Dual 1 Form A Solid-State Relay (Normally Open)

**DESCRIPTION**

The VOR2121 is a 250 V dual channel normally open optically isolated solid-state relay (SPST - 1 form A). Based on hybrid architecture which allows fast switching times with a wide operating ambient temperature range. A high efficient GaAlAs IRED enables low forward current on the input side. On the output side high performance MOSFET switches provide a low $R_{ON}$ and can switch both DC and AC signals.

**FEATURES**

- Isolation test voltage 5300 $V_{RMS}$
- Typical $R_{ON}$ 12 $\Omega$
- Load voltage 250 V
- Load current 200 mA / 140 mA
- Clean bounce free switching
- Low power consumption
- Wide temperature range

**APPLICATIONS**

- General telecom switching
- Metering
- Security equipment
- Instrumentation
- Industrial controls
- Battery management systems
- Automatic test equipment

**AGENCY APPROVALS**

- UL 1577
- cUL
- DIN EN 60747-5-5 (VDE 0884-5)

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>PART NUMBER</th>
<th>PACKAGE CONFIGURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD-8, tape and reel</td>
<td>VOR2121B8T</td>
<td>UL, cUL, VDE</td>
</tr>
<tr>
<td>SMD-8, tube</td>
<td>VOR2121B8</td>
<td></td>
</tr>
<tr>
<td>DIP-8, tube</td>
<td>VOR2121A8</td>
<td></td>
</tr>
</tbody>
</table>

For technical questions, contact: optocoupleranswers@vishay.com

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## ABSOLUTE MAXIMUM RATINGS  
(T<sub>amb</sub> = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRED continuous forward current</td>
<td></td>
<td>I&lt;sub&gt;F&lt;/sub&gt;</td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td>IRED reverse voltage</td>
<td></td>
<td>V&lt;sub&gt;R&lt;/sub&gt;</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Input power dissipation</td>
<td></td>
<td>P&lt;sub&gt;diss&lt;/sub&gt;</td>
<td>80</td>
<td>mW</td>
</tr>
<tr>
<td>Junction temperature</td>
<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt;</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>OUTPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC or peak AC load voltage</td>
<td></td>
<td>V&lt;sub&gt;L&lt;/sub&gt;</td>
<td>250</td>
<td>V</td>
</tr>
<tr>
<td>Continuous DC load current at 25 °C, one channel</td>
<td></td>
<td>I&lt;sub&gt;L&lt;/sub&gt;</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>Continuous DC load current at 25 °C, two channels</td>
<td></td>
<td>I&lt;sub&gt;L&lt;/sub&gt;</td>
<td>140</td>
<td>mA</td>
</tr>
<tr>
<td>SSR output power dissipation</td>
<td></td>
<td>P&lt;sub&gt;diss&lt;/sub&gt;</td>
<td>550</td>
<td>mW</td>
</tr>
<tr>
<td>Junction temperature</td>
<td></td>
<td>T&lt;sub&gt;j&lt;/sub&gt;</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>SSR</td>
<td></td>
<td>T&lt;sub&gt;amb&lt;/sub&gt;</td>
<td>-40 to +100</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td></td>
<td>T&lt;sub&gt;stg&lt;/sub&gt;</td>
<td>-40 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering temperature</td>
<td>t = 10 s max.</td>
<td>T&lt;sub&gt;sld&lt;/sub&gt;</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Note**
- Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

## ELECTRICAL CHARACTERISTICS  
(T<sub>amb</sub> = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT</td>
<td>IRED forward current, switch turn-on</td>
<td>I&lt;sub&gt;on&lt;/sub&gt;</td>
<td>-</td>
<td>0.4</td>
<td>2</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>IRED forward current, switch turn-off</td>
<td>I&lt;sub&gt;off&lt;/sub&gt;</td>
<td>0.05</td>
<td>0.35</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>IRED reverse voltage</td>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
<td>-</td>
<td>1.4</td>
<td>1.6</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>I&lt;sub&gt;R&lt;/sub&gt;</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>μA</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>On-resistance</td>
<td>R&lt;sub&gt;ON&lt;/sub&gt;</td>
<td>-</td>
<td>12</td>
<td>15</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td>Off-resistance</td>
<td>R&lt;sub&gt;OFF&lt;/sub&gt;</td>
<td>1.0</td>
<td>5000</td>
<td>-</td>
<td>GΩ</td>
</tr>
<tr>
<td></td>
<td>Off-state leakage current</td>
<td>I&lt;sub&gt;O&lt;/sub&gt;</td>
<td>-</td>
<td>&lt; 1</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td>Output capacitance pin 3 to 4</td>
<td>C&lt;sub&gt;O&lt;/sub&gt;</td>
<td>-</td>
<td>39</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 0 mA, V&lt;sub&gt;L&lt;/sub&gt; = 1 V, 1 MHz</td>
<td></td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td>TRANSFER</td>
<td>Capacitance (input to output)</td>
<td>V&lt;sub&gt;ID&lt;/sub&gt; = 1 V</td>
<td>C&lt;sub&gt;ID&lt;/sub&gt;</td>
<td>-</td>
<td>0.4</td>
<td>-</td>
</tr>
</tbody>
</table>

**Note**
- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information only and are not part of the testing requirements.

## SWITCHING CHARACTERISTICS  
(T<sub>amb</sub> = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn-on time</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 5 mA, I&lt;sub&gt;L&lt;/sub&gt; = 50 mA</td>
<td>t&lt;sub&gt;on&lt;/sub&gt;</td>
<td>-</td>
<td>0.20</td>
<td>0.5</td>
<td>ms</td>
</tr>
<tr>
<td>Turn-off time</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 5 mA, I&lt;sub&gt;L&lt;/sub&gt; = 50 mA</td>
<td>t&lt;sub&gt;off&lt;/sub&gt;</td>
<td>-</td>
<td>0.03</td>
<td>0.2</td>
<td>ms</td>
</tr>
</tbody>
</table>

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**SAFETY AND INSULATION RATINGS**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climatic classification</td>
<td>According to IEC 68 part 1</td>
<td></td>
<td>40 / 100 / 21</td>
<td></td>
</tr>
<tr>
<td>Pollution degree</td>
<td>According to DIN VDE 0109</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Comparative tracking index</td>
<td>Insulation group IIIa</td>
<td>CTI</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>Maximum rated withstanding isolation voltage</td>
<td>According to UL1577, t = 1 min</td>
<td>VISO</td>
<td>5300</td>
<td>Vrms</td>
</tr>
<tr>
<td>Maximum transient isolation voltage</td>
<td>According to DIN EN 60747-5-5</td>
<td>VIORM</td>
<td>890</td>
<td>Vpeak</td>
</tr>
<tr>
<td>Maximum repetitive peak isolation voltage</td>
<td>According to DIN EN 60747-5-5</td>
<td>VIORM</td>
<td>890</td>
<td>Vpeak</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>One channel</td>
<td>RIO</td>
<td>≥ 10^12</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td>Two channels</td>
<td>PSI0</td>
<td>640</td>
<td>mW</td>
</tr>
<tr>
<td>Output safety power</td>
<td>One channel</td>
<td>PSI0</td>
<td>640</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>Two channels</td>
<td>PSI0</td>
<td>640</td>
<td>mW</td>
</tr>
<tr>
<td>Safety temperature</td>
<td>One channel</td>
<td>PSI0</td>
<td>640</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>Two channels</td>
<td>PSI0</td>
<td>640</td>
<td>mW</td>
</tr>
<tr>
<td>Safety temperature</td>
<td>T_s</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td>Creepage distance</td>
<td>DIP-8</td>
<td></td>
<td>≥ 7</td>
<td>mm</td>
</tr>
<tr>
<td>Clearance distance</td>
<td>SMD-8</td>
<td></td>
<td>≥ 7</td>
<td>mm</td>
</tr>
<tr>
<td>Creepage distance</td>
<td>SMD-8</td>
<td>DTI</td>
<td>≥ 0.4</td>
<td>mm</td>
</tr>
<tr>
<td>Clearance distance</td>
<td>SMD-8</td>
<td>DTI</td>
<td>≥ 0.4</td>
<td>mm</td>
</tr>
<tr>
<td>Insulation thickness</td>
<td>DTI</td>
<td>≥ 0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input to output test voltage, method B</td>
<td>VORM x 1.875 = VPR, 100% production test with t_M = 1 s, partial discharge &lt; 5 pC</td>
<td>VPR</td>
<td>1669</td>
<td>Vpeak</td>
</tr>
<tr>
<td>Input to output test voltage, method A</td>
<td>VORM x 1.6 = VPR, 100% production test with t_M = 10 s, partial discharge &lt; 5 pC</td>
<td>VPR</td>
<td>1424</td>
<td>Vpeak</td>
</tr>
</tbody>
</table>

**Note**
- As per IEC 60747-5-5, § 7.4.3.8.2, this optocoupler is suitable for “safe electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

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Fig. 1 - Timing Schematic

Fig. 2 - Output Safety Power vs. Ambient Temperature

Fig. 3 - Input Safety Current vs. Ambient Temperature
**TYPICAL CHARACTERISTICS** (T\textsubscript{amb} = 25 °C, unless otherwise specified)

![Fig. 4 - Load Current vs. Ambient Temperature](image1)

![Fig. 5 - Forward Voltage vs. Ambient Temperature](image2)

![Fig. 6 - Forward Current vs. Forward Voltage](image3)

![Fig. 7 - Normalized Forward Current vs. Ambient Temperature](image4)

![Fig. 8 - Normalized On-Resistance vs. Ambient Temperature](image5)

![Fig. 9 - Switch Capacitance vs. Load Voltage](image6)
Fig. 10 - Leakage Current vs. Load Voltage

Fig. 11 - Normalized Turn-On Time vs. Ambient Temperature

Fig. 12 - Normalized Turn-Off Time vs. Ambient Temperature

Fig. 13 - Turn-On Time vs. Forward Current

Fig. 14 - Turn-Off Time vs. Forward Current
PACKAGE MARKING (example)

![Package Marking Diagram](Image)

**Notes**
- XXXX = LMC (lot marking code)
- Tape and reel suffix (TR) is not part of the package marking

PACKING INFORMATION (in millimeters)

![Packing Information Diagram](Image)

<table>
<thead>
<tr>
<th>TAPE AND REEL PACKING</th>
<th>UNITS/REEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD-8</td>
<td>1000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TUBE PACKING</th>
<th>UNITS/TUBE</th>
<th>TUBES/BOX</th>
<th>UNITS/BOX</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD-8</td>
<td>50</td>
<td>40</td>
<td>2000</td>
</tr>
<tr>
<td>DIP-8</td>
<td>50</td>
<td>40</td>
<td>2000</td>
</tr>
</tbody>
</table>
SOLDER PROFILES

Fig. 17 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD Devices

Fig. 18 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP Devices

HANDLING AND STORAGE CONDITIONS
ESD level: HBM class 2
Floor life: unlimited
Conditions: T_{amb} < 30 °C, RH < 85 %
Moisture sensitivity level 1, according to J-STD-020
### Footprint and Schematic Information for VOR2121

The footprint and schematic symbols for the following parts can be accessed using the associated links. They are available in Eagle, Altium, KiCad, OrCAD / Allegro, Pulsionix, and PADS.

Note that the 3D models for these parts can be found on the Vishay product page.

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>FOOTPRINT / SCHEMATIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOR2121B8T</td>
<td><a href="www.snapeda.com/parts/VOR2121B8T/Vishay/view-part">www.snapeda.com/parts/VOR2121B8T/Vishay/view-part</a></td>
</tr>
</tbody>
</table>

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