



# AK8777B

## Hall Effect IC for Pulse Encoders

### Overview

The AK8777B 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 output OUTA and OUTB are switched according to the vertical and horizontal magnetic fields applied to the device. The AK8777B is for use in the incremental pulse encoders or rotational detection systems.

### Features

- 4.0 to 24V supply voltage operation
- Sensitivity (Vertical, Horizontal) :  $\pm 1.7\text{mT}(\text{Typ.})$
- Two outputs : OUTA (detects vertical magnetic field), OUTB (detects horizontal magnetic field)
- Small package: SOP-6pin
- Halogen free

## Block Diagram

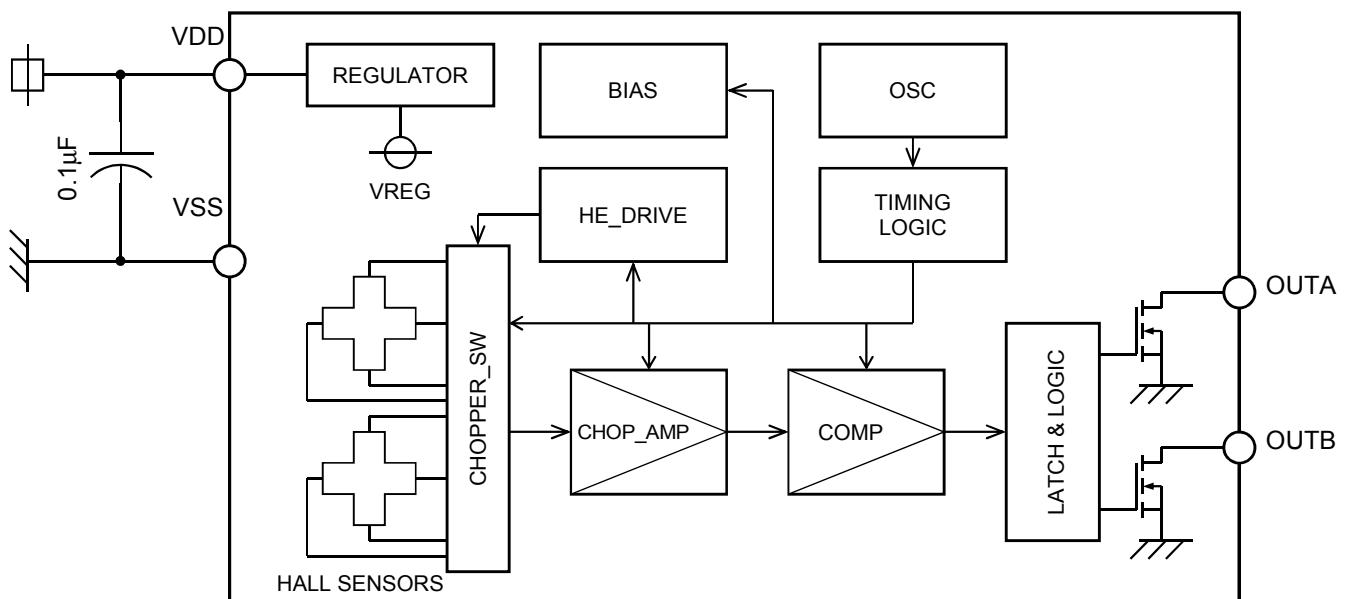


Figure 1. Block diagram

## Circuit Configuration

Table 1. Circuit configuration

Block	Function
REGULATOR	Generate internal operating voltage.
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 internal circuits.
HE_DRIVE	Generates bias current for Hall sensors.
OSC	Generates operating clock.
TIMING LOGIC	Generates timing signal for internal circuits.
LATCH & LOGIC	Logical circuits and open drain driver.

## Pin/Function

Table 2. Description of pin name and function

Pin No.	Pin name	I/O	Function	Note
1	VDD		Power supply pin	
2	TAB		(TAB pin)	
3	OUTA	O	Output A pin. Relating to the vertical magnetic field.	Open drain
4	OUTB	O	Output B pin. Relating to the horizontal magnetic field.	Open drain
5	TAB		(TAB pin)	
6	VSS		Ground pin	

Note) TAB pins should be connected to VSS.

## Absolute Maximum Ratings

Table 3. Absolute maximum ratings

Parameter	Symbol	Min.	Max.	Unit	Note
Supply voltage	$V_{DD}$	-0.3	+32	V	$V_{SS}=0V$
Output voltage	$V_{OUT}$	-0.3	+32	V	OUTA,OUTB pin $V_{SS}=0V$
Output current	$I_{OUT}$		20	mA	OUTA,OUTB pin
Storage temperature	$T_{STG}$	-55	+150	°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
Supply voltage	$V_{DD}$	4.0	12.0	24.0	V
Output current	$I_{SINK}$			15	mA
Operating temperature	Ta	-40		+125	°C

## Electrical Characteristics

Table 5. Electrical characteristics at  $V_{DD}=4.0$  to 24.0V,  $Ta= -40$  to  $+125^{\circ}\text{C}$ 

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Current consumption	$I_{DD}$	1.4	3.0	5.6	mA	
Output saturation voltage	$V_{SAT}$			0.4	V	OUTA,OUTB pin, $I_{SINK}= 15\text{mA}$
Output leak current	$I_{LEAK}$			10	$\mu\text{A}$	OUTA, OUTB = $V_{DD}$
Output refresh period	$T_P$	12.0	16.7	30.5	$\mu\text{s}$	

## Magnetic Characteristics

Table 6. Magnetic characteristics at  $V_{DD}=4.0$  to 24.0V,  $Ta= -40$  to  $+125^{\circ}\text{C}$ 

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Operating point of vertical magnetic field	$B_{opV}$	0.1	1.7	4.0	mT	(*1)
Releasing point of vertical magnetic field	$B_{rpV}$	-4.0	-1.7	-0.1	mT	(*1)
Operating point of horizontal magnetic field	$B_{opH}$	0.1	1.7	4.0	mT	(*2)
Operating point of horizontal magnetic field	$B_{rpH}$	-4.0	-1.7	-0.1	mT	(*2)
Hysteresis	$B_{hV}, B_{hH}$	1.5	3.4	6.8	mT	(*1), (*2)

(\*1) Horizontal magnetic flux density is zero.

(\*2) Vertical magnetic flux density is zero.

## Operational Characteristics

The signal OUTA switches 'Low' state (ON) when the magnetic field perpendicular to the marking side of the package exceeds BopV. When the magnetic field is reduces below BrpV, the OUTA goes 'High' state (OFF). Otherwise; that is, in case of the magnetic field strength is greater than BrpV and smaller than BopV; OUTA keeps its status.

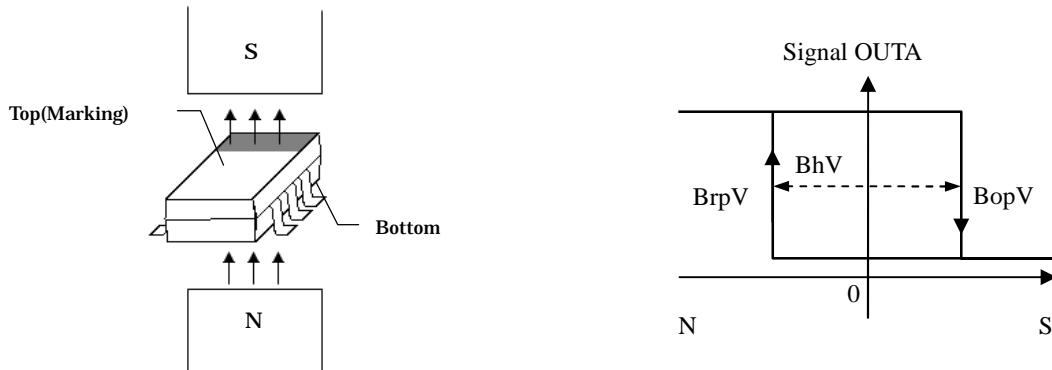


Figure 2. Switching behavior of the signal OUTA when vertical magnetic field is applied

The signal OUTB switches 'Low' state (ON) when the magnetic field parallel to the marking side of the package exceeds BopH. When the magnetic field is reduces below BrpH, the OUTB goes 'High' state (OFF). Otherwise; that is, in case of the magnetic field strength is greater than BrpH and smaller than BopH; OUTB keeps its status.

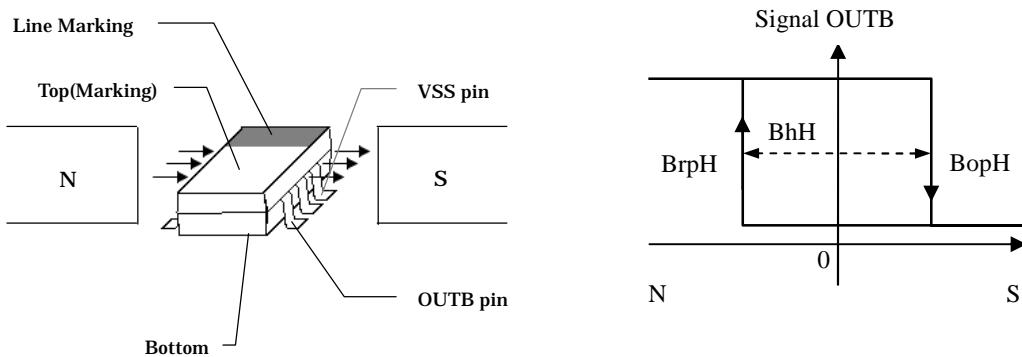


Figure 3. Switching behavior of the signal OUTB when horizontal magnetic field is applied

## Functional Timing

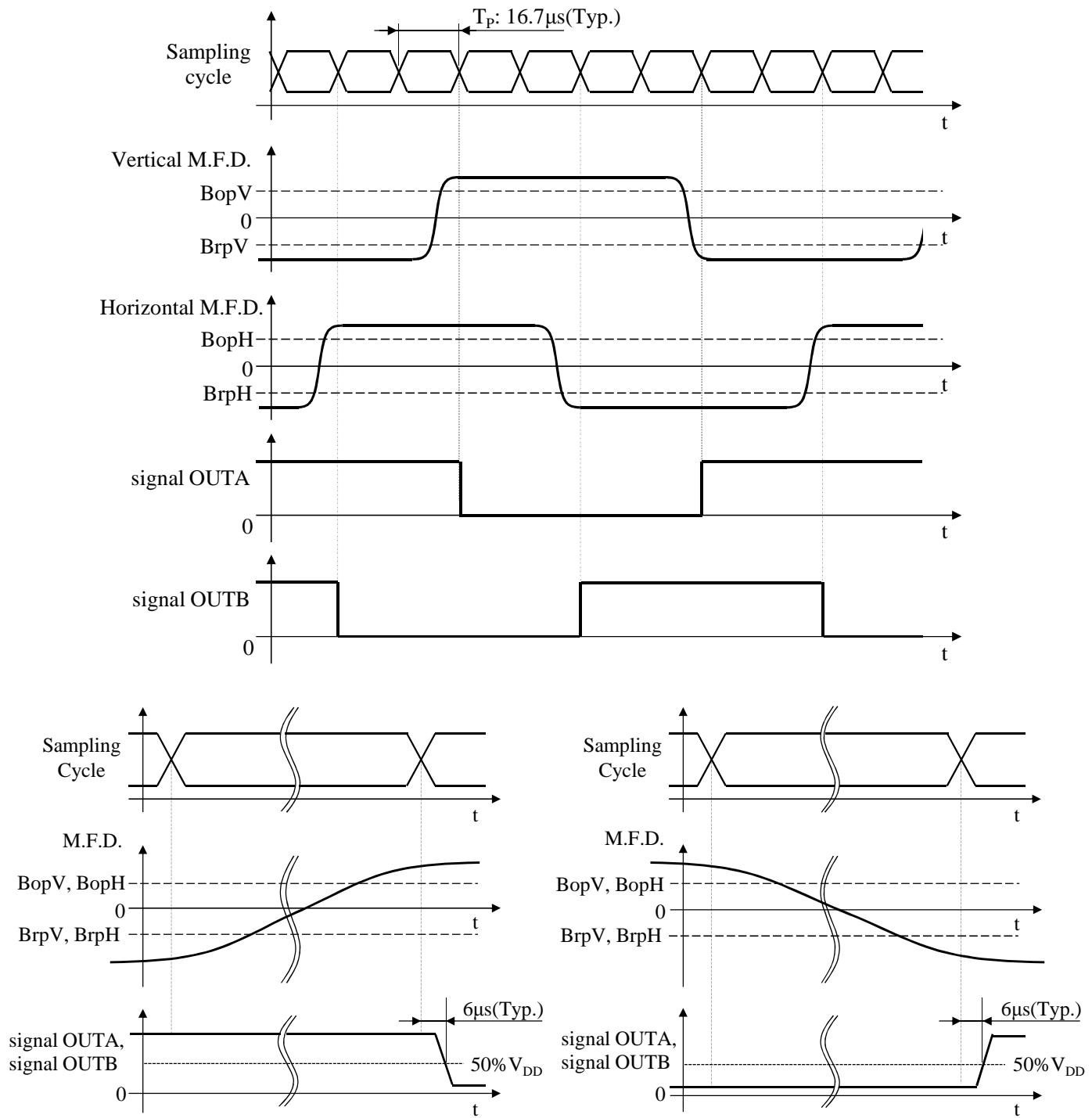


Figure 4. Timing diagram

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

Note)  $V_{DD}=12.0V$ ,  $R_L=10k\Omega$ ,  $C_L=20pF$

## Typical Characteristic Data (for reference)

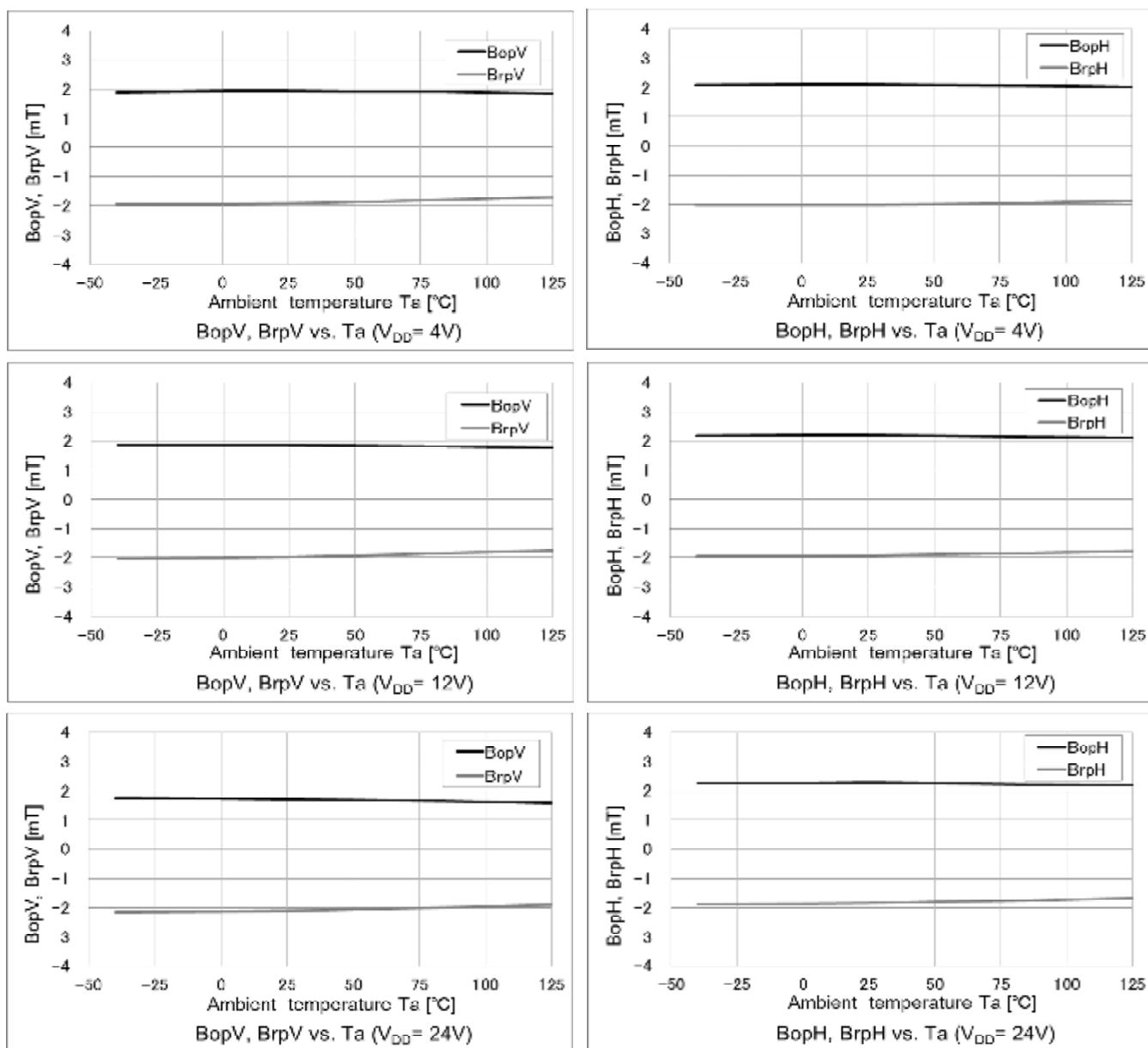


Figure 5. Temperature dependence of sensitivity

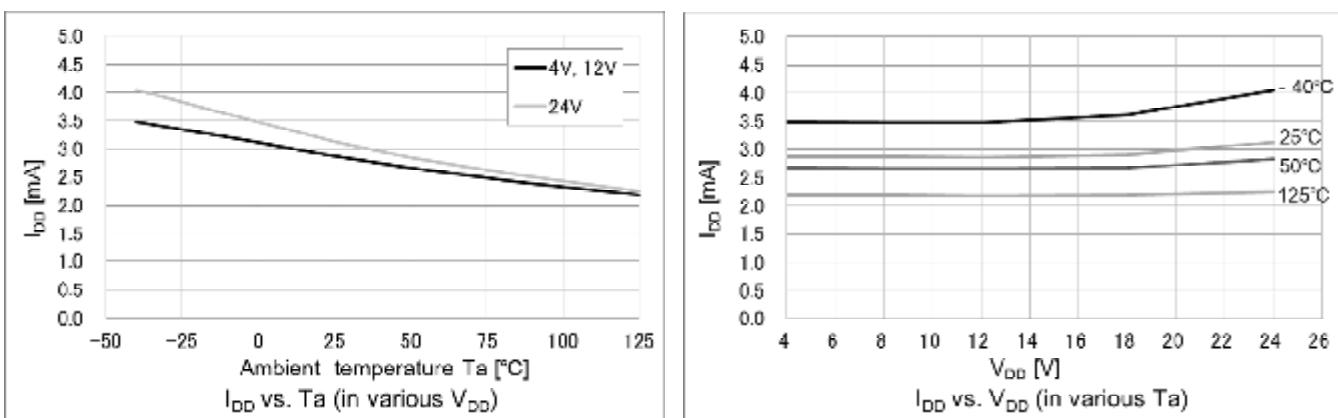


Figure 6. Temperature dependence of current consumption

## Package

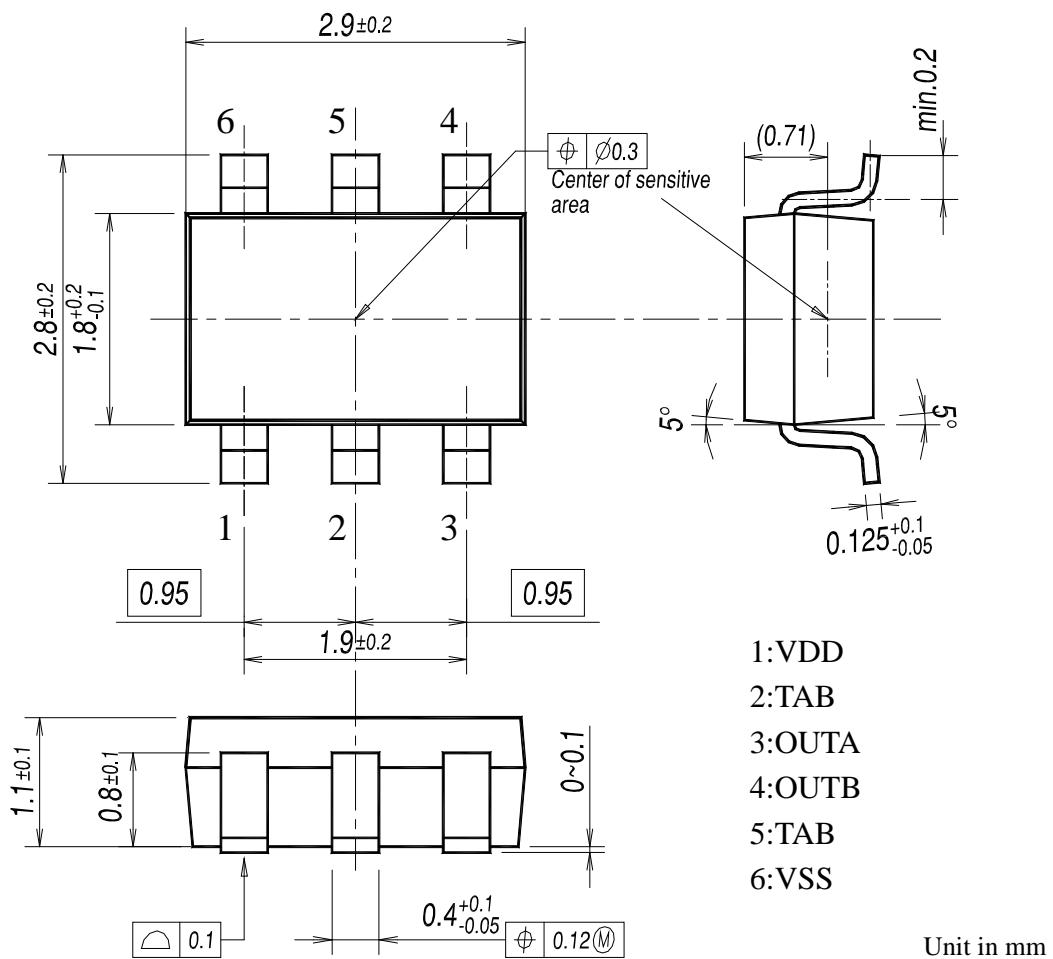


Figure 7. Package dimensions

Note 1) The center of the sensitive area is located within the  $\phi 0.3$ mm circle.

Note 2) Coplanarity: The differences between standoff of terminals are max. 0.1mm.

Note 3) The sensor part is located 0.71mm(Typ.) from marking surface.

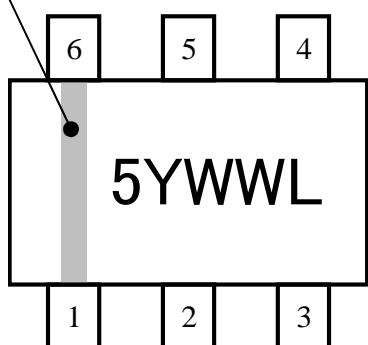
Material of terminals: Cu alloy

Material of plating for terminals: Sn 100%

Thickness of plating for terminals: 10 $\mu$ m (Typ.)

## Marking

Line Marking



Marking is performed by laser

Product name : 5 (AK8777B)

Date code : YWWL

Y : Manufactured year

WW : Manufactured week

L : Lot

Figure 8. Marking

## Recommended External Circuit

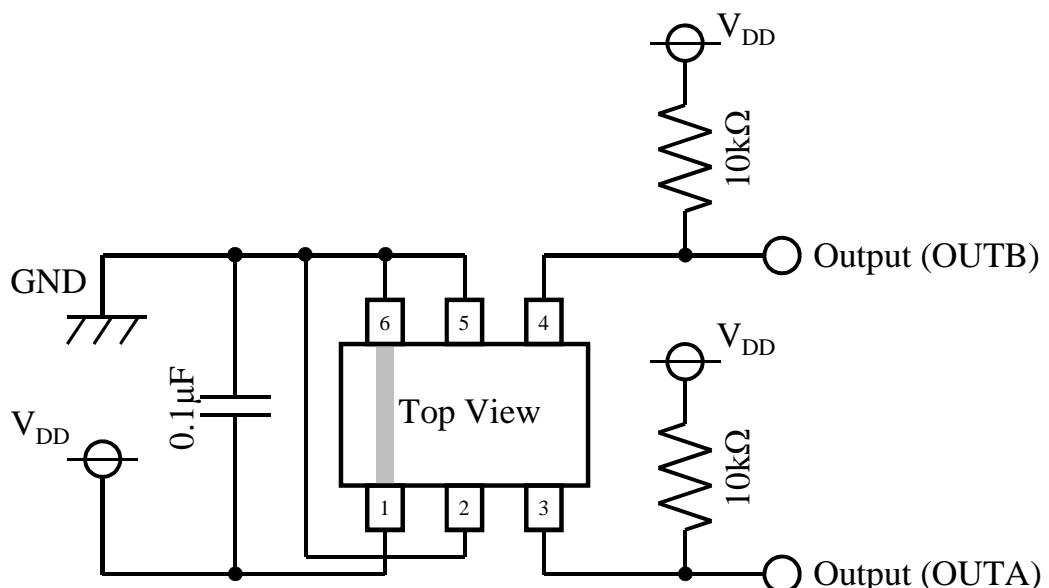


Figure 9. Recommended external circuit

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