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 kΩ
- 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
## Resistor Performance Specifications

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

* Assumed equivalent to MIC
** Without cooling. See datasheet for active cooling
## Resistor Mechanical Specifications

<table>
<thead>
<tr>
<th></th>
<th>MIC</th>
<th>MIB</th>
<th>MIF</th>
<th>FC</th>
<th>RCP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substrate</strong></td>
<td>Alumina (Al2O3)</td>
<td>Alumina (Al2O3)</td>
<td>Alumina (Al2O3)</td>
<td>Alumina (Al2O3)</td>
<td>Aluminum nitride (AlN)</td>
</tr>
<tr>
<td><strong>Resistor material</strong></td>
<td>TaN</td>
<td>TaN</td>
<td>TaN</td>
<td>NiCr</td>
<td>RuO2</td>
</tr>
<tr>
<td><strong>Passivation</strong></td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>SPM</td>
<td>Epoxy</td>
</tr>
<tr>
<td><strong>Barrier</strong></td>
<td>Pd</td>
<td>None</td>
<td>None</td>
<td>Ni</td>
<td>Ni</td>
</tr>
<tr>
<td><strong>Terminations</strong></td>
<td>Gold, aluminum, SnPb solder, Pb-free solder</td>
<td>Gold, aluminum, SnPb solder, Pb-free solder</td>
<td>Gold</td>
<td>Gold, SnPb solder, Pb-free solder</td>
<td>SnPb solder, Pb-free solder</td>
</tr>
<tr>
<td><strong>Case size</strong></td>
<td>0402</td>
<td>0201</td>
<td>02016</td>
<td>0402, 0505, 0603, 0805, 1005, and 1206</td>
<td>0505, 0603, 1203, and 2512</td>
</tr>
<tr>
<td><strong>Assembly</strong></td>
<td>Wire bondable, flip chip, and solder attach</td>
<td>Wire bondable and solder attach</td>
<td>Wire bondable</td>
<td>Solder, flip chip, and epoxy attach</td>
<td>Solder and epoxy attach</td>
</tr>
</tbody>
</table>
VISHAY DALE HIGH FREQUENCY PRODUCTS

**PRODUCT OVERVIEW**

**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 ± 1 % to ± 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 ± 5 % to ± 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 ± 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 (Al2O3) substrate
- 50 Ω micro-strip configuration
- Mechanical tolerance of ± 0.002 in
RF Custom Substrates
- Polished and as-fired Al₂O₃, 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?49103
SEMICONDUCTORS

MOSFETs Segment
- 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
- 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