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 150°C
- **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)
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4. Block Diagram and Functions

4.1. Block Diagram

![Block Diagram of AK8779A](image)

Figure 1. AK8779A 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</td>
</tr>
<tr>
<td></td>
<td>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

![Figure 2. Pin Layout](image)

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>F</td>
<td>O</td>
<td>Output pin (relating to the pulse output)</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>D</td>
<td>O</td>
<td>Output pin (relating to the direction output)</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</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>F pin, D pin VSS = 0V</td>
</tr>
<tr>
<td>Output Current</td>
<td>I_SINK</td>
<td>20</td>
<td>mA</td>
<td></td>
<td>F pin, D pin</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>
<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>$Ta$</td>
<td>-40</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

8. Electrical Characteristics

<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>$F_{pin}, D_{pin}, I_{SINK} = 15mA$</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>$F, D = V_{DD}$</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>
<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>$BopV$</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>$BrpV$</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>$BopH$</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>$BrpH$</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. 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 \( B_{opV} \). When the magnetic field is reduced below \( B_{rpV} \), the internal signal A goes ‘H’ (OFF). Otherwise; that is, in case of the magnetic field strength is greater than \( B_{rpV} \) and smaller than \( B_{opV} \); the internal signal A keeps its status.

![Diagram of Internal Signal A](image)

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 \( B_{opH} \). When the magnetic field is reduced below \( B_{rpH} \), the internal signal B goes ‘H’ (OFF). Otherwise; that is, in case of the magnetic field strength is greater than \( B_{rpH} \) and smaller than \( B_{opH} \); the internal signal B keeps its status.

![Diagram of Internal Signal B](image)

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
* $V_{DD} = 12V$, $R_L = 10k\Omega$, $C_L = 20pF$
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

![Land Pattern Diagram]

Figure 13. Land Pattern

14.4. Marking

![Marking Diagram]

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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