MT613X

Omni-polar, Low Power, 360 Degree Switch IC

1 Product Description

The MT613X family is produced with monolithic technology which builds AMR sensor & ASIC on one chip. The IC internally includes a Wheatstone bridge with magnetic film, a current regulator for operating with supply voltage from 1.65V to 5.0V, a sleep/awake logic for low power consumption requirement, small signal amplifier and Schmitt trigger comparator with dynamic offset cancellation, and an output driver with push pull output.

When combined with a magnet, it becomes a non-contact switch with low power consumption, high sensitivity and high reliability. All directions of horizontal magnetic field parallel to the electrode of the package can be detected by an arbitrary polarity.

The MT613X family provide SOT-23 for surface mount RoHS compliant.

2 Feature

Monolithic Technology

360 Degree AMR (Anisotropic Magneto Resistance)

Omni-polar Switch

1.65 5.0V Operating Vcc Range

-40 ~125 Operating Temperature

Package Option:

SOT-23

Magnetic Sensitivity Option:

$B_{OP}=\pm 18Gs$, $B_{RP}=\pm 13Gs$

Push Pull & Open Drain Output Option:

MT6131 & MT6132: Push Pull

MT6133 & MT6135: Open Drain

Operation Frequency Option:

MT6131 & MT6133: 20Hz

MT6132 & MT6135: 1KHz

Low Power Consumption

RoHS Compliant: 2011/65/EU

3 Product Overview of MT613X

Part No.	Description
MT613XAT	SOT-23, tape & reel (3000pcs/bag)

4 Application

Home appliances, Industrial

Position Detection

Proximity Switch

Smart Meter

Speed Detection

Handheld Device

Consumer Device

5. Pin Configuration and Functions

	Vcc	Out	GND
SOT-23	1	2	3
Description	Power	Output Push Pull or Open Drain	Ground

SOT-23 Top-View

GND

3

1

2

Vcc

OUT

Pin Configuration & Functions

Table of Contents

Reversion History

1   Originally Version   2018 Nov

6 Definition of Switching Function

Figure.2 shows the device functionality and hysteresis

Vcc

North B_{OP} N B_{RP} N B_{RP} S B_{OP} S   South
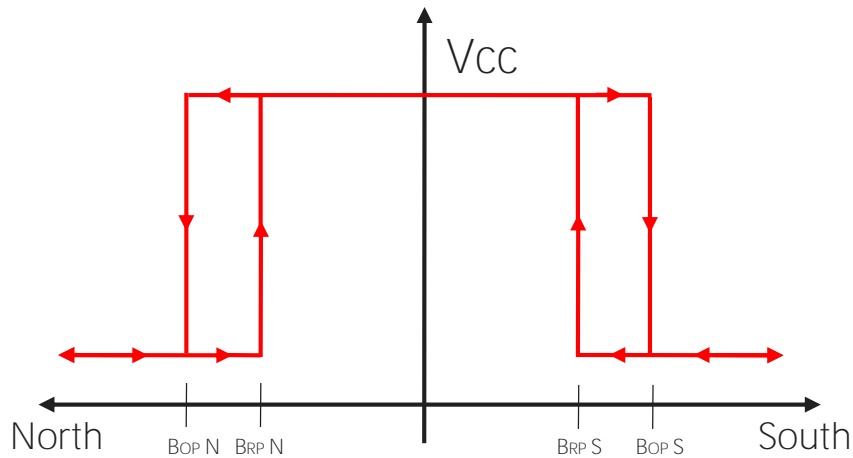
Figure.2   Omni-polar Switching Function

7 Function Description

B_{OP}: Operating Point, Magnetic flux density applied on the branded side of the package which turns the output driver ON (V_{OUT}=Low)

B_{RP}: Releasing Point, Magnetic flux density applied on the branded side of the package which turns the output driver OFF (V_{OUT}=High)

B_{HYST}: Hysteresis Window, |B_{OP} - B_{RP}|

8 Feature Description

The MT613X series is sensitive to the magnetic field that is parallel to the package (X & Y axis). To operate the MR switch, the magnetic field should be applied to the sensor parallel to the package. MT613X series detect the magnetic field in any parallel direction, but it does not respond to magnetic field in the vertical direction.
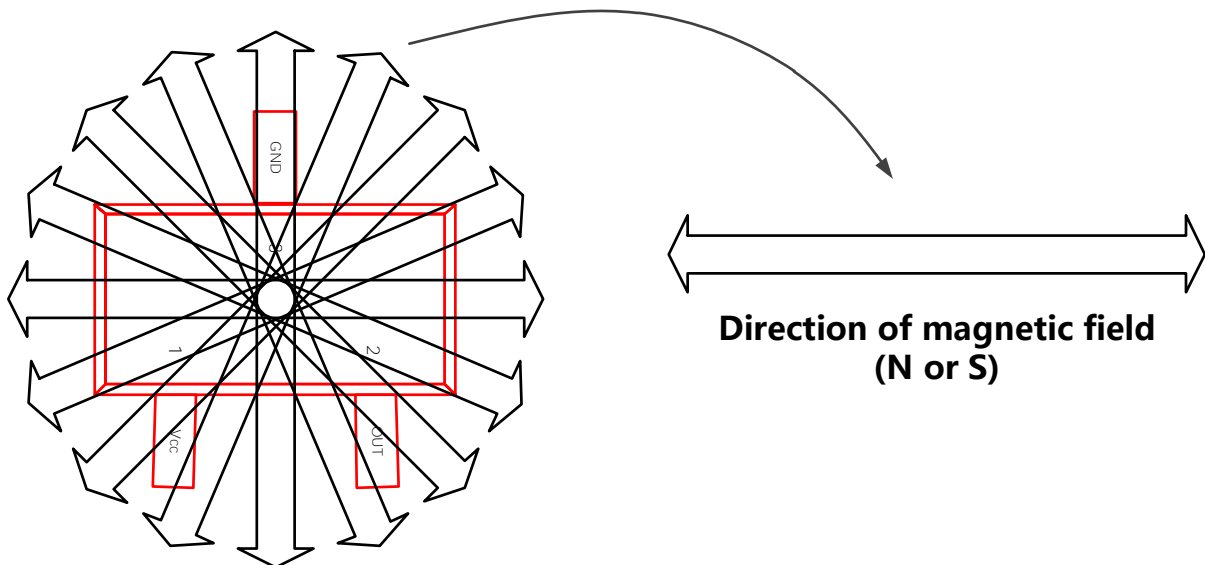

Direction of magnetic field (N or S)

Figure.3   Detection of magnetic field

9 Functional Block Diagram

Vcc

Regulator

Slee

Out

GND

Figure.4   Functional Block Diagram (MT6131 & MT6132)

10 Electrical and Magnetic Characteristics

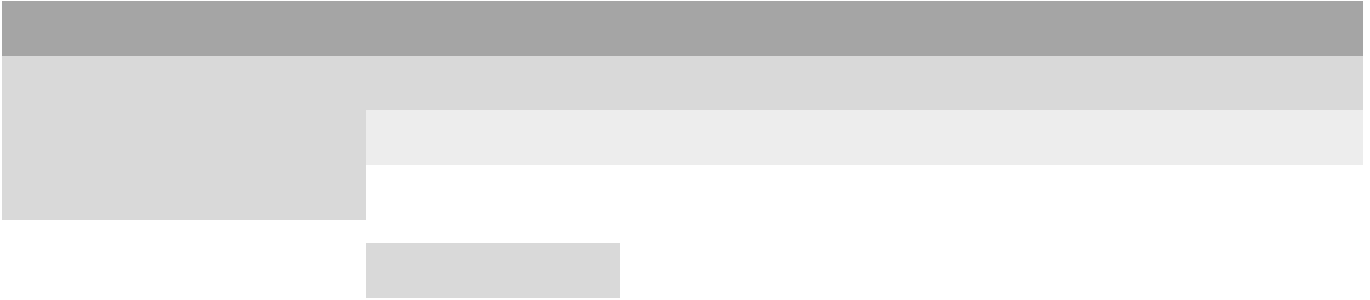## 10.1 Absolute Maximum Ratings

Absolute maximum ratings are limited values to be applied individually, and beyond which the serviceability of the circuit may be impaired. Functional operability is not necessarily implied. Exposure to absolute maximum rating conditions for an extended period of time may affect device reliability.

Symbol	Parameters	Min	Max	Units
V_{CC}	Supply Voltage	-	7	V
V_{RCC}	Reverse Battery Voltage	-0.4	-	V
V_{OUT}	Output Voltage	-	7	V
I_{OUT}	Continuous Output Current	-	20	mA
T_A	Operating Ambient Temperature	-40	125	
T_S	Storage Temperature	-50	150	
T_J	Junction Temperature	-	165	
B	Magnetic Flux Density	1200		Gs

10.2 Electrical Specifications

At T_A=-40~125 , V_{CC}=1.65V~5.0V (unless otherwise specified)

Symbol	Parameters	Test Condition	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	Operating	1.65	3.60	5.00	V
I_{CC}	Supply Current	MT6131 & MT6133, V_{CC}=3.6V, B < B_{RP}	1.0	2.0	3.0	uA
		MT6132 & MT6135, V_{CC}=3.6V, B < B_{RP}	10.0	15.0	20.0	uA
V_{OH}	Output High Voltage	MT6131 & MT6132, V_{CC}=5V, I_{OUT}=5mA, B > B_{OP}	4.6	-	-	V
V_{OL}	Output Low Voltage	V_{CC}=5V, I_{OUT}=-5mA, B > B_{OP}	-	-	0.4	V
I_{OFF}	Output Leakage Current	V_{OUT}=5V, B < B_{RP}	-	-	0.1	uA
T_{PO}	Power on Time	dVcc/dt>3.6V/us, B>B_{OP}(MAX)	-	80	120	us
F_{OP}	Operation Frequency	MT6131 & MT6133, V_{CC}=3.6V	10	20	-	Hz
		MT6132 & MT6135, V_{CC}=3.6V	0.5K	1K	-	Hz
T_{AW}	Awake Time	V_{CC}=3.6V	-	16	-	us
T_{SL}	Sleep Time	V_{CC}=3.6V	-	50	-	ms
D.C.	Duty Cycle	V_{CC}=3.6V	-	0.03	-	%
R_{TH}	Thermal Resistance of SOT-23		-	301	-	/W

10.5 Characteristic Performance

Figure.6 Supply Current vs. Temperature

Figure.7 Magnetic Characteristics vs. Temperature

(B_{OP} & B_{RP}) (At V_{CC}=3.6V)

Magnetic Field @ 90 Degree & 180 Degree
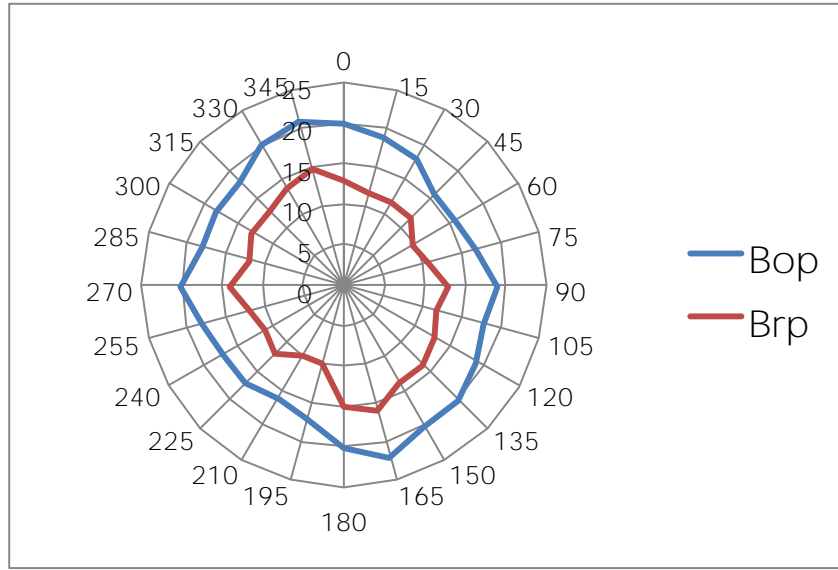
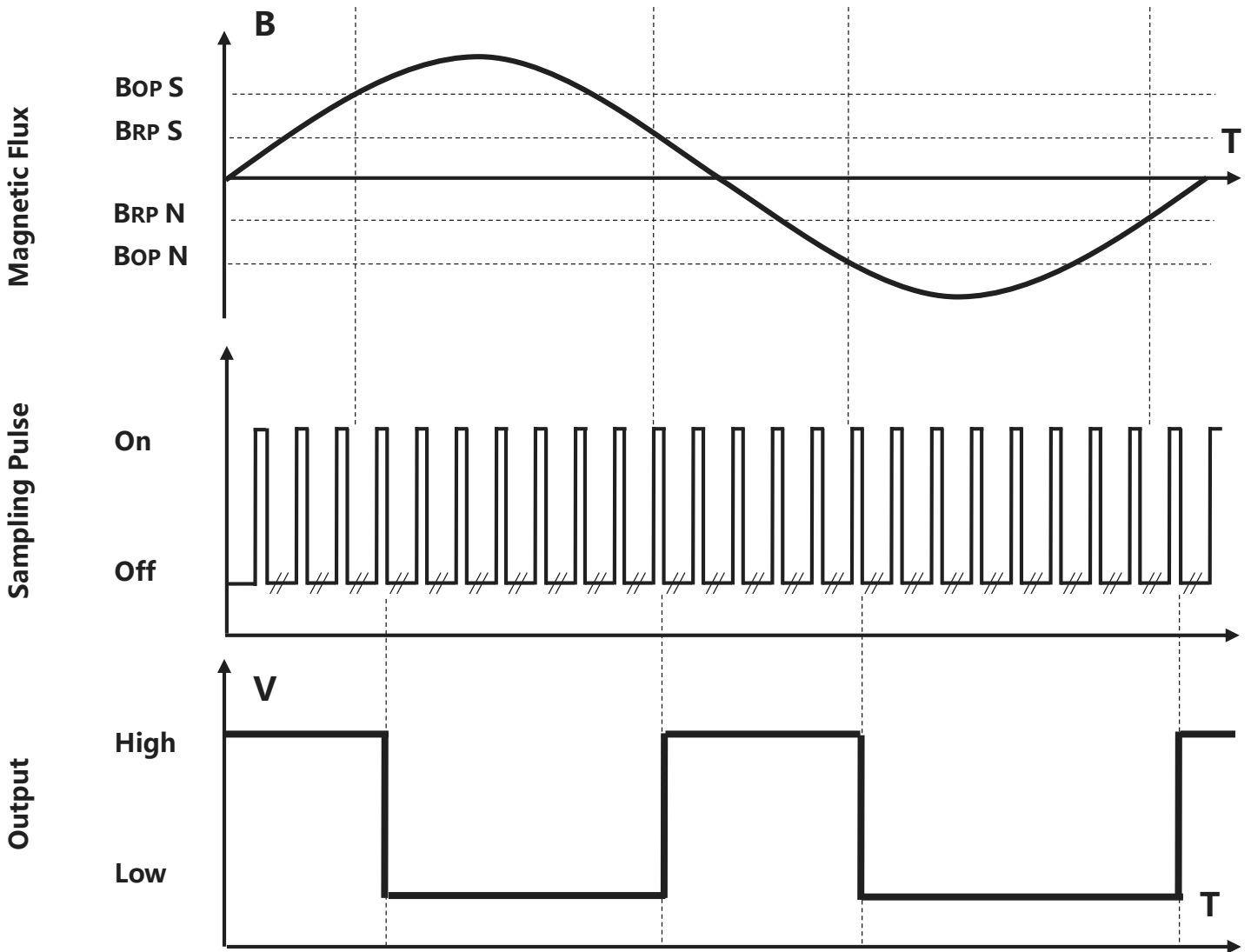## 10.5 Characteristic Performance (continued)

Figure.9   360 Degree Magnetic Characteristics (At Vcc=3.6V, TA= 25

10.6 Typical Output Waveform

MT6131A as example

Note: Output is not immediately updated until the chip wakes up from sleep mode and samples the input

Figure.10   Digital Output vs. Magnetic Flux Density & Sampling Pulse

11 Typical Application Circuit

C₁=100nF

Vcc

Vcc | 1

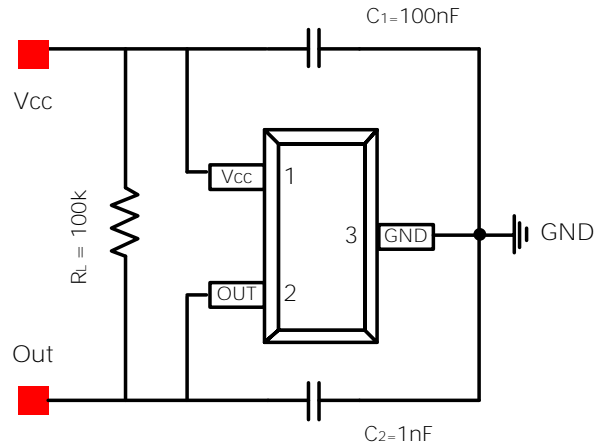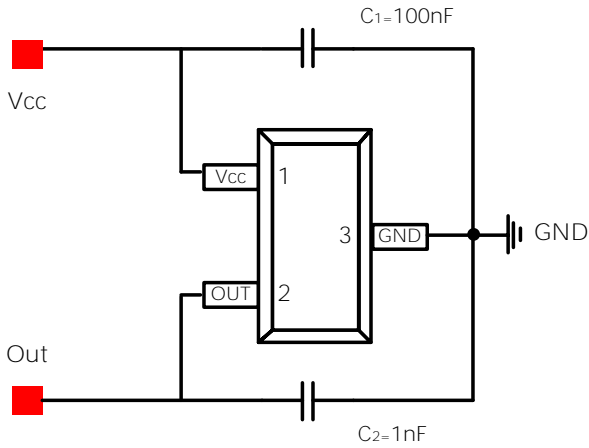3 | GND → GND

OUT | 2

Out

C₂=1nF

Figure.11   Typical Application Circuit

Push Pull Output

MT6131 & MT 6132

Figure.12   Typical Application Circuit

Open Drain Output

MT6133 & MT 6135

12 Power on Output Waveform

V_{CC} rise time < 1us, T_{PO} is the time from the stable point of V_{CC} to the valid point of output

Vcc

Magnetic Flux

$B > B_{OP}$ $B < B_{RP}$
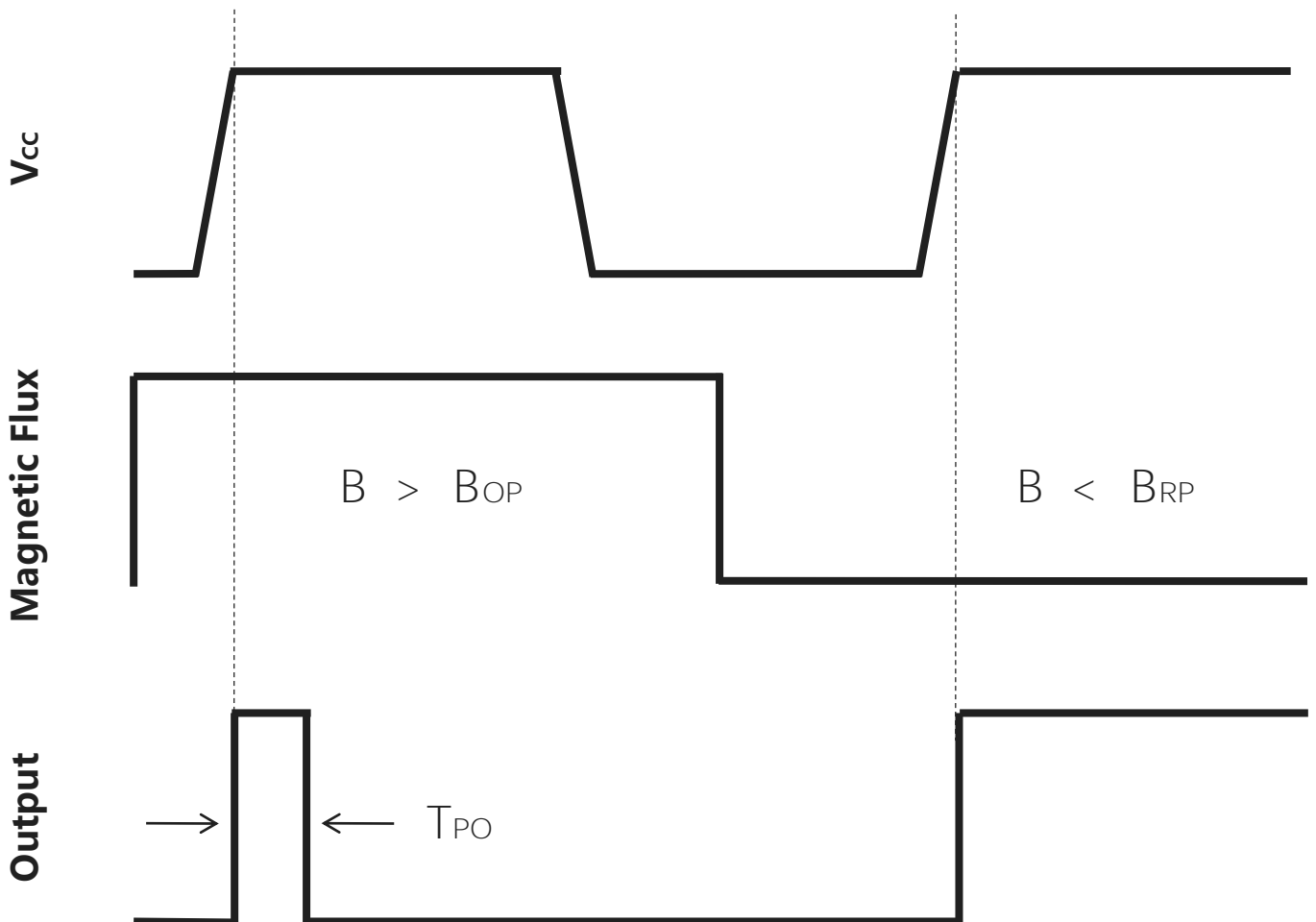
Output

T_{PO}

Figure.13   Power on Output Waveform

13 Package Material Information   (For Reference Only – Not for Tooling Use)

13.1 SOT-23 Package Information

GND