

PHOTOCOUPLER

T-41-85

6N138, 6N139 GaAlAs INFRARED+ PHOTO-IC

The 6N138 and 6N139 consist of a GaAlAs infrared emitting diode coupled with a split-Darlington output configuration. A high speed GaAlAs infrared manufactured with a unique LPE junction, has the virtue of fast rise and fall time at low drive current.

APPLICATIONS

- CURRENT LOOP DRIVER
- LOW INPUT CURRENT LINE RECEIVER
- CMOS LOGIC INTERFACE

FEATURES

- Isolation voltage: 2500V_{rms} (Min.)
- Current transfer ratio: 6N138 - 300% Min. ($I_F = 1.6\text{mA}$)
6N139 - 400% Min. ($I_F = 0.5\text{mA}$)
- Switching time: 6N138 - $t_{PHL} = 10\mu\text{s}$ Max.
- $t_{PLH} = 35\mu\text{s}$ Max.
6N139 - $t_{PHL} = 1\mu\text{s}$ Max.
- $t_{PLH} = 7\mu\text{s}$ Max.

MAXIMUM RATINGS ($T_a = 25^\circ\text{C}$)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (Note 1)	I_F	20	mA
Pulse Forward Current	I_{FP*1}	40	mA
Total Pulse Forward Current	I_{FP*2}	1	A
Reverse Voltage	V_R	5	V
Diode Power Dissipation (Note 2)	P_D	35	mW
Output Current (Note 3)	I_O	60	mA
Emitter-Base Reverse Voltage	V_{EB}	0.5	V
Supply Voltage	V_{CC*3}	-0.5 ~ 18	V
Output Voltage	V_O*3	-0.5 ~ 18	V
Output Power Dissipation (Note 4)	P_O	100	mW
Operating Temperature Range	T_{opr}	- 0 ~ 70	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	- 55 ~ 125	$^\circ\text{C}$
Lead Solder Temperature (10 sec.)	T_{sld}	260	$^\circ\text{C}$
Isolation Voltage (1 min., RH $\leq$ 60%)	BV_S^{**}	2500 3540	V_{rms} V_{dc}

* JEDEC Registered Data.

** Not Registered JEDEC.

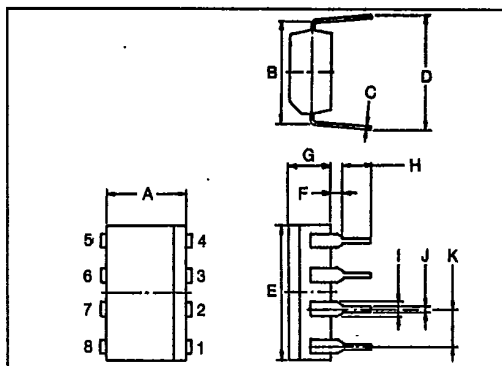
*1: 50% duty cycle, 1ms pulse width.

*2: Pulse width 1 μs , 300pps.

*3: 6N138 ... -0.5 to 7V.

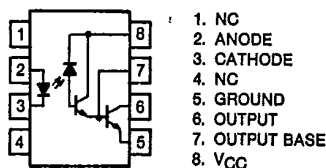
*4: 1.6mm below seating plane.

A - LED B - DETECTOR

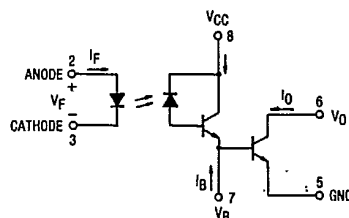


SYMBOL	INCHES	MM
A	0.252	6.4
B	0.300	7.62 ± 0.25
C	0.010 ± 0.002	0.25 ± 0.05
D	0.309 ~ 0.348	7.85 ~ 8.80
E	0.380 ± 0.010	9.66 ± 0.25
F	0.031	0.8
G	0.144	3.65
H	0.100 MIN	2.5 MIN
I	0.047	1.2
J	0.020	0.5
K	0.100 ± 0.010	2.54 ± 0.25

PIN CONFIGURATION (TOP VIEW)



SCHEMATIC



PHOTOCOUPLER

OPTO-ELECTRICAL CHARACTERISTICS OVER RECOMMENDED TEMPERATURE ($T_a = 0^\circ\text{C} \sim 70^\circ\text{C}$ Unless otherwise noted)

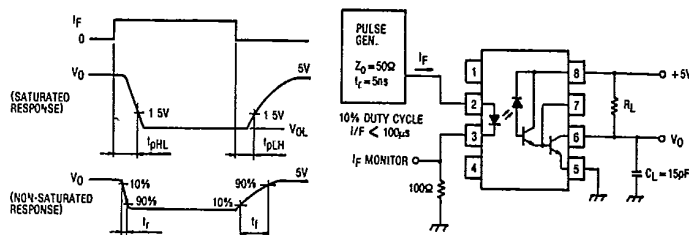
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CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.**	MAX.	UNIT
Current Transfer Ratio (Note 5, 6)	6N139	CTR*	$I_F = 0.5\text{mA}, V_O = 0.4\text{V}$ $V_{CC} = 4.5\text{V}$	400	800	—
	6N138					
Logic Low Output Voltage (Note 6)	6N139	VOL	$I_F = 1.6\text{mA}, I_O = 6.4\text{mA}$ $V_{CC} = 4.5\text{V}$	—	0.1	0.4
Logic High Output Current (Note 6)	6N139	IOH*	$I_F = 0\text{mA}, V_O = V_{CC} = 18\text{V}$	—	0.05	100
	6N138					
Logic Low Supply Current (Note 6)		ICCL	$I_F = 1.6\text{mA}, V_O = \text{Open}, V_{CC} = 5\text{V}$	—	0.2	—
Logic High Supply Current (Note 6)		ICCH	$I_F = 0\text{mA}, V_O = \text{Open}, V_{CC} = 5\text{V}$	—	10	—
Input Forward Voltage		VF*	$I_F = 1.6\text{mA}, T_a = 25^\circ\text{C}$	—	1.65	1.7
Input Reverse Breakdown Voltage		BVR*	$I_R = 10\mu\text{A}, T_a = 25^\circ\text{C}$	5	—	—
Temperature Coefficient of Forward Voltage		$\frac{\Delta V_F}{\Delta T_a}$	$I_F = 1.6\text{mA}$	—	-1.9	—
Input Capacitance		CIN	$f = 1\text{MHz}, V_F = 0$	—	60	—
Input-Output Isolation Leakage Current		II-O*	45% Relative Humidity, $t = 5\text{s}, V_{I-O} = 3000\text{Vdc}$ $T_a = 25^\circ\text{C}$ (Note 7)	—	—	1.0
Resistance (Input-Output)		RI-O	$V_{I-O} = 500\text{Vdc}$ (Note 7)	—	10^{12}	—
Capacitance (Input-Output)		CI-O	$f = 1\text{MHz}$ (Note 7)	—	0.6	—

** JEDEC Registered Data.

* All typicals at $T_a = 25^\circ\text{C}$ and $V_{CC} = 5\text{V}$, Unless otherwise noted..

TEST CIRCUIT 1.



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SWITCHING CHARACTERISTICS ($T_a = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$, Unless otherwise noted)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to Logic Low at Output (Note 6, 8)	6N139	1	$I_F = 0.5\text{mA}$, $R_L = 4.7\text{k}\Omega$	—	5	25.0	μs
	6N138		$I_F = 12\text{mA}$, $R_L = 270\Omega$	—	0.2	1	μs
	6N138		$I_F = 1.6\text{mA}$, $R_L = 2.2\text{k}\Omega$	—	1	10	μs
Propagation Delay Time to Logic High at Output (Note 6, 8)	6N139	1	$I_F = 0.5\text{mA}$, $R_L = 4.7\text{k}\Omega$	—	5	60	μs
	6N138		$I_F = 12\text{mA}$, $R_L = 270\Omega$	—	1	7	μs
	6N138		$I_F = 1.6\text{mA}$, $R_L = 2.2\text{k}\Omega$	—	4	35	μs
Common Mode Transient Immunity at Logic High Level Output (Note 9)	CM_H	2	$I_F = 0\text{mA}$, $R_L = 2.2\text{k}\Omega$ $V_{CM} = 400\text{Vp-p}$	—	500	—	$\text{V}/\mu\text{s}$
Common Mode Transient Immunity at Logic Low Level Output (Note 9)	CM_L	2	$I_F = 1.6\text{mA}$, $R_L = 2.2\text{k}\Omega$ $V_{CM} = 400\text{Vp-p}$	—	-500	—	$\text{V}/\mu\text{s}$

* JEDEC Registered Data.

Note 1: Derate linearly above 50°C free-air temperature at a rate of $0.4\text{mW}/^\circ\text{C}$.Note 2: Derate linearly above 50°C free-air temperature at a rate of $0.7\text{mW}/^\circ\text{C}$.Note 3: Derate linearly above 25°C free-air temperature at a rate of $0.7\text{mW}/^\circ\text{C}$.Note 4: Derate linearly above 25°C free-air temperature at a rate of $2.0\text{mW}/^\circ\text{C}$.Note 5: 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%.

Note 6: Pin 7 Open.

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

Note 8: Use of a resistor between pin 5 and 7 will decrease gain and delay time.

Note 9: 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., $V_O > 2.0\text{V}$). 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., $V_O < 0.8\text{V}$).

TEST CIRCUIT 2.

