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Key components for
ENGINE VEHICLE CONTROL UNIT - 12 V / 24 V

THE VISHAY ADVANTAGE
AEC Qualifications
High-Temperature Performance
High Reliability
Low Profile
Long Life
High Vibration Handling
**Engine Cooling (BLDC)**

### ALUMINUM CAPACITORS
SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR

**260 CLA-V**
- High ripple current up to 1400 mA at 150 °C, capacitance up to 3300 µF
- Useful life up to 2000 h at 150 °C, high vibration capability

### MOSFETs
N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 160 A, 1.2 mΩ

**SQJQ100EL**
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Ultra-low $R_{DS(on)}$, thermally enhanced PowerPAK® 8x8L replaces D²PAK in less than half of the area

### RESISTORS
Power Metal Strip® SMD Resistors, High Power (Down to 0.001 Ω)

**WSHM2818**
- Very high power rating of 7 W in small 2818 package
- Very low resistance values, 0.001 Ω to 0.10 Ω, with tolerance of 1 %

### NON-LINEAR RESISTORS
SMD Glass-Protected NTC Thermistors

**NTCS…e3**
- Standard series, AEC-Q200 compliant
- Glass-protected with soft terminations

### INDUCTORS
Low-Profile, High-Current IHLP® Inductors

**IHLP-6767GZ-5A**
- Lowest $DCR/µH$ in this package size
- High temperature up to 155 °C, shielded construction

### CERAMIC CAPACITORS
AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R

**VJ…31X RoHS Automotive MLCCs**
- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

### CERAMIC CAPACITORS
High Operating Temperature, Automotive Grade Leaded MLCC Capacitors

**HOTcap® K…H, A…R, K…R**
- High-reliability MLCC insert with wet build process
- High operating temperature (up to 175 °C for K…H and up to 160 °C for A…R and K…R), rated voltages: 50 V, 100 V, 200 V
Exhaust Emission Control System

MOSFETs
N-Channel MOSFETs as Known Good Die (KGD) Rated at 60 V, 71 mΩ
SQC462BKGD
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Efficient KGD packaging allows high power density and reduced parasitics

P-Channel MOSFETs as Known Good Die (KGD) Rated at -60 V, 14 mΩ
SQC461KGD
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Efficient KGD packaging allows high power density and reduced parasitics

RECTIFIERS
Schottky Diode Chips, 15 V to 150 V, Up to 3 A
SC036H100S6B
- Wafers in box, sawn on film, Al or Ag top metal

DIODES
Surface Mount PAR® TVS, 11 V to 48 V Breakdown Voltage
SM8S10
- AEC-Q101 qualified and high power up to 6600 W (10 x 1000 μs)
- Meet ISO7637-2 surge specification (varied by test conditions)

RESISTORS
Power Metal Strip® SMD Resistors, High Temperature (275 °C), High Power (1 W)
WSLT2010...18
- High temperature for harsh environments, resistance values down to 0.01 Ω
- Power Metal Strip® construction offers high reliability in critical applications

RESISTORS
Precision High-Temperature (215 °C) Thin Film Resistors, Low TCR with ± 5 ppm/°C
PLTT0603
- Gold terminations, Special Passivation Method (SPM)

NON-LINEAR RESISTORS
Platinum SMD Flat Chip Temperature Sensors
PTS AT Series
- Standard characteristics according to IEC 60751
- Short reaction times down to 2 s (in air)

NON-LINEAR RESISTORS
AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, COG (NPO), X7R, and X8R
VJ...31X RoHS Automotive MLCCs
- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

CERAMIC CAPACITORS
High Operating Temperature, Automotive Grade Leaded MLCC Capacitors
HOTcap® K...H, A...R, K...R
- High-reliability MLCC insert with wet build process
- High operating temperature (up to 175 °C for K...H and up to 160 °C for A...R and K...R), rated voltages: 50 V, 100 V, 200 V

www.vishay.com
Spotlight on SQ Rugged Series of Automotive MOSFETs

Dedicated Automotive Process Flow Reduces Defects

The Vishay Siliconix SQ series of AEC-Q101-qualified power MOSFETs is produced using a special process that is optimized for automotive excellence. Featuring n-channel and p-channel TrenchFET® technologies with low on-resistance, our automotive power MOSFETs are rated for a maximum junction temperature of 175 °C.

Packages include the traditional D²PAK (TO-263), DPAK (TO-252), SO-8, TSOP-6, SOT-23, SC-70, and innovative space saving PowerPAK® packages in sizes ranging from large (8 mm x 8 mm) to small (2 mm x 2 mm). The PowerPAK® 8x8L, at 8 mm x 8 mm, offers on-resistance down to 1.2 mΩ and high-current capability in less than half the size of the D²PAK, offering a significant reduction in board space. The PowerPAK® SO-8L, at 5 mm x 6 mm, offers on-resistance down to 3 mΩ in less than half the size of a DPAK and thermal resistance as low as 1.5 °C/W. It also comes in dual symmetric and asymmetric configurations, allowing high-side and low-side MOSFETs to be optimized for applications. The PowerPAK® 1212-8, at 3 mm x 3 mm, delivers on-resistance and current capability similar to the SO-8 in one-third the size. It is also available in dual configuration and with wettable flanks for AOI. Even smaller, the PowerPAK® SC-70, at 2 mm x 2 mm, offers low on-resistance and current capability similar to that of the larger sized TSOP-6 and SOT-23. In addition, Vishay offers Known Good Die (KGD) packaging, where die are singulated, tested, and packaged in tape and reel, which provides high quality and reliable performance.

For details on these and other MOSFETs for automotive applications, visit http://www.vishay.com/mosfets/automotive-mosfets/
Key components for

POWERTRAIN - INJECTION CONTROL AND FUEL PUMP

THE VISHAY ADVANTAGE
AEC Qualifications
High-Temperature Performance
High Reliability
Low Profile
Long Life
High-Voltage SMD Components
**Direct Injection Control**

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<td>SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR</td>
<td>Precision Thin Film Chip Resistor Arrays, Superior Moisture Resistivity</td>
<td>Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 60 V, 12 mΩ</td>
</tr>
<tr>
<td>260 CLA-V</td>
<td>ACAS0612 AT Precision</td>
<td>SQJB60EP</td>
</tr>
<tr>
<td>• High ripple current up to 1400 mA at 150 °C, capacitance up to 3300 µF</td>
<td>• Resistance ratio up to 1:20, superior tracking stability over lifetime</td>
<td>• AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation</td>
</tr>
<tr>
<td>• Useful life up to 2000 h at 150 °C, high vibration capability</td>
<td>• Relative TCR to ± 5 ppm/K (tracking), AEC-Q200 qualified, sulfur-resistant</td>
<td>• Dual configuration in thermally enhanced PowerPAK® SO-8L saves board space</td>
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<tr>
<th>RECTIFIERS</th>
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<td>200 V, 2 x 3 A Fred Pt® Hyperfast Rectifiers</td>
<td>Surface-Mount PAR® TVS, 600 W, 6.8 V to 51 V</td>
</tr>
<tr>
<td>VS-6CSH02HM3</td>
<td>VS-8DKH02</td>
<td>TA6Fxx</td>
</tr>
<tr>
<td>• Hyperfast recovery time, t&lt;sub&gt;r&lt;/sub&gt; = 27 ns, reduced Q&lt;sub&gt;rr&lt;/sub&gt;, and soft recovery</td>
<td>• Dual 5x6 (FlatPAK™) package</td>
<td>• Very-low-profile DO-221AC (SlimSMA™) package - typical height of 0.95 mm</td>
</tr>
<tr>
<td>• Low forward voltage drop and low leakage current</td>
<td>• T&lt;sub&gt;j&lt;/sub&gt; = 175 °C</td>
<td>• T&lt;sub&gt;j&lt;/sub&gt; = 185 °C</td>
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<th>RESISTORS</th>
<th>INDUCTORS</th>
<th>CERAMIC CAPACITORS</th>
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<tr>
<td>Power Metal Strip® SMD Resistors, Wide Terminal, 1 mΩ to 3 mΩ, 1 W</td>
<td>Low-Profile, High-Current IHLP® Inductors</td>
<td>AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R</td>
</tr>
<tr>
<td>WSL0612</td>
<td>IHLP-5050FD-5A</td>
<td>VJ...31X RoHS Automotive MLCCs</td>
</tr>
<tr>
<td>• Low EMF, high temperature up to 170 °C</td>
<td>• Excellent high-temperature performance and noise filtering</td>
<td>• RoHS and Green compliant parts available</td>
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<table>
<thead>
<tr>
<th>MOSFETs</th>
<th>NON-LINEAR RESISTORS</th>
<th>MOSFETs</th>
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<td>N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 80 V, 7 mΩ</td>
<td>SMD Glass-Protected NTC Thermistors</td>
<td>Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 40 V, 9.66 mΩ</td>
</tr>
<tr>
<td>SQJA80EP</td>
<td>NTCS...e3</td>
<td>SQJB42EP</td>
</tr>
<tr>
<td>• AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation</td>
<td>• Standard series, AEC-Q200 compliant</td>
<td>• AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation</td>
</tr>
<tr>
<td>• Ultra-low R&lt;sub&gt;DS(on)&lt;/sub&gt;, thermally enhanced PowerPAK® 8x8L replaces D²PAK in less than half of the area</td>
<td>• Glass-protected with soft terminations</td>
<td>• Dual configuration in thermally enhanced PowerPAK® SO-8L saves board space</td>
</tr>
</tbody>
</table>
## Piezo Injection Control

### RESISTORS

- **Professional High-Temperature Mini-MELF Resistors**
  - **MMA 0204 HT**
    - Operating temperature up to 175°C, power handling of 500 mW
    - AEC-Q200 qualified, high overall stability |ΔR/R| ≤ 0.1%, intrinsically sulfur-resistant

### MOSFETs

- **N-Channel MOSFETs in DPAK Package Rated at 300 V, 10 A, 330 mΩ**
  - **SQD10N30-330H**
    - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
    - Up to 300 V operation in DPAK package

### RECTIFIERS

- **600 V, 2 A FRED Pt® Ultrafast Rectifiers**
  - **VS-2EFU06HM3**
    - SMF (DO-219AB) package, operating temperature up to 175 °C
    - Pulse current up to 30 A (6 ms)

### INDUCTORS

- **Low-Profile, High-Current IHLP® Inductors**
  - **IHLP-5050FD-5A**
    - Excellent high-temperature performance
    - Noise filtering

- **Radial Miniature, High-Voltage, Up to 450 V with CR Up to 220 µF**
  - **152RMH**
    - High voltage applications, 105 °C long life
    - Miniaturized, ultra-high CV product per unit volume

- **N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®, 100 V, 32 A, 11 mΩ**
  - **SQJ402EP**
    - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
    - 100 V MOSFETs for use in low-side flyback converters

### ALUMINUM CAPACITORS

- **Radial Miniature, High-Voltage, Up to 450 V with CR Up to 220 µF**
  - **152RMH**
    - High voltage applications, 105 °C long life
    - Miniaturized, ultra-high CV product per unit volume

### NON-LINEAR RESISTORS

- **SMD Glass-Protected NTC Thermistors**
  - **NTCS...e3**
    - Standard series, AEC-Q200 compliant
    - Glass-protected with soft terminations

### DIODES

- **Unidirectional and Bidirectional Power SMD TVS Diodes, SMA Package, Up to 400 W**
  - **SMAJxx**
    - DO-214AC (SMA) package, high-voltage clamping
    - 6.4 V to 231 V

### CERAMIC CAPACITORS

- **AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R**
  - **VJ...31X RoHS Automotive MLCCs**
    - RoHS and Green compliant parts available
    - AgPd termination available for epoxy bonding

### POWERTRAIN – INJECTION CONTROL AND FUEL PUMP

- **www.vishay.com**
**Fuel Pump Control (BLDC)**

**ALUMINUM CAPACITORS**
SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR

**260 CLA-V**
- High ripple current up to 1400 mA at 150 °C, capacitance up to 3300 µF
- Useful life up to 2000 h at 150 °C, high vibration capability

**MOSFETS**
N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 40 V, 3.2 mΩ

**SQJ444EP**
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Logic level Vth, low RDS(on), thermally enhanced PowerPAK® SO-8L replaces DPAK in less than half of the area

**MOSFETS**
N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 40 V, 3.0 mΩ

**SQJA46EP**
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Thermally enhanced PowerPAK® SO-8L replaces DPAK in less than half of the area

**RESISTORS**
Power Metal Strip® SMD Resistors, Very High Power (3 W), Low Value (to 0.0005 Ω)

**WSLP2512**
- Very high power rating of 3 W in 2512 package
- Extremely low resistance values from 0.0005 Ω to 0.01 Ω and tolerance of 1 %

**RECTIFIERS**
1 A, 200 V FRED Pt® Hyperfast Rectifiers

**VS-1EFH02HM3**
- Hyperfast recovery time, tr = 25 ns, reduced Qrr, and soft recovery
- DO-219AB (SMF) package, high Tj of 175 °C

**RESISTORS**
Power Metal Strip® SMD Resistors, Wide Terminal, 1 µΩ to 6 µΩ, 6 W

**WSL1020**
- TCR < 20 ppm/K, high-temperature performance up to 170 °C

**MOSFETS**
Dual N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 100 A, 3.4 mΩ

**SQJO904E**
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- High power density dual PowerPAK® 8x8L offers significant reduction in PCB area

**NON-LINEAR RESISTORS**
SMD Glass-Protected NTC Thermistors

**NTCS...e3**
- Standard series, AEC-Q200 compliant
- Glass-protected with soft terminations

**INDUCTORS**
Power SMD IHLP® Storage Inductors, E-Field Shielded, Inductance of 0.22 µH to 22 µH

**IHLE-4040DD-5A**
- Shielded housing provides excellent protection against EMI (B and E fields)
- Optimized for high frequency

**CERAMIC CAPACITORS**
AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R

**VJ...31X RoHS Automotive MLCCs**
- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

**CERAMIC CAPACITORS**
High Operating Temperature, Automotive Grade Leaded MLCC Capacitors

**HOTcap® K...H, A...R, K...R**
- High-reliability MLCC insert with wet build process
- High operating temperature (up to 175 °C for K...H and up to 160 °C for A...R and K...R), rated voltages: 50 V, 100 V, 200 V

www.vishay.com
Key components for CHASSIS CONTROL

THE VISHAY ADVANTAGE
AEC Qualifications
High Power Density
High Pulse Current Capabilities
Low Profile
Long Life
Small Size

Electric Power Steering (BLDC Motor Drive)
Transmission ECU, Double Clutch BLDC
**Electric Power Steering**  
**(BLDC Motor Drive)**

**ALUMINUM CAPACITORS**
SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR

<table>
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<tr>
<th>Capacitors</th>
<th>Specifications</th>
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| 260 CLA-V  | • High ripple current up to 1400 mA at 150 °C, capacitance up to 3300 µF  
• Useful life up to 2000 h at 150 °C, high vibration capability |

**RESISTORS**
Thin Film Resistors, 4.7 Ω to 3.01 MΩ, 0402 to 1210 Case Sizes, 50 V to 200 V

<table>
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<th>Specifications</th>
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</thead>
<tbody>
<tr>
<td>TNPW e3</td>
<td>• Excellent stability $</td>
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**MOSFETs**
N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 160 A, 1.2 mΩ

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<th>Specifications</th>
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</table>
| SQJQ100EL | • AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation  
• Ultra-low $R_{DS(on)}$ thermally enhanced PowerPAK® 8x8L replaces D²PAK in less than half of the area |

**SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR**

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<th>Capacity</th>
<th>Current</th>
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<tbody>
<tr>
<td>260 CLA-V</td>
<td>1400 mA at 150 °C</td>
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</table>

**THIN FILM RESISTORS**
Precision Thin Film Chip Resistor Arrays, Superior Moisture Resistivity

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Specifications</th>
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</table>
| ACAS0612 AT Precision | • Resistance ratio up to 1:20, superior tracking stability over lifetime  
• Relative TCR to ± 5 ppm/K (tracking), AEC-Q200 qualified, sulfur-resistant |

**INDUCTORS**
Shielded SMD Low-Profile, High-Current IHLP® Inductors, EMI Filters, 155 °C, Low DCR

<table>
<thead>
<tr>
<th>Inductors</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHLP-6767GZ-5A</td>
<td>• Very high-current and high-temperature operation for filters</td>
</tr>
</tbody>
</table>

**POWER METAL STRIP® SMD RESISTORS**

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Specifications</th>
</tr>
</thead>
</table>
| WSLP2726 | • Very high power (7 W)  
• Resistance = 0.3 mΩ to 4 mΩ |

<table>
<thead>
<tr>
<th>Filters</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHXL-2000VZ-5A</td>
<td>• Very high-current and high-temperature operation for filters and energy storage</td>
</tr>
</tbody>
</table>

**OPTOELECTRONICS**
3-Channel SMD Transmissive Sensors for “Turn and Push” Optical Encoding

<table>
<thead>
<tr>
<th>Sensors</th>
<th>Specifications</th>
</tr>
</thead>
</table>
| TCUT1630X01 | • Wide operating temperature range of -40 °C to +110 °C, 3 output channels  
• Sensing of motion, speed, and direction; third channel for trigger signal |

**NON-LINEAR RESISTORS**
SMD Glass-Protected NTC Thermistors

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Specifications</th>
</tr>
</thead>
</table>
| NTCs...e3 | • Standard series, AEC-Q200 compliant  
• Glass-protected with soft terminations |

**CERAMIC CAPACITORS**
AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X6R

<table>
<thead>
<tr>
<th>Capacitors</th>
<th>Specifications</th>
</tr>
</thead>
</table>
| VJ...31X RoHS Automotive MLCCs | • RoHS and Green compliant parts available  
• AgPd termination available for epoxy bonding |
Transmission ECU, Double Clutch BLDC

MOSFETs
N-Channel MOSFETs as Known Good Die (KGD) Rated at 40 V, 0.72 mΩ
SQC200N04-0m72KGD
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Efficient KGD packaging allows high power density and reduced parasitics

MOSFETs
N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 40 V, 3.0 mΩ
SQJA46EP
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Thermally enhanced PowerPAK® SO-8L replaces DPAK in less than half of the area

MOSFETs
Dual N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 100 A, 3.4 mΩ
SQJQ904E
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- High power density dual PowerPAK® 8x8L offers significant reduction in PCB area

CHASSIS CONTROL

MOSFETs
N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 40 V, 3.0 mΩ
SQJA46EP
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Thermally enhanced PowerPAK® SO-8L replaces DPAK in less than half of the area

CERAMIC CAPACITORS
AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, COG (NPO), X7R, and X8R
VJ...31X RoHS Automotive MLCCs
- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

MOSFETs
N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 40 V, 3.0 mΩ
SQJA46EP
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Thermally enhanced PowerPAK® SO-8L replaces DPAK in less than half of the area

RECTIFIERS
High Current Density Surface-Mount Schottky Barrier Rectifiers
SS3P4L
- AEC-Q101 qualified
- Very low profile - typical height of 1.0 mm

INDUCTORS
Coupled Inductors for SEPIC Converter
IHCL-3232DZ-5A
- High-temperature operation up to 155 °C
- Frequency range up to 5.0 MHz

DIODES
600 W, 6.8 V to 51 V SMD PAR® TVS Diodes
TA6FxX
- Tj = 185 °C
- Very low profile - typical height of 0.95 mm

RESISTORS
SMD Thick Film Resistors, High Stability
RCA0603
- TCR = 50 to 200 ppm/K
- Sulfur-resistant

NON-LINEAR RESISTORS
SMD Glass-Protected NTC Thermistors
NTCS...e3
- Standard series, AEC-Q200 compliant
- Glass-protected with soft terminations

RESISTORS
Power Metal Strip® SMD Resistors, Wide Terminal, 1 mΩ to 30 mΩ, 2 W
WSLP2010
- Very high power to footprint size ratio (2 W in 2010)
- Construction is impervious to high-sulfur environments

RESISTORS
Precision Gold Terminated Thin Film Chip Resistor Arrays for Conductive Gluing
ACAS 0606 ATAU Precision
- Glueable gold terminations, resistance ratio up to 1:20, tolerance ± 0.05 %
- AEC-Q200 qualified, extreme sulfur resistance, superior tracking stability

www.vishay.com
Spotlight on Power Metal Strip® Resistors

Combining Low TCR (< 30 ppm/°C), Low Ohmic Values Down to 0.2 mΩ, Tight Tolerance, and High-Temperature Capabilities

Vishay’s Power Metal Strip® current sensing resistors combine superior performance in high-temperature applications with a wide range of package sizes and a choice of resistance values from 0.0002 Ω to 1 Ω. These patented, state-of-the-art products deliver overload capabilities equivalent to wirewound devices and temperature coefficients as low as 30 ppm/°C.

Current sensing Power Metal Strip resistors allow control circuitry to monitor the level of current in a circuit by translating current into a voltage that can be monitored easily. The devices work by resisting the current flow in a circuit to a calibrated level, thus allowing a voltage drop to be detected and monitored by control circuitry. The low resistance values of Power Metal Strip resistors allow this function to be carried out with exceptional efficiency.

High Power Density (up to 222 W/in², 34.4 W/cm²)

Vishay’s Power Metal Strip resistors have evolved to “High Power” WSL…-18, WSLP, WSR3, WSR5, and WSHM2818 type resistors. Specially selected materials and processing permit these components to attain high power ratings of up to 10 W. The WSL…-18, WSLP, WSR3, WSR5, and WSHM2818 resistors offer a high power-to-package-size ratio while maintaining superior electrical characteristics. These high power ratings enable designers to use smaller PCBs, which in turn increases manufacturing speed and reduces raw material costs.

Very High-Power, Surface-Mount Power Metal Strip Current Sensing Resistors

FEATURES

- High power in small case sizes: up to 10 W
- Very low resistance values: 0.0002 Ω to 1.0 Ω
- Tight resistance tolerance: down to ± 0.1 %

Low Temperature Coefficient of Resistance (TCR) (Down to 30 ppm/°C)

The low TCR of Vishay Power Metal Strip resistors minimizes the resistance change caused by self-heating and high-temperature environments.

This chart shows the voltage of a 30 ppm/°C Vishay Power Metal Strip resistor compared to typical 100 ppm/°C metal strip and 700 ppm/°C thick film chip resistors.
Key components for

BODY ELECTRONICS

THE VISHAY ADVANTAGE
AEC Qualifications
High Power Density
Low Profile
Durability
Customization

Comfort, Door, Window Controls
Infotainment, Navigation, Audio
Interior LED Lighting
### MOSFETs

<table>
<thead>
<tr>
<th>N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®</th>
<th>SQJ868EP</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 V, 58 A, 6.3m Ω</td>
<td></td>
</tr>
</tbody>
</table>

- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Thermally enhanced PowerPAK SO-8L replaces DPAK in less than half of the area

### RECTIFIERS

<table>
<thead>
<tr>
<th>Surface-Mount Schottky Barrier Rectifiers</th>
<th>MSS1P4</th>
</tr>
</thead>
</table>

- Very low profile - typical height of 0.65 mm
- AEC-Q101 qualified

### DIODES

<table>
<thead>
<tr>
<th>SMD Power ESD Diodes, Up to ± 30 kV, I_{FSM} = 50 A</th>
<th>SMFxx</th>
</tr>
</thead>
</table>

- SMF package: 3.5 mm x 1.9 mm
- Breakdown voltage = 6.4 V to 64.4 V

### RESISTORS

<table>
<thead>
<tr>
<th>Thick Film Surface-Mount Chip Resistors, Wraparound, Extremely Low Value</th>
<th>RCWE</th>
</tr>
</thead>
</table>

- Low resistance values from 0.01 Ω to 0.99 Ω and tolerance of 1 %
- Thick film construction with 2x power capacity

### OPTOELECTRONICS

<table>
<thead>
<tr>
<th>Ambient Light PIN Photodiode Sensors</th>
<th>TEMD6200FX01</th>
</tr>
</thead>
</table>

- SMD 0805 package, low profile of 0.85 mm, wide viewing angle of ± 60 °
- Spectral sensitivity close to human eye, high signal output linearity

<table>
<thead>
<tr>
<th>Silicon PIN Photodiode with Excellent Output Linearity Characteristics</th>
<th>VEMD6160X01</th>
</tr>
</thead>
</table>

- SMD 1206 package, daylight blocking filter, wide viewing angle of ±70°
- Low capacitance of 4.6pF, ideal for noisy environments and small signal detection

### INDUCTORS

<table>
<thead>
<tr>
<th>Low-Profile, High-Current IHLP® Inductors</th>
<th>IHLP-4040DZ-5A</th>
</tr>
</thead>
</table>

- Excellent high-current performance for noise filters
- High-temperature operation up to 155 °C

### TANTALUM CAPACITORS

<table>
<thead>
<tr>
<th>Solid Tantalum Chip Capacitors, High CV Leadframeless Molded, Automotive Grade</th>
<th>TP3 / TP8</th>
</tr>
</thead>
</table>

- TP3 - AEC-Q200 qualified; low ESR; A, B, C, D and E cases
- TP8 - AEC-Q200 qualified

### ALUMINUM CAPACITORS

<table>
<thead>
<tr>
<th>Aluminum Capacitors, Increased Vibration Resistance</th>
<th>246 CTI-V</th>
</tr>
</thead>
</table>

- High temperature, low impedance, high vibration capability
- High ripple current, long useful life

### OPTOELECTRONICS

<table>
<thead>
<tr>
<th>SMD Silicon PIN Photodiodes with Large Active Area for High Photo Currents</th>
<th>VEMD5110X01</th>
</tr>
</thead>
</table>

- QFN package with wettable flanks, reduced noise sensitivity
- Wide operating temperature range of -40 °C to +110 °C, wide viewing angle of ± 65 °

<table>
<thead>
<tr>
<th>850 nm SMD Infrared Emitters</th>
<th>VSMY1850ITX01</th>
</tr>
</thead>
</table>

- SMD 0805 package, low profile of 0.85 mm, high radiant intensity of 10 mW/sr
- Wide operating temperature range of -40 °C to +105 °C, wide viewing angle of ± 60 °

### CERAMIC CAPACITORS

<table>
<thead>
<tr>
<th>High Operating Temperature, Automotive Grade Leaded MLCC Capacitors</th>
<th>HOTcap® K...H, A...R, K...R</th>
</tr>
</thead>
</table>

- High-reliability MLCC insert with wet build process
- High operating temperature (up to 175 °C for K...H and up to 160 °C for A...R and K...R), rated voltages: 50 V, 100 V, 200 V
### Infotainment, Navigation, Audio

#### MOSFETs
- **Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®, 40 V, 11 mΩ / 22 mΩ**
  - **SQJ942EP**
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
  - Optimized for high-frequency DC/DC applications, lower switching losses

#### OPTOELECTRONICS
- **890 nm SMD Infrared Emissors**
  - **VSMF970011X01**
  - Low-profile PLCC² package, wavelength matched to sensitivity of proximity sensor
  - External emitter to enable gesture function of proximity sensor

#### INDUCTORS
- **IHL® High-Temperature (155 °C) Parts in Double Inductor Package**
  - **IHL-4032KB-5A**
  - Optimal design provides high quality sound and low distortion
  - Low coupling for minimal cross-talk between inductors

#### RESISTORS
- **Thick Film Surface-Mount Chip Resistors, Wraparound, Extremely Low Value**
  - **RCWE0603**
  - Low resistance values from 0.01 Ω to 0.99 Ω and tolerance of 1 %
  - Thick film construction with 2x power capacity

#### OPTOELECTRONICS
- **Integrated Proximity and Ambient Light Sensors with I²C Interface**
  - **VCNL4020X01**
  - Low-profile QFN SMD package, 16 bit resolution, proximity distance up to 200 mm
  - Suitable for extended detection range, gesture function with external emitters

#### MOSFETs
- **Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®, 12 V, 2.7 mΩ / 7.4 mΩ**
  - **SQJ202EP**
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
  - Low-voltage, high-frequency synchronous buck applications, lower switching losses

#### RECTIFIERS
- **Surface-Mount Schottky Barrier Rectifiers**
  - **MSS1P4**
  - Very low profile - typical height of 0.65 mm
  - AEC-Q101 qualified

#### INDUCTORS
- **Low-Profile, High-Current IHL® Inductors**
  - **IHLP-2525CZ-5A**
  - Excellent high-temperature performance for DC/DC converter input and output filters

#### RESISTORS
- **Precision Thin Film Resistor Arrays, Superior Moisture Resistivity, TCR ± 0.05**
  - **ACAS 0606 AT**
  - Arbitrary resistance ratio up to 1:20, superior tracking stability over lifetime
  - Relative TCR down to ± 5 ppm/K (tracking), AEC-Q200 qualified

#### TANTALUM CAPACITORS
- **Solid Tantalum Chip Capacitors, High CV Leadframeless Molded, Automotive Grade**
  - **TP8**
  - Smallest AEC-Q200 qualified tantalum capacitors with case sizes as small as 0603

#### CERAMIC CAPACITORS
- **AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R**
  - **VJ...31X RoHS Automotive MLCCs**
  - RoHS and Green compliant parts available
  - AgPd termination available for epoxy bonding

#### INDUCTORS
- **High-Curent SMD Inductors with E-Field Shielding and 155 °C Operating Temperature**
  - **IHLE-3232DD-5A**
  - Excellent EMI protection, double-shielded
# Automotive Interior LED Lighting

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### RESISTORS

**Pulse-Proof, High-Power Thick Film Chip Resistors**
- **CRCW-HP e3**
  - Excellent pulse load capability
  - Enhanced power rating

### MOSFETs

**N-Channel MOSFETs in 3 mm x 3 mm PowerPAK® 1212, 60 V, 18 A, 23 mΩ**
- **SQ7414AENW**
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
  - High power density PowerPAK® 1212 with wettable flanks for AOI

**P-Channel MOSFETs in 3 mm x 3 mm PowerPAK® 1212, -60 V, -16 A, 65 mΩ**
- **SQ7415AENW**
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
  - High power density PowerPAK® 1212 with wettable flanks for AOI

### RECTIFIERS

**Surface-Mount Schottky Barrier Rectifiers**
- **MSS1P6**
  - Low-profile MicroSMP package for low-voltage, high-frequency inverters; DC/DC converters; and polarity protection applications

### RESISTORS

**Power Metal Strip® SMD Resistors, Wide Terminal, 1 mΩ to 3 mΩ, 1 W**
- **WSL0612**
  - Low EMF, high temperature up to 170 °C

### NON-LINEAR RESISTORS

**SMD Glass-Protected NTC Thermistors**
- **NTCS...e3**
  - Standard series, AEC-Q200 compliant
  - Glass-protected with soft terminations

### INDUCTORS

**Low-Profile, High-Current IHLP® Inductors**
- **IHL-1616BZ-A1**
  - Shielded construction, lowest DCR/µH in this package size
  - Excellent DC/DC energy storage up to 5 MHz

---

**www.vishay.com**
Key components for
ACTIVE SAFETY

THE VISHAY ADVANTAGE
AEC Qualifications
High-Temperature Performance
Low Profile
High Reliability
Long Life

- Enhanced Electrical Braking (EEB)
- Electronic Stability Program (ESP) Vehicle Stability Control (VSC)
- Electrical Parking Brake (EPB) Integrated Parking Brake (IPB)
- Advanced Driver Assistance System (ADAS)
### Enhanced Electrical Braking (EEB)

**RESISTORS**
- Thin Film Resistors, 4.7 Ω to 3.01 MΩ, 0402 to 1210 Case Sizes, 50 V to 200 V
  - **TNPW e3**
    - Excellent stability $|ΔR/R| \leq 0.05 \%$ after 1000 h at 70 °C, 0402 to 1210 case sizes

**RESISTORS**
- Power Metal Strip® SMD Resistors, 4-Terminal, Low Value (Down to 0.0001 Ω)
  - **WSK1216**
    - High power rating of 3 W to 5 W with TCR of 20 ppm/K
    - Very low resistance values, 0.0001 Ω to 0.004 Ω, with tolerance of 1 %

**MOSFETs**
- N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 160 A, 1.2 mΩ
  - **SQJQ100EL**
    - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
    - Ultra-low $R_{DS(on)}$, thermally enhanced PowerPAK® 8x8L replaces D²PAK in less than half of the area

**INDUCTORS**
- Power SMD IHLP® Storage Inductors, 0.22 µH to 22µH
  - **IHLP5050FD-5A**
    - Soft saturation, high rated current, temperature up to 155 °C

**RESISTORS**
- Power Metal Strip® SMD Resistors, 4-Terminal, Low Value (Down to 0.0001 Ω)
  - **WSK1216**
    - High power rating of 3 W to 5 W with TCR of 20 ppm/K
    - Very low resistance values, 0.0001 Ω to 0.004 Ω, with tolerance of 1 %

**MOSFETs**
- N-channel MOSFET in Reverse DPAK Rated at 40 V, 3.8 mΩ
  - **SQR50N04-3m8 GE3**
    - AEC-Q101 Qualified, 100 % UIS & RG tested with up to 175 °C operation
    - Reverse DPAK package allows excellent heat transfer and is good for high current application such as park brake

**NON-LINEAR RESISTORS**
- SMD Glass-Protected NTC Thermistors
  - **NTCS...e3**
    - Standard series, AEC-Q200 compliant
    - Glass-protected with soft terminations

**INDUCTORS**
- SMD Low-Profile, High-Current IHLP® Inductors, 0.22 µH to 33 µH
  - **IHLP-3232DZ-5A**
    - High-temperature (up to +155 °C), high-current shielded inductors

**INDUCTORS**
- Low-Profile, High-Current IHLP® Inductors
  - **IHLP-4040DZ-5A**
    - Excellent high-current performance for noise filters
    - High-temperature operation up to 155 °C

**CERAMIC CAPACITORS**
- AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, COG (NPO), X7R, and X8R
  - **VJ...31X RoHS Automotive MLCCs**
    - RoHS and Green compliant parts available
    - AgPd termination available for epoxy bonding

**ALUMINUM CAPACITORS**
- SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR
  - **260 CLA-V**
    - High ripple current up to 1400 mA at 150 °C, capacitance up to 3300 µF
    - Useful life up to 2000 h at 150 °C, high vibration capability

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[www.vishay.com](http://www.vishay.com)
### Automotive Electronic Stability Program (ESP)
### Vehicle Stability Control (VSC)

#### ALUMINUM CAPACITORS
SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR

**260 CLA-V**
- High ripple current up to 1400 mA at 150 °C, capacitance up to 3300 µF
- Useful life up to 2000 h at 150 °C, high vibration capability

#### RESISTORS
SMD Thick Film Resistors, High Stability, Sulfur-Resistant

**RCA0603**
- TCR = 50 ppm/K to 200 ppm/K

#### MOSFETs
N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 160 A, 1.2 mΩ

**SQJQ100EL**
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Ultra-low R<sub>DS(on)</sub>, thermally enhanced PowerPAK® 8x8L replaces D²PAK in less than half of the area

#### MOSFETs
Dual N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 100 A, 3.9 mΩ

**SQJQ900E**
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- High power density dual PowerPAK® 8x8L offers significant reduction in PCB area

#### RESISTORS
Power Metal Strip® SMD Resistors, Wide Terminal, 1 mΩ to 3 mΩ, 1 W

**WSL0612**
- Low EMF, high temperature up to 170 °C

#### RECTIFIERS
1A, 200 V FRED Pt® Hyperfast Rectifiers

**VS-1EFH02HM3**
- Hyperfast recovery time, t<sub>r</sub> = 25 ns, reduced Q<sub>r</sub>, and soft recovery
- DO-219AB (SMF) package, high T<sub>j</sub> of 175 °C

#### INDUCTORS
Low-Profile, High-Current IHLP® Inductors

**IHLP-2525CZ-5A**
- Excellent high-temperature performance for DC/DC converter input and output filters

#### INDUCTORS
Low-Profile, High-Current IHLP® Inductors

**IHLP-4040DZ-5A**
- Excellent high-temperature performance for noise filters
- High-temperature operation up to 155 °C

#### CERAMIC CAPACITORS
AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R

**VJ...31X RoHS Automotive MLCCs**
- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

#### TANTALUM CAPACITORS
Solid Tantalum Surface-Mount Chip Capacitors, Molded Case, Automotive Grade

**TH3 / TH4**
- High-temperature molded tantalum capacitors, HI-TMP®, TH4 = up to 175 °C, TH3 = up to 150 °C

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[www.vishay.com](http://www.vishay.com)
**Electrical Parking Brake (EPB)**

**Integrated Parking Brake (IPB)**

**ALUMINUM CAPACITORS**

SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR

260 CLA-V

- High ripple current up to 1400 mA at 150 °C, capacitance up to 3300 µF
- Useful life up to 2000 h at 150 °C, high vibration capability

**RESISTORS**

Power Metal Strip® SMD Resistors, 4-Terminal, Low Value (Down to 0.0001 Ω)

WSK1216

- High power rating of 3 W to 5 W with TCR of 20 ppm/K
- Very low resistance values, 0.0001 Ω to 0.004 Ω, with tolerance of 1 %

**MOSFETs**

N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 160 A, 1.2 mΩ

SQJ100EL

- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Ultra-low R_{DS(on)}, thermally enhanced PowerPAK® 8x8L replaces DPAK in less than half of the area

**MISFETs**

Dual N-Channel MOSFETs in 8 mm x 8 mm PowerPAK®, 40 V, 100 A, 3.9 mΩ

SQJQ900E

- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- High power density dual PowerPAK® 8x8L offers significant reduction in PCB area

**INDUCTORS**

Shielded EMI Filter Up to 190 A_{DCR}, 2.2µH, Ultra-Low DCR (0.22 mΩ)

IHXL-2000VZ-5A

- Very high-current and high-temperature operation for filters and energy storage

**CERAMIC CAPACITORS**

AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, COG (NPO), X7R, and X8R

VJ...31X RoHS Automotive MLCCs

- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

**TANTALUM CAPACITORS**

Solid Tantalum Surface-Mount Chip Capacitors, Molded Case, Automotive Grade

TH3 / TH4

- High-temperature molded tantalum capacitors, HI-TMP®, TH3 = up to 175 °C, TH3 = up to 150 °C

www.vishay.com
**Advanced Driver Assistance System (ADAS)**

- **MOSFETs**
  - Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®, 40 V, 11 mΩ / 22 mΩ
  - **SQJ942EP**
    - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
    - Optimized for high-frequency DC/DC applications, lower switching losses

- **INDUCTORS**
  - Low-Profile, High-CURRENT IHLP® Inductors
  - **IHLP-1616BZ-A1**
    - Shielded construction, lowest DCR/µH in this package size
    - Excellent DC/DC energy storage up to 5 MHz

- **DIODES**
  - SMD Power ESD Diodes, Up to ± 30 kV, I_{FSM} = 50 A
  - **SMFx**
    - SMF package: 3.5 mm x 1.9 mm
    - Breakdown voltage = 6.4 V to 64.4 V

- **OPTOELECTRONICS**
  - Integrated Proximity and Ambient Light Sensors with I²C Interface
  - **VCNL4020X01**
    - Low-profile QFN SMD package, 16 bit resolution, proximity distance up to 200 mm
    - Suitable for extended detection range, gesture function with external emitters

- **RESISTORS**
  - Precision Thin Film Resistor Arrays, Superior Moisture Resistivity, TCR ± 0.05
  - **ACAS 0606 AT**
    - Arbitrary resistance ratio up to 1:20, superior tracking stability over lifetime
    - Relative TCR down to ± 5 ppm/K (tracking), AEC-Q200 qualified

- **RECTIFIERS**
  - Surface-Mount Schottky Barrier Rectifiers
  - **MSS1P4**
    - Very low profile - typical height of 0.65 mm
    - AEC-Q101 qualified

- **TANTALUM CAPACITORS**
  - Solid Tantalum Chip Capacitors, High CV Leadframeless Molded, Automotive Grade
  - **TP8**
    - Smallest AEC-Q200 qualified tantalum capacitors with case sizes as small as 0603

- **CERAMIC CAPACITORS**
  - AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R
  - **VJ...31X RoHS Automotive MLCCs**
    - RoHS and Green compliant parts available
    - AgPd termination available for epoxy bonding

- **INDUCTORS**
  - High-Current SMD Inductors with E-Field Shielding and 155 °C Operating Temperature
  - **IHLE-3232DD-5A**
    - Excellent EMI protection, double-shielded

- **MOSFETs**
  - Dual N-Channel MOSFET in Small 2 mm x 2 mm SC-70 Package Rated at 20 V, 28 mΩ
  - **SQ1912AEEH-T1 GE3**
    - AEC-Q101 Qualified, 100 % UIS & RG tested with up to 175 °C operation
    - Compact part for use in sync buck power supply for camera system

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www.vishay.com
Spotlight on the IHLP® Inductor Loss Calculator Tool

Vishay’s new IHLP Loss Calculator is a free tool that assists designers in selecting the correct IHLP inductor based on the operating conditions of their circuit. This tool will simulate the losses in the inductor, including core and both AC and DC copper losses. The temperature rise and final component temperature will also be predicted based on the estimated losses. This tool will allow designers to compare several different inductors, both in size and value, to assist in the selection process. The calculator can be used for buck, boost and buck/boost style converters.

The calculator has ten inputs: input voltage, output voltage, switch (FET) voltage drop, diode (or sync FET) voltage drop, output current, frequency, ambient temperature and inductance. The calculator will do the rest based on these inputs. Inductance can be selected by using the “radio” buttons on the left hand side.

Please note: all designs should be verified in circuit as this tool is for simulation only.

Access the loss calculator tool at: www.vishay.com/inductors/calculator-home-list/
Access the user guide at: www.vishay.com/doc?49421

Important Design Criteria

IHLP inductors have a recommended maximum component temperature of 125 °C. Subtracting the ambient temperature will give us the maximum allowed temperature rise for the part. If this number should exceed 40 °C it is recommended that 40 °C be used for the allowed temperature rise. The recommended range for the ripple current is 30 % to 50 % of inductor current. This is based on a trade-off of inductor size and cost versus output capacitor size and cost. The maximum peak current should be kept below the last value of the selected inductor, although it can be exceeded with caution due to the soft saturation characteristics of the powdered iron core material. The calculators are based on operation in the continuous conduction mode only. Information determined in the discontinuous conduction mode should be considered suspect and in need of verification by the user.

[Image of IHLP® Inductor Loss Calculator Tool]
Key components for
PASSIVE SAFETY

THE VISHAY ADVANTAGE
AEC Qualifications
High Reliability
Proven Performance
Proven Lifetimes

Airbag Control Systems
Restraint System Power Supplies
Pedestrian Protection Systems
### Automotive

#### PASSIVE SAFETY

---

**Airbag Control Systems**

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Resistors</th>
<th>MOSFETs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin Film Resistors, 4.7 Ω to 3.01 MΩ, 0402 to 1210 Case Sizes, 50 V to 200 V</td>
<td>Massive Electro-Pyrotechnic Initiator Chip Resistors</td>
<td>Dual N- and P-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L, 40/-40 V, 11/30 mΩ</td>
</tr>
<tr>
<td><strong>TNPW e3</strong></td>
<td><strong>MEPIC</strong></td>
<td><strong>SQJ500AEP</strong></td>
</tr>
<tr>
<td>• Excellent stability</td>
<td>• Low firing energy down to 1.5 mJ, fast firing time down to 250 μs</td>
<td>• AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation</td>
</tr>
<tr>
<td></td>
<td>• Standard 0805 SMD case, alternative to bridge wire technology</td>
<td>• Package saves board space</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOSFETs</th>
<th>Rectifiers</th>
<th>Inductors</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®, 40 V, 58 A, 6.3m Ω</td>
<td>High Current Density Surface-Mount Schottky Barrier Rectifiers</td>
<td>Low-Profile, High-Current IHLP® Inductors</td>
</tr>
<tr>
<td><strong>SQJ868EP</strong></td>
<td><strong>SS3P4L</strong></td>
<td><strong>IHLP-4040DZ-5A</strong></td>
</tr>
<tr>
<td>• AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation</td>
<td>• AEC-Q101 qualified</td>
<td>• Excellent high-current performance for noise filters</td>
</tr>
<tr>
<td>• Thermally enhanced PowerPAK SO-8L replaces DPAK in less than half of the area</td>
<td>• Very low profile - typical height of 1.0 mm</td>
<td>• High-temperature operation up to 155 °C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diodes</th>
<th>Tantalum Capacitors</th>
<th>Aluminum Capacitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Power TVS, Up to 6.6 kW, Standoff with 24 V, 700 A Peak Current</td>
<td>Solid Tantalum Chip Capacitors, High CV Leadframeless Molded, Automotive Grade</td>
<td>Aluminum Capacitors, Increased Vibration Resistance</td>
</tr>
<tr>
<td><strong>SMBS24AT</strong></td>
<td><strong>TP8</strong></td>
<td><strong>246CTI-V</strong></td>
</tr>
<tr>
<td>• PAR® TVS in DO-218AC package for automotive load dump protection applications</td>
<td>• Smallest AEC-Q200 qualified tantalum capacitors with case sizes as small as 0603</td>
<td>• High temperature, low impedance, high vibration capability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ceramic Capacitors</th>
<th>Tantalum Capacitors</th>
<th>Ceramic Capacitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Operating Temperature, Automotive Grade Leaded MLCC Capacitors</td>
<td>Solid Tantalum Surface-Mount Chip Capacitors, Tantamount® Molded Case, Automotive Grade</td>
<td>High Operating Temperature, Automotive Grade Leaded MLCC Capacitors</td>
</tr>
<tr>
<td><strong>HOTcap® K...H, A...R, K...R</strong></td>
<td><strong>TH3</strong></td>
<td><strong>HOTcap® K...H, A...R, K...R</strong></td>
</tr>
<tr>
<td>• High-reliability MLCC insert with wet build process</td>
<td>• High-temperature molded tantalum capacitors, HI-TMP®, up to 150 °C</td>
<td>• High-reliability MLCC insert with wet build process</td>
</tr>
<tr>
<td>• High operating temperature (up to 175 °C for K...H and up to 160 °C for A...R and K...R), rated voltages: 50 V, 100 V, 200 V</td>
<td></td>
<td>• High operating temperature (up to 175 °C for K...H and up to 160 °C for A...R and K...R), rated voltages: 50 V, 100 V, 200 V</td>
</tr>
</tbody>
</table>

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**www.vishay.com**
## Restraint System Power Supplies

### Resistors
- **Thick Film Resistors, Pulse-Proof, Excellent Stability**
  - CRCW-IF e3
  - High pulse performance up to 10 kW
  - Stability $|\Delta R/R| \leq 1\%$ after 1000 h at 70 °C

### Aluminum Capacitors
- **Aluminum Capacitors, Increased Vibration Resistance**
  - 246CTI-V
  - High temperature, low impedance, high vibration capability
  - High ripple current, long useful life

### MOSFETs
- **P-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L, -60 V, 52 A, 18 mΩ**
  - SQJ459EP
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
  - Thermally enhanced package replaces DPAK in less than half the area

### Rectifiers
- **Ultrafast Rectifiers, 200 V, 1.2 A**
  - ES07D
  - AEC-Q101 qualified low-profile DO-219AB (SMF) package for surface-mount applications

### Resistors
- **Power Metal Strip® SMD Resistors, 4-Terminal, Low Values (Down to 0.0001 Ω)**
  - WSK1216
  - High power rating of 3 W to 5 W with $\text{TCR} = 20 \text{ ppm/K}$
  - Very low resistance values, 0.0001 Ω to 0.004 Ω, with tolerance of 1 %

### Inductors
- **Low-Profile, High-Current IHLP® Inductors**
  - IHLP-5050FD-5A
  - Excellent high-temperature performance and noise filtering

### Ceramic Capacitors
- **AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, COG (NPO), X7R, and X8R**
  - VJ…31X RoHS Automotive MLCCs
  - RoHS and Green compliant parts available
  - AgPd termination available for epoxy bonding

### Diodes
- **Surface-Mount PAR® TVS**
  - TPSMA
  - AEC-Q101 qualified, $T_j = 185 \degree C$ capability, suitable for automotive applications
  - 400 W peak pulse power capability with 10/1000 μs waveform

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**www.vishay.com**
## Pedestrian Protection Systems

RESISTORS
Thin Film Resistors, 4.7 Ω to 3.01 MΩ, 0402 to 1210 Case Sizes, 50 V to 200 V

**TNPW e3**
- Excellent stability $|\Delta R/R| \leq 0.05 \%$ after 1000 h at 70 °C, 0402 to 1210 case sizes

MOSFETs
Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®, 12 V, 2.7 mΩ / 7.4 mΩ

**SQJ202EP**
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Low-voltage, high-frequency synchronous buck applications, lower switching losses

INDUCTORS
Low-Profile, High-Current Inductors

**IHLP® Inductors**
- Excellent high-temperature performance for DC/DC converter input and output filters

INDUCTORS
Low-Profile, High-Current Inductors with E-Field Shield

**IHLE-2525CD-5A**
- High temperature operation up to 155 °C
- Integrated e-field shield eliminates need for separate shielding

MOSFETs
Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®, 40 V, 11 mΩ / 22 mΩ

**SQJ942EP**
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Optimized for high-frequency DC/DC applications, lower switching losses

RECTIFIERS
Surface-Mount Schottky Barrier Rectifiers

**MSS1P4**
- Very low profile - typical height of 0.65 mm
- AEC-Q101 qualified

INDUCTORS
Low-Profile, High-Current Inductors

**IHLP-2525CZ-5A**
- Excellent high-temperature performance for DC/DC converter input and output filters

INDUCTORS
Low-Profile, High-Current Inductors

**IHLP-4040DZ-5A**
- Excellent high-current performance for noise filters
- High-temperature operation up to 155 °C

CERAMIC CAPACITORS
AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R

**VJ...31X RoHS Automotive MLCCs**
- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

DIODES
Trench Schottky Rectifiers in SMPC (TO-277A), High Pulse Current up to 220 A, 150 V

**V15P15HM3**
- Low-profile TO-277A (SMPC) package for use in low-voltage, high-frequency inverters; DC/DC converters; and polarity protection applications

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www.vishay.com
Key components for
EXTERIOR LIGHTING

THE VISHAY ADVANTAGE
Automotive Qualified
High-SFR Components
EMI-Improved Components
High-Temperature-Approved Passive Components (≥ 155 °C)
**LED Headlight Units**

**MOSFETs**

Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L, 60 V, 12 mΩ

SQJB60EP
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
- Dual configuration in thermally enhanced PowerPAK® SO-8L saves board space

**INDUCTORS**

Low Profile, High Current Inductors with E-Field Shield

IHLE-3232DD-5A
- High temperature operation up to 155 °C
- Integrated e-field shield eliminates need for separate shielding

**DIODES**

Surface-Mount TRANSZORB® TVS

P6SMB36CA
- AEC-Q101 qualified
- 600 W peak pulse power capability with 10/1000 μs waveform

**RESISTORS**

Professional Thin Film MELF Resistors

MMB 0207
- Unrivaled surge handling capability, ultimate stability over lifetime
- AEC-Q200 qualified, approved according to EN 140401-803, intrinsically sulfur-resistant, Green product

**RESISTORS**

Power Metal Strip® SMD Resistors, Very High Power (to 3 W), Extremely Low Resistance (to 0.0005 Ω)

WSLP
- Very high power rating, to 3 W
- Extremely low resistance values from 0.0005 Ω to 0.1 Ω and tolerance of 1 %

**NON-LINEAR RESISTORS**

SMD Glass-Protected NTC Thermistors

NTCS...e3
- Standard series, AEC-Q200 compliant
- Glass-protected with soft terminations

**RECTIFIERS**

High Current Density, Surface-Mount Trench MOS Barrier Schottky Rectifiers

V8P10HM3
- Ultra-low $V_f = 0.466$ V at $I_f = 4$ A
- Very low profile - typical height of 1.1 mm

**INDUCTORS**

Low-Profile, High-Current Coupled Inductor

IHCL-4040DZ-5A
- High-temperature operation up to 155 °C
- Shielded construction

**INDUCTORS**

Low-Profile, High-Current IHLP® Inductors

IHLP-5050EZ-5A
- High saturation current
- High-temperature operation up to 155 °C

**CERAMIC CAPACITORS**

AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R

VJ...31X RoHS Automotive MLCCs
- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

**TANTALUM CAPACITORS**

Solid Tantalum Surface-Mount Chip Capacitors, Tantamount® Molded Case, Automotive Grade

TH3
- High-temperature molded tantalum capacitors, HI-TMP®, up to 150 °C
## Daytime Lighting

### RESISTORS

**Pulse-Proof, High-Power Thick Film Chip Resistors**
- **CRCW-HP e3**
  - Excellent pulse load capability
  - Enhanced power rating

### MOSFETs

**N-Channel MOSFETs in Small 3 mm x 3 mm SOT-23, 100 V, 1.6 A, 300 mΩ**
- **SQ2398ES**
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
  - 100 V MOSFETs for switching low currents in small packages

**Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK SO-8L, 40 V, 33 mΩ**
- **SQJ946EP**
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
  - Optimized for high-frequency DC/DC applications, lower switching losses

**N-Channel MOSFETs in 3 mm x 3 mm PowerPAK® 1212 with Wettable Flanks, 80 V, 25 mΩ**
- **SQSA80ENW**
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
  - For higher currents

### RECTIFIERS

**High Current Density, Surface-Mount Trench MOS Barrier Schottky Rectifier**
- **V8P10HM3**
  - Ultra-low Vf = 0.466 V at If = 4 A
  - Very low profile - typical height of 1.1 mm

**High-Voltage Schottky Diode, 100 V, 2 A, Tj = 175 °C**
- **SS2PH10**
  - Very low profile - typical height of 1.0 mm
  - Low forward voltage drop, low power losses

### DIODES

**High Power Density Surface-Mount PAR® TVS**
- **TPSMP**
  - AEC-Q101 qualified, Tj = 185 °C capability, suitable for automotive applications
  - Very low profile - typical height of 1.0 mm

**Thick Film Surface-Mount Chip Resistors, Wraparound, Extremely Low Value**
- **RCWE**
  - Low resistance values from 0.01 Ω to 0.976 Ω and tolerance of 1 %
  - Thick film construction with 2x power capacity

### OPTOELECTRONICS

**SMD PLCC-2 Plus 0.5 W White LEDs**
- **VLMW51Q2R3**
  - Luminous intensity up to 51 lm in compact 3.5 x 3.5 x 1.2 mm surface-mount package
  - White color coordinates of 0.33 (X) and 0.33 (Y) with 120° viewing angle

### NON-LINEAR RESISTORS

**SMD Glass-Protected NTC Thermistors**
- **NTCS...e3**
  - Standard series, AEC-Q200 compliant
  - Glass-protected with soft terminations

### RESISTORS

**Professional Thin Film MELF Resistors**
- **MMB 0207**
  - Unrivaled surge handling capability, ultimate stability over lifetime
  - AEC-Q200 qualified, approved according to EN 140401-803, intrinsically sulfur-resistant, Green product

**AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R**
- **VJ...31X RoHS Automotive MLCCs**
  - RoHS and Green compliant parts available
  - AgPd termination available for epoxy bonding
# LED Fog Lighting

## RESISTORS

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRCW-HP e3</td>
<td>Pulse-Proof, High-Power Thick Film Chip Resistors</td>
</tr>
<tr>
<td></td>
<td>• Excellent pulse load capability</td>
</tr>
<tr>
<td></td>
<td>• Enhanced power rating</td>
</tr>
</tbody>
</table>

## MOSFETs

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQJ942EP</td>
<td>Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK®, 40 V, 11 mΩ / 22 mΩ</td>
</tr>
<tr>
<td></td>
<td>• AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation</td>
</tr>
<tr>
<td></td>
<td>• Optimized for high-frequency DC/DC applications, lower switching losses</td>
</tr>
</tbody>
</table>

## RECTIFIERS

<table>
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<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS2P4</td>
<td>2 A, 40 V Schottky Diodes</td>
</tr>
<tr>
<td></td>
<td>• Low-profile DO-220AA (SMP) package for low-voltage, high-frequency DC/DC converters; switching power supplies; free-wheeling diodes; and polarity protection</td>
</tr>
</tbody>
</table>

## RECTIFIERS

<table>
<thead>
<tr>
<th>Name</th>
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</thead>
<tbody>
<tr>
<td>V3PAL45</td>
<td>45 V, 3 A Trench Schottky Diodes, Ultra-Low Vf</td>
</tr>
<tr>
<td></td>
<td>• Low-profile DO-221BC (SMPA) package for low-voltage, high-frequency DC/DC converters; switching power supplies; freewheeling diodes; and polarity protection</td>
</tr>
</tbody>
</table>

## DIODES

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<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>TPSMA</td>
<td>Surface-Mount PAR® TVS</td>
</tr>
<tr>
<td></td>
<td>• 400 W peak pulse power capability with a 10/1000 µs waveform</td>
</tr>
</tbody>
</table>

## NON-LINEAR RESISTORS

<table>
<thead>
<tr>
<th>Name</th>
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</tr>
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<tbody>
<tr>
<td>NTCs...e3</td>
<td>SMD Glass-Protected NTC Thermistors</td>
</tr>
<tr>
<td></td>
<td>• Standard series, AEC-Q200 compliant</td>
</tr>
<tr>
<td></td>
<td>• Glass-protected with soft terminations</td>
</tr>
</tbody>
</table>

## CERAMIC CAPACITORS

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<th>Description</th>
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<tr>
<td>VJ...31X RoHS Automotive MLCCs</td>
<td>AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R</td>
</tr>
<tr>
<td></td>
<td>• RoHS and Green compliant parts available</td>
</tr>
<tr>
<td></td>
<td>• AgPd termination available for epoxy bonding</td>
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## INDUCTORS

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<tr>
<td>IHLP-2020CZ-5A</td>
<td>Low-Profile, High-Current IHLP Inductors</td>
</tr>
<tr>
<td></td>
<td>• Excellent high-temperature performance for DC/DC converter input and output filters</td>
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## INDUCTORS

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<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>IHLP-2525CZ-5A</td>
<td>Low-Profile, High-Current IHLP Inductors</td>
</tr>
<tr>
<td></td>
<td>• Compact size and high current, low saturation for noise filtering</td>
</tr>
<tr>
<td></td>
<td>• Up to 155 °C continuous operation</td>
</tr>
</tbody>
</table>

## RECTIFIERS

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<tr>
<td>RCWE</td>
<td>Thick Film Surface Mount Chip Resistors, Wraparound, Extremely Low Values</td>
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<td></td>
<td>• Low resistance values from 0.01 Ω to 0.976 Ω and tolerance of 1 %</td>
</tr>
<tr>
<td></td>
<td>• Thick film construction with 2x power capacity</td>
</tr>
</tbody>
</table>
## Rear and Signal LED Lights

### RESISTORS

**Pulse-Proof, High-Power Thick Film Chip Resistors**

**CRCW-HP e3**
- Excellent pulse load capability
- Enhanced power rating

**Professional Thin Film MELF Resistors**

**MMB 0207**
- Unrivaled surge handling capability, ultimate stability over lifetime
- AEC-Q200 qualified, approved according to EN 140401-803, intrinsically sulfur-resistant, Green product

### MOSFETs

**N-Channel MOSFETs**

- 3 mm x 3 mm PowerPAK® 1212 with Wettable Flanks Rated at 40 V, 9 mΩ
  - SQS484ENW
  - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation

### RECTIFIERS

**Surface-Mount Schottky Barrier Rectifiers**

**MSS1P6HM3**
- Low-profile MicroSMP package for low-voltage, high-frequency inverters; DC/DC converters; and polarity protection applications
- AEC-Q101 qualified

### INDUCTORS

**Low-Profile, High-Current IHLP® Inductors**

**IHLP-1616BZ-A1**
- Shielded construction, lowest DCR/µH in this package size
- Excellent DC/DC energy storage up to 5 MHz

**IHLP-2020CZ-5A**
- Compact size and high current, low saturation for noise filtering
- Up to 155 °C continuous operation

### RESISTORS

**Power Metal Strip® SMD Resistors, Wide Terminal, 1 mΩ to 3 mΩ, 1 W**

**WSL0612**
- Low EMF, high temperature up to 170 °C

**Optoelectronics**

**SMD High-Power, 1 W Visible LEDs (Red, Amber, and Yellow)**

**VLMR71AAAC**
- Compact, high-power SMD package: 6 x 6 x 1.5 mm
- Wide viewing angle of 120°

**Non-linear Resistors**

**SMD Glass-Protected NTC Thermistors**

**NTCS...e3**
- Standard series, AEC-Q200 compliant
- Glass-protected with soft terminations

### CERAMIC CAPACITORS

**AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R**

**VJ...31X RoHS Automotive MLCCs**
- RoHS and Green compliant parts available
- AgPd termination available for epoxy bonding

**INDUCTORS**

**Low-Profile, High-Current IHLP® Inductors**

**IHLP-2020CZ-5A**
- Compact size and high current, low saturation for noise filtering
- Up to 155 °C continuous operation
Spotlight on Automotive Qualified Tantalum Capacitors

TP8 MICROtan® Low-Profile, High-CV Leadframeless Capacitors

For space-constrained designs, the TP8 series offers capacitance values up to 100 µF and case sizes down to 0805 and 0603. The table below summarizes the advantages of the MICROtan series over conventional molded tantalum devices.

TP8 Next Generation Tantalum Chip Capacitors

ADVANTAGES

| Industry’s best volumetric efficiency | → | Reduced size, higher ratings |
| No lead frames | → | Improved reliability, reduced ESR, reduced cost |
| L-shape termination design | → | Superior mechanical and electrical contact, visual inspection of solder joints |
| Tantalum technology | → | Unlike MLCC, no piezoelectric noise |
| RoHS-compliant and halogen-free | → | Environmentally friendly |

Select Application Examples for Tantalum Capacitors

POWER MANAGEMENT AND CONVERSION
Tantalum capacitor options include devices in a broad variety of case sizes and with the high temperature ratings required by the automotive environment. They provide effective filtering in switchmode power supplies and deliver exceptionally stable, high-capacitance performance over a long life and in high-temperature (under-the-hood) environments.

ENERGY STORAGE
Today’s automotive circuitry requires stability under various loads and peak power requirements. Vishay tantalum capacitors provide a low-cost bulk energy storage solution for power bus hold-up applications.

COUPLING
Automotive analog circuitry, including audio, sensor, and telematics applications, requires a coupling capacitor to connect two circuits so that only the AC signal passes from the first circuit to the next. The capacitor, often called a blocking capacitor, blocks the DC signal, isolating the DC bias of the two coupled circuits. Vishay tantalum capacitors offer the requisite capacitance, DC leakage current, and stability over temperature and time for automotive analog coupling.

Capabilities Overview

<table>
<thead>
<tr>
<th>Series</th>
<th>TP3</th>
<th>TP8</th>
<th>TH3</th>
<th>TH4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Low-ESR molded SMD</td>
<td>MICROtan® Leadframeless SMD</td>
<td>High-Temperature (+150 °C) SMD</td>
<td>High-Temperature (+175 °C) SMD</td>
</tr>
<tr>
<td>Capacitance Range</td>
<td>0.1 µF to 470 µF</td>
<td>1 µF to 100 µF</td>
<td>0.33 µF to 220 µF</td>
<td>10 µF to 47 µF</td>
</tr>
<tr>
<td>Voltage Range</td>
<td>4 V to 50 V</td>
<td>6.3 V to 40 V</td>
<td>6.3 V to 50 V</td>
<td>6.3 V to 35 V</td>
</tr>
<tr>
<td>Capacitance Tolerance</td>
<td>± 10 %, ± 20 %</td>
<td>± 20 %, ± 10 %</td>
<td>± 10 %, ± 20 %</td>
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</tr>
</tbody>
</table>
Key components for 48 V\textsubscript{DC} BOARDNET

- Integrated Starter Generators (48 V\textsubscript{DC})
- DC/DC Converters, Bidirectional (48 V\textsubscript{DC})
- HVAC (E-Compressor for 48 V\textsubscript{DC})

**THE VISHAY ADVANTAGE**

- New Semiconductor High-Voltage Technology, 80 V to 150 V
- EMI-Improved Semiconductors Diodes with Lowest Ringing Voltage
- High-Temperature Operation Up to 175 °C
- Newest Power SO-8 Packages Up to 240 A
### Integrated Starter Generators (48 V<sub>DC</sub>)

<table>
<thead>
<tr>
<th>Component Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOSFETs</td>
<td>N-Channel MOSFETs in 5 mm x 6 mm PowerPAK® SO-8L Rated at 80 V, 7 mΩ SQJA80EP - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation - Ultra-low R&lt;sub&gt;DS(on)&lt;/sub&gt; thermally enhanced PowerPAK® 8x8L replaces D²PAK in less than half of the area</td>
</tr>
<tr>
<td>NON-LINEAR RESISTORS</td>
<td>SMD Glass-Protected NTC Thermistors NTCS...e3 - Standard series, AEC-Q200 compliant - Glass-protected with soft terminations</td>
</tr>
<tr>
<td>MODULES</td>
<td>MOSFET H Bridges or B6 Bridges Based on Customer Specifications EMIPAK 1B/2B Customized - 80 V to 100 V MOSFET power modules</td>
</tr>
<tr>
<td>CERAMIC CAPACITORS</td>
<td>High Operating Temperature, Automotive Grade Leaded MLCC Capacitors HOTcap® K...H, A...R, K...R - High-reliability MLCC insert with wet build process - High operating temperature (up to 175 °C for K...H and up to 160 °C for A...R and K...R), rated voltages: 50 V, 100 V, 200 V</td>
</tr>
<tr>
<td></td>
<td>EMI Filters with Flat Copper Wire, SMD or Leaded Up to 260 A Customized EMI Filters - Customized solutions for 48 V applications, low DCR, high current</td>
</tr>
<tr>
<td></td>
<td>DC-Link Polyester Film Capacitors, Operating Temperature Up to 150 °C, High Ripple Current MKT1820S - Low voltage DC-link capacitors with high-temperature capabilities - Customized solutions for 48 V applications</td>
</tr>
</tbody>
</table>

**www.vishay.com**
DC/DC Converters, Bidirectional (48 V<sub>DC</sub>)

**RESISTORS**  
Professional High-Temperature Mini-MELF Resistors  
**MMA 0204 HT**  
- Operating temperature up to 175 °C, power handling of 500 mW, high surge capability  
- AEC-Q200 qualified, high overall stability |ΔR/R| ≤ 0.1 %, intrinsically sulfur-resistant

**MOSFETs**  
N-Channel MOSFETs in 8 mm x 8 mm PowerPAK<sup>®</sup> 8x8L, 80 V, 150 A, 2.7 mΩ  
**SQJQ0480E**  
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation  
- Ultra-low R<sub>DS(on)</sub> thermally enhanced package reduces board area

**MOSFETs**  
N-Channel MOSFETs in 8 mm x 8 mm PowerPAK<sup>®</sup>, 40 V, 160 A, 1.2 mΩ  
**SQJQ100EEL**  
- AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation  
- Ultra-low R<sub>DS(on)</sub> thermally enhanced PowerPAK<sup>®</sup> 8x8L replaces D-PAK in less than half of the area

**INDUCTORS**  
Shielded SMD Low-Profile, High-Current IHLP<sup>®</sup> Inductors, EMI Filter, 155 °C, Low DCR  
**IHLP-8767QZ-5A**  
- Very high-current and high-temperature operation for filters

**INDUCTORS**  
Coupled Inductors for SEPIC Converter  
**IHCL-3232DZ-5A**  
- High-temperature operation up to 155 °C  
- Frequency range up to 5.0 MHz

**INDUCTORS**  
EMI Filters with Flat Copper Wire as SMD or Leaded, Up to 260 A  
**WSK1216**  
- High power rating of 3 W to 5 W with TCR = 20 ppm/K  
- Very low resistance values, 0.0001 Ω to 0.004 Ω, with tolerance of 1 %

**RESISTORS**  
Power Metal Strip<sup>®</sup> SMD Resistors, 4-Terminal, Low Values (Down to 0.0001 Ω)  
**WSK1216**

**FILM CAPACITORS**  
DC-Link Polyester Film Capacitors, Operating Temperature Up to 150 °C, High Ripple Current  
**MKT1820S**  
- Low voltage DC-link capacitors with high-temperature capabilities  
- Customized solutions for 48 V applications

**FILM CAPACITORS**  
SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR  
**260 CLA-V**  
- High ripple current up to 1400 mA at 150 °C, capacitance up to 3300 µF  
- Useful life up to 2000 h at 150 °C, high vibration capability

**CERAMIC CAPACITORS**  
X1/Y2 AC Line Rated Ceramic Disc Capacitors for Automotive Applications  
**AY2**  
- AEC-Q200 qualified, X1/Y2 safety rating according to IEC 60384-14, 3rd edition  
- Proven to withstand 3000 temperature cycles from -55 °C to +125 °C
### Automotive HVAC

**E-Compressor for 48 V<sub>DC</sub>**

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<tr>
<td><strong>CAPACITORS MLCC</strong></td>
<td>AEC-Q200 Qualified, Broad Range of Sizes and Working Voltages, C0G (NPO), X7R, and X8R</td>
</tr>
<tr>
<td><strong>VJ…31X RoHS Automotive MLCCs</strong></td>
<td>• RoHS and Green compliant parts available</td>
</tr>
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<td>• AgPd termination available for epoxy bonding</td>
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<td>• Ultra-low R&lt;sub&gt;DS(on)&lt;/sub&gt; thermally enhanced package reduces board area</td>
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<td><strong>INDUCTORS</strong></td>
<td>Shielded EMI Filters Up to 190 A&lt;sub&gt;i&lt;sub&gt;peak&lt;/sub&gt;&lt;/sub&gt;, 2.2µH, Ultra-Low DCR (0.22 mΩ)</td>
</tr>
<tr>
<td><strong>IHLP-8787MZ-5A</strong></td>
<td>• Very high-current and high-temperature operation for filters and energy storage</td>
</tr>
<tr>
<td><strong>ALUMINUM CAPACITORS</strong></td>
<td>SMD Aluminum Capacitors, High Temperature Up to 150 °C, Low ESR</td>
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Visit [www.vishay.com](http://www.vishay.com) for more information.
Key components for FULL HYBRID VEHICLES (HEVs)

THE VISHAY ADVANTAGE
AEC Qualifications
High-Temperature Performance
High Reliability
New High-Voltage Passive Components in SMD Packages
High-Voltage Semiconductors
Transient-Voltage Capabilities
**Electrical Motor Drives (DC/AC)**

**CERAMIC CAPACITORS**

High Operating Temperature, Automotive Grade Leaded MLCC Capacitors

**HOTcap® K…H, A…R, K…R**
- High-reliability MLCC insert with wet build process
- High operating temperature (up to 175 °C for K…H and up to 160 °C for A…R and K…R), rated voltages: 50 V, 100 V, 200 V

**RESISTORS**

High-Voltage Thin Film Flat Chip Resistors, Up to 1 kV

**TNPV1210 e3**
- 0.1 %, 0.5 %, and 1 % tolerances
- Excellent stability |ΔR/R| ≤ 0.05 % after 1000 h at 70 °C

**RECTIFIERS**

600 V, 30 A Hyperfast Rectifiers

**VS-ETH3006SHM3**
- TO-263AB (D²PAK) power package optimized for fast battery charging systems and main inverter applications up to 20 kW

**RESISTORS**

Surface-Mount Molded Dividers, High-Voltage

**CDMx**
- High voltage up to 3000 V, sulfur-resistant
- Automotive compliant terminations, wide range of resistance values and ratios
*Preliminary

**INDUCTORS**

EMI Filters with Flat Copper Wire as SMD or Leaded Up to 260 A

**Customized EMI Filters**
- Customized solutions for 48 V applications, low DCR, high current

**MODULES**

Trench FS IGBT Modules

**VS-GC30C065TB**
- Optimized for use with FRED® Pt® Gen 4 ultrafast diodes
- Low collector-to-emitter voltages, extremely low conduction losses

**FILM CAPACITORS**

High-Performance DC-Link Capacitors for Automotive Traction Applications (EV/HEV)

**MKP1849**
- High voltage, high capacitance, high ripple current
- Customized upon request

**FILM CAPACITORS**

Metallized Polypropylene DC-Link Film Capacitors, 450 VDC to 1200 VDC

**MKP1848**
- OBC and HEV inverter DC link
- High ripple current, capacitance up to 400 µF

www.vishay.com
Key components for
FULL ELECTRIC VEHICLES (FEVs)

THE VISHAY ADVANTAGE
AEC Qualifications
High-Temperature Performance
High Reliability
New High-Voltage Passive Components in SMD Packages
High-Voltage Semiconductors
Transient-Voltage Capabilities

Electric Motor Drives (DC/AC)
Battery Management and DC/DC
On-Board Chargers
# Automotive

## FULL ELECTRIC VEHICLES (FEVs)

### Electric Motor Drives (DC/AC)

<table>
<thead>
<tr>
<th>CERAMIC CAPACITORS</th>
<th>RESISTORS</th>
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<td>IGBR</td>
</tr>
<tr>
<td>• High-reliability MLCC insert with wet build process</td>
<td>• High voltage up to 3000 V, sulfur-resistant</td>
<td>• Back-contact resistors for single wirebond assembly with power ratings up to 4 W</td>
</tr>
<tr>
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<td>• Automotive compliant terminations, wide range of resistance values and ratios</td>
<td>• Available case sizes from 0202 to 2010</td>
</tr>
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<table>
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<tr>
<th>NON-LINEAR RESISTORS</th>
<th>INDUCTORS</th>
<th>FILM CAPACITORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTC Thermistors, Low Thermal Gradient Lug Sensors</td>
<td>EMI Filters with Flat Copper Wire as SMD or Leaded Up to 260 A</td>
<td>Metallized Polypropylene DC-Link Film Capacitors, 450 Vdc to 1000 Vdc</td>
</tr>
<tr>
<td>NTCALUG02A</td>
<td>Customized EMI Filters</td>
<td>MKP1848S</td>
</tr>
<tr>
<td>• Low thermal gradient surface temperature sensor</td>
<td>• Customized solutions for 48 V applications, low DCR, high current</td>
<td>• OBC and HEV inverter DC link</td>
</tr>
<tr>
<td>• High insulation voltage</td>
<td></td>
<td>• High ripple current and high capacitance up to 100 µF</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>MODULES</th>
<th>FILM CAPACITORS</th>
<th>RECTIFIERS</th>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

www.vishay.com
## Battery Management and DC/DC

### Ceramic Capacitors
- **X1/Y2 AC Line Rated Ceramic Disc Capacitors for Automotive Applications**
  - **AY2**
    - AEC-Q200 qualified, X1/Y2 safety rating according to IEC 60384-14, 3rd edition
    - Proven to withstand 3000 temperature cycles from -55 °C to +125 °C

### Resistors
- **Long-Side Termination Thick Film Resistors, 250 mW to 2 W in 0406 to 1225 sizes, 1 Ω - 1 mΩ**
  - RCL_e3
    - Operating temperature up to 155 °C, TCR = 100 ppm/K to 200 ppm/K
- **Thin Film Chip Resistors, Resistance = 1 Ω to 10 mΩ, TCR = 25 ppm/K to 50 ppm/K**
  - MCT 0603 AT
    - Tolerance = 0.5 % to 1 %
    - Power rating 125 mW
- **Power Metal Strip® Battery Shunt Resistors, Very Low Values (100 μΩ, 125 μΩ, and 250 μΩ)**
  - WSBS8518
    - High power to resistor size ratio
    - Low thermal EMF, < 3 μV / °C, for accurate current sensing

### MOSFETs
- **Dual N-Channel MOSFETs in 5 mm x 6 mm PowerPAK SO-8L, 40 V, 33 mΩ**
  - SQJ946EP
    - AEC-Q101 qualified, 100 % UIS and RG tested with up to 175 °C operation
    - Optimized for high-frequency DC/DC applications, lower switching losses

### Resistors
- **High Pulse Load Carbon Film MELF Resistors, Pulse Handling Up to 3 kW, ESD Up to 16 kV**
  - CMB 0207
    - 1.0 W rated dissipation in MELF 0207 package
    - Resistance from 2.2 Ω to 1.5 MΩ
- **SMD Power Resistors, 35 W, 10 mΩ to 550 KΩ, Non-Inductive**
  - D2TO35
    - TO-263 package, TCR = 150 ppm/K
    - AEC-Q200 qualified

### Diodes
- **400 W PAR® TVS Diodes, Voltage = 6.8 V to 43 V, Tj = 185 °C**
  - TPSMA6.8
    - DO-214AC (SMA) package to protect ICs, MOSFETs, and signal lines of sensor units against voltage transients induced by inductive load switching and lightning
- **NTC Thermistors, Mini Lug Sensors**
  - NTCA Lug03
    - Robust surface temperature sensors
    - AEC-Q200 compliant, UL recognized

### Zener Diodes
- **500 mW Zener diodes in < 0.6 mm low-profile MicroSMF package**
  - PLZ Series Zener Diode
    - Excellent stability for voltage stabilization and reference voltage generation
    - AEC-Q101 qualified versions available
## On-Board Chargers

### CERAMIC CAPACITORS

**X1/Y2 AC Line Rated Ceramic Disc Capacitors for Automotive Applications**

- AEC-Q200 qualified, X1/Y2 safety rating according to IEC 60384-14, 3rd edition
- Proven to withstand 3000 temperature cycles from -55 °C to +125 °C

**AY2**

### RESISTORS

**Power Resistors, 100 W, 15 mΩ to 1 MΩ, Non-Inductive**

- TO-247 package, TCR = 150 ppm/K
- AEC-Q200 qualified

**LTO100**

### RECTIFIERS

**15 A, 1200 V FRED Pt Hyperfast Rectifiers**

- AEC-Q101 qualified, hyperfast and soft recovery time with reduced Qr in TO-220AC package
- 175 °C maximum operating temperature

**VS-15ETU12HN3**

### NON-LINEAR RESISTORS

**Wirebondable Gate Resistor for IGBT Applications**

- Back-contact resistors for single wirebond assembly with power rating up to 4 W
- Available case sizes from 0202 to 2010

**IGBR**

### INDUCTORS

**High Isolation as Press-Fit or SMD Version Flyback Transformers**

**Customized Transformers**

- Customized solutions up to kW ranges

### RESISTORS

**High Pulse Load Carbon Film MELF Resistors, Pulse Handling Up to 3 kW, ESD Up to 16 kV**

- 1.0 W rated dissipation in MELF 0207 package
- Resistance from 2.2 Ω to 1.5 MΩ

**CMB 0207**

### TRANSFORMERS

**1 kW to 3 kW Standard Power Planar Transformers and Custom Power Planar Inductors**

**Planar Series**

- Planar and flat wire designs available for improved efficiency

### MICROCONTROLLERS

**Press-Fit Semiconductor Power Modules for IGBT or MOSFET Drives**

**EMIPAK-1B / 2B**

- 600 V to 650 V, or lower voltages upon customer request

### FILM CAPACITORS

**Interference Suppression Film Capacitors, MKP Radial Potted Type**

**MKP339**

- RFI X2 capacitor for standard across-the-line applications
- Automotive grade, AEC-Q200 compliant
Spotlight on MELF Resistors
The World’s Most Reliable and Predictable High-Performance Film Resistors

For more than 25 years, Vishay’s MELF resistors have successfully met the demanding requirements of the automotive industry. They offer superior SMD resistor performance in terms of accuracy, stability, reliability, and pulse load capability. The cylindrical construction of MELF devices provides an optimal power rating and pulse load capability relative to the mounting space. Continuous development has led to improved long-term stability and moisture resistance, and enables high-temperature operation to +175 °C.

KEY PERFORMANCE BENEFITS:
• Predictable behavior of components
• Zero-defect philosophy
• Ideal for harsh operating environments
• Long-term stability
• Moisture resistance
• Operating voltage up to 1 kV for MM_HV series
• Temperature cycling (up to 2000 cycles) in lead (Pb)-free assembly processes
• Insulation voltage up to 500 V

APPROVALS
• EN 140401-803
• AEC-Q200

All products are completely lead (Pb)-free and comply with the Global Automotive Declarable Substances List (GADSL), which includes full compliance with the RoHS directive.

TEMPERATURE COEFFICIENT, TOLERANCE, AND STABILITY
Resistor temperature coefficients down to ± 5 ppm/K are available, as well as tolerances down ± 0.02 %. Long-term stability results in a superior maximum resistance change (ΔR/R) of < ± 0.05 % after 8000 h operation for high-precision MELF resistors.

PULSE LOAD CAPABILITY
Another aspect of MELF resistors is their reliability when exposed to various overload conditions. The metal film technology, together with the cylindrical construction of the MELF devices, provides an advantage compared to standard thick and thin film chip resistors in regard to pulse load capability. MELF resistors are also available in advanced carbon film technology, offering up to 6 kV ESD capability on the 1206 pad size, or 10 kV surge handling on the 2512 pad size. As shown in the diagram below, thick film flat chip resistors fail at much lower pulse loads than thin film flat chips, and both types are outperformed by thin film and carbon film MELF resistors.

For technical questions, contact: melf@vishay.com

![Typical Destructive Pulse Load Limit](image-url)