

### Descriptions

TPMAX20331AEWLT is over voltage protection IC designed to protect the audio codecs and electronics of portable devices. Connecting the TPMAX20331AEWLT between the 3.5mm jack and audio path electronics provides protection against high-voltage conditions to  $\pm 35V$ . The 9-Ball Wafer Level Chip Scale Package (WLCSP) 1.2mm x 1.2mm with Pb-free and Halogen-free, makes it ideal for mobile device. High Performance Pin-to-Pin Replaceable TPMAX20331AEWLT, 9-Ball WLCSP 1.2mm x 1.2mm

### Features

- Pin-to-Pin **MAX20331AEWLT**, 9-Ball WLCSP 1.2mm x 1.2mm
- Wide VCC Supply Range: **2.3V~5.0V**
- Protects Devices from High-Voltage Conditions:  **$\pm 35V$**  Tolerant Inputs
- OVP Threshold:  **$\pm 4.1V$**
- High **Input/Output Swing**  $>2.5V$  rms, Superior **SNR**  $>130dBA$ .
- Ultra-Low **THD+N**: **-106dB**, 32 $\Omega$  Load; **-112dB**, 600 $\Omega$  Load; **-120dB**, 100k $\Omega$  Load
- Audio Path **Pop & Click Elimination**

### Applications

- **4G/5G** Smart Phone, Tablets and **Mobile** Device with 3.5mm Audio Jack
- Bluetooth/Intelligent Speaker

### Typical Application Circuit

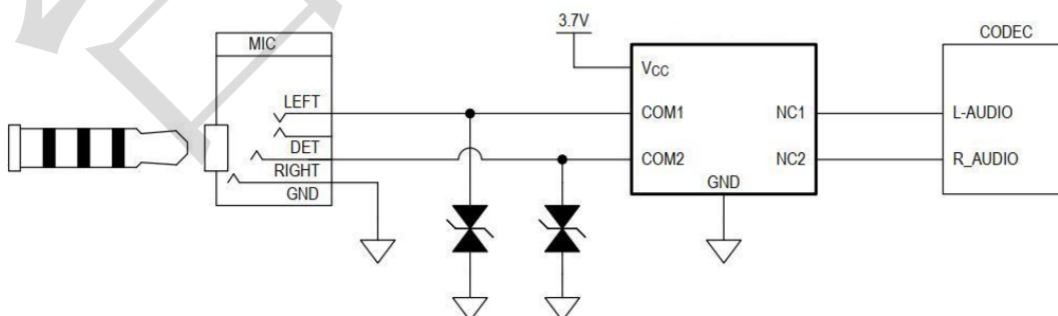


Fig.1 Typical Application Circuit

### Functional Diagram

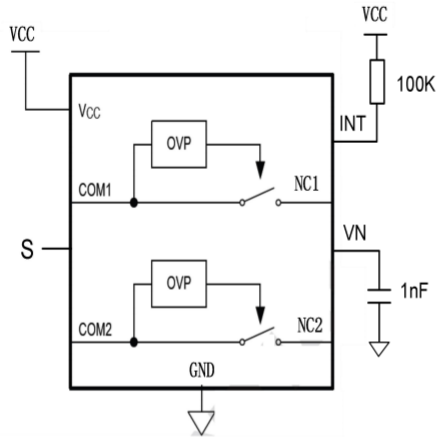


Fig.2 Functional Diagram

### Pin Configuration

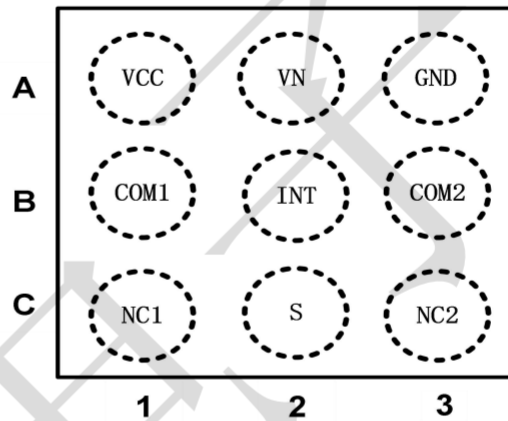


Fig.3 Top-Through View Pin Configuration

### Pin Descriptions

Pin #	Name	Type	Description
A1	<b>VCC</b>	PWR	1.65~5.5V Positive Supply. Bypass VCC to GND 0.1uF decoupling capacitor ACAP
A2	<b>VN</b>	GND	1nF Capacitor Connection to GND as close as possible
A3	<b>GND</b>	GND	Primary Ground Connection
B1	<b>COM1</b>	I/O	External Audio Line 1. Connect to external audio jack
B2	<b>INT</b>	I/O	Open Drain Interrupt Output when COMx reach OVP threshold
B3	<b>COM2</b>	I/O	External Audio Line 2. Connect to external audio jack
C1	<b>NC1</b>	I/O	Protected Audio Line 1. Connect to internal audio codec
C2	<b>S</b>	I/O	GPIO control. When S is low, NCx connect to COMx; When S is high, disconnection
C3	<b>NC2</b>	I/O	Protected Audio Line 2. Connect to internal audio codec

Table-1 Pin Descriptions

**Absolute Maximum Ratings** over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

		Range	Unit
Power Supply Voltage	VCC	-0.5 ~ 6.0	V
Common Ports Voltage	V <sub>COM</sub>	±35	V
Internal Ports Voltage	V <sub>NC</sub>	±6	V
VN Voltage	V <sub>VN</sub>	-35 ~ +0.5	V
Continuous Current into Device	I <sub>DC</sub>	750	mA
Storage Temperature Range	T <sub>STG</sub>	-55 ~ 150	°C
ESD <b>HBM</b> , ANSI/ESDA/JEDEC JS-001-2012	VCC	±2	kV
	COMx	±2	kV
	Other I/O Pins	±2	kV
ESD <b>MM</b> , JESD22-A115	VCC	±200	V
	COMx	±2	kV
	Other I/O Pins	±2	kV

**Table-2 Absolute Maximum Ratings**

(1) Stresses beyond those listed in Table-2 *Absolute Maximum Ratings* may cause permanent damage to the device. They are stress ratings only, which do not imply functional operation of the device at these or any other conditions. Beyond those indicated under *Recommended Operating Conditions*, exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**Recommend Operating Conditions**

		Range	Unit
Power Supply Voltage	VCC	2.3 ~ 5.5	V
Common Ports Voltage	V <sub>COM</sub>	±5	V
Internal Ports Voltage	V <sub>NC</sub>	±3.5	V
Operating Temperature	T <sub>A</sub>	-40 ~ 85	°C

**Table-3 Recommend Operating Conditions**

Electrical Characteristics (Ta=25°C, VCC=3.3V, unless otherwise specified)

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Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>POWER SUPPLY</b>						
Supply Voltage Range	V <sub>CC</sub>		2.3	3.3	5.0	V
Supply Current	I <sub>CC</sub>	S=1 disconnection		50		uA
		S=0 connection		160		uA
<b>DIGITAL INPUT CONTROL</b>						
S control input logic high	V <sub>IH</sub>		1.6		5.5	V
S control input logic low	V <sub>IL</sub>		-0.1		0.5	V
S Internal pull-down resistor	R <sub>PD</sub>			2		MΩ
<b>SWITCH ON RESISTANCE AND SIGNAL RANGE</b>						
On-Resistance	R <sub>AUDIO</sub>	V <sub>IS</sub> = -3.0V~+3.0V I <sub>OUT</sub> =30mA		0.6	1.1	Ω
R <sub>ON</sub> Flatness <sup>(1)</sup>	R <sub>FLAT</sub>	V <sub>IS</sub> = -3.0V~+3.0V I <sub>OUT</sub> =30mA		0.001	0.005	Ω
R <sub>ON</sub> Matching Between Channels <sup>(2)</sup>	ΔR <sub>ON</sub>	V <sub>IS</sub> = -3.0V~+3.0V I <sub>OUT</sub> =30mA		0.02	0.05	Ω
Effective Signal Range	V <sub>IS</sub>	THD+N < 0.1% @R <sub>L</sub> =600Ω			2.5	V <sub>rms</sub>
<b>SWITCH DYNAMICS</b>						
Total Harmonic Distortion	THD+N	f=10Hz to 20KHz V <sub>IS</sub> =2V <sub>rms</sub> @R <sub>L</sub> =600Ω		-112		dB
		f=10Hz to 20kHz V <sub>IS</sub> =1V <sub>rms</sub> @R <sub>L</sub> =32Ω		-106		dB
Signal-to-Noise Ratio	SNR	f=10Hz to 20KHz, Inputs grounded @R <sub>L</sub> =32Ω	130			dBrA
OFF Isolation	OIRR	f=10Hz to 20KHz, V <sub>IS</sub> = 1V <sub>rms</sub> @R <sub>L</sub> =32Ω		-100		dB
Crosstalk <sup>(3)</sup> (Channel-to-Channel)	ACRX	f=10Hz to 20KHz, V <sub>IS</sub> = 1V <sub>rms</sub> @R <sub>L</sub> =32Ω Source Impedance=0Ω		-100		dB
Power Supply Ripple Rejection	PSRR	f=20KHz, V <sub>IS</sub> = 0.316V <sub>rms</sub> @R <sub>L</sub> =32Ω		-100		dB
-3dB Bandwidth	BW	@R <sub>L</sub> =50Ω		80		MHz
Turn-on Time	t <sub>ON</sub>	V <sub>IS</sub> = ±100mV @R <sub>L</sub> =32Ω S switches from High to Low		50		mS
Turn-off Time	t <sub>OFF</sub>	V <sub>IS</sub> = ±100mV @R <sub>L</sub> =32Ω S switches from Low to High		15		mS
<b>POSITIVE OVER VOLTAGE PROTECTION</b>						
Positive OVP Lockout Threshold	V <sub>POS-OVP</sub>	V <sub>COM</sub> Rising Edge		4.1		V
Positive OVP Hysteresis	V <sub>POS-HYS</sub>	V <sub>COM</sub> Falling Edge		300		mV
Positive OVP Response Time	t <sub>FP</sub>	V <sub>COM</sub> =1V to 6 step @R <sub>NC</sub> =1KΩ		0.6		uS
Positive OVP Recovery Time	t <sub>FPR</sub>	V <sub>COM</sub> =6V to 1 step @R <sub>NC</sub> =1KΩ		130		uS
Positive OVP Leakage Current	I <sub>POS-OVP</sub>	V <sub>COM</sub> =+35V @R <sub>NC</sub> =1KΩ		66	90	uA
<b>NEGATIVE OVER VOLTAGE PROTECTION</b>						
Negative OVP Lockout Threshold	V <sub>NEG-OVP</sub>	V <sub>COM</sub> Falling Edge		-4.1		V
Negative OVP Hysteresis	V <sub>NEG-HYS</sub>	V <sub>COM</sub> Rising Edge		600		mV
Negative OVP Response Time	t <sub>FN</sub>	V <sub>COM</sub> =-1V to -6 step @R <sub>NC</sub> =1KΩ		0.6		uS
Negative OVP Recovery Time	t <sub>FNR</sub>	V <sub>COM</sub> =-6V to -1 step @R <sub>NC</sub> =1KΩ		150		uS

Negative OVP Leakage Current	$I_{NEG-OVP}$	$V_{COM} = -35V$	@ $R_{NC} = 1K\Omega$	100	140	$\mu A$
<b>THERMAL PROTECTION</b>						
Thermal Shutdown	$T_{SHDN}$			150		$^{\circ}C$
Thermal Hysteresis	$T_{HYST}$			20		$^{\circ}C$

**Table-4 Electrical Characteristics**

**Note:**

- (1) Flatness is defined as the difference between maximum and minimum value of ON-resistance at the specified analog signal voltage points.
- (2)  $R_{ON}$  matching between channels is calculated by subtracting the channel with the lowest max  $R_{ON}$  value from the channel with the highest max  $R_{ON}$  value.
- (3) Crosstalk is inversely proportional to source impedance

## Package Outline Dimensions

WLCSP-9B

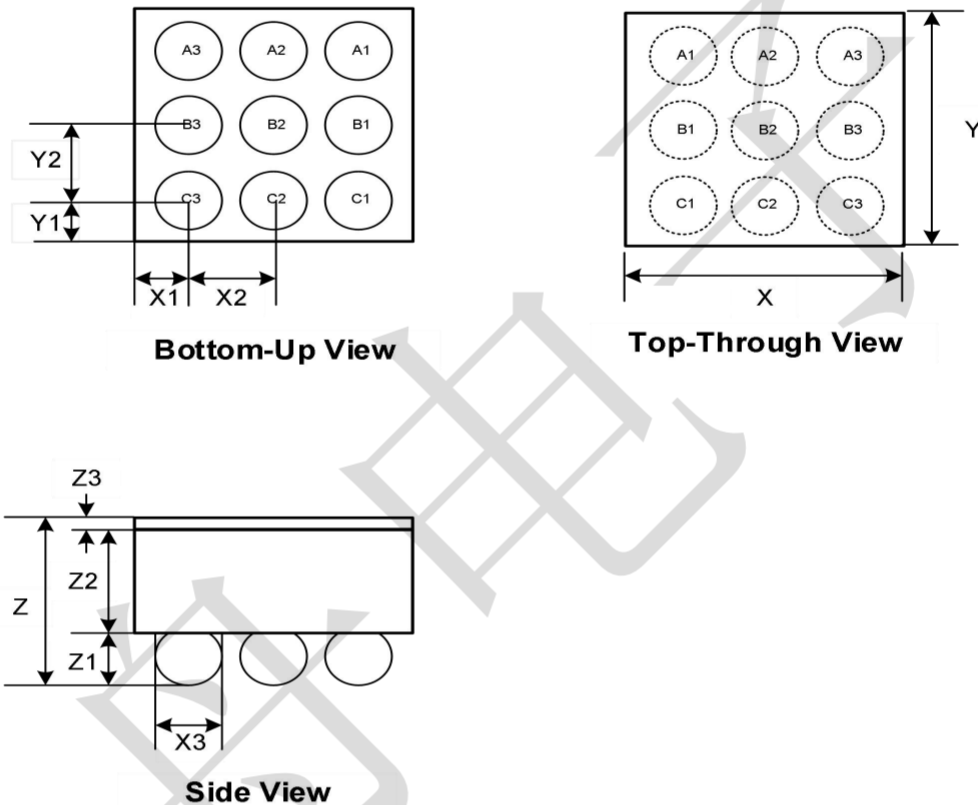


Fig.4 Package Outline Dimensions

Symbol	Dimensions In Millimeter		
	Min.	Typ.	Max.
X	1.14	1.17	1.2
Y	1.14	1.17	1.2
X1		0.18	
X2		0.40	
X3	0.21	0.23	0.25
Y1		0.18	
Y2		0.40	
Z	0.545	0.575	0.605
Z1	0.165	0.185	0.205
Z2	0.3525	0.365	0.3775
Z3	0.02	0.025	0.03

Table-4 Package Outline Dimensions