Low Voltage Operation Unipolar Detection

Type Hall Effect Switch IC

General Description

The ET3712A30BSCLE is a high sensitivity and high-accuracy Unipolar 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_{OP}) and the output voltage will recover to high until the magnetic flux density is smaller than the release point(B_{RP}). 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 ET3712A30BSCLE uses a small DFN4 with thermal pad package.

The ET3712A30BSCLE 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. 2.0 μA with a 1.85 V supply.

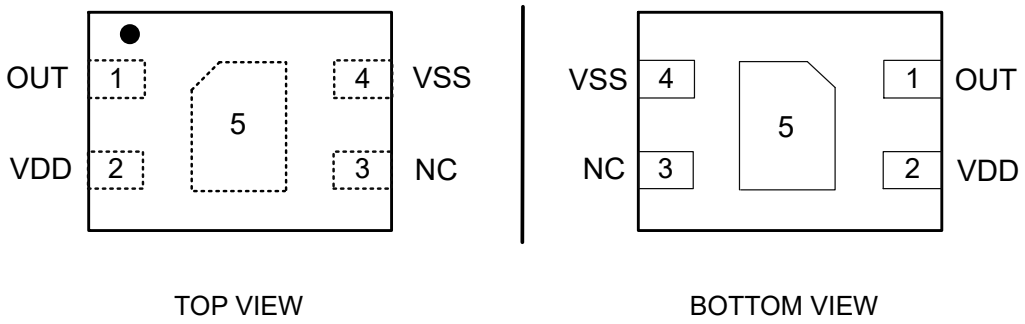
Features

- Pole detection：S 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} = 50.85ms typ.
- Current consumption：I_{DD} = typ. 2.0 μA at 1.85 V
- Power supply voltage range：V_{DD} = 1.6 V to 3.5 V
- Operation temperature range：T_A = -40°C to +85°C
- Lead-free (Sn 100%), halogen-free
- Small DFN4(with thermal pad) 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

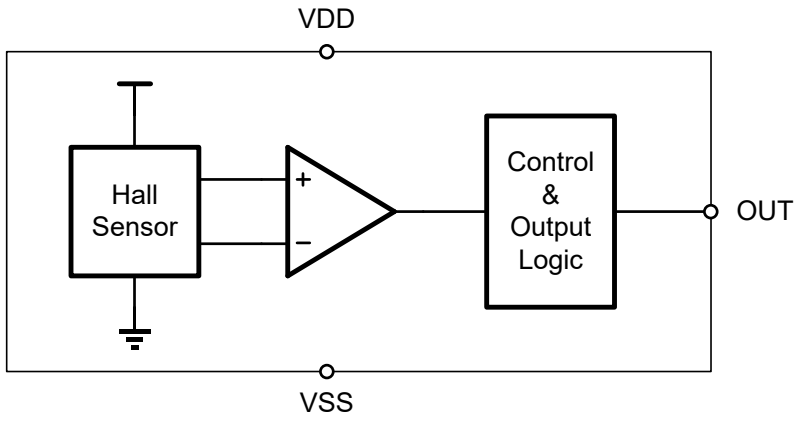
Pin Configuration



Pin Function

Pin No.	Pin Name	Pin Function
1	OUT	Output pin
2	VDD	Power supply pin
3	NC	No connection
4	VSS	Ground Pin
5	Thermal Pad	No Connect

Block Diagram



Functional Description

Applied magnetic flux

The magnetic flux applied to ET3712A30BSCLE should on the vertical direction on marking surface. If not, the horizontal component has no effect to detection. ET3712A30BSCLE is S pole type detector, the output voltage (V_{OUT}) is inverted when the S type magnetic flux is applied to IC.

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

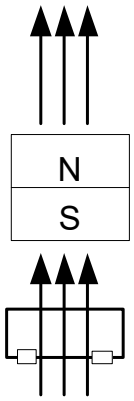


Figure 1. Magnetic flux direction

Hall sensor Position

The Hall sensor embedded in ET3712A30BSCLE 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.

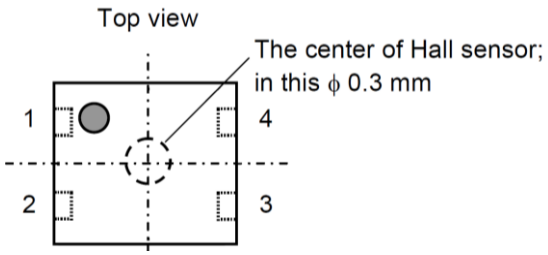


Figure 2. Hall sensor Position

Detecting Operation

ET3712A30BSCLE detects magnetic field periodically. When vertical component of the magnetic flux applied to IC exceeds the operating point (B_{OPS}) such as the S 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_{RPS}), V_{OUT} changes from "L" to "H".

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

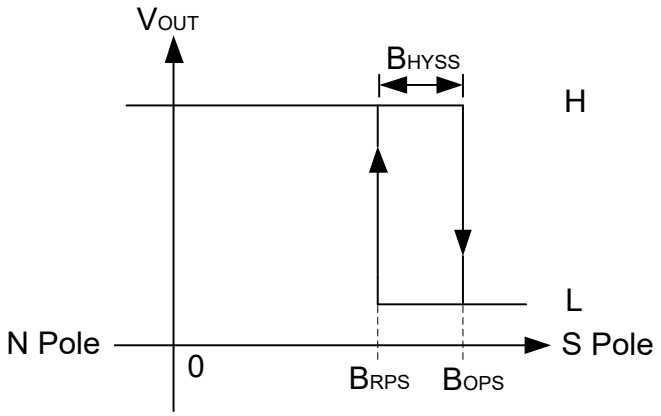


Figure 3. Magnetic flux density vs V_{OUT}

Operating Current

ET3712A30BSCLE 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 1000 μA typically, and 0.5 μA at sleep mode. Please refer to electrical characteristic table for detail.

The time dependency of the current consumption is shown below.

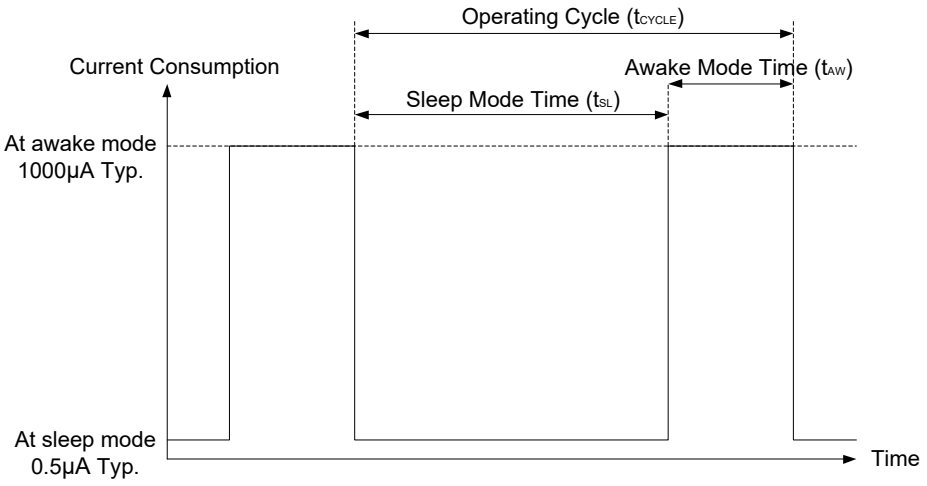


Figure 4. Operating Current

Timing Diagram

The operation timing of this IC is shown below.

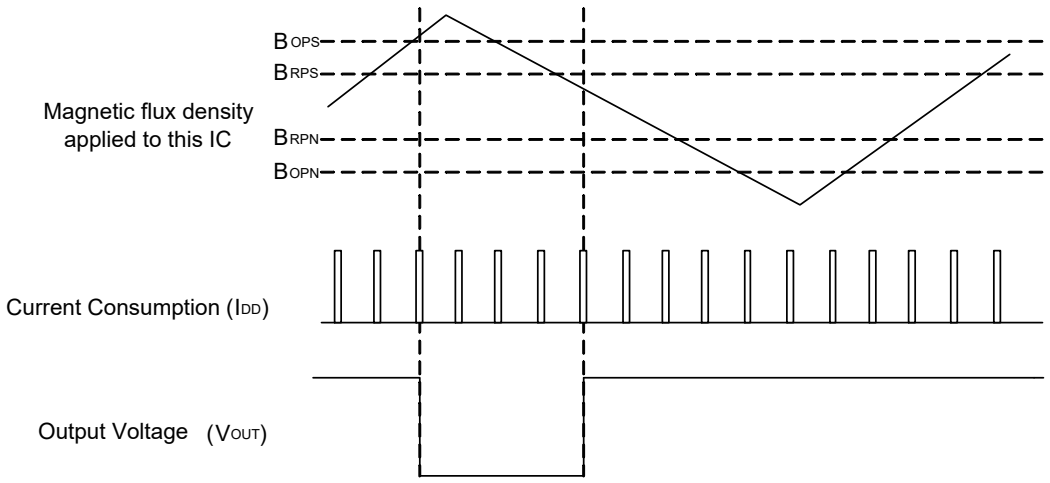


Figure 5. Timing Diagram

Absolute Maximum Ratings

(T_A = +25°C unless otherwise specified)

Symbol	Parameters		Rating	Unit
V_{DD}	Power supply voltage		V_{SS}-0.3 ~ V_{SS}+7.0	V
I_{OUT}	Output current		±1.0	mA
V_{OUT}	Output voltage		V_{SS} − 0.3 ~ V_{DD} + 0.3	V
T_A	Operation ambient temperature		−40 ~ +85	°C
T_{STG}	Storage temperature		−65 ~ +150	°C
θ_{JA}	Junction-to-ambient thermal resistance		200	°C/W
ESD	HBM	ESDA/JEDEC JS-001-2017	±4000	V
	CDM	ESDA/JEDEC JS-002-2014	±1500	V

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

(T_A = +25°C, V_{DD} = 1.85 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			2.0	4.0	μA
V_{OUT}	Output voltage	CMOS output	Output transistor Nch, I_{OUT} = 0.5mA			0.4	V
			Output transistor Pch, I_{OUT} = −0.5mA	V_{DD}-0.4			V
t_{AW}	Awake mode time				0.05		ms
t_{SL}	Sleep mode time				50.80		ms
t_{CYCLE}	Operating cycle				50.85	100.00	ms

Magnetic Characteristics

(T_A = +25°C, V_{DD} = 1.85 V, unless otherwise specified)

Parameters		Symbol	Conditions	Min	Typ	Max	Unit
Operation point(1)	S Pole	B_{OPS}		1.4	3.0	4.0	mT(4)
Release point(2)	S Pole	B_{RPS}		1.1	2.2	3.7	mT
Hysteresis width(3)	S Pole	B_{HYSS}	B_{HYSS}= | B_{OPS} − B_{RPS} |		0.8		mT

Notes:

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

(2) Release points (B_{RPS}): 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_{RPS}, V_{OUT} status is held.

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

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

Application Circuit

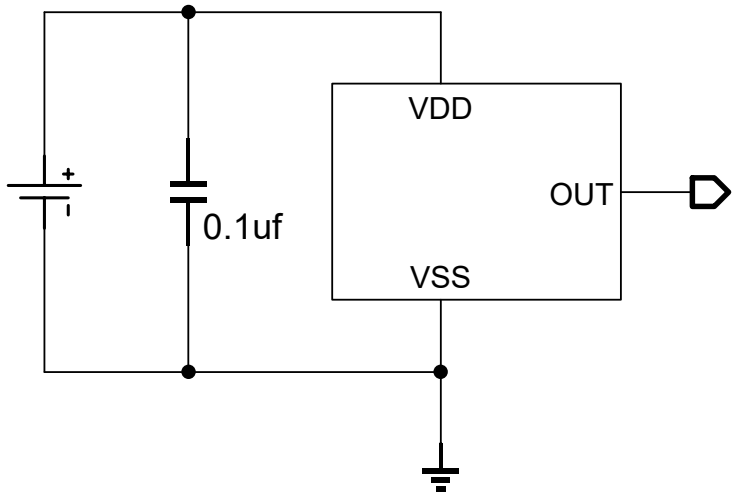


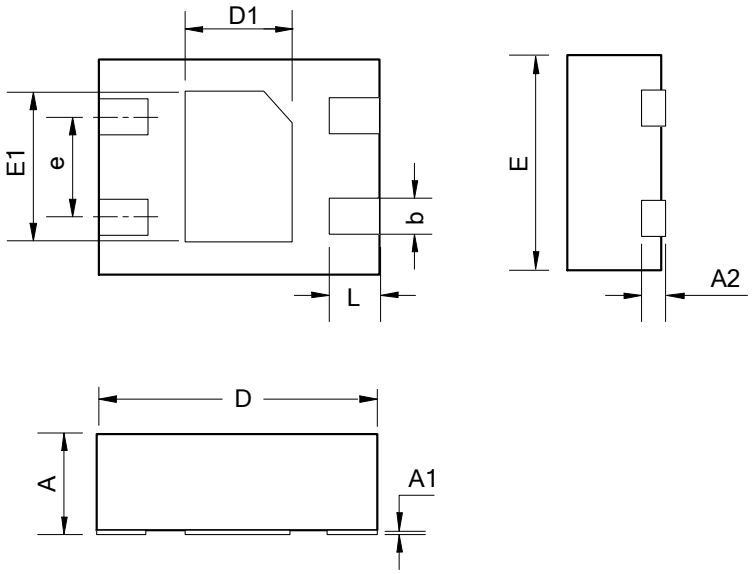
Figure 7. Reference Application Circuit

Precautions

- 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.
- 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.

Package Dimension

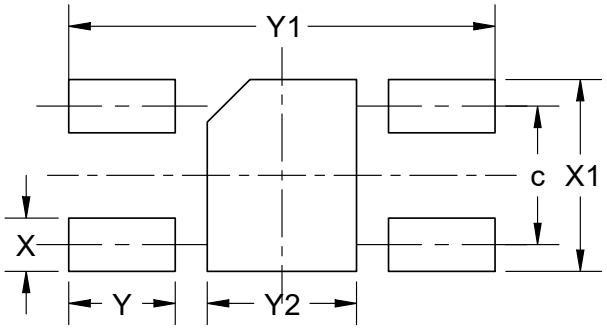
DFN4(with thermal pad)



COMMON DIMENSIONS (Unit: mm)

SYMBOL	MIN	NOM	MAX
A	0.40	-	0.50
A1	0	-	0.05
A2		0.125 REF	
b	0.15	0.20	0.25
D	1.55	1.60	1.65
D1	0.60	0.65	0.70
E	1.15	1.20	1.25
E1	0.80	0.85	0.90
e		0.65 BSC	
L	0.15	0.25	0.35

Suggested Pad Layout



Dimensions	Value
C	0.65
X	0.25
X1	0.90
Y	0.50
Y1	2.00
Y2	0.70
All Dimensions in mm	

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2023.5.26	Released Version	Wanggp	Wanggp	Zhujl