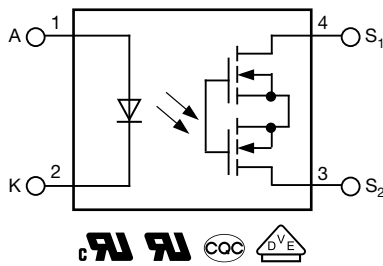


# 1 Form A Solid-State Relay



## DESCRIPTION

The VOR1060M4 is an optically isolated 1 form A solid-state relay in a surface-mount 4 pin SOP package. This 1 form A opto-isolated relay comes in a low profile SOP-4 package making it suitable for space constrained high voltage designs.

### Note

- For automotive qualification please get in touch with our local sales

## FEATURES

- Load voltage 600 V
- Load current 50 mA
- Isolation voltage 3750 V<sub>RMS</sub>
- Low on resistance R<sub>ON</sub> = 40 Ω (typ.)
- Fast switching:  
t<sub>on</sub> = 0.3 ms (typ.), t<sub>off</sub> = 0.15 ms (typ.)
- Low leakage current I<sub>LEAK</sub> = 2 nA (typ.)
- Material categorization:  
for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

## APPLICATIONS

- Hybrid / electric vehicle applications
- Battery management
- Security systems
- Instrumentation
- Industrial controls

## AGENCY APPROVALS

- UL (pending)
- cUL (pending)
- DIN EN 60747-5-5 (VDE 0884-5) (pending)
- CQC (pending)

ORDERING INFORMATION	
<div style="display: flex; justify-content: space-around; align-items: 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;">1</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">6</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">M</div> <div style="border: 1px solid black; padding: 2px 5px;">4</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> </div> <p style="text-align: center; margin-top: 5px;">PART NUMBER</p>	<p>TAPE AND REEL</p>
<b>PACKAGE</b>	<b>UL, cUL, CQC, VDE, FIMKO</b>
SOP-4, tape and reel	VOR1060M4T

<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)				
PARAMETER	CONDITIONS	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
LED continuous forward current		$I_F$	50	mA
LED reverse voltage		$V_R$	5	V
<b>OUTPUT</b>				
DC or peak AC load voltage		$V_L$	600	V
Continuous load current		$I_L$	50	mA
<b>SSR</b>				
Total power dissipation		$P_{diss}$	550	mW
Ambient temperature range		$T_{amb}$	-40 to +125	$^{\circ}\text{C}$
Storage temperature range		$T_{stg}$	-40 to +150	$^{\circ}\text{C}$
Soldering temperature	$t \leq 10\text{ s max.}$	$T_{sld}$	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.

<b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>						
LED forward current, switch turn-on	$I_L = 50\text{ mA}$ , $t_{delay} = 10\text{ ms}$	$I_{Fon}$	-	2	5	mA
LED forward current, switch turn-off	$I_L = 1\text{ }\mu\text{A}$	$I_{Foff}$	0.1	0.2	-	mA
LED reverse current	$V_R = 5\text{ V}$	$I_R$	-	0.04	1.3	$\mu\text{A}$
LED forward voltage	$I_F = 10\text{ mA}$	$V_F$	-	1.4	1.6	V
LED reverse voltage	$I_R = 10\text{ }\mu\text{A}$	$V_R$	5	10	-	V
<b>OUTPUT</b>						
On-resistance	$I_F = 10\text{ mA}$ , $I_L = 50\text{ mA}$	$R_{ON}$	-	40	70	$\Omega$
Off-state leakage current	$I_F = 0\text{ mA}$ , $V_L = 600\text{ V}$	$I_{LEAK}$	-	0.002	1	$\mu\text{A}$

**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.

<b>SWITCHING CHARACTERISTICS</b>						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Turn-on time	$I_F = 10\text{ mA}$ , $R_L = 200\text{ }\Omega$ , $I_L = 50\text{ mA}$	$t_{on}$	-	0.3	3	ms
Turn-off time	$I_F = 10\text{ mA}$ , $R_L = 200\text{ }\Omega$ , $I_L = 50\text{ mA}$	$t_{off}$	-	0.15	0.5	ms

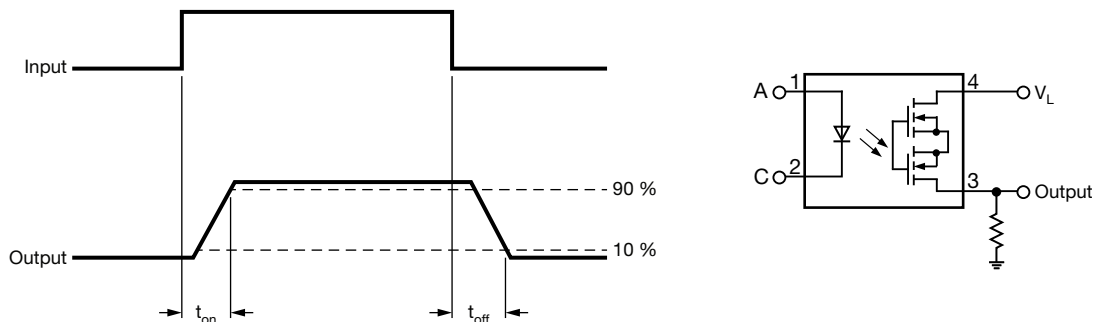


Fig. 1 - Timing Schematic



SAFETY AND INSULATION RATINGS				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	According to IEC 68 part 1		55 / 125 / 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 <sub>ISO</sub>	3750	V <sub>RMS</sub>
Maximum transient isolation voltage	According to DIN EN 60747-5-5	V <sub>IOTM</sub>	4800	V <sub>peak</sub>
Maximum repetitive peak isolation voltage	According to DIN EN 60747-5-5	V <sub>IORM</sub>	707	V <sub>peak</sub>
Insulation resistance	T <sub>amb</sub> = 25 °C, V <sub>IO</sub> = 500 V	R <sub>IO</sub>	≥ 10 <sup>12</sup>	Ω
	T <sub>amb</sub> = 125 °C, V <sub>IO</sub> = 500 V	R <sub>IO</sub>	≥ 10 <sup>10</sup>	Ω
	T <sub>amb</sub> = 150 °C, V <sub>IO</sub> = 500 V	R <sub>IO</sub>	≥ 10 <sup>9</sup>	Ω
Output safety power		P <sub>SO</sub>	750	mW
Input safety current		I <sub>SI</sub>	200	mA
Input safety temperature		T <sub>S</sub>	150	°C
Clearance distance			≥ 5.2	mm
Creepage distance			≥ 5.2	mm

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.

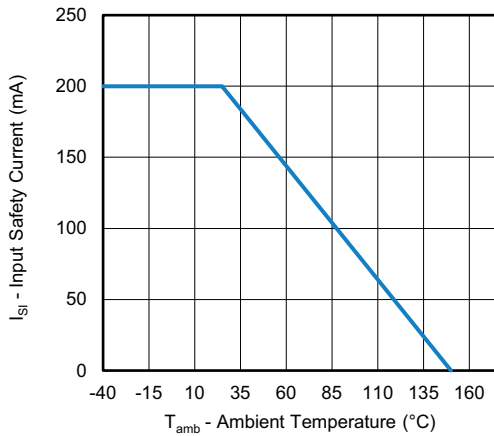


Fig. 2 - Safety Input Current vs. Ambient Temperature

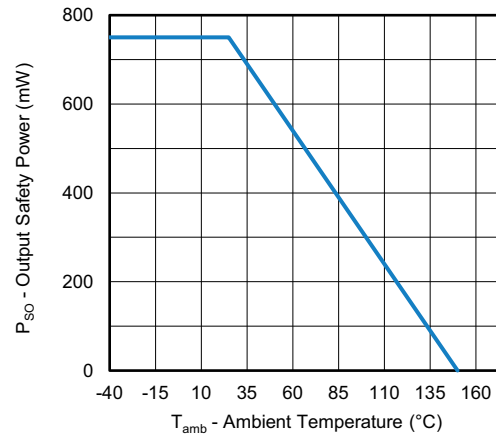


Fig. 3 - Safety Power Dissipation vs. Ambient Temperature

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

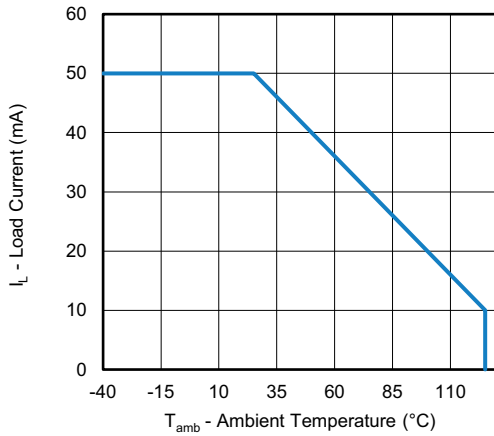


Fig. 4 - Load Current vs. Ambient Temperature

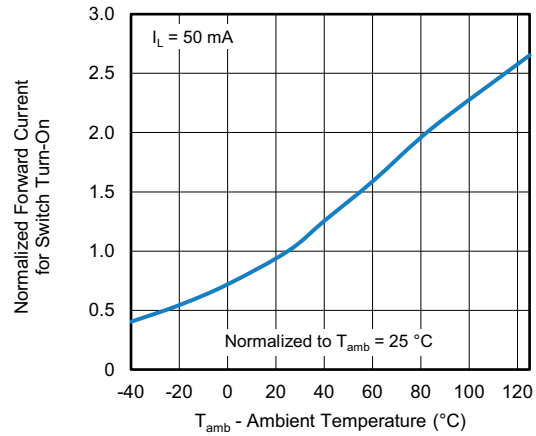


Fig. 7 - Normalized Forward Current for Switch Turn-On vs. Ambient Temperature

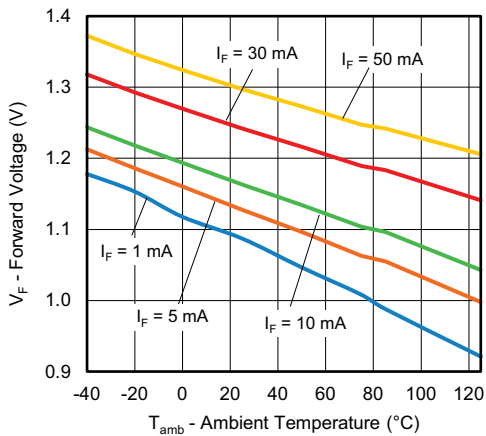


Fig. 5 - Forward Voltage vs. Ambient Temperature

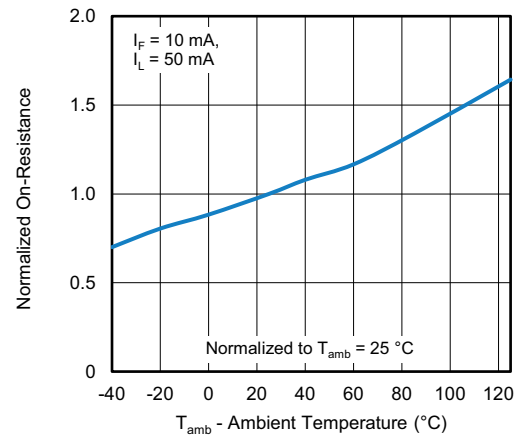


Fig. 8 - Normalized On-Resistance vs. Ambient Temperature

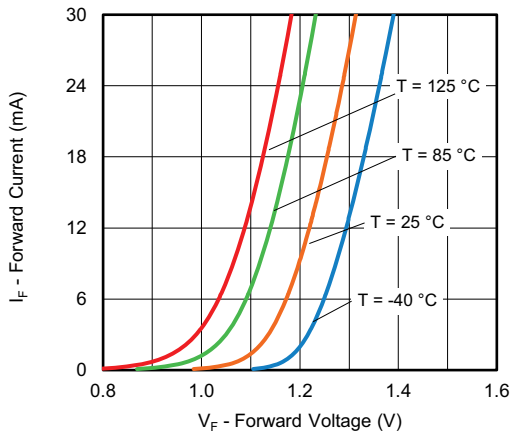


Fig. 6 - Forward Current vs. Forward Voltage

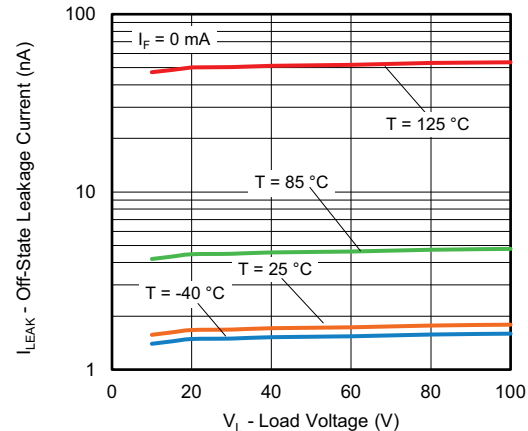


Fig. 9 - Off-State Leakage Current vs. Load Voltage

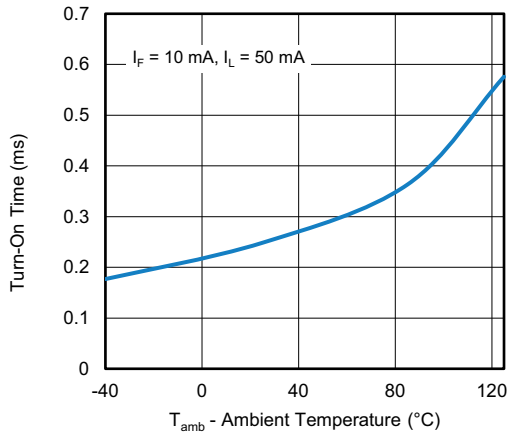


Fig. 10 - Turn-On Time vs. Ambient Voltage

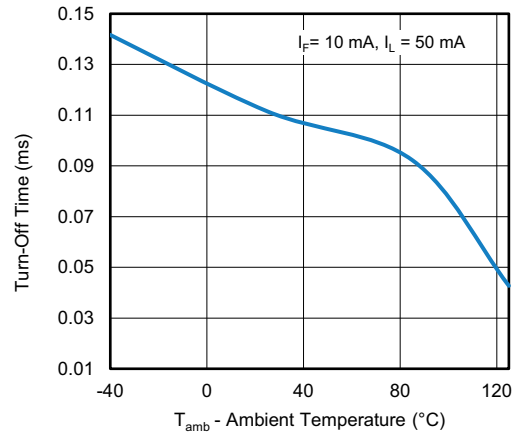


Fig. 12 - Turn-Off Time vs. Ambient Temperature

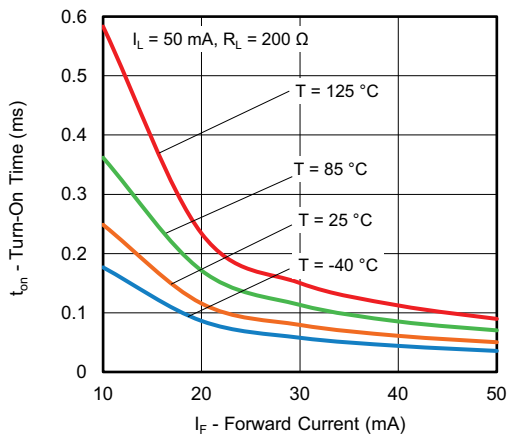


Fig. 11 - Turn-On Time vs. Forward Current

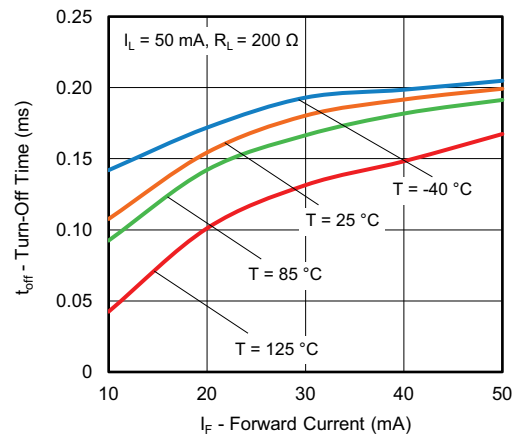


Fig. 13 - Turn-Off Time vs. Forward Current

**PACKAGE DIMENSIONS** (in millimeters)

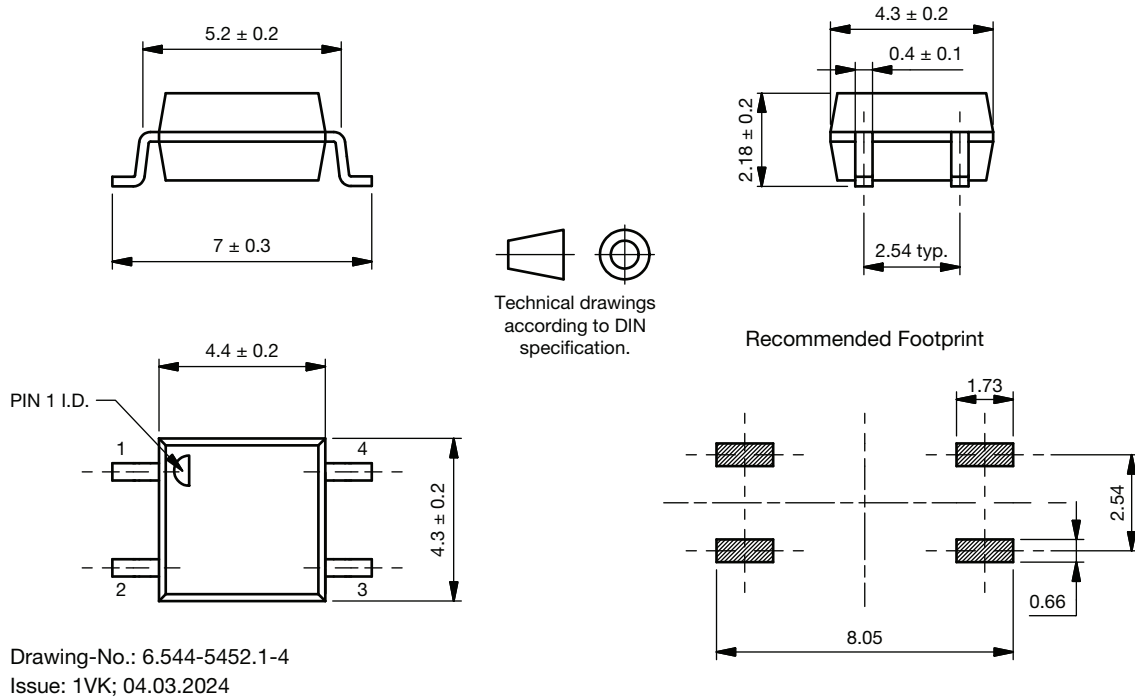


Fig. 14 - Package Drawings

**PACKAGE MARKING**

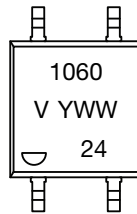
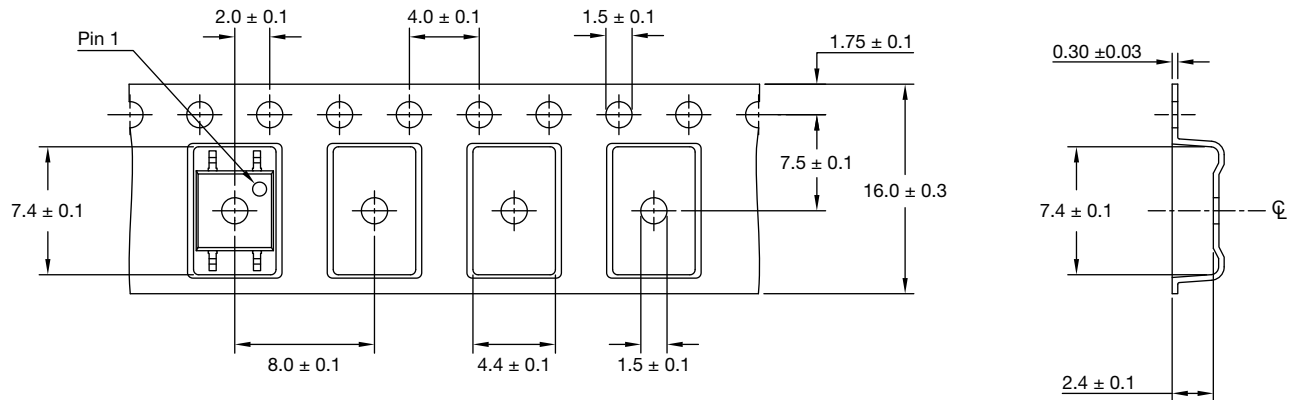


Fig. 15 - VOR1060M4

**Notes**

- YWW = date code
- Tape and reel suffix (T) is not part of the package marking

**TAPE AND REEL INFORMATION** (in millimeters)

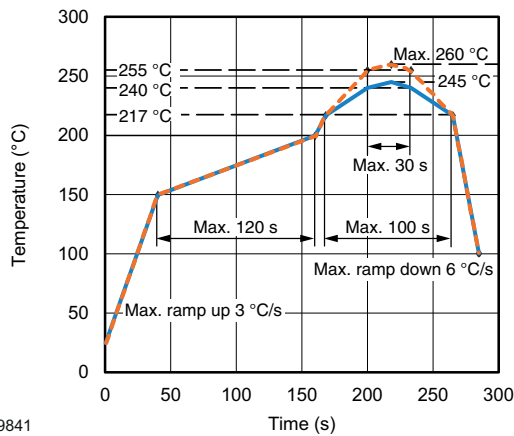


**Note:**

- Cumulative tolerance of 10 sprocket holes is 0.20

Fig. 16 - VOR1060M4T (3000 pieces on reel)

**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: 168 h

Conditions:  $T_{amb} < 30\text{ }^{\circ}\text{C}$ , RH < 60 %

Moisture sensitivity level 3, according to J-STD-020



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