VO3150

Vishay Semiconductors

Optocoupler, IGBT and MOSFET Driver

19813

thdip87

NC 1   8 V_CC
A 2   7 V_O
C 3   6 V_O
NC 4   5 V_EE
SHIELD

19814

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

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
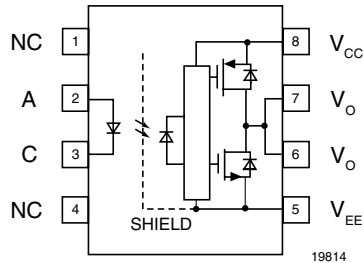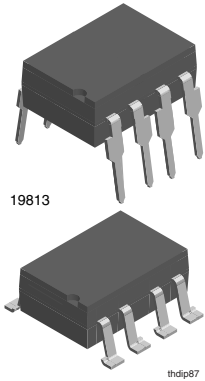
DESCRIPTION

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.

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
INPUT				
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

ABSOLUTE MAXIMUM RATINGS [1]

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
OUTPUT				
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
OPTOCOUPLER				
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 °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 µs, 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).

RECOMMENDED OPERATING CONDITION

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

THERMAL CHARACTERISTICS

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	θ_{JEB}	169	°C/W
Thermal resistance, junction emitter to case	at 25 °C	θ_{JEC}	192	°C/W
Thermal resistance, junction detector to board	at 25 °C	θ_{JDB}	82	°C/W
Thermal resistance, junction detector to case	at 25 °C	θ_{JDC}	80	°C/W
Thermal resistance, junction emitter to junction detector	at 25 °C	θ_{JED}	200	°C/W
Thermal resistance, case to ambient	at 25 °C	θ_{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.
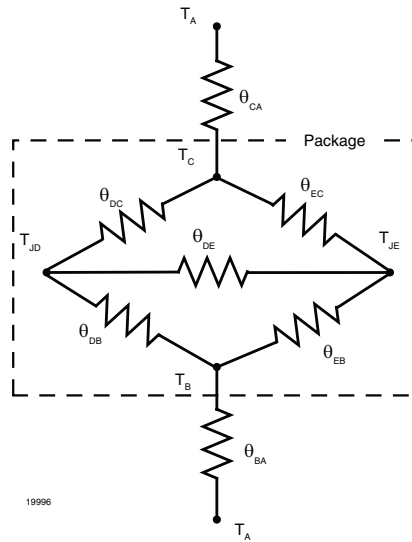
ELECTRICAL CHARACTERISTICS [1]

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
High level output current	$R_g = 2.3\ \Omega$, $C_g = 22$ nF	I_{OH} [2]	0.1	0.4		A
	$R_g = 2.3\ \Omega$, $C_g = 22$ nF	I_{OH} [3]	0.5			A
Low level output current	$R_g = 2.3\ \Omega$, $C_g = 22$ nF	I_{OL} [2]	0.1	0.6		A
	$R_g = 2.3\ \Omega$, $C_g = 22$ nF	I_{OL} [3]	0.5			A
High level output voltage	$I_O = -100$ mA	V_{OH} [4]	$V_{CC} - 1.5$	$V_{CC} - 0.6$		V
Low level output voltage	$I_O = 100$ mA	V_{OL}		0.3	1.0	V
High level supply current	Output open, $I_F = 8$ to 16 mA	I_{CCH}		4.2	7.0	mA
Low level supply current	Output open, $V_F = -3.0$ to $+0.8$ V	I_{CCL}		3.7	7.0	mA
Threshold input current low to high	$I_O = 0$ mA, $V_O > 5$ V	I_{FLH}		1.1	5.0	mA
Threshold input voltage high to low		V_{FHL}	0.8			V
Input forward voltage	$I_F = 10$ mA	V_F	1.0	1.3	1.6	V
Temperature coefficient of forward voltage	$I_F = 10$ mA	$\Delta V_F / \Delta T_A$		-1.4		mV/°C
Input reverse breakdown voltage	$I_R = 10\ \mu A$	BV_R	5			V
Input capacitance	$f = 1$ MHz, $V_F = 0$ V	C_{IN}		60		pF
UVLO threshold	$V_O \geq 5$ V	V_{UVLO+}	11.0	12.2	13.5	V
	$I_F = 10$ 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 ($T_A = -40$ °C to 110 °C, $I_{F(ON)} = 7$ mA to 16 mA, $V_{F(OFF)} = -3.0$ V to 0.8 V, $V_{CC} = 15$ V to 30 V, $V_{EE} =$ 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 $T_{amb} = 25$ °C and with $V_{CC} - V_{EE} = 30$ V.

[2] Maximum pulse width = 50 μs, maximum duty cycle = 0.5 %.

[3] Maximum pulse width = 10 μs, 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 %.
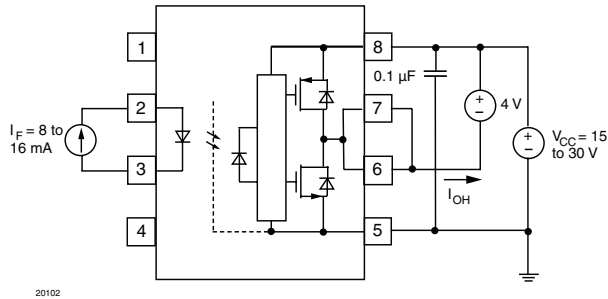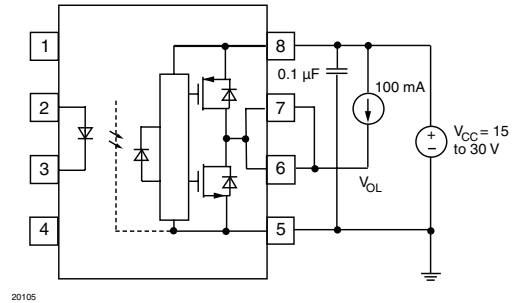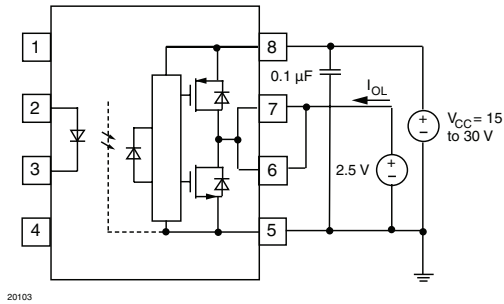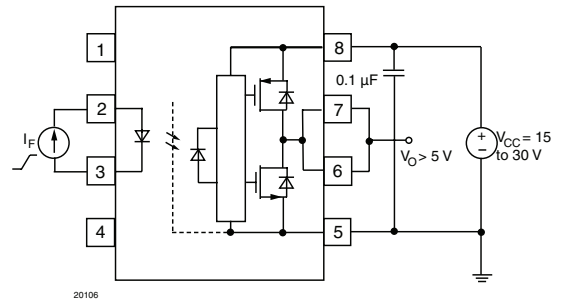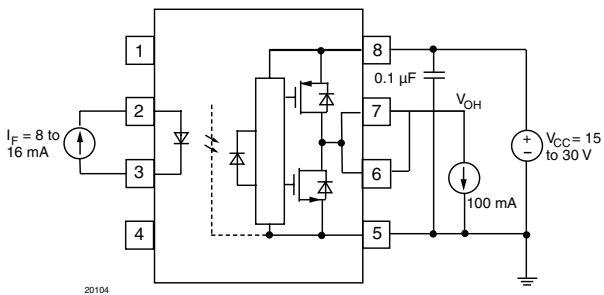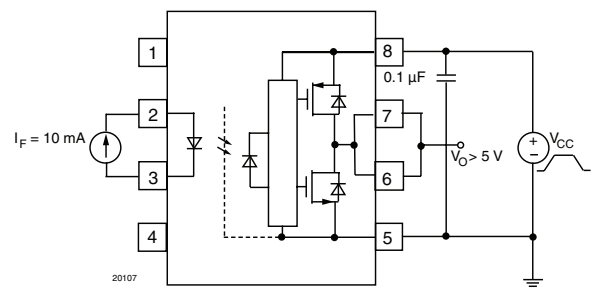
TEST CIRCUITS

Fig. 1 - I_{OH} Test Circuit

Fig. 2 - I_{OL} Test Circuit

Fig. 3 - V_{OH} Test Circuit

Fig. 4 - V_{OL} Test Circuit

Fig. 5 - I_{FLH} Test Circuit

Fig. 6 - UVLO Test Circuit

VO3150

Vishay Semiconductors

Optocoupler,
IGBT and MOSFET Driver

SWITCHING CHARACTERISTICS [1]

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

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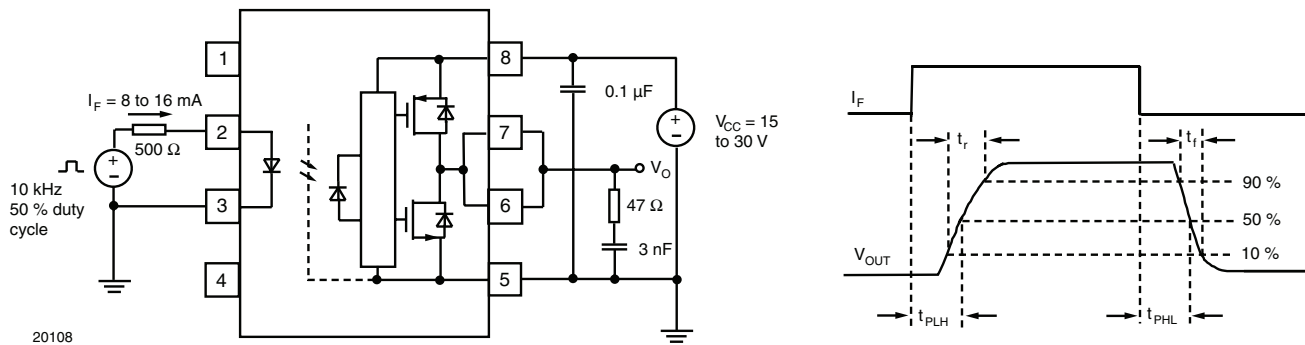
Fig. 7 - t_{PLH}, t_{PHL}, t_r and t_f Test Circuit and Waveforms

COMMON MODE TRANSIENT IMMUNITY

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Common mode transient immunity at logic high output [1, 2]	$T_A = 25$ °C, $I_F = 10$ to 16 mA, $V_{CM} = 1500$ V, $V_{CC} = 30$ V	$|CM_H|$	15	30		kV/µs
Common mode transient immunity at logic low output [1, 3]	$T_A = 25$ °C, $V_{CM} = 1500$ V, $V_{CC} = 30$ V, $V_F = 0$ V	$|CM_L|$	15	30		kV/µs

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., $V_O > 15$ 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., $V_O < 1$ V).
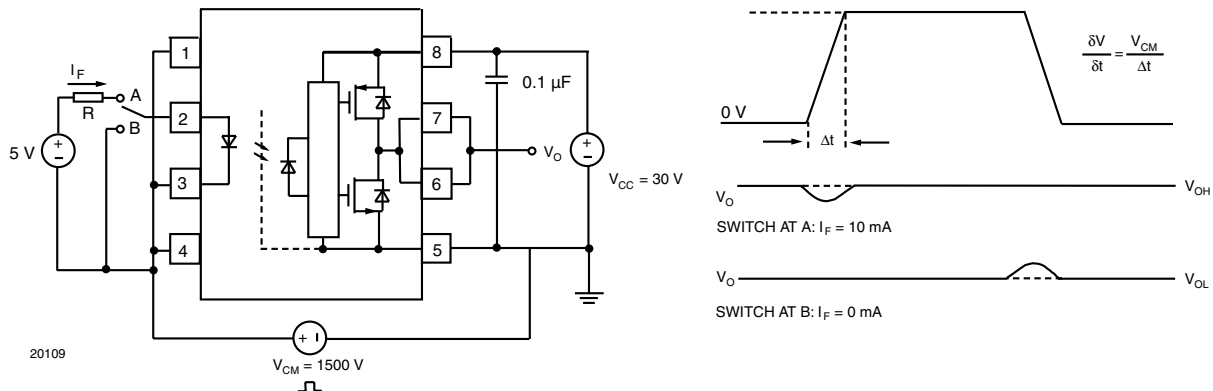
Fig. 8 - CMR Test Circuit and Waveforms

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 prodective circuits.
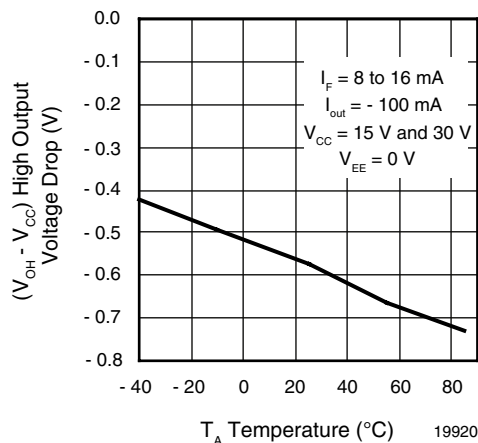
Fig. 9 - V_{OH} vs. Temperature
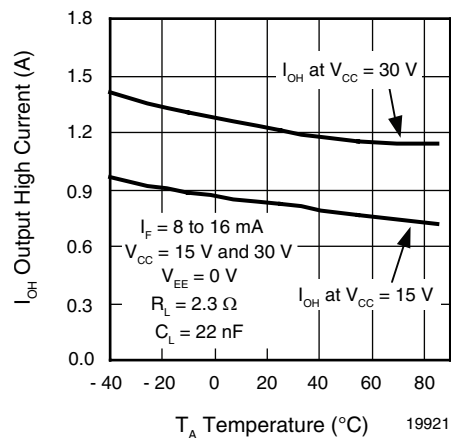
Fig. 10 - I_{OH} vs. Temperature
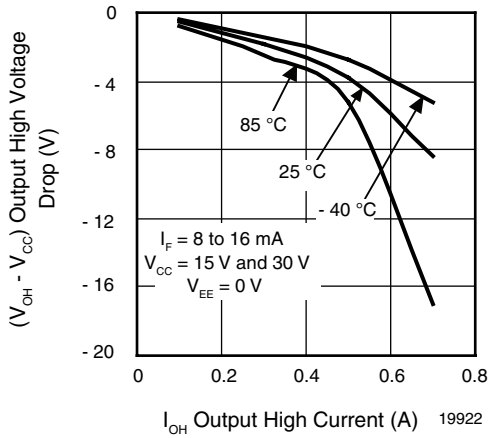
Fig. 11 - V_{OH} vs. I_{OH}
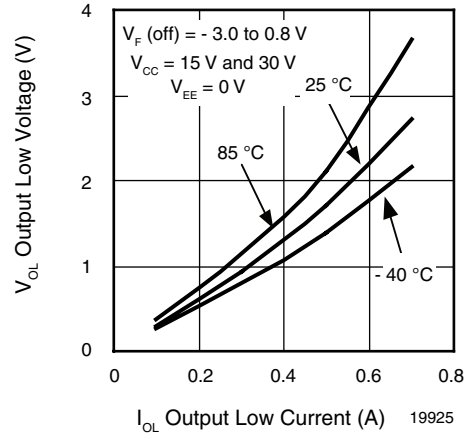
Fig. 14 - V_{OL} vs. I_{OL}
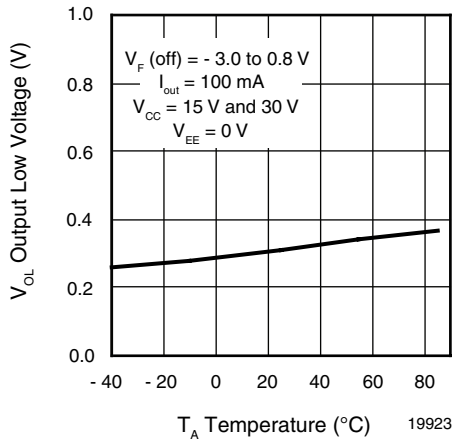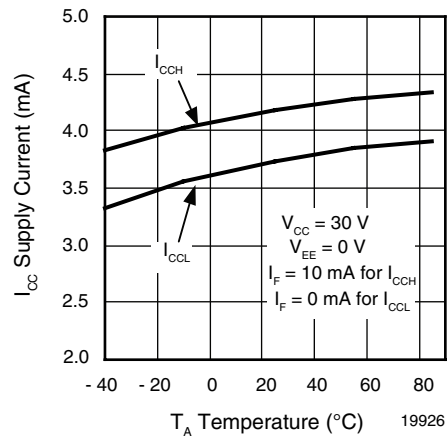

Fig. 12 - V_{OL} vs. Temperature
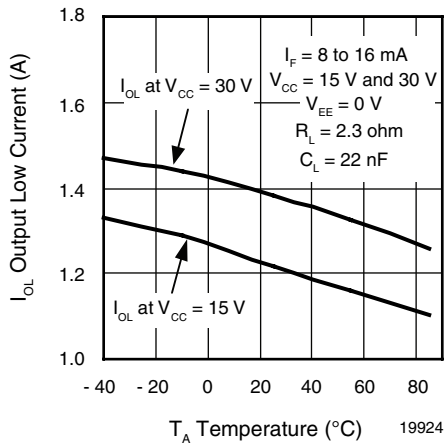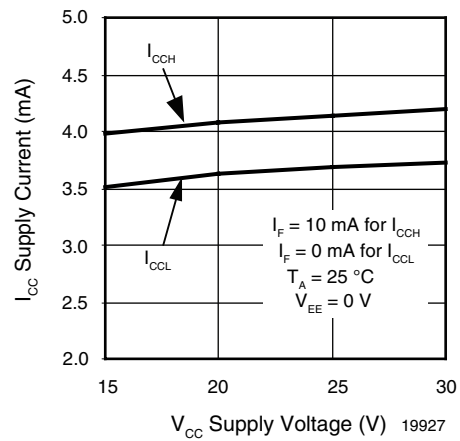

Fig. 15 - I_{CC} vs. Temperature

Fig. 13 - I_{OL} vs. Temperature

Fig. 16 - I_{CC} vs. V_{CC}
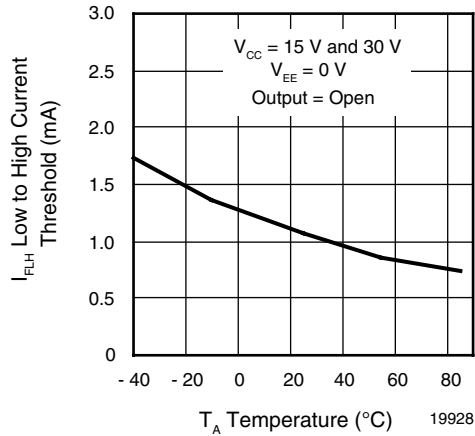
Fig. 17 - I_{FLH} vs. Temperature
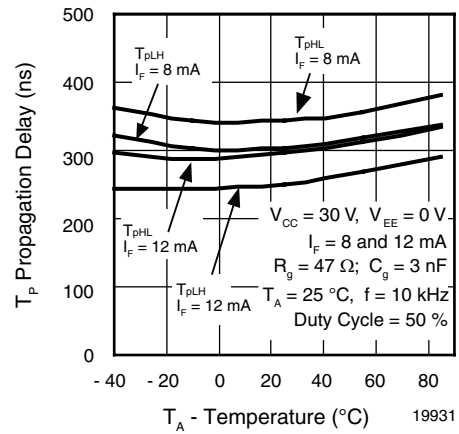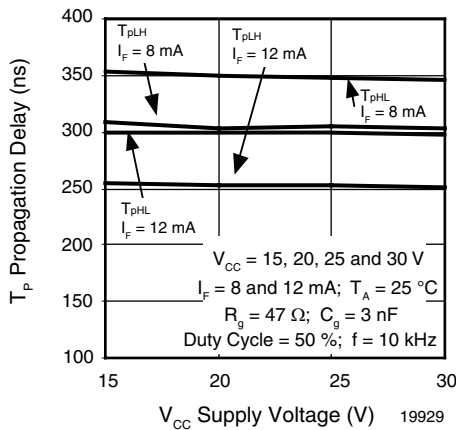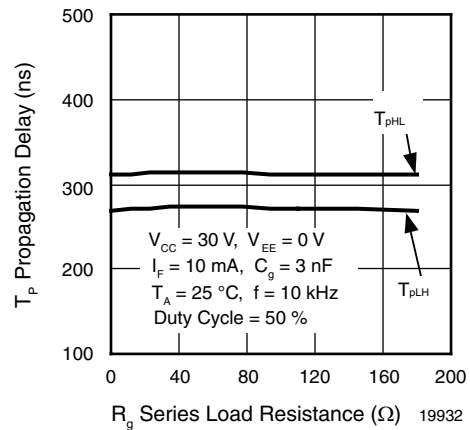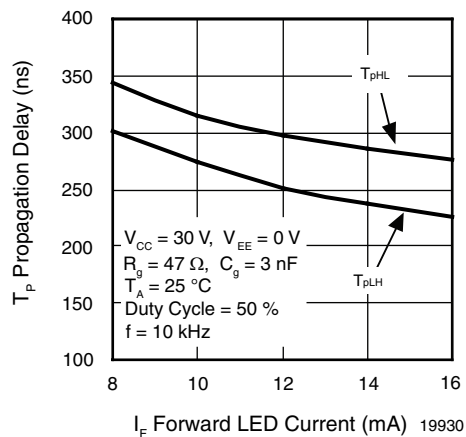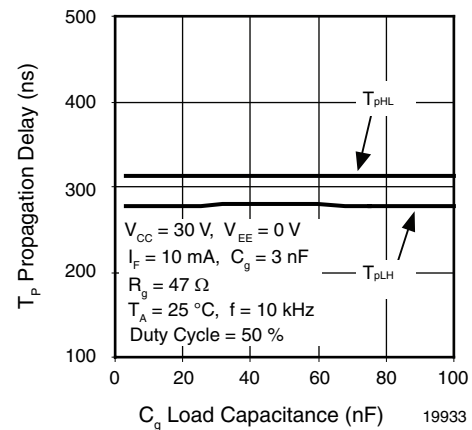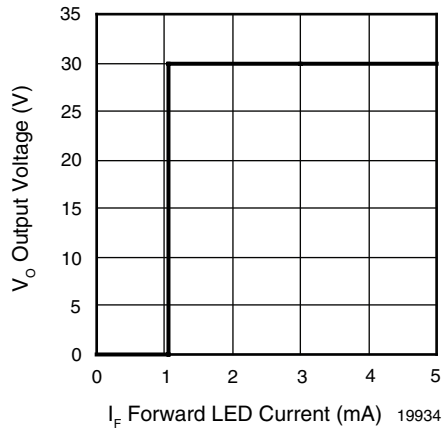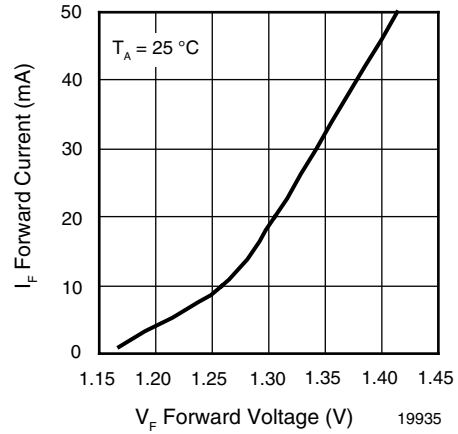

Fig. 20 - Propagation Delay vs. Temperature

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

Fig. 21 - Propagation Delay vs. R_g

Fig. 19 - Propagation Delay vs. I_F
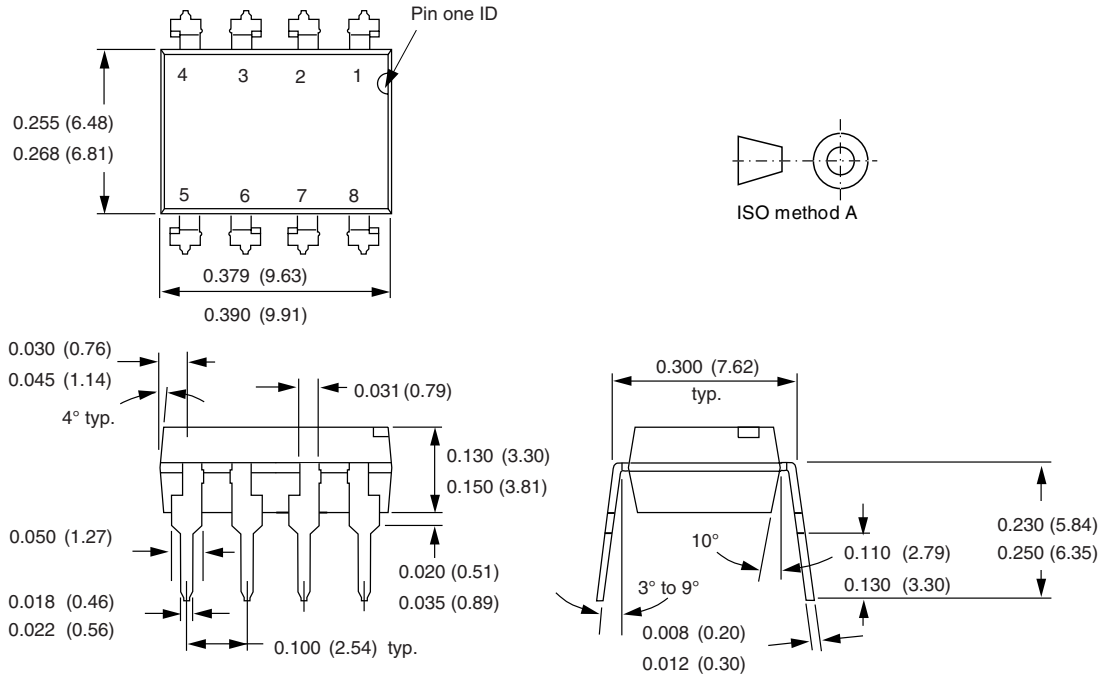

Fig. 22 - Propagation Delay vs. C_g

Fig. 23 - Transfer Characteristics

Fig. 24 - Input Current vs. Forward Voltage

PACKAGE DIMENSIONS in inches (millimeters)

ISO method A

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.

Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

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 in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk and agree to fully indemnify and hold Vishay and its distributors harmless from and against any and all claims, liabilities, expenses and damages arising or resulting in connection with such use or sale, including attorneys fees, even if such claim alleges that Vishay or its distributor was negligent regarding the design or manufacture of the part. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

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