Low Voltage S-Pole Detection Type

Hall Effect Switch IC

General Description

The ET3712A45BSCLD is a high sensitivity and high-accuracy S 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 S Pole magnetic flux density is larger than operate point(BOPS) and the output voltage will recover to high until the S Pole magnetic flux density is smaller than the release point(BRPS). 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 ET3712A45BSCLD is suitable for battery powered portable devices such as mobile phones and portable PCs etc.

To achieve a high-density mounting the ET3712A45BSCLD uses a super-small DFN4 package.

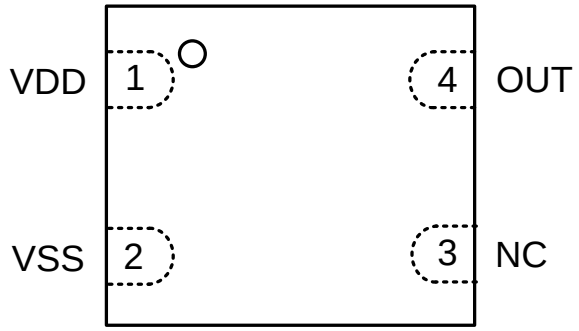
Features

- Pole detection：S pole
- Output logic：Active low
- Output form：CMOS output, no external pull-up resistor required
- Operating Point：B_{OP} = 4.5 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 5.5 V
- Operation temperature range：T_A = -40°C to +85°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

Pin Configuration

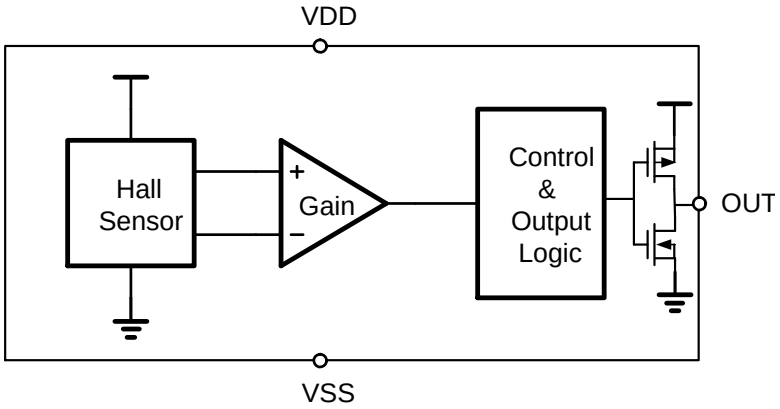


TOP VIEW

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



Functional Description

Applied magnetic flux

The magnetic flux applied to ET3712A45BSCLD should on the vertical direction on marking surface. If not, the horizontal component has no effect to detection. ET3712A45BSCLD 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.

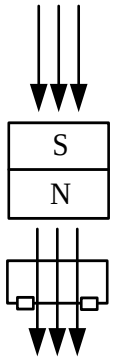


Figure1. Magnetic flux direction

Hall sensor Position

The Hall sensor embedded in ET3712A45BSCLD 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.

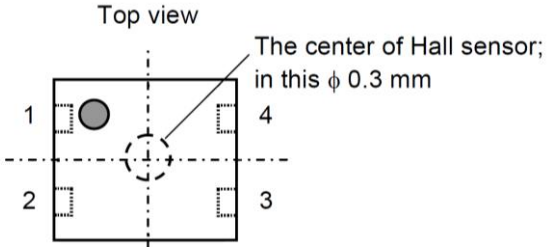


Figure2. Hall sensor Position

Detecting Operation

ET3712A45BSCLD 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".

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

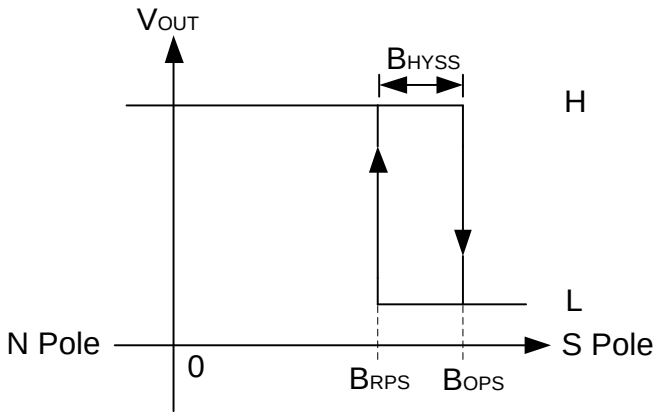


Figure3. Magnetic flux density vs V_{OUT}

Operating Current

ET3712A45BSCLD 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.

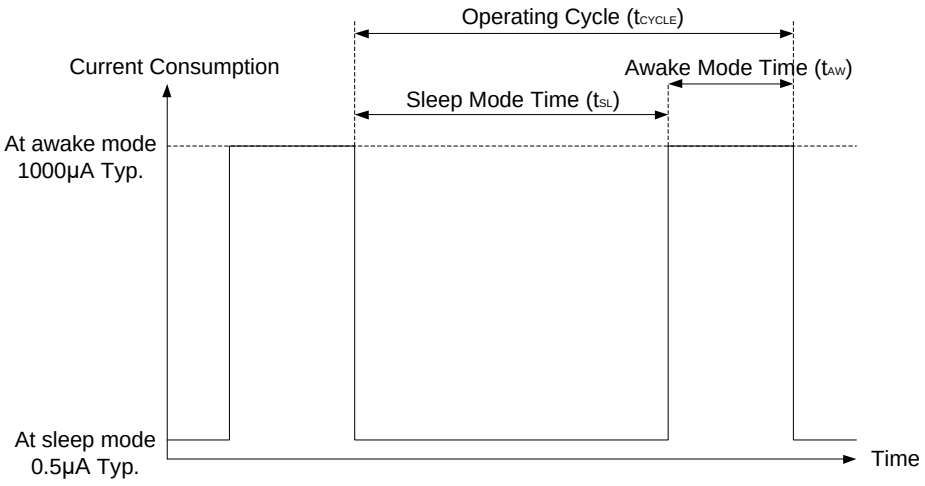


Figure4. Operating Current

Timing Diagram

The operation timing of this IC is shown below.

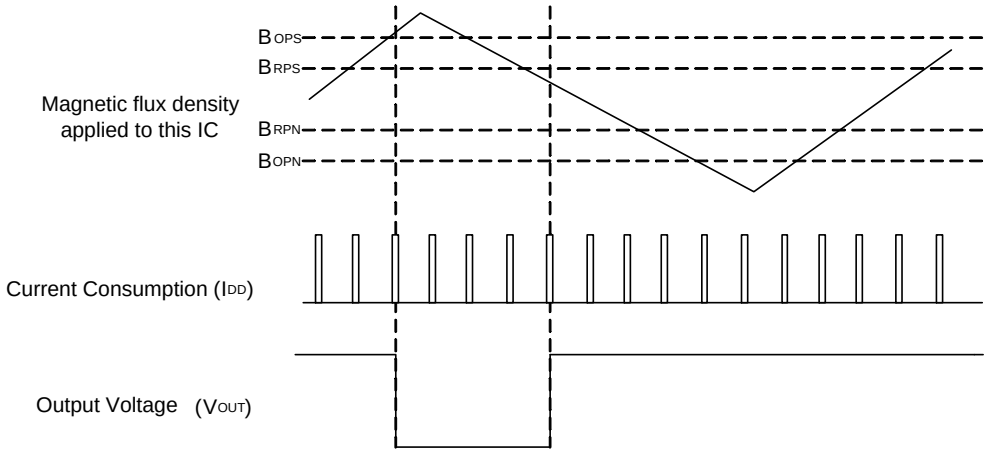


Figure5. Timing Diagram

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		−40 ~ +125	°C
θ_{JA}	Junction-to-ambient thermal resistance		300	°C/W
ESD	HBM	ESDA/JEDEC JS-001-2017	±6000	V
	CDM	ESDA/JEDEC JS-002-2014	±1500	V
	MM	JESD22-A115C	±300	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	5.50	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	t_{AW} + t_{SL}			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	S Pole	B_{OPS}		2.5	4.5	6.0	mT
Release point	S Pole	B_{RPS}		2.0	3.5	5.5	mT
Hysteresis width	S Pole	B_{HYSS}	B_{HYSS}= | B_{OPS} − B_{RPS} |		1.0		mT

Notes:

*1. Operating points (B_{OPS}):

B_{OPS} is the value 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} is the values of magnetic flux density makes the output voltage (V_{OUT}) recover to high by decreasing the 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_{HYSS}):

B_{HYSS} is the difference between B_{OPS} and B_{RPS}.

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

Application Circuit

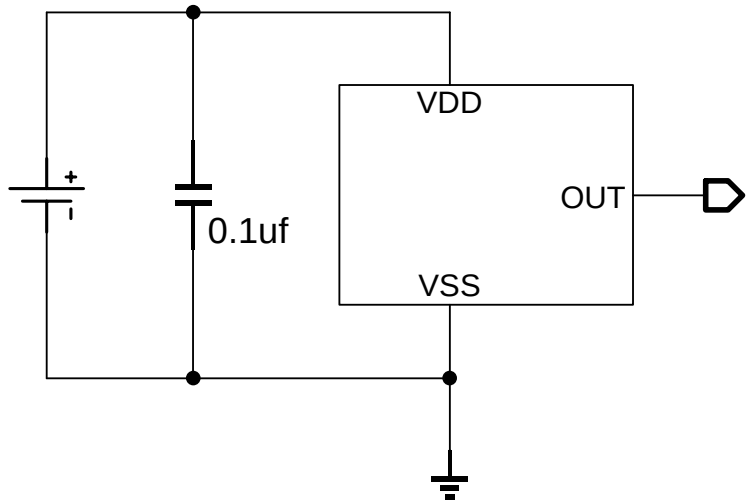


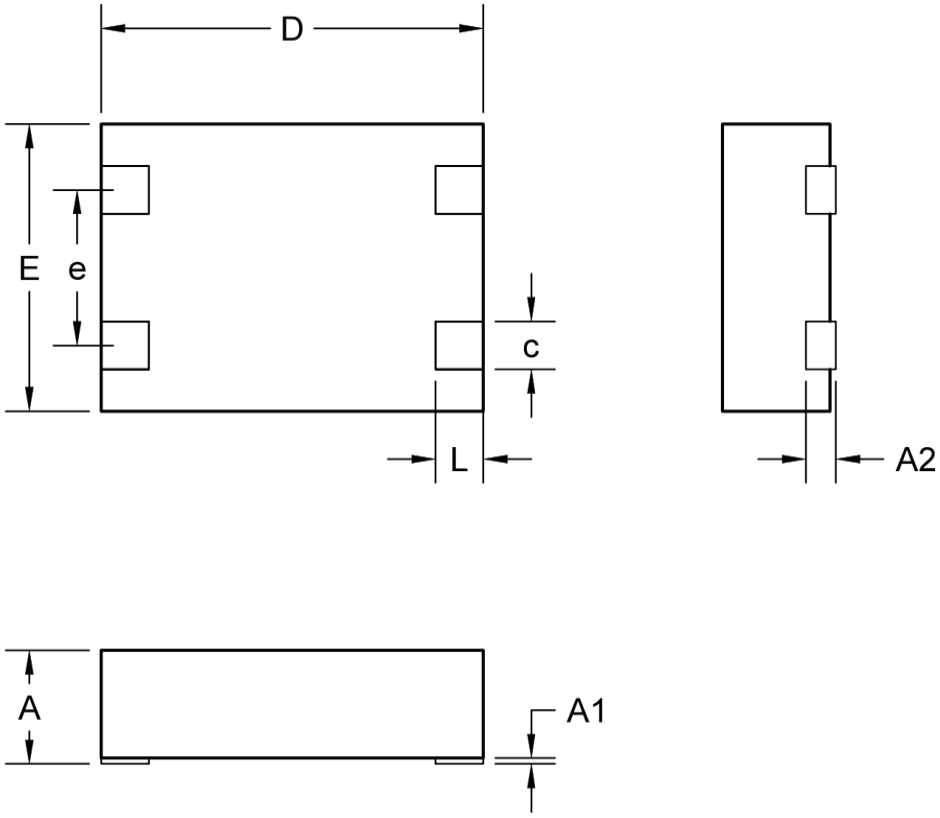
Figure7.

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



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

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2020.10.21	Preliminary Version	Wanggp	Wanggp	Zhujl
1.1	2019.1.15	Released Version	Wanggp	Wanggp	Zhujl
1.2	2022.11.2	Update Typeset	Lvds Shib	Wanggp	Zhujl