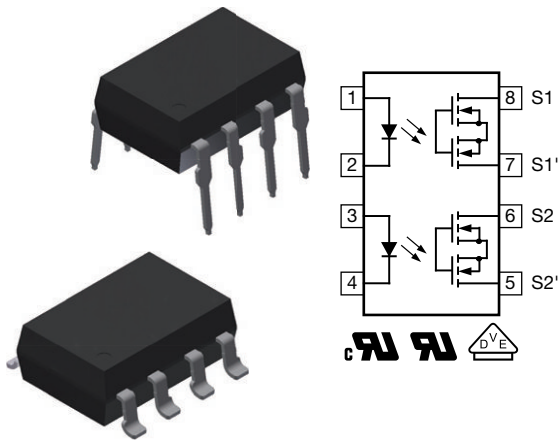


## Dual 1 Form A Solid-State Relay (Normally Open)



### FEATURES

- Isolation test voltage 5300 V<sub>RMS</sub>
- Typical R<sub>ON</sub> 12 Ω
- Load voltage 250 V
- Load current 200 mA / 140 mA
- Clean bounce free switching
- Low power consumption
- Wide temperature range
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

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

### LINKS TO ADDITIONAL RESOURCES



### 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<sub>ON</sub> and can switch both DC and AC signals.

### AGENCY APPROVALS

- [UL 1577](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\)](#)

| ORDERING INFORMATION   |              |
|--|--------------|
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px 5px;">V</div> <div style="border: 1px solid black; padding: 2px 5px;">O</div> <div style="border: 1px solid black; padding: 2px 5px;">R</div> <div style="border: 1px solid black; padding: 2px 5px;">2</div> <div style="border: 1px solid black; padding: 2px 5px;">1</div> <div style="border: 1px solid black; padding: 2px 5px;">2</div> <div style="border: 1px solid black; padding: 2px 5px;">1</div> </div> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">8</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> </div> <div style="text-align: center; margin-left: 20px;"> </div> </div> <p style="text-align: center; margin-top: 5px;">PART NUMBER                      PACKAGE CONFIGURATION</p> |              |
| PACKAGE  | UL, cUL, VDE |
| SMD-8, tape and reel   | VOR2121B8T   |
| SMD-8, tube  | VOR2121B8    |
| DIP-8, tube  | VOR2121A8    |



| ABSOLUTE MAXIMUM RATINGS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                        |            |             |                    |
|---|------------------------|------------|-------------|--------------------|
| PARAMETER   | CONDITION              | SYMBOL     | VALUE       | UNIT               |
| <b>INPUT</b>  |                        |            |             |                    |
| IRED continuous forward current   |                        | $I_F$      | 50          | mA                 |
| IRED reverse voltage  |                        | $V_R$      | 5           | V                  |
| Input power dissipation   |                        | $P_{diss}$ | 80          | mW                 |
| Junction temperature  |                        | $T_j$      | 125         | $^{\circ}\text{C}$ |
| <b>OUTPUT</b>   |                        |            |             |                    |
| DC or peak AC load voltage  |                        | $V_L$      | 250         | V                  |
| Continuous DC load current at 25 $^{\circ}\text{C}$ , one channel                               |                        | $I_L$      | 200         | mA                 |
| Continuous DC load current at 25 $^{\circ}\text{C}$ , two channels                              |                        | $I_L$      | 140         | mA                 |
| SSR output power dissipation  |                        | $P_{diss}$ | 550         | mW                 |
| Junction temperature  |                        | $T_j$      | 125         | $^{\circ}\text{C}$ |
| <b>SSR</b>  |                        |            |             |                    |
| Ambient temperature range   |                        | $T_{amb}$  | -40 to +100 | $^{\circ}\text{C}$ |
| Storage temperature range   |                        | $T_{stg}$  | -40 to +150 | $^{\circ}\text{C}$ |
| Soldering temperature   | $t = 10\text{ s max.}$ | $T_{sld}$  | 260         | $^{\circ}\text{C}$ |

**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 ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |   |            |      |      |      |                  |
|---|---|------------|------|------|------|------------------|
| PARAMETER   | TEST CONDITION                                    | SYMBOL     | MIN. | TYP. | MAX. | UNIT             |
| <b>INPUT</b>  |   |            |      |      |      |                  |
| IRED forward current, switch turn-on  | $I_L = 100\text{ mA}$ , $t = 10\text{ ms}$        | $I_{Fon}$  | -    | 0.4  | 2    | mA               |
| IRED forward current, switch turn-off   | $V_L = \pm 200\text{ V}$                          | $I_{Foff}$ | 0.05 | 0.35 | -    | mA               |
| IRED forward voltage  | $I_F = 10\text{ mA}$                              | $V_F$      | -    | 1.4  | 1.6  | V                |
| IRED reverse current  | $V_R = 5\text{ V}$                                | $I_R$      | -    | -    | 10   | $\mu\text{A}$    |
| <b>OUTPUT</b>   |   |            |      |      |      |                  |
| On-resistance   | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$        | $R_{ON}$   | -    | 12   | 15   | $\Omega$         |
| Off-resistance  | $I_F = 0\text{ mA}$ , $V_L = \pm 100\text{ V}$    | $R_{OFF}$  | 1.0  | 5000 | -    | $\text{G}\Omega$ |
| Off-state leakage current   | $I_F = 0\text{ mA}$ , $V_L = \pm 100\text{ V}$    | $I_O$      | -    | < 1  | 100  | nA               |
|   | $I_F = 0\text{ mA}$ , $V_L = \pm 200\text{ V}$    | $I_O$      | -    | < 1  | 500  | nA               |
| Output capacitance pin 3 to 4   | $I_F = 0\text{ mA}$ , $V_L = 1\text{ V}$ , 1 MHz  | $C_O$      | -    | 39   | -    | pF               |
|   | $I_F = 0\text{ mA}$ , $V_L = 50\text{ V}$ , 1 MHz | $C_O$      | -    | 6    | -    | pF               |
| <b>TRANSFER</b>   |   |            |      |      |      |                  |
| Capacitance (input to output)   | $V_{IO} = 1\text{ V}$                             | $C_{IO}$   | -    | 0.4  | -    | pF               |

**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 ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |           |      |      |      |      |
|--|--|-----------|------|------|------|------|
| PARAMETER  | TEST CONDITION                             | SYMBOL    | MIN. | TYP. | MAX. | UNIT |
| Turn-on time   | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$ | $t_{on}$  | -    | 0.20 | 0.5  | ms   |
| Turn-off time  | $I_F = 5\text{ mA}$ , $I_L = 50\text{ mA}$ | $t_{off}$ | -    | 0.03 | 0.2  | ms   |

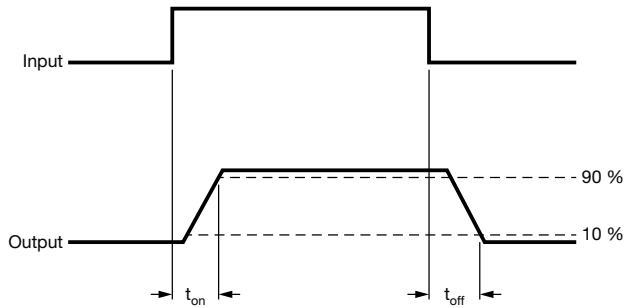
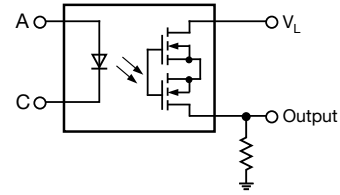


Fig. 1 - Timing Schematic



| SAFETY AND INSULATION RATINGS                |  |            |                |                    |
|--|--|------------|----------------|--------------------|
| PARAMETER                                    | CONDITION  | SYMBOL     | VALUE          | UNIT               |
| Climatic classification                      | According to IEC 68 part 1   |            | 40 / 100 / 21  |                    |
| Pollution degree                             | According to DIN VDE 0109  |            | 2              |                    |
| Comparative tracking index                   | Insulation group IIIa  | CTI        | 175            |                    |
| Maximum rated withstanding isolation voltage | According to UL1577, t = 1 min   | $V_{ISO}$  | 5300           | $V_{RMS}$          |
| Maximum transient isolation voltage          | According to DIN EN 60747-5-5  | $V_{IOTM}$ | 8000           | $V_{peak}$         |
| Maximum repetitive peak isolation voltage    | According to DIN EN 60747-5-5  | $V_{IORM}$ | 890            | $V_{peak}$         |
| Insulation resistance                        | $V_{IO} = 500\text{ V}, T_{amb} = 25\text{ }^{\circ}\text{C}$  | $R_{IO}$   | $\geq 10^{12}$ | $\Omega$           |
|  | $V_{IO} = 500\text{ V}, T_{amb} = 100\text{ }^{\circ}\text{C}$   | $R_{IO}$   | $\geq 10^{11}$ | $\Omega$           |
| Output safety power                          | One channel  | $P_{SO}$   | 640            | mW                 |
|  | Two channels   |            | 480            |                    |
| Input safety current                         | One channel  | $I_{SI}$   | 240            | mA                 |
|  | Two channels   |            | 200            |                    |
| Safety temperature                           |  | $T_S$      | 175            | $^{\circ}\text{C}$ |
| Creepage distance                            | DIP-8  |            | $\geq 7$       | mm                 |
| Clearance distance                           |  |            | $\geq 7$       | mm                 |
| Creepage distance                            | SMD-8  |            | $\geq 8$       | mm                 |
| Clearance distance                           |  |            | $\geq 8$       | mm                 |
| Insulation thickness                         |  | DTI        | $\geq 0.4$     | mm                 |
| Input to output test voltage, method B       | $V_{IORM} \times 1.875 = V_{PR}$ , 100 % production test with $t_M = 1\text{ s}$ , partial discharge $< 5\text{ pC}$ | $V_{PR}$   | 1669           | $V_{peak}$         |
| Input to output test voltage, method A       | $V_{IORM} \times 1.6 = V_{PR}$ , 100 % sample test with $t_M = 10\text{ s}$ , partial discharge $< 5\text{ pC}$      | $V_{PR}$   | 1424           | $V_{peak}$         |

**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

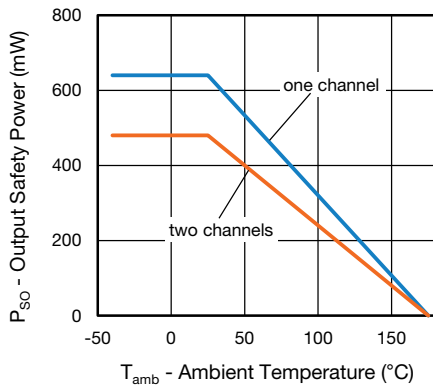


Fig. 2 - Output Safety Power vs. Ambient Temperature

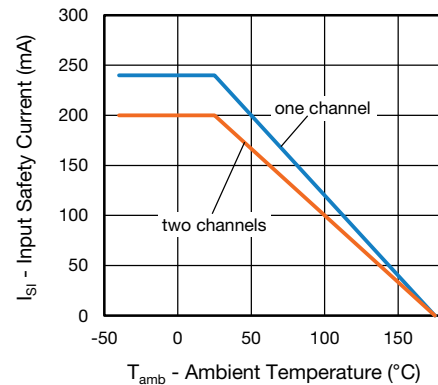


Fig. 3 - Input Safety Current vs. Ambient Temperature

## TYPICAL CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

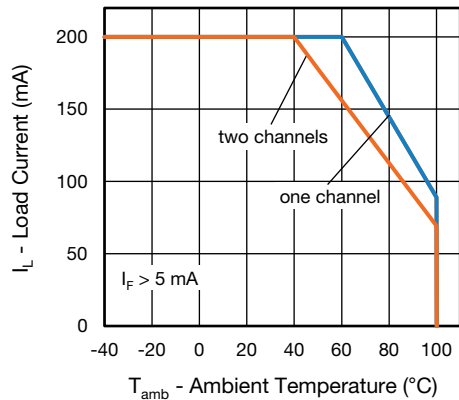


Fig. 4 - Load Current vs. Ambient Temperature

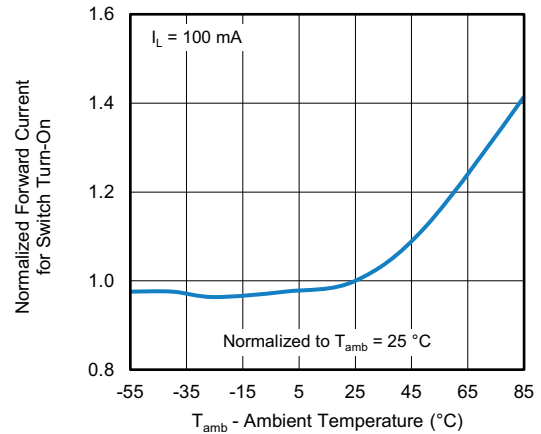


Fig. 7 - Normalized Forward Current vs. Ambient Temperature

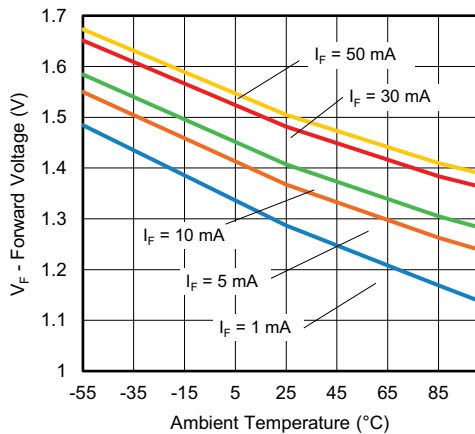


Fig. 5 - Forward Voltage vs. Ambient Temperature

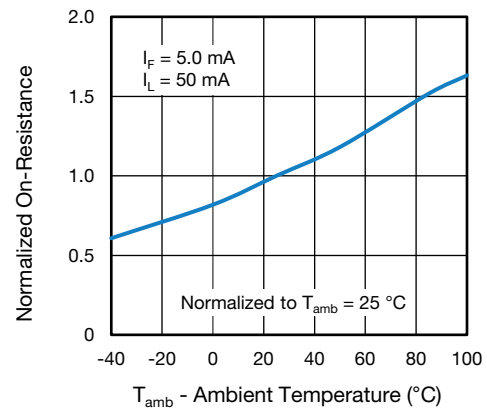


Fig. 8 - Normalized On-Resistance vs. Ambient Temperature

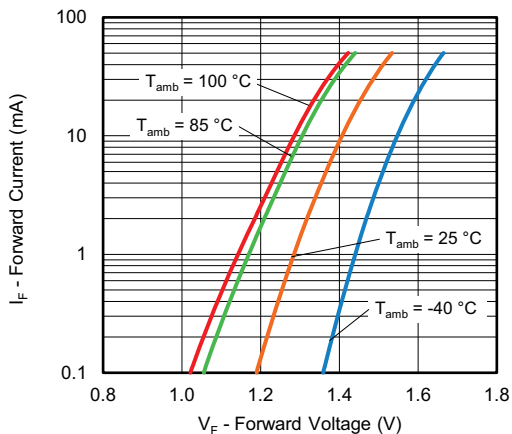


Fig. 6 - Forward Current vs. Forward Voltage

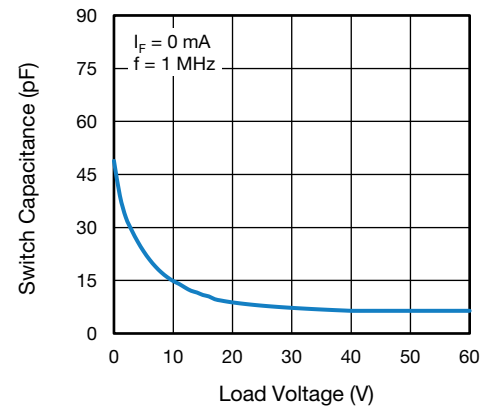


Fig. 9 - Switch Capacitance vs. Load Voltage

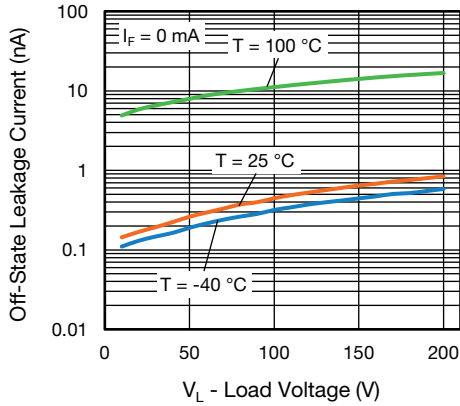


Fig. 10 - Leakage Current vs. Load Voltage

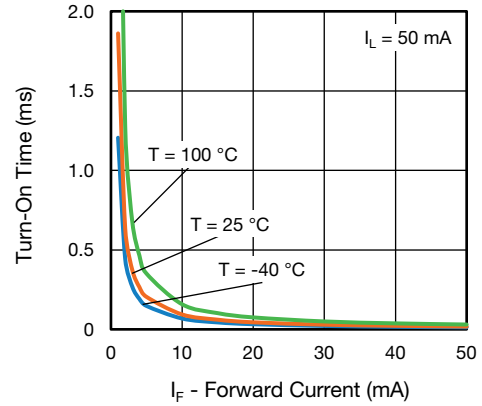


Fig. 13 - Turn-On Time vs. Forward Current

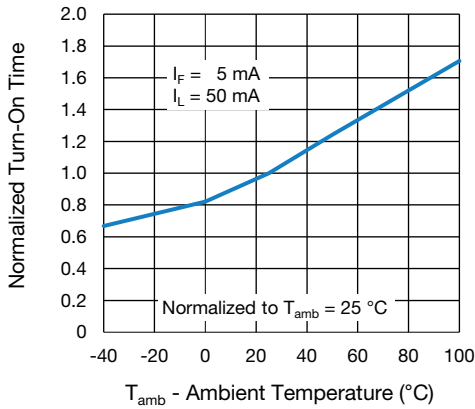


Fig. 11 - Normalized Turn-On Time vs. Ambient Temperature

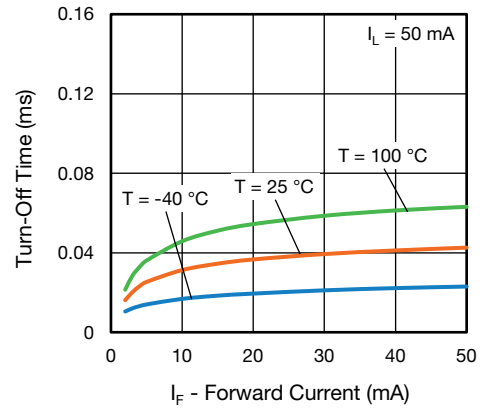


Fig. 14 - Turn-Off Time vs. Forward Current

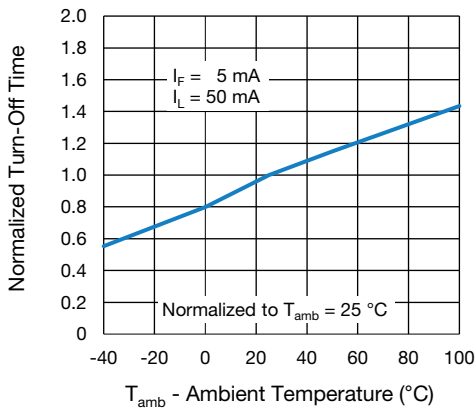
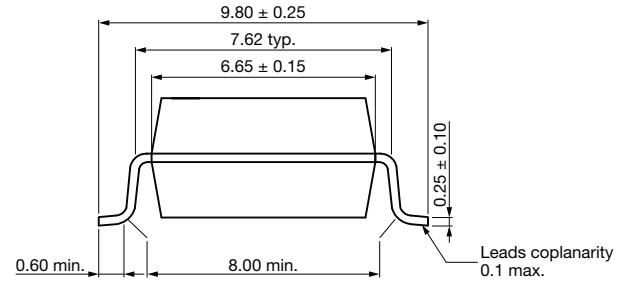
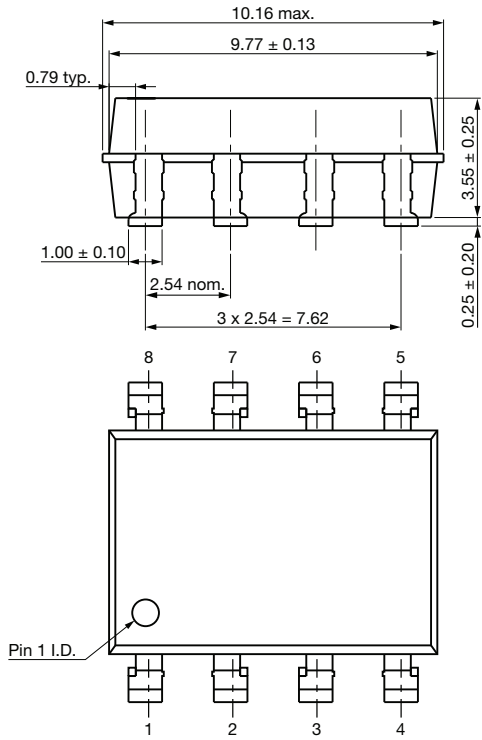


Fig. 12 - Normalized Turn-Off Time vs. Ambient Temperature

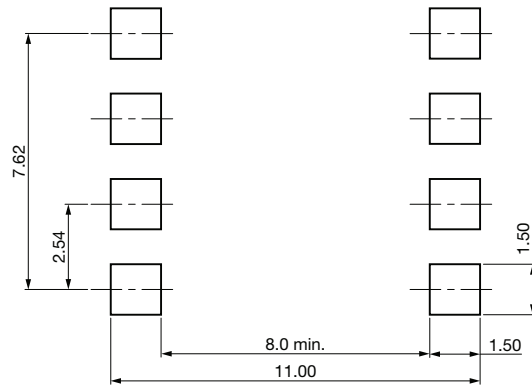


## PACKAGE DIMENSIONS in millimeters

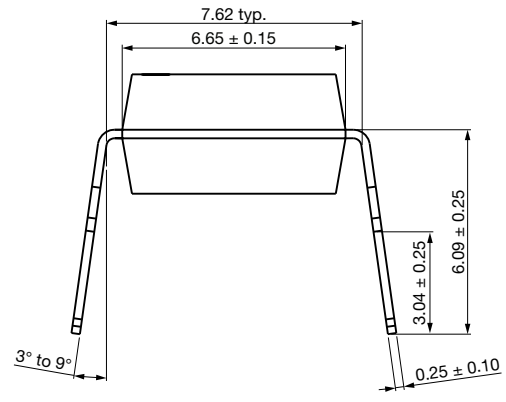
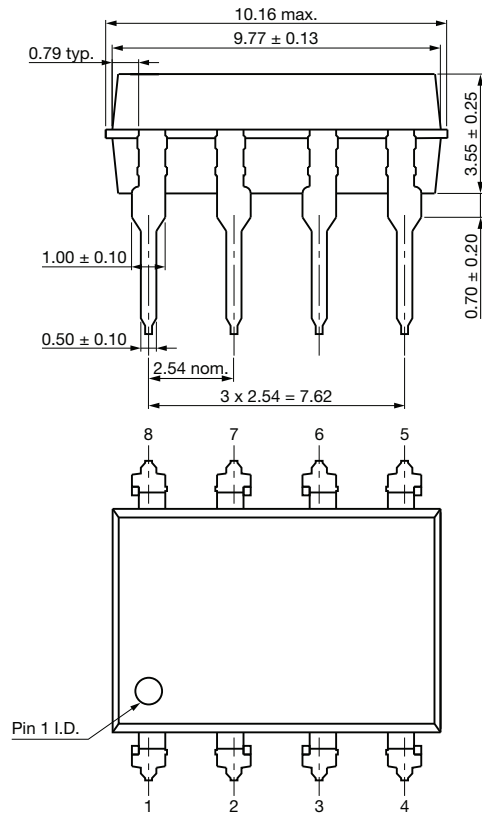
### SMD-8



### Recommended footprint



### DIP-8





**PACKAGE MARKING** (example)

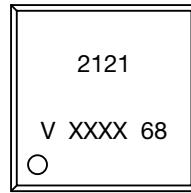


Fig. 15 - VOR2121

**Notes**

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

**PACKING INFORMATION** (in millimeters)

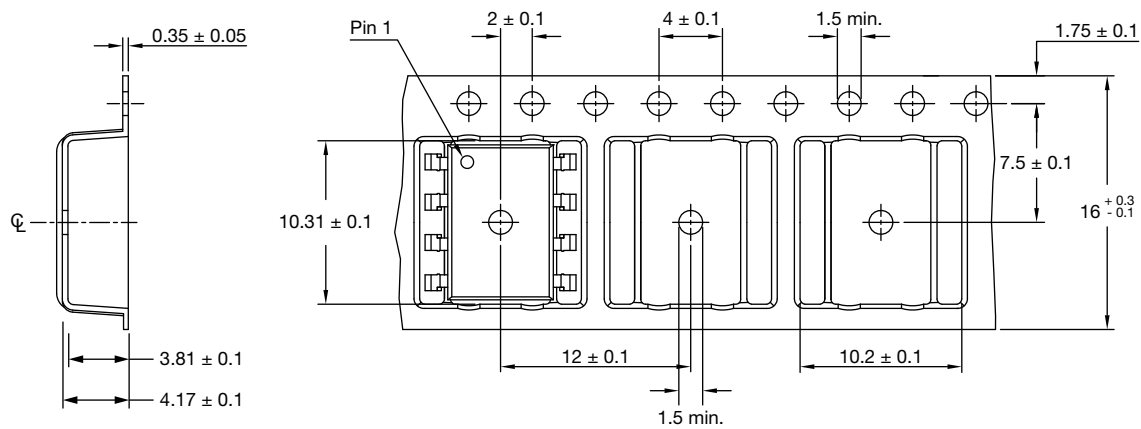
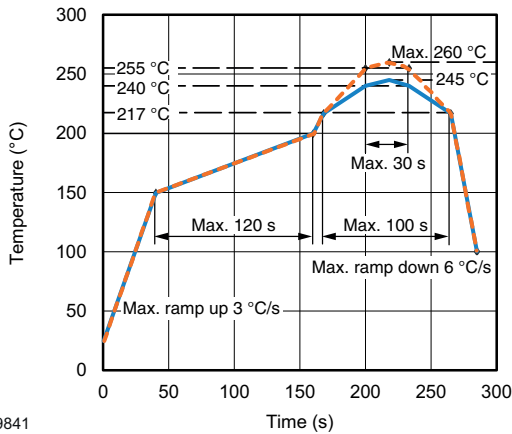


Fig. 16 - Tape and Reel Packing

| TAPE AND REEL PACKING |            |
|-----------------------|------------|
| TYPE                  | UNITS/REEL |
| SMD-8                 | 1000       |

| TUBE PACKING |            |           |           |
|--------------|------------|-----------|-----------|
| TYPE         | UNITS/TUBE | TUBES/BOX | UNITS/BOX |
| SMD-8        | 50         | 40        | 2000      |
| DIP-8        | 50         | 40        | 2000      |

## SOLDER PROFILES



19841

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

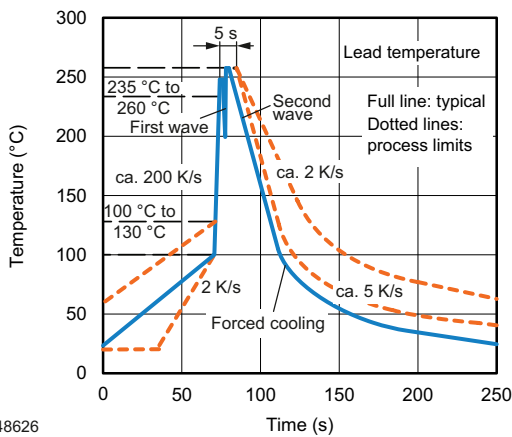
## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

Conditions:  $T_{amb} < 30\text{ }^{\circ}\text{C}$ , RH < 85 %

Moisture sensitivity level 1, according to J-STD-020



948626

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





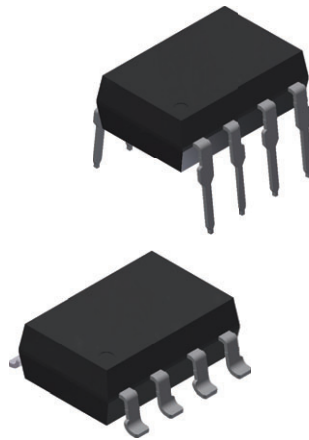
## Footprint and Schematic Information for VOR2121

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, Pulsonix, and PADS.

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

| PART NUMBER | FOOTPRINT / SCHEMATIC  |
|-------------|--|
| VOR2121A8   | <a href="http://www.snapeda.com/parts/VOR2121A8/Vishay/view-part">www.snapeda.com/parts/VOR2121A8/Vishay/view-part</a>   |
| VOR2121B8   | <a href="http://www.snapeda.com/parts/VOR2121B8/Vishay/view-part">www.snapeda.com/parts/VOR2121B8/Vishay/view-part</a>   |
| VOR2121B8T  | <a href="http://www.snapeda.com/parts/VOR2121B8T/Vishay/view-part">www.snapeda.com/parts/VOR2121B8T/Vishay/view-part</a> |

For technical issues and product support, please contact [optocoupleranswers@vishay.com](mailto:optocoupleranswers@vishay.com).





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