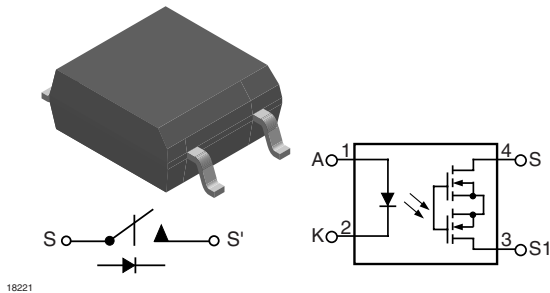


# 1 Form A Solid State Relay



20050



18221

## DESCRIPTION

The VO1400AEFTR is an optically isolated 1 form A solid-state relay in a surface mount 4 pin SOP package.

## FEATURES

- Maximum  $R_{ON}$  5  $\Omega$
- Load voltage 60 V
- Load current 100 mA
- Isolation test voltage 1500 V<sub>RMS</sub>
- Small 4 pin SOP package
- Clean bounce free switching
- TTL/CMOS compatible input
- High reliability hybrid receptor
- Available on tape and reel
- Lead (Pb)-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC



RoHS COMPLIANT

## APPLICATIONS

- Security systems
- Instrumentation
- Industrial controls

## AGENCY APPROVALS

UL: file no. E300068 system code K  
 CUL : file no. E300068  
 DIN EN: 60747-5-5 (VDE 0884)

ORDER INFORMATION		
PART	REMARKS	PACKAGE
VO1400AEFTR	Tape and reel	SOP-4
VO1400AEFT2	Tape and reel (product rotated in tape)	SOP-4

ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
LED continuous forward current		$I_F$	50	mA
LED reverse voltage		$V_R$	5.0	V
<b>OUTPUT</b>				
DC or peak AC load voltage		$V_L$	60	V
<b>SSR</b>				
Total power dissipation		$P_{diss}$	400	mW
Ambient temperature range		$T_{amb}$	- 40 to + 85	°C
Storage temperature range		$T_{stg}$	- 40 to + 125	°C
Soldering temperature <sup>(2)</sup>	$t \leq 10$ s max.	$T_{sld}$	260	°C
Isolation test voltage	$t = 1.0$ s	$V_{ISO}$	1500	V <sub>RMS</sub>

### Notes

- <sup>(1)</sup>  $T_{amb} = 25$  °C, unless otherwise specified.  
 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.
- <sup>(2)</sup> Refer to reflow profile for soldering conditions for surface mounted devices.

**ABSOLUTE MAXIMUM RATING CURVE**

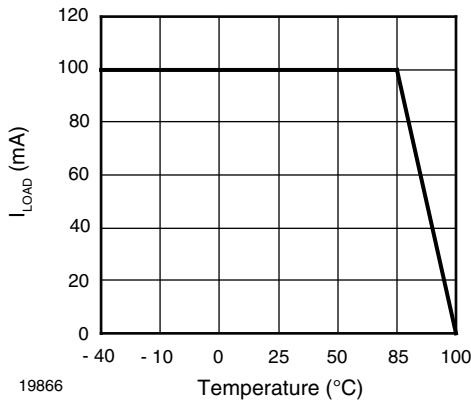
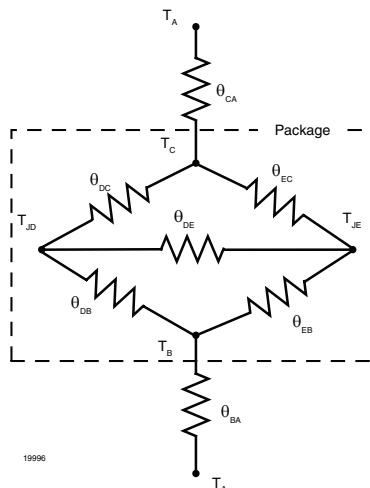


Fig. 1 - I<sub>LOAD</sub> vs. Temperature

<b>THERMAL CHARACTERISTICS</b>				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
LED power dissipation	at 25 °C	P <sub>diss</sub>	60	mW
Output power dissipation	at 25 °C	P <sub>diss</sub>	50	mW
Total power dissipation	at 25 °C	P <sub>tot</sub>	110	mW
Maximum LED junction temperature		T <sub>jmax.</sub>	125	°C
Maximum output die junction temperature		T <sub>jmax.</sub>	125	°C
Thermal resistance, junction emitter to board		θ <sub>JEB</sub>	114	°C/W
Thermal resistance, junction emitter to case		θ <sub>JEC</sub>	99	°C/W
Thermal resistance, junction detector to board		θ <sub>JDB</sub>	60	°C/W
Thermal resistance, junction detector to case		θ <sub>JDC</sub>	80	°C/W
Thermal resistance, junction emitter to junction detector		θ <sub>JED</sub>	115	°C/W
Thermal resistance, case to ambient		θ <sub>CA</sub>	2396	°C/W

**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.



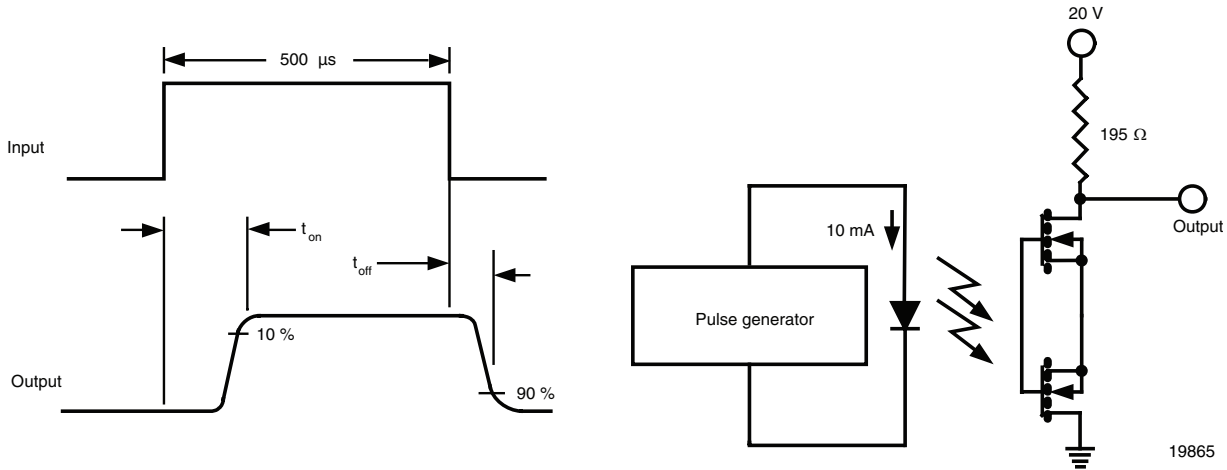
ELECTRICAL CHARACTERISTICS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>						
LED forward current, switch turn-on	$I_L = 100 \text{ mA}, V_L \leq 0.5 \text{ V}, t = 10 \text{ ms}$	$I_{Fon}$	0.3	1.0	3.2	mA
LED forward current, switch to remain off	$V_L = 60 \text{ V}$	$I_{Foff}$	100	150		$\mu\text{A}$
Input reverse current	$V_R = 5.0 \text{ V}$	$I_R$		0.001	10	$\mu\text{A}$
LED forward voltage	$I_F = 5.0 \text{ mA}$	$V_F$	0.8	1.1	1.4	V
LED reverse voltage	$I_R = 10 \mu\text{A}$	$V_R$	5	40		V
<b>OUTPUT</b>						
Peak load voltage		$V_L$			60	V
Load current AC peak	$I_F = 2.0 \text{ mA}$	$I_L$			100	mA
Peak load current	10 ms	$I_{LPK}$			350	mA
On-resistance	$I_F = 10 \text{ mA}, I_L = 100 \text{ mA}$	$R_{ON}$		2.3	5	$\Omega$
Off-state leakage current	$I_F = 0 \text{ mA}, V_L = 60 \text{ V}$	$I_{LEAK}$		0.002	1	$\mu\text{A}$

**Note**

$T_{amb} = 25 \text{ }^\circ\text{C}$ , unless otherwise specified.

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						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Turn-on time	$I_F = 10 \text{ mA}, V_L = 20 \text{ V}, I_L = 100 \text{ mA}$	$t_{on}$		52	500	$\mu\text{s}$
Turn-off time	$I_F = 10 \text{ mA}, V_L = 20 \text{ V}, I_L = 100 \text{ mA}$	$t_{off}$		36	500	$\mu\text{s}$



SAFETY AND INSULATION RATINGS				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	IEC 68 part 1		40/85/21	
Pollution degree	DIN VDE 0109		2	
Tracking resistance (comparative tracking index)	Insulation group IIIa	CTI	175	
Highest allowable overvoltage	Transient overvoltage	$V_{IOTM}$	6000	$V_{peak}$
Maximum working insulation voltage	Recurring peak voltage	$V_{IORM}$	707	$V_{peak}$
Insulation resistance at 25 °C	$V_{IO} = 500 V$	$R_{IS}$	$\geq 10^{12}$	$\Omega$
Insulation resistance at $T_S$	$V_{IO} = 500 V$	$R_{IS}$	$\geq 10^9$	$\Omega$
Insulation resistance at 100 °C	$V_{IO} = 500 V$	$R_{IS}$	$\geq 10^{11}$	$\Omega$
Partial discharge test voltage	Method a, $V_{pd} = V_{IORM} \times 1.875$	$V_{pd}$	1325	$V_{peak}$
Isolation test voltage, 1 s		$V_{RMS}$	1800	$V_{RMS}$
Safety limiting values - maximum values allowed in the event of a failure	Output power	$P_{SO}$	400	mW
	Input current	$I_{SI}$	150	mA
	Case temperature	$T_{SI}$	165	°C
Minimum external air gap (clearance distance)	Measured from input terminals to output terminals, shortest distance through air		$\geq 5.0$	mm
Minimum external tracking (creepage distance)	Measured from input terminals to output terminals, shortest distance path along body		$\geq 5.0$	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.

**TYPICAL CHARACTERISTICS**

$T_{amb} = 25\text{ °C}$ , unless otherwise specified

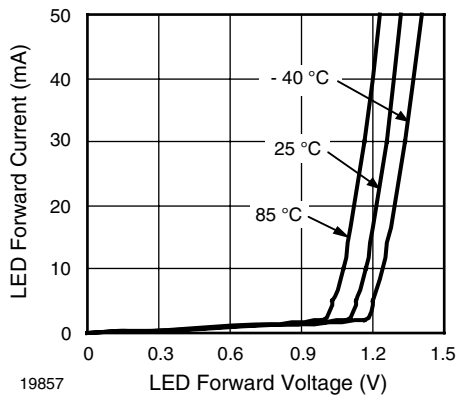


Fig. 2 - Typical LED Forward Voltage vs. Current

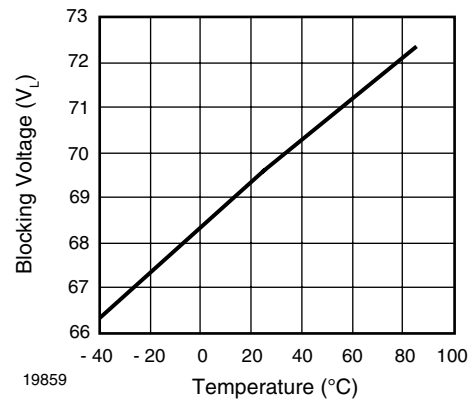


Fig. 3 - Typical Blocking Voltage vs. Temperature

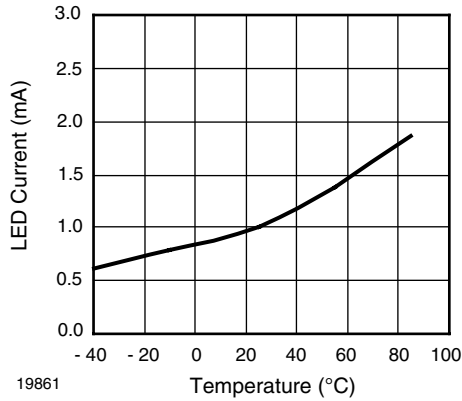


Fig. 4 - Typical  $I_F$  for Switch Operation vs. Temperature (Load Current = 100 mA)

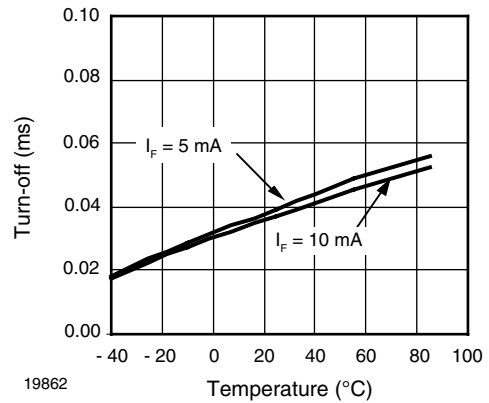


Fig. 7 - Typical Turn-off vs. Temperature (Load Current = 100 mA)

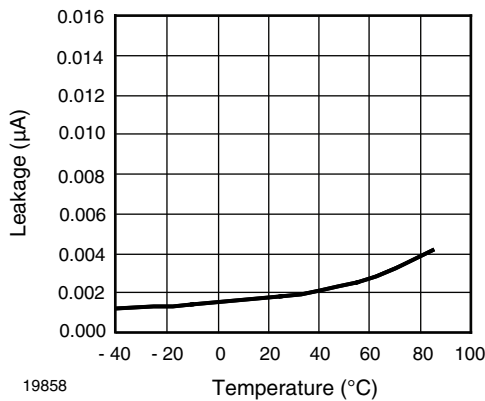


Fig. 5 - Typical Leakage vs. Temperature ( $V_L = 60 V$ )

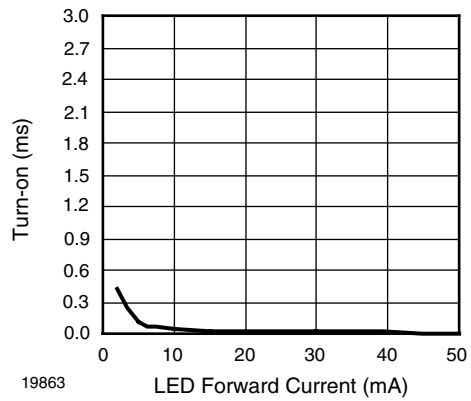


Fig. 8 - Typical Turn-on vs. LED Forward Current (Load Current = 100 mA)

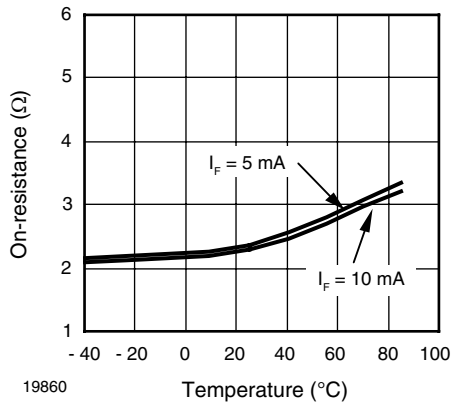


Fig. 6 - Typical On-resistance vs. Temperature (Load Current = 100 mA)

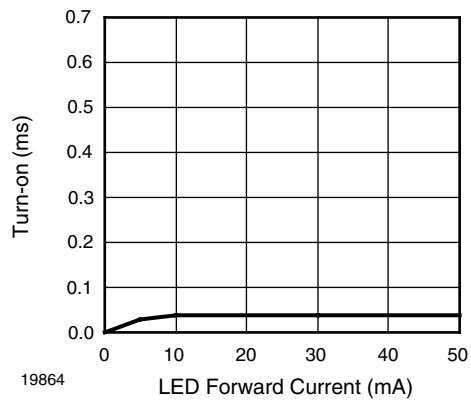
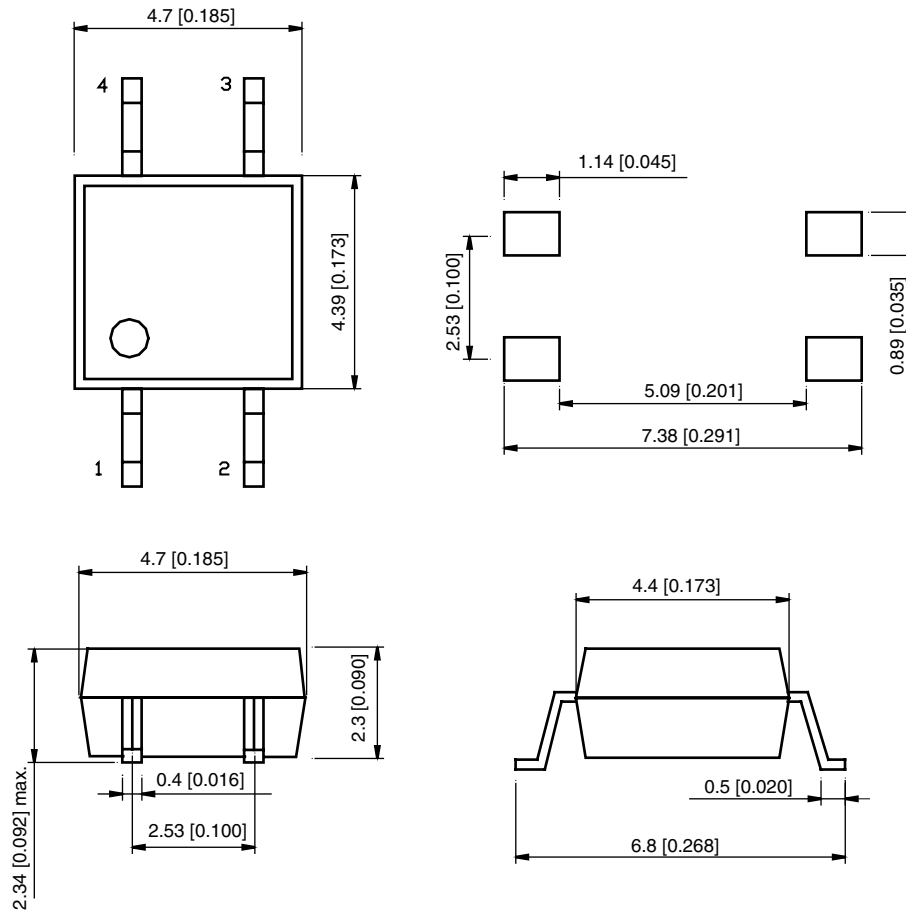


Fig. 9 - Typical Turn-off vs. LED Forward Current (Load Current = 100 mA)

**PACKAGE DIMENSIONS** in inches (millimeters)



19410

**ESD CAUTION**

This is an ESD (electro static discharge) sensitive device. Electrostatic charges accumulate on the human body and test equipment and can discharge without detection, Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality. ESD withstand voltage of this device is up to 1500 V acc. to JESD22-A114-B.



20055\_1

**OZONE DEPLETING SUBSTANCES POLICY STATEMENT**

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively.
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA.
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

We reserve the right to make changes to improve technical design  
and may do so without further notice.

Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use Vishay Semiconductors products for any unintended or unauthorized application, the buyer shall indemnify Vishay Semiconductors against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany



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