

# **AC7006F Datasheet**

**Zhuhai Jieli Technology Co.,LTD**

**Version: 1.3**

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# AC7006F 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 12 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
- Supports Four PDM digital MIC inputs
- Two channels analog AUX , supports stereo
- Supports cap-less, single-ended, and Two differential mode at the DAC path
- Supports 16ohm and 32ohm Speaker loading

## ANC

- ANC processing engine up to 750 kHz sample rate
- 7.5 $\mu$ s analog to analog latency
- Supports 4 digital microphone inputs, 2 differential or single-ended analog inputs for ANC
- Supports 2 channels Feed-Forward, Feed-Back, Hybrid ANC
- ANC module include 20 double precision Biquad filters for each FF/FB/ music compensation control

## 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
- Three 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

- QFN32(4mm\*4mm)

#### Temperature

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

#### Applications

- Bluetooth Stereo Headsets and Headphones
- Bluetooth Stereo ANC Headsets and Headphones
- Bluetooth ANC TWS Earphones

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## 1、 Pin Definition

### 1.1 Pin Assignment

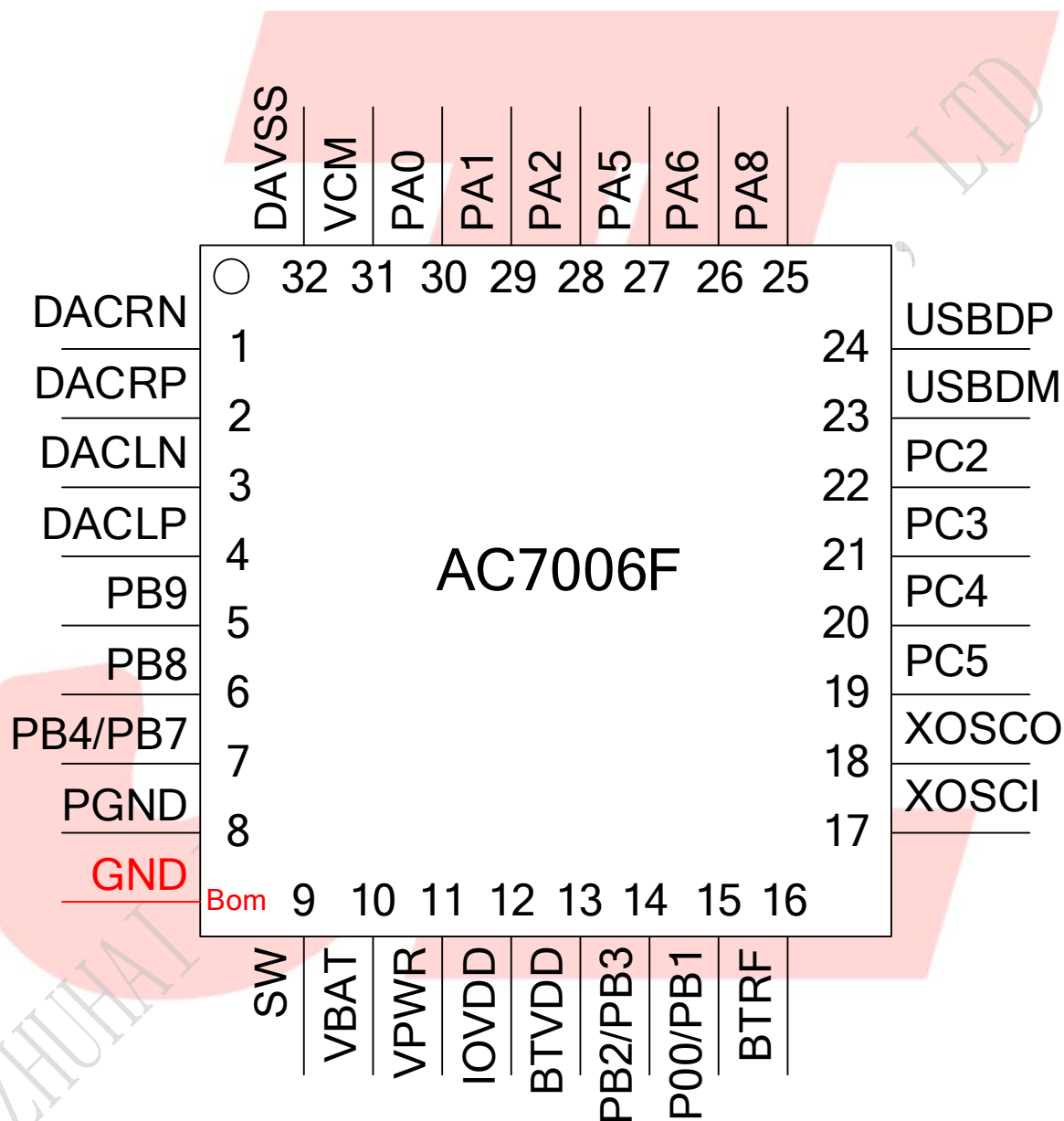


Figure 1-1 AC7006F Package Diagram

## 1.2 Pin Description

**Table 1-1 AC7006F Pin Description**

PIN NO.	Name	I/O Type	Drive (mA) 4 level	Function	Other Function
1	DACRN	O	/		Different DAC Right Negative Channel
2	DACRP	O	/		Different DAC Right Positive Channel
3	DACLN	O	/		Different DAC Left Negative Channel
4	DACLP	O	/		Different DAC Left Positive Channel
5	PB9	I/O	2.4~64	GPIO	
	SDPG	PO	/		SDPG: Supply voltage to SD Card
6	PB8	I/O	2.4~64	GPIO	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;
7	PB7	I/O	2.4~64	GPIO	MIC_BIAS1: MIC1 Bias Output; MIC1_N: Different MIC1 Negative AMUX_B1: Analog Channel B1 L/R Input;; UART0TXB: Uart0 Data Output(B);
	PB4	I/O	2.4~64	GPIO	LP_TH3: Low Power Touch Channel 3 ADC8: ADC Input Channel 8; TMR2: Timer2 Clock Input; LVD:
8	PGND	P	/		DCDC Ground
9	SW	P	/		DCDC switch output, connected to inductor
10	VBAT	PI	/		Power Supply, connect to battery
11	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;
12	IOVDD	PO	/		IO Power 3.3v
13	BTVDD	PO	/	GPIO	BT Power
14	PB2	I/O	2.4~64	GPIO	LP_TH2: Low Power Touch Channel 2

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					ADC7: ADC Input Channel 7; CAP5: Timer5 Capture; UART2RXC: Uart2 Data Input(C); SPI2DOC: SPI2 Data Out(C);
	PB3	I/O	2.4~64	GPIO	
	EVDD	PO	/		EVDD: Supply voltage to Peripherals
15	P00	I/O	8		Test pin
	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);
16	BTRF	/	/		BT Antenna
17	XOSCI	I	/		XOSC In
18	XOSCO	O	/		XOSC Out
19	PC5	I/O	2.4~64	GPIO	SD0CLKA: SD0 Clock(A); UART2RXD: Uart2 Data Input(D); SPI1DOB: SPI1 Data Out(B); ALNK_DAT3(B): Audio Link Data3(B); IIC_SDA_B: IIC SDA(B); ADC5: ADC Input Channel 5;
20	PC4	I/O	2.4~64	GPIO	SD0CMDA: SD0 CMD(A); UART2TXD: Uart2 Data Output(D); SPI1CLKB: SPI1 Clock(B); ALNK_DAT2(B): Audio Link Data2(B); IIC_SCL_B: IIC SCL(B); ADC4: ADC Input Channel 4; PWM4: Timer4 PWM Output;
21	PC3	I/O	2.4~64	GPIO	SD0DATA: SD0 Data(A); UART0RXD: Uart0 Data Input(D); SPI1DIB: SPI1 Data In(B); ALNK_LRCK(B): Audio Link Word Select(B); IIC_SDA_C: IIC SDA(C); TMR3: Timer3 Clock Input;
22	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;
23	USBDM	I/O	4	USB Negative Data	UART1RXD: Uart1 Data Input(D); IIC_SDA_A: IIC SDA(A); ADC11: ADC Input Channel 11;

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					SPI2DOB: SPI2 Data Out(B); ISP_DI:
24	USBDP	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:
25	PA8	I/O	2.4~64	GPIO	ALNK_LRCK(A): Audio Link Word Select(A); UART2RXB: Uart1 Data Input(B); PLNK_DAT1: PLNK Data1; ADC3: ADC Input Channel 3;
26	PA6	I/O	2.4~64	GPIO	ALNK_DAT3(A): Audio Link Data3(A); UART0RXA: Uart1 Data Input(A); PLNK_DAT0: PLNK Data0; IIC_SDA_D: IIC SDA(D); ADC2: ADC Input Channel 2; CAP0: Timer0 Capture; SPI2DOA: SPI2 Data Out(A);
27	PA5	I/O	2.4~64	GPIO	ALNK_DAT2(A): Audio Link Data2(A); UART0TXA: Uart0 Data Output(A); PLNK_SCLK: PLNK Serial Clock; IIC_SCL_D: IIC SCL(D); ADC1: ADC Input Channel 1; PWM5: Timer5 PWM Output; SPI2CLKA: SPI2 Clock(A);
28	PA2	I/O	2.4~64	GPIO	ALNK_MCLK(A): ALNK Master Clock(A); MIC_BIAS0: MIC0 Bias Output; MIC0_N: Different MIC0 Negative AMUX_A1: Analog Channel A1 L/R Input; CAP3: Timer3 Capture; UART1RXC: Uart1 Data In(C); CLKOUT1:
29	PA1	I/O	2.4~64	GPIO	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);
30	PA0	I/O	2.4~64	GPIO	MIC Power Supply
31	VCM	P	/		DAC reference voltage
32	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
BTVDD	Voltage output	–	1.25	–	V	IOVDD=3.0V, 10mA loading
	Loading current	–	–	60	mA	BTVDD=1.25V@IOVDD=3.0v
EVDD	Voltage output	–	1.1	–	V	BTVDD=1.25V, 1mA loading
	Loading current	–	–	5	mA	EVDD=1.1V@BTVDD=1.25v
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
PA0~PA8 PB1~PB9 PC2~PC5	2.4	8	26.4	64	10K	10K	1、PB1 default pull up 2、USBDM & USBDP default pull Down
PP0(VPWR), P00	8				10K	10K	3、PP0(VPWR), P00 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		0.55	0.71	V <sub>rms</sub>	–	1KHz/0dB
THD+N	–	-78	–	dB	PCM	32 ohm loading
	–	-69.4	–	dB	SBC	With A-Weighted

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S/N	-	100	102	dB	PCM	Filter
	-	99.5	-	dB	SBC	
Crosstalk	-	-110.0	-	dB	-	
Dynamic Range	-	100.2	-	dB	PCM	Differential Mode 1KHz/-60dB 32 ohm loading With A-Weighted Filter
	-	100	-	dB	SBC	
Noise Floor	-	6.0	-	uVrms	-	A-Weighted Filter
DAC Output Power	-	9.5	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
SNR	-	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	10	dBm	25°C, Power Supply
RF Power Control Range		18.2		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	11.4		%	
	DEVM 99%	10	19.7		%	
	DEVM Peak	15	24.8		%	
Modulation Accuracy	+2MHz		-40		dBm	
Adjacent Channel	-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			-92		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\_4.0x4.0

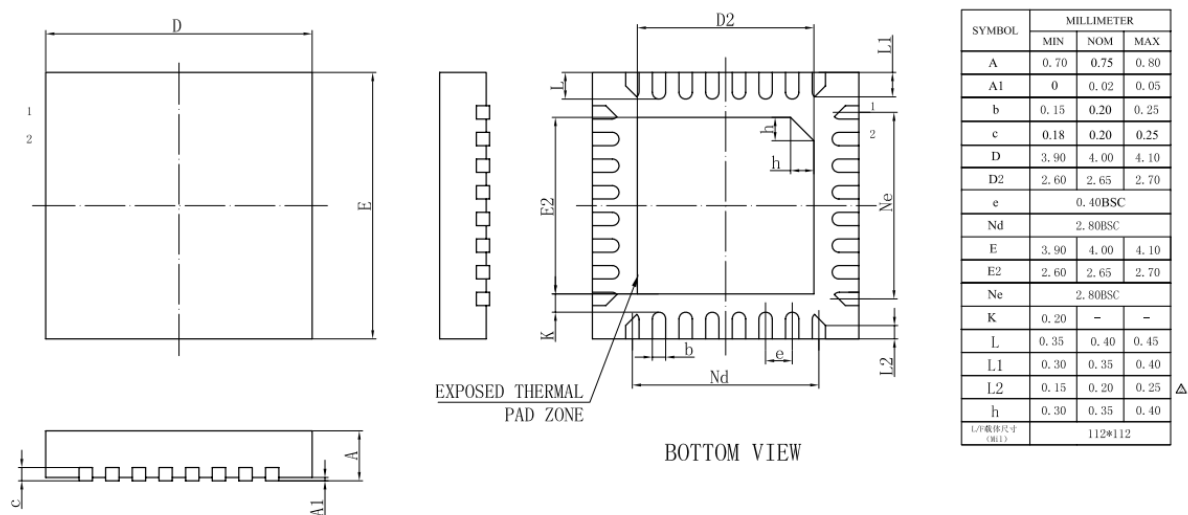


Figure 3-1 AC7006F Package

## 4、 Revision History

Date	Revision	Description
2021.05.13	V1.0	Initial Release
2021.05.27	V1.1	Update Electrical Characteristics
2021.08.03	V1.2	Update Bluetooth Vision and profile, Update Audio and Bluetooth Characteristics
2021.12.29	V1.3	Add Chip ESD Protection Characteristics

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