIII	CKTBS500/24/300	500	40	40	24	300	152	265	16.5	0.2

CKTB



SERIES	TYPE	Capacitance (pF)	Cmin (pF)	Voltage (Peak test) (kVp)	Voltage (RF working) (kVp)	Current (Arms)	Diameter (mm)	Length (mm)	Turns (N)	Torque (N.m)
I	CKTB30/15/30	30	3	15	9	30	35	104.5	17.5	0.3
	CKTB30/9/30									
	CKTB/125/8/36	125	5	8	4.8	36	35	99	19.5	0.15
	CKTB125/4.8/36									
II	CKTB650/5/63	650	8	5	3	63	44.7	114.3	9	0.15
	CKTB650/3.5/63(I)									
III	CKTB400/11/60	400	8	10.5	7.5	60	62	168	23	0.2
	CKTB400/7.5/60 (IV)									
	CKTB1000/5/60	1000	10	5	3.5	60	62	168	23	0.2
	CKTB1000/3.5/60 (III)									
IV	CKTB100/15/54 (I)	100	10	15	9	54	55	134	12	0.2
	CKTB100/10/54									
V	CKTB2000/3/86 (I)	2000	200	3	1.8	86	64	134	11	0.2
	CKTB2000/2.1/86									
VI	CKTB500/15/100	500	50	15	9	100	73	140	12	0.2
	CKTB1400/5/100	1400	90	5	3	100	73	140	12	0.2
	CKTB1000/5/100	1000	50	5	3	100	73	140	12	0.2
	CKTB500/20/100	500	50	20	12	100	76	140	12	0.2
VII	CKTB100/15/54	100	10	15	9	54	60.4	140	12	0.2
	CKTB250/15/100	250	15	15	9	100	60.4	140	12	0.2
	CKTB500/8/100	500	20	8	4.8	100	60.4	140	12	0.2



Variable Vacuum Capacitors

PRODUCT NAMING RULES

YL XX — XX — XX C (II)

- Screw with cross latch
- Water-cooling
- Capacitance
- Peak test Voltage
- Outer diameter
- Name of series

- Low loss and high strength by copper plated stainless steel bellows
- Equipped with precision Spiral electrode
- Wide variable capacitance range
- High bending withstand strength
- DLC coated screw enables longer life
- Can satisfy to customer specifications
- YL115 is a water cooled unit with large current carrying capability (200A) and low torque

YL

I II III IV

SERIES	TYPE	Capacitance (pF)	Cmin (pF)	Voltage (Peak test) (kVp)	Voltage (RF working) (kVp)	Current (Arms)	Diameter (mm)	Length (mm)	Turns (N)	Torque (N.m)
I	YL56-20-100	100	10	20	12	72	56	133.5	10.5	0.18
	YL56-15-250	250	25	15	9	95			10.5	0.18
	YL56-8-500	500	45	8	4.8	95			10.5	0.18
	YL56-5-1000	1000	45	5	3	95			10.5	0.18
	YL56-4-1500	1500	50	4	2.4	95			10.5	0.18
II	YL67D-15-250TC	250	25	15	9	130	67	133.5	10.5	0.2
	YL67D-15-500	500	40	15	9	130			10.5	0.18
	YL67-12-500	500	40	12	7.2	95			10.5	0.18
	YL67-15-500	500	40	15	9	95			10.5	0.18
	YL67-10-1000	1000	100	10	6	95			10.5	0.18
	YL67-8-1000	1000	100	8	4.8	95			10.5	0.18
	YL67-5-1500	1500	50	5	3	95			10.5	0.18
	YL67D-5-1500TC	1500	150	5	3	130			10.5	0.2
	YL67-3-2000	2000	100	3	1.8	95			10.5	0.18
III	YL75-15-500	500	40	15	9	95	72	134	10.5	0.18
	YL75-9-1500	1500	150	9	5.4	95	75	133.5	10.5	0.18
IV	YL115-30-250C	250	25	30	18	200	115	161	14.3	0.2
	YL115-25-500C	500	40	25	15	200			14.3	0.2
	YL115-15-1000C	1000	40	15	9	200			14.3	0.2
	YL115-8-1500C	1500	40	8	4.8	200			14.3	0.2
	YL115-10-1500	1500	40	10	6	200			14.3	0.2
	YL115-8-2000C	2000	60	8	4.8	200			14.3	0.2

Fixed Vacuum Capacitors

PRODUCT NAMING RULES

C K T XX / XX / XX

- Maximum current(A)
- Peak test(working) voltage
- Capacitance
- Ceramic envelope
- Vacuum dielectric
- Capacitor

- Compact size
- High quality and reliable capacitor for both high and low current applications
- Low internal inductance for operation in excess of 100 MHz
- Unique rugged and cost effective design
- Widely used in different applications like matching networks, DC blocking and RF sealing
- Delivered with mounting kit for easy installation

CKT

SERIES	TYPE	Capacitance (pF)	Voltage (Peak test) (kVp)	Voltage (RF working) (kVp)	Current (Arms)	Diameter (mm)	Length (mm)
I	CKT50/5/9TC	50	5	3	9	19.6	76
	CKT100/3/11TC	100	3	1.8	11	20	20
	CKT120/3/13TC	120	3	1.8	13	20	20
	CKT65/5/35	65	5	3	33	40	30
	CKT65/3.5/35						
	CKT200/5/36TC	200	5	3	56	38	26
II	CKT30/20/21	30	20	12	21	36	43
	CKT75/10/41	75	15	9	41	36	43
	CKT50/15/27 (I)	50	15	9	27	36	43
	CKT100/15/50	100	15	9	50	36	43
	CKT100/9/50						
	CKT200/15/50	200	15	9	50	36	43
	CKT200/9/50						

Fixed Vacuum Capacitors

CKT

SERIES	TYPE	Capacitance (pF)	Voltage (Peak test) (kVp)	Voltage (RF working) (kVp)	Current (Arms)	Diameter (mm)	Length (mm)
III	CKT220/15/119	220	15	9	119	48	52
	CKT220/10/119						
	CKT230/15/124	230	15	9	124		
	CKT230/10/124						
	CKT240/15/130	240	15	9	130		
	CKT240/10/130						
	CKT250/15/134	250	15	9	134		
	CKT250/10/134						
	CKT260/15/132	260	15	9	132		
	CKT260/10/132						
	CKT325/15/132	325	15	9	132		
	CKT350/15/132	350	15	9	132		
	CKT350/10/132						
	CKT360/15/134	360	15	9	134		
	CKT360/10/134						
	CKT380/12/106	380	12	7.2	106		
	CKT380/8.5/106						
	CKT500/12/126	500	12	7.2	126		
	CKT500/8.5/126						
	CKT750/10/116	750	10	6	116		
	CKT750/7/116						
	CKT1000/8/115	1000	8	4.8	115		
	CKT1000/5.6/115						
	CKT1250/5/112	1250	5	3	112		
	CKT2000/3/105	2000	3	1.8	105		
	CKT2000/1.8/105						

SERIES	TYPE	Capacitance (pF)	Voltage (Peak test) (kVp)	Voltage (RF working) (kVp)	Current (Arms)	Diameter (mm)	Length (mm)
IV	CKT25/15/13	25	15	9	13	48	62
	CKT25/10/13						
	CKT50/15/27 (I)	50	15	9	27		
	CKT50/9/27						
	CKT75/15/41 (I)	75	15	9	41		
	CKT75/10/41						
	CKT100/15/54	100	15	9	54		
	CKT100/10/54(I)						
	CKT130/15/70	130	15	9	70		
	CKT130/10/70						
	CKT140/15/76	140	15	9	76		
	CKT140/10/76						
	CKT150/15/81	150	15	9	81		
	CKT150/10/81						
	CKT180/15/97	180	15	9	97		
	CKT180/10/97						
	CKT200/15/107	200	15	9	107		
	CKT200/10/107						
V	CKT50/30/54	50	30	18	54	48	73
	CKT50/18/54						
	CKT100/30/108	100	30	18	108		
	CKT100/21/108						
	CKT125/30/135	125	30	18	135		
	CKT125/21/135						
	CKT150/25/135	150	25	15	135		
	CKT150/17.5/135						
	CKT200/25/143	200	25	15	143		
	CKT200/17.5/143						
VI	CKT500/42/170	500	42	30	170	155	160
	CKT500/30/170						
VII	CKT4000/5/121	4000	5	3	121	76	52
	CKT4000/3/121						

Trimmer Vacuum Capacitors

PRODUCT NAMING RULES

C K T B T XX / XX / XX

- Maximum current(A)
- RF working voltage
- Capacitance
- Trimmer
- Variable capacitor
- Ceramic envelope
- Vacuum dielectric
- Capacitor

- Allows to compensate for small, but critical, impedance differences from match to match
- Compensate for tool "drift" overtime
- Tool for fine tuning during design and development phase
- Usable for a very precise voltage divider
- Less expensive than variable solution

CKTBT

I

II

SERIES	TYPE	Capacitance (pF)	Cmax (pF)	Cmin (pF)	Voltage (Peak test) (kVp)	Voltage (RF working) (kVp)	Current (Arms)	Diameter (mm)	Length (mm)
I	CKTBT15/18/21	15	20	10	30	18	21	47	76
	CKTBT30/18/37	30	35	25	30	18	37		
	CKTBT50/18/59	50	55	45	30	18	59		
	CKTBT60/18/70	60	65	55	30	18	70		
	CKTBT74/18/85	74	79	69	30	18	85		
	CKTBT85/18/97	85	90	80	30	18	97		
	CKTBT100/18/113	100	105	95	30	18	113		
	CKTBT115/18/101	115	120	110	30	18	101		
	CKTBT120/18/101	120	125	115	30	18	101		
	CKTBT130/18/101	130	135	125	30	18	101		
	CKTBT200/12/101	200	205	195	20	12	101		
II	CKTBT156/15/150	156	166	146	25	15	150	64	95
	CKTBT270/15/175	270	280	260	25	15	175		
	CKTBT300/15/168	300	310	290	25	15	168		
	CKTBT320/15/170	320	330	310	25	15	170		
	CKTBT350/15/170	350	360	340	25	15	170		
	CKTBT400/15/159	400	410	390	25	15	159		
	CKTBT440/15/156	440	450	430	25	15	156		

Motorized Vacuum Capacitors

PRODUCT NAMING RULES

C K T B M XX / XX / XX
- Maximum current(A)
- Peak test voltage
- Capacitance
- Motorized
- Variable capacitor
- Ceramic envelope
- Vacuum dielectric
- Capacitor

YL XX — XX — XX M
- Motorized
- Capacitance
- Peak test voltage
- Outer diameter
- Name of series

- Accurate alignment of variable Vacuum Capacitor and stepper-motor and a durable, backlash-free coupling result in long, consistent lifetime
- Assembled solution for easy installation for higher system uptime and productivity
- Highly accurate repeatability of capacitance positions
- Increased capacitance resolution (position control) to 0.01 pF
- Lower total cost of ownership.

CKTBM

I II III

SERIES	TYPE	Capacitance (pF)	Cmin (pF)	Voltage (Peak test) (kVp)	Voltage (RF working) (kVp)	Current (Arms)	Diameter (mm)	Length (mm)	Capacitance per 100 steps (pF/turn)	Linear Range
I	YL56-15-250M	250	25	15	9	95	56	209.6	11.1	±1%
	YL56-5-1000M	1000	100	5	3				47	
	YL56-4-1500M	1500	150	4	2.4				70	
II	YL67-3-2000M	2000	100	3	1.8	95	67	212.6	93.5	±1%
III	CKTBM500/8/57N1	500	5	8	4.8	57	54	225.1	14.55	±1%
	CKTBM250/15/94N1(I)	250	25	15	9	94	55	210.4	10.7	
	CKTBM250/15/94N1	250	25	15	9	94	55	209.1	10.7	
	CKTBM1500/4/85N1	1500	150	4	2.4	85	56	209.1	61.95	
	CKTBM1500/4/85N1(I)	1500	150	4	2.4	85	56	210.4	61.95	
	CKTBM500/12/94N1(I)	500	50	12	7.2	94	64	210.4	20.5	

CUSTOMIZED SOLUTIONS

If your required product solution is not within our standard portfolio. Talk to us about the challenges you are facing and let's work together to develop the ideal solution for your needs.

In GLVAC R&D center, we customize precision vacuum capacitors.

- Frequency range from 100kHz to 500 MHz
- Power range from 0.5kW to 50 kW
- Voltage range from 1kVp to 50 kVp
- Current range up to 200 Arms

TECHNICAL INFORMATION

Withstand Voltage

withstand voltage is determined by:

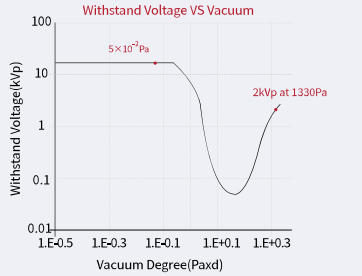
- vacuum degree
- electrode gap
- electrode material
- electrode surface condition

Vacuum degree

<1> According to Paschen's Law, at a vacuum level of $5X10^{-2}$, voltage withstand can maintain 20kVp at 1mm gap.

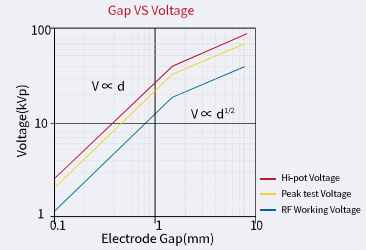
<2> After 10 years, the vacuum degree can maintain the vacuum limit in production 5×10^{-2}Pa/【52(weeks)×10(years)】 ≈ 1×10^{-4}Pa，so weekly allowable pressure change ⩽ 1×10^{-4}Pa.

<3> Vacuum withstand voltage at vacuum (less than 1×10^{-3}Pa) is about 10 times of withstand voltage at atmosphere (1 atm).



Electrode gap

The electrode gap directly determines the withstand voltage capability of vaccum capacitor. The larger the electrode gap, the smaller the electric field strength, and the stronger the vacuum capacitor's ability to withstand voltage.



Electrode material

The withstand voltage, conductivity, and ESR of different materials may vary.

Electrode surface polishing condition

Improving the smoothness of the electrode surface through polishing can enhance insulation capacity.

Peak Test Voltage

Vacuum capacitor can withstand the peak test voltage without flashover, arcing, glow or breakdown within 1min at 50Hz/60Hz frequency. Peak Test Voltage must be tested before a capacitor is put in storage, delivery or installation. Peak Testing Voltage rating is only suitable for AC and not for DC.

RF Working Voltage

It's the maximum RF working voltage that a vacuum capacitor can withstand. For safety and reliability, it should be less than 60% of the peak test voltage rating. The suitable RF frequency range of vacuum capacitor should be ⩽ 100MHz and the capacitance must be considered. This frequency range is dependant to their inherent resonant frequency of each unit. Peak working voltage is a permissible value of an application. Peak working voltage is a permissible value of an application. When a customer chooses a capacitor, the suggested working voltage is less than or equal to 60% of Peak Test Voltage (Upt).

Permissible Current

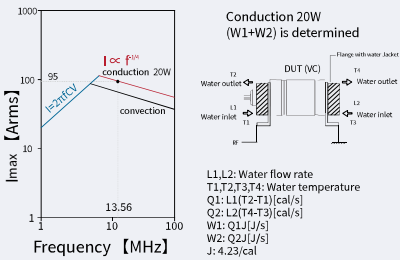
<1> Permissible Current is limited by RF working voltage: $I=2\pi fCV$

<2>Permissible Current is continuous current which may not exceed permissible surface temperature(silver plating:125 °C) and Permissible Current is limited by the skin effect:

$$I=I_{RF}(f_{RF}/f)^{1/4}$$

I_{RF}:RF permissible current,(f_{RF}:13.56MHz)

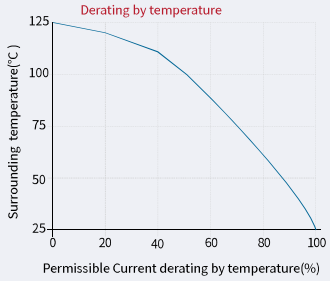
TECHNICAL INFORMATION



<3> Permissible Current is detemined by the allowable surface temperature of vacuum capacitor, therefore if the ambient temperature is higher, the allowable current is derated and lower.

$$I(Ta)=Imax\sqrt{\frac{Tmax-Ta}{Tmax-25}}$$

Ta:Ambient Temperature
Tmax:Allowable Surface Temperature
I(Ta):Allowable Current
Imax:Max. Allowable Current



DC Leakage Current

The expected value for DC leakage current is "less than 10μA" when 60 % of the peak test voltage is applied in DC. It shall be measured at the maximum capacitance position. The measured value varies according to storage duration and energization.

Capacitance

<1> Accuracy of vacuum capacitor
Fixed capacitor with nominal capacitance ⩽ 50pF are allowable tolerance within±10%.
Nominal capacitance >50pF have a tolerance of ±5%.

Variable capacitor can be adjusted from nominal capacitance to minimum capacitance by turn the lead screw.The tolerance of maximum capacitance is ±5%of nominal capacitance.
The normal tolerance of the linear range is less than±5%.Minimum tolerance can reach ±1% according to user requirement.

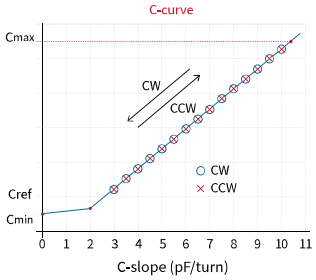
<2> Calculation of Capacitance
GLVAC have 2 types of electrode:
(1) Spiral electrode

$$C=\frac{\varepsilon wl}{d}$$

d:electrode gap;
w:seat length;
l:cross length;
ε:dielectric constant;
(2) Thin cylinder electrode

$$\Sigma\ C=\frac{2\pi\varepsilon l}{\cosh^{-1}\left(\frac{a^2+b^2-f\alpha^2}{2ab}\right)}$$

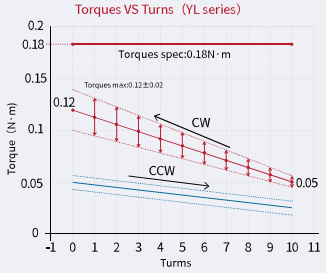
a:outer cylinder radius;
b:inner cylinder radius;
α:misalignment;



* from Cref turns to Cmax turns:linear;
* from Cmin turns to Cref turns:nolinear.

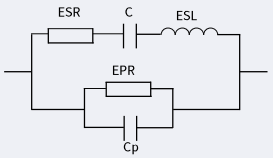
Torque

The torque of variable vacuum capacitor is primarity determined by:
<1> Vacuum capacitor's atmospheric pressure force
<2> Weight of moving-side electrode part
<3> Screw efficiency (diameter, lead etc.)
<4> Frictional force of the sliding part(combination of the shaft, the screw and the lubricant agent)
<5> Torque formula:



Equivalent Circuit of Vacuum Capacitor

Equivalent circuit of vacuum capacitor is shown as below:

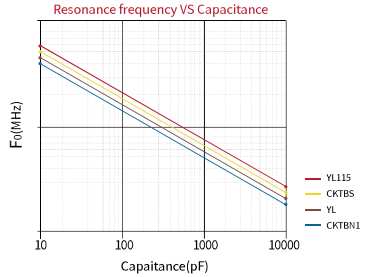


C:Capacitance
ESR:Equivalent Series Resistance
EPR:Parallel Equivalent Resistance
ESL:Equivalent Series Inductance
Cp:Parasitic Capacitance of ceramic envelope

The self-resonance frequency and ESL

<1> The self-resonance frequency
The self-resonance frequency is inversely proportional to the product capacity value.

$$f_0=\frac{1}{2\pi\sqrt{ESL\times C}}$$



<2> ESL

$$ESL=\frac{1}{4\pi^2cf_0^2}$$

ESL component:bellows and VC diameter
Bellows ESL is 5nH
Electrode ESL is directly proportional to the VC diameter.

TYPE	ESL(MH)at13.56MHz
CKTBN1	7.5~9.0
YL	6.0~8.5
CKTBS	3.5~5.0
YL115	3.0~4.0

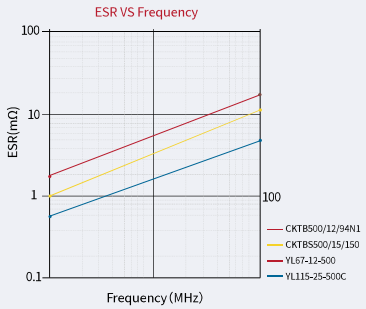
ESR

ESR_0 [resonance] is calculated by: $\frac{1}{2\pi f_0 CQ}$

ESR (13.56MHz)= $ESR_0\times\sqrt{13.56/f_0}$

TECHNICAL INFORMATION

f_0=resonance frequency
Q=Q factor
by measured impedence analyser
ESR is directly proportional to $\sqrt{f}$



Mechanical Life

The life of variable vacuum capacitor depends on bellows' life and screw system's life. Bellows' life is mainly determined by the working range.The screw system's life depends on temperature, torque (acceleration) and the turning speed.

<1> Bellows life
Maximum current(95A) under the condition of conduction 20W, VC surface temperature is arround 125 °C , that time estimated bellows temperature is arround 200 °C and bellows life time become to reduce. If current is larger than 95A, then the estimated bellows temperature is arround 300 °C , in this case, bellows life is arround half life time.

<2> Screw life

TYPE: YL56-8-500,CKTB500/8/94
Test condition:
Temperature:125 °C
Turn speed:600rpm
Acceleration:4.5rpm/ms

TYPE	Tures/million
CKTBN1	30
YL	30

Remark:

- Lift time is decided by over the specified torque. We recommend a regrease cycle every 200 thousand turns.
- It's also necessary to connect motor and vacuum capacitor with a maximum misalignment of less than 0.2mm.