

# **AC6965A Datasheet**

**Zhuhai Jieli Technology Co.,LTD**

**Version: V1.0**

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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);<br>SPI1DOB: SPI1 Data Out(B);<br>IIC_SDA_B: IIC SDA(B);<br>ADC12: ADC Input Channel 12;<br>TMR1: Timer1 Clock Input;<br>UART2RXD: Uart2 Data In(D);                                         |
| 2       | PC4   | I/O      | /          | GPIO                          | SD0CMDA: SD0 Command(A);<br>SPI0_DAT3AB(3): SPI0 Data3(AB);<br>SPI1CLKB: SPI1 Clock(B);<br>IIC_SCL_B: IIC SCL(B);<br>ADC11: ADC Input Channel 11;<br>PWM1: Timer1 PWM Output;<br>UART2TXD: Uart2 Data Out (D);     |
| 3       | USBDM | I/O      | /          | USB Negative Data (pull down) | SPI2DOB: SPI2 Data Out(B);<br>IIC_SDA_A: IIC SDA(A);<br>ADC14: ADC Input Channel 14;<br>UART1RXD: Uart1 Data In(D);                                                                                                |
|         | PC3   | I/O      | /          | GPIO                          | SD0DAT0A: SD0 Data0(A);<br>SPI0_DAT2B(2): SPI0 Data2(B);<br>SPI1DIB: SPI1 Data In(B);<br>CAP2: Timer2 Capture;<br>UART0TXD: Uart0 Data Out (D);<br>UART0RXD: Uart0 Data In(D);                                     |
| 4       | USBDP | I/O      | /          | USB Positive Data (pull down) | SPI2CLKB: SPI2 Clock(B);<br>IIC_SCL_A: IIC SCL(A);<br>ADC13: ADC Input Channel 13;<br>UART1TXD: Uart1 Data Output(D);                                                                                              |
| 5       | PA4   |          | /          |                               | SD0CMDC: SD0 Command(C)<br>AMUX0R: Analog Channel0 Right;<br>PLNK_DAT1: PLNK Data1;<br>UART1_RTS: Uart1 Request to send;<br>ADC3: ADC Input Channel 3;<br>TMR4: Timer4 Clock Input;<br>UART2RXA: Uart2 Data In(A); |
| 6       | PA3   |          | /          |                               | SD0DATC: SD0 Data(C);                                                                                                                                                                                              |

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

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|    |         |   |   |  |                                                             |
|----|---------|---|---|--|-------------------------------------------------------------|
|    |         |   |   |  | UART0TXC: Uart0 Data Out(C);<br>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 <sub>3.3IO</sub> | 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 <sub>3.3</sub>     | Voltage output  | —   | 3.3 | —   | V    | VBAT = 5V, 100mA loading |
| V <sub>BT_AVDD</sub> | Voltage output  | —   | 1.3 | —   | V    | VBAT=5V, 100mA loading   |
| V <sub>DACVDD</sub>  | DAC Voltage     | —   | 2.7 | —   | V    | VBAT = 5V, 10mA loading  |
| I <sub>L3.3</sub>    | 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 <sub>IL</sub>           | Low-Level Input Voltage   | -0.3       | —   | 0.3* VDDIO | V    | VDDIO = 3.3V    |
| V <sub>IH</sub>           | High-Level Input Voltage  | 0.7* VDDIO | —   | VDDIO+0.3  | V    | VDDIO = 3.3V    |
| IO output characteristics |                           |            |     |            |      |                 |
| V <sub>OL</sub>           | Low-Level Output Voltage  | —          | —   | 0.33       | V    | VDDIO = 3.3V    |
| V <sub>OH</sub>           | 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<br>PB4、PB6<br>PB7<br>PC4、PC5 |          | 8mA            | 24mA       | 10K                       | 10K                         | 1、USBDM & USBDP default pull down<br>2、PB5 can pull-up resistance to 5V<br>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<br>10Kohm loading<br>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<br>10Kohm loading<br>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,<br>Power Supply<br>VBAT=5V<br>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,<br>Power Supply<br>VBAT=5V<br>2441MHz |
| $\pi/4$ DQPSK<br>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,<br>Power Supply<br>VBAT=5V<br>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,<br>Power Supply<br>VBAT=5V<br>2441MHz |
| Co-channel Interference Rejection          |       |     | -13 |     | dB   |                                             |
| Adjacent Channel<br>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<br>EMF | (S+N)/N=26dB                |
| Adjacent Channel Selectivity |     | 48  |     | dB          | ± 200kHz                    |
| IIP3                         |     | 88  |     | dBμV<br>EMF | Δf1=200 kHz,<br>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

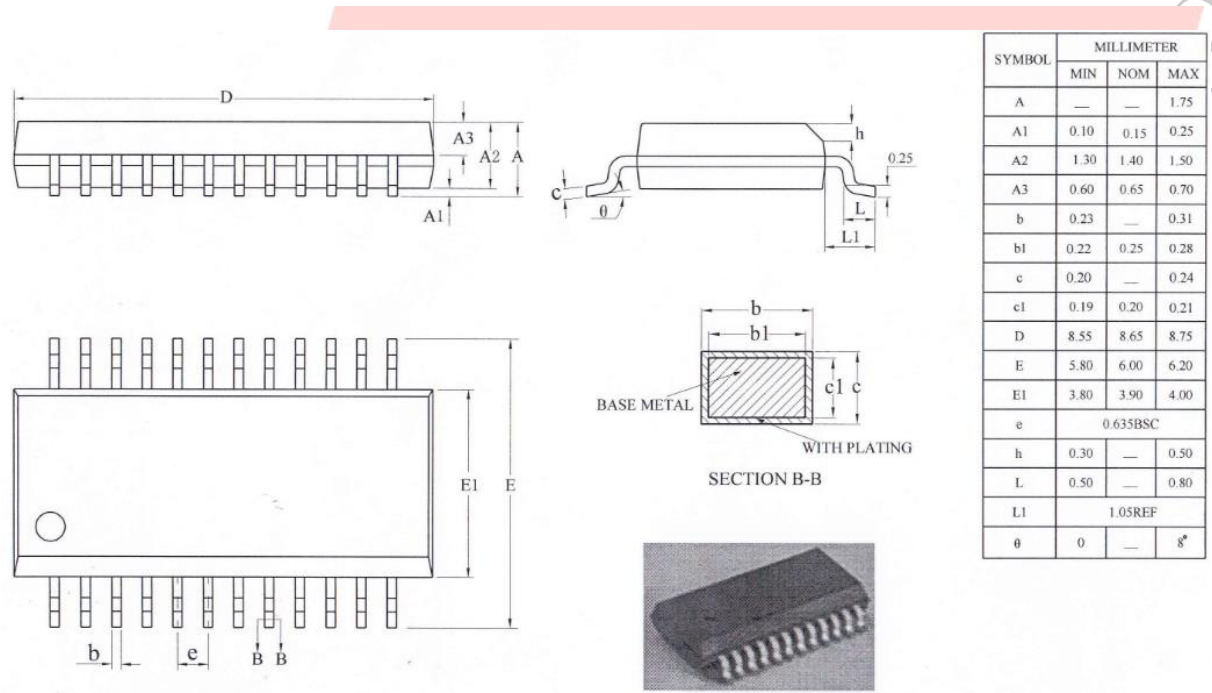


Figure 3-1. AC6965A Package

## 4、Revision History

| Date       | Revision | Description     |
|------------|----------|-----------------|
| 2020.05.20 | V1.0     | Initial Release |
|            |          |                 |