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Encoder module

P11159-201AS

Small package and high resolution encoder module

The P11159-201AS is an encoder module that incorporates a red LED and a photo IC designed specifically for optical encoders. This encoder module detects the displacement or rotation angle of the object. When the slit optical pattern attached to the object moves between the LED and photo IC, the 4-element photodiode in the photo IC reads the slit optical pattern, and then outputs the pattern signals (phase A and phase B).

Features

- **High resolution: 0.05 mm (2-phase output)**
- **Positioning pin for easy alignment**
- **Small package**
- **Suitable for lead-free flow soldering**
- **Low power consumption**

Applications

- **Rotary encoder**
- **Linear encoder**

Absolute maximum ratings (Ta=25 °C)

Parameter		Symbol	Condition	Value	Unit
Input (LED)	Forward current*1	I_F max		25	mA
	Reverse voltage	V_R max		5	V
	Power dissipation	P		100	mW
Output (photo IC)	Supply voltage	Vcc max		-0.5 to +7	V
	Output voltage	Vo max		-0.5 to Vcc + 0.5	V
	Output current	Io max		4	mA
	Power dissipation*2	P		250	mW
Operating temperature		Topr	No dew condensation*3	-40 to +85	°C
Storage temperature		Tstg	No dew condensation*3	-40 to +90	°C

*1: Forward current decreases at a rate of 0.5 mA/°C above Ta=55 °C
*2: Power dissipation decreases at a rate of 3.1 mW/°C above Ta=25 °C
*3: When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.
Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

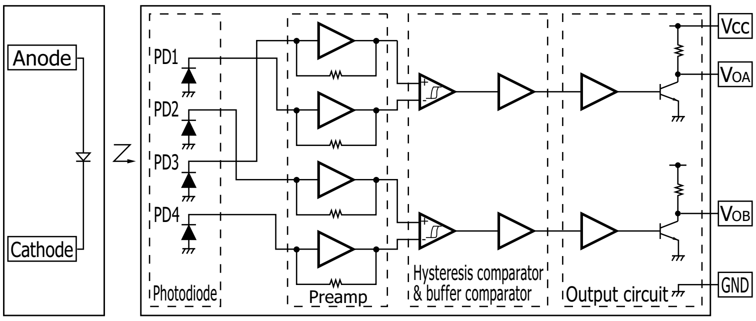
Electrical and optical characteristics (Ta=25 °C, Vcc=5 V, unless otherwise noted)

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit
Input (LED)	Forward voltage	V_F	I_F=10 mA	-	1.9	2.4	V
	Reverse current	I_R	V_R=5 V	-	-	10	μA
	Peak emission wavelength	λp	I_F=10 mA	-	650	-	nm
Output (photo IC)	Operating supply voltage	Vcc		3.0	-	7.0	V
	Low level output voltage	V_{OL}	I_{OL}=1 mA	-	-	0.4	V
	High level output voltage	V_{OH}		4.5	-	-	V
	Supply current	Icc	V_{OA}=V_{OB}=L	-	6.0	10	mA
Transfer characteristics	Duty ratio*4	t_{AH}/t_{AP}	I_F=5 mA, f=10 kHz	35	50	65	%
		t_{BH}/t_{BP}		35	50	65	%
	Phase difference*4	θ_{AB}	I_F=5 mA, f=10 kHz	60	90	120	degree
	Rise time	tr	I_F=5 mA, C_L=10 pF	-	0.5	2	μs
	Fall time	tf	I_F=5 mA, C_L=10 pF	-	0.04	0.3	μs
	Maximum response frequency*4 *5	f max	I_F=5 mA	50	-	-	kHz

*4: Measured when recommended slits are used in specified position
Response frequency f is the reciprocal of the time required to move one pitch.
*5: Maximum frequency at which no error occurs in the output transition sequence (See operation timing diagram.)
Note: Connect a capacitor of 0.1 μF or more between Vcc and GND terminal.

Block diagram, truth table

The output of the photo IC for encoder is 2-phase digital output (TTL compatible) consisting of phase A and phase B. Phase A (V_{OA}) shows which of PD1 or PD3 is receiving more light, and phase B (V_{OB}) shows which of PD2 or PD4 is receiving more light.



LED | Photo IC

Input		Output	
		V_{OA}	V_{OB}
PD1 < PD3	PD2 > PD4	Low	Low
PD1 < PD3	PD2 < PD4	Low	High
PD1 > PD3	PD2 > PD4	High	Low
PD1 > PD3	PD2 < PD4	High	High

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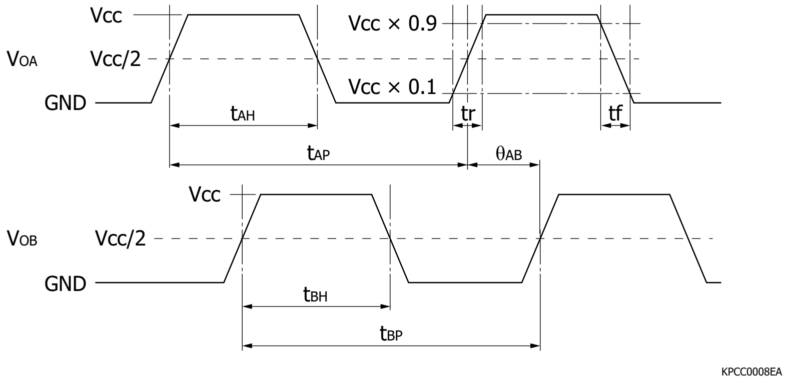
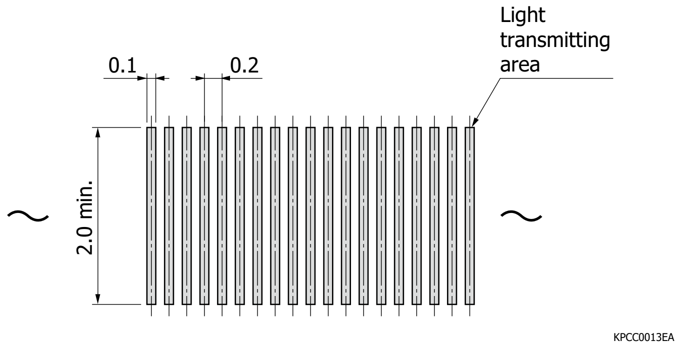
Operation timing diagram

Measured when the slits move at a constant speed towards you from the inner side as viewed from the front, in the middle left drawing in "Dimensional outline".

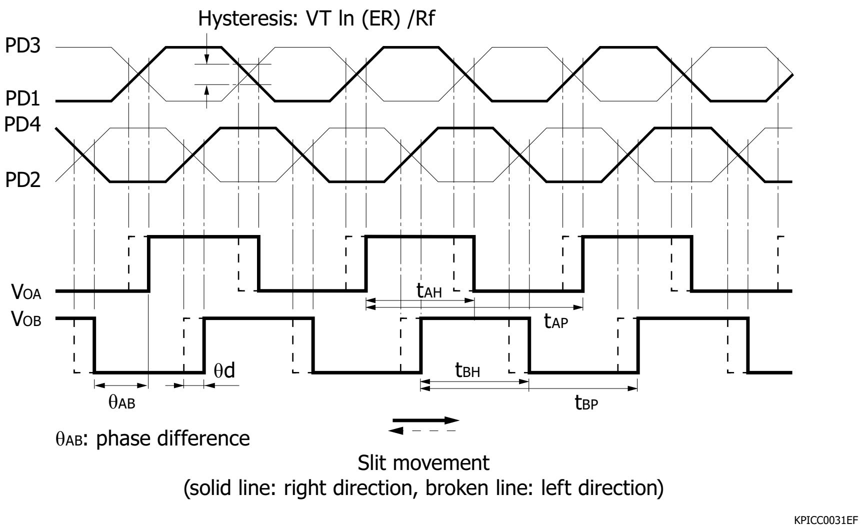


Recommended slit dimension (unit: mm, t=0.1)

(For center of slit plate position, see "Dimensional outline.")

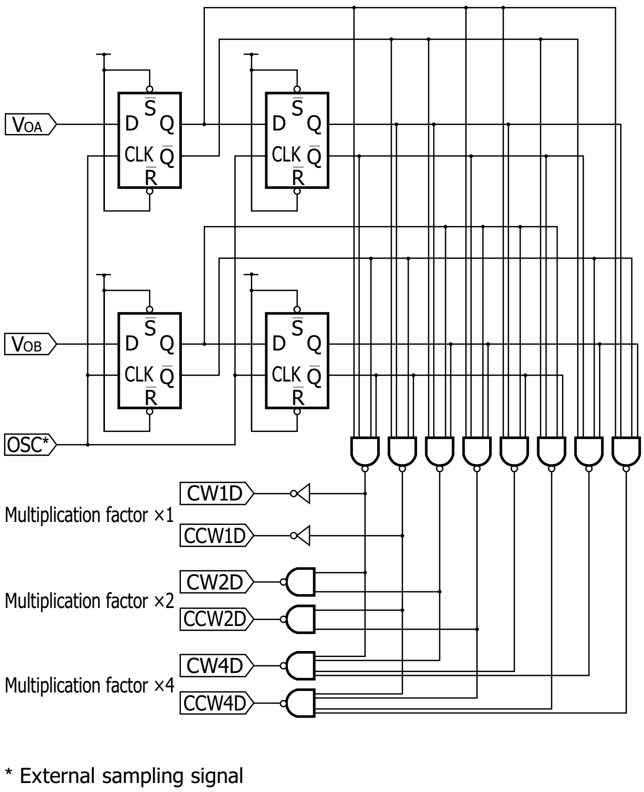


Timing chart



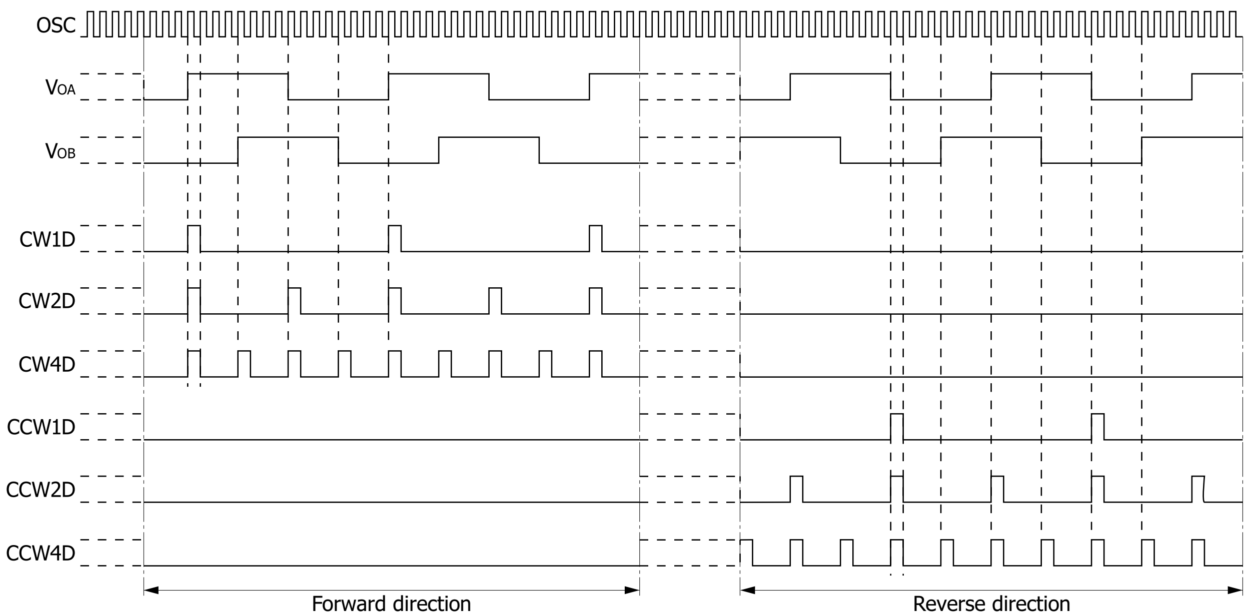
Application circuit example (CW/CCW pulse signal generator circuit)

When the following application circuit is configured using the output (VOA, VOB) of the encoder module, the order of state transitions in VOA and VOB is detected at the OSC timing, and pulse signals are generated to the CWnD terminal in response to state transitions in the positive direction and to the CCWnD terminal in response to state transitions in the reverse direction (CWnD/CCWnD are output terminals for the multiplication factor × n).

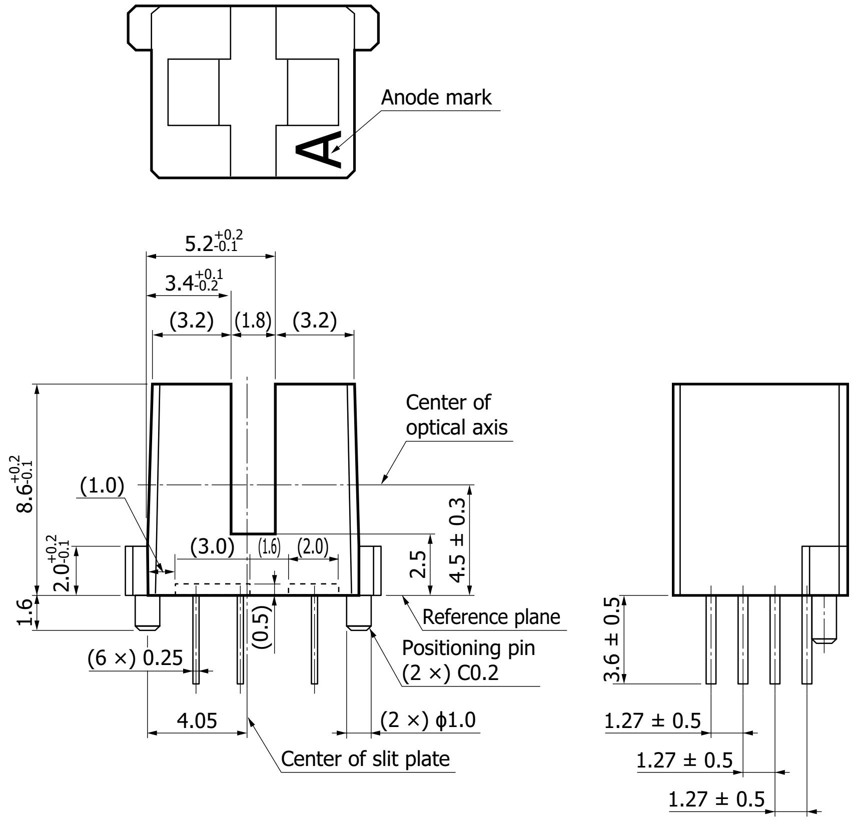


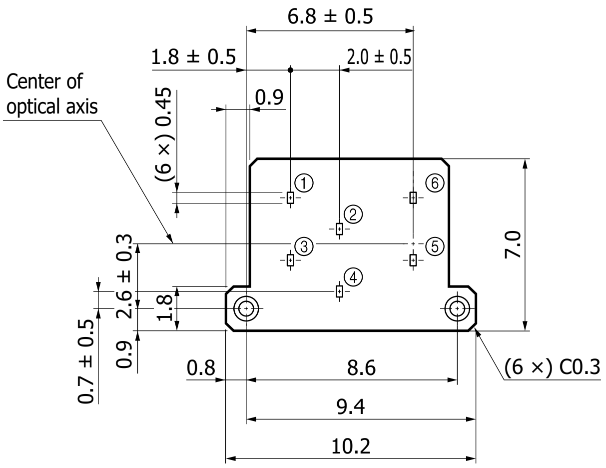
Decoder output timing chart (when used with application circuit shown above)

A suitable sampling signal frequency is 40 or more times larger than the maximum frequency of one period of the VOA and VOB state transitions (in the following figure, 16 times for purposes of simplicity). Pulses appearing at each terminal are generated with a slight delay from the instant that the defined state transition occurs [maximum theoretical delay time = 1/{2 × OSC frequency} (unit: cycles)]. Each of these signals is input to the up-count terminal and down-count terminal of the up/down counter. The amount of movement from the origin point can then be detected with a circuit that clears the up/down counter at origin position.



Dimensional outline (unit: mm)





① VOA
② GND
③ Vcc
④ VOB
⑤ Cathode
⑥ Anode

Tolerance unless otherwise noted: ±0.1, ±2°
Lead position is specified at the reference plane.
Values in parentheses indicate reference values.
Packing type: 50 pcs/stick

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Recommended soldering conditions

Parameter	Specification	Note
Soldering temperature	260 °C max. (3 seconds or less)	at least 1 mm away from case surface

Note: When you set soldering conditions, check that problems do not occur in the product by testing out the conditions in advance.

Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions

· Disclaimer

· Metal, ceramic, plastic products

Information described in this material is current as of October 2021.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use.

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