High-Voltage Protection 3.5mm Audio Line Over-Voltage-Protection (OVP)

Descriptions

RLCS331 is over voltage protection IC designed to protect the audio codecs and electronics of portable devices. Connecting the RLCS331 between the 3.5mm jack and audio path electronics provides protection against high-voltage conditions to ±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. 9-Ball WLCSP 1.2mm x 1.2mm.

Features

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

Applications

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

Typical Application Circuit

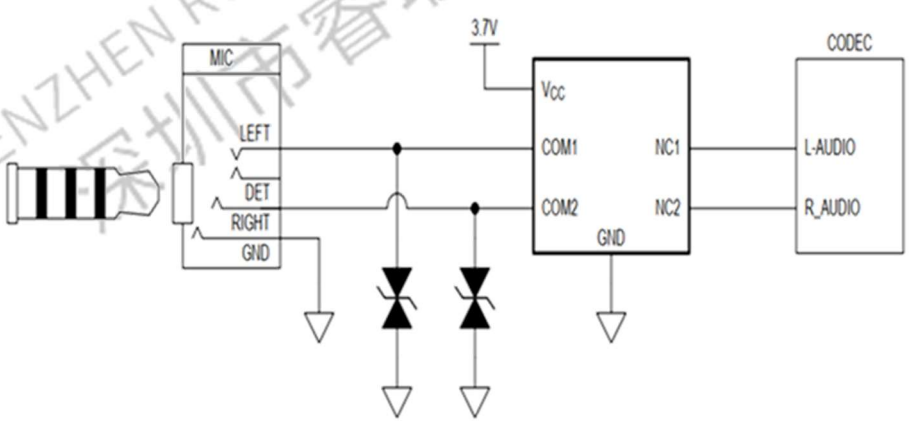


Fig.1 Typical Application Circuit

Functional Diagram

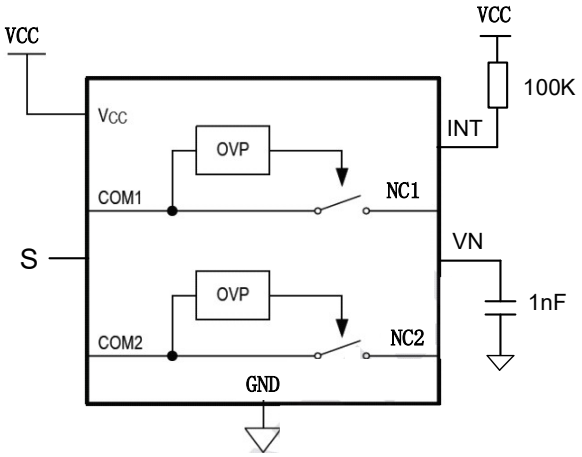


Fig.2 Functional Diagram

Pin Configuration

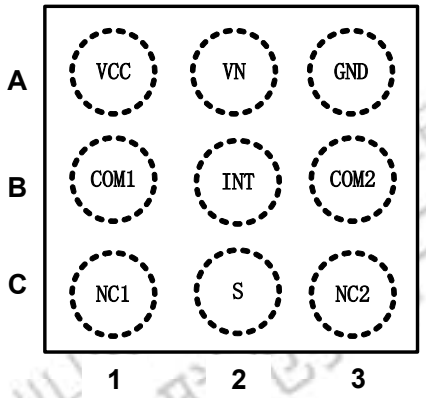


Fig.3 Top-Through View Pin Configuration

Pin Descriptions

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

Table-1 Pin Descriptions

Order Information

Package		Part Number	Quantity per Reel
WLCSP 1.2 x1.2 -9 Ball	Tape and Reel	RLCS331WL9/R6	3,000PCS

Table-2 Order Information

Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted) (1)

Parameter	Symbol	Range	Unit
Power Supply Voltage	VCC	-0.5 ~ 6.0	V
Common Ports Voltage	V_{COM}	±35	V
Internal Ports Voltage	V_{NC}	±6	V
VN Voltage	V_{VN}	-35 ~ +0.5	V
Continuous Current into Device	I_{DC}	750	mA
Storage Temperature Range	T_{STG}	-55 ~ 150	°C
ESD HBM, ANSI/ESDA/JEDEC JS-001-2012	VCC	±2	KV
	COMx	±2	KV
	Other I/O Pins	±2	KV
ESD MM, JESD22-A115	VCC	±200	V
	COMx	±2	KV
	Other I/O Pins	±2	KV

Table-3 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

Parameter	Symbol	Range	Unit
Power Supply Voltage	VCC	2.3 ~ 5.5	V
Common Ports Voltage	V_{COM}	±5	V
Internal Ports Voltage	V_{NC}	±3.5	V
Operating Temperature	T_A	-40 ~ 85	°C

Table-4 Recommend Operating Conditions

(1) TBD

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
POWER SUPPLY						
Supply Voltage Range	V_{CC}		2.3	3.3	5.0	V
Supply Current	I_{CC}	S=1 disconnection		50		uA
		S=0 connnection		160		uA
DIGITAL INPUT CONTOL						
S control input logic high	V_{IH}		1.6		5.5	V
S control input logic low	V_{IL}		-0.1		0.5	V
S Internal pull-down resistor	R_{PD}			2		MΩ
SWITCH ON RESISTANCE AND SIGNAL RANGE						
On-Resistance	R_{AUDIO}	V_{IS}= -3.0V~+3.0V I_{OUT}=30mA		0.6	1.1	Ω
R_{ON} Flatness(1)	R_{FLAT}	V_{IS}= -3.0V~+3.0V I_{OUT}=30mA		0.001	0.005	Ω
R_{ON} Matching Between Channels(2)	ΔR_{ON}	V_{IS}= -3.0V~+3.0V I_{OUT}=30mA		0.02	0.05	Ω
Effective Signal Range	V_{IS}	THD+N < 0.1% @R_L=600Ω			2.5	Vrms
SWITCH DYNAMICS						
Total Harmonic Distortion	THD+N	f=10Hz to 20KHz V_{IS}=2Vrms @R_L=600Ω		-112		dB
		f=10Hz to 20kHz V_{IS}=1Vrms @RL=32Ω		-106		dB
Signal-to-Noise Ratio	SNR	f=10Hz to 20KHz, Inputs grounded @R_L=32Ω	130			dBrA
OFF Isolation	OIRR	f=10Hz to 20KHz, V_{IS}= 1Vrms @R_L=32Ω		-100		dB
Crosstalk (3) (Channel-to-Channel)	ACRX	f=10Hz to 20KHz, V_{IS} = 1Vrms @R_L=32Ω Source Impedance=0Ω		-100		dB
Power Supply Ripple Rejection	PSRR	f=20KHz, V_{IS} = 0.316Vrms @R_L=32Ω		-100		dB
-3dB Bandwidth	BW	@R_L=50Ω		80		MHz
Turn-on Time	t_{ON}	V_{IS}= ±100mV @R_L=32Ω S switches from High to Low		50		mS
Turn-off Time	t_{OFF}	V_{IS}= ±100mV @R_L=32Ω S switches from Low to High		15		mS
POSITIVE OVER VOLTAGE PROTECTION						
Positive OVP Lockout Threshold	$V_{POS-OVP}$	V_{COM} Rising Edge		4.1		V

Positive OVP Hysteresis	$V_{POS-HYS}$	V_{COM} Falling Edge		300		mV
Positive OVP Response Time	t_{FP}	V_{COM} =1V to 6 step @R_{NC}=1KΩ		0.6		uS
Positive OVP Recovery Time	t_{FPR}	V_{COM} =6V to 1 step @R_{NC}=1KΩ		130		uS
Positive OVP Leakage Current	$I_{POS-OVP}$	V_{COM} =+35V @R_{NC}=1KΩ		66	90	uA
NEGATIVE OVER VOLTAGE PROTECTION						
Negative OVP Lockout Threshold	$V_{NEG-OVP}$	V_{COM} Falling Edge		-4.1		V
Negative OVP Hysteresis	$V_{NEG-HYS}$	V_{COM} Rising Edge		600		mV
Negative OVP Response Time	t_{FN}	V_{COM} =-1V to -6 step @R_{NC}=1KΩ		0.6		uS
Negative OVP Recovery Time	t_{FNR}	V_{COM} =-6V to -1 step @R_{NC}=1KΩ		150		uS
Negative OVP Leakage Current	$I_{NEG-OVP}$	V_{COM} =-35V @R_{NC}=1KΩ		100	140	uA
THERMAL PROTECTION						
Thermal Shutdown	T_{SHDN}			150		°C
Thermal Hysteresis	T_{HYST}			20		°C

Table-5 Electrical Characteristics

Note:

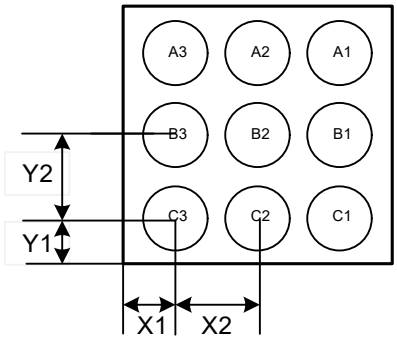
(1) Flatness is defined as the difference between maximum and minimum value of ON-resistance at the specified analog signal voltage points.

(2) RON matching between channels is calculated by subtracting the channel with the lowest max Ron value from the channel with the highest max Ron value.

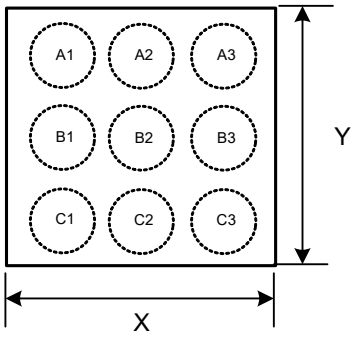
(3) Crosstalk is inversely proportional to source impedance

Package Outline Dimensions

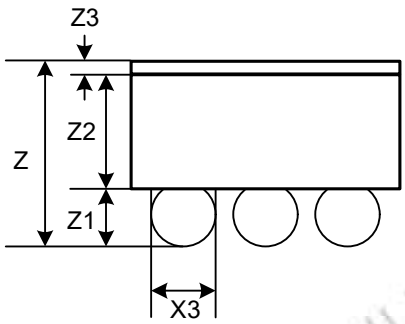
WLCSP-9B



Bottom-Up View



Top-Through View



Side View

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-6 Package Outline Dimensions

Important Note

As the RLC product continues to improve gradually, we may experience significant changes. RLC reserves the right to correct, modify, enhance, and amend the products and services they provide, as well as the right to discontinue any product or service. Before placing an order, customers should obtain the latest information to verify that it is current and complete. All products sold must comply with RLC's terms and conditions in order to ensure proper processing of orders. RLC guarantees that the products they sell conform to the terms and conditions applicable to semiconductor sales. Only under this guarantee does RLC consider it necessary to employ testing and quality control measures for their products. Unless mandated by applicable laws requiring strict compliance, there is no obligation for testing all product parameters. RLC does not assume responsibility for customer product design or application. The materials provided contain circuit examples and usage methods solely for reference purposes; they do not guarantee suitability for volume production designs. Additionally, these materials may contain errors that could result in damages incurred by customers; therefore, RLC disclaims any liability in such cases. Customers are advised to use products within the limits specified in these materials while paying particular attention to absolute maximum ratings, operating voltages, and voltage characteristics. Any use of products outside of these specifications absolves RLC from responsibility; customers must accept full responsibility themselves. To minimize risks associated with customer-designed applications, adequate design safety measures should be implemented. When using RLC products, please ensure compliance with relevant laws and regulations pertaining to your country or region regarding application standards as well as testing requirements related to safety performance. For exports of RLC products overseas, it is essential that you adhere strictly to foreign exchange regulations and transaction laws throughout all necessary procedures involved in exportation processes. In case of disposal of any abandoned RLC product(s), please follow appropriate rules and regulations for proper disposal.

RLC products are not designed to be radiation - resistant. Based on the intended usage, customers can incorporate radiation protection measures during the product design process. Under normal circumstances, RLC products do not harm human health. However, since they contain chemicals and heavy metals, do not put them in your mouth. Additionally, the fracture surfaces of wafers and chips can be sharp. When touching them with bare hands, please be careful to avoid injury.Semiconductor products have a certain probability of failure or malfunction. To prevent disruptions and social damages resulting from personal accidents, fire accidents, etc., as well as to avoid malfunctions, customers are required to be responsible for comprehensive design, implementing fire - spread prevention measures, and safety design against misoperation. Please conduct a full assessment of the entire system, and customers can determine its applicability on their own.This material also includes content related to the company's copyright and know - how. The records in this material are not intended to promise or guarantee the implementation and use of the company's and third - party intellectual property and other rights. Without the permission of our company, it is strictly prohibited to reprint, copy any part of this work, or disclose the material information to third parties.

RLC shall not be held responsible for any damage or harm that occurs which is not related to the product itself, as well as for any infringement of third - party rights such as intellectual property rights.

For more details about this material, please contact our sales office.