AC6965E Datasheet

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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)
- Single/Dual 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 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
- 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℃ to +70℃
- Storage temperature: -65℃ to +150℃

Applications

- Bluetooth speaker

1、 Pin Definition

1.1 Pin Assignment

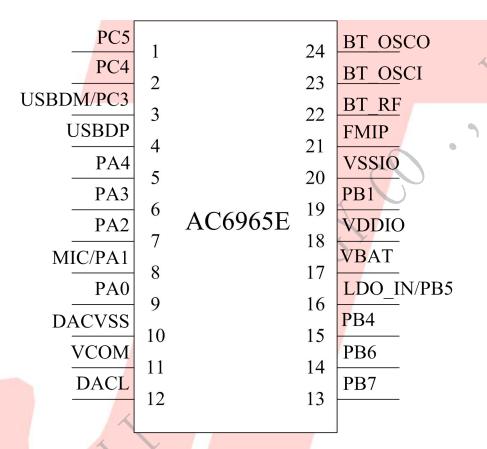|		
PC5	1	24	BT_OSCO
PC4	2	23	BT_OSCI
USBDM/PC3	3	22	BT_RF
USBDP	4	21	FMIP
PA4	5	20	VSSIO
PA3	6	19	PB1
PA2	7	18	VDDIO
MIC/PA1	8	17	VBAT
PA0	9	16	LDO_IN/PB5
DACVSS	10	15	PB4
VCOM	11	14	PB6
DACL	12	13	PB7

AC6965E

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	-20	+70	°C
Tstg	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	2.2	5.5	V
$V_{3.3IO}$	3.3V IO Input Voltage	-0.3	VDDIO+0.3	V
LDO_IN	Charge Input Voltage	-0.3	5.5	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_{DVDD}	Voltage output	0.9	1.2	1.25	V	VBAT = 4.2V, 30mA loading
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	
THD+N	–	-75	–	dB	1KHz/0dB
S/N	–	95	–	dB	10Kohm loading
Crosstalk	–	-90	–	dB	With A-Weighted Filter
Output Swing		1		Vrms	
Dynamic Range		90		dB	1KHz/-60dB 10Kohm loading With A-Weighted Filter
DAC Output Power	11		–	mW	32ohm loading

2.7   ADC Characteristics

Table 2-7

Parameter	Min	Typ	Max	Unit	Test Conditions
Dynamic Range		80		dB	1KHz/-60dB
S/N	_	90	91	dB	
THD+N	_	-70	_	dB	1KHz/-60dB
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℃,
RF Power Control Range			20		dB	
20dB Bandwidth			950		KHz	Power Supply
Adjacent Channel Transmit Power	+2MHz		-40		dBm	VBAT=5V
	-2MHz		-38		dBm	
	+3MHz		-44		dBm	2441MHz
	-3MHz		-35		dBm	

Enhanced Data Rate   **Table 2-9**

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