

## Omni-directional Microphone with High SNR Digital Output (Top Port)

### DESCRIPTION

The ZTS6538SE is a high quality, high performance, low power digital output top-ported omni-directional MEMS microphone. ZTS6538SE consists of a MEMS microphone element and an analog-to-digital converter. ZTS6538SE has a high SNR and flat wideband frequency response with  $\pm 2\text{dB}$  in 12KHz. 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, ZTS6538SE shows high immunity to EMI. The ZTS6538SE is available in a thin 2.75mm X 1.85mm X 1.25mm surface-mount package. It is reflow solder compatible with no sensitivity degradation. The ZTS6538SE is Halogen and Lead free.

### APPLICATIONS

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

### ORDERING INFORMATION

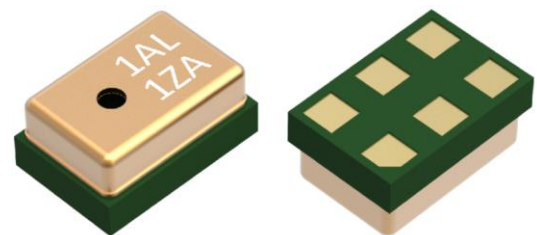
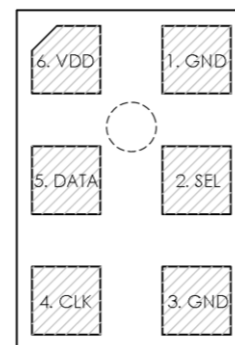
PART	RoHS	Ship, Quantity
ZTS6538SE	Yes	Tape and Reel, 4.8K

### FEATURES

- 2.75mm X 1.85mm X 1.25mm surface-mount package
- Stable sensitivity over power supply range of 1.6V-3.6V
- SNR of 63dB(A)
- Sensitivity of  $-26\text{dB FS}$
- Multi Chip Module (MCM) Package

### Pins Configuration and Description

Bottom View

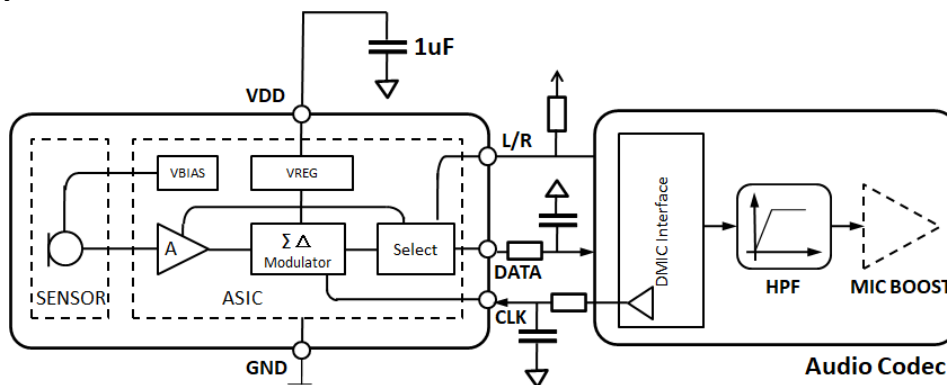


Top

Bottom

Isometric Views of ZTS6538SE Microphone Package

### Typical Applications



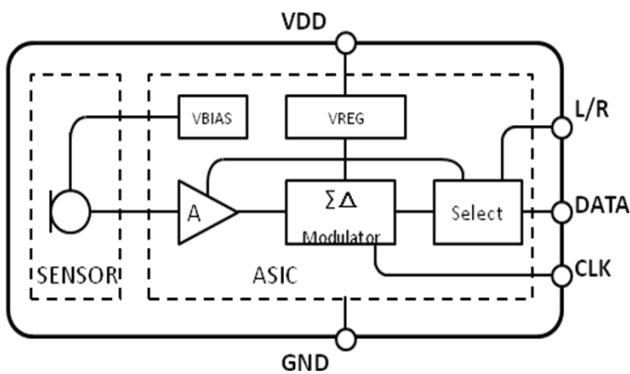
Label	Select	Drives Data After	High-Z After
Data_H	High	Rising Clock Edge	Falling Clock Edge
Data_L	Low (default)	Falling Clock Edge	Rising Clock Edge

### Absolute Maximum Ratings

CLOCK to Ground ..... -0.3V to +6.0V  
 SELECT, V<sub>DD</sub>, DATA to Ground ..... -0.3V to +6.0V  
 Input Current ..... ±5mA  
 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.

### Microphone Block Diagram



### Electro-Static Discharge Sensitivity

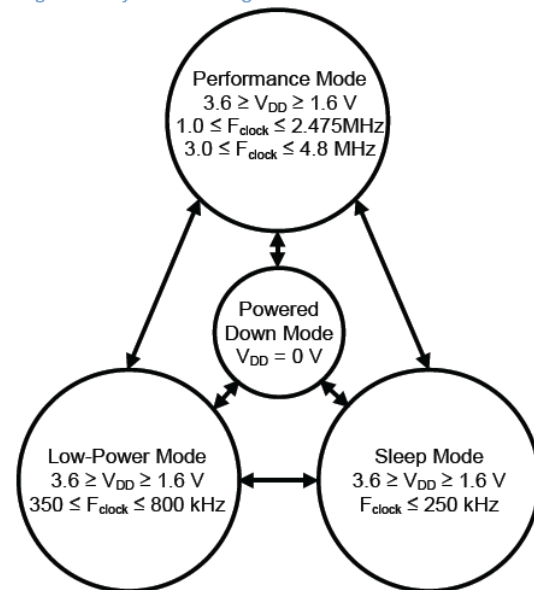


This integrated circuit can be damaged by ESD. It is recommended that all integrated circuits be handled with proper precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure.

### Pins Description

Pin	Symbol	Description
1	GND	Ground.
2	SEL	Select.
3	GND	Ground.
4	CLK	Clock.
5	DATA	Output.
6	VDD	Power Supply (VDD).

### Microphone State Diagram



## Specifications

(TA = +23°C, VDD = +1.8V, f<sub>clock</sub> = 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)	V <sub>DD</sub>			1.6		3.6	V	
Clock Frequency	f <sub>clock</sub>			1.0		4.8	MHz	
Current Consumption (Note 1,6)	I <sub>DD</sub>				600	700	μA	
Standby Current (Sleep Mode) (Note 5,6)	I <sub>STANDBY</sub>	f <sub>clock</sub> < 250KHz			80		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			63		dB(A)	
Total Harmonic Distortion	THD	120dB SPL @ 1KHz				10	%	
Acoustic Overload Point	AOP	10% THD @ 1KHz			120		dB SPL	
Power Supply Rejection	PSR	217Hz, 100mV Vp-p, square wave on V <sub>DD</sub>	V <sub>DD</sub> = 1.8V V <sub>DD</sub> = 3.3V		-65 -71		dB FS	
Polarity		Increasing sound pressure		Increasing density of 1's				
Fall-Asleep Time (Note 2,3)		V <sub>DD</sub> = On, f <sub>clock</sub> < 1KHz				10	ms	
Wake-Up Time (Note 2,4)		V <sub>DD</sub> = On, f <sub>clock</sub> ≥ 1MHz				10	ms	
Short Circuit Output Current	I <sub>SC</sub>	Grounded output pin			1	10	mA	
Output Load	C <sub>LOAD</sub>					100	pF	
Data Format				1/2 cycle PDM				
Clock Duty Cycle				40		60	%	
Clock Rise Time	t <sub>cr</sub>					10	ns	
Clock Fall Time	t <sub>ct</sub>					10	ns	
Logic Input/Output Low	V <sub>IOL</sub>	I <sub>out</sub> = 1mA		-0.3		0.35×V <sub>DD</sub>	V	
Logic Input/Output High	V <sub>IOH</sub>	I <sub>out</sub> = 1mA		0.65×V <sub>DD</sub>		V <sub>DD</sub> +0.3	V	
Delay Time for Valid Data	t <sub>dv</sub>	CLK = 3.072MHz, Oscilloscope: APx525 (probe Cin = 24pF)	Data Transition High	1.8V	30		180	ns
				3.3V	24		119	
			Data Transition Low	1.8V	30		180	
				3.3V	22		118	
Delay Time for High Z	t <sub>dz</sub>	CLK = 3.072MHz, Oscilloscope: APx525 (probe Cin = 24pF)	Data Transition High	1.8V	1		14	ns
				3.3V	1		10	
			Data Transition Low	1.8V	1		14	
				3.3V	1		10	
Settling time	t <sub>s</sub>			1.8V		13.5	25	ms
				3.3V				
Startup Time		Powered Down → Active Mode		1.8V		13.5	25	ms
				3.3V				

(TA = +23°C, VDD = +1.8V, fclock = 768KHz, 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)	V <sub>DD</sub>		1.6		3.6	V	
Clock Frequency	f <sub>clock</sub>		350		800	KHz	
Current Consumption (Note 1,6)	I <sub>DD</sub>			250	290	μA	
Standby Current (Sleep Mode) (Note 5,6)	I <sub>STANDBY</sub>	f <sub>clock</sub> < 250KHz		80		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		63		dB(A)	
Total Harmonic Distortion	THD	120dB SPL @ 1KHz			10	%	
Acoustic Overload Point	AOP	10% THD @ 1KHz		120		dB SPL	
Power Supply Rejection	PSR	217Hz, 100mV Vp-p, square wave on V <sub>DD</sub>	V <sub>DD</sub> = 1.8V	-65		dB FS	
			V <sub>DD</sub> = 3.3V	-71			
Polarity		Increasing sound pressure	Increasing density of 1's				
Fall-Asleep Time (Note 2,3)		V <sub>DD</sub> = On, f <sub>clock</sub> < 1KHz			10	ms	
Wake-Up Time (Note 2,4)		V <sub>DD</sub> = On, f <sub>clock</sub> ≥ 1MHz			10	ms	
Short Circuit Output Current	I <sub>SC</sub>	Grounded output pin		1	10	mA	
Output Load	C <sub>LOAD</sub>				100	pF	
Data Format			1/2 cycle PDM				
Clock Duty Cycle			40		60	%	
Clock Rise Time	t <sub>cr</sub>				10	ns	
Clock Fall Time	t <sub>ct</sub>				10	ns	
Logic Input/Output Low	V <sub>IOL</sub>	I <sub>out</sub> = 1mA	-0.3		0.35×V <sub>DD</sub>	V	
Logic Input/Output High	V <sub>IOH</sub>	I <sub>out</sub> = 1mA	0.65×V <sub>DD</sub>		V <sub>DD</sub> +0.3	V	
Delay Time for Valid Data	t <sub>dv</sub>	CLK = 3.072MHz, Oscilloscope: APx525 (probe Cin = 24pF)	Data Transition High	1.8V	30	180	ns
				3.3V	24	119	
			Data Transition Low	1.8V	30	180	
				3.3V	22	118	
Delay Time for High Z	t <sub>dz</sub>	CLK = 3.072MHz, Oscilloscope: APx525 (probe Cin = 24pF)	Data Transition High	1.8V	1	14	ns
				3.3V	1	10	
			Data Transition Low	1.8V	1	14	
				3.3V	1	10	
Settling time	t <sub>s</sub>		1.8V		13.5	25	ms
			3.3V				
Startup Time		Powered Down → Active Mode	1.8V		13.5	25	ms
			3.3V				

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).

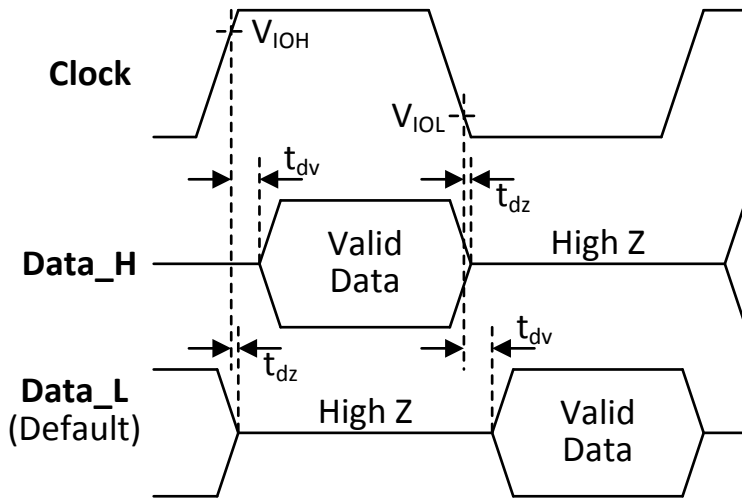
Note 3: Time from f<sub>clock</sub> < 1KHz to sleep current specification is met when transitioning from Active to Sleep Mode.

Note 4: Time from f<sub>clock</sub> ≥ 1MHz to all applicable specifications when transitioning from Sleep to Active Mode.

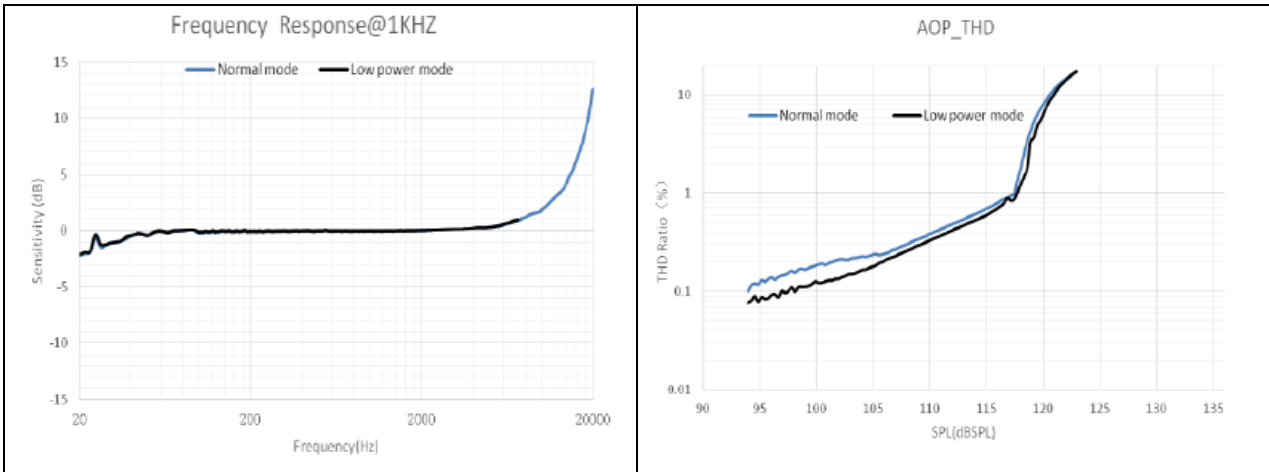
Note 5: ΔI<sub>DD</sub> = 0.5 × V<sub>DD</sub> × C<sub>LOAD</sub> × f<sub>clock</sub>

Note 6: Specified max values are measured at V<sub>DD</sub> = +3.6V.

**Timing Diagram**



**Typical Performance Characteristics**

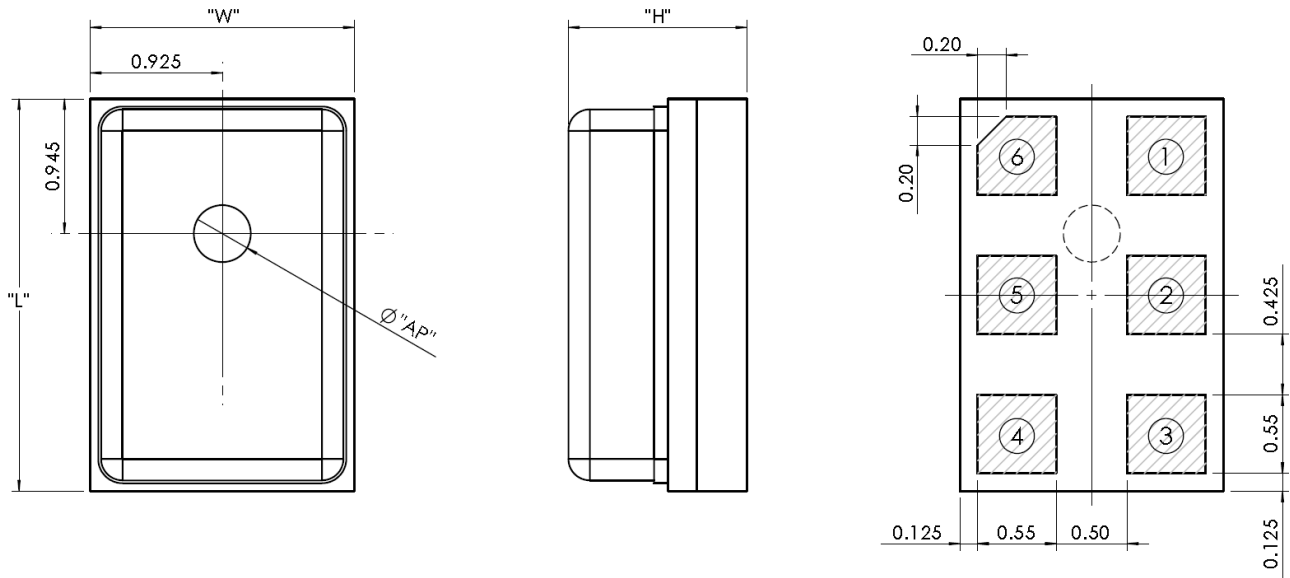


## Reliability Tests

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: $85\pm 3\% \text{RH}$ Duration: 1000 hours
	Temperature: $65\pm 3^{\circ}\text{C}$ Humidity: $95\pm 3\% \text{RH}$ 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 $\Omega$ Duration: 10 times Air Discharge: Level 4 (+/-15kV) Direct contact discharge: Level 4 (+/-8kV)
11. Human Body Mode	$\pm 5000$ Volt
12. Charged-Device Model	$\pm 500$ Volt
13. Reflow	5 reflow cycles with peak temperature of $260^{\circ}\text{C}$
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: $85\pm 3\% \text{RH}$ Duration: 96 hours Voltage: Applied
17. Air Blow	0.45MPa, distance 3cm, time 10s

**MECHANICAL SPECIFICATIONS**

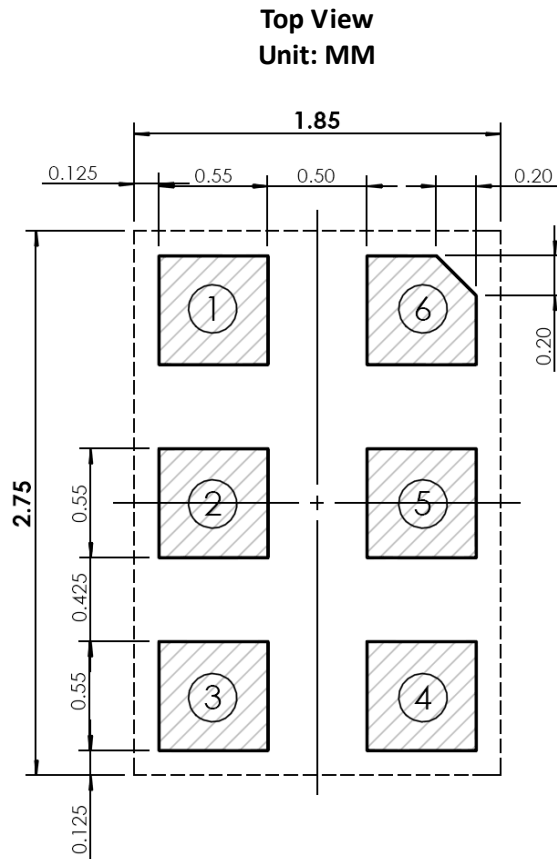


ITEM	DIMENSION	TOLERANCE	UNITS
Length (L)	2.75	±0.100	mm
Width (W)	1.85	±0.100	mm
Height (H)	1.25	±0.100	mm
<b>Acoustic Port (AP)</b>	Ø0.40	±0.050	mm

Pin	Symbol	Description
1	GND	Ground.
2	SEL	Select.
3	GND	Ground.
4	CLK	Clock.
5	DATA	Output.
6	VDD	Power Supply (VDD).

**RECOMMENDED CUSTOMER LAND PATTERN**

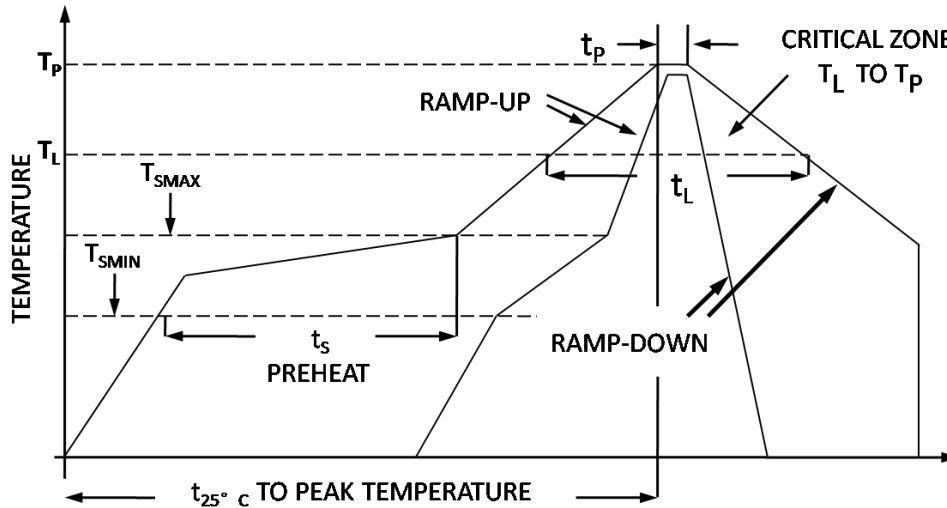
The recommended PCB land pattern for the ZTS6538SE should have a 1:1 ratio to the solder pads on the microphone package. Care should be taken to avoid applying solder paste to the sound hole in PCB. The dimensions of suggested solder paste pattern refer to the land pattern **which should be shrunk by 0.025 per side**.





**SOLDER FLOW PROFILE**

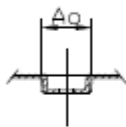
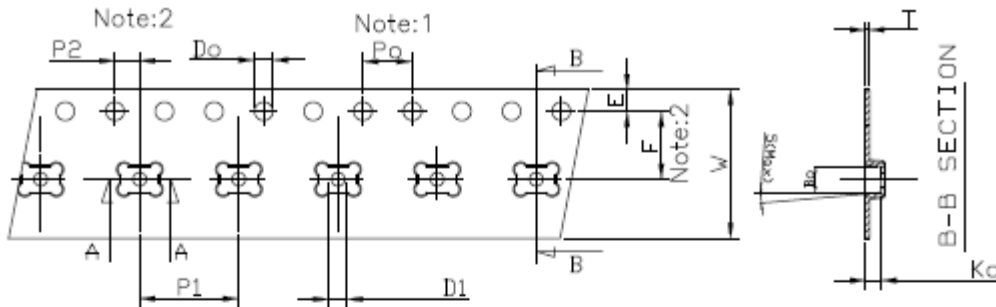
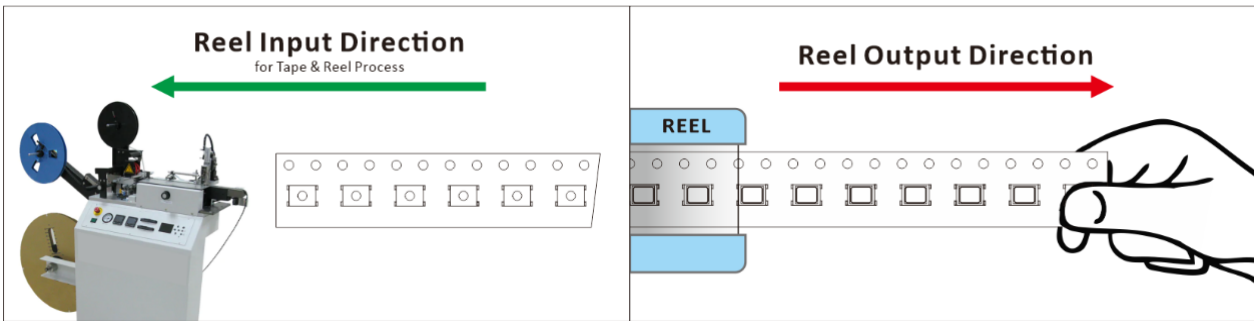
The reflow profile specified in this section describes expected maximum heat exposure of components during the reflow process of NMP product PWBs. Temperature is measured on top of component. All components have to tolerate at least this profile five times (5x) without affecting electrical performance,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



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

Parameter	Reference	Pb-Free
Average Ramp Rate	$T_L$ to $T_P$	3°C/sec max
Preheat	Minimum Temperature	150°C
	Maximum Temperature	200°C
	Time	$T_{SMIN}$ to $T_{SMAX}$
Time Maintained Above	Temperature	217°C
	Time	$t_L$
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 ( $t_{250c}$ ) to Peak Temperature		8 min max

**PACKAGING**



$$A_o = \frac{3.05 \pm 0.10}{\text{mm}}$$

$$B_o = \frac{2.10 \pm 0.10}{\text{mm}}$$

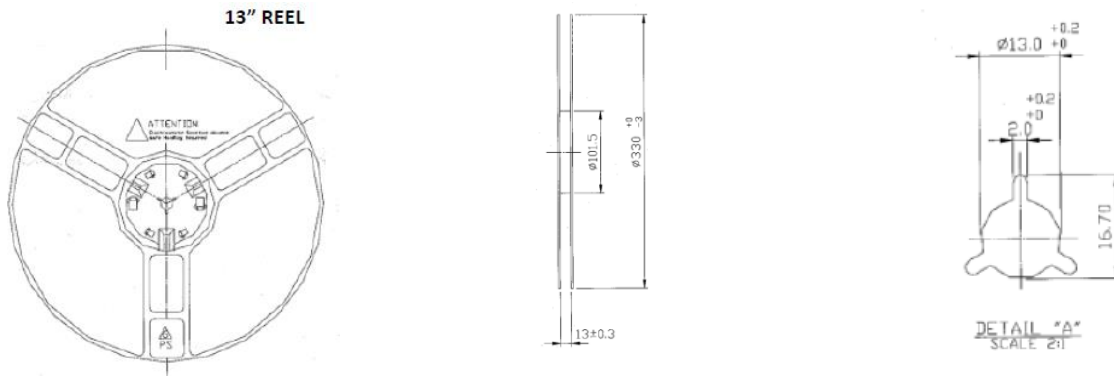
$$K_o = \frac{1.50 \pm 0.10}{\text{mm}}$$

Unit: mm

Symbol	Spec.
Po	4.0±0.10
P1	8.0±0.10
P2	2.0±0.05
Do	1.50 <sup>+0.10</sup> / <sub>-0.</sub>
D1	1.10±0.10
E	1.75±0.10
F	5.50±0.05
10Po	40.0±0.10
W	12.0±0.10
T	0.30±0.05

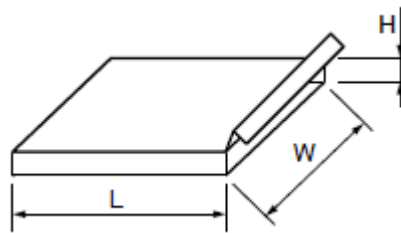
Notice:

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.



Part NO.	Reel Diameter	Quantity Per Reel	Quantity Per Inner Box	Quantity Per Outer Box
ZTS6538SE	13"	4800	4800	43200

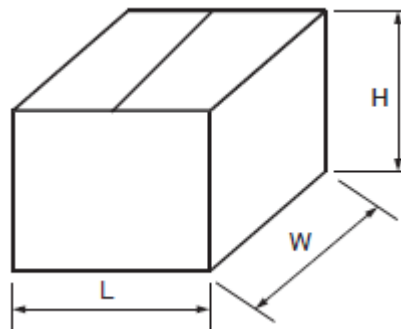
**Dimensions for Inner Box**



Unit : mm

L	W	H
335	339	45

**Dimensions for Outer Box**



Unit : mm

L	W	H
445	360	372

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