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IN A NUTSHELL

MOSFETS

Automotive AEC-Q101 Qualified
Optimized for Low Conduction and Low Switching Losses

Low Voltage 25 V and 30 V
Industry’s Lowest $R_{DS(on)}$ in Advanced Space Saving Packages

Medium Voltage 40 V to 250 V
Industry’s Lowest $R_{DS(on)}$, $Q_{oss}$, Figure of Merit (FOM)

P-Channel Gen III and IV TrenchFET®
Industry Leader in $R_{DS(on)}$ With Packages That Minimize Power Loss and Voltage Drop

DIODES / RECTIFIERS

FRED Pt® Rectifiers eSMP® Series Packages
Space-Saving Footprints and Low Profile Package Solutions for all Major Applications

FRED Pt® Rectifiers in SlimDPak (TO-252AE)
Increased Power Density and Improved Thermal Performance

FRED Pt® Rectifiers
Offer Higher Power Density in Low Profile SMD Package

FRED Pt® Rectifiers in FlatPAK 5 x 6
Increase Power Density and Performance

PowerPAIR®
Integrated Dual MOSFET Power Stage in Compact Packages for Increased Power Density

TrenchFET® and E-Series
Wide Range of Advanced Packages

OPTOELECTRONICS

Fully Integrated Short and Long Range Proximity Sensors
Include IR Emitter Photodiode Signal Processing and Programmability via I2C

VCNL4035X01
Gesture Sensor Enables any System to Respond to a Swipe Left, Swipe Right, or in and out Gesture

Single, Dual, Tri and Quad Channel Transmissive Sensors
For Incremental and Absolute Encoding

Minimold IR Receivers
Offer Improved off Angle Transmit Distance and RF Noise Immunity in a Through-Hole or Surface-Mount Package

TVCast SMD IR Receivers
Lowest Profile (1.6 mm) Receiver on the Market for Super Thin TVs and Tight Spaces

VOR Series Solid-State Relays
Low Voltages of 400 V and Load Currents Up to 140 mA, Ideal for Replacing Mechanical Relays

Large PIN Photodiodes
7.5 mm x 7.5 mm Radiant Active Area

POWER ICS

SiC46x and SiC47x microBUCK®
4.5 V to 60 V Buck Regulators Deliver Up to 200 W Output Power

SiC43x microBUCK®
Buck Regulator Family Enables High Power Density and Efficiency

Analog Switches and Multiplexers
Enhanced Series for Precision Applications Designs
196 HVC ENYCAP™ HYBRID ENERGY STORAGE CAPACITORS

IN A NUTSHELL

Electrostatic Storage + Electrochemical Storage = Hybrid Storage

THE 196 HVC ENYCAP “SWEET SPOT”

Higher Energy Density by Volume

FOUR CAPACITANCE OPTIONS

196 HVC ENYCAP™ HYBRID ENERGY STORAGE CAPACITORS

Available in Multiple Package Styles

196 HVC ENYCAP POWER SOURCE

NORMAL MODE

POWER MANAGEMENT UNIT

LOAD

CHARGE 196 HVC

BACKUP MODE

POWER MANAGEMENT UNIT

LOAD

SUPPLY FAIL 196 HVC

STACKABLE

1.4 V

8.4 V on request

196 HVC ENYCAP vs. a Battery

• More charge and discharge cycles: over 100,000
• No memory effect
• Longer lifetime

196 HVC ENYCAP vs. a Traditional Supercapacitor

• Lower self - discharge
• More than three times the energy density
• No cell balancing

1000
100
10
1
0.1
0.01
10
100
1000
10,000
Energy Density (Wh/kg)

10
100
1000
10,000
Power Density (W/kg)

Fuel Cells

Conventional Batteries

Ultracapacitors

Conventional Capacitors

1 hour

1 second

0.03 seconds

Energy Density (Wh/kg)

100 1000 10 000

Power Density (W/kg)

10
100
1000
10,000

100 1000 10 000

Power Density (W/kg)

Higher Energy Density by Volume

EDLC Supercapacitor

13 Ws/g

1/3 of the volume

460 Ws OF STORED ENERGY (4 CELLS)

Example 1 A for 200 s

Not just a capacitor, it’s the 196 HVC ENYCAP hybrid energy storage capacitor!

For Technical Questions: hybridstorage@vishay.com
220 EDLC
ENERGY STORAGE CAPACITORS

IN A NUTSHELL

PRODUCT VERSIONS

ENERGY
POWER

Energy Storage Capacitors

MULTIPLE CAPACITANCE VALUES

15 F to 60 F
16 mm x 20 mm to 18 mm x 40 mm

Joule = Ws

COMPARISON OF ALU VS. 220 EDLC

220 EDLC VS. BATTERY CELL

• Higher discharge current
• > 500 000 charge / discharge cycles
• Superfast charge and discharge
• Category temperature of -40 °C to +85 °C

POWER BACK-UP APPLICATIONS

VOLTAGE VS. TEMPERATURE

For Technical Questions: hybridstorage@vishay.com
HIGH TEMPERATURE ALUMINUM
SMD, RADIAL, AND AXIAL: +125 °C AND +150 °C

AEC-Q200 QUALIFIED WITH PPAP AVAILABLE

LEAD (Pb)-FREE SOLDERING ACCORDING TO JEDEC®-J-STD-020

FEATURES
- Up to 6800 µF
- Up to 100 V
- Up to 2000 h / 150 °C

CASE SIZES (mm)
- SMD 8 x 10 up to 18 x 21
- Radial 10 x 12 up to 18 x 40
- Axial 10 x 30 up to 21 x 38

HAPPY HIGH TEMPERATURE CAPS

Aluminum Electrolytic Capacitors for Harsh and High Temperature Operating Conditions

APPLICATIONS
- INDUSTRIAL
  - CONTROL UNITS
  - MACHINERY
  - AUTOMATION
  - MOTOR DRIVES
  - WELDING
- AUTOMOTIVE
  - UNDER THE HOOD
  - CHASSIS
  - POWER TRAIN

IN A NUTSHELL

HIGH QUALITY
HIGH RELIABILITY
HIGH PERFORMANCE

For Technical Questions: aluminumcaps2@vishay.com
IN A NUTSHELL

SNAP-IN ALUMINUM CAPACITORS
4-TERMINAL SNAP-IN DC-LINK SOLUTION

LONG LIFETIME
299 PHL-4TSI: 5000 h at 105 °C

EFFICIENT ASSEMBLY,
SOLDER ON HIGH CURRENT PCB

LESS MANUAL WORK SAVES TIME AND COSTS

SNAP-IN SOLUTION

299 PHL-4TSI

KEYED POLARITY
= ONE-WAY MOUNTING

DATA SHEET LIFETIME
vs. APPLICATION LIFETIME

20 years at 60 °C
3000 h 105 °C 15 years
10 000 h 85 °C 10 years
5000 h 85 °C 5 years

SIZES BETWEEN SI AND ST

2-Pin SI (mm)
22 x 25
35 x 50

299 PHL-4TSI (mm)
35 x 60
45 x 100

ST (mm)
35 x 80
90 x 220

Long life at high temperature
Low cost mounting
High ripple current

SNAP-IN ALUMINUM CAPACITORS
4-TERMINAL SNAP-IN DC-LINK SOLUTION

For Technical Questions: aluminumcaps2@vishay.com
DC-LINK FILM CAPACITORS
LOW ESR, HIGH RIPPLE CURRENT CAPABILITIES

IN A NUTSHELL

APPLICATIONS
• On-Board Chargers
• 48 V Board Net
• Forklifts
• Renewable Energy
• Welding Equipment
• Power Supplies
• Motor Drives

ADVANTAGES OF DC-LINK FILM CAPACITORS OVER ALUMINUM ELECTROLYTIC
• High voltage capability: no series connection; no balancing resistors
• Self-healing technology
• Lifetime over 100 000 hours
• No dry out—stable parameters until the end of life
• Stable electrical parameters across temperature range

FILM CAPACITOR RIPPLE CURRENT CAPABILITY VS. ALUMINUM ELECTROLYTICS

ADVANTAGES OF DC-LINK FILM CAPACITORS OVER ALUMINUM ELECTROLYTIC

DC-LINK CAPACITORS VOLTAGE VS. CAPACITANCE RANGE

For Technical Questions: dc-film@vishay.com
**THB AC FILTERING**

**ROBUST DESIGN FOR HIGH HUMIDITY ENVIRONMENTS**

**TYPICAL PERFORMANCE AT 85 °C / 85 % RELATIVE HUMIDITY CONDITIONS FOR 1000 HOURS AT U_{NAC}**

**APPLICATIONS**

- Outdoor applications
  - Inverters and converters
- High power supplies and large drives
- UPS
- Renewable energy
- Welding equipment
- AC harmonic filters

**MKP1847H**

**UL810-COMPLIANT SEGMENTED FILM**

**HIGH PERFORMANCE FREQUENCY FILTER: HARMONICS + SWITCHING NOISE**

**BROAD CAPACITANCE RANGE**

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<th>C (µF)</th>
<th>CONSTRUCTION</th>
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<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>250 V_{AC}</td>
<td>27.5</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>310 V_{AC}</td>
<td>27.5</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>350 V_{AC}</td>
<td>27.5</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>480 V_{AC}</td>
<td>27.5</td>
<td>37.5</td>
</tr>
</tbody>
</table>

**For Technical Questions:** dc-film@vishay.com
**VISHAY**

**LVAC POWER CAPACITORS**

**LOW LOSS MKP TECHNOLOGY**

**FLEXIBLE DESIGN OPTIONS**

- Footprint: 64 mm / 84 mm / 116 mm / 136 mm
- Height: 82 mm to 340 mm

**HIGHLIGHT**

- Estaspring: maintenance-free, vibration-proof, and reduces assembly times up to 60%

**STANDARDS**

- IEC 60831

**ESTAspring CONNECTION**

- Lever-operated spring connection
- Cable cross section: 2.5 mm² up to 25 mm²
- Max. terminal current = 90 A<sub>rms</sub>
- Protection level: IP20

**APPLICATIONS**

- **PhMKP SERIES**
- Vishay ESTA Capacitors

**TEMPERATURE CLASS**

- -40 °C / D

**LIFE EXPECTANCY**

- > 130 000 h
- 100 FIT

**SAFETY FEATURES**

- Internal tear-off fuses
- Self-healing film
- Discharge resistor < 50 V/1 minute

**FILLING AGENT**

- ESTAdry gas
- ESTAprop oil

**STANDARDS**

- IEC 60831

**HARMONIC FILTERS**

- ≤ 1000 VAC<sub>rms</sub>

**POWER FACTOR CORRECTION**

- ≤ 1000 VAC<sub>rms</sub>

**INPUT**

- Voltage AC RMS: 230 V to 1000 V
- Output: 2.0 kvar to 37.1 kvar
- 3-Phase Delta Capacitance: 11.5 µF to 335 µF

**CUSTOMIZABLE**

For Technical Questions: esta@vishay.com
**In a Nutshell**

**PhMKDg Series**

- **Highlight**
  - Triangular design provides lowest height for 50 kVAR; custom heights for higher outputs on request
  - Maintenance-free, vibration-proof bolt-terminal by counternuts, 20 Nm

- **Height**
  - 210 mm

**Standards**

IEC 60831

**Connection**

- M10 threaded bolt, 20 Nm
- Max. terminal current = 110 A_{rms}
- Protection level: IP00, terminal covers upon request

**Applications**

- Wind Power Plants
- Harmonic Filters
- Pole-Mounted Outdoor
- Solar Panels and Inverters
- Thermal Power Stations
- Power Factor Correction

**Voltage AC RMS**

- 230 V
- 1000 V

**Output**

- 30 kVAR
- 56.2 kVAR
- 115.5 µF
- 331.6 µF

**Also Customizable for Outdoor Applications**

For Technical Questions: powcap@vishay.com
**POWER ELECTRONIC CAPACITORS**

**HIGH CURRENT, LOW INDUCTANCE**

**HDMKP SERIES**

**Vishay ESTA Capacitors**

**FOR TECHNICAL QUESTIONS:** esta@vishay.com

**STANDARDS**

- IEC 61071, IEC 61881-1

**RoHS COMPLIANT**

**VOLTAGE DC**

- 900 V to 2700 V

**CAPACITANCE**

- 40 µF to 2235 µF

**LIFE EXPECTANCY**

- > 100 000 h
- < 100 FIT

**FILLING AGENT**

- ESTAdry resin
- UL 94 V-0

**FEATURES**

- High RMS current rating
- High impulse current rating
- High reliability and lifetime expectation
- Resistance to heavy-duty shock vibration
- Non-polar, low loss dielectric
- Temperature class: -40 °C / 70 °C

**APPLICATIONS**

**TRANSPORTATION**

- DC link and DC filters for industrial and traction converters
- DC link for low power drives
- DC link for wind turbine converters
- Impulse discharge capacitors for magnetizing and welding
- Replacement of aluminum electrolytic capacitors

**INDUSTRIAL**

- DC link and DC filters for industrial and traction converters
- DC link for low power drives
- DC link for wind turbine converters
- Impulse discharge capacitors for magnetizing and welding
- Replacement of aluminum electrolytic capacitors

**CONNECTION**

- Bolts M8
- Inserts M8 x 12

**SAFETY**

- Self-healing film

**OPTIONS**

- CUSTOMIZABLE

**FOOTPRINT**

- 116 mm
- 84 mm

**HEIGHT**

- 105 mm to 260 mm

For Technical Questions: esta@vishay.com
IN A NUTSHELL

CLASS X
Differential Mode Filtering Across the Line

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<th>Sub Class</th>
<th>Peak Impulse Voltage</th>
<th>Typical Application</th>
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<td>X1</td>
<td>4.0 kV</td>
<td>High Pulse</td>
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<tr>
<td>X2</td>
<td>2.5 kV</td>
<td>General Purpose</td>
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CLASS Y
Common Mode Filtering Line to Ground

<table>
<thead>
<tr>
<th>Sub Class</th>
<th>Peak Impulse Voltage</th>
<th>Typical Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1</td>
<td>8.0 kV</td>
<td>High Pulse</td>
</tr>
<tr>
<td>Y2</td>
<td>5.0 kV</td>
<td>General Purpose</td>
</tr>
</tbody>
</table>

Technology | Rating | Series | Capacitance | Certificates | Special Features |
---|--------|--------|-------------|--------------|-----------------|
Ceramic Disc | X1 / Y1 | VY1, VY1C, WKP, 440L | 10 pF to 20 nF | IEC, UL, CSA, and CQC | Industry-first 20 nF, 85 °C / 85 % RH 1000 h available |
| X1 / Y2 | VY2, AY2, WYO | 10 pF to 12 nF | IEC, UL, CSA, and CQC | AEC-Q200 available |
MLCC | X1 / Y2 | VJ Safety Certified COG (NP0) | 10 pF to 1000 pF | IEC, cCSA | 1 nF in X1/Y2 with COG (NP0) Meets IEC 60384-14 min. 4 mm creepage |
| X2 | | 10 pF to 470 pF | IEC, cCSA | Meets IEC 60384-14 min. 4 mm creepage |
| X1 / Y2 | VJ Safety Certified X7R | 100 pF to 4700 pF | IEC, cCSA | Meets IEC 60384-14 min. 4 mm creepage |
| X2 | | 100 pF to 12000 pF | IEC, cCSA | Meets IEC 60384-14 min. 4 mm creepage |
Film | X1 | F339X1 480 VAC, 330 VAC | 0.001 µF to 2.2 µF | IEC, UL, CSA, and CQC | THB grade available |
| X2 | F1772(S), F339M, MKP339, F1773 | 0.001 µF to 40 µF | IEC, UL, CSA, and CQC | AEC-Q200 available, THB grade; axials on demand |
| Y2 | MKP3386Y2 | 0.001 µF to 0.47 µF | IEC, UL, and CSA | AEC-Q200 available |

For Technical Questions: cdc@vishay.com or mlcc@vishay.com

For a Full Overview of RFI Capacitors, Please Visit www.vishay.com/doc?48140
CERAMIC RF POWER CAPACITORS
DETERMINED BY VOLTAGE, CURRENT, AND POWER

IN A NUTSHELL

CUSTOMIZED PRODUCTS AVAILABLE

APPLICATIONS
- INDUSTRIAL
- MEDICAL
- TELECOMMUNICATION
- RAIL
- MILITARY

RF POWER MAP

HIGHEST PROVEN PERFORMANCE AND QUALITY IN THE MARKET

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<th>Plate Caps</th>
<th>Barrel Caps</th>
<th>Water Cooled Pot Caps</th>
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<td>Low losses</td>
<td>•</td>
<td>• Small size</td>
<td>• High voltage, current, and power rating</td>
</tr>
<tr>
<td>High reliability</td>
<td>•</td>
<td>• Geometry minimizes inductance, optimizes voltage strength, and maximizes heat radiation</td>
<td></td>
</tr>
<tr>
<td>Wide range of capacitance values</td>
<td>•</td>
<td></td>
<td>• Water cooling and rugged mechanical construction for highest reliability</td>
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</table>

For Technical Questions: powcap@vishay.com
IN A NUTSHELL

HIGH VOLTAGE CERAMIC CAPACITOR
RADIAL-LEADED SINGLE DISC

2 nF HVCC Comparison

COMPETITOR SOLUTION
State of the art 12 stage multiplier, 15 kV, 2 x 1 nF in parallel

VISHAY REPLACEMENT
Unique 2 nF cap enables space saving 12 stage multiplier, 15 kV, 1 x 2 nF

SAVE SPACE

SAVE COSTS

SAVE TIME

GAIN PERFORMANCE

For Technical Questions: slcap@vishay.com
# AUTOMOTIVE GRADE CERAMIC SAFETY CAPACITORS

## LEADED CERAMIC SINGLE DISC AND SMD MLCCs

**IN A NUTSHELL**

For Technical Questions: powcap@vishay.com

<table>
<thead>
<tr>
<th>Technology</th>
<th>Series</th>
<th>Rating</th>
<th>Rated Voltage</th>
<th>Capacitance</th>
<th>Peak Impulse Voltage</th>
<th>Features</th>
</tr>
</thead>
</table>
| Ceramic Single Disc         | AY1    | X1 / Y1 | X1: 760 V<sub>AC</sub>  
                             |         |         | Y1: 500 V<sub>AC</sub>  
                             |         |         | 1500 V<sub>DC</sub>  | 470 pF to 4.7 nF | X1: 4 kV  
|                             |        |        |               |             | Y1: 10 kV            | 10 kV peak impulse voltage                                               |
| Ceramic Single Disc         | AY2    | X1 / Y2 | X1: 440 V<sub>AC</sub>  
                             |         |         | Y2: 300 V<sub>AC</sub>  
                             |         |         | 1000 V<sub>DC</sub> | 10 pF to 10 nF | X1: 4 kV  
|                             |        |        |               |             | Y2: 5 kV              | Passes 3000 temperature cycles  
|                             |        |        |               |             |                      | 6.8 nF and 10 nF available                                               |
| SMD MLCC COG (NPO)          | VJ...A...X1A | X1 / Y2 | 250 V<sub>AC</sub>  | C0G(NPO): 10 pF to 1 nF  
                             | SMD MLCC X7R |       |               | X7R: 100 pF to 4.7 nF | X1 / Y2: 5 kV            | Small body size, low profile, min. 4 mm creepage, voltage-proof test min. 1500 V<sub>AC</sub>,  
|                             | VJ...Y...X1A |       |               |             |                      | Class I COG (NPO), stable electric up to 1 nF, SMD reflow assembly      |
| SMD MLCC COG (NPO)          | VJ...A...X2A | X2     | 250 V<sub>AC</sub>  | C0G(NPO): 10 pF to 390 pF  
                             | SMD MLCC X7R |       |               | X7R: 100 pF to 12 nF | X2: 2.5 kV               | Small body size, low profile, voltage-proof test min. 1075 V<sub>DC</sub>, min. 4 mm creepage, SMD reflow assembly |

## OUTSTANDING QUALIFICATION TEST

<table>
<thead>
<tr>
<th>Test</th>
<th>IEC 60384-14.4 (Industry standard)</th>
<th>AEC-Q200 (Automotive standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature cycles</td>
<td>-40 °C / +125 °C 5 cycles</td>
<td>-55 °C / +125 °C 1000 cycles</td>
</tr>
<tr>
<td>Humidity (biased)</td>
<td>500 h at 40 °C 90 to 95 % r.h., U&lt;sub&gt;rated&lt;/sub&gt;</td>
<td>1000 h at 85 °C 95 % r.h., U&lt;sub&gt;rated&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

### APPLICATIONS

- On-board Charger
- External Charging Station
- Battery Management
- DC/DC Converter

- On-board voltage is changing from 12 V to 48 V
- You need to bring more reliability to your OBC?
- Your choice is Vishay

For Technical Questions: powcap@vishay.com
HIGH OPERATING TEMPERATURE
RADIAL-LEADED AUTOMOTIVE MLCCs

IN A NUTSHELL

AEC-Q200 Qualified
With PPAP Available

OPERATING TEMPERATURE IN AUTOMOTIVE

Not an ordinary CAPACITOR, it’s built for the MOST EXTREME automotive operating conditions

KEY APPLICATIONS
✓ Engine control
✓ Engine sensor protection
✓ Exhaust system

HOTcap®
INDUSTRY FIRST
K...H Series

200 ºC*

Dielectric | COG | X0U | X7R
---|---|---|---
Voltage V_{dc} | 50 pF | 100 pF | 200 pF | 50 nF | 100 nF | 200 nF
Min. Cap. | 100 pF | 100 pF | 100 pF | 47 nF | 47 nF | 82 nF
Max. Cap. | 12 nF | 12 nF | 8.2 nF | 1 µF | 470 nF | 470 nF

Absorb Bending Stress
High Reliability
Extremely Robust

SMD
Leaded MLCC

• PCB bending and vibration may cause mechanical stress and capacitor cracks
• BOARD DEFLECTION CRACKS
  Leaded Product
  Chip Component

• More robust to thermo-mechanical stress and vibration
• Impact on the MLCC is reduced as the lead wires absorb the bending stress
• The capacitor can be welded or soldered directly to a lead frame and overmolded with plastic

* 200 °C for max. 500 hours and 175 °C unlimited time

For Technical Questions: cmll@vishay.com
IN A NUTSHELL

VJ HIFREQ SERIES

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Capacitance Range (pF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.1 to 82</td>
</tr>
<tr>
<td>50</td>
<td>0.1 to 56</td>
</tr>
<tr>
<td>100</td>
<td>0.1 to 27</td>
</tr>
<tr>
<td>200</td>
<td>0.1 to 27</td>
</tr>
<tr>
<td>250</td>
<td>0.1 to 100</td>
</tr>
</tbody>
</table>

Tolerance as tight as ± 0.05 pF for capacitance values ≤ 10 pF
Tolerance as tight as ± 1 % for capacitance values > 10 pF

QUAD HIFREQ SERIES

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Capacitance Range (pF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>0.1 to 100</td>
</tr>
<tr>
<td>250</td>
<td>0.1 to 56</td>
</tr>
<tr>
<td>300</td>
<td>0.2 to 470</td>
</tr>
<tr>
<td>500</td>
<td>0.2 to 180</td>
</tr>
<tr>
<td>630</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>800</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>1000</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>1500</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>2000</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>2500</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>3000</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>3600</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>5000</td>
<td>0.2 to 110</td>
</tr>
<tr>
<td>7200</td>
<td>0.2 to 110</td>
</tr>
</tbody>
</table>

Tolerance as tight as ± 0.05 pF for cap. values ≤ 10 pF (0505 / 1111)
Tolerance as tight as ± 1 % for capacitance values > 10 pF
### MAP POLYMER CAPACITORS
**HIGH ENERGY DENSITY CAPACITORS**

#### DERATING

<table>
<thead>
<tr>
<th>Standard Tantalum</th>
<th>Polymer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specified Derating</td>
<td>50 %</td>
</tr>
<tr>
<td>Rated Voltage</td>
<td>10 V</td>
</tr>
<tr>
<td>Design Voltage</td>
<td>5 V</td>
</tr>
<tr>
<td></td>
<td>6.3 V</td>
</tr>
</tbody>
</table>

#### TERMINATIONS
- **L-Shaped** (T58, T52)
- **Wraparound** (T59, T54)

#### APPLICATIONS
- **SMART PHONES**
- **TABLET**
- **NETWORK INFRASTRUCTURE**

#### VISHAY MAP MEANS MORE CAP
- **Large anode size**

#### MAP POLYMER
- **vPolyTan™ Polymer Capacitors**

#### VISHAY CAPABILITY

<table>
<thead>
<tr>
<th>T58</th>
<th>T52</th>
<th>T59</th>
<th>T54</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB</td>
<td>B2</td>
<td>B0</td>
<td>A0</td>
</tr>
<tr>
<td>0.138 (3.5)</td>
<td>0.138 (3.5)</td>
<td>0.138 (3.5)</td>
<td>0.126 (3.2)</td>
</tr>
<tr>
<td>0.11 (2.8)</td>
<td>0.11 (2.8)</td>
<td>0.11 (2.8)</td>
<td>0.063 (1.6)</td>
</tr>
<tr>
<td>0.072 (2.3)</td>
<td>0.072 (2.3)</td>
<td>0.062 (1.6)</td>
<td>0.030 (0.8)</td>
</tr>
<tr>
<td>0.039 (1.0)</td>
<td>0.039 (1.0)</td>
<td>0.035 (0.9)</td>
<td>0.035 (0.9)</td>
</tr>
</tbody>
</table>

#### FOOTPRINT + PROFILE
- **Profile in inches (millimeters)**

#### Examples:
- **T58** – 330 µF at 6.3 V, BB case size
- **T58** – 47 µF at 6.3 V, M0 case size
- **T52** – 330 µF at 16 V, M1 case size
- **T59** – 470 µF at 16 V, EE case size

For Technical Questions: polytech@vishay.com
POLYMER CAPACITORS
HIGH CAPACITANCE, LOW ESR CAPACITORS

IN A NUTSHELL

DERATING

<table>
<thead>
<tr>
<th>Example</th>
<th>Specified Derating</th>
<th>Rated Voltage</th>
<th>Design Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Tantalum</td>
<td>50 %</td>
<td>10 V</td>
<td>5 V</td>
</tr>
<tr>
<td>Polymer</td>
<td>20 %</td>
<td>6.3 V</td>
<td>5 V</td>
</tr>
</tbody>
</table>

Ultra Low ESR (10x improvement)

- Standard Tantalum: 125 mΩ
- Polymer: 12 mΩ

330 µF, 6.3 V, D CASE SIZE

Polymer Capacitors Advantages Over MLCC
- No piezo noise effect
- No capacitance loss with DC bias
- More robust design (no cracking)
- Superior temperature stability

Polymer Capacitors Advantages Over Standard Tantalum
- Lower ESR
- Non-burn feature
- Better derating

Polymer Capacitors Advantages Over Aluminum
- Superior stability
- Longer life
- Higher operating temperature range
- Better volumetric efficiency

VISHAY CAP MAP

VISHAY CAPABILITY

FOOTPRINT + PROFILE

Shown at actual size (when viewed or printed at 100 %)

For Technical Questions: polytech@vishay.com
# AUTOMOTIVE GRADE TANTALUM CAPACITORS

## HIGH PERFORMANCE, HIGH TEMPERATURE, SMALL SIZES

### Solid Tantalum Surface-Mount Chip Capacitors, Molded Case

<table>
<thead>
<tr>
<th>Series</th>
<th>Feature</th>
<th>AUTOMOTIVE GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP3</td>
<td>High Performance</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>High Reliability</td>
<td></td>
</tr>
<tr>
<td>TH3</td>
<td>150 ºC</td>
<td>✓</td>
</tr>
<tr>
<td>TH4</td>
<td>175 ºC</td>
<td>✓</td>
</tr>
<tr>
<td>TP8</td>
<td>Leadframeless, High CV</td>
<td>✓</td>
</tr>
</tbody>
</table>

## AUTOMOTIVE APPLICATIONS

<table>
<thead>
<tr>
<th>Application</th>
<th>TP3</th>
<th>TP8</th>
<th>TH3</th>
<th>TH4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power train</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline direct injection</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Oil &amp; water pump</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Oil quality sensor</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive safety</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tire pressure monitoring sensor (TPMS)</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active safety</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anti-lock braking system (ABS)</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lane departure camera</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Electric stability program (ESP)</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive safety</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key less entry</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Smart airbag igniter</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Chassis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic power steering (EPS)</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical park break</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating, ventilation, air-con</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LED lighting</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Battery management</td>
<td>Charging control</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Infotainment &amp; navigation</td>
<td>Display and controller LDO</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Surround view camera</td>
<td>FPGA power supply</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Electric vehicle</td>
<td>On-board charger</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## AUTOMOTIVE GRADE FOR SUPERIOR QUALITY

### Quality
- IATF 16949
- AEC-Q200
- TAQ:
  - LAT
  - Maverick lots
  - Error proofing
  - 6 Sigma
  - FMEA

### AUTOMOTIVE GRADE TANTALUM CAPACITORS

- HIGH PERFORMANCE, HIGH TEMPERATURE, SMALL SIZES

### Performance Characteristics

**Series**
- TP3: High Performance, High Reliability
- TH3: 150 ºC
- TH4: 175 ºC
- TP8: Leadframeless, High CV

**Applications**

- Power train
- Gasoline direct injection
- Transmission
- Oil & water pump
- Oil quality sensor
- Passive safety
- Tire pressure monitoring sensor (TPMS)
- Active safety
- Anti-lock braking system (ABS)
- Lane departure camera
- Electric stability program (ESP)
- Passive safety
- Key less entry
- Smart airbag igniter
- Chassis
- Electronic power steering (EPS)
- Body control
- Electrical park break
- Heating, ventilation, air-con
- LED lighting
- Battery management
- Charging control
- Infotainment & navigation
- Display and controller LDO
- Surround view camera
- FPGA power supply
- Electric vehicle
- On-board charger

**Station / process**

<table>
<thead>
<tr>
<th>Station / process</th>
<th>Automotive Grade</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powder preparation</td>
<td>Use of single powder batch</td>
<td>Use of mixed powder batches</td>
</tr>
<tr>
<td>Pressing / Sintering</td>
<td>Pellet lot from single powder batch</td>
<td>No requirement</td>
</tr>
<tr>
<td>Formation</td>
<td>Visual inspection for coating dimensions: 5 pellet per bar x 3 bars per lot</td>
<td>No requirement</td>
</tr>
<tr>
<td>Cap test</td>
<td>Conductivity monitoring</td>
<td>No requirement</td>
</tr>
<tr>
<td>Silver check</td>
<td>Visual inspection: 3 bars per rack (zero defect allowed)</td>
<td>Visual inspection, 4 bars per lot</td>
</tr>
<tr>
<td>Assembly</td>
<td>Inspection of each 5th LF (zero defect allowed)</td>
<td>Inspection of each 9th LF (specified allowed failure rate)</td>
</tr>
<tr>
<td>Special technician inspection and adjustment after each no weld detected</td>
<td>No requirement</td>
<td></td>
</tr>
<tr>
<td>Electrical test</td>
<td>Redundant test</td>
<td>Single test (A / B / C cases); redundant test (D / E cases)</td>
</tr>
<tr>
<td>Surge test</td>
<td>B, C, D, and E cases</td>
<td>D and E cases</td>
</tr>
<tr>
<td>Labeling</td>
<td>Autolabeling attachment only</td>
<td>No requirement</td>
</tr>
<tr>
<td>QC</td>
<td>Scan / scan verification of each reel</td>
<td>First and last reel only</td>
</tr>
</tbody>
</table>

For Technical Questions: tantalum@vishay.com
WET TANTALUM CAPACITORS
THE ULTIMATE RELIABILITY AND PERFORMANCE CHOICE FOR EXTREME APPLICATIONS

KEY FACTORS
- Capacitance
- Performance
- Energy
- Temperature

QUALIFICATIONS
- M39006/09/21/22/25/30/31/33
- DLA 06013/06014/06015/06016
- DLA 04003/10004/10011/13017/15008/93026
- CECC 30202/001/002/004/005/801

LEAD CONFIGURATIONS
- Axial
- Radial
- SMD

TERMINATION OPTIONS
- Tin / Lead
- Lead (Pb)-free (100 % tin)
- RoHS-compliant

APPLICATIONS
- AVIONICS
- SPACE
- OIL and GAS

VISHAY CAP MAP
- Voltage
- Capacitance
- Energy Storage
- Heavy-CURRENT Power Film (ESTA)
- Polymer Solid Tantalum
- Aluminum
- Ceramic Multilayer
- Thin Film
- Ceramic Single-Layer

VISHAY CAPABILITY
- T16 / T18
- HE5
- EP1
- T22

FOOTPRINT + PROFILE
- HE5
- EP1
- T22

Shown at actual size (when viewed or printed at 100%)

For Technical Questions: tantalum@vishay.com
IHLE HIGH CURRENT INDUCTORS
WITH INTEGRATED E-FIELD SHIELD

**Reduced** noise

0.393 in • 1.0 cm

-20 dB

**ELECTROMAGNETIC FIELD STRENGTH VS. DISTANCE FROM INDUCTOR**

**APPLICATIONS**

**FOOTPRINT AND PROFILE CAPABILITY**

**Integrated E-Field Shield**

**HIGH TEMPERATURE operation** to +155 °C

**COMPACT** size with no additional external EMI shielding required

**DC/DC INVERTERS**

**AUTOMOTIVE**

**IHLE-2525**

**IHLE-3232**

**IHLE-4040**

shown at actual size

(when viewed or printed at 100 %)

For Technical Questions: magnetics@vishay.com
## IHLP® POWER INDUCTORS

**LOW PROFILE POWER INDUCTORS**

### APPLICATIONS
- **DC/DC converters**
  - Power supplies for computers, notebooks, graphic cards, servers
- **Class “D” amplifiers**
  - LCD TVs and portable MP3 speakers
- **LED driver power**
  - Commercial LED lighting
  - LCD display backlights
- **Automotive**
  - DC/DC converters
  - Filters for noise suppression

All currently available IHLP footprints meet or exceed AEC-Q200 Grade 0 and Grade 1 requirements.

### SATURATION – IHLP VS. FERRITE INDUCTOR

![Saturation Graph](image)

### NINE FOOTPRINTS AVAILABLE WITH A VARIETY OF HEIGHT OPTIONS

<table>
<thead>
<tr>
<th>Size</th>
<th>Current rating for 1 µH (A)</th>
<th>Footprint (mm)</th>
<th>Profile</th>
<th>Profile height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1212</td>
<td>4.5</td>
<td>3 x 3</td>
<td>AZ, AB, BZ</td>
<td></td>
</tr>
<tr>
<td>1616</td>
<td>4.5</td>
<td>4 x 4</td>
<td>AB, BZ</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>9.2</td>
<td>5 x 5</td>
<td>AB, BZ, CZ</td>
<td></td>
</tr>
<tr>
<td>2525</td>
<td>13.0</td>
<td>6 x 6</td>
<td>AH, BD, CZ</td>
<td></td>
</tr>
<tr>
<td>3232</td>
<td>18.0</td>
<td>8 x 8</td>
<td>CZ, DZ</td>
<td></td>
</tr>
<tr>
<td>4040</td>
<td>20.0</td>
<td>10 x 10</td>
<td>DZ</td>
<td></td>
</tr>
<tr>
<td>5050</td>
<td>32.0</td>
<td>13 x 13</td>
<td>CE, EZ, FD</td>
<td></td>
</tr>
<tr>
<td>6767</td>
<td>48.0</td>
<td>17 x 17</td>
<td>DZ, GZ</td>
<td></td>
</tr>
<tr>
<td>8787</td>
<td>69.0</td>
<td>22 x 22</td>
<td>MZ</td>
<td></td>
</tr>
</tbody>
</table>

### Four Different Material Types
- **Commercial Series**
  - Original Series
  - Low DCR Series
  - High Temp Series (+155 °C)
  - High Temp Series (+180 °C)
- **Automotive Grade Series**
  - IHLP - 01
  - IHLP - 11
  - IHLP - 51
  - IHLP - 81

### Lead (Pb)-free / Packaging
- **L Tol Material / Special L (µH)**
  - AZ = 1.0
  - AB = 1.2
  - AH = 1.8
  - BD = 2.4
  - CE = 3.5
  - DZ = 4.0
  - EZ = 5.0
  - FD = 6.4
  - GZ = 7.0
  - MZ = 13.0

For Technical Questions: magnetics@vishay.com
SPACE GRADE IHLP® POWER INDUCTORS
MIL-STD-981 CLASS S COMPLIANT

APPLICATIONS

- Low profile, high current power supplies
- High current POL converters
- DC/DC converters in distributed power systems
- “Flight-ready” solar inverters
- Noise suppression

FIVE FOOTPRINTS AVAILABLE

<table>
<thead>
<tr>
<th>Size</th>
<th>Current Rating for 1 µH (A)</th>
<th>Footprint (mm)</th>
<th>Profile</th>
<th>Profile Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>10.8</td>
<td>6.2 x 6.2</td>
<td>DC</td>
<td>DC = 4.3</td>
</tr>
<tr>
<td>48</td>
<td>23.5</td>
<td>12.2 x 12.2</td>
<td>FA</td>
<td>FA = 6.1</td>
</tr>
<tr>
<td>60</td>
<td>40.0</td>
<td>15.2 x 15.2</td>
<td>HE</td>
<td>HE = 8.5</td>
</tr>
<tr>
<td>73</td>
<td>53.0</td>
<td>18.8 x 18.8</td>
<td>HF</td>
<td>HF = 8.6</td>
</tr>
<tr>
<td>97</td>
<td>69.0</td>
<td>24.5 x 24.5</td>
<td>OZ</td>
<td>OZ = 15</td>
</tr>
</tbody>
</table>

SATURATION – IHLP® VS. FERRITE INDUCTOR

SGIHLPM Screen
<table>
<thead>
<tr>
<th>Screening Code</th>
<th>Two Different Levels of Screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>1P Basic Production Screen</td>
<td></td>
</tr>
<tr>
<td>1S MIL-STD-981 Group A / B Full Screen</td>
<td></td>
</tr>
</tbody>
</table>

Product and testing can be customized based on your requirements. Contact us!

For Technical Questions: magnetics@vishay.com
MINI PLANAR GATE DRIVE TRANSFORMER

MGDT

FEATURES

- Provides a high isolation of 3750 V_{AC} from drive to gate
- Offers low profile gate drive transformer package < 12 mm
- Excellent rise time and minimal overshoot capabilities
- Very small package, meeting 8 mm creepage and clearance distance
- Almost 4 times smaller than equivalent toroidal wound design

APPLICATIONS

- Directly drives high side MOSFETs / IGBTs on busses up to 1200 V
- Isolated power switch in motor drives
- Industrial, military, and aerospace applications

SPECIFICATIONS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>LIMITS</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dielectric withstand voltage</td>
<td>Drive to gate, 1 min</td>
<td>3750 minimum</td>
<td>V_{AC}</td>
</tr>
<tr>
<td></td>
<td>Gate to gate, 1 min</td>
<td>2500 minimum</td>
<td>V_{AC}</td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td>100 to 500</td>
<td>kHz</td>
</tr>
<tr>
<td>Size (L x W x H)</td>
<td></td>
<td>20.57 x 18.42 x 11.43</td>
<td>mm</td>
</tr>
<tr>
<td>Terminals</td>
<td>Through-hole and surface-mount</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For Technical Questions: magnetics@vishay.com
PLANAR TRANSFORMERS

MTPL

POWER LOSS VS. OUTPUT POWER
MTPL VS. BOBBIN WOUND

MTPL 2516 S12V
Product Family
W, H Dimensions (mm)
Output Voltage

STANDARD ELECTRICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Output Voltage (V)</th>
<th>Magnetizing Inductance min (µH)</th>
<th>Leakage Inductance max (µH)</th>
<th>Interwinding Capacitance max (pF)</th>
<th>Transfer Ratio PRI : Sec</th>
<th>DCR (mΩ)</th>
<th>Rated Current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>MTPL-2516-S12V</td>
<td>12</td>
<td>450</td>
<td>1.70</td>
<td>120</td>
<td>0.176</td>
<td>23.0</td>
<td>22.0</td>
</tr>
<tr>
<td>MTPL-2516-S15V</td>
<td>15</td>
<td>450</td>
<td>2.00</td>
<td>120</td>
<td>0.214</td>
<td>28.0</td>
<td>16.25</td>
</tr>
<tr>
<td>MTPL-2516-S24V</td>
<td>24</td>
<td>450</td>
<td>1.30</td>
<td>120</td>
<td>0.333</td>
<td>23.0</td>
<td>12.5</td>
</tr>
</tbody>
</table>

For Technical Questions: magnetics@vishay.com
CARBON FILM MELF RESISTORS
HIGH PULSE LOAD CAPABILITY

HIGHEST PULSE CAPABILITY FOR SMD FILM RESISTORS

- Case Size 0204
  - 100 W Thin Film MELF 0204
  - 450 W Carbon Film MELF 0204

- Case Size 0207
  - 230 W Thin Film MELF 0207
  - 3000 W Carbon Film MELF 0207

LARGEST EFFECTIVE RESISTIVE AREA
for highest pulse handling capability

CARBON FILM
Highest melting point of all elements

3700 °C Carbon
1400 °C Thin Film Metal Alloy

SURGE VOLTAGE CAPABILITY

- 2 kV 0204 Thin Film MELF
- 4 kV 0204 Carbon Film MELF
- 3 kV 0207 Thin Film MELF
- 10 kV 0207 Carbon Film MELF

APPLICATIONS

INVERTERS  I/O PROTECTION  SMART METERS

SIZE COMPARISON
MELF size = Chip size
0204 = 1206
0207 = 2512

For Technical Questions: melf@vishay.com
CURRENT SENSE RESISTORS
FOR BATTERY MANAGEMENT AND SAFETY

IN A NUTSHELL

WHAT IS YOUR TOLERANCE TO ACCURACY AND PRECISION?

DOES TCR RUIN YOUR DESIGN STABILITY?

POWER METAL STRIP®

PRECISION AND ACCURACY / TCR

What is your tolerance to accuracy and precision?

Does TCR ruin your design stability?

Power Metal Strip Advantages Over Thick Film
- Pulse performance
- Better temperature derating
- Superior temperature stability (down to 35 ppm)
- Low thermal EMF (3 µV/ºC)
- RoHS-compliant without exemption

Power Metal Strip Advantages Over Thin Film
- High power (up to 36 W)
- Not ESD-sensitive
- Lower solder joint stress
- Pulse performance

Power Metal Strip Advantages Over Commercial Foil
- Pulse performance
- Low CTE mismatch with PCB
- Low resistance (down to 0.05 mΩ)

APPLICATIONS

Network UPS Systems
AMS (Avionics, Military, and Space)
Industrial
Medical
Ev Automotive
EV Automotive
Medical

MULTIPLE PACKAGE SIZES (0603 to 5931)

Footprint

<table>
<thead>
<tr>
<th></th>
<th>0603</th>
<th>0805</th>
<th>0612</th>
<th>1206</th>
<th>1020</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2512</td>
<td></td>
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<tr>
<td>2816</td>
<td></td>
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<td>2818</td>
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<td>2726</td>
<td></td>
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<table>
<thead>
<tr>
<th></th>
<th>3637</th>
<th>3921</th>
<th>4026</th>
<th>5931</th>
</tr>
</thead>
<tbody>
<tr>
<td>8518</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Shown at actual size (when viewed or printed at 100%)

For Technical Questions: ww2bresistors@vishay.com
LOW OHMIC MELF RESISTORS
FOR PRECISE CURRENT MEASUREMENT AND EFFICIENT MOSFET GATE DRIVING

EXCELLENT LONG TERM STABILITY

APPLICATIONS
Current Measurement in: LED Drivers

IGBT / MOSFET Gate Resistor in:

EXCELLENT LONG TERM STABILITY

LOW TEMPERATURE COEFFICIENT

Resistances Drift in %

Time

1000 h

EXCELLENT LONG TERM STABILITY

LOW OHMIC MELF RESISTORS

For Technical Questions: melf@vishay.com

IN A NUTSHELL

LOW OHMIC MELF RESISTORS

RESISTANCE VALUES

SIZE COMPARISON
MELF Size = Chip Size
0102 = 0805
0204 = 1206
0207 = 2512

0.22 Ω TO > 10 Ω FOR 0102
0.1 Ω TO > 10 Ω AND 0204

0.22 Ω TO > 10 Ω

FOR 0207

EXCELLENT LONG TERM STABILITY

LOW TEMPERATURE COEFFICIENT

0.22 Ω TO > 10 Ω

FOR 0102

0.1 Ω TO > 10 Ω

AND 0204

0.22 Ω TO > 10 Ω

FOR 0207

EXCELLENT LONG TERM STABILITY

LOW TEMPERATURE COEFFICIENT
**MELF RESISTORS**

**FOR PULSE LOAD APPLICATIONS**

**SUPERIOR PULSE CAPABILITY**

<table>
<thead>
<tr>
<th>Metal Film</th>
<th>10 W</th>
<th>Thick Film Chip 0805</th>
<th>150 W</th>
<th>Thin Film MELF 0102</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Film</td>
<td>50 W</td>
<td>Thick Film Chip 2512</td>
<td>2000 W</td>
<td>Carbon Film MELF 0207</td>
</tr>
</tbody>
</table>

**LARGEST EFFECTIVE RESISTIVE AREA**

for highest pulse handling capability

**RESISTANCE RANGE AVAILABILITY**

- 20 Ω
- 0.22 Ω
- 0.1 Ω
- 75 Ω
- 25 Ω
- 50 Ω
- 1 MΩ
- 390 kΩ

**SIZE COMPARISON**

MELF size = chip size

- 0102 = = 0805
- 0204 = = 1206
- 0207 = = 2512

**EXCELLENT LONG TERM STABILITY**

- 0.02%
- 0.01%

**HIGH VOLTAGE OPERATION**

- 200 V
- 500 V
- 500 V
- 1000 V

**APPLICATIONS**

- SOLAR INVERTERS
- INVERTER
- SMART METER
- ELECTRIC AND HYBRID VEHICLES (FEV / HEV)

**For Technical Questions:** melf@vishay.com
CURRENT SENSE RESISTORS
HIGH POWER DENSITY, LOW RESISTANCE

POWER DENSITY (W/in²) vs. STANDARD POWER RATED SIZES

POWER METAL STRIP®

Vishay Automotive Grade
Exceeds AEC-Q200

BENEFITS OF POWER METAL STRIP®
- All-metal welded construction provides superior pulse tolerance
- Extremely low resistance values — minimizes power loss and prevents parallel resistance elements
- Low TCR — better temperature stability
- Tight tolerance — improves measurement accuracy
- Laser trimmed — enables design flexibility

APPLICATIONS
- INDUSTRIAL
- DRIVES
- UPS SYSTEMS
- SOLAR INVERTERS
- PROFESSIONAL COMPUTERS

FOOTPRINT
- WSLF2512
- WSK1216
- WSHP2818

BENEFIT
- Replace (2) high power 2512
- 4-terminal / TCR performance
- Flexible resistance range and high power capability
- Shown at actual size

For Technical Questions: ww2bresistors@vishay.com
CURRENT SENSE RESISTORS
HIGH POWER, LOW RESISTANCE

Power Metal Strip®
Advantages Over
Thick Film
• Pulse performance
• Better temperature
derating
• Superior temperature
stability (down to 75 ppm)
• Low thermal EMF
(3 µV/ºC)
• RoHS-compliant without
exemption

Power Metal Strip®
Advantages Over
Thin Film
• High power (up to 10 W)
• Not ESD-sensitive
• Lower solder joint stress
• Pulse performance

Power Metal Strip®
Advantages Over
Commercial Foil
• Pulse performance
• Low CTE mismatch with PCB
• Low resistance (down to 0.2 mΩ)

MULTIPLE PACKAGE SIZES (0603 to 5931)

For Technical Questions: ww2bresistors@vishay.com
CURRENT SENSE RESISTORS
HIGH POWER, LOW RESISTANCE

POWER DENSITY

IN A NUTSHELL

MULTIPLE PACKAGE SIZES (0603 to 5931)

FOOTPRINT

0603 0805 0612* 1206 1020*
2010 2512 2816 2726 3637
3921 4026 5931

WSL SERIES
- WSL5931 (High Power)
- WSL0603 (Small Size)
- WSL2512 (Standard Size)
- WSL1020 (Side Terminated)
- WSL2726 (Kelvin 4-Terminal Connection)

Power Metal Strip® Advantages Over Thick Film
- Pulse performance
- Better temperature derating
- Superior temperature stability (down to 75 ppm)
- Low thermal EMF (3 µV/ºC)
- RoHS-compliant without exemption

Power Metal Strip® Advantages Over Thin Film
- High power (up to 5 W)
- Not ESD-sensitive
- Lower solder joint stress
- Pulse performance

Power Metal Strip® Advantages Over Commercial Foil
- Pulse performance
- Low CTE mismatch with PCB
- Low resistance (down to 0.2 mΩ)

For Technical Questions: ww2bresistors@vishay.com
HIGH POWER THIN FILM RESISTORS
EXCELLENT STABILITY IN HIGH POWER APPLICATIONS

SUPERIOR POWER RATING

MCU 0805 HP
Size 0805
0.4 W

MCT 0603 HP
Size 0603
0.25 W

MCS 0402 HP
Size 0402
0.2 W

SPACE SAVING
Reduce Component Count and Save Board Space for 0.2 W Rated Power

1 x standard 0805 type
62 % Less

1 x MCS 0402 HP

3 x standard 0402 type
67 % Less

1 x MCS 0402 HP

EXCELLENT LONG TERM STABILITY
At Increased Power Rating

0.2 % Maximum resistance drift after 1000 h

APPLIEDS

AUTOMOTIVE

DRIVES

DC/DC CONVERTERS

INVERTERS

For Technical Questions: thinfilmchip@vishay.com
IN A NUTSHELL

**THICK FILM POWER RESISTORS**

**AEC-Q200 POWER RESISTORS**

**SPACE SAVING**
- Fewer components on PCB
- Can replace 5 to 20 chip resistors

**APPLICATIONS**
- AMS
- INDUSTRIAL
- AUTOMOTIVE

**FOOTPRINT**
- DTO25
- D2TO20
- D2TO35
- LTO 100

**PROVEN QUALITY**
- AEC-Q200 qualified
- With PPAP available

**PROVEN RELIABILITY**
- 27 severe AEC-Q200 tests passed

**Energy Curve: DTO vs. Competitor**

**DTO, D2TO, LTO**
- DTO25
- D2TO20
- D2TO35
- LTO 100

**Non-Inductive**
- Widest Ω range

**Driving the main EV / HV manufacturers**

For Technical Questions: sferixedresistors@vishay.com
**WIDE TERMINAL THIN FILM RESISTORS**

**HIGH POWER, SPACE SAVING**

---

**IN A NUTSHELL**

**SUPERIOR POWER RATING**

- MCW 0612 AT - 1 W
- Standard 1206 - 0.25 W
- MCW 0406 AT - 0.3 W
- Standard 0603 - 0.1 W

**ADVANCED THERMAL CYCLING**

- MCW 0406 AT - 3000 cycles
- MCW 0612 AT - 2000 cycles
- Standard 1206 case size - 1000 cycles

**HIGHER POWER DISSIPATION**

- MCW Thin Film Technology
- Thick Film Technology

**SPACE SAVING**

- **Component Count and Board Space for 1 W Rated Power**
  - 1 x standard 2512 type
  - 1 x MCW 0612 AT
  - 4 x standard 1206 type

- **Applications**
  - Lighting
  - Inverter
  - Professional Computer
  - Automotive

**For Technical Questions:** thinfilmchip@vishay.com
CDMM
HIGH VOLTAGE MOLDED CHIP DIVIDER

FEATURES
• Specifically designed for EV and HV automotive applications
• AEC-Q200 qualified
• Compliant terminations
• Sulfur-resistant
• High creepage distance
• Wide resistance values and ratios
• Good TCR tracking and ratio tolerances vs. individual components

IN A NUTSHELL

1 CDMM MEANS MORE SPACE
6 - 8 STANDARD RESISTORS

1 CDMM resistor rated at 1500 V each

1.5 kV

FOOTPRINT
Shown at actual size

0.456 in ± 0.005 in

0.275 in ± 0.005 in

1

2

3

3

2

3

1

MAX. WORKING VOLTAGE

Maximum Working Voltage (V)

3000

2250

1500

750

0

STD CHIPS

CDMM

APPLICATIONS
• Industrial
• Consumer
• Automotive

For Technical Questions: te1resistors@vishay.com
**IN A NUTSHELL**

**CDMx (CDMM, CDMP, CDMH) SERIES**

**HIGH VOLTAGE MOLDED CHIP DIVIDER**

**FEATURES**
- Specifically designed for EV and HV automotive applications
- AEC-Q200 qualified
- Sulfur-resistant
- Wide resistance values and ratios
- Good TCR tracking and ratio tolerances vs. individual components
- High creepage distance

**APPLICATIONS**
- Industrial
- Consumer
- Automotive

**FOOTPRINT**
Shown at actual size

**MAX. WORKING VOLTAGE**

<table>
<thead>
<tr>
<th>0</th>
<th>STD CHIPS</th>
<th>CDMP</th>
<th>CDMM</th>
<th>CDMH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>750</td>
<td>1500</td>
<td>2250</td>
<td>3000</td>
</tr>
</tbody>
</table>

1 CDMx resistor rated @ 1100 V to 3000 V each
THICK FILM POWER RESISTORS
HIGH POWER, COMPACT THICK FILM RESISTORS

<table>
<thead>
<tr>
<th>RCEC 750</th>
<th>Wirewound</th>
</tr>
</thead>
<tbody>
<tr>
<td>750 W</td>
<td>750 W</td>
</tr>
</tbody>
</table>

**Size**
- RCEC 750

**Footprint**
- 60 70
- 370 40

**Weight**
- 100 g
- 1400 g

**Case Temp.**
- 70 ºC
- 450 ºC

**Inductance**
- Non-inductive
- Inductive

**Resistance**
- 0.3 Ω to 1 MΩ
- 8.2 Ω to 60 kΩ

**Dielectric**
- Up to 12 kV
- Not insulated

**Partial Discharge**
- < 5 pC
- > 1000 pC

**KEY APPLICATIONS**
- Snubbers
- Discharge
- Balancing
- Dividers
- Filters

**CUSTOM FRIENDLY**
- Specific terminals (size and diameter M4 - M5)
- Terminals with leads
- Possibility of two or three resistors in the same case (RCEC 400, RCEC 850)
- Creeping and clearance distances (HV version)
- Assemblies (resistors mounted on heatsink)

**LPS, RCMC, RCEC**

For Technical Questions: sferixedresistors@vishay.com or mcbfixedresistors@vishay.com
HIGH POWER RESISTORS
RCP / PHP / PCAN

HIGH PRECISION
POWER RATING
REDUCES COMPONENT COUNT AND PCB AREA
FOOTPRINT AND PROFILE CAPABILITY

RCP
THICK FILM CHIP RESISTOR
POWER RATING

PCAN
THIN FILM RESISTORS
RATED POWER AT 70 ºC

HIGH POWER RESISTORS
RATED POWER AT 70 ºC

PHOTOGRAPHIC RESISTANCE ADVANTAGE

RCP
Thick film Aluminum nitride 10 Ω to 2 kΩ • High frequency

PCAN
Thin film Aluminum nitride 2 Ω to 30 kΩ • Tighter TCR • Tighter tolerance

PHP
Thin film Alumina 10 Ω to 30 kΩ • Tighter TCR • Tighter tolerance

APPLICATIONS

For Technical Questions: thinfilm@vishay.com
**FUSIBLE SAFETY WIREWOUND RESISTORS**

**IN A NUTSHELL**

**SAFE + SILENT FUSING**

Fusible Safety + High Surge

**AC-CS OPTIONS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Rated Power, $P_{40}$</th>
<th>Surge Voltage Max.</th>
<th>Fusing Time</th>
<th>Ohmic Range</th>
<th>Diameter</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC01-CS</td>
<td>1.1 W</td>
<td>0.7 kV to 3.2 kV</td>
<td>&lt; 30 s for 30 W overload</td>
<td>3 Ω to 100 Ω, 5 %</td>
<td>5 mm</td>
<td>11 mm</td>
</tr>
<tr>
<td>AC03-CS</td>
<td>3 W</td>
<td>2 kV to 4 kV</td>
<td>&lt; 25 s for 45 W overload</td>
<td>4.7 Ω to 100 Ω, 5 %</td>
<td>6 mm</td>
<td>13 mm</td>
</tr>
<tr>
<td>AC05-CS</td>
<td>5 W</td>
<td>4 kV (10 Ω to 20 Ω) 6 kV (22 Ω to 100 Ω)</td>
<td>&lt; 45 s for 100 W overload</td>
<td>10 Ω to 100 Ω, 5 %</td>
<td>10 mm</td>
<td>17 mm</td>
</tr>
</tbody>
</table>


For Technical Questions: [ww1resistors@vishay.com](mailto:ww1resistors@vishay.com)
RESISTOR ARRAYS
WHEREVER A STABLE RESISTANCE RATIO IS REQUIRED

IN A NUTSHELL

THIN FILM CHIP RESISTOR ARRAYS

With Four or Eight Terminals

TOLERANCE

Absolute Tolerance

Relative Tolerance (Matching)

Resistance Change

Resistance Change

+0.1 %

0

-0.1 %

TIME

Divider Error Over Lifetime

+0.05 %

0

-0.05 %

20 000 h

P = P_{70}

P = 0

P = P_{70}

P = 0

THERMAL COUPLING

THIN FILM CHIP RESISTOR ARRAYS

ACAS 0606

ACAS 0612

TEMPERATURE COEFFICIENT

Absolute TCR

Relative TCR (Tracking)

Resistance Change

Resistance Change

Possible TCR Behavior

+ 5 ppm/K

20

T (°C)

APPLIED Resistance Change

Absolute TCR: ± 25 ppm/K

Relative TCR: ± 5 ppm/K

APPLICATIONS

VOLTAGE DIVIDER

FEEDBACK LOOP

AUTOMOTIVE

DC/DC CONVERTERS

MEASUREMENT EQUIPMENT

EQUIVALENT AGING DRIFT

Divide Ratio Stability: Aging Over Lifetime

0.1 %

0.02 %

Discrete Thin Film Chip Resistors

Thin Film Array Elements on Same Chip

Time

20 000 h

For Technical Questions: thinfilmarray@vishay.com

+0.1 %

0

-0.1 %

Absolute Tolerance

+0.05 %

0

-0.05 %

Resistance Change

+0.1 %

0

-0.1 %

Resistance Change

+0.05 %

0

-0.05 %

20 000 h

P = P_{70}

P = 0

P = P_{70}

P = 0

THERMAL COUPLING

THIN FILM CHIP RESISTOR ARRAYS

ACAS 0606

ACAS 0612

TEMPERATURE COEFFICIENT

Absolute TCR

Relative TCR (Tracking)

Resistance Change

Resistance Change

Possible TCR Behavior

+ 5 ppm/K

20

T (°C)

APPLIED Resistance Change

Absolute TCR: ± 25 ppm/K

Relative TCR: ± 5 ppm/K

APPLICATIONS

VOLTAGE DIVIDER

FEEDBACK LOOP

AUTOMOTIVE

DC/DC CONVERTERS

MEASUREMENT EQUIPMENT

EQUIVALENT AGING DRIFT

Divide Ratio Stability: Aging Over Lifetime

0.1 %

0.02 %

Discrete Thin Film Chip Resistors

Thin Film Array Elements on Same Chip

For Technical Questions: thinfilmarray@vishay.com
WATER-COOLED WIREWOUND RESISTORS
ULTRA HIGH POWER INTEGRATED RESISTORS

IN A NUTSHELL

WCR and DCRF Advantages Over Thick Film Water-Cooled Resistors
- Pulse performance (wirewound technology)
- High power dissipation (up to 9 kW)
- Overload capability (2 Pn during 60 s)
- Multiple resistive element option (low and high ohmic values on the same support)
- Safe failure mode (no leakage)

WCR and DCRF Advantages Over Plastic Box Water-Cooled Resistors
- High power dissipation (up to 9 kW)
- Overload capability (2 Pn during 60 s)
- Low inductivity option (< 500 nH)
- Multiple resistive element option (low and high ohmic values on the same support)
- Safe failure mode (no leakage)

WCR and DCRF Advantages Over Standard Wirewound Resistors
- High power dissipation (up to 9 kW)
- Limited external radiation (surface temperature < 120 ºC)
- Helps customers gain competitive advantage by reducing equipment size and cost
- Multiple resistive element option (low and high ohmic values on the same support)

PRODUCT PORTFOLIO

APPLICATIONS
- LARGE DRIVE
- INDUSTRY FIRST
- WIND POWER
- HVDC-SVC TRANSMISSION
- SOLAR
- INDUSTRIAL

CUSTOMIZATION OPTIONS
- Multiple resistive elements on the same tube (up to eight)
- Combination possible with WCR and DCRF resistive elements (MDCR)
- Custom assemblies (twin tubes)

INTEGRATED SOLUTION, NO HEATSINK NEEDED

Power Range From 1.5 kW to 9 kW

For Technical Questions: mcbfixedresistors@vishay.com
CRHV / CRMV SERIES
HIGH VOLTAGE THICK FILM RESISTORS

6 Standard Resistors

= 1 CRxV

MEANS MORE BOARD SPACE

1 CRHV2512 resistor rated at 3000 V

6 STANDARD resistors rated at 500 V each

CRHV / CRMV

VOLTAGE HANDLING

1206 1210 2010 2510 2512

APPLICATIONS

MEDICAL
TELECOMMUNICATION
INDUSTRIAL
CONSUMER

FOOTPRINT

1206 1210 2010 2510 2512

Shown at actual size
(when viewed or printed at 100 %)

- Design flexibility with multiple termination configurations and materials including non-magnetic, allows design flexibility
- Available as chip divider also – CDHV and CDMV, respectively

For Technical Questions: te1resistors@vishay.com
The Active Area of an Igniter Is a Volume of Resistive Element to Heat

CURRENT PASSING THROUGH THE IGNITER

MEPIC AND EPIC

ADVANTAGES OF EPIC / MEPIC OVER WIRE BRIDGE

- EASY TO MOUNT
  - STD SMD CASES (0603 / 0805)
  - TAPE AND REEL PACKING FOR PICK AND PLACE MACHINES
  - STD REFLOW PROCESS

- CUSTOMIZATION
  - ADAPTATION OF OUR ACTIVE AREA TO "ALL FIRE / NO FIRE" CUSTOMER REQUIREMENTS
  - CUSTOMIZATION HAS NO IMPACT ON THE FOOTPRINTS
  - COMPATIBLE TO ALL EXPLOSIVE MATERIALS

- RELIABILITY – REPRODUCTIBILITY
  - RELIABILITY & PREDICTABILITY IN THE SOLDERING PROCESS
  - DIMENSION OF ACTIVE AREA 100% CONTROLLED
  - EACH YEAR WE CONTRIBUTE TO SAVING 5000 LIVES WITH OUR TECHNOLOGY

PERFORMANCE

<table>
<thead>
<tr>
<th></th>
<th>EPIC</th>
<th>MEPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Fire Energy</td>
<td>Down to 50 µJ</td>
<td>Down to 1000 µJ</td>
</tr>
<tr>
<td>Time</td>
<td>Down to 50 µs</td>
<td>Down to 250 µs</td>
</tr>
<tr>
<td>No Fire Current</td>
<td>0.3 A to 0.8 A</td>
<td>0.5 A to 1.2 A</td>
</tr>
<tr>
<td>No Fire Duration</td>
<td>2 s to 5 s</td>
<td>2 s to 10 s</td>
</tr>
<tr>
<td>Faster and lower energy needed for ignition</td>
<td>Withstands higher energy without ignition</td>
<td></td>
</tr>
</tbody>
</table>

APPLICATIONS (DOMAIN SPECIFIC)

- PYROTECHNICS
- DEMOLITION ROCK FRAGMENTATION
- MILITARY
- AIRBAGS
- SEAT BELTS
- ADAPTATION OF OUR ACTIVE AREA TO "ALL FIRE / NO FIRE" CUSTOMER REQUIREMENTS
- COMPATIBLE TO ALL EXPLOSIVE MATERIALS

MEPIC: Massive Electro-Pyrotechnic Initiator Chip Resistor
EPIC: Electro-Pyrotechnic Initiator Thin Film Chip Resistor

For Technical Questions: sferthinfilm@vishay.com
UIPMA-UFPMA SERIES
ULTRA THIN, WATERPROOF, EASY TO MOUNT LINEAR AND ANGULAR POSITION SENSORS

SPACE SAVING

**Thickness** of about **0.5 mm**

- 0.51 ± 0.1 total thickness

WATERPROOF

Totally **sealed**

IP66

EASY TO MOUNT

High integration **capacity** by adhesive layer

“**stick and play**”

PROVEN RELIABILITY, HIGH DURABILITY

UIPMA **3 M** cycles

UFPMA **25 M** cycles

APPLICATIONS

- **OFF-ROAD**
- **MEDICAL**
- **INDUSTRIAL**

CUSTOMIZATION

- Output by leads or contacts
- Outdoor version
- Redundant functions
- Version to support pressure variations

PRODUCT PORTFOLIO

<table>
<thead>
<tr>
<th>UIPMA</th>
<th>UIPMC</th>
<th>UFPMA</th>
<th>UIFPMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>200</td>
<td>250</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No direct contact of wiper so no wearing of the track

For Technical Questions: mcbprecisionpot@vishay.com
PANEL POTENTIOMETERS: MODEL P11
THE MOST VERSATILE MODULAR PANEL POTENTIOMETER

MODULAR PANEL POTENTIOMETER
- Various Shaft Designs
  - Up to 21 available designs
  - Lengths, diameters, machining, and custom models
- Various Bushing Types
  - Up to 10 different bushing options
  - Various diameters and lengths
- Sealing Level
  - IP64 Optional: additional panel and shaft sealing
- Detent Modules
  - Higher rotating torque
  - CW / CCW / Central / up to 21 detents
- Resistive Module
  - 20 Ω up to 10 MΩ
  - Up to 7 resistive modules in one P11
- Electrical Laws (Tapers)
  - Up to 6 different tapers
  - Most common: linear, log, and reverse log
- Custom Friendly

KEY APPLICATIONS
- Welding Machines
- Off-Road
- Audio
- Syringe Pumps
- Cockpit
- Off-Road

MULTIPLE MODELS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SPECIFICITY</th>
<th>MARKETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>P11A*</td>
<td>Low noise and CRV</td>
<td>Audio</td>
</tr>
<tr>
<td>P11S</td>
<td>Genuine model</td>
<td>Avionics</td>
</tr>
<tr>
<td>P11P &amp; upon request</td>
<td>High torque</td>
<td>Heavy duty vibration</td>
</tr>
<tr>
<td>P11L</td>
<td>High dielectric strength</td>
<td>High voltages</td>
</tr>
<tr>
<td>T11</td>
<td>No shaft, knob actuated</td>
<td>PCB mounting</td>
</tr>
</tbody>
</table>

For Technical Questions: ww2bresistors@vishay.com
NTC LUG THERMISTORS
SURFACE TEMPERATURE SENSORS

HIGH INSULATION VOLTAGE FOR EV HIGH POWER INVERTERS

- Competition
- LUG03A
- LUG01A
- LUG02A
- LUG01T

EASY MOUNTING MECHANICAL OPTIONS

<table>
<thead>
<tr>
<th>Metric screw</th>
<th>M2</th>
<th>M3</th>
<th>M3.5</th>
<th>M4</th>
<th>M5</th>
<th>M6</th>
<th>M8</th>
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</thead>
<tbody>
<tr>
<td>Stud screw</td>
<td>#1-2</td>
<td>#3-4</td>
<td>#5-6</td>
<td>#8</td>
<td>#10</td>
<td>#1/4</td>
<td>#5/16</td>
</tr>
</tbody>
</table>

CABLE AWG24
CABLE AWG26
CABLE AWG28
CABLE AWG30
CABLE AWG32

NTC LUG SERIES
AEC-Q200 Qualified

RELIABLE OPERATING TEMP. OVER TIME

- LUG 01T
- LUG 01A
- LUG 03A
- Premium Competition
- Competition

- 125 ºC
- 150 ºC

For Technical Questions: NLR@vishay.com
WIRE BONDABLE NTC THERMISTOR DIE

DESIGNED FOR IGBT MODULES

Integrated NTC Chip Sensor

Real-Time Current Control Chip

SUITABLE FOR WIRE BONDING AND NANO-SILVER PASTE SINTERING

Temperature Sensing and Regulation

Accurate / Stable at High Temperature (175 ºC)

Industries

- Power modules for EVs and hybrid vehicles
- Inverters for windmills and solar panels

For Technical Questions: nlr@vishay.com
**IN A NUTSHELL**

**NTCLE LEADED - EPOXY COATED NTC THERMISTORS**

**RADIAL LEADS - SAWING TECHNOLOGY**

**ACCURACY IN TEMPERATURE MEASUREMENT**

Temperature accuracy 1 point or 2 point sensor

**MULTIPLE DESIGN TOOLS AVAILABLE**

- Resistance / temperature curve in “My Vishay NTC Curve” (©Excel)
- 3D models available (online)
- LT and PSpice models (online)
- SPICE multi-simulator models on request (adapted to most other SPICE simulators like Multisim / TINA...)

**APPLICATIONS**

- EV battery sensor
- Charging plug
- Ambient thermostats
- Fire detectors
- Inlet Air Temp (IAT)
- Engine Coolant (ECT)
- Air conditioning

**COMPONENTS AVAILABLE IN DIFFERENT WIRE GAGES, LENGTHS, WITH(OUT) INSULATION**

<table>
<thead>
<tr>
<th>Insulator</th>
<th>Wire gage</th>
<th>None</th>
<th>ETFE</th>
<th>PEEK</th>
<th>PTFE</th>
<th>PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWG32</td>
<td>Ag-plated Ni or NiFe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AWG30</td>
<td>Sn-plated Ni</td>
<td>Sn-plated Ni</td>
<td>Ag-plated Ni</td>
<td>Ag-plated Ni</td>
<td>Sn-plated Cu</td>
<td></td>
</tr>
<tr>
<td>AWG28</td>
<td>Sn-plated Ni</td>
<td>Sn-plated Cu</td>
<td>Ag-plated Cu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AWG26</td>
<td>Sn-plated Ni</td>
<td>Sn-plated Cu</td>
<td>Ag-plated Cu</td>
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<td></td>
<td></td>
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<td>AWG24</td>
<td>Sn-plated Ni</td>
<td>Sn-plated Cu</td>
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<td></td>
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<td>AWG23</td>
<td>Sn-plated Cu</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PID Temperature Controller With NTC Thermistor**

(Temperature / Voltage Driven)

For Technical Questions: thermistor1@vishay.com
NTCS SURFACE-MOUNT NTC THERMISTORS
GLASS PROTECTED / NI BARRIER - SN TERMINATIONS

IN A NUTSHELL

COMPLIANCE TO STANDARDS
• AEC-Q200 qualified
• Sustaining ESD air discharge: 25 kV (HBM)
• UL 1434 certified (File E148885)
• Sulfur-resistant to ASTM B809-95
• RoHS-compliant
• Whisker testing according to JESD 201 A

TEMPERATURE SENSING / CONTROL / PROTECTION
NTCS0805

MULTIPLE DESIGN TOOLS AVAILABLE
• Resistance / temperature curve in “My Vishay NTC Curve” (©Excel)
• Resistor / thermistor network output computation (online)
• SPICE multi-simulator models (PSpice / LTspice / TINA / Multisim / Altium / Simetrix / SaberRD…)

(VERY) STABLE IN CLIMATIC TESTING (OPERATIONAL LIFE)

APPLICATIONS
• LED over-current limitation
• Li-ion and Li-polymer over-temperature detection
• Power modules (EV, HEV, …)
• Optoelectronics
• Car infotainment
• Medical equipment

For Technical Questions: mcbfixedresistors@vishay.com
FRED Pt® rectifiers available in the following packages:

- **Standard Products**
  - SlimDPAK (TO-252AE)
  - SlimSMA (DO-221AC)
  - SMF (DO-219AB)
  - SMPC (TO-277A)
  - SMPD (TO-263AC)

- **AEC-Q101 Qualified Products**
  - SlimDPAK (TO-252AE)
  - SlimSMA (DO-221AC)
  - SMF (DO-219AB)
  - SMPC (TO-277A)
  - SMPD (TO-263AC)

FRED Pt® AEC-Q101 qualified products have undergone part average testing (PAT) and statistical yield limit (SYL) analysis to ensure their electrical parameters meet the highest quality level for automotive applications.

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
**FRED Pt® RECTIFIERS IN SlimDPAK PACKAGE**

**INCREASE POWER DENSITY AND IMPROVE THERMAL PERFORMANCE**

Reverse voltages: 200 V and 600 V

Ultrafast recovery times down to 14 ns

Low forward drop reduces power losses and improves efficiency

Footprint compatible with DPAK with 43% lower profile for slimmer end products, while heatsink area is 14% larger for lower thermal resistance

FRED Pt® (Fast Recovery Epitaxial Diodes) products are based on a Pt doping technology that allows maximum operating junction temperature **Up to 175 ºC**

**APPLICATIONS**

- **AUTOMOTIVE**
  - ECU, ABS, and HID / LED lighting
- **COMMERCIAL / INDUSTRIAL**
  - Telecom power supplies

**DC/DC CONVERTERS**

**9.0 mm x 6.2 mm x 1.3 mm (L x W x H)**

<table>
<thead>
<tr>
<th>Vishay P/N</th>
<th>io (A)</th>
<th>Vr (V)</th>
<th>Vf (V)</th>
<th>Io at I (A)</th>
<th>tr (ns)</th>
<th>IFSM (A)</th>
<th>TJ max. (ºC)</th>
<th>AEC-Q101 Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS-0EVH02HM3</td>
<td>4</td>
<td>200</td>
<td>0.71</td>
<td>4</td>
<td>16</td>
<td>100</td>
<td>175</td>
<td>Yes</td>
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<tr>
<td>VS-0EVH02M3</td>
<td>4</td>
<td>200</td>
<td>0.71</td>
<td>4</td>
<td>16</td>
<td>100</td>
<td>175</td>
<td>No</td>
</tr>
<tr>
<td>VS-0CVH02HM3</td>
<td>2 x 3</td>
<td>200</td>
<td>0.75</td>
<td>3</td>
<td>20</td>
<td>140</td>
<td>175</td>
<td>Yes</td>
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<td>VS-0CVH02M3</td>
<td>2 x 3</td>
<td>200</td>
<td>0.75</td>
<td>3</td>
<td>16</td>
<td>100</td>
<td>175</td>
<td>No</td>
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<tr>
<td>VS-0CVH02M3</td>
<td>2 x 4</td>
<td>200</td>
<td>0.71</td>
<td>4</td>
<td>16</td>
<td>200</td>
<td>175</td>
<td>Yes</td>
</tr>
<tr>
<td>VS-0CVH02M3</td>
<td>2 x 4</td>
<td>200</td>
<td>0.71</td>
<td>4</td>
<td>16</td>
<td>200</td>
<td>175</td>
<td>No</td>
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<tr>
<td>VS-1CVH02HM3</td>
<td>2 x 5</td>
<td>200</td>
<td>0.74</td>
<td>5</td>
<td>16</td>
<td>200</td>
<td>175</td>
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<tr>
<td>VS-1CVH02M3</td>
<td>2 x 5</td>
<td>200</td>
<td>0.74</td>
<td>5</td>
<td>16</td>
<td>200</td>
<td>175</td>
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<tr>
<td>VS-6EVL06HM3</td>
<td>6</td>
<td>600</td>
<td>0.98</td>
<td>6</td>
<td>34</td>
<td>80</td>
<td>175</td>
<td>Yes</td>
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<tr>
<td>VS-6EVL06M3</td>
<td>6</td>
<td>600</td>
<td>0.98</td>
<td>6</td>
<td>34</td>
<td>80</td>
<td>175</td>
<td>No</td>
</tr>
<tr>
<td>VS-0EVH06HM3</td>
<td>6</td>
<td>600</td>
<td>1.26</td>
<td>6</td>
<td>16</td>
<td>70</td>
<td>175</td>
<td>Yes</td>
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<tr>
<td>VS-0EVH06M3</td>
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<td>600</td>
<td>1.26</td>
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<td>70</td>
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<td>VS-6EVL06HM3</td>
<td>6</td>
<td>600</td>
<td>1.55</td>
<td>6</td>
<td>14</td>
<td>50</td>
<td>175</td>
<td>Yes</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Vishay P/N</th>
<th>io (A)</th>
<th>Vr (V)</th>
<th>Vf (V)</th>
<th>Io at I (A)</th>
<th>tr (ns)</th>
<th>IFSM (A)</th>
<th>TJ max. (ºC)</th>
<th>AEC-Q101 Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS-6EVL06M3</td>
<td>8</td>
<td>600</td>
<td>0.98</td>
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<td>130</td>
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<td>8</td>
<td>600</td>
<td>1.30</td>
<td>8</td>
<td>16</td>
<td>90</td>
<td>175</td>
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<td>600</td>
<td>1.30</td>
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<tr>
<td>VS-6EVH06HM3</td>
<td>8</td>
<td>600</td>
<td>1.40</td>
<td>8</td>
<td>14</td>
<td>80</td>
<td>175</td>
<td>Yes</td>
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<td>VS-6EVH06M3</td>
<td>8</td>
<td>600</td>
<td>1.40</td>
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<td>80</td>
<td>175</td>
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<td>VS-15EVL06HM3</td>
<td>15</td>
<td>600</td>
<td>0.98</td>
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<td>600</td>
<td>0.98</td>
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<td>15</td>
<td>600</td>
<td>1.10</td>
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<td>600</td>
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<td>VS-15EVH06M3</td>
<td>15</td>
<td>600</td>
<td>1.20</td>
<td>15</td>
<td>20</td>
<td>120</td>
<td>175</td>
<td>No</td>
</tr>
</tbody>
</table>

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
**FRED Pt® RECTIFIERS IN SMPD (TO-263AC)**

**OFFER HIGHER POWER DENSITY**

**FEATURES**
- Hyperfast and ultrafast recovery
- Fast and soft recovery (down to 25 ns)
- Low forward voltage drop (down to 0.75 V typ.)
- AEC-Q101 qualified

**REDUCED POWER LOSSES**
- Reduced noise
- Reduced EMI

**MORE EFFICIENT DESIGNS**

FRED Pt® technology allows high operating temperatures to +175 ºC

**APPLICATIONS**

AUTOMOTIVE and INDUSTRIAL
- APD for inverters
- ECU
- EV / HEV battery charging systems

**SMPD package** is compatible with D²PAK footprint but with lower profile

<table>
<thead>
<tr>
<th>Vishay P/N</th>
<th>Type</th>
<th>Diode Variation</th>
<th>I_{FMAX} (A)</th>
<th>V_{RMS} (V)</th>
<th>I_{F(AV)} (A)</th>
<th>V_{F} Typ at Rated I (V)</th>
<th>T_{rr} Typ (ns)</th>
<th>AEC-Q101</th>
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</thead>
<tbody>
<tr>
<td>VS-10CDH06-M3</td>
<td>Hyperfast</td>
<td>Dual</td>
<td>2 x 5</td>
<td>600</td>
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<td>35</td>
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<tr>
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<td>Hyperfast</td>
<td>Dual</td>
<td>2 x 5</td>
<td>600</td>
<td>1</td>
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<td>VS-12CDU06-M3</td>
<td>Ultrafast</td>
<td>Dual</td>
<td>2 x 6</td>
<td>600</td>
<td>0.89</td>
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<td>600</td>
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<td>Dual</td>
<td>2 x 8</td>
<td>200</td>
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<td>Dual</td>
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<td>200</td>
<td>0.77</td>
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<tr>
<td>VS-16CDU06-M3</td>
<td>Ultrafast</td>
<td>Dual</td>
<td>2 x 8</td>
<td>600</td>
<td>0.94</td>
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<td>Dual</td>
<td>2 x 8</td>
<td>600</td>
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<tr>
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<tr>
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<td>Single</td>
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<td>600</td>
<td>0.91</td>
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<td>16</td>
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<td>VS-20CDH02-M3</td>
<td>Hyperfast</td>
<td>Dual</td>
<td>2 x 10</td>
<td>200</td>
<td>0.77</td>
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<td>600</td>
<td>0.9</td>
<td>55</td>
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</tbody>
</table>

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
**FRED Pt® ULTRAFAST RECTIFIERS IN FLATPAK™ 5 X 6**

**INCREASE POWER DENSITY AND PERFORMANCE EFFICIENCY**

**APPLICATIONS**

- DC/DC converters
  - AEC-Q101 rectifiers: automotive engine control units (ECU), anti-lock braking systems (ABS), and HID and LED lighting
  - Commercial / industrial rectifiers: telecom power supplies

**200 V reverse voltage**

**Low forward drop reduces power losses and improves efficiency**

**High forward current ratings of 6 A (2 x 3 A) and 8 A (2 x 4 A)**

**Ultrafast recovery times down to 25 ns**

**2000 hours of high temperature reverse bias (HTRB) testing guarantees long term reliability**

**Operating temperature range of -55 °C to +175 °C**

---

**FlatPAK™ 5 X 6**

- **6.20 mm**
- **5.15 mm**
- **0.99 mm**

---

**Simplify PCB layouts with ONE PACKAGE INSTEAD OF TWO; SAVING > 65 % PCB SPACE**

<table>
<thead>
<tr>
<th>Vishay P/N</th>
<th>Forward Current $I_{F(AV)}$</th>
<th>Forward Voltage $V_F$ at $I_F$</th>
<th>Reverse Recovery Time $t_{rr}$</th>
<th>AEC-Q101</th>
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<tr>
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<td>2 x 4 A</td>
<td>0.7 V</td>
<td>25 ns</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
TMBS® RECTIFIERS IN eSMP® SERIES
TRENCH MOS BARRIER SCHOTTKY TECHNOLOGY IN SPACE-SAVING FOOTPRINTS AND LOW PROFILE PACKAGE SOLUTIONS

Select TMBS® rectifiers available in the following packages:
- MicroSMP (DO-219AD)
- SlimDPAK (TO-252AE)
- SlimSMA (DO-221AC)
- SMP (DO-220AA)
- SMPA (DO-221BC)
- SMPC (TO-277A)
- SMPD (TO-263AC)

AEC-Q101 Qualified

TMBS® AEC-Q101 qualified products have undergone part average testing (PAT) and statistical yield limit (SYL) analysis to ensure their electrical parameters meet the highest quality level for automotive applications.

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
eSMP® SERIES
SMALL AND LOW PROFILE PACKAGE SOLUTIONS FOR SELECT DIODES AND RECTIFIERS

**eSMP® Packages**
Enhanced Surface-Mount Power packages

Enable **higher current** and **power efficiency** with a **unique design** that promotes better **thermal performance** and **reliability**

**APPLICATIONS**
- DC/DC Converters
- Free-Wheeling
- Automotive
- Industrial
- Lighting
- Telecommunication

**PRODUCT TECHNOLOGIES AVAILABLE**
- ESD protection diodes
- PAR® TVS diodes
- TRANSZORB® TVS diodes
- Zener diodes
- Avalanche rectifiers
- FRED Pt® rectifiers
- Schottky rectifiers
- Standard and fast recovery rectifiers
- TMBS® rectifiers
- Ultrafast recovery rectifiers

**AVAILABLE IN** asymmetrical and symmetrical flat type packages

**USEFUL LINKS**
eSMP® series product overview:
Diodes / rectifiers in eSMP® series package:
[www.vishay.com/landingpage/tradeshows/diodes/](http://www.vishay.com/landingpage/tradeshows/diodes/)

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
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For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com

STANDARD RECOVERY RECTIFIERS

Esd capability

• Oxide planar chip technology
• ESD capability
  – Provide class H3B (> 8 kV) performance based on the AEC-Q101-001 human body model (contact mode) and/or JESD22-A114, class 3B

Electrical Static Discharge (ESD)

Current range from 0.7 A to 20 A

Reverse voltage from 100 V to 600 V

V

AVAILABLE IN eSMP® SERIES PACKAGES

• General purpose
• Polarity protection
• Rail to rail protection

CONSUMER

AUTOMOTIVE

APPLICATIONS

Maximum operating junction temperature of +175 ºC

Low forward voltage drop, low leakage current

AEC-Q101 qualified products have undergone part average testing (PAT) and statistical yield limit (SYL) analysis to ensure their electrical parameters meet the highest quality level for automotive applications

<table>
<thead>
<tr>
<th>Device</th>
<th>eSMP® Package</th>
<th>I(F) (A)</th>
<th>Vbr Range (V)</th>
<th>Max Vf at IF (V)</th>
<th>AEC-Q101 Automotive Grade</th>
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<tr>
<td>SE07PB thru SE07PJ</td>
<td>SMP (DO-220AA)</td>
<td>0.7</td>
<td>100 to 600</td>
<td>1.05</td>
<td>0.7</td>
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<td>MSE07PB thru MSE07PJ</td>
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<td>SE15FD thru SE15FJ</td>
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<td>SE20PB thru SE20PJ</td>
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<td>SE020FJ thru SE20FJ</td>
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<td>2.0</td>
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</table>

(1) Reverse voltage, where: A = 50 V, B = 100 V, C = 150 V, D = 200 V, F = 300 V, G = 400 V, H = 500 V, J = 600 V

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
**TransZorb® TVS in SMB (DO-214AA)**

**Offer tighter ± 3.5% breakdown voltage tolerance**

### Features
- ± 3.5% tightened breakdown voltage tolerance of ± 3.5%
- High peak pulse surge currents from 2.03 A to 65.9 A
- 9.1 V to 301 V excellent clamping capability from 9.1 V to 301 V
- High surge capability to 600 W at 10/1000 µs
- Available with unidirectional or bidirectional polarity

### Applications
- Designed to protect sensitive electronics against voltage transients induced by inductive load switching and lightning
- General voltage surge protection in consumer, computer, industrial, and telecommunications equipment

### Electrical Characteristics (Tamb = 25 °C unless otherwise noted)

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Breakdown Voltage VBR, (V)</th>
<th>Test Current IT (A)</th>
<th>Stand-Off Voltage VWM (V)</th>
<th>Max Reverse Leakage at VWM ID (µA)</th>
<th>Max Peak Pulse Surge Current IPPM (A)</th>
<th>Max Clamping Voltage at VWM Vc (V)min max</th>
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<td>SMBJ5.0D*</td>
<td>6.50</td>
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*All tests and symbols are consistent with ANSI/IEEE C62.35 (1) Pulse test: tp < 50 ms (2) For bi-directional types having VWM of 12 V and less, the ID limit is doubled (3) Surge current waveform per fig. 3 and derate per fig. 2

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
High surge capability of 400 W at 10/1000 µs

Low profile (1 mm) SMF (DO-219AB) package

VTVS Series consists of 23 devices (VTVS5V0ASMF to VTVS63GSMF)

APPLICATIONS
Ideal for space-constrained electronics

COMPETITIVE ADVANTAGE
- Low avalanche breakdown voltage tolerance allows tighter design of electronic circuits
- Lower avalanche breakdown voltage tolerance = lower clamping voltage tolerance
- Important when a transient voltage signal must be clamped close to the max. voltage range!

LOW LEAKAGE CURRENT

LOW NOISE TECHNOLOGY

VERY FAST RESPONSE TIME

PRECISE PROTECTION FOR KEY COMPONENTS

PRIMARY CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{BR}$</td>
<td>6.4 V to 78.2 V</td>
</tr>
<tr>
<td>$V_{WM}$</td>
<td>5.0 V to 63 V</td>
</tr>
<tr>
<td>$P_{PPM}$</td>
<td>400 W</td>
</tr>
<tr>
<td>$T_{j \text{ max.}}$</td>
<td>175 °C</td>
</tr>
</tbody>
</table>

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
TRANSIENT VOLTAGE SUPRESSORS IN eSMP® SERIES PACKAGES

TransZorb® and PAR® TVS

High temperature stability in high reliability conditions to +185 °C

Low profile eSMP® packages:
- MicroSMP (DO-219AD): 0.65 mm typical
- SlimSMA (DO-221AC): 0.95 mm
- SMP (DO-220AA): 1.0 mm
- SMF (DO-219AB): 1.0 mm
- SMPC (TO-277A): 1.1 mm typical

AEC-Q101 qualified and Automotive Grade versions available

Applications
- Protect sensitive electronics against voltage transients

Applications
- CONSUMER
- COMPUTER
- INDUSTRIAL
- TELECOM
- AUTOMOTIVE

TransZorb® TVS diodes are recommended for general applications

PAR® TVS diodes are the first choice for automotive applications

SNAPSHOT

<table>
<thead>
<tr>
<th>Series</th>
<th>Package Outline</th>
<th>Power Rating (W)</th>
<th>TVS Polarity</th>
<th>VBR Min. (V)</th>
<th>VWM Min. (V)</th>
<th>VWM Max. (V)</th>
<th>TJ Max. (°C)</th>
<th>Product Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSMP6.0 thru MSMP20A</td>
<td>MicroSMP (DO-219AD)</td>
<td>150</td>
<td>Unidirectional</td>
<td>6.67</td>
<td>6</td>
<td>20</td>
<td>150</td>
<td>TransZorb® TVS</td>
</tr>
<tr>
<td>MSP3V3, MSP5.0A</td>
<td>MicroSMP (DO-219AD)</td>
<td>150</td>
<td>Unidirectional</td>
<td>4.1</td>
<td>3.3</td>
<td>5</td>
<td>150</td>
<td>TransZorb® TVS</td>
</tr>
<tr>
<td>SMP3V3 thru SMP36A</td>
<td>SMP (DO-220AA)</td>
<td>400</td>
<td>Unidirectional</td>
<td>4.1</td>
<td>3.3</td>
<td>36</td>
<td>150</td>
<td>TransZorb® TVS</td>
</tr>
<tr>
<td>TPSMP6.8A thru TPSMP43A</td>
<td>SMP (DO-220AA)</td>
<td>400</td>
<td>Unidirectional</td>
<td>6.45</td>
<td>5</td>
<td>36.8</td>
<td>185</td>
<td>TransZorb® TVS</td>
</tr>
<tr>
<td>SMPC5.0A thru SMPC36A, SMPC22AN thru SMPC83AN</td>
<td>SMPC (TO-277A)</td>
<td>1500</td>
<td>Unidirectional</td>
<td>6.4</td>
<td>5</td>
<td>85</td>
<td>150</td>
<td>TransZorb® TVS</td>
</tr>
<tr>
<td>TPC11CA thru TPC36CA</td>
<td>SMPC (TO-277A)</td>
<td>1500</td>
<td>Bidirectional</td>
<td>10.5</td>
<td>9.4</td>
<td>30.8</td>
<td>185</td>
<td>PAR® TVS</td>
</tr>
<tr>
<td>TPC6.8A thru TPC51A</td>
<td>SMPC (DO-277A)</td>
<td>1500</td>
<td>Bidirectional</td>
<td>6.45</td>
<td>5</td>
<td>43.6</td>
<td>185</td>
<td>PAR® TVS</td>
</tr>
<tr>
<td>VTVS3V3ASMF to VTVS63GSMF</td>
<td>SMF (DO-219AB)</td>
<td>400</td>
<td>Unidirectional</td>
<td>6.4</td>
<td>3.3</td>
<td>63</td>
<td>175</td>
<td>TransZorb® TVS</td>
</tr>
<tr>
<td>SMA6F5.0A thru SMA6F20A</td>
<td>SlimSMA (DO-221AC)</td>
<td>600</td>
<td>Unidirectional</td>
<td>6.4</td>
<td>5</td>
<td>20</td>
<td>175</td>
<td>TransZorb® TVS</td>
</tr>
<tr>
<td>TA6F6.8A thru TA6F51A</td>
<td>SlimSMA (DO-221AC)</td>
<td>600</td>
<td>Unidirectional</td>
<td>6.45</td>
<td>5</td>
<td>43.6</td>
<td>185</td>
<td>PAR® TVS</td>
</tr>
</tbody>
</table>

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
### ESD Protection Diodes

**Single-line and 4-line ESD protection diodes**

**Working range:** ± 3.3 V to ± 10 V

**Low leakage current:** < 0.1 µA

**AEC-Q101 Qualified versions available**

**Operating temperature range:** -55 °C to +150 °C

**Applications**

ESD protection of high speed interfaces in:

- **Smartphones**
- **Digital Cameras**
- **Automotive Entertainment Systems**
- **Gaming Systems**

<table>
<thead>
<tr>
<th>Vishay P/N</th>
<th>( V_{\text{max}} ) (V)</th>
<th>( I_L ) (µA)</th>
<th>( C_P ) (PF)</th>
<th>Contact Discharge (KV)</th>
<th>Air Discharge (KV)</th>
<th>AEC-Q101 Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>VBUS03B1-S0D0</td>
<td>± 3.3</td>
<td>&lt; 0.05</td>
<td>0.29 typ.</td>
<td>± 16</td>
<td>± 16</td>
<td>Yes</td>
</tr>
<tr>
<td>VBUS05B1-S0D0</td>
<td>± 5.5</td>
<td>&lt; 0.05</td>
<td>0.29 typ.</td>
<td>± 16</td>
<td>± 16</td>
<td>Yes</td>
</tr>
<tr>
<td>VBUS54FD-S0D1</td>
<td>± 5.5</td>
<td>&lt; 0.1</td>
<td>0.9 typ.</td>
<td>± 15</td>
<td>± 15</td>
<td>No</td>
</tr>
<tr>
<td>VCUT03E1-S0D0</td>
<td>± 3.3</td>
<td>&lt; 0.1</td>
<td>&lt; 14</td>
<td>± 30</td>
<td>± 30</td>
<td>Yes</td>
</tr>
<tr>
<td>VCUT05E1-S0D0</td>
<td>± 5.5</td>
<td>&lt; 0.1</td>
<td>&lt; 14</td>
<td>± 30</td>
<td>± 30</td>
<td>Yes</td>
</tr>
<tr>
<td>VCUT10A1-S0D0</td>
<td>± 10</td>
<td>&lt; 0.1</td>
<td>&lt; 9</td>
<td>± 24</td>
<td>± 24</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
PLZ SERIES
ZENER DIODES IN MICROSMF (DO-219AC) PACKAGE

500 mW power dissipation

Ultra compact MicroSMF (DO-219AC) flat lead package; < 0.6 mm low profile

Extremely tight tolerances of ± 2.5 %

COMPETITIVE ADVANTAGE
Combining extremely tight tolerances with low leakage current and excellent stability, the PLZ series is designed to withstand ESD pulses of 8000 V (human body model)

ESD / SURGE CAPABILITY

<table>
<thead>
<tr>
<th>ESD Discharge Current</th>
<th>Peak Pulse Current</th>
</tr>
</thead>
</table>

| Rise time = 0.7 ns to 1 ns |

<table>
<thead>
<tr>
<th>R</th>
<th>s (µs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

| 8 µs to 100 % |

<table>
<thead>
<tr>
<th>t (µs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

| 20 µs to 50 % |

<table>
<thead>
<tr>
<th>t (µs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

APPLICATIONS
Voltage stabilization and reference voltage generation in power supplies and LED lighting

<table>
<thead>
<tr>
<th>AUTOMOTIVE</th>
<th>TELECOM AND INDUSTRIAL</th>
<th>ELECTRONIC LIGHTING</th>
<th>SWITCHING POWER SUPPLIES</th>
</tr>
</thead>
</table>

Saves PCB space

Increases pick and place speeds on assembly lines

AEC-Q101 qualified

Primary Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_z, range nom.</td>
<td>2.0 V to 39 V</td>
</tr>
<tr>
<td>Test current I_{ZT}</td>
<td>5 mA to 20 mA</td>
</tr>
<tr>
<td>V_z specification</td>
<td>Pulse current</td>
</tr>
<tr>
<td>Int. construction</td>
<td>Single</td>
</tr>
</tbody>
</table>


For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com
**BZD SERIES ZENER DIODES**

**IN SMF (DO-219AB) PACKAGE WITH SURGE CURRENT SPECIFICATION**

**IN A NUTSHELL**

- Full voltage range: **3.6 V to 200 V**
  - **2 % Zener voltage tolerance**

**Zener and surge current specification**

- **Low leakage current**

**ESD capability to AEC-Q101**
- Human body model > 8 kV
- Machine model > 800 V

**APPLICATIONS**

- **AUTOMOTIVE**
- **ELECTRICAL LIGHTING**
- **INDUSTRIAL**

- SMPS
- • VOLTAGE STABILIZATION / VOLTAGE REGULATION
- • OVERVOLTAGE SURGE PROTECTION

---

<table>
<thead>
<tr>
<th>Vishay P/N</th>
<th>Qualification Level</th>
<th>Environmental Status</th>
<th>T_J Max. (ºC)</th>
<th>Zener Voltage Tolerance (%)</th>
<th>Zener Voltage Range (V)</th>
<th>Test Current I_{ZT} (A)</th>
<th>V_{WM} (V)</th>
<th>V_{WM} (V)</th>
<th>P_{TWM} (W)</th>
<th>VZ Specifications</th>
<th>Circuit Configuration</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>BZD27B Series</td>
<td>RoHS-compliant</td>
<td>175</td>
<td>2</td>
<td>3.6 to 200</td>
<td>5 to 100</td>
<td>7.35 to 196</td>
<td>6.2 to 160</td>
<td>150</td>
<td>Pulse current</td>
<td>Single</td>
<td>Uni-directional</td>
<td></td>
</tr>
<tr>
<td>BZD27B-M Series</td>
<td>Halogen-free</td>
<td>175</td>
<td>2</td>
<td>3.6 to 200</td>
<td>5 to 100</td>
<td>7.35 to 196</td>
<td>6.2 to 160</td>
<td>150</td>
<td>Pulse current</td>
<td>Single</td>
<td>Uni-directional</td>
<td></td>
</tr>
<tr>
<td>BZD27C Series</td>
<td>RoHS-compliant</td>
<td>175</td>
<td>5</td>
<td>3.6 to 200</td>
<td>5 to 100</td>
<td>7 to 188</td>
<td>6.2 to 160</td>
<td>150</td>
<td>Pulse current</td>
<td>Single</td>
<td>Uni-directional</td>
<td></td>
</tr>
<tr>
<td>BZD27C-M Series</td>
<td>Halogen-free</td>
<td>175</td>
<td>5</td>
<td>3.6 to 200</td>
<td>5 to 100</td>
<td>7 to 188</td>
<td>6.2 to 160</td>
<td>150</td>
<td>Pulse current</td>
<td>Single</td>
<td>Uni-directional</td>
<td></td>
</tr>
</tbody>
</table>

---

For Technical Questions: [DiodesAmericas@vishay.com](mailto:DiodesAmericas@vishay.com), [DiodesEurope@vishay.com](mailto:DiodesEurope@vishay.com), or [DiodesAsia@vishay.com](mailto:DiodesAsia@vishay.com)
AUTOMOTIVE TrenchFET®
SQ SERIES POWER MOSFETS

Wide range of N- and P-channel MOSFETs
- N-ch \( V_{DS} = 12 \text{ V to } 300 \text{ V} \)
- P-ch \( V_{DS} = -12 \text{ V to } -200 \text{ V} \)

Available in single, dual, and dual asymmetric configurations

Highly efficient packages with power density up to 11 W/mm²
- \( R_{DS(on)} \) down to 1 mΩ

AEC-Q101 Qualified to +175 °C

Latest trench technologies optimized for low conduction and low switching losses

Product testing includes extended temp screening with dynamic PAT, SYL, and SBL to reduce defects

APPLICATIONS
- AUTOMOTIVE
- CAR BATTERIES
- INFOTAINMENT
- LIGHTING
- BRAKING
- FEV

SQ Package Portfolio

Compact PowerPAK® packages ~ optimized for high board-level reliability

<table>
<thead>
<tr>
<th>Package Size</th>
<th>Voltage Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerPAK® 8 x 8L</td>
<td>8 mm x 8 mm</td>
</tr>
<tr>
<td>PowerPAK® SQ-8L</td>
<td>5 mm x 6 mm</td>
</tr>
<tr>
<td>PowerPAK® 1212</td>
<td>3.3 mm x 3.3 mm</td>
</tr>
<tr>
<td>PowerPAK® SC-70</td>
<td>2 mm x 2 mm</td>
</tr>
<tr>
<td>KGD Known Good Die</td>
<td>1 mm x 1 mm to 8 mm x 12 mm</td>
</tr>
</tbody>
</table>

For Technical Questions: automostechsupport@vishay.com
POWER MOSFETs
LOW VOLTAGE TRENCHFET®

IN A NUTSHELL

Industry’s lowest
$R_{DS(on)}$ n-channel MOSFETs in an array of advanced packages

- Less than 0.58 mΩ
- Breakdown voltages: 25 V to 30 V
- Excellent $R_{DS(on)}$ vs. Qg FOM improves efficiency for switch mode power supplies

TYPICAL EFFICIENCY IMPROVEMENT EXPECTATION
Benchmarking condition 12.9 $V_{IN}$, 1.8 $V_{OUT}$, 800 kHz

Dual-sided cooling feature

Higher efficiency
Increased power density
Space-saving packages

Applications
- TELECOM
- EQUIPMENT
- COMPUTERS
- SERVERS
- CONSUMER
- ELECTRONICS
- DRONES

For Technical Questions: pmostechsupport@vishay.com
**POWER MOSFETs**
**MEDIUM VOLTAGE TRENCHFET®**

**IN A NUTSHELL**

Enable the **HIGHEST** efficiency

↑ **INCREASE** power density

**REDUCE** component counts  

**COMPACT** and **HIGHLY EFFICIENT**

devices enable layout optimization

---

**Breakdown voltages:** **40 V to 250 V**

**Industry’s lowest** $R_{DS} - Q_{oss}$

**figure-of-merit (FOM)** in an advanced package array

Excellent dynamic parameters optimize switching characteristics

**Double-cooled** PowerPAK SO-8

**High Current, Rugged Package**

**Compact and Low Profile**

**Typical Efficiency Improvement**

48 V$_{in}$, 8.3 V$_{out}$, 250 kHz, 1/4 brick with half-bridge topology

---

**Applications**

- **TELECOM EQUIPMENT**
- **POWER SUPPLIES**
- **MOTOR DRIVE CONTROL**
- **RENEWABLE ENERGY**

For Technical Questions: pmostechsupport@vishay.com
**P-CHANNEL MOSFETs**

-12 V TO -40 V TRENCHFET® GEN III AND IV

**Breakdown voltages:** -12 V to -40 V

*Industry’s lowest $R_{DS(on)}$ in an array of advanced packages*
- Minimize power loss and voltage drop

**Up to 31 A** continuous drain current rating in 2 mm x 2 mm package

**Enabled longer** battery life

**INCREASE** efficiency of power delivery

**PREVENT** undesired fault signals

**Compact** and space saving PCB layout **OPTIMIZATION**

**APPLICATIONS**
- Battery-powered equipment
- Notebooks / tablets
- Game consoles
- Consumer electronics
- Wearables

For Technical Questions: pmosnchp@vishay.com
POWERPAIR® MOSFETS
INTEGRATED DUAL-MOSFET POWER STAGE

IN A NUTSHELL

Input Voltage Range: 4.5 V to 24 V
Internally Connected Half-Bridge

Supports Single or Multi-Phase Designs, Reduces PCB Footprint Area for MOSFET Components

Optimized Gen IV MOSFET Pair Enables High Efficiency

PowerPAIR 6x5F for Layout Optimization
Simplifies Placement of Input Capacitor
Separation of “Power” and “Signal” Partition

APPLICATIONS
COMPUTERS
GRAPHIC CARDS
GAME CONSOLES
TELECOM EQUIPMENT
CONSUMER ELECTRONICS
DRONES
USER INTERFACES

For Technical Questions: pmostechsupport@vishay.com
Broad range of power MOSFETs in a wide selection of advanced packages

- N- and p-channel families
- Breakdown voltages: -200 V to 800 V
- Wide range of gate drive voltages starting at 1.2 V
- Commercial, automotive, and medical product grades

Breakdown Voltage and Package Selection

For Technical Questions: pmostechsupport@vishay.com

Application-Specific Technology Platforms

- Optimized with lowest $R_{DS(on)}$ for load switch applications
- Optimized for lowest gate charge and capacitances for fast switching

MARKETS AND APPLICATIONS

Full Range Of Leaded and Surface-Mount Packages, Including:

- TO-247
- D²PAK / DPAK
- PowerPAK® 8 x 8 / 8 x 8L
- PowerPAK® SO-8 to 0806
- SOT, TSOP, SC Families
- MICRO FOOT®
IN A NUTSHELL

COMPETITIVE ADVANTAGE
- Sensors include 16-bit ambient light sensor at no extra cost
- Optical noise suppression

PART NUMBER

<table>
<thead>
<tr>
<th>Part Number</th>
<th>L</th>
<th>W</th>
<th>H</th>
<th>IR LED</th>
<th>Prox</th>
<th>ALS</th>
<th>Interrupt</th>
<th>Package</th>
<th>AEC-Q101</th>
<th>Range</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCNL4010</td>
<td>3.9</td>
<td>3.9</td>
<td>0.7</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>FAM</td>
<td>0.2 m</td>
<td>Lowest height</td>
<td></td>
</tr>
<tr>
<td>VCNL4020X01</td>
<td>4.9</td>
<td>2.4</td>
<td>0.8</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>FAM</td>
<td>0.2 m</td>
<td>Highest operating temperature in market</td>
<td></td>
</tr>
<tr>
<td>VCNL3020</td>
<td>4.9</td>
<td>2.4</td>
<td>0.8</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>FAM</td>
<td>0.2 m</td>
<td>Low height, proximity only</td>
<td></td>
</tr>
<tr>
<td>VCNL4040</td>
<td>4</td>
<td>2</td>
<td>1.1</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>PCB</td>
<td>0.2 m</td>
<td>Smallest package in the market. Improved ALS with Filtron™</td>
<td></td>
</tr>
<tr>
<td>VCNL4200</td>
<td>8</td>
<td>3</td>
<td>1.8</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>PCB</td>
<td>1.5 m</td>
<td>1.5 meter proximity</td>
<td></td>
</tr>
</tbody>
</table>

APPLICATIONS
- Mobile devices (e.g. smart phones, touch phones, PDAs, GPS) for touch screen locking, power saving
- Automotive for presence detection
- Attract mode engagement
- Automatic doors, faucets, and toilets
- Robots for cliff detection and docking
- Toys for edge of table detection and collision avoidance

For Technical Questions: sensorstechsupport@vishay.com
VCNL4035X01 GESTURE SENSOR
LIGHT TO DIGITAL PORTFOLIO

IN A NUTSHELL

High resolution proximity sensor with a 12- or 16-bit option

Outstanding sensitivity for object detection up to two feet

16-bit ambient light sensor resolution

Superior Gesture Recognition
Low profile package: 0.75 mm

S12

Incorporates proximity and ambient light photodiodes, multiplexer, signal conditioning, and I2C interface in a single package

APPLICATIONS
Ideal for gesture recognition in automotive, consumer, and industrial applications

COMPETITIVE ADVANTAGE
- Operating temperature range up to 105 °C
- Emitters are discrete versus integrated, allowing customer to configure sensing zone
- Temperature compensation to keep output stable over temperature

Drivers for up to THREE emitters

Upper and lower thresholds, and interrupt functions

Excellent background light cancellation

Primary Characteristics

<table>
<thead>
<tr>
<th>Operating Range (V)</th>
<th>2.5 to 3.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>I2C Bus Voltage Range (V)</td>
<td>1.8 to 5</td>
</tr>
<tr>
<td>IRED Pulse Current (mA)</td>
<td>up to 200</td>
</tr>
<tr>
<td>Ambient Light Range (lx)</td>
<td>0.004 to 4192</td>
</tr>
<tr>
<td>Ambient Light Resolution (lx)</td>
<td>0.004</td>
</tr>
<tr>
<td>Output Code 16 Bit</td>
<td>I²C</td>
</tr>
</tbody>
</table>

For Technical Questions: sensorstechsupport@vishay.com
**Transmissive Sensors**

**Surface-Mount**

**In a Nutshell**

- **Wide gap of 3 mm**
  - Moisture sensitivity level (MSL) of 1
  - Surface-mount package
  - Rugged, single piece construction

- **Output current of 1.6 mA**
  - Compact size: 5.5 mm x 4.0 mm x 4.0 mm
  - Automotive qualified to AEC-Q101

- **Rise time of 9 µs, typical**

- **Deep slot for turn and push function**

- **Operating temperature up to +125 °C**

**Applications**

- Gear shift
- Ignition lock
- Adaptive headlight control
- Climate control knobs
- Latches
- Simple encoders
- Switches
- Motor speed and travel distance

**Part Number**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>TCPT1350X01</th>
<th>TCUT1350X01</th>
<th>TCPT1600X01</th>
<th>TCUT1600X01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Channel</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Dual Channel</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Slot Depth</td>
<td>2.8</td>
<td>2.8</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>L x W x H</td>
<td>5.5 mm x 4 mm x 4 mm</td>
<td>5.5 mm x 4 mm x 4 mm</td>
<td>5.5 mm x 4 mm x 5.7 mm</td>
<td>5.5 mm x 4 mm x 5.7 mm</td>
</tr>
<tr>
<td>Function</td>
<td>Presence of object determines speed of turn</td>
<td>Determines speed and direction of turn</td>
<td>Turn and push function presence of object determines speed of turn</td>
<td>Turn and push function determines speed and direction of turn</td>
</tr>
<tr>
<td>Gap</td>
<td>3 mm</td>
<td>3 mm</td>
<td>3 mm</td>
<td>3 mm</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40 °C to +125 °C</td>
<td>-40 °C to +105 °C</td>
<td>-40 °C to +105 °C</td>
<td>-40 °C to +105 °C</td>
</tr>
<tr>
<td>Output Current</td>
<td>1.6 mA at I_f = 15 mA</td>
<td>1.6 mA at I_f = 15 mA</td>
<td>1.6 mA at I_f = 15 mA</td>
<td>1.6 mA at I_f = 15 mA</td>
</tr>
<tr>
<td>On / Off Time</td>
<td>9 µs, 16 µs</td>
<td>9 µs, 16 µs</td>
<td>9 µs, 16 µs</td>
<td>9 µs, 16 µs</td>
</tr>
</tbody>
</table>

**Competitive Advantage**

- Extremely high operating temperature
- Package design ensures alignment of emitter and detector
- High photo current output allows lower forward current of emitter

**How it works:** Simple encoder drawings

For Technical Questions: sensorstechsupport@vishay.com
**IN A NUTSHELL**

**APPLICATIONS**
- FLAT SCREEN TV
- SET-TOP BOXES
- STREAMING MEDIA PLAYERS
- LIGHT BARRIERS

**COMPETITIVE ADVANTAGE**
- Smaller outline and lower cost than full lens packages
- Robust RF with enhanced optical filter against out of band optical noise
- Pin in paste capable
- TSOP53xxxP10P or P16P side-view holder for 1.0 mm to 1.6 mm PCB thickness

**New Minimold Package**

- Supports IR reflow soldering
- Available in two holder and three bend options, including a top-view surface-mount version
- RoHS compliant
- Halogen-free

**45° Superior angular performance with off-angles up to 45°**

<table>
<thead>
<tr>
<th>Key Specifications</th>
<th>TSOP33xxx</th>
<th>TSOP53xxx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical irradiance at 0° (mW/m²)</td>
<td>0.08</td>
<td>0.12</td>
</tr>
<tr>
<td>Supply voltage (V)</td>
<td>2.5 to 5.5</td>
<td></td>
</tr>
<tr>
<td>Typical supply current (mA)</td>
<td>0.35</td>
<td>0.7</td>
</tr>
<tr>
<td>Transmission range (m)</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Carrier frequencies (kHz)</td>
<td>30 to 56</td>
<td></td>
</tr>
</tbody>
</table>

For Technical Questions: IRR@vishay.com
**VISHAY**

**TSOPx9xxxTR1 SERIES**

**LOWEST SIDE-VIEW IR RECEIVER PROFILE**

2 V supply voltage available

Low profile (2.6 mm) side-view package

HALOGEN FREE  
RoHS COMPLIANT

**COMPETITIVE ADVANTAGE**

- Winged package for "in the board" mounting
- High sensitivity and long range
- Reflow solderable

**APPLICATIONS**

Ideal for space-constrained electronics

- **FLAT SCREEN TV**
- **SET-TOP BOXES**
- **STREAMING MEDIA PLAYERS**

**TVCastSMD**

For Pick and Place

**PRIMARY CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width, Height, Depth (mm)</td>
<td>6.8 x 2.6 x 5.3</td>
</tr>
<tr>
<td>Supply Current (typ)</td>
<td>0.35 mA</td>
</tr>
<tr>
<td>Minimum Irradiance (typ)</td>
<td>0.08 mW/m²</td>
</tr>
</tbody>
</table>

Ideal for space-constrained electronics

For Technical Questions: IRR@vishay.com
IN A NUTSHELL

High reliability and noiseless switching (no click)

Tiny footprint relative to electro-mechanical relays

Fast switching times

Low on-resistance, down to 12 Ω (typ.)

**Compact Packages**

**APPLICATIONS**
- Security Systems
- Battery Management
- Automatic Measurement Equipment
- Industrial
- Metering
- Telecommunication
- Instrumentation

**AC AND DC CONFIGURATION WITH SSRs**

**VOR SERIES**

<table>
<thead>
<tr>
<th>Single / Dual Channel</th>
<th>VOR1121A6</th>
<th>VOR1121B6</th>
<th>VOR2121A8</th>
<th>VOR2121B8</th>
<th>VOR1142M4</th>
<th>VOR1142B4</th>
<th>VOR1142A6</th>
<th>VOR1142B6</th>
<th>VOR2142A8</th>
<th>VOR2142B8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>DIP-6</td>
<td>SMD-6</td>
<td>DIP-8</td>
<td>SMD-8</td>
<td>SOP-4</td>
<td>SMD-4</td>
<td>DIP-6</td>
<td>SMD-6</td>
<td>DIP-8</td>
<td>SMD-8</td>
</tr>
<tr>
<td>Isolation Test Voltage (VRMS/1 min)</td>
<td>5300</td>
<td>5300</td>
<td>5300</td>
<td>5300</td>
<td>3750</td>
<td>5300</td>
<td>5300</td>
<td>5300</td>
<td>5300</td>
<td></td>
</tr>
<tr>
<td>Typical On-Resistance (Ω)</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Load Voltage (V)</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Typical Turn-On Time (ms)</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Typical Turn-Off Time (ms)</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>

For Technical Questions: optocoupleranswers@vishay.com
LARGE PIN PHOTO DIODES
7.5 mm² ACTIVE AREA

Radiant sensitive area of 7.5 mm²

High photo sensitivity

Low profile of 0.9 mm

Rise and fall time down to 5 ns

Excellent photocurrent linearity

Narrow variance of output current from part to part

APPLICATIONS

Wearables
- Fitness bands
- Smart Watches

Medical
- Pulse Oximetry
- Blood Analysis

Automotive
- Rain-Light-Tunnel Sensor
- Solar sensor

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Spectral Bandwidth (nm)</th>
<th>Peak Wavelength λp (nm)</th>
<th>OutputCurrent (µA)</th>
<th>Angle of Half Sensitivity, φ (±deg)</th>
<th>Photo Sensitive Area (mm²)</th>
<th>Package Dimensions L x W x H (mm)</th>
<th>Competitive Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>VEMD5010X01</td>
<td>430 to 1100</td>
<td>940</td>
<td>48</td>
<td>65</td>
<td>7.5</td>
<td>5 x 4 x 0.9</td>
<td>AEC-Q101 qualified</td>
</tr>
<tr>
<td>VEMD5060X01</td>
<td>350 to 1070</td>
<td>820</td>
<td>26</td>
<td>45</td>
<td></td>
<td></td>
<td>Fastest rise and fall times. AEC-Q101 qualified</td>
</tr>
<tr>
<td>VEMD5080X01</td>
<td>350 to 1100</td>
<td>950</td>
<td>45</td>
<td>65</td>
<td>7.5</td>
<td>5 x 4 x 0.9</td>
<td>Enhanced sensitivity to visible light. AEC-Q101 qualified</td>
</tr>
<tr>
<td>VEMD5110X01</td>
<td>790 to 1050</td>
<td>940</td>
<td>48</td>
<td>65</td>
<td>7.5</td>
<td>5 x 4 x 0.9</td>
<td>Daylight blocking filter. AEC-Q101 qualified</td>
</tr>
<tr>
<td>VEMD5160X01</td>
<td>700 to 1070</td>
<td>840</td>
<td>26</td>
<td>65</td>
<td>7.5</td>
<td>5 x 4 x 0.9</td>
<td>Daylight blocking filter with fastest rise and fall times. AEC-Q101 qualified</td>
</tr>
<tr>
<td>VEMD5510C</td>
<td>440 to 700</td>
<td>550</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td>Not sensitive to infrared radiation</td>
</tr>
<tr>
<td>VEMD5510CF</td>
<td>440 to 620</td>
<td>540</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
<td>Not sensitive to infrared radiation and matches human eye sensitivity</td>
</tr>
</tbody>
</table>

For Technical Questions: detectortechsupport@vishay.com

Additional Features:
- AEC-Q101 qualified
- Unique FAM packaging allows for high operating temperature up to +110 °C
SiC46X and SiC47X microBUCK® SERIES
4.5 V to 60 V BUCK REGULATORS

200 W 4.5 V to 60 V **buck regulator** capable of delivering up to 200 W output power

**COMPETITIVE ADVANTAGE**

**Highly Integrated**
- Competition
- Compact Packaging
- MOSFET Technology
- IC Design

**Scalable Solution**
- 2 to 12 A buck regulators in a compact MLP 5x5 package

**APPLICATIONS**
- Design your application using our online PowerCAD Simulation Tool

**Rugged and Reliable**
- **PROTECTION**
  - OCP / OVP, UVLO, SCP, UVP, OTP

**INDUSTRY BEST**

**INDUSTRIAL**
- BASE STATION POWER SUPPLIES
- ATM / VENDING
- BATTERY OPERATED VEHICLE / EQUIPMENT
- INDUSTRIAL

**Measured Efficiency for SiC471 @ Fsw=300kHz**

<table>
<thead>
<tr>
<th>Load Current (A)</th>
<th>2 A</th>
<th>3 A</th>
<th>5 A</th>
<th>6 A</th>
<th>8 A</th>
<th>10 A</th>
<th>12 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIN = 42 V, Vo = 28 V</td>
<td>100%</td>
<td>98.5%</td>
<td>95%</td>
<td>90%</td>
<td>85%</td>
<td>80%</td>
<td>75%</td>
</tr>
<tr>
<td>VIN = 48 V, Vo = 24 V</td>
<td>100%</td>
<td>98.5%</td>
<td>95%</td>
<td>90%</td>
<td>85%</td>
<td>80%</td>
<td>75%</td>
</tr>
<tr>
<td>VIN = 42 V, Vo = 12 V</td>
<td>100%</td>
<td>98.5%</td>
<td>95%</td>
<td>90%</td>
<td>85%</td>
<td>80%</td>
<td>75%</td>
</tr>
<tr>
<td>VIN = 48 V, Vo = 12 V</td>
<td>100%</td>
<td>98.5%</td>
<td>95%</td>
<td>90%</td>
<td>85%</td>
<td>80%</td>
<td>75%</td>
</tr>
</tbody>
</table>

For Technical Questions: powerictechsupport@vishay.com
SiC43X: 3 V TO 24 V microBUCK®
8 A TO 24 A FAMILY ENABLES HIGH POWER DENSITY AND EFFICIENCY

IN A NUTSHELL

COMPACT AND SIMPLE

INTERNALLY COMPENSATED

VERSATILE

HIGHLY EFFICIENT

APPLICATIONS

SiC431 Efficiency From 12 V

50 µA quiescent current > 80% efficiency at 1 mA
Peak efficiencies of 95% to 98% at heavier loads

VOUT = 5 V, L = 1 µH
VOUT = 3.3 V, L = 1 µH
VOUT = 1.2 V, L = 0.33 µH

50 µA quiescent current > 80% efficiency at 1 mA
Peak efficiencies of 95% to 98% at heavier loads

PORTABLE
Tablet PCs
Ultrabooks
Notebooks

HOME ENTERTAINMENT
Streaming Media
Boxes
Televions

INFRASTRUCTURE
Line Cards
Modems
Transmitters / Base Stations
AC/DC SMPS

COMPUTING AND PERIPHERALS
Servers
Embedded Systems
SSD
UPS
Networking
Printers

GAMING
Game Consoles
Portable Game Consoles
Accessories / Controllers / Steering Wheels

For Technical Questions: powerICtechsupport@vishay.com
From **ultra low charge** injection to **ultra low resistance**, Vishay’s Enhanced Series analog switches have your **precision designs** covered.

- **Rugged** reliability
- **Power down** protection
- **High** ESD and latch up levels

**APPLICATIONS**
- VEHICLE DIAGNOSTICS
- AUDIO AND VIDEO SYSTEMS
- CONTROLS AND AUTOMATION
- COMMUNICATION SYSTEMS
- INSTRUMENTATION AND DATA ACQUISITION

**INDUSTRY’S BROADEST VOLTAGE RANGE AND CHOICE OF CONFIGURATIONS**

For Technical Questions: analogswitchtechsupport@vishay.com
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Vishay also offers a library of one page articles called “Did You Know” that are written by our engineering support teams and provide tips on product performance to assist design engineers in product selection.

They typically cover raw material, construction advantages, and/or specific tips to ensure designers are able to maximize board performance or minimize component count and or board real estate.

Links to these articles are located in the infographics landing page area.

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To assist, we offer a library of “Capabilities and Custom Options” documents in the infographics landing page area.

Where available, these provide information about available construction styles (including lead attachments, and lengths, etc.), testing, and other capabilities to better match the unique needs of the designer. Contact our sales team for further information.

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Capabilities and custom options, 3D models, application notes, design tools, videos, and more

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