6N138

High Sensitivity, High Speed OPIC Photocoupler

■ Features

1. High current transfer ratio
   （CTR : MIN. 300% at I_F = 1.6mA）
2. High speed response
   （ t_{PHL} : TYP. 2μ s at R_L = 2.2kΩ ）
3. Instantaneous common mode rejection
   voltage（CM_H : TYP. 500V/μ s ）
4. TTL compatible output
5. Overseas standard model
6. Recognized by UL, file No. E64380.

■ Applications

1. Interfaces for computer peripherals
2. Electronic calculators, measuring instruments, control equipment
3. Telephone sets
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions   （ Unit : mm）

1. NC   5. GND
2. Anode   6. V_O
3. Cathode   7. V_B
4. NC   8. V_{CC}
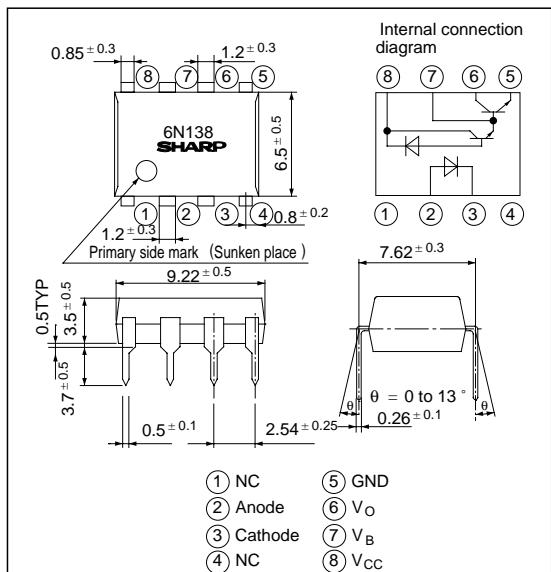
* "OPIC" （Optical IC) is a trademark of the SHARP Corporation. An OPIC consists of a light-detecting element and signal-processing circuit integrated onto a single chip.

■ Absolute Maximum Ratings   （Ta = 25˚C）

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	20	mA
	*1 Peak forward current	I_F	40	mA
	*2 Peak transient forward current	I_{FM}	1	A
	Reverse voltage	V_R	5	V
	Power dissipation	P	35	mW
Output	Supply voltage	V_{CC}	- 0.5 to + 7	V
	Output voltage	V_O	- 0.5 to + 7	V
	Emitter-base reverse withstand voltage （pin 5 to 7)	V_{EBO}	0.5	V
	*3 Average output current	I_O	60	mA
	Power dissipation	P_O	100	mW
	*4 Isolation voltage	V_{iso}	2 500	V_{rms}
	Operating temperature	T_{opr}	0 to + 70	˚C
	Storage temperature	T_{stg}	- 55 to + 125	˚C
	*5 Soldering temperature	T_{sol}	260	˚C

*1 50% duty cycle, Pulse width: 1ms
*2 pulse width＜=1μ s, 300pps
*3 Decreases at the rate of 0.7mA /˚C if the external temperature is 25˚C or more.
*4 40 to 60% RH, AC for 1 minute
*5 For 10 seconds

■ Electro-optical Characteristics

(Ta= 0 to 70°C unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
[1]Current transfer ratio	CTR	I_F= 1.6mA, V_O= 0.4V, V_{CC}= 4.5V	300	1 600	-	%
Logic （0）output voltage	V_{OL}	I_O= 4.8mA, V_{CC}= 4.5V, I_F= 1.6mA	-	0.1	0.4	V
Logic (1) output current	I_{OH}	I_F= 0, V_{CC}= V_O= 7V	-	0.1	250	μA
Logic （0）supply current	I_{CCL}	I_F= 1.6mA, V_{CC}= 5V, V_O= open	-	0.5	-	mA
Logic (1) supply current	I_{CCH}	I_F= 0, V_{CC}= 5V, V_O= open	-	10	-	nA
Input forward voltage	V_F	I_F= 1.6mA, Ta= 25°C	-	1.5	1.7	V
Input forward voltage temperature coefficient	[2]	I_F= 1.6mA	-	- 1.9	-	mV/°C
Input reverse voltage	BV_R	I_R= 10μA, Ta= 25°C	5.0	-	-	V
Input capacitance	C_{IN}	V_F= 0, f= 1MHz	-	60	-	pF
[3]Leak current （input-output）	I_{I-O}	Ta= 25°C, 45% RH, t= 5s V_{I-O}= 3kV DC	-	-	1.0	μA
[3]Isolation resistance （input-output）	R_{I-O}	V_{I-O}= 500V DC	-	10^{12}	-	Ω
[3]Capacitance （input-output）	C_{I-O}	f= 1MHz	-	0.6	-	pF

[1] Current transfer ratio is a ratio of input current and output current expressed in % .

[2] $\Delta V_F / \Delta$ Ta

[3] Measured as 2-pin element （Short 1, 2, 3, 4 and 5, 6, 7, 8. ）

Note) Typical value : at Ta= 25°C, V_{CC}= 5V

■ Switching Characteristics

(Ta= 25°C, V_{CC}= 5V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
[4]Propagation delay time Output (1) → （0）	t_{PHL}	I_F= 1.6mA R_L= 2.2kΩ	-	2	10	μs
[4]Propagation delay time Output （0）→ (1)	t_{PLH}	I_F= 1.6mA R_L= 2.2kΩ	-	7	35	μs
[5][6]Instantaneous common mode rejection voltage " Output (1)"	CM_H	I_F= 0, V_{CM}= 10V P-P R_L= 2.2kΩ	-	500	-	V/μs
[5][6]Instantaneous common mode rejection voltage " Output (0)"	CM_L	I_F= 1.6mA, V_{CM}= 10V P-P R_L= 2.2kΩ	-	- 500	-	V/μs

[5] Instantaneous common mode rejection voltage " output (1)" represents a common mode voltage variation that can hold the output above (1) level （V_O> 2.0V）.

Instantaneous common mode rejection voltage " output（0）" represents a common mode voltage variation that can hold the output above（0）level （V_O< 0.8V）.

[4] Test circuit for Propagation Delay Time
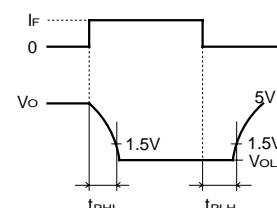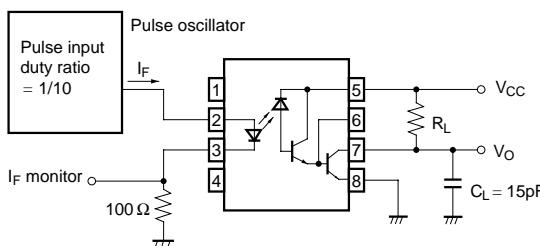
*6 Test Circuit for Instantaneous Common Mode Rejection Voltage
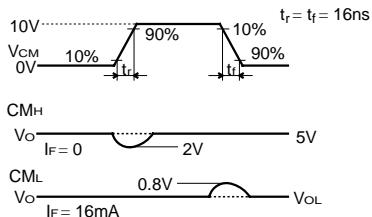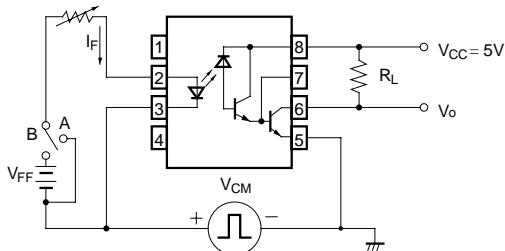

**Fig. 1 Forward Current vs.
   Ambient Temperature**
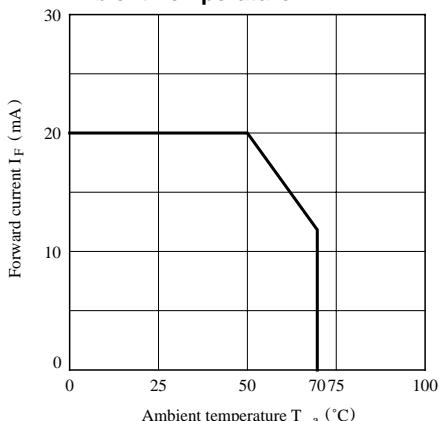
**Fig. 2 Power Dissipation vs.
   Ambient Temperature**
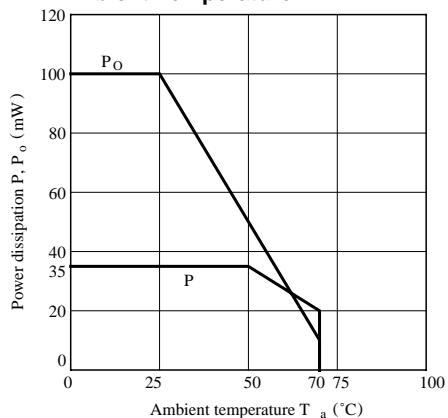
**Fig. 3 Forward Current vs. Forward Voltage**
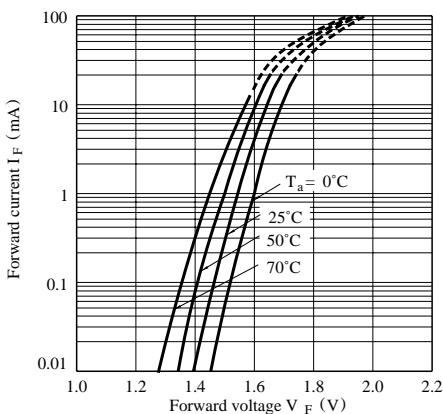
Fig. 4 Output Current vs. Output Voltage
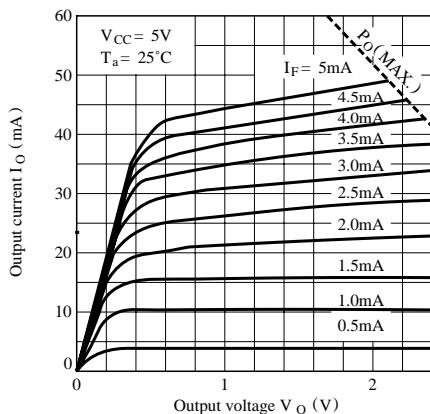
Fig. 5 Current Transfer Ratio vs. Forward Current

Current transfer ratio CTR (%)

$V_{CC} = 4.5V$
$V_O = 0.4V$
$T_a = 70°C$
25°C
0°C

Forward current I_F (mA)
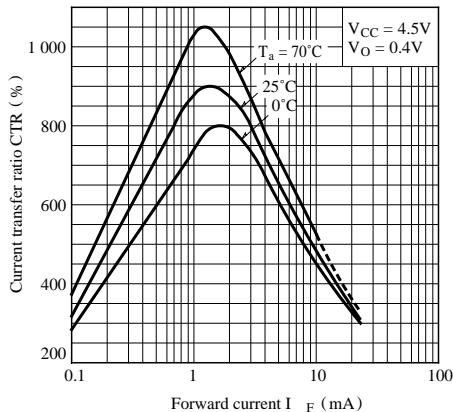
Fig. 6 Output Current vs. Forward Current
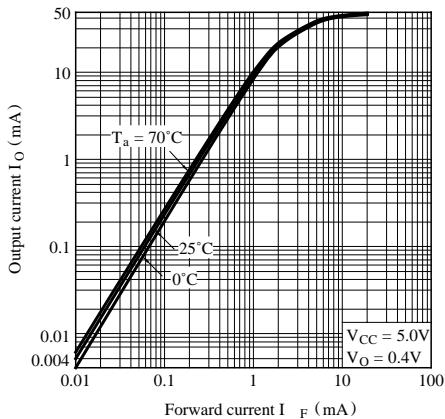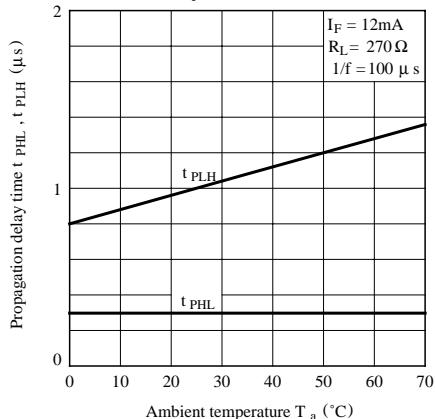
Output current I_O (mA)

$T_a = 70°C$
25°C
0°C

$V_{CC} = 5.0V$
$V_O = 0.4V$

Forward current I_F (mA)

Fig. 7-a Propagation Delay Time vs. Ambient Temperature

Propagation delay time t_{PHL}, t_{PLH} (µs)

$I_F = 12mA$
$R_L = 270\,\Omega$
$1/f = 100\,\mu s$

t_{PLH}
t_{PHL}

Ambient temperature T_a (°C)

Fig. 7-b Propagation Delay Time vs. Ambient Temperature

Propagation delay time t_{PHL}, t_{PLH} (µs)

$I_F = 0.5mA$
$R_L = 4.7k\Omega$
$1/f = 1ms$

t_{PLH}
t_{PHL}

Ambient temperature T_a (°C)

Fig. 8 Rise Time, Fall Time vs. Load Resistance

Rise time, fall time t_r, t_f (µs)

Adjust I_F to $V_{OL} = 2V$
$T_a = 25°C$

t_f
t_r
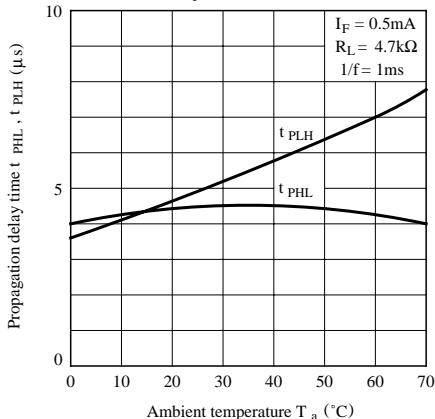
Load resistance R_L (kΩ)
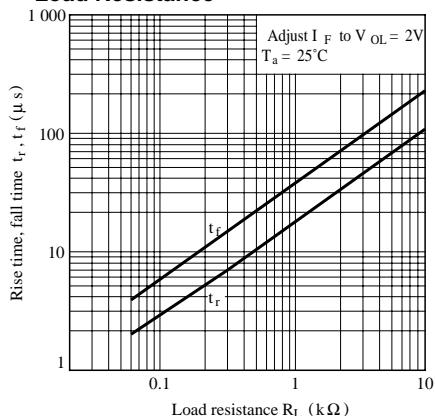
Fig. 9 Logic (1) Supply Current vs. Ambient Temperature

Logic (1) supply current I_{CCH} (A)

$I_F = 0mA$
$V_{CC} = 15V$
$V_O = OPEN$

Ambient temperature T_a (°C)
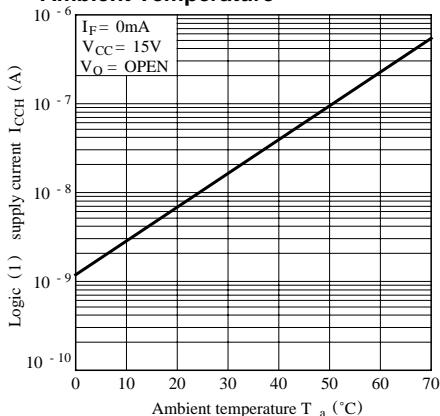
*7 Test Circuit for Rise Time, Fall Time vs. Load Resistance
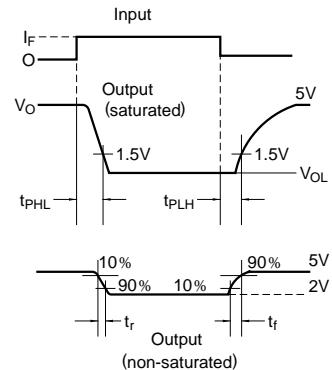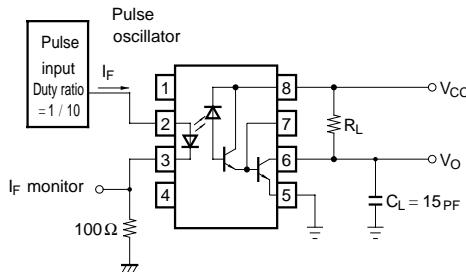
■ Precautions for Use

（1）It is recommended that a by-pass capacitor of more than 0.01 μ F be added between V $_{CC}$ and GND near the device in order to stabilize power supply line.

（2）Transistor of detector side in bipolar configuration is apt to be affected by static electricity for its minute design. When handling them, general counterplan against static electricity should be taken to avoid breakdown of devices or degradation of characteristics.

（3）As for other general cautions, refer to the chapter "Precautions for Use".