AK8779B
Hall Effect IC for Pulse Encoders

1. General Description

The AK8779B is a Hall effect latch which detects both “vertical” and “horizontal” (perpendicular and parallel to the marked side of the package) magnetic fields at the same time. The OUTA and OUTB outputs are switched according to the vertical and horizontal magnetic fields applied to the device. The AK8779B is for use in the incremental pulse encoders or rotational detection systems.

2. Features

- Supply Voltage: 3.8 to 24V
- Operation Temperature: –40 to 150°C
- Sensitivity (Vertical): ±2.0mT(Typ.), ±4.0mT(Max.)
- Sensitivity (Horizontal): ±2.0mT(Typ.), ±4.0mT(Max.)
- Two Outputs:
  - OUTA (vertical magnetic field detection)
  - OUTB (horizontal magnetic field detection)
- Package: 6-pin SOP Type (RoHS Compliant, Halogen free)
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4. Block Diagram and Functions

4.1. Block Diagram

Figure 1. AK8779B Block Diagram

4.2. Functions

Table 1. Circuit configuration

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

5.1. Pin Configurations

![Pin Layout Image]

Figure 2. Pin Layout

5.2. Functions

Table 2. Description of pin name and function

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin Name</th>
<th>I/O</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OUTB</td>
<td>O</td>
<td>Output pin (relating to the horizontal magnetic field)</td>
<td>Open Drain</td>
</tr>
<tr>
<td>2</td>
<td>TAB</td>
<td>-</td>
<td>(TAB pin)</td>
<td>(* 1)</td>
</tr>
<tr>
<td>3</td>
<td>OUTA</td>
<td>O</td>
<td>Output pin (relating to the vertical magnetic field)</td>
<td>Open Drain</td>
</tr>
<tr>
<td>4</td>
<td>VDD</td>
<td>-</td>
<td>Power Supply pin</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TAB</td>
<td>-</td>
<td>(TAB pin)</td>
<td>(* 1)</td>
</tr>
<tr>
<td>6</td>
<td>VSS</td>
<td>-</td>
<td>Ground pin (GND)</td>
<td></td>
</tr>
</tbody>
</table>

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

6. Absolute Maximum Ratings

Table 3. Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>V_DD</td>
<td>−0.3</td>
<td>32</td>
<td>V</td>
<td>VSS = 0V</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>V_OUT</td>
<td>−0.3</td>
<td>32</td>
<td>V</td>
<td>OUTA pin, OUTB pin VSS = 0V</td>
</tr>
<tr>
<td>Output Current</td>
<td>I_SINK</td>
<td>20</td>
<td>mA</td>
<td>OUTA pin, OUTB pin</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_STG</td>
<td>−55</td>
<td>150</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>$V_{DD}$</td>
<td>3.8</td>
<td>12</td>
<td>24</td>
<td>V</td>
</tr>
<tr>
<td>Output Current</td>
<td>$I_{SINK}$</td>
<td>15</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Operation Temperature</td>
<td>$T_a$</td>
<td>-40</td>
<td></td>
<td>150</td>
<td>ºC</td>
</tr>
</tbody>
</table>

8. Electrical Characteristics

Table 5. Electrical characteristics at $V_{DD} = 3.8$ to 24V, $T_a = -40$ to 150ºC

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Consumption</td>
<td>$I_{DD}$</td>
<td>1.7</td>
<td>3.5</td>
<td>6.2</td>
<td>mA</td>
<td>$V_{DD} = 3.8$ to 24V</td>
</tr>
<tr>
<td>Current Consumption (2)</td>
<td>$I_{DD2}$</td>
<td>1.7</td>
<td>3.5</td>
<td>6.0</td>
<td>mA</td>
<td>$V_{DD} = 3.8$ to 18V</td>
</tr>
<tr>
<td>Output Saturation Voltage</td>
<td>$V_{SAT}$</td>
<td>0.4</td>
<td></td>
<td></td>
<td>V</td>
<td>OUTA pin, OUTB pin, $I_{SINK} = 15mA$</td>
</tr>
<tr>
<td>Output Leak Current</td>
<td>$I_{LEAK}$</td>
<td>10</td>
<td></td>
<td>16.7</td>
<td>µA</td>
<td>OUTA, OUTB pin = $V_{DD}$</td>
</tr>
<tr>
<td>Output Refresh Period</td>
<td>$T_p$</td>
<td>5.0</td>
<td>8.3</td>
<td>16.7</td>
<td>µs</td>
<td></td>
</tr>
</tbody>
</table>

9. Magnetic Characteristics

Table 6. Magnetic characteristics at $V_{DD} = 3.8$ to 24V, $T_a = -40$ to 150ºC

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operate point of vertical magnetic field</td>
<td>$B_{opV}$</td>
<td>0.5</td>
<td>2.0</td>
<td>4.0</td>
<td>mT</td>
<td>(* 2)</td>
</tr>
<tr>
<td>Release point of vertical magnetic field</td>
<td>$B_{rpV}$</td>
<td>-4.0</td>
<td>-2.0</td>
<td>-0.5</td>
<td>mT</td>
<td>(* 2)</td>
</tr>
<tr>
<td>Operate point of horizontal magnetic field</td>
<td>$B_{opH}$</td>
<td>0.5</td>
<td>2.0</td>
<td>4.0</td>
<td>mT</td>
<td>(* 3)</td>
</tr>
<tr>
<td>Release point of horizontal magnetic field</td>
<td>$B_{rpH}$</td>
<td>-4.0</td>
<td>-2.0</td>
<td>-0.5</td>
<td>mT</td>
<td>(* 3)</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>$B_{Hv}, B_{Hh}$</td>
<td>2.0</td>
<td>4.0</td>
<td>6.4</td>
<td>mT</td>
<td>(* 2, * 3, * 4)</td>
</tr>
<tr>
<td>Magnetic offset</td>
<td>$B_{offV}, B_{offH}$</td>
<td>-1.1</td>
<td>0.0</td>
<td>+1.1</td>
<td>mT</td>
<td>(* 2, * 3, * 5)</td>
</tr>
</tbody>
</table>

* 2. Horizontal magnetic flux density is zero.
* 3. Vertical magnetic flux density is zero.
* 4. $B_{h} = B_{op} - B_{rp}$
* 5. $B_{off} = (B_{op} + B_{rp}) / 2$

Figure 3. Definition of Bh and Boff
10. Operating Characteristics

10.1. Definition of Vertical Magnetic Field

The OUTA signal switches ‘L’ (ON) when the magnetic field perpendicular to the marking side of the package exceeds $B_{opV}$. When the magnetic field is reduced below $B_{rpV}$, the OUTA goes ‘H’ (OFF). Otherwise; that is, in case of the magnetic field strength is greater than $B_{rpV}$ and smaller than $B_{opV}$; OUTA keeps its status.

![Diagram of OUTA signal with vertical magnetic field](image)

Figure 4. Switching behavior of OUTA signal when vertical magnetic field is applied

10.2. Definition of Horizontal Magnetic Field

The OUTB signal switches ‘L’ (ON) when the magnetic field parallel to the marking side of the package exceeds $B_{opH}$. When the magnetic field is reduced below $B_{rpH}$, the OUTB goes ‘H’ (OFF). Otherwise; that is, in case of the magnetic field strength is greater than $B_{rpH}$ and smaller than $B_{opH}$; OUTB keeps its status.

![Diagram of OUTB signal with horizontal magnetic field](image)

Figure 5. Switching behavior of the OUTB signal when horizontal magnetic field is applied
10.3. Behaviors of OUTA and OUTB Signals when a Rotating Magnetic Field Is Applied on The AK8779B

![Diagram of behaviors of OUTA and OUTB signals with rotating magnetic field](image)

Figure 6. Behaviors of OUTA and OUTB Signals with Rotating Magnetic Field

* M.F.D. = Magnetic Flux Density

* The indeterminate output state appears only in the powering up of this device.
11. Functional Timing

Figure 7. Output Signal Timing Diagram

Figure 8. Output Signal Timing Diagram (in detail)

* M.F.D. = Magnetic Flux Density
* $V_{DD} = 12V$, $R_L = 10k\,\Omega$, $C_L = 20pF$
12. Recommended External Circuit

Figure 9. Recommended External Circuit
13. Typical Characteristics Data (for reference)

![Graphs showing temperature dependence of Bop, Brp and BopH, BrpH](image)

**Figure 10. Temperature Dependence of Bop, Brp**

![Graphs showing current consumption vs. ambient temperature](image)

**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: B(AK8779B)
Date code: YWWL
Y: Manufactured Year
WW: Manufactured Week
L: Lot Number

Figure 14. Marking
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