

AC6965E Datasheet

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AC6965E 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)
- One analog MIC Environmental Noise Cancellation (ENC)
- Multi-band DRC limiter
- 10-band EQ configuration for voice Effects

Audio Codec

- One 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 V5.3+BR+EDR+BLE specification
- Meet class2 and class3 transmitting power

requirement

- Support GFSK and $\pi/4$ DQPSK all packet types
- Provides maximum +6dbm transmitting power
- receiver with minimum -90dBm sensitivity
- Fast AGC for enhanced dynamic range
- Supports
 - a2dp \avctp \avdtp \avrcp \hfp \spp \smp \att \gap \gatt \rfcomm \sdp \l2cap profile
 - a2dp 1.3.2 \avctp 1.4 \avdtp 1.3 \avrcp 1.6.2 \hfp 1.8 \spp 1.2 \rfcomm 1.1 \pnp 1.3 \hid 1.1.1 \sdp core5.3 \l2cap core 5.3

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
- 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: -40°C to +85°C
- Storage temperature: -65°C to +150°C

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Applications

 Bluetooth speaker



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1、 Pin Definition

1.1 Pin Assignment

PC5	1	24	BT OSC0
PC4	2	23	BT OSC1
USBDM/PC3	3	22	BT_RF
USBDP	4	21	FMIP
PA4	5	20	VSSIO
PA3	6	19	PB1
PA2	7	18	VDDIO
MIC/PA1	8	17	VBAT
PA0	9	16	LDO_IN/PB5
DACVSS	10	15	PB4
VCOM	11	14	PB6
DACL	12	13	PB7

Figure 1-1 AC6965E Package Diagram

1.2 Pin Description

Table 1-1 AC6965E Pin Description

PIN NO.	Name	I/O Type	Drive (mA)	Function	Other Function
1	PC5	I/O	24/8	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	24/8	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	4	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	24/8	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	4	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	I/O	24/8		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	I/O	24/8		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	24/8	GPIO	SD0CLKC: SD0 Clock(C); MIC_BIAS: Microphone Bias Output CAP3: Timer3 Capture;
8	PA1	I/O	24/8	GPIO	ADC1: ADC Input Channel 1; PWM4: Timer4 PWM Output; UART1RXC: Uart0 Data In(C);
	MIC	I	/		MIC: MIC Input Channel ;
9	PA0	I/O	/		SDPG: SD Power Supply ADC0: ADC Input Channel 0; CLKOUT0 UART1TXC: Uart1 Data Output(C);
10	DACVSS	P	/		DAC Ground
11	VCOM		/		
12	DACL	O	/		DAC Left Channel
13	PB7	I/O	24/8	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	24/8	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	24/8	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	8	GPIO	SPI2DIA: SPI2 Data Input(A);

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				(High Voltage Resistance)	PWM3: Timer3 PWM Output; CAP1: Timer1 Capture; UART0TXC: Uart0 Data Out(C); UART0RXC: Uart0 Data In(C);
17	VBAT	P	/		Battery Power Supply
18	VDDIO	P	/		IO Power 3.3v
19	PB1	I/O	24/8	GPIO (pull up)	Long Press Reset; ADC5: ADC Input Channel 5; TMR2: Timer2 Clock Input; UART0RXB: Uart0 Data In(B);
20	VSSIO	P	/		Ground
21	FMIP	I	/		FM Antenna
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	-40	+85	°C
Tstg	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	-0.3	4.5	V
V _{3.3IO}	3.3V IO Input Voltage	-0.3	VDDIO+0.3	V
LDO_IN	Charge Input Voltage	-0.3	6.5	V

2.2 PMU Characteristics

Table 2-2

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
LDO_IN	Loading current	—	—	300	mA	VBAT = 4.2V
VBAT	Voltage Input	2.2	3.7	5.5	V	
V _{VDDIO}	Voltage output	—	3.3	—	V	VBAT = 4.2V, 100mA loading
V _{BT_AVDD}	Voltage output	—	1.3	—	V	VBAT=4.2V, 100mA loading

2.3 Battery Charge

Table 2-3

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
LDO_IN	Charge Input Voltage	4.5	5	5.5	V	—
V _{Charge}	Charge Voltage	4.15	4.2	4.25	V	—
I _{Charge}	Charge Current	20	—	300	mA	Charge current at fast charge mode
I _{Trinkl}	Trickle Charge Current	20	45	70	mA	V _{BAT} <V _{Trinkl}

2.4 IO Input/Output Electrical Logical Characteristics

Table 2-4

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

2.5 Internal Resistor Characteristics

Table 2-5

Port	General Output	High Drive	Internal Pull-Up Resistor	Internal Pull-Down Resistor	Comment	
PA1~PA4 PC3~PC5 PB1,PB4 PB6,PB7	8mA	24mA	10K	10K	1、PB1 default pull up 2、USBDM & USBDP default pull down 3、internal pull-up/pull-down resistance accuracy ±20%	
PA0	Output 0	8mA	24mA	10K		10K
	Output 1	8mA	64mA	10K		10K
PB5	8mA	–	10K	10K		
USBDM	4mA	–	1.5K	15K		
USBDM	4mA	–	180K	15K		

2.6 DAC Characteristics

Table 2-6

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		V _{rms}	
Dynamic Range		95		dB	1KHz/-60dB 10Kohm loading With A-Weighted Filter
DAC Output Power		20	–	mW	32ohm loading

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2.7 ADC Characteristics

Table 2-7

Parameter	Min	Typ	Max	Unit	Test Conditions
Dynamic Range		80		dB	Fsample=44.1kHz Fin=1KHz 2mVpp Input
S/N	–	90	91	dB	Fsample=44.1kHz Fin=1KHz 1.2Vpp Input
THD+N	–	-70	–	dB	
Crosstalk	–	-90	–	dB	

2.8 BT Characteristics

2.8.1 Transmitter

Basic Data Rate

Table 2-8

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 2-9

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	

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2.8.2 Receiver

Basic 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	+1MHz		+5		dB	
	-1MHz		+2		dB	
	+2MHz		+37		dB	
Interference Rejection	-2MHz		+36		dB	
	+3MHz		+40		dB	
	-3MHz		+35		dB	

Enhanced Data Rate

Table 2-11

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	

2.9 FM Receiver Characteristics

Table 2-12

Parameter	Min	Typ	Max	Unit	Test Conditions
Input Frequency	76		108	MHz	
Usable Sensitivity	3	4	8	dB μ V EMF	(S+N)/N=26dB
Adjacent Channel Selectivity		48		dB	\pm 200kHz
IIP3		88		dB μ V EMF	Δ f1=200 kHz, Δ f2=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	
Audio Total Harmonic Distortion (THD)		0.4		%	

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3、 Package Information

3.1 QSOP24

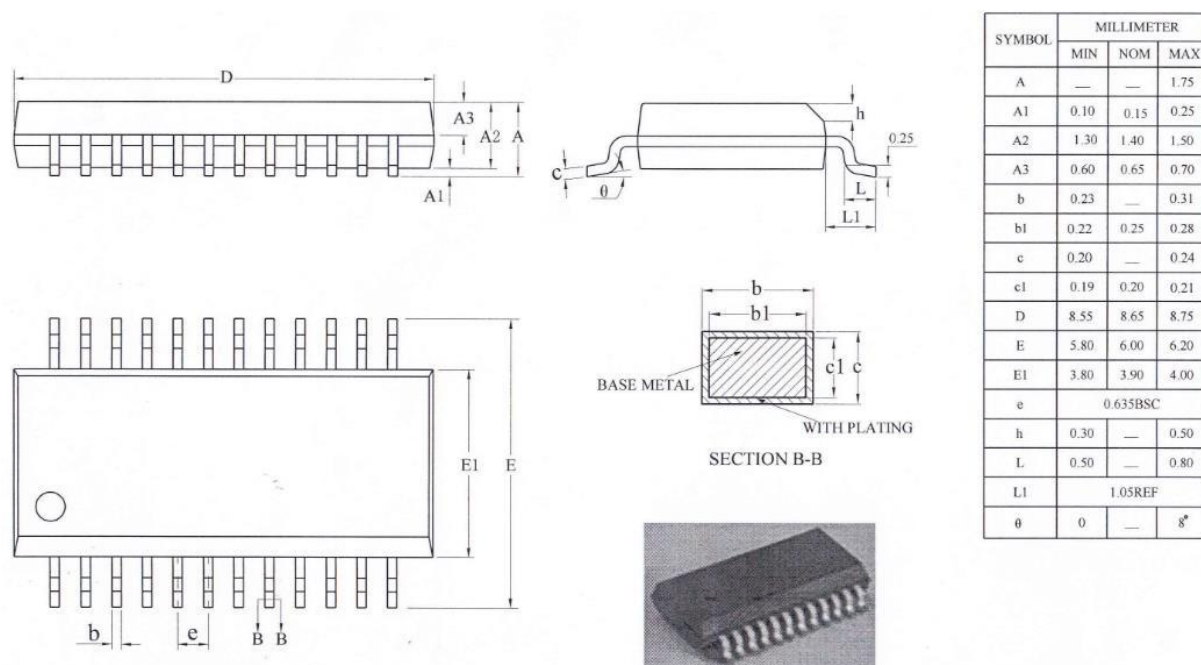


Figure 3-1. AC6965E_QSOP24 Package

3、Revision History

Date	Revision	Description
2020.06.01	V1.0	Initial Release
2021.11.22	V1.1	Update Bluetooth Vision and profiles, Update Audio characters

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