

Low Voltage Operation Omnipolar Detection

Type Hall Effect Switch IC

General Description

The ET3712A31 is a high sensitivity and high-accuracy Omnipolar Hall effect switch IC that operates at a low voltage and low current consumption. The output voltage will be pulled low when this IC detects the magnetic flux density is larger than operate point(B_{OPN}/B_{OPS}) and the output voltage will recover to high until the magnetic flux density is smaller than the release point(B_{RPN}/B_{RPS}). Using this IC with a magnet makes it possible to detect the open / close status in various applications.

To achieve a high-density mounting the ET3712A31 uses a super-small DFN4 package.

The ET3712A31 is suitable for battery powered portable devices such as mobile phones and portable PCs etc. due to its low voltage operation and low current consumption, the average current consumption is only typ. 12 μ A with a 1.85 V supply.

Features

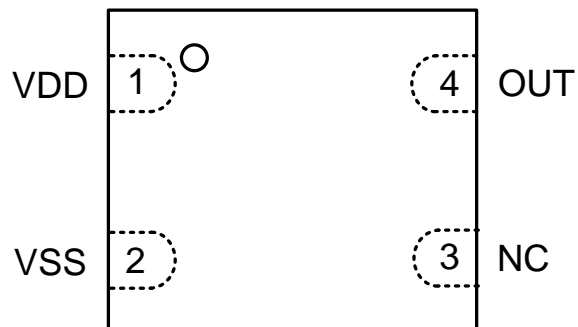
- Pole detection: Omnipolar pole
- Output logic: Active low
- Output form: CMOS output, no external pull-up resistor required
- Operating Point: $B_{OP} = 3.0$ mT typ.
- Operating cycle: $t_{CYCLE} = 5.70$ ms typ.
- Current consumption: $I_{DD} = \text{typ. } 12.0$ μ A at 1.85 V
- Power supply voltage range: $V_{DD} = 1.6$ V to 3.5 V
- Operation temperature range: $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
- Lead-free (Sn 100%), halogen-free
- Super small DFN4 package

Application

- Open/Close detection for flip mobile phones
- Smart cover for smart phones
- Smart cover for portable PCs, tablet PCs
- Digital video cameras and portable game consoles
- Home appliances

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Pin Configuration

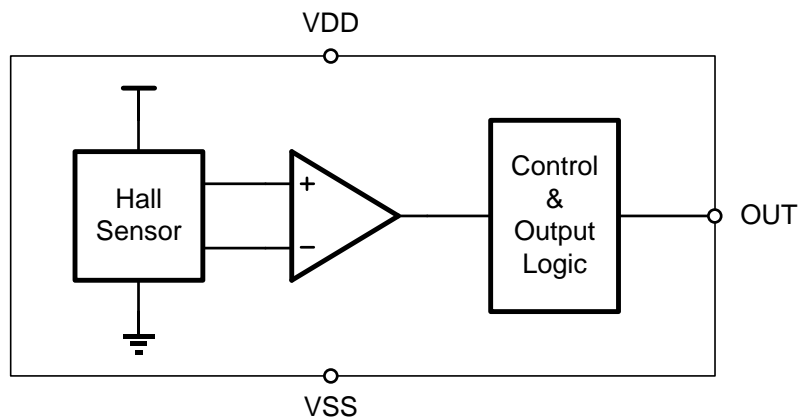


TOP VIEW

Pin Function

| Pin No. | Pin Name | Pin Function |
|---------|----------|------------------|
| 1 | VDD | Power supply pin |
| 2 | VSS | Ground Pin |
| 3 | NC | No connection |
| 4 | OUT | Output pin |

Block Diagram



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Functional Description

Applied magnetic flux

The magnetic flux applied to ET3712A31 should be on the vertical direction on marking surface. If not, the horizontal component has no effect to detection. ET3712A31 is omnipolar type detector, the output voltage (V_{OUT}) is inverted when the S or N type magnetic flux is applied to IC.

Below shows the direction in which magnetic flux should be applied.

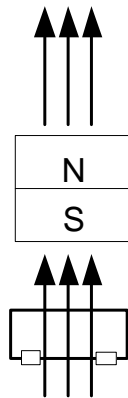


Figure1. Magnetic flux direction

Hall sensor Position

The Hall sensor embedded in ET3712A31 is at the center of IC. As show below, the position of this Hall sensor is located in the area indicated by a circle, the diameter size of which is about 0.3 mm.

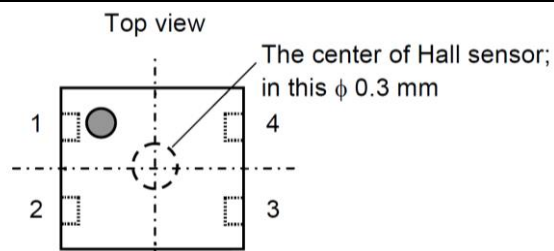


Figure2. Hall sensor Position

Detecting Operation

ET3712A31 detects magnetic field periodically. When vertical component of the magnetic flux applied to IC exceeds the operating point (B_{OPN} or B_{OPS}) such as the S or N pole of a magnet is moved closer to IC, V_{OUT} changes from "H" to "L". On the contrary, if magnetic flux is lower than the release point (B_{RPN} or B_{RPS}), V_{OUT} changes from "L" to "H".

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The relationship between the magnetic flux density and V_{OUT} is shown below.

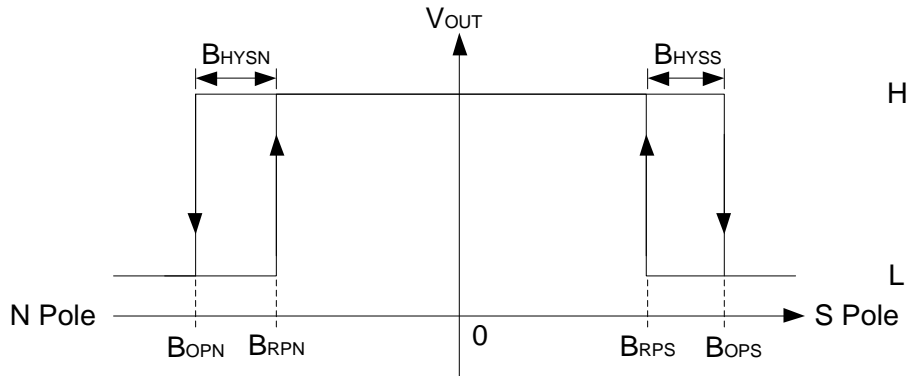


Figure3. Magnetic flux density vs V_{OUT}

Operating Current

ET3712A31 performs the intermittent operation, therefore the average current consumption depends on the current in active mode, the active period (t_{AW}), the current in sleep mode, and sleep period (t_{SL}). The active current is about 640 μA typically, and 0.72 μA at sleep mode. Please refer to electrical characteristic table for detail.

The time dependency of the current consumption is shown below.

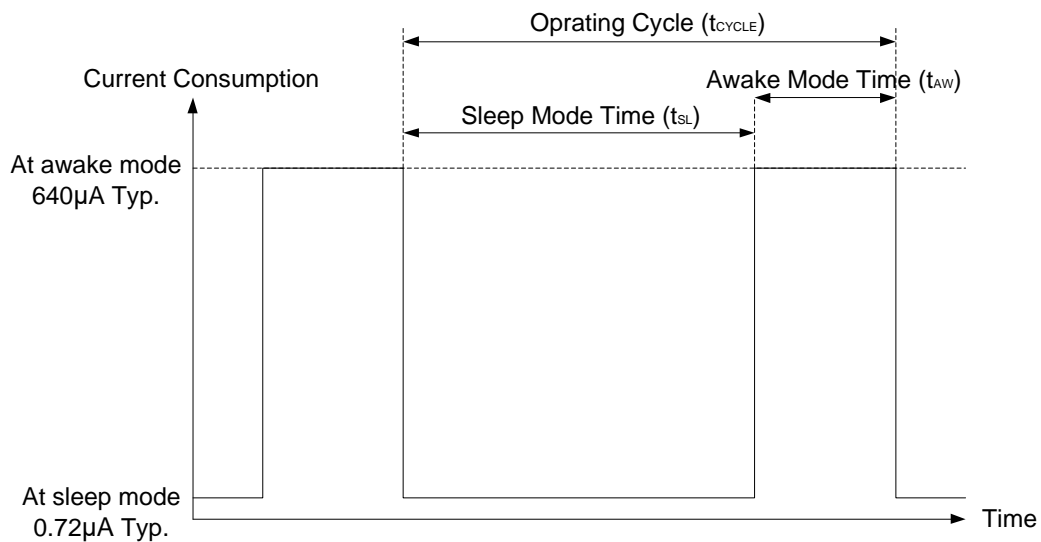
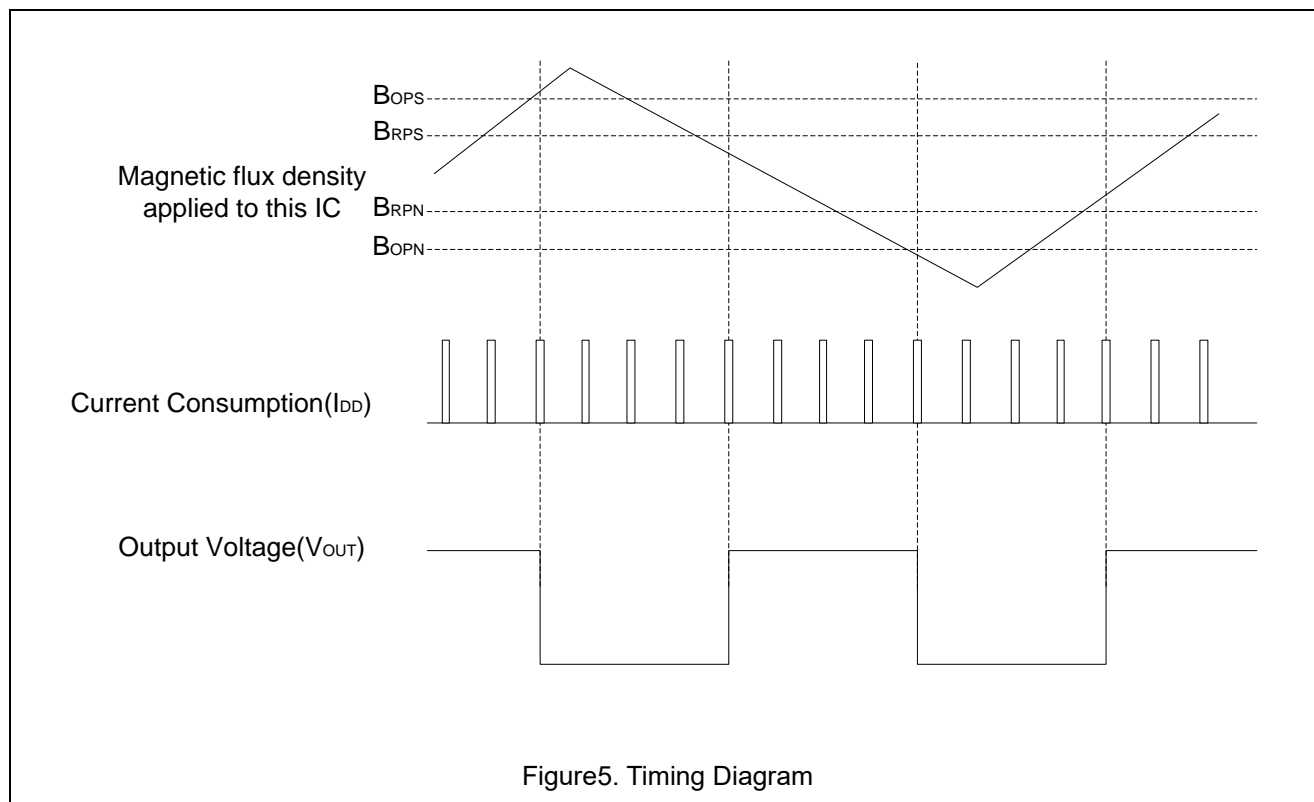


Figure4. Operating Current

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Timing Diagram

The operation timing of this IC is shown below.



Absolute Maximum Ratings

($T_A = +25^\circ\text{C}$ unless otherwise specified)

| Symbol | Parameters | Rating | Unit |
|---------------|--|----------------------------------|--------------------|
| V_{DD} | Power supply voltage | $V_{SS}-0.3 \sim V_{SS}+7.0$ | V |
| I_{OUT} | Output current | ± 1.0 | mA |
| V_{OUT} | Output voltage | $V_{SS} - 0.3 \sim V_{DD} + 0.3$ | V |
| T_A | Operation ambient temperature | $-40 \sim +85$ | $^\circ\text{C}$ |
| T_{STG} | Storage temperature | $-40 \sim +125$ | $^\circ\text{C}$ |
| θ_{JA} | Junction-to-ambient thermal resistance | 300 | $^\circ\text{C/W}$ |

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

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Electrical Characteristics

($T_A = +25^\circ\text{C}$, $V_{DD} = 1.85\text{ V}$, unless otherwise specified)

| Symbol | Parameters | Conditions | Min | Typ | Max | Unit |
|-------------|----------------------|---|--------------|------|-------|---------------|
| V_{DD} | Power supply voltage | - | 1.60 | 1.85 | 3.50 | V |
| I_{DD} | Current consumption | Average Supply Current | | 12.0 | 22.0 | μA |
| V_{OUT} | Output voltage | CMOS output Output transistor Nch, $I_{OUT} = 0.5\text{mA}$ | | | 0.4 | V |
| | | Output transistor Pch, $I_{OUT} = -0.5\text{mA}$ | $V_{DD}-0.4$ | | | V |
| t_{AW} | Awake mode time | | | 0.10 | | ms |
| t_{SL} | Sleep mode time | | | 5.60 | | ms |
| t_{CYCLE} | Operating cycle | | | 5.70 | 12.00 | ms |

Magnetic Characteristics

($T_A = +25^\circ\text{C}$, $V_{DD} = 1.85\text{ V}$, unless otherwise specified)

| Parameters | Symbol | Conditions | Min | Typ | Max | Unit |
|---------------------------------|--------|--------------------------------|------|------|------|-------------------|
| Operation point ⁽¹⁾ | N pole | B_{OPN} | 2.0 | 3.0 | 4.0 | mT ⁽⁴⁾ |
| | S pole | B_{OPS} | -4.0 | -3.0 | -2.0 | mT |
| Release point ⁽²⁾ | N pole | B_{RPN} | 1.8 | 2.2 | 3.7 | mT |
| | S pole | B_{RPS} | -3.7 | -2.2 | -1.8 | mT |
| Hysteresis width ⁽³⁾ | N pole | $B_{HN} = B_{OPN} - B_{RPN}$ | | 0.8 | | mT |
| | S pole | $B_{HS} = B_{OPS} - B_{RPS} $ | | 0.8 | | mT |

Notes:

(1) Operating points (B_{OPN} , B_{OPS}): B_{OPN} and B_{OPS} are the values of magnetic flux density triggers the output voltage (V_{OUT}) to low by increasing the N pole or S pole magnetic flux density applied to this IC. Even when the magnetic flux density is larger than B_{OPN} or B_{OPS} , V_{OUT} status is held.

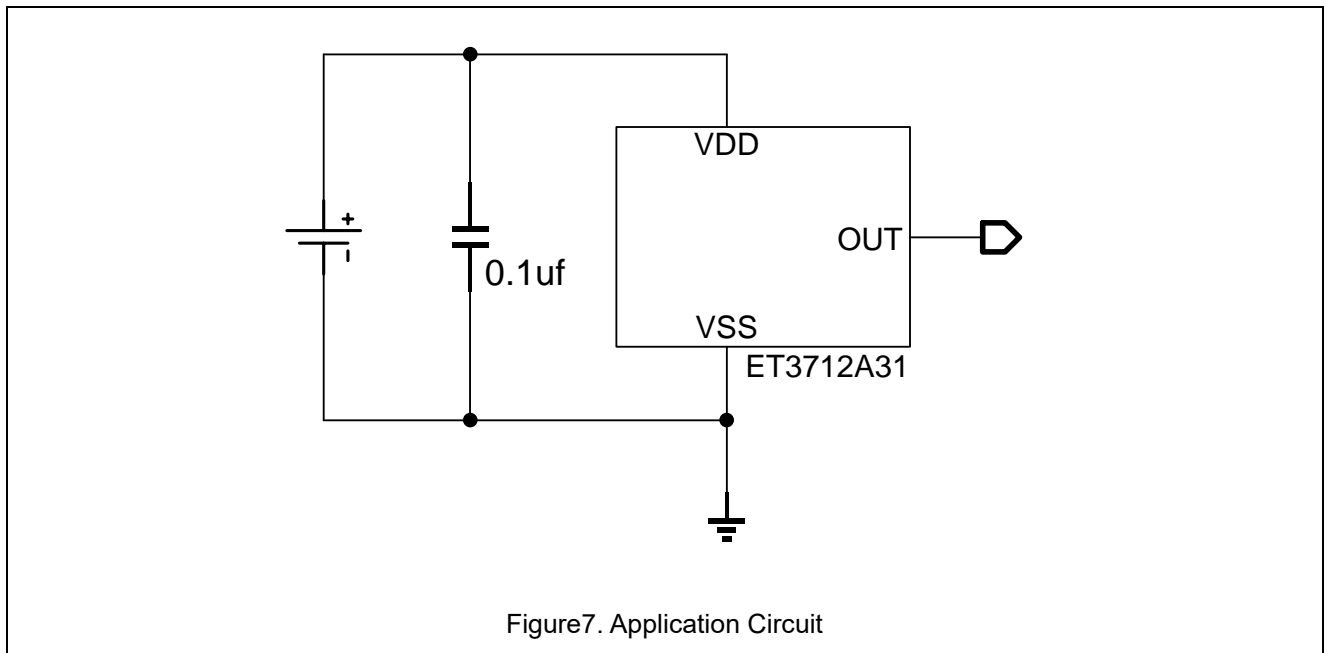
(2) Release points (B_{RPN} , B_{RPS}): B_{RPN} and B_{RPS} are the values of magnetic flux density makes the output voltage (V_{OUT}) recover to high by decreasing the N pole or S pole magnetic flux density applied to this IC. Even when the magnetic flux density is lower than B_{RPN} or B_{RPS} , V_{OUT} status is held.

(3) Hysteresis widths (B_{HN} , B_{HS}): B_{HN} and B_{HS} are the difference between B_{OPN} and B_{RPN} , and B_{OPS} and B_{RPS} , respectively.

(4) The unit of magnetic density mT can be converted by using the formula $1\text{ mT} = 10\text{ Gauss}$.

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Application Circuit



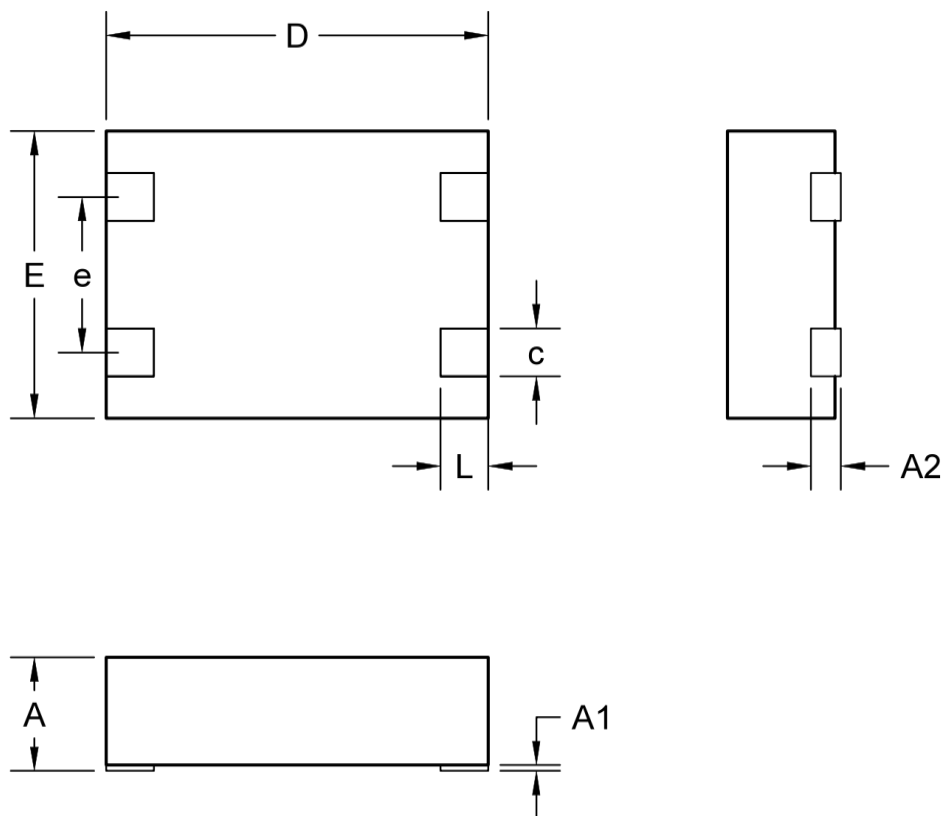
Precautions

- The power supply for this IC should have low impedance, the IC may malfunction due to a supply voltage drop caused by feed through current.
- Power supply voltage rapidly changing may cause IC malfunction.
- Large stress on this IC may affect the magnetic characteristics. Avoid large stress applied to the IC on a board.

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Package Dimension

DFN4



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|--------|-----------|------|------|
| A | 0.40 | 0.45 | 0.50 |
| A1 | 0 | - | 0.05 |
| A2 | 0.125 REF | | |
| c | 0.15 | 0.20 | 0.25 |
| D | 1.55 | 1.60 | 1.65 |
| E | 1.15 | 1.20 | 1.25 |
| e | 0.65 BSC | | |
| L | 0.15 | 0.20 | 0.25 |

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Revision History and Checking Table

| Version | Date | Revision Item | Modifier | Function & Spec Checking | Package & Tape Checking |
|---------|------------|-----------------|----------|-----------------------------|----------------------------|
| 1.0 | 2019-11-07 | Initial Version | Chenh | Wanggp | Zhuji |
| 1.1 | 2023.1.17 | Update Typeset | Shib | Wanggp | Zhuji |
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