TOSHIBA Photocoupler GaAℓAs Ired & Photo IC

6N138, 6N139

Current Loop Driver.

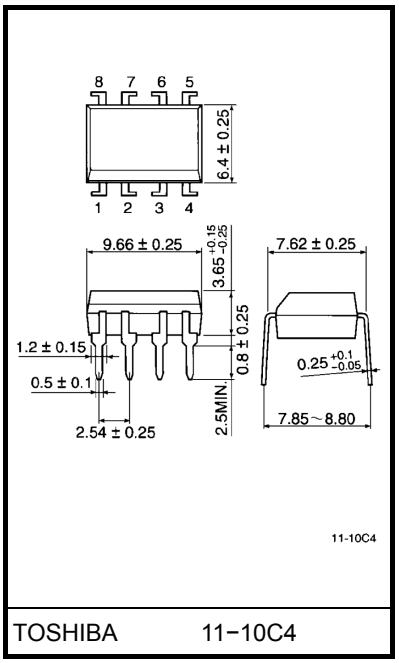
Low Input Current Line Receiver.

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.

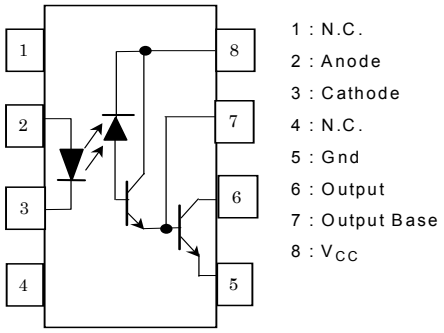
- Isolation voltage: 2500Vrms (min.)
- Current transfer ratio
  : 6N138 − 300% (min.) (I_F=1.6mA)
  : 6N139 − 400% (min.) (I_F=0.5mA)
- Switching time: 6N138 − t_{PHL}=10μs (max.)
  − t_{PLH}=35μs (max.)
  6N139 − t_{PHL}=1μs (max.)
  − t_{PLH}=7μs (max.)
- UL recognized: UL1577, file no. E67349

Unit in mm

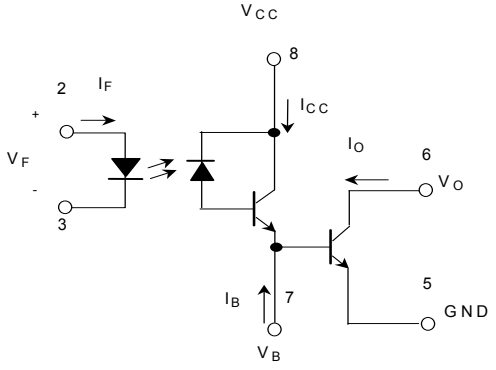


Weight: 0.54 g

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} (*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
Detector	Output current	(Note 3)	I_O	60	mA
	Emitter−base reverse voltage		V_{EB}	0.5	V
	Supply voltage		V_{CC} (*3)	−0.5 to 18	V
	Output voltage		V_O (*3)	−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) (*4)			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
(*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	—	%
			I_F=1.6mA, V_O=0.4V, V_{CC}=4.5V	500	900	—	
	6N138			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		$\Delta V_F / \Delta Ta$	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 (Note 7), R.H.≤ 60%	—	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.

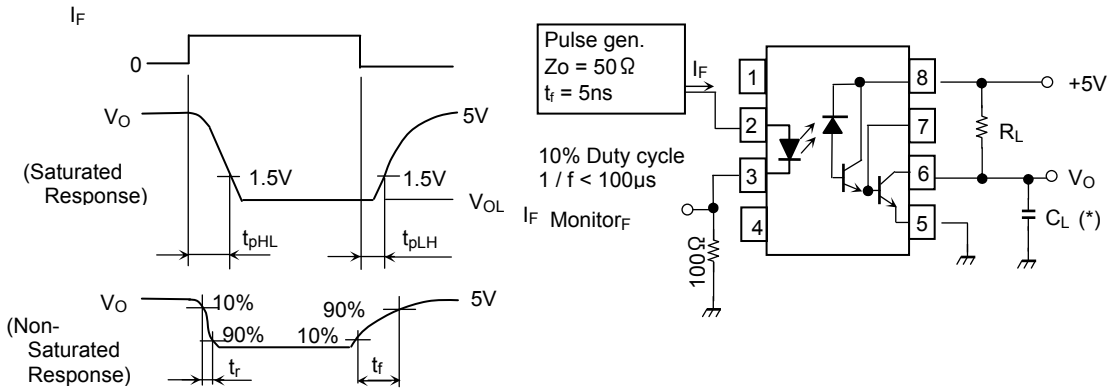
Switching Specifications (Ta=25°C, V_{CC}=5V, unless otherwise specified)

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
				I_F=12mA, R_L=270Ω	—	0.2	1	
	6N138			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
				I_F=12mA, R_L=270Ω	—	1	7	
	6N138			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.

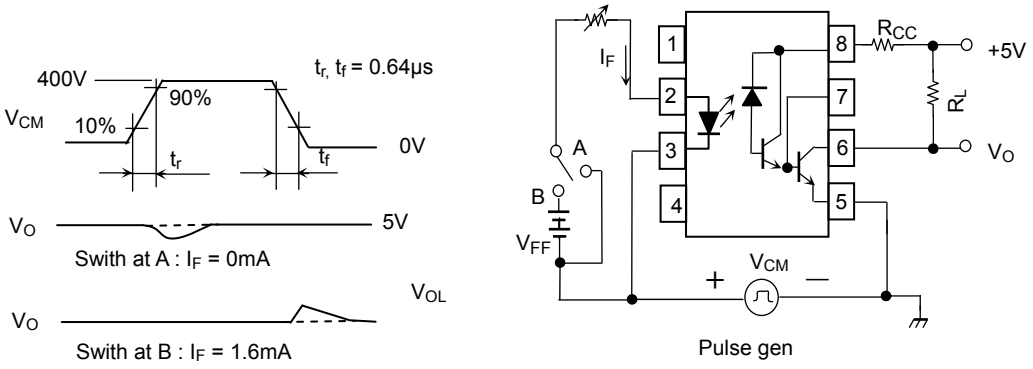
(Note 1): Derate linearly above 50°C free−air temperature at a rate of 0.4mA / °C
(Note 2): Derate linearly above 50°C free−air temperature at a rate of 0.7mW / °C
(Note 3): Derate linearly above 25°C free−air temperature at a rate of 0.7mA / °C
(Note 4): Derate linearly above 25°C free−air temperature 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.



RESTRICTIONS ON PRODUCT USE

20070701-EN

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in his document shall be made at the customer’s own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties.
- GaAs(Gallium Arsenide) is used in this product. The dust or vapor is harmful to the human body. Do not break, cut, crush or dissolve chemically.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.