



NSM0411DB Bottom-Inlet Digital Silicon Microphone Specification

Rev 1.7



1. GENERAL DESCRIPTION

NSM0411DB is an ultra-compact with a package size of 4mm*3mm*1mm, low-power, and omnidirectional silicon microphone with digital output and bottom inlet for sound input. It consists of a MEMS sensor and an encoder IC. It converts sensor analog output signal into 1-bit digital PDM data. The digital output format eliminates AC coupling capacitor, reduces RF noise coupling and eases PCB layout requirement.

NSM0411DB is a cost-effective alternative to traditional electret condenser microphone (ECM). Provided on tap-and-reel, it is ideally suited for high volume applications. And it can be processed directly to customer's PCB using standard automatic pick-and-place equipment and surface mounted via standard solder reflow equipment.

NSM0411DB can be used in (but not limited to) the following applications:

1. Portable communication device
2. Notebook and desktop
3. Headphone and headset accessories

2. ABSOLUTE MAXIMUM RATINGS

Supply voltage: VDD to GND-0.3V~5V

L/R, CLOCK, DATA Voltage to GND.....-0.3V~ (VDD+0.3V)

ESD Tolerance

The Lid Mode8kV

The I/O Pin Mode4kV

TEMPERATURE CHARACTERISTICS					
Parameter	Conditions	Min	Typ	Max	Unit
Operating Temperature		-40		+85	°C
Storage Temperature	Solder on PC board	-40		+105	°C
	In Tape and Reel	-10		+50	°C



3. ACOUSTIC & ELECTRICAL SPECIFICATIONS

Unless otherwise specified, test conditions are:

Supply voltage $V_{DD} = 3.3V$

Clock Frequency = 2.048MHz, Duty Cycle = 50%, No Load

Input sound pressure $P_{IN} = 94dB \text{ SPL}@1kHz$

Test room temperature $T_a = 25^{\circ}C$, Room Humidity = $50 \pm 20\%$

SNR & noise floor measurement is based on 100 – 8 KHz pass band with A-Weighting filter applied

PERFORMANCE					
Parameter	Conditions	Min	Typ	Max	Unit
Directivity		Omni-Directional			
Sensitivity	@1KHz (0 dB = 1V/Pa)	-25	-22	-19	dBFS
Signal-to-Noise Ratio	@1KHz (0 dB = 1V/Pa)		60.5		dB(A)
Total Harmonic Distortion (THD) @ 100dB SPL	@1KHz		0.2	0.5	%
Total Harmonic Distortion (THD) @ 115dB SPL	@1KHz		0.5	1	%
Max Input Sound Pressure	@1KHz, THD < 10%		130		dB SPL
Power Supply Rejection (PSR)	217Hz, 100m Vpp square wave		-70	-65	dBFS
INPUT CHARACTERISTICS					
Operating Frequency		1.024	2.048	3.250	MHz
Clock Duty Cycle		40	50	60	%
Power supply Voltage		1.6		3.6	V
Sensitivity Loss Across Power Supply Voltage	Change in sensitivity from 1.6V to 3.6V power supply voltage	No change			dB
Total Operation Current	1.6V-3.6V power supply voltage No load on DATA		850	1000	uA
Standby Current	1.6V-3.6V power supply voltage, Clock off			2	uA
OUTPUT CHARACTERISTICS					
LOAD Capacitance				100	pF
Short Circuit Output Current	@1KHz (0 dB = 1 V/Pa)	1		10	mA
Data Format		1/2 Cycle 1-bit PDM			
Lid to Ground Resistance				100	Ω



4. MICROPHONE STATE DIAGRAM

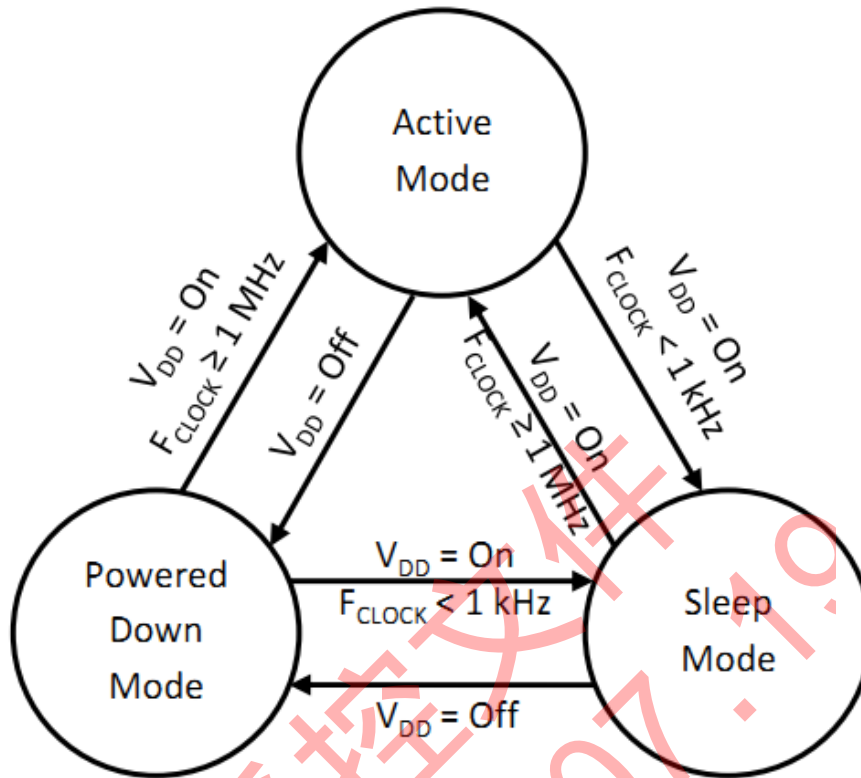


Figure1. Microphone state diagram

5. FREQUENCY RESPONSE CURVE

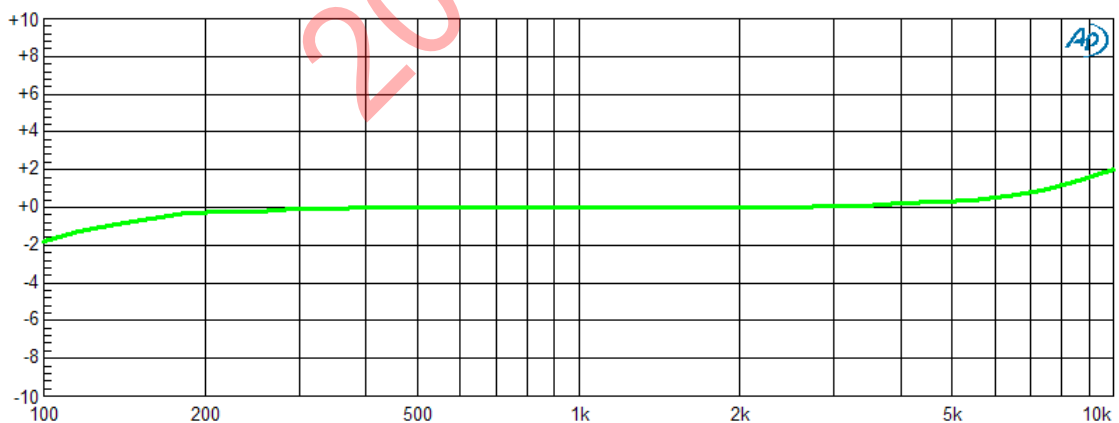
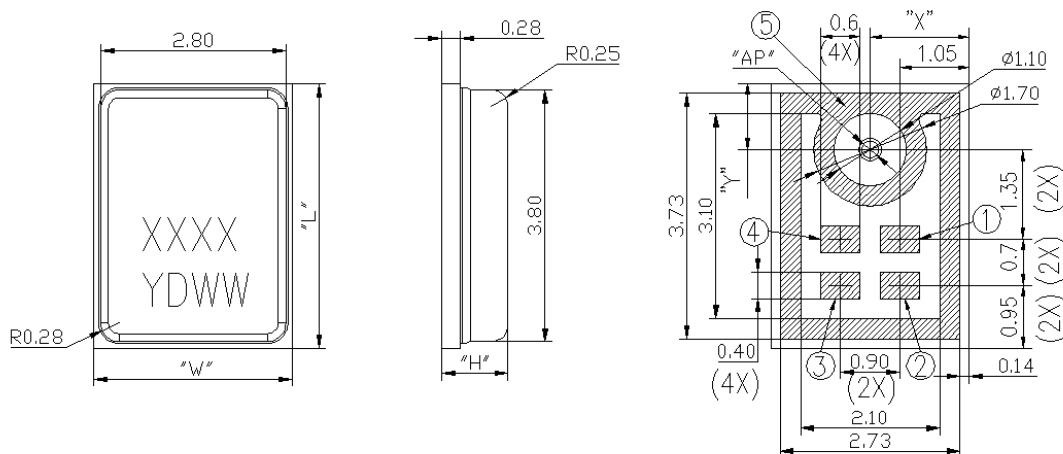


Figure 2. Typical free field frequency response (Normalized to 1 KHz)



6. MECHANICAL SPECIFICATIONS



ITEM	DIMENSION	TOLERANCE	UNITS	PIN OUTPUT	
LENGTH(L)	4.00	± 0.10	mm	PIN#	FUNCTION
WIDTH(W)	3.00	± 0.10	mm	1	POWER (VDD)
HEIGHT(H)	1.00	± 0.10	mm	2	OUTPUT (DATA)
ACOUSTIC PORT(AP)	$\Phi 0.25$	± 0.05	mm	3	CLOCK (CLK)
AP LOCATION (X)	1.50	± 0.20	mm	4	SELECT
AP LOCATION (Y)	1.00	± 0.20	mm	5	GROUND (GND)

Code marking		Remarks
XXXX	Production lot number	"D" means month, "1":January; "2":February; "3":March; "4":April; "5":May; "6":June; "7":July; "8":August; "9":September; "A":October; "B":November; "C":December
Y	The last number of year	
D	Month	
WW	Week	

Note:

Dimensions are in millimeters unless otherwise specified.

Tolerance ± 0.15 mm unless otherwise specified

Figure3. Detailed mechanical drawings



7. RECOMMENDED CUSTOMER LANDING PATTERN

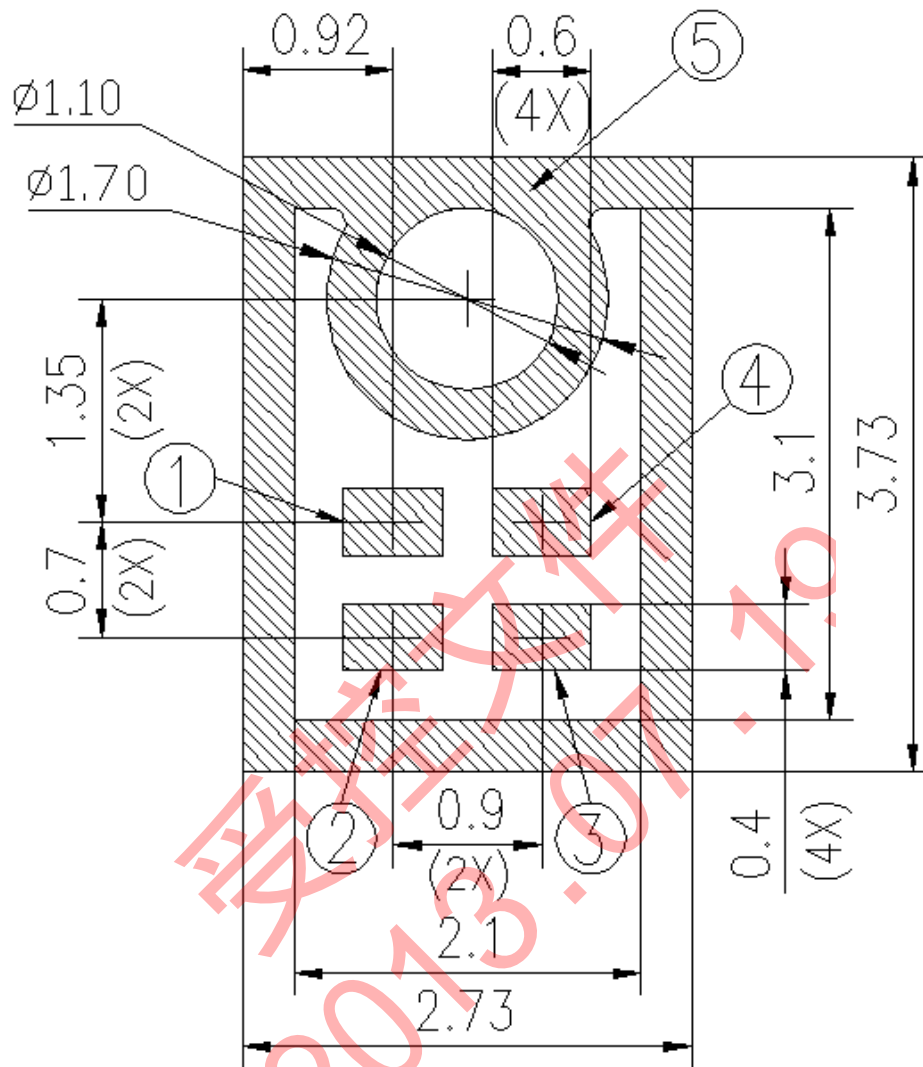
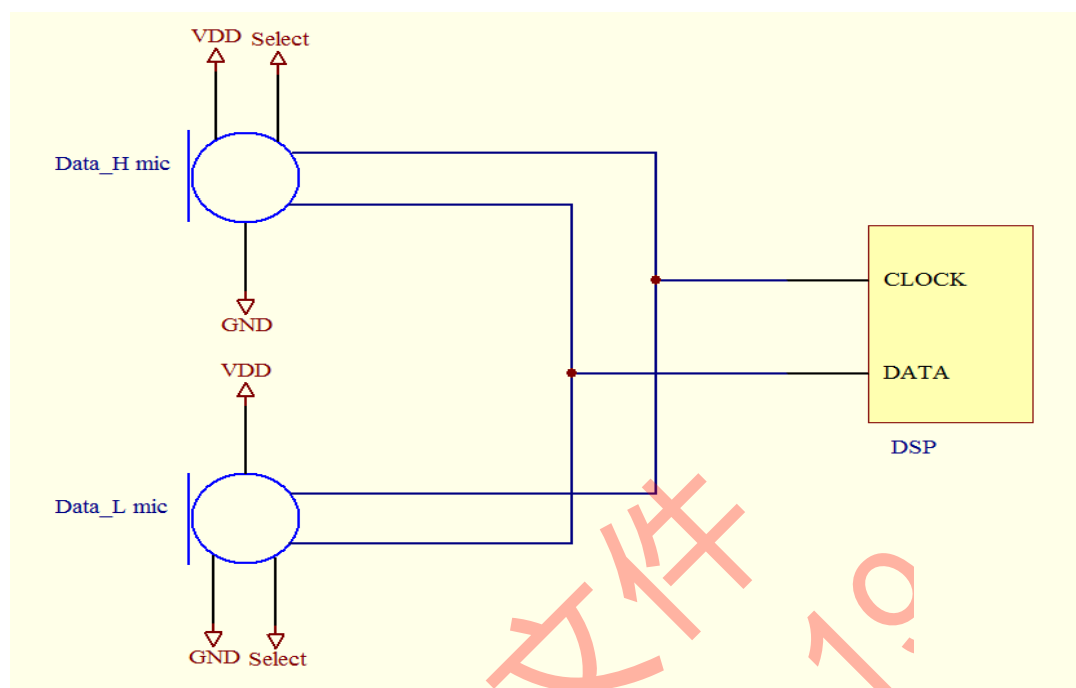


Figure 4. Recommended landing pattern on customers' PCB



8. RECOMMENDED INTERFACE CIRCUIT



LABEL	Select	Drives data after	High_Z after
Data_H	High	Rising clock edge	Falling clock edge
Data_L	Low	Falling clock edge	Rising clock edge

Figure 5. Schematic of NSM0411DB iSAM enhance array configuration (2 microphones array)

9. TIMING DIAGRAM

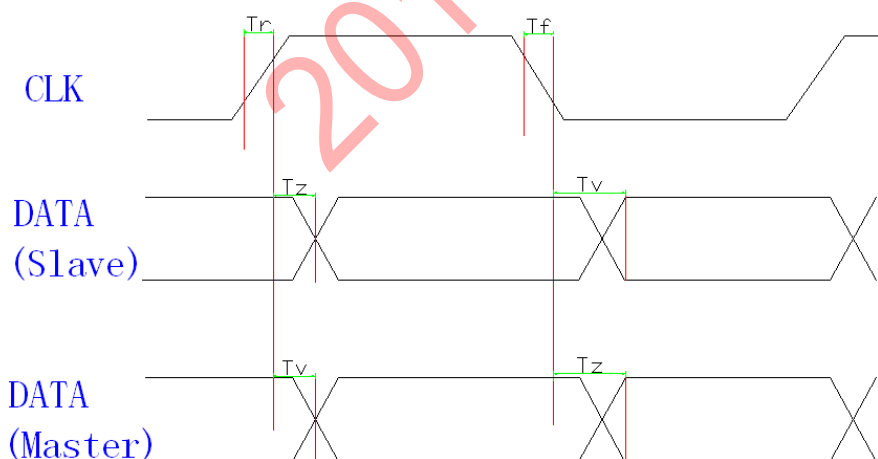
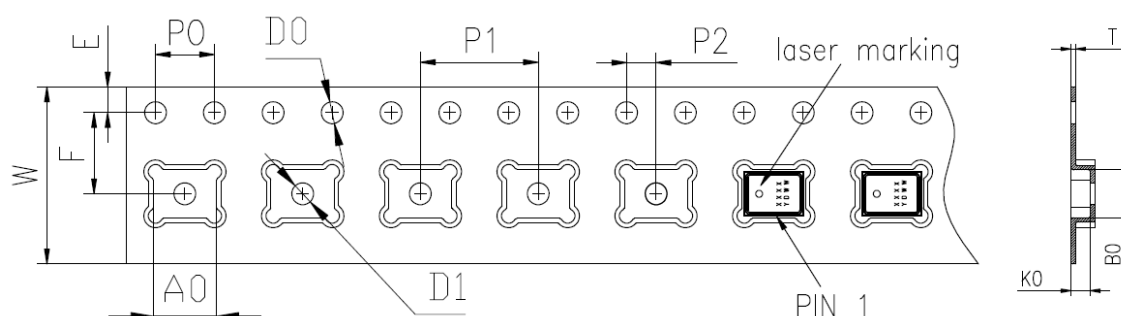


Figure 6. Timing Diagram for NSM0411DB



10. PACKAGING SPECIFICATIONS



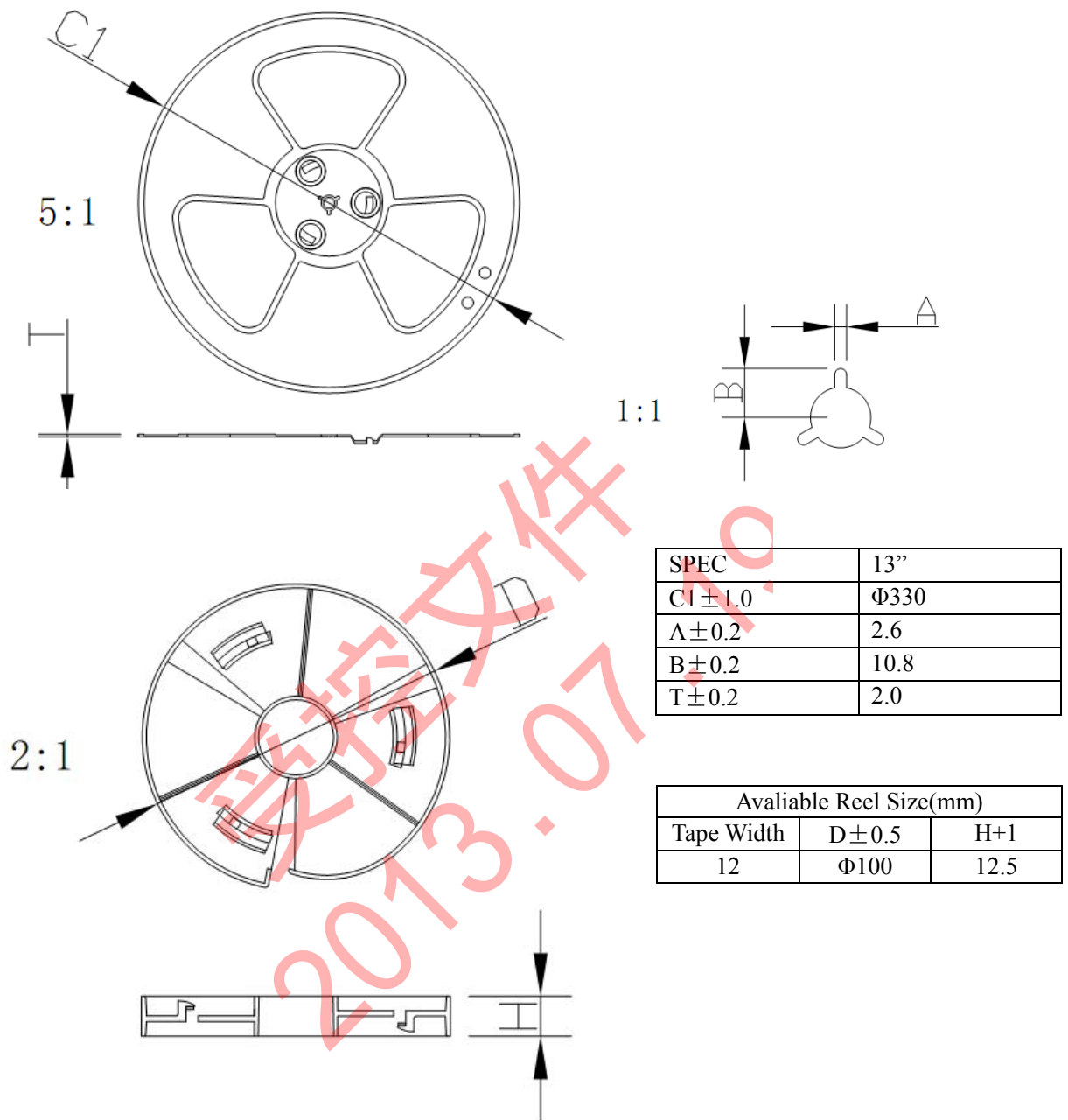
D0	1.5 ± 0.1	W	12.0 ± 0.30
D1	1.5 ± 0.1	E	1.75 ± 0.10
A0	4.2 ± 0.10	F	5.50 ± 0.10
B0	3.2 ± 0.10	P0	4.00 ± 0.10
K0	1.20 ± 0.10	P1	8.00 ± 0.10
T	0.3 ± 0.05	P2	2.00 ± 0.10

Notes:

- (1) Tape & Reel Per EIA-481 standard;
- (2) Label applied to external package and direct to reel

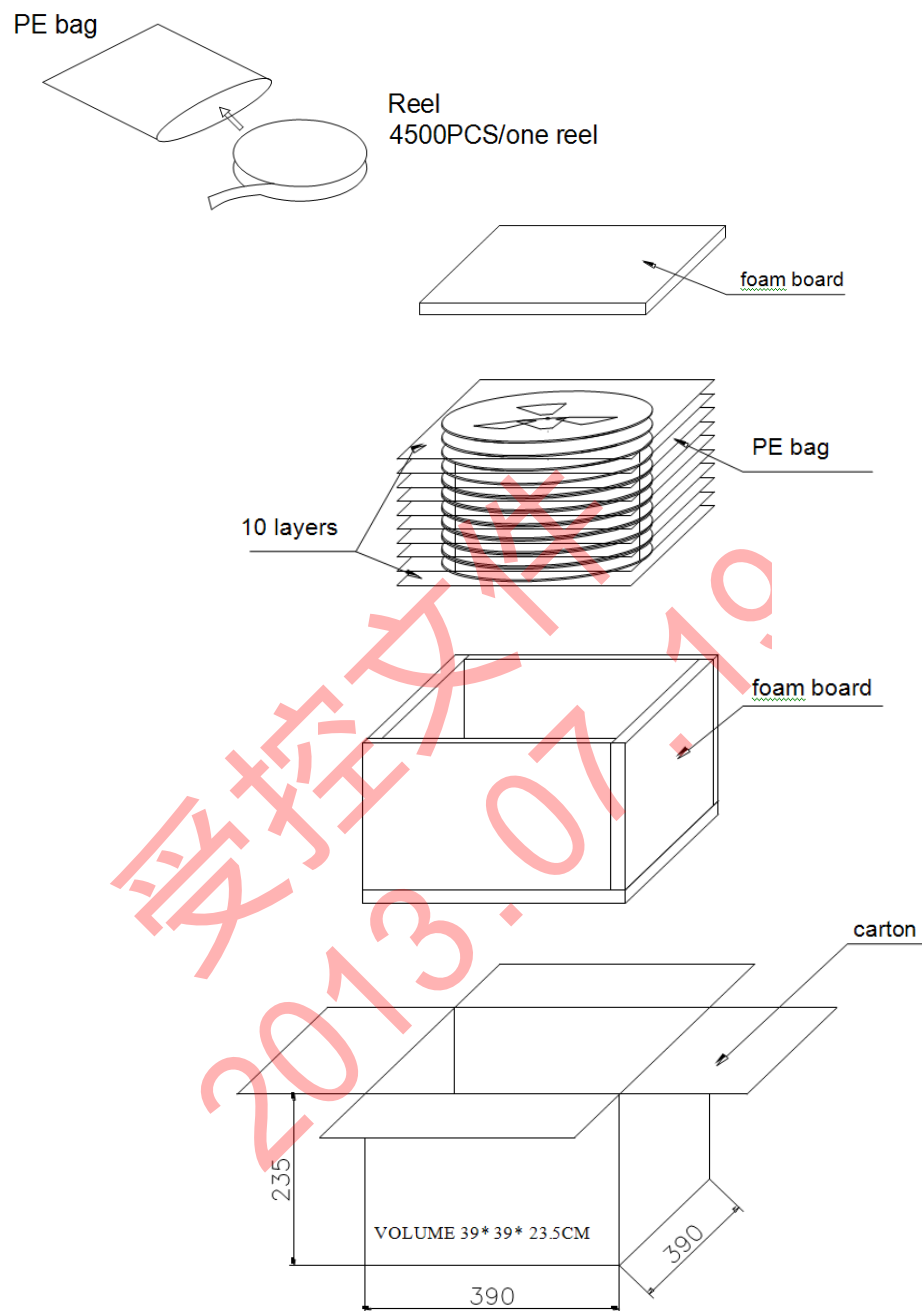
Order Part Number	Reel Diameter	Qty per Reel
NSM0411DB	13"	4,500

Figure 7. Tape Specification



4,500PCS PRODUCTS/1 reel

Figure 8. Reel Specification

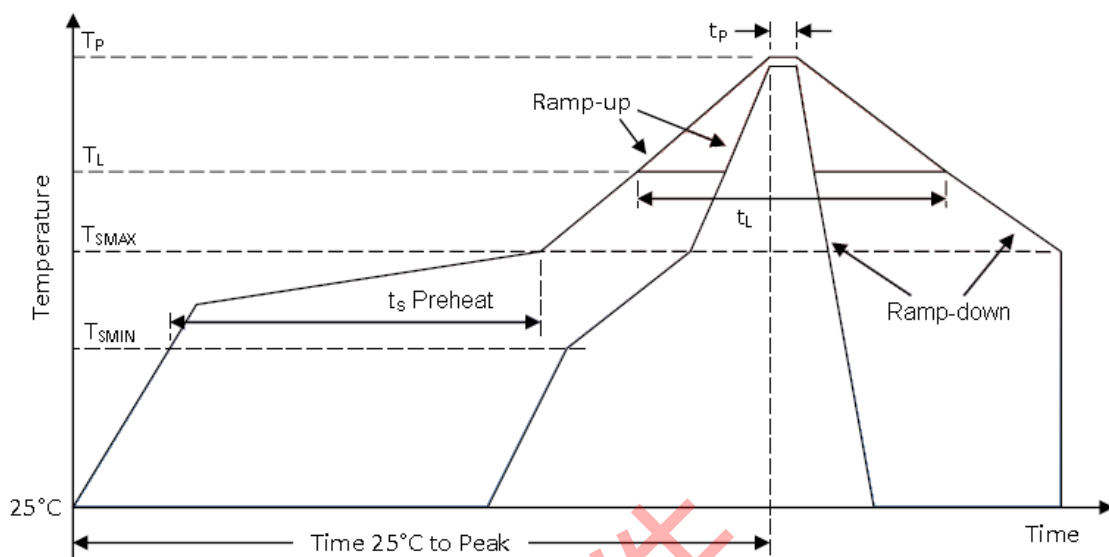


45,000 Pieces of Products per Carton

Figure 9. Packaging Specification



11. SOLDER REFLOW PROFILE



Profile Feature	Pb-Free
Average Ramp-up rate ($T_{S\text{MAX}}$ to T_P)	3°C/second max.
Preheat	
Temperature Min ($T_{S\text{MIN}}$)	150°C
Temperature Max ($T_{S\text{MAX}}$)	200°C
Time ($T_{S\text{MIN}}$ to $T_{S\text{MAX}}$) (t_s)	60-180 seconds
Time maintained above:	
Temperature (T_L)	217°C
Time (t_L)	60-150 seconds
Peak Temperature (T_P)	260°C
Time within 5°C of actual Peak Temperature (t_P)	20-40 seconds
Ramp-down rate(T_P to $T_{S\text{MAX}}$)	6°C/second max
Time 25°C to Peak Temperature	8 minutes max

Figure10. Recommended leadless solder reflow temperature profile

Notes:

1. Vacuuming over acoustical hole of the microphone is not allowed, because the Devices can be damaged by vacuum.
2. Washing the board after reflow process is not allowed, because board washing and Cleaning agents can damage the devices. A device should not be exposed to ultrasonic processing or cleaning.
3. Recommended number of reflow is no more than 5 times.



12. RELIABILITY SPECIFICATIONS

Test item	Detail	standard
Reflow Simulation	Refer to Sec.9 for solder reflow profile, total 5 times	/
Low Temperature Bias	Conditions:-40℃ Duration:168 hours while under bias	IEC 60068-2-2 Test Aa
High Temperature Bias	Conditions: 105℃ Duration:168 hours while under bias	IEC 60068-2-2 Test Ba
Thermal Shock	Conditions: 100 cycles of air-air thermal shock from -40℃ to 125℃ with 15-minute soaks	IEC 60068-2-4
Temperature/Humidity Bias	Conditions: 85℃ /85%RH environment while under bias for 168 hours	JESD 22-A101A-B
Mechanical Shock	Conditions:3 pulses of 10,000g in the X,Y and Z direction	IEC 60068-2-27 Test Ea
Vibration Test	Test axis: X,Y,Z Conditions: 2~400Hz 1 oct/min Test time: 15 mins per axis Use fixture during the testing	IEC 60068-2-6
Drop Test	Conditions: For each sample, drop by all corners, edges, surfaces respectively. Steel floor. Drop height: 1800mm.	IEC 60068-2-32
ESD	Conditions: ±8KV direct contact to the lid when unit is grounded ,±4KV direct contact to the I/O pins.10 times	IEC 61000-4-2

Note: Immediately after reliability test, the samples shall be stored under climatic conditions such as that normally exist in ordinary rooms or laboratories. Unless otherwise noted, the recovery period shall be 2 hours at least before performance testing. After test condition is performed, the sensitivity of the microphone shall not deviate more than 3dB from its initial value.



13. REVISION HISTORY:

Version	Date	Description	Change from	Change to
1.0	02/08/2012	Initial release		
1.1	20/08/2012	Updated Vibration test		
1.2	10/10/2012	Updated absolute maximum ratings		
1.3	27/02/2013	1. Add Sensitivity(Min) and (Max), units of Sensitivity、SNR and PSR change to dBFS、dB(A)、dBFS .(Section3) 2. Add “X”, “Y” mark.(Section6) 3. Update landing pattern.(Section7) 4. Delete the dimension not related to the specifications marked in packaging, K0 (1.50) change to K0 (1.20) . (Section10) 5. Updated Mechanical Shock 6.Updated Drop Test.	JEC 60068-2-27	IEC 60068-2-27
1.4	10/05/2013	Updated solder reflow profile		
1.5	03/06/2013	Updated section 7		
1.6	21/06/2013	Updated section 6		
1.7	19/07/2013	Updated section 10 packaging specification		

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