PC923L0NSZ0F Series

High Speed, Gate Drive DIP 8 pin *OPIC Photocoupler

■ Description

PC923L0NSZ0F Series contains a LED optically coupled to an OPIC chip.

It is packaged in a 8 pin DIP, available in SMT gullwing lead form option.

Input-output isolation voltage(rms) is 5.0 kV, High speed response (t_{PHL}, t_{PLH} : MAX. 0.5 μs).

■ Features

1. 8 pin DIP package
2. Double transfer mold package (Ideal for Flow Soldering)
3. Built-in direct drive circuit for MOSFET / IGBT drive (I_{O1P}, I_{O2P} : 0.6 A)
4. High speed response (t_{PHL}, t_{PLH} : MAX. 0.5 μs)
5. Wide operating supply voltage range (V_{CC}=15 to 30 V)
6. High noise immunity due to high instantaneous common mode rejection voltage (CM_H : MIN. –15kV/μs, CM_L : MIN. 15kV/μs)
7. High isolation voltage between input and output ($V_{iso(rms)}$: 5.0 kV)
8. Lead-free and RoHS directive compliant

■ Agency approvals/Compliance

1. Recognized by UL1577 (Double protection isolation), file No. E64380 (as model No. **PC923L**)
2. Approved by VDE, DIN EN60747-5-2(*) (as an option), file No. 40008898 (as model No. **PC923L**)
3. Package resin : UL flammability grade (94V-0)

(*)DIN EN60747-5-2 : successor standard of DIN VDE0884

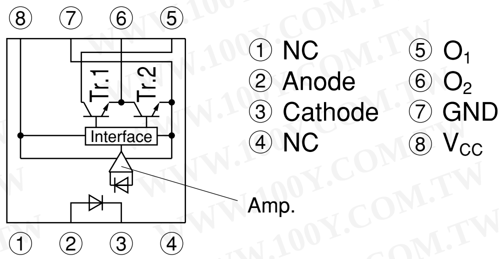
■ Applications

1. IGBT/MOSFET gate drive for inverter control

* "OPIC"(Optical IC) is a trademark of the SHARP Corporation. An OPIC consists of a light-detecting element and a signal-processing circuit integrated onto a single chip.

Sheet No.: D2-A06002EN
Date Jun. 30. 2005

■ Internal Connection Diagram



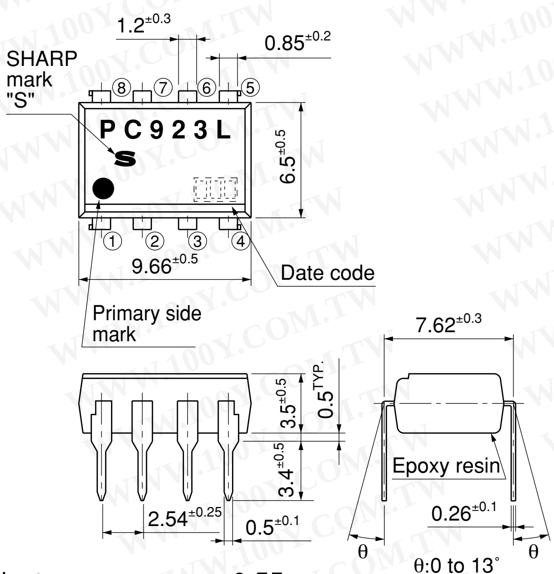
■ Truth table

Input	O_2 Terminal output	Tr. 1	Tr. 2
ON	High level	ON	OFF
OFF	Low level	OFF	ON

■ Outline Dimensions

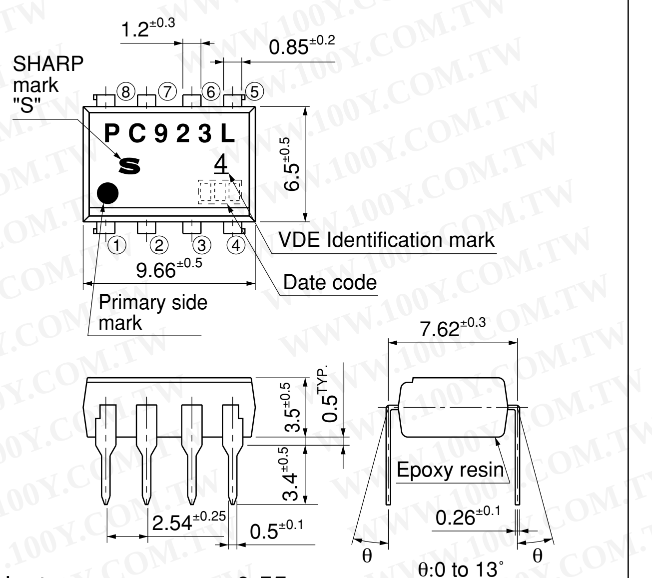
(Unit : mm)

1. Through-Hole [ex. **PC923L0NSZ0F**]



Product mass : approx. 0.55g

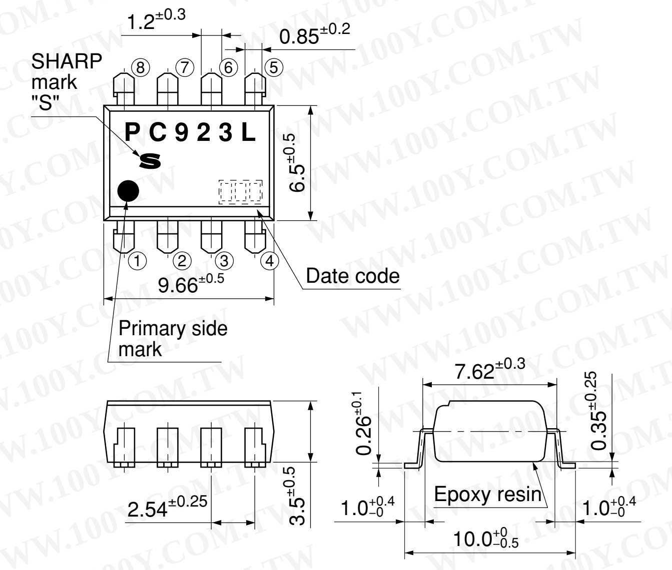
2. Through-Hole (VDE option) [ex. **PC923L0YSZ0F**]



Product mass : approx. 0.55g

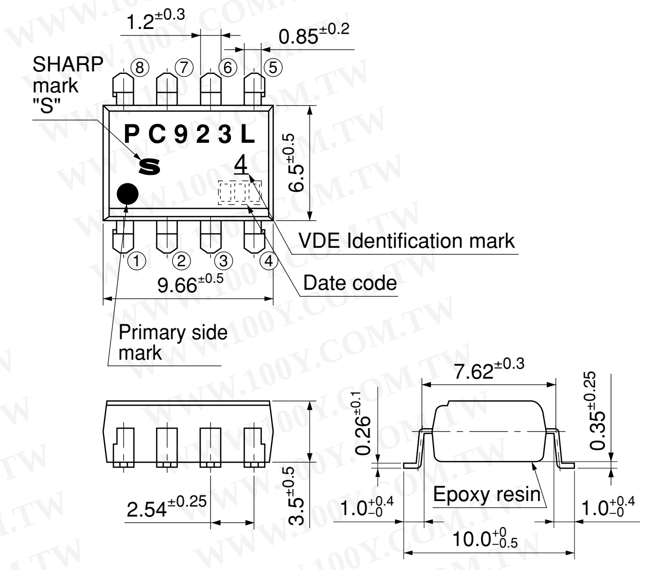
(Unit : mm)

3. SMT Gullwing Lead-Form [ex. **PC923L0NIP0F**]



Product mass : approx. 0.51g

4. SMT Gullwing Lead-Form (VDE option) [ex. **PC923L0YIP0F**]



Product mass : approx. 0.51g

Plating material : SnCu (Cu : TYP. 2%)

Date code (3 digit)

1st digit				2nd digit		3rd digit	
Year of production				Month of production		Week of production	
A.D.	Mark	A.D	Mark	Month	Mark	Week	Mark
1990	A	2002	P	January	1	1st	1
1991	B	2003	R	February	2	2nd	2
1992	C	2004	S	March	3	3rd	3
1993	D	2005	T	April	4	4th	4
1994	E	2006	U	May	5	5.6th	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		

repeats in a 20 year cycle

Country of origin

Japan

Rank mark

There is no rank mark indicator.

■ Absolute Maximum Ratings

(T_a=25˚C)

Parameter		Symbol	Rating	Unit
Input	*1 Forward current	I_F	20	mA
	Reverse voltage	V_R	5	V
Output	Supply voltage	V_{CC}	35	V
	O_1 output current	I_{O1}	0.1	A
	*2 O_1 Peak output current	I_{O1P}	0.6	A
	O_2 output current	I_{O2}	0.1	A
	*2 O_2 Peak output current	I_{O2P}	0.6	A
	O_1 output voltage	V_{O1}	35	V
	*3 Power dissipation	P_O	500	mW
*4 Total power dissipation		P_{tot}	550	mW
*5 Isolation voltage		$V_{iso\ (rms)}$	5.0	kV
Operating temperature		T_{opr}	−40 to +85	˚C
Storage temperature		T_{stg}	−55 to +125	˚C
*6 Soldering temperature		T_{sol}	270	˚C

*1 The derating factors of a absolute maximum ratings due to ambient temperature are shown in Fig.10
*2 Pulse width≤0.15μs, Duty ratio : 0.01
*3, 4 The derating factors of a absolute maximum ratings due to ambient temperature are shown in Fig.11
*5 AC for 1minute, 40 to 60 %RH, f=60Hz
*6 For 10s

■ Electro-optical Characteristics*7

(Unless otherwise specified T_a=T_{opr})

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_{F1}	T_a=25˚C, I_F=10mA	–	1.6	1.75	V
			V_{F2}	T_a=25˚C, I_F=0.2mA	1.2	1.5	–	V
	Reverse current		I_R	T_a=25˚C, V_R=5V	–	–	10	μA
	Terminal capacitance		C_t	T_a=25˚C, V=0, f=1MHz	–	60	150	pF
Output	Supply voltage		V_{CC}	–	15	–	30	V
	O_1 Low level output voltage		V_{O1L}	V_{CC1}=12V, V_{CC2}=−12V, I_{O1}=0.1A, I_F=5mA	–	0.2	0.4	V
	O_2 High level output voltage		V_{O2H}	V_{CC}=V_{O1}=24V, I_{O2}=−0.1A, I_F=5mA	20	22	–	V
	O_2 Low level output voltage		V_{O2L}	V_{CC}=24V, I_{O2}=0.1A, I_F=0	–	0.5	0.8	V
	O_1 leak current		I_{O1L}	V_{CC}=V_{O1}=35V, I_F=0	–	–	500	μA
	O_2 leak current		I_{O2L}	V_{CC}=V_{O2}=35V, I_F=5mA	–	–	500	μA
	*9 High level supply current		I_{CCH}	V_{CC}=24V, I_F=5mA	–	1.3	3.0	mA
	*9 Low level supply current		I_{CCL}	V_{CC}=24V, I_F=0	–	1.3	3.0	mA
Transfer characteristics	*8 "Low→High" input threshold current		I_{FLH}	T_a=25˚C, V_{CC}=24V	0.3	1.5	3.0	mA
				V_{CC}=24V	0.2	–	5.0	mA
	Isolation resistance		R_{ISO}	T_a=25˚C, DC500V, 40 to 60%RH	5×10^{10}	10^{11}	–	Ω
	Response time	"Low→High" propagation delay time	t_{PLH}	T_a=25˚C, V_{CC}=24V, I_F=5mA R_G=47Ω, C_G=3 000pF	–	0.3	0.5	μs
		"High→Low" propagation delay time	t_{PHL}		–	0.3	0.5	μs
		Rise time	t_r		–	0.2	0.5	μs
		Fall time	t_f		–	0.2	0.5	μs
	Instantaneous common mode rejection voltage (High level output)		CM_H	T_a=25˚C, V_{CM}=1.5kV$_{(p-p)}$ I_F=5mA, V_{CC}=24V, ΔV_{O2H}=2.0V	-15	–	–	kV/μs
	Instantaneous common mode rejection voltage (Low level output)		CM_L	T_a=25˚C, V_{CM}=1.5kV$_{(p-p)}$ I_F=0, V_{CC}=24V, ΔV_{O2L}=2.0V	15	–	–	kV/μs

*7 It shall connect a by-pass capacitor of 0.01μF or more between V_{CC} (pin ⑧) and GND (pin ⑦) near the device, when it measures the transfer characteristics and the output side characteristics
*8 I_{FLH} represents forward current when output goes from "Low" to "High" *9 O_2 output terminal is set open

■ Model Line-up

Lead Form	Through-Hole		SMT Gullwing			
Package	Sleeve				Taping	
	50pcs/sleeve				1 000pcs/reel	
DIN EN60747-5-2	———	Approved	———	Approved	———	Approved
Model No.	**PC923L0NSZ0F**	**PC923L0YSZ0F**	**PC923L0NIZ0F**	**PC923L0YIZ0F**	**PC923L0NIP0F**	**PC923L0YIP0F**

Please contact a local SHARP sales representative to inquire about production status.

Fig.1 Test Circuit for O_1 Low Level Output Voltage

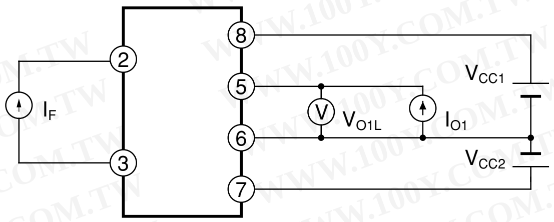


Fig.2 Test Circuit for O_2 High Level Output Voltage

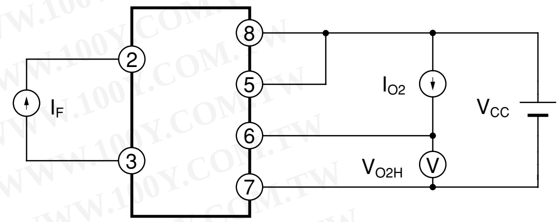


Fig.3 Test Circuit for O_2 Low Level Output Voltage

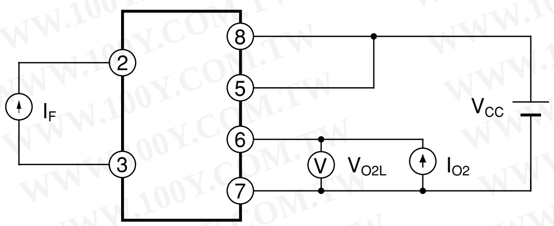


Fig.4 Test Circuit for O_1 Leak Current

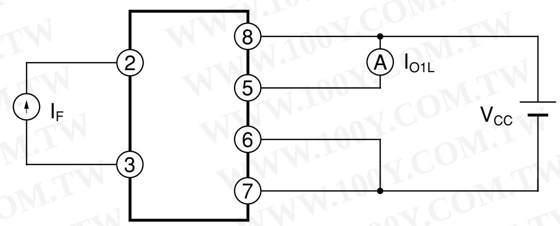


Fig.5 Test Circuit for O_2 Leak Current

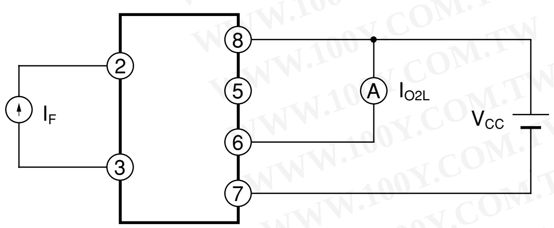


Fig.6 Test Circuit for High Level / Low Level Supply Current

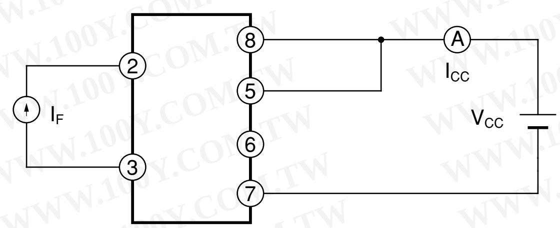


Fig.7 Test Circuit for "Low→High" Input Threshold Current

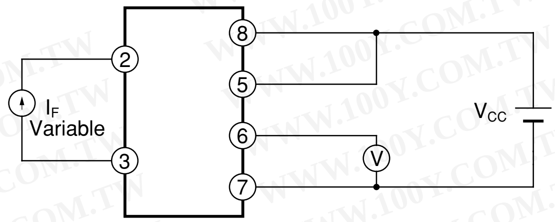


Fig.8 Test Circuit for Response Time

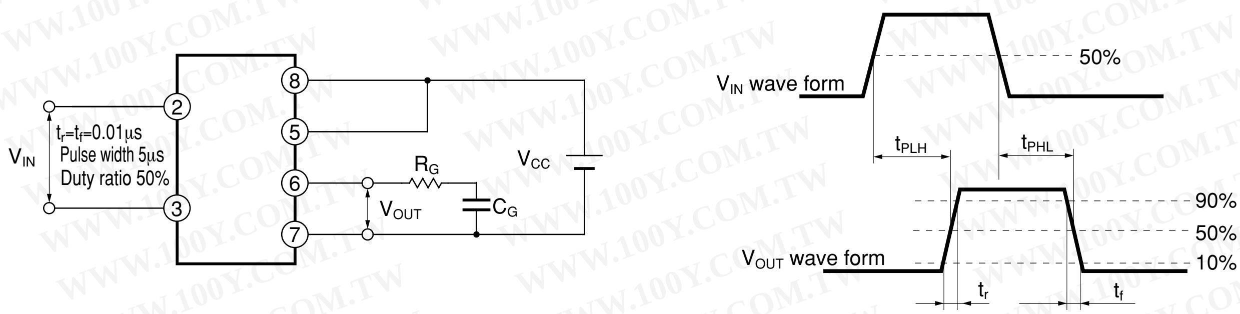


Fig.9 Test Circuit for Instantaneous Common Mode Rejection Voltage

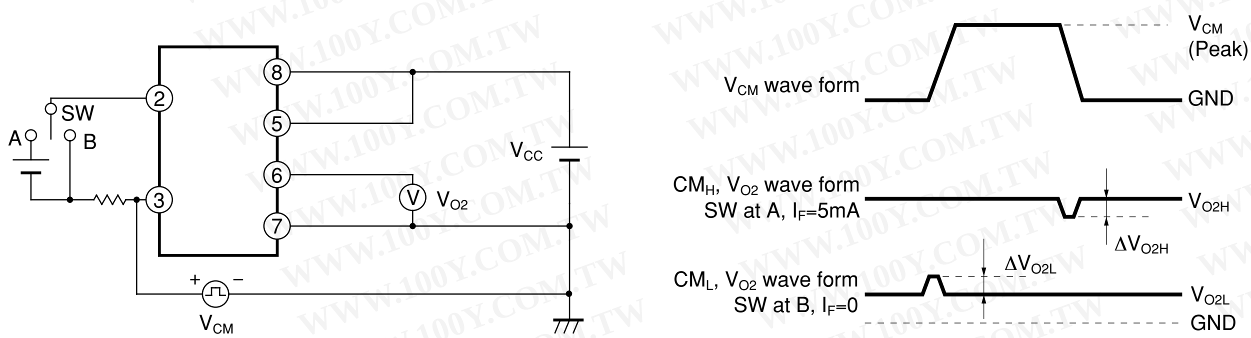


Fig.10 Forward Current vs. Ambient Temperature

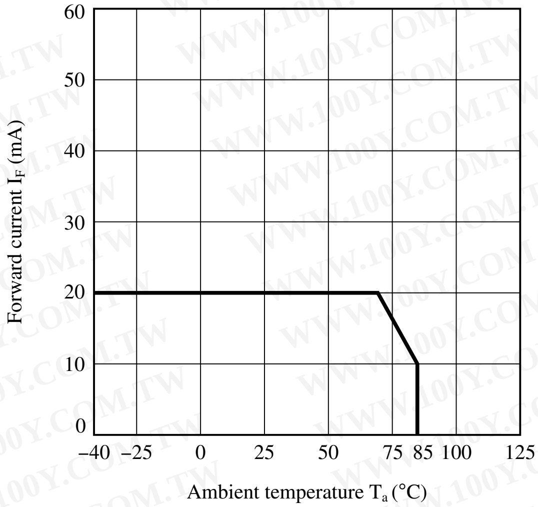


Fig.11 Power Dissipation vs. Ambient Temperature

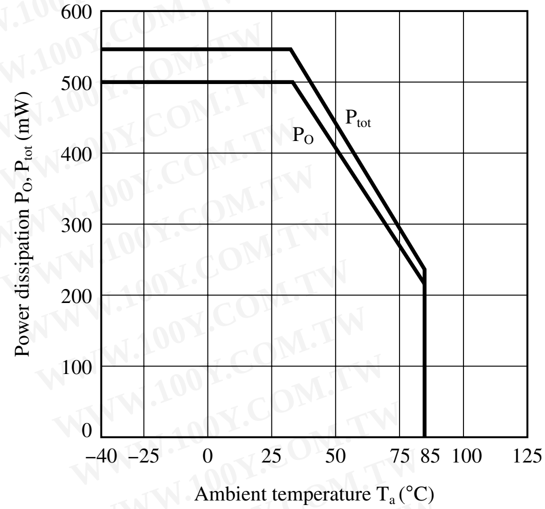


Fig.12 Forward Current vs. Forward Voltage

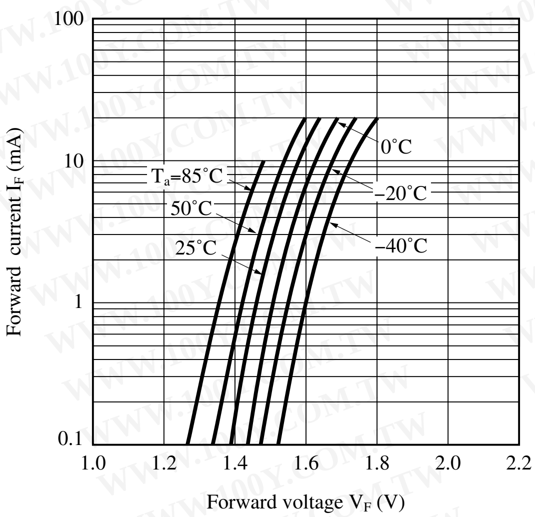


Fig.13 "Low→High" Relative Input Threshold Current vs. Supply Voltage

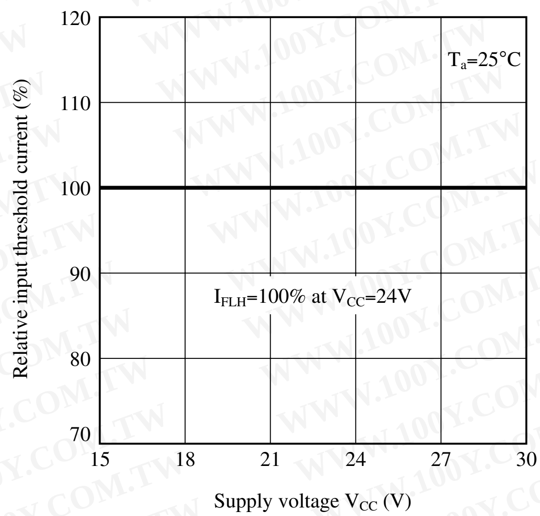


Fig.14 "Low→High" Relative Input Threshold Current vs. Ambient Temperature

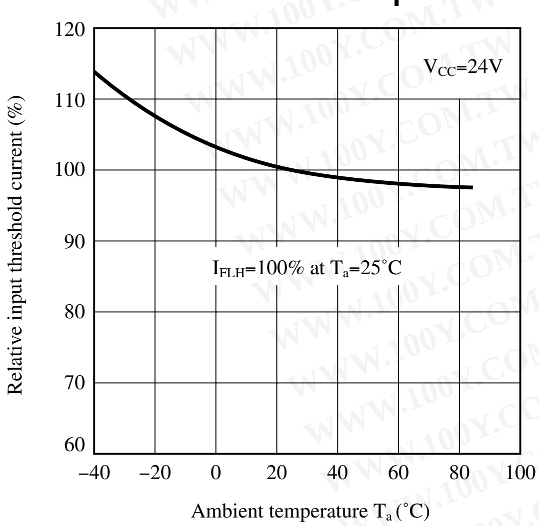


Fig.15 O_1 Low Level Output Voltage vs. O_1 Output Current

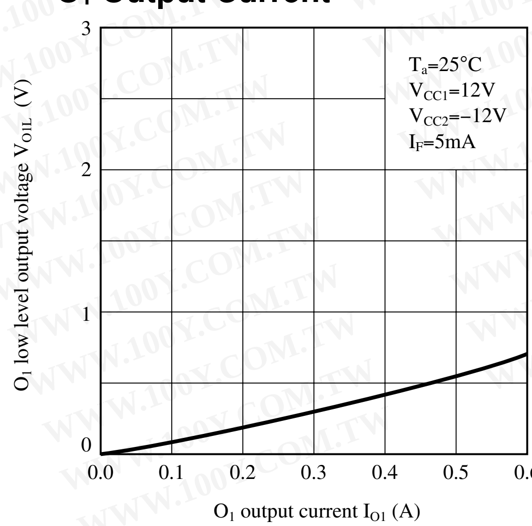


Fig.16 O_1 Low Level Output Voltage vs. Ambient Temperature

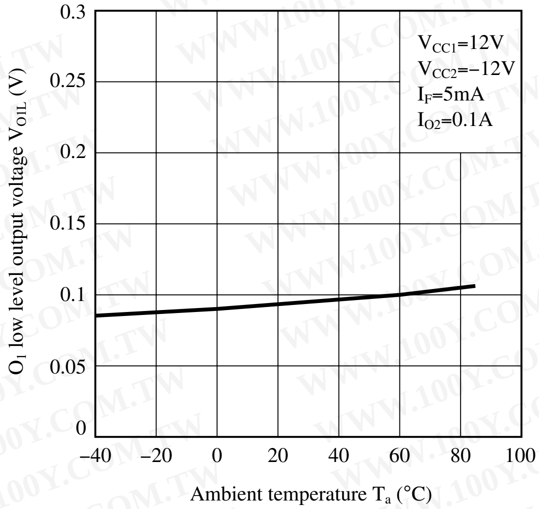


Fig.17 O_2 Output Voltage Drop vs. O_2 Output Current

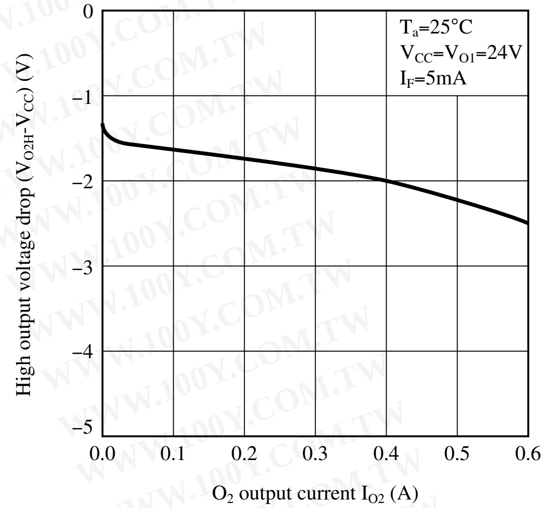


Fig.18 O_2 High Level Output Voltage vs. Supply Voltage

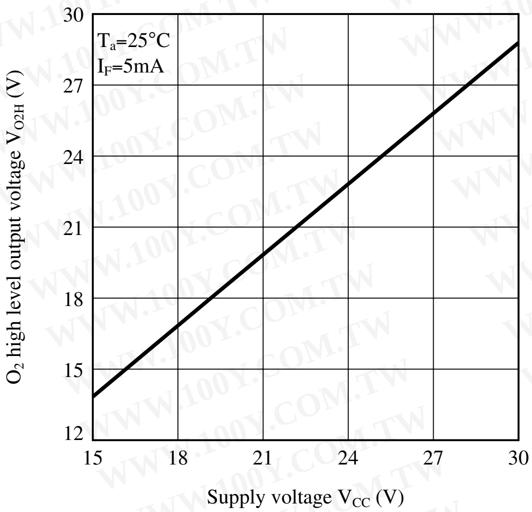


Fig.19 O_2 High Level Output Voltage vs. Ambient Temperature

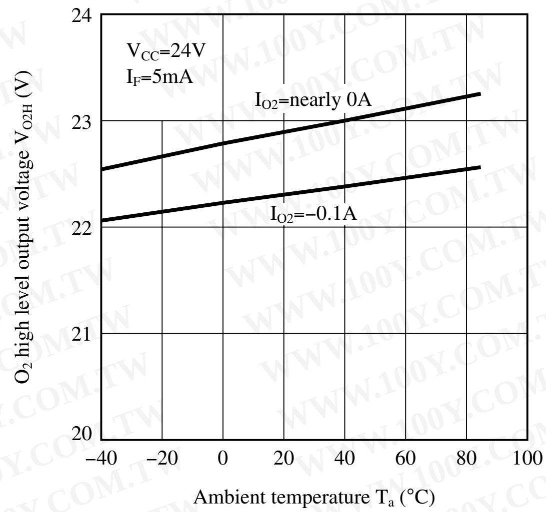


Fig.20 O_2 Low Level Output Voltage vs. O_2 Output Current

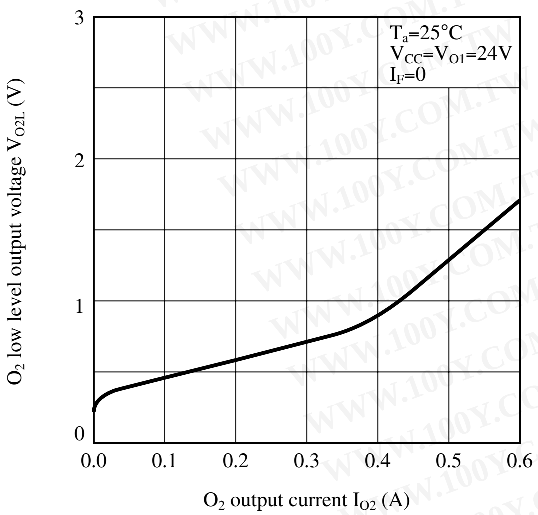


Fig.21 O_2 Low Level Output Voltage vs. Ambient Temperature

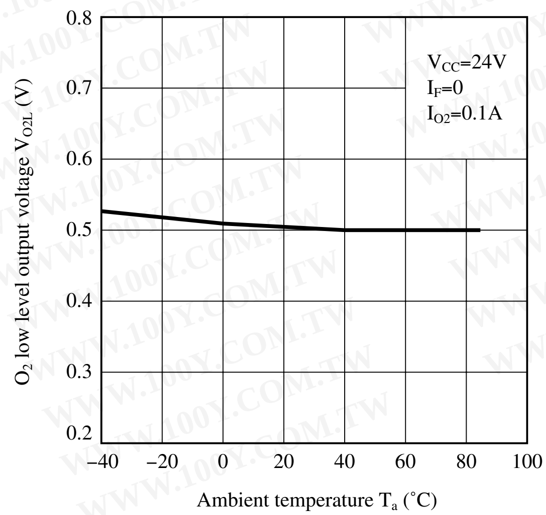


Fig.22 High Level Supply Current vs. Supply Voltage

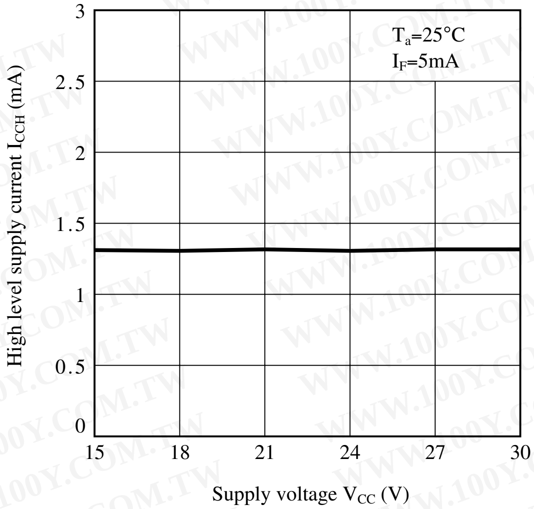


Fig.23 Low Level Supply Current vs. Supply Voltage

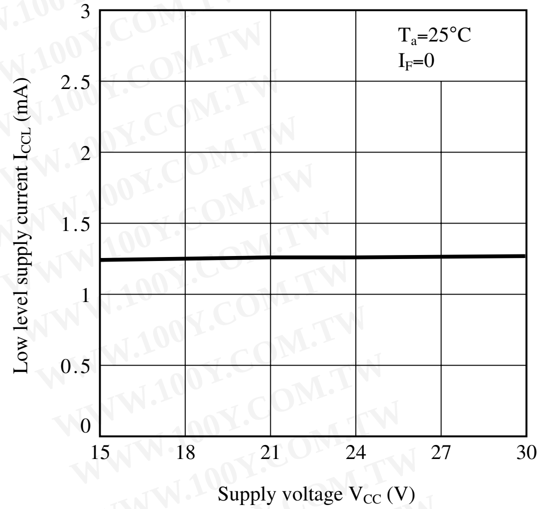


Fig.24 High Level Supply Current vs. Ambient Temperature

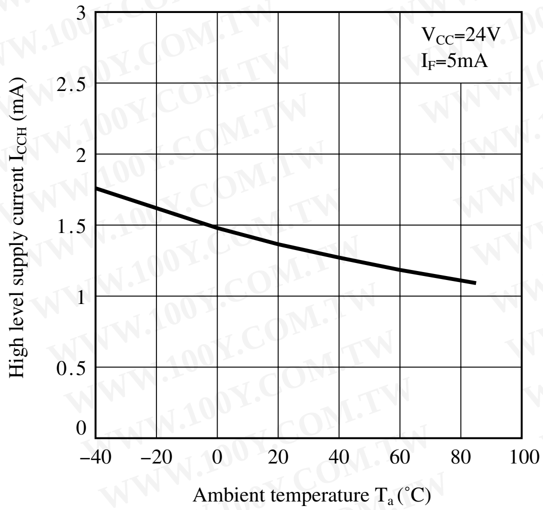


Fig.25 Low Level Supply Current vs. Ambient Temperature

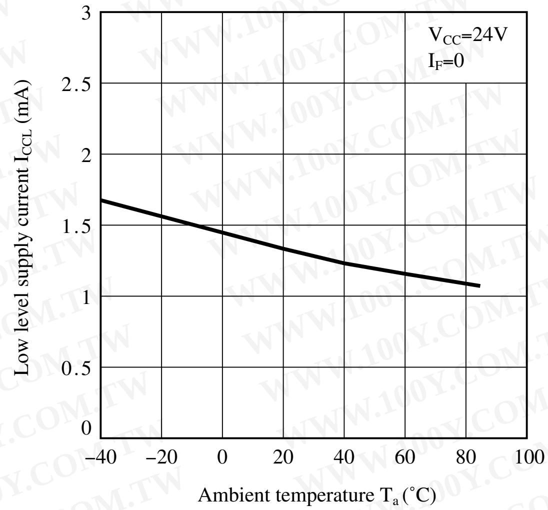


Fig.26 Propagation Delay Time vs. Forward Current

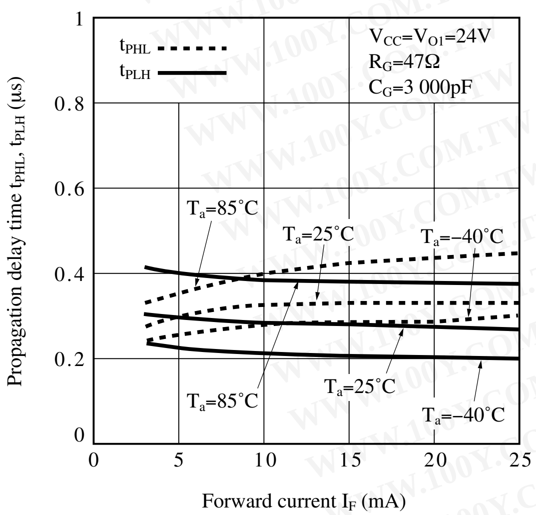
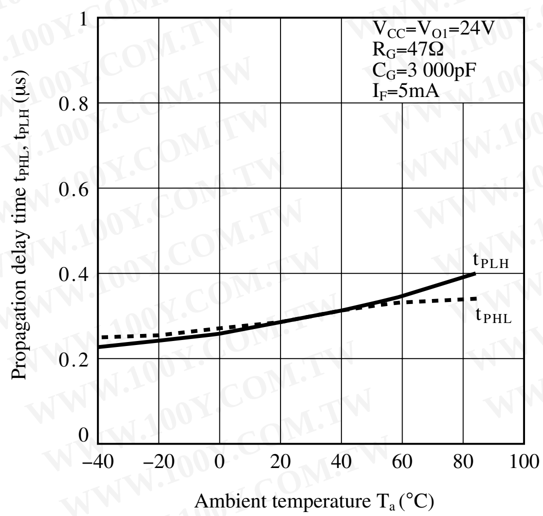


Fig.27 Propagation Delay Time vs. Ambient Temperature



Remarks : Please be aware that all data in the graph are just for reference and not for guarantee.

■ Design Considerations

● Recommended operating conditions

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Forward current	I_F	10	–	20	mA
Supply voltage	V_{CC}	15	–	30	V
Operating temperature	T_{opr}	–40	–	70	˚C

● Notes about static electricity

Transistor of detector side in bipolar configuration may be damaged by static electricity due to its minute design.
When handling these devices, general countermeasure against static electricity should be taken to avoid breakdown of devices or degradation of characteristics.

● Design guide

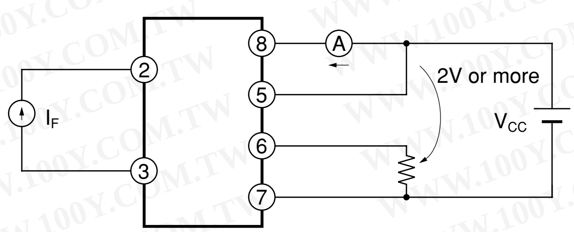
In order to stabilize power supply line, we should certainly recommend to connect a by-pass capacitor of 0.01μF or more between V_{CC} and GND near the device.

In case that some sudden big noise caused by voltage variation is provided between primary and secondary terminals of photocoupler some current caused by it is floating capacitance may be generated and result in false operation since current may go through LED or current may change.
If the photocoupler may be used under the circumstances where noise will be generated we recommend to use the bypass capacitors at the both ends of LED.

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 product is not designed against irradiation and incorporates non-coherent LED.

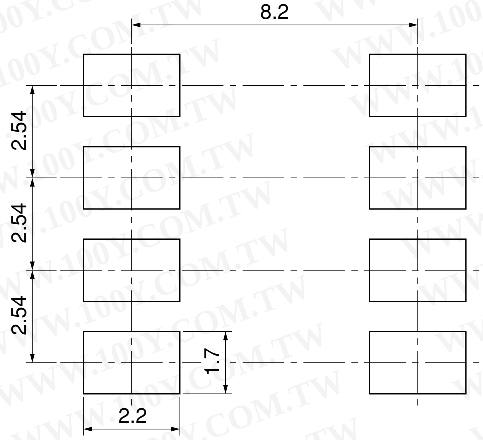
This photocoupler is dedicated to the use for IGBT or MOSFET Gate Drive.
Please do not use this for the other application.
As mentioned below, when the input is on, if DC load (resistor etc.) is connected between O_2 output pin 6 and GND pin 7 and if the electric potential V_{O2} goes approx. 2V below than electric potential V_{CC} pin 8 continuously, supply current I_{CC} may flow more than usually and go beyond power dissipation.



● Degradation

In general, the emission of the LED used in photocouplers will degrade over time.
In the case of long term operation, please take the general LED degradation (50% degradation over 5 years) into the design consideration.
Please decide the input current which become 2 times of MAX. I_{FLH}.

● Recommended Foot Print (reference)



(Unit : mm)

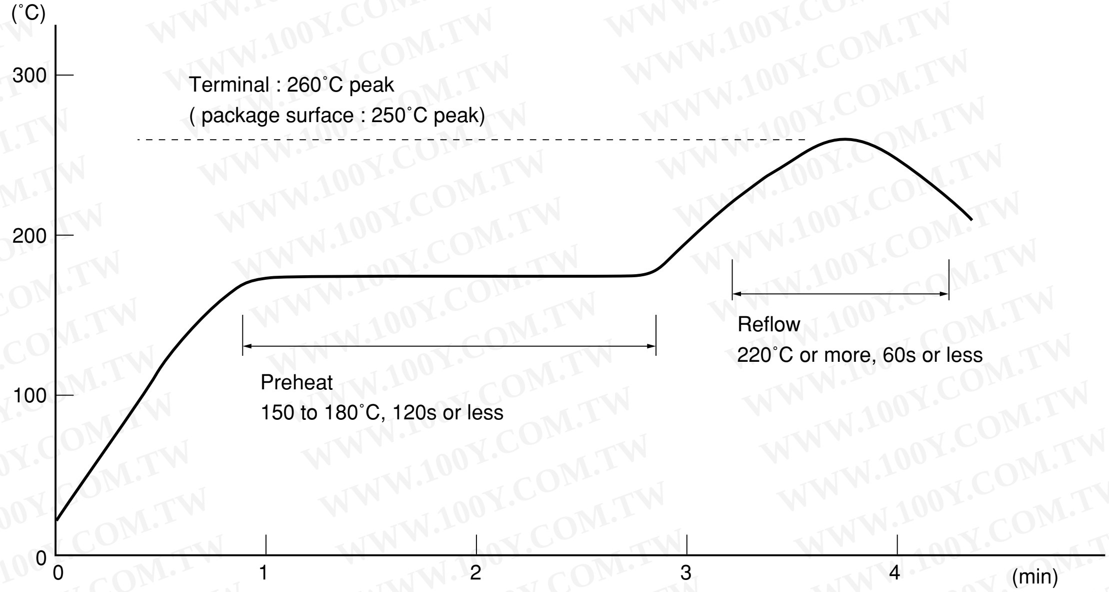
☆ For additional design assistance, please review our corresponding Optoelectronic Application Notes.

■ Manufacturing Guidelines

● Soldering Method

Reflow Soldering:

Reflow soldering should follow the temperature profile shown 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˚C and within 10s.
Preheating is within the bounds of 100 to 150˚C and 30 to 80s.
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˚C.
Please don't solder more than twice.

Other notices

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

● Cleaning instructions

Solvent cleaning:

Solvent temperature should be 45˚C or below Immersion time should be 3 minutes 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 conditions in advance of mass production.

Recommended solvent materials:

Ethyl alcohol, Methyl alcohol and Isopropyl alcohol

In case 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 packaging resin.

● Presence of ODC

This product shall not contain the following materials.

And they are not used in the production process for this product.

Regulation substances : CFCs, Halon, Carbon tetrachloride, 1.1.1-Trichloroethane (Methylchloroform)

Specific brominated flame retardants such as the PBBOs and PBBs are not used in this product at all.

This product shall not contain the following materials banned in the RoHS Directive (2002/95/EC).

- Lead, Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls (PBB), Polybrominated diphenyl ethers (PBDE).

■ Package specification

● Sleeve package

Package materials

Sleeve : HIPS (with anti-static material)

Stopper : Styrene-Elastomer

Package method

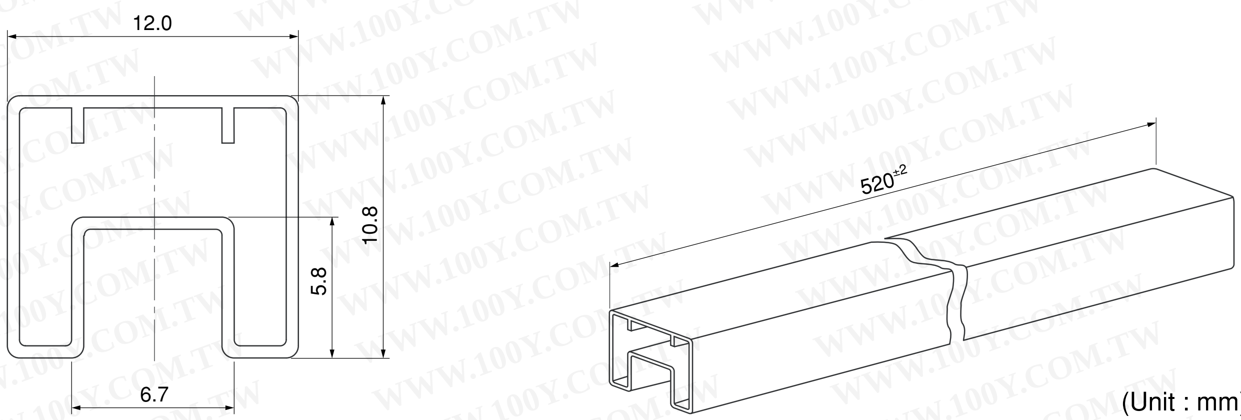
MAX. 50 pcs. of products shall be packaged in a sleeve.

Both ends shall be closed by tabbed and tabless stoppers.

The product shall be arranged in the sleeve with its primary side mark on the tabless stopper side.

MAX. 20 sleeves in one case.

Sleeve outline dimensions



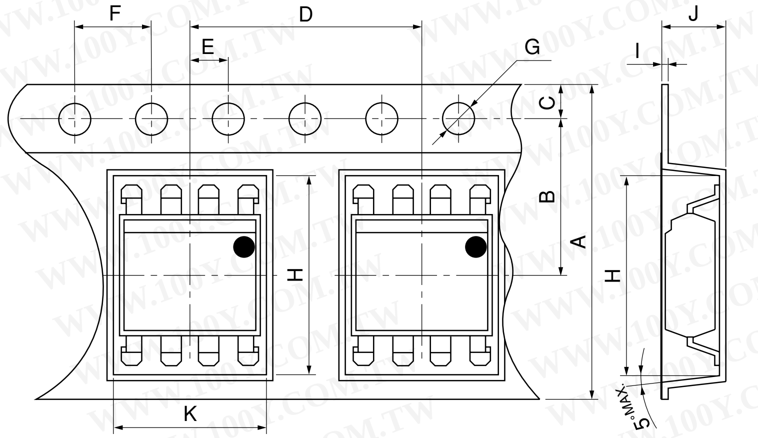
(Unit : mm)

● Tape and Reel package

Package materials

Carrier tape : A-PET (with anti-static material)
Cover tape : PET (three layer system)
Reel : PS

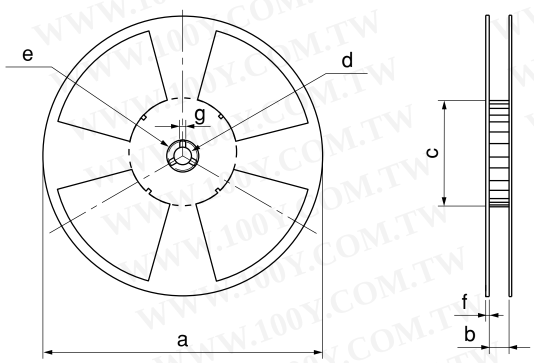
Carrier tape structure and Dimensions



Dimensions List (Unit : mm)

A	B	C	D	E	F	G
16.0±0.3	7.5±0.1	1.75±0.1	12.0±0.1	2.0±0.1	4.0±0.1	φ1.5 $^{+0.1}_{-0}$
H	I	J	K			
10.4±0.1	0.4±0.05	4.2±0.1	10.2±0.1			

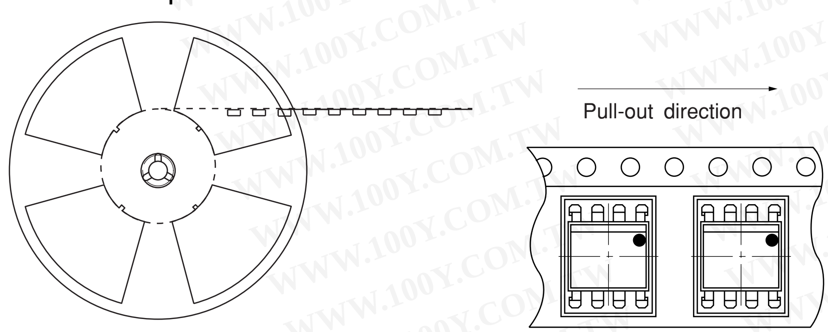
Reel structure and Dimensions



Dimensions List (Unit : mm)

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	

Direction of product insertion



[Packing : 1 000pcs/reel]

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(i) The devices in this publication are designed for use in general electronic equipment designs such as:

--- 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 to 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:

--- Space applications
--- Telecommunication equipment [trunk lines]
--- Nuclear power control equipment
--- Medical and other life support equipment (e.g., scuba).

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