

AC7065E Datasheet

Zhuhai Jieli Technology Co.,LTD

Version 1.2

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Revision History

Date	Revision	Description
2024.04.01	V1.0	Initial Release
2024.04.25	V1.1	Update Datasheet Format And Content
2024.07.30	V1.2	Update Pin Description Update FM Characteristics



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AC7065E 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
- 32.768kHz 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
 - ❖ Supports differential mode
 - ❖ Sampling rate 8~96kHz
- 1 x 16bit ADC
 - ❖ SNR 98dB
 - ❖ Sampling rate 8~48kHz
 - ❖ Support AMUX
- I²S AUDIO Master/Slave interface

Bluetooth

- Dual-mode BT5.4 with LE Audio (QDID 222830)
- Support AoA/AoD
- Support LE audio BIS/CIS
- Support long range BLE

- Maximum transmitting power 10dBm
- Receiver sensitivity
 - ❖ -93dBm @BR
 - ❖ -92dBm @EDR Π/4 DQPSK
 - ❖ -84dBm @EDR 8DPSK

FM

- FM RX,Support Mono/Stereo
- Receiver sensitivity 10 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)
- 12 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 live sound card
- Bluetooth soundbar

1 Block Diagram

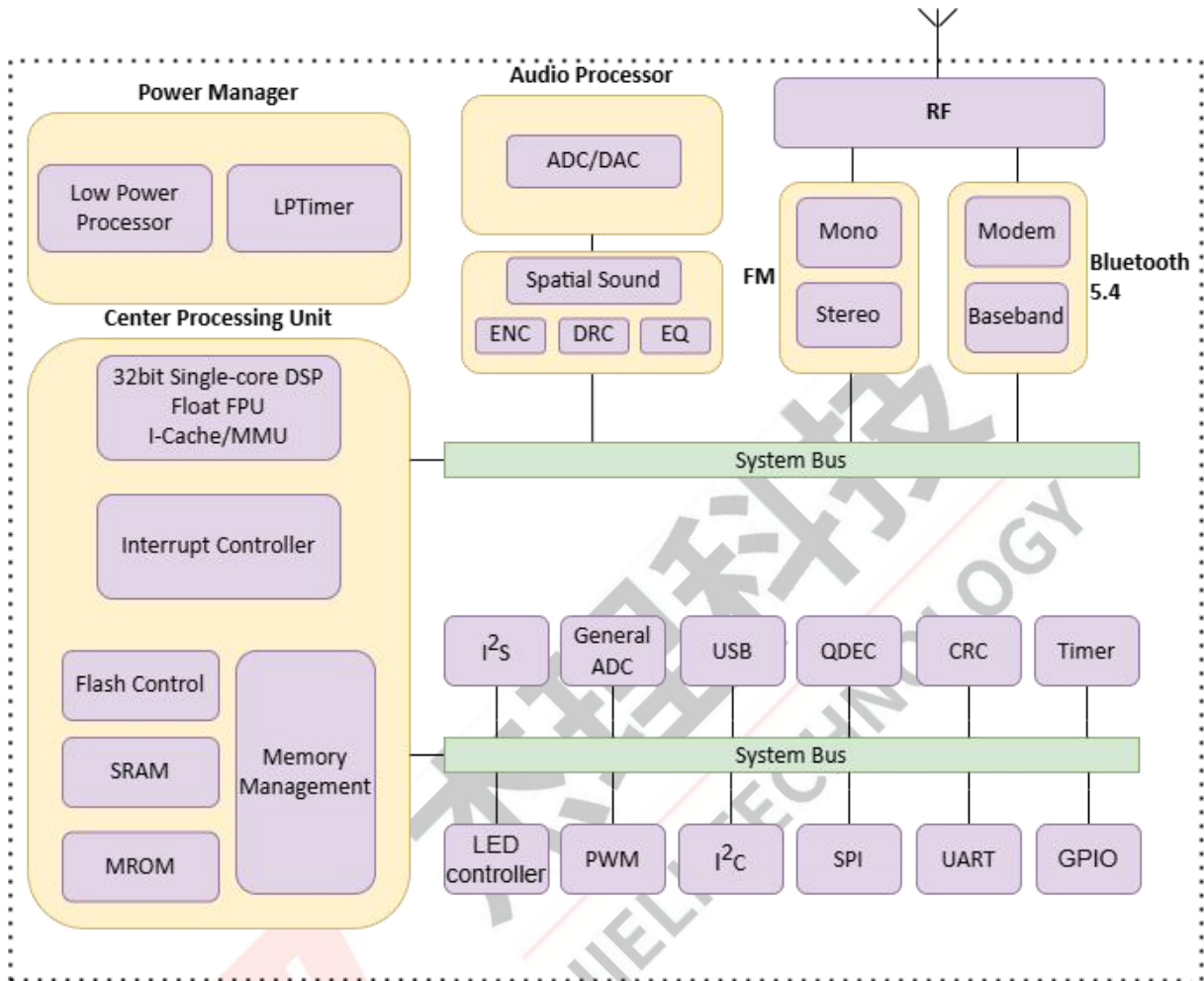


Figure 1-1 AC7065E Block Diagram

2 Pin Definition

2.1 Pin Assignment

PA4	1	AC7065E SSOP24	24	USBDP
PA3	2		23	USBDM/PC3
PA1/PA0	3		22	PC4
AVSS	4		21	PC5
DACL	5		20	XOSCO
PB7/DACR	6		19	XOSCI
PB6	7		18	FMIP
PB5	8		17	VSS
VPWR	9		16	BTRF
VBAT	10		15	PB3
IOVDD	11		14	PB2
PB0	12		13	PB1

Figure 2-1 AC7065E Pin Assignment

2.2 Pin Description

Table 2-2-1 AC7065E Pin Description

Pin No.	Name	Type	IO Initial State	Description
1	PA4	I/O	Z	ADC3(ADC Input Channel 3) AUX2(Audio ADC Input) SPI1 DATA1(A) I ² S LRCK(A) I ² S Data3(B)
2	PA3	I/O	Z	ADC2(ADC Input Channel 2) AUX1(Audio ADC Input) SPI1 DATA0(A) I ² S SCLK(A) I ² S Data2(B)
3	PA1	I/O	Z	ADC1(ADC Input Channel 1) MIC(Audio ADC Input) I ² S Data1(A)
	PA0	I/O	Z	ADC0(ADC Input Channel 0) MICBIAS(MIC Bias Output) I ² S Data0(A) I ² S Data0(B) Clockout0
4	AVSS	G	--	Audio Ground
5	DACL	O	--	Left Channel DAC Output
6	DACR	O	--	Right Channel DAC Output
	PB7	I/O	Z	ADC9(ADC Input Channel 9) SPI0 DATA0(B) SPI1 DATA0(C) I ² C SDA(C) Q-decoder DATA1
7	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
8	PB5	I/O	Z	ADC5(ADC Input Channel 5) SD Power SPI0 DATA1(B) SPI1 DATA1(C)

Pin No.	Name	Type	IO Initial State	Description
9	VPWR	I/O	Z	Charge Power Input UART0 TX(C) UART0 RX(C) TIMER3 PWM TIMER1 Capture
10	VBAT	P	--	Battery Input
11	IOVDD	P	--	IO Power
12	PB0	I/O	Z	UART0 TX(B)
13	PB1	I/O	200kΩ Pull-up	Hold down 0 to reset UART0 RX(B) TIMER2 CLK
14	PB2	I/O	Z	ADC6(ADC Input Channel 6) 32.768k Crystal Oscillator Input TIMER0 Capture
15	PB3	I/O	Z	AUX3(Audio ADC Input) 32.768k Crystal Oscillator Output TIMER2 PWM
16	BTRF	RF	--	Bluetooth RF Antenna
17	VSS	G	--	Ground
18	FMIP	I	--	FM Postive Input
19	XOSCI	I	--	Crystal Oscillator Input
20	XOSCO	O	--	Crystal Oscillator Output
21	PC5	I/O	Z	ADC12(ADC Input Channel 12) SPI1 DATA0(B) I ² C SDA(B) TIMER1 CLK
22	PC4	I/O	Z	ADC11(ADC Input Channel 11) SPI1 CLK(B) I ² C SCL(B) TIMER1 PWM
23	PC3	I/O	Z	ADC10(ADC Input Channel 10) SPI1 Data1(B) SPI1 Data1(D) UART0 TX(D) UART0 RX(D) TIMER2 Capture
	USBDM	I/O	15kΩ Pull-down	ADC14(ADC Input Channel 14) USB Negative Data SPI1 DATA0(D) I ² C SDA(A)

Pin No.	Name	Type	IO Initial State	Description
24	USBDP	I/O	15kΩ Pull-down	ADC13(ADC Input Channel 13) USB Positive Data SPI1 CLK(D) I ² C SCL(A)

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	°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 (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
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,PA3,PA4 PB0~PB3,PB5~PB7 PC3~PC5 USBDP USBDM VPWR	-0.3	1.4	V
V _{IH}	High-Level Input Voltage	IOVDD = 3.0V	PA0,PA1,PA3,PA4 PB1~PB3,PB5~PB7 PC3~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,PA1,PA3,PA4 PB1~PB3,PB5~PB7 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	PB0 USBDP USBDM	8	mA	
I _{OH}	Output Current	IOVDD = 3.0V Voutput = 2.7V	PA0,PA1,PA3,PA4 PB1~PB3,PB5~PB7 PC3~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,PA1,PA3,PA4 PB0,PB2,PB3 PB5~PB7 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,PA3,PA4 PB0~PB3,PB5~PB7 PC3~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 Stereo 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
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	97	--	dB

Parameter	Conditions	Min	Typ	Max	Unit
Dynamic Range	Differential Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	102	--	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=10kΩ	--	-85	--	dB
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted load=10kΩ	--	-80	--	dB
Noise Floor	Differential Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	13	--	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 load=10kΩ	--	6	--	uVrms
	Single-ended Mode B/W=20Hz~20kHz A-Weighted load=10kΩ	--	12	--	uVrms
Stereo Crosstalk	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	--	82	--	mW

Parameter	Conditions	Min	Typ	Max	Unit
	THD+N < 0.1%				
	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 SNR 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	--	-80	--	dB

Parameter	Conditions	Min	Typ	Max	Unit
	Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB				
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	--	-84	--	dBm
	BLE-1Mbps	--	-96	--	dBm
	BLE-2Mbps	--	-93	--	dBm

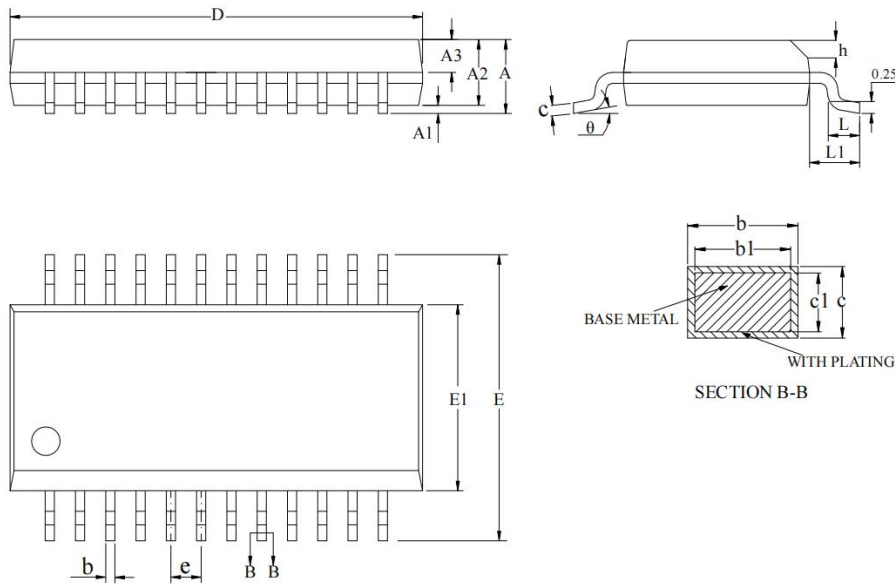
3.9 FM Characteristics

Table 3-9 FM Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Frequency range	--	64	--	108	MHz
RF Mono sensitivity	(S+N)/N=26dB	--	10	--	dBuV
Mono Audio SNDR	--	--	65	--	dB
Stereo Audio SNDR	--	--	55	--	dB
Stereo channel separation	--	--	40	--	dB

4 Package Information

4.1 SSOP24



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	0.15	0.25
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.23	—	0.31
b1	0.22	0.25	0.28
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	8.55	8.65	8.75
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	0.635BSC		
h	0.30	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°

Figure 4-1 AC7065E Package

5 IC Marking Information

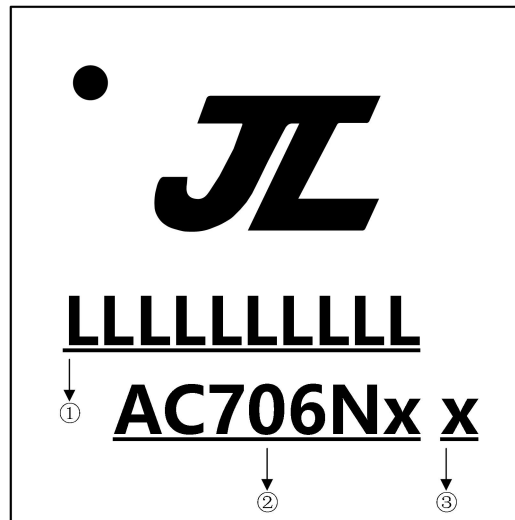


Figure 5-1 AC7065E Package Outline

- ① LLLLLLLLLL Production Batch
- 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

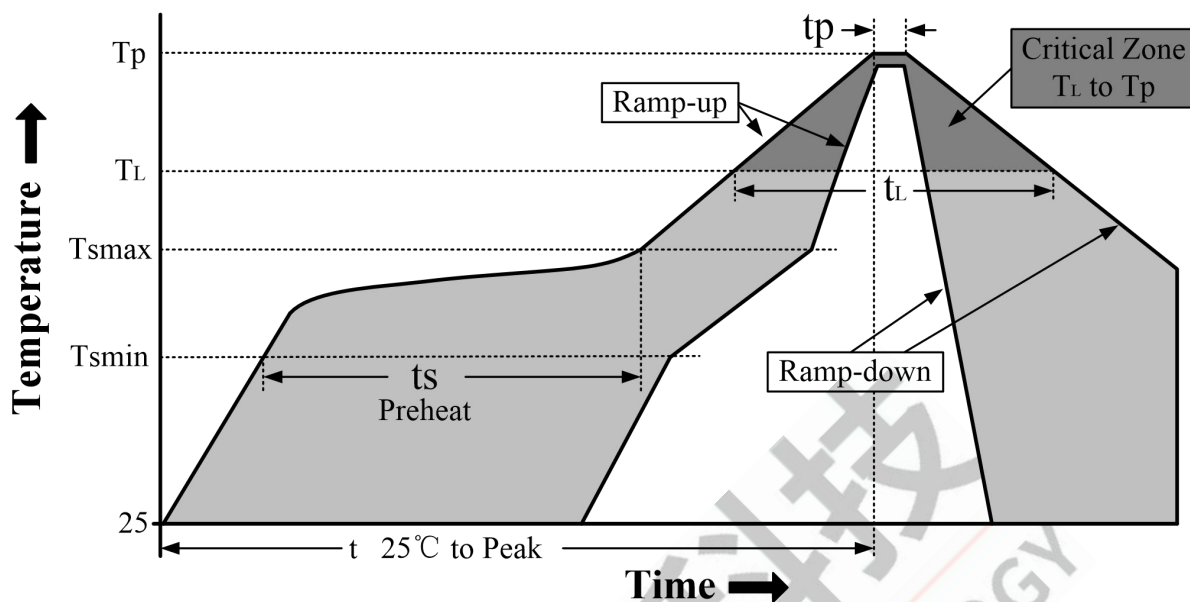


Figure 6-1 Classification Reflow Profile

Table 6-1 Classification Profiles

Profile Feature		Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat/Soak	Temperature Min (T_{smin})	100°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 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.

