GP1A70R/GP1A71R

OPIC Photointerrupter with Encoder Functions

■ Features
1. 2-phase (A, B) digital output
2. Sensing accuracy
   (GP1A70R Disk slit pitch : 1.14mm)
   (GP1A71R Disk slit pitch : 0.7mm)
3. PWB mounting type
   (Lead bending type)
4. TTL compatible output
5. Compact, lightweight

■ Applications
1. Printers
2. Copiers
3. Numerical control machines

■ Outline Dimensions

*“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

<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>50</td>
<td>mA</td>
</tr>
<tr>
<td>“1” Peak forward current</td>
<td>I_FM</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>V_R</td>
<td>6</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>P</td>
<td>75</td>
<td>mW</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>V_CC</td>
<td>7</td>
<td>V</td>
</tr>
<tr>
<td>Low level output current</td>
<td>I_OH</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>P_O</td>
<td>250</td>
<td>mW</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>T_opr</td>
<td>0 to + 70</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T_stg</td>
<td>-40 to +80</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering temperature</td>
<td>T_sol</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

*1 Pulse width <= 100μs, Duty ratio 0.01
*2 For 5 seconds

In the absence of confirmation by device specification sheets, SHARP takes no responsibility for any defects that occur in equipment using any of SHARP’s devices, shown in catalogs, data books, etc. Contact SHARP in order to obtain the latest version of the device specification sheets before using any SHARP’s device.
## Electro-optical Characteristics

(Ta = 25°C unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>$V_F$</td>
<td>$I_F = 20mA, Ta= 25°C$</td>
<td>-</td>
<td>1.2</td>
<td>1.4</td>
<td>V</td>
</tr>
<tr>
<td>Reverse current</td>
<td>$I_R$</td>
<td>$V_R= 3V, Ta= 25°C$</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>µA</td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating supply voltage</td>
<td>$V_CC$</td>
<td></td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>µA</td>
</tr>
<tr>
<td>High level output voltage</td>
<td>$V_{OH}$</td>
<td>$V_{CC}= 5V, I_{F}= 20mA$</td>
<td>2.4</td>
<td>4.9</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Low level output voltage</td>
<td>$V_{OL}$</td>
<td>$I_{OL}= 8mA, V_{CC}= 5V, I_{F}= 20mA$</td>
<td>-</td>
<td>0.1</td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td>Supply current</td>
<td>$I_CC$</td>
<td>$V_{CC}= 5V, I_{F}= 20mA$</td>
<td>-</td>
<td>5</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>Transfer characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duty ratio</td>
<td>$D_A, D_B$</td>
<td>$D_{A}, D_{B}$ : $\frac{t_{AH}}{t_{AP}} \times 100, D_{B} : \frac{t_{BH}}{t_{BP}} \times 100, Duty ratio: Average disk rotation time per turn</td>
<td>25</td>
<td>50</td>
<td>75</td>
<td>%</td>
</tr>
<tr>
<td>Response frequency</td>
<td>$f_{MAX}$</td>
<td>$f_{MAX}: V_{CC}= 5V, I_{F}= 20mA$</td>
<td>25</td>
<td>50</td>
<td>75</td>
<td>%</td>
</tr>
</tbody>
</table>

*3 Measured under the condition shown in Measurement Conditions.
*4 In the condition that output A and B are low level.
*5 $D_A: \frac{t_{AH}}{t_{AP}} \times 100, D_B: \frac{t_{BH}}{t_{BP}} \times 100, Duty ratio: Average disk rotation time per turn

## Output Waveforms

![Output Waveforms Diagram]

### Fig. 1 Forward Current vs. Ambient Temperature

![Fig. 1 Forward Current vs. Ambient Temperature](image)

### Fig. 2 Output Power Dissipation vs. Ambient Temperature

![Fig. 2 Output Power Dissipation vs. Ambient Temperature](image)
Fig. 6-a Phase Difference vs. Ambient Temperature

![Graph showing phase difference vs. ambient temperature for GP1A70R/GP1A71R.]

\[ \theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360' \]

Ambient temperature \( T_a (\degree C) \)

Fig. 6-b Phase Difference vs. Ambient Temperature

![Graph showing phase difference vs. ambient temperature for GP1A70R/GP1A71R.]

\[ \theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360' \]

Ambient temperature \( T_a (\degree C) \)

Fig. 7-a Duty Ratio vs. Distance (X direction) (GP1A70R)

![Graph showing duty ratio vs. distance for GP1A70R.]

\[ \theta_{AB1} = \frac{t_{AH}}{t_{AP}} \times 100 \text{ (Output A)} \]

\[ \theta_{AB1} = \frac{t_{BH}}{t_{BP}} \times 100 \text{ (Output B)} \]

Distance X (mm) (Shifting encoder)

Fig. 7-b Duty Ratio vs. Distance (X direction) (GP1A71R)

![Graph showing duty ratio vs. distance for GP1A71R.]

\[ \theta_{AB1} = \frac{t_{AH}}{t_{AP}} \times 100 \text{ (Output A)} \]

\[ \theta_{AB1} = \frac{t_{BH}}{t_{BP}} \times 100 \text{ (Output B)} \]

Distance X (mm) (Shifting encoder)

Fig. 8-a Phase Difference vs. Distance (X direction) (GP1A70R)

![Graph showing phase difference vs. distance for GP1A70R.]

\[ \theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360' \]

Distance X (mm) (Shifting encoder)

Fig. 8-b Phase Difference vs. Distance (X direction) (GP1A71R)

![Graph showing phase difference vs. distance for GP1A71R.]

\[ \theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360' \]

Distance X (mm) (Shifting encoder)
Fig. 9-a Duty Ratio vs. Distance (Y direction) (GP1A70R)

- $V_{CC} = 5V$
- $I_f = 20mA$
- $f = 2.5kHz$
- $T_a = 25^\circ C$

$\frac{t_{AH}}{t_{AP}} \times 100$ (Output A)

$\frac{t_{BH}}{t_{BP}} \times 100$ (Output B)

Distance Y (mm) (Shifting encoder)

Fig. 9-b Duty Ratio vs. Distance (Y direction) (GP1A71R)

- $V_{CC} = 5V$
- $I_f = 20mA$
- $f = 2.5kHz$
- $T_a = 25^\circ C$

$\frac{t_{AH}}{t_{AP}} \times 100$ (Output A)

$\frac{t_{BH}}{t_{BP}} \times 100$ (Output B)

Distance Y (mm) (Shifting encoder)

Fig. 10-a Phase Difference vs. Distance (Y direction) (GP1A70R)

- $V_{CC} = 5V$
- $I_f = 20mA$
- $f = 2.5kHz$
- $T_a = 25^\circ C$

$\theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360^\circ$

Distance Y (mm) (Shifting encoder)

Fig. 10-b Phase Difference vs. Distance (Y direction) (GP1A71R)

- $V_{CC} = 5V$
- $I_f = 20mA$
- $f = 2.5kHz$
- $T_a = 25^\circ C$

$\theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360^\circ$

Distance Y (mm) (Shifting encoder)

Fig. 11-a Duty Ratio vs. Distance (Z direction) (GP1A70R)

- $V_{CC} = 5V$
- $I_f = 20mA$
- $f = 2.5kHz$
- $T_a = 25^\circ C$

$\frac{t_{AH}}{t_{AP}} \times 100$ (Output A)

$\frac{t_{BH}}{t_{BP}} \times 100$ (Output B)

Distance Z (mm) (Shifting encoder)

Fig. 11-b Duty Ratio vs. Distance (Z direction) (GP1A71R)

- $V_{CC} = 5V$
- $I_f = 20mA$
- $f = 2.5kHz$
- $T_a = 25^\circ C$

$\frac{t_{AH}}{t_{AP}} \times 100$ (Output A)

$\frac{t_{BH}}{t_{BP}} \times 100$ (Output B)

Distance Z (mm) (Shifting encoder)
**Fig.12-a Phase Difference vs. Distance (Z direction)**

\[
\theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360' \]

\[
\theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360' \]

**GP1A70R**

- \( V_{CC} = 5V \)
- \( I_f = 20mA \)
- \( f = 2.5kHz \)
- \( T_a = 25^\circC \)

**Fig.12-b Phase Difference vs. Distance (Z direction)**

\[
\theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360' \]

\[
\theta_{AB1} = \frac{t_{AB1}}{t_{AP}} \times 360' \]

**GP1A71R**

- \( V_{CC} = 5V \)
- \( I_f = 20mA \)
- \( f = 2.5kHz \)
- \( T_a = 25^\circC \)

---

**<Measurement Conditions>**

(Unit: mm)

---

**<GP1A70R Basic Design>**

\[ R_O = \frac{N}{60} \times 10.89 \text{ (mm)} \]

\[ S = R_O - 2.265 \text{ (mm)} \]

**<GP1A71R Basic Design>**

\[ R_O = \frac{N}{120} \times 13.45 \text{ (mm)} \]

\[ S = R_O - 2.265 \text{ (mm)} \]

---

**Precautions for Use**

1. This device is designed to be used under the condition of \( I_f = 20mA \)
2. It is recommended that a by-pass capacitor of more than 0.01\( \mu \text{F} \) be added between \( V_{CC} \) and GND near the device in order to stabilize power supply line.
3. As for other general cautions, refer to the chapter “Precautions for Use”.
NOTICE

● 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 this 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).

● Contact a SHARP representative in advance when intending to use SHARP devices for any "specific" applications other than those recommended by SHARP or when it is unclear which category mentioned above controls the intended use.

● If the SHARP devices listed in this publication fall within the scope of strategic products described in the Foreign Exchange and Foreign Trade Control 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 of 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.