

AC6965A Datasheet

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AC6965A Features

CPU

- 32-bit DSP supports hardware Float Point Unit (FPU)
- Up to 160MHz programmable processor
- 64 Vectored interrupts
- 4 Levels interrupt priority

DSP Audio Processing

- SBC, AAC Audio decodes supported for BT audio
- mSBC voice codecs supported for BT phone
- Supports MP2, MP3, WMA, APE, FLAC, AAC, MP4, M4A, WAV, AIF, AIFC audio decoding
- Packet Loss Concealment (PLC) for voice processing
- Acoustic echo cancellation/suppression (AEC, AES)
- Single MIC Environmental Noise Cancellation (ENC)
- Multi-band DRC limiter
- 10-band EQ configuration for voice Effects

Audio Codec

- Two channels 16-bit DAC, SNR $\geq$ 95dB
- One channels 16-bit ADC, SNR $\geq$ 90dB
- Sampling rates of 8KHz/11.025KHz/16KHz/22.05KHz/24KHz/32KHz/44.1KHz/48KHz are supported
- One analog MIC amplifier, build-in MIC bias generator
- Supports two PDM digital MIC inputs
- Two channels Mono analog MUX
- Supports cap-less, single-ended, and differential mode at the DAC path
- Supports 16ohm and 32ohm Speaker loading

Bluetooth

- Compliant with Bluetooth V5.1+BR+EDR+BLE specification
- Meet class1 class2 and class3 transmitting

power requirement

- Support GFSK and $\pi/4$ DQPSK all packet types
- Provides +6dbm transmitting power
- receiver with -90dBm sensitivity
- Fast AGC for enhanced dynamic range
- Supports a2dp/avctp/avdtp/avrcp/hfp/spp/smp/att/gap/gatt/rfcomm/sdp/l2cap profile

Peripherals

- One full speed USB 2.0 OTG controller
- Six multi-function 32-bit timers, support capture and PWM mode
- Three full-duplex basic UART, UART0 and UART1 supports DMA mode
- Two SPI interface supports host and device mode
- One hardware IIC interface supports host and device mode
- 10-bit ADC for analog sampling
- External wake up/interrupt on all GPIOs

PMU

- Low voltage LDO for internal digital and analog circuit supply
- 3uA current consumption in the soft-off mode
- Built-in LDO for the core, I/O, Bluetooth and flash
- VBAT is 2.2V to 5.5V
- VDDIO is 2.2V to 3.6V

Packages

- QSOP24

Temperature

- Operating temperature: -20°C to +70°C
- Storage temperature: -65°C to +150°C

Applications

- Bluetooth headset
- Bluetooth speaker

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1、 Pin Definition

1.1 Pin Assignment

PC5	1	24	BT_OSCO
PC4	2	23	BT_OSCI
USBDM/PC3	3	22	BT_RF
USBDP	4	21	FM_ANT
PA4	5	20	VSSIO
PA3	6	19	BT_AVDD
PA2/PA0	7	18	VDDIO
MIC	8	17	VBAT
DACVSS	9	16	LDO_IN/PB5
VCOM	10	15	PB4
DACL	11	14	PB6
DACR	12	13	PB7

Figure 1-1 AC6965A Package Diagram

1.2 Pin Description

Table 1-1 AC6965A Pin Description

PIN NO.	Name	I/O Type	Drive (mA)	Function	Other Function
1	PC5	I/O	/	GPIO	SD0CLKA: SD0 Clock(A); SPI1DOB: SPI1 Data Out(B); IIC_SDA_B: IIC SDA(B); ADC12: ADC Input Channel 12; TMR1: Timer1 Clock Input; UART2RXD: Uart2 Data In(D);
2	PC4	I/O	/	GPIO	SD0CMDA: SD0 Command(A); SPI0_DAT3AB(3): SPI0 Data3(AB); SPI1CLKB: SPI1 Clock(B); IIC_SCL_B: IIC SCL(B); ADC11: ADC Input Channel 11; PWM1: Timer1 PWM Output; UART2TXD: Uart2 Data Out (D);
3	USBDM	I/O	/	USB Negative Data (pull down)	SPI2DOB: SPI2 Data Out(B); IIC_SDA_A: IIC SDA(A); ADC14: ADC Input Channel 14; UART1RXD: Uart1 Data In(D);
	PC3	I/O	/	GPIO	SD0DAT0A: SD0 Data0(A); SPI0_DAT2B(2): SPI0 Data2(B); SPI1DIB: SPI1 Data In(B); CAP2: Timer2 Capture; UART0TXD: Uart0 Data Out (D); UART0RXD: Uart0 Data In(D);
4	USBDP	I/O	/	USB Positive Data (pull down)	SPI2CLKB: SPI2 Clock(B); IIC_SCL_A: IIC SCL(A); ADC13: ADC Input Channel 13; UART1TXD: Uart1 Data Output(D);
5	PA4		/		SD0CMDC: SD0 Command(C) AMUX0R: Analog Channel0 Right; PLNK_DAT1: PLNK Data1; UART1_RTS: Uart1 Request to send; ADC3: ADC Input Channel 3; TMR4: Timer4 Clock Input; UART2RXA: Uart2 Data In(A);
6	PA3		/		SD0DATC: SD0 Data(C);

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					AMUX0L: Analog Channel0 Left; PLNK_SCLK: PLNK Serial Clock; UART1_CTS: Uart1 Clear to send; ADC2: ADC Input Channel 3; PWM5: Timer5 PWM Output; UART2TXA: Uart1 Data Output(D);
7	PA2	I/O	/	GPIO	SD0CLKC: SD0 Clock(C); MIC_BIAS: Microphone Bias Output CAP3: Timer3 Capture;
	PA0		/		SDPG: SD Power Supply ADC0: ADC Input Channel 0; CLKOUT0 UART1TXC: Uart1 Data Output(C);
8	MIC	I	/		MIC: MIC Input Channel ;
9	DACVSS	P	/		DAC Ground
10	VCOM		/		
11	DACL	O	/		DAC Left Channel
12	DACR	O	/		DAC RightChannel
13	PB7	I/O	/	GPIO	SD0CLKF: SD0Clock(F) AMUX1R: Analog Channel1Right; SPI2DOA: SPI2 Data Out(A); IIC_SDA_C: IIC DAT(C); ADC9: ADC Input Channel 9; PWM5: Timer5 PWM Output; UART1RXA: Uart1 Data In(A);
14	PB6	I/O	/	GPIO	SD0CMDf: SD0 Command(F); AMUX1L: Analog Channel1 Left; SPI2CLKA: SPI2 Data Out(A); IIC_SCL_C: IIC SCL(C); ADC8: ADC Input Channel 8; TMR3: Timer3 Clock Input; UART1TXA: Uart1 Data Out(A);
15	PB4	I/O	/	GPIO	SD0DAT0F: SD0 Data0(F); SPI0_DAT2A(2): SPI0 Data2 Out_A(2); ADC7: ADC Input Channel 7; CLKOUT1 UART2TXC: Uart2 Data Out(C); UART2RXC: Uart2 Data In(C);
16	LDO_IN	P	/		Battery Charger In
	PB5	I/O	/	GPIO (High Voltage Resistance)	SPI2DIA: SPI2 Data Input(A); PWM3: Timer3 PWM Output; CAP1: Timer1 Capture;

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					UART0TXC: Uart0 Data Out(C); UART0RXC: Uart0 Data In(C);
17	VBAT	P	/		Battery Power Supply
18	VDDIO	P	/		IO Power 3.3v
19	BT_AVDD	P	/		BT Power
20	VSSIO	P	/		Ground
21	FMIP	I	/		
22	BT_RF	/	/		BT Antenna
23	BT_SOCI	I	/		BT OSC In
24	BT_SOCO	O	/		BT OSC Out

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2、Electrical Characteristics

2.1 Absolute Maximum Ratings

Table 2-1

Symbol	Parameter	Min	Max	Unit
Tamb	Ambient Temperature	-20	+70	°C
Tstg	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	2.2	5.5	V
LDO_IN	Charger Voltage	4.5	5.5	V
V _{3.3IO}	3.3V IO Input Voltage	-0.3	VDDIO+0.3	V

2.2 PMU Characteristics

Table 2-2

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
VBAT	Voltage Input	2.2	3.7	5.5	V	
LDO_IN	Charger Voltage	4.5	5.0	5.5	V	
V _{3.3}	Voltage output	—	3.3	—	V	VBAT = 5V, 100mA loading
V _{BT_AVDD}	Voltage output	—	1.3	—	V	VBAT=5V, 100mA loading
V _{DACVDD}	DAC Voltage	—	2.7	—	V	VBAT = 5V, 10mA loading
I _{L3.3}	Loading current	—	—	150	mA	VBAT = 5V

2.3 IO Input/Output Electrical Logical Characteristics

Table 2-3

IO input characteristics						
Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V _{IL}	Low-Level Input Voltage	-0.3	—	0.3* VDDIO	V	VDDIO = 3.3V
V _{IH}	High-Level Input Voltage	0.7* VDDIO	—	VDDIO+0.3	V	VDDIO = 3.3V
IO output characteristics						
V _{OL}	Low-Level Output Voltage	—	—	0.33	V	VDDIO = 3.3V
V _{OH}	High-Level Output Voltage	2.7	—	—	V	VDDIO = 3.3V

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2.4 Internal Resistor Characteristics

Table 2-4

Port		General Output	High Drive	Internal Pull-Up Resistor	Internal Pull-Down Resistor	Comment
PA2~PA4 PB4、PB6 PB7 PC4、PC5		8mA	24mA	10K	10K	1、USBDM & USBDP default pull down 2、PB5 can pull-up resistance to 5V 3、internal pull-up/pull-down resistance accuracy ±20%
PA0	Output 0	8mA	24mA	10K	10K	
	Output 1	8mA	64mA			
PB5		8mA	—	10K	10K	
USBDP		4mA	—	1.5K	15K	
USBDM		4mA	—	180K	15K	

2.5 DAC Characteristics

Table 2-5

Parameter	Min	Typ	Max	Unit	Test Conditions
Frequency Response	20	—	20K	Hz	1KHz/0dB 10Kohm loading With A-Weighted Filter
THD+N	—	-75	—	dB	
S/N	—	95	—	dB	
Crosstalk	—	-90	—	dB	
Output Swing	—	1	—	Vrms	
Dynamic Range	—	90	—	dB	1KHz/-60dB 10Kohm loading With A-Weighted Filter
DAC Output Power	11	—	—	mW	32ohm loading

2.6 ADC Characteristics

Table 2-6

Parameter	Min	Typ	Max	Unit	Test Conditions
Dynamic Range	—	80	—	dB	1KHz/-60dB
S/N	—	90	91	dB	1KHz/-60dB
THD+N	—	-70	—	dB	
Crosstalk	—	-80	—	dB	

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2.7 BT Characteristics

2.7.1 Transmitter

Basic Data Rate

Table 2-7

Parameter		Min	Typ	Max	Unit	Test Conditions
RF Transmit Power			4	6	dBm	25°C, Power Supply VBAT=5V 2441MHz
RF Power Control Range			20		dB	
20dB Bandwidth			950		KHz	
Adjacent Channel	+2MHz		-40		dBm	
	-2MHz		-38		dBm	
Transmit Power	+3MHz		-44		dBm	
	-3MHz		-35		dBm	

Enhanced Data Rate

Table 2-8

Parameter		Min	Typ	Max	Unit	Test Conditions
Relative Power			-1		dB	25°C, Power Supply VBAT=5V 2441MHz
$\pi/4$ DQPSK Modulation Accuracy	DEVM RMS		6		%	
	DEVM 99%		10		%	
	DEVM Peak		15		%	
Adjacent Channel	+2MHz		-40		dBm	
	-2MHz		-38		dBm	
Transmit Power	+3MHz		-44		dBm	
	-3MHz		-35		dBm	

2.7.2 Receiver

Basic Data Rate

Table 2-9

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-90		dBm	25°C, Power Supply VBAT=5V 2441MHz
Co-channel Interference Rejection			-13		dB	
Adjacent Channel	+1MHz		+5		dB	
	-1MHz		+2		dB	
	+2MHz		+37		dB	
Interference Rejection	-2MHz		+36		dB	
	+3MHz		+40		dB	
	-3MHz		+35		dB	

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Enhanced Data Rate**Table 2-10**

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-90		dBm	25°C, Power Supply VBAT=5V 2441MHz
Co-channel Interference Rejection			-13		dB	
Adjacent Channel Interference Rejection	+1MHz		+5		dB	
	-1MHz		+2		dB	
	+2MHz		+37		dB	
	-2MHz		+36		dB	
	+3MHz		+40		dB	
	-3MHz		+35		dB	

2.8 FM Receiver Characteristics**Table 2-11**

Parameter	Min	Typ	Max	Unit	Test Conditions
Input Frequency	76		108	MHz	
Usable Sensitivity	3	4	8	dBμV EMF	(S+N)/N=26dB
Adjacent Channel Selectivity		48		dB	± 200kHz
IIP3		88		dBμV EMF	Δf1=200 kHz, Δf2=400 kHz
Audio Output Voltage	0		3	V	Empty Load
Audio Frequency Response	20		20k	Hz	DacTest
Audio (S+N)/N		58		dB	
Stereo Separation		40		dB	

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3、Package Information

3.1 QSOP24

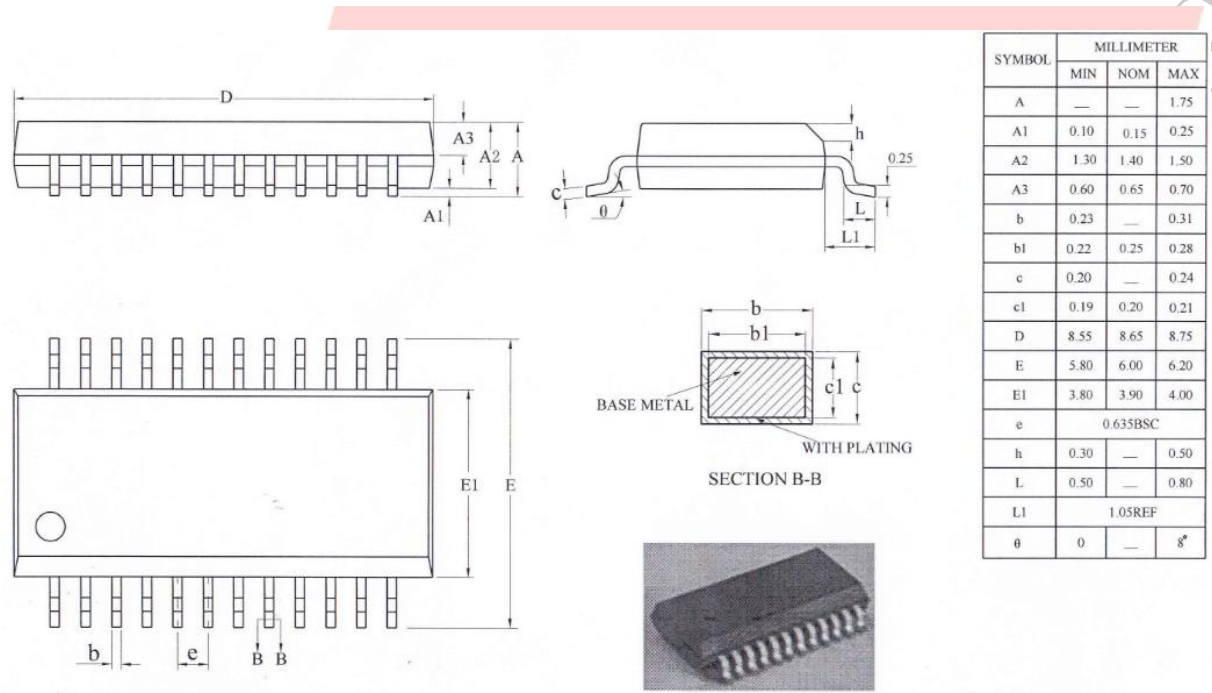


Figure 3-1. AC6965A Package

4、Revision History

Date	Revision	Description
2020.05.20	V1.0	Initial Release

FCC Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help important announcement

Important Note:

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Country Code selection feature to be disabled for products marketed to the US/Canada.

This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna,
3. For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change. (if modular only test Channel 1-11)

As long as the three conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

The final end product must be labeled in a visible area with the following"

Contains FCC ID: **2A9G7-AI00750** "

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01r01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

2.7 Antennas

This radio transmitter **FCC ID:2A9G7-AI00750** has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
			Antenna	
Bluetooth	/	PCB Antenna	1.0	2400-2500MHz

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains **FCC ID:2A9G7-AI00750**".

2.9 Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

2.11 Note EMI Considerations

Host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

2.12 How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure.

ISED Statement

- English: This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

- French: Cet appareil contient des émetteurs/récepteurs exempts de licence qui sont conformes aux CNR exempts de licence d'Innovation, Sciences et Développement économique Canada. Le fonctionnement est soumis aux deux conditions suivantes :

(1) Cet appareil ne doit pas causer d'interférences.

(2) Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment.

This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé.

Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

ISED Modular Usage Statement

NOTE 1: When the ISED certification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use the wording "Contains transmitter module IC: 29756-AI00750" or "Contains IC: 29756-AI00750".

NOTE 1: Lorsque le numéro de certification ISED n'est pas visible lorsque le module est installé dans un autre appareil, l'extérieur de l'appareil dans lequel le module est installé doit également afficher une étiquette faisant référence au module inclus. Cette étiquette extérieure peut être libellée Contient le module émetteur IC: 29756-AI00750 ou Contient IC: 29756-AI00750.