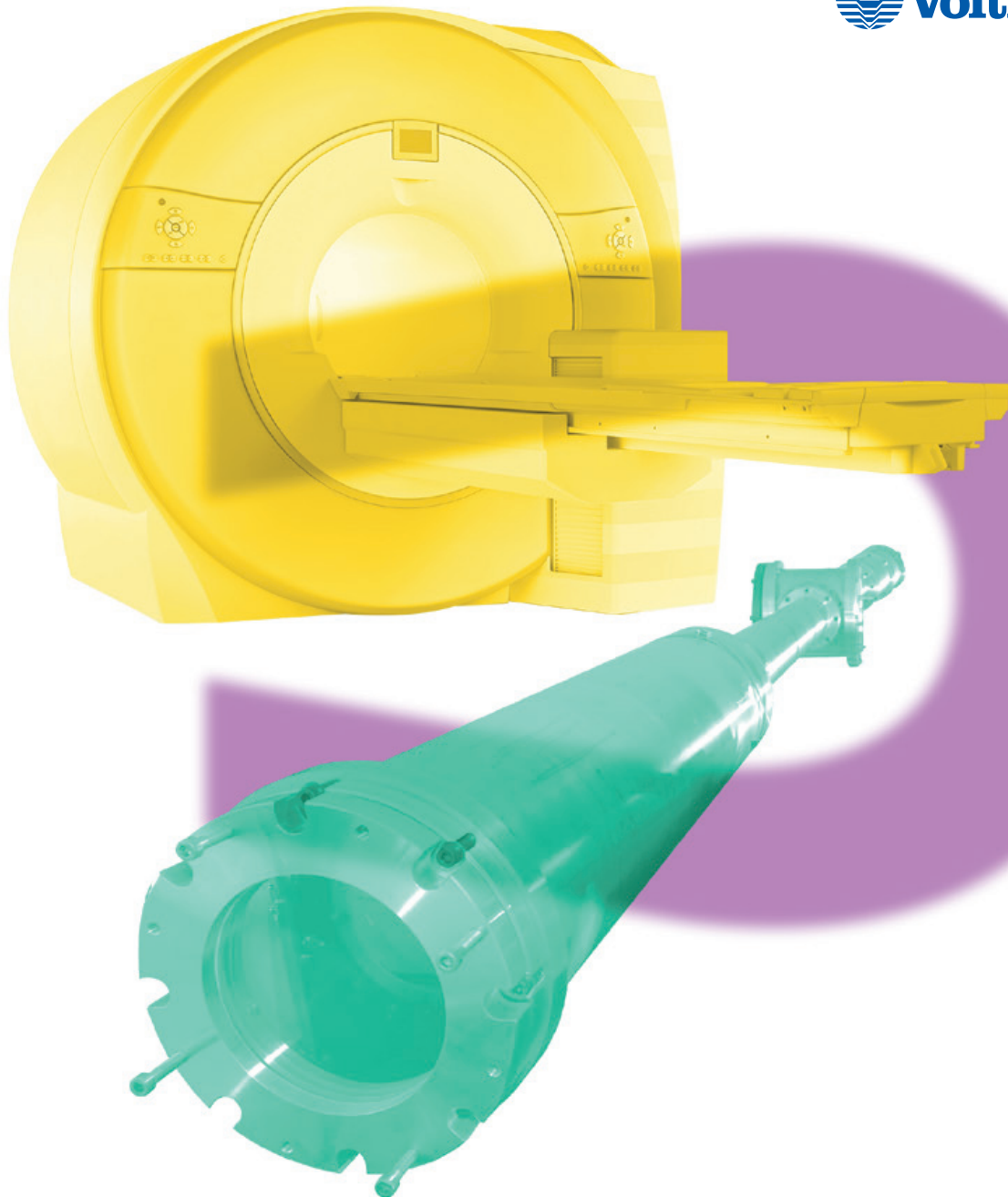


Non-Magnetic Capability Guide



DLI•JohansonMFG•Novacap•Syfer•Voltronics

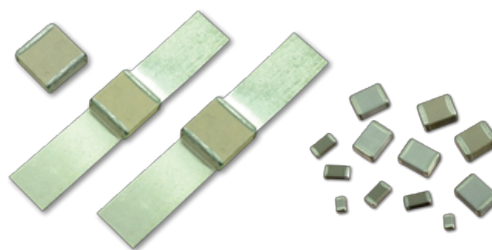
Non-Magnetic and High Power RF Capacitors

High Q, COG/NP0, X7R
16V to 7.2kV

MLC capacitors with silver/palladium (Ag/Pd) terminations have often been used in medical applications where non-magnetic components are required, for example in MRI equipment - however, conventional nickel barrier terminations are not suitable due to their magnetic properties. In addition, RoHS requirement to use lead-free solders would cause an increase in soldering temperatures and cause solder leaching problems for the Ag/Pd termination. This has meant alternatives have had to be found and one solution is to use a copper barrier, instead of a nickel barrier, with a tin finish on top. This non-magnetic termination is offered with selected non-magnetic COG/NP0, High Q and X7R dielectrics, providing a fully non-magnetic component ($\mu r = 1.0000$).

To meet high temperature 260°C soldering reflow profiles as detailed in J-STD-020, COG/NP0 dielectrics are supplied with FlexiCap™ or sintered termination whilst X7R dielectrics are supplied only with the FlexiCap™ termination.

Available in chip or ribbon led format for certain case sizes (consult sales office).



High Power RF capacitors

A range of ultra-low High Q ceramic capacitors with COG/ Porcelain P90/ $\pm 15\text{ppm}/^\circ\text{C}$ characteristics suitable for high power applications where minimal power loss and very low self heating is demanded.

Common applications include MRI body coils and wireless charging systems operating in the kHz and MHz frequencies.

2225 and 4040 available in chip or ribbon led format.

COG/NP0 & High Q - min/max cap. values

Chip Size	0402	0603	0505	0805	1206	1210	1808	1812	2220
Min Cap	0.1pF	0.1pF	0.2pF	0.2pF	0.5pF	0.3pF	1.0pF	1.0pF	2.0pF
Min Cap Tolerance	$\pm 0.05\text{pF}$ ($< 4.7\text{pF}$) 0.1pF ($\geq 4.7\text{pF}$ & $< 10\text{pF}$) and $\pm 1\%$ ($\geq 10\text{pF}$)								
50V 63V	22pF	100pF	220pF	470pF	1.5nF	-	-	-	-
100V	15pF	68pF	150pF	330pF	1.0nF	2.2nF	2.2nF	4.7nF	10nF
150V	10pF	47pF	100pF	220pF	680pF	1.5nF	1.5nF	3.3nF	6.8nF
200V 250V	6.8pF	33pF	56pF	150pF	470pF	1.0nF	1.0nF	2.2nF	4.7nF
300V	-	27pF	47pF	120pF	390pF	820pF	820pF	1.8nF	3.9nF
500V	-	-	-	68pF	270pF	680pF	680pF	1.5nF	3.3nF
630V	Min Capacitance Tolerance $\pm 0.05\text{pF}$ ($< 4.7\text{pF}$) 0.1pF ($\geq 4.7\text{pF}$ & $< 10\text{pF}$) $\pm 1\%$ ($\geq 10\text{pF}$)				150pF	390pF	390pF	1.0nF	2.2nF
1000V					82pF	220pF	220pF	680pF	1.5nF
2000V					18pF	68pF	68pF	150pF	470pF
3000V					-	-	-	68pF	150pF

High Power RF Caps Q material - min/max cap. values

Chip size	1111		Case size 25 - 2225		Case size 40 - 4040	
	Min.	Max.	Min.	Max.	Min.	Max.
100V	1.8nF	2.2nF	-	-	-	-
150V	1.2nF	1.5nF	-	-	-	-
200V	-	-	6.2nF	10nF	16nF	27nF
250V	820pF	1nF	-	-	-	-
500V	470pF	680pF	5.1nF	5.6nF	13nF	15nF
630V	270pF	390pF	3.9nF	4.7nF	12nF	12nF
1kV	82pF	220pF	1.2nF	3.3nF	5.6nF	10nF
2kV	0.3pF	68pF	510pF	1.0nF	1.6nF	5.1nF
3kV	-	-	120pF	470pF	910pF	1.5nF
3.6kV*	-	-	1nF	47*/100pF	-	-
4kV	-	-	-	-	620pF	820pF
5kV	-	-	-	-	390pF	560pF
6kV	-	-	-	-	160pF	330pF
7.0/7.2kV	-	-	-	-	1pF	56**/150pF

Notes: *2225 - 47pF max. for dual rated @2.5kVdc 30MHz

**4040 - 56pF max. for dual rated @5kVdc 30MHz.

X7R - min/max cap. values

Chip Size	0402	0603	0805	1206	1210	1808	1812	2220
Min Cap	47pF	100pF	330pF	680pF	1.5nF	2.2nF	3.3nF	6.8nF
Min Cap Tolerance	$\pm 5\%$							
16V	10nF	100nF	330nF	1.0μF	1.5μF	1.5μF	3.3μF	5.6μF
25V	6.8nF	68nF	220nF	820nF	1.2μF	1.2μF	2.2μF	4.7μF
50V 63V	4.7nF	47nF	150nF	470nF	1.0μF	1.0μF	1.5μF	3.3μF
100V	1.5nF	10nF	47nF	150nF	470nF	330nF	1.0μF	1.5μF
200V 250V	680pF	5.6nF	27nF	100nF	220nF	180nF	470nF	1.0μF
500V	-	1.5nF	8.2nF	33nF	100nF	100nF	270nF	560nF
630V	-	-	4.7nF	10nF	27nF	33nF	150nF	330nF
1000V	-	-	3.3nF	4.7nF	15nF	18nF	56nF	120nF
1200V	Min Capacitance Tolerance $\pm 5\%$			3.3nF	10nF	10nF	33nF	82nF
1500V				2.7nF	6.8nF	6.8nF	22nF	47nF
2000V				2.2nF	4.7nF	4.7nF	10nF	27nF

High Power RF Caps - min/max cap. values - F & H materials

Chip Size	Case size 5 0505		Case size 11 1111		Case size 25 2225		Case size 38 3838	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
50V	-	-	680pF	1nF	-	-	-	-
100V	-	-	510pF	620pF	-	-	-	-
200V	36pF	100pF	220pF	470pF	-	-	-	-
250V	0.1pF	33pF	-	-	-	-	-	-
300V	-	-	-	-	2.2nF	2.7nF	-	-
500V	-	-	110pF	200pF	1.5nF	1.8nF	2.7nF	5.1nF
1kV	-	-	0.1pF	100pF	510pF	1.2nF	750pF	2.2nF
1.5kV	-	-	-	-	300pF	470pF	-	-
2kV	-	-	-	-	-	-	-	-
2.5kV	-	-	-	-	0.3pF	270pF	430pF	680pF
3.6kV	-	-	-	-	-	-	110pF	390pF
7.2kV	-	-	-	-	-	-	0.3pF	100pF

Note: Special capacitance values available upon request.

High Power RF & Ribbon Ledged capacitors - Ordering information

11		470		J		1000		W		F		R	
Chip size		Capacitance		Tolerance		Voltage		Termination		Material		Lead/Packaging	
4	0402*	OR1	0.1pF	A	±0.05pF	50	50V	W	Ag/Cu/Sn (H & F dielectrics only)	H	AH +90±20ppm/°C	R	Ribbon
5	0505		10pF	B	±0.1pF	100	100V	S	Pd/Ag (H & F dielectrics only)	F	CF 0±15ppm/°C	T	Tape & Reel
6	0603*		100pF	C	±0.25pF	1000	1000V	M	Poly/Cu/Sn (H & F dielectrics only)	Q	High Q 0±30ppm/°C	B	Bulk
8	0805*		1000pF	D	±0.5pF	etc.		2	Ag/Cu/Sn - (Q dielectric only)	X	X7R (2R1)		
11	1111†			F	±1%			3	Poly/Cu/Sn - (X dielectric only)				
12	1206*			G	±2%			B	Silver - (Q ribbon only)				
13	1210*			J	±5%			V	Silver, laquer Coated - (Q ribbon only)				
18	1812*			K	±10%								
22	2220*			M	±20%								
25	2225†												
38	3838†	*X and Q dielectric only. † Ribbon Leads available.											
40	4040†												

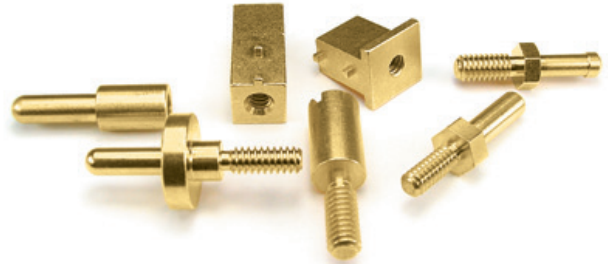
*X and Q dielectric only. † Ribbon Leads available.

Hardware and assorted Non-Magnetic Components

Due to the severe non-magnetism requirements in the magnetic resonance industries, we use only high purity metals that exhibit no measurable magnetism. Commercial brass is simply not acceptable for these applications. Our strict traceability and testing regimes insure this essential parameter.

We can offer sizes, styles, and lengths beyond those shown in the tables on these pages – such as Cheese Head, Round Head and set screws. We also offer flat washers to complete your needs.

Coils also require inserts, pins, and other special shapes that are custom-designed to satisfy the specific requirements of the coil designer. The ability to quickly and precisely supply custom designs is part of our heritage and we are eager to sample our high quality hardware based on your requirements. As with the screws, washers and nuts, we use only high purity metals that exhibit no measurable magnetism.



Pan Head

2-56 Thread	
48-109	5/64"
48-107	3/32"
48-105	3/16"
48-100	1/25"
48-106	5/16"
48-101	3/8"
48-102	1/2"
48-101	5/8"
48-104	3/4"
48-108	1"
48-500	Hex Nut
4-40 Thread	
48-115	3/16"
48-110	1/4"
48-116	5/16"
48-111	3/8"
48-112	1/2"
48-117	5/8"
48-113	3/4"
48-114	1"
48-118	2"
48-501	Hex Nut
6-32 Thread	
48-120	1/4"
48-124	3/16"
48-121	3/8"
48-122	1/2"
48-123	3/4"
48-125	1"
48-502	Hex Nut
8-32 Thread	
48-130	1/4"
48-131	3/8"
48-132	1/2"
48-133	3/4"
48-503	Hex Nut
10-32 Thread	
48-140	1/4"
48-141	3/8"
48-142	1/2"
48-143	5/8"
48-144	3/4"
48-145	1"
48-505	Hex Nut
1/4-20 Thread	
48-150	3/8"
48-152	1/2"
48-151	1"
48-153	1-1/4"
48-506	Hex Nut

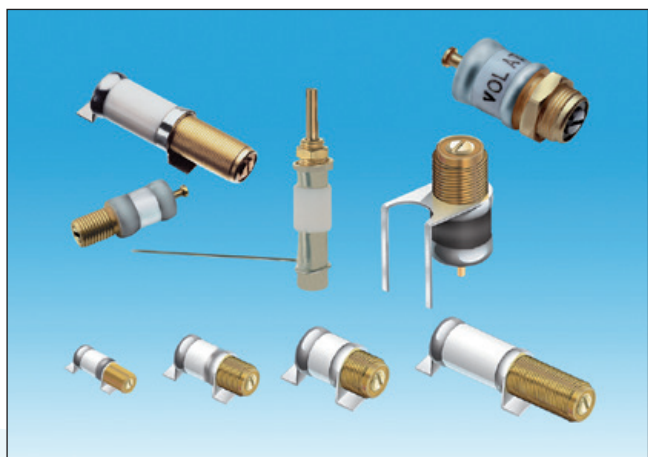
M2 x .4 Thread	
48-300	6mm
48-301	12mm
48-302	16mm
48-600	Hex Nut
M2.5 x .45 Thread	
48-310	8mm
48-601	Hex Nut
M3 x .5 Thread	
48-320	5mm
48-321	6mm
48-322	7.5mm
48-323	8mm
48-324	10mm
48-325	12mm
48-326	16mm
48-327	20mm
48-602	Hex Nut
M4 x .7 Thread	
48-330	8mm
48-331	10mm
48-332	12mm
48-333	16mm
48-334	20mm
48-335	25mm
48-603	Hex Nut
M5 x .8 Thread	
48-340	8mm
48-341	10mm
48-342	12mm
48-343	16mm
48-344	20mm
48-345	25mm
48-604	Hex Nut

Flat Head

2-56 Thread	
48-205	9/64"
48-203	3/16"
48-200	1/4"
48-204	3/8"
48-201	1/2"
48-202	1"
48-500	Hex Nut
4-40 Thread	
48-210	1/4"
48-216	5/16"
48-211	3/8"
48-212	1/2"
48-213	3/4"
48-214	1"
48-215	1-1/4"
48-501	Hex Nut
6-32 Thread	
48-220	1/4"
48-221	3/8"
48-228	7/16"
48-222	1/2"
48-223	3/4"
48-224	1"
48-225	1-1/4"
48-229	1-3/8"
48-226	1-1/2"
48-227	1-3/4"
48-502	Hex Nut
8-32 Thread	
48-230	3/8"
48-231	1/2"
48-232	5/8"
48-233	3/4"
48-503	Hex Nut
10-32 Thread	
48-240	3/8"
48-241	1/2"
48-242	5/8"
48-243	3/4"
48-244	1"
48-245	1-1/4"
48-505	Hex Nut
1/4-20 Thread	
48-250	3/4"
48-506	Hex Nut

M2 x .4 Thread	
48-400	5mm
48-401	10mm
48-600	Hex Nut
M3 x .5 Thread	
48-415	6mm
48-410	8mm
48-411	10mm
48-412	12mm
48-413	16mm
48-414	20mm
48-602	Hex Nut
M4 x .7 Thread	
48-420	8mm
48-421	10mm
48-422	12mm
48-423	16mm
48-424	20mm
48-603	Hex Nut
M5 x .8 Thread	
48-430	8mm
48-431	10mm
48-432	12mm
48-433	16mm
48-434	20mm
48-435	25mm
48-604	Hex Nut

Non-Magnetic Trimmer Summary

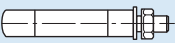


Increasing magnetic resonance applications caused Voltronics to launch an active engineering effort in this field years ago, one that continues today. Due to the severe non-magnetism requirements in these industries, we use only materials that exhibit no measurable magnetism. Commercial brass and plating materials are not acceptable. Our strict traceability and testing regimes ensure this essential parameter.

Most of our trimmers are internally sealed so that they withstand immersion in flux and solvents without leaking. Most of our non-magnetic trimmers can be offered in cryogenic format to be used and tuned at temperatures as low as 4K. Many of our selection of trimmers have been developed for specific customer needs.

Voltronics have developed a unique test setup to allow for Q and RF Voltage breakdown measurement at MRI operational frequencies. This has allowed for development of improved parts designed specifically to meet the stringent requirements of the application.

Product Selection Guide - Consult Factory for Complete Catalog

Product Line	Description	Series	Maximum Capacitance	Maximum DC Working Voltage	Typical minimum Q value
A1_4/8  A1_12 	Miniature PTFE Dielectric	NM A4_HV	12pF	1000	2000 - 4000
A4_3  A4_5 		NM A1_HV	5pF	1000	2000 - 3000
A_HV 	High Voltage PTFE Dielectric	NM A_HV	30pF	1000	2000
A_HV Ext Range 		NM A_HV	55pF ext. range	1000	780 - 2000
K_HV 		NM K_HV	15pF	1000	780 - 2000
NT 	20kV PTFE Dielectric	NM NT	95pF	10000	2000
GLASS  	Glass Dielectric	NM HTM NM TF NM TM NM TP	250pF 36pF 130pF 180pF	1250 1000 1250 1250	250 - 1000
QUARTZ 	Quartz Dielectric	NM QM	24pF	1250	2000
SAPPHIRE 	Sapphire Dielectric	NM P	40pF	500	1500 - 4000

NMNT Series - Non-Magnetic PTFE Trimmer Capacitors



4kV to 10kV

Voltronics NMNT series of PTFE trimmers are designed for applications requiring greater capacitance and voltage ratings than the popular smaller trimmers but without the large size and expense of vacuum capacitors.

The NMNT Line offers:

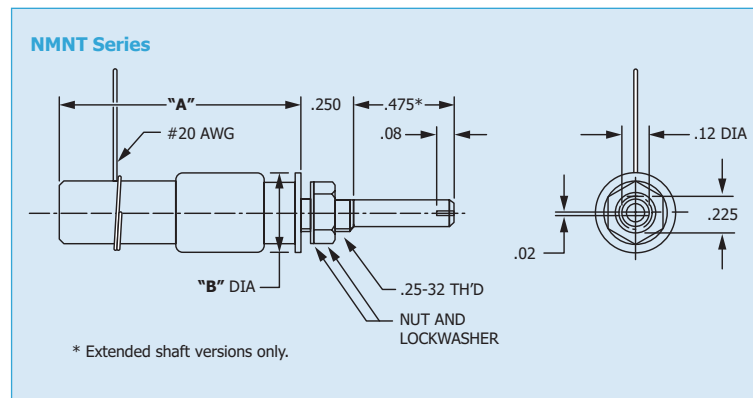
- High voltage
- Non-rotating piston, long life and no tuning noise
- Extremely stable under shock and vibration
- Screw head does not move in and out

Proven RF performance and power handling these high performance trimmer capacitors are utilized in MRI body coils, NMR equipment and RF power transfer applications.

Part Number	DC Working Voltage	DC Withstanding Voltage	Capacitance (pF) <	Capacitance (pF) >	"A" Dim ±.06	"B" Dim ±.06
NMNT2-20	10000	20000	1.0	2.0	1.205	1.125
NMNT5-8	4000	8000	1.0	5.0	1.13	0.31
NMNT5-18	8750	17500	1.0	5.0	2.0	0.75
NMNT10-6	3000	6000	1.0	10.0	1.15	0.38
NMNT10-12	6000	12000	2.0	10.0	1.83	.063
NMNT15	2000	4000	1.0	15.0	1.69	0.31
NMNT23-6	3000	6000	3.0	23.0	1.70	0.38
NMNT23-12	6000	12000	3.0	23.0	1.845	0.63
NMNT25-6	3000	6000	5.0	25.0	1.62	.063
NMNT25-15	7500	15000	7.0	25.0	1.77	1.13
NMNT30	3000	6000	4.0	30.0	2.25	1.50
NMNT50	4500	9000	5.0	50.0	2.25	1.50
NMNT70-6	3000	6000	2.5	70.0	3.00	0.70
NMNT70-15	7500	15000	6.5	70.0	3.25	1.63
NMNT85	3000	6000	5.0	85.0	3.25	1.50
NMNT100-4	2500	3600	2.0	95.0	4.25	0.31

Note: Preferred parts. Others available but may be subject to an increased MOQ.

Dimensions -



JZ & JZ_HV Series - Ceramic Chip Trimmer Capacitors



Voltronics has been offering high performance, High Q, half-turn trimmer capacitors for over two decades. The J-series is a proven performer that delivers uncompromising stability for even the most demanding applications, such as RFID, medical devices, cellular technologies, and much more. Available in standard and HV ranges up to 50pF and 300Vdc working voltage.

Whilst not meeting the ultimate non-magnetic specifications of the other parts in this brochure, the J-series have a very low magnetic material content rendering them suitable for many MRI applications.

General Specifications

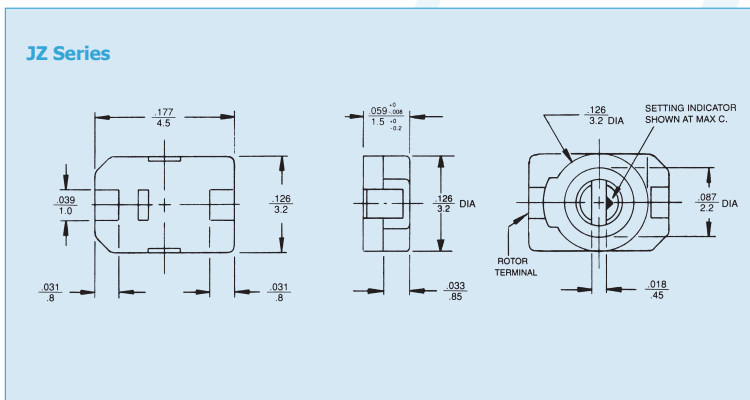
Part No. JZ Series	JZ030	JZ060	JZ080	JZ100	JZ150	JZ200	JZ300	JZ400	JZ500
DC Working Voltage	125	125	125	125	125	125	125	125	125
DC Withstanding Voltage	250	250	250	250	250	250	250	250	250

Part No. JZ_HV Series	JZ030HV	JZ060HV	JZ080HV	JZ100HV	JZ150HV	JZ200HV	JZ300HV	JZ400HV
DC Working Voltage	350	350	350	350	350	350	350	350
DC Withstanding Voltage	700	700	700	700	700	700	700	700

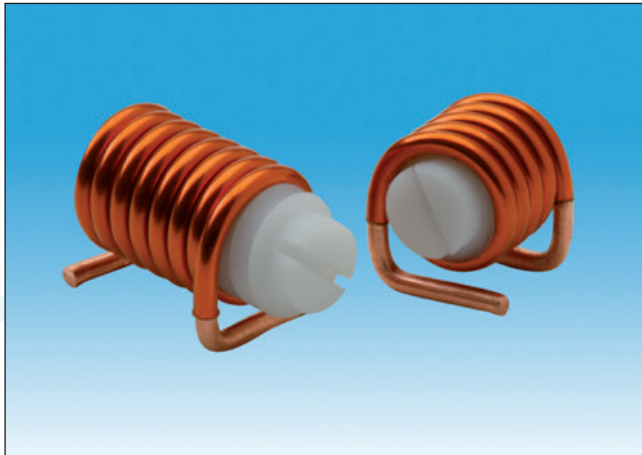
Capacitance (pF)	Minimum Maximum	1.5 3.0 +50% -0%	2.0 6.0 +50% -0%	3.0 8.0 +50% -0%	2.0 10.0 +100% -0%	3.0 15.0 +100% -0%	4.5 20.0 +100% -0%	5.5 30.0 +100% -0%	8.0 40.0 +100% -0%	8.0 50.0 +100% -0%
Marking Color*		Black	Blue	Violet	White	Pink	Red	Orange	Yellow	Green
Temperature Coefficient (ppm/°C)		0 ± 200	0 ± 300	-750 ± 500	0 ± 300	0 ± 300	0 ± 500	-1500 ± 1000	-1500 ± 1000	-1500 ± 1000
Approximate Self Resonant Frequency at Maximum Rated Capacitance	JZ_HV Series	2.1GHz	1.5GHz	1.25GHz	1.16GHz	0.92GHz	0.81GHz	0.70GHz	0.60GHz	0.53GHz
Insulation Resistance		10 ⁴ megohms								
Operating Temperature		-40°C to +85°C (Tunable temp range -25°C to +85°C)								
Torque		0.14 to 1.0 in-oz								
Packaging		All parts furnished on 12mm tape and reel. 1,000 pcs. per reel.								

* HV parts are indicated by a second, green dot.

Dimensions - Drawing tolerances where not specified ± 0.008"/0.2mm



Non-magnetic variable inductors



Applications

- MRI / NMR Systems
- Radios / Jammers
- Power Amplifiers
- Radar
- Avionics Instrumentation
- Test Equipment

Characteristics

- Precision machined design. US Patent No. 8,248,198
- 7mm high horizontal SMD
- Vertical SMD and thru-hole versions
- Nominal values of 32 to 118nH, 2 to 7 turns
- Q as high as 121 @ 100MHz, SRF 0.7 to 1.2GHz
- Superb shock, vibration and thermal tolerances
- -40°C to +85°C
- Customized version requests welcomed

	Part No.	L(nH) Q				@ 100MHz	SRF (GHz)	Turns	Thread (mm)
		Min	Nom	Max	No Core				
Surface Mount - Horizontal	VTC02E030TRSM	32	33	34	39	90	1.2	2	6
	VTC03E048TRSM	46	49	52	59	95	1	3	6
	VTC04E065TRSM	60	64	68	78	101	0.9	4	6
	VTC05E088TRSM	74	81	87	99	114	0.9	5	8
	VTC06E110TRSM	94	107	119	123	119	0.7	6	8
	VTC07E130TRSM	104	118	133	142	121	0.7	7	10
	VTC09E160TRSM	122	139	170	191	162	0.58	9	13
	VTC13E250TRSM	185	219	270	294	199	0.43	13	18
	VTC19E375TRSM	281	345	436	457	171	0.31	19	25
	Part No.	L(nH) Q				@ 100MHz	SRF (GHz)	Turns	Thread (mm)
		Min	Nom	Max	No Core				
Surface Mount - Vertical	VTC02E030TVSM	32	33	34	39	90	1.2	2	6
	VTC03E048TVSM	46	49	52	59	95	1	3	6
	VTC04E065TVSM	60	64	68	78	101	0.9	4	6
	VTC05E088TVSM	74	81	87	99	114	0.9	5	8
	VTC06E110TVSM	94	107	119	123	119	0.7	6	8
	VTC07E130TVSM	104	118	133	142	121	0.7	7	10
	Part No.	L(nH) Q				@ 100MHz	SRF (GHz)	Turns	Thread (mm)
		Min	Nom	Max	No Core				
Thru Hole Mount - Vertical	VTC02E030TVPC	32	33	34	39	90	1.2	2	6
	VTC03E048TVPC	46	49	52	59	95	1	3	6
	VTC04E065TVPC	60	64	68	78	101	0.9	4	6
	VTC05E088TVPC	74	81	87	99	114	0.9	5	8
	VTC06E110TVPC	94	107	119	123	119	0.7	6	8
	VTC07E130TVPC	104	118	133	142	121	0.7	7	10



knowles

DLI • Johanson MFG • Novacap • Syfer • Voltronics

Knowles Capacitors designs, manufactures and sells special electronic components. Our products are used in military, space, telecom infrastructure, medical and industrial applications where function and reliability are crucial.



Knowles (Cazenovia)
2777 Route 20 East, Cazenovia,
NY 13035 USA

Phone: +1 315 655 8710
Fax: +1 315 655 0445
KCCSales@knowles.com



Knowles (Cazenovia)
2777 Route 20 East, Cazenovia,
NY 13035 USA

Phone: +1 315 655 8710
Fax: +1 315 655 0445
KCCSales@knowles.com



Knowles (Valencia)
25111 Anza Drive, Valencia,
CA 91355 USA

Phone: +1 661 295 5920
Fax: +1 661 295 5928
NovacapSales@knowles.com



Knowles (UK) Ltd
Hethel Engineering Centre, Chapman Way,
Hethel, Norwich, Norfolk NR14 8FB

Phone: +44 1603 723300
Fax: +44 1603 723301
SyferSales@knowles.com



Knowles (Cazenovia)
2777 Route 20 East, Cazenovia,
NY 13035 USA

Phone: +1 315 655 8710
Fax: +1 315 655 0445
VoltronicsSales@knowles.com