

TOSHIBA Photocoupler GaAlAs Ired & Photo IC

6N138, 6N139

Current Loop Driver.

Low Input Current Line Receiver.

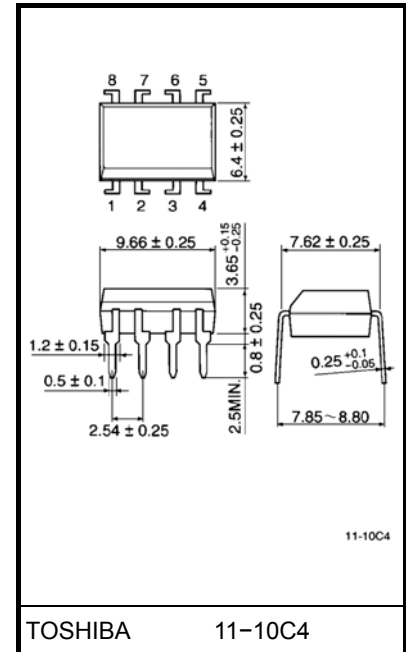
CMOS Logic Interface.

The TOSHIBA 6N138 and 6N139 consists of a GaAlAs infrared emitting diode coupled with a split-Darlington output configuration.

A high speed GaAlAs Ired manufactured with an unique LPE junction, has the virtue of fast rise and fall time at low drive current.

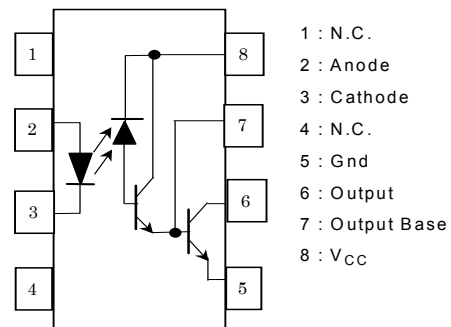
- Isolation voltage: 2500Vrms (min.)
- Current transfer ratio
 - : 6N138 – 300% (min.) ($I_F=1.6\text{mA}$)
 - : 6N139 – 400% (min.) ($I_F=0.5\text{mA}$)
- Switching time: 6N138 – $t_{PHL}=10\mu\text{s}$ (max.)
 – $t_{PLH}=35\mu\text{s}$ (max.)
 6N139 – $t_{PHL}=1\mu\text{s}$ (max.)
 – $t_{PLH}=7\mu\text{s}$ (max.)
- UL recognized: UL1577, file no. E67349

Unit in mm

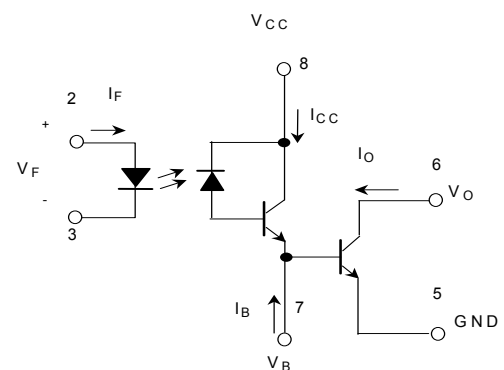


Weight: 0.54 g (typ.)

Pin Configuration (top view)



Schematic



Absolute Maximum Ratings (*) (Ta = 0°C to + 70°C)

Characteristic		Symbol	Rating	Unit
LED	Forward current (Note 1)	I _F	20	mA
	Pulse forward current	I _{FP} ^(*)	40	mA
	Total pulse forward current	I _{FP} ^(*)	1	A
	Reverse voltage	V _R	5	V
	Diode power dissipation (Note 2)	P _D	35	mW
Detector	Output current (Note 3)	I _O	60	mA
	Emitter-base reverse voltage	V _{EB}	0.5	V
	Supply voltage	V _{CC} ^(*)	−0.5 to 18	V
	Output voltage	V _O ^(*)	−0.5 to 18	V
	Output power dissipation (Note 4)	P _O	100	mW
Operating temperature range		T _{opr}	0 to 70	°C
Storage temperature range		T _{stg}	−55 to 125	°C
Lead solder temperature (10s) ^(*)		T _{sol}	260	°C
Isolation voltage (1min., R.H.≤ 60%)		BV _S ^(**)	2500	V _{rms}
			3540	V _{dc}

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

(*) JEDEC registered data

(**) Not registered JEDEC

(*) 50% duty cycle, 1ms pulse width

(*) Pulse width 1μs, 300pps

(*) 6N138... −0.5 to 7V

(*) 1.6mm below seating plane

Electrical Characteristics

Over Recommended Temperature (Ta = 0°C to 70°C, unless otherwise noted)

Characteristic		Symbol	Test Condition	Min.	(*5)Typ.	Max.	Unit
Current transfer ratio (Note 5, 6)	6N139	CTR(*)	I _F =0.5mA, V _O =0.4V V _{CC} =4.5V	400	800	—	%
	6N138		I _F =1.6mA, V _O =0.4V V _{CC} =4.5V	500	900	—	
					300	600	
Logic low output voltage (Note 6)	6N139	V _{OL}	I _F =1.6mA, I _O =6.4mA V _{CC} =4.5V	—	0.1	0.4	V
			I _F =5mA, I _O =15mA V _{CC} =4.5V	—	0.1	0.4	
			I _F =12mA, I _O =24mA V _{CC} =4.5V	—	0.2	0.4	
	6N138		I _F =1.6mA, I _O =4.8mA V _{CC} =4.5V	—	0.1	0.4	
Logic high output current (Note 6)	6N139	I _{OH} (*)	I _F =0mA, V _O =V _{CC} =18V	—	0.05	100	μA
	6N138		I _F =0mA, V _O =V _{CC} =7V	—	0.05	250	
Logic low supply current (Note 6)		I _{CCL}	I _F =1.6mA, V _O =Open V _{CC} =5V	—	0.2	—	mA
Logic high supply current (Note 6)		I _{CCH}	I _F =0mA, V _O =Open, V _{CC} =5V	—	10	—	nA
Input forward voltage		V _F (*)	I _F =1.6mA, Ta=25°C	—	1.65	1.7	V
Input reverse breakdown voltage		BV _R (*)	I _R =10μA, Ta=25°C	5	—	—	V
Temperature coefficient of forward voltage		ΔV _F / ΔTa	I _F =1.6mA	—	−1.9	—	mV / °C
Input capacitance		C _{IN}	f=1MHz, V _F =0	—	60	—	pF
Resistance (input–output)		R _{I–O}	V _{I–O} =500V R.H.≤ 60% (Note 7),	—	10 ¹²	—	Ω
Capacitance (input–output)		C _{I–O}	f=1MHz (Note 7)	—	0.6	—	pF

(**) JEDEC registered data.

(*5) All typicals at Ta=25°C and V_{CC}=5V, unless otherwise noted.

Switching Specifications (Ta=25°C, VCC=5V, unless otherwise specified)

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	μs
			$I_F=12\text{mA}$, $R_L=270\Omega$	—	0.2	1	
	6N138		$I_F=1.6\text{mA}$, $R_L=2.2\text{k}\Omega$	—	1	10	
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
			$I_F=12\text{mA}$, $R_L=270\Omega$	—	1	7	
	6N138		$I_F=1.6\text{mA}$, $R_L=2.2\text{k}\Omega$	—	4	35	
Common mode transient immunity at logic high level output (Note 9)	CM_H	2	$I_F=0\text{mA}$, $R_L=2.2\text{k}\Omega$ $V_{CM}=400V_{p-p}$	—	500	—	$V / \mu\text{s}$
Common mode transient immunity at logic low level output (Note 9)	CM_L	2	$I_F=1.6\text{mA}$ $R_L=2.2\text{k}\Omega$ $V_{CM}=400V_{p-p}$	—	–500	—	$V / \mu\text{s}$

(*)JEDEC registered data.

(Note 1): Derate linearly above 50°C free-air temperature at a rate of 0.4mA / °C

(Note 2): Derate linearly above 50°C free-air temperature at a rate of 0.7mW / °C

(Note 3): Derate linearly above 25°C free-air temperature at a rate of 0.7mA / °C

(Note 4): Derate linearly above 25°C free-air temperature at a rate of 2.0mW / °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.

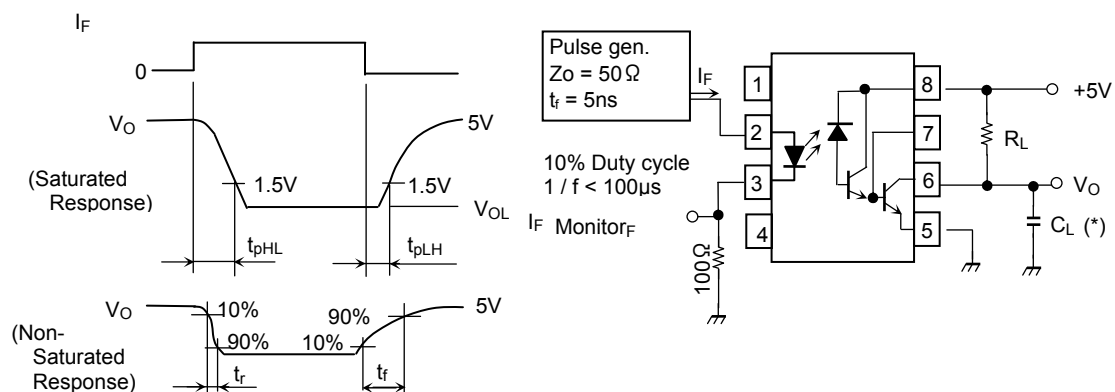
(Note 7): Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7 and 8 shorted together.

(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., $V_O > 2.0V$).

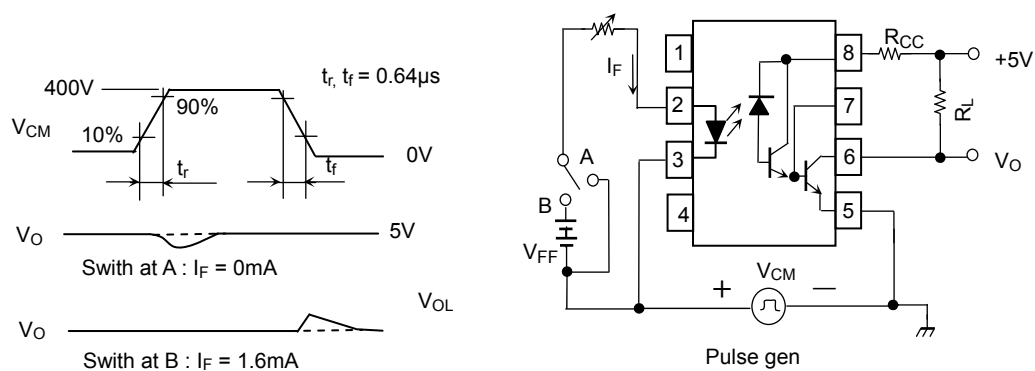
Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dv_{CM} / dt on the trailing edge of the common mode pulse signal, V_{CM} , to assure that the output will remain in a logic low state (i.e., $V_O < 0.8V$).

Test Circuit 1.



(*) C_L is approximately 15pF which includes probe and stray wiring capacitance.

Test Circuit 2.



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