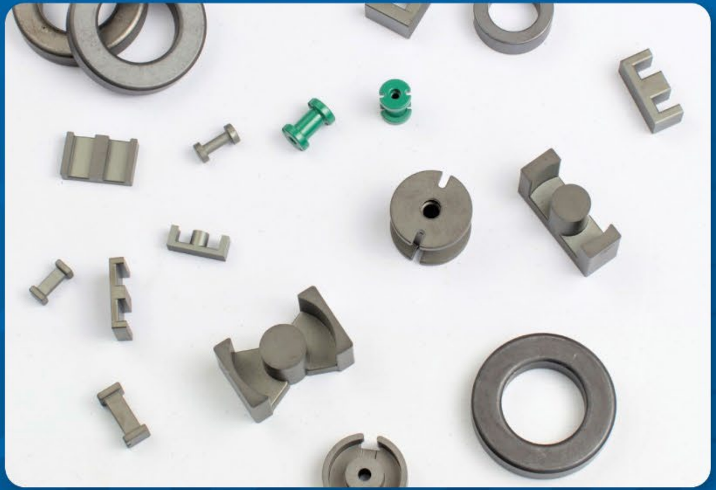
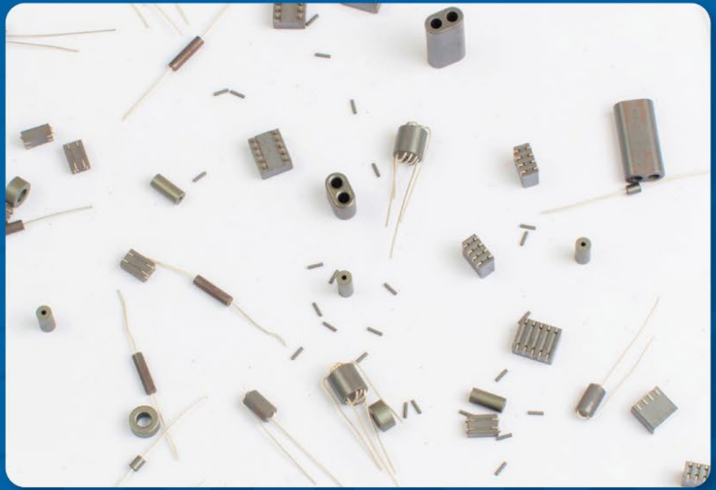
Fair-Rite Products Corp.

Ferrite Test and Measurement

Your Signal Solution®

Fair-Rite Products Corp.





Your Signal Solution®

DESIGN | DEVELOP | DELIVER

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- Intro to Fair-Rite
- Ferrite Basics
- Test and Validation
- Determining Test Requirements
- Mechanical Testing
- Electrical Testing
- Special Requirements

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Introduction

FAIR-RITE PRODUCTS CORP.

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ABOUT FAIR-RITE

Founded in 1952, family-owned and operated.

ISO9001:2015 and IATF16949:2016 certified

Providing ferrite components for the electronics industry for nearly 70 years.

- Component manufacturing in New York and Asia.
- Powder production and warehousing in Illinois.

Used for various application s:

- EMI Suppression
- RFID / Antenna
- Inductive
- Power

nqa. ISO 9001 QUALITY MANAGEMENT

nqa. IATF 16949 AUTOMOTIVE MANAGEMENT

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Ferrite Basics

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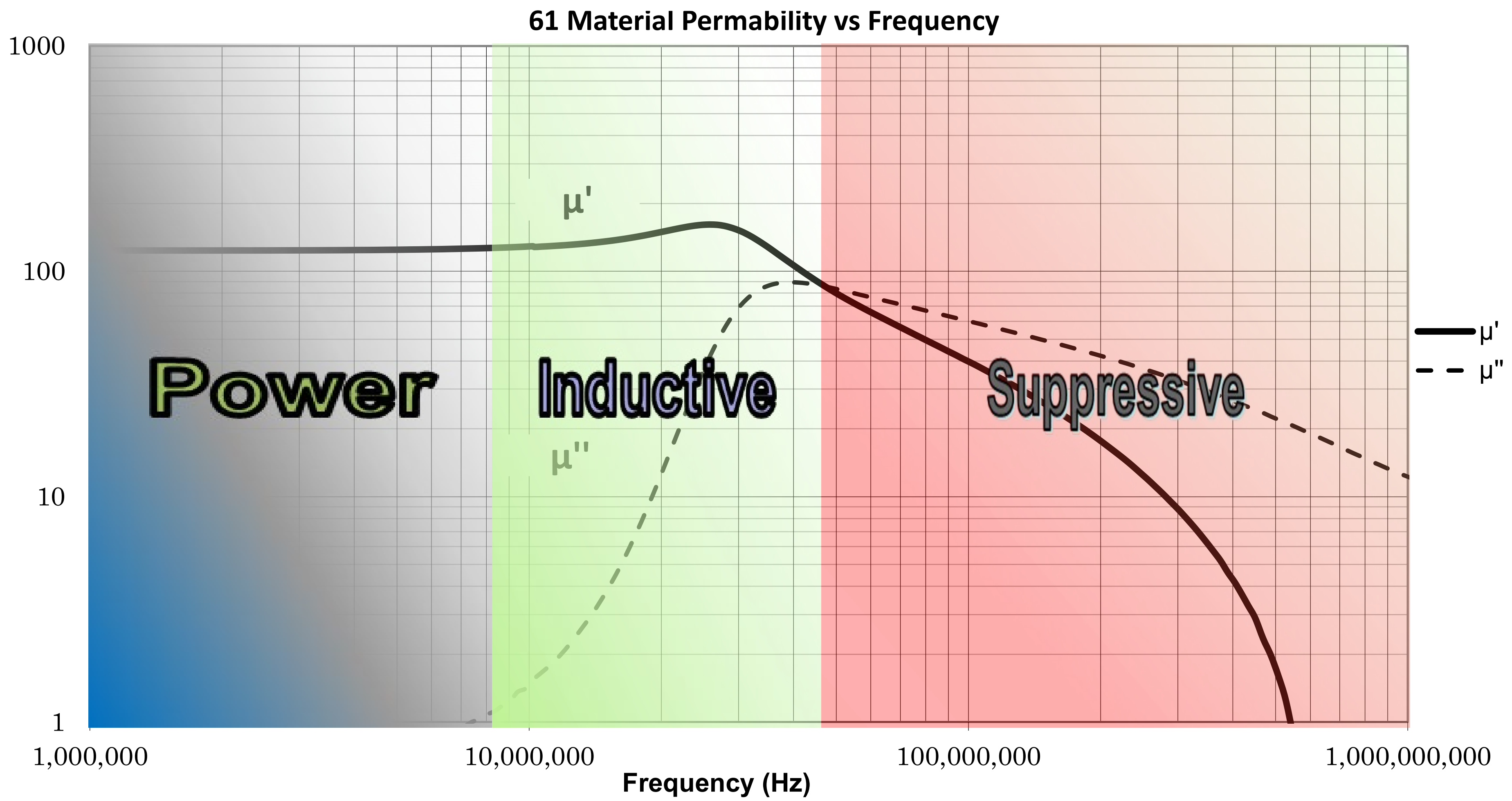
What Is Ferrite?

Ferrite is a soft magnetic material formed by pressing and firing metal oxides into a ceramic material.

Two basic Materials: MnZn and NiZn

A 'Soft' magnetic material is one that can be both easily magnetized and demagnetized.

Application Areas of One Material



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Testing Overview

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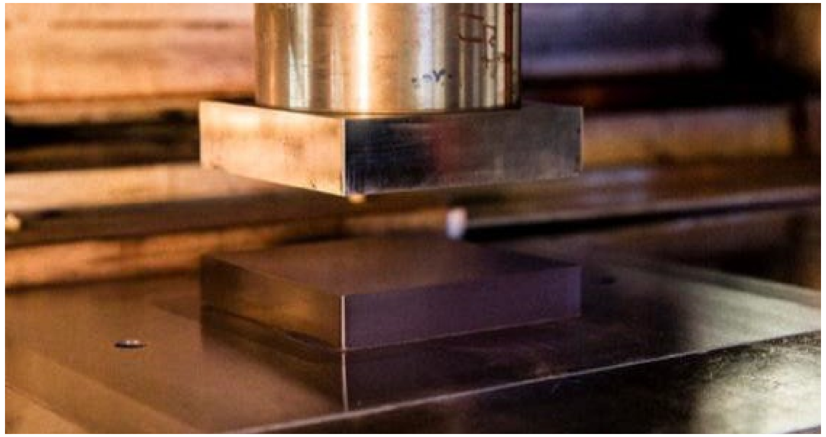
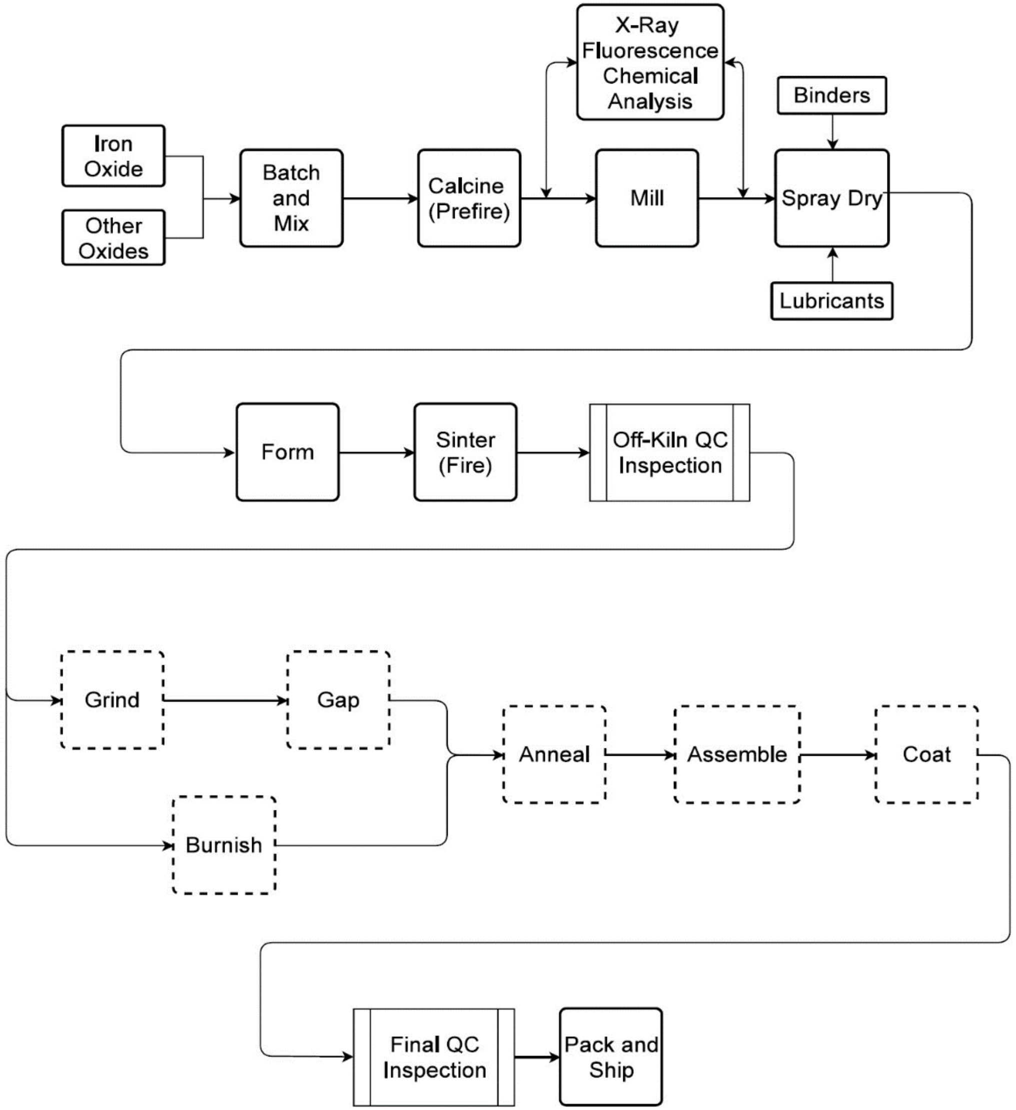
Test & Validation

Ferrite production requires extensive quality control checks throughout the manufacturing process

This starts during the production of the raw materials and ends with a final quality check immediately preceding packaging of the cores

How Ferrite Is Made



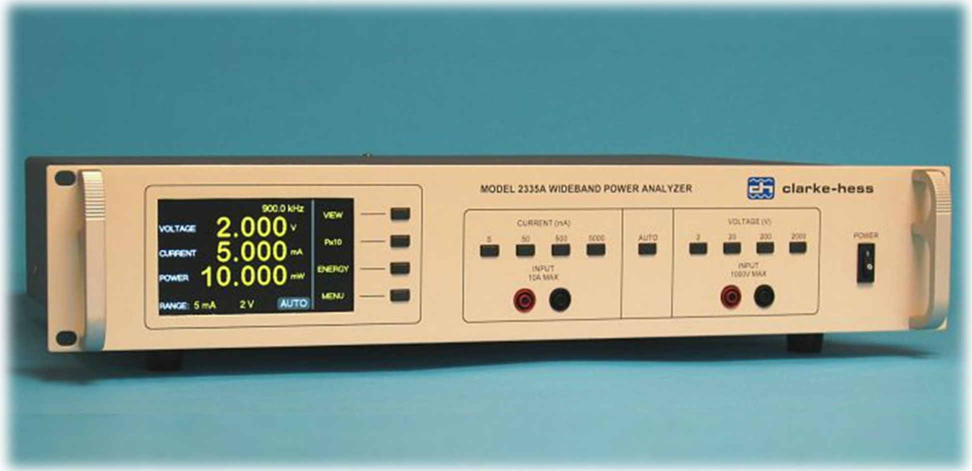


Shapes & Materials

Basic testing of ferrite cores comes down to mechanical (dimensional) measurement and electrical performance characterization

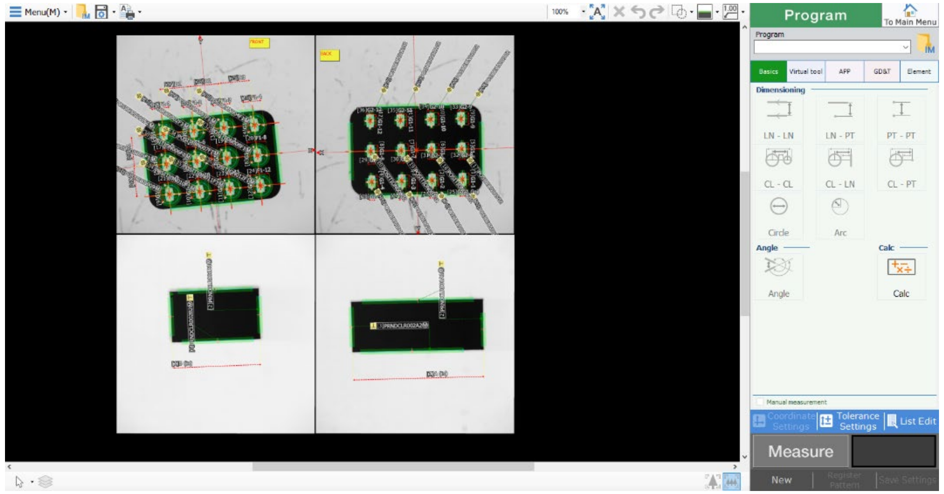
Electrical and mechanical characteristics are a function of both material input at the beginning of the process AND the various production steps following

Process variation at any point in the process can have significant knock-on effects later and could result in unacceptable production parts



Electrical Test Equipment

- LCR meters
- Impedance analyzers
- Network analyzers
- Ohm-meters
- AC Wattmeters
- Oscilloscopes



Mechanical Test Equipment

- Calipers, micrometers, depth/height gauges
- Pin/plug, go, no-go gauges
- Coordinate measuring machine
- Optical measuring machines
- Surface profilometers

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Material Properties

- Much of the basic characterization done to ferrite cores is derived from the materials (nominal) characteristics
- These are back calculated to set specifications in measurable parameters for the individual part (ie. Measuring inductance to validate permeability)

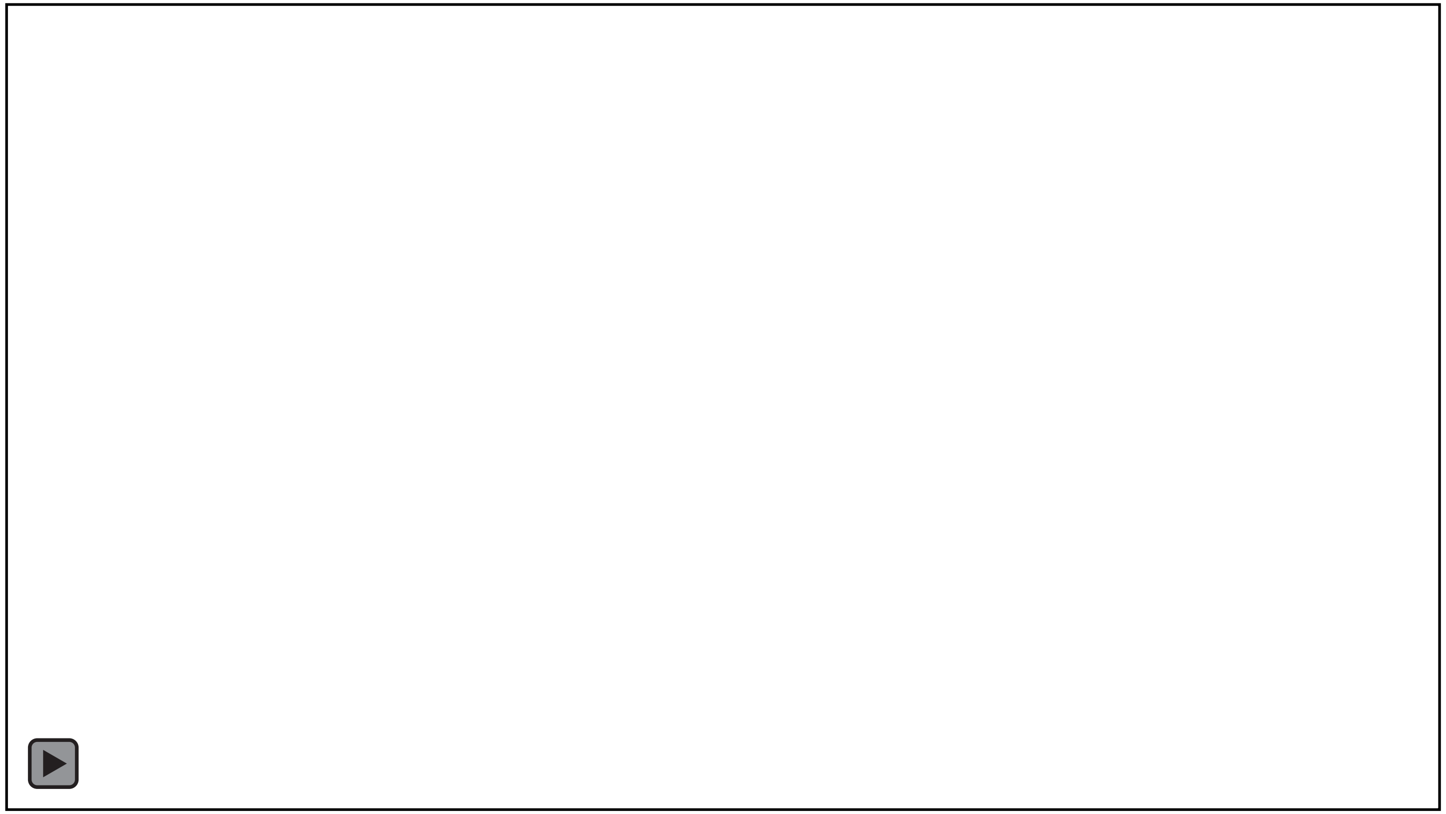
Property	Unit	Symbol	61	52	51	44	46	43	15	31	77	78	20	73	75	76
Material Type			NiZn	NiZn	NiZn	NiZn	MgZn	NiZn	NiZn	MnZn	MnZn	MnZn	NiZn	MnZn	MnZn	MnZn
Initial Permeability @ B <10 gauss		μ	125	250	350	500	500	800	1500	1500	2000	2300	2300	2500	5000	10000
Flux Density	gauss	B	2500	4200	3500	3000	2550	3500	2700	3600	5100	4800	2700	4200	4800	4000
	mT		250	420	350	300	250	350	270	360	510	480	270	420	480	400
@ Field Strength	oersted	H	15	10	10	10	10	10	5	5	5	5	10	5	5	5
	A/m		1200	800	800	800	800	800	800	400	400	400	800	400	400	400
Residual Flux Density	gauss	Br	1000	2900	2300	1100	1680	2200	1800	2600	1800	1500	1800	1100	1000	1800
	mT		100	290	230	110	168	220	180	260	180	150	180	110	100	180
Coercive Force	oersted	Hc	1.2	0.6	0.6	0.45	0.53	0.36	0.2	0.34	0.25	0.2	0.18	0.18	0.11	0.12
	A/m		96	48	48	36	32	36	16	27	20	16	14	16	9	10
Loss Factor	10^{-6}	tan δ/μ	90	45	30	150	60	100	15	20	15	3	10	10	15	15
@ Frequency	MHz		10	1	1	1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.025
Temperature Coefficient of Initial Permeability (20 – 70ºC)	%/ºC	T.C.	0.1	0.8	1.3	1.6	0.85	1.25	1.1	1.3	1.2	1	0.8	0.5	1	0.5
Curie Temperature	ºC	Tc	>300	>250	>170	>160	>140	>130	>105	>130	>200	>200	>95	>160	>140	>120
Resistivity	ohm-cm	p	10^{8}	10^{9}	10^{9}	10^{9}	10^{8}	10^{5}	10^{8}	3000	100	200	10^{7}	100	300	50
Application Area	**EMI suppression**															
Recommended Frequency Range	MHz		200-2000	50-1000	50-500	25-300	25-300	25-300	10-300	1-300	<10	<10	5-200	<50	<20	<5

Application Specific

- Some of the characteristics measured are a result of the use case of the core
- An example of this would be measuring impedance on a suppression core or core losses on a power rated part at levels or frequencies outside of the material property derived norms

Custom Tests

- In some cases (primarily in custom cores), tests are designed to accurately replicate very specific conditions the core will be subjected to
- Simple ones might include mechanical strength or over temperature performance
- More complex tests may involve multiple variable inputs

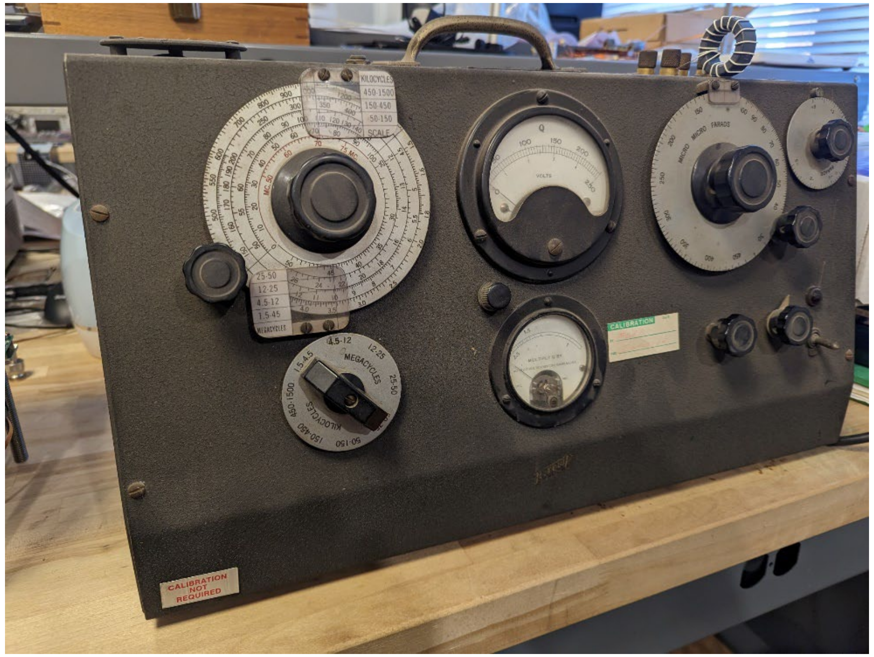


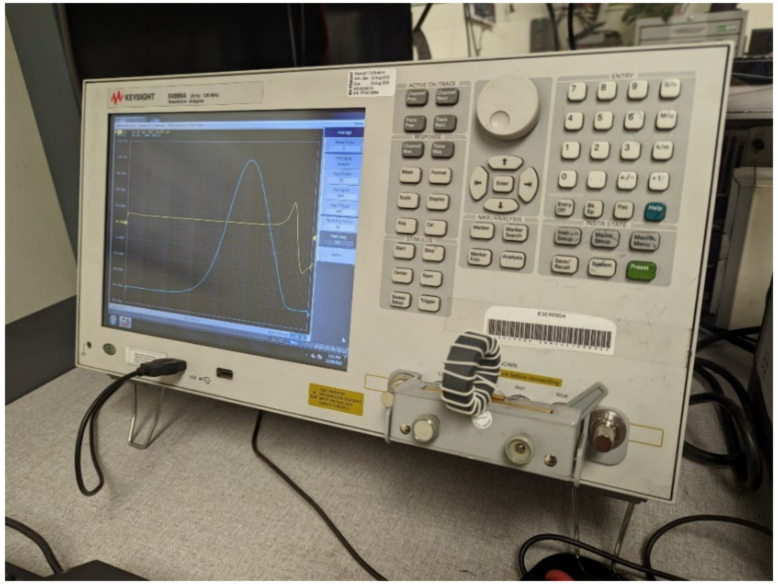
Electrical Testing

Inductance and Quality Factor

- Inductance factor (Al) is a standard test carried out on inductive rated parts
- Cores are measured at 10kHz sinusoidal with a flux density of less than 1mT (same as initial permeability)
- Lead length is deliberately kept to minimum and turn count high enough to mitigate the inductance added by the wire

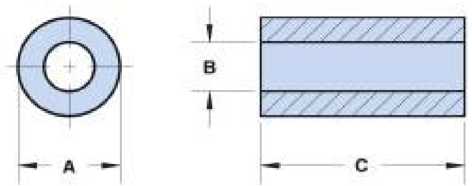
- Series inductance and quality factor will also be measured at some higher frequency to ascertain loss factor
- The frequency at which this is characterized will depend on the material and/or application
- Flux density is at or below 100µT

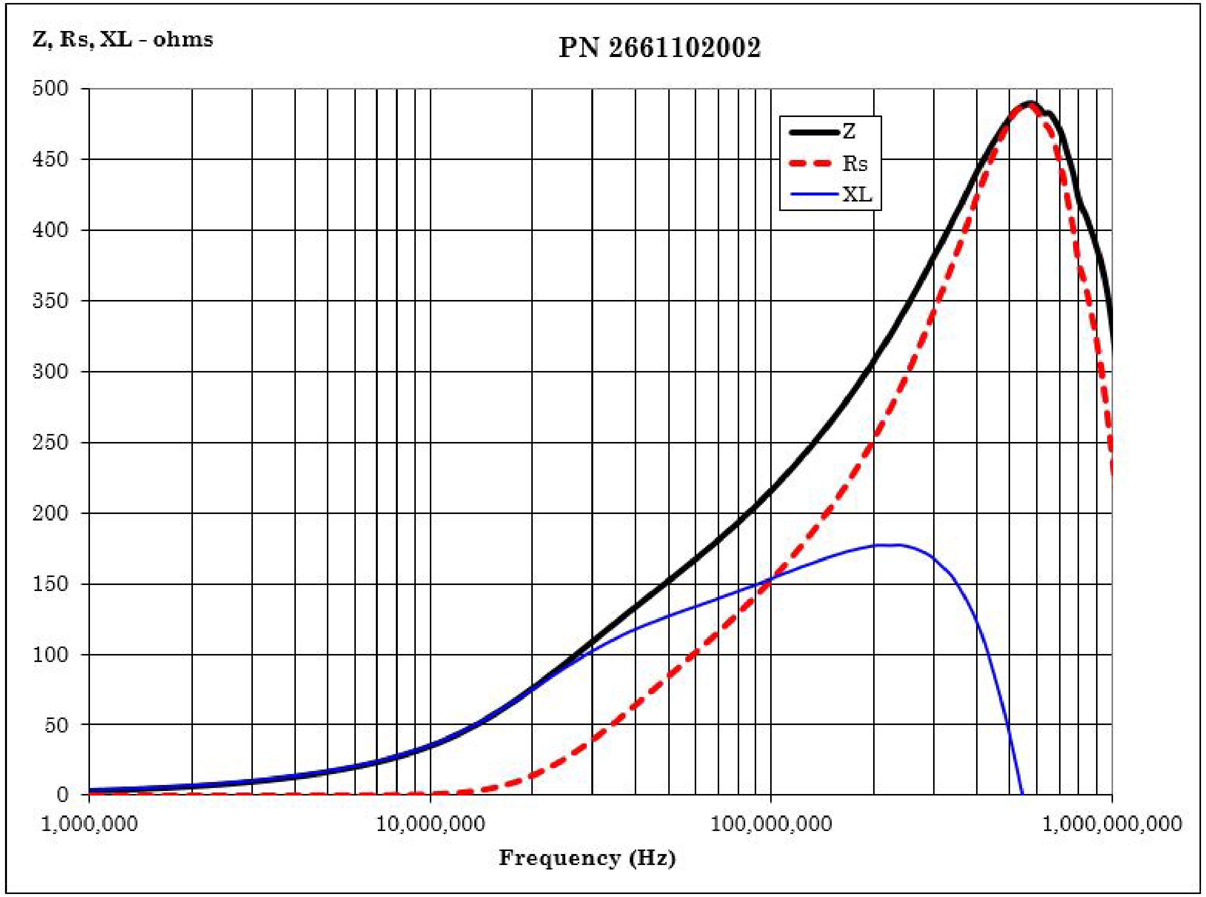




Impedance

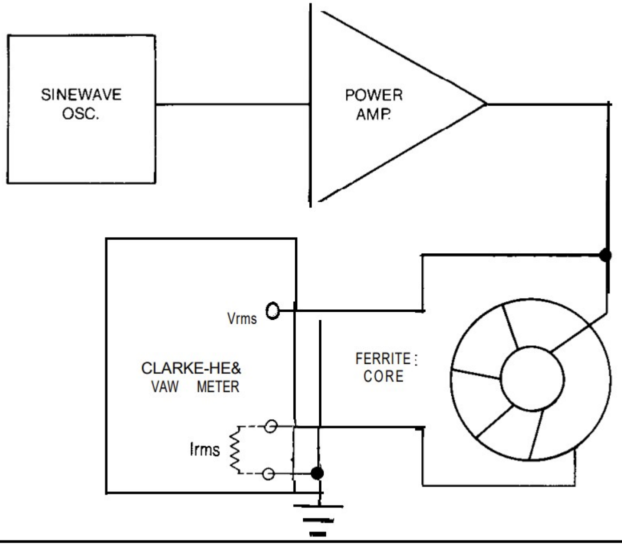
- For cores that are used as suppression devices, the vector quantity of the impedance is characterized on an impedance analyzer
- The frequency of the measurement will be determined by the effective suppression frequencies of the material and/or the application
- Wire length being kept to a minimum is of critical importance here as the testing is generally carried out very low turn count (usually 1)





Core Loss

- In addition to Al and loss factor, parts that will be operating at high flux densities may be tested for core loss
- This testing is performed with a sinusoidal excitation and a wattmeter (at low frequencies)
- The frequency and flux density are variable depending on the material and application



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Thank You!

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