

# AC7003D Datasheet

**Zhuhai Jieli Technology Co.,LTD**

**Version: 1.0**

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# AC7003D Features

## CPU

- 32bit Dual-Issue DSP
- Up to 160MHz programmable processor
- With IEEE754 Single precision FPU
- With cordic accelerate engine
- Advanced debug with 8 hardware breakpoints/watchpoints
- Advanced system execution capture unit

## Interrupt

- Support for up to 64 interrupts with 8 priority level
- NMI supported
- SWI supported, with configurable priority
- Low power wake up by polling pending 8 IO interrupts for low power wake up

## DSP Audio Processing

- SBC, AAC Audio decodes supported for BT audio
- mSBC voice codec 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
- Single/Dual MIC Environmental Noise Cancellation (ENC)
- Multi-band DRC limiter
- 20-band EQ configuration for voice Effects

## Audio Codec

- Two channels 24-bit DAC, SNR  $\geq$  102dB
- Two channels 24-bit ADC , SNR  $\geq$  95dB
- DAC Sampling rates of 8kHz/11.025kHz/16kHz/22.05kHz/24kHz/32kHz/44.1kHz/48kHz/64kHz/88.2kHz/96kHz are supported
- ADC Sampling rates of 8kHz/11.025kHz/16kHz/22.05kHz/24kHz/32kHz/44.1kHz/48kHz are supported

- Two analog MIC amplifier, build-in MIC bias generator
- Two channels analog AUX , supports Stereo
- Supports cap-less, single-ended, and One 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 DQPSK all packet types
- Provides maximum +10dbm transmitting power
- EDR receiver with minimum -94dBm sensitivity
- Fast AGC for enhanced dynamic range
- Supports a2dp\avctp\avdtp\avrcp\hfp\spp\smpt\att\gap\gatt\rfcomm\sdpl2cap 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\sdpcore5.3\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、UART1 support DMA mode
- One hardware IIC interface supports host and device mode
- Two Built-in low power Cap Sense Keys
- LED controller, support 2 LED control by one IO
- 10-bit ADC for analog sampling
- External wake up/interrupt on all GPIOs
- Crossbar IO support: timer\SPI\SDC\IIC \UART\RDEC\ALINK\PLINK

**PMU**

- Low voltage LDO and DC-DC for internal digital and analog circuit supply
- Less 2uA current consumption in the soft-off mode
- Built-in LDO and DC-DC for the core, I/O, Bluetooth and flash
- VBAT is 2.2V to 4.4V
- IOVDD is 2.2V to 3.6V

**Packages**

- QFN20(3mm\*3mm)

**Temperature**

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

**Applications**

- Bluetooth TWS Earphones

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# 1、 Pin Definition

## 1.1 Pin Assignment

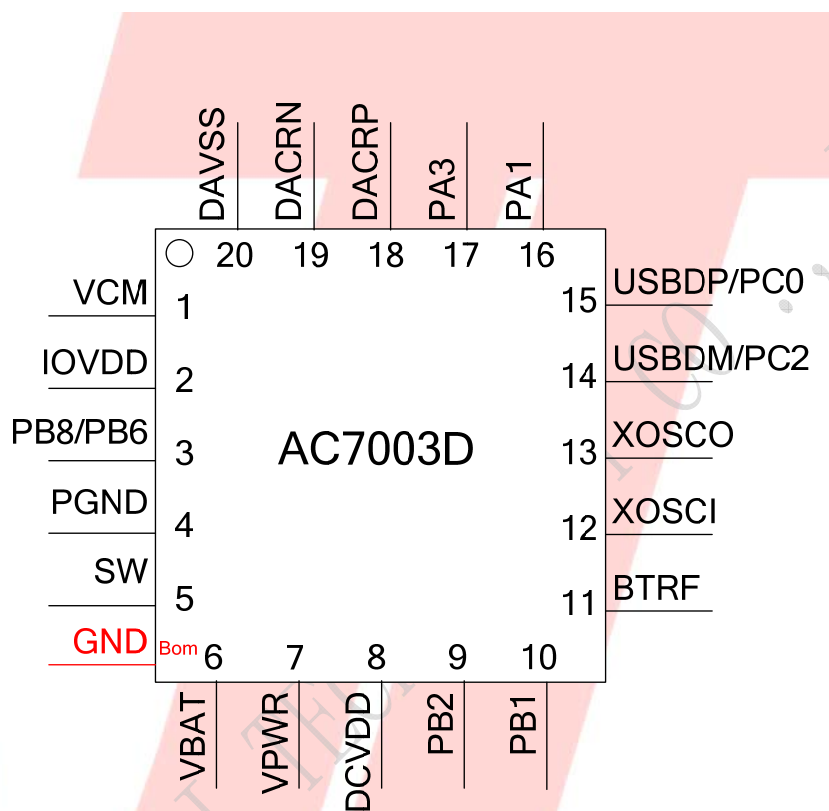


Figure 1-1 AC7003D Package Diagram

## 1.2 Pin Description

Table 1-1 AC7003D Pin Description

PIN NO.	Name	I/O Type	Drive (mA) 4 level	Function	Other Function
1	VCM	P	/		DAC reference voltage
2	IOVDD	PO	/		IO Power 3.3v
3	PB8	I/O	2.4~64	GPIO	AIN_B0: MIC1: MIC1 Input Channel; MIC1_P: Different MIC1 Positive AMUX_B0: Analog Channel B0 L/R Input; UART0RXB: Uart0 Data Input(B); CAP4: Timer4 Capture;
	PB6	I/O	2.4~64	GPIO	ADC9: ADC Input Channel 9; UART1RXA: Uart1 Data Input(A); PWM2: Timer2 PWM Output;
4	PGND	P	/		DCDC Ground
5	SW	P	/		DCDC switch output, connected to inductor
6	VBAT	PI	/		Power Supply, connect to battery
7	VPWR	PI	/		Charge Power Input;
		I/O	8	GPIO	High Voltage Resistance I/O; UART0TXC: Uart0 Data Output(C); UART0RXC: Uart0 Data Input(C); PWM3: Timer3 PWM Output; CAP1: Timer1 Capture;
8	DCVDD	PO	/		Internal power
9	PB2	I/O	2.4~64	GPIO	LP_TH2: Low Power Touch Channel 2 ADC7: ADC Input Channel 7; CAP5: Timer5 Capture; UART2RXC: Uart2 Data Input(C); SPI2DOC: SPI2 Data Out(C);
10	PB1	I/O	2.4~64	GPIO (pull up)	Long Press Reset; LP_TH1: Low Power Touch Channel 1 UART2TXC: Uart2 Data Output(C) ADC6: ADC Input Channel 6; SPI2CLKC: SPI2 Clk(C);
11	BTRF	/	/		BT Antenna
12	XOSCI	I	/		XOSC In

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13	XOSCO	O	/		XOSC Out
14	DM	I/O	4	USB Negative Data	UART1RXD: Uart1 Data Input(D); IIC_SDA_A: IIC SDA(A); ADC11: ADC Input Channel 11; SPI2DOB: SPI2 Data Out(B); ISP_DI:
	PC2	I/O	2.4~64	GPIO	ALNK_SCLK(B): Audio Link Serial Clock(B); IIC_SCL_C: IIC SCL(C); UART0TXD: Uart0 Data Output(D); TMR1: Timer1 Clock Input;
15	DP	I/O	4	USB Positive Data	UART1TXD: Uart1 Data Output(D); IIC_SCL_A: IIC SCL(A); ADC10: ADC Input Channel 10; SPI2CLKB: SPI2 Clock(B); ISP_CLK:
	PC0	I/O	8	GPIO	High Voltage Resistance I/O; UART1TXB: Uart0 Data Output(B); ALNK_DAT0(B): Audio Link Data0(B);
16	PA1	I/O	2.4~64	GPIO	AIN_A0: MIC0: MIC0 Input Channel ; MIC0_P: Different MIC0 Positive AMUX_A0: Analog Channel A0 L/R Input; PWM0: Timer0 PWM Output; UART1TXC: Uart1 Data Output(C);
17	PA3	I/O	2.4~64	GPIO	ALNK_DAT0(A): Audio Link Data0(A); UART2TXA: Uart2 Data Output(A); ADC0: ADC Input Channel 0; PWM1: Timer1 PWM Output; SPI1DOC: SPI1 Data Output(C); ISP_DO;
18	DACRP	O	/		Different DAC Right Positive Channel
19	DACRN	O	/		Different DAC Right Negative Channel
20	DAVSS	P	/		Analog Ground
/	Bom	P	/		Ground

P: Power or Ground PO:Power Output PI:Power Input I/O:Input or Output I:Input O:Output

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## 2、Electrical Characteristics

### 2.1 Absolute Maximum Ratings

Table 2-1

Symbol	Parameter	Min	Max	Unit
Topt	Operating temperature	-40	+85	°C
Tstg	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	-0.3	4.5	V
VPWR	Charger Voltage	-0.3	6	V
V <sub>3.0IO</sub>	3.0V IO Input Voltage (IOVDD)	-0.3	3.6	V

Note : The chip can be damaged by any stress in excess of the absolute maximum ratings listed below

### 2.2 PMU Characteristics

Table 2-2

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
VBAT	Voltage Input	2.2	3.7	4.4	V	
VPWR	Charger supply Voltage	4.5	5.0	5.5	V	
Normal mode						
IOVDD	Voltage output	–	3.0	–	V	VBAT = 4.2V, 10mA loading
	Loading current	–	–	100	mA	IOVDD=3.0V@VBAT = 4.2V
DCVDD	Voltage output	–	1.25	–	V	IOVDD=3.0V, 10mA loading
	Loading current	–	–	60	mA	DCVDD=1.25V@IOVDD=3.0v
LP mode						
IOVDD	Loading current			5	mA	IOVDD=3V@VBAT = 4.2V

### 2.3 Battery Charge

Table 2-3

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
VPWR	Charge Input Voltage	4.5	5	5.5	V	–
V <sub>Charge</sub>	Charge Voltage	4.15	4.2	4.25	V	VPWR > 4.5V
		4.30	4.35	4.40	V	VPWR > 4.65V

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$I_{Charge}$	Charge Current	20		200	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	—	$0.3 * IOVDD$	V	$IOVDD = 3.0V$
$V_{IH}$	High-Level Input Voltage	$0.7 * IOVDD$	—	$IOVDD + 0.3$	V	$IOVDD = 3.0V$
IO output characteristics						
$V_{OL}$	Low-Level Output Voltage	—	—	0.33	V	$IOVDD = 3.0V$
$V_{OH}$	High-Level Output Voltage	2.7	—	—	V	$IOVDD = 3.0V$

## 2.5 Internal Resistor Characteristics

Table 2-5

Port	Drive(mA)				Internal Pull-Up Resistor	Internal Pull-Down Resistor	Comment
PA1 PA3 PB1 PB2 PB6 PB8 PC2	2.4	8	26.4	64	10K	10K	1、PB1 default pull up 2、USBDM & USBDP default pull Down
PP0(VPWR), PC0	8				10K	10K	3、PP0(VPWR) , PC0 are high voltage resistance to 5V
USBDP	4				1.5K	15K	4、internal pull-up/pull-down resistance   accuracy $\pm 20\%$
USBDM	4				180K	15K	

## 2.6 DAC Characteristics

Table 2-6

Parameter	Min	Typ	Max	Unit	Audio Format	Test Conditions
Frequency Response	20	—	20K	Hz	—	Differential Mode
Output Swing		0.56	0.72	V <sub>rms</sub>		1KHz/0dB
THD+N	—	-78	—	dB	PCM	32 ohm loading

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	-	-69.6	-	dB	SBC	With A-Weighted Filter
S/N	-	100	102	dB	PCM	
	-	99.5	-	dB	SBC	
Dynamic Range	-	100.2	-	dB	PCM	Differential Mode 1KHz/-60dB 32 ohm loading With A-Weighted Filter
	-	100	-	dB	SBC	
Noise Floor	-	5.9	-	uV	-	A-Weighted Filter
DAC Output Power	-	9.7	16.0	mW	-	Differential Mode 32ohm loading

## 2.7 ADC Characteristics

Table 2-7

Parameter	Min	Typ	Max	Unit	Test Conditions
Dynamic Range		95		dB	Fsample=44.1kHz Fin=1KHz 2mVpp Input
S/N	-	95	-	dB	Fsample=44.1kHz Fin=1KHz 2Vpp Input
THD+N	-	-72	-	dB	
Crosstalk	-	-80	-	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		8.2	10	dBm	25°C, Power Supply
RF Power Control Range		18.0		dB	
20dB Bandwidth		950		KHz	
Adjacent Channel	+2MHz	-40		dBm	VBAT=3.7V 2441MHz 2 Layer Board
	-2MHz	-38		dBm	
Transmit Power	+3MHz	-44		dBm	
	-3MHz	-35		dBm	

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**Enhanced Data Rate****Table 2-9**

Parameter		Min	Typ	Max	Unit	Test Conditions
Relative Power			-1.2		dB	25°C, Power Supply VBAT=3.7V 2441MHz 2 Layer Board
$\pi/4$ DQPSK	DEVM RMS	6	10.9		%	
	DEVM 99%	10	19.0		%	
Modulation Accuracy	DEVM Peak	15	24.3		%	
Adjacent Channel	+2MHz		-40		dBm	
	-2MHz		-38		dBm	
Transmit Power	+3MHz		-44		dBm	
	-3MHz		-35		dBm	

**2.8.2 Receiver****Basic Data Rate****Table 2-10**

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-91		dBm	25°C, Power Supply
Co-channel Interference Rejection			-10		dB	
Adjacent Channel	+1MHz		+4		dB	VBAT=3.7V 2441MHz
	-1MHz		+2		dB	
	+2MHz		+38		dB	
Interference Rejection	-2MHz		+38		dB	DH5 2 Layer Board
	+3MHz		>+40		dB	
	-3MHz		+34		dB	

**Enhanced Data Rate****Table 2-11**

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-94		dBm	25°C, Power Supply
Co-channel Interference Rejection			-11		dB	
Adjacent Channel	+1MHz		+4		dB	VBAT=3.7V 2441MHz
	-1MHz		+2		dB	
	+2MHz		+38		dB	
Interference Rejection	-2MHz		+38		dB	2DH5 2 Layer Board
	+3MHz		>+40		dB	
	-3MHz		+34		dB	

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## 2.9 ESD Protection

Parameter	Typ.	Test pin	Reference standard
Human Body Mode	$\pm 4\text{KV}$	All pins	JEDEC EIA/JESD22-A114
Machine Mode	$\pm 200\text{V}$	All pins	JEDEC EIA/JESD22-A115
Charge Device Model	$\pm 1\text{KV}$	All pins	JEDEC EIA/JESD22-C101F
Latch up	$\pm 200\text{mA}$	All GPIO pins	JEDEC STANDARD NO.78E
	$1.5 \times V_{\text{opmax}}$	All power pins	

Note :  $1.5 \times V_{\text{opmax}}$  = 1.5 times maximum operating voltage

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### 3、 Package Information

#### 3.1 QFN32\_3.0x3.0

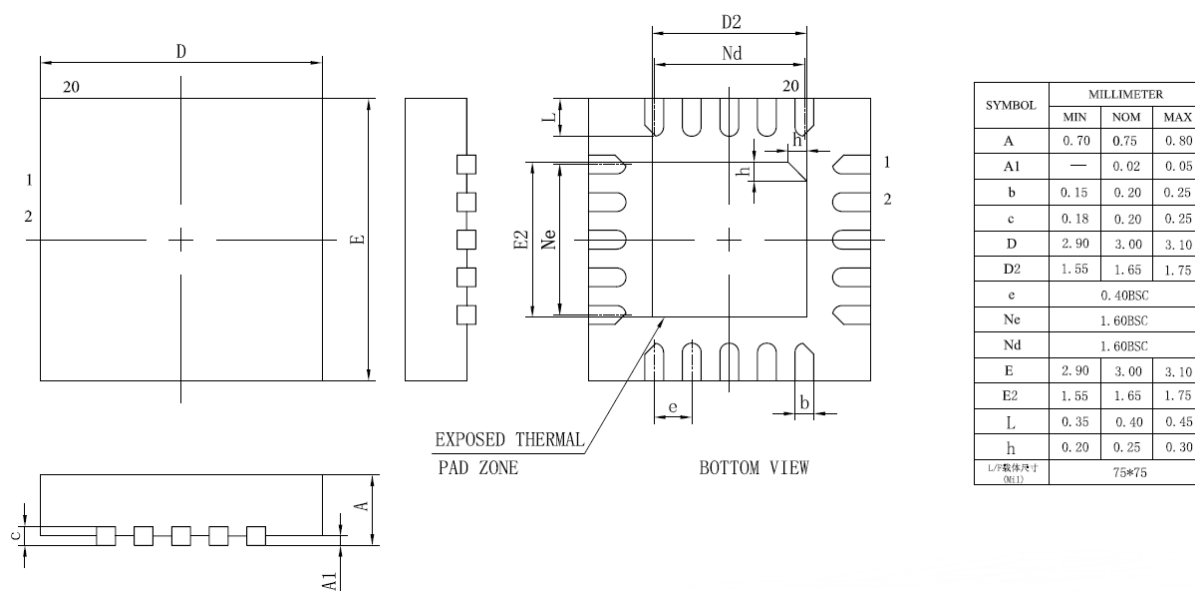


Figure 3-1 AC7003D Package

#### 4、 Revision History

Date	Revision	Description
2022.02.12	V1.0	Initial Release

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