SmartTrim™ MEMS Microphone with I2S/TDM for Microphone Array

DESCRIPTION

The ZTS6631 is a high quality, high performance, low power digital output top-ported omni-directional MEMS microphone. ZTS6631 consists of a MEMS microphone element and an analog-to-digital converter. ZTS6631 has a high SNR and flat wideband frequency response, resulting in natural sound with high intelligibility. Due to built-in filter, ZTS6631 shows high immunity to EMI.

The ZTS6631 is available in a thin 4.00mm × 3.00mm × 1.00mm surface-mount package. It is reflow solder compatible with no sensitivity degradation. The ZTS6631 is Halogen and Lead free.

APPLICATIONS

- Small portable devices, wearables
- Set-top boxes, TV, gaming, remote controllers
- Smart home devices, Internet of Things, Connected equipment

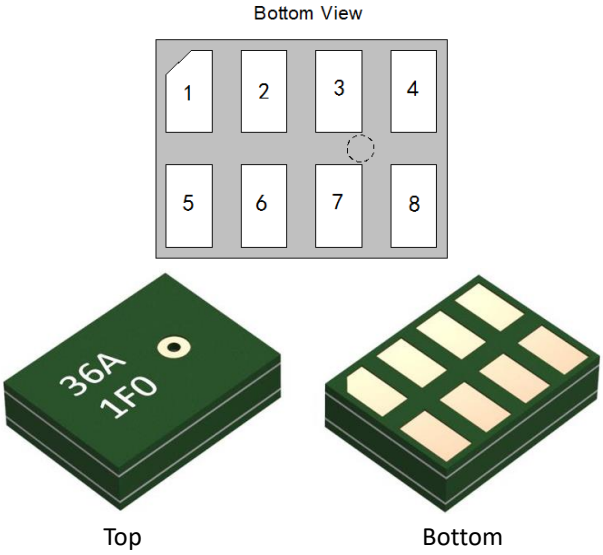
ORDERING INFORMATION

PART	RoHS	Ship, Quantity
ZTS6631	Yes	Tape and Reel, 5.2K

FEATURES

- Audio data Slave I2S or time division multiplexed (TDM) output interface
- Configurable TDM slots, support upto 8 format
- Supply operation: 1.60 V to 3.60V
- 64×/128×/192×/256×/384×/512× output sample rate BCLK
- Automatic CLK ratio detection
- Output sample rate: 4 kHz to 96 kHz
- SNR of 64 dB(A)
- Sensitivity of −26 +/-1dBFS with 2nd Generation SmartTrim™ Technology
- Multi Chip Module (MCM) Package 4.00mm×3.00mm×1.00mm surface-mount package

Pins Configuration and Description



Isometric Views of ZTS6631 Microphone Package

Typical Applications

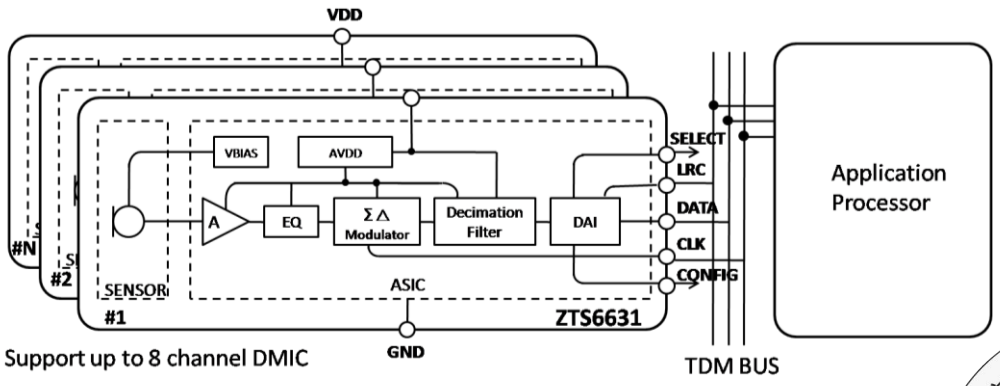


Figure.1 Application Diagram

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Hsinchu City 30078,
Tel: (886) 3577 7509,
Email: sales@zilltek.com

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
Data Output Short Circuit ..... Indefinite to Ground or V_{DD}
Operating Temperature Range ..... –40°C to +125°C
Storage Temperature Range ..... –40°C to +125°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.

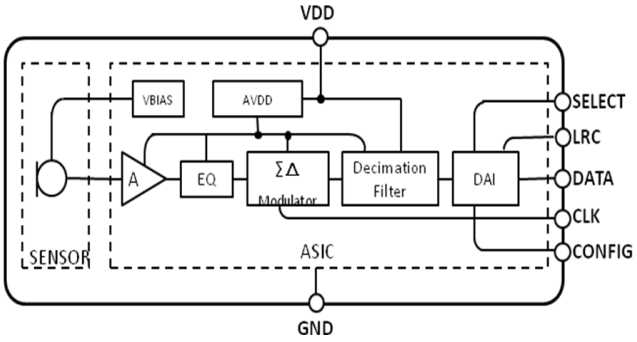
Electro-Static Discharge Sensitivity

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.

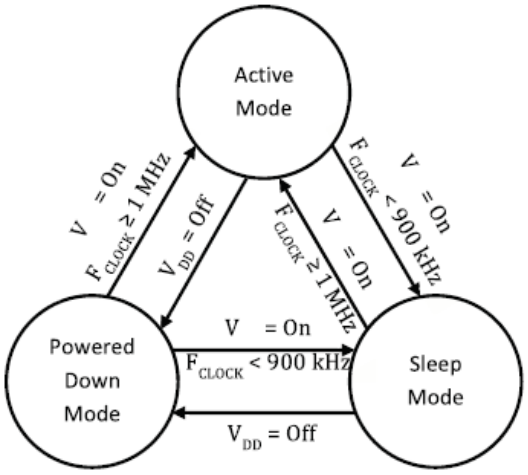
Pins Description

Pin	Symbol	Description
1	DATA	Output.
2	LRC	Frame Sync
3	GND	Ground
4	SELECT	Selection
5	BCLK	Bit Clock
6	VDD	Power Supply (VDD).
7	GND	Ground
8	CONFIG	Interface Configuration

Microphone Block Diagram



Microphone State Diagram



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Specifications

(TA = +23°C, VDD = +1.8V, fclock = 3.072MHz, R.H. = 60%~70%, no load, VDD Decoupling cap=1.0uF unless otherwise noted.)

PARAMETER	Symbol	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage (Note 1)	VDD		1.60		3.60	V
Current Consumption (Note 1,5,6)	IDD			925	1200	μA
Sleep Current (Note 6)	ISLEEP	fclock < 1KHz			30	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		64		dB(A)
Total Harmonic Distortion	THD	94dB SPL @ 1KHz			0.12	%
		116dB SPL @ 1KHz			1	%
Acoustic Overload Point	AOP	10% THD @ 1 kHz, S = Typ.		120		dB SPL
Power Supply Rejection Ratio	PSRR	200 mVpp sine wave@1kHz		60		dBV/FS
Power Supply Rejection	PSR+N	217Hz, 100mV Vp-p, square wave on VDD		−86		dBFS (A)
Short Circuit Output Current	ISC	Grounded output pin	2		10	mA
Sleep Current	Iddsleeep				10	uA
Output Load	CLOAD				120	pF
Data Format			24bits			
Clock Frequency	fclock		1.024		4.8	MHz
Sleep Clock Frequency	fsleep				900	KHz
Clock Duty Cycle			40		60	%
Logic Input Low	VIL		−0.3		0.35×VDD	V
Logic Input High	VIH		0.65×VDD		VDD+0.3	V
Logic Output Low	VOL	Iout = 2mA	0		0.3×VDD	V
Logic Output High	VOH	Iout = 2mA	0.7×VDD		VDD	V
Low→ High Threshold	VL-H		0.55×VDD		0.65×VDD	V
High→ Low Threshold	VH-L		0.35×VDD		0.45×VDD	V
Hysteresis Width	VHYST		0.10×VDD		0.29×VDD	V
Data Time	tsetup	Measured from 0.1 to 0.9 VDD	10			ns
Functional Temperature		Functional with lower performance	-40		100	˚C
Operating Temperature		Specifications guaranteed	0		45	˚C
Power-up Time(Note 4)		VDD ≥ V(min)		13	50	ms
SELECT (high)			VDD -0.2		VDD	V
SELECT (low)		GND			GND+0.2	V
Select Input	CSELECT				2	pF
Clock Input	CCLK				2	pF
Clock Duty Cycle			40	50	60	%
TIE Clock Jitter	TIE	Time Interval Jitter on CLK line			2	ns RMS
Output Load	CLOAD				120	pF

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 fclock < 1KHz to sleep current specification is met when transitioning from Active to Sleep Mode.

Note 4: Time from fclock ≥ 1MHz to all applicable specifications are met when transitioning from Sleep to Active Mode.

Note 5: ΔIDD = 0.5 × VDD × CLOAD × fclock

Note 6: Specified max values are measured at VDD = +3.6V.

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Tel: (886) 3577 7509,
Email: sales@zilltek.com

Timing Diagram

In I2S mode, the MSB of the left channel is valid on the second rising edge of the bit clock after the falling edge of the LR clock. Similarly the MSB of the right channel is valid on the second rising edge of the bit clock after the rising edge of the LRclock.

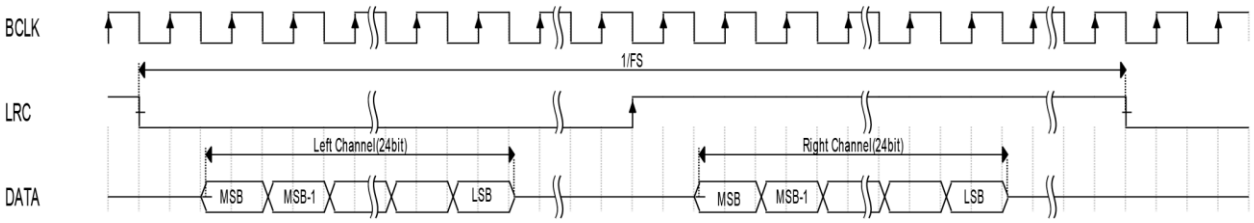

Figure 1

TDM mode

In TDM mode, the falling edge of the LR clock starts the data transfer with the slot 0data first and immediately followed by the slot1 data. Each data bit is valid on the rising edge of the bit clock.

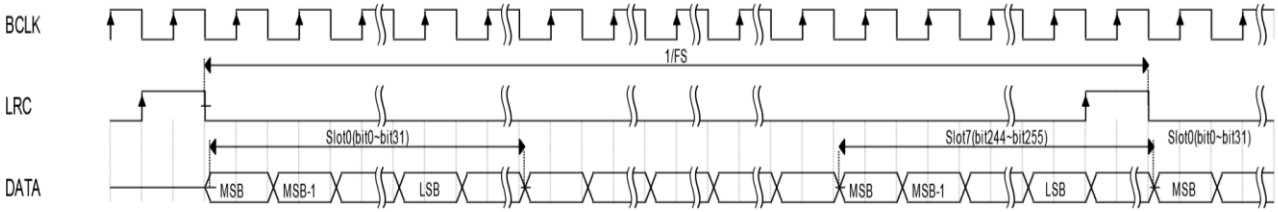

Figure 2

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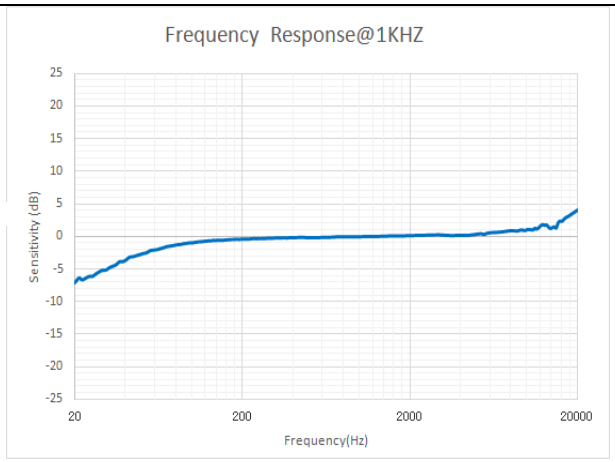
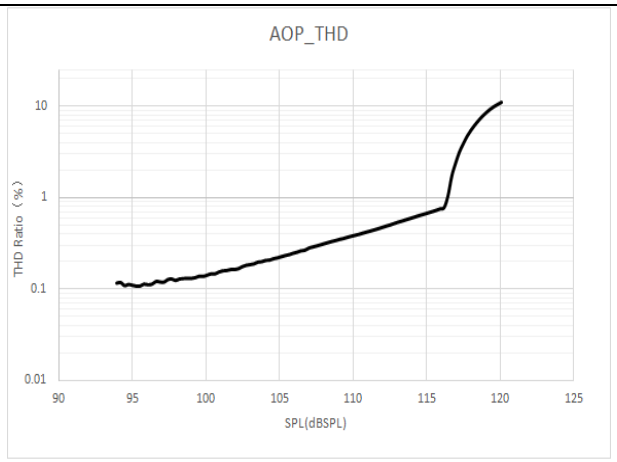
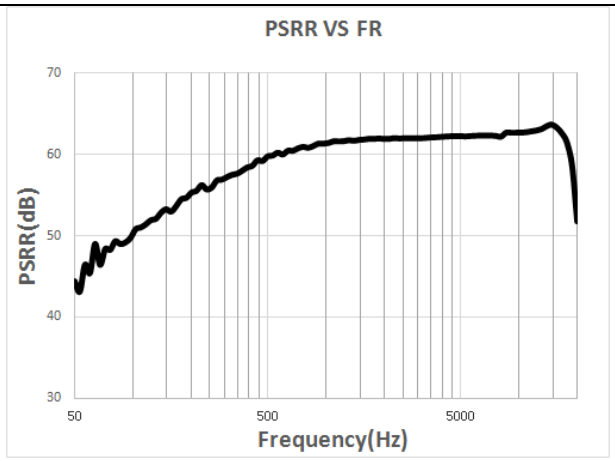
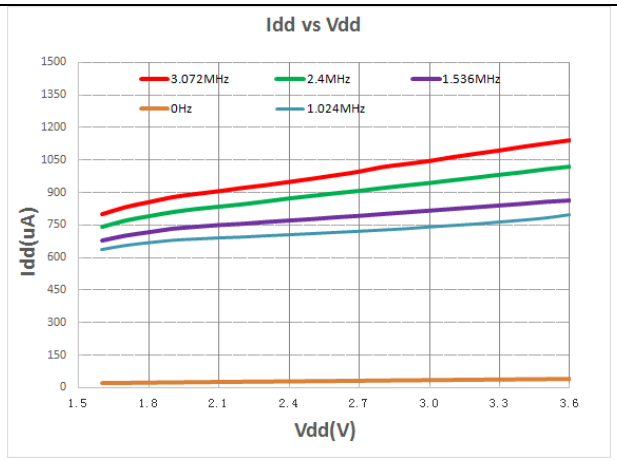
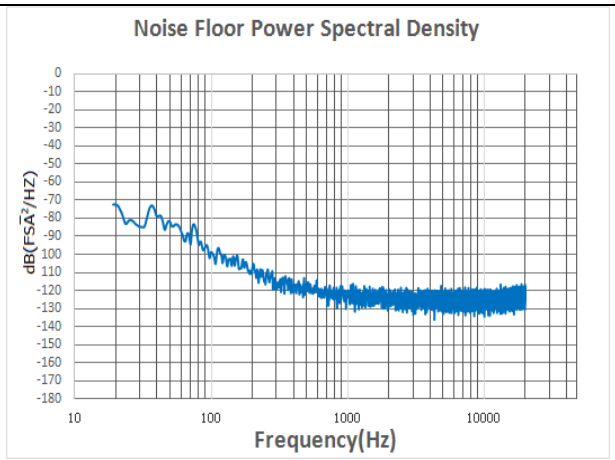
Typical Performance Characteristics











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Application Notes

The ZTS6631 provides stereo decimation from a 1-bit PDM source to a 20-bit PCM audio. The downsampling ratio is fixed at 64×. The 20-bit downsampled PCM audio is output via standard I2S or TDM formats. The input source for the ZTS6631 can be any device that has a PDM output, such as a digital MEMS microphone. The output pins of these microphones can connect directly to the input pins of the ZTS6631.

The ZTS6631 requires a BCLK rate that is a minimum of 64×the LRCLK sample rate. BCLK rates of 128×, 192×, 256×, 384×, and 512× the LRCLK rate are also supported. The ZTS6631 automatically detects the ratio between BCLK and LRCLK and generates a PDM clock output at 64× the LRCLK rate. The minimum sample rate is 4 kHz, and the maximum is 96 kHz, which correspond to a PDM clock range of 256 kHz to 6.144 MHz. When BCLK is removed, the ZTS6631 powers down automatically. When BCLK is not present, the PDM_CLK output stops.

SERIAL AUDIO OUTPUT INTERFACE

The ZTS6631 supports I2S and TDM serial output formats. Format selection and TDM slot placement is set with the CONFIG pin. The SDATA pin is in tristate mode, except when the port is driving serial data based on the CONFIG pin configuration.

CONFIG	SELECT	DEVICE SETTING
Float	Pull High	I2S Format Right Channel
	Pull Low	I2S Format Left Channel
Pull Low	Pull Low	TDM Slot 1
	Pull High	TDM Slot 2
Pull High	Pull Low	TDM Slot 3
	Pull High	TDM Slot 4
Pull High with 47K ohm	Pull Low	TDM Slot 5
	Pull High	TDM Slot 6
Pull Low with 47Kohm	Pull Low	TDM Slot 7
	Pull High	TDM Slot 8

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Reliability Tests

The microphone sensitivity after stress must deviate by no more than ±3dB from the initial value.

1. Heat Test, Operational	Temperature: 125±3 °C Duration: 1000 hours Voltage: Applied
2. Cold Test, Operational	Temperature: -40±3°C Duration: 1000 hours Voltage: Applied
3. Heat Test, Non-Operational	Temperature: 125±3°C Duration: 1000 hours Voltage: Not Applied
4. Cold Test, Non-Operational	Temperature: -40±3°C Duration:1000 hours Voltage: Not Applied
5. Thermal Shock Test, Non-Operational	Temperature: -40±3°C and 125±3°C Duration: 30 minutes each, during 5 minutes ramp, 256 cycles Voltage: Not applied
6. Temperature humidity storage	Temperature: 85±3°C Humidity: 85±3%RH Duration: 1000 hours
	Temperature: 65±3°C Humidity: 95±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 ±X, ±Y, and ±Z directions
10. Electrostatic Discharge Test	Capacitance: 150pF Resistance: 330Ω Duration: 10 times Air Discharge: Level 4(+/-15kV) Direct contact discharge: Level 4 (+/-8kV)
11. Human Body Mode	±5000 Volt
12. Charged-Device Model	±500 Volt
13. Reflow	5 reflow cycles with peak temperature of 260°C
14. Solderability	245 ± 5 °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±3°C Humidity: 85±3%RH Duration: 96 hours Voltage: Applied
17. Air Blow	0.45MPa, distance 3cm, time 10s

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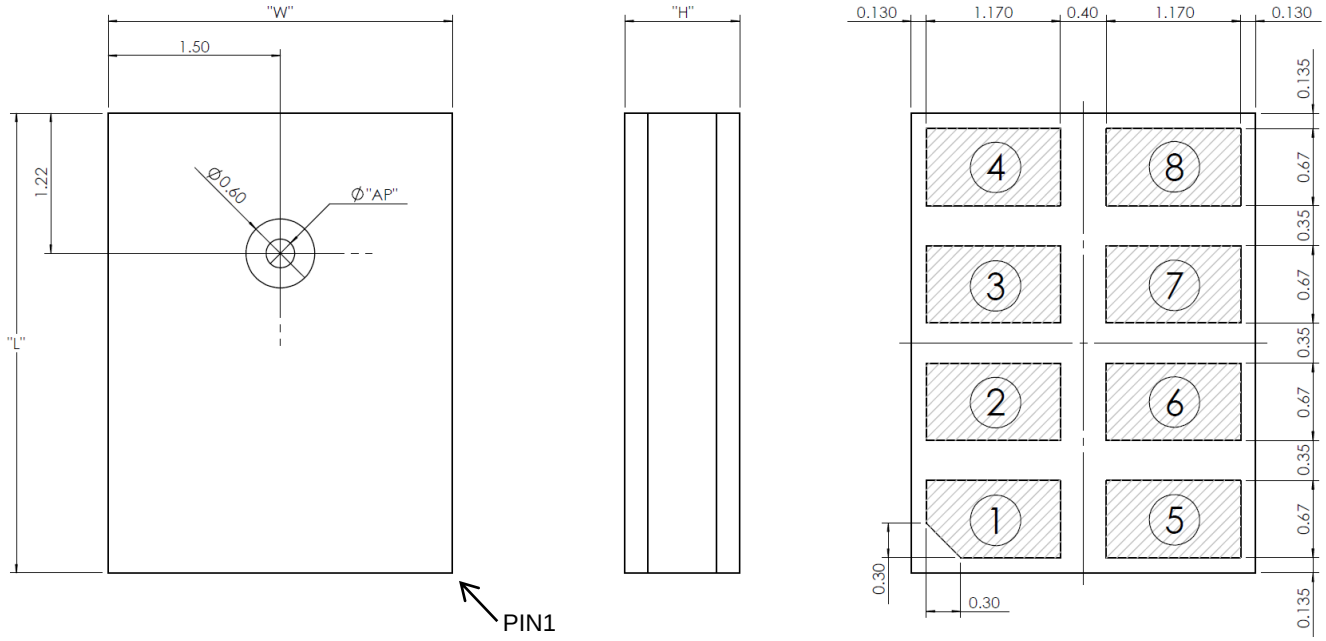
MECHANICAL SPECIFICATIONS



ITEM	DIMENSION	TOLERANCE	UNITS
Length (L)	4.00	±0.10	mm
Width (W)	3.00	±0.10	mm
Height (H)	1.00	±0.10	mm
Acoustic Port (AP)	Ø0.25	±0.075	mm

Pin	Symbol	Description
1	DATA	Output.
2	LRC	Frame Sync
3	GND	Ground
4	SELECT	Selection
5	BCLK	Bit Clock
6	VDD	Power Supply (VDD).
7	GND	Ground
8	CONFIG	Interface Configuration

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Tel: (886) 3577 7509, Fax: (886) 3577 7390
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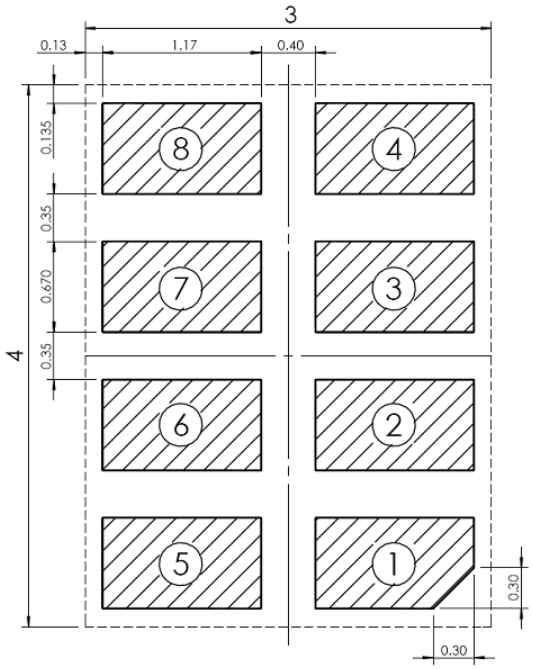
RECOMMENDED CUSTOMER LAND PATTERN

The recommended PCB land pattern for the ZTS6631 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**.

Top View

(Units: mm)



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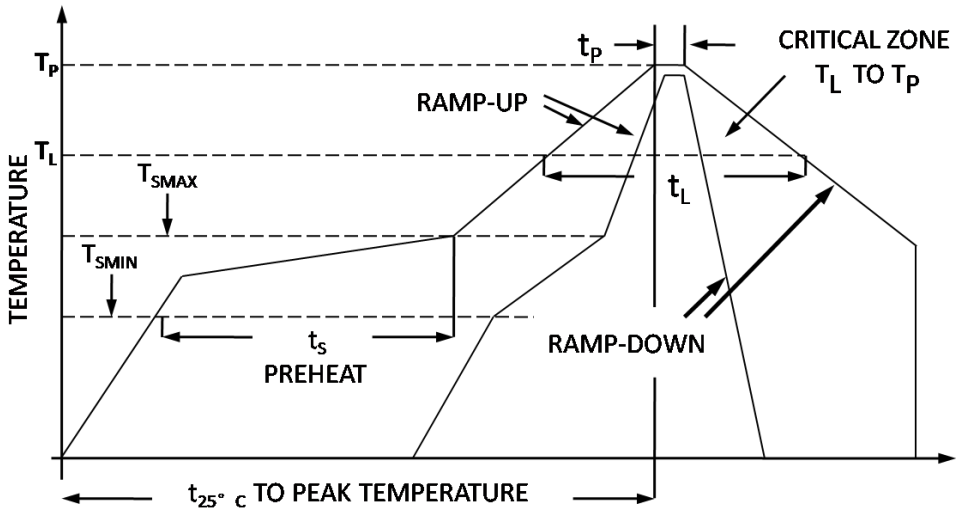
SOLDER REFLOW PROFILE

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 reflow profile requirements for soldering heat resistance:

Parameter		Reference	Pb-Free
Average Ramp Rate		T_L to T_P	3°C/sec max
Preheat	Minimum Temperature	T_{SMIN}	150°C
	Maximum Temperature	T_{SMAX}	200°C
	Time	T_{SMIN} to T_{SMAX}	60sec to 180sec
Time Maintained Above	Temperature	T_L	217°C
	Time	t_L	60sec to 150sec
Peak Temperature		T_P	260°C
Time Within +5°C of Actual Peak Temperature		t_P	20 sec to 40 sec
Ramp-Down Rate		T_{peak}	6°C/sec max
Time +25°C (t_{25OC}) to Peak Temperature			8 min max

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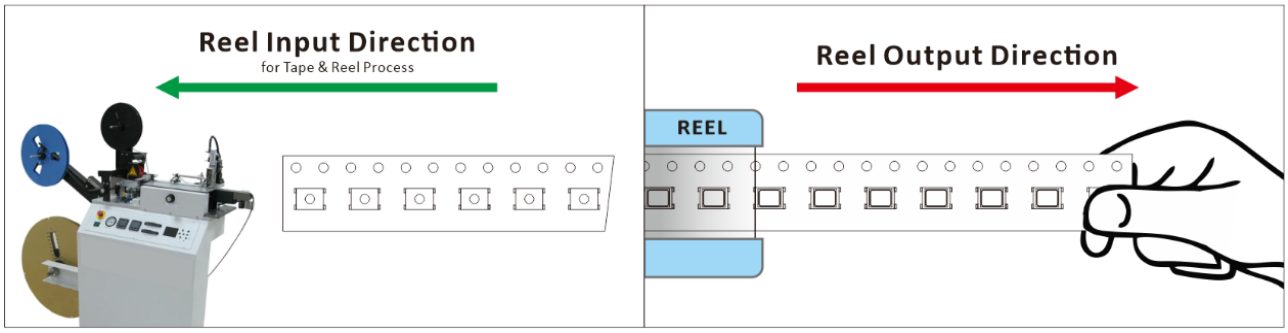
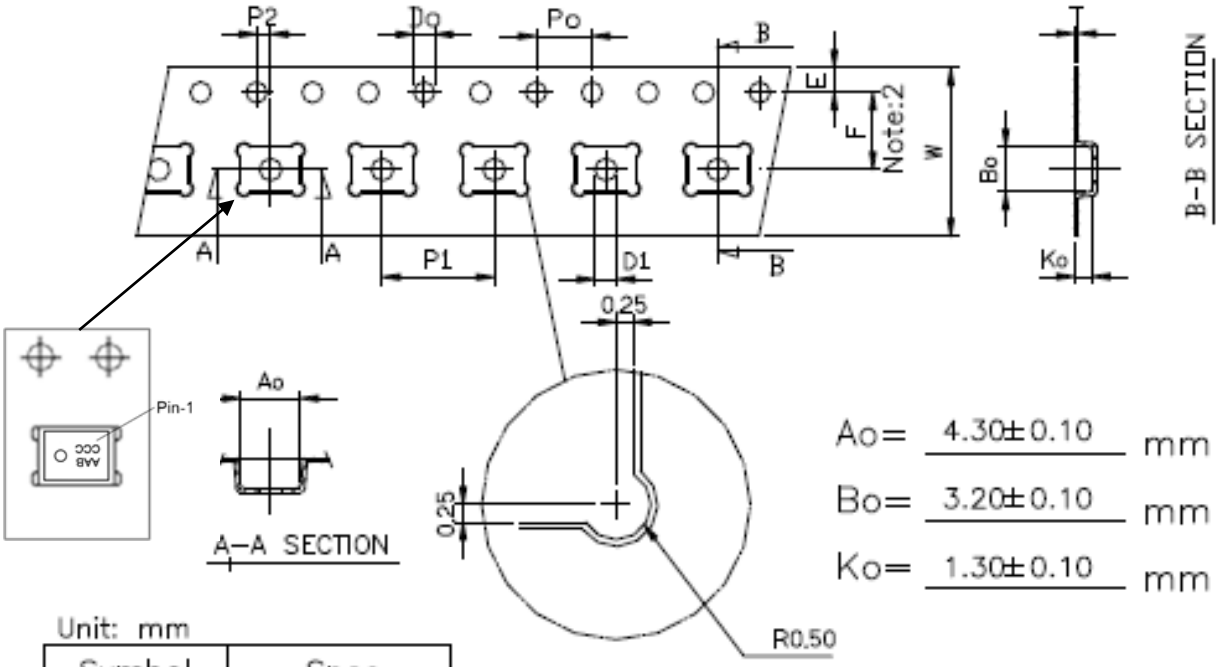
PACKAGING





Unit: mm

Symbol	Spec.
Po	4.0±0.10
P1	8.0±0.10
P2	1.0±0.10
Do	$1.50^{+0.1}_{-0}$
D1	$1.50^{+0.1}_{-0}$
E	1.75±0.10
F	5.50±0.10
10Po	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. Ao & Bo measured on a place 0.3mm above the bottom of the pocket to top surface of the carrier.
4. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
5. Carrier camber shall be not than 1mm per 100mm through a length of 250mm.

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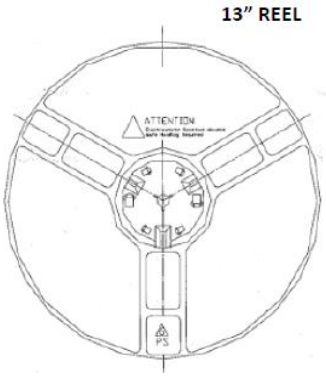
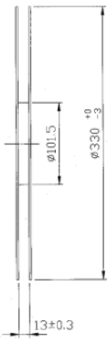
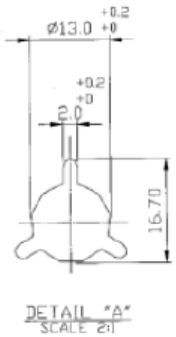
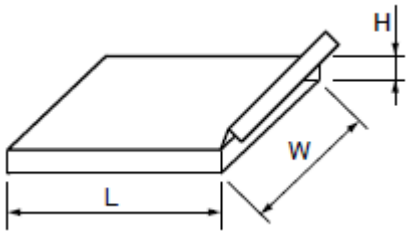






Part NO.	Reel Diameter	Quantity Per Reel	Quantity Per Inner Box	Quantity Per Outer Box
ZTS6631	13"	5200	5200	46800

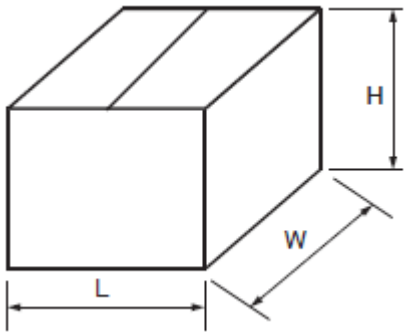
Dimensions for Inner Box



Unit：mm

L	W	H
335	339	45

Dimensions for Outer Box



Unit：mm

L	W	H
445	360	372

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