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 (IO1P, IO2P=MAX. 0.6A)
3. High speed response (tPLH, tPHL : MAX. 0.5μs)
4. Wide operating supply voltage range (VCC=15 to 35V)
5. Low dissipation current (ICC=TYP. 1.3mA)
6. High noise reduction type (CMR=MIN. 15kV/μs @ VCM=1500V)
7. High isolation voltage (Viso=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

- 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

<table>
<thead>
<tr>
<th>Year of production</th>
<th>Month of production</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.D</td>
<td>Mark</td>
</tr>
<tr>
<td>1990</td>
<td>A</td>
</tr>
<tr>
<td>1991</td>
<td>B</td>
</tr>
<tr>
<td>1992</td>
<td>C</td>
</tr>
<tr>
<td>1993</td>
<td>D</td>
</tr>
<tr>
<td>1994</td>
<td>E</td>
</tr>
<tr>
<td>1995</td>
<td>F</td>
</tr>
<tr>
<td>1996</td>
<td>H</td>
</tr>
<tr>
<td>1997</td>
<td>J</td>
</tr>
<tr>
<td>1998</td>
<td>K</td>
</tr>
<tr>
<td>1999</td>
<td>L</td>
</tr>
<tr>
<td>2000</td>
<td>M</td>
</tr>
<tr>
<td>2001</td>
<td>N</td>
</tr>
</tbody>
</table>

- Weekly code

<table>
<thead>
<tr>
<th>1st Week</th>
<th>2nd Week</th>
<th>3rd Week</th>
<th>4th Week</th>
<th>5th and 6th Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward current</td>
<td>(I_F)</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>(V_R)</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>(V_{cc})</td>
<td>35</td>
<td>V</td>
</tr>
<tr>
<td>O1 Output current</td>
<td>(I_{O1})</td>
<td>0.1</td>
<td>A</td>
</tr>
<tr>
<td>O1 Peak output current</td>
<td>(I_{O1P})</td>
<td>0.6</td>
<td>A</td>
</tr>
<tr>
<td>O2 Output current</td>
<td>(I_{O2})</td>
<td>0.1</td>
<td>A</td>
</tr>
<tr>
<td>O2 Peak output current</td>
<td>(I_{O2P})</td>
<td>0.6</td>
<td>A</td>
</tr>
<tr>
<td>O1 Output voltage</td>
<td>(V_{O1})</td>
<td>35</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>(P_o)</td>
<td>500</td>
<td>mW</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>(P_{tot})</td>
<td>550</td>
<td>mW</td>
</tr>
<tr>
<td>Isolation voltage</td>
<td>(V_{iso(\text{max})})</td>
<td>5.0</td>
<td>kV</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>(T_{stg})</td>
<td>-40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>(T_{stg})</td>
<td>-55 to +125</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering temperature</td>
<td>(T_{sol})</td>
<td>270 (For 10s)</td>
<td>°C</td>
</tr>
</tbody>
</table>

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

*4 Pulse width \(\leq 0.15 \mu s\), Duty ratio : 0.01

*5 AC for 1min, 40 to 60%RH, \(T_a=25^\circ C\)
### Electro-optical Characteristics

(Unspecified : Ta=40 to +85°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
<th>Test circuit Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward voltage</td>
<td>$V_{F1}$</td>
<td>-</td>
<td>1.6</td>
<td>1.75</td>
<td>V</td>
<td>Ta=25°C, $I_F=10mA$</td>
</tr>
<tr>
<td>Reverse current</td>
<td>$I_R$</td>
<td>-</td>
<td>1.2</td>
<td>1.5</td>
<td>-</td>
<td>Ta=25°C, $V_R=5V$</td>
</tr>
<tr>
<td>Terminal capacitance</td>
<td>$C_t$</td>
<td>-</td>
<td>60</td>
<td>150</td>
<td>pF</td>
<td>Ta=25°C, $V=0$, f=1MHz</td>
</tr>
<tr>
<td>Operating supply voltage range</td>
<td>$V_{cc}$</td>
<td>15</td>
<td>-</td>
<td>30</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>O₁ Low level output voltage</td>
<td>$V_{O1L}$</td>
<td>-</td>
<td>0.2</td>
<td>0.4</td>
<td>V</td>
<td>(1) $V_{cc1}=12V$, $V_{cc2}=12V$, $I_{O1}=0.1A$, $I_F=5mA$</td>
</tr>
<tr>
<td>O₂ High level output voltage</td>
<td>$V_{O2H}$</td>
<td>20</td>
<td>22</td>
<td>-</td>
<td>V</td>
<td>(2) $V_{cc}=24V$, $I_{O2}=-0.1A$, $I_F=5mA$</td>
</tr>
<tr>
<td>O₁ Low level output voltage</td>
<td>$V_{O1L}$</td>
<td>-</td>
<td>0.5</td>
<td>0.8</td>
<td>V</td>
<td>(3) $V_{cc}=24V$, $I_{O2}=-0.1A$, $I_F=0mA$</td>
</tr>
<tr>
<td>O₂ Leak current</td>
<td>$I_{O2L}$</td>
<td>-</td>
<td>-</td>
<td>500</td>
<td>$\mu$A</td>
<td></td>
</tr>
<tr>
<td>High level supply current *3</td>
<td>$I_{CH}$</td>
<td>-</td>
<td>1.3</td>
<td>3.0</td>
<td>mA</td>
<td>(6) $V_{cc}=24V$, $I_F=5mA$</td>
</tr>
<tr>
<td>Low level supply current *3</td>
<td>$I_{CL}$</td>
<td>-</td>
<td>1.3</td>
<td>3.0</td>
<td>mA</td>
<td>$V_{cc}=24V$, $I_F=0mA$</td>
</tr>
<tr>
<td>&quot;L ☐ H&quot; threshold input current *2</td>
<td>$I_{FLH}$</td>
<td>0.3</td>
<td>1.5</td>
<td>3.0</td>
<td>mA</td>
<td>(7) $V_{cc}=24V$</td>
</tr>
<tr>
<td>Isolation resistance</td>
<td>$R_{ISO}$</td>
<td>$5\times10^{10}$</td>
<td>$10^{11}$</td>
<td>-</td>
<td>$\Omega$</td>
<td>Ta=25°C, DC=500V, 40 to 60%RH</td>
</tr>
<tr>
<td>&quot;L ☐ H&quot; propagation time</td>
<td>$t_{FLH}$</td>
<td>-</td>
<td>0.3</td>
<td>0.5</td>
<td>$\mu$s</td>
<td></td>
</tr>
<tr>
<td>&quot;H ☐ L&quot; propagation time</td>
<td>$t_{PHL}$</td>
<td>-</td>
<td>0.3</td>
<td>0.5</td>
<td>$\mu$s</td>
<td></td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_r$</td>
<td>-</td>
<td>0.2</td>
<td>0.5</td>
<td>$\mu$s</td>
<td></td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_f$</td>
<td>-</td>
<td>0.2</td>
<td>0.5</td>
<td>$\mu$s</td>
<td></td>
</tr>
<tr>
<td>Instantaneous common mode rejection voltage (High level output)</td>
<td>$CM_H$</td>
<td>-15</td>
<td>-</td>
<td>-</td>
<td>kV/ $\mu$s</td>
<td></td>
</tr>
<tr>
<td>Instantaneous common mode rejection voltage (Low level output)</td>
<td>$CM_L$</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 It shall connect a by-pass capacitor of 0.01 $\mu$F or more between $V_{cc}$ (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 O₂ Output pin is open (please refer to the Design guide for Photocouplers).

---

### Truth Table

<table>
<thead>
<tr>
<th>Input</th>
<th>O₂ Output</th>
<th>Tr1</th>
<th>Tr2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>High level</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>OFF</td>
<td>Low level</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>
Test Circuit

(Fig.1)\n
(Fig.2)\n
(Fig.3)\n
(Fig.4)\n
(Fig.5)\n
(Fig.6)\n
(Fig.7)\n
(Fig.8)\n
(Fig.9)\n
\[ V_{CM} \text{ wave form} \]

\[ V_{CM(Peak)} \]

\[ V_{CM}, V_{O2} \text{ wave form} \]

\[ V_{O2H} \]

\[ V_{O2L} \]

\[ V_{O2L}, V_{O2H} \text{ wave form} \]

\[ V_{IN} \text{ wave form} \]

\[ V_{OUT} \text{ wave form} \]
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)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward current</td>
<td>IF</td>
<td>10</td>
<td>-</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>VCC</td>
<td>15</td>
<td>-</td>
<td>30</td>
<td>V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Topr</td>
<td>-40</td>
<td>-</td>
<td>70</td>
<td>°C</td>
</tr>
</tbody>
</table>

- **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 Optoelectronic 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°C and within 10s.
  Preheating is within the bounds of 100 to 150°C 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°C.
  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°C 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: CFC₃, Halon, Carbon tetrachloride, 1,1,1-Trichloroethane (Methylchloroform)
Specific brominated flame retardants such as the PBBO₃, and PBB₃ are not used in this product at all.
**Package specification**

1. **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. 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

![Diagram of sleeve dimensions]
2. Tape and Reel package

- **SMT Package materials**
  - Carrier tape: PS (with anti-static material)
  - Cover tape: PET (three layer system)
  - Reel: PS
- **Package method**
  - MAX. 100 pcs. of products shall be packaged in a carrier tape.
  - MAX. 4 reels are packed in one carton.
- **Carrier tape structure and dimensions**
  - SMT Gullwing Lead-Form
  - Unit: mm

![Carrier Tape Diagram]

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16.0±0.3</td>
<td>7.5±0.1</td>
<td>1.75±0.1</td>
<td>12.0±0.1</td>
<td>2.0±0.1</td>
<td>4.0±0.1</td>
<td>φ 1.5 ±0.1</td>
<td>10.4±0.1</td>
</tr>
<tr>
<td>I</td>
<td>0.4±0.05</td>
<td>4.2±0.1</td>
<td>10.2±0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Reel structure and dimensions**

![Reel Diagram]

**Dimension List**

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>330</td>
<td>17.5±1.5</td>
<td>100±1.0</td>
<td>13±0.5</td>
</tr>
<tr>
<td>e</td>
<td>23±1.0</td>
<td>2.0±0.5</td>
<td>2.0±0.5</td>
<td></td>
</tr>
</tbody>
</table>
Important Notices

• The circuit application examples in this publication are provided to explain representative applications of SHARP devices and are not intended to guarantee any circuit design or license any intellectual property rights. SHARP takes no responsibility for any problems related to any intellectual property right of a third party resulting from the use of SHARP’s devices.

• Contact SHARP in order to obtain the latest device specification sheets before using any SHARP device. SHARP reserves the right to make changes in the specifications, characteristics, data, materials, structure, and other contents described herein at any time without notice in order to improve design or reliability. Manufacturing locations are also subject to change without notice.

• Observe the following points when using any devices in the publication. SHARP takes no responsibility for damage caused by improper use of the devices which does not meet the conditions and absolute maximum ratings to be used specified in the relevant specification sheet nor meet the following conditions:
  (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).

• If the SHARP device listed in this publication fall within the scope of strategic products described in the Foreign Exchange and Foreign Trade Law of Japan, it is necessary to obtain approval to export such SHARP devices.

• This publication is the proprietary product of SHARP and is copyrighted, with all rights reserved. Under the copyright laws, no part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, in whole or in part, without the express written permission of SHARP. Express written permission is also required before any use or this publication may be made by a third party.

• Contact and consult with a SHARP representative if there are any questions about the contents of this publication.