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# **JL6976D Datasheet**

**Zhuhai Jieli Technology Co.,LTD**

**Version: 1.0**

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# JL6976D Features

## CPU

- 32-bit DSP supports hardware Float Point Unit(FPU)
- Up to 160MHz programmable processor
- 64Vectored interrupts
- 8 Levels interrupt priority

## 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
- Acoustic echo cancellation/suppression (AEC,AES)
- Single/Dual analog/digital MIC Environmental Noise Cancellation (ENC)
- Multi-band DRC limiter
- 20-band EQ configuration for voice Effects

## Audio Codec

- Two channels 24-bit DAC, SNR  $\geq$  101dB
- Two channels 24-bit ADC , SNR  $\geq$  85dB
- 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 two PDM digital MIC inputs
- One channel Stereo analog MUX
- Supports cap-less, single-ended, and differential mode at the DAC path
- Supports 16ohm and 32ohm Speaker loading

## Bluetooth

- Compliant with Bluetooth

V5.3+BR+EDR+BLE specification

- Meet class2 and class3 transmitting power requirement
- Support GFSK and  $\pi/4$  DQPSK all packet types
- Provides maximum +8dbm transmitting power
- 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\sdp core5.3\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, support DMA mode
- One hard ware IIC interface supports host and device mode
- Built-in Cap Sense Key controller
- Two Built-in low power Cap Sense Keys
- 10-bit ADC for analog sampling
- External wake up/interrupt on all GPIOs

## PMU

- Low voltage LDO and DC-DC for internal digital and analog circuit supply
- 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 4.5V
- VDDIO is 2.2V to 3.4V

## Packages

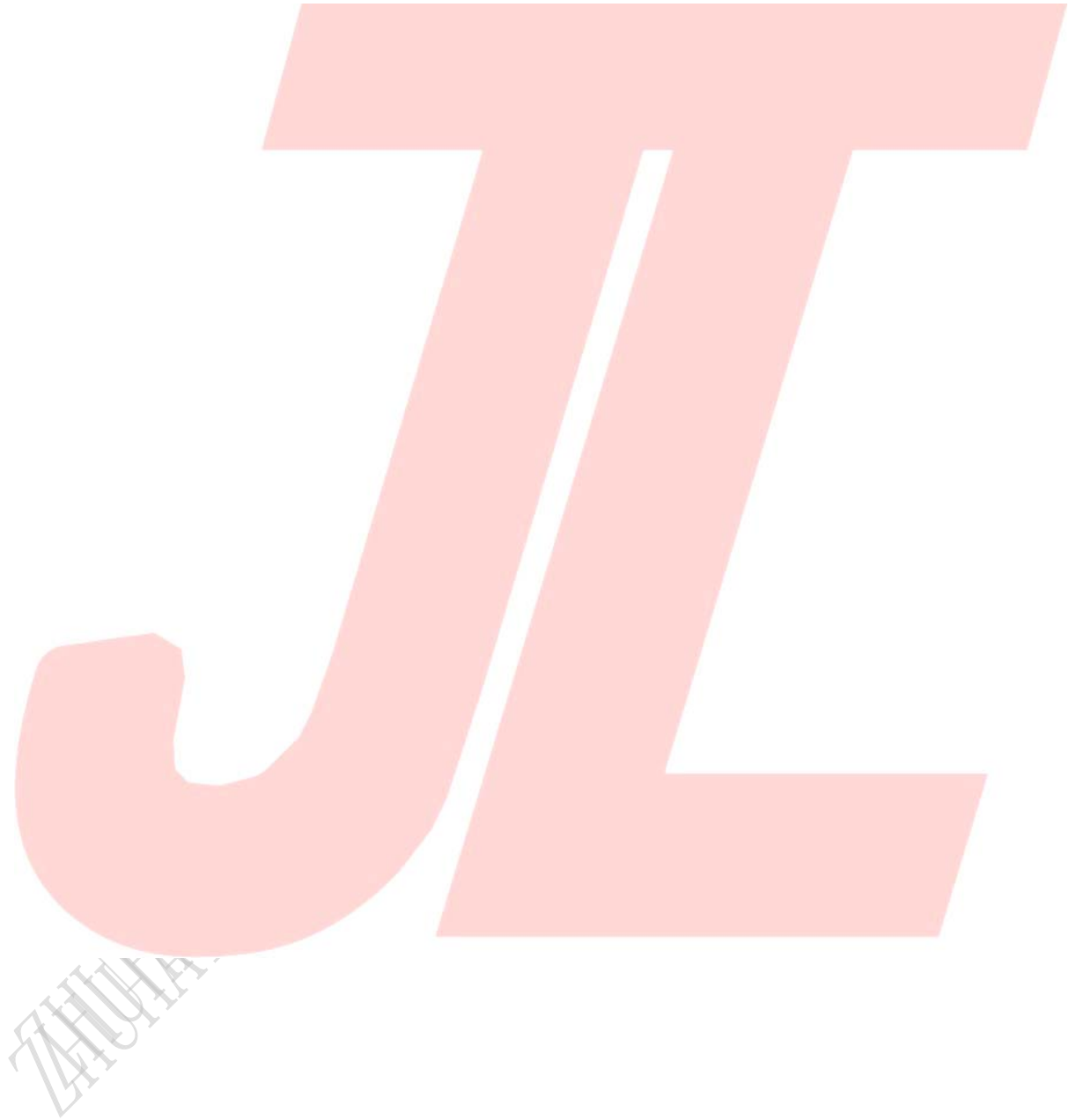
- QFN32(4mm\*4mm)

### Temperature

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

### Applications

- Bluetooth TWS headsets



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# 1、 Pin Definition

## 1.1 Pin Assignment

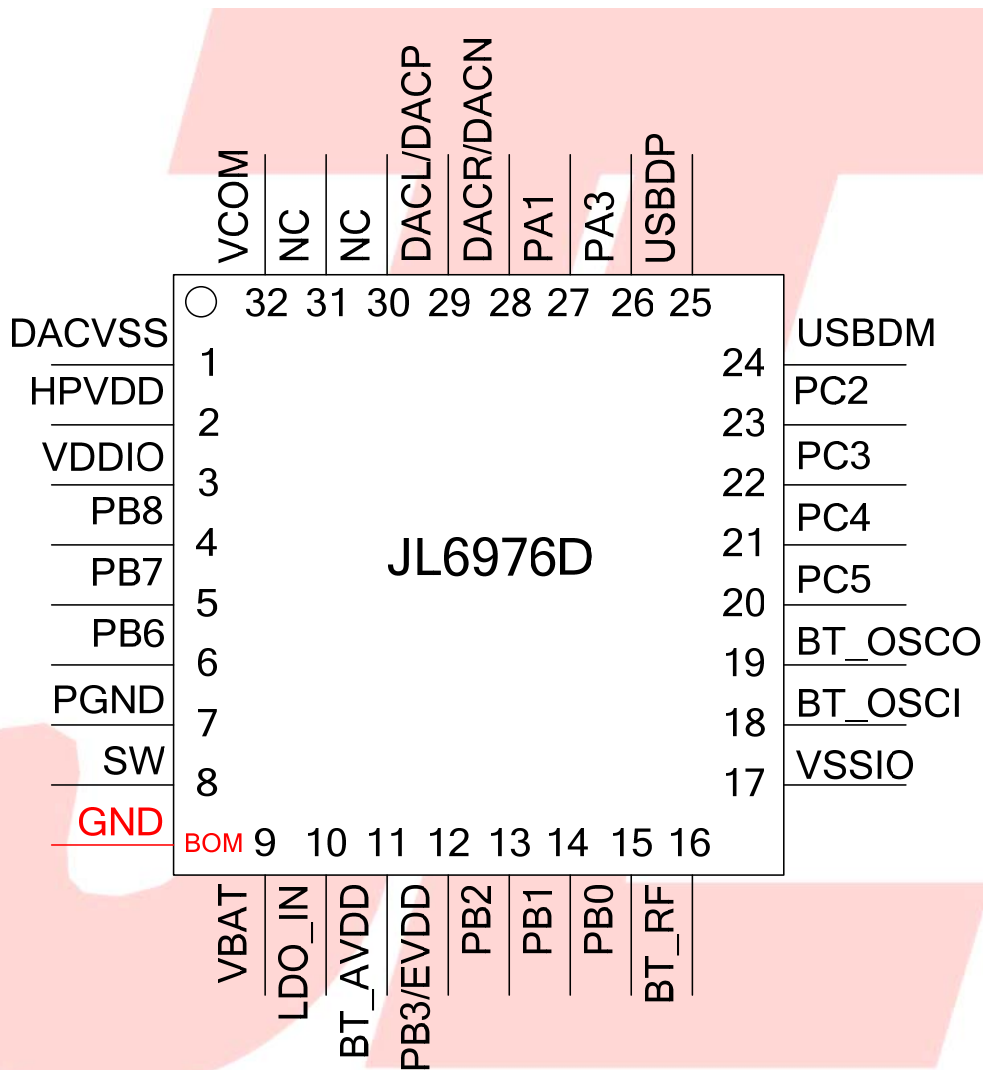


Figure 1-1 JL6976D Package Diagram

## 1.2 Pin Description

**Table 1-1 JL6976D Pin Description**

PIN NO.	Name	I/O Type	Drive (mA)	Function	Other Function
1	DACVSS	P	/		Analog Ground
2	HPVDD	P	/		Headphone AMP Power
3	VDDIO	P	/		IO Power 3.3v
4	PB8	I/O	8/24	GPIO	MIC1: MIC1 Input Channel; UART0RXB: Uart0 Data Input(B); CAP4: Timer4 Capture;
5	PB7	I/O	8/24	GPIO	MIC_BIAS1: MIC1 Bias Output; UART0TXB: Uart0 Data Output(B);
6	PB6	I/O	8/24	GPIO	UART1RXA: Uart1 Data Input(A); PWM2: Timer2 PWM Output; ADC9: ADC Input Channel 9; Touch7: Touch Input Channel 7;
7	PGND	P	/		DCDC Ground
8	SW	P	/		DCDC switch output, connected to inductor
9	VBAT	P	/		Power Supply, connect to battery
10	LDO_IN	P	/		Charge Power Input; UART0TXC: Uart0 Data Output(C); UART0RXC: Uart0 Data Input(C); PWM3: Timer3 PWM Output; CAP1: Timer1 Capture;
11	BT_AVDD	P	/	GPIO	BT Power
12	PB3	I/O	8/24	GPIO	
	EVDD	P	/		EVDD: Supply volte to peripherals
13	PB2	I/O	8/24	GPIO	UART2RXC: Uart2 Data Input(C); SPI2DOC: SPI2 Data Out(C); CAP5: Timer5 Capture; ADC7: ADC Input Channel 7; LP_TH1: Low Power Touch Channel 1
14	PB1	I/O	8/24	GPIO (pull up)	Long Press Reset; SPI2CLKC: SPI2 Clk(C); UART2TXC: Uart2 Data Output(C) ADC6: ADC Input Channel 6; LP_TH0: Low Power Touch Channel 0
15	PB0	I/O	8	GPIO	SPI2_DIC: SPI2 Data In(C);

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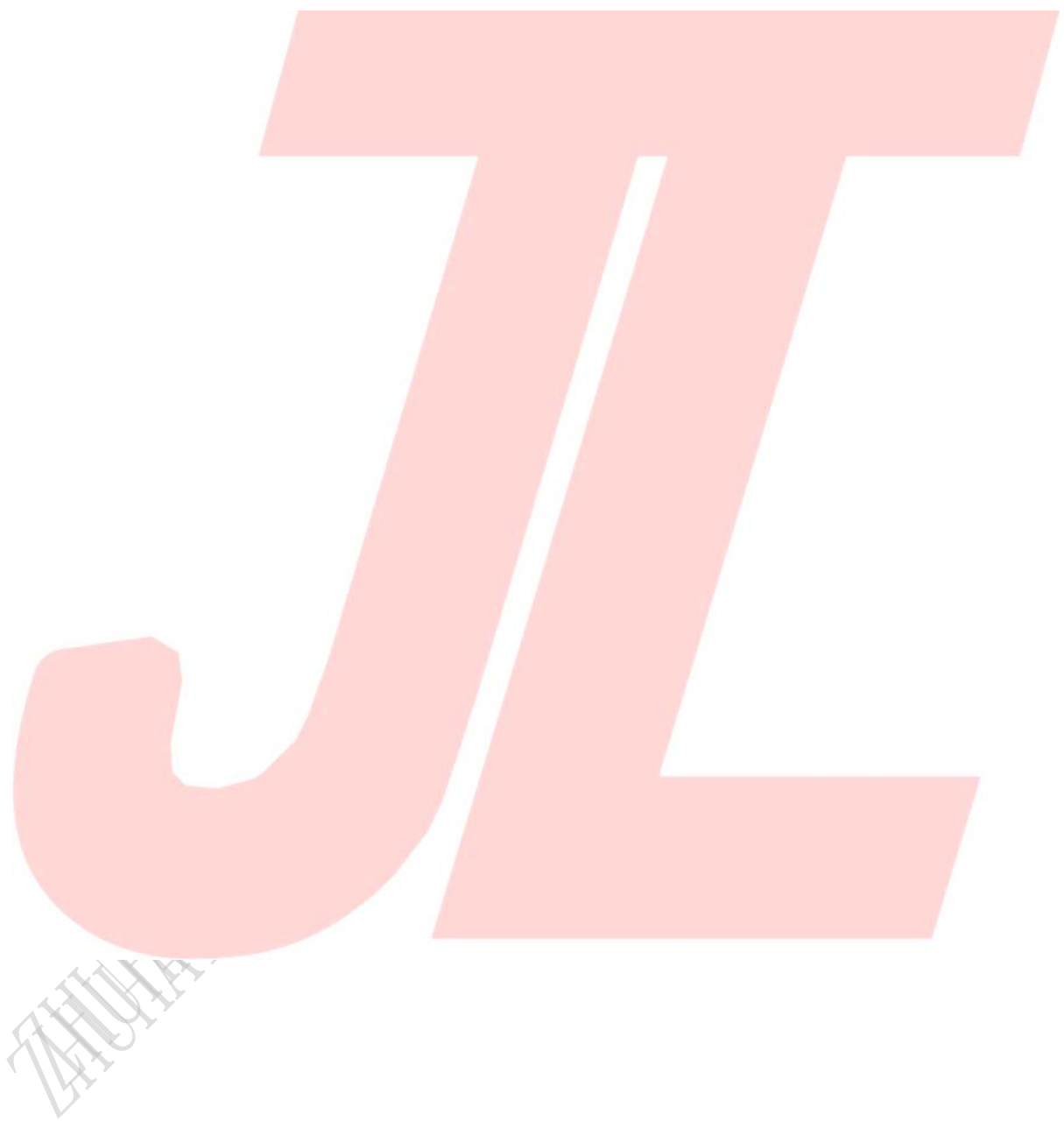
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				(High Voltage Input)	ALNK_MCLK(B): ALNK1 Master Clock(B); TMR4: Timer4 Clock Input;
16	BT_RF	/	/		BT Antenna
17	VSSIO	P	/		Ground
18	BT_OSCI	I	/		BTOSC In
19	BT_OSCO	O	/		BTOSC Out
20	PC5	I/O	8/24	GPIO	UART2RXD: Uart2 Data Input(D); SPI1DOB: SPI1 Data Out(B); ALNK_DAT3(B): Audio Link Data3(B); IIC_SDA_B: IIC SDA(B); ADC5: ADC Input Channel 5;
21	PC4	I/O	8/24	GPIO	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;
22	PC3	I/O	8/24	GPIO	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;
23	PC2	I/O	8/24	GPIO	ALNK_SCLK(B): Audio Link Serial Clock(B); IIC_SCL_C: IIC SCL(C); UART0TXD: Uart0 Data Output(D); TMR1: Timer1 Clock Input;
24	USBDM	I/O	4	USB Negative Data	UART1RXD: Uart1 Data Input(D); IIC_SDA_A: IIC SDA(A); ADC11: ADC Input Channel 11;
25	USBDP	I/O	4	USB Positive Data	UART1TXD: Uart1 Data Output(D); IIC_SCL_A: IIC SCL(A); ADC10: ADC Input Channel 10;
26	PA3	I/O	8/24	GPIO	UART2TXA: Uart2 Data Output(A); ADC0: ADC Input Channel 0; PWM1: Timer1 PWM Output; Touch0: Touch Input Channel 0;
27	PA1	I/O	8/24	GPIO	MIC0: MIC0 Input Channel ; PWM0: Timer0 PWM Output; UART1TXC: Uart1 Data Output(C);
28	DACR/DACN	O	/		DAC Right Channel Different DAC Negative Channel

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29	DACL/DACP	O	/		DAC Left Channel Different DAC Positive Channel
30	NC				
31	NC				
32	VCOM	P	/		DAC reference voltage



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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
LDO_IN	Charger Voltage	-0.3	6	V
V <sub>3.3IO</sub>	3.3V IO Input Voltage	-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	4.2	V	
LDO_IN	Charger supply Voltage	4.5	5.0	5.5	V	
Normal mode						
VDDIO	Voltage output	–	3.0	–	V	VBAT = 4.2V, 10mA loading
	Loading current	–	–	100	mA	VDDIO=3V@VBAT = 4.2V
BT_AVDD	Voltage output	–	1.3	–	V	VDDIO=3.0V, 10mA loading
	Loading current	–	–	60	mA	BT_AVDD=1.25V@VDDIO=3.0v
EVDD	Voltage output	–	1.1	–	V	BT_AVDD=1.25V, 1mA loading
	Loading current	–	–	5	mA	EVDD=1.1V@BT_AVDD=1.25v
LP mode						
VDDIO	Loading current			5	mA	VDDIO=3V@VBAT = 4.2V

### 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 <sub>Charge</sub>	Charge Voltage	4.15	4.2	4.25	V	LDO_IN>4.5V

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		4.30	4.35	4.40	V	LDO_IN > 4.65V
I <sub>Charge</sub>	Charge Current	20		200	mA	Charge current at fast charge mode
I <sub>Trickl</sub>	Trickle Charge Current	20	45	70	mA	V <sub>BAT</sub> < V <sub>Trickl</sub>

## 2.4 IO Input/Output Electrical Logical Characteristics

Table 2-4

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

## 2.5 Internal Resistor Characteristics

Table 2-5

Port	General Output	High Drive	Internal Pull-Up Resistor	Internal Pull-Down Resistor	Comment
PA1~PA3 PC2~PC5 PB3~PB3 PB6~PB8	8mA	24mA	10K	10K	1、PB1 default pull up 2、USBDM & USBDP default pull down 3、internal pull-up/pull-down resistance   accuracy ±20%
PB0	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	–	-80	–	dB	
S/N	–	101	–	dB	
Crosstalk	–	-80	–	dB	

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Output Swing		0.45		Vrms	
Dynamic Range		90		dB	1KHz/-60dB 10Kohm loading With A-Weighted Filter
DAC Output Power	-	4	-	mW	32ohm loading

## 2.7 ADC Characteristics

Table 2-7

Parameter	Min	Typ	Max	Unit	Test Conditions
Dynamic Range		85		dB	Fsample=44.1kHz Fin=1KHz 2mVpp Input
S/N	-	85	-	dB	Fsample=44.1kHz Fin=1KHz 1.2Vpp Input
THD+N	-	-60	-	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		6	8	dBm	25°C, Power Supply VBAT=5V 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 2-9

Parameter	Min	Typ	Max	Unit	Test Conditions
Relative Power		-1		dB	25°C, Power Supply VBAT=5V 2441MHz
$\pi/4$ DQPSK	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

## 2.8.2 Receiver

### Basic Data Rate

Table 2-10

Parameter	Min	Typ	Max	Unit	Test Conditions
Sensitivity		-92		dBm	25°C, Power Supply VBAT=5V 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	

### Enhanced Data Rate

Table 2-11

Parameter	Min	Typ	Max	Unit	Test Conditions
Sensitivity		-94		dBm	25°C, Power Supply VBAT=5V 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	

## 2.8.3 BLE Transmitter

### 1M Data Rate

Table 2-12

Parameter	Min	Typ	Max	Unit	Test Conditions
Sensitivity		-94		dBm	25°C, Power Supply VBAT=5V 2441MHz
RF Transmit Power		7	9	dB	
In-band Spurious	+2MHz	-42	-20	dB	
	-2MHz	-34	-20	dB	
Emission	+3MHz	-46	-30	dB	
	-3MHz	-36	-30	dB	
Modulation	$\Delta f1$ avg	225	247		

Characteristics	$\Delta f_2$ 99%	185	236		
	$\Delta f_{1avg}/\Delta f_{2av}$	0.8	0.9		
Carrier Frequency Offset		-150	+/-10	+150	KHz
Frequency Drift		-50	+/-5	+50	KHz
Frequency Drift Rate		-20	3	+20	KHz/50us

**2M Data Rate**

**Table 2-13**

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-94			25°C, Power Supply VBAT=5V 2441MHz
RF Transmit Power			7	9	dB	
Adjacent Channel	+2MHz		-46	-20	dB	
	-2MHz		-38	-20	dB	
Transmit	+3MHz		-53	-30	dB	
	-3MHz		-42	-30	dB	
Frequency Deviation	$\Delta f_1$ avg	450	520			
	$\Delta f_2$ 99%	370	500			
	$\Delta f_{1avg}/\Delta f_{2av}$	0.8	0.9			
Carrier Frequency Offset		-150	+/-10	+150	KHz	
Frequency Drift		-50	+/-5	+50	KHz	
Frequency Drift Rate		-20	+/-3	+20	KHz/50us	

**2.9 ESD Protection**

Parameter	Typ.	Test pin	Reference standard
Human Body Mode	±4KV	All pins	JEDEC EIA/JESD22-A114
Machine Mode	±200V	All pins	JEDEC EIA/JESD22-A115
Charge Device Model	±1KV	All pins	JEDEC EIA/JESD22-C101F
Latch up	±200mA	All GPIO pins	JEDEC STANDARD NO.78E
	1.5xVopmax	All power pins	

Note : 1.5xVopmax = 1.5 times maximum operating voltage

### 3、 Package Information

#### 3.1 QFN32\_4.0x4.0

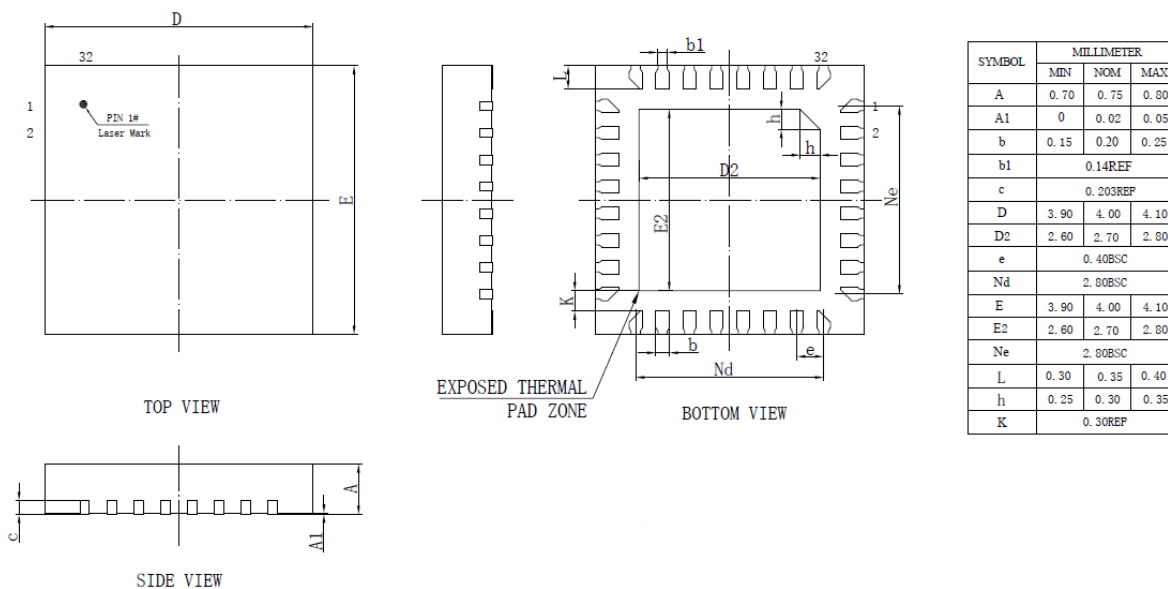
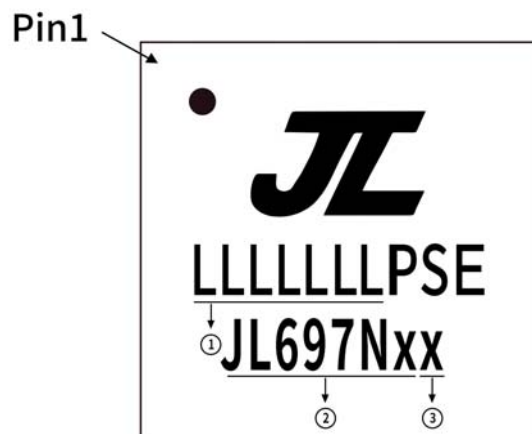


Figure 3-1 JL6976D Package

## 4、 IC Marking information



- ① LLLLLL: Production Batch
- ② JL697Nx: Chip Model
- ③ x: Built-in Flash Size
  - 0: No Flash
  - 2: 2Mbit
  - 4: 4Mbit
  - 8: 8Mbit
  - 6: 16Mbit
  - 3: 32Mbit

## 5、 Solder-Reflow Condition

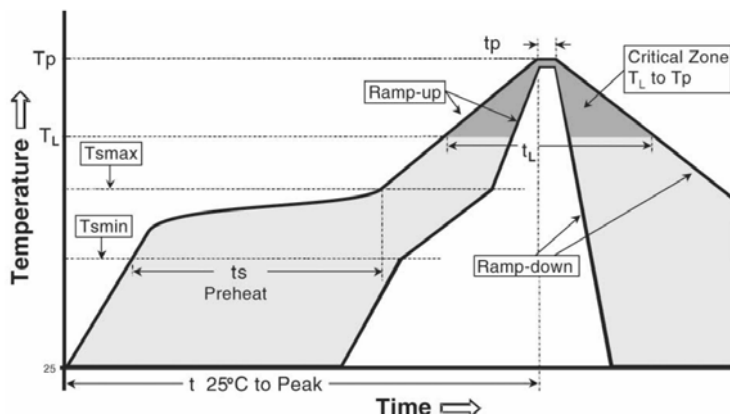


Figure 5-1 Classification Reflow Profile

### Classification Profiles

Table 5-1

Profile Feature		Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat /Soak	Temperature Min ( $T_{smin}$ )	100°C	150°C
	Temperature Max ( $T_{smax}$ )	150°C	200°C
	Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ )	60-120 seconds	60-180 seconds
Average ramp-up rate ( $T_{smax}$ to $T_p$ )		3°C/second max	3°C/second max
Liquidous temperature ( $T_L$ )		183°C	217°C
Time ( $t_L$ ) maintained above $T_L$		60-150 seconds	60-150 seconds
Peak package body temperature ( $T_p$ )		See Table 5-2	See Table 5-3
Time within 5°C of actual Peak Temperature ( $t_p$ ) <sup>2</sup>		10-30 seconds	20-40 seconds
Ramp-down rate ( $T_p$ to $T_L$ )		6°C/second max	6°C/second max
Time 25°C to peak temperature		6 minutes max	8 minutes max

Note 1: All temperatures refer to topside of the package, measured on the package body surface.

Note 2: Time within 5°C of actual peak temperature ( $t_p$ ) specified for the reflow profiles is a “supplier” minimum and “user” maximum.

### SnPb - Classification Temperature

Table 5-2

Package Thickness	Volume mm <sup>3</sup> < 350	Volume mm <sup>3</sup> ≥ 350
<2.5 mm	240 +0/-5°C	225 +0/-5°C
≥2.5 mm	225 +0/-5°C	225 +0/-5°C

**Pb-free - Classification Temperature**      **Table 5-3**

<b>Package Thickness</b>	<b>Volume mm<sup>3</sup> &lt; 350</b>	<b>Volume mm<sup>3</sup> 350 - 2000</b>	<b>Volume mm<sup>3</sup> &gt; 2000</b>
< 1.6mm	260°C	260°C	260°C
1.6 mm - 2.5mm	260°C	250°C	245°C
> 2.5mm	250°C	245°C	245°C

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## 6、 Revision History

Date	Revision	Description
2022.05.16	V1.0	Initial Release

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