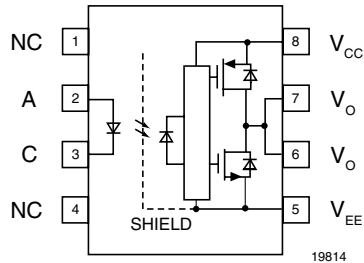
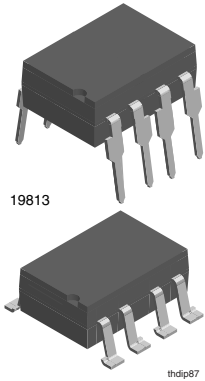


## Optocoupler, IGBT and MOSFET Driver



### FEATURES

- 0.5 A minimum peak output current
- 15 kV/μs minimum common mode rejection (CMR) at  $V_{CM} = 1500$  V
- 1.0 V maximum low level output voltage ( $V_{OL}$ ) eliminates need for negative gate drive
- $I_{CC} = 2$  mA maximum supply current
- Under voltage lock-out (UVLO) with hysteresis
- Wide operating  $V_{CC}$  range: 15 V to 30 V
- 0.2 μs maximum propagation delay
- Industrial temperature range: - 40 °C to 110 °C



**RoHS**  
COMPLIANT

### DESCRIPTION

The VO3150 consists of a LED optically coupled to an integrated circuit with a power output stage. This optocoupler is ideally suited for driving power IGBTs and MOSFETs used in motor control inverter applications. The high operating voltage range of the output stage provides the drive voltages required by gate controlled devices. The voltage and current supplied by this optocoupler makes it ideally suited for directly driving IGBTs with ratings up to 1200 V/50 A. For IGBTs with higher ratings, the VO3150 can be used to drive a discrete power stage which drives the IGBT gate.

### AGENCY APPROVALS

- Isolated IGBT/MOSFET gate driver
- AC and brushless DC motor drives
- Industrial inverters
- Switch mode power supplies (SMPS)
- Uninterruptible power supplies (UPS)

### APPLICATIONS

- UL - File
- CUL - File
- DIN EN 60747-5-2 (VDE 0884) available with option 1

ORDER INFORMATION	
PART	REMARKS
VO3150	Tubes, DIP-8
VO3150-X001	EN60747, tubes, DIP-8
VO3150-X017T	EN60747, tape and reel, SMD-8

TRUTH TABLE			
LED	$V_{CC} - V_{EE}$ "POSITIVE GOING" (TURN ON)	$V_{CC} - V_{EE}$ "NEGATIVE GOING" (TURN OFF)	$V_o$
OFF	0 to 30 V	0 to 30 V	Low
ON	0 to 11 V	0 to 9.5 V	Low
ON	11 to 13.5 V	9.5 to 12 V	Transition
ON	13.5 to 30 V	12 to 30 V	High

ABSOLUTE MAXIMUM RATINGS (1)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Input forward current		$I_F$	25	mA
Peak transient input current	< 1 μs pulse width, 300 pps	$I_{F(TRAN)}$	1	A
Reverse input voltage		$V_R$	5	V
Output power dissipation		$P_{diss}$	35	mW



<b>ABSOLUTE MAXIMUM RATINGS (1)</b>				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>OUTPUT</b>				
High peak output current (2)		$I_{OH(PEAK)}$	0.6	A
Low peak output current (2)		$I_{OL(PEAK)}$	0.6	A
Supply voltage		$(V_{CC} - V_{EE})$	0 to + 35	V
Output voltage		$V_{O(PEAK)}$	0 to + $V_{CC}$	V
Output power dissipation		$P_{diss}$	250	mW
<b>OPTOCOUPLER</b>				
Isolation test voltage between emitter and detector, climate per DIN 500414, part 2, Nov. 74	t = 1.0 min	$V_{ISO}$	5300	$V_{RMS}$
Storage temperature range		$T_S$	- 55 to + 125	°C
Ambient operating temperature range		$T_A$	- 40 to + 110	°C
Total power dissipation		$P_{tot}$	285	mW
Lead solder temperature (3)	for 10 s, 1.6 mm below seating plane		260	°C

**Notes**

(1)  $T_{amb} = 25\text{ °C}$ , 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.

(2) Maximum pulse width = 10  $\mu$ s, maximum duty cycle = 0.2 %. This value is intended to allow for component tolerances for designs with  $I_O$  peak minimum = 2.5 A. See applications section for additional details on limiting  $I_{OH}$  peak.

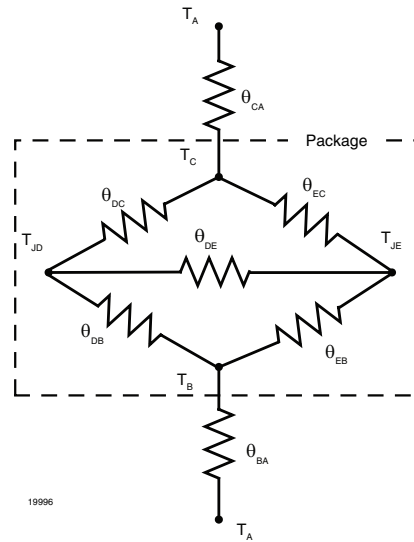
(3) Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

<b>RECOMMENDED OPERATING CONDITION</b>				
PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Power supply voltage	$V_{CC} - V_{EE}$	15	30	V
Input LED current (ON)	$I_F$	7	16	mA
Input voltage (OFF)	$V_{F(OFF)}$	- 3	0.8	V
Operating temperature	$T_{amb}$	- 40	+ 110	°C

<b>THERMAL CHARACTERISTICS</b>				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
LED power dissipation	at 25 °C	$P_{diss}$	35	mW
Output power dissipation	at 25 °C	$P_{diss}$	250	mW
Total power dissipation	at 25 °C	$P_{tot}$	285	mW
Maximum LED junction temperature	at 25 °C	$T_{jmax}$	125	°C
Maximum output die junction temperature	at 25 °C	$T_{jmax}$	125	°C
Thermal resistance, junction emitter to board	at 25 °C	$\theta_{JEB}$	169	°C/W
Thermal resistance, junction emitter to case	at 25 °C	$\theta_{JEC}$	192	°C/W
Thermal resistance, junction detector to board	at 25 °C	$\theta_{JDB}$	82	°C/W
Thermal resistance, junction detector to case	at 25 °C	$\theta_{JDC}$	80	°C/W
Thermal resistance, junction emitter to junction detector	at 25 °C	$\theta_{JED}$	200	°C/W
Thermal resistance, case to ambient	at 25 °C	$\theta_{CA}$	2645	°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.



19996

ELECTRICAL CHARACTERISTICS (1)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
High level output current	$R_g = 2.3 \Omega, C_g = 22 \text{ nF}$	$I_{OH}^{(2)}$	0.1	0.4		A
	$R_g = 2.3 \Omega, C_g = 22 \text{ nF}$	$I_{OH}^{(3)}$	0.5			A
Low level output current	$R_g = 2.3 \Omega, C_g = 22 \text{ nF}$	$I_{OL}^{(2)}$	0.1	0.6		A
	$R_g = 2.3 \Omega, C_g = 22 \text{ nF}$	$I_{OL}^{(3)}$	0.5			A
High level output voltage	$I_O = -100 \text{ mA}$	$V_{OH}^{(4)}$	$V_{CC} - 1.5$	$V_{CC} - 0.6$		V
Low level output voltage	$I_O = 100 \text{ mA}$	$V_{OL}$		0.3	1.0	V
High level supply current	Output open, $I_F = 8 \text{ to } 16 \text{ mA}$	$I_{CCH}$		4.2	7.0	mA
Low level supply current	Output open, $V_F = -3.0 \text{ to } +0.8 \text{ V}$	$I_{CCL}$		3.7	7.0	mA
Threshold input current low to high	$I_O = 0 \text{ mA}, V_O > 5 \text{ V}$	$I_{FLH}$		1.1	5.0	mA
Threshold input voltage high to low		$V_{FHL}$	0.8			V
Input forward voltage	$I_F = 10 \text{ mA}$	$V_F$	1.0	1.3	1.6	V
Temperature coefficient of forward voltage	$I_F = 10 \text{ mA}$	$\Delta V_F / \Delta T_A$		-1.4		mV/°C
Input reverse breakdown voltage	$I_R = 10 \mu\text{A}$	$BV_R$	5			V
Input capacitance	$f = 1 \text{ MHz}, V_F = 0 \text{ V}$	$C_{IN}$		60		pF
UVLO threshold	$V_O \geq 5 \text{ V}$	$V_{UVLO+}$	11.0	12.2	13.5	V
	$I_F = 10 \text{ mA}$	$V_{UVLO-}$	9.5	10.7	12.0	V
UVLO hysteresis		$UVLO_{HYS}$		1.5		V

**Notes**

- (1) Minimum and maximum values were tested over recommended operating conditions ( $T_A = -40 \text{ }^\circ\text{C}$  to  $110 \text{ }^\circ\text{C}$ ,  $I_{F(ON)} = 7 \text{ mA}$  to  $16 \text{ mA}$ ,  $V_{F(OFF)} = -3.0 \text{ V}$  to  $0.8 \text{ V}$ ,  $V_{CC} = 15 \text{ V}$  to  $30 \text{ V}$ ,  $V_{EE} = \text{ground}$ ) unless otherwise specified. 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. All typical values were measured at  $T_{amb} = 25 \text{ }^\circ\text{C}$  and with  $V_{CC} - V_{EE} = 30 \text{ V}$ .
- (2) Maximum pulse width =  $50 \mu\text{s}$ , maximum duty cycle = 0.5 %.
- (3) Maximum pulse width =  $10 \mu\text{s}$ , maximum duty cycle = 0.2 %. This value is intended to allow for component tolerances for designs with  $I_O$  peak minimum = 0.5 A.
- (4) In this test  $V_{OH}$  is measured with a dc load current. When driving capacitive loads  $V_{OH}$  will approach  $V_{CC}$  as  $I_{OH}$  approaches zero amps. Maximum pulse width = 1 ms, maximum duty cycle = 20 %.

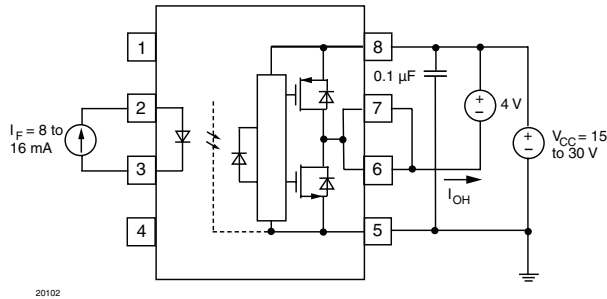
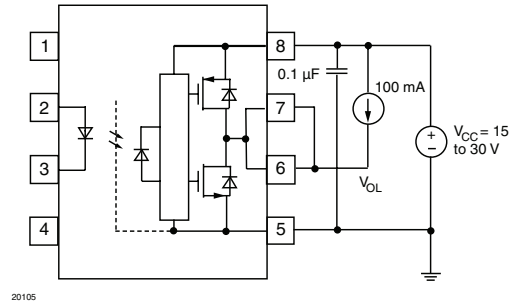
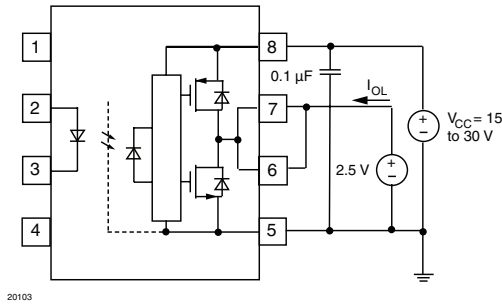
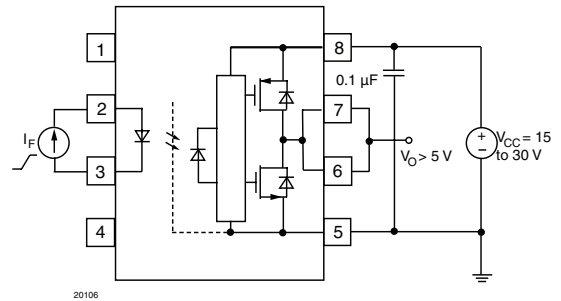
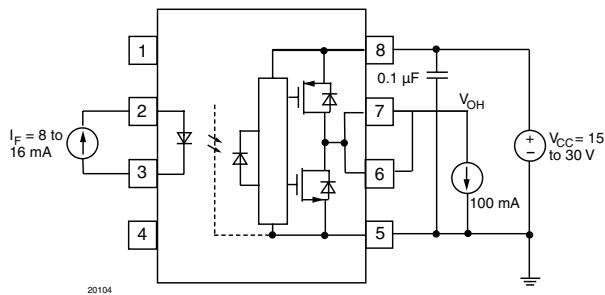
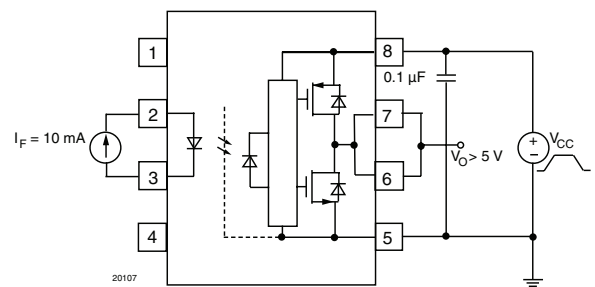
**TEST CIRCUITS**

 Fig. 1 -  $I_{OH}$  Test Circuit

 Fig. 4 -  $V_{OL}$  Test Circuit

 Fig. 2 -  $I_{OL}$  Test Circuit

 Fig. 5 -  $I_{FLH}$  Test Circuit

 Fig. 3 -  $V_{OH}$  Test Circuit


Fig. 6 - UVLO Test Circuit

SWITCHING CHARACTERISTICS (1)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Propagation delay time to logic low output (1)	$R_g = 47 \Omega$ , $C_g = 3 \text{ nF}$ , $f = 10 \text{ kHz}$ , duty cycle = 50 %	$t_{PHL}$	0.2		0.4	$\mu\text{s}$
Propagation delay time to logic high output (1)	$R_g = 47 \Omega$ , $C_g = 3 \text{ nF}$ , $f = 10 \text{ kHz}$ , duty cycle = 50 %	$t_{PLH}$	0.2		0.4	$\mu\text{s}$
Pulse width distortion (2)	$R_g = 47 \Omega$ , $C_g = 3 \text{ nF}$ , $f = 10 \text{ kHz}$ , duty cycle = 50 %	PWD			0.2	$\mu\text{s}$
Propagation delay difference between any two parts (3)	$R_g = 47 \Omega$ , $C_g = 3 \text{ nF}$ , $f = 10 \text{ kHz}$ , duty cycle = 50 %	PDD ( $t_{PHL} - t_{PLH}$ )	- 0.35		0.35	$\mu\text{s}$
Rise time	$R_g = 47 \Omega$ , $C_g = 3 \text{ nF}$ , $f = 10 \text{ kHz}$ , duty cycle = 50 %	$t_r$		0.1		$\mu\text{s}$
Fall time	$R_g = 47 \Omega$ , $C_g = 3 \text{ nF}$ , $f = 10 \text{ kHz}$ , duty cycle = 50 %	$t_f$		0.01		$\mu\text{s}$
UVLO turn on delay	$V_O > 5 \text{ V}$ , $I_F = 10 \text{ mA}$	$T_{UVLO-ON}$		1.1		$\mu\text{s}$
UVLO turn off delay	$V_O > 5 \text{ V}$ , $I_F = 10 \text{ mA}$	$T_{UVLO-OFF}$		1.1		$\mu\text{s}$

**Notes**

- (1) This load condition approximates the gate load of a 1200 V/25 A IGBT.
- (2) Pulse Width Distortion (PWD) is defined as  $|t_{PHL} - t_{PLH}|$  for any given device.
- (3) The difference between  $t_{PHL}$  and  $t_{PLH}$  between any two VO3150 parts under the same test condition.

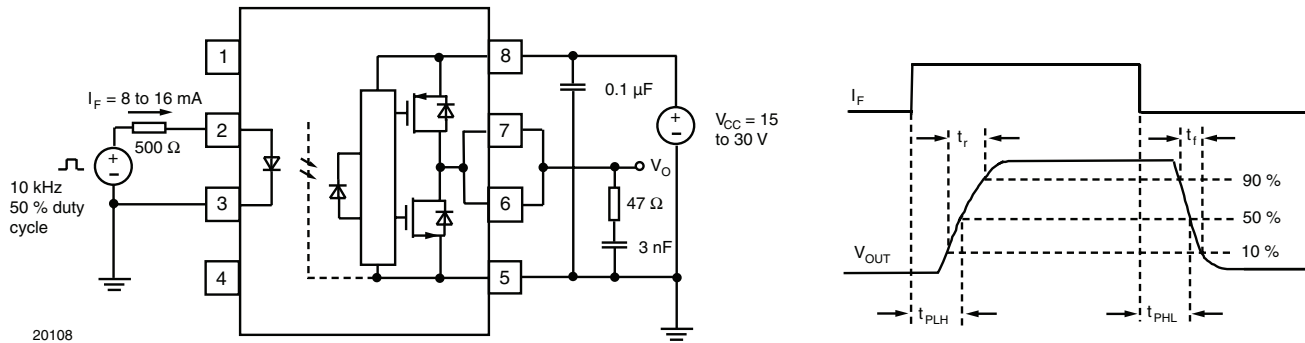


Fig. 7 -  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$  Test Circuit and Waveforms

COMMON MODE TRANSIENT IMMUNITY						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Common mode transient immunity at logic high output (1, 2)	$T_A = 25 \text{ }^\circ\text{C}$ , $I_F = 10 \text{ to } 16 \text{ mA}$ , $V_{CM} = 1500 \text{ V}$ , $V_{CC} = 30 \text{ V}$	$ CM_H $	15	30		$\text{kV}/\mu\text{s}$
Common mode transient immunity at logic low output (1, 3)	$T_A = 25 \text{ }^\circ\text{C}$ , $V_{CM} = 1500 \text{ V}$ , $V_{CC} = 30 \text{ V}$ , $V_F = 0 \text{ V}$	$ CM_L $	15	30		$\text{kV}/\mu\text{s}$

**Notes**

- (1) Pins 1 and 4 need to be connected to LED common.
- (2) Common mode transient immunity in the high state is the maximum tolerable  $|dV_{CM}/dt|$  of the common mode pulse,  $V_{CM}$ , to assure that the output will remain in the high state (i.e.,  $V_O > 15 \text{ V}$ ).
- (3) Common mode transient immunity in a low state is the maximum tolerable  $|dV_{CM}/dt|$  of the common mode pulse,  $V_{CM}$ , to assure that the output will remain in a low state (i.e.,  $V_O < 1 \text{ V}$ ).

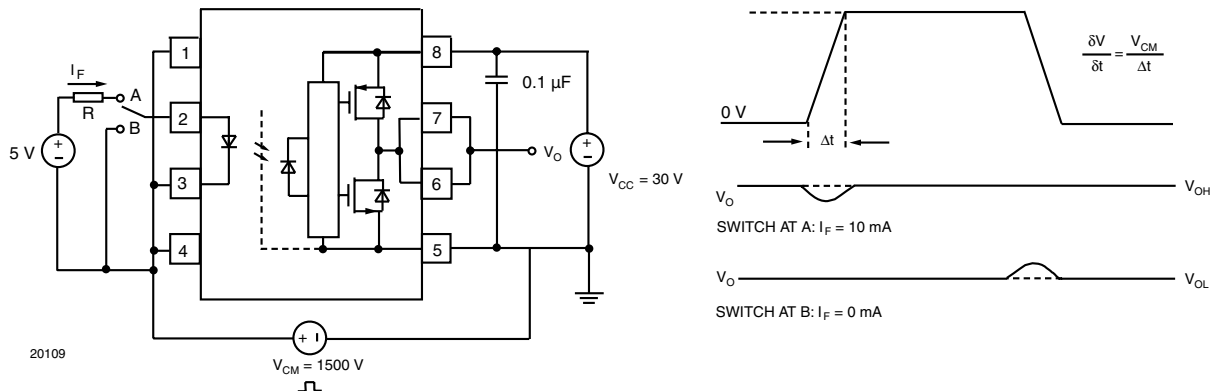
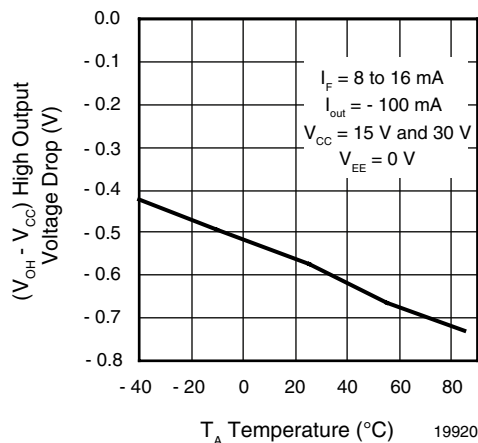
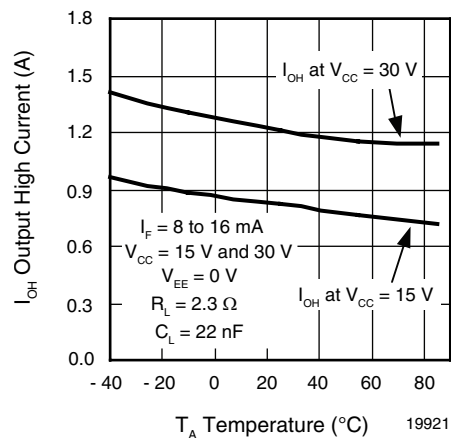


Fig. 8 - CMR Test Circuit and Waveforms

SAFETY AND INSULATION RATINGS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Climatic classification (according to IEC68 part 1)				55/110/21		
Comparative tracking index		CTI	175		399	
Peak transient overvoltage		$V_{IOTM}$	8000			V
Peak insulation voltage		$V_{IORM}$	630			V
Safety rating - power output		$P_{SO}$			500	mW
Safety rating - input current		$I_{SI}$			300	mA
Safety rating - temperature		$T_{SI}$			175	°C
Creepage distance	standard DIP-8		7			mm
Clearance distance	standard DIP-8		7			mm
Creepage distance	400 mil DIP-8		8			mm
Clearance distance	400 mil DIP-8		8			mm

**Note**

As per IEC 60747-5-2, § 7.4.3.8.1, 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. 9 -  $V_{OH}$  vs. Temperature

 Fig. 10 -  $I_{OH}$  vs. Temperature

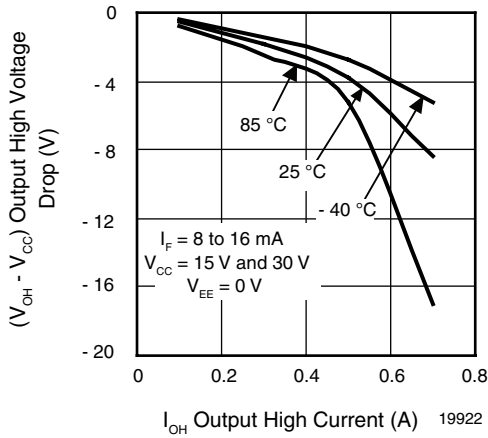


Fig. 11 -  $V_{OH}$  vs.  $I_{OH}$

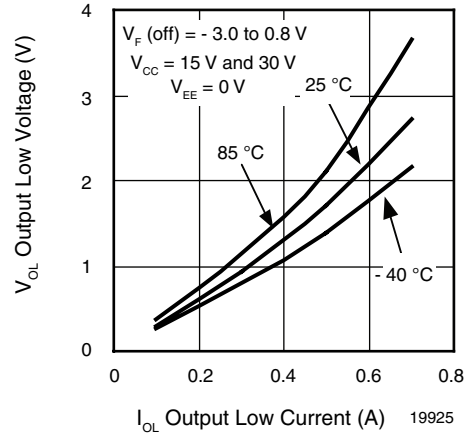


Fig. 14 -  $V_{OL}$  vs.  $I_{OL}$

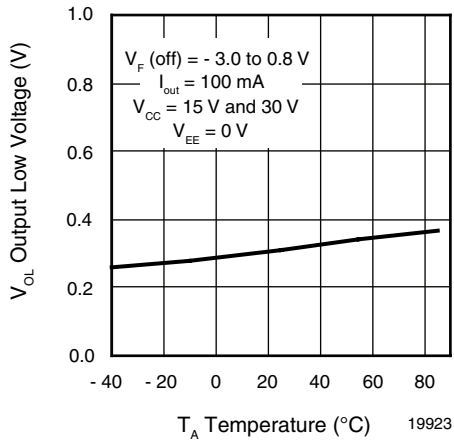


Fig. 12 -  $V_{OL}$  vs. Temperature

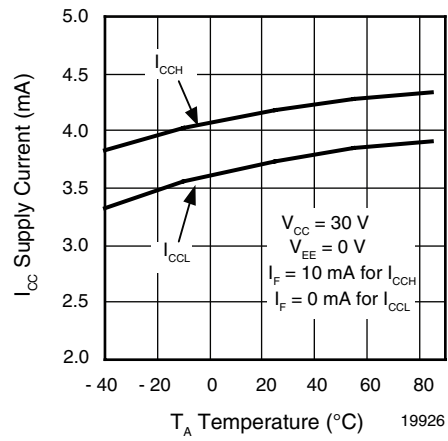


Fig. 15 -  $I_{CC}$  vs. Temperature

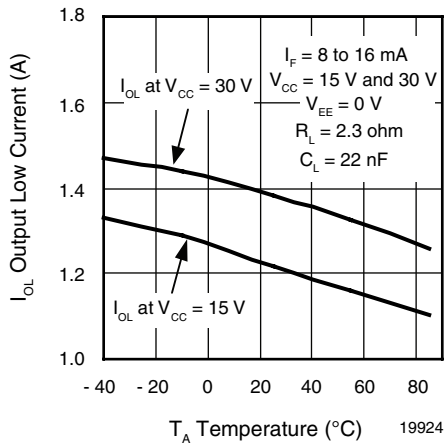


Fig. 13 -  $I_{OL}$  vs. Temperature

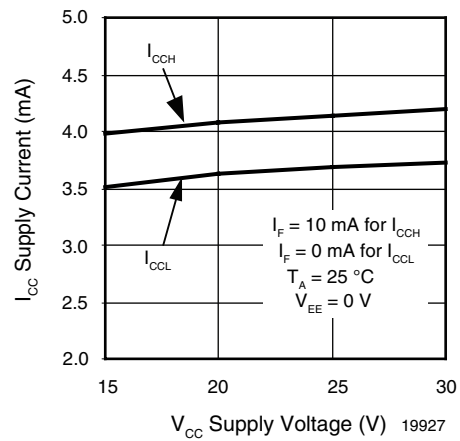


Fig. 16 -  $I_{CC}$  vs.  $V_{CC}$

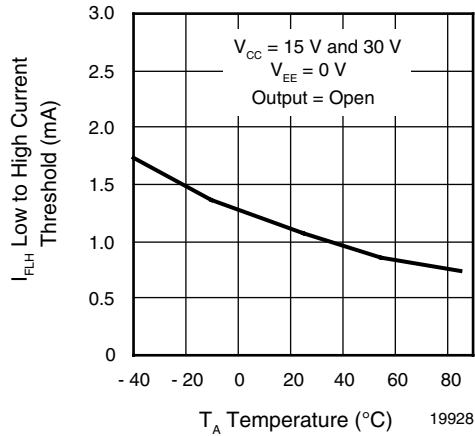
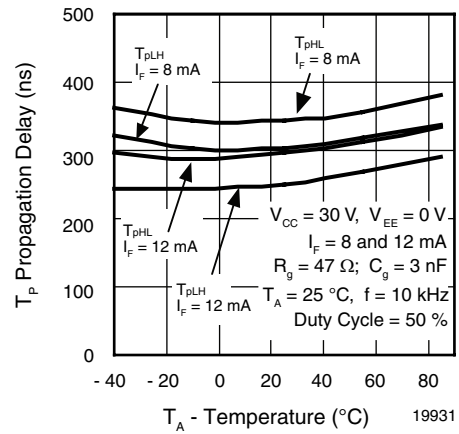
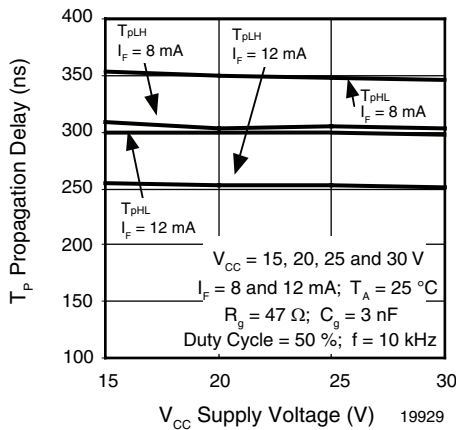
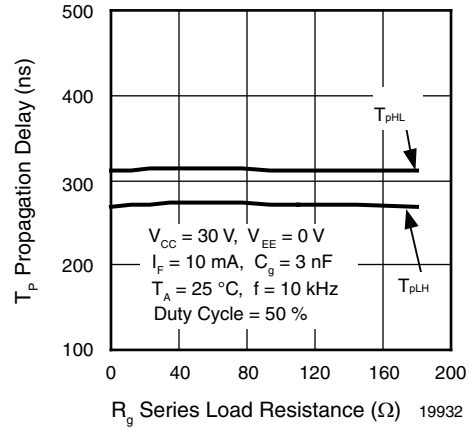
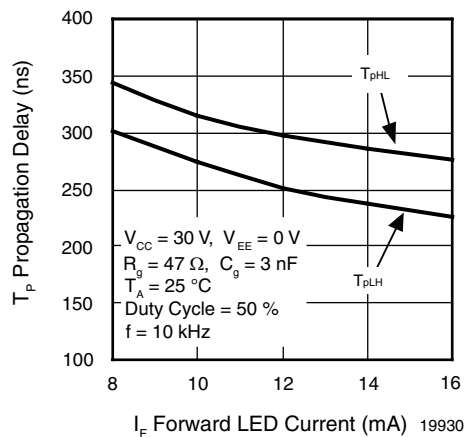
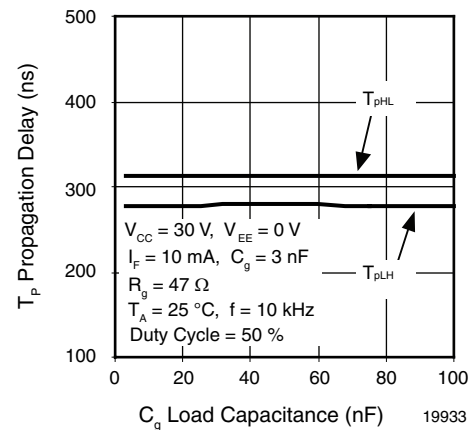
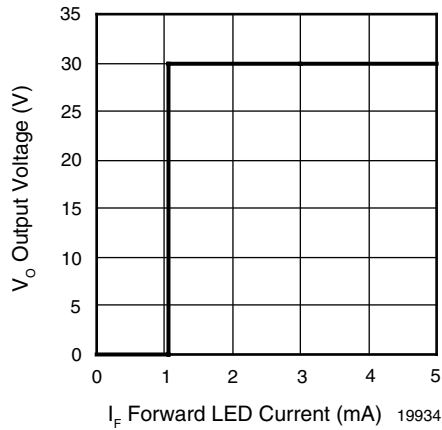

 Fig. 17 -  $I_{FLH}$  vs. Temperature


Fig. 20 - Propagation Delay vs. Temperature

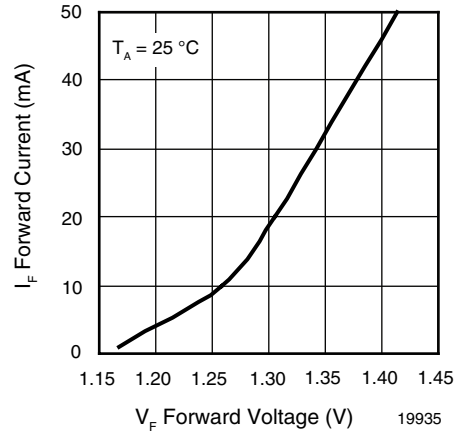

 Fig. 18 - Propagation Delay vs.  $V_{CC}$ 

 Fig. 21 - Propagation Delay vs.  $R_g$ 

 Fig. 19 - Propagation Delay vs.  $I_F$ 

 Fig. 22 - Propagation Delay vs.  $C_g$





$I_F$  Forward LED Current (mA) 19934

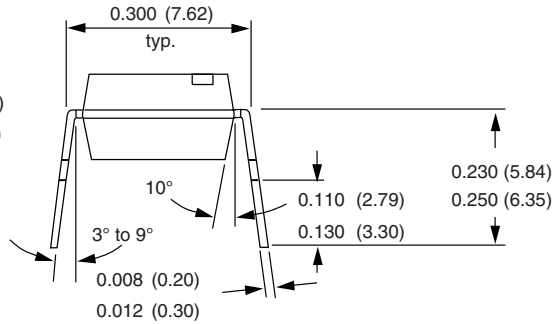
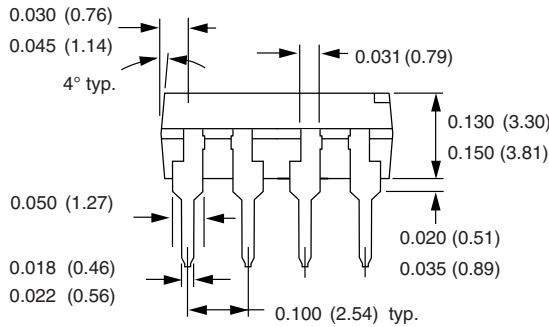
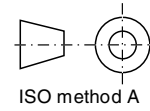
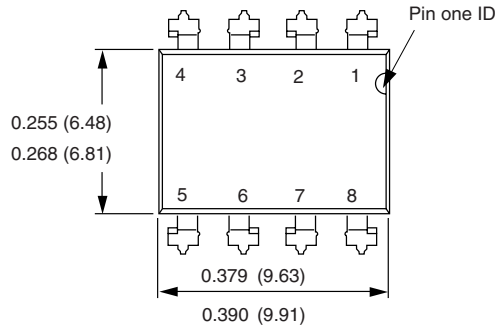
Fig. 23 - Transfer Characteristics



$V_F$  Forward Voltage (V) 19935

Fig. 24 - Input Current vs. Forward Voltage

**PACKAGE DIMENSIONS** in inches (millimeters)



i178006

**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



## Disclaimer

All product specifications and data are subject to change without notice.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.