AK8775

Hall IC for Pulse Encoder

Overview

AK8775 is a Hall effect latch which detects both "vertical" and "horizontal"(perpendicular and parallel to the marking side of the package) magnetic field at the same time. The result of Hall effect latch operation in vertical and horizontal magnetic field is read out to OUTA pin and OUTB pin. AK8775 is for use in portable devices which uses rotational detection system or incremental pulse encoder such as jog dial utilized for input devices.

Features

- 1.6 to 5.5V operation
- Bop, Brp (Vertical, Horizontal) ±1.5mT(Typ.), Highly sensitive
- Low power operation : Average 90μA(Typ.) @V_{DD}=3V
- Two outputs : OUTA (detects vertical magnetic field), OUTB (detects horizontal magnetic field)
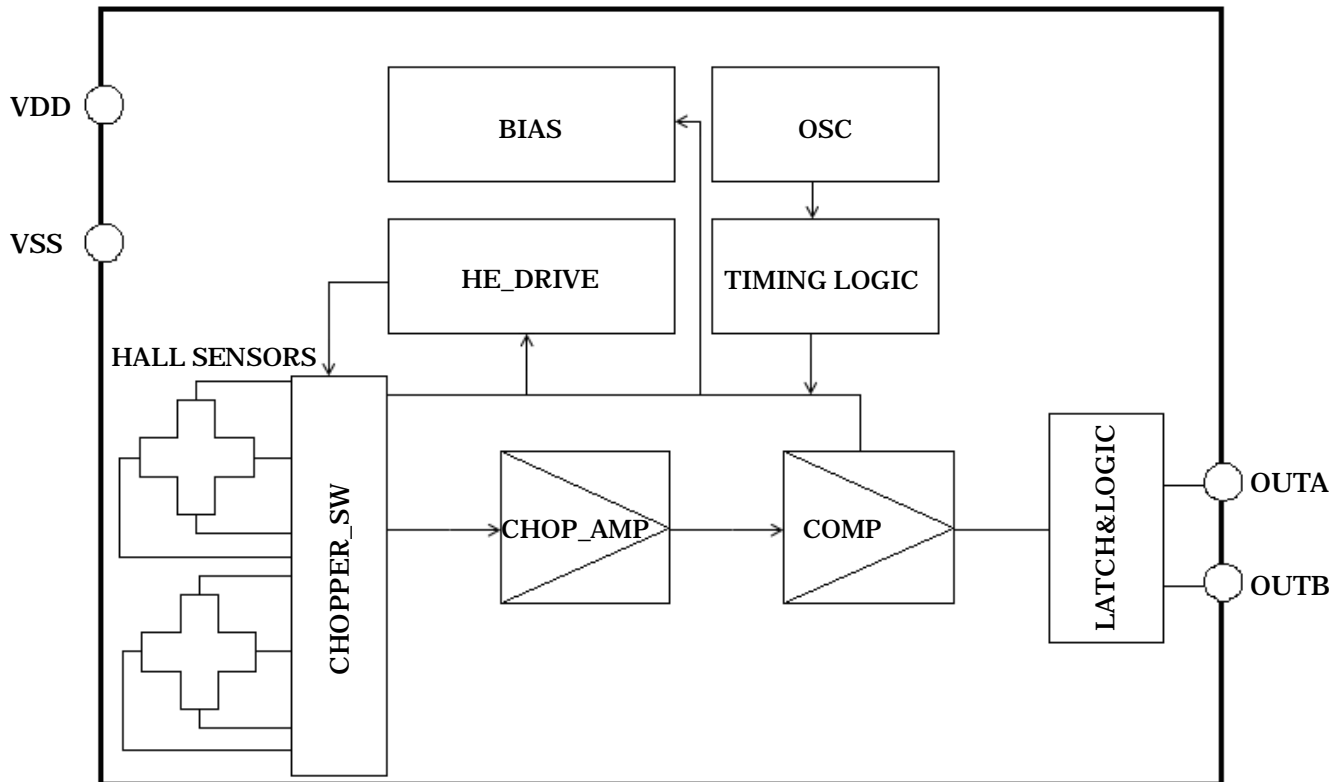- Small package: SOP-4pin, Halogen free

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Block Diagram

Figure 1. Block diagram

Circuit Configuration

Table 1. Circuit configuration

Block	Function
HALL SENSORS	Two Hall elements fabricated by CMOS process.
CHOPPER_SW	Perform chopping in order to cancel the offset of Hall sensor.
CHOP_AMP	Amplifies two Hall sensor output voltage with summation and subtraction circuit.
COMP	Hysteresis comparator.
BIAS	Generates bias current to other circuits.
HE_DRIVE	Generates bias current for Hall sensors.
OSC	Generates operating clock.
TIMING LOGIC	Generates timing signal required for Chopper SW, AMP and COMP.
LATCH & LOGIC	Logical circuits and CMOS output buffer.

Pin/Function

Table 2. Description of pin name and function

Pin No.	Pin name	I/O	Function	Note
1	VDD	–	Power supply pin	
2	OUTA	O	Output A pin. Relating to the **vertical magnetic field**	CMOS output
3	OUTB	O	Output B pin. Relating to the **horizontal magnetic field**	CMOS output
4	VSS	–	Ground pin	

Absolute Maximum Ratings

Table 3. Absolute maximum ratings

Parameter	Symbol	Min.	Max.	Unit	Note
Power supply voltage	V_{DD}	−0.3	+6.5	V	
Output current	I_{OUT}	−0.5	+0.5	mA	OUTA,OUTB pin
Storage temperature	T_{STG}	−40	+125	°C	

Note) Stress beyond these listed values may cause permanent damage to the device.

Recommended Operating Conditions

Table 4. Recommended operating conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{DD}	1.6	3.0	5.5	V
Operating temperature	Ta	−30		+85	°C

Electrical Characteristics

Table 5. Electrical characteristics (Ta=25°C, V_{DD} = 3.0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Current consumption	I_{DD}		90	210	μA	Average
High level output Voltage	V_{OH}	V_{DD}-0.4			V	OUTA,OUTB pin, I_{OUT}= −0.5mA
Low level output Voltage	V_{OL}			0.4	V	OUTA,OUTB pin, I_{OUT}= +0.5mA
Pulse drive period	T_{PD1}	0.5	1.0	2.0	ms	
Pulse drive duration time	T_{PD2}	12.2	24.4	48.8	μs	

 Note) Internal data is determined just before the internal circuit turns off. And after 6.1μs (Typ.), the output changes.

Magnetic Characteristics

 The output OUTA and OUTB is determined by the applied magnetic field and threshold level BopV, BrpV, BopH and BrpH as follows.

Table 6. Magnetic characteristics(Ta = 25°C, V_{DD} = 3.0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Vertical magnetic field operating point	BopV		1.5	4.0	mT	(*1)
Vertical magnetic field releasing point	BrpV	−4.0	−1.5		mT	(*1)
Horizontal magnetic field operating point	BopH		1.5	4.0	mT	(*2)
Horizontal magnetic field releasing point	BrpH	−4.0	−1.5		mT	(*2)
Hysteresis	BhV, BhH		3.0		mT	(*1), (*2)

(*1) Horizontal magnetic flux density is zero.

(*2) Vertical magnetic flux density is zero.

Operational Characteristics

AK8775 detects the "vertical" (perpendicular to the marking side of the package) magnetic field, and the resulting output signal OUTA changes state. When the magnetic field is more positive than BopV, the signal OUTA changes to 'Low' state. And it is kept while the magnetic field remains more positive than BrpV. When the magnetic field drops below BrpV, the signal OUTA changes to 'High' state. Those threshold magnetic flux density levels are defined in Table 6.
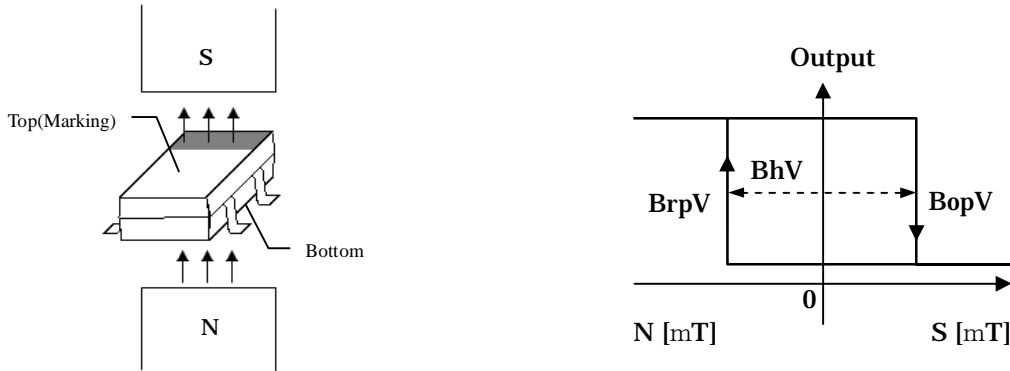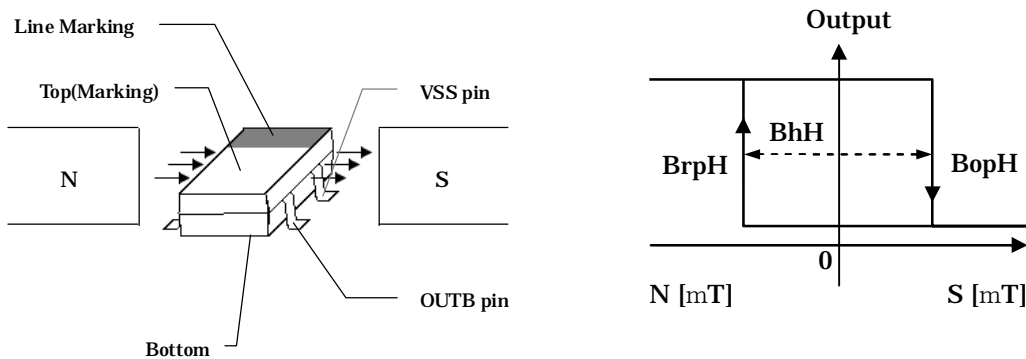

Figure 2. Switching behavior of output signal OUTA
when vertical magnetic field is applied

AK8775 detects "horizontal "(parallel to the marking side of the package) magnetic field, and the resulting output signal OUTB changes state. When the magnetic field is more positive than BopH, the signal OUTB changes to 'Low' state. And it is kept while the magnetic field remains more positive than BrpH. When the magnetic field drops below BrpH, the signal OUTB changes to 'High' state. Those threshold magnetic flux density levels are defined in Table 6.

Figure 3. Switching behavior of output signal OUTB
when horizontal magnetic field is applied
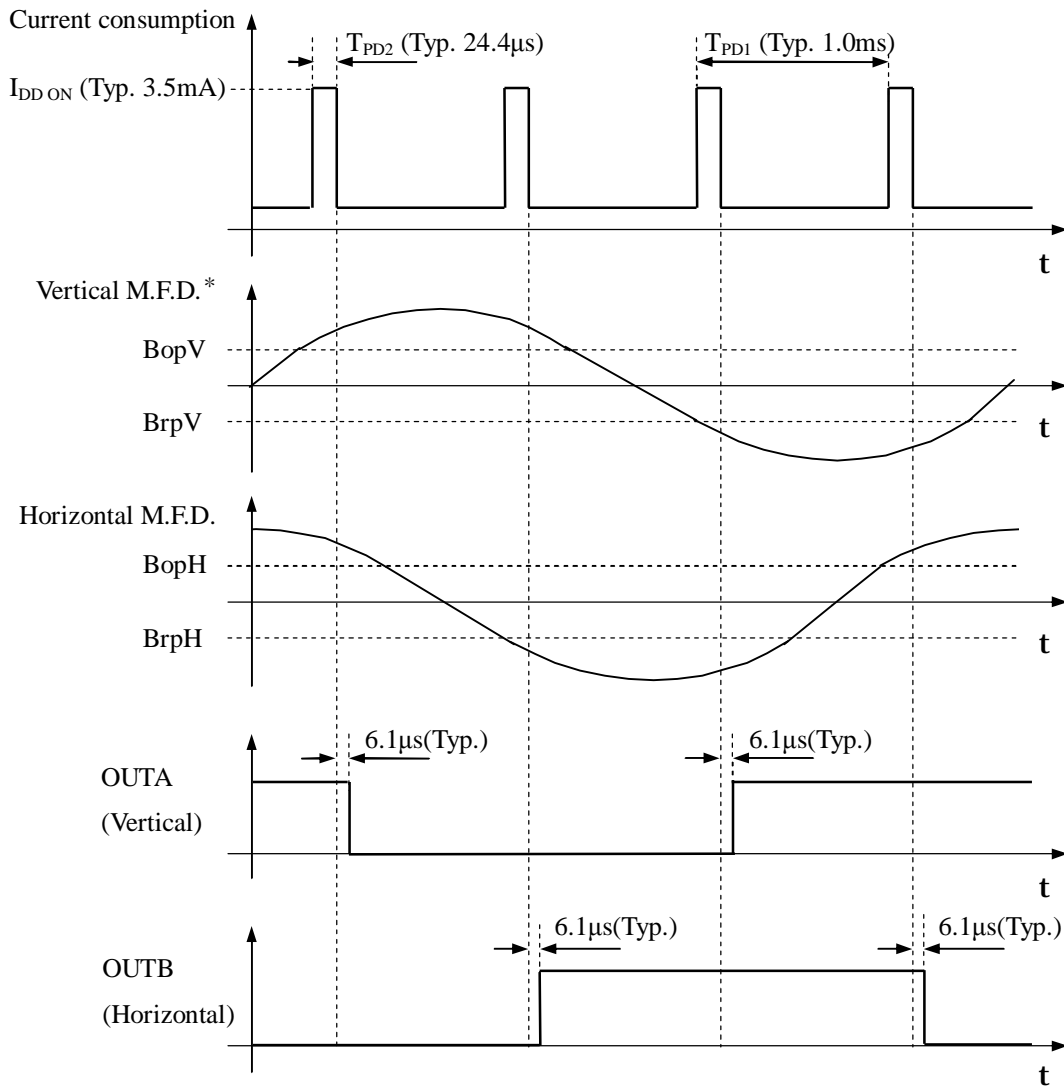
Functional Timing

Current consumption

T_{PD2} (Typ. 24.4μs) T_{PD1} (Typ. 1.0ms)

$I_{DD\ ON}$ (Typ. 3.5mA)

t

Vertical M.F.D.*

BopV

BrpV

t

Horizontal M.F.D.

BopH

BrpH

t

OUTA
(Vertical)

6.1μs(Typ.)   6.1μs(Typ.)

t

OUTB
(Horizontal)

6.1μs(Typ.)   6.1μs(Typ.)

t

Figure 4. The timing chart of current consumption
and transition timing of output signal

*M.F.D. is Magnetic Flux Density.

Note)V_{DD}=3.0V.

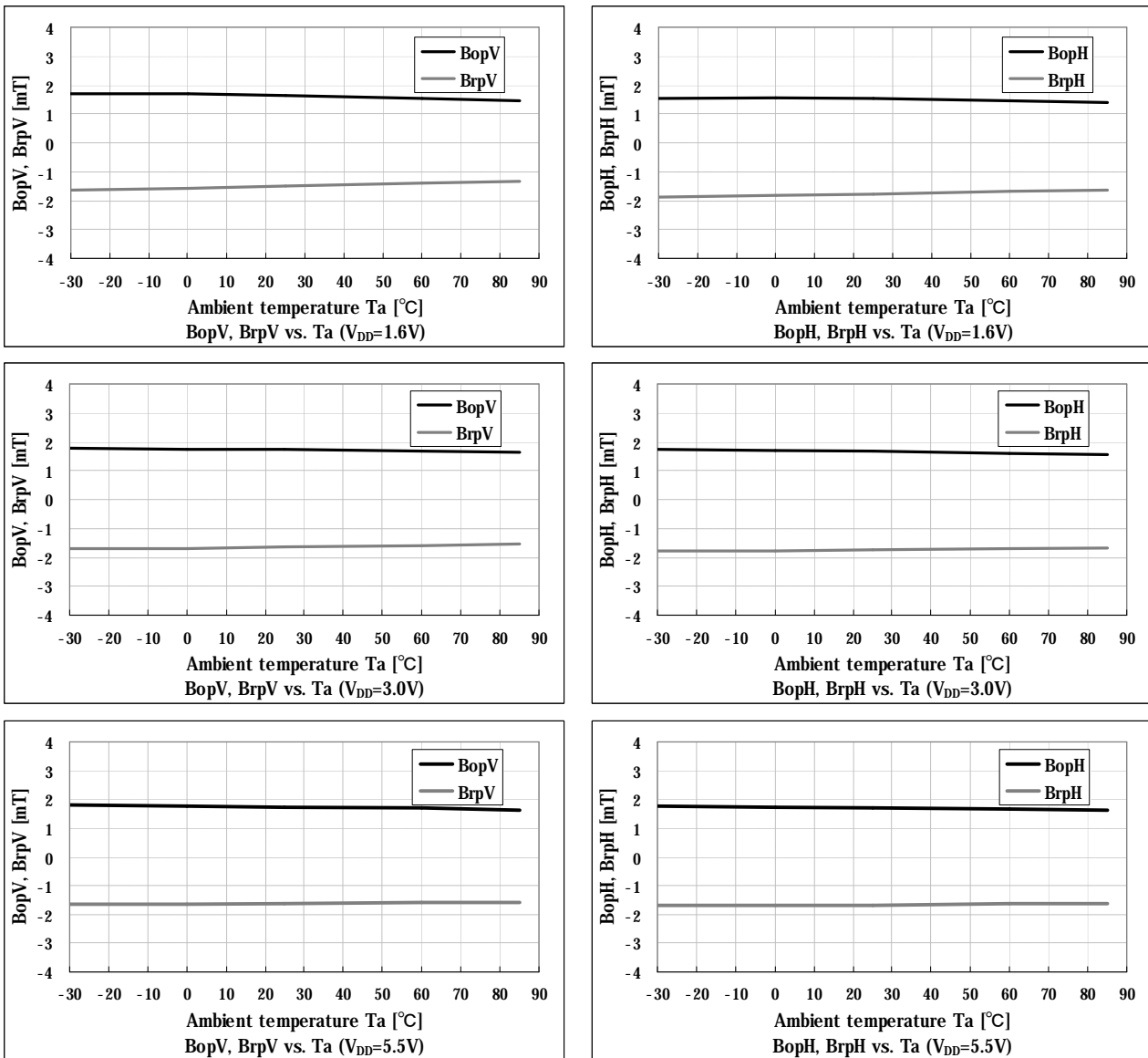# Typical Characteristic Data (for reference)

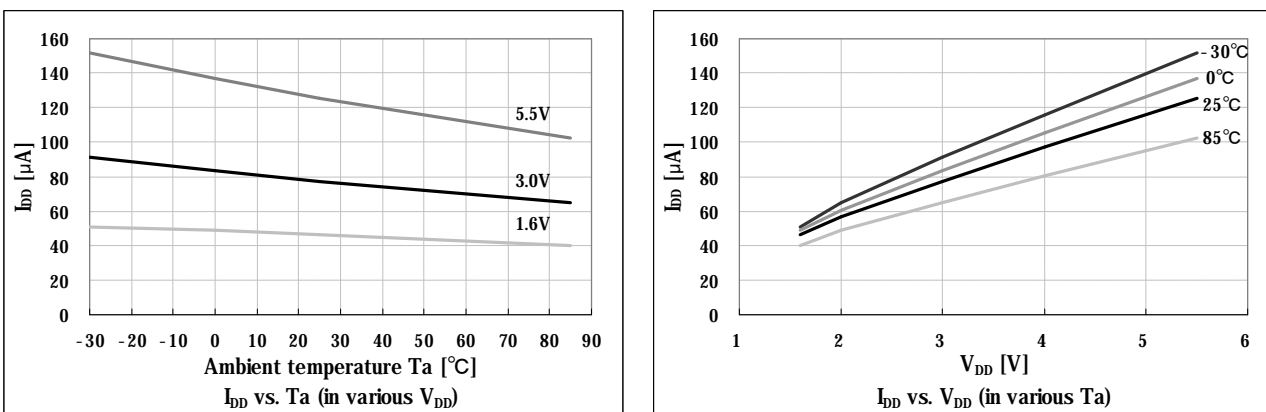Figure 5. Temperature dependence of sensitivity

Figure 6. Temperature dependence of current consumption
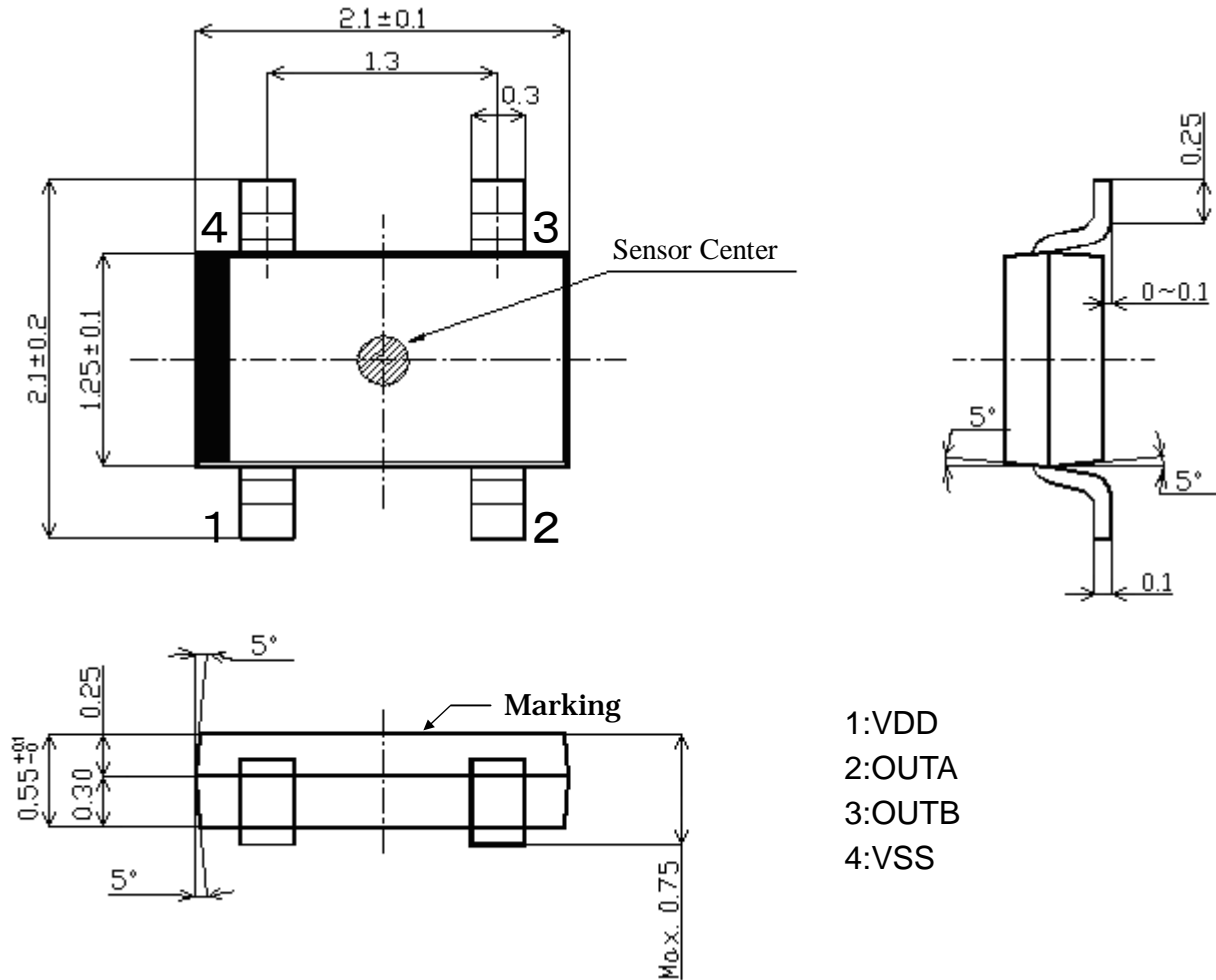
Package

Unit in mm

Sensor Center

Marking

1:VDD
2:OUTA
3:OUTB
4:VSS

Figure 7. Package dimensions

Note 1) The center of the sensor is located within the ф0.3mm circle.

Note 2) The tolerances of dimensions otherwise noted are ±0.1mm.

Note 3) Coplanarity: The differences between standoff of terminals are max. 0.1mm.

Note 4) The sensor part is located 0.4mm±0.1mm far from marking surface.

Material of terminals : Cu alloy

Material of plating for terminals : Sn 100%

Thickness of plating for terminals : 10μm (Typ.)

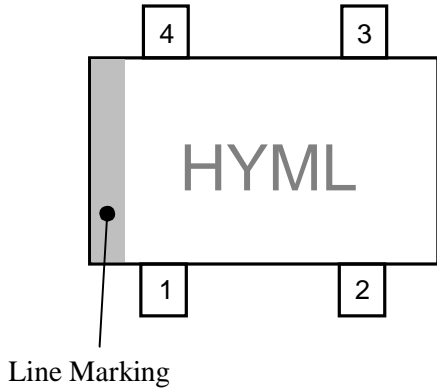## Marking

Line Marking

Figure 8. Marking

Marking is performed by laser

Product name ： H (AK8775)

Date code ： YML

Y ： Last one digit of manufactured year （0~ 9）

M ： Manufactured month

Jan.	C	Jul.	J
Feb.	D	Aug.	K
Mar.	E	Sept.	L
Apr.	F	Oct.	M
May.	G	Nov.	N
Jun.	H	Dec.	P

L ： Lot(1~ 9,A~ Z)
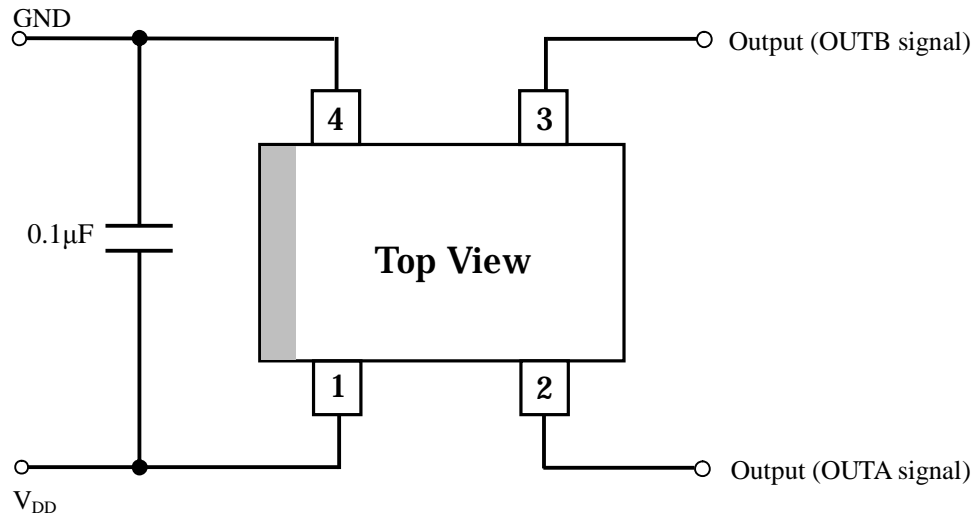
Recommended External Circuit

Figure 9. Recommended external circuit

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