



NSM0405DT Top-Inlet Digital Silicon Microphone Specification

Rev. 2.3



1. GENERAL DESCRIPTION

NSM0405DT is a Silicon Microphone with digital output and top 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.

NSM0405DT 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.

NSM0405DT can be used to implement the array microphones. Speech quality can be significantly improved by combining two microphones and Fortemedia's SAMTM technology.

NSM0405DT 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)	-29	-26	-23	dBFS
Signal-to-Noise Ratio	@1KHz (0 dB = 1V/Pa)		56		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	3.072	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

© 2013Wuxi NeoMEMS Technologies, Inc.

Advanced datasheet subject to changes. The above information is the exclusive intellectual property of Wuxi NeoMEMS Technologies, Inc. and shall not be disclosed, distributed or reproduced without permission from Wuxi NeoMEMS Technologies, Inc.



4. FREQUENCY RESPONSE CURVE

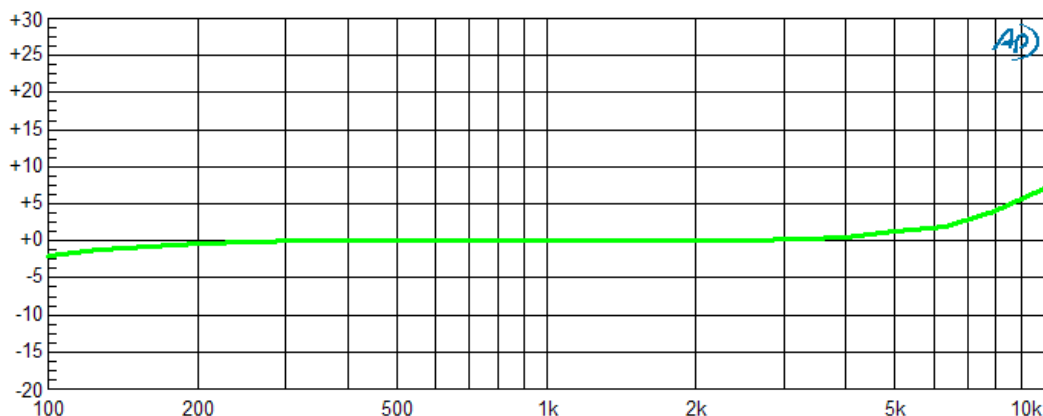
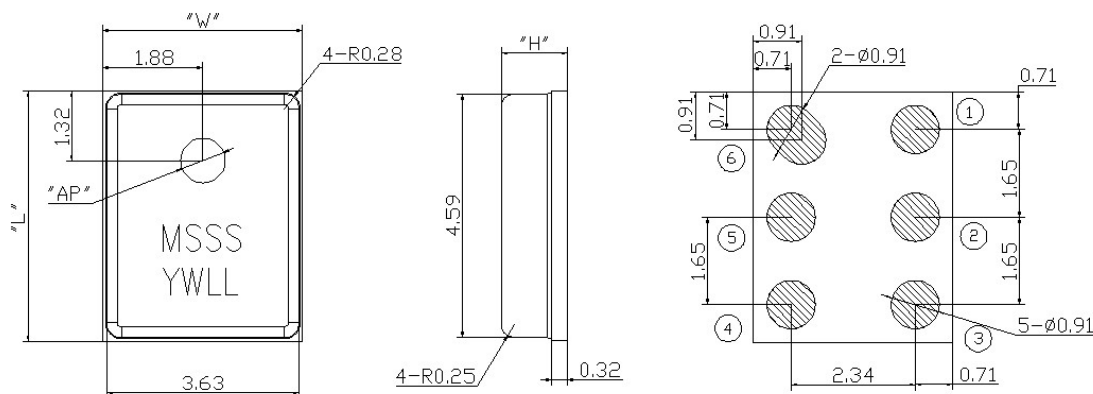


Figure1. Typical free field frequency response (Normalized to 1 KHz)

5. MECHANICAL SPECIFICATIONS



ITEM	DIMENSION	TOLERANCE	UNITS	PIN OUTPUT	
LENGTH(L)	4.72	±0.10	mm	PIN#	FUNCTION
WIDTH(W)	3.76	±0.10	mm	1	ENHANCE
HEIGHT(H)	1.25	±0.10	mm	2	CS
ACOUSTIC PORT(AP)	Φ0.84	±0.10	mm	3	GROUND (GND)
				4	CLOCK (CLK)
				5	DATA
				6	POWER (VDD)

Code marking		Remarks
SSS	stands for manufacturing (order) serial number	"M" 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	stands for Year from 0~9	
M	Month	
WLL	WLL is sub assembly lot number.	

Note: Dimensions are in millimeters unless otherwise specified.

Tolerance ±0.15mm unless otherwise specified

Figure2. Detailed mechanical drawings



6. RECOMMENDED CUSTOMER LANDING PATTERN

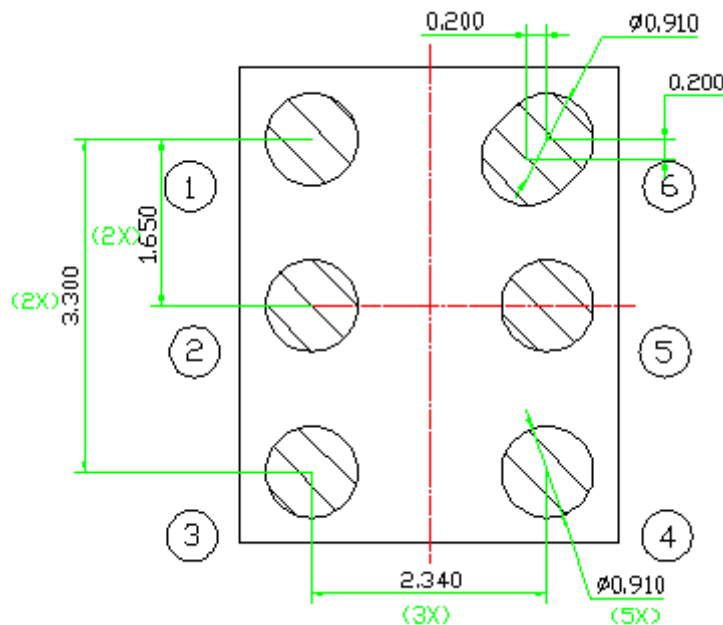


Figure3. Recommended landing pattern on customers' PCB

7. RECOMMENDED INTERFACE CIRCUIT

The Enhance pin must connect to VDD. Main microphone and Reference microphone Shares the pin of CLK, VDD&GND. The data pin of the Reference microphone connects to the CS pin of the main microphone. The CS pin of the Reference microphone connects to Ground. The data pin of Main microphone connect to the module output pin "DATA".

Output PDM data

The output format of NSM0405DT is 1-bit PDM. Oversampling ratio is 64 in typical case. It is comprised of low frequency input signal and high frequency out of band noise. To convert bit PDM into PCM format, a low pass filter is required to remove the out of band noise. This can be done by several 3 parties CODEC or Fortemedia's FM3X chip.

If input voltage is in the mid-level, the output will change alternatively between "zero" and "one". If input voltage is higher than mid-level, the output data stream will contain more "ones" Than "zeros".

Power down mechanism:

NSM0405DT will begin to operate when clock applied. It will enter power down mode when clock stops (no matter stops at high or low). Recommended minimum operation dock frequency is 1.024 MHz to avoid any un-wanted malfunction.

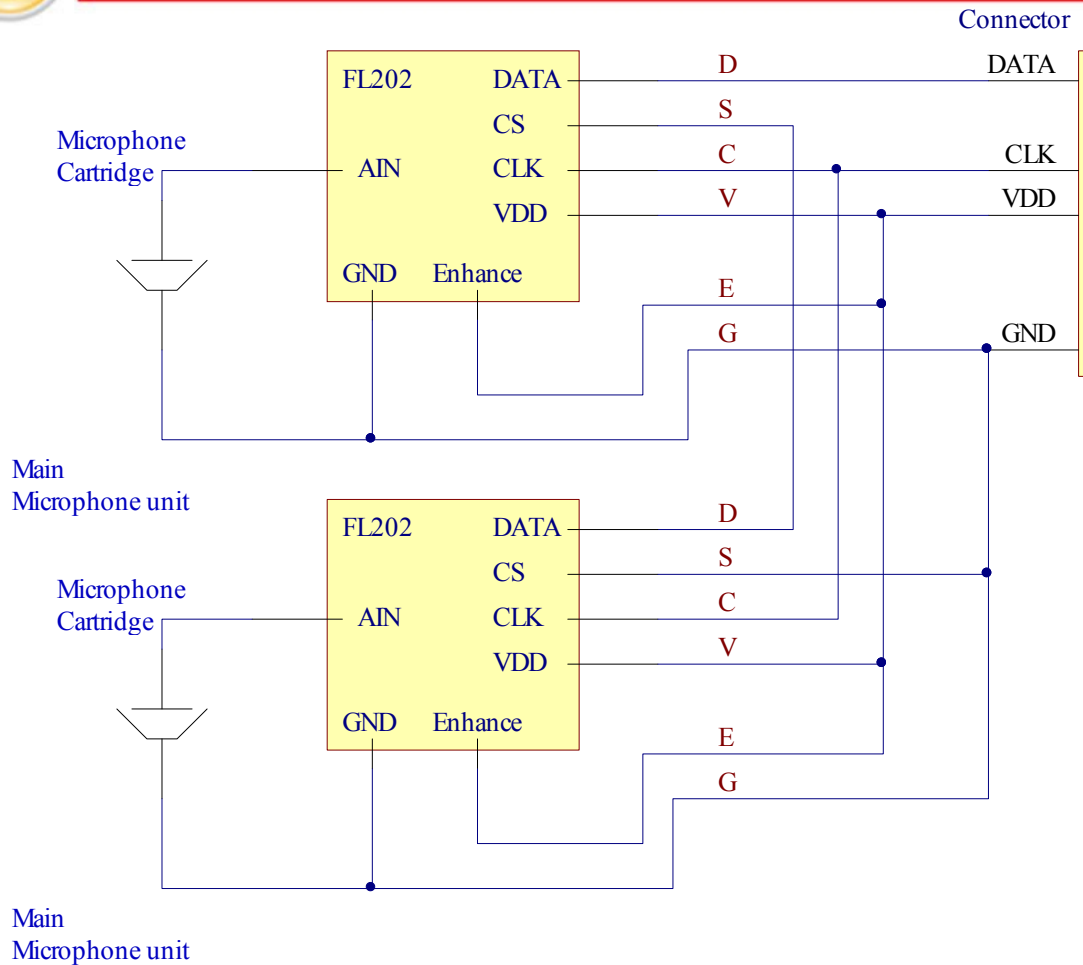


Figure 4 Schematic of NSM0405DT iSAM enhance array configuration (2 microphones array)

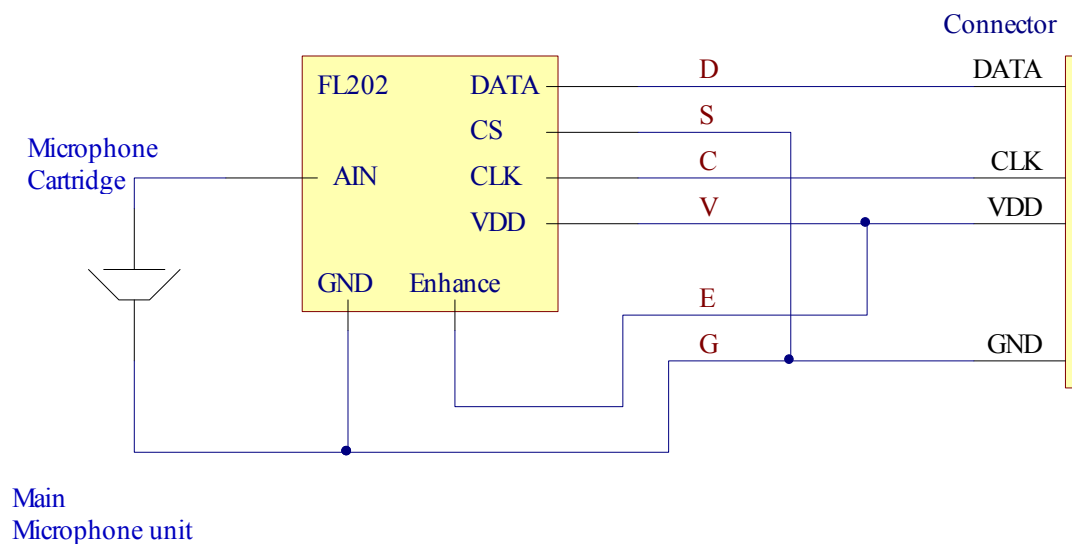


Figure 5. Schematic of NSM0405DT iSAM enhance configuration (1 microphone)



8. TIMING DIAGRAM

Digital Logic Characteristics

*under no loading condition

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OH}	Output Logic High Level		$V_{DD} * 0.9$			V
V_{OL}	Output Logic Low Level				$V_{DD} * 0.1$	V

Timing Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Comments
Clock Rising Time	T_R			10	ns	$R_L=1M\Omega$, $C_L=12pF$
Clock Falling Time	T_F			10	ns	$R_L=1M\Omega$, $C_L=12pF$
DATA into Hi Z Time	T_Z	0		15	ns	$R_L=1M\Omega$, $C_L=12pF$
DATA Valid Time	T_V	18		40	ns	$R_L=1M\Omega$, $C_L=12pF$
Clock Jitter				0.5	ns	Period jitter in RMS
Clock Duty Cycle		40	50	60	%	
Clock Frequency		1.024	2.048	3.072	MHZ	

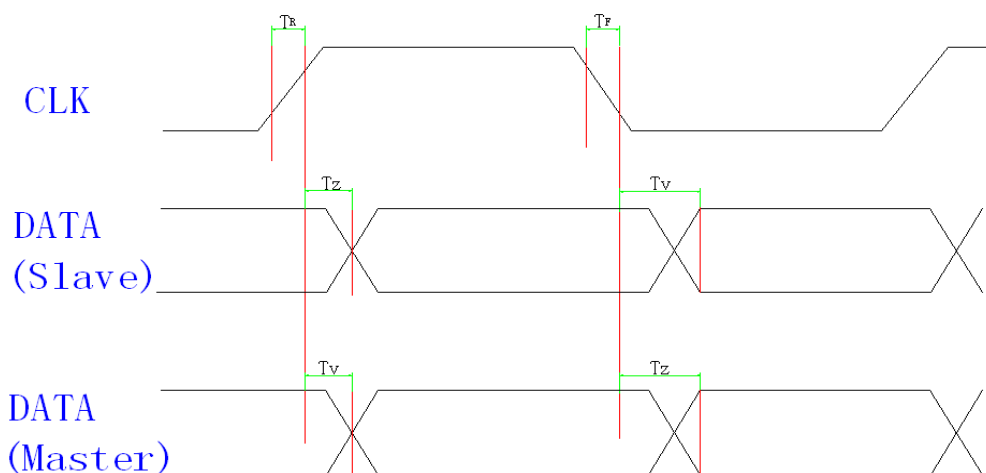


Figure 6. Timing Diagram for NSM0405DT

Note:

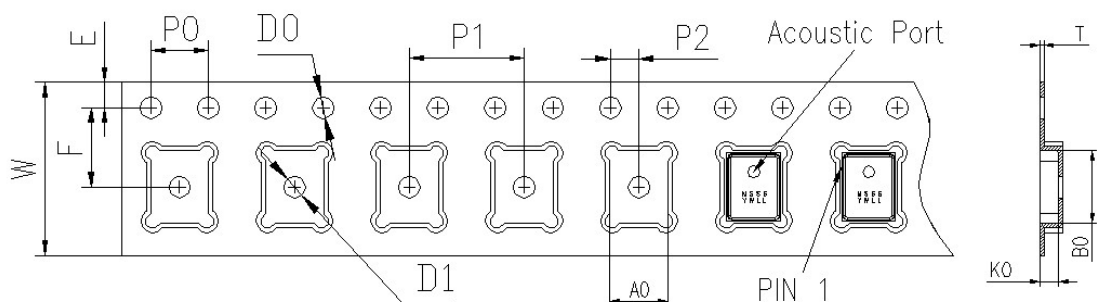
1. Slave is defined as CS = constant (GND). Master is defined as CS = toggle (CS input toggles in complimentary fashion).
2. Normally, Enhance mode only applies to two microphones application with Slave's CS Input tied to GND, while Master's CS input is connected to Slave's DATA output. Final PDM data is available from Master's DATA output.
3. If one microphone is used in Enhance mode, the DATA waveform will be waveform of the slave microphone.
4. Please refer to reference schematic in Section 7.

© 2013 Wuxi NeoMEMS Technologies, Inc.

Advanced datasheet subject to changes. The above information is the exclusive intellectual property of Wuxi NeoMEMS Technologies, Inc. and shall not be disclosed, distributed or reproduced without permission from Wuxi NeoMEMS Technologies, Inc.



9. PACKAGING SPECIFICATIONS



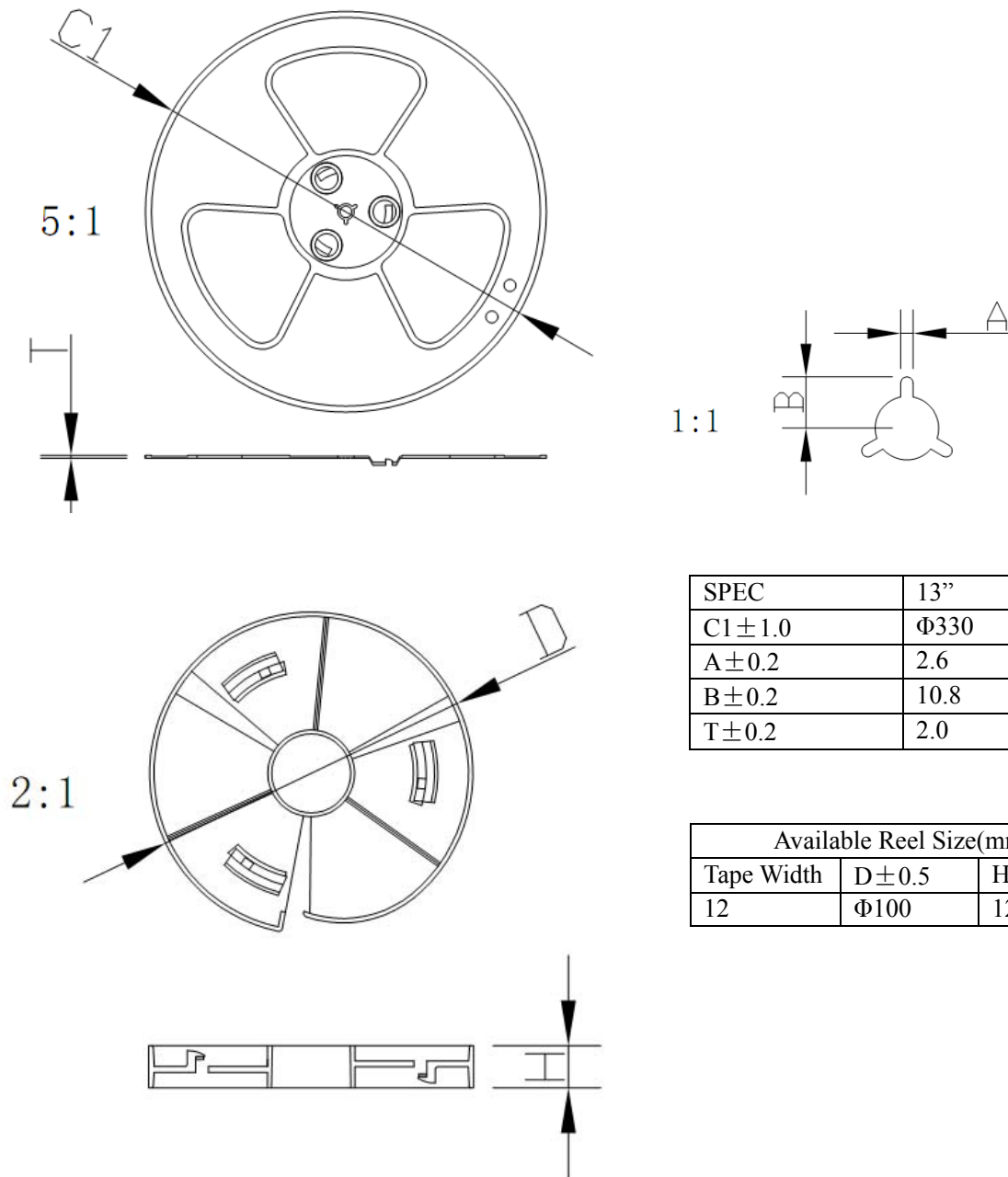
D0	1.5 ± 0.1	W	12.0 ± 0.30
D1	1.5 ± 0.1	E	1.75 ± 0.10
A0	4.06 ± 0.10	F	5.50 ± 0.10
B0	5.02 ± 0.10	P0	4.00 ± 0.10
K0	1.50 ± 0.10	P1	8.00 ± 0.10
T	0.3 ± 0.05	P2	2.00 ± 0.10

Notes:

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

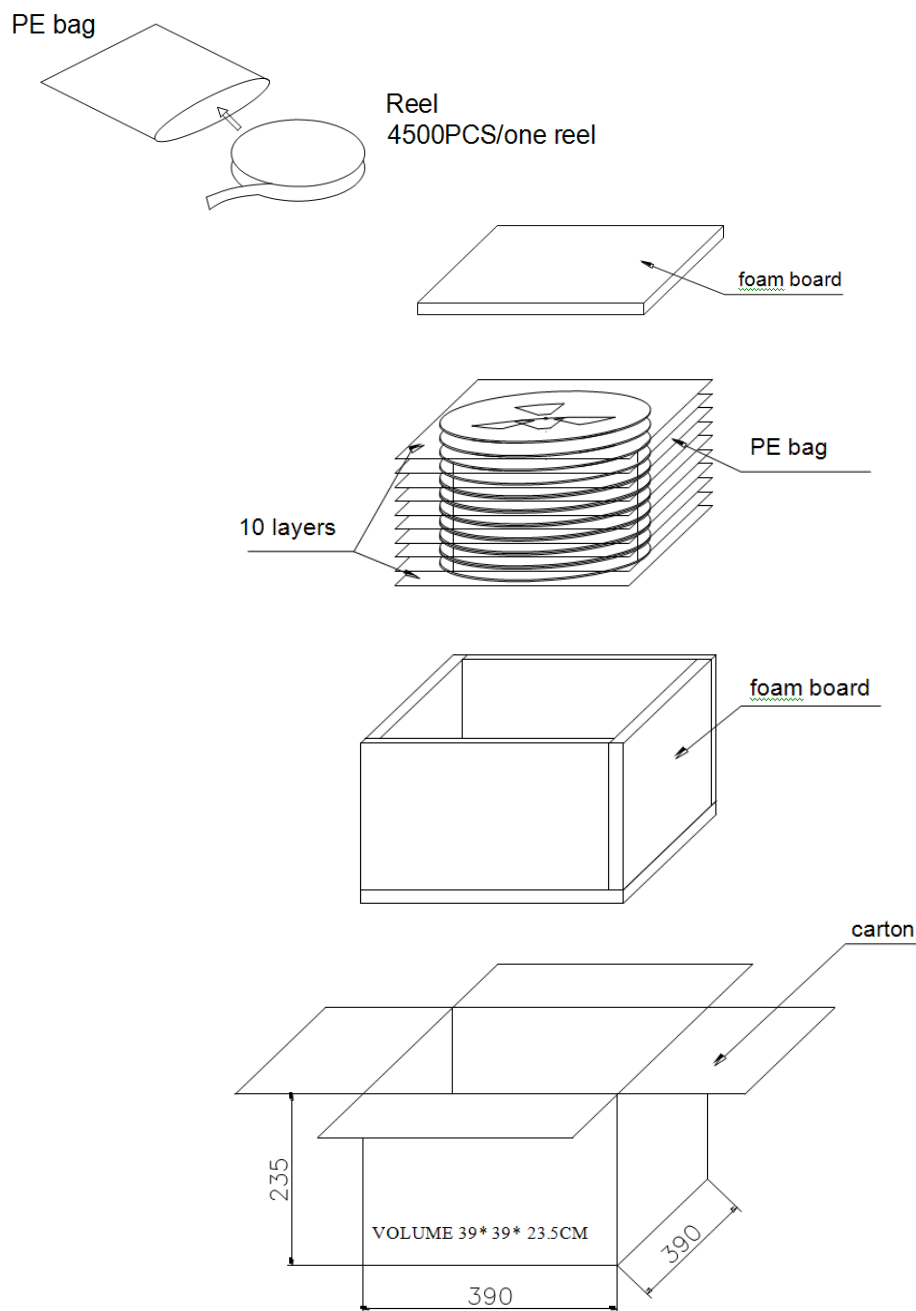
Order Part Number	Reel Diameter	Qty per Reel
NSM0405DT	13"	4,500

Figure 7. Tape Specification



4,500PCS PRODUCTS/1 reel

Figure 8. Reel Specification

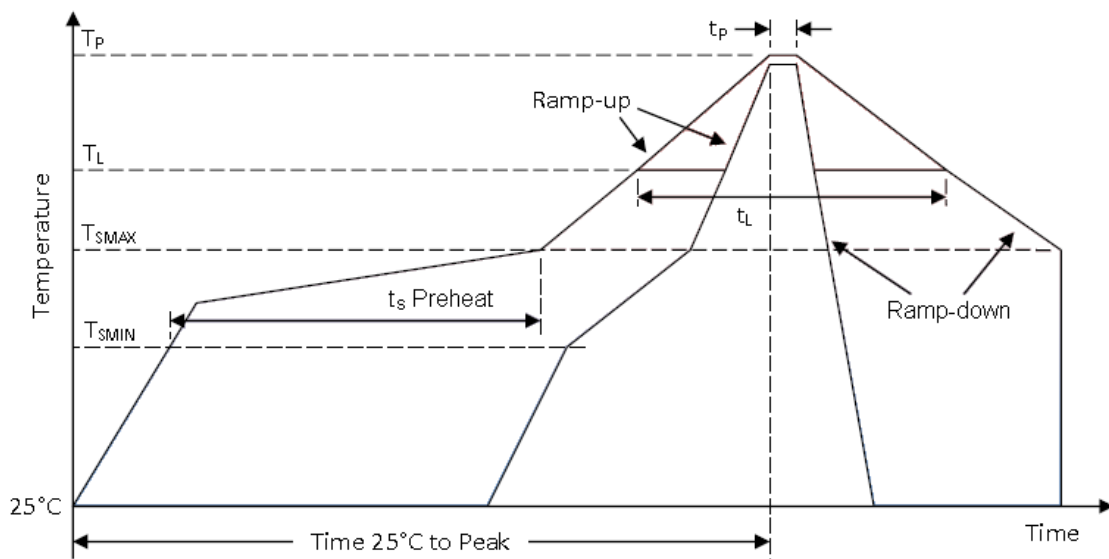


45,000 Pieces of Products per Carton

Figure 9. Packaging Specification



10. 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 ($T_{S\text{MIN}}$) Temperature Max ($T_{S\text{MAX}}$) Time ($T_{S\text{MIN}}$ to $T_{S\text{MAX}}$) (t_s)	150°C 200°C 60-180 seconds
Time maintained above: Temperature (T_L) Time (t_L)	217°C 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

Figure 10 .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 device. A device should not be exposed to ultrasonic processing or cleaning.
3. Recommended number of reflow is no more than 5 times.



11. 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.



12. REVISION HISTORY:

Version	Date	Description	Change from	Change to
1.0	08/09/2011	Initial release		
1.1	10/01/2012	Corrected time of temperature bias	1000 hours	168 hours
1.2	19/01/2012	Corrected PSR for testing		
1.3	06/06/2012	Corrected PSR for testing		
1.4	14/06/2012	Update mechanical specification and solder reflow profile		
1.5	05/07/2012	Updated Reel Specification		
1.6	20/08/2012	Updated Vibration Test		
1.7	10/10/2012	Updated absolute maximum ratings		
1.8	27/02/2013	Updated general description; Units of Sensitivity、SNR and PSR change to dBFS、dB(A) 、 dBFS .(Section3); Updated mechanical specifications; Delete the dimension not related to the specifications marked in packaging; Updated Drop Test. Updated Mechanical Shock	JEC 60068-2-27	IEC 60068-2-27
1.9	10/05/2013	Updated solder reflow profile		
2.0	03/06/2013	Updated section 7		
2.1	08/06/2013	Updated section 5		
2.2	19/07/2013	Updated section 9 packaging specification		
2.3	16/01/2014	Trace code change		

Disclaimer: The information contained in this literature is based on our experience to date and is believed to be reliable and it is subject to change without notice. It is intended as a guide for use by persons having technical skill at their own discretion and risk. We do not guarantee favorable results or assume any liability in connection with its use. Dimensions contained herein are for reference purposes only. For specific dimensional requirements consult factory. This publication is not to be taken as a license to operate under, or recommendation to infringe any existing patents. This supersedes and voids all previous literature.