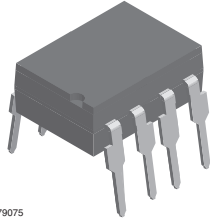
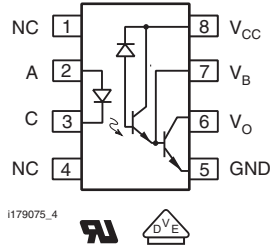


# High Speed Optocoupler, 100 kBd, Low Input Current, High Gain



I179075



I179075\_4

## DESCRIPTION

High common mode transient immunity and very high current ratio together with 5300 V<sub>RMS</sub> insulation are achieved by coupling an LED with an integrated high gain photon 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.

Photodarlington operation is achieved by tying the V<sub>CC</sub> and V<sub>O</sub> terminals together. Access to the base terminal allows adjustment to the gain bandwidth.

The SFH6138 is ideal for TTL applications since the 300 % minimum current transfer ratio with an LED current of 1.6 mA enables operation with one unit load-in and one unit load-out with a 2.2 kΩ pull-up resistor.

The SFH6139 is best suited for low power logic applications involving CMOS and low power TTL. A 400 % current transfer ratio with only 0.5 mA of LED current is guaranteed from 0 °C to 70 °C.

## FEATURES

- High current transfer ratio, 800 %
- Low input current requirement, 0.5 mA
- High output current, 60 mA
- Isolation test voltage, 5300 V<sub>RMS</sub>
- TTL compatible output, V<sub>OL</sub> = 0.1 V
- High common mode rejection, 500 V/μs
- DC to 0.1 megabit/s operation
- Adjustable bandwidth access to base
- Standard molded DIP plastic package
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC


**RoHS**  
COMPLIANT

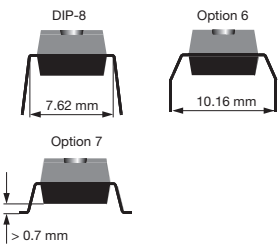
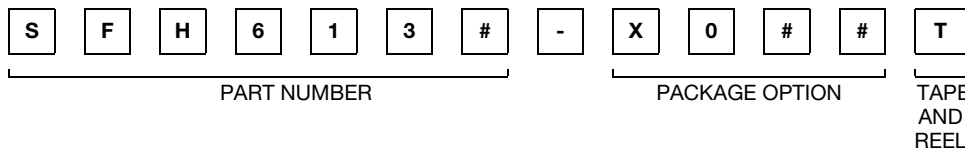
## APPLICATIONS

- Logic ground isolation-TTL/TTL, TTL/CMOS, CMOS/CMOS, CMOS/TTL
- EIA RS 232 C line receiver
- Low input current line receiver-long lines, party lines
- Telephone ring detector
- 117 V<sub>AC</sub> line voltage status indication-low input power dissipation
- Low power systems-ground isolation

## AGENCY APPROVALS

- UL1577, file no. E52744 system code H or J, double protection
- DIN EN 60747-5-5 (VDE 0884) available with option 1

## ORDERING INFORMATION



AGENCY CERTIFIED/PACKAGE	CTR (%)	
<b>UL</b>	≥ 300	≥ 500
DIP-8	SFH6138	SFH6139
DIP-8, option 6	SFH6138-X006	SFH6139-X006
<b>VDE, UL</b>	≥ 300	≥ 500
SMD-8, option 7	SFH6138-X017T (1)	SFH6139-X017T (1)

### Note

(1) Also available in tubes; do not add T to end

ABSOLUTE MAXIMUM RATINGS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)					
PARAMETER	TEST CONDITION	PART	SYMBOL	VALUE	UNIT
<b>INPUT</b>					
Reverse voltage				5	V
Average current			$I_{F(AVG)}$	20	mA
Peak current	50 % duty cycle - 1 ms pulse width			40	mA
Peak transient current	$t \leq 1\text{ }\mu\text{s}$ , 300 pps			1	A
<b>OUTPUT</b>					
Supply and output voltage	$V_{CC}$ (pin 8-5), $V_O$ (pin 6-5)	SFH6138	$V_S, V_O$	- 0.5 to 7	V
		SFH6139	$V_S, V_O$	- 0.5 to 18	V
Emitter base reverse voltage (pin 5 to 7)			$V_{EBO}$	0.5	V
Output current $I_O$ (pin 6)			$I_O$	60	mA
Derate linearly above 25 $^{\circ}\text{C}$ , free air temperature				0.7	mA/ $^{\circ}\text{C}$
Input power dissipation			$P_{diss IN}$	35	mW
Derate linearly above 50 $^{\circ}\text{C}$ , free air temperature				0.7	mW/ $^{\circ}\text{C}$
Output power dissipation			$P_{diss OUT}$	100	mW
Derate linearly above 25 $^{\circ}\text{C}$ , free air temperature				0.2	mA/ $^{\circ}\text{C}$
<b>COUPLER</b>					
Isolation test voltage	$t = 1\text{ s}$		$V_{ISO}$	5300	$V_{RMS}$
Isolation resistance	$V_{IO} = 500\text{ V}$ , $T_{amb} = 100\text{ }^{\circ}\text{C}$		$R_{IO}$	$\geq 10^{11}$	$\Omega$
	$V_{IO} = 500\text{ V}$ , $T_{amb} = 25\text{ }^{\circ}\text{C}$		$R_{IO}$	$\geq 10^{12}$	$\Omega$
Storage temperature range			$T_{stg}$	- 55 to + 125	$^{\circ}\text{C}$
Ambient temperature range			$T_{amb}$	- 55 to + 100	$^{\circ}\text{C}$
Lead soldering temperature <sup>(1)</sup>	$t = 10\text{ s}$		$T_{slid}$	260	$^{\circ}\text{C}$

### Notes

- 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>(1)</sup> Refer to wave profile for soldering conditions for through hole devices.

ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>							
Forward voltage	$I_F = 16\text{ mA}$		$V_F$		1.4	1.7	V
Reverse breakdown voltage	$I_R = 10\text{ }\mu\text{A}$		$BV_R$	5			V
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>	$I_F = 16\text{ mA}$ , $I_O = 4.8\text{ mA}$ , $V_{CC} = 4.5\text{ V}$	SFH6138	$V_{OL}$		0.1	0.4	V
	$I_F = 16\text{ mA}$ , $I_O = 8\text{ mA}$ , $V_{CC} = 4.5\text{ V}$	SFH6139	$V_{OL}$		0.1	0.4	V
Logic low output voltage	$I_F = 5\text{ mA}$ , $I_O = 15\text{ mA}$ , $V_{CC} = 4.5\text{ V}$	SFH6139	$V_{OL}$		0.15	0.4	V
	$I_F = 12\text{ mA}$ , $I_O = 24\text{ mA}$ , $V_{CC} = 4.5\text{ V}$	SFH6139	$V_{OL}$		0.25	0.4	V
Logic high output current <sup>(1)</sup>	$I_F = 0\text{ mA}$ , $V_O = V_{CC} = 7\text{ V}$	SFH6138	$I_{OH}$		0.1	250	$\mu\text{A}$
	$I_F = 0\text{ mA}$ , $V_O = V_{CC} = 18\text{ V}$	SFH6139	$I_{OH}$		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	$I_F = 0\text{ mA}$ , $V_O = \text{open}$ , $V_{CC} = 18\text{ V}$		$I_{CCH}$		0.001	10	$\mu\text{A}$

<b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>COUPLER</b>							
Input capacitance	$f = 1\text{ MHz}, V_F = 0$		$C_{IN}$		25		pF
Capacitance (input to output) <sup>(2)</sup>	$f = 1\text{ MHz}$		$C_O$		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.

(1) Pin 7 open.

(2) Device considered a two-terminal device: pins 1, 2, 3 and 4 shorted together and pins 5, 6, 7, and 8 shorted together.

<b>CURRENT TRANSFER RATIO</b>							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Current transfer ratio <sup>(1)</sup>	$I_F = 1.6\text{ mA}, V_O = 0.4\text{ V}, V_{CC} = 4.5\text{ V}$	SFH6138	CTR	300	1600		%
		SFH6139	CTR	400	1600		%
Current transfer ratio	$I_F = 1.6\text{ mA}, V_O = 0.4\text{ V}, V_{CC} = 4.5\text{ V}$	SFH6139	CTR	500	2000		%

### Note

(1) DC current transfer ratio is defined as the ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$  times 100 %. Pin 7 open.

<b>SWITCHING CHARACTERISTICS</b>							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Propagation delay time to logic low at output	$I_F = 1.6\text{ mA}, R_L = 2.2\text{ k}\Omega$	SFH6138	$t_{PHL}$		2	10	$\mu\text{s}$
	$I_F = 0.5\text{ mA}, R_L = 4.7\text{ k}\Omega$	SFH6139	$t_{PHL}$		6	25	$\mu\text{s}$
	$I_F = 12\text{ mA}, R_L = 270\text{ }\Omega$	SFH6139	$t_{PHL}$		0.6	1	$\mu\text{s}$
Propagation delay time to logic high at output <sup>(1)</sup>	$I_F = 1.6\text{ mA}, R_L = 2.2\text{ k}\Omega$	SFH6138	$t_{PLH}$		4	35	$\mu\text{s}$
	$I_F = 0.5\text{ mA}, R_L = 4.7\text{ k}\Omega$	SFH6139	$t_{PLH}$		5	60	$\mu\text{s}$
	$I_F = 12\text{ mA}, R_L = 270\text{ }\Omega$	SFH6139	$t_{PLH}$		1	7	$\mu\text{s}$

### Note

(1) Pin 7 open. Using a resistor between pin 5 and 7 will decrease gain and delay time.

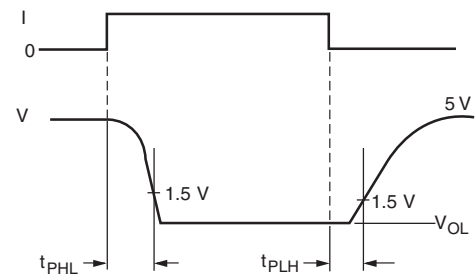
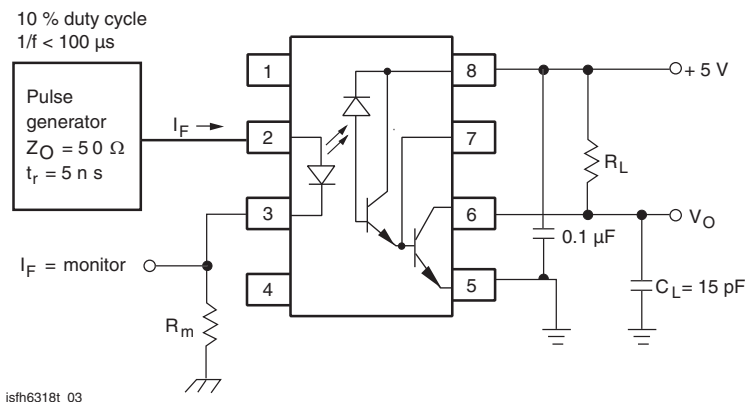


Fig. 1 - Switching Test Circuit

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

**Note**

<sup>(1)</sup> Common mode transient immunity in logic high level is the maximum tolerable (positive)  $dV_{CM}/dt$  on the leading edge of the common mode pulse,  $V_{CM}$ , to assure that the output will remain in a logic high state (i.e.  $V_O > 2 \text{ V}$ ) common mode transient immunity in logic low level is the maximum tolerable (negative)  $dV_{CM}/dt$  on the trailing edge of the common mode pulse signal,  $V_{CM}$ , to assure that the output will remain in a logic low state (i.e.  $V_O < 0.8 \text{ V}$ ).

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

SAFETY AND INSULATION RATINGS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Climatic classification (according to IEC 68 part 1)				55/100/21		
Comparative tracking index		CTI	175		399	
$V_{IOTM}$			8000			V
$V_{IORM}$			890			V
$P_{SO}$					500	mW
$I_{SI}$					300	mA
$T_{SI}$					175	$^{\circ}\text{C}$
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**

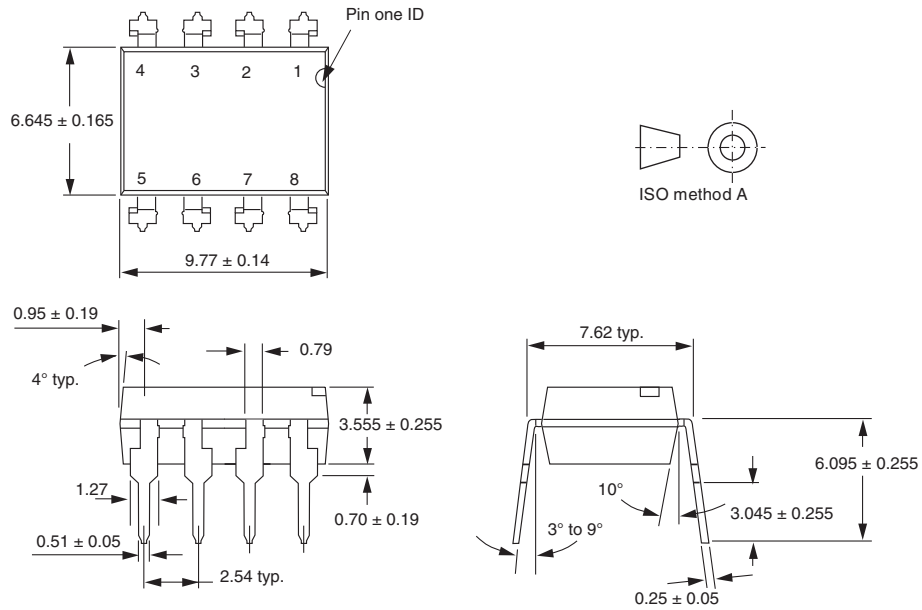
- As per IEC 60747-5-5, §7.4.3.8.1, this optocoupler is suitable for "safe electrical insulation" only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.



# SFH6138, SFH6139

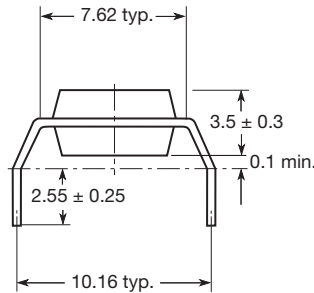
High Speed Optocoupler, 100 kBd, Vishay Semiconductors  
Low Input Current, High Gain

## PACKAGE DIMENSIONS in millimeters



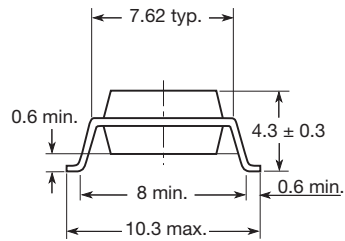
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### Option 6

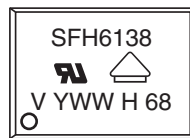


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### Option 7



## PACKAGE MARKING



21764-67



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