AC6965E Datasheet

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Version：V1.3

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AC6965E Features

CPU

- 32-bit DSP supports hardware Float Point Unit (FPU)
- Up to 160MHz programmable processor
- 64Vectored 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 >= 95dB
- One channels 16-bit ADC , SNR >= 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 V6.0+BR+EDR+BLE specification (DN Q334307)
- Meet class2 and class3 transmitting power requirement
- Support GFSK and π/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 1.4\avctp 1.4\avdtp 1.3\ avrcp 1.6.3\ hfp 1.9\spp 1.2\rfcomm 1.2\pnp 1.3\ hid 1.1.1\sdp core 6.0\l2cap core 6.0

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℃ to +85℃
- Storage temperature: -65℃ to +150℃

Applications

- Bluetooth speaker

1、Pin Definition

1.1 Pin Assignment

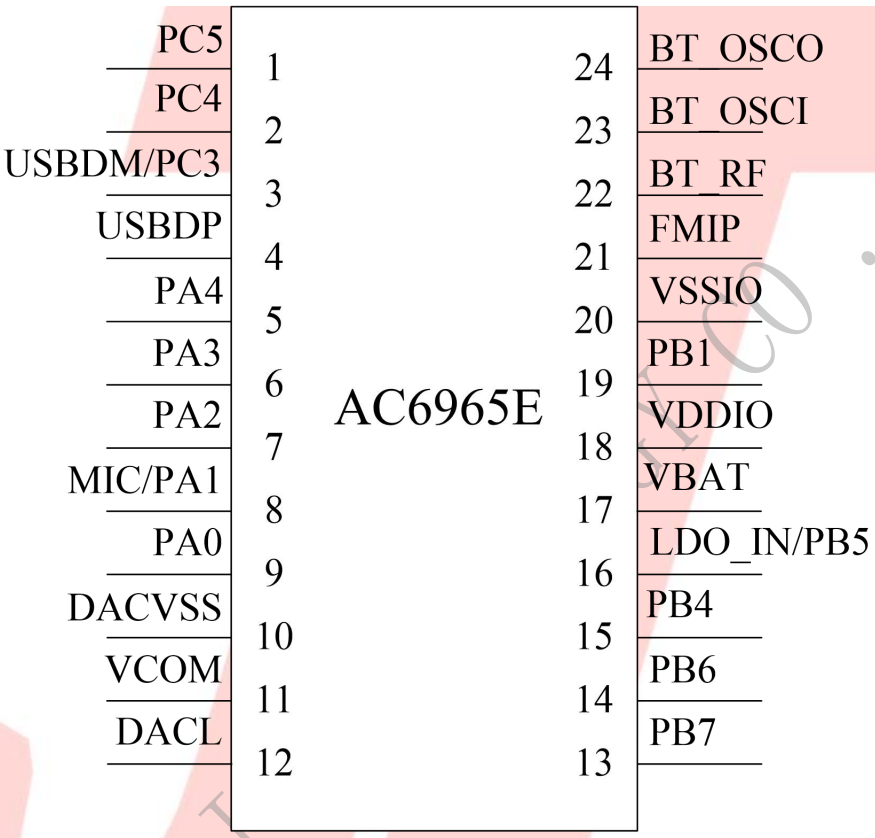


Figure 1-1 AC6965E Package Diagram

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);

					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)；

				(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

2、Electrical Characteristics

2.1 Absolute Maximum Ratings

Table 2-1

Symbol	Parameter	Min	Max	Unit
Tamb	Ambient Temperature	-40	+85	℃
Tstg	Storage temperature	-65	+150	℃
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_{Trikl}	Trickle Charge Current	20	45	70	mA	$V_{BAT}<V_{Trikl}$

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	
USBDP		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		Vrms	
Dynamic Range		95		dB	1KHz/-60dB 10Kohm loading With A-Weighted Filter
DAC Output Power		20	_	mW	32ohm loading

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℃, Power Supply VBAT=5V 2441MHz
RF Power Control Range			20		dB	
20dB Bandwidth			950		KHz	
Adjacent Channel Transmit Power	+2MHz		-40		dBm	
	-2MHz		-38		dBm	
	+3MHz		-44		dBm	
	-3MHz		-35		dBm	

Enhanced Data Rate **Table 2-9**

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

2.8.2 Receiver

Basic Data Rate **Table 2-10**

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-90		dBm	25℃, 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	

Enhanced Data Rate **Table 2-11**

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-90		dBm	25℃, 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	

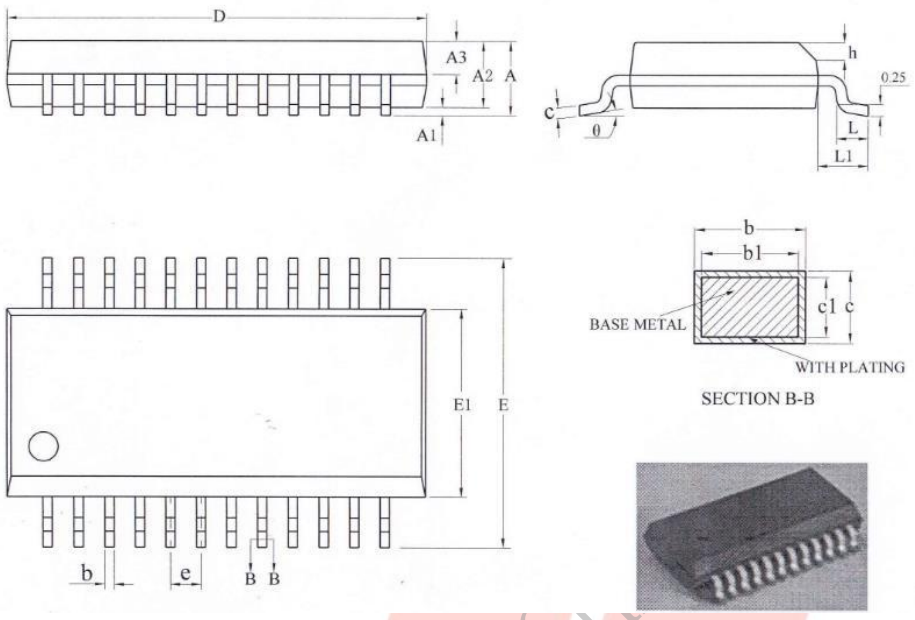
2.9 FM Receiver Characteristics

Table 2-12

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	
Audio Total Harmonic Distortion (THD)		0.4		%	

3、 Package Information

3.1 QSOP24



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	0.15	0.25
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.23	—	0.31
b1	0.22	0.25	0.28
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	8.55	8.65	8.75
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	0.635BSC		
h	0.30	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°

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
2023.12.11	V1.2	Update Bluetooth Vision and profiles
2025.01.09	V1.3	Update Bluetooth Vision and profiles