

Product Overview

NSM105X magnetic switch and latch series chips integrate tunnel magneto resistive (TMR) sensors and digital circuits for position detection. NSM105X converts the change of magnetic field into switch signal to achieve accurate position detection. Output interface supports open drain and push-pull.

This series of chips has very low power consumption and supports full time power mode or time-sharing power mode (4 different models). The full-time power version continuously detects the magnetic field signal with low power consumption, avoiding missing detection, and average current consumption is as low as 1.5 μ A. The sampling frequency of time-sharing power mode is as low as 156Hz, and the average current consumption is as low as 200nA, which is suitable for battery powered equipment.

Key Features

- Power supply range: 1.8~5.5V
- High sensitivity, multiple B_{OP}/B_{RP} options
- Sampling frequency: 5kHz, 2.5kHz, 1.25kHz, 156Hz
- Very low power consumption: the power supply current of the full-time power supply version is as low as 1.5 μ A, and that of the time-sharing power supply version is as low as 200nA
- Magnetic field detection direction: parallel to the chip package
- Optional magnetic field polarity: working in the south magnetic field or the north magnetic field
- Output polarity: high or low
- Output interface: push-pull or open drain

Applications

- Reed switch replacement
- Liquid level detection
- Proximity switch
- Water meter, gas meter, heat meter
- Speed detection
- Wake up magnetic switch
- Rotation position detection

Device Information

Part Number	Package	Body Size
NSM105X-XXXXX-DSTDR	SOT23-3	2.90mm*2.80mm
NSM105X-XXXXX-DTOB	TO92S	17.60mm*4.00mm

Functional Block Diagrams

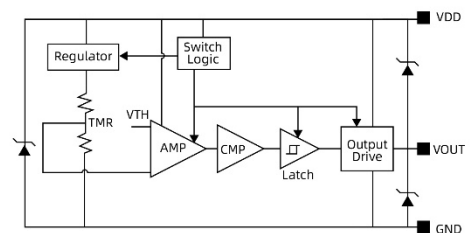


Figure 1 NSM105X Block Diagram

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1. Pin Configuration and Functions

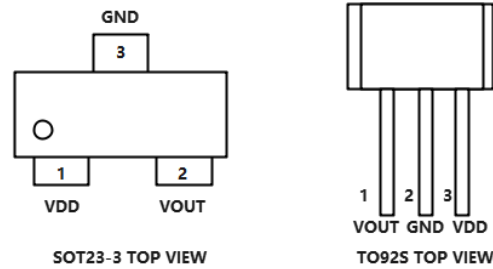


Figure 1.1 NSM105X Package

Table 1.1 NSM105X Pin Configuration and Description

NSM105X SOT23 Pin No.	NSM105X TO92S Pin No.	Symbol	Function
1	3	VDD	Power supply
2	1	VOUT	Digital output
3	2	GND	Power GND

2. Reflow Temperature Characteristics

The typical preferred maximum temperature range is 240°C to 250°C for SMD Using Lead (Pb) Free Solder and acceptable maximum temperature is below 260°C. The typical preferred maximum temperature range is 215°C to 245°C for SMD Using Tin-Lead Solder. The duration of SMT time is less than 600 seconds. Detailed feature reference Figure 2.1 and Figure 2.2.

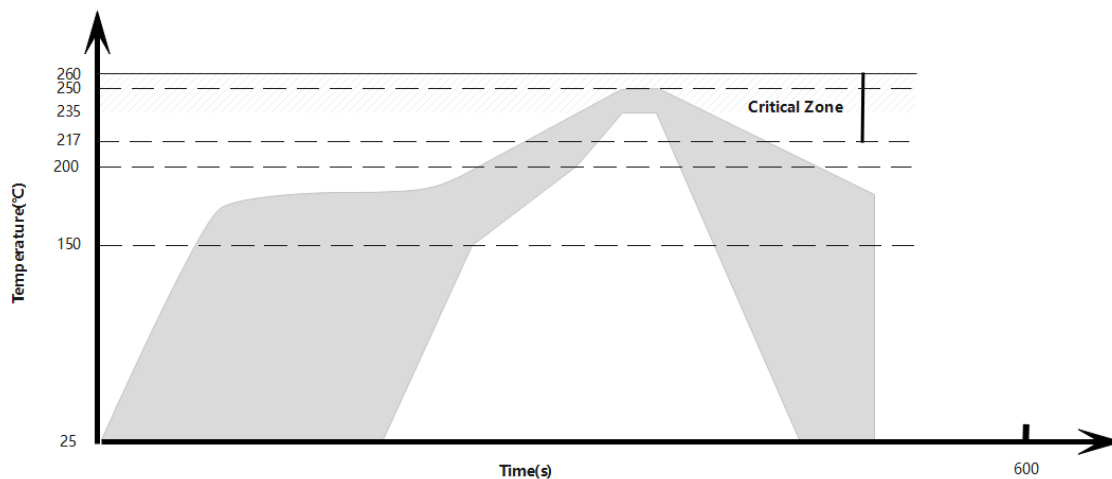


Figure 2.1 Solder Reflow Profile for SMD Using Lead (Pb) Free Solder

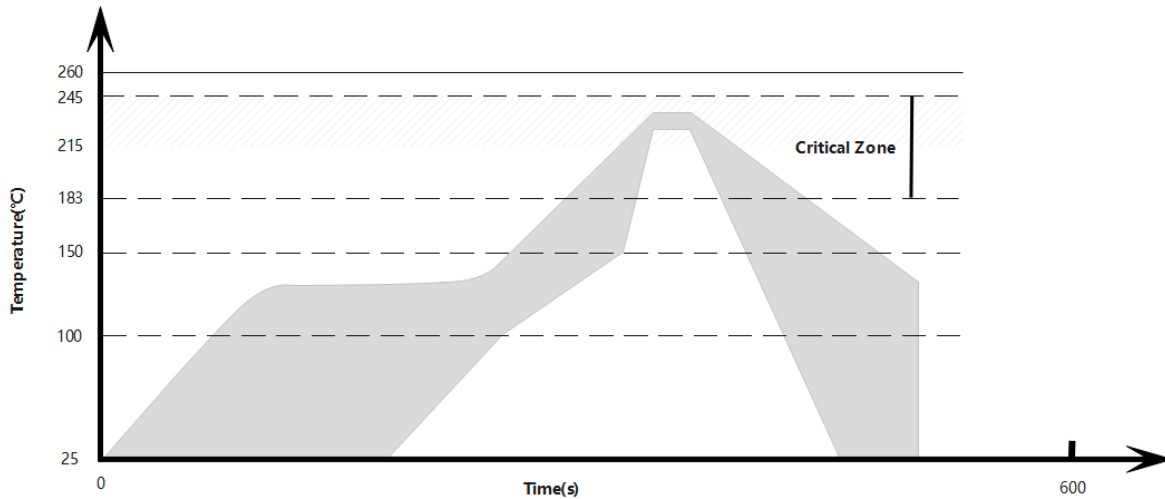


Figure 2.2 Solder Reflow Profile for SMD Using Tin-Lead Solder

3. Absolute Maximum Ratings

Parameters	Symbol	Min	Max	Unit	Comments
Power Supply Voltage	VDD	-0.3	6.5	V	-
Output Voltage (Open Drain)	VOUT _{OD}	-0.3	6.5	V	-
Output Voltage (Push-pull)	VOUT _{PP}	-0.3	VDD+0.3	V	-
Input and Output Current	I _{IN} /I _{OUT}	-	±12	mA	-
Operating Ambient Temperature	T _A	-40	125	°C	-
Junction Temperature	T _{J(max)}	-	125	°C	-
Storage Temperature	T _{Storage}	-40	150	°C	-
Lead Soldering Temperature, <10 seconds	T _{Soldering}	-	260	°C	-
Output Short-Circuit Current Limit	I _{OM}	-	±12	mA	-
Magnetic Flux Density	B _{MAX}	-	700	Gauss	-

Special attention shall be paid to protection during use, and output short circuit is prohibited, otherwise the chip will be damaged.

4. ESD Ratings

		Ratings	Value	Unit
ESD Voltage	Human body model (HBM), per AEC-Q100-002-RevD	● All pins	±4.0	kV
	Charged device model (CDM), per AEC-Q100-011-RevB	● All pins	±1000	V
Latch Up	Latch Up, per AEC-Q100-004		100	mA

5. Thermal Information

Parameters	Symbol	Value	Unit
Junction-to-ambient thermal resistance of package SOT-23	θ_{JA}	300	°C/W
Junction-to-ambient thermal resistance of package TO92S	θ_{JA}	250	°C/W

6. Specifications

6.1. Common Characteristics

(Operating voltage VDD=3V, ambient temperature T_A=25°C, and with C_{BYP} = 0.1 μF, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply voltage	VDD	1.8	3	5.5	V	
NSM1051x Average Supply Current	I _{CC}	-	1.17	-	uA	Power Mode:1 (F _s =5kHz)
		-	0.67	-	uA	Power Mode:2 (F _s =2.5kHz)
		-	0.40	-	uA	Power Mode:3 (F _s =1.25kHz)
		-	0.19	-	uA	Power Mode:4 (F _s =156Hz)
NSM1052x Average Supply Current	I _{CC}	-	2.17	-	uA	Power Mode:1 (F _s =5kHz)
		-	1.17	-	uA	Power Mode:2 (F _s =2.5kHz)
		-	0.67	-	uA	Power Mode:3 (F _s =1.25kHz)
		-	0.22	-	uA	Power Mode:4 (F _s =156Hz)
NSM1053x Average Supply Current	I _{CC}	-	1.14	-	uA	Power Mode:1 (F _s =5kHz)
		-	0.64	-	uA	Power Mode:2 (F _s =2.5kHz)
		-	0.40	-	uA	Power Mode:3 (F _s =1.25kHz)
		-	0.19	-	uA	Power Mode:4 (F _s =156Hz)
Power on Time	T _{ON}	-	1	-	ms	T _A = 25°C, VDD=5V
Power on State	POS	High			-	VDD ≥ VDD _(MIN) , t < t _{ON}
Sample Frequency	F _s	-	5	-	kHz	Power Mode:1 (F _s =5kHz)
		-	2.5	-	kHz	Power Mode:2 (F _s =2.5kHz)
		-	1.25	-	kHz	Power Mode:3 (F _s =1.25kHz)
		-	156	-	Hz	Power Mode:4 (F _s =156Hz)
Push-pull Output						
Output Voltage High	V _{OH}	0.9*VDD	-	-	V	I _{OUT} =5mA
Output Voltage Low	V _{OL}	-	-	0.1*VDD	V	I _{OUT} =-5mA
Output Rise Time	t _R	-	4.3	-	ns	VDD = 5 V
Output Fall Time	t _F	-	5.3	-	ns	VDD = 5 V

Open Drain Output						
Output Leakage Current	I_{OUTOFF}	-	10	-	nA	VOUT=High, Pull up to VDD
Output Voltage High	V_{OH}	-	VDD	-	V	VOUT =High
Output Voltage Low	V_{OL}	-	-	0.3	V	VOUT =Low, $I_{OUT} = -5$ mA

6.2. Magnetic Specifications

(Operating voltage VDD=3V, ambient temperature $T_A = 25^\circ\text{C}$, and with $C_{BYP} = 0.1 \mu\text{F}$, unless otherwise specified)

NSM1051 and NSM1052. Device Switch Threshold Magnitude:

Code (Suffix)	Operating Point $ B_{OP} $ (Gauss)			Release Point $ B_{RP} $ (Gauss)			Hysteresis B_{HYS} (Gauss)		
	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max
0	3	7	11	1	5	9	2	2	-
1	9	14	19	5	10	15	3	4	-
2	13	18	23	8	13	18	3	5	-
3	28	35	42	18	25	32	8	10	-
4	40	50	60	30	40	50	8	10	-
5	65	75	85	55	65	75	8	10	-

NSM1053. Device Switch Threshold Magnitude:

Code (Suffix)	Operating Point B_{OP} (Gauss)			Release Point B_{RP} (Gauss)			Hysteresis B_{HYS} (Gauss)		
	Min	Typ	Max	Max	Typ	Min	Min	Typ	Max
0	3	7	11	-3	-7	-11	6	14	-
1	9	14	19	-9	-14	-19	18	28	-
2	13	18	23	-13	-18	-23	26	36	-
3	28	35	42	-28	-35	-42	56	70	-
4	40	50	60	-40	-50	-60	80	100	-
5	65	75	85	-65	-75	-85	130	150	-

6.1. Typical Performance Characteristics

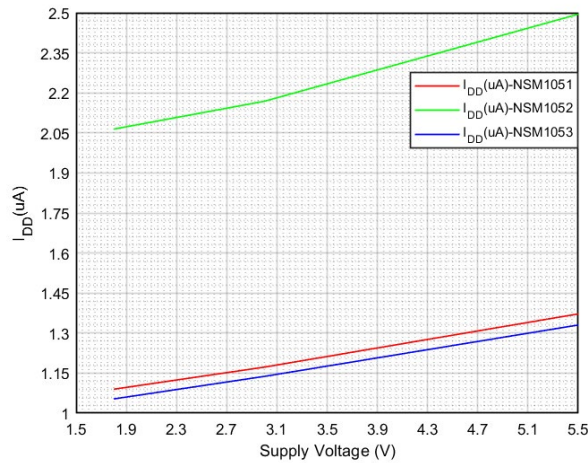


Figure 6.1 Average Supply Current vs. Supply Voltage at Fs=5kHz, TA=25°C

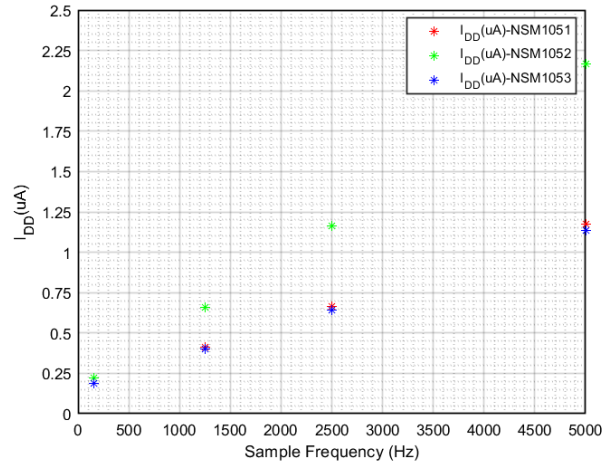


Figure 6.2 Average Supply Current vs. Sampling Frequency at VDD=3V, TA=25°C

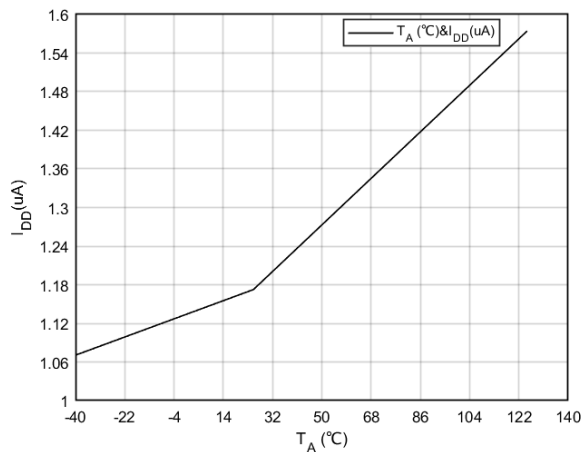


Figure 6.3 NSM1051 Average Supply Current vs. Temperature at VDD=3V, Fs=5kHz

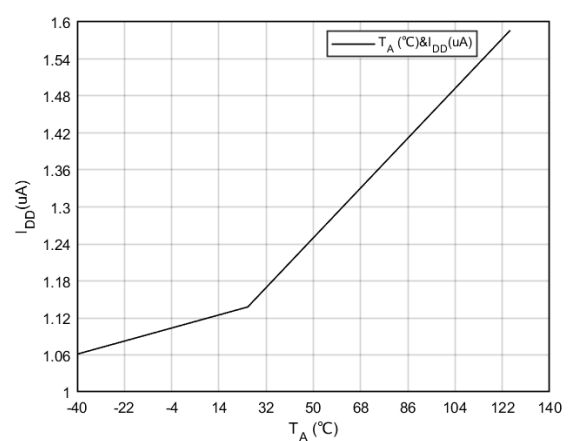


Figure 6.4 NSM1053 Average Supply Current vs. Temperature at VDD=3V, Fs=5kHz

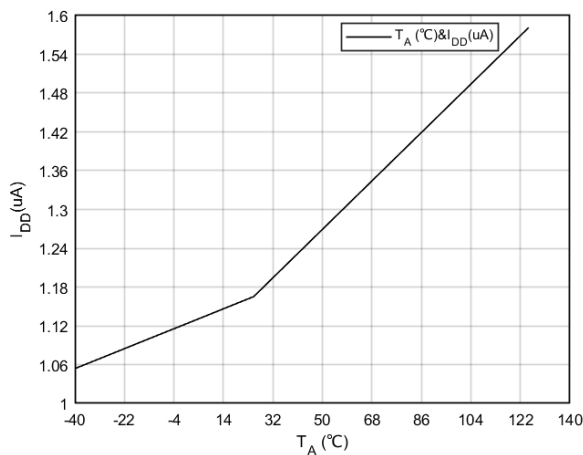


Figure 6.5 NSM1052 Average Supply Current vs. Temperature at VDD=3V, Fs=2.5kHz

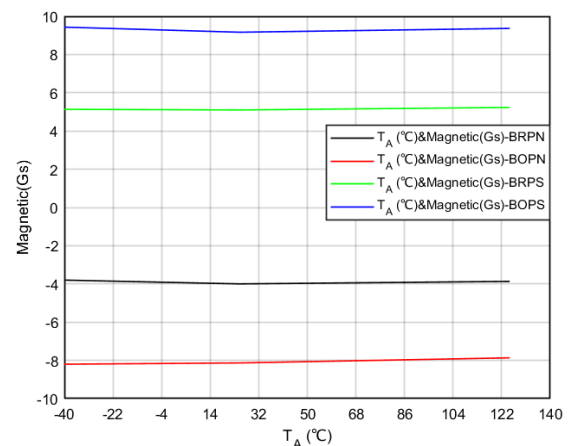


Figure 6.6 BRP and BOP vs. Temperature at VDD=3V

7. Function Description

7.1. Principal

The output of these devices switches when a magnetic field parallel to the TMR sensor exceeds the operate point threshold (B_{OP}). When the magnetic field is reduced below the release point (B_{RP}), the device output switches to the alternate state. The output state (polarity) and magnetic field polarity depends on the selected device options.

For unipolar south switch, an increasing south field is required (see Figure 7.2); Likewise, for unipolar north switch, an increasing north field is required (see Figure 7.3) to exceed B_{OP} . The output state is a configuration option. In omni-polar mode, the device will switch on and off with either magnetic polarity, while latching will require both polarities.

The difference between operate (B_{OP}) and release (B_{RP}) is the hysteresis (B_{HYS}). Hysteresis allows clean switching of the output even in the presence of external mechanical vibration and electrical noise.

Figure 7.2 shows the output switching behavior of Unipolar South Polarity relative to increasing and decreasing magnetic field. On the horizontal axis, the B+ direction indicates increasing south polarity magnetic field strength.

Figure 7.4 shows the output switching behavior of Unipolar North Polarity relative to increasing and decreasing magnetic field. On the horizontal axis, the B- direction indicates increasing North polarity magnetic field strength.

Figure 7.5 shows the output switching behavior of Omni-polar Polarity relative to increasing and decreasing magnetic field. On the horizontal axis, the B+ direction indicates increasing south polarity magnetic field strength and the B- direction indicates increasing North polarity magnetic field strength.

Figure 7.6 shows the output switching behavior of Latch Polarity relative to increasing and decreasing magnetic field. On the horizontal axis, the B+ direction indicates increasing south polarity magnetic field strength and the B- direction indicates increasing North polarity magnetic field strength.

The NSM105X TMR digital position sensor can be configured to respond to a north or south magnetic field, as well as the output polarity. The direction of the applied magnetic field is parallel to the branded face of the IC (see Figure 7.1 or Figure 7.3).

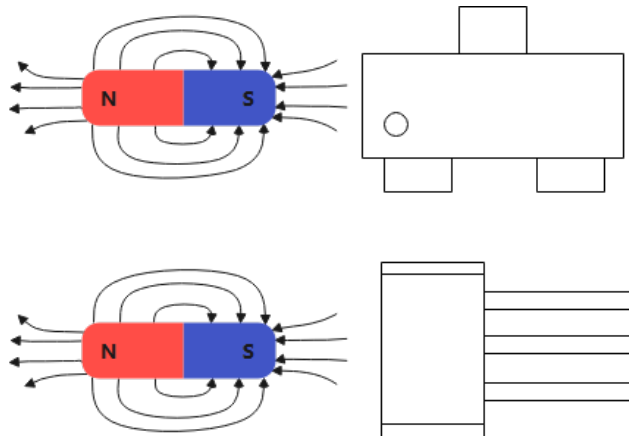


Figure 7.1 South Polar(B+)

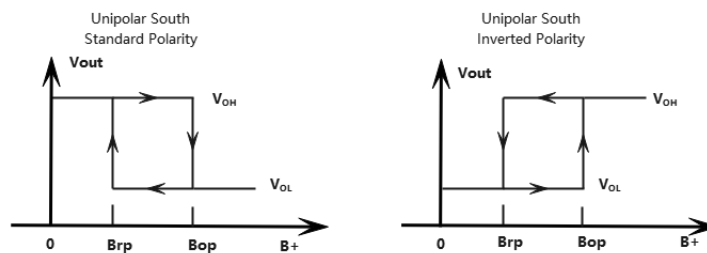


Figure 7.2 Unipolar South Polarity (Output polarity of standard($B > B_{OP}$): L, Output polarity of inverted($B > B_{OP}$): H)

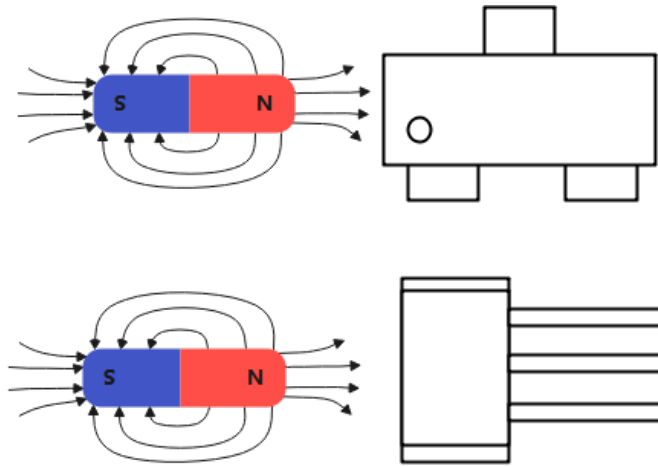


Figure 7.3 North Polar(B-)

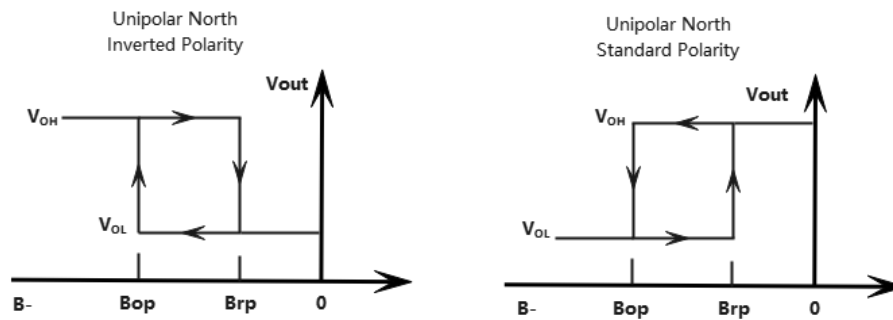


Figure 7.4 Unipolar North Polarity (Output polarity of inverted($B > B_{OP}$): H, Output polarity of standard($B > B_{OP}$): L)

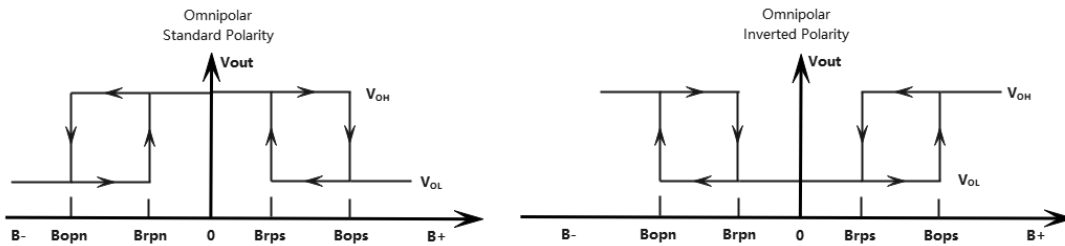


Figure 7.5 Omnipolar Polarity (Output polarity of standard($B > B_{OP}$): L, Output polarity of inverted($B > B_{OP}$): H)

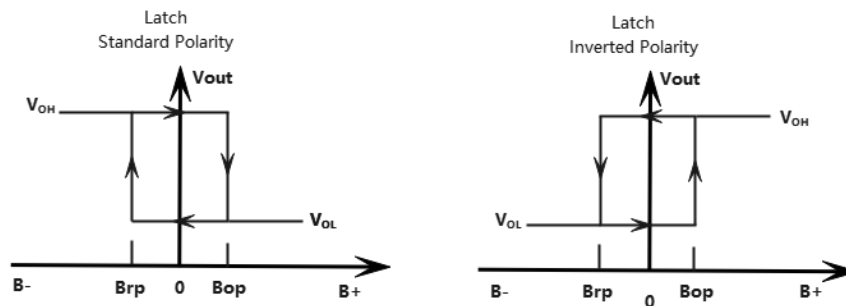


Figure 7.6 Latch Polarity (Output polarity of standard($B > B_{OP}$): L, Output polarity of inverted($B > B_{OP}$): H)

7.2. Power-on Time

As the NSM105X powers up, it stays in undefined state until the supply voltage exceeds $V_{DD(MIN)}$, and then in the power-on state (POS) when the supply voltage exceeds $V_{DD(MIN)}$. After t_{ON} , the output state, according to the magnetic field and the device configuration.

Similarly, when the supply voltage decreases, the device returns to the device returns to the undefined state when the supply voltage drops below $V_{DD(MIN)}$.

When the device powers on in the hysteresis range (less than B_{OP} and higher than B_{RP}), the output corresponds to the power-on state. In this case, the correct state is attained after the first excursion beyond B_{OP} or B_{RP} .

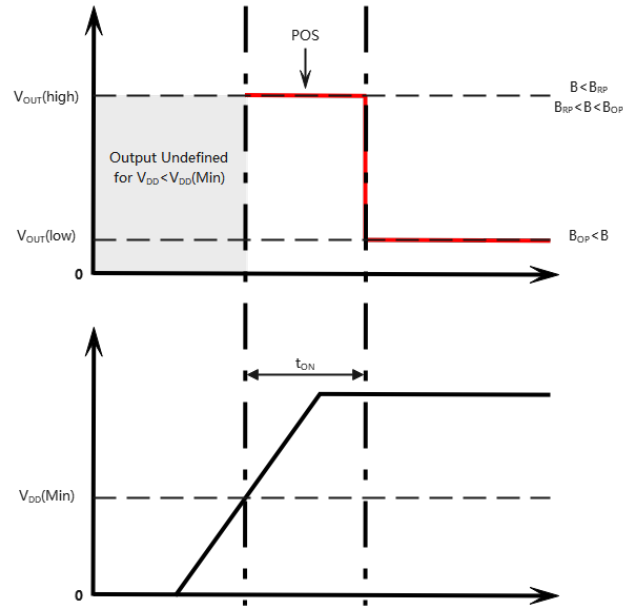


Figure 7.7 NSM105X Power-on Time

8. Application Note

8.1. Typical Application Circuit

It is strongly recommended that an external bypass capacitor be connected between the supply and ground of the device to guarantee correct performance under harsh environmental conditions and to reduce noise from internal circuitry.

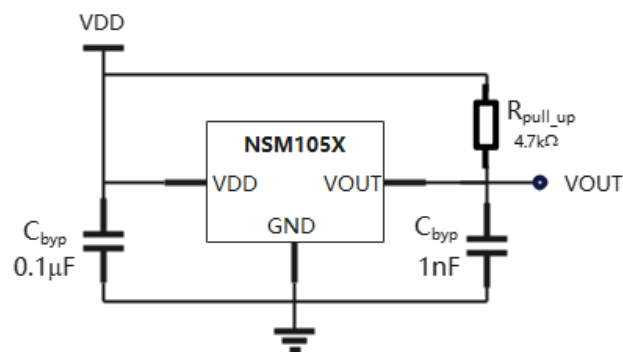


Figure 8.1 Typical Application Circuit of NSM105X (Open drain)

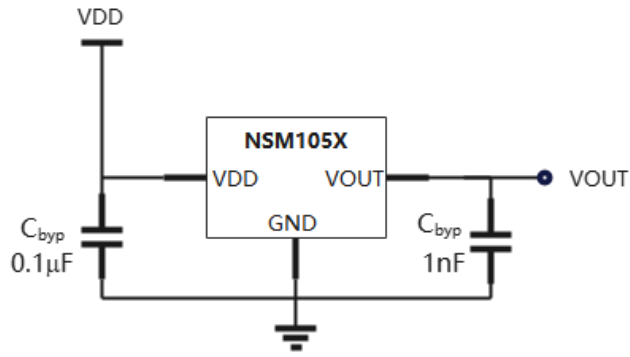
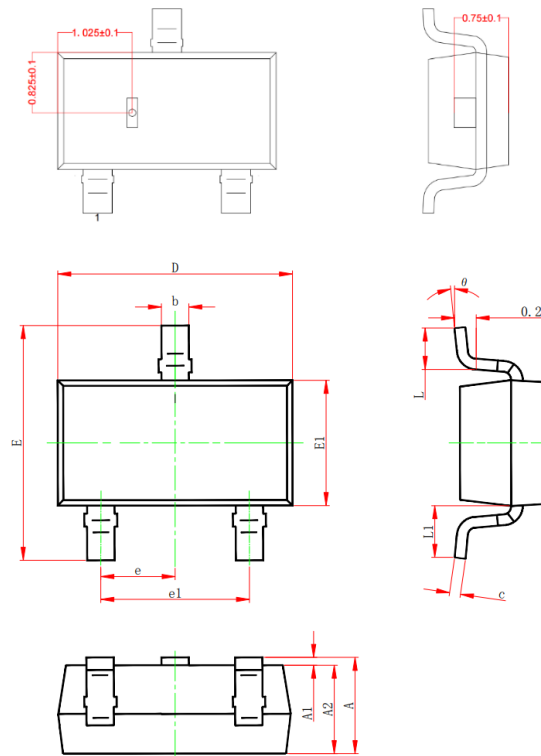


Figure 8.2 Typical Application Circuit of NSM105X (Push-pull)

9. Package Information

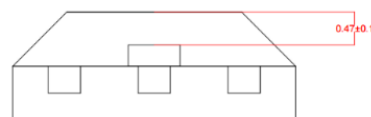
9.1. SOT-23 Package

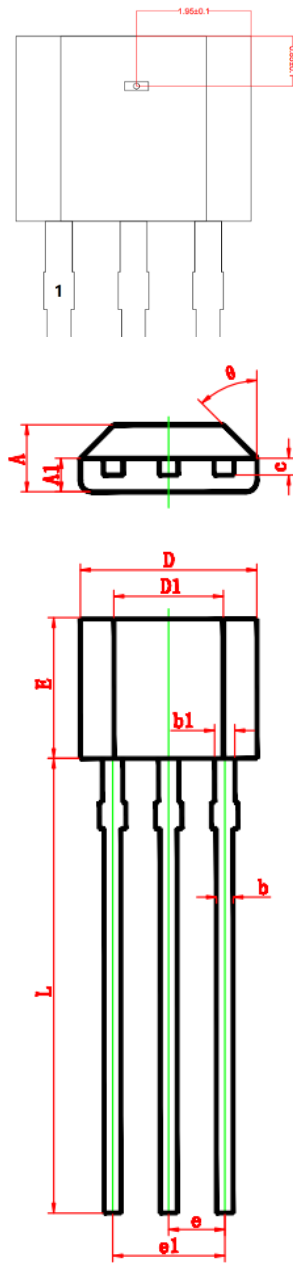


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
L1	0.600REF.		0.024REF.	
θ	0°	8°	0°	8°

Figure 9.1 Package Definition of SOT23

9.2. TO-92S Package





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.420	1.620	0.056	0.064
A1	0.660	0.860	0.026	0.034
b	0.330	0.480	0.013	0.019
b1	0.400	0.510	0.016	0.020
c	0.330	0.510	0.013	0.020
D	3.900	4.100	0.154	0.161
D1	2.280	2.680	0.090	0.106
E	3.050	3.250	0.120	0.128
e	1.270 TYP.		0.050 TYP.	
e1	2.440	2.640	0.096	0.104
L	15.100	15.500	0.594	0.610
θ	45° TYP.		45° TYP.	

Figure 9.2 Package Definition of TO92S

10. Ordering Information

Part Number	Power Supply(V)	Temperature	MSL	Package Type	SPQ
NSM1051-2SL1D-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1052-1SL1D-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1052-1SL4D-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1052-2SL1P-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1052-2SL3P-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1052-3SL1P-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1052-3SL3P-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1053-1SL1P-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1053-2SL1P-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1053-3SL1P-DSTDR	1.8-5.5	-40 to 125°C	MSL1	SOT23	3000
NSM1052-0SL4P-DTOB	1.8-5.5	-40 to 125°C	-	TO92S	1000
NSM1052-5SL4P-DTOB	1.8-5.5	-40 to 125°C	-	TO92S	1000
NSM1052-3SL4P-DTOB	1.8-5.5	-40 to 125°C	-	TO92S	1000
NSM1053-0SL3P-DTOB	1.8-5.5	-40 to 125°C	-	TO92S	1000

If you need other device , please contact NOVOSENSE.

Part Number Rule:

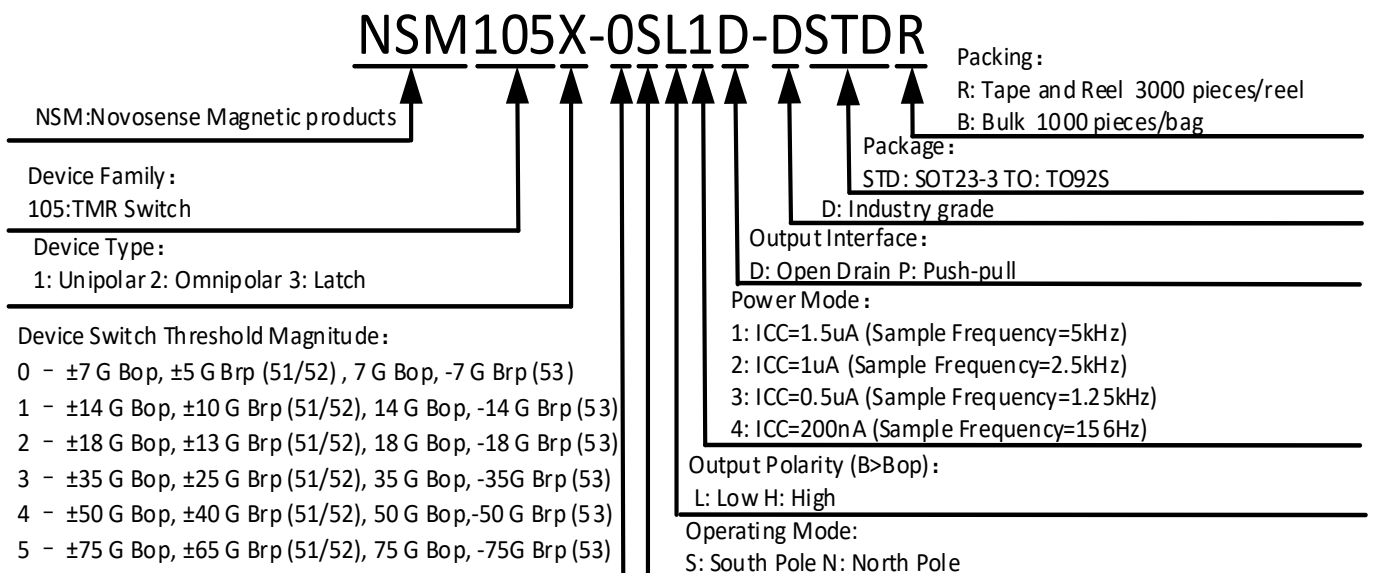
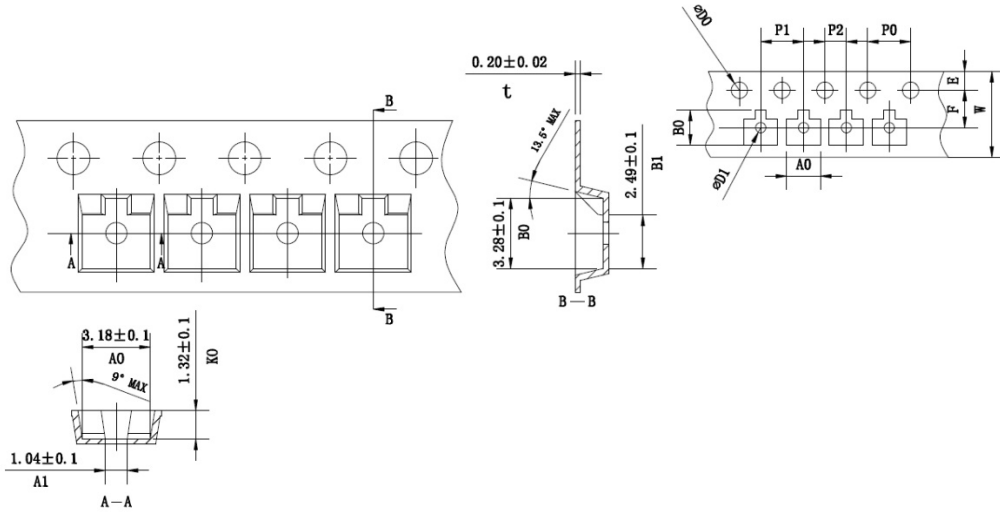


Figure 10.1 Complete Part Number Format

11. Tape and Reel Information

规格	W	E	F	D0	D1	P0	P2	10P0	P1	A0	A1	B0	B1	K0	K1	t
尺寸	8.00 ±0.10	1.75 ±0.10	3.50 ±0.05	ø1.50 +0.10	ø1.0 ^{+0.25} ₋₀	4.00 ±0.10	2.00 ±0.05	40.00 ±0.20	4.00 ±0.10	3.18 ±0.10	1.04 ±0.10	3.28 ±0.10	2.49 ±0.10	1.32 ±0.10		0.20 ±0.05



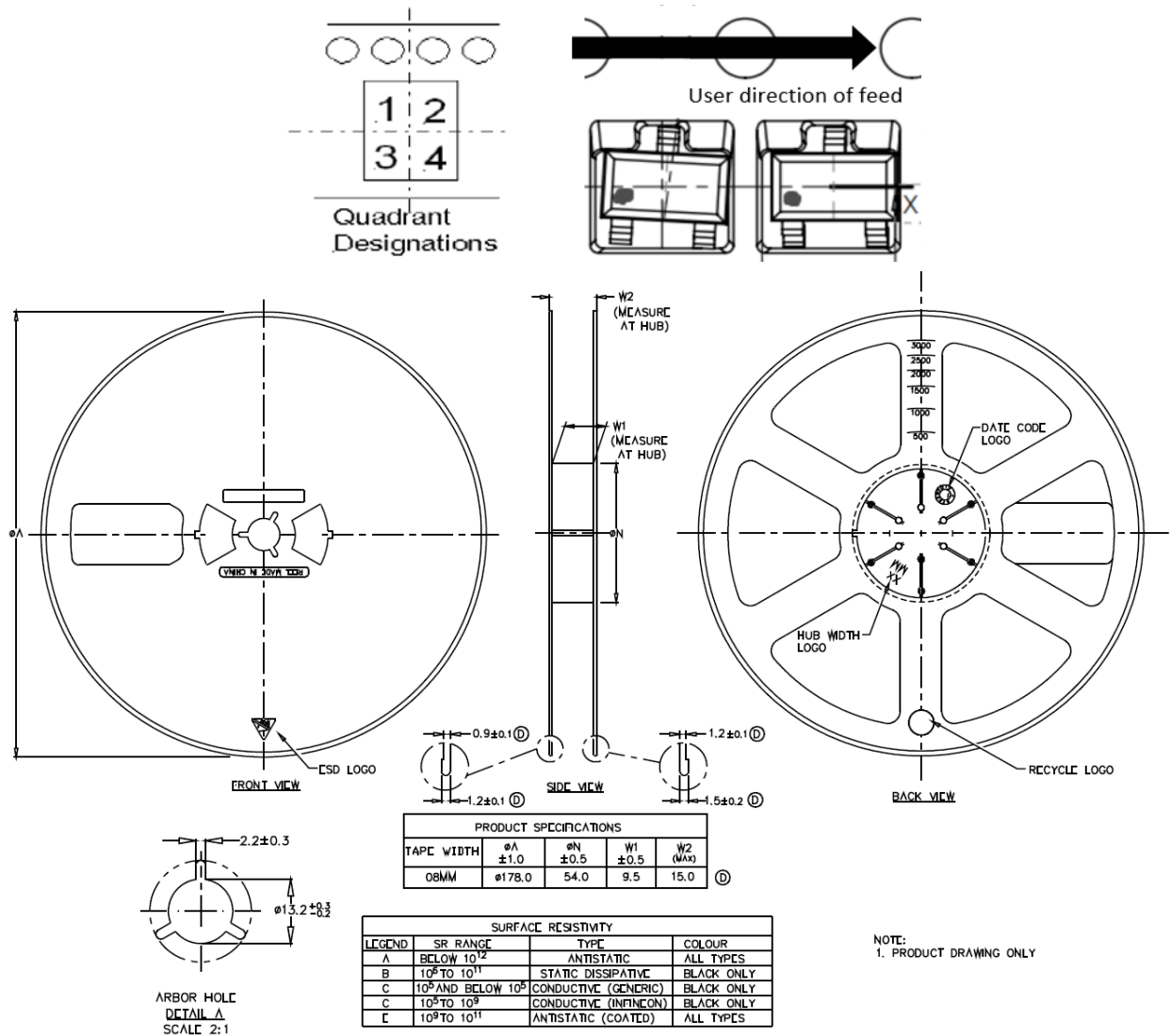


Figure 11.1 Tape and Reel Information

12. Revision History

Revision	Description	Date
1.0	Initial Version.	2024/5/28

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