AK8779A

Hall Effect IC for Pulse Encoders

1. General Description

The AK8779A is a Hall effect latch which detects both “vertical magnetic field” and “horizontal magnetic field” (perpendicular and parallel to the marked side of the package) at the same time. The pulse output F and the 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 on a rising or falling edge of output F. The AK8779A is for use in the incremental pulse encoders or rotational detection systems.

2. Features

☐ Supply Voltage:	3.8 to 24V
☐ Operation Temperature:	–40 to 150ºC
☐ Sensitivity (Vertical):	±2.0mT(Typ.), ±4.0mT(Max.)
☐ Sensitivity (Horizontal):	±2.0mT(Typ.), ±4.0mT(Max.)
☐ Two Outputs:	F (Pulse) D (Direction)
☐ Package:	6-pin SOP (RoHS Compliant, Halogen free)

3. Table of Contents

4. Block Diagram and Functions

4.1. Block Diagram

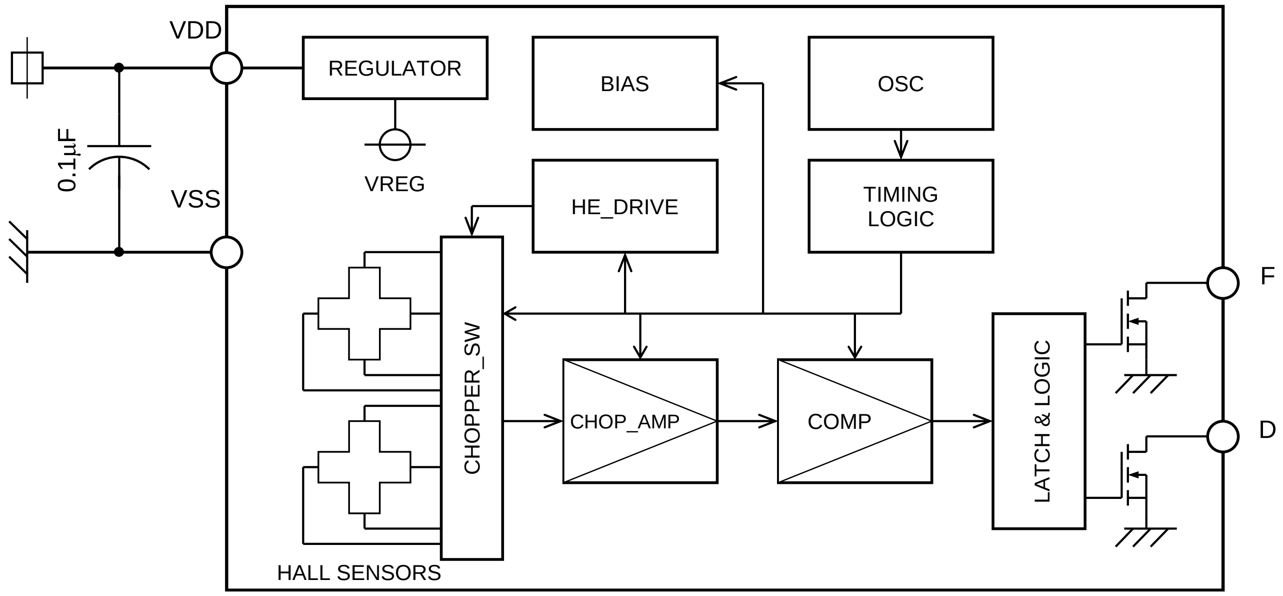


Figure 1. AK8779A Block Diagram

4.2. Functions

Table 1. Circuit configuration

Block Name	Function
REGULATOR	Generate internal operating voltage.
HALL SENSORS	Two Hall elements fabricated by CMOS process.
CHOPPER_SW	Hall sensor drive switch. Perform chopping in order to cancel the offset of Hall sensor.
CHOP_AMP	Amplify two Hall sensor output voltages with summation and subtraction circuit.
COMP	Hysteresis comparator.
BIAS	Generate bias current to internal circuits.
HE_DRIVE	Generate bias current for Hall sensors.
OSC	Generate operational clock.
TIMING LOGIC	Generate timing signal for internal circuits.
LATCH & LOGIC	Logical circuits and open drain driver.

5. Pin Configurations and Functions

5.1. Pin Configurations

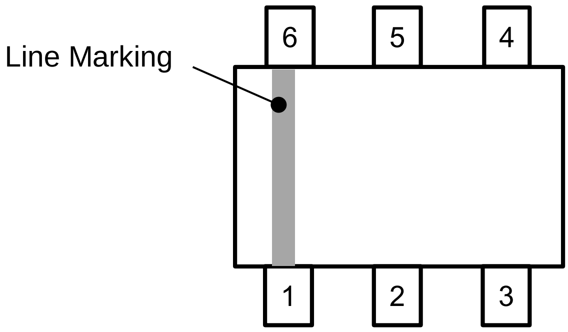


Figure 2. Pin Layout

5.2. Functions

Table 2. Description of pin name and function

Pin No.	Pin Name	I/O	Function	Description
1	F	O	Output pin (relating to the pulse output)	Open Drain
2	TAB	-	(TAB pin)	(* 1)
3	D	O	Output pin (relating to the direction output)	Open Drain
4	VDD	-	Power supply pin	
5	TAB	-	(TAB pin)	(* 1)
6	VSS	-	Ground pin	

* 1. The TAB pin should be connected to the VSS pin.

6. Absolute Maximum Ratings

Table 3. Absolute maximum ratings

Parameter	Symbol	Min.	Max.	Unit	Description
Supply Voltage	V_{DD}	–0.3	32	V	VSS = 0V
Output Voltage	V_{OUT}	–0.3	32	V	F pin, D pin VSS = 0V
Output Current	I_{SINK}		20	mA	F pin, D pin
Storage Temperature	T_{STG}	–55	150	ºC	

Operation at or beyond these limits may result in permanent damage to the device. Normal operation is not guaranteed at these extremes.

7. Recommended Operating Conditions

Table 4. Recommended operating conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	3.8	12	24	V
Output Current	I_{SINK}			15	mA
Operation Temperature	Ta	–40		150	ºC

8. Electrical Characteristics

Table 5. Electrical characteristics at V_{DD} = 3.8 to 24V, Ta = –40 to 150ºC

Parameter	Symbol	Min.	Typ.	Max.	Unit	Description
Current Consumption	I_{DD}	1.7	3.5	6.2	mA	V_{DD} = 3.8 to 24V
Current Consumption (2)	I_{DD2}	1.7	3.5	6.0	mA	V_{DD} = 3.8 to 18V
Output Saturation Voltage	V_{SAT}			0.4	V	F pin, D pin, I_{SINK} = 15mA
Output Leak Current	I_{LEAK}			10	μA	F, D = V_{DD}
Output Refresh Period	Tp	5.0	8.3	16.7	μs	

9. Magnetic Characteristics

Table 6. Magnetic characteristics at V_{DD} = 3.8 to 24V, Ta = –40 to 150ºC

Parameter	Symbol	Min.	Typ.	Max.	Unit	Description
Operate point of vertical magnetic field	BopV	0.5	2.0	4.0	mT	(* 2)
Release point of vertical magnetic field	BrpV	–4.0	–2.0	–0.5	mT	(* 2)
Operate point of horizontal magnetic field	BopH	0.5	2.0	4.0	mT	(* 3)
Release point of horizontal magnetic field	BrpH	–4.0	–2.0	–0.5	mT	(* 3)
Hysteresis	BhV, BhH	2.0	4.0	6.4	mT	(* 2, * 3, * 4)
Magnetic offset	BoffV, BoffH	–1.1	0.0	+1.1	mT	(* 2, * 3, * 5)

* 2. Horizontal magnetic flux density is zero.
* 3. Vertical magnetic flux density is zero
* 4. Bh = Bop – Brp
* 5. Boff = (Bop + Brp) / 2

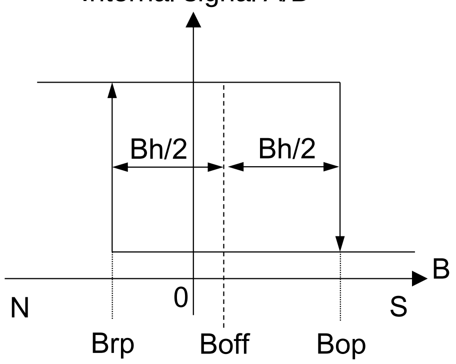


Figure 3. Definition of Bh and Boff

10. Magnetic Field Detection

10.1. Definition of Vertical Magnetic Field's Polarity

The internal signal A switches 'L' (ON) 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 'H' (OFF). 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.

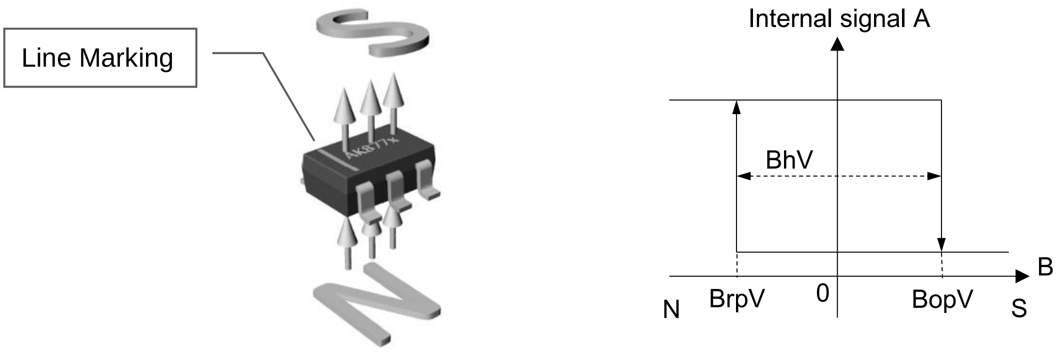


Figure 4. Switching behavior of the internal signal A when vertical magnetic field is applied

10.2. Definition of Horizontal Magnetic Field's Polarity

The internal signal B switches 'L' (ON) 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 'H' (OFF). 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.

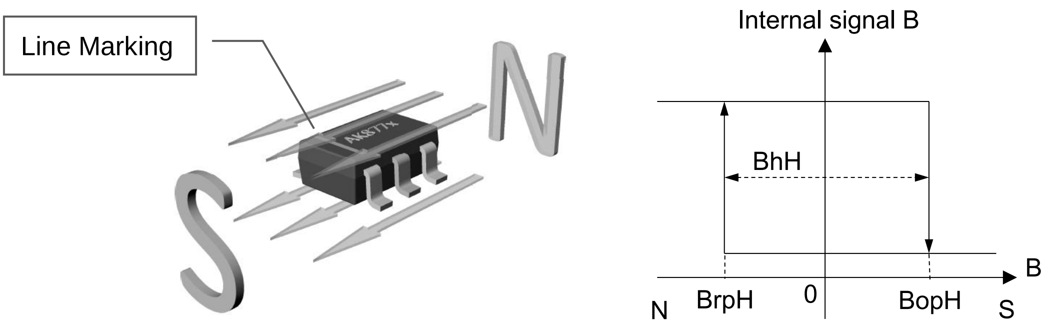


Figure 5. Switching behavior of the internal signal B when horizontal magnetic field is applied

10.3. Behaviors of Internal and Output Signals when a Rotating Magnetic Field Is Applied on The AK8779A

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

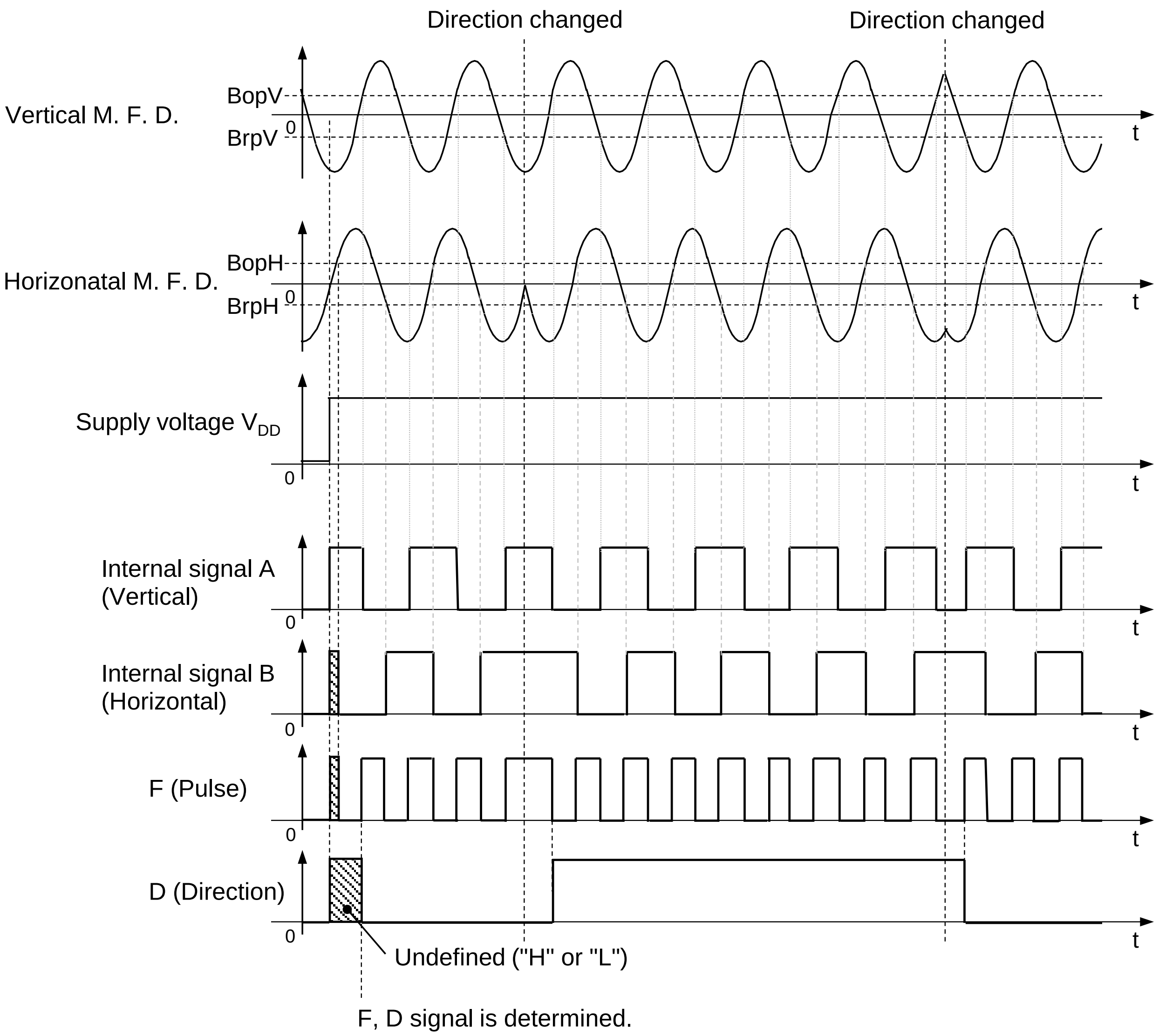


Figure 6. Behaviors of Internal Signal A, B and Output Signal F, D with Rotating Magnetic Field

* M.F.D. = Magnetic Flux Density
* D signal is determined after one F signal pulse is sent out. The indeterminate output state appears only in the powering up of this device.
* F and D signals are changed at the same time.

11. Operational Timing

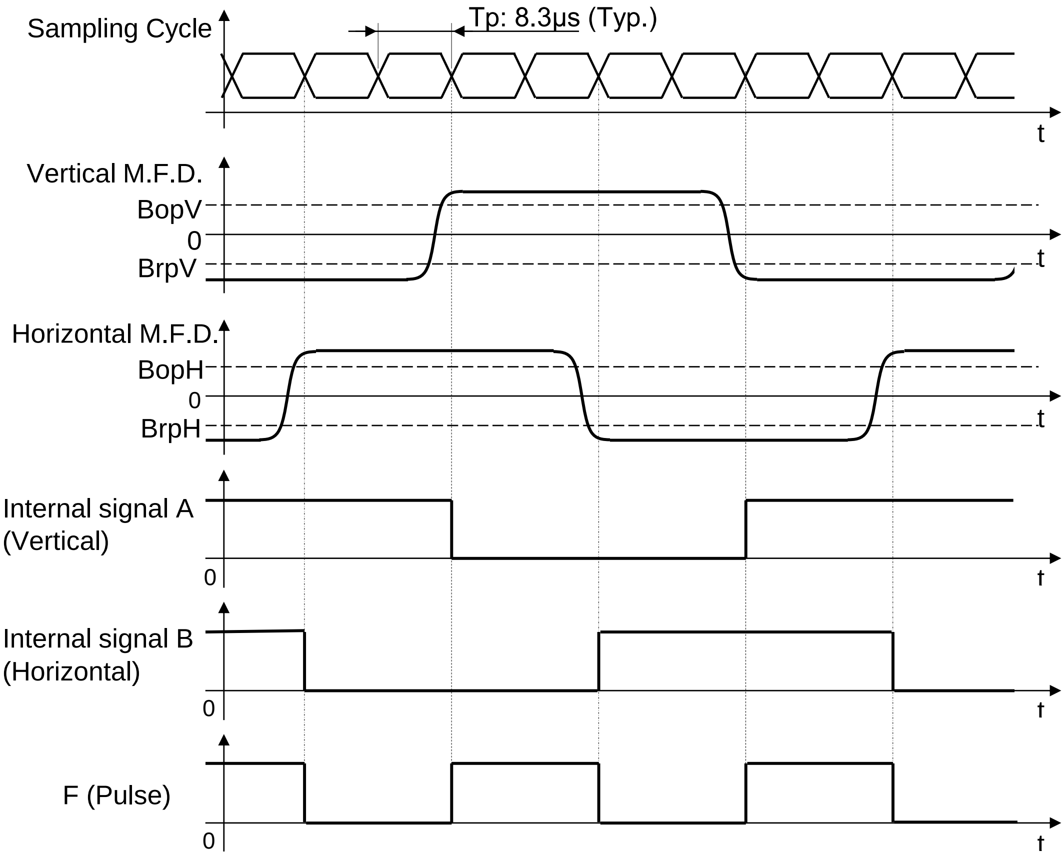


Figure 7. Output Signal Timing Diagram

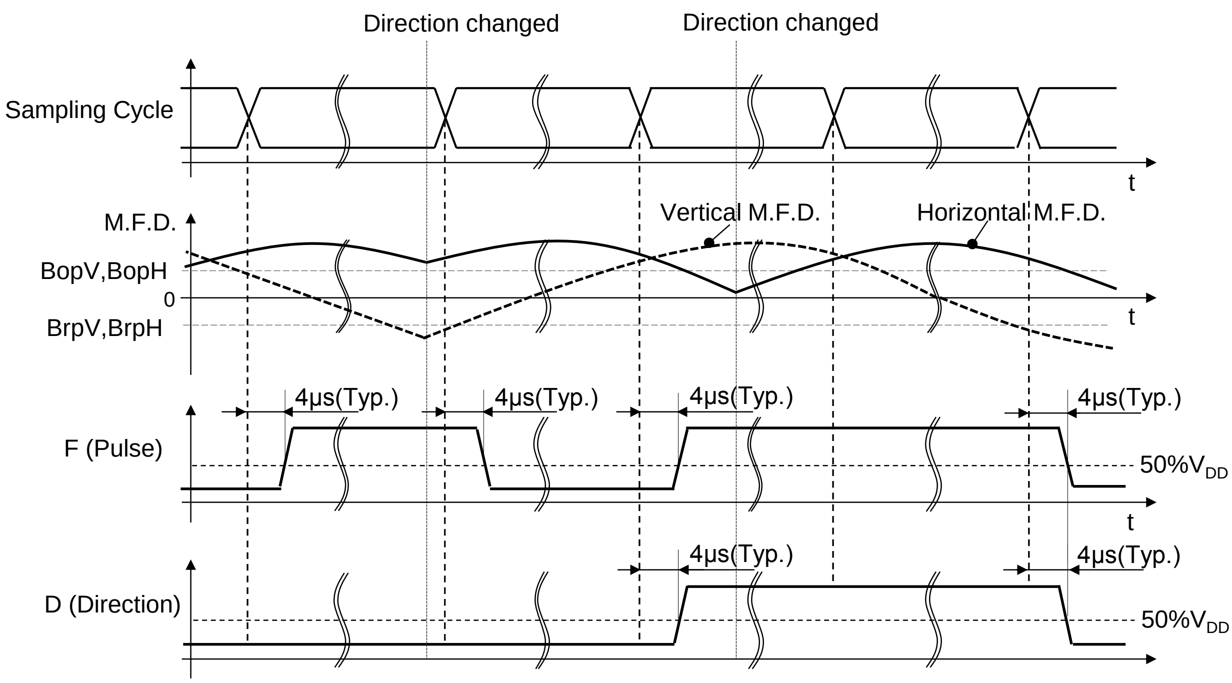


Figure 8. Output Signal Timing Diagram (in detail)

* M.F.D. = Magnetic Flux Density
* V_{DD} = 12V, R_L = 10kΩ, C_L = 20pF

12. Recommended External Circuit

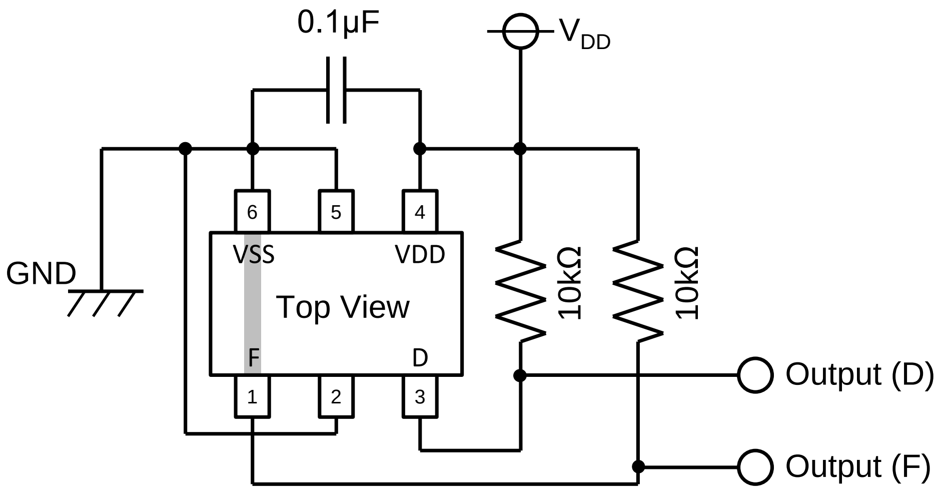


Figure 9. Recommended External Circuit

13. Typical Characteristics Data (for reference)

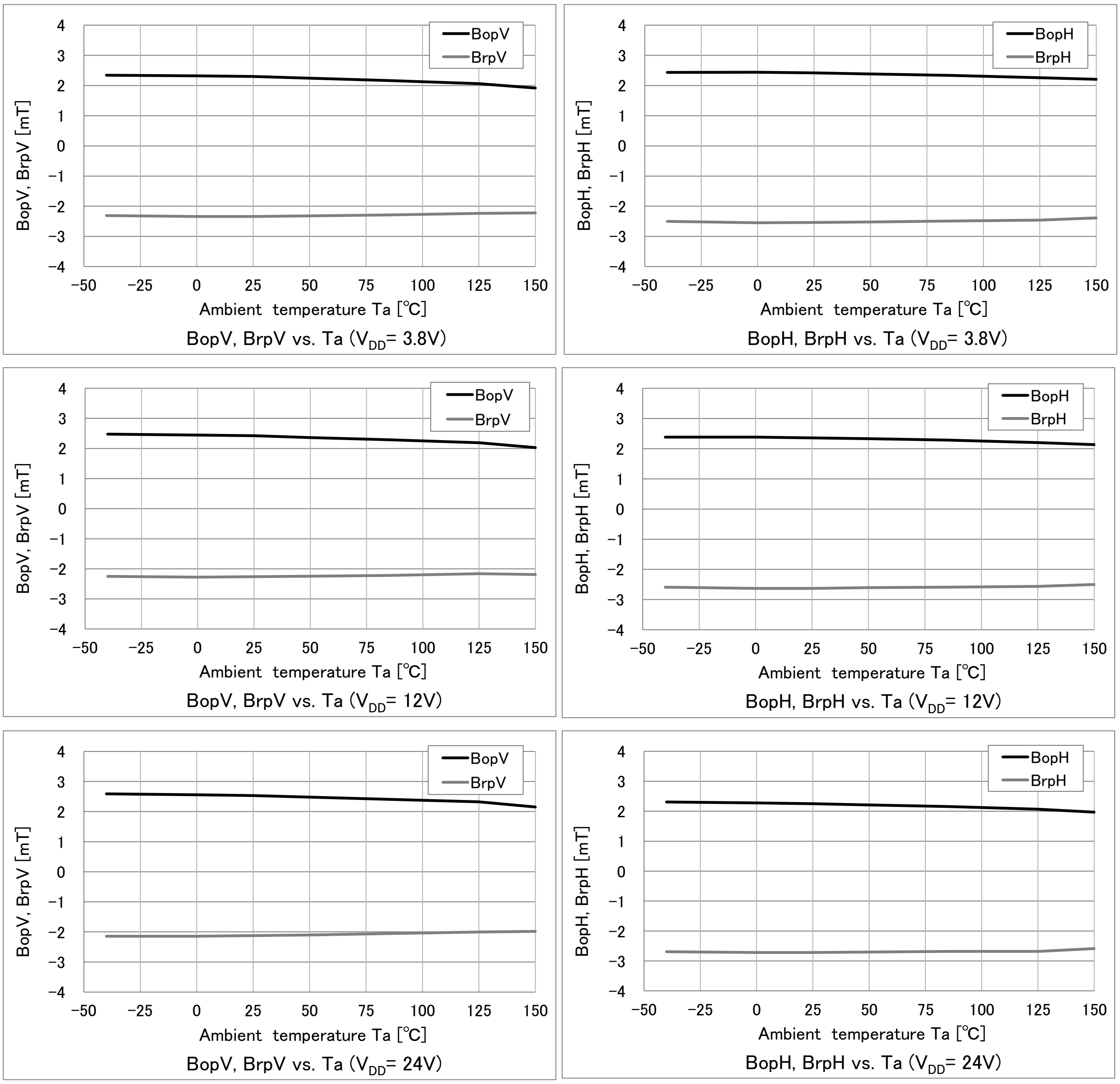


Figure 10. Temperature Dependence of Bop, Brp

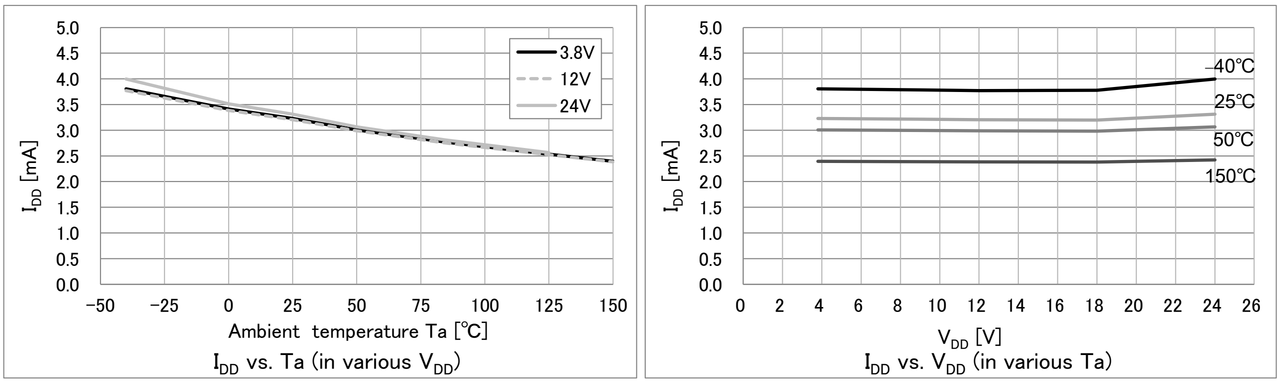


Figure 11. Temperature Dependence of Current Consumption

14. Package

14.1. Outline Dimensions

6-pin SOP (Unit: mm)

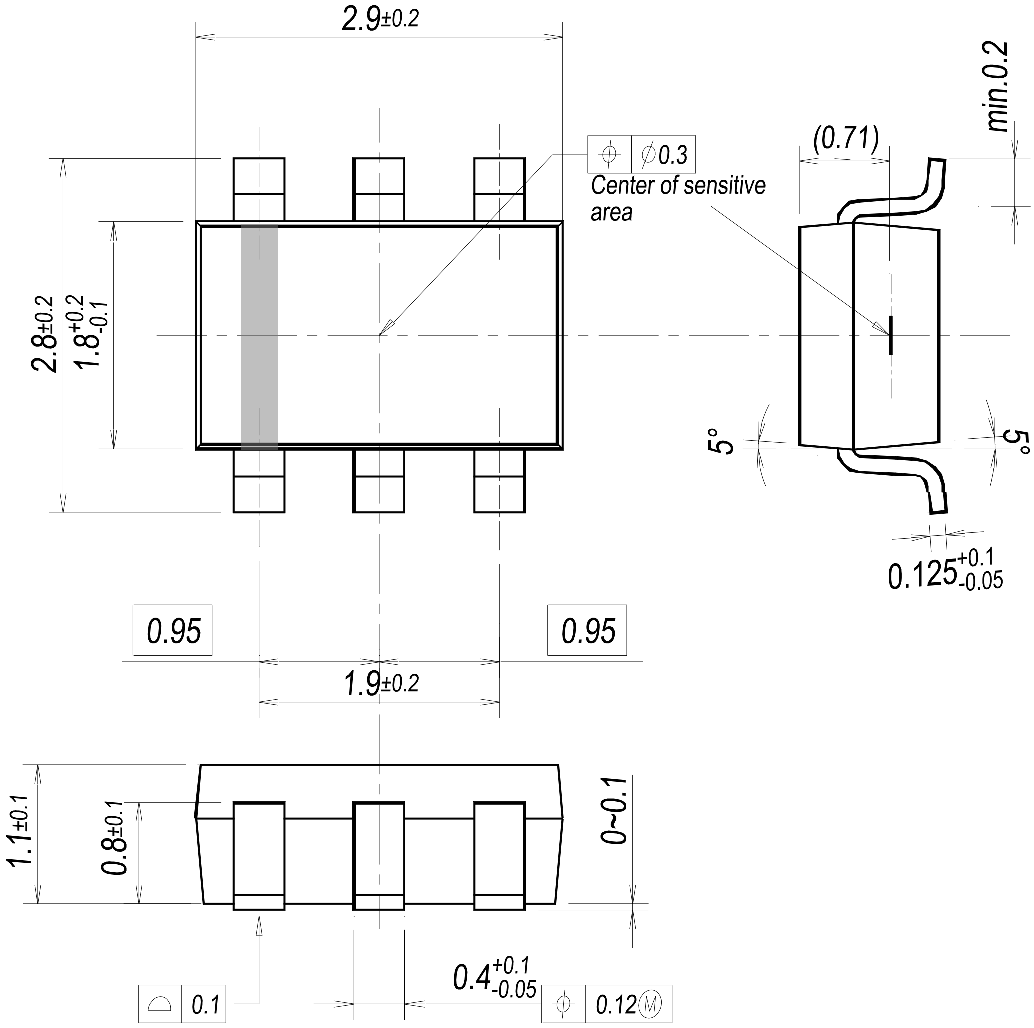


Figure 12. Outline Dimensions

* The center of the sensitive area is located within a φ0.3mm circle.
* Lead flatness: The standoff differences among terminals are Max. 0.1mm.
* The sensor part is located at 0.71mm (Typ.) deep from the marked surface.

14.2. Material of Terminals

Material:	Cu alloy
Plating:	Sn 100%
Thickness:	10µm (Typ.)

14.3. Land Pattern

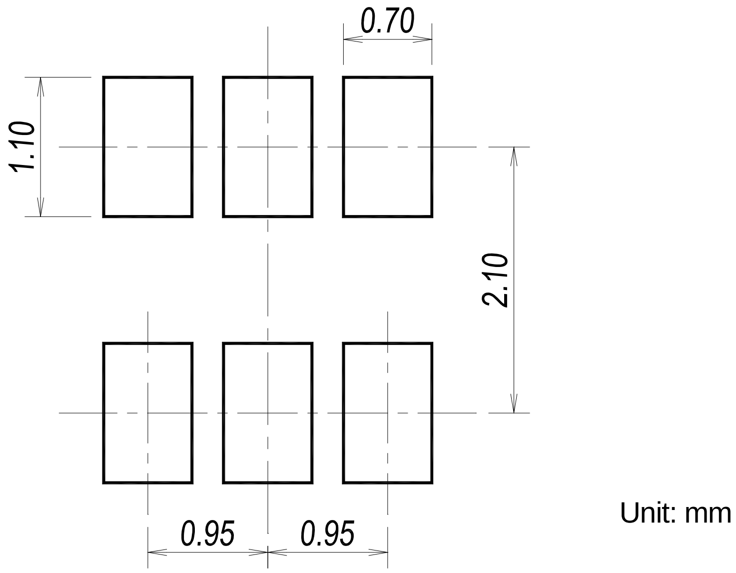
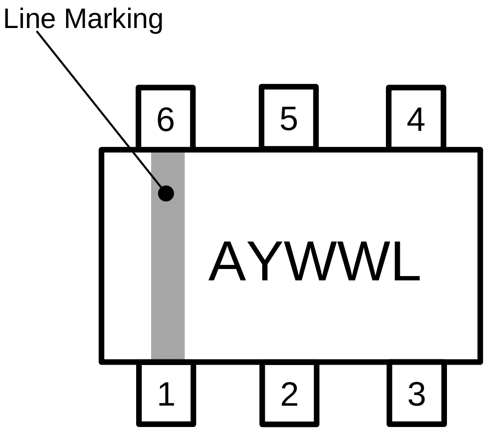


Figure 13. Land Pattern

14.4. Marking



Marking is performed by laser

Product name	A(AK8779A)
Date code	YWWL
	Y: Manufactured Year
	WW: Manufactured Week
	L: Lot Number

Figure 14. Marking

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