



## Medical Resistors 101



### INTRODUCTION

Vishay Dale is a market leader in medical resistor technology. Resistors for medical applications cover a wide range of applications and operating environments; whether they are found in implantable devices, imaging equipment, surgical or patient monitoring equipment, as part of a hospital's physical plant, or part of home-based health care, these resistors need to have a high level of performance, stability, and precision.

Vishay Dale's wide range of resistor products offers solutions for a variety of engineering challenges. Our technical staff can help designers select the device best matched to their application. This guide highlights some of our resistor products with target applications; in addition, Vishay can also design and produce custom components.

Quality and reliability are of the utmost importance for medical devices. Vishay Dale provides comprehensive environmental testing and failure analysis capabilities; MIL specifications augmented by customer specific requirements form our testing protocols. Process control and stability is an important aspect of Vishay's high product reliability; lot traceability is maintained for all products. All Vishay Dale resistor facilities are ISO 9001 and 14001 certified and selected facilities are also ISO 13485 certified.





# MEDICAL PRODUCTS

## Vishay Dale Resistors - Medical 101

### Medical Implantable

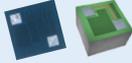


**Applications**

- Cardiac rhythm management
- Neurostimulation
- Muscle stimulation

**Features**

- Small size
- Battery optimization
- Pulse handling
- Stability / precision

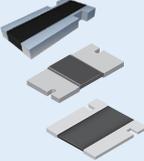
Series/Part Number	Features and Descriptions	Benefits
<b>M</b> 	<ul style="list-style-type: none"> <li>• High-reliability thick film SMT chip resistor</li> <li>• Wide resistance range available: 10 Ω to 22 MΩ</li> </ul>	<ul style="list-style-type: none"> <li>• 100 % thermal shock, electrical, and visual inspected</li> <li>• Tolerance as low as 1 % and power rating up to 2 W</li> </ul>
<b>PNS (MIL-PRF-55342)</b> 	<ul style="list-style-type: none"> <li>• Precision thin film SMT chip resistor</li> <li>• Wide resistance range available : 10 Ω to 6.19 MΩ</li> </ul>	<ul style="list-style-type: none"> <li>• Wide selection of case sizes with power ratings to 2 W</li> <li>• TCR as low as 10 ppm/°C available</li> <li>• Tolerance to ± 0.02 %</li> </ul>
<b>SFM, MSFM</b> 	<ul style="list-style-type: none"> <li>• Wirebondable</li> <li>• Wide resistance range available: 1 Ω to 1 MΩ</li> </ul>	<ul style="list-style-type: none"> <li>• Small footprint (0.015 in x 0.015 in)</li> <li>• Rated power to 250 mW</li> </ul>
<b>NET, PSS</b> 	<ul style="list-style-type: none"> <li>• Wirebondable</li> <li>• Custom resistor networks</li> </ul>	<ul style="list-style-type: none"> <li>• Good pulse handling</li> <li>• Tight ratio tolerance and TC tracking</li> </ul>
<b>WSL WSL...18 WSLP</b> 	<ul style="list-style-type: none"> <li>• Power Metal Strip® resistors</li> <li>• Very low resistance values of 0.5 mΩ to 500 mΩ</li> <li>• Tight tolerance of 1 % standard, and available down to 0.1 %</li> </ul>	<ul style="list-style-type: none"> <li>• Accurate current sensing, allowing the use of lower-cost ICs</li> <li>• Small size</li> <li>• Au-plated terminations available</li> </ul>
<b>CRHV</b> 	<ul style="list-style-type: none"> <li>• High-voltage thick film chip resistor</li> <li>• Voltages to 3 kV</li> <li>• Divider chip available</li> </ul>	<ul style="list-style-type: none"> <li>• Stability to &lt; 0.5 %</li> <li>• Tolerances to 0.5 %</li> <li>• Custom sizes, terminations, testing, and performance available</li> </ul>
<b>CRMV</b> 	<ul style="list-style-type: none"> <li>• Medium-voltage thick film chip resistor</li> <li>• Voltages to 800 V</li> </ul>	<ul style="list-style-type: none"> <li>• Stability to &lt; 0.5 %</li> <li>• Tolerances to 0.5 %</li> <li>• Custom sizes, terminations, testing, and performance available</li> </ul>
<b>RCWP</b> 	<ul style="list-style-type: none"> <li>• Thick film industrial / medical chip resistor</li> <li>• Sulfur-impervious construction and materials</li> </ul>	<ul style="list-style-type: none"> <li>• 100 % tested to MIL-PRF-55342, Group A</li> <li>• Tolerances to 0.5 %</li> <li>• Non-magnetic solderable termination available</li> <li>• Value range of 1 Ω to 22 MΩ standard</li> </ul>



# MEDICAL PRODUCTS

## Vishay Dale Resistors - Medical 101

Medical Implantable, continued

<p><b>WSK0612</b> <b>WSK2512</b> <b>WSL3637</b></p> 	<ul style="list-style-type: none"> <li>• Power Metal Strip resistors</li> <li>• 4-terminal Kelvin connection</li> <li>• Very low resistance values of 0.5 mΩ to 200 mΩ</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Low-RTC resistance element (&lt; 20 ppm/°C) results in accurate current sensing, allowing the use of lower cost ICs</li> <li>• Tight tolerance of 1 % standard, and available down to 0.1 %</li> <li>• Provides high-temperature performance that can surpass that of thick film resistors</li> <li>• Saves space by enabling use of a single low-value resistor instead of multiple high-value resistors in parallel</li> </ul>
<p><b>RCWE</b></p> 	<ul style="list-style-type: none"> <li>• Thick film resistors with wrap termination</li> <li>• Extremely low resistance range, from 0.01 Ω to 0.979 Ω</li> <li>• High power capacity to 2 W</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• High power</li> <li>• High surge pulse performance</li> <li>• Tight tolerances: ± 1 %, ± 5 %</li> <li>• Temperature coefficient: from ± 100 ppm/°C to ± 700 ppm/°C depending on value</li> <li>• Operating temperature range : -55 °C to +155 °C</li> </ul>

### Medical Instrumentation

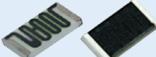


#### Applications

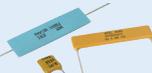
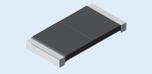
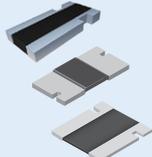
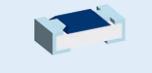
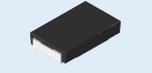
- Patient monitoring
- Portable defibrillator
- Glucose monitoring
- Stress test equipment

#### Features

- Precision
- Stability
- Low TCR

Series/Part Number	Features and Descriptions	Benefits
<b>LNS</b> 	<ul style="list-style-type: none"> <li>• Low-value SMT chip resistor</li> <li>• Moisture-resistant nickel alloy film</li> <li>• Resistance range from 0.03 Ω to 10 Ω</li> </ul>	<ul style="list-style-type: none"> <li>• Non-standard resistance values available</li> <li>• Pre soldered or gold terminations</li> <li>• Tolerance down to 1 % and TCR as low as 300 ppm/°C</li> </ul>
<b>PLT</b> 	<ul style="list-style-type: none"> <li>• Precision low-TCR SMT chip resistor</li> <li>• Resistance range from 250 Ω to 775 kΩ</li> </ul>	<ul style="list-style-type: none"> <li>• Non-standard resistance values available</li> <li>• Tolerance down to 0.01 %</li> <li>• Low TCR of 5 ppm/°C over entire operating range</li> </ul>
<b>MPM</b> 	<ul style="list-style-type: none"> <li>• Precision thin film resistor divider network</li> <li>• Small SOT-23 package</li> <li>• Multiple standard divider ratios: 1:1 to 100:1 available</li> </ul>	<ul style="list-style-type: none"> <li>• Custom divider ratios available</li> <li>• Tight TCR tracking down to 2 ppm/°C</li> <li>• Ratio tolerance as low as 0.01 %</li> </ul>
<b>DFN/DFN Divider</b> 	<ul style="list-style-type: none"> <li>• 8 mm pitch, dual flat no-lead package resistor network</li> <li>• Low-profile 1 mm seated height</li> </ul>	<ul style="list-style-type: none"> <li>• Custom schematics and divider ratios available</li> <li>• Tight TCR tracking down to 3 ppm/°C</li> <li>• Ratio tolerance as low as 0.025 %</li> </ul>
<b>ORN / ORN Divider</b> 	<ul style="list-style-type: none"> <li>• 8-pin SOIC precision resistor network</li> <li>• 33 Ω and 500 kΩ resistance per element</li> <li>• Multiple standard divider ratios: 2:1 to 100:1 available</li> </ul>	<ul style="list-style-type: none"> <li>• Customer schematics and divider ratios available</li> <li>• Tight TCR tracking down to 5 ppm/°C</li> <li>• Ratio tolerance as low as 0.01 %</li> </ul>
<b>NOMC</b> 	<ul style="list-style-type: none"> <li>• 14- and 16-pin SOIC precision resistor networks</li> <li>• 100 Ω to 100 kΩ resistance per element</li> <li>• Isolated and bussed schematics available</li> </ul>	<ul style="list-style-type: none"> <li>• Customer schematics and divider ratios available</li> <li>• Tight TCR tracking down to 5 ppm/°C</li> <li>• Ratio tolerance as low as 0.05 %</li> </ul>
<b>HLZ, FVE, FSE, RB</b> 	<ul style="list-style-type: none"> <li>• Wirewound</li> <li>• 35 W to 2000 W</li> <li>• 0.010 Ω to 391 Ω</li> </ul>	<ul style="list-style-type: none"> <li>• High power</li> <li>• Custom designs</li> <li>• Mounting solutions</li> <li>• Overload capacity of 10x rated power for 5 s</li> </ul>
<b>RNX / ROX</b> 	<ul style="list-style-type: none"> <li>• High-voltage metal oxide axial resistors</li> <li>• Voltage to 8 kV on the RNX and 45 kV on the ROX</li> </ul>	<ul style="list-style-type: none"> <li>• Tolerances to 0.5 % and TCR to 50 ppm/°C</li> <li>• Alternative construction available</li> <li>• Special testing available</li> </ul>
<b>CRHV / CRMV</b> 	<ul style="list-style-type: none"> <li>• High- or medium-voltage thick film chip resistor</li> <li>• Voltages to 3 kV</li> <li>• Divider chip available</li> </ul>	<ul style="list-style-type: none"> <li>• Stability to &lt; 0.5 %</li> <li>• Tolerances to 0.5 %</li> <li>• Custom sizes, terminations, testing, and performance available</li> </ul>

Medical Instruments, continued

<p><b>PTF / PSF</b></p> 	<ul style="list-style-type: none"> <li>• High-precision, high-stability metal film resistors</li> <li>• Through-hole (axial) product available in PTF series</li> <li>• Surface-mount (SMD) product available in PSF series</li> </ul>	<ul style="list-style-type: none"> <li>• Tolerances to 0.01 % and TCR to 5 ppm/°C</li> <li>• Very low noise and voltage coefficient</li> </ul>
<p><b>TR / FHV</b></p> 	<ul style="list-style-type: none"> <li>• High-voltage through-hole thick film planar resistors</li> <li>• Radial or axial lead available</li> <li>• Voltages to 30 kV</li> </ul>	<ul style="list-style-type: none"> <li>• Non-inductive design</li> <li>• Tolerances to 1 % and TCR to 100 ppm/°C</li> <li>• Ohmic values ranging from 10 Ω to 3 TΩ</li> </ul>
<p><b>WSL WSL...18 WSLP</b></p> 	<ul style="list-style-type: none"> <li>• Power Metal Strip® resistors</li> <li>• Very low resistance values of 0.5 mΩ to 500 mΩ</li> <li>• Tight tolerance of 1 % standard, and available down to 0.1 %</li> <li>• Instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Low-RTC resistance element (&lt; 20 ppm/°C) results in accurate current sensing, allowing the use of lower cost ICs</li> <li>• Provides high-temperature performance that can surpass that of thick film resistors</li> <li>• Available with gold plated terminations for wire bond or epoxy bond applications</li> <li>• Saves space by enabling use of a single low-value resistor instead of multiple high-value resistors in parallel</li> </ul>
<p><b>WSK0612 WSK2512 WSL3637</b></p> 	<ul style="list-style-type: none"> <li>• Power Metal Strip resistors</li> <li>• 4-terminal Kelvin connection</li> <li>• Very low resistance values of 0.5 mΩ to 200 mΩ</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Low-RTC resistance element (&lt; 20 ppm/°C) results in accurate current sensing, allowing the use of lower cost ICs</li> <li>• Tight tolerance of 1 % standard, and available down to 0.1 %</li> <li>• Provides high-temperature performance that can surpass that of thick film resistors</li> <li>• Saves space by enabling use of a single low-value resistor instead of multiple high-value resistors in parallel</li> </ul>
<p><b>RCWE</b></p> 	<ul style="list-style-type: none"> <li>• Thick film resistors with wrap terminations</li> <li>• Extremely low resistance range, from 0.01 Ω to 0.979 Ω</li> <li>• High power capacity to 2 W</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• High power</li> <li>• High surge pulse performance</li> <li>• Tight tolerances: ± 1 %, ± 5 %</li> <li>• Temperature coefficient: from ± 100 ppm/°C to ± 700 ppm/°C, depending on value</li> <li>• Operating temperature range : -55 °C to +155 °C</li> </ul>
<p><b>WSR</b></p> 	<ul style="list-style-type: none"> <li>• Power Metal Strip resistors</li> <li>• Very low resistance values of 1 mΩ to 1 Ω</li> <li>• High power capacity to 5 W</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Compact 4527 package size</li> <li>• Inductance values as low as 0.5 nH</li> <li>• Resistant to thermal and mechanical shock, extreme temperatures, humidity, and vibration</li> <li>• Operating temperature range: -65 °C to +275 °C</li> <li>• Lead (Pb)-free version is RoHS-compliant</li> </ul>
<p><b>WSC WSN SM</b></p> 	<ul style="list-style-type: none"> <li>• Wirewound SMD design</li> <li>• Wide resistance range from 0.1 Ω to 40 KΩ</li> <li>• High power capacity to 4 W</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Complete molded construction</li> <li>• Available in non-inductive (WSN) version</li> <li>• Resistant to thermal and mechanical shock, extreme temperatures, humidity, and vibration</li> <li>• Operating temperature range: -65 °C to +275 °C</li> <li>• Lead (Pb)-free version is RoHS-compliant</li> </ul>



# MEDICAL PRODUCTS

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### Medical Imaging



**Applications**

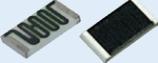
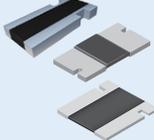
- X-ray
- MRI
- Portable ultrasounds
- CT scanning

**Features**

- High voltage handling
- Non-magnetic construction

Series/Part Number	Features and Descriptions	Benefits
<b>PNM</b> 	<ul style="list-style-type: none"> <li>• Precision thin film non-magnetic SMT chip resistor</li> <li>• Resistance range from 20 Ω to 3 MΩ</li> </ul>	<ul style="list-style-type: none"> <li>• Tight tolerance of 0.1 % and low TCR of 25 ppm/°C</li> <li>• Wide variety of case sizes with power levels up to 1 W</li> <li>• Non-standard resistance values available</li> </ul>
<b>CSOM/CSO</b> 	<ul style="list-style-type: none"> <li>• 25 mil and 50 mil pitch dual in-line SMT resistor network</li> <li>• Ceramic package with no cavities</li> <li>• Tantalum nitride or passivated nichrome resistive film</li> </ul>	<ul style="list-style-type: none"> <li>• Custom schematics available</li> <li>• Tight TCR tracking of 5 ppm/°C</li> <li>• Ratio tolerance as low as ± 0.02 %</li> </ul>
<b>PLT</b> 	<ul style="list-style-type: none"> <li>• Precision low-TCR SMT chip resistor</li> <li>• Resistance range from 250 Ω to 775 kΩ</li> </ul>	<ul style="list-style-type: none"> <li>• Non-standard resistance values available</li> <li>• Tolerance down to 0.01 %</li> <li>• Low TCR of 5 ppm/°C over entire operating range</li> </ul>
<b>MPM</b> 	<ul style="list-style-type: none"> <li>• Precision thin film resistor divider network</li> <li>• Small SOT-23 package</li> <li>• Multiple standard divider ratios: 1:1 to 100:1 available</li> </ul>	<ul style="list-style-type: none"> <li>• Custom divider ratios available</li> <li>• Tight TCR tracking down to 2 ppm/°C</li> <li>• Ratio tolerance as low as 0.01 %</li> </ul>
<b>DFN / DFN Divider</b> 	<ul style="list-style-type: none"> <li>• 8 mm pitch, dual flat no-lead package resistor network</li> <li>• Low-profile 1 mm seated height</li> </ul>	<ul style="list-style-type: none"> <li>• Custom schematics and divider ratios available</li> <li>• Tight TCR tracking down to 3 ppm/°C</li> <li>• Ratio tolerance as low as 0.025 %</li> </ul>
<b>ORN / ORN Divider</b> 	<ul style="list-style-type: none"> <li>• 8-pin SOIC precision resistor network</li> <li>• 33 Ω to 500 kΩ resistance per element</li> <li>• Multiple standard divider ratios: 2:1 to 100:1 available</li> </ul>	<ul style="list-style-type: none"> <li>• Customer schematics and divider ratios available</li> <li>• Tight TCR tracking down to 5 ppm/°C</li> <li>• Ratio tolerance as low as 0.01 %</li> </ul>
<b>HLZ, FVE, FSE, RB</b> 	<ul style="list-style-type: none"> <li>• Wirewound</li> <li>• 35 W to 2000 W</li> <li>• 0.010 Ω to 391 Ω</li> </ul>	<ul style="list-style-type: none"> <li>• High power</li> <li>• Custom designs</li> <li>• Mounting solutions</li> <li>• Overload capacity of 10x rated power for 5 s</li> </ul>
<b>MRA</b> 	<ul style="list-style-type: none"> <li>• Axial-leaded wirewound</li> <li>• RoHS compliant</li> <li>• Welded construction</li> </ul>	<ul style="list-style-type: none"> <li>• Non-inductive / non-magnetic</li> <li>• Power ratings of 4 W to 12 W</li> <li>• Excellent pulse performance</li> </ul>
<b>RNX / ROX</b> 	<ul style="list-style-type: none"> <li>• High-voltage metal oxide axial resistors</li> <li>• Voltage to 8 kV on the RNX and 45 kV on the ROX</li> </ul>	<ul style="list-style-type: none"> <li>• Tolerances to 0.5 % and TCR to 50 ppm/°C</li> <li>• Alternative construction available</li> <li>• Special testing available</li> </ul>

Medical Imaging, continued

<p><b>CMF Non-Magnetic</b></p> 	<ul style="list-style-type: none"> <li>• Precision industrial / medical axial-leaded metal film resistor</li> <li>• Same electrical characteristics as the standard CMF series</li> </ul>	<ul style="list-style-type: none"> <li>• Fully non-magnetic construction</li> <li>• Tolerances to 0.1 % and TCR to 25 ppm/°C</li> <li>• Value ranges from 0.1 <math>\Omega</math> to 50 M<math>\Omega</math> standard</li> <li>• Custom construction and testing available</li> </ul>
<p><b>RCWP Non-Magnetic</b></p> 	<ul style="list-style-type: none"> <li>• Non-magnetic industrial / medical thick film resistor</li> <li>• Sulfur-impervious construction and materials</li> </ul>	<ul style="list-style-type: none"> <li>• 100 % tested to MIL-PRF-55342, Group A</li> <li>• Tolerances to 0.5 %</li> <li>• Value range of 1 <math>\Omega</math> to 22 M<math>\Omega</math> standard</li> <li>• Custom size, values, materials, testing available</li> </ul>
<p><b>CRHV / CRMV Non-Magnetic</b></p> 	<ul style="list-style-type: none"> <li>• Non-magnetic high- or medium-voltage thick film chip resistor</li> <li>• Voltages to 3 kV</li> <li>• Divider chip available</li> </ul>	<ul style="list-style-type: none"> <li>• Stability to &lt; 0.5 %</li> <li>• Tolerances to 0.5 %</li> <li>• Custom sizes, terminations, testing, and performance available</li> </ul>
<p><b>WSL WSL...18 WSLP</b></p> 	<ul style="list-style-type: none"> <li>• Power Metal Strip® resistors</li> <li>• Very low resistance values of 0.5 m<math>\Omega</math> to 500 m<math>\Omega</math></li> <li>• Tight tolerance of 1 % standard, and available down to 0.1 %</li> <li>• Instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Low-RTC resistance element (&lt; 20 ppm/°C) results in accurate current sensing, allowing the use of lower cost ICs</li> <li>• Provides high-temperature performance that can surpass that of thick film resistors</li> <li>• Available with gold-plated terminations for wire-bond or epoxy-bond applications</li> <li>• Saves space by enabling use of a single low-value resistor instead of multiple high-value resistors in parallel</li> </ul>
<p><b>WSK0612 WSK2512 WSL3637</b></p> 	<ul style="list-style-type: none"> <li>• Power Metal Strip resistors</li> <li>• 4-terminal Kelvin connection</li> <li>• Very low resistance values of 0.5 m<math>\Omega</math> to 200 m<math>\Omega</math></li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Low-RTC resistance element (&lt; 20 ppm/°C) results in accurate current sensing, allowing the use of lower cost ICs</li> <li>• Tight tolerance of 1 % standard, and available down to 0.1 %</li> <li>• Provides high-temperature performance that can surpass that of thick film resistors</li> <li>• Saves space by enabling use of a single low-value resistor instead of multiple high-value resistors in parallel</li> </ul>
<p><b>RCWE</b></p> 	<ul style="list-style-type: none"> <li>• Thick film resistors with wrap termination</li> <li>• Extremely low resistance range, from 0.01 <math>\Omega</math> to 0.979 <math>\Omega</math></li> <li>• High power capacity to 2 W</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• High power</li> <li>• High surge pulse performance</li> <li>• Tight tolerances: <math>\pm 1</math> %, <math>\pm 5</math> %</li> <li>• Temperature coefficient: from <math>\pm 100</math> ppm/°C to <math>\pm 700</math> ppm/°C, depending on value</li> <li>• Operating temperature range : -55 °C to +155 °C</li> </ul>
<p><b>WSR</b></p> 	<ul style="list-style-type: none"> <li>• Power Metal Strip resistors</li> <li>• Very low resistance values of 1 m<math>\Omega</math> to 1 <math>\Omega</math></li> <li>• High power capacity to 5 W</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Compact 4527 package size</li> <li>• Inductance values as low as 0.5 nH</li> <li>• Resistant to thermal and mechanical shock, extreme temperatures, humidity, and vibration</li> <li>• Operating temperature range: -65 °C to +275 °C</li> <li>• Lead (Pb)-free version is RoHS-compliant</li> </ul>
<p><b>WSC WSN SM</b></p> 	<ul style="list-style-type: none"> <li>• Wirewound SMD design</li> <li>• Wide resistance range from 0.1 <math>\Omega</math> to 40 K<math>\Omega</math></li> <li>• High power capacity to 4 W</li> <li>• Implantable instrumentation imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Complete molded construction.</li> <li>• Available in non-inductive (WSN) version.</li> <li>• Resistant to thermal and mechanical shock, extreme temperatures, humidity, and vibration</li> <li>• Operating temperature range: -65 °C to +275 °C</li> <li>• Lead (Pb)-free version is RoHS-compliant</li> </ul>



# MEDICAL PRODUCTS

## Vishay Dale Resistors - Medical 101

### Medical Facilities

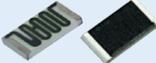


**Applications**

- Ground fault protection
- Neutral grounding
- Neutral earthing

**Features**

- High power
- Overload capacity

Series/Part Number	Features and Descriptions	Benefits
<b>HL, FST, FVT, RD</b> 	<ul style="list-style-type: none"> <li>• Wirewound</li> <li>• 5 W to 1150 W</li> <li>• 0.012 Ω to 651 kΩ</li> </ul>	<ul style="list-style-type: none"> <li>• High power</li> <li>• Custom designs</li> <li>• Mounting solutions</li> <li>• Overload capacity of 10 x rated power for 5 s</li> </ul>
<b>NGR</b> 	<ul style="list-style-type: none"> <li>• Grounding of industrial power systems for ground fault, over voltage, and short circuit protection</li> <li>• Steel grid technology</li> <li>• System voltage from 2.4 kV to 13.8 kV</li> <li>• Current rating from 100 A to 1000 A</li> </ul>	<ul style="list-style-type: none"> <li>• Tied live design</li> <li>• Application specific designs</li> <li>• Designed per IEEE-32</li> <li>• High thermal capacity to absorb high currents</li> <li>• Rugged shock resistant IP23 rated enclosures</li> </ul>
<b>CRHV / CRMV</b> 	<ul style="list-style-type: none"> <li>• High- or medium-voltage thick film chip resistor</li> <li>• Voltages to 3 kV</li> <li>• Divider chip available</li> </ul>	<ul style="list-style-type: none"> <li>• Stability to &lt; 0.5 %</li> <li>• Tolerances to 0.5 %</li> <li>• Custom sizes, terminations, testing, and performance available</li> </ul>



## MEDICAL PRODUCTS

### Vishay Dale Resistors - Medical 101

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