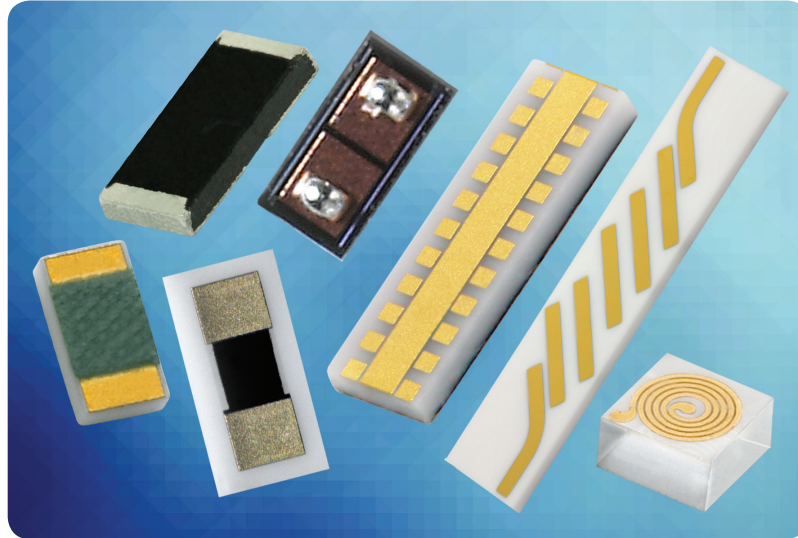




VISHAY DALE HIGH FREQUENCY PRODUCTS

Vishay Electro-Films / Vishay Thin Film / Vishay Dale

RF / High Frequency Products



INTRODUCTION

With the ever-increasing demand for wireless data streams and emerging technologies such as 5G and internet of things (IoT), the entire telecommunications, military, and medical industries are again witnessing major breakthroughs and racing to develop next-generation systems. To pave the way and fuel the needs of such advanced technologies, the availability of superior and robust high frequency components is paramount.

Using state of the art manufacturing methods, Vishay Dale is able to produce a wide range of products from chip resistors to spiral inductors in the high frequency range. Vishay Dale high frequency products are all manufactured at ISO 9001-registered facilities to ensure the highest quality. Key features of these products include:

- S-parameter files – Easy online access and file download option for design use
- Stable resistor performance – Intensive testing and controlled manufacturing processes result in extremely stable performance over time
- Part sizes – Industry-standard case sizes as low as 0201 and custom sizes up to 0.500in are available
- Resistor ranges – High frequency chip resistors are manufactured for a wide range of resistance values from 10 Ω to 2 k Ω
- Terminations – Several different termination options, including wire bondable, solderable, flip chip, epoxy mount, and surface mount
- Custom orders – Beyond standard values and tolerances, Vishay Dale offers several high frequency products at custom values and tolerances
- Custom designs - Custom-designed substrates can be manufactured for thin film RF applications

RESOURCES

- For technical questions, contact efi@vishay.com
- For more detailed information, please visit www.vishay.com

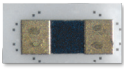
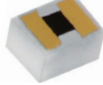
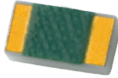
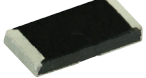




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Resistor Performance Specifications

	<u>MIC</u>	<u>MIB</u>	<u>MIF</u>	<u>FC</u>	<u>RCP</u>
					
Description	Precision, moisture resistant, high frequency	Precision, moisture resistant, high frequency	Precision, moisture resistant, high frequency	Precision, high frequency	Thick film, high frequency
Film type	Thin	Thin	Thin	Thin	Thick
Maximum frequency (GHz)	≤ 20	$\leq 20^*$	$\leq 20^*$	≤ 40	≤ 6
Resistor material	Tantalum nitride	Tantalum nitride	Tantalum nitride	Passivated nickel chromium	Ruthenium oxide
Overall resistance range (Ω)	2 to 20,000	20 to 2,000	20 to 2,000	10 to 1,000	10 to 2,000
Microwave resistance range (Ω)	20 to 500	20 to 100	20 to 100	10 to 1,000	10 to 2,000
Absolute tolerance range (%)	± 1.0 to ± 20	± 1.0 to ± 20	± 1.0 to ± 20	± 0.1 to ± 5.0	± 1.0 to ± 5.0
TCR range (ppm/C)	± 25 to ± 200	± 100 to ± 200	± 100 to ± 200	± 25 to ± 100	± 150
Power rating (mW)	125	25	50	50 to 330	1,400 to 3,500 **
Working voltage (V)	< 100	< 100	< 100	30 to 75	3.7 to 83.6
Noise (dB)	-20 typ.	-20 typ.	-20 typ.	< -35	< -10
Operating temperature range (C)	-55 to +125	-55 to +125	-55 to +125	-55 to +155	-55 to +155
S-parameters	Available online	Not available	Not available	Available online	Available online

* Assumed equivalent to MIC

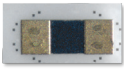
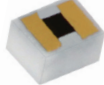
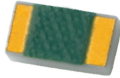
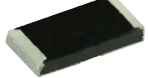
** Without cooling. See datasheet for active cooling



VISHAY DALE HIGH FREQUENCY PRODUCTS

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Resistor Mechanical Specifications

	<u>MIC</u>	<u>MIB</u>	<u>MIF</u>	<u>FC</u>	<u>RCP</u>
					
Substrate	Alumina (Al ₂ O ₃)	Alumina (Al ₂ O ₃)	Alumina (Al ₂ O ₃)	Alumina (Al ₂ O ₃)	Aluminum nitride (AlN)
Resistor material	TaN	TaN	TaN	NiCr	RuO ₂
Passivation	None	None	None	SPM	Epoxy
Barrier	Pd	None	None	Ni	Ni
Terminations	Gold, aluminum, SnPb solder, Pb-free solder	Gold, aluminum, SnPb solder, Pb-free solder	Gold	Gold, SnPb solder, Pb-free solder	SnPb solder, Pb-free solder
Case size	0402	0201	02016	0402, 0505, 0603, 0805, 1005, and 1206	0505, 0603, 1203, and 2512
Assembly	Wire bondable, flip chip, and solder attach	Wire bondable and solder attach	Wire bondable	Solder, flip chip, and epoxy attach	Solder and epoxy attach



VISHAY DALE HIGH FREQUENCY PRODUCTS

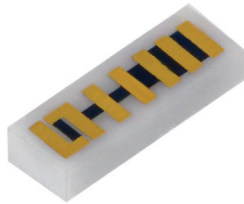
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Thin Film Resistor Network

TMR – Thin film tapped microwave resistor

Features:

- Multiple low ohm taps
- Case size: 0602
- Wire bondable
- Alumina substrate
- Total resistor value of 240 Ω
- Tolerances from $\pm 1\%$ to $\pm 20\%$
- Resistor TCR range from ± 25 ppm/C to ± 200 ppm/C
- Moisture resistant

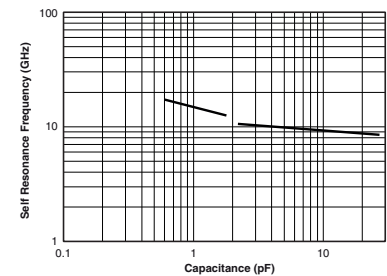
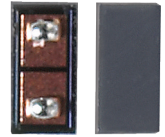


Thin Film High Frequency Capacitor

RFCS – Thin film wire bondable RF capacitor

Features:

- Frequency response up to 20 GHz
- Case size: 0402
- Capacitance value range from 0.6 pF to 27 pF
- Tolerances from $\pm 5\%$ to $\pm 25\%$
- S-parameters are available online
- Wire bondable and epoxy attach
- Surface mount
- Silicon substrate

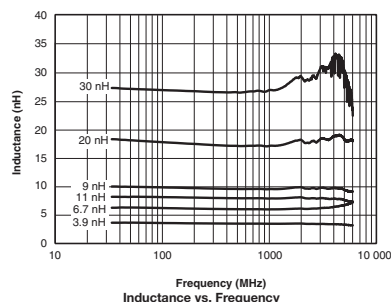
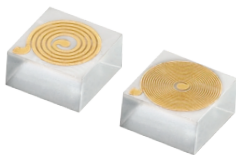


Thin Film High Frequency Spiral Inductor

RFLW – High frequency wire bondable RF spiral inductor

Features:

- Frequency response up to 1.0 GHz
- Case sizes: 0303 and 0505
- S-parameters are available online
- Wire bondable
- Inductance value range from 3.9 nH to 150 nH
- Quartz substrate
- Tolerance of $\pm 20\%$

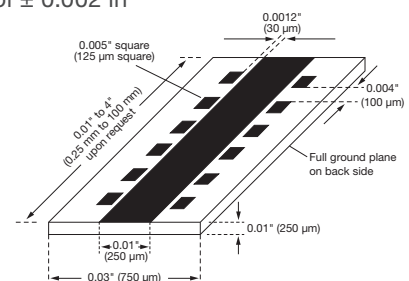
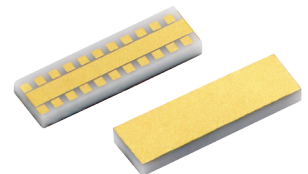


Thin Film High Frequency Micro-Strip Transmission Line

MTLP – Wire bondable thin film micro-strip transmission line resistor arrays

Features:

- Custom sizes from 0301 to 0350
- Wire bondable
- Alumina (Al_2O_3) substrate
- 50 Ω micro-strip configuration
- Mechanical tolerance of ± 0.002 in





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RF Custom Substrates

- Polished and as-fired Al_2O_3 , AlN, and BeO substrates available in standard or custom thicknesses
- Specialty garnet, ferrite, and quartz substrates available
- Au-filled Via capability for RF performance, front to back connectivity, and heat dissipation
- Solderable and wire-bondable metal stack options
- Custom shapes
- Build to print

RF Distributed Element Filters

- RF capacitance measurement capability
- Functional RF measurement capability
- Measurement frequencies up to 50 GHz



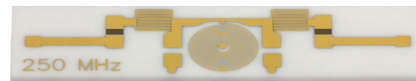
Lange Couplers / Air Bridges

- 1 mil line and space capability
- Tight tolerance pattern linewidths



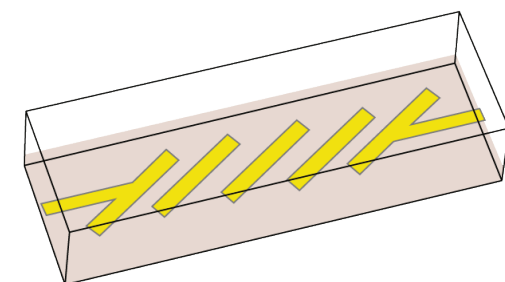
RF Integrated Lumped Element Filters

- Integrated RF microwave resistor element capability
- Integrated RF spiral inductor element capability

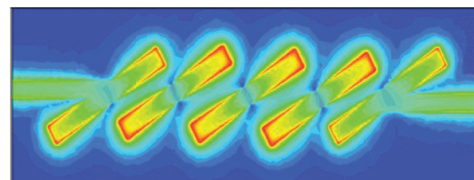


Resources

- For more detailed information, please visit <http://www.vishay.com/company/brands/electro-films/>
- For design guidelines, please reference <http://www.vishay.com/doc?91000>



Clamp to range: [Min: 0/Max: 100000]



Type = E-Field (peak)
 Monitor = e-field (f = 10)
 Component = Abs
 Plane at z = - 0.47576
 Frequency = 10
 Amplitude Plot
 Maximum - 2d = 462599 V/n at - 220.488/- 36.604/- 0.47576

V/n
 1.03e5
 71511
 54133
 49458
 28701
 21235
 14577
 9337
 5214
 1570
 0



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SEMICONDUCTORS

MOSFETs Segment

MOSFETs

- Low Voltage TrenchFET® Power MOSFETs
- Medium Voltage Power MOSFETs
- High Voltage Planar MOSFETs
- High Voltage Superjunction MOSFETs
- Automotive Grade MOSFETs

ICs

- VRPower® DrMOS Integrated Power Stages
- Power Management and Power Control ICs
- Smart Load Switches
- Analog Switches and Multiplexers

Diodes Segment

Rectifiers

- Schottky Rectifiers
- Ultrafast Recovery Rectifiers
- Standard and Fast Recovery Rectifiers
- High Power Rectifiers / Diodes
- Bridge Rectifiers

Small Signal Diodes

- Schottky and Switching Diodes
- Zener Diodes
- RF Pin Diodes

Protection Diodes

- TVS TRANSZORB® and PAR® (unidirectional, bidirectional)
- ESD Protection Diodes (including arrays)

Thyristors / SCRs

- Phase Control Thyristors
- Fast Thyristors

IGBTs

- Field Stop Trench
- Punch Through Trench

Power Modules

- Input Modules (diodes and thyristors)
- Output and Switching Modules (contain MOSFETs, IGBTs, and diodes)
- Custom Modules

Optoelectronic Components Segment

Infrared Emitters and Detectors

Optical Sensors

- Proximity
- Ambient Light
- Light Index (RGBW, UV, IR)
- Humidity
- Quadrant Sensors
- Transmissive
- Reflective

Infrared Remote Control Receivers

Optocouplers

- Phototransistor, Photodarlington
- Linear
- Phototriac
- High Speed
- IGBT and MOSFET Drivers

Solid-State Relays

- LEDs and 7-Segment Displays
- Infrared Data Transceiver Modules
- Custom Products

PASSIVE COMPONENTS

Resistors and Inductors Segment

Film Resistors

- Metal Film Resistors
- Thin Film Resistors
- Thick Film Resistors
- Power Thick Film Resistors
- Metal Oxide Film Resistors
- Carbon Film Resistors

Wirewound Resistors

- Vitreous, Cemented, and Housed Resistors
- Braking and Neutral Grounding Resistors
- Custom Load Banks

Power Metal Strip® Resistors

- Battery Management Shunts
- Crowbar and Steel Blade Resistors

Thermo Fuses

Chip Fuses

Pyrotechnic Initiators / Igniters

Variable Resistors

- Cement Variable Resistors
- Wirewound Variable Resistors
- Conductive Plastic Variable Resistors
- Contactless Potentiometers

Hall Effect Position Sensors

Precision Management Encoders

Networks / Arrays

Non-Linear Resistors

- NTC Thermistors
- PTC Thermistors
- Thin Film RTDs
- Varistors

Magnetics

- Inductors
- Wireless Charging Coils
- Planar Devices
- Transformers
- Custom Magnetics

Connectors

Capacitors Segment

Tantalum Capacitors

- Molded Chip Tantalum Capacitors
- Molded Chip Polymer Tantalum Capacitors
- Tantalum MAP Capacitors
- Polymer Tantalum MAP Capacitors
- Coated Chip Tantalum Capacitors
- Solid Through-Hole Tantalum Capacitors
- Wet Tantalum Capacitors

Ceramic Capacitors

- Multilayer Chip Capacitors
- Disc Capacitors
- Multilayer Chip RF Capacitors
- Chip Antennas
- Thin Film Capacitors

Film Capacitors

- Power Capacitors
- Heavy-Current Capacitors
- Aluminum Electrolytic Capacitors
- ENYCAP™ Energy Storage Capacitors