MT935X

1.7V~3.6V，Linear Hall Effect Sensor ICs

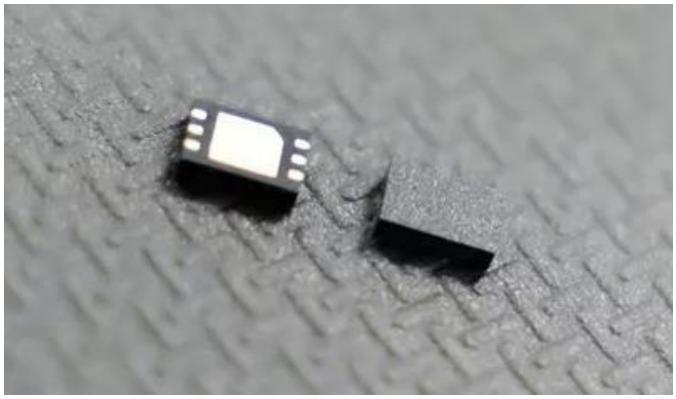
With Tri-State Output and User-Selectable Sleep Mode

1 Product Description

The MT935X series product is a low-voltage, low-power linear Hall-effect IC with user-selectable sleep mode. The chip can work under the ultra-low operating voltage of 1.7V~3.6V. In addition, by setting $\overline{\text{SLEEP}}$<VINL, the chip change to sleep mode, and the current consumption is only 40uA. At this time, the output of the chip change to "high-impedance state" and does not respond to the change of the external magnetic field; by setting $\overline{\text{SLEEP}}$>VINH, the chip change to active mode. The current consumption is 2mA, and the output is proportional to the induced magnetic field voltage signal.

The $\overline{\text{SLEEP}}$ pin can be set to select the sleep and awake mode to help users further reduce power consumption. Therefore, it is very suitable for battery powered applications. In the sleep mode, since the output changes to "high resistance state", multiple chips can share one ADC interface.

The output of the MT935X series products is proportional to the VREF pin. When there is no magnetic field, VOUT=50% VREF, so it is not related to the power supply.



2 Features

- CMOS Technology
- 1.7~3.6V Operating VCC Range
- -20~85℃ Operating Temperature
- Low current consumption :
  $\overline{\text{SLEEP}}$<VINL, ICC=40uA
  $\overline{\text{SLEEP}}$>VINH, ICC=2mA
- Magnetic Sensitivity Option :
  2.50mV/Gs MT9352 @ VCC=VREF=VCCN
  5.00mV/Gs MT9353 @ VCC=VREF=VCCN
  10.0mV/Gs MT9355 @ VCC=VREF=VCCN
- User-Selectable Sleep Mode
- High-impedance output during sleep mode
- The output voltage is proportional to the reference voltage (VREF pin)
- Package Option :
  DFN-2030
- RoHS Compliant : (EU)2015/863

3 Product Overview of MT935X

Part No.	Description
MT935XDT	DFN-2030 tape & reel (3000pcs/bag)

4 Applications

- Position Detection
- Magnetic scale
- AR/VR handle trigger
- Game 3D joystick
- TWS
- Battery-Powered Devices

5 Pin Configuration and Function

No.	PIN	Function
1	VCC	Supply
2	OUT	Output
3	GND	Ground
4	GND	Ground
5	$\overline{\text{SLEEP}}$	Toggle sleep mode
6	VREF	Supply for ratiometric reference
7	GND	Ground

DFN-2030

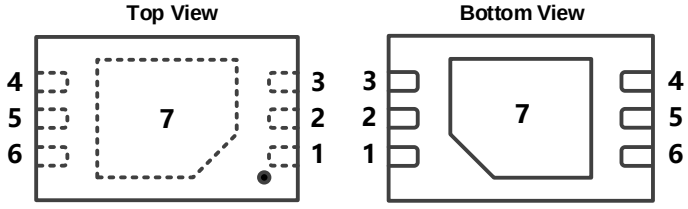


Figure.1 Pin Configuration & Functions

Table of Contents

Reversion History

1	Originally Version	
2	Vision 0.2	Update package info, NF and ROUT Spec

6 Transfer Characteristics

Finure.2 shows three sensitivity options enable maximal output voltage swing based on the required sensing range.

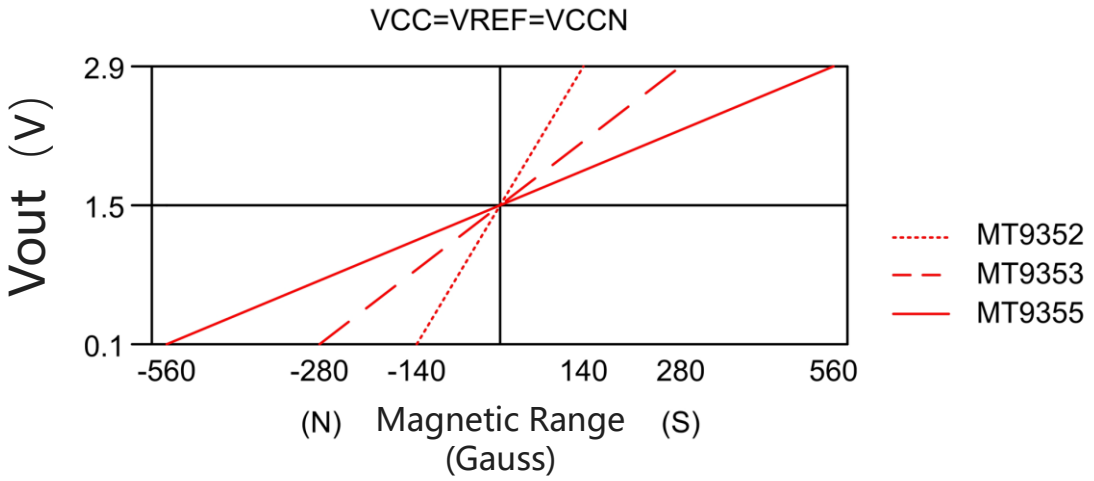


Figure.2 Transfer Characteristics

7 Feature Description

The MT935X device is sensitive to the magnetic field component that is perpendicular to the top of the package.

When the magnetic field moving from the left side of the IC to the center of the IC which showed in the left of the Figure.3,the VOUT changing from 0.1 to 1.5V linearity (VCC=VREF=VCCN)

When the magnetic field located at the center of the IC which showed in the middle of the Figure.3, the VOUT is 2.5V (VCC=VREF=VCCN)

When the magnetic field moving from the center of the IC to the right side of the IC which showed in the right of the Figure.3, the VOUT changing from 1.5 to 2.9V linearity (VCC=VREF=VCCN)

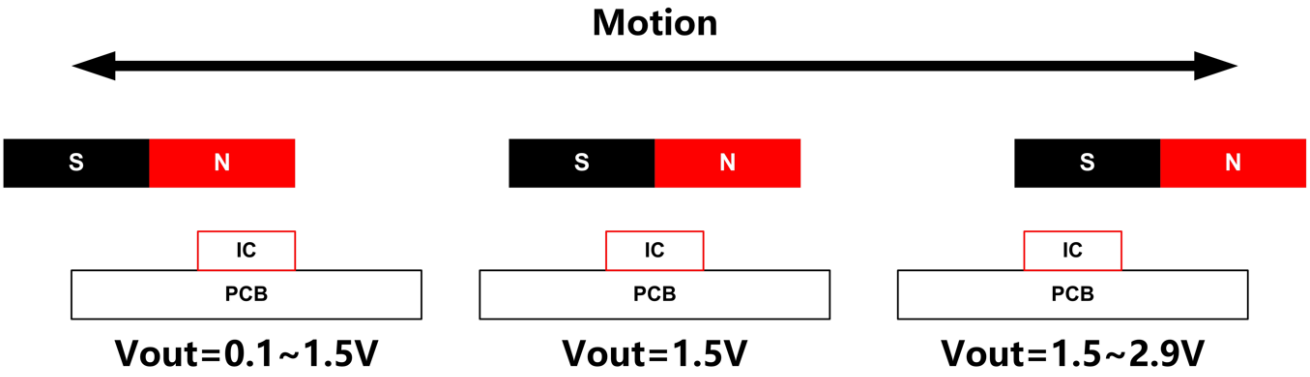


Figure.3 Feature Description

8 Functional Block Diagram

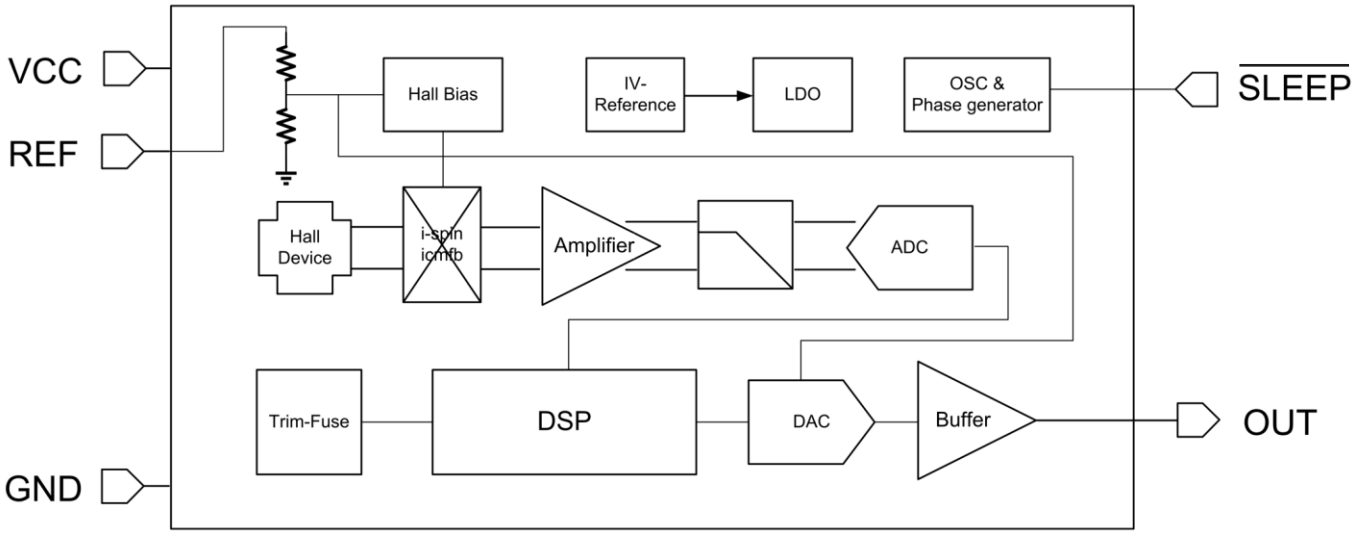


Figure.4 Functional Block Diagram

9 Electrical and Magnetic Characteristics

9.1 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
VCC	Supply Voltage	-	6	V
VRCC	Reverse Battery Voltage	-0.1	-	V
VREF	Ratiometric Supply Reference Voltage	-	6	V
VRREF	Reverse Ratiometric Supply Reference Voltage	-0.1	-	V
VSLEEP	Logic Supply Voltage	-	6	V
VRSLEEP	Reverse-Logic Supply Voltage	0.1	-	V
VOUT	Output Voltage	-	VCC+0.1	V
IOUT	Continuous Output Current	-	10	mA
TA	Operating Ambient Temperature	-20	85	℃
TS	Storage Temperature	-50	150	℃
TJ	Junction Temperature	-	150	℃

9.2 ESD Ratings

Symbol	Parameters	Reference	Class
VESD	Human-body model (HBM)	AEC-Q100-002	Class II
	Charged-device model (CDM)	AEC-Q100-011	Class C3
	Latch up	AEC-Q100-004	Class IA

9.3 Electrical Specifications

T_A=-20~85 ℃, Vcc=1.7V~3.6V, C_{BYPASS}=0.1uF (unless otherwise specified)

Symbol	Parameters	Test Condition	Min	Typ	Max	Unit
VCC[1)]	Supply Voltage	-	1.7	-	3.6	V
VCCN	Nominal Supply Voltage	-	-	3.0	-	V
VREF[1)]	Ratiometric Reference Voltage		1.8	-	VCC	V
VINH	Active Threshold Voltage	For active mode	-	0.45 x VCC	-	V
VINL	SLEEP Threshold Voltage	For sleep mode	-	0.20 x VCC	-	V
RREF	Ratiometric Reference Input Resistance	TA=25℃	250	-	-	kΩ
ICC	Supply Current	VSLEEP>VINH, VCC=VCCN，TA=25℃	-	2	-	mA
		VSLEEP<VINL, VCC=VCCN，TA=25℃	-	40	-	uA
TPON	Power-On Time	TA=25℃	-	60	100	us
TPOFF	Power-Off Time	TA=25℃	-	1	-	us
BW	Bandwidth	-3dB, CL=1nF, VCC=VCCN	-	10	-	KHz
ROUT	Output Resistance	IOUT<1.5mA,VCC=VCCN VSLEEP>VINH, B=0Gs	-	5	10	Ω
		IOUT<1.5mA,VCC=VCCN VSLEEP>VINH, B=0Gs	4	-	-	MΩ
RL	Output Load Resistance	Output to ground	4.7	-	-	KΩ
		Output to Supply	4.7	-	-	KΩ
CL	Output Load Capacitance	OUT to GND	-	-	10	nF

1) VREF<=VCC

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Electrical Specifications(*Continued from previous page*)

At T_A =-20~85 ℃, V_{CC}=1.7~3.6V，C_{BYPASS}=0.1uF (unless otherwise specified)

Symbol	Parameters	Test Condition	Min	Typ	Max	Unit
VOL[1)]	Linear Output Low Voltage	VCC=VCCN, RL>=4.7KΩ	-	-	0.1	V
VOH[1)]	Linear Output High Voltage	VCC=VCCN, RL>=4.7KΩ	VREF-0.1	-	-	V
ELIN	Linearity	TA=25°C, VOUT= 0.1V~VREF-0.1V	-1.5	-	1.5	%
VOQ	Quiescent Voltage	TA=25°C, B=0Gs	-	0.5 x VREF	-	V
VOE	Quiescent Voltage Error	TA=25°C, B=0Gs VCC=VREF=VCCN	1.47	1.5	1.53	V
SNST	Sensitivity	MT9352, TA=25°C, VCC=VREF=VCCN	2.425	2.5	2.575	mV/Gs
		MT9353, TA=25°C, VCC=VREF=VCCN	4.85	5	5.15	mV/Gs
		MT9355, TA=25°C, VCC=VREF=VCCN	9.7	10	10.3	mV/Gs
VOQ_TC	VOQ Variation Over Temperature	-	-2	-	2	%
SNST_TC	SNST Variation Over Temperature	-	-	1100	-	ppm/℃
ERAT_VOQ	Ratiometry Quiescent Voltage Output Error	TA=25°C, VREF=1.7~1.9V	-1.5	-	1.5	%
		TA=25°C, VREF=2.7~3.3V	-1.5	-	1.5	%
ERAT_SNST	Ratiometry Sensitivity Error	TA=25°C, VREF=1.7~1.9V	-2	-	2	%
		TA=25°C, VREF=2.7~3.3V	-2	-	2	%
VN	Noise	MT9352	-	18	-	mVpp
		MT9353	-	35	-	mVpp
		MT9355	-	70	-	mVpp

1) VREF<=VCC

9.4 Characteristic Performance

The MT935X devices are low-power Hall effect sensor ICs that are perfect for power sensitive customer applications. The current consumption of these devices is typically 2 mA, while the device is in the active mode, and less than 40 μA when the device is in the sleep mode. Toggling the logic level signal connected to the $\overline{\text{SLEEP}}$ pin drives the device into either the active mode or the sleep mode.

A logic low sleep signal drives the device into the sleep mode, while a logic high sleep signal drives the device into the active mode.

In the case in which the VREF pin is powered before the VCC pin, the device will not operate within the specified limits until the supply voltage is equal to the reference voltage. When the device is switched from the sleep mode to the active mode, a time defined by TPON must elapse before the output of the device is valid. The device output transitions into the high impedance state approximately TPOFF seconds after a logic low signal is applied to the $\overline{\text{SLEEP}}$ pin (see figure 5).

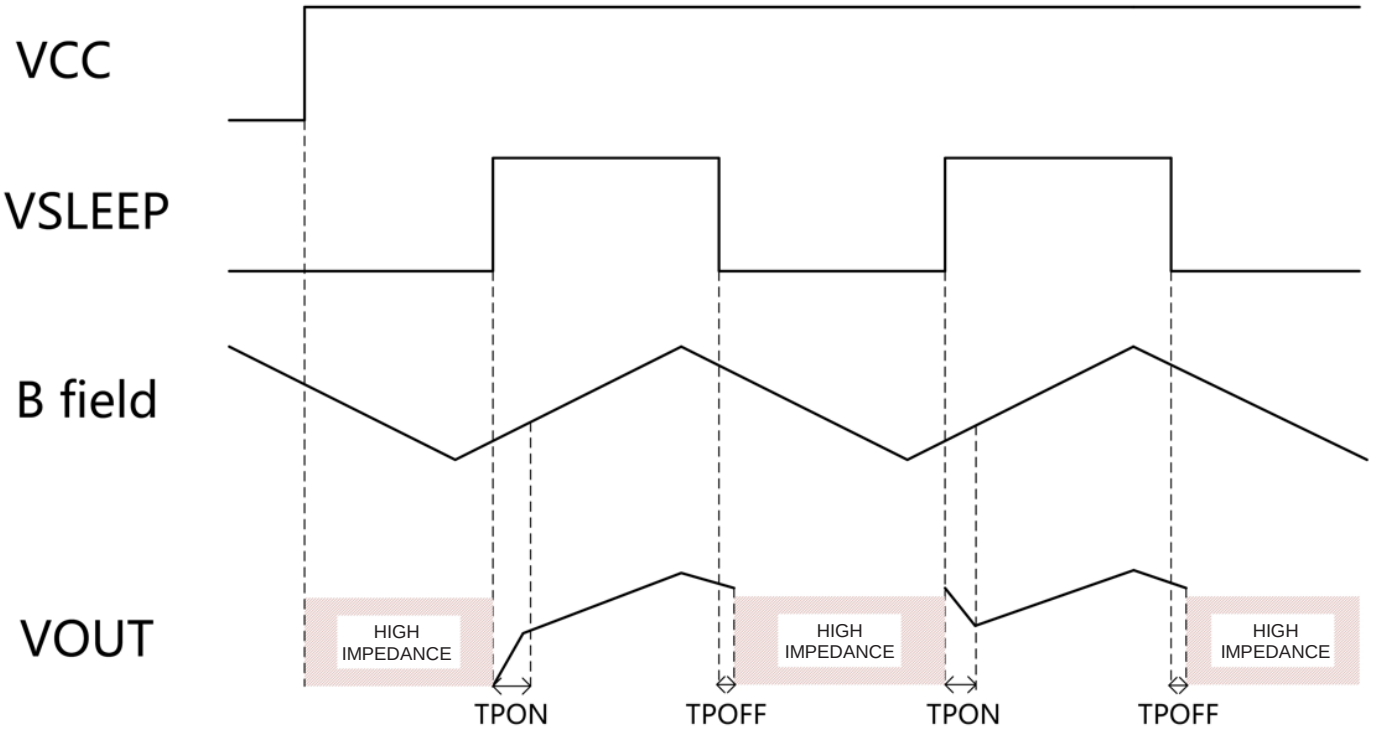

Figure.5 Timing diagram of chip working status

10 Typical Application Circuit

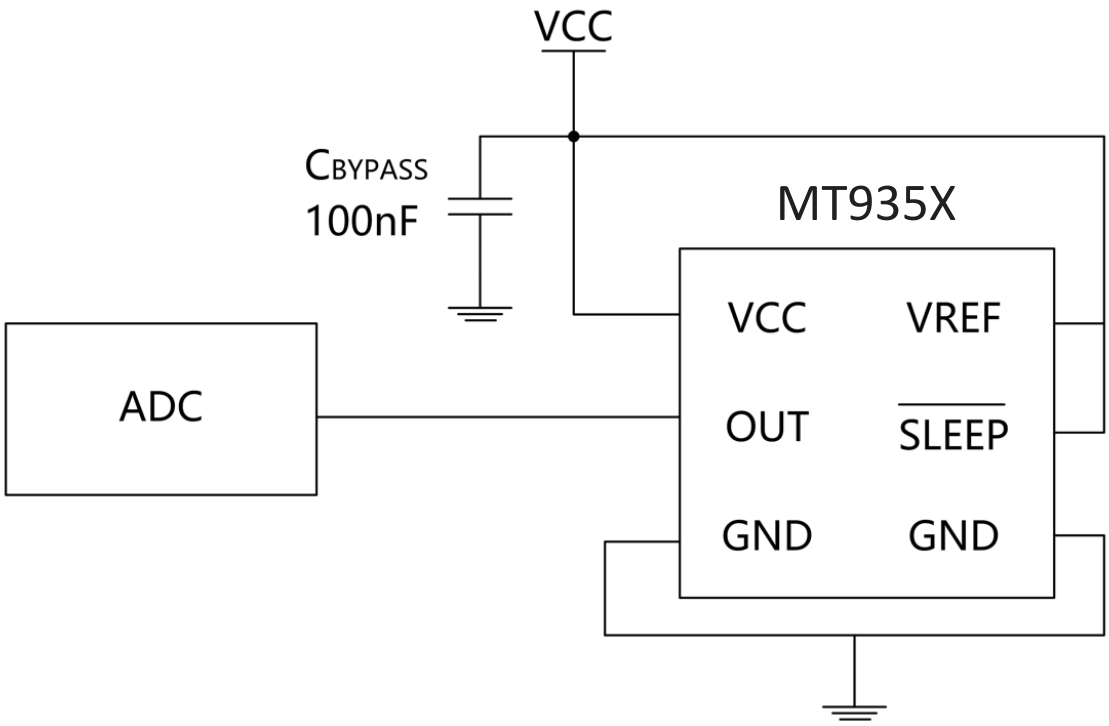

Figure.6 Active Mode Application Circuit

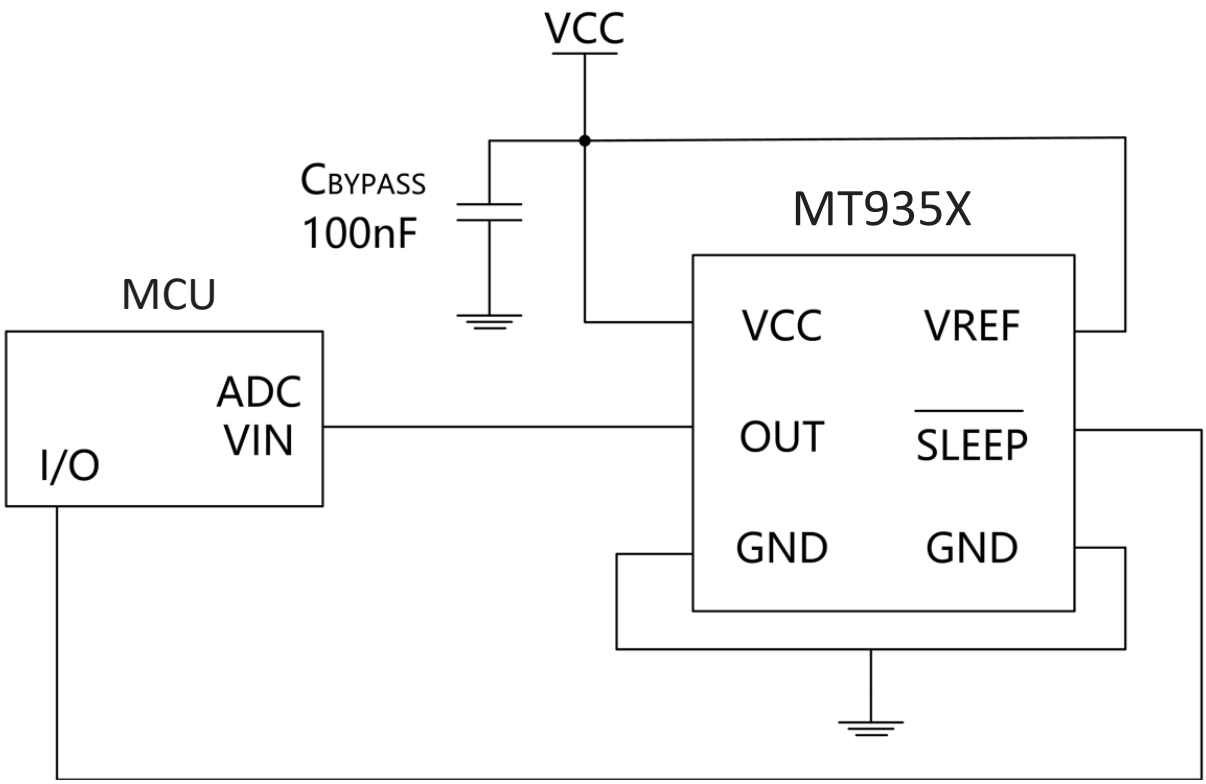

Figure.7 User-Selectable Sleep Mode Application Circuit

11 Package Material Information (For Reference Only)

11.1 DFN-2030 Package Information

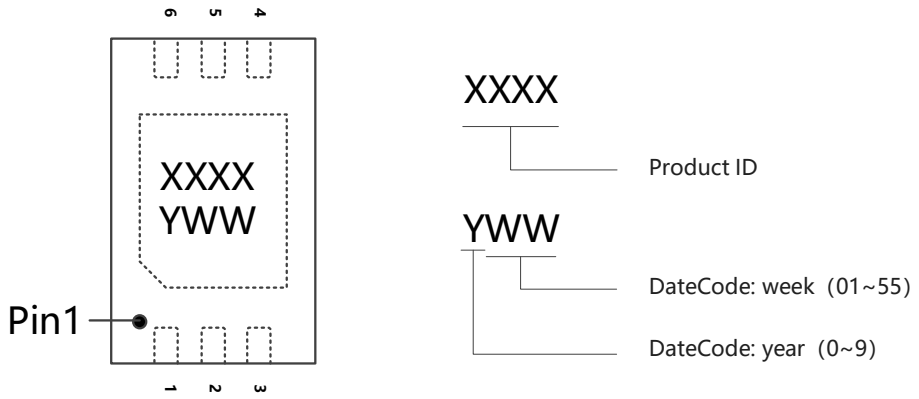

Figure.8 DFN-2030 Chip Marking Spec

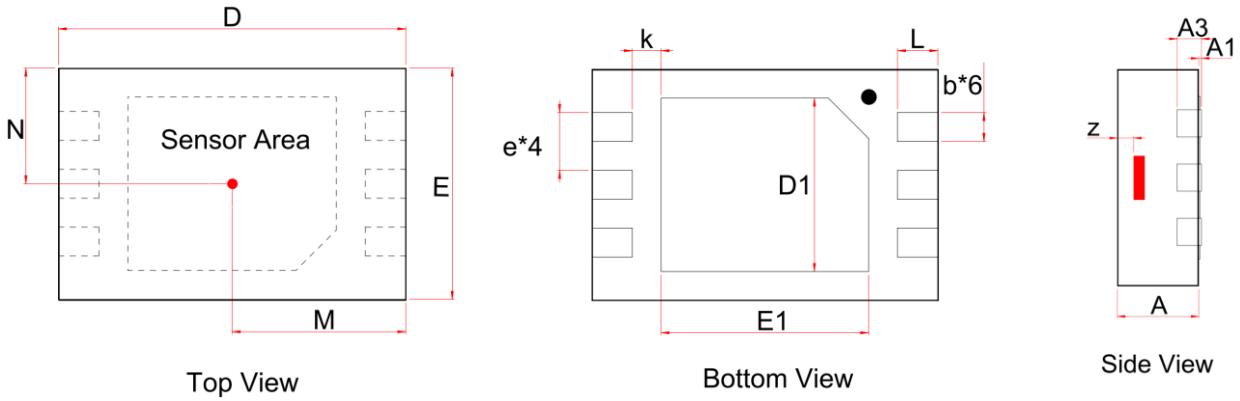

Figure.9 DFN-2030 Package Drawing

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203 REF		0.008 REF	
D	2.950	3.050	0.116	0.120
E	1.950	2.050	0.077	0.081
D1	1.400	1.600	0.055	0.063
E1	1.600	1.800	0.063	0.071
b	0.200	0.300	0.008	0.012
e	0.500 TYP		0.020 TYP	
k	0.200 MIN		0.008 MIN	
L	0.300	0.400	0.012	0.016
M	1.500 TYP		0.060 TYP	
N	1.000 TYP		0.040 TYP	
z	0.320 TYP		0.013 TYP	

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