

# High Speed Optocoupler, 100 kBd, Low Input Current, Photodiode Darlington Output



## DESIGN SUPPORT TOOLS

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## DESCRIPTION

High common mode transient immunity and very high current ratio together with 5300  $V_{RMS}$  insulation are achieved by coupling an LED with an integrated high gain photo detector in an eight pin dual-in-line package. Separate pins for the photo diode and output stage enable TTL compatible saturation voltages with high speed operation.

Access to the base terminal allows adjustment to the gain bandwidth.

The 6N139 is suited for low power logic applications involving CMOS and low power TTL applications. A 400 % current transfer ratio with only 0.5 mA of LED current is guaranteed.

**Caution:** Due to the small geometries of this device, it should be handled with Electrostatic Discharge (ESD) precautions. Proper grounding would prevent damage further and/or degradation which may be induced by ESD.

## FEATURES

- High current transfer ratio, 500 %
- Low input current, 1.6 mA
- High common mode rejection, 500 V/ $\mu$ s
- Adjustable bandwidth-access to base
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

## APPLICATIONS

- Microprocessor system interface
- PLC, ATE input / output isolation
- EIA RS232 line receiver
- TTL, CMOS voltage level translation
- Multiplexed data transmission
- Digital control power supply
- Ground loop and electrical noise elimination

## AGENCY APPROVALS

- [UL 1577](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\), available with option 1](#)

## ORDERING INFORMATION



AGENCY CERTIFIED/PACKAGE	CTR (%)
	<b>1.6 mA</b>
<b>UL, cUL</b>	<b>&gt; 500</b>
DIP-8	6N139
SMD-8, option 7	6N139-X007, 6N139-X007T
SMD-8, option 9	6N139-X009, 6N139-X009T
<b>UL, cUL, VDE (option 1)</b>	<b>&gt; 500</b>
DIP-8	6N139-X001
SMD-8, option 7	6N139-X017T
SMD-8, option 9	6N139-X019T

### Note

- For additional information on the available options refer to option information



<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		$V_R$	5	V
Forward current		$I_F$	25	mA
Average input current		$I_{f(avg)}$	20	mA
Input power dissipation		$P_{diss}$	35	mW
<b>OUTPUT</b>				
Supply and output voltage	Pin 8 to 5, pin 6 to 5	$V_{CC}, V_O$	-0.5 to 18	V
Emitter base reverse voltage	Pin 5 to 7		0.5	V
Peak input current	50 % duty cycle - 1 ms pulse width		40	mA
Peak transient input current	$t_p \leq 1\text{ }\mu\text{s}$ , 300 pps		1	A
Output current	Pin 6	$I_O$	60	mA
Output power dissipation		$P_{diss}$	100	mW
<b>COUPLER</b>				
Storage temperature		$T_{stg}$	-55 to +150	$^{\circ}\text{C}$
Operating temperature		$T_{amb}$	-55 to +100	$^{\circ}\text{C}$
Lead soldering temperature	$t = 10\text{ s}$	$T_{sld}$	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>						
Input forward voltage	$I_F = 1.6\text{ mA}$	$V_F$	-	1.4	1.7	V
Input reverse breakdown voltage	$I_R = 10\text{ }\mu\text{A}$	$B_{VR}$	5	-	-	V
Input capacitance	$f = 1\text{ MHz}$ , $V_F = 0$	$C_{IN}$	-	25	-	pF
Temperature coefficient of forward voltage	$I_F = 1.6\text{ mA}$		-	-1.8	-	mV/ $^{\circ}\text{C}$
<b>OUTPUT</b>						
Logic low, output voltage <sup>(1)</sup>	$I_F = 1.6\text{ mA}$ , $I_O = 8\text{ mA}$ , $V_{CC} = 4.5\text{ V}$	$V_{OL}$	-	0.1	0.4	V
	$I_F = 5\text{ mA}$ , $I_O = 15\text{ mA}$ , $V_{CC} = 4.5\text{ V}$	$V_{OL}$	-	0.15	0.4	V
	$I_F = 12\text{ mA}$ , $I_O = 24\text{ mA}$ , $V_{CC} = 4.5\text{ V}$	$V_{OL}$	-	0.25	0.4	V
Logic high, output current <sup>(1)</sup>	$I_F = 0\text{ mA}$ , $V_{CC} = 18\text{ V}$	$I_{OH}$	-	0.05	100	$\mu\text{A}$
Logic low supply current <sup>(1)</sup>	$I_F = 1.6\text{ mA}$ , $V_O = \text{OPEN}$ , $V_{CC} = 18\text{ V}$	$I_{CCL}$	-	0.2	1.5	mA
Logic high supply current <sup>(1)</sup>	$I_F = 0\text{ mA}$ , $V_O = \text{OPEN}$ , $V_{CC} = 18\text{ V}$	$I_{CCH}$	-	0.001	10	$\mu\text{A}$
<b>COUPLER</b>						
Input output insulation leakage current	45 % relative humidity, $T_{amb} = 25\text{ }^{\circ}\text{C}$ , $t = 5\text{ s}$ , $V_{IO} = 3000\text{ V}_{DC}$		-	-	1	$\mu\text{A}$
Coupling capacitance	$f = 1\text{ MHz}$	$C_{IO}$	-	0.6	-	pF

**Notes**

- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements

<sup>(1)</sup> Pin 7 open

**CURRENT TRANSFER RATIO**

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Current transfer ratio <sup>(1)</sup>	$I_F = 0.5 \text{ mA}, V_O = 0.4 \text{ V}, V_{CC} = 4.5 \text{ V}$	CTR	400	1600	-	%
	$I_F = 1.6 \text{ mA}, V_O = 0.4 \text{ V}, V_{CC} = 4.5 \text{ V}$	CTR	500	2000	-	%

**Notes**

<sup>(1)</sup> Pin 7 open

**SAFETY AND INSULATION RATINGS** ( $T_{amb} = 25 \text{ }^\circ\text{C}$ , unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	According to IEC 68 part 1		55 / 100 / 21	
Comparative tracking index	Insulation group IIIa	CTI	175	
Maximum rated withstanding isolation voltage	According to UL 1577, $t = 1 \text{ min}$	$V_{ISO}$	5300	$V_{RMS}$
Maximum transient isolation voltage	According to DIN EN 60747-5-5	$V_{IOTM}$	8000	$V_{peak}$
Maximum repetitive peak isolation voltage	According to DIN EN 60747-5-5	$V_{IORM}$	890	$V_{peak}$
Isolation resistance	$T_{amb} = 25 \text{ }^\circ\text{C}, V_{IO} = 500 \text{ V}$	$R_{IO}$	$\geq 10^{12}$	$\Omega$
	$T_{amb} = 100 \text{ }^\circ\text{C}, V_{IO} = 500 \text{ V}$	$R_{IO}$	$\geq 10^{11}$	$\Omega$
Output safety power		$P_{SO}$	500	mW
Input safety current		$I_{SI}$	300	mA
Input safety temperature		$T_S$	175	$^\circ\text{C}$
Creepage distance	DIP-8		$\geq 7$	mm
Clearance distance			$\geq 7$	mm
Creepage distance	SMD-8, option 7, SMD-8, option 9		$\geq 8$	mm
Clearance distance			$\geq 8$	mm
Insulation thickness		DTI	$\geq 0.4$	mm

**Note**

- As per IEC 60747-5-5, § 7.4.3.8.2, 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

**SWITCHING CHARACTERISTICS**

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Propagation delay time to logic low at output	$I_F = 0.5 \text{ mA}, R_L = 4.7 \text{ k}\Omega$	$t_{PHL}$	-	6	25	$\mu\text{s}$
	$I_F = 12 \text{ mA}, R_L = 270 \Omega$	$t_{PHL}$	-	0.6	1	$\mu\text{s}$
Propagation delay time to logic high at output	$I_F = 0.5 \text{ mA}, R_L = 4.7 \text{ k}\Omega$	$t_{PLH}$	-	4	60	$\mu\text{s}$
Propagation delay time to logic high at output	$I_F = 12 \text{ mA}, R_L = 270 \Omega$	$t_{PLH}$	-	1.5	7	$\mu\text{s}$

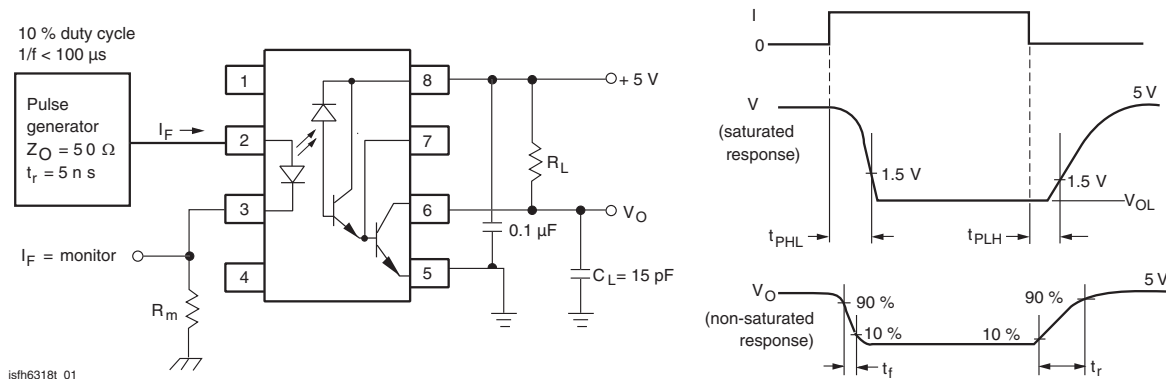


Fig. 1 - Switching Test Circuit

COMMON MODE TRANSIENT IMMUNITY						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Common mode transient immunity, logic high level output <sup>(1)</sup>	$I_F = 0 \text{ mA}$ , $R_L = 2.2 \text{ k}\Omega$ , $R_{CC} = 0$ , $ V_{CM}  = 10 \text{ V}_{P-P}$	$ CM_H $	-	500	-	V/ $\mu\text{s}$
Common mode transient immunity, logic low level output <sup>(1)</sup>	$I_F = 16 \text{ mA}$ , $R_L = 2.2 \text{ k}\Omega$ , $R_{CC} = 0$ , $ V_{CM}  = 10 \text{ V}_{P-P}$	$ CM_L $	-	- 500	-	V/ $\mu\text{s}$

**Note**

<sup>(1)</sup> In applications where  $dV/dt$  may exceed 50 000 V/ $\mu\text{s}$  (such as state discharge) a series resistor,  $R_{CC}$  should be included to protect  $I_C$  from destructively high surge currents. The recommend value is  $R_{CC} \equiv [(1 \text{ V})/(0.15 I_F \text{ (mA)})] \text{ k}\Omega$



Fig. 2 - Test Circuit for Transient Immunity and Typical Waveforms

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

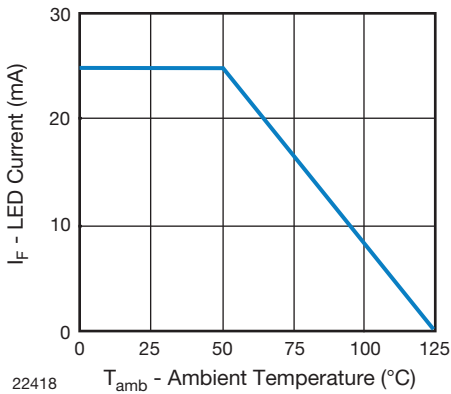


Fig. 2 - Permissible Forward LED Current vs. Temperature



Fig. 3 - Permissible Power Dissipation vs. Temperature



**PACKAGE DIMENSIONS** (in millimeters)

**DIP-8**



22672

**SMD-8, Option 7**



22674

SMD-8, Option 9



22675

PACKAGE MARKING



Fig. 3 - Example of 6N139-X017T

Note

- VDE logo is only marked on option 1 parts
- Tape and reel suffix (T) is not part of the package marking

**PACKING INFORMATION** (in millimeters)

**Tube**

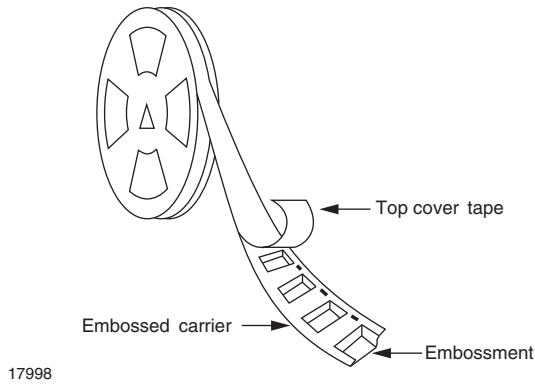

Fig. 4 - Shipping Tube Specifications for DIP-8 Packages

DEVICES PER TUBS			
TYPE	UNITS/TUBE	TUBES/BOX	UNITS/BOX
DIP-8	50	40	2000

**DIP-8**

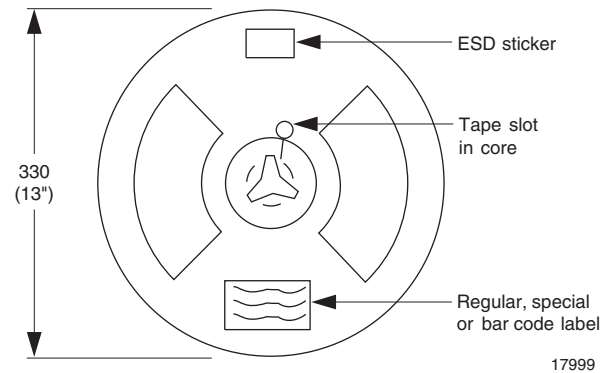

Fig. 5 - Tube Shipping Medium

Tape and Reel



17998

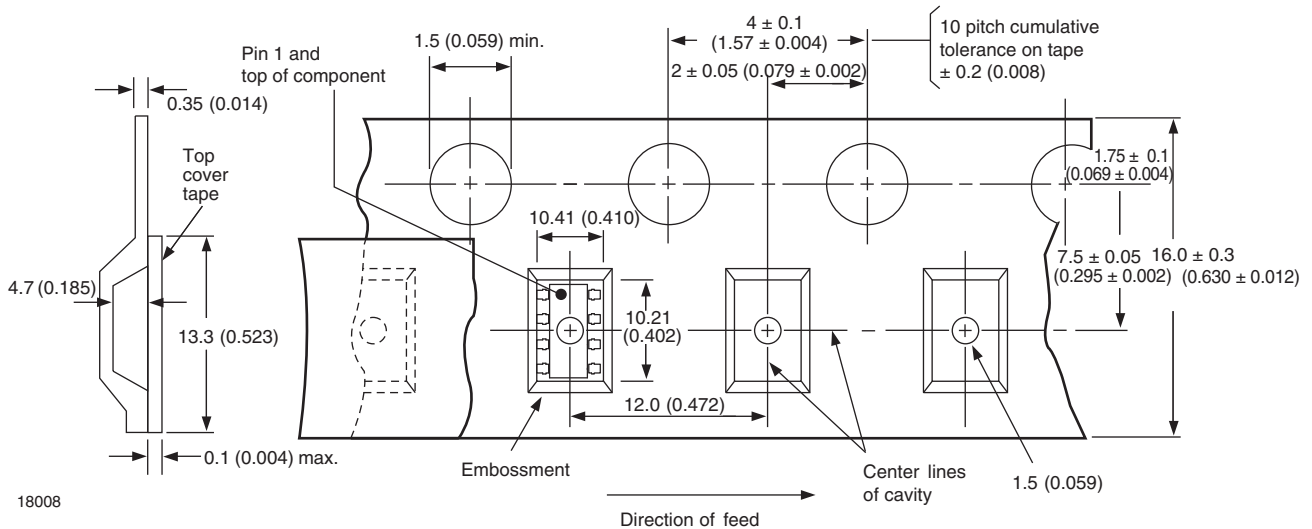
Fig. 6 - Tape and Reel Shipping Medium



17999

Fig. 7 - Tape and Reel Shipping Medium

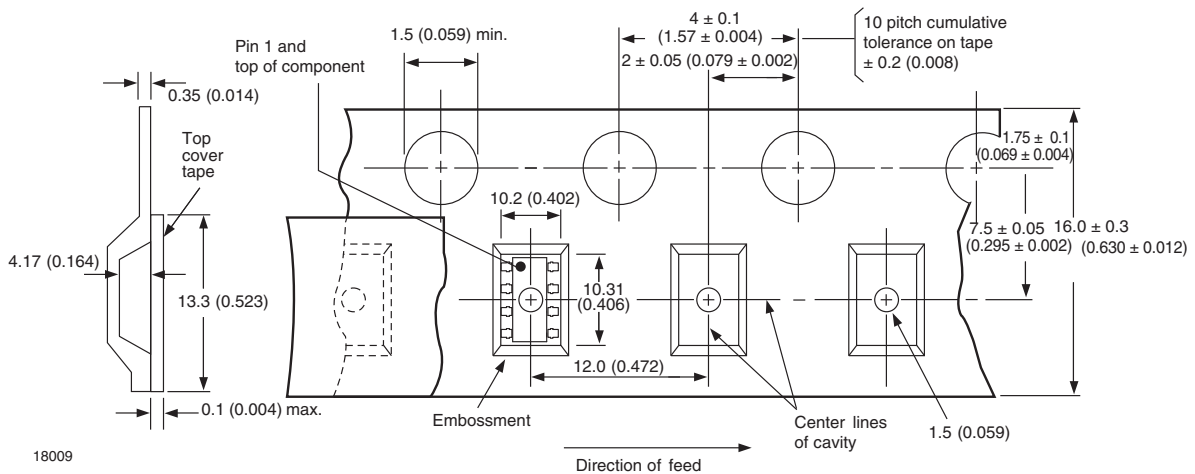
SMD-8 (option 7)



18008

Fig. 8 - Tape and Reel Packing (1000 pieces on Reel)

SMD-8 (option 9)



18009

Fig. 9 - Tape and Reel Shipping Medium



**SOLDER PROFILES**



948626

Fig. 10 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP-8 Devices



19841

Fig. 11 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD-8 Devices

**HANDLING AND STORAGE CONDITIONS**

ESD level: HBM class 2

Floor life: unlimited

Conditions:  $T_{amb} < 30\text{ °C}$ , RH < 85 %

Moisture sensitivity level 1, according to J-STD-020



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