

# **AC6951C Datasheet**

**Zhuhai Jieli Technology Co.,LTD**

**Version: V1.3**

**Date: 2020.03.19**

# AC6951C Features

## CPU

- 32-bit DSP supports hardware Float Point Unit (FPU)
- Up to 240MHz 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
- 30-band EQ configuration for voice Effects

## Audio Codec

- Two channels 16-bit DAC, SNR >= 95dB
- Three 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
- three channels 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 V5.1+BR+EDR+BLE specification
- Meet class1 class2 and class3 transmitting

power requirement

- Support GFSK and  $\pi/4$  DQPSK all paket 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
- Two PCM/IIS for external digital Audio code, supports host and device mode
- Four multi-function 16-bit timers, support capture and PWM mode
- Three 16-bit PWM generator for motor driving
- Three full-duplex basic UART, UART0 and UART1 supports DMA mode
- Three SPI interface supports host and device mode
- Two SD Card Host controller
- One hardware IIC interface supports host and device mode
- Four SPDIF receiving interface without analog amplify
- Supports HDMI ARC (Audio Return Channel) receiving
- Segment LCD panels
- Digital matrix LED panels
- Built-in Cap Sense Key controller
- 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

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- VBAT is 2.2V to 5.5V
- VDDIO is 2.2V to 3.6V
- RTCVDD33 is 2.2V to 3.6V

**Packages**

- LQFP48(7mm\*7mm)

**Temperature**

- Operating temperature: -20°C to +70°C
- Storage temperature: -65°C to +150°C

**Applications**

- Bluetooth Stereo speaker
- Bluetooth soundbar
- Bluetooth car speaker
- Bluetooth TWS speaker
- Bluetooth alarm clock speaker
- Bluetooth Rod speaker

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# 1、 Pin Definition

## 1.1 Pin Assignment

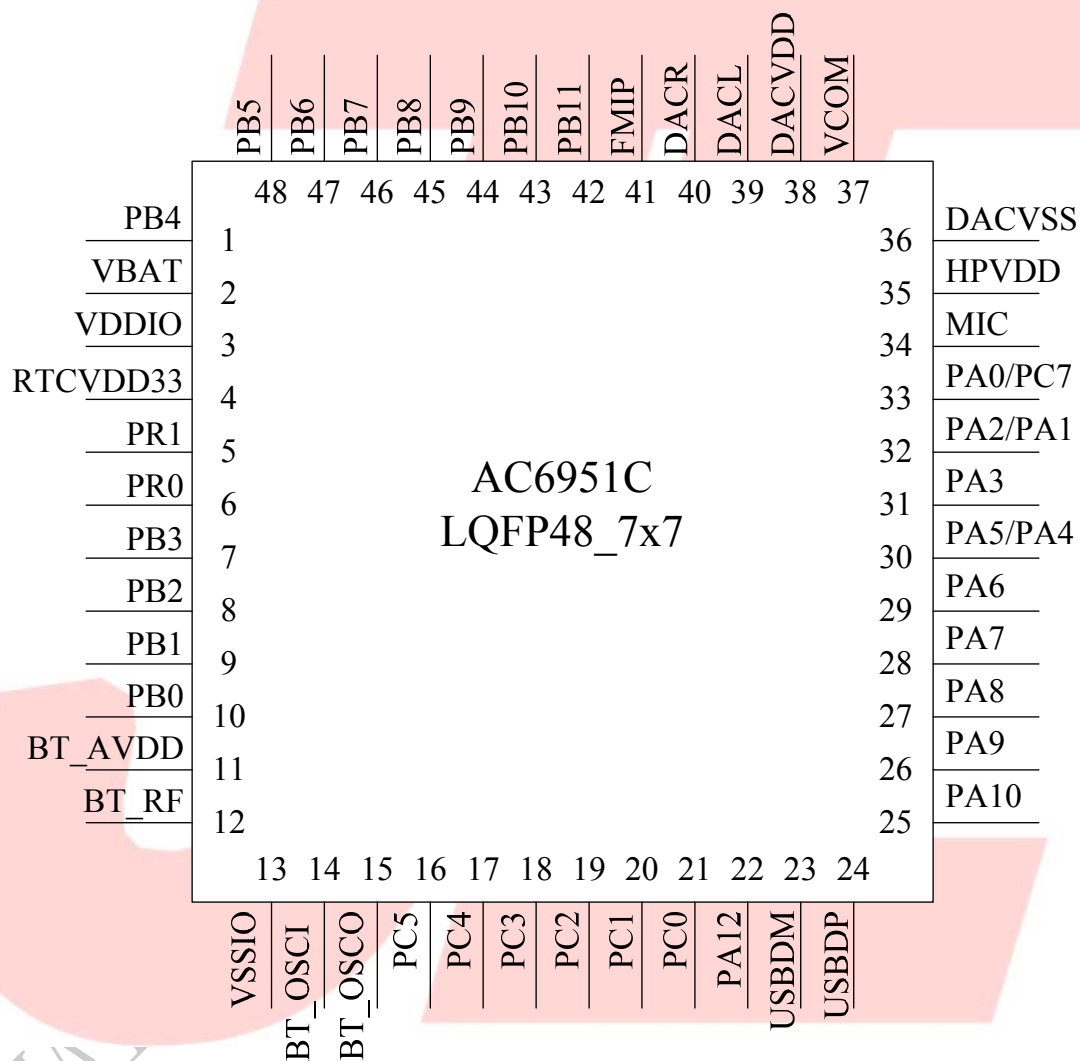


Figure 1-1 AC6951C Package Diagram

## 1.2 Pin Description

Table 1-1 AC6951C Pin Description

PIN NO.	Name	I/O Type	Drive (mA)	Function	Other Function
1	PB4	I/O	24/8	GPIO	SD1DAT0B: SD1 Data0(B); SD0DAT3B: SD0 Data3(B); IIC_SCL_C: IIC SCL(C); ADC7: ADC Input Channel 7; UART0TXB: Uart0 Data Out(B); LVD: Low Voltage Detect Input; PWMCH2H: Motor PWM Channel2 (H);
2	VBAT	P	/		Power Supply
3	VDDIO	P	/		IO Power 3.3v
4	RTVDDD33	P	/		RTC Power
5	PR1	I/O		RTCIO1	OSCO_32K
6	PR0	I/O		RTCIO0	OSCI_32K
7	PB3	I/O	24/8	GPIO	PWM2: Timer2 PWM Output; ADC6: ADC Input Channel 6;
8	PB2	I/O	8	GPIO (High Voltage Resistance)	SPI1DIA: SPI1 Data In(A); PWMCH1L: Motor PWM Channel1 (L);
9	PB1	I/O	24/8	GPIO (pull up)	Long Press Reset; SPI1DOA: SPI1 Data Out(A); ADC5: ADC Input Channel 5; TMR2: Timer2 Clock Input; UART1RXA: Uart1 Data In(A); SPDIF_IN_D: Sony/Philips Digital Interface Input(D)
10	PB0	I/O	8	GPIO (High Voltage Resistance)	SPI1CLKA: SPI1 Clock(A); ALNK1_MCLK: ALNK1 Master Clock; SPDIF_IN_C: Sony/Philips Digital Interface Input(C) UART1TXA: Uart1 Data Out(A); PWMCH1H: Motor PWM Channel1(H);
11	BT_AVDD	P	/		BT Power
12	BT_RF	/	/		BT Antenna
13	VSSIO	P	/		Ground
14	BT_OSCI	I	/		BT OSC In

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15	BT_OSCO	O	/		BT OSC Out
16	PC5	I/O	24/8	GPIO	SD1CLKA: SD1 Clock(A); SPI1DOB: SPI1 Data Out(B); UART2RXD: Uart2 Data In(D); IIC_SDA_B: IIC SDA(B); ALNK1_DAT3: Audio Link Data3; ADC13: ADC Input Channel 13; COM0: LCD COM Output 0; PAPD7: PAP Data 7; Touch15: Touch Input Channel 15; PWMCH5L: Motor PWM Channel5(L);
17	PC4	I/O	24/8	GPIO	SD1CMDA: SD1 Command(A); SPI1CLKB: SPI1 Clock(B); UART2TXD: Uart2 Data Out(D); IIC_SCL_B: IIC SCL(B); ALNK1_DAT2: Audio Link Data2; ADC10: ADC Input Channel 10; COM1: LCD COM Output 1; PAPD6: PAP Data 6; Touch14: Touch Input Channel 14; PWMCH5H: Motor PWM Channel5(H);
18	PC3	I/O	24/8	GPIO	SD1DAT0A: SD1 Data0(A); SPI1DIB: SPI1 Data In(B); ALNK1_DAT1: Audio Link Data1; COM2: LCD COM Output 2; PAPD5: PAP Data 5; Touch13: Touch Input Channel 13;
19	PC2	I/O	24/8	GPIO	SD1DAT1A: SD1 Data1(A); ALNK1_DAT0: Audio Link Data0; COM3: LCD COM Output 3; SEG18: LCD SEG Output18; PAPD4: PAP Data 4; Touch12: Touch Input Channel 12; FPIN5: Motor Auto-Stop Protective Pin5;
20	PC1	I/O	24/8	GPIO	SD1DAT2A: SD1 Data2(A); ALNK1_LRCK: Audio Link Word Select; COM4: LCD COM Output 4; SEG17: LCD SEG Output17; PAPD3: PAP Data 3; Touch11: Touch Input Channel 11; UART1RXB: Uart1 Data In(B); FPIN4: Motor Auto-Stop Protective Pin4;
21	PC0	I/O	24/8	GPIO	SD1DAT3A: SD1 Data3(A); ALNK1_SCLK: Audio Link Serial Clock;

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					COM5: LCD COM Output 5; SEG16: LCD SEG Output16; PAPD2: PAP Data 2; Touch10: Touch Input Channel 10; UART1TXB: Uart1 Data Out(B); FPIN3: Motor Auto-Stop Protective Pin3;
22	PA12	I/O	24/8	GPIO	PWM1: Timer1 PWM Output; ALNK0_DAT1B: Audio Link Data1(B); ADC4: ADC Input Channel 4; SEG12: LCD SEG Output12; PAPWR: PAP Write; UART0RXD: Uart0 Data In(D);
23	USBDM	I/O	4	USB Negative Data (pull down)	UART1RXD: Uart1 Data In(D); SPI2DOB: SPI2 Data Out(B); IIC_SDA_A: IIC SDA(A);
24	USBDP	I/O	4	USB Positive Data (pull down)	UART1TXD: Uart1 Data Out(D); SPI2CLKB: SPI2 Clock(B); IIC_SCL_A: IIC SCL(A); ADC12: ADC Input Channel 12;
25	PA10	I/O	24/8	GPIO	SD0CLKA: SD0 Clock(A); ALNK0_LRCKB: Audio Link Word Select(B); ADC3: ADC Input Channel 3; SPDIF_IN_B: Sony/Philips Digital Interface Input(B) TMR1: Timer1 Clock Input; SEG10: LCD SEG Output10; PAPD1: PAP Data 1; Touch9: Touch Input Channel 9; UART2RXB: Uart2 Data In(B); PWMCH4L: Motor PWM Channel4(L);
26	PA9	I/O	24/8	GPIO	SD0CMA: SD0 Command(A); ALNK0_SCLKB: Audio Link Serial Clock(B); SPDIF_IN_A: Sony/Philips Digital Interface Input(A) SEG9: LCD SEG Output9; PAPD0: PAP Data 0; Touch8: Touch Input Channel 8; UART2TXB: Uart2 Data Out(B); PWMCH4H: Motor PWM Channel4(H);
27	PA8	I/O	24/8	GPIO	SD0DAT3A: SD0 Data3(A); ALNK0_MCLKA: ALNK Master Clock(A); SEG8: LCD SEG Output8; BT_Freq FPIN2: Motor Auto-Stop Protective Pin2;

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28	PA7	I/O	24/8	GPIO	SD0DAT2A: SD0 Data2(A); ALNK0_DAT3A: Audio Link Data3(A); SEG7: LCD SEG Output7; BT_priority TMR0: Timer0 Clock Input; Touch7: Touch Input Channel 7;
29	PA6	I/O	24/8	GPIO	SD0DAT1A: SD0 Data1(A); ALNK0_DAT2A: Audio Link Data2(A); ADC2: ADC Input Channel 2; Wlan_Active: IIC_SDA_D: IIC SDA(D); SEG6: LCD SEG Output6; Touch6: Touch Input Channel 6; UART0RXA: Uart0 Data In(A);
30	PA5	I/O	24/8	GPIO	SD0DAT0A: SD0 Data0(A); ALNK0_DAT1A: Audio Link Data1(A); ADC1: ADC Input Channel 1; BT_Active: IIC_SCL_D: IIC SCL(D); SEG5: LCD SEG Output5; Touch5: Touch Input Channel 5; PWM0: Timer0 PWM Output; UART0TXA: Uart0 Data Out(A);
	PA4	I/O	24/8	GPIO	ALNK0_DAT0A: Audio Link Data0(A); SEG4: LCD SEG Output4; Touch4: Touch Input Channel 4;
31	PA3	I/O	24/8	GPIO	PLNK_DAT1: PLNK Data1; ALNK0_LRCKA: Audio Link Word Select(A); SEG3: LCD SEG Output3; Touch3: Touch Input Channel 3; UART2RXA: Uart2 Data In(A);
32	PA2	I/O	24/8	GPIO	PLNK_SCLK: PLNK Serial Clock; ALNK0_SCLKA: Audio Link Serial Clock(A); SEG2: LCD SEG Output2; Touch2: Touch Input Channel 2; UART2TXA: Uart2 Data Out(A); CAP3: Timer3 Capture;
	PA1	I/O	24/8	GPIO	AMUX0R: Analog Channel0 Right; SEG1: LCD SEG Output1; Touch1: Touch Input Channel 1; ADC0: ADC Input Channel 0; UART1RXC: Uart1 Data In(C); PWMCH0L: Motor PWM Channel0(L);

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33	PA0	I/O	24/8	GPIO	AMUX0L: Analog Channel0 Left; SEG0: LCD SEG Output0; Touch0: Touch Input Channel 0; CLKOUT0: UART1TXC: Uart1 Data Out(C); PWMCH0H: Motor PWM Channel0(H);
	PC7	I/O	/	GPIO	MIC_BIAS: Microphone Bias Output SEG21: LCD SEG Output21;
34	MIC	I	/		MIC: MIC Input Channel;
35	HPVDD	P	/		Headphone AMP Power
36	DACVSS	P	/		DAC Ground
37	VCOM	P	/		DAC Reference
38	DACVDD	P	/		DAC Power
39	DACL	O	/		DAC Left Channel
40	DACR	O	/		DAC Right Channel
41	FMIP	I	/		FM Single Input
42	PB11	I/O	/	GPIO	SDPG:SDC Power Gate;
43	PB10	I/O	24/8	GPIO	AMUX2R: Analog Channel2 Right; SD0CMB: SD0 Command(B); SPI2DOA: SPI2 Data Out(A); SD1DAT3B: SD1 Data3(B); ADC9: ADC Input Channel 9; UART2RXC: Uart2 Data In(C); PWMCH3L: Motor PWM Channel3(L);
44	PB9	I/O	24/8	GPIO	AMUX2L: Analog Channel2 Left; SD0CLKB: SD0 Clock(B); SPI2CLKA: SPI2 Clk(A); SD1DAT2B: SD1 Data2(B); CAP0: Timer0 Capture; UART2TXC: Uart2 Data Out(C); PWMCH3H: Motor PWM Channel3(H);
45	PB8	I/O	24/8	GPIO	AMUX1R: Analog Channel1 Right; SD0DAT0B: SD0 Data0(B); SPI2_DIA: SPI2 Data In(A); SD1DAT1B: SD1 Data1(B); ADC8: ADC Input Channel 8; CLKOUT1: Clk Out1;
46	PB7	I/O	24/8	GPIO	AMUX1L: Analog Channel1 Left;
47	PB6	I/O	24/8	GPIO	SD1CLKB: SD1 Clock(B); SD0DAT1B: SD0 Data1(B); IIC_SDA_C: IIC SDA(C); TMR3: Timer3 Clock Input;

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					UART0RXB: Uart0 Data In(B); PWMCH2L: Motor PWM Channel2 (L);
48	PB5	I/O	8	GPIO (High Voltage Resistance)	SD1CMDB: SD1 Command(B); SD0DAT2B: SD1 Data2(B); PWM3: Timer3 PWM Output; CAP1: Timer1 Capture; UART0TXC: Uart0 Data Out(C); UART0RXC: Uart0 Data In(C);

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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

## 2.4 Internal Resistor Characteristics

Table 2-4

Port		General Output	High Drive	Internal Pull-Up Resistor	Internal Pull-Down Resistor	Comment
PA0~PA12 PB1, PB3, PB4, PB6~PB10 PC0~PC5		8mA	24mA	10K	10K	1、PB1 default pull up 2、USBDM & USBDP default pull down 3、PB0, PB2, PB5 can pull-up resistance to 5V 4、internal pull-up/pull-down resistance   accuracy $\pm 20\%$ 5、PRx supply by RTCVDD
PB11 PC7	Output 0	8mA	24mA	10K	10K	
	Output 1	8mA	64mA			
PB0, PB2, PB5		8mA	–	10K	10K	
PR0-PR1		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 10Kohm loading With A-Weighted Filter
THD+N	–	-75	–	dB	
S/N	–	95	–	dB	
Crosstalk	–	-80	–	dB	
Output Swing		1		Vrms	
Dynamic Range		90		dB	1KHz/-60dB 10Kohm loading With A-Weighted Filter
DAC Output Power	11		–	mW	32ohm loading

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## 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	

## 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, 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 2-8

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

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## 2.7.2 Receiver

### Basic Data Rate

Table 2-9

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-90		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 2-10

Parameter		Min	Typ	Max	Unit	Test Conditions
Sensitivity			-90		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 FM Receiver Characteristics

Table 2-11

Parameter	Min	Typ	Max	Unit	Test Conditions
Input Frequency	76		108	MHz	
Usable Sensitivity	3	4	8	dB $\mu$ V EMF	(S+N)/N=26dB
Adjacent Channel Selectivity		48		dB	$\pm$ 200kHz
IIP3		88		dB $\mu$ V EMF	$\Delta$ f1=200 kHz, $\Delta$ f2=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		%	

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### 3、 Package Information

#### 3.1 LQFP48(7mm\*7mm)

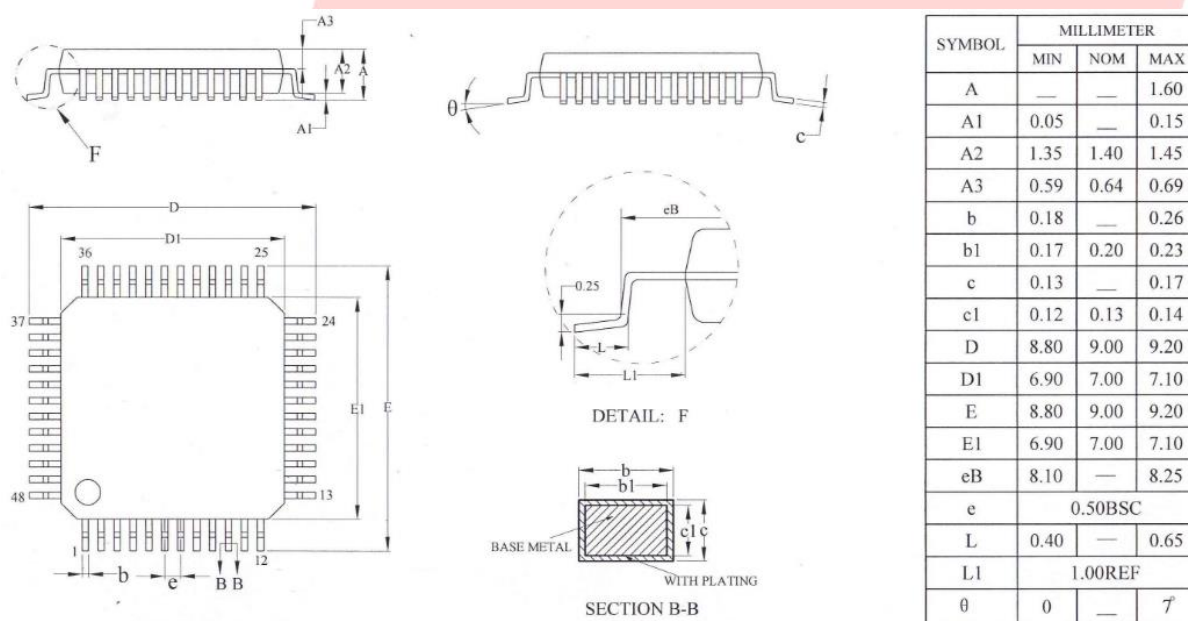


Figure 3-1. AC6951C Package

### 3、Revision History

Date	Revision	Description
2019.11.15	V1.0	Initial Release
2019.12.04	V1.1	Updata 16-bit ADC Numbers
2019.12.17	V1.2	Updata Featrues
2020.03.19	V1.3	Updata Pin Assignment