

Waterproof Omni-directional Microphone with Digital Output

DESCRIPTION

The ZTS6431E is a high quality, low cost, low power digital output top-ported omni-directional MEMS microphone. ZTS6431E consists of a MEMS microphone element and a preamplifier. ZTS6431E has a high SNR and flat wideband frequency response with $\pm 2\text{dB}$ in 7KHz. Sensitivity is a single tone distribution in a narrow window with under $\pm 1\text{dB}$, resulting in natural sound with high intelligibility. Due to built-in filter, ZTS6431E shows high immunity to EMI.

The ZTS6431E is available in a thin 4.00mm \times 3.00mm \times 1.15mm surface-mount package. In addition, ZTS6431E equips with a mesh on top of the cap for waterproof and anti-dust. It is reflow solder compatible with no sensitivity degradation. The ZTS6431E is halide free.

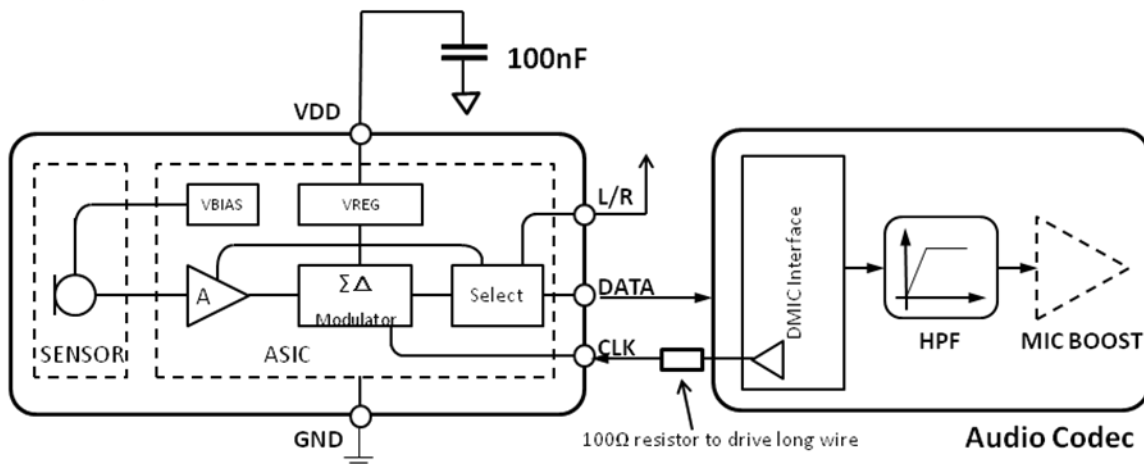
APPLICATIONS

- Mobile telephones
- PDAs
- Digital video cameras
- Portable media devices with audio input

ORDERING INFORMATION

PART	RoHS	Ship, Quantity
ZTS6431E	Yes	Tape and Reel, 5.2K

Typical Applications

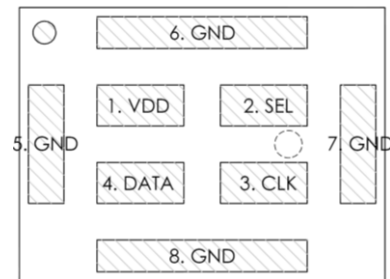


Label	Select	Drives Data After	High-Z After
Data_H	High	Rising Clock Edge	Falling Clock Edge
Data_L	Low (default)	Falling Clock Edge	Rising Clock Edge

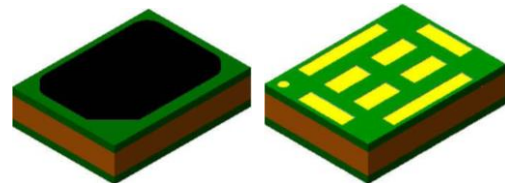
FEATURES

- 4.00mm \times 3.00mm \times 1.15mm surface-mount package
- Stable sensitivity over power supply range of 1.60V-3.60V •
- SNR of 65dB(A)
- Sensitivity of -26dB FS
- Multi Chip Module (MCM) Package
- Waterproof IP67

Pins Configuration and Description



Bottom View



Top

Bottom

Isometric Views of ZTS6431E Microphone Package

Absolute Maximum Ratings

CLOCK to Ground -0.3V to +5.0V
 SELECT, V_{DD}, DATA to Ground -0.3V to +5.0V
 Input Current ±5mA
 Operating Temperature Range -40°C to +100°C
 Storage Temperature Range -40°C to +100°C

CAUTION: Stresses above those listed in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electro-Static Discharge Sensitivity

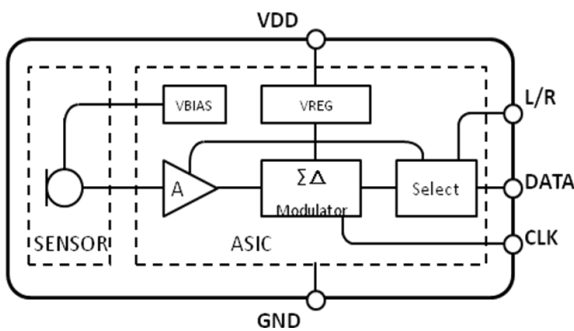


This integrated circuit can be damaged by ESD. It is recommended that all integrated circuits be handled with proper precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure.

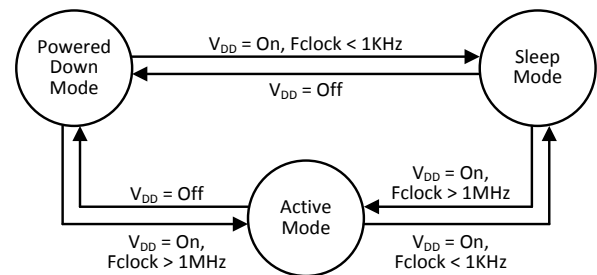
Pins Description

Pin	Symbol	Description
1	VDD	Power Supply (V _{DD}).
2	SELECT	Select.
3	CLOCK	Clock.
4	DATA	Output.
5,6,7,8	GND	Ground

Microphone Block Diagram



Microphone State Diagram



Specifications

($T_A = +15^{\circ}\text{C} \sim +25^{\circ}\text{C}$, $V_{DD} = +1.8\text{V}$, $f_{\text{clock}} = 3.072\text{MHz}$, R.H. = 60%~70%, no load, unless otherwise noted.)

PARAMETER	Symbol	TEST CONDITIONS		MIN	TYP	MAX	UNIT	
Supply Voltage (Note 1)	V_{DD}			1.60		3.60	V	
Current Consumption (Note 1,6)	I_{DD}				600		μA	
Standby Current (Sleep Mode) (Note 5,6)	I_{STANDBY}	$f_{\text{clock}} < 1\text{KHz}$			1	5	μA	
Directivity				Omni-directional				
Sensitivity (Note 1)	S	94dB SPL @ 1KHz		-27	-26	-25	dB FS	
Signal to Noise Ratio	SNR	94dB SPL @ 1KHz, A-weighted			65		dB(A)	
Total Harmonic Distortion	THD	100dB SPL @ 1KHz				1	%	
		114dB SPL @ 1KHz				10	%	
Power Supply Rejection	PSR	217Hz, 100mV Vp-p, square wave on V_{DD}	$V_{DD} = 1.8\text{V}$		-82		dB FS	
			$V_{DD} = 3.3\text{V}$		-80			
Polarity		Increasing sound pressure		Increasing density of 1's				
Fall-Asleep Time (Note 2,3)		$V_{DD} = \text{On}$, $f_{\text{clock}} < 1\text{KHz}$				10	ms	
Wake-Up Time (Note 2,4)		$V_{DD} = \text{On}$, $f_{\text{clock}} \geq 1\text{MHz}$				10	ms	
Short Circuit Output Current	I_{SC}	Grounded output pin			1	10	mA	
Output Load	C_{LOAD}					100	pF	
Data Format				1/2 cycle PDM				
Clock Frequency	f_{clock}			1.0		3.25	MHz	
Clock Duty Cycle				40		60	%	
Clock Rise Time	t_{cr}					10	ns	
Clock Fall Time	t_{ct}					10	ns	
Logic Input/Output Low	V_{IOL}	$I_{\text{out}} = 1\text{mA}$		-0.3		$0.35 \times V_{DD}$	V	
Logic Input/Output High	V_{IOH}	$I_{\text{out}} = 1\text{mA}$		$0.65 \times V_{DD}$		$V_{DD} + 0.3$	V	
Delay Time for Valid Data	t_{dv}	CLK = 3.072MHz, Oscilloscope: APx525 (probe Cin = 24pF)	Data Transition High	1.8V	43		190	ns
				3.3V	33		129	
			Data Transition Low	1.8V	44		189	
				3.3V	34		130	
Delay Time for High Z	t_{dz}	CLK = 3.072MHz, Oscilloscope: APx525 (probe Cin = 24pF)	Data Transition High	1.8V		27		ns
				3.3V		9		
			Data Transition Low	1.8V		22		
				3.3V		18		
Maximum Acoustic Input					120		dB SPL	
Settling time	t_s			1.8V		2.65	5.5	ms
				3.3V				
Startup Time		Powered Down → Active Mode		1.8V		2.65	5.5	ms
				3.3V				

($T_A = +15^{\circ}\text{C} \sim +25^{\circ}\text{C}$, $V_{DD} = +1.8\text{V}$, $f_{\text{clock}} = 2.4\text{MHz}$, R.H. = 60%~70%, no load, unless otherwise noted.)

PARAMETER	Symbol	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Supply Voltage (Note 1)	V_{DD}		1.60		3.60	V	
Current Consumption (Note 1,6)	I_{DD}			580		μA	
Standby Current (Sleep Mode) (Note 5,6)	I_{STANDBY}	$f_{\text{clock}} < 1\text{KHz}$		1	5	μA	
Directivity			Omni-directional				
Sensitivity (Note 1)	S	94dB SPL @ 1KHz	-27	-26	-25	dB FS	
Signal to Noise Ratio	SNR	94dB SPL @ 1KHz, A-weighted		65		dB(A)	
Total Harmonic Distortion	THD	100dB SPL @ 1KHz			1	%	
		114dB SPL @ 1KHz			10	%	
Power Supply Rejection	PSR	217Hz, 100mV Vp-p, square wave on V_{DD}	$V_{DD} = 1.8\text{V}$ $V_{DD} = 3.3\text{V}$	-82 -80		dB FS	
Polarity		Increasing sound pressure	Increasing density of 1's				
Fall-Asleep Time (Note 2,3)		$V_{DD} = \text{On}$, $f_{\text{clock}} < 1\text{KHz}$			10	ms	
Wake-Up Time (Note 2,4)		$V_{DD} = \text{On}$, $f_{\text{clock}} \geq 1\text{MHz}$			10	ms	
Short Circuit Output Current	I_{SC}	Grounded output pin		1	10	mA	
Output Load	C_{LOAD}				100	pF	
Data Format			1/2 cycle PDM				
Clock Frequency	f_{clock}		1.0		3.25	MHz	
Clock Duty Cycle			40		60	%	
Clock Rise Time	t_{cr}				10	ns	
Clock Fall Time	t_{ct}				10	ns	
Logic Input/Output Low	V_{IOL}	$I_{out} = 1\text{mA}$	-0.3		$0.35 \times V_{DD}$	V	
Logic Input/Output High	V_{IOH}	$I_{out} = 1\text{mA}$	$0.65 \times V_{DD}$		$V_{DD} + 0.3$	V	
Delay Time for Valid Data	t_{dv}	CLK = 3.072MHz, Oscilloscope: APx525 (probe $C_{in} = 24\text{pF}$)	Data Transition High	1.8V	43	190	ns
			Data Transition High	3.3V	33	129	
			Data Transition Low	1.8V	44	189	
			Data Transition Low	3.3V	34	130	
Delay Time for High Z	t_{dz}	CLK = 3.072MHz, Oscilloscope: APx525 (probe $C_{in} = 24\text{pF}$)	Data Transition High	1.8V		27	ns
			Data Transition High	3.3V		9	
			Data Transition Low	1.8V		22	
			Data Transition Low	3.3V		18	
Maximum Acoustic Input				120		dB SPL	
Settling time	t_s		1.8V	3.4	6	ms	
			3.3V				
Startup Time		Powered Down \rightarrow Active Mode	1.8V	3.4	6	ms	
			3.3V	3.2	5.6		

Note 1: 100% tested.

Note 2: Valid microphone states are: Power Down Mode (mic off), Sleep Mode (low current, no output, fast start-up), and Active Mode (normal operation).

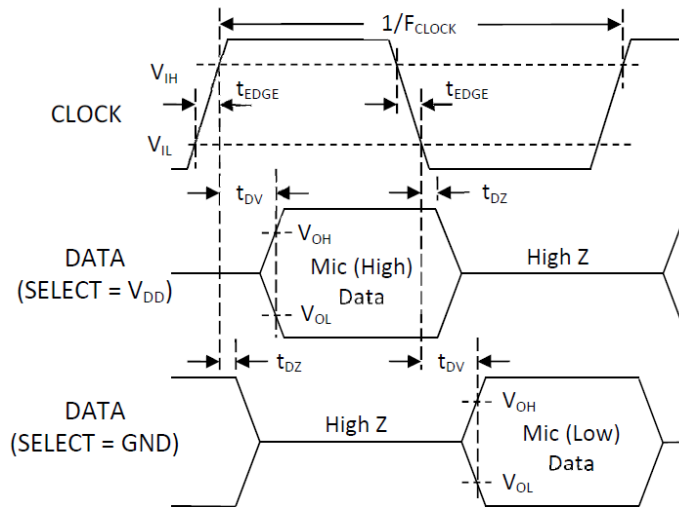
Note 3: Time from $f_{\text{clock}} < 1\text{KHz}$ to sleep current specification is met when transitioning from Active to Sleep Mode.

Note 4: Time from $f_{\text{clock}} \geq 1\text{MHz}$ to all applicable specifications when transitioning from Sleep to Active Mode.

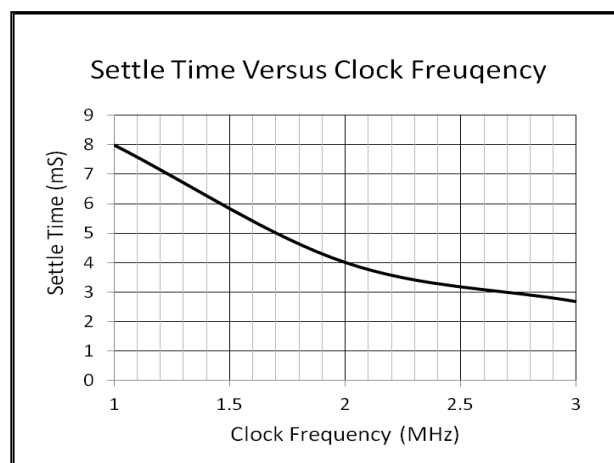
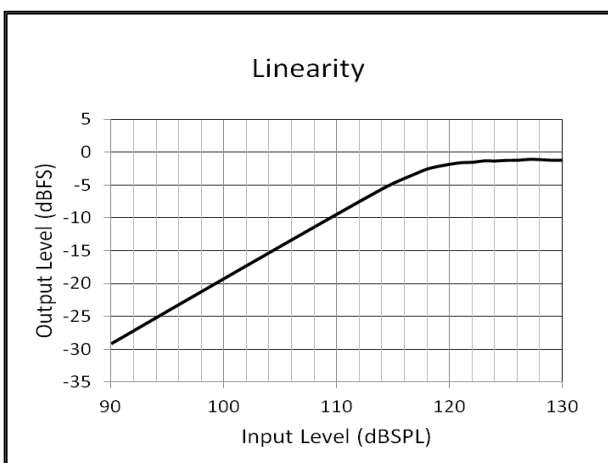
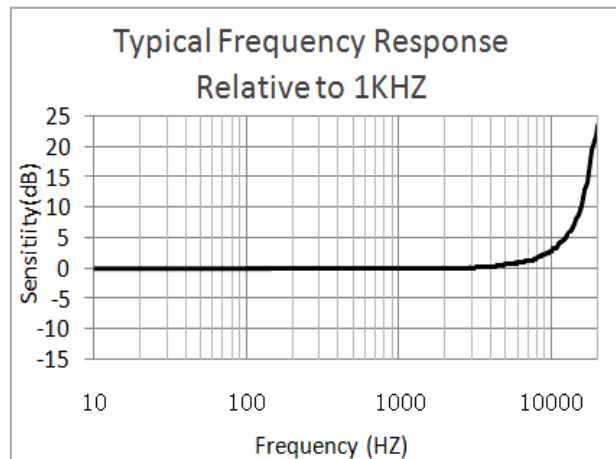
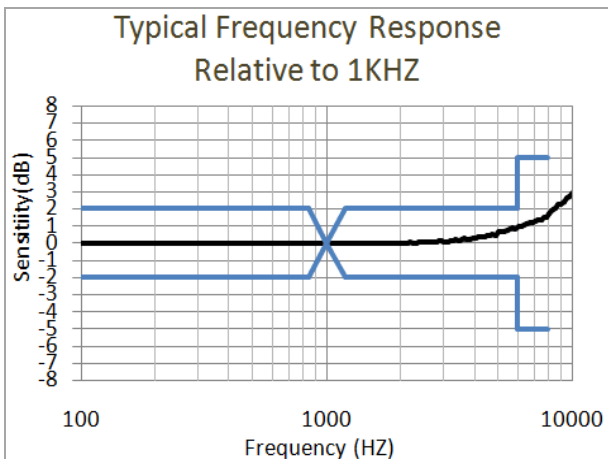
Note 5: $\Delta I_{DD} = 0.5 \times V_{DD} \times C_{LOAD} \times f_{\text{clock}}$

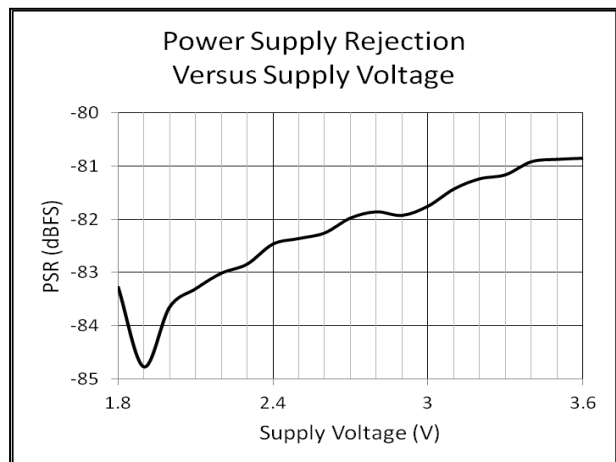
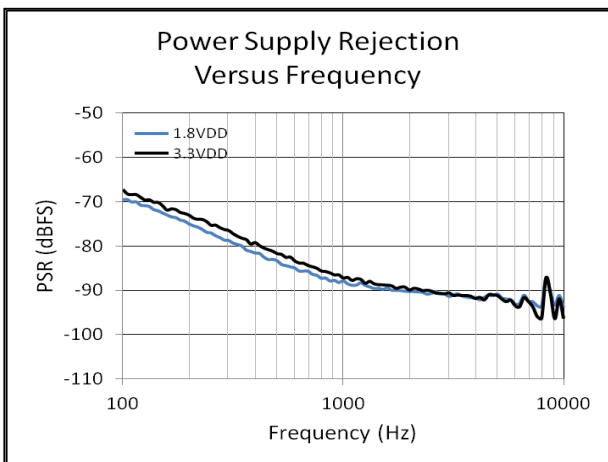
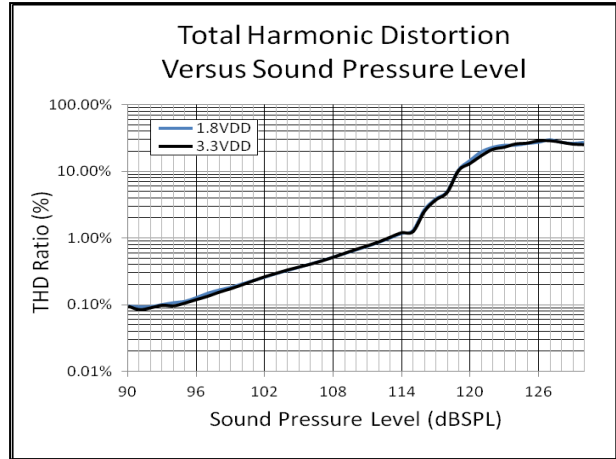
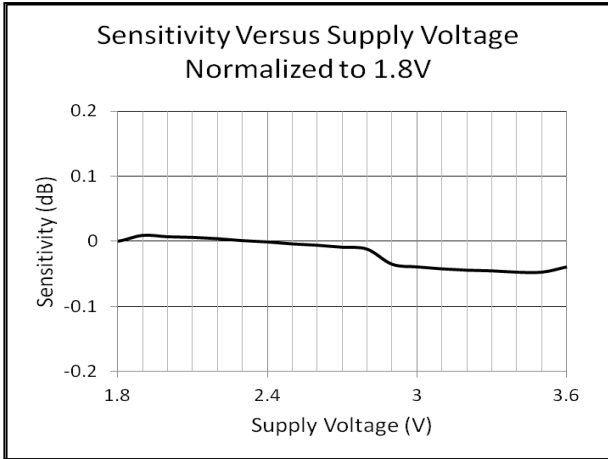
Note 6: Specified max values are measured at $V_{DD} = +3.6\text{V}$.

Timing Diagram



Typical Performance Characteristics



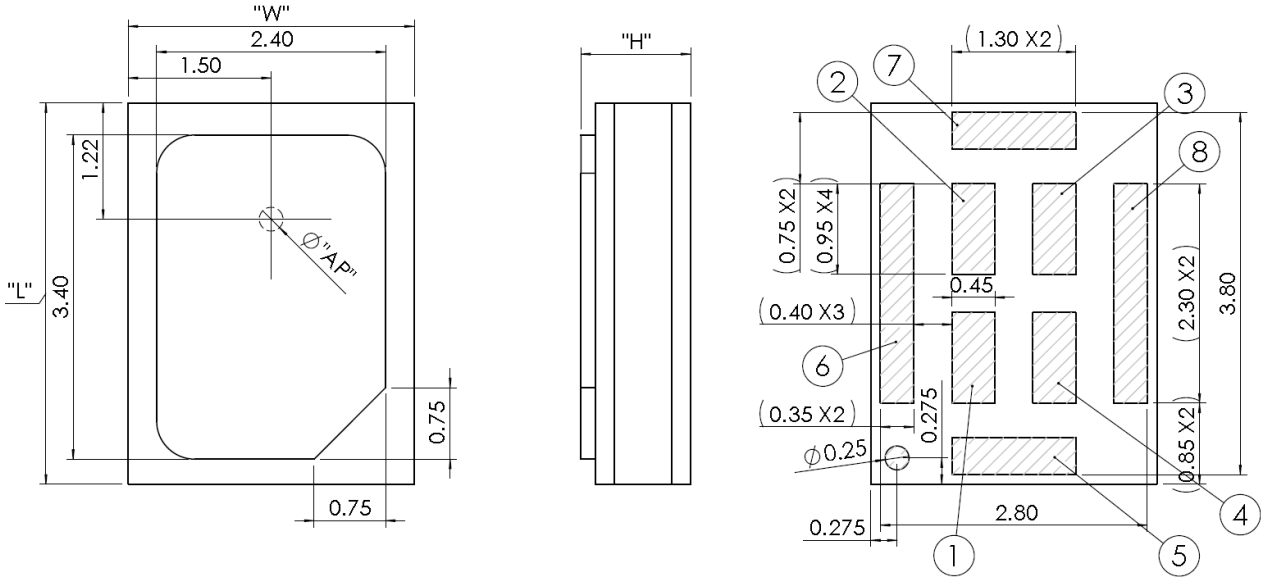


Reliability Tests

The microphone sensitivity after stress must deviate by no more than $\pm 3\text{dB}$ from the initial value.

1. Heat Test, Operational	Temperature: $125\pm 3^{\circ}\text{C}$ Duration: 1000 hours Voltage: Applied
2. Cold Test, Operational	Temperature: $-40\pm 3^{\circ}\text{C}$ Duration: 1000 hours Voltage: Applied
3. Heat Test, Non-Operational	Temperature: $125\pm 3^{\circ}\text{C}$ Duration: 1000 hours Voltage: Not Applied
4. Cold Test, Non-Operational	Temperature: $-40\pm 3^{\circ}\text{C}$ Duration: 1000 hours Voltage: Not Applied
5. Thermal Shock Test, Non-Operational	Temperature: $-40\pm 3^{\circ}\text{C}$ and $125\pm 3^{\circ}\text{C}$ Duration: 30 minutes each, during 5 minutes ramp, 256 cycles Voltage: Not applied
6. Temperature humidity storage	Temperature: $85\pm 3^{\circ}\text{C}$ Humidity: $85\pm 3\%RH$ Duration: 1000 hours
	Temperature: $65\pm 3^{\circ}\text{C}$ Humidity: $95\pm 3\%RH$ Duration: 168 hours
7. Free Fall Test 1.5m	Placed inside test fixture and dropped on concrete from height 1.5m. 4 times by each surface and corner
8. Vibration	4 cycles of 20 to 2000 Hz sinusoidal sweep with 20G peak acceleration lasting 12 minutes in X, Y, and Z directions
9. Mechanical Shock	5 pulses of 10000g in each of the $\pm X$, $\pm Y$, and $\pm Z$ directions
10. Electrostatic Discharge Test	Capacitance: 150pF Resistance: 330 Ω Duration: 10 times Air Discharge: Level 4(+/-15kV) Direct contact discharge: Level 4 (+/-8kV)
11. Human Body Mode	± 2000 Volt
12. Charged-Device Model	± 250 Volt
13. Reflow	5 reflow cycles with peak temperature of 260°C
14. Solderability	$245\pm 5^{\circ}\text{C}$, 5sec, 95% Tin on pad surface
15. Tumble test	300 tumbles from a height of 1m onto a steel base.
16. HAST	Temperature: $130\pm 3^{\circ}\text{C}$ Humidity: $85\pm 3\%RH$ Duration: 96 hours Voltage: Applied
17. Air Blow	0.45MPa, distance 3cm, time 10s

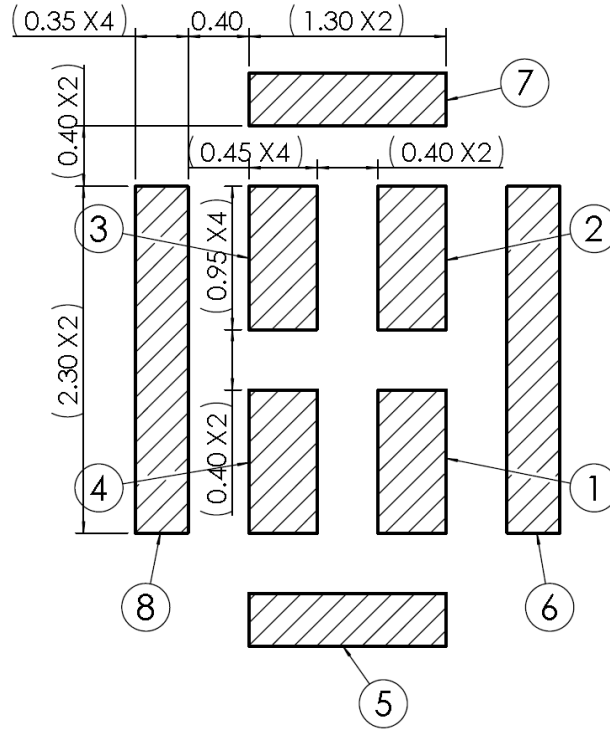
MECHANICAL SPECIFICATIONS



Item	Dimension	Tolerance
Length (L)	4.00	±0.10
Width (W)	3.00	±0.10
Height (H)	1.15	±0.10
Acoustic Port (AP)	Ø0.25	±0.075

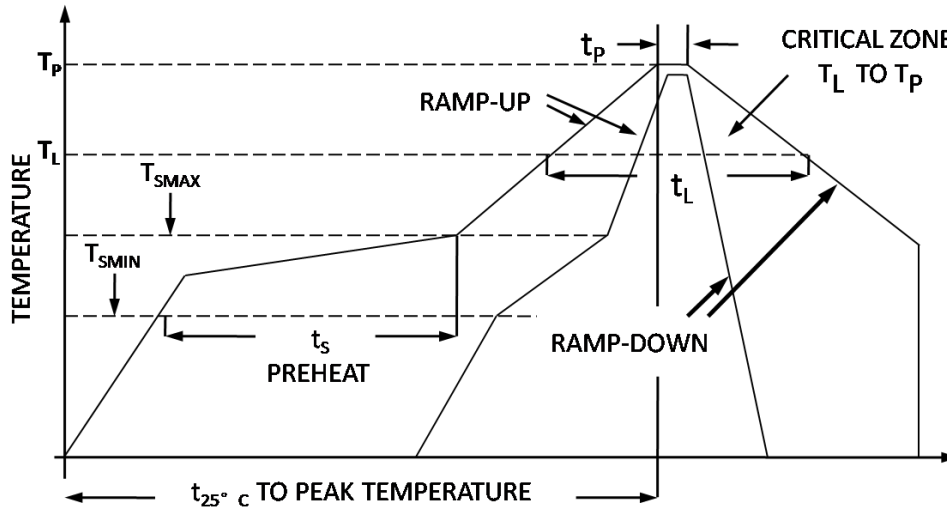
RECOMMENDED CUSTOMER LAND PATTERN

The recommended PCB land pattern for the ZTS6431E should have a 1:1 ratio to the solder pads on the microphone package. Care should be taken to avoid applying solder paste to the sound hole in PCB. The dimensions of suggested solder paste pattern refer to the land pattern **which should be shrunk by 0.025 per side**.



SOLDER FLOW PROFILE

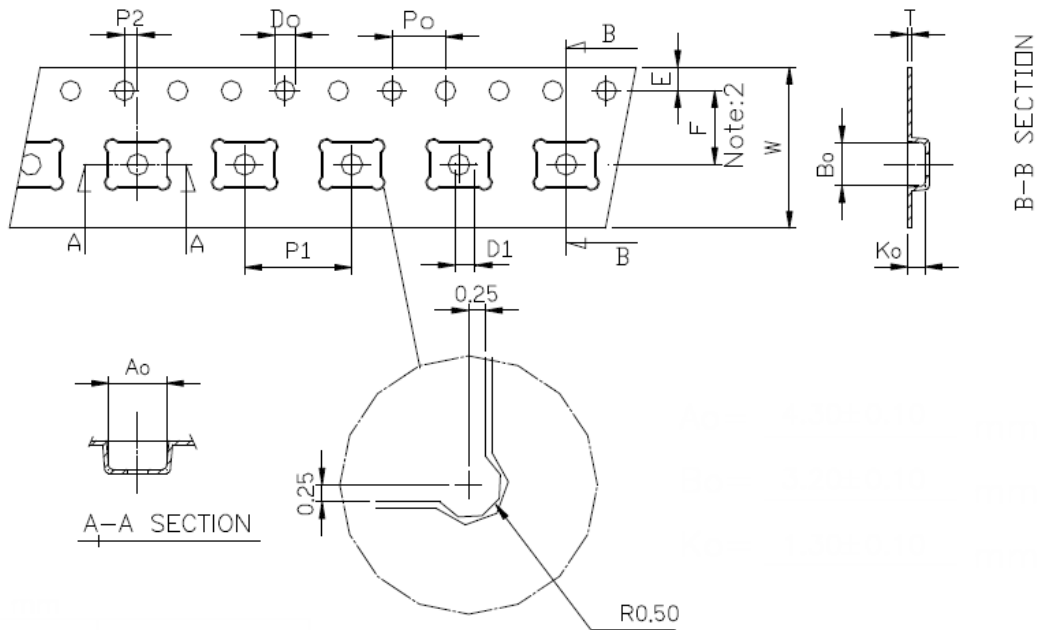
The reflow profile specified in this section describes expected maximum heat exposure of components during the reflow process of NMP product PWBs. Temperature is measured on top of component. All components have to tolerate at least this profile five times (5x) without affecting electrical performance, mechanical performance or reliability.



Pb-free and Sn63/Pb37 reflow profile requirements for soldering heat resistance:

Parameter	Reference	Pb-Free	Sn63/Pb37
Average Ramp Rate	T_L to T_p	1.25°C/sec max	1.25 °C /sec max
Preheat	Minimum Temperature	100°C	100 °C
	Maximum Temperature	200°C	150 °C
	Time	T_{SMIN} to T_{SMAX}	60sec to 120sec
Ramp-Up Rate	T_{SMAX} to T_L	1.25°C/sec	1.25 °C /sec
Time Maintained Above Liquidous	t_L	60sec to 150sec	60sec to 150sec
Liquidous Temperature	T_L	217°C	183 °C
Peak Temperature	T_p	260°C +0°C/-5°C	215 °C +3 °C /-3 °C
Time Within +5°C of Actual Peak Temperature	t_p	20 sec to 30 sec	20 sec to 30 sec
Ramp-Down Rate	T_{peak}	6°C/sec max	6 °C /sec max
Time +25°C (t_{250C}) to Peak Temperature		8 min max	6 min max

PACKAGING



$$A_o = 4.30 \pm 0.10 \text{ mm}$$

$$B_o = 3.20 \pm 0.10 \text{ mm}$$

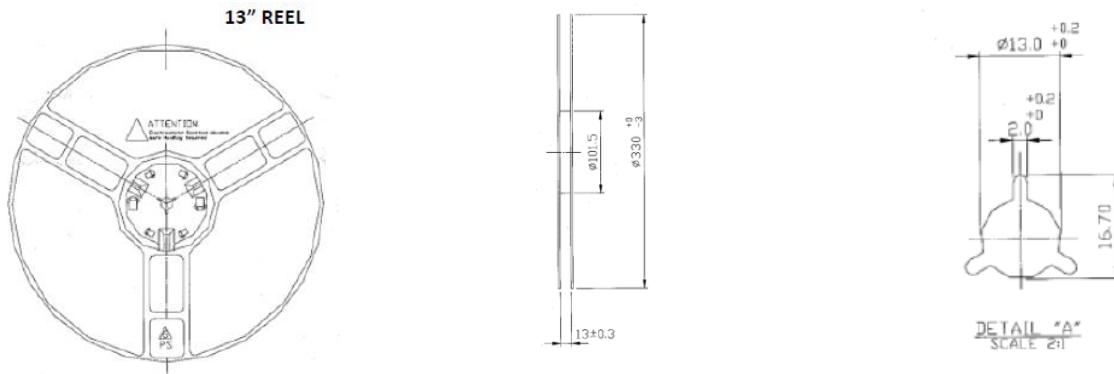
$$K_o = 1.30 \pm 0.10 \text{ mm}$$

Unit : mm

Symbol	Spec.
P _o	4.0 ± 0.10
P ₁	8.0 ± 0.10
P ₂	1.0 ± 0.10
D _o	1.55 ± 0.05
D ₁	1.50 (MIN)
E	1.75 ± 0.10
F	5.50 ± 0.10
10P _o	40.0 ± 0.10
W	12.0 ± 0.30
T	0.30 ± 0.05

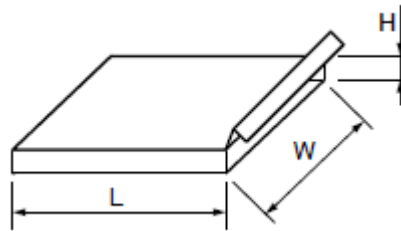
Notice :

- 1 · 10 Sprocket hole pitch cumulative tolerance is ± 0.1mm.
- 2 · Pocket position relative to sprocket hole measured as true position of pocket not pocket hole.
- 3 · A_o & B_o measured on a place 0.3mm above the bottom of the pocket to top surface of the carrier.
- 4 · K_o measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
- 5 · Carrier camber shall be not that 1mm per 100mm through a length of 250mm.



Part NO.	Reel Diameter	Quantity Per Reel	Quantity Per Inner Box	Quantity Per Outer Box
ZTS6431E	13"	5200	5200	46800

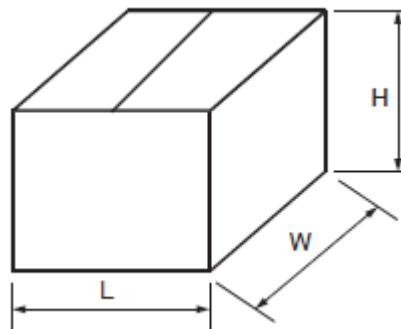
Dimensions for Inner Box



Unit : mm

L	W	H
335	339	45

Dimensions for Outer Box



Unit : mm

L	W	H
445	360	372