



Latest Advances in Inductor Design Software

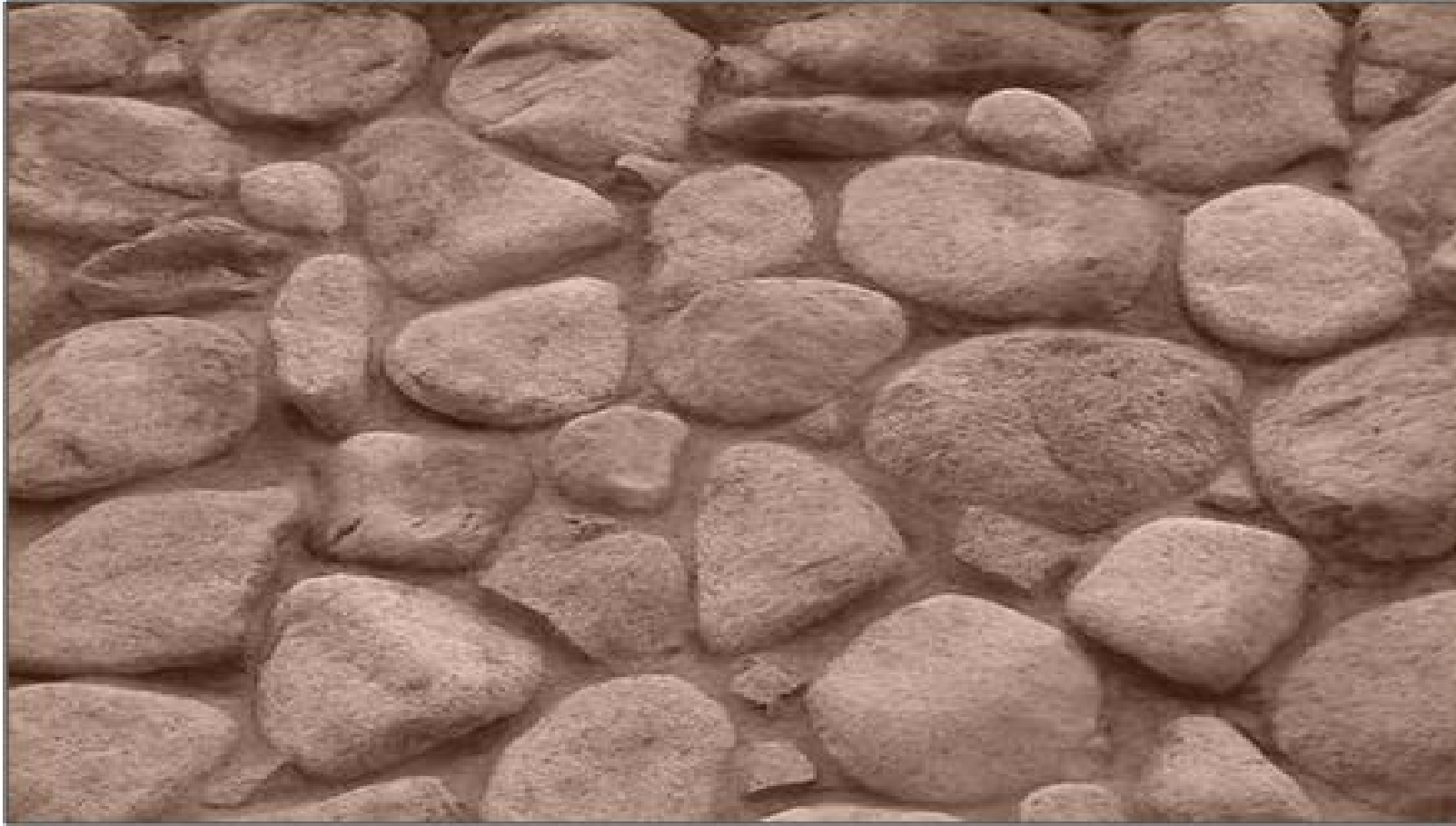
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Outline

- Distributed Gap Powder Core Materials - Description
- Simulation Tool - Description
- Simulation Tool - Demonstration

What is a Powder Core?



Powder Core Characteristics

- Distributed Air gap
- Discrete gap not required – minimal Fringing
- Eddy Currents restricted to flowing within particles
- “Soft” Saturation
- Flexible Material Choices
 - Bsat
 - Losses
- Permeability controlled by Insulation Level

Simulation Tool: Description

- Online Tool – Free to use at www.micrometals.com
- Major Update Launched March 23, 2020
- 4 Separate Modules:
 - DC Inductors (Buck, Boost, Bus Bar)
 - AC Inductors (Resonant, DM Filter, Inverter Filters)
 - AC Inductors w/Ripple Current (Inverter Filters, Class D)
 - PFC Inductors (Specialized Case)
- More than 4000 Powder Core Material Part Numbers in Library
 - Core shapes include Toroids, E Cores, EQ, PQ
 - Permeability ranges from 4 to 205
 - Iron Powder, HF, MPP, Sendust, Iron Silicon, RF materials, etc.
- Includes Inductor Analyzer, for Evaluation and Optimization of Existing Designs

Simulation Tool: Features for High Frequency “Front of the House”

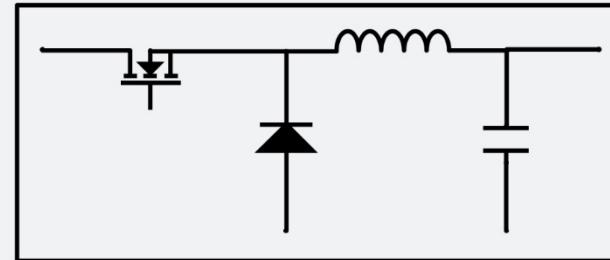
- Distributed Gap Cores Well Suited for High Frequency
 - No Need For Discrete Air Gap
 - Only “Micro Fringing” of Flux
- Wide Range of Powder Core Materials
 - RF Iron Powder Materials – Introduced 1950s
 - Materials 2, 6, 10, 17 (Permeability = 10 , 8.5, 6.0 and 4.0 respectively)
 - High Saturation (>1T) Materials Designed for RF Communications >100MHz
 - Inherently Low Losses
 - Low Permeability Materials Force more Turns, Lowering AC Flux Density and Core Losses
 - High Frequency Sendust – Introduced 2017
 - Extends useful Frequency Range of Sendust from 1MHz to 5MHz, Maximum
 - Permeability ranges up to 125
- Skin Depth reported as R_{ac}/R_{dc} Ratio

Simulation Tool: Features for High Frequency “In the Kitchen”

- All Materials Core Losses Characterized by HL/EL Model
- Duty Cycle Dependent Core Loss Calculation
- Duty Cycle Dependent Skin Depth Calculation
- Temperature Dependent R_{dc} , R_{ac} Calculation (Dynamic)
- Segmented PFC Calculation (in Analyzer)
- Thermal Aging Calculation Incorporated (Iron Powder)

Simulation Tool: Demonstration - DC/DC Buck Converter

- $V_{in} = 48V$
- $V_{out} = 12V$
- $V_{ON} = 36V, V_{OFF} = 12V$
- $I_{out} = 3A$
- $L = 1.0\mu H$
- Frequency = 1.5MHz
- Ripple Current = 6App, $D = 0.25$



Thank You!