

AC7065F Datasheet

Zhuhai Jieli Technology Co.,LTD

Version 2.0

Date 2025.01.16

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Revision History

Date	Revision	Description
2024.06.07	V1.0	Initial Release
2024.07.30	V1.1	Update Pin Description Update FM Characteristics
2024.09.27	V1.2	Update Pin Description(Update FMIP&FMIN IO Type)
2025.01.16	V2.0	Update Features_Bluetooth Update Block Diagram

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AC7065F Features

SYSTEM

- 32-bit Single-core DSP 192MHz
- With IEEE754 Single precision FPU
- Support FFT/MATRIX/MATH
- 1 x I-cache
- Support EMU
- On-chip SRAM 152kbyte
- 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

Bluetooth

- Dual-mode BT6.0 with LE Audio (DN Q332415)
- Support AoA/AoD
- Support LE audio BIS/CIS
- Support long range BLE
- Maximum transmitting power 10dBm

- Receiver sensitivity

- ❖ -93dBm @BR
- ❖ -92dBm @EDR $\pi/4$ DQPSK
- ❖ -85dBm @EDR 8DPSK

FM

- Support Mono/Stereo
- Receiver sensitivity 6 dBuV

Peripherals

- 1 x Full speed USB
- 1 x SD host controller
- 4 x Multi-function 16bit timer
- 2 x UART interface
- 1 x I²C Master/Slave interface
- 2 x SPI Master/Slave interface
- 1 x QDEC
- 4 x MCPWM
- 1 x 10bit ADC(11 Channel)
- 10 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

- SSOP24

Temperature

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

Applications

- Bluetooth Stereo Headphones

1 Block Diagram

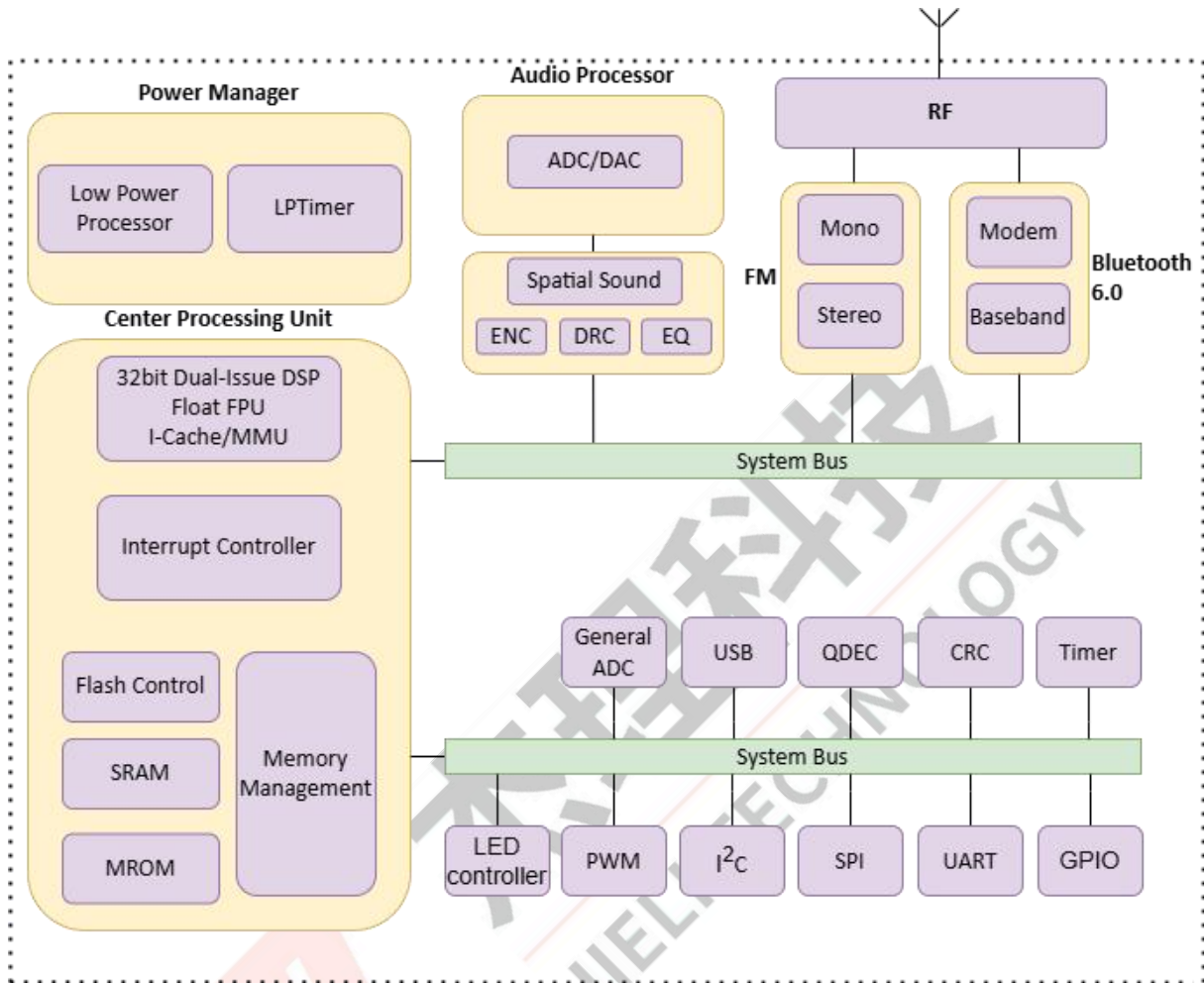


Figure 1-1 AC7065F Block Diagram

2 Pin Definition

2.1 Pin Assignment

PC5	1	AC7065F SSOP24	24	XOSCO
PC4	2		23	XOSCI
PC3	3		22	VSS
USBDM	4		21	FMIP
USBDP	5		20	FMIN
PA4	6		19	BTRF
PA1	7		18	PB2
PA0	8		17	PB1
AVSS	9		16	IOVDD
DACR	10		15	VBAT
DACL	11		14	VPWR
VCMO/PB6	12		13	PB5

Figure 2-1 AC7065F Pin Assignment

2.2 Pin Description

Table 2-2-1 AC7065F Pin Description

Pin No.	Name	Type	IO Initial State	Description
1	PC5	I/O	Z	ADC12(ADC Input Channel 12) SPI1 DATA0(B) I ² C SDA(B) TIMER1 CLK
2	PC4	I/O	Z	ADC11(ADC Input Channel 11) SPI1 CLK(B) I ² C SCL(B) TIMER1 PWM
3	PC3	I/O	Z	ADC10(ADC Input Channel 10) SPI1 Data1(B) SPI1 Data1(D) UART0 TX(D) UART0 RX(D) TIMER2 Capture
4	USBDM	I/O	15kΩ Pull-down	ADC14(ADC Input Channel 14) USB Negative Data SPI1 DATA0(D) I ² C SDA(A)
5	USBDP	I/O	15kΩ Pull-down	ADC13(ADC Input Channel 13) USB Positive Data SPI1 CLK(D) I ² C SCL(A)
6	PA4	I/O	Z	ADC3(ADC Input Channel 3) AUX2(Audio ADC Input) SPI1 DATA1(A)
7	PA1	I/O	Z	ADC1(ADC Input Channel 1) MIC(Audio ADC Input)
8	PA0	I/O	Z	ADC0(ADC Input Channel 0) MICBIAS(MIC Bias Output) Clockout0
9	AVSS	G	--	Audio Ground
10	DACR	O	--	Right Channel DAC Output
11	DACL	O	--	Left Channel DAC Output
12	VCMO	O	--	Audio Common-mode Output voltage

Pin No.	Name	Type	IO Initial State	Description
	PB6	I/O	Z	ADC8(ADC Input Channel 8) AUX0(Audio ADC Input) SPI0 CLK(B) SPI1 CLK(C) I ² C SCL(C) TIMER3 CLK
13	PB5	I/O	Z	ADC5(ADC Input Channel 5) SD Power SPI0 DATA1(B) SPI1 DATA1(C)
14	VPWR	I/O	Z	Charge Power Input UART0 TX(C) UART0 RX(C) TIMER3 PWM TIMER1 Capture
15	VBAT	P	--	Battery Input
16	IOVDD	P	--	IO Power
17	PB1	I/O	200kΩ Pull-up	Hold down 0 to reset UART0 RX(B) TIMER2 CLK
18	PB2	I/O	Z	ADC6(ADC Input Channel 6) TIMER0 Capture
19	BTRF	RF	--	Bluetooth RF Antenna
20	FMIN	RF	--	FM Negative Input
21	FMIP	RF	--	FM Positive Input
22	VSS	G	--	Ground
23	XOSCI	I	--	Crystal Oscillator Input
24	XOSCO	O	--	Crystal Oscillator Output

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 functions also can be remapped to any I/O.
- 3.MCPWM, UART1, SD and QDEC 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	°C
Tstg	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	-0.3	4.5	V
VPWR		-0.3	6.0	V
IOVDD		-0.3	3.6	V
GPIO	Input voltage of GPIO	-0.3	3.6	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
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 _{Trickl}	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,PA1,PA4 PB1,PB2,PB5,PB6 PC3~PC5 USBDP USBDM VPWR	-0.3	1.4	V
V _{IH}	High-Level Input Voltage	IOVDD = 3.0V	PA0,PA1,PA4 PB1,PB2,PB5,PB6 PC3~PC5 USBDP USBDM	1.7	3.3	V
		IOVDD = 3.0V	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,PA1,PA4 PB1,PB2,PB5,PB6 PC3~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	USBDP USBDM	8	mA	
I _{OH}	Output Current	IOVDD = 3.0V Voutput = 2.7V	PA0,PA1,PA4 PB1,PB2,PB5,PB6 PC3~PC5	2(HD=0) 6(HD=1) 20(HD=2) 45(HD=3)	mA	
		IOVDD = 3.0V	VPWR	2	mA	

		Voutput = 2.7V			
		IOVDD = 3.0V	USBDP	8	mA
		Voutput = 2.7V	USBDM		
Internal Resistance Characteristics					
Symbol	Parameter	Conditions	IO	Typ	Unit
R _{pu}	Pull-up Resistance	IOVDD = 3.0V	PA0,PA1,PA4 PB2,PB5,PB6 PC3~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,PA1,PA4 PB1,PB2,PB5,PB6 PC3~PC5 VPWR	10k	Ω
		IOVDD = 3.0V	USBDP USBDM	15k	Ω

Note

1. Internal pull-up/pull-down resistance accuracy $\pm 20\%$

3.6 Audio DAC Characteristics

Table 3-6 DAC Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Resolution	--	--	16	--	bit
Sample Rate	--	8	--	96	kHz
SNR ^①	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 Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	--	97	--	dB

Parameter	Conditions	Min	Typ	Max	Unit
	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	--	98	--	dB
	Single-ended Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	94	--	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	--	13	--	uVrms
	VCMO Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	9	--	uVrms
	Single-ended Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	16	--	uVrms
Noise Floor with MUTE	Differential Mode B/W=20Hz~20kHz A-Weighted	--	6	--	uVrms

Parameter	Conditions	Min	Typ	Max	Unit
	load=10kΩ				
	VCMO Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	5	--	uVrms
	Single-ended Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	12	--	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	--	94	--	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	--	94	--	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 $\pi/4$ DQPSK EDR 8DPSK	--	8	--	dBm
Relative Transmit Power	EDR $\pi/4$ 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 $\pi/4$ DQPSK	--	-92	--	dBm
	EDR 8DPSK	--	-85	--	dBm
	BLE-1Mbps	--	-96	--	dBm
	BLE-2Mbps	--	-93	--	dBm

3.9 FM Characteristics

Table 3-9 FM Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Frequency range	--	64	--	108	MHz
RF Mono sensitivity	(S+N)/N=26dB	--	6	--	dBuV
Mono Audio SNDR	--	--	65	--	dB
Stereo Audio SNDR	--	--	55	--	dB
Stereo channel separation	--	--	40	--	dB

Note

1.The best FM sensitivity performance requires an external differential circuit, refer to the schematic diagram.

4 Package Information

4.1 SSOP24

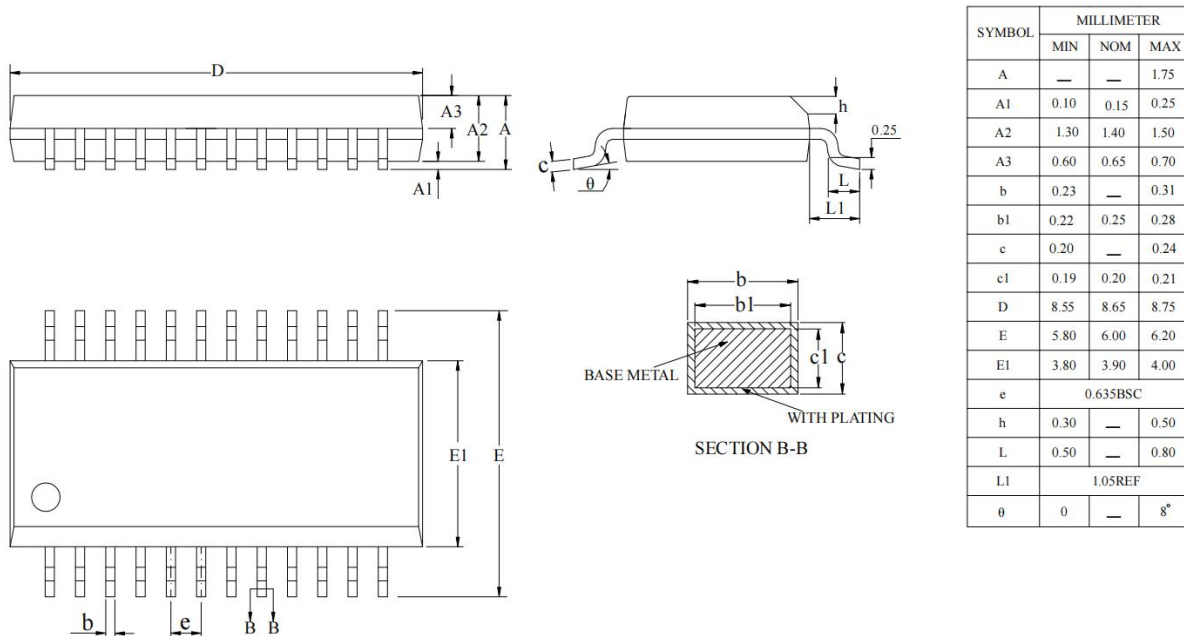


Figure 4-1 AC7065F Package

5 IC Marking Information

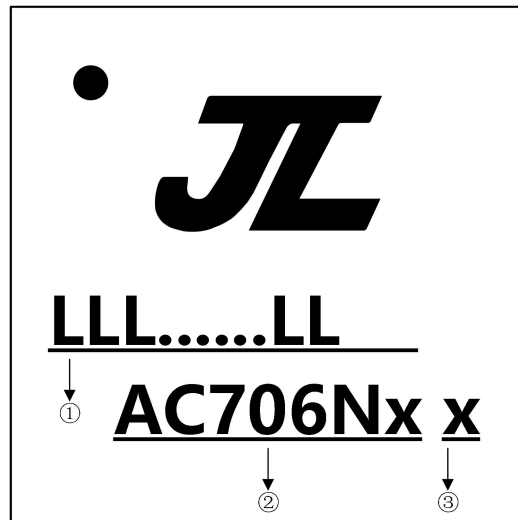


Figure 5-1 AC7065F Package Outline

- 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

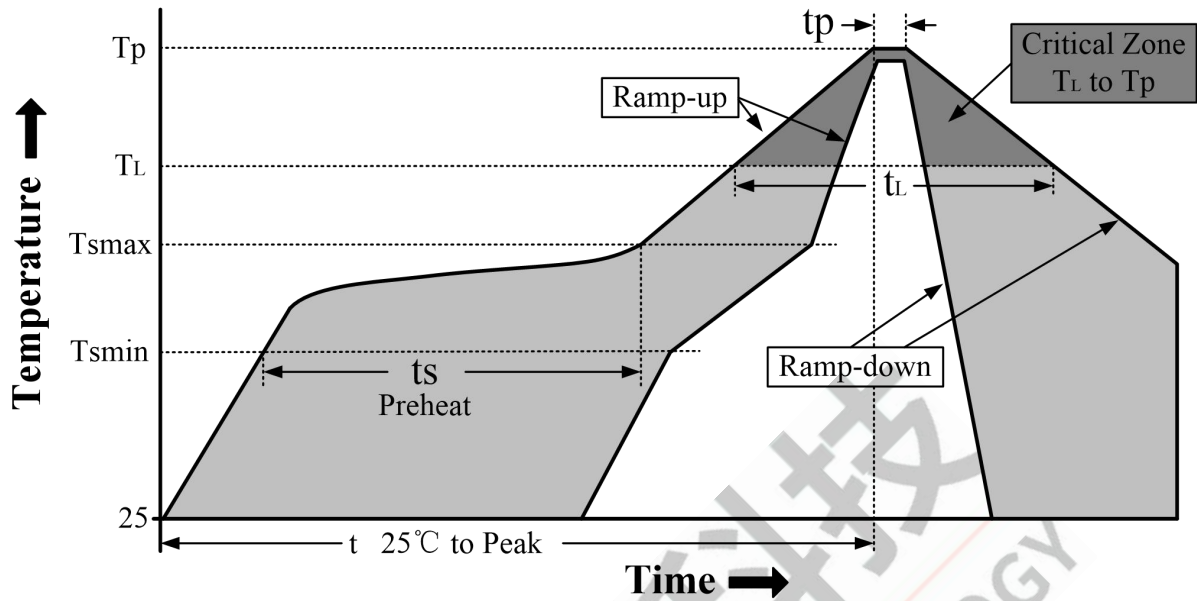


Figure 6-1 Classification Reflow Profile

Table 6-1 Classification Profiles

Profile Feature		Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat/Soak	Temperature Min (T_{smmin})	100°C	150°C
	Temperature Max (T_{smmax})	150°C	200°C
	Time (t_s) from (T_{smmin} to T_{smmax})	60-120 seconds	60-180 seconds
Average ramp-up rate (T_{smmax} 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 6-2	See Table 6-3
Time within 5°C of actual Peak Temperature (t_p) ²		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
2. Time within 5°C of actual peak temperature (t_p) specified for the reflow profiles is a "supplier" and "user" maximum.

Table 6-2 SnPb Classification Temperature

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

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°C	260°C	260°C
1.6 mm - 2.5mm	260°C	250°C	245°C
> 2.5mm	250°C	245°C	245°C

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°C.For example 260°C+0°C)at the rated MSL level.