1 Form A Solid State Relay

DESCRIPTION
The VO14642AT are high speed SPST normally open (1 form A) solid-state relay in a DIP-6 package. The relays are constructed as a multi-chip hybrid device. Actuation control is via an infrared LED. The output switch is a combination of a photodiode array with MOSFET switches. The relays can be configured for AC/DC or DC only operation.

FEATURES
- High speed SSR - t_{on}/t_{off} < 800 μs
- Maximum R_{ON} 0.25 Ω
- Isolation test voltage 5300 V_{RMS}
- Load voltage 60 V
- Load current 2 A DC configuration
- DIP-6 package
- Clean bounce free switching
- TTL/CMOS compatible input
- Available on tape and reel
- Pure tin leads
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC

APPLICATIONS
- Instrumentation
- Industrial controls
- Security

AGENCY APPROVALS
UL1577: file no. E52744 system code H, double protection
cUL - UL1577: file no. E52744 system code H, double protection

Notes
- IEC 60747-5-2 (VDE 0884) capable, consult sales representative for details
- Agency approvals are valid only for ambient temperature range - 40 °C to 85 °C

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>V</th>
<th>O</th>
<th>1</th>
<th>4</th>
<th>6</th>
<th>4</th>
<th>2</th>
<th>A</th>
<th>x</th>
<th>x</th>
<th>T</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART NUMBER</td>
<td>ELECTR. VARIATION</td>
<td>PACKAGE CONFIG.</td>
<td>TAPE AND REEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>UL, cUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD-6, tape and reel</td>
<td>VO14642AABTR</td>
</tr>
<tr>
<td>DIP-6, Tubes</td>
<td>VO14642AT</td>
</tr>
</tbody>
</table>
## ABSOLUTE MAXIMUM RATINGS *(1) (T_{amb} = 25 \, ^\circ C, unless otherwise specified)*

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INPUT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED continuous forward current</td>
<td>I_F</td>
<td>50</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>LED reverse voltage</td>
<td>V_R</td>
<td>5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>LED power dissipation</td>
<td>at 25 , ^\circ C</td>
<td>P_{diss}</td>
<td>80</td>
<td>mW</td>
</tr>
<tr>
<td><strong>OUTPUT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC or peak AC load voltage</td>
<td>V_L</td>
<td>60</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Load current (DC only)</td>
<td>I_L</td>
<td>2</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Peak load current (AC/DC)</td>
<td>t = 10 ms</td>
<td>I_{LPK}</td>
<td>3.6</td>
<td>A</td>
</tr>
<tr>
<td>Output power dissipation</td>
<td>at 25 , ^\circ C</td>
<td>P_{diss}</td>
<td>250</td>
<td>mW</td>
</tr>
<tr>
<td><strong>SSR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>P_{diss}</td>
<td>330</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>T_{amb}</td>
<td>- 55 to + 85</td>
<td>, ^\circ C</td>
<td></td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>T_{stg}</td>
<td>- 55 to + 125</td>
<td>, ^\circ C</td>
<td></td>
</tr>
<tr>
<td>Soldering temperature <em>(2)</em></td>
<td>t \leq 10 s max.</td>
<td>T_{sld}</td>
<td>260</td>
<td>, ^\circ C</td>
</tr>
<tr>
<td>Isolation test voltage</td>
<td>for 1 s</td>
<td>V_{ISO}</td>
<td>5300</td>
<td>V_{RMS}</td>
</tr>
</tbody>
</table>

### Notes

*(1)* 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.

*(2)* Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

### ABSOLUTE MAXIMUM RATING CURVE

![Load Current (AC/DC) vs. Temperature](image)

Fig. 1 - Load Current (AC/DC) vs. Temperature
**THERMAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum LED junction temperature</td>
<td>at 25 °C</td>
<td>$T_{j\text{max.}}$</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>Maximum output die junction temperature</td>
<td>at 25 °C</td>
<td>$T_{j\text{max.}}$</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>Thermal resistance, junction emitter to board</td>
<td>at 25 °C</td>
<td>$\theta_{EB}$</td>
<td>176</td>
<td>°C/W</td>
</tr>
<tr>
<td>Thermal resistance, junction emitter to case</td>
<td>at 25 °C</td>
<td>$\theta_{EC}$</td>
<td>208</td>
<td>°C/W</td>
</tr>
<tr>
<td>Thermal resistance, junction detector to board</td>
<td>at 25 °C</td>
<td>$\theta_{DB}$</td>
<td>67</td>
<td>°C/W</td>
</tr>
<tr>
<td>Thermal resistance, junction detector to case</td>
<td>at 25 °C</td>
<td>$\theta_{DC}$</td>
<td>134</td>
<td>°C/W</td>
</tr>
<tr>
<td>Thermal resistance, case to junction detector</td>
<td>at 25 °C</td>
<td>$\theta_{ED}$</td>
<td>310</td>
<td>°C/W</td>
</tr>
<tr>
<td>Thermal resistance, case to ambient</td>
<td>at 25 °C</td>
<td>$\theta_{CA}$</td>
<td>2180</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

**Note**
- The thermal model is represented in the thermal network below. Each resistance value given in this model can be used to calculate the temperatures at each node for a given operating condition. The thermal resistance from board to ambient will be dependent on the type of PCB, layout and thickness of copper traces. For a detailed explanation of the thermal model, please reference Vishay’s thermal characteristics of optocouplers application note.

![Thermal Network Diagram]

**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><strong>INPUT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED forward current, switch turn-on</td>
<td>$I_L = 1$ A, $V_L \leq 0.5$ V, $t = 10$ ms</td>
<td>$I_{On}$</td>
<td>0.5</td>
<td>2</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>LED forward current, switch turn-off</td>
<td>$V_L = 60$ V, $I_L &lt; 1$ μA</td>
<td>$I_{F\text{off}}$</td>
<td>50</td>
<td></td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>LED reverse current</td>
<td>$V_R = 5$ V</td>
<td>$I_R$</td>
<td>10</td>
<td></td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>LED forward voltage</td>
<td>$I_F = 10$ mA</td>
<td>$V_F$</td>
<td>1.3</td>
<td>1.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td><strong>OUTPUT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-resistance (AC/DC)</td>
<td>$I_F = 10$ mA, $I_L = 1$ A</td>
<td>$R_{ON}$</td>
<td>0.18</td>
<td>0.25</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>On-resistance (DC only)</td>
<td>$I_F = 10$ mA, $I_L = 2$ A</td>
<td>$R_{ON}$</td>
<td>0.05</td>
<td>0.07</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>Off-state leakage current</td>
<td>$I_F = 0$ mA, $V_L = 60$ V</td>
<td>$I_{\text{Leak}}$</td>
<td>1</td>
<td></td>
<td>μA</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.
**PIN CONFIGURATION**

**SWITCHING CHARACTERISTICS (AC/DC CONNECTION)**

<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>$I_F = 10\ mA, V_L = 30\ V, I_L = 200\ mA$</td>
<td>$t_{on}$</td>
<td>370</td>
<td>800</td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td>Turn-off time</td>
<td>$I_F = 10\ mA, V_L = 30\ V, I_L = 200\ mA$</td>
<td>$t_{off}$</td>
<td>50</td>
<td>800</td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td>Turn-on time</td>
<td>$I_F = 10\ mA, V_L = 5\ V, I_L = 1\ A$</td>
<td>$t_{on}$</td>
<td>550</td>
<td></td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td>Turn-off time</td>
<td>$I_F = 10\ mA, V_L = 5\ V, I_L = 1\ A$</td>
<td>$t_{off}$</td>
<td>18</td>
<td></td>
<td>μs</td>
<td></td>
</tr>
</tbody>
</table>

**AC/DC configuration**

Anode 1
Cathode 2
Load 3
Load 4
Do not use 5

**DC only configuration**

Anode 1
Cathode 2
Do not use 3
Load 4

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**VO14642AT, VO14642AABTR**

Vishay Semiconductors 1 Form A Solid State Relay

For technical questions, contact: optocoupleranswers@vishay.com

www.vishay.com

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# SAFETY AND INSULATION RATINGS

<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>Climatic classification</td>
<td>IEC 68 part 1</td>
<td></td>
<td>40/85/21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution degree</td>
<td>DIN VDE 0109</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tracking resistance (comparative tracking index)</td>
<td>Insulation group IIIa</td>
<td>CTI</td>
<td>175</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest allowable overvoltage</td>
<td>Transient overvoltage</td>
<td>V_{ITM}</td>
<td>8000</td>
<td></td>
<td></td>
<td>V_{peak}</td>
</tr>
<tr>
<td>Maximum working insulation voltage</td>
<td>Recurring peak voltage</td>
<td>V_{ORM}</td>
<td>890</td>
<td></td>
<td></td>
<td>V_{peak}</td>
</tr>
<tr>
<td>Insulation resistance at 25 °C</td>
<td>V_{IO} = 500 V</td>
<td>R_{IS}</td>
<td>≥ 10^{12}</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation resistance at TS</td>
<td>V_{IO} = 500 V</td>
<td>R_{IS}</td>
<td>≥ 10^{9}</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation resistance at 100 °C</td>
<td>V_{IO} = 500 V</td>
<td>R_{IS}</td>
<td>≥ 10^{11}</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partial discharge test voltage</td>
<td>Method b, V_{pd} = V_{ORM} \times 1.875</td>
<td>V_{pd}</td>
<td>1669</td>
<td></td>
<td></td>
<td>V_{peak}</td>
</tr>
<tr>
<td>Isolation test voltage</td>
<td>V_{ISO} = 5300</td>
<td>V_{RMS}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety limiting values - maximum values allowed in the event of a failure</td>
<td>Case temperature</td>
<td>T_{SI}</td>
<td>165</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety limiting values - maximum values allowed in the event of a failure</td>
<td>Input current</td>
<td>I_{SI}</td>
<td>150</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety limiting values - maximum values allowed in the event of a failure</td>
<td>Output power</td>
<td>P_{SO}</td>
<td>400</td>
<td>mW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum external air gap (clearance distance)</td>
<td>Measured from input terminals to output terminals, shortest distance through air</td>
<td>≥ 7</td>
<td>mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum external tracking (creepage distance)</td>
<td>Measured from input terminals to output terminals, shortest distance path along body</td>
<td>≥ 7</td>
<td>mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note**
- This SSR is suitable for “safe electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

# TYPICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

![Fig. 2 - LED Forward Voltage vs. Current](image)

![Fig. 3 - LED Leakage Current vs. Temperature](image)
Fig. 4 - Output Leakage Current vs. Temperature
Fig. 5 - LED Voltage vs. Temperature
Fig. 6 - Diode Breakdown Voltage vs. Temperature
Fig. 7 - LED Current for Switch Turn-on vs. Temperature
Fig. 8 - On-resistance vs. Temperature
Fig. 9 - Turn-off Time vs. Temperature
VO14642AT, VO14642AABTR
1 Form A Solid State Relay
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Fig. 10 - Turn-off Time vs. LED

Fig. 11 - Turn-on Time vs. Temperature

Fig. 12 - Turn-on Time vs. LED

Fig. 13 - Load Current vs. Load Voltage

Fig. 14 - Switch Capacitance vs. Applied Voltage
**PACKAGE DIMENSIONS** in millimeters

![Package Dimensions Diagram]

**PACKAGE MARKING**

![Package Marking Diagram]

**Note**
- Tape and reel suffix (TR) is not part of the package marking.
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