# Low Voltage N-Pole Detection Type

# Hall Effect Switch IC

## General Description

The ET3712A30BNCLH is a high sensitivity and high-accuracy N pole detection 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 N pole magnetic flux density is larger than operate point($B_{OPN}$) and the output voltage will recover to high until the N pole magnetic flux density is smaller than the release point($B_{RPN}$). Using this IC with a magnet makes it possible to detect the open / close status in various applications.

Due to its low voltage operation and low current consumption the ET3712A30BNCLH is suitable for battery powered portable devices such as mobile phones and portable PCs etc.

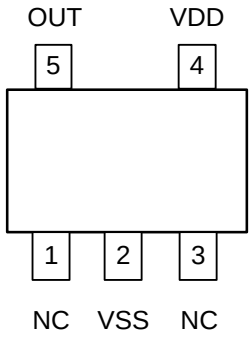
## Features

- Pole detection: N pole type
- Output logic: Active "L"
- Output form: CMOS output
- Magnetic sensitivity: $B_{OP}$ = 3.0 mT typ.
- Operating cycle (current consumption): $t_{CYCLE}$ = 50.85 ms ($I_{DD}$ = 2.0 μA) typ.
- Power supply voltage range: $V_{DD}$ = 1.6 V to 5.5 V
- Operation temperature range: Ta = -40°C to +85°C
- Package: SOT-553
- Lead-free (Sn 100%), halogen-free

## 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

## Pin Configuration

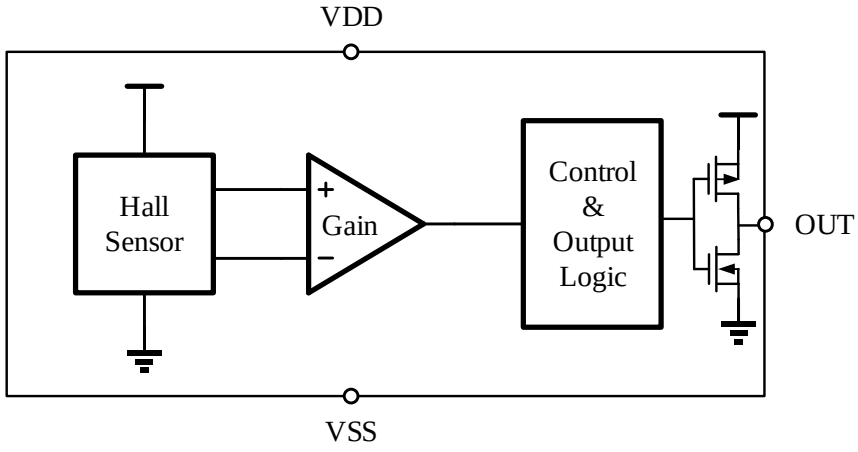



TOP VIEW

## Pin Function

| Pin No. | Pin Name | Pin Function |
|---|---|---|
| 1 | NC | No connection |
| 2 | VSS | GND Pin |
| 3 | NC | No connection |
| 4 | VDD | Power supply pin |
| 5 | OUT | Output pin |

## Block Diagram



## Absolute Maximum Ratings

(Ta = +25°C unless otherwise specified)

| Parameters | Symbol | Rating | Unit |
|---|---|---|---|
| Power supply voltage | $V_{DD}$ | $V_{SS}$-0.3~$V_{SS}$+7.0 | V |
| Output current | $I_{OUT}$ | ±1.0 | mA |
| Output voltage | $V_{OUT}$ | $V_{SS}$ − 0.3 ~ $V_{DD}$ + 0.3 | V |
| Operation ambient temperature | $T_A$ | −40 ~ +85 | °C |
| Storage temperature | $T_{STG}$ | −40 ~ +125 | °C |
| Junction-to-ambient thermal resistance | $\theta_{JA}$ | 300 | °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.

## Electrical Characteristics

(Ta = +25°C, $V_{DD}$ = 1.85 V, $V_{SS}$ = 0 V unless otherwise specified)

| Parameters | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Power supply voltage | $V_{DD}$ | - | 1.60 | 1.85 | 5.50 | V |
| Current consumption | $I_{DD}$ | Average value | | 2.0 | 4.0 | uA |
| Output voltage | $V_{OUT}$ | Output transistor Nch, $I_{OUT}$ = 0.5 mA | | | 0.4 | V |
| | | Output transistor Pch, $I_{OUT}$ = -0.5 mA | $V_{DD}$-0.4 | | | V |
| Awake mode time | $t_{AW}$ | | | 0.05 | | ms |
| Sleep mode time | $t_{SL}$ | | | 50.80 | | ms |
| Operating cycle | $t_{CYCLE}$ | $t_{AW}$ + $t_{SL}$ | | 50.85 | 100.00 | ms |

## Magnetic Characteristics

(Ta = +25°C, $V_{DD}$ = 1.85 V, $V_{SS}$ = 0 V unless otherwise specified)

| Parameters | | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Operation point[(1)] | N pole | $B_{OPN}$ | | -4.0 | -3.0 | -1.4 | mT[(4)] |
| Release point[(2)] | N pole | $B_{RPN}$ | | -3.7 | -2.2 | -1.1 | mT |
| Hysteresis width[(3)] | N pole | $B_{HYSN}$ | $B_{HYSN}$= \| $B_{OPN}$ − $B_{RPN}$ \| | | 0.8 | | mT |

***Notes:***

***1**. Operating points ($B_{OPN}$):

$B_{OPN}$ is the value of magnetic flux density triggers the output voltage ($V_{OUT}$) to low by increasing the N pole magnetic flux density applied to this IC.

Even when the magnetic flux density is larger than $B_{OPN}$, $V_{OUT}$ status is held

***2**. Release points ($B_{RPN}$):

$B_{RPN}$ is the values of magnetic flux density makes the output voltage ($V_{OUT}$) recover to high by decreasing the magnetic flux density applied to this IC.

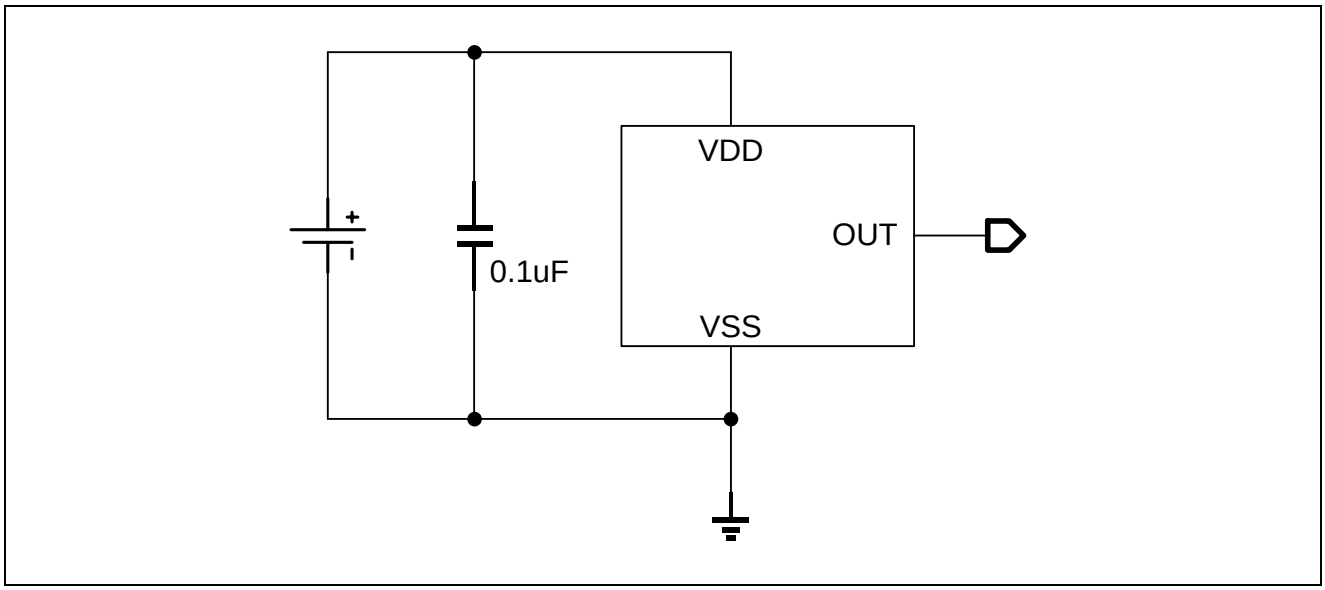
Even when the magnetic flux density is lower than $B_{RPN}$, $V_{OUT}$ status is held.

***3**. Hysteresis widths ($B_{HYSN}$):

$B_{HYSN}$ is the difference between $B_{OPN}$ and $B_{RPN}$.

***4**. The unit of magnetic density mT can be converted by using the formula 1 mT = 10 Gauss.

## Typical Application Circuit

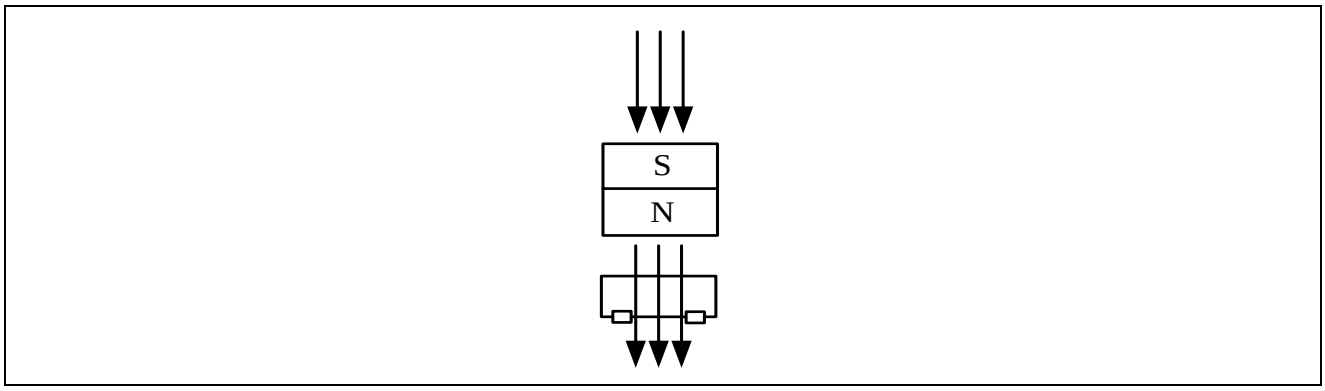



## Operation

### 1. Applied magnetic flux

The magnetic flux applied to ET3712A30BNCLH should on the vertical direction on marking surface. If not, the horizontal component has no effect to detection.

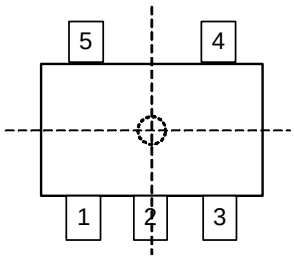
This product is omnipolar type detector, the output voltage ($V_{OUT}$) is inverted when the magnetic flux is applied to IC.Below shows the direction in which magnetic flux should be applied.




### 2. Hall sensor Position

The Hall sensor embedded in ET3712A30BNCLH is at the center of IC using SOT-553 package.

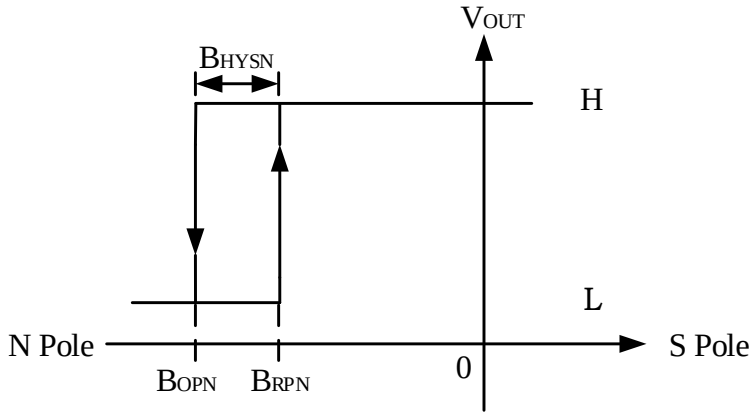
As show below, the position of this Hall sensor is located in the area indicated by a circle.




### 3. Detecting Operation

ET3712A30BNCLH detects magnetic field periodically. When vertical component of the magnetic flux applied to IC exceeds the operating point ($B_{OPN}$) such as the 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 ($B_{RPN}$), $V_{OUT}$ changes from "L" to "H".

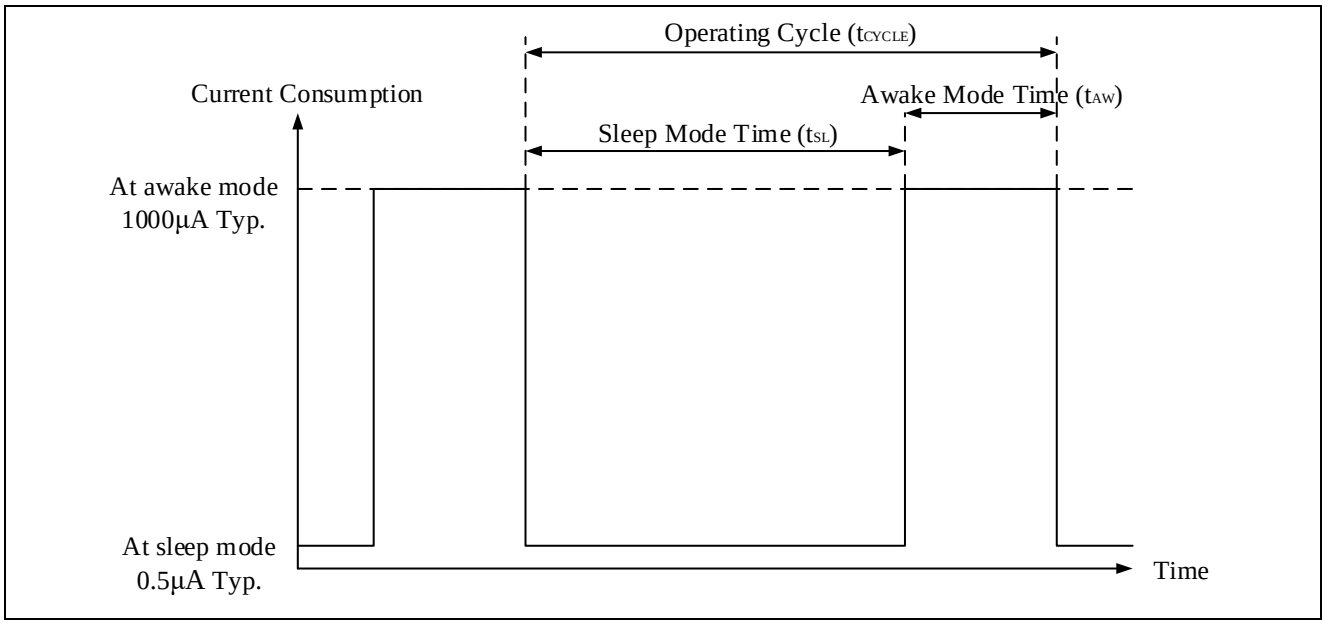
The relationship between the magnetic flux density and $V_{OUT}$ is shown below.



### 4. Operating Current

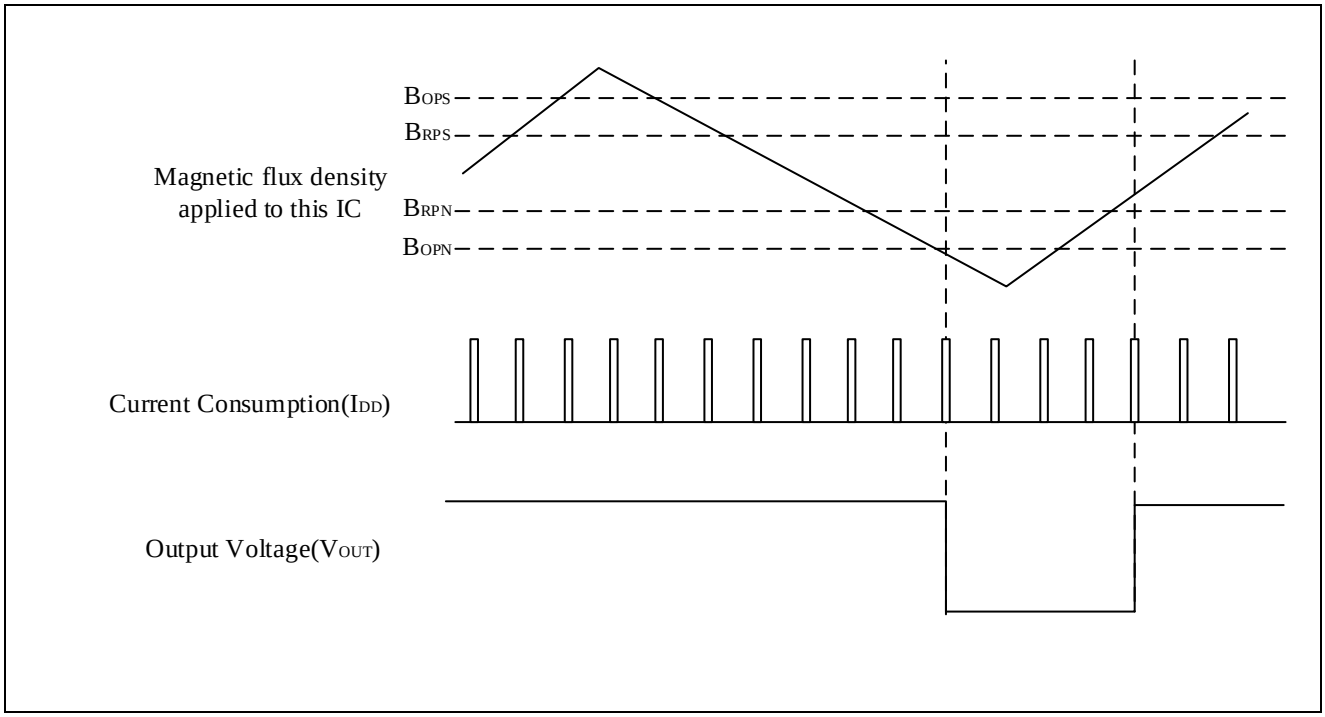
ET3712A30BNCLH perform the intermittent operation, therefore the average current consumption depends on the current in active mode, the active period ($t_{AW}$), the current in sleep mode, and sleep period ($t_{SL}$). The active current is about 1000uA typically, and 0.5uA at sleep mode. Please refer to electrical characteristic table for detail.

The time dependency of the current consumption is shown below.



### 5. Timing Diagram

The operation timing of this IC is shown below.




## Precautions

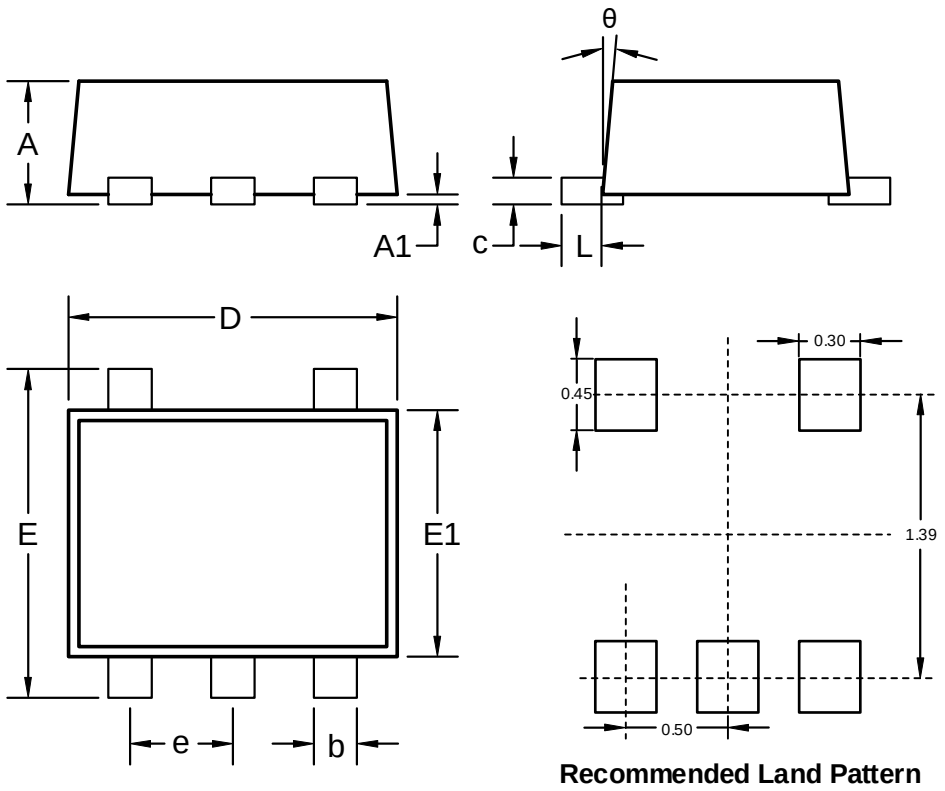
1. The power supply for this IC should has low impedance, the IC may malfunction due to a supply voltage drop caused by feed through current.

2. Power supply voltage rapidly changing may cause IC malfunction.

3. Large stress on this IC may affect the magnetic characteristics. Avoid large stress applied to the IC on a board.

## Package Dimension

SOT-553




**Recommended Land Pattern**

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 0.525 | - | 0.600 |
| A1 | 0 | - | 0.050 |
| e | 0.450 | 0.500 | 0.550 |
| c | 0.090 | - | 0.160 |
| D | 1.500 | 1.600 | 1.700 |
| b | 0.170 | - | 0.270 |
| E1 | 1.100 | 1.200 | 1.300 |
| E | 1.500 | 1.600 | 1.700 |
| L | 0.100 | 0.200 | 0.300 |
| θ | 7°REF | | |

## Revision History and Checking Table

| Version | Date | Revision Item | Modifier | Function & Spec Checking | Package & Tape Checking |
|---|---|---|---|---|---|
| 1.0 | 2019.11.8 | Preliminary Version | Chenh | Wanggp | Zhujl |
| 1.1 | 2023.1.11 | Data Sheet Update | Shibo | Wanggp | Zhujl |