AC7066M Datasheet

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Version 1.5

Date 2024.07.30

Revision History

Date	Revision	Description
2023.07.19	V1.0	Initial Release
2023.08.29	V1.1	Update Pin Assignment
2023.10.13	V1.2	Add IC Marking Information Update BT_Features
2023.10.24	V1.3	Update Block Diagram
2023.11.03	V1.4	Update BT_Features Update IC Marking Information
2024.07.30	V1.5	Update Datasheet Format Update Pin Description

Table of Contents

AC7066M Features

SYSTEM

- 32-bit Single-core DSP 192MHz
- With IEEE754 Single precision FPU
- Support FFT/MATRIX/MATH
- 1 x I-cache
- Support EMU
- Support MMU
- Support MPU
- Built-In Flash
- 24MHz crystal oscillator
- Internal RC oscillator,PLL

DSP Audio Processing

- SBC/AAC codec
- mSBC voice codec supported for BT phone
- PLC for voice processing
- Single MIC ENC
- Multi-band DRC
- Multi-band EQ
- Support spatial sound

Audio

- 2 x 16bit DAC
  - SNR 108dB
  - Noise 6uVrms
  - Support differential mode
  - Support VCMO mode
  - Sampling rate 8~96kHz
- 1 x 16bit ADC
  - SNR 98dB
  - Sampling rate 8~48kHz
  - Support AMUX
- I^2S AUDIO Master/Slave interface

Bluetooth

- Dual-mode BT5.4 with LE Audio (QDID 222830)
- Support LE audio BIS/CIS
- Support long range BLE
- Maximum transmitting power 10dBm
- Receiver sensitivity
  - -93dBm @BR
  - -92dBm @EDR Π/4 DQPSK
  - -86dBm @EDR 8DPSK

Peripherals

- 1 x Full speed USB
- 4 x Multi-function 16bit timer
- 2 x UART interface
- 1 x I^2C Master/Slave interface
- 2 x SPI Master/Slave interface
- 1 x QDEC
- 4 x MCPWM
- 1 x 10bit ADC(16 Channel)
- 18 x GPIO Support function remapping

PMU

- Integrated battery charger up to 300mA
- Support temperature sensor
- VPWR range 4.5V to 5.5V
- VBAT range 2.7V to 4.5V
- IOVDD range 2.7V to 3.6V

Packages

- QFN32(4mm*4mm)

Temperature

- Operating temperature
  TC = -20℃ to +85℃(standard range)
  TC = -40℃ to +105℃(extended range)
- Storage temperature -65℃ to +150℃

Applications

- Wireless microphone

1 Block Diagram

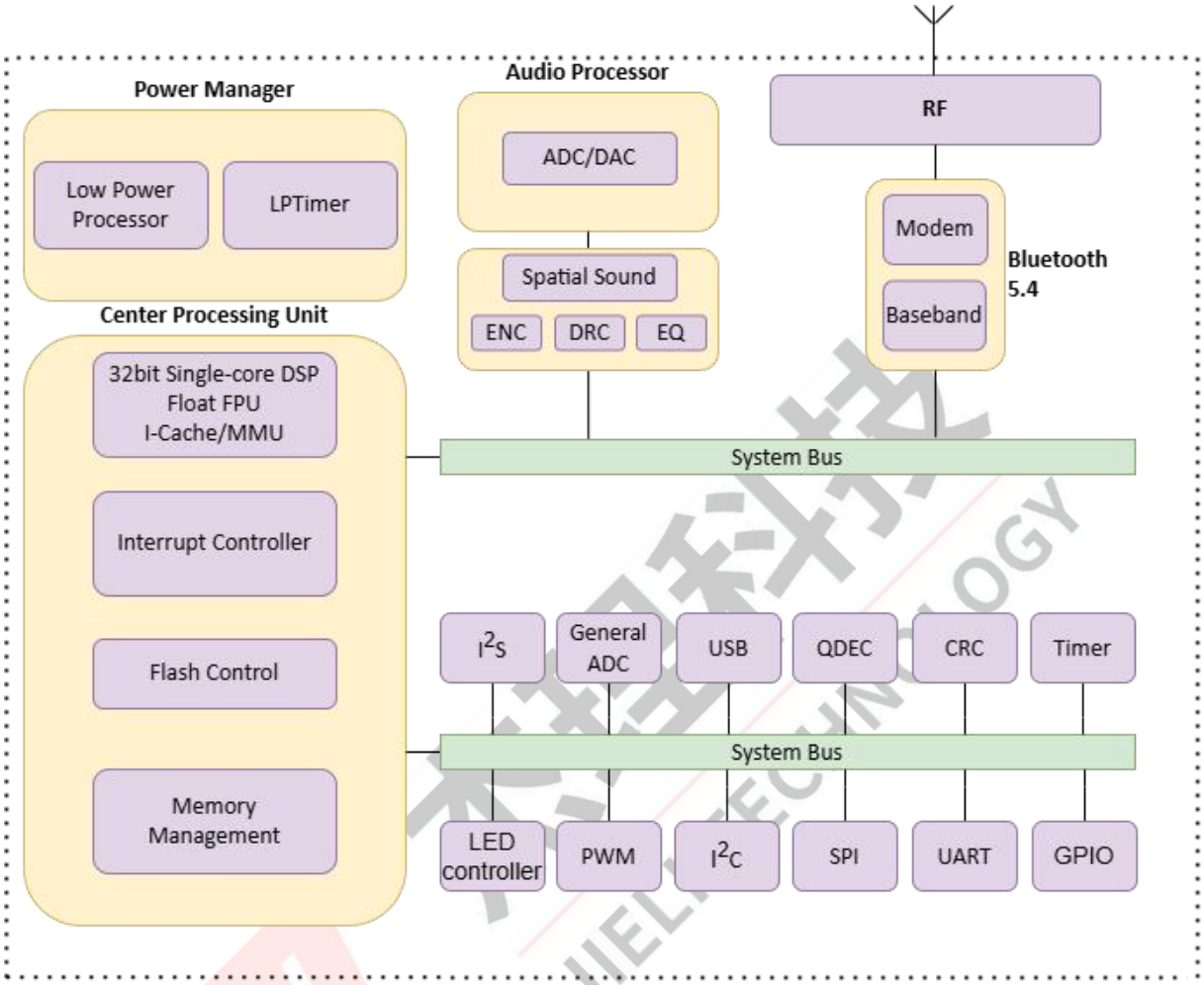


Figure 1-1 AC7066M Block Diagram

2 Pin Definition

2.1 Pin Assignment

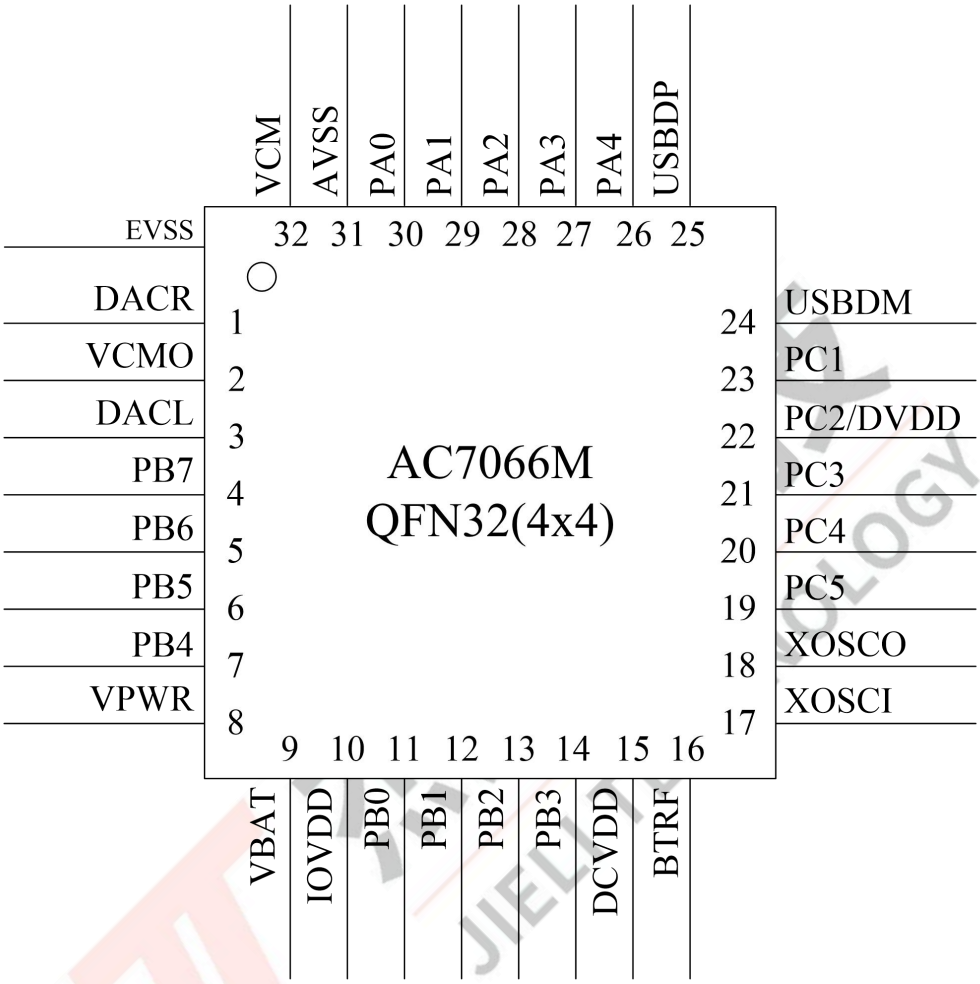


Figure 2-1 AC7066M Pin Assignment

2.2 Pin Description

Table 2-2-1 AC7066M Pin Description

Pin No.	Name	Type	IO Initial State	Description
1	DACR	O	--	Right Channel DAC Output
2	VCMO	O	--	Audio Common-mode Output voltage
3	DACL	O	--	Left Channel DAC Output
4	PB7	I/O	Z	ADC9(ADC Input Channel 9) SPI0 DATA0(B) SPI1 DATA0(C) I^2C SDA(C) Q-decoder DATA1
5	PB6	I/O	Z	ADC8(ADC Input Channel 8) AUX0(Audio ADC Input) SPI0 CLK(B) SPI1 CLK(C) I^2C SCL(C) TIMER3 CLK
6	PB5	I/O	Z	ADC5(ADC Input Channel 5) SD Power SPI0 DATA1(B) SPI1 DATA1(C)
7	PB4	I/O	Z	ADC7(ADC Input Channel 7) LVD(External Low Voltage Detection Input) Q-decoder DATA0 Clockout1
8	VPWR	I/O	Z	Charge Power Input UART0 TX(C) UART0 RX(C) TIMER3 PWM TIMER1 Capture
9	VBAT	P	--	Battery Input
10	IOVDD	P	--	IO Power
11	PB0	I/O	Z	UART0 TX(B)
12	PB1	I/O	200kΩ Pull-up	Hold down 0 to reset UART0 RX(B) TIMER2 CLK
13	PB2	I/O	Z	ADC6(ADC Input Channel 6) TIMER0 Capture
14	PB3	I/O	Z	AUX3(Audio ADC Input) TIMER2 PWM
15	DCVDD	P	--	1.2V Power

Pin No.	Name	Type	IO Initial State	Description
16	BTRF	RF	--	Bluetooth RF Antenna
17	XOSCI	I	--	Crystal Oscillator Input
18	XOSCO	O	--	Crystal Oscillator Output
19	PC5	I/O	Z	ADC12(ADC Input Channel 12) SPI1 DATA0(B) I^2C SDA(B) TIMER1 CLK
20	PC4	I/O	Z	ADC11(ADC Input Channel 11) SPI1 CLK(B) I^2C SCL(B) TIMER1 PWM
21	PC3	I/O	Z	ADC10(ADC Input Channel 10) SPI1 Data1(B) SPI1 Data1(D) UART0 TX(D) UART0 RX(D) TIMER2 Capture
22	PC2	I/O	Z	ADC15(ADC Input Channel 15) SPI1 DATA2(B) SPI1 DATA2(C) SPI1 DATA2(D) I^2S MCLK(B)
	DVDD	P	--	Digital Power
23	PC1	I/O	10kΩ Pull-up	MCLR(Device Reset) SPI1 DATA3(B) SPI1 DATA3(C) SPI1 DATA3(D) TIMER0 CLK
24	USBDM	I/O	15kΩ Pull-down	ADC14(ADC Input Channel 14) USB Negative Data SPI1 DATA0(D) I^2C SDA(A)
25	USBDP	I/O	15kΩ Pull-down	ADC13(ADC Input Channel 13) USB Positive Data SPI1 CLK(D) I^2C SCL(A)
26	PA4	I/O	Z	ADC3(ADC Input Channel 3) AUX2(Audio ADC Input) SPI1 DATA1(A) I^2S LRCK(A) I^2S Data3(B)

Pin No.	Name	Type	IO Initial State	Description
27	PA3	I/O	Z	ADC2(ADC Input Channel 2) AUX1(Audio ADC Input) SPI1 DATA0(A) I²S SCLK(A) I²S Data2(B)
28	PA2	I/O	10kΩ Pull-down	SPI1 CLK(A) I²S MCLK(A) I²S Data1(B) TIMER3 Capture
29	PA1	I/O	Z	ADC1(ADC Input Channel 1) MIC(Audio ADC Input) I²S Data1(A)
30	PA0	I/O	Z	ADC0(ADC Input Channel 0) MICBIAS(MIC Bias Output) I²SData0(A) I²S Data0(B) Clockout0
31	AVSS	G	--	Audio Ground
32	VCM	P	--	Audio reference voltage

Note

1.IO initial state abbreviations Z--High resistance, H--High level, L--Low level, X--May be changed during power on.

2.Timer, UART0 and QDEC functions also can be remapped to any I/O.

3.MCPWM, UART1, SD functions can be remapped to any I/O.

Table 2-2-2 Pin Types Description

Pin Type	Description	Pin Type	Description
P	Power	I/O	Input or Output
G	Ground	I	Input
RF	RF antenna	O	Output

3 Electrical Characteristics

3.1 Absolute Maximum Ratings

Table 3-1 Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
Topt	Operating temperature	-20	+85	℃
Tstg	Storage temperature	-65	+150	℃
VBAT	Supply Voltage	-0.3	4.5	V
VPWR		-0.3	6.0	V
IOVDD		-0.3	3.6	V
DCVDD		-0.3	1.5	V
GPIO	Input voltage of GPIO (except PB0)	-0.3	3.6	V
HVTIO	Input voltage of HVT-IO (PB0)	-0.3	6.0	V

Note

1.Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device.

3.2 ESD Ratings

Table 3-2 ESD Ratings

Parameter	Typ	Test pin	Reference standard
Human Body Mode	±4kV	All pins	JEDEC EIA/JESD22-A114
Machine Mode	±400V	All pins	JEDEC EIA/JESD22-A115
Charge Device Model	±2kV	All pins	JEDEC EIA/JESD22-C101F

3.3 PMU Characteristics

Table 3-3 PMU Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VPWR	Power supply	--	4.5	5.0	5.5	V
VBAT	Power supply	--	2.7	3.7	4.5	V
Operating mode						
Symbol	**Parameter**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
IOVDD	Voltage output	--	--	3.0	--	V
	Loading current	IOVDD=3.0V@VBAT = 3.7V	--	--	250	mA
DCVDD	Voltage output	--	--	1.35	--	V
	Loading current	DCVDD=1.25V@IOVDD = 3V	--	--	50	mA
Low Power mode						
Symbol	**Parameter**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
IOVDD	Loading current	IOVDD=3.0V@VBAT = 3.7V	--	--	10	mA

3.4 Battery Charge

Table 3-4 Charger Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
VPWR	Charge Input Voltage	VBAT+0.1V	5.0	5.5	V
CV	CV Mode Voltage Accuracy	4.175	4.2	4.225	V
		4.325	4.35	4.375	V
CC	CC Mode Current	20	--	300	mA
I_{end}	End Of Charge Current	2	--	30	mA
V_{Trikl}	Trickle Charge Voltage	--	3.0	--	V

3.5 IO Characteristics

Table 3-5 IO Characteristics

Input Characteristics						
Symbol	**Parameter**	**Conditions**	**IO**	**Min**	**Max**	**Unit**
V_{IL}	Low-Level Input Voltage	IOVDD = 3.0V	PA0~PA4 PB0~PB7 PC1~PC5 USBDP USBDM VPWR	-0.3	1.4	V
V_{IH}	High-Level Input Voltage	IOVDD = 3.0V	PA0~PA4 PB1~PB7 PC1~PC5 USBDP USBDM	1.7	3.3	V
		IOVDD = 3.0V	PB0 VPWR	1.7	5.5	V
Output Characteristics						
Symbol	**Parameter**	**Conditions**	**IO**	**Typ**		**Unit**
| I_{OL} |	Output Current	IOVDD = 3.0V Voutput = 0.3V	PA0~PA4 PB1~PB7 PC1~PC5	2(HD=0) 6(HD=1) 20(HD=2) 24(HD=3)		mA
		IOVDD = 3.0V Voutput = 0.3V	VPWR	2		mA
		IOVDD = 3.0V Voutput = 0.3V	PB0 USBDP USBDM	8		mA
| I_{OH} |	Output Current	IOVDD = 3.0V Voutput = 2.7V	PA0~PA4 PB1~PB7 PC1~PC5	2(HD=0) 6(HD=1) 20(HD=2)		mA

				45(HD=3)	
		IOVDD = 3.0V Voutput = 2.7V	VPWR	2	mA
		IOVDD = 3.0V Voutput = 2.7V	PB0 USBDP USBDM	8	mA
Internal Resistance Characteristics					
Symbol	**Parameter**	**Conditions**	**IO**	**Typ**	**Unit**
R_{pu}	Pull-up Resistance	IOVDD = 3.0V	PA0~PA4 PB0,PB2~PB7 PC1~PC5	10k	Ω
		IOVDD = 3.0V	PB1 VPWR	200k	Ω
		IOVDD = 3.0V	USBDP	1.5k	Ω
		IOVDD = 3.0V	USBDM	180k	Ω
R_{pd}	Pull-down Resistance	IOVDD = 3.0V	PA0~PA4 PB0~PB7 PC1~PC5 VPWR	10k	Ω
		IOVDD = 3.0V	USBDP USBDM	15k	Ω

Note

1.Internal pull-up/pull-down resistance accuracy ±20%

3.6 Audio DAC Characteristics

Table 3-6 DAC Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Resolution	--	--	16	--	bit
Sample Rate	--	8	--	96	kHz
SNR①	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	108	--	dB
	VCMO Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	105	--	dB
	Single-ended Mode	--	107	--	dB

Parameter	Conditions	Min	Typ	Max	Unit
	Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ				
Dynamic Range	Differential Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	102	--	dB
	VCMO Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	100	--	dB
	Single-ended Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	100	--	dB
THD+N	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=32Ω	--	-85	--	dB
	VCMO Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=32Ω	--	-80	--	dB
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=32Ω	--	-80	--	dB
Noise Floor	Differential Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	12	--	uVrms
	VCMO Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	8	--	uVrms
	Single-ended Mode B/W=20Hz~20kHz A-Weighted	--	8	--	uVrms

Parameter	Conditions	Min	Typ	Max	Unit
	load=10kΩ				
Noise Floor with MUTE	Differential Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	6	--	uVrms
	VCMO Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	5	--	uVrms
	Single-ended Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	4	--	uVrms
Stereo Crosstalk	VCMO Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	-120	--	dB
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	-110	--	dB
Max Output Power	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=16Ω THD+N＜0.1%	--	82	--	mW
	VCMO Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=16Ω THD+N＜0.1%	--	33	--	mW
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=16Ω THD+N＜0.1%	--	33	--	mW

Note

1.①SNR is the ratio of output level with a 1kHz full-scale input to output level with MUTE on

3.7 Audio ADC Characteristics

Table 3-7 Audio ADC Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Resolution	--	--	16	--	bit
Sample Rate	--	8	--	48	kHz
SNR	Differential input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	98	--	dB
	Single-ended input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	97	--	dB
Dynamic Range	Differential input Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	98	--	dB
	Single-ended input Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	97	--	dB
THD+N	Differential input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	-90	--	dB
	Single-ended input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	-80	--	dB
Analogue Gain	--	-6	--	21	dB
Max Input Level	Differential input Mode ADC gain=0dB	--	2	--	Vrms
	Single-ended input Mode ADC gain=0dB	--	1	--	Vrms

3.8 BT Characteristics

3.8.1 Transmitter

Table 3-8-1 Transmitter characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Maximum RF Transmit Power	BR	--	8	10	dBm
Maximum RF Transmit Power	EDR Π/4 DQPSK EDR 8DPSK	--	8	--	dBm
Relative Transmit Power	EDR Π/4 DQPSK EDR 8DPSK	--	-3	--	dB
Maximum RF Transmit Power	BLE-1Mbps	--	8	--	dBm

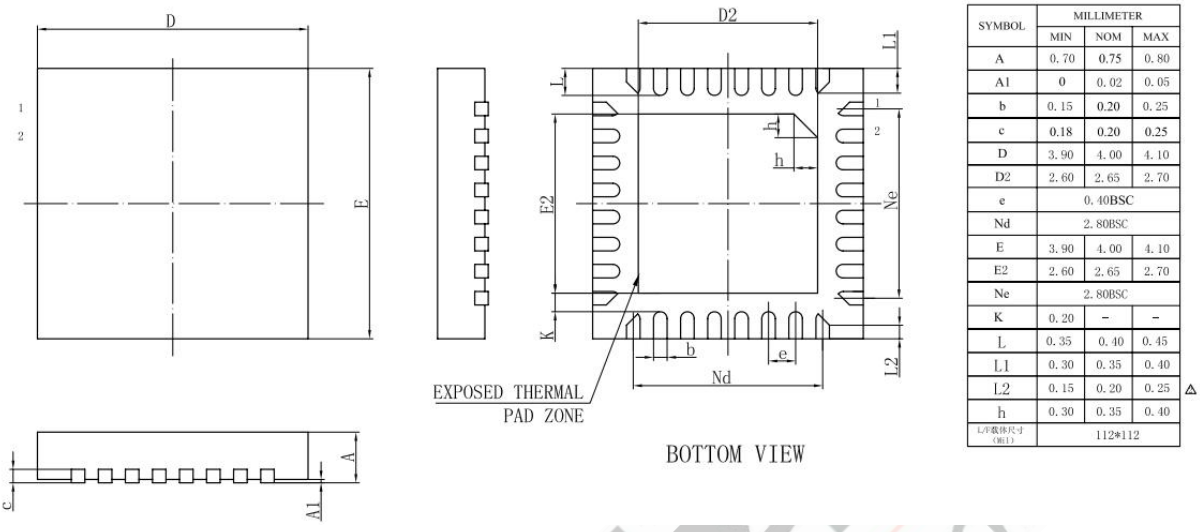
3.8.2 Receiver

Table 3-8-2 Receiver characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity	BR	--	-93	--	dBm
	EDR Π/4 DQPSK	--	-92	--	dBm
	EDR 8DPSK	--	-86	--	dBm
	BLE-1Mbps	--	-97	--	dBm
	BLE-2Mbps	--	-93	--	dBm

4 Package Information

4.1 QFN32_4×4mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	0.02	0.05
b	0.15	0.20	0.25
c	0.18	0.20	0.25
D	3.90	4.00	4.10
D2	2.60	2.65	2.70
e	0.40BSC		
Nd	2.80BSC		
E	3.90	4.00	4.10
E2	2.60	2.65	2.70
Ne	2.80BSC		
K	0.20	–	–
L	0.35	0.40	0.45
L1	0.30	0.35	0.40
L2	0.15	0.20	0.25
h	0.30	0.35	0.40
载体尺寸 (脚位)	112*112		

Figure 4-1 AC7066M Package

5 IC Marking Information

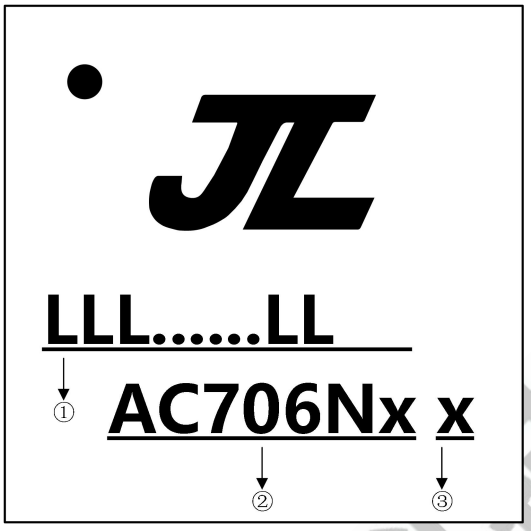


Figure 5-1 AC7066M Package Outline

① LLL……LL LOT No. , It contains 7 to 18 alphanumerics

② AC706Nx Chip Model

③ x Built-in flash size

0 No Flash Memory

2 2Mbit Flash

4 4Mbit Flash

8 8Mbit Flash

6 16Mbit Flash

3 32Mbit Flash

6 Solder-Reflow Condition

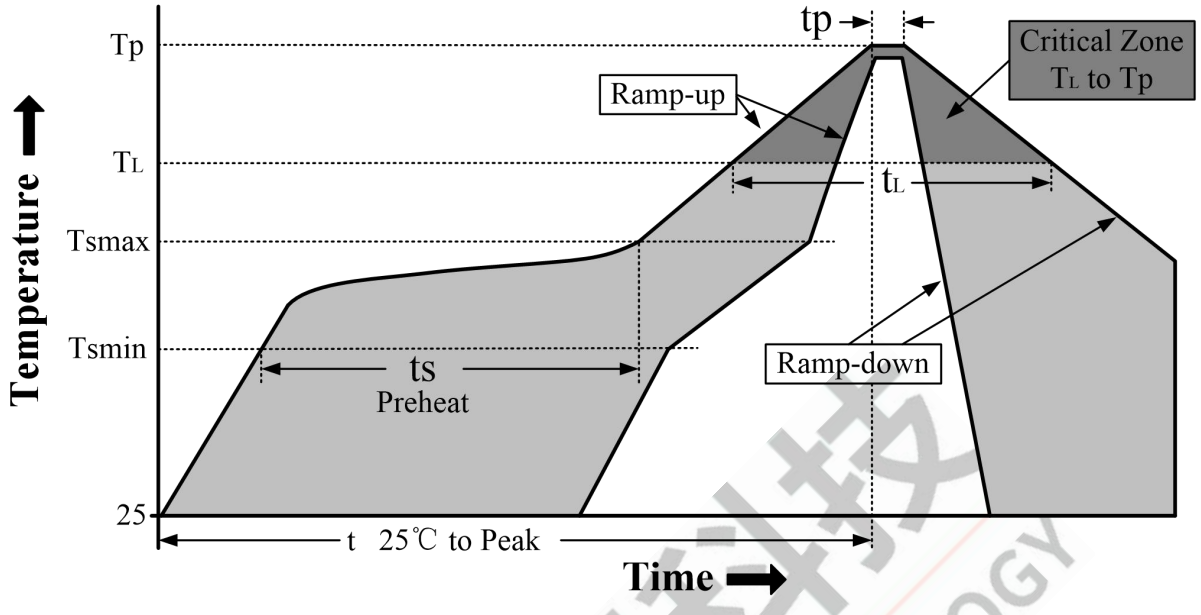


Figure 6-1 Classification Reflow Profile

Table 6-1 Classification Profiles

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

2.Time within 5℃ of actual peak temperature (tp) specified for the reflow profiles is a “supplier” and “user” maximum.

Table 6-2 SnPb Classification Temperature

Package Thickness	Volume mm^3 < 350	Volume mm^3 ≥ 350
<2.5 mm	240 +0/-5℃	225 +0/-5℃
≥2.5 mm	225 +0/-5℃	225 +0/-5℃

Table 6-3 Pb-free - Classification Temperature

Package Thickness	Volume mm^3 < 350	Volume mm^3 350 - 2000	Volume mm^3 > 2000
< 1.6mm	260℃	260℃	260℃
1.6 mm - 2.5mm	260℃	250℃	245℃
> 2.5mm	250℃	245℃	245℃

Note

1.*Tolerance The device manufacturer/supplier shall assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0℃.For example 260℃+0℃)at the rated MSL level.