Polar Selectable Hall Effect Switch IC

General Description

The ET3716 is a high sensitivity and high-accuracy polar selectable 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. Polar of detection is selectable with SWP terminal.

To achieve a high-density mounting the ET3716 uses a small DFN4 package.

The ET3716 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.

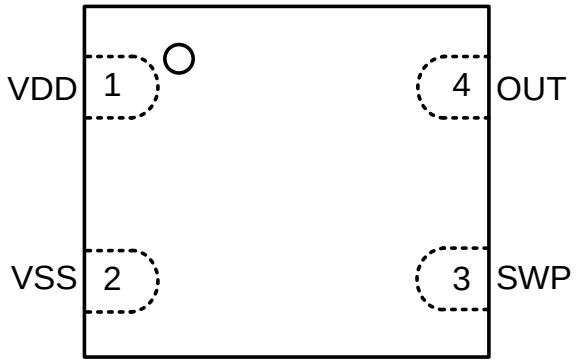
Features

- Pole detection：Polar selectable
- Output logic：Active low
- Output form：CMOS output, no external pull-up resistor required
- Operating Point：B_{OP} = 2.0 mT typ.
- Current consumption：(V_{DD} = 1.85 V)
  - Omnipolar：I_{DD} = 12.0 μA typ.
  - Unipolar：I_{DD} = 8.0 μA typ.
- Power supply voltage range：V_{DD} = 1.6 V to 3.5 V
- Operation temperature range：Ta = -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

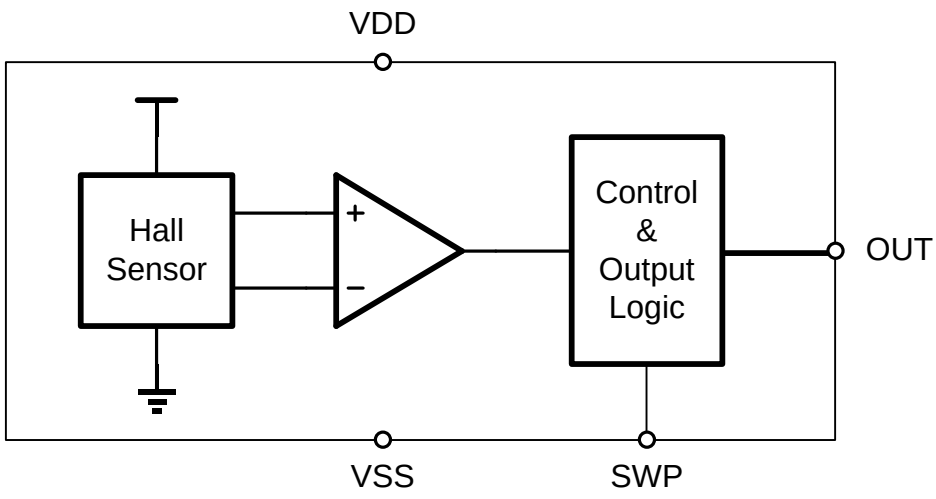


TOP VIEW

Pin Function

Pin No.	Pin Name	Pin Function
1	VDD	Power supply pin
2	VSS	Ground Pin
3	SWP	Polar selection pin
4	OUT	Output pin

Block Diagram



Functional Description

Applied magnetic flux

The magnetic flux applied to ET3716 should on the vertical direction on marking surface. If not, the horizontal component has no effect to detection. ET3716 is omnipolar type detector, the output voltage is inverted when the S or N type magnetic flux is applied to IC.

Below is polar selection truth table:

SWP Tied To	Detection Polar Type
VDD	N Polar
VSS	S Polar
Floating	Omnipolar

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

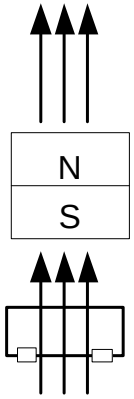


Figure1. Magnetic flux direction

Hall sensor Position

The Hall sensor embedded in ET3716 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.

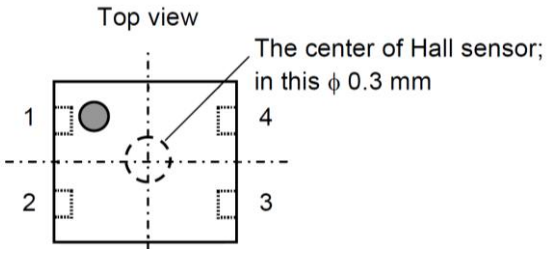


Figure2. Hall sensor Position

Detecting Operation

ET3716 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".

(1) SWP is floating:

When SWP is floating this IC performs omnipolar detection, the relationship between the magnetic flux density and V_{OUT} is shown below.

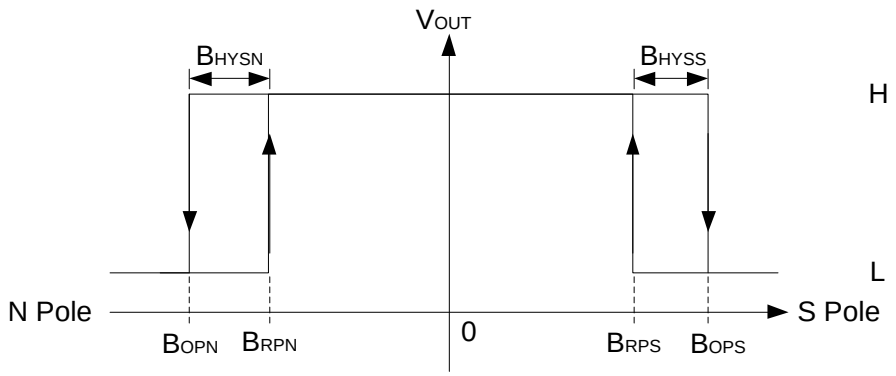


Figure3. Magnetic flux density vs V_{OUT} (SWP is floating)

(2) SWP is tied to VDD:

When SWP is tied to VDD this IC performs N polar detection, the relationship between the magnetic flux density and V_{OUT} is shown below.

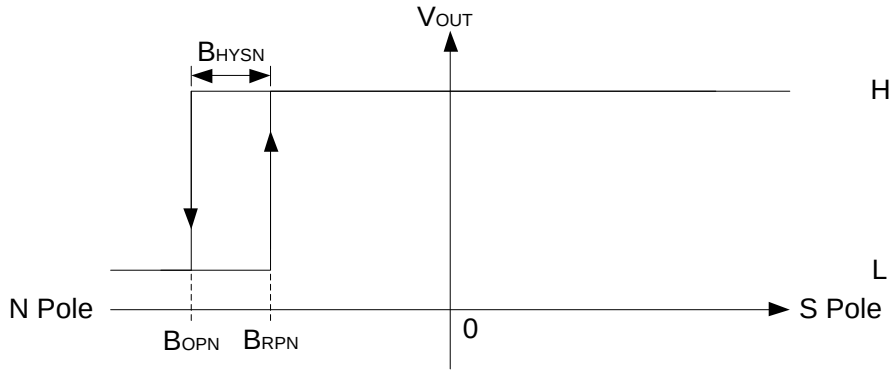


Figure4. Magnetic flux density vs V_{OUT}(SWP is tied to VDD)

(3) SWP is tied to VSS:

When SWP is tied to VSS this IC performs S polar detection, the relationship between the magnetic flux density and V_{OUT} is shown below.

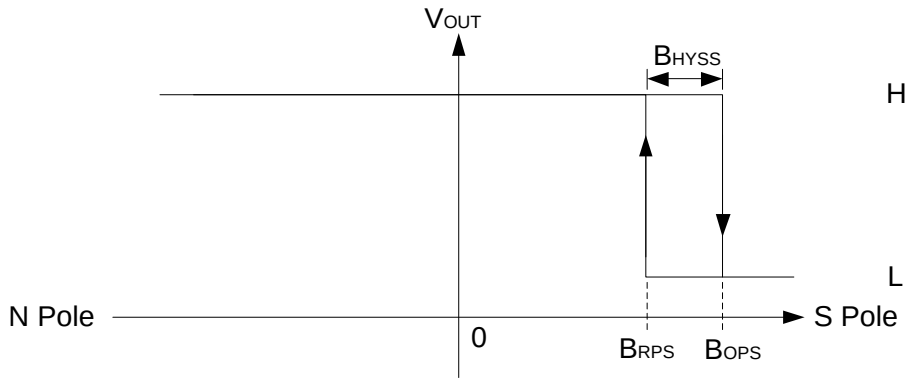


Figure5. Magnetic flux density vs V_{OUT} (SWP is tied to VSS)

Operating Current

ET3716 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 640μA typically, and 0.72μA at sleep mode. Please refer to electrical characteristic table for detail.

The time dependency of the current consumption is shown below.

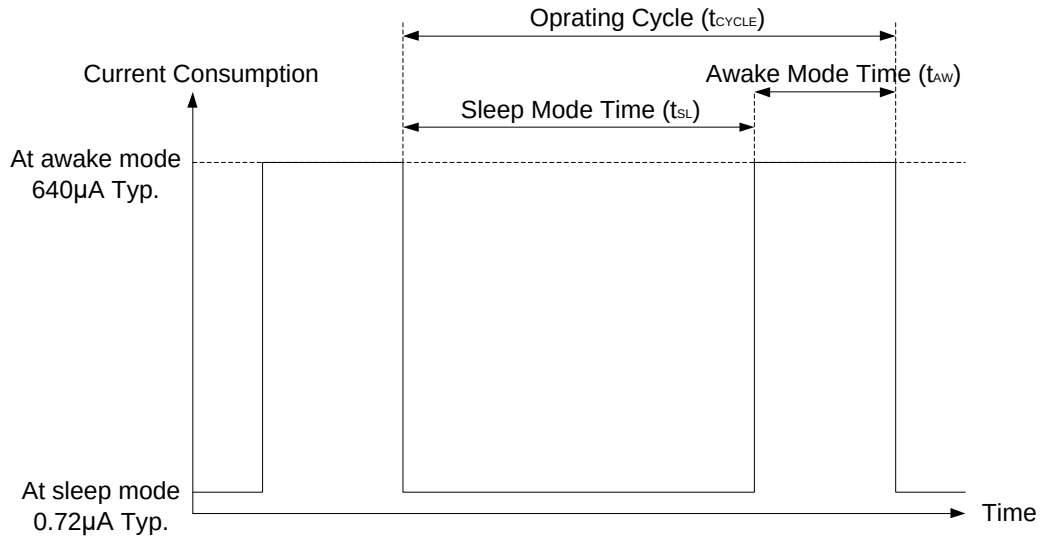


Figure6. Operating Current

Timing Diagram

The operation timing of this IC is shown below.

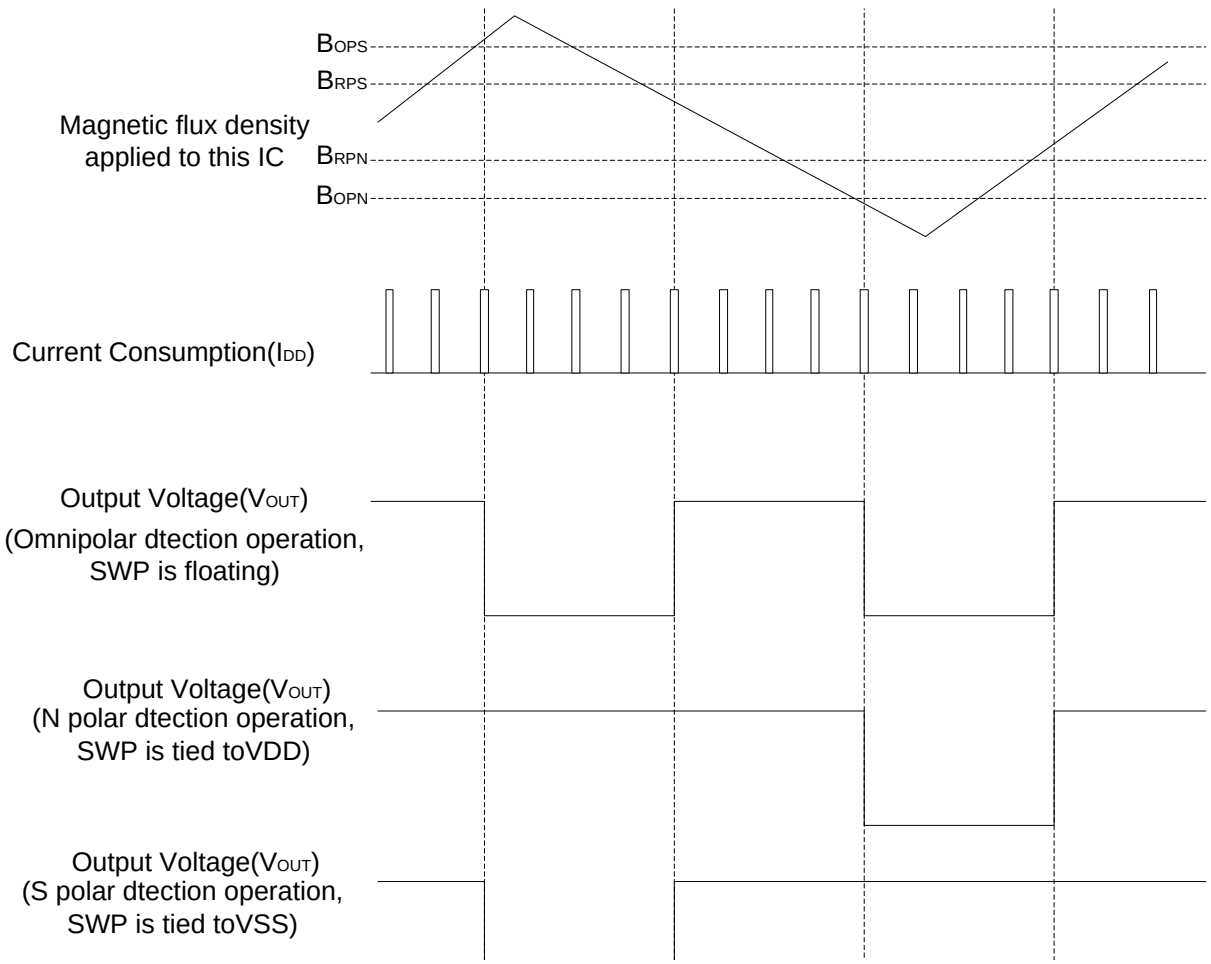


Figure7. Timing Diagram

Absolute Maximum Ratings

(Ta = +25°C unless otherwise specified)

Symbol	Parameters	Rating	Unit
V_{DD}	Power supply voltage	V_{SS}-0.3 ~ V_{SS}+7.0	V
V_{SWP}	SWP input voltage	V_{SS}-0.3 ~ V_{DD}+0.3	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

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, 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 (Omnipolar)	Average Supply Current SWP Floating			12.0	22.0	μA
I_{DD}	Current consumption (Unipolar)	Average Supply Current SWP tied to VDD or VSS			8.0	15.0	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
I_{HI}	SWP high level sink current (1)	SWP tied to VDD (peak value, in awake time)		9	18	36	μA
I_{LI}	SWP low level source current (1)	SWP tied to VSS (peak value, in awake time)		-36	-18	-9	μA
t_{AW}	Awake mode time (Omnipolar)	SWP Floating			0.10		ms
t_{SL}	Sleep mode time (Omnipolar)				5.60		ms
t_{CYCLE}	Operating cycle (Omnipolar)				5.70	12.00	ms
t_{AW}	Awake mode time (Unipolar)	SWP tied to VDD or VSS			0.05		ms
t_{SL}	Sleep mode time (Unipolar)				6.00		ms
t_{CYCLE}	Operating cycle (Unipolar)				6.05	12.00	ms

Note1: SWP sink or source current in sleep mode is less than 1nA.

Magnetic Characteristics

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

PARAMETER		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Operation point (2)	S pole	B_{OPS}		1.2	2.0	2.8	mT(5)
	N pole	B_{OPN}		-2.8	-2.0	-1.2	mT
Release point (3)	S pole	B_{RPS}		0.9	1.7	2.5	mT
	N pole	B_{RPN}		-2.5	-1.7	-0.9	mT
Hysteresis width (4)	S pole	B_{HYSS}	$B_{HYSS} = B_{OPS} - B_{RPS}$		0.3		mT
	N pole	B_{HYSN}	$B_{HYSN} = \lvert B_{OPS} - B_{RPS} \rvert$		0.3		mT

Notes:

(2) 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.

(3) 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.

(4) 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.

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

Application Circuit

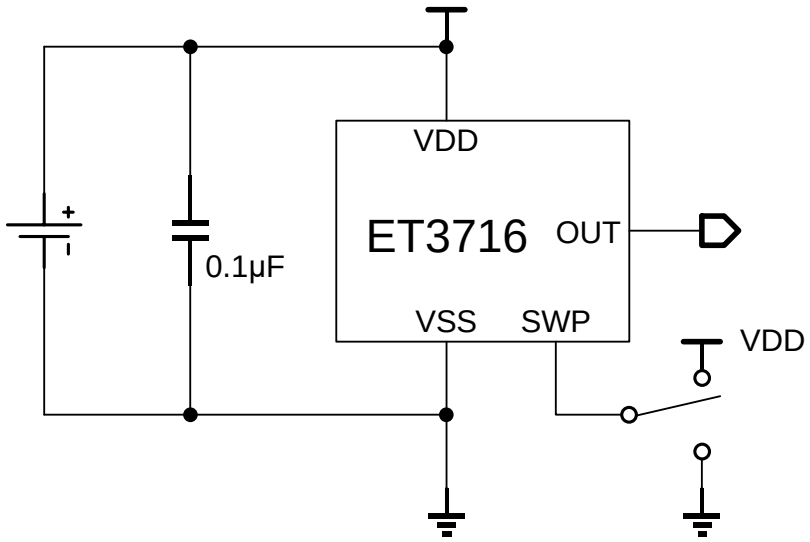
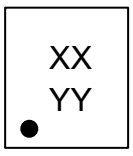


Figure8.

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.

Marking

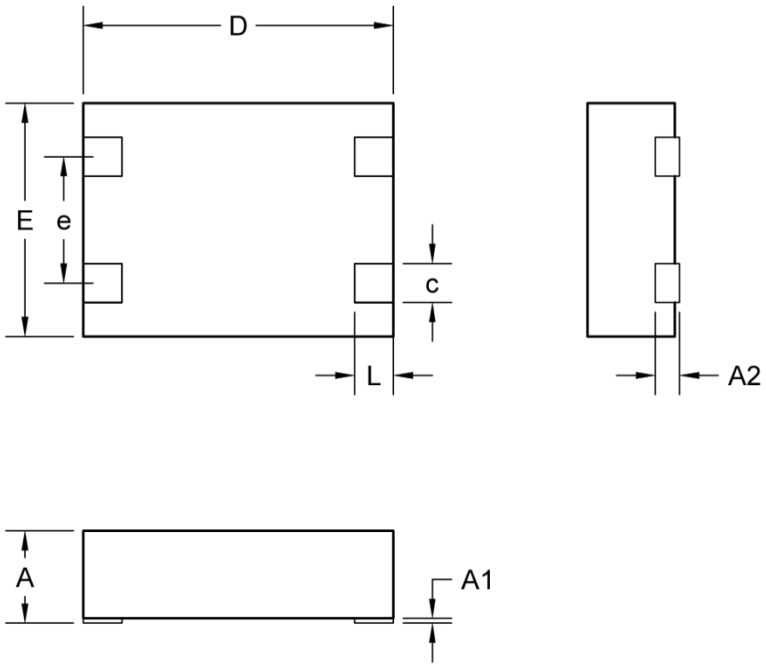


XX - Part Number

YY - Tracking Number

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	2020.8.25	Preliminary Version	Wanggp	Wanggp	Zhujl
1.0	2022.7.27	Update Typeset	Shibo	Wanggp	Zhujl