INTRODUCTION
This capabilities brochure is designed to help circuit designers and component engineers understand the advantages of utilizing thin film integrated resistor network technology. It also highlights some common applications for thin film precision resistor networks.

RESOURCES
- For technical questions contact: thinfilm@vishay.com
- Vishay Dale Thin Film Brands page: www.vishay.com/company/brands/daletinfilm/
- Vishay Dale Thin Film Interactive Sample Board: www.vishay.com/landingpage/SMD_Board/index.html
Thin Film Integrated Construction

Advantages

- Extremely close matching of all elements in a network, ensuring close tracking over temperature and throughout life
- Very small, high-density, multi-element networks which save printed circuit board real estate
- Repeatable and consistent characteristics, part to part, and lot to lot
- Very low inductance
- Outstanding reliability – fewer individual interconnections
- No thermoelectric effects
- Installed costs no more than discretes – often less
<table>
<thead>
<tr>
<th>Semi-Precision</th>
<th>VSOR</th>
<th>VSSR</th>
<th>VTSR</th>
<th>VSSRC</th>
<th>VSORC</th>
<th>VTSRC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Package</strong></td>
<td><img src="#" alt="VSOR" /></td>
<td><img src="#" alt="VSSR" /></td>
<td><img src="#" alt="VTSR" /></td>
<td><img src="#" alt="VSSRC" /></td>
<td><img src="#" alt="VSORC" /></td>
<td><img src="#" alt="VTSRC" /></td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>16</td>
<td>16, 20, 24</td>
<td>20, 24</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td><strong>Number of Resistors</strong></td>
<td>8 or 15</td>
<td>8 to 23</td>
<td>10 to 23</td>
<td>18 R 18 C</td>
<td>18 R 18 C</td>
<td>18 R 18 C</td>
</tr>
<tr>
<td><strong>Range (Ω)</strong></td>
<td>10 to 47K</td>
<td>10 to 47K</td>
<td>10 to 47K</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Absolute Tolerance (%)</strong></td>
<td>2 to 5</td>
<td>2 to 5</td>
<td>2 to 5</td>
<td>R = 10, C = 20</td>
<td>R = 10, C = 20</td>
<td>R = 10, C = 20</td>
</tr>
<tr>
<td><strong>Ratio Tolerance (%)</strong></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>TCR (ppm/C) -55 °C to +125 °C</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td><strong>TCR Tracking</strong></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Power per R (W per element)</strong></td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Package Power (W)</strong></td>
<td>16 pin = 1, 20 pin = 1.2, 24 pin = 1.4</td>
<td>16 pin = 1, 20 pin = 1.2, 24 pin = 1.4</td>
<td>1.2</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Precision Dividers and Networks**

**VISHAY INTERTECHNOLOGY, INC.**

**THIN FILM RESISTOR NETWORKS**

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www.vishay.com
## Surface-Mount Networks (Molded) Precision

<table>
<thead>
<tr>
<th>Package</th>
<th>MP</th>
<th>MPM</th>
<th>MORN</th>
<th>ORN</th>
<th>ORNA (Divider)</th>
<th>ORNV (Divider)</th>
<th>HTRN</th>
<th>NOMC</th>
<th>OSOP</th>
<th>MPMA</th>
<th>AORN</th>
<th>NOMCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>SC-70</td>
<td>SOT-23</td>
<td>QSOIP 8 pin</td>
<td>SOIC 8 pin</td>
<td>SOIC 8 pin</td>
<td>SOIC 14, 16</td>
<td>SOIC 16, 20, 24</td>
<td>SOT-23</td>
<td>SOIC 8 pin</td>
<td>SOIC 14, 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schematic</td>
<td>Center Tapped or Isolated</td>
<td>Center Tapped</td>
<td>Isolated</td>
<td>Isolated</td>
<td>Voltage Divider and Reference R</td>
<td>Isolated</td>
<td>Isolated, Center Tapped</td>
<td>Center Tapped</td>
<td>Isolated, Divider</td>
<td>Isolated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Resistors</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>7, 8</td>
<td>up to 23</td>
<td>2</td>
<td>4</td>
<td>7, 8</td>
</tr>
<tr>
<td>Range (Ω)</td>
<td>100 to 50K</td>
<td>100 to 100K</td>
<td>400 to 500K</td>
<td>1k to 100K</td>
<td>2k to 50K</td>
<td>1K to 100K</td>
<td>100 to 100K</td>
<td>500 to 100K</td>
<td>1K to 100K</td>
<td>1K to 50K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute Tolerance (%)</td>
<td>0.1 to 1</td>
<td>0.05 to 1</td>
<td>0.05 to 1</td>
<td>0.05 to 1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td></td>
</tr>
<tr>
<td>Ratio Tolerance (%)</td>
<td>0.5 to 0.05</td>
<td>0.5 to 0.01</td>
<td>0.01 to 0.05</td>
<td>0.01 to 0.01</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05 to 0.025</td>
<td>0.05 to 0.025</td>
<td>0.05 to 0.5</td>
<td>0.05 to 0.5</td>
<td>0.05 to 0.5</td>
<td></td>
</tr>
<tr>
<td>TCR Tracking</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power per R (W per element)</td>
<td>0.075</td>
<td>0.1</td>
<td>0.05</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Package Power (W)</td>
<td>0.15</td>
<td>0.2</td>
<td>0.2</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4 / 0.5</td>
<td>0.4</td>
<td>0.2</td>
<td>0.4 / 0.5</td>
<td></td>
</tr>
</tbody>
</table>

**AEC-Q200 Qualified**

**VISHAY INTERTECHNOLOGY, INC.**

**THIN FILM RESISTOR NETWORKS**

**Precision Dividers and Networks**

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www.vishay.com
# Precision Dividers and Networks

## Surface-Mount Networks (Molded) Precision

<table>
<thead>
<tr>
<th>Package</th>
<th>CSO</th>
<th>TOMC</th>
<th>WOMC</th>
<th>DFN</th>
<th>DFN (Divider)</th>
<th>QFN-LCC/TLCC</th>
<th>FP (Flatpack)</th>
<th>CSOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>SOIC 6, 8, 12, 14, 16</td>
<td>SOIC 16 Medium</td>
<td>SOIC 16 Wide</td>
<td>8 Pin Dual Flat No-Lead</td>
<td>8 Pin Dual Flat No-Lead</td>
<td>20 Pin Dual Flat No-Lead</td>
<td>4, 16, 18, 20</td>
<td>14, 16</td>
</tr>
<tr>
<td>Schematic</td>
<td>Any</td>
<td>Isolated and Common</td>
<td>Custom</td>
<td>Isolated</td>
<td>Isolated</td>
<td>Custom</td>
<td>Isolated and Common</td>
<td>Isolated and Common</td>
</tr>
<tr>
<td>Number of Resistors</td>
<td>Custom</td>
<td>8</td>
<td>Custom</td>
<td>4</td>
<td>4</td>
<td>Custom</td>
<td>8 to 23</td>
<td>Custom</td>
</tr>
<tr>
<td>Range (Ω)</td>
<td>up to 1.5M total</td>
<td>100 to 200K</td>
<td>100 to 500K</td>
<td>100 to 100K</td>
<td>100 to 100K</td>
<td>100 to 500K</td>
<td>100 to 100K</td>
<td>10 to 1M</td>
</tr>
<tr>
<td>Absolute Tolerance (%)</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
</tr>
<tr>
<td>Ratio Tolerance (%)</td>
<td>0.1 to 0.02</td>
<td>0.5 to 0.025</td>
<td>0.1 to 0.05</td>
<td>0.5 to 0.025</td>
<td>0.05</td>
<td>0.1 to 0.05</td>
<td>n/a</td>
<td>0.1 to 0.01</td>
</tr>
<tr>
<td>TCR (ppm/C) -55 ºC to +125 ºC</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>TCR Tracking</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Power per R (W per element)</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>Common 0.05 Isolated 0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Package Power (W)</td>
<td>0.5</td>
<td>0.75</td>
<td>0.5</td>
<td>0.05 x number of resistors</td>
<td>0.05 x number of resistors</td>
<td>0.05 x number of resistors</td>
<td>0.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

## Surface-Mount (Hermetic) Precision

<table>
<thead>
<tr>
<th>Package</th>
<th>LCC/TLCC</th>
<th>FP (Flatpack)</th>
<th>CSOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>14, 16, 20</td>
<td>14, 16</td>
<td>14, 16</td>
</tr>
<tr>
<td>Schematic</td>
<td>Isolated and Common</td>
<td>Isolated and Common</td>
<td>Any</td>
</tr>
<tr>
<td>Number of Resistors</td>
<td>Custom</td>
<td>Custom</td>
<td>Custom</td>
</tr>
<tr>
<td>Range (Ω)</td>
<td>up to 500K total</td>
<td>up to 500K total</td>
<td>up to 500K total</td>
</tr>
<tr>
<td>Absolute Tolerance (%)</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
</tr>
<tr>
<td>Ratio Tolerance (%)</td>
<td>0.1 to 0.01</td>
<td>0.02 to 0.1</td>
<td></td>
</tr>
<tr>
<td>TCR (ppm/C) -55 ºC to +125 ºC</td>
<td>25, 50</td>
<td>25, 50</td>
<td></td>
</tr>
<tr>
<td>TCR Tracking</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Power per R (W per element)</td>
<td>Common 0.05 Isolated 0.1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Package Power (W)</td>
<td>0.5</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>

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## Through-Hole Precision

<table>
<thead>
<tr>
<th>Package</th>
<th>TDP</th>
<th>HD (Hermetic Dip)</th>
<th>VTF SIP</th>
<th>TSP Molded Sip</th>
<th>HVPS</th>
<th>83401 SIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>14, 16</td>
<td>8, 14, 16, 18, 20</td>
<td>3, 4, 5, 6, 7, 8, 9, 10</td>
<td>6, 8, 10</td>
<td>2</td>
<td>6, 8, 10</td>
</tr>
<tr>
<td>Schematic</td>
<td>Isolated and Common</td>
<td>Custom</td>
<td>Standard or Custom</td>
<td>Isolated and Common</td>
<td>Isolated</td>
<td>Isolated and Common</td>
</tr>
<tr>
<td>Number of Resistors</td>
<td>7, 8</td>
<td>Custom</td>
<td>2 to 9</td>
<td>5 to 9</td>
<td>1</td>
<td>3 to 9</td>
</tr>
<tr>
<td>Range (Ω)</td>
<td>100 to 100K</td>
<td>50 to 1.5M total</td>
<td>100 to 1M</td>
<td>100 to 200K</td>
<td>50K to 10M</td>
<td>100 to 200K</td>
</tr>
<tr>
<td>Absolute Tolerance (%)</td>
<td>0.5 to 1</td>
<td>0.1 to 1</td>
<td>0.1 to 1</td>
<td>0.5 to 1</td>
<td>0.01 to 1.0</td>
<td>0.1 to 5</td>
</tr>
<tr>
<td>Ratio Tolerance (%)</td>
<td>0.1 to 0.05</td>
<td>0.1 to 0.01</td>
<td>0.1 to 0.02</td>
<td>0.1 to 0.05</td>
<td>n/a</td>
<td>0.05</td>
</tr>
<tr>
<td>TCR (ppm/C) -55 ºC to +125 ºC</td>
<td>25</td>
<td>10</td>
<td>10</td>
<td>25</td>
<td>5</td>
<td>25 to 300</td>
</tr>
<tr>
<td>TCR Tracking</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>n/a</td>
<td>5</td>
</tr>
<tr>
<td>Power per R (W per element)</td>
<td>Common 0.05</td>
<td>Isolated 0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>HVPS1: 0.125 HVPS2: 0.250</td>
<td>0.06 to 0.12</td>
</tr>
<tr>
<td>Package Power (W)</td>
<td>0.8</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
<td>HVPS1: 0.125 HVPS2: 0.250</td>
<td>0.18 to 1.0</td>
</tr>
</tbody>
</table>
### VISHAY DALE THIN FILM APPLICATION SPECIFICATION GUIDE

Vishay Dale Thin Film Reference No.: 

Name and Title: 

Company: ___________________________  Division: ______________________  Dept.: __________

Address: ________________________________________________________________

City: ___________________________  State: ___________________________  Zip: ______________

Phone: ___________________________  Fax/Email: ___________________________

Expected Usage/Year: ______________  Timing-Prototypes: __________  Prod.: __________

Application: _______________________________  Hermetic Sealed: [ ] Yes  [ ] No

Drawing No.: _______________________________  Package Choices: 1st: __________  2nd: __________

Special Testing: ___________________________  Operating Temperature Range: __________ ºC to __________ ºC

<table>
<thead>
<tr>
<th>Resistor No.</th>
<th>Resistor Value (Ω)</th>
<th>Tolerance</th>
<th>TCR</th>
<th>Reference Resistor</th>
<th>Max Voltage</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Absolute + %</td>
<td>Ratio + %</td>
<td>Absolute + ppm/ºC</td>
<td>Tracking + ppm/ºC</td>
<td>Peak (V)</td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td></td>
<td></td>
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</tr>
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<td>14</td>
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<td>4</td>
<td>15</td>
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<td>16</td>
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<td>18</td>
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<td>8</td>
<td>19</td>
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<tr>
<td>9</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>10</td>
<td>21</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Vishay Dale Thin Film**

2160 Liberty Drive

Niagara Falls, NY 14304

Ph: +1-716-283-4025

Fax: +1-716-283-5932

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THIN FILM RESISTOR NETWORKS

Precision Dividers and Networks

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
- Ultra-Fast 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® Diodes (unidirectional, bidirectional)
- ESD Protection Diodes (including arrays)

Thyristors/SCRs
- Phase-Control Thyristors
- Fast Thyristors

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
Large PIN Photo Diodes

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

Infrared Remote Control Receivers
Optocouplers
- Phototransistor, Photodarlington
- Linear
- Phototriac
- High-Speed
- IGBT and MOSFET Driver

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

PASSIVE COMPONENTS

Resistors Segment

Film Resistors – Chip, MELF, Leaded, and Networks
- 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
High Power Water Cooled Resistors
Thermo Fuses
Chip Fuses
Pyrotechnic Initiators / Igniters
Variable Resistors
- Cermet Variable Resistors
- Wirewound Variable Resistors
- Conductive Plastic Variable Resistors
- Contactless Potentiometers
- Hall Effect Position Sensors
- Precision Magnetic Encoders

Networks/Arrays/ Attenuators
RF and Microwave Resistors
High Voltage Resistors
Dividers
Non-Linear Resistors and Temperature Sensors
- NTC Thermistors
- PTC Thermistors
- Thin Film RTDs
- Varistors
- Platinum Chip Temperature Sensors

Inductors Segment

Magnetics
- Power Inductors Automotive and Commercial
- Grade
- Coupled Inductors

Power Chokes
- Common Mode Chokes
- High Frequency RF Inductors
- Magnetic Actuators
- 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