

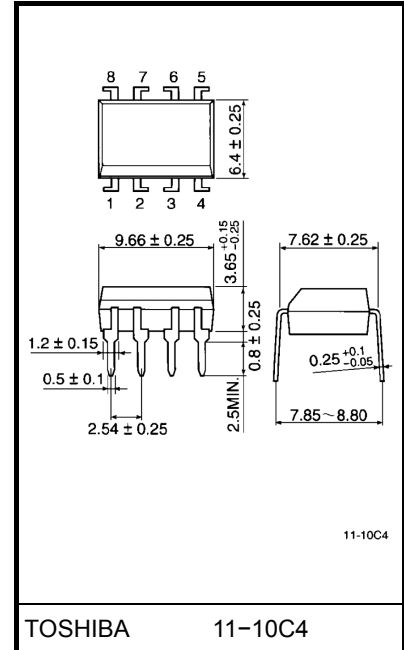
6N138, 6N139

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.

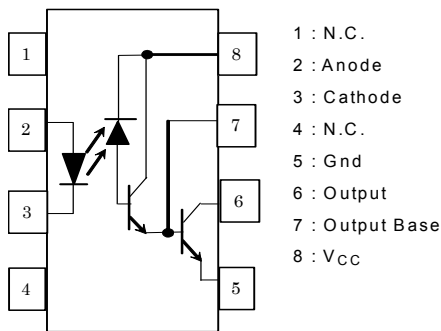
- Isolation voltage: 2500 Vrms (min)
- Current transfer ratio
 - : 6N138 – 300% (min) ($I_F=1.6\text{mA}$)
 - : 6N139 – 400% (min) ($I_F=0.5\text{mA}$)
- Switching time: 6N138
 - $t_{PHL} = 10\mu\text{s}$ (max)
 - $t_{PLH} = 35\mu\text{s}$ (max)
 6N139
 - $t_{PHL} = 1\mu\text{s}$ (max)
 - $t_{PLH} =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

Unit: mm

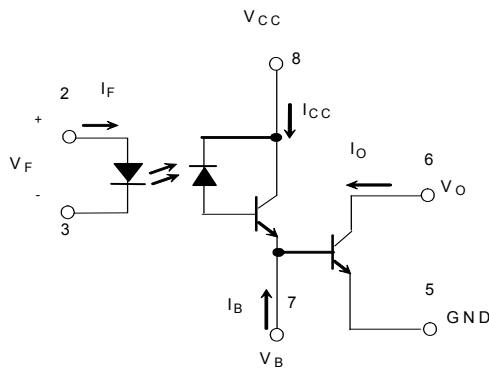


Weight: 0.54 g (typ.)

Pin Configuration (top view)



Schematic



Start of commercial production
 1988/02

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 (1minute, 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

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

(*2) Pulse width 1μs, 300pps

(*3) 6N138... -0.5 to 7V

(*4) 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	—	
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 typical values are 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	t _{pHL} (*)	1	I _F =0.5mA, R _L =4.7kΩ	—	5	25	μs
	6N138			I _F =12mA, R _L =270Ω	—	0.2	1	
				I _F =1.6mA, R _L =2.2kΩ	—	1	10	
Propagation delay time to logic high at output (Note 6, 8)	6N139	t _{pLH} (*)	1	I _F =0.5mA, R _L =4.7kΩ	—	5	60	μs
	6N138			I _F =12mA, R _L =270Ω	—	1	7	
				I _F =1.6mA, R _L =2.2kΩ	—	4	35	
Common mode transient immunity at logic high level output (Note 9)		CM _H	2	I _F =0mA, R _L =2.2kΩ V _{CM} =400V _{p-p}	—	500	—	V / μs
Common mode transient immunity at logic low level output (Note 9)		CM _L	2	I _F =1.6mA R _L =2.2kΩ V _{CM} =400V _{p-p}	—	-500	—	V / μs

(*)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.

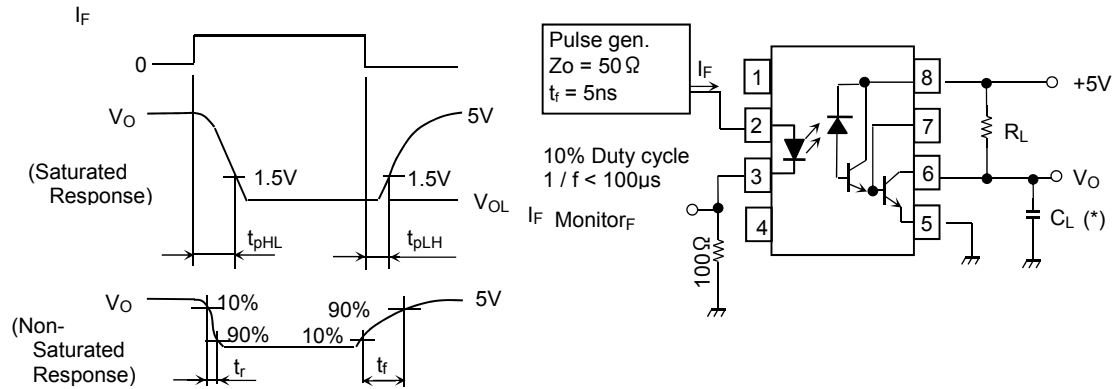
(Note 7): Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7 and 8 shorted together.

(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).

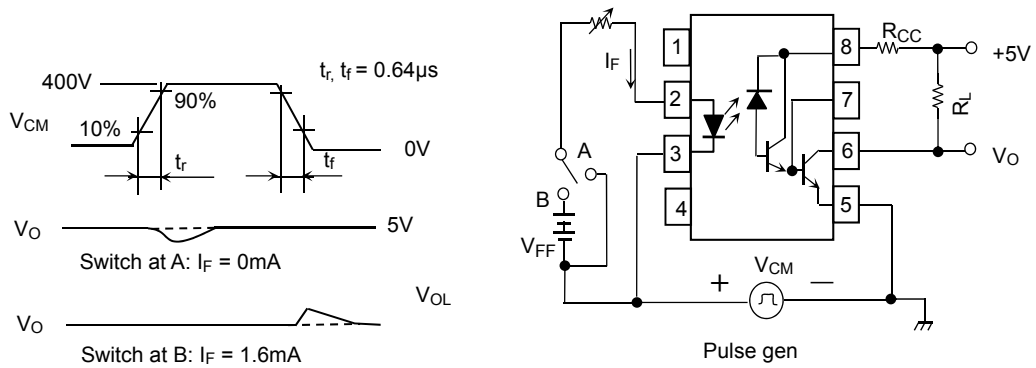
Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM} / dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a logic low state (i.e. V_O < 0.8V).

Test Circuit 1.



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

Test Circuit 2.



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