



REALTEK

ALC4030

(PN: ALC4030-CG/ALC4030-CGT)

USB2.0 AUDIO CODEC WITH HARDWARE EQUALIZER

DATASHEET

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Realtek Semiconductor Corp.

No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

Tel.: +886-3-578-0211. Fax: +886-3-577-6047

www.realtek.com

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USING THIS DOCUMENT

This document is intended for the hardware and software engineer's general information on the Realtek ALC4030 USB2.0 Audio Codec.

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide. In that event, please contact your Realtek representative for additional information that may help in the development process.

REVISION HISTORY

Revision	Release Date	Summary
0.1	2017/05/24	First release.
1.0	2017/12/19	Update part features
1.1	2018/03/13	Update part feature and status
1.2	2018/04/16	Add T&R part

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1. General Description

The ALC4030 is a single-chip USB 2.0 audio codec with embedded USB 2.0 to I2C and digital microphone interface for high analog and digital audio performance. The ALC4030 integrates stereo analog input and output, USB, I2C and digital microphone interfaces, to support a standard USB audio device class designed for all major commercial operating systems, e.g., Windows, Linux, and Android.

The ALC4030 features a Class-G type ultra-low-power cap-saving headphone amplifier. It is a high efficiency audio amplifier with an integrated Class-G voltage converter that enhances efficiency at low output power. The ALC4030 integrates a USB 2.0 function controller and USB transceiver optimized for a high data transfer rate, a high speed MCU (Micro Processor Unit), DC-to-DC regulators, digital I2C control interface, and SPI interface into a single chip.

Features

1.1. General Hardware Features

- Digital-to-Analog Converter with 95dBA SNR
- Analog-to-Digital Converter with 94dBA SNR
- One stereo DAC supports 8/16/24/32/44.1/48/96KHz Sample Rate, 16/24-bit
- One stereo and mono ADCs support 8/16/24/32/44.1/48/96KHz Sample Rate, 16/24-bit
- Class-G type headphone output without DC blocking capacitors
- Hardware EQ function for playback path (HPFx2, BPFx3, LBFx1, Biquadx1)
- Hardware EQ function for recording path (LPFx1, HPFx1, BPFx4)
- Single-ended analog microphone inputs with pre-amplifiers (0/20/30dB)
- Low noise microphone and programmable MICBIAS voltage level
- Audio jack detection feature
- 4-Button Headset in-line with customizable multi-function control support
- Stereo digital microphone interfaces
- Embedded 64K Byte flash and 16K Byte OTP for F/W programming
- SPI connection to serial flash for switching code and configuration of customized parameters
- Built-in Analog LDO
- 48-pin QFN ‘Green’ package

1.2. USB Controller Features

- Compliant with USB Specification 2.0 Full-Speed and High-Speed transfer mode
- Compliant with USB Audio Class Specification Rev1.0 and Rev2.0
- Supports Selective Suspend mode

- Support jack detection, headset's 4-button detection and GPIOs Remote wakeup function in suspend mode
- Internal PLL supports non-crystal design

1.3. Micro Controller Unit

- On-chip high-performance and low-power MCU
- Software controlled connection to USB bus for re-enumeration
- Internal programmable memory support for various Realtek codec and audio configurations
- Watchdog control for MCU reset and interrupt
- Configurable VID (Vendor ID), PID (Product ID) and serial number string from external serial flash

1.4. Configurable GPIO Pins

- Programmable inputs and outputs for control purposes
- Toggle PWM LED driver and controller upon firmware or custom driver customizations

1.5. Software Features

- No custom audio driver required
- USB Audio Class compliant; operates with native driver in Microsoft Windows XP, VISTA, Windows 7, Windows 8, Windows 8.1, and Windows 10
- Realtek custom audio driver provides certified logo driver for Microsoft Windows XP, VISTA, Windows 7, Windows 8, 8.1, and Windows 10

2. System Applications

- USB Docking Station for Notebook, Tablet, PCs
- Embedded USB audio applications
- USB headset, headphone, microphone, speaker and generic accessory audio

3. Block Diagram

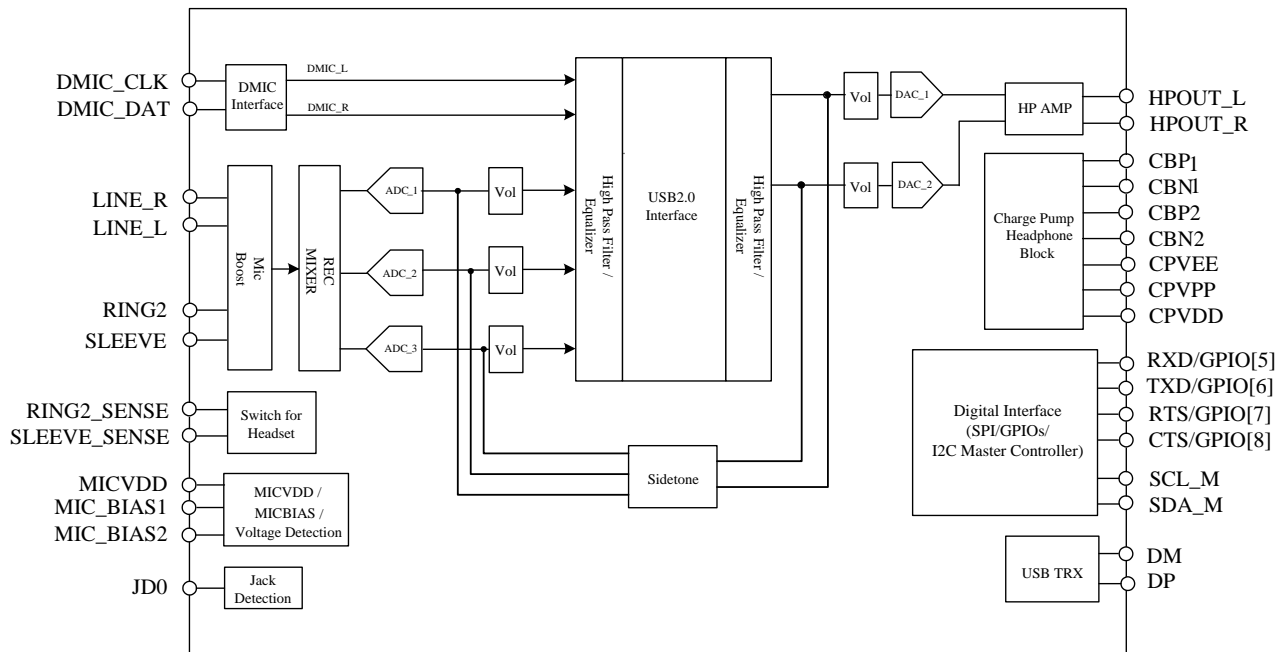


Figure 1. Block Diagram

4. Pin Assignments

4.1. Pin Assignments Figure

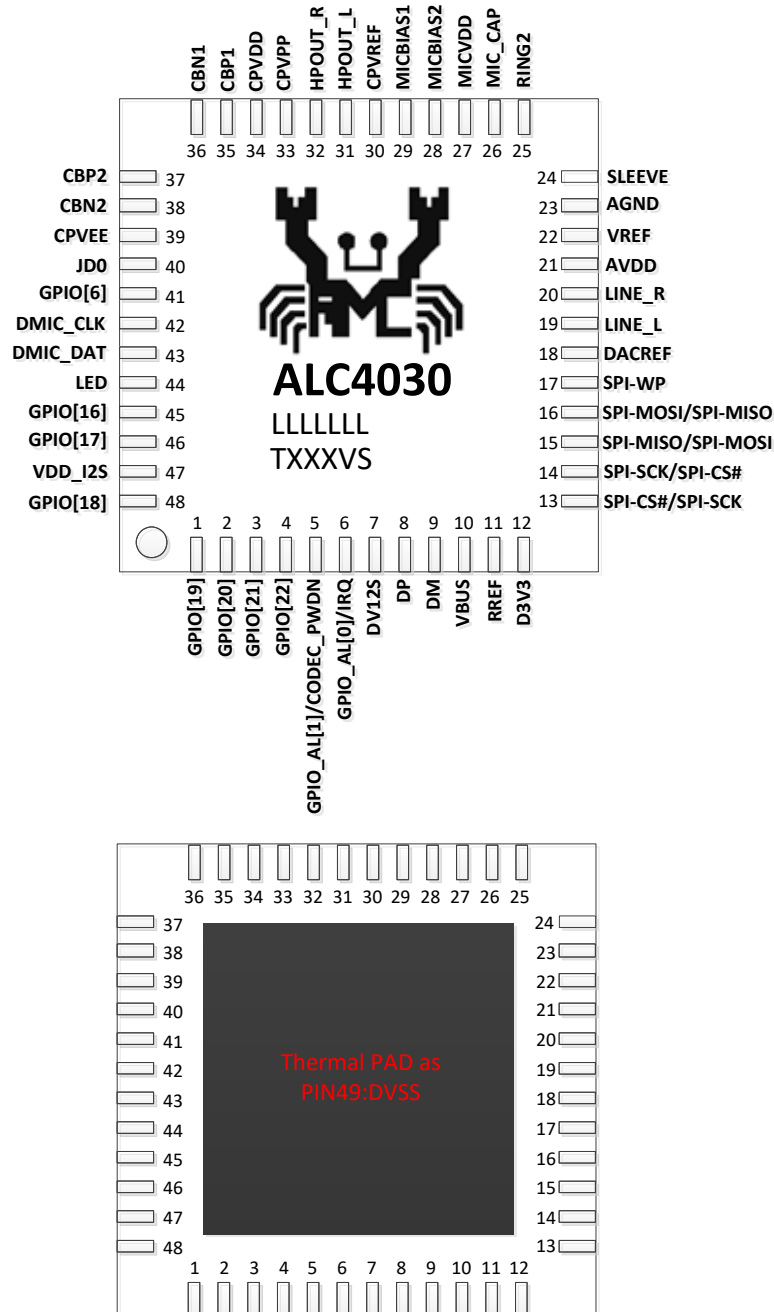


Figure 2. Pin Assignments

4.2. Package and Version Identification

Green package is indicated by a ‘G’ in the location marked ‘T’ in ‘TXXXVS’ in Figure 2.

5. Pin Descriptions

5.1. I/O Type Description

Table 1. I/O Type Description

I/O Type	Description
I	Input
O	Output
IH	Input with internal pull-up 200K
IL	Input with internal pull-down 200K
IO	Input/Output
IOH	Input/Output with internal pull-up 200K
IOL	Input/Output with internal pull-down 200K
IOSH	Input/Output with Schmitt trigger
IO-U	USB related IO
CLK	Clock related IO
PWR-O	Power output pin
PWR-I	Power input pin
GND	Ground related pin

5.2. USB Transceiver Interface

Table 2. USB Transceiver Pins

Name	Type	Pin No.	Description
DP	IO-U	8	USB D+ signal
DM	IO-U	9	USB D- signal
RREF	-	11	External Reference. Requires 1% precision 6.25k/6.2k resistor to ground
-			Total: 3 Pins

5.3. GPIO, SPI Serial Flash, DMIC Interface

Table 3. GPIO, SPI Serial Flash, UART, DMIC Interface

Name	Type	Pin No.	Description
GPIO_AL[1] /Codec_PWDN	IOH	5	General purpose input and output; operates even in USB suspend mode
GPIO_AL[0] /IRQ	IOH	6	General purpose input and output; operates even in USB suspend mode
SPI-WP#	O	17	SPI serial flash write protected
SPI-MOSI	I	16	Serial data in to external flash
SPI-MISO	O	15	Serial data out from external flash
SPI-SCK	O	14	Clock signal to external flash
SPI-CS#	O	13	Chip select to external flash
LED	O	44	LED controller
DMIC_DAT	I	43	DMIC data
DMIC_CLK	O	42	DMIC clock
SPI-CS#	O	41	Chip select to external flash
JD0	I	40	Jack detection
-			Total: 12 Pins

5.4. GPIO Interface

Table 4. I2S Interface

Name	Type	Pin No.	Description
GPIO[19]	IO	1	General purpose input and output
GPIO[20]	IO	2	General purpose input and output
GPIO[21]	IO	3	General purpose input and output
GPIO[22]	IO	4	General purpose input and output
GPIO[18]	IO	48	General purpose input and output
-			Total: 5 Pins

5.5. Analog I/O Pins

Table 5. Analog I/O Pads

Name	Type	Pin No.	Description	Characteristic Definition
RING2	I	25	Combo jack microphone input	Analog input
SLEEVE	I	24	Combo jack microphone input	Analog input
LINE_L	I	19	Line input left channel	Analog input
LINE_R	I	20	Line input right channel	Analog input
HPOUT_R	O	32	Headphone output Right channel	Analog output
HPOUT_L	O	31	Headphone output Left channel	Analog output
-			Total: 6 Pins	

5.6. Filter/Reference

Table 6. Filter/Reference Pads

Name	Type	Pin No.	Description	Characteristic Definition
VREF	R	22	Analog I/O reference voltage	Capacitor to analog ground
CPVREF	R	30	Analog I/O reference voltage	To analog ground
MICBIAS1	O	29	MIC BIAS Voltage output	Programmable Analog DC output
MICBIAS2	O	28	MIC BIAS Voltage output	Programmable Analog DC output
MIC_CAP	I	26	Microphone input reference voltage	Capacitor to analog ground
DACREF	O	18	DAC/ADC reference voltage	Capacitor to analog ground
CBN1	R	36	Charge pump Bucket Capacitor	2.2μF capacitor to CPN1
CBP1	R	35	Charge pump Bucket Capacitor	2.2μF capacitor to CPP1
CBN2	R	38	Charge pump Bucket Capacitor	2.2μF capacitor to CPN2
CBP2	R	37	Charge pump Bucket Capacitor	2.2μF capacitor to CPP2
-			Total: 10 Pins	

5.7. Power/Ground

Table 7. Power/Ground Pins

Name	Type	Pin No.	Description
DV12S	PWR-O	7	Regulated 1.2V output for core power
D3V3	PWR-O	12	3.3V power output from integrated VBUS-to-3.3V regulator and I/O interface
VBUS	PWR-I	10	USB bus 5.0V power input for integrated multiple regulators. This power pin can accept 3.3V of USB power input for 3.3V system
VDD_I2S	PWR-O	47	VDD_I2S for companion I2S IO power
AVDD	PWR-O	21	Analog power
CPVPP	PWR-O	33	Charge Pump Positive Voltage Output
CPVDD	PWR-O	34	Charge Pump Voltage Output
CPVEE	PWR-O	39	Charge Pump Negative Voltage Output
MICVDD	PWR-O	27	Microphone bias power
AGND	GND	23	Analog ground
-			Total: 10 Pins

6. Electrical Characteristics

6.1. Absolute Maximum Ratings

Table 8. Absolute Maximum Ratings

Parameter	Symbol	Minimum	Typical	Maximum	Units
Power Supplies					
Digital Power	VBus	-0.3	5.0	5.5	V
Ambient Operating Temperature	Ta	0	-	+70	°C
Storage Temperature	Ts	-40	-	+125	°C
ESD (Electrostatic Discharge)					
-	Susceptibility Voltage				
All Pins	Pass 2500V				

6.2. Recommended Operation Condition

Table 9. Operation Condition

Symbol	Description	Min.	Typ.	Max.	Unit
VBus	Supply Voltage	4.5	5	5.5	V

6.3. DC Characteristics

Table 10. DC Characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
V _{IH}	Input Voltage High	2	-	3.3	V
V _{IL}	Input Voltage Low	-0.5	-	0.8	V
V _{OH}	Output Voltage High	2.4	-	-	V
V _{OL}	Output Voltage Low	-	-	0.4	V
I _{OH}	Output Current High	-	-	4	mA
I _{OL}	Output Current Low	-	-	4	mA

6.4. Analog Performance

Standard Test Conditions

Tambient=25°C, VBUS=5.0V ±5%

1kHz input sine wave; Sampling frequency=48kHz; 0dB=1Vrms

10KΩ/50pF load; Test bench Characterization BW: 20Hz~22kHz

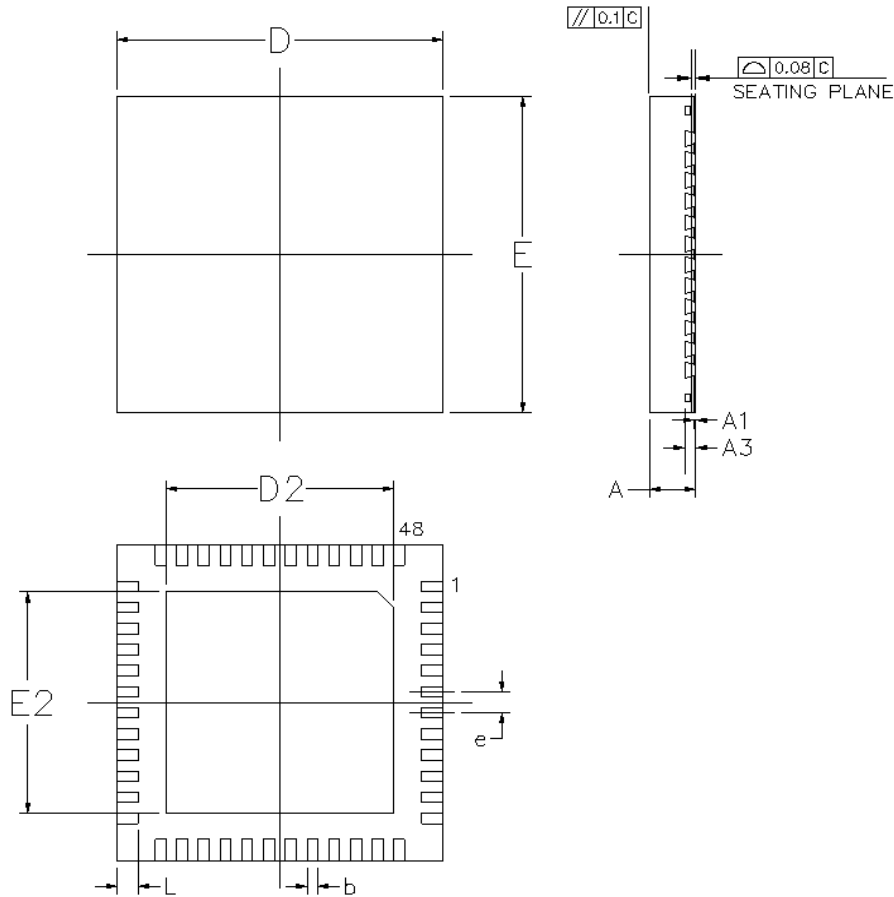
Table 11. Analog Performance

Parameter	Min	Typ	Max	Units
Full-Scale Input Voltage All ADC (Gain=0dB) Line Input MIC Input	-	0.6 0.6 0.6	-	Vrms
Full-Scale Output Voltage All DAC (Gain=0dB) Headphone Out @10KΩ load Headphone Out @32Ω load Headphone Out @16Ω Load	- - - - -	1.0 1.0 1.0 1.0 0.9	- - - - -	Vrms
SNR (A Weighted) ADC DAC Headphone Out @16Ω Load Headphone Out @32Ω Load MIC_IN to Stereo ADC with 0dB LINE_IN to stereo ADC with 0dB	- - - - - -	94 95 95 95 93 93	- - - - - -	dB FSA
Total Harmonic Distortion Plus Noise, THD+N ADC DAC Headphone Out @16Ω Load Headphone Out @32Ω Load	- - - - -	-84 -85 -81 -81	- - - -	dB FS
Frequency Response ADC (-3dB lower edge, -1dB higher edge) DAC (-3dB lower edge, -1dB higher edge)	10 10	- -	0.454*Fs 0.454*Fs	Hz
Crosstalk	-	-80	-	dB
Current consumption @ Idle	-	30	-	mA
Current consumption @ Active	-	45	-	mA
Current consumption @ Suspend	-	490	-	μA

Note: FSA=Full-Scale with A-weighting filter. FS=Full-Scale.

7. Mechanical Dimensions

7.1. Mechanical Dimensions – QFN 48 6x6mm Outline



7.2. Mechanical Dimensions Notes

Symbol	Dimension in mm			Dimension in inch		
	Min	Nom	Max	Min	Nom	Max
A	0.75	0.85	1.00	0.030	0.034	0.039
A ₁	0.00	0.02	0.05	0.000	0.001	0.002
A ₃	0.20 REF			0.008 REF		
b	0.15	0.20	0.25	0.006	0.008	0.010
D/E	6.00BSC			0.236BSC		
D2/E2	4.15	4.4	4.65	0.163	0.173	0.183
e	0.40BSC			0.016BSC		
L	0.30	0.40	0.50	0.012	0.016	0.020

Notes: CONTROLLING DIMENSION: MILLIMETER (mm).

REFERENCE DOCUMENT: JEDEC MO-220

8. Application Circuits

To guarantee the best compatibility and performance quality in hardware design with specific requirements, please contact Realtek to receive the latest application circuits. Any modification made to the reference circuits is recommended to be reviewed by Realtek. Realtek may update the latest application circuits without modifying this datasheet.

9. Ordering Information

Table 12. Ordering Information

Part Number	Package	Status
ALC4030-CG	MQFN-48 'Green' Package (6mm x 6mm)	MP
ALC4030-CGT	MQFN-48 'Green' Package (6mm x 6mm)	MP

Realtek Semiconductor Corp.

Headquarters

No. 2, Innovation Road II

Hsinchu Science Park, Hsinchu 300, Taiwan

Tel.: +886-3-578-0211. Fax: +886-3-577-6047

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