



VANGUARD ELECTRONICS

Highly Engineered Solutions

SINCE 1952

Designing and Application Considerations for Space Grade Ferrite Beads



THE 26TH ANNUAL
COMPONENTS
FOR MILITARY & SPACE ELECTRONICS
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iNRCORE FAMILY OF BRANDS

World Class Designer and Manufacturer of Catalog and Custom Passive Components



iNRCORE

Designs and manufactures magnetic components that transmit high-speed, mission-critical signal and power in the harshest operating conditions.

incore.com



Gowanda Electronics

Inductors, broadband conicals, defense QPL, magnetic devices, non-magnetic designs, transformers, filters, bias tees, resistors, capacitors, delay lines and solenoids.

gowanda.com



Vanguard Electronics

Designs and manufactures high-reliability inductors and transformers that operate defect-free in demanding environments. Specializes in high performance RF and power product.

VE1.com



Custom Magnetics

Manufacturers of high performance custom magnetic components, DC Solenoids and electronic assemblies for high reliability applications, including rail transportation safety systems.

biconusa.com
dycoelectronics.com
hisonic.com



TTE Filters

Develop and manufacture of high-quality RF and microwave filters, bias tees, diplexers, multiplexers, amplitude equalizers and EMI/RFI filters, especially for critical test and measurement applications.

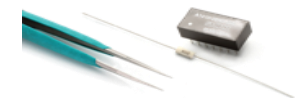
tte.com



RCD Components

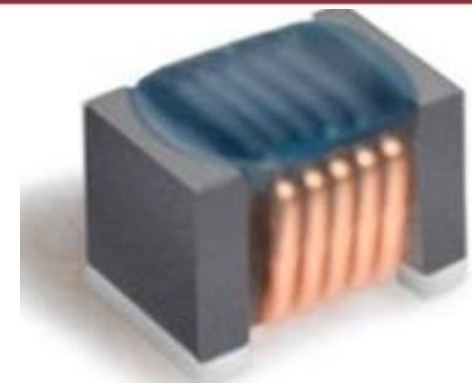
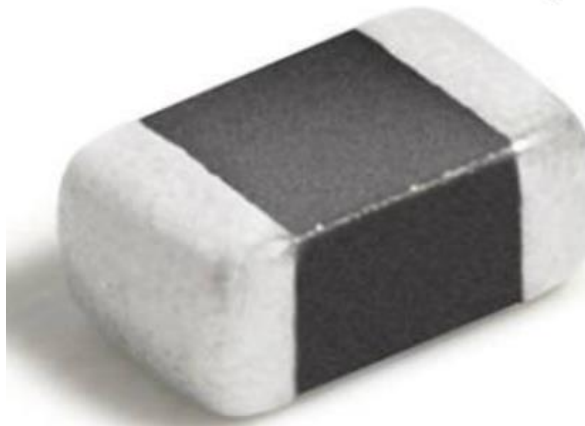
Manufacturer of passive components, including resistors, capacitors, coils and delay lines for the aerospace, medical, defense and commercial industries.

rcdcomponents.com



Understanding Ferrite Beads

- A bead is one method used to attenuate high-frequency electromagnetic interference (EMI) in a circuit.
- It works like a low pass filter that allows only low frequency signals to pass through a circuit and eliminates the high-frequency.
 - It is resistive over the desired frequency range
 - Dissipates the EMI energy in the form of heat
- They are widely used on all applications from cells phones to satellites.
- Methods to attenuate EMI:
 - At the Panel/Box Level
 - Solder in Filters
 - Bolt in Filters
 - Board Level
 - Wirewound
 - Traditional Chip (Multilayer)



Ferrite Beads DOs and DON'Ts

- Care must be taken on selection
 - DO NOT
 - Use Ferrite Beads to control ripple
 - Attempt to Bridge Ground Planes with Beads (different potential)
 - Exception – Analog and Digital power planes (same potential)
 - Use to control AC Power Lines, place a bypass cap
 - At Low Frequencies, Beads can act as inductors!
 - Ferrite Beads are not inductors (they dissipate EMI in the form of heat), not store energy (inductor)
 - DO
 - Be careful on Cap selection you do not resonate
 - Be Mindful of L and C parasitics
 - Be Aware that Performance Changes over Current
 - Install Bead inline with circuitry to insulate DC/DC Converter and Analog lines



Helpful Equations

Ferrite Bead Basic Model

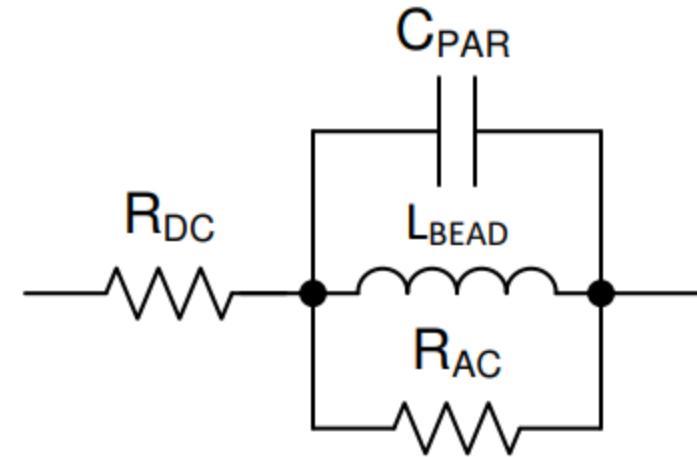
3 Key Components

R_{DC} DC Resistance

R_{AC} AC Resistance

C_{PAR} Parasitic Capacitance

L_{BEAD} – Inductance



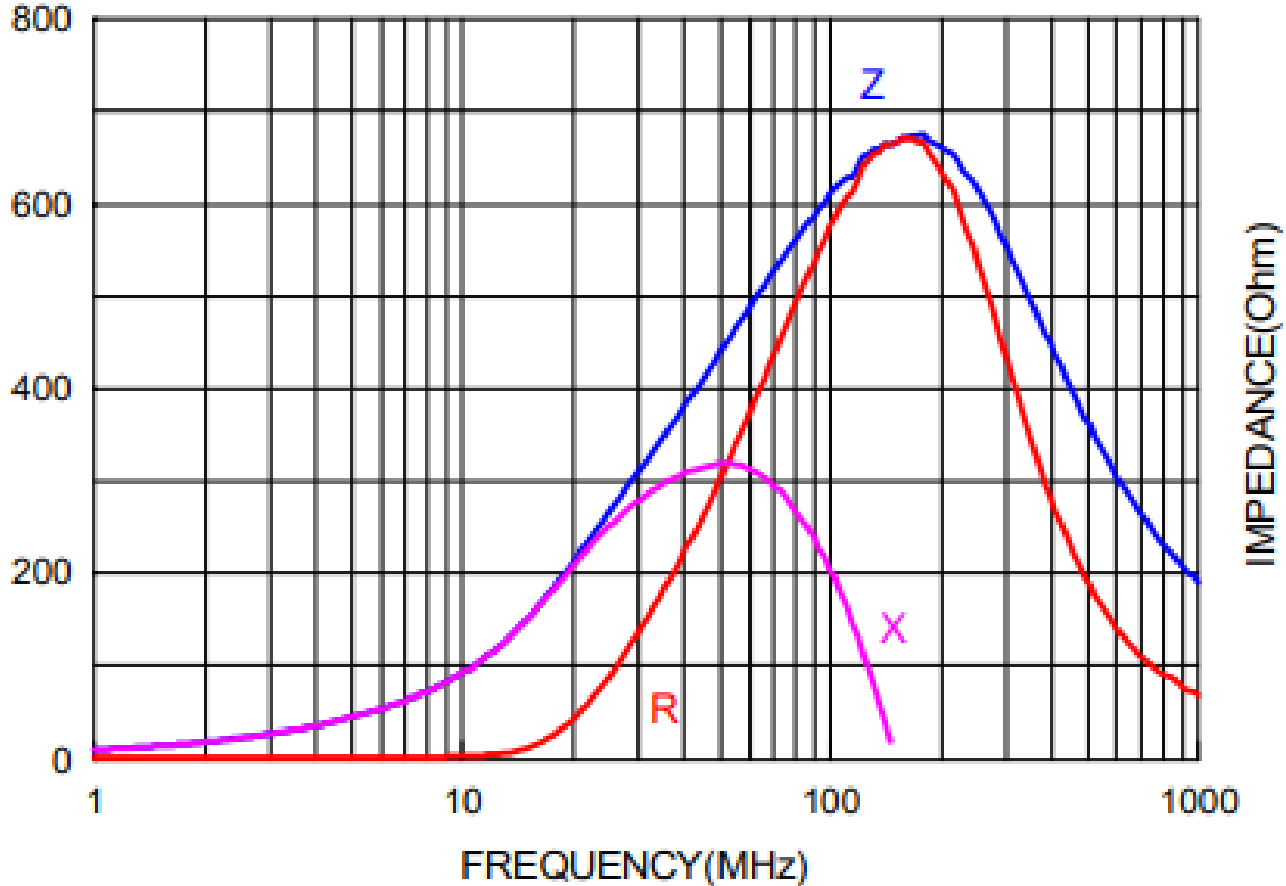
Inductive Component becomes dominant at lower frequencies

C_{PAR} becomes dominant at or above SRF

$$L_{BEAD} = \frac{X_L}{2 \times \pi \times f}$$

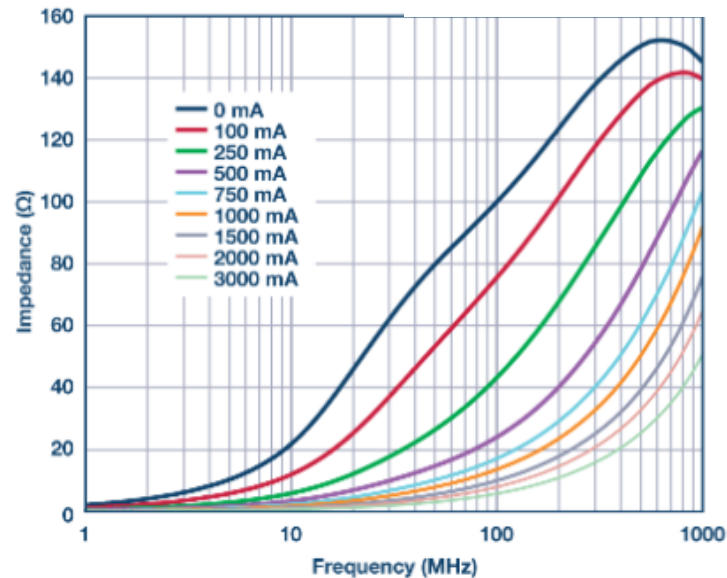
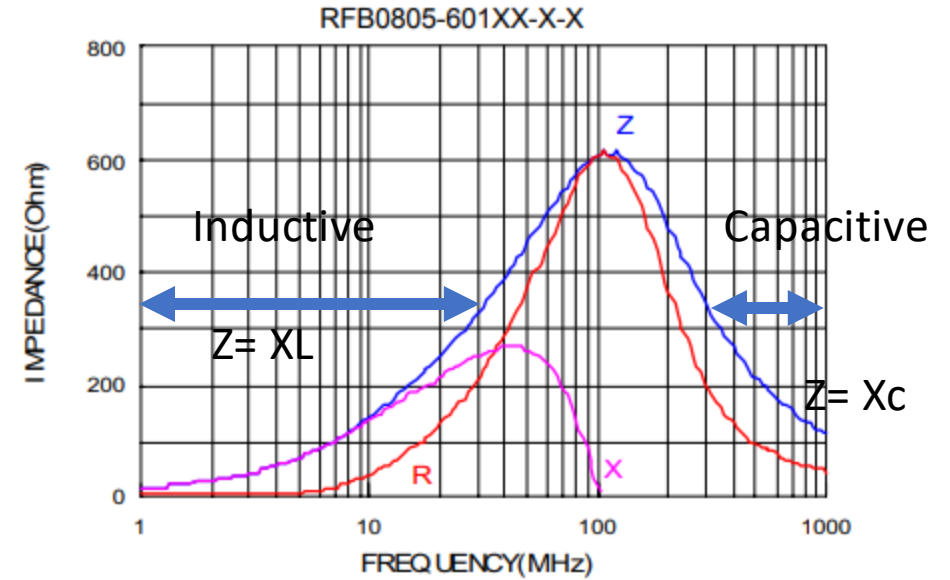
$$C_{PAR} = \frac{1}{2 \times \pi \times f \times |X_C|}$$

RFB0603-601XX-X-X



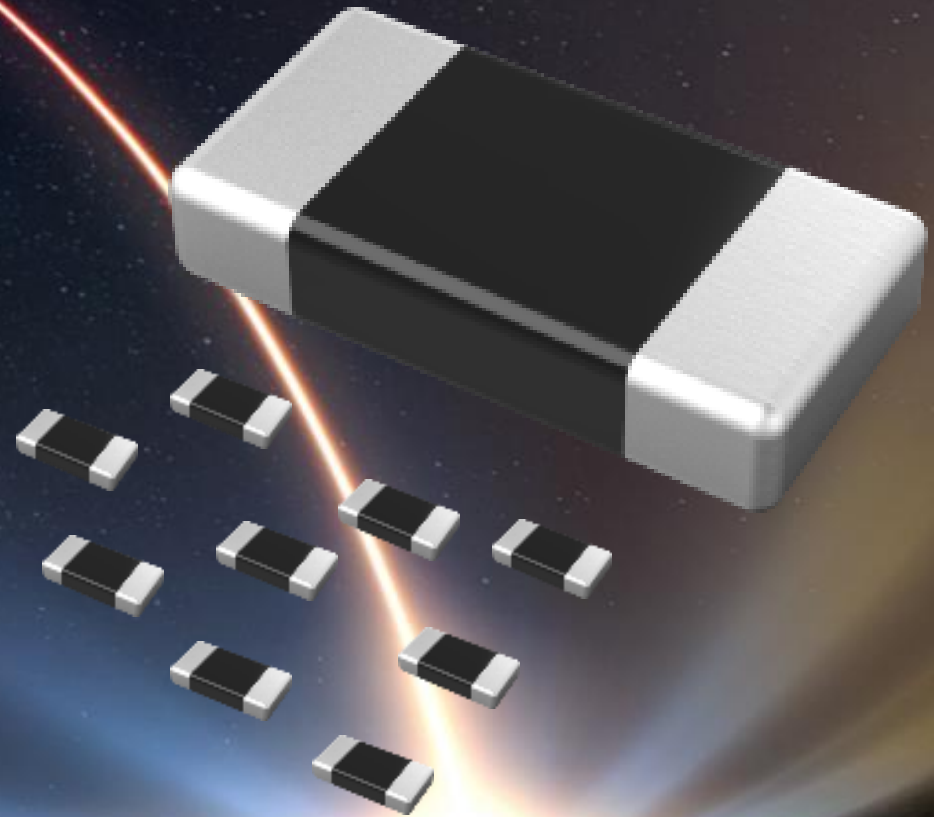
Bead Selection

- Select a bead to have high impedance at the noise frequency and low impedance at the “pass frequency”
- Choose a bead based on saturation current.
 - Attenuation starts to occur well before max current
 - Choose a bead based on keeping impedance high at peak currents
 - Not all bead suppliers publish this data, but it can be provided



FERRITE BEADS FOR SPACE AND HIREL

- QPL to DLA's DSCC 03024
- MIL-STD-981 Option (SRFB)
- Used for suppressing and filtering EM interference
- 1 KHz to 100 MHz
- Custom values and sizes



FERRITE BEADS PN 03024 VS SRFB (MIL STD 981) "Group A" Built the same just tested differently

DWG 03024

"GROUP A"	
Inspection	QTY
Thermal Shock 5 Cycle)	100%
DC Resistance	100%
Impedance	100%
Visual and Mechanical Examination	100%
Material Verification Outgassing	3 Pcs
Material Verification Terminations/Body	3 Pcs

MIL STD 981

"GROUP A"	
Inspection	QTY
Thermal Shock 25 Cycle)	100%
DC Resistance	100%
Impedance	100%
Visual and Mechanical Examination	100%
Burnin 96 hrs at +125°C	100%
Radiographic Inspection:	100%
	100%
IR	100%
Electrical Validation	100%



FERRITE BEADS PN 03024 VS SRFB (MIL STD 981) "Group B"

Built the same just tested differently

SubGrp		"GROUP B"		SubGrp	"GROUP B"	
		Inspection	QTY		Inspection	QTY
I		Resistance to Solvents	6 PCS	I	Resistance to Solvents	2
II		Solderability	8 PCS	I	Solderability	2
III		Test DCR & impedance		I	Test DCR & impedance	2
		Resistance to Soldering Heat	4 PCS	I	Resistance to Soldering Heat	2
		Test DCR & impedance		I	Sinusoid Vibe	2
IV		Test DCR		I	Shock 1500G	2
		Terminal Strength	4 PCS	II	Visual	2
		Test DCR		II	Life 2000 hours	2
V		Current Carrying Capacity	8 PCS	II	Solderability	2
			30 pcs total			4

note : Grp B test units are taken directly from Grp A lot after all test are completed



FERRITE BEADS PN 03024 VS SRFB (MIL STD 981) "Group C"

Built the same just tested differently

SubGrp	leadtime	"GROUP C"	
		Inspection	QTY
I	7 wks	Test DCR & impedance	16 Pcs
		Low Temperature Operation	
	Test DCR & impedance		
	Life (1000Hours)		
7	7	Test DCR & impedance	8 Pcs
		Thermal Vacuum (separate Samples)	
		Test DCR & impedance	
II	1	Test DCR & impedance	6 Pcs
		Bending	
		Test DCR & impedance	
III	4 wks	Test impedance	4 Pcs
		Vibration	
		Shock	
		Test impedance	
IV	4 wks	Test impedance	4 Pcs
		Salt Spray	
		Test impedance	
		Thermal Shock(100 cycle)	
		Test impedance	
V	3 wks	Test impedance	4 Pcs
		Moisture Resistance	
		Test impedance	
		Thermal Shock (5 cycle)	
		Current Carrying Capacity	
VI	1	Insulation Resistance	4 Pcs

46 pcs
total



Available resources

- RFB Designer Kit
- New Values being added to SRFB offering
 - 0402
 - Other values and higher ratings
- Current Rating Curves (Q3 2023)
- VE Engineering and Tech Support



RF & Microwave

- ✓ Air Cores, Chip Inductors & Wideband Transformers
- ✓ Achieving desired electrical characteristics up to 3 GHz+
- ✓ QPL, Space, COTS+ and custom solutions
- ✓ Gullwing, surface mount, thru-hole, radial & flying leaded mounting options available
- ✓ Line-to-line configuration and traditional transformer topology offered

[LEARN MORE](#)



Power Magnetics

- ✓ High Power Density
- ✓ Low Core & Copper Losses
- ✓ Efficient thermal management
- ✓ Power levels to 10 kW+, Voltages to 40 kV+
- ✓ Magnetics for GaN Applications & traditional power supplies
- ✓ Temperature range from -55°C to 200°C+

[LEARN MORE](#)



Pulse & Data Bus

- ✓ QPL: MIL-PRF-21038/27
- ✓ MIL-STD-1553 (single and dual/redundant)
- ✓ Military, Commercial and Space grade options available
- ✓ Custom and SCD

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Custom

- ✓ Build to Print / Design to Concept
- ✓ MIL-STD-981 / MIL-PRF-27
- ✓ ESCC Compliant / EEE-INST-002
- ✓ Quick Prototypes Shipped Direct
- ✓ SCD Creation Assistance

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**Contact Vanguard to engineer the solutions
to your current and future challenges**

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