PC923L

High Speed Type Photocoupler for MOS-FET/IGBT Drive

■ Description

PC923L contains a IRED optically coupled a OPIC.
It is packaged in a 8-pin DIP, available in SMT gullwing lead-form option.
Input-output isolation voltage(rms) is 5.0kV.

■ Features

1. Double transfer mold package (ideal for Flow Soldering)
2. Built-in direct drive circuit for MOS-FET/IGBT (I_{O1P},I_{O2P}=MAX. 0.6A)
3. High speed response (t_{PLH}, t_{PHL} : MAX. 0.5 μ s)
4. Wide operating supply voltage range (V_{CC}=15 to 35V)
5. Low dissipation current (I_{CC}=TYP. 1.3mA)
6. High noise reduction type (CMR=MIN. 15kV/ μ s @ V_{CM}=1500V)
7. High isolation voltage (V_{iso}=5kV)

■ Agency / Compliance

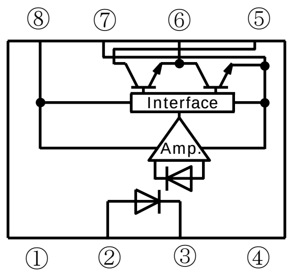
1. Recognized by UL1577 (Double protection isolation), file No.E64380 (as model No.**PC923L**)
2. Package resion : UL flammability grade (94V-0)

■ Application

1. Inverter controlled refrigerator
2. Inverter controlled air-conditioner
3. General purpose inverter (High accuracy control)
4. Electromagnetic cooking device

Notice In the absence of confirmation by device specification sheets, SHARP takes no responsibility for any defects that may occur in equipment using any SHARP device shown in catalogs, data books, etc. Contact SHARP in order to obtain the latest device specification sheets before using any SHARP device.

■ Internal Connection Diagram

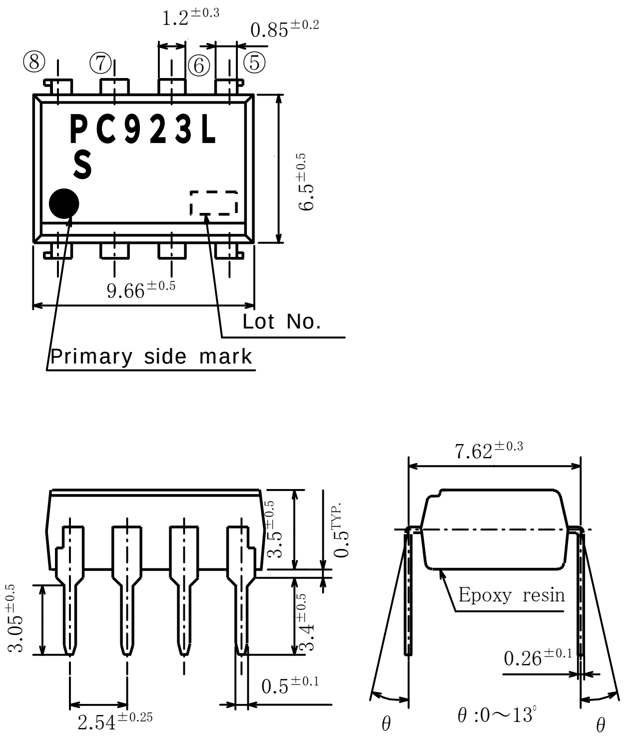


① NC
② Anode
③ Cathode
④ NC
⑤ O_1
⑥ O_2
⑦ GND
⑧ V_{CC}

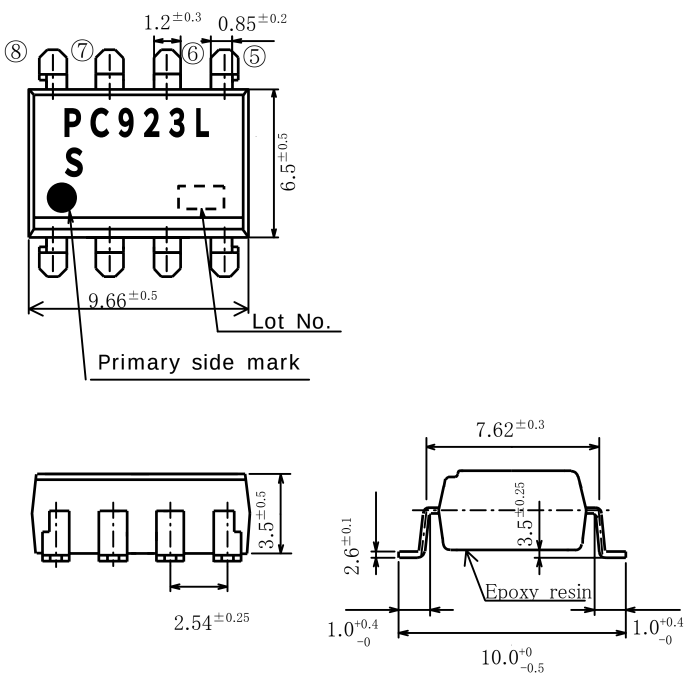
■ Outline Dimensions

(Unit : mm)

1. Through-Hole [ex. PC923L0NSZ]
   product mass : 0.55g



2. SMT Gullwing Lead-Form [ex. PC923L0NIP]
   product mass : 0.51g

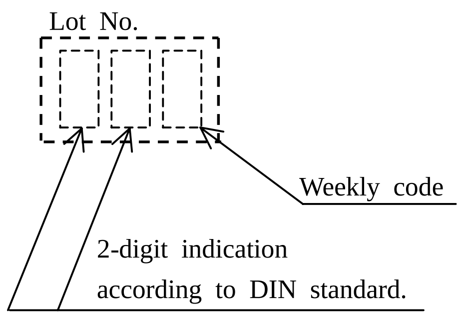


・Lot No. (2digit) code

1st digit				2nd digit	
Year of production				Month of production	
A.D	Mark	A.D	Mark	Month	Mark
1990	A	2002	P	January	1
1991	B	2003	R	February	2
1992	C	2004	S	March	3
1993	D	2005	T	April	4
1994	E	2006	U	May	5
1995	F	2007	V	June	6
1996	H	2008	W	July	7
1997	J	2009	X	August	8
1998	K	2010	A	September	9
1999	L	2011	B	October	O
2000	M	2012	C	November	N
2001	N	⋮	⋮	December	D

・Weekly code

1st Week	1
2nd Week	2
3rd Week	3
4th Week	4
5th and,6th Week	5



■ Absolute Maximum Ratings

Ta=25℃

Parameter		Symbol	Rating	Unit
Input	*1 Forward current	I_F	20	mA
	Reverse voltage	V_R	5	V
Output	Supply voltage	Vcc	35	V
	O_1 Output current	Io_1	0.1	A
	*4 O_1 Peak output current	Io_{1P}	0.6	A
	O_2 Output current	Io_2	0.1	A
	*4 O_2 Peak output current	Io_{2P}	0.6	A
	O_1 Output voltage	V_{O1}	35	V
	*2 Power dissipation	Po	500	mW
	*3 Total power dissipation	Ptot	550	mW
	*5 Isolation voltage	$Viso_{(rms)}$	5.0	kV
	Operating temperature	Tstg	-40 to +85	℃
	Storage temperature	Tstg	-55 to +125	℃
	Soldering temperature	Tsol	270 (For 10s)	℃

*1,2,3 The derating factors of absolute maximum due to ambient temperature are shown in Fig.10,11.

*4 Pulse width≦0.15 μ s, Duty ratio : 0.01

*5 AC for 1min, 40 to 60%RH, Ta=25℃

■ Electro-optical Characteristics

(Unspecified : Ta=-40 to +85℃)

	Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test circuit	Conditions
Input	Forward voltage	V_{F1}	-	1.6	1.75	V	-	Ta=25℃, I_F=10mA
		V_{F2}	1.2	1.5	-	V	-	Ta=25℃, I_F=0.2mA
	Reverse current	I_R	-	-	10	μA	-	Ta=25℃, V_R=5V
	Terminal capacitance	Ct	-	60	150	pF	-	Ta=25℃, V=0, f=1MHz
Output	Operating supply voltage range	Vcc	15	-	30	V	-	
	O_1 Low level output voltage	V_{O1L}	-	0.2	0.4	V	(1)	Vcc_1=12V, V_{CC2}=-12V, I_{O1}=0.1A, I_F=5mA
	O_2 High level output voltage	V_{O2H}	20	22	-	V	(2)	Vcc=V_{O1}=24V, I_{O2}=-0.1A, I_F=5mA
	O_2 Low level output voltage	V_{O2L}	-	0.5	0.8	V	(3)	Vcc=24V, I_{O2}=-0.1A, I_F=0mA
	O_1 Leak current	I_{O1L}	-	-	500	μA	(4)	Vcc=V_{O1}=35V, I_F=0mA
	O_2 Leak current	I_{O2L}	-	-	500	μA	(5)	Vcc=V_{O2}=35V, I_F=5mA
	High level supply current *3	I_{CCH}	-	1.3	3.0	mA	(6)	Vcc=24V , I_F=5mA
	Low level supply current *3	I_{CCL}	-	1.3	3.0	mA		Vcc=24V, I_F=0mA
Transfercharacteristics	"L→ H" threshold input current *2	I_{FLH}	0.3	1.5	3.0	mA	(7)	Ta=25℃, Vcc=24V
			0.2	-	5.0			Vcc=24V
	Isolation resistance	R_{ISO}	5×10^{10}	10^{11}	-	Ω	-	Ta=25℃, DC=500V, 40 to 60%RH
	Response time: "L→ H" propagation time	t_{PLH}	-	0.3	0.5	μs	(8)	Ta=25℃ Vcc=24V, I_F=5mA, R_G=47Ω, C_G=3000pF
	Response time: "H→ L" propagation time	t_{PHL}	-	0.3	0.5			
	Response time: Rise time	tr	-	0.2	0.5			
	Response time: Fall time	tf	-	0.2	0.5			
	Instantaneous common mode rejection voltage (High level output)	CM_H	-15	-	-	kV/μs	(9)	Ta=25℃, V_{CM}=1.5kV(p-p) I_F=5mA, V_{CC}=24V ΔV_{O2H}=2.0V
	Instantaneous common mode rejection voltage (Low level output)	CM_L	15	-	-			Ta=25℃, V_{CM}=1.5kV(p-p) I_F=0mA, V_{CC}=24V ΔV_{O2L}=2.0V

*1 It shall connect a by-pass capacitor of 0.01μF or more between Vcc (Pin No. 8) and GND (Pin No. 7) near the device, when it measures the transfer characteristics and the output side characteristics.

*2 I_{FLH} is the value of forward current when output becomes from "L" to "H".

*3 O_2 Output pin is open (please refer to the Design guide for Photocouplers).

■ Truth Table

Input	O_2 Output	Tr1	Tr2
ON	High level	ON	OFF
OFF	Low level	OFF	ON

■ Test Circuit

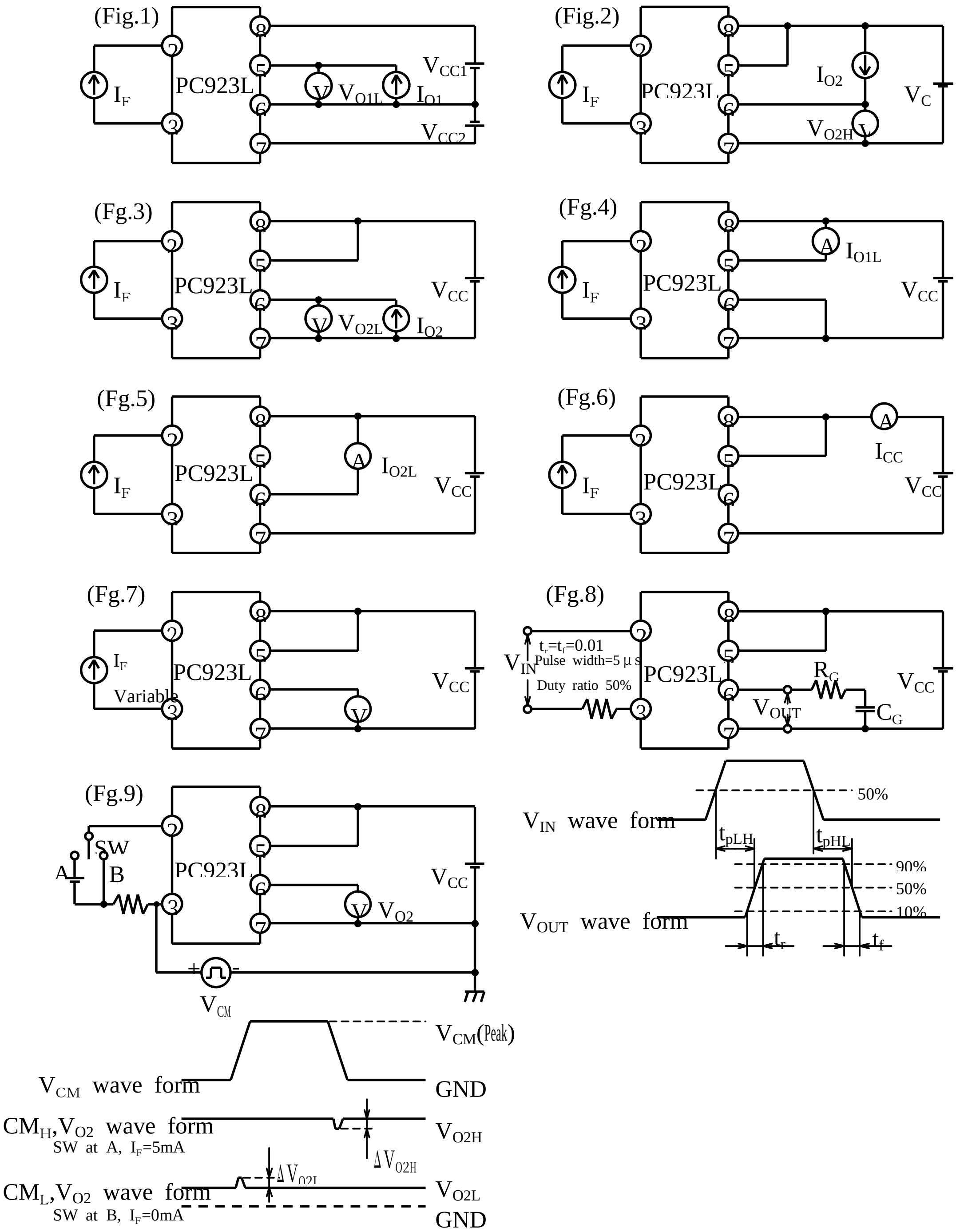


Fig.10 Forward Current vs. Ambient Temperature

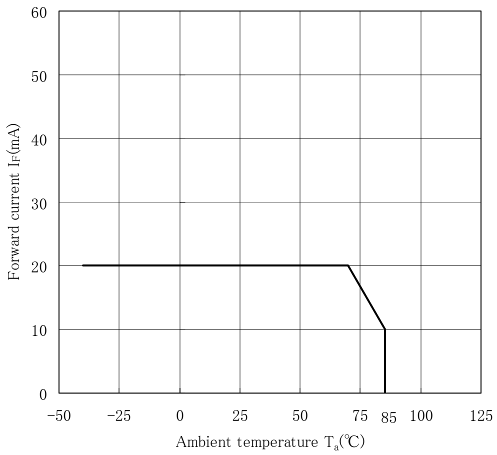


Fig.11 Power Dissipation vs. Ambient Temperature

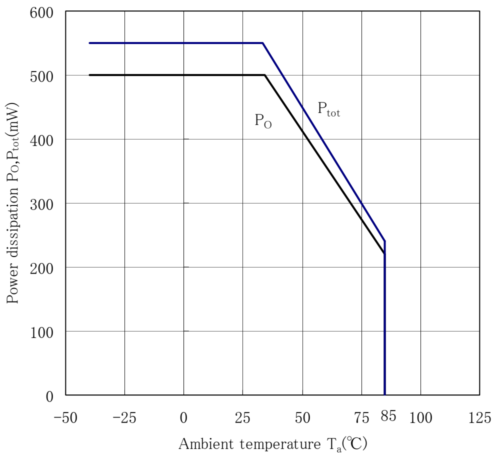


Fig.12 Forward Current vs. Forward Voltage

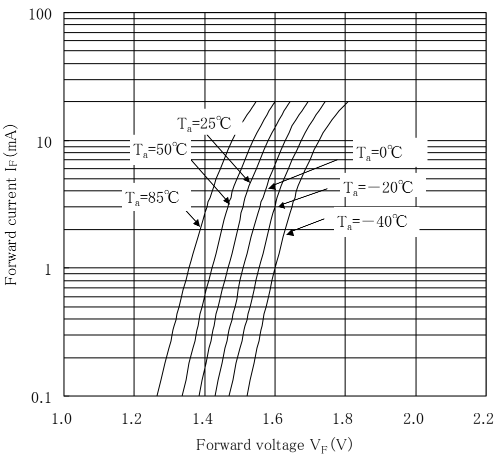


Fig.13 "Low→High Relative Threshhold Input Current vs. Supply Voltage

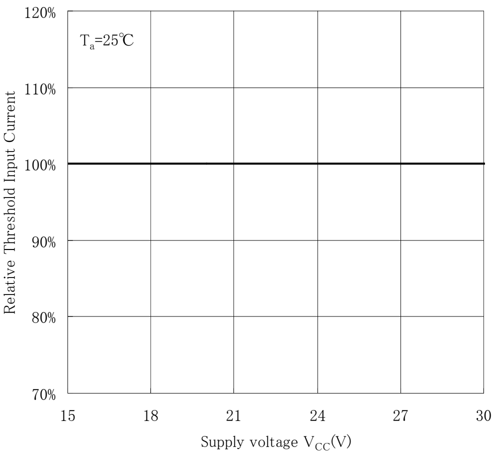


Fig.14 "Low→High Relative Threshhold Input Current vs. Ambient Temperature

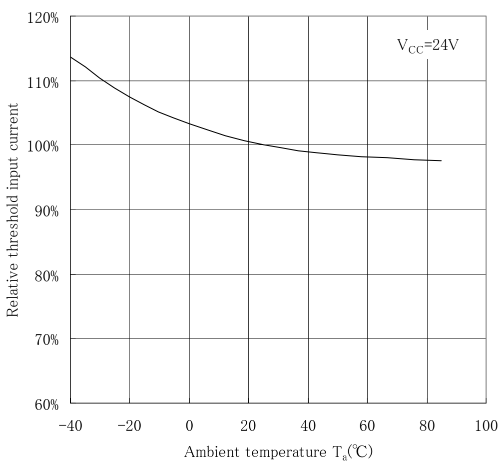


Fig.15 O_1 Low Level Output Voltage vs. O_1 Output Current

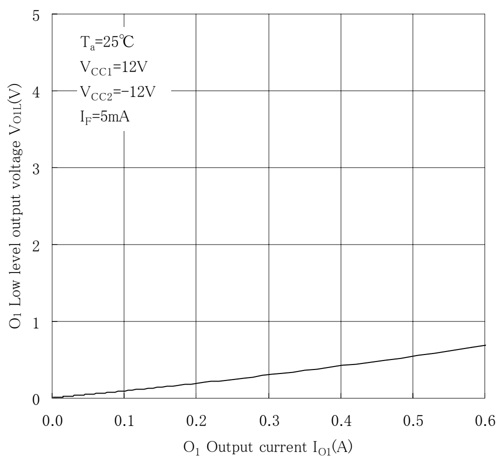


Fig.16 O_1 Low Level Output Voltage vs. Ambient Temperature

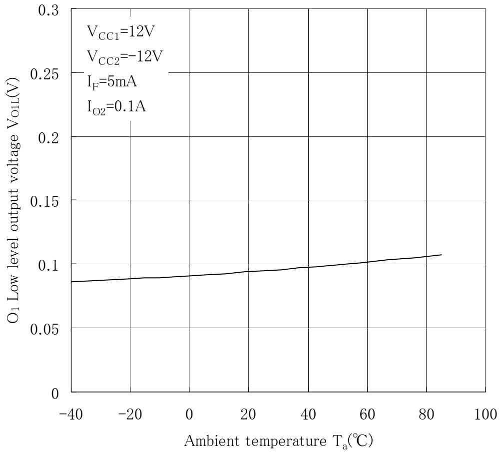


Fig.17 O_2 Output Voltage Drop Vs. O_2 Output Current

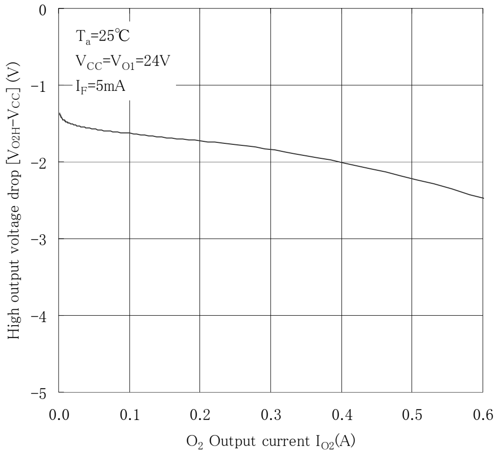


Fig.18 O_2 High Level Output Voltage vs. vs. Supply Voltage

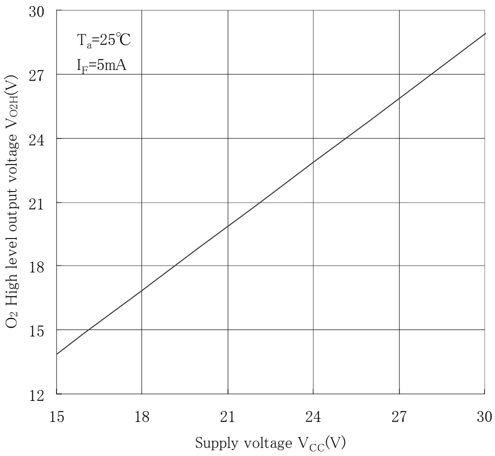


Fig.19 O_2 High Level Output Voltage vs. Ambient Temperature

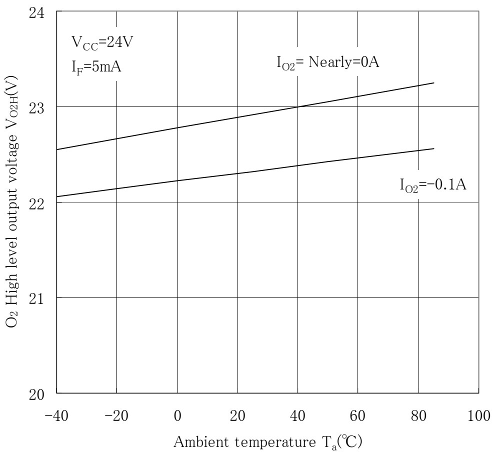


Fig.20 O_2 Low Level Output Voltage vs. O_2 Output Current

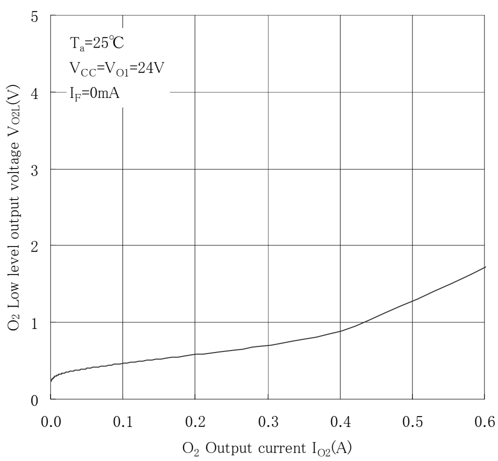


Fig.21 O_2 Low Level Output Voltage vs. Ambient Temperature

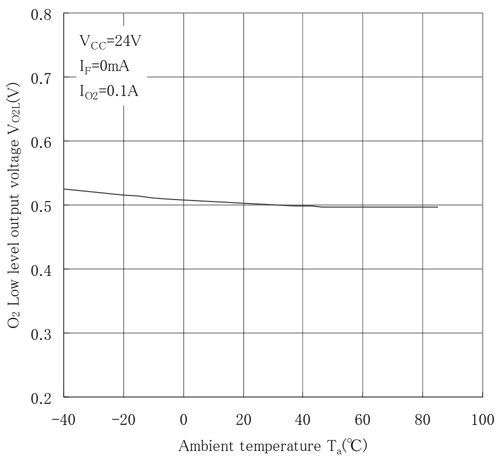


Fig.22 High Level Supply Current vs. Supply Voltage

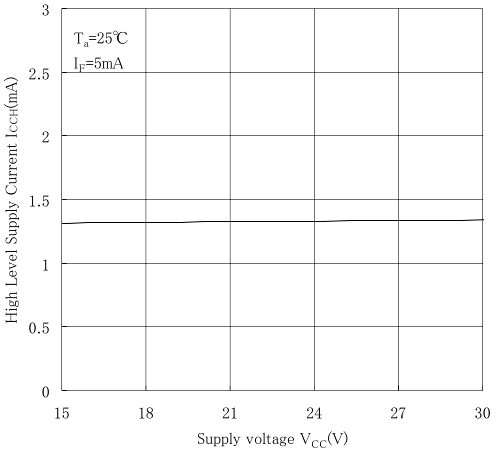


Fig.23 Low Level Supply Current vs. Supply Voltage

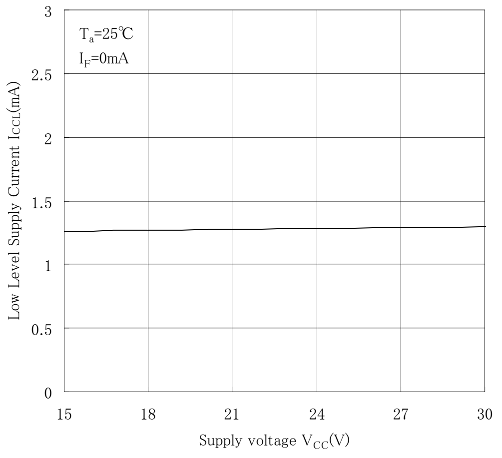


Fig.24 High Level Supply Current vs. Ambient Temperature

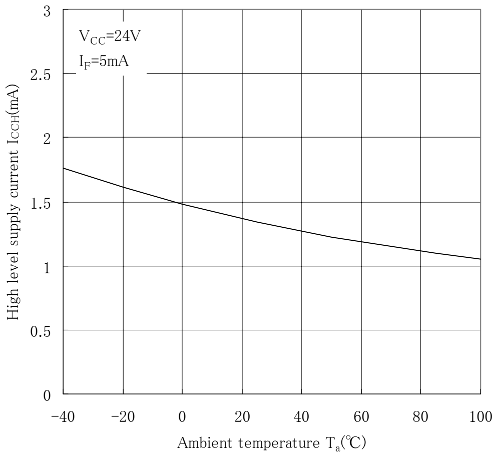


Fig.25 Low Level Supply Current vs. Ambient Temperature

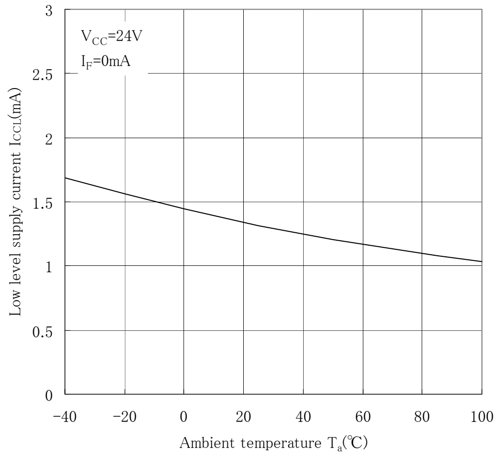


Fig.26 Propagation Delay Time vs. Forward Current

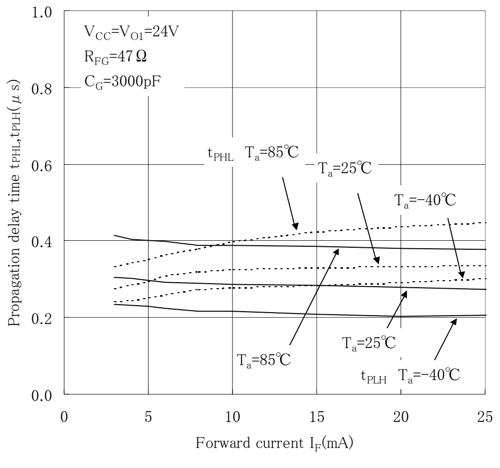
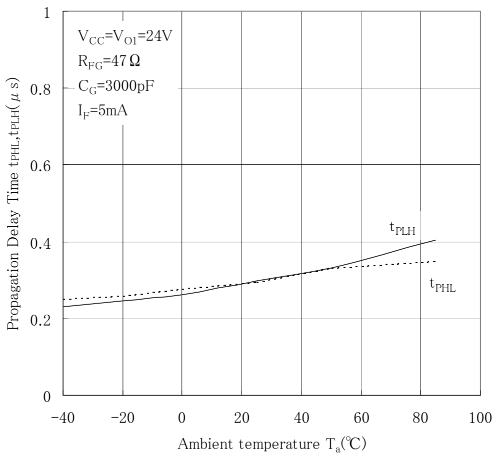


Fig.27 Propagation Delay Time vs. Ambient Temperature



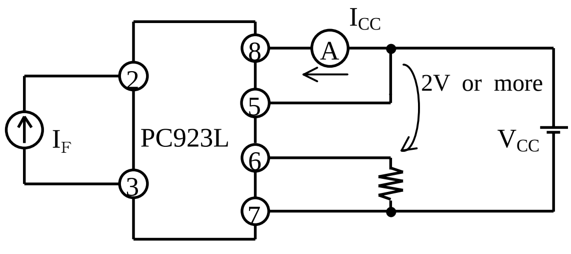
■ Design Consideration

● Recommended operating condition (reference)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Forward current	I_F	10	-	20	mA
Supply voltage	V_{CC}	15	-	30	V
Operating Temperature	Topr	-40	-	70	℃

● Design guide

- In order to stabilize power supply line, we should certainly recommend to connect a by-pass capacitor of 0.01 μF or more between Vcc and GND near the device.
- When steep voltage noise is applied between the primary side and the secondary side of the photocoupler, current flows or changes in the light emitting diode through a parasitic capacitance between the primary side and the secondary side of the photocoupler, then there is a case that miss operation occurs depending upon the applied noise level.
  We should certainly recommend to use a by-pass capacitor between both terminals of the light emitting diode where used in a noisy environment.
- The detector which is used in this device, has parasitic diode between each pins and GND.
  There are cases that miss operation or destruction possibly may be occurred if electric potential of any pin becomes below GND level even for instant.
  Therefore it shall be recommended to design the circuit that electric potential of any pin does not become below GND level.
- This photocoupler is dedicated to the use for IGBT or MOS-FET Gate Drive. Please do not use this for the other application.
  As mentioned below, when the input is on, if DC load (resistor etc) is connected between 2 output pin 6 and GND pin 7 and if the electric potential Vo2 goes approx. 2V below than the electric potential Vcc pin 8 continuously, supply current Icc may flow more than usually and go beyond power dissipation.



■ Design Condition

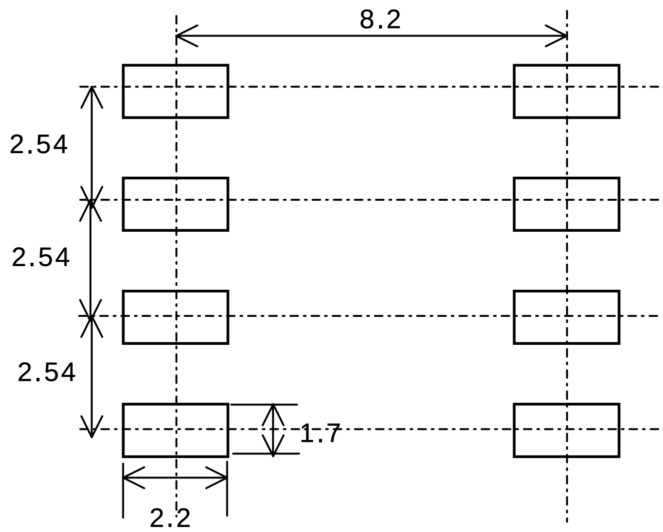
● Degradation

・The LED used in the Photocoupler generally decreases the light emission power by operation. In case of long operation time, please design the circuit with considering the decrease of the light emission power of the LED. (50%/5years)

● Recommend Foot Print (reference)

Unit : mm

SMT Gullwing lead-form



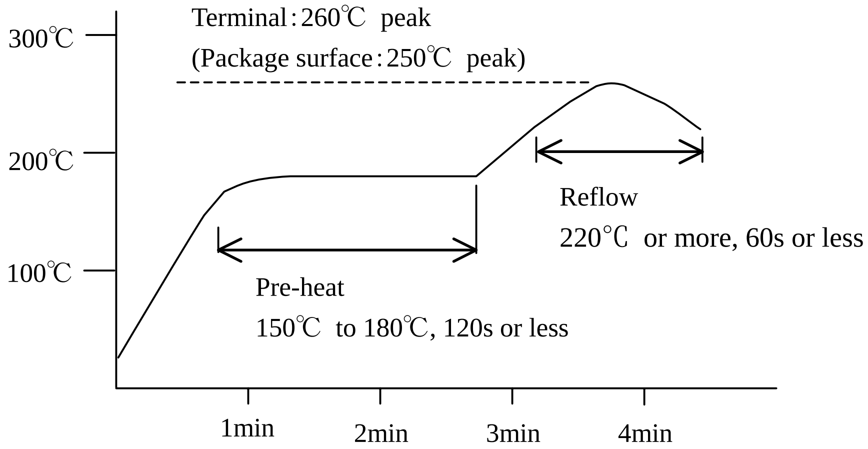
☆ For additional design assistance, please review our corresponding Optoelectoric Application Notes.

■ Manufacturing Guideline

● Soldering Method

・Reflow Soldering :

Reflow soldering should follow the temperature profile below.
Soldering should not exceed the curve of temperature profile and time.
Please don't solder more than twice.



・Flow Soldering :

Due to SHARP's double transfer mold construction submersion in flow solder bath is allowed under the below listed guidelines.

Flow soldering should be completed below 270℃and within 10s.
Preheating is within the bounds of 100 to 150 ℃ and 30 to 80 s.
Please don't solder more than twice.

・Hand soldering :

Hand soldering should be completed within 3s when the point of solder iron is below 400℃.
Please don't solder more than twice.

・Other notices :

Please test soldering method in actual condition and make sure the soldering works fine,
since the impact on the junction between the twice and PCB varies depending on the tooling and soldering conditions.

● Cleaning Instructions

・ Solvent cleaning :
Solvent temperature should be 45℃or below.
Immersion time should be 3 min or less.

・ Ultrasonic cleaning :
The impact on the device varies depending on the size of the cleaning bath, ultrasonic output, cleaning time, size of PCB and mounting method of the device.
Therefore, please make sure the device withstands the ultrasonic cleaning in actual condition in advance of mass production.

・ Recommended solvent materials :
Ethyl alcohol, Methyl alcohol, Isopropyl alcohol
In cases the other type of solvent materials are intended to be used, please make sure they work fine in actual using conditions since some materials may erode the package resin.

● Presence of ODC

This product shall not contain the following materials.
And they are not used in the production process for this device.
Regulation substances : CFC_S, Halon, Carbon tetrachloride, 1.1.1-Trichloroethane (Methylchloroform)
Specific brominated flame retardants such as the $PBBO_S$, and PBB_S are not used in this product at all.

■ Package specfication

1. Sleeve package

· package materials

Sleeve : HIPS (with and anti-static material)

Stopper : Styrene-Elastomer

· package method

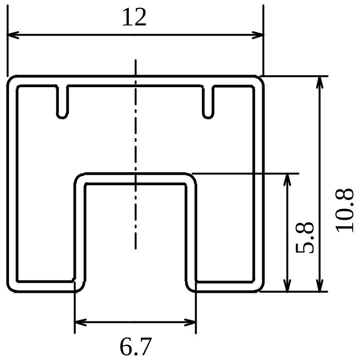
MAX. 50 pcs. of products shall be package in a sleeve. Ends shall be fixed by stoppers.

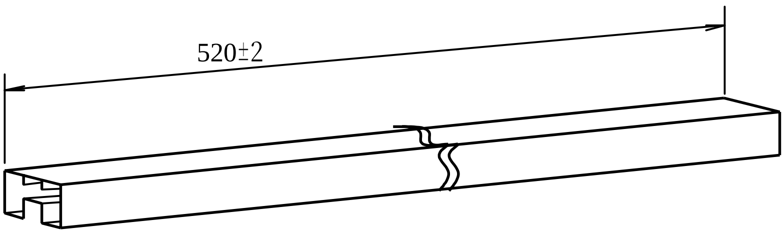
MAX. 20 pcs. sleeves in one case

· Sleeve out line dimensions

Through-Hole or SMT Gullwing Lead-Form

Unit : mm





2. Tape and Reel package

· SMT Package materials

Carrier tape : PS (with and anti-static material)

Cover tape : PET (three layer system)

Reel : PS

· package method

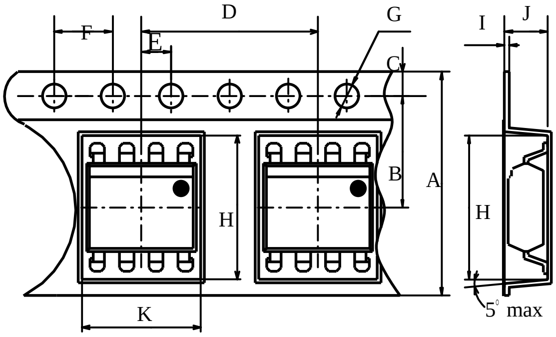
MAX. 100 pcs. of products shall be package in a carrier tape.

MAX. 4 reels are packed in one carton.

· Carrier tape structure and dimensions

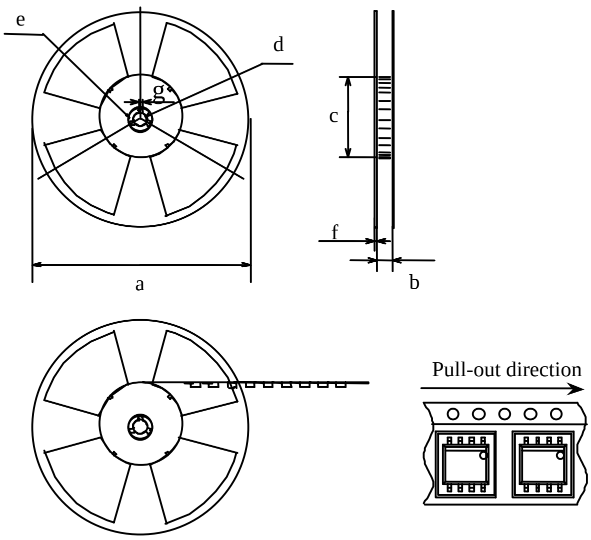
SMT Gullwing Lead-Form

Unit : mm



A	B	C	D	E	F	G	H
16.0±0.3	7.5±0.1	1.75±0.1	12.0±0.1	2.0±0.1	4.0±0.1	ϕ 1.5 $^{+0.1}_{-0}$	10.4±0.1
I	J	K					
0.4±0.05	4.2±0.1	10.2±0.1					

· Reel structure and dimensions



Dimension List

a	b	c	d
330	17.5±1.5	100±1.0	13±0.5
e	f	g	
23±1.0	2.0±0.5	2.0±0.5	

■ Important Notices

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--- Personal computers
--- Office automation equipment
--- Telecommunication equipment [terminal]
--- Test and measurement equipment
--- Industrial control
--- Audio visual equipment
--- Consumer electronics
(ⅱ) Measures such as fail-safe function and redundant design should be taken no ensure reliability and safety when SHARP devices are used for or in connection with equipment that requires higher reliability such as:
--- Transportation control and safety equipment(i.e.,aircraft,trains,automobiles, etc.)
--- Traffic signals
--- Gas leakage sensor breakers
--- Alarm equipment
--- Various safety devices, etc.
(ⅲ) SHARP devices shall not be used for or in connection with equipment that requires an extremely high level of reliability and safety such as:
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--- Telecommunication equipment [trunk lines]
--- Nuclear power control equipment
--- Medical and other life support equipment (e.g., scuba).

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