AK8778B

Hall Effect IC for Pulse Encoders

Overview

The AK8778B is a Hall effect latch which detects both “vertical magnetic field” and “horizontal magnetic field” (perpendicular and parallel to the marking side of the package) at the same time. The pulse output F and direction output D are switched according to the vertical and horizontal magnetic fields applied to the device. The direction is calculated internally and output D is switched at a rising or falling edge of output F. The AK8778B is for use in the incremental pulse encoders or rotational detection systems.

Features

- 4.0 to 24V supply voltage operation
- Sensitivity (Vertical, Horizontal) : ±1.7mT(Typ.)
- Two outputs : F (Pulse), D (Direction)
- Small package: SOP-6pin
- Halogen free

Block Diagram

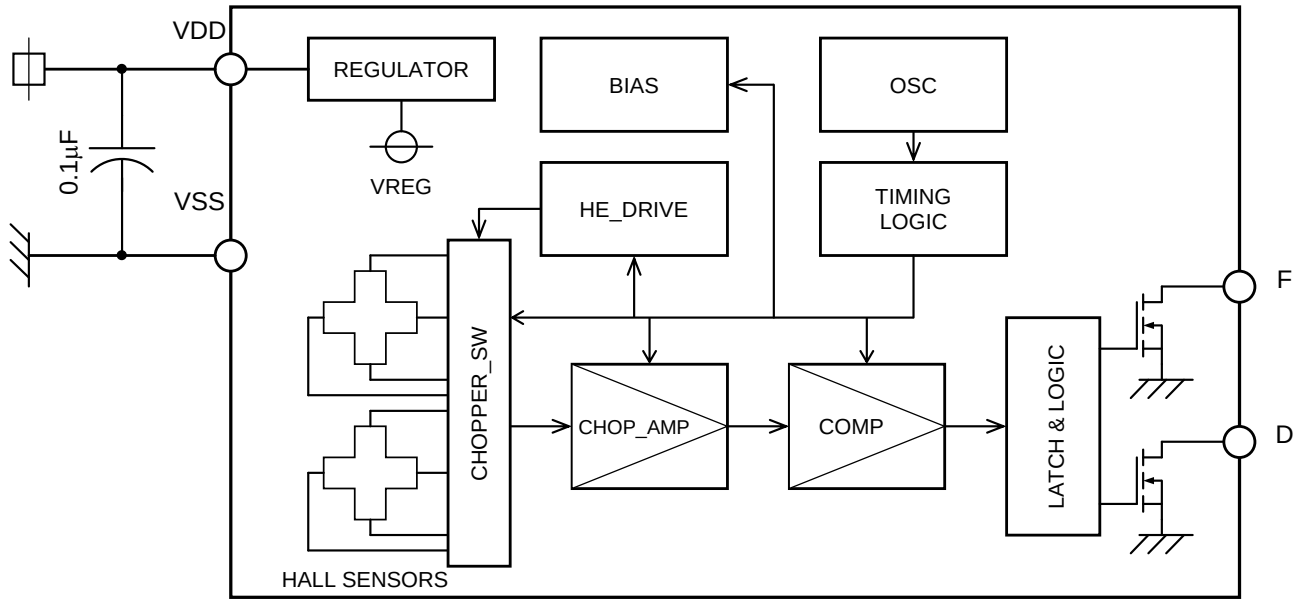


Figure 1. Block diagram

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	F	O	Output F (Pulse) pin	Open drain
4	D	O	Output D (Direction) pin	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	VSS=0V
Output voltage	V_{OUT}	–0.3	+32	V	F,D pin VSS=0V
Output current	I_{SINK}		20	mA	F,D 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°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	F, D pin, I_{SINK}= 15mA
Output leak current	I_{LEAK}			10	μA	F, D=V_{DD}
Output refresh period	T_P	12.0	16.7	30.5	μs	

Magnetic Characteristics

Table 6. Magnetic characteristics at V_{DD}=4.0 to 24.0V, Ta= –40 to +125°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Operating point of vertical magnetic field	BopV	0.1	1.7	4.0	mT	(*1)
Releasing point of vertical magnetic field	BrpV	–4.0	–1.7	–0.1	mT	(*1)
Operating point of horizontal magnetic field	BopH	0.1	1.7	4.0	mT	(*2)
Operating point of horizontal magnetic field	BrpH	–4.0	–1.7	–0.1	mT	(*2)
Hysteresis	BhV, BhH	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 internal signal A switches 'Low' state when the magnetic field perpendicular to the marking side of the package exceeds BopV. When the magnetic field is reduced below BrpV, the internal signal A goes 'High' state. Otherwise; that is, in case of the magnetic field strength is greater than BrpV and smaller than BopV; the internal signal A keeps its status.

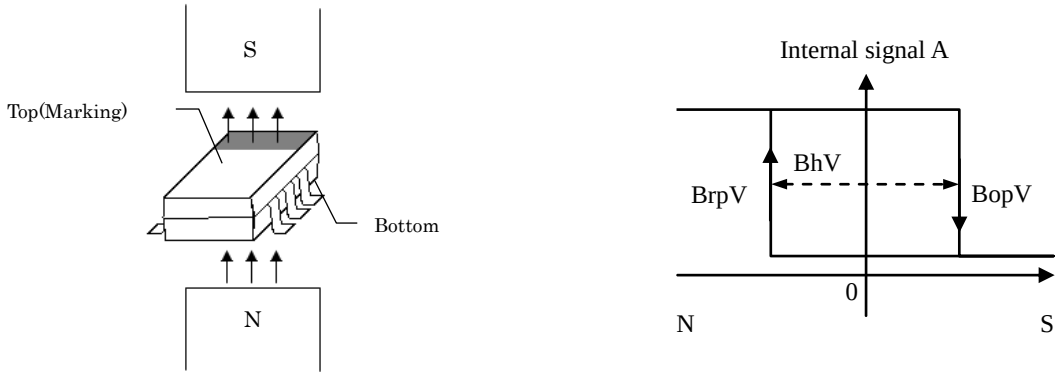


Figure 2. Switching behavior of the internal signal A when vertical magnetic field is applied

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

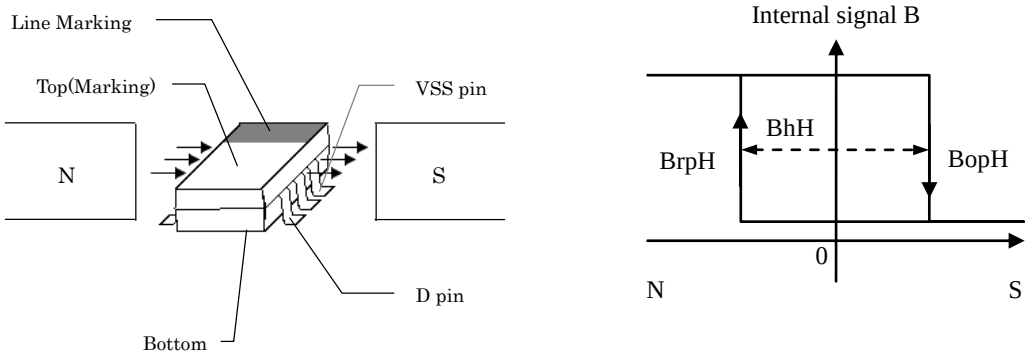


Figure 3. Switching behavior of the internal signal B when horizontal magnetic field is applied

Behaviors of internal signal A,B and output signal F, D when a rotating magnetic field is applied on AK8778B

F signal (pulse) is correspond to the result of EX-OR operation of internal signal A and B. And signal D (direction) is calculated by the state of internal signal A and B.

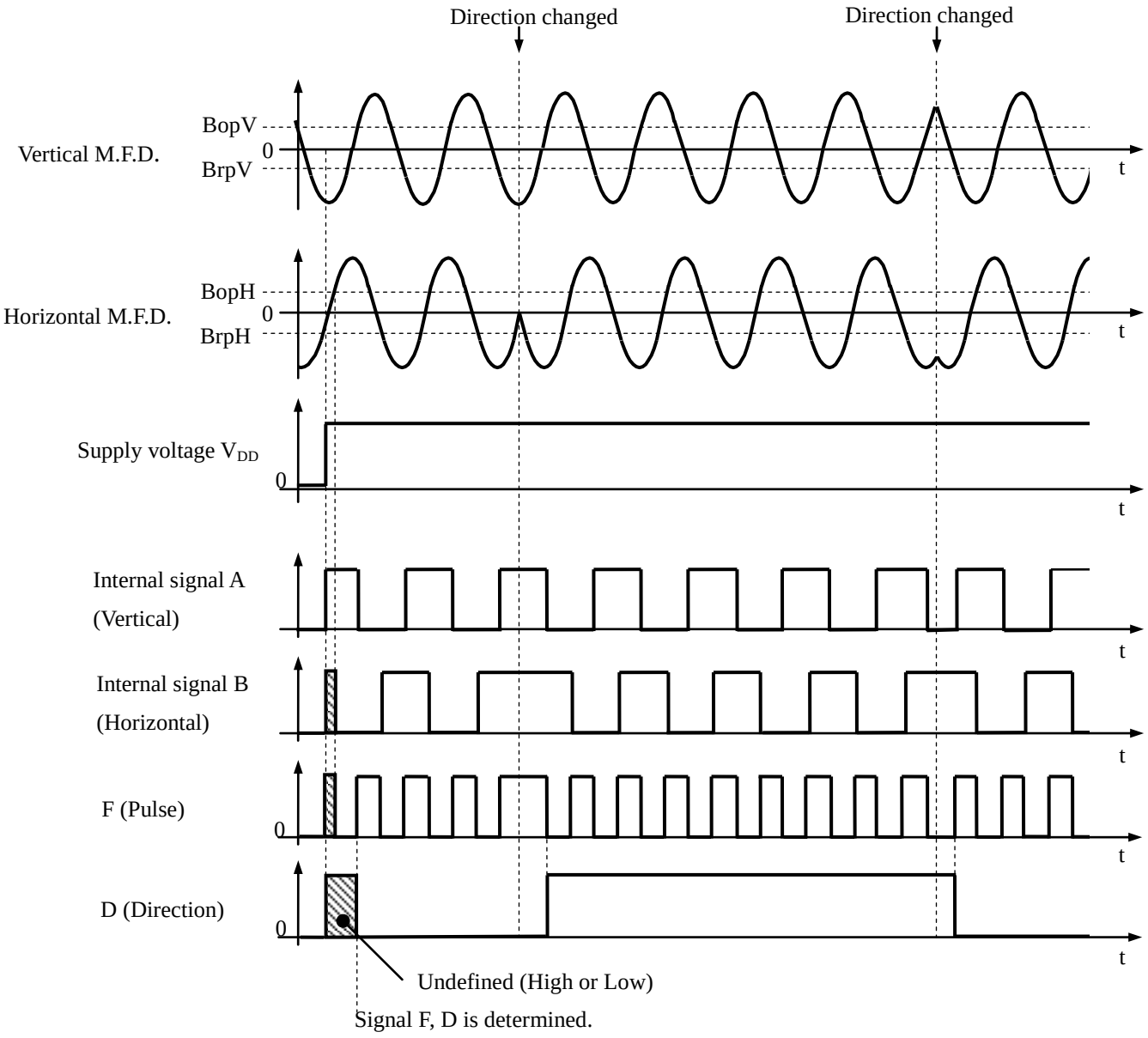


Figure 4. Behaviors of internal signal A,B and signal F, D when a rotating magnetic field is applied on AK8778B

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

Note) Signal D is determined after one signal F pulse is sent out. The indeterminate output state appears only in the powering up of this device.

Functional Timing

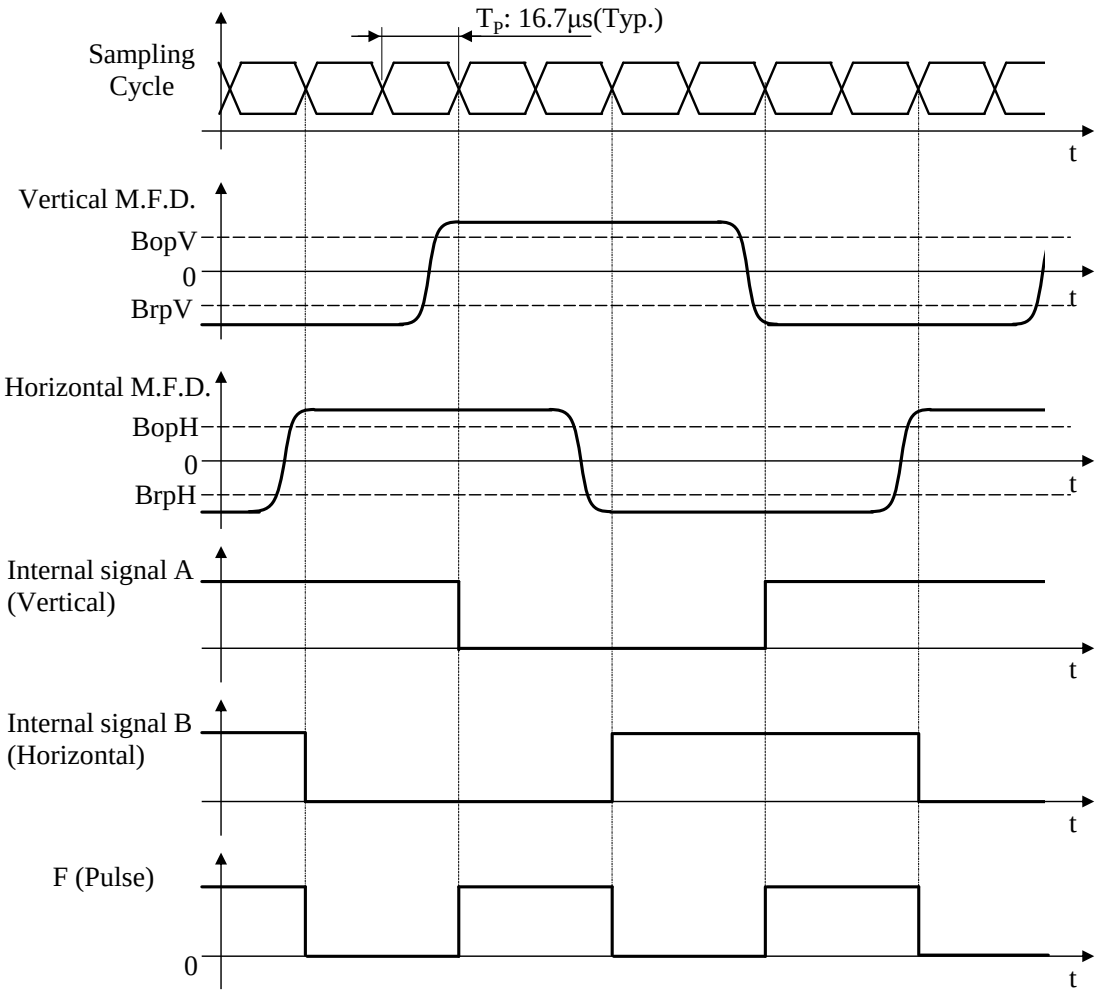


Figure 5. Timing diagram

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

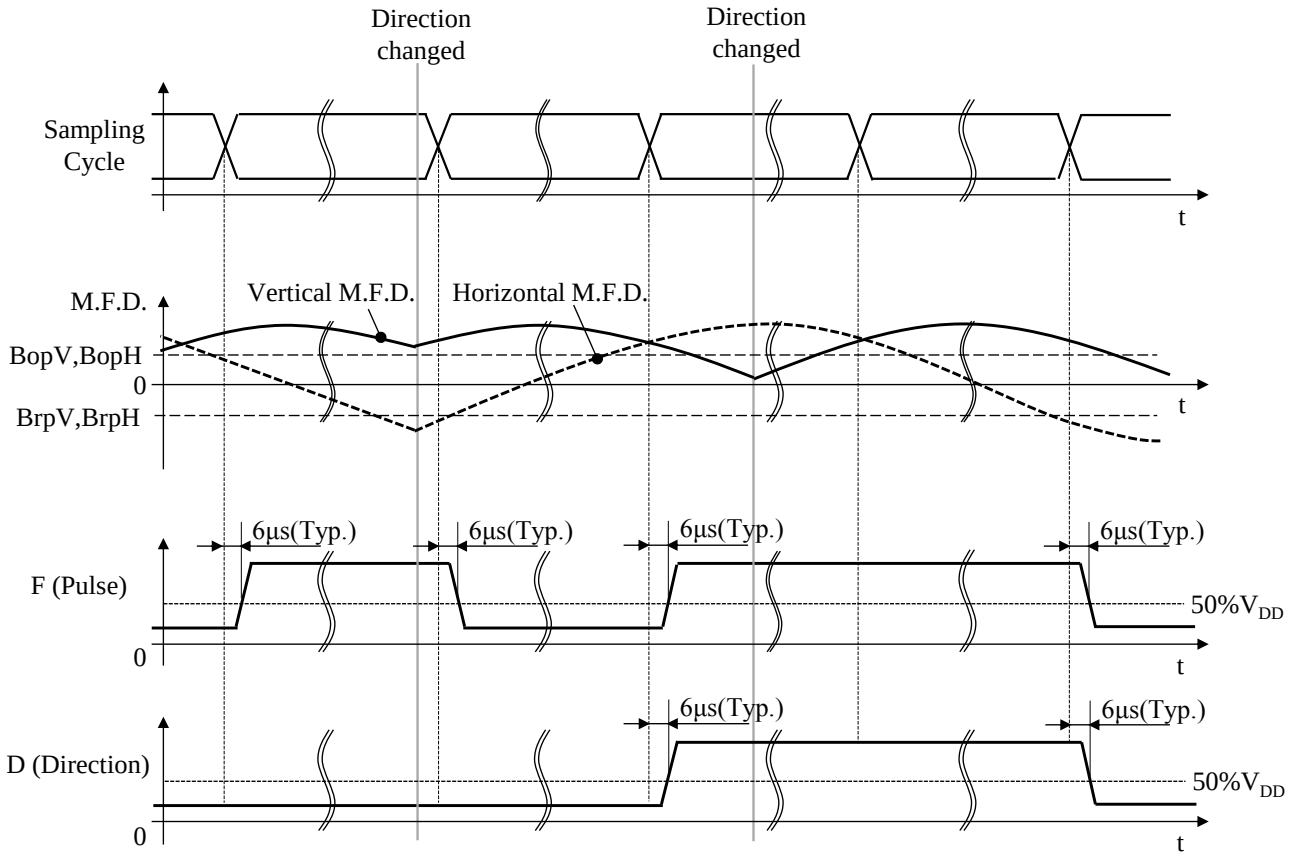
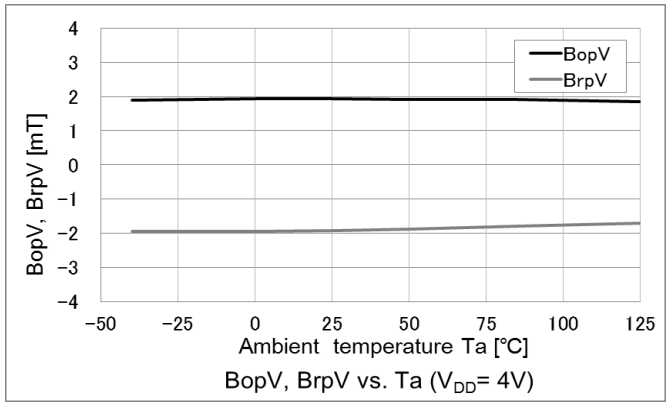


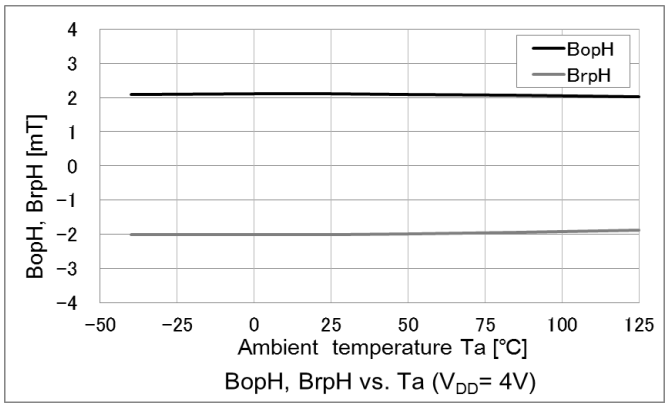
Figure 6. Timing diagram (in detail)

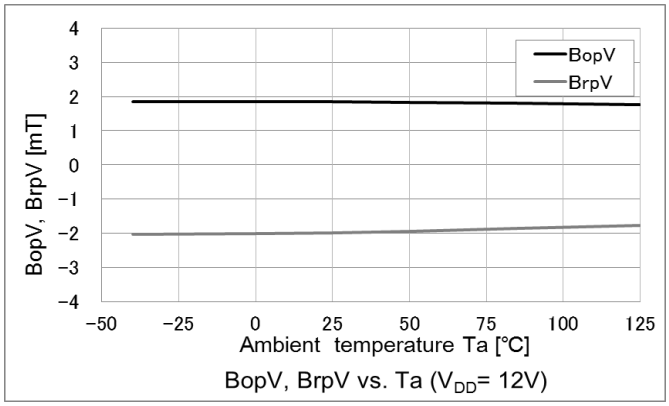
*M.F.D. is Magnetic Flux Density.

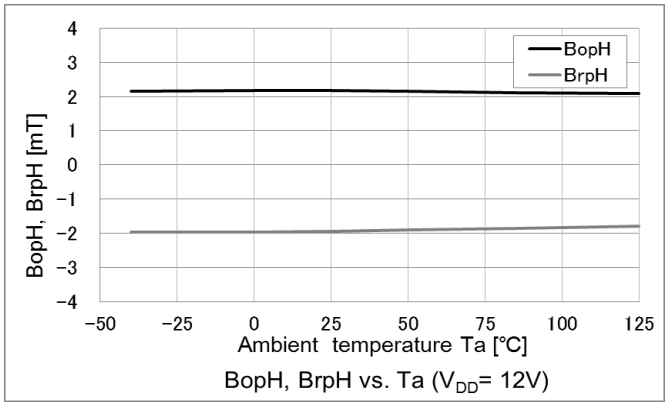
Note) V_{DD}=12.0V ,R_L=10kΩ, C_L=20pF

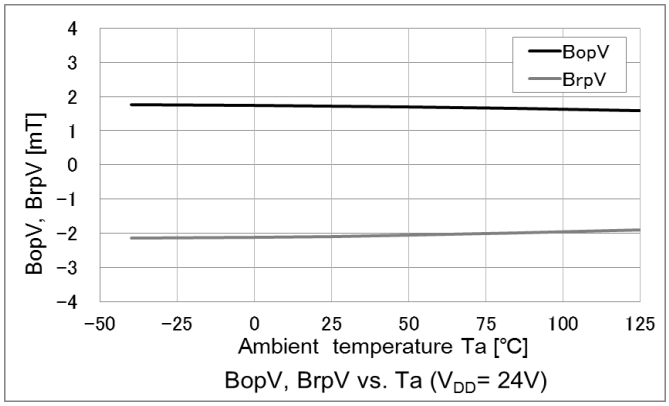
Typical Characteristic Data (for reference)











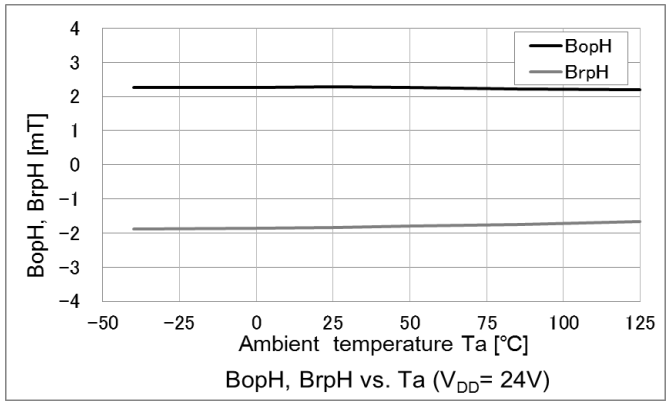
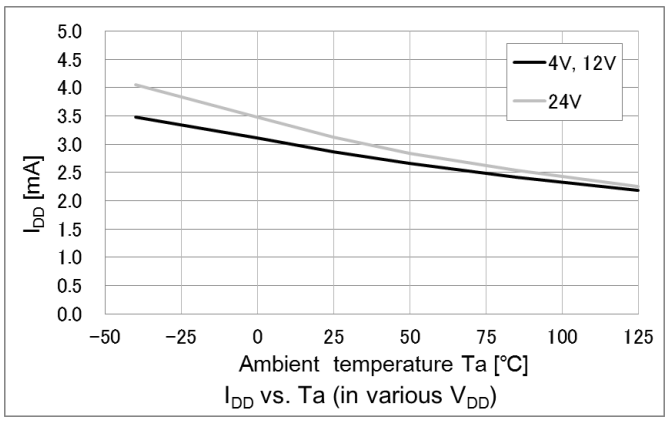


Figure 7. Temperature dependence of sensitivity



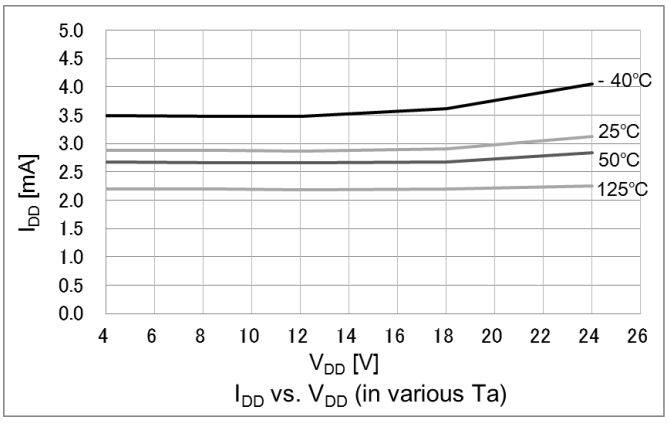


Figure 8. Temperature dependence of current consumption

Package

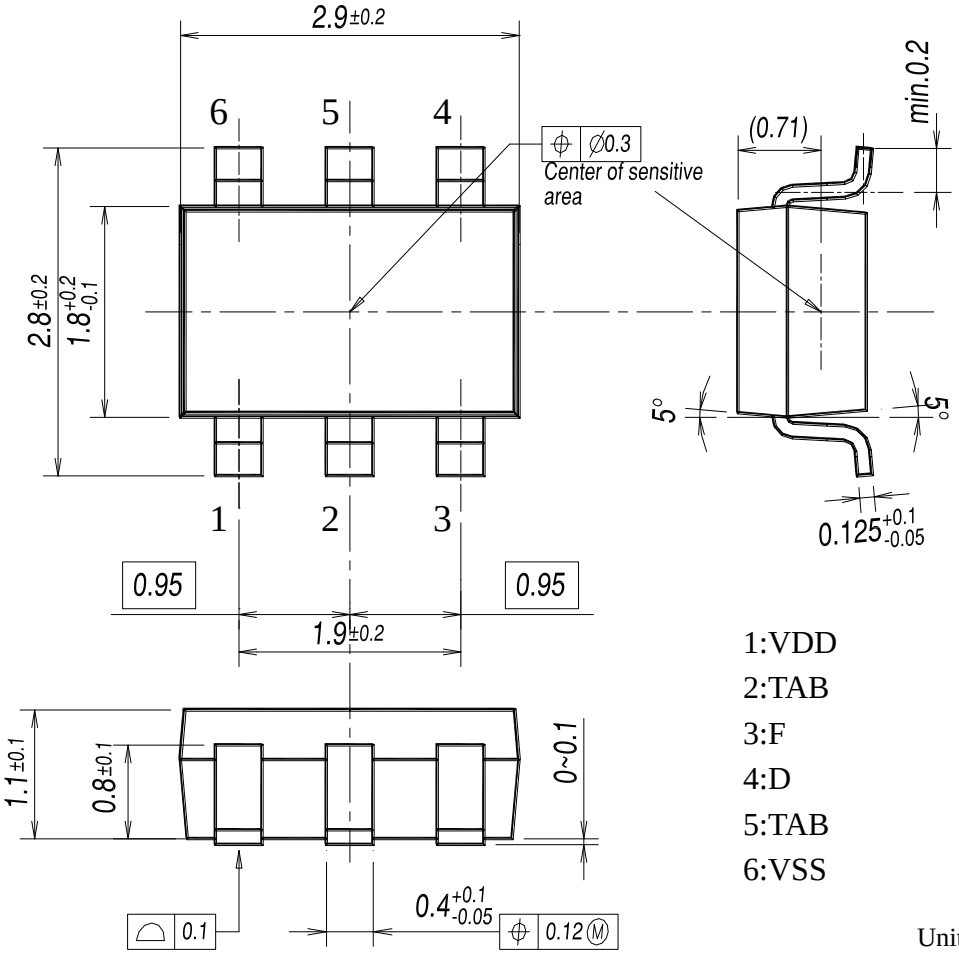


Figure 9. Package dimensions

Note 1) The center of the sensitive area is located within the ϕ0.3mm circle.

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

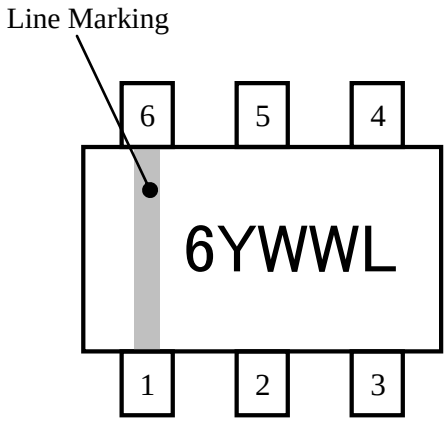
Note 3) The sensor part is located 0.71mm(Typ.) from marking surface.

Material of terminals: Cu alloy

Material of plating for terminals: Sn 100%

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

Marking



Marking is performed by laser
Product name : 6 (AK8778B)
Date code : YWWL
Y : Manufactured year
WW : Manufactured week
L : Lot

Figure 10. Marking

Recommended External Circuit

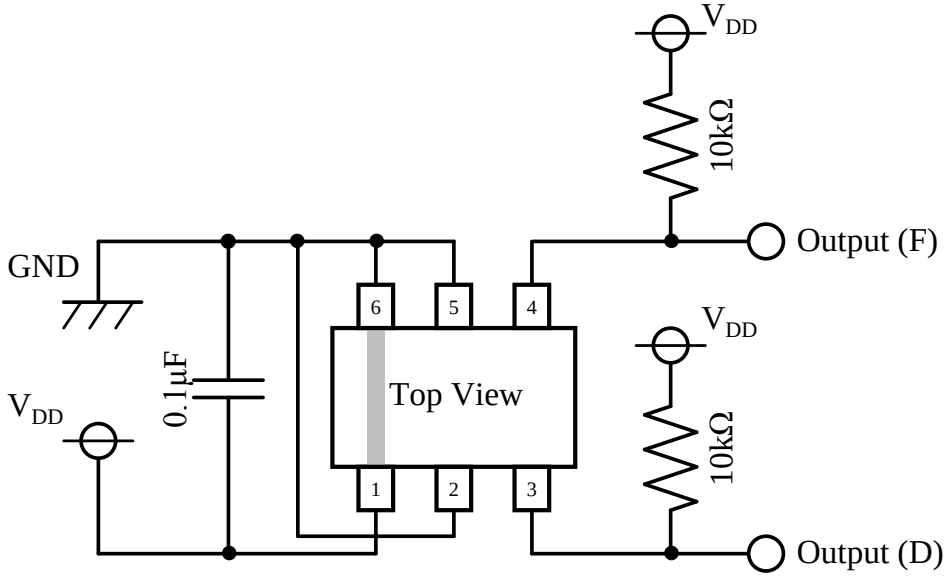


Figure 11. Recommended external circuit

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