

AC7053F2 Datasheet

Zhuhai Jieli Technology Co.,LTD

Version 1.1

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Revision History

Date	Revision	Description
2024.09.02	V1.0	Initial Release
2025.01.16	V1.1	Update Features_Bluetooth Update Block Diagram

Table of Contents

Revision History	1
Table of Contents	2
AC7053F Features	3
1 Block Diagram	4
2 Pin Definition	5
2.1 Pin Assignment	5
2.2 Pin Description	6
3 Electrical Characteristics	7
3.1 Absolute Maximum Ratings	7
3.2 ESD Ratings	7
3.3 PMU Characteristics	7
3.4 Battery Charge	8
3.5 IO Characteristics	8
3.6 Audio DAC Characteristics	9
3.7 Audio ADC Characteristics	10
3.8 BT Characteristics	11
4 Package Information	12
4.1 QFN20_3x3mm	12
5 IC Marking Information	13
6 Solder-Reflow Condition	14

AC7053F Features

SYSTEM

- 32bit Dual-Issue DSP
- With IEEE754 Single precision FPU
- With I-cache and D-cache
- Support FFT/MATRIX/MATH
- 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 EQ

Audio Codec

- 2 x 16bit DAC
 - ❖ SNR 107dB
 - ❖ Noise 3uVrms
 - ❖ Supports differential mode
 - ❖ Sampling rate 8~96kHz
- 1 x 16bit ADC
 - ❖ SNR 93dB
 - ❖ Sampling rate 8~48kHz

Bluetooth

- Dual-mode BT6.0
(DN Q334307)
- Maximum transmitting power 7dBm
- Receiver sensitivity
 - ❖ -92.5dBm @BR
 - ❖ -93Bm @EDR $\pi/4$ DQPSK
 - ❖ -87dBm @EDR 8DPSK

Peripherals

- 4 x Multi-function 32bit timers
- 2 x Uart interface support DMA
- 1 x I²C Master/Slave interface

- 2 x SPI Master/Slave interface
- 1 x 10bit ADC(4 Channels)
- 6 x GPIO Support function remapping
- 2 x LP_Touch with low power wake up

PMU

- Integrated battery charger up to 150mA
- 1 x Buck DC-DC converter
- 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

- QFN20(3mm*3mm)

Temperature

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

Applications

- Bluetooth audio device

1 Block Diagram

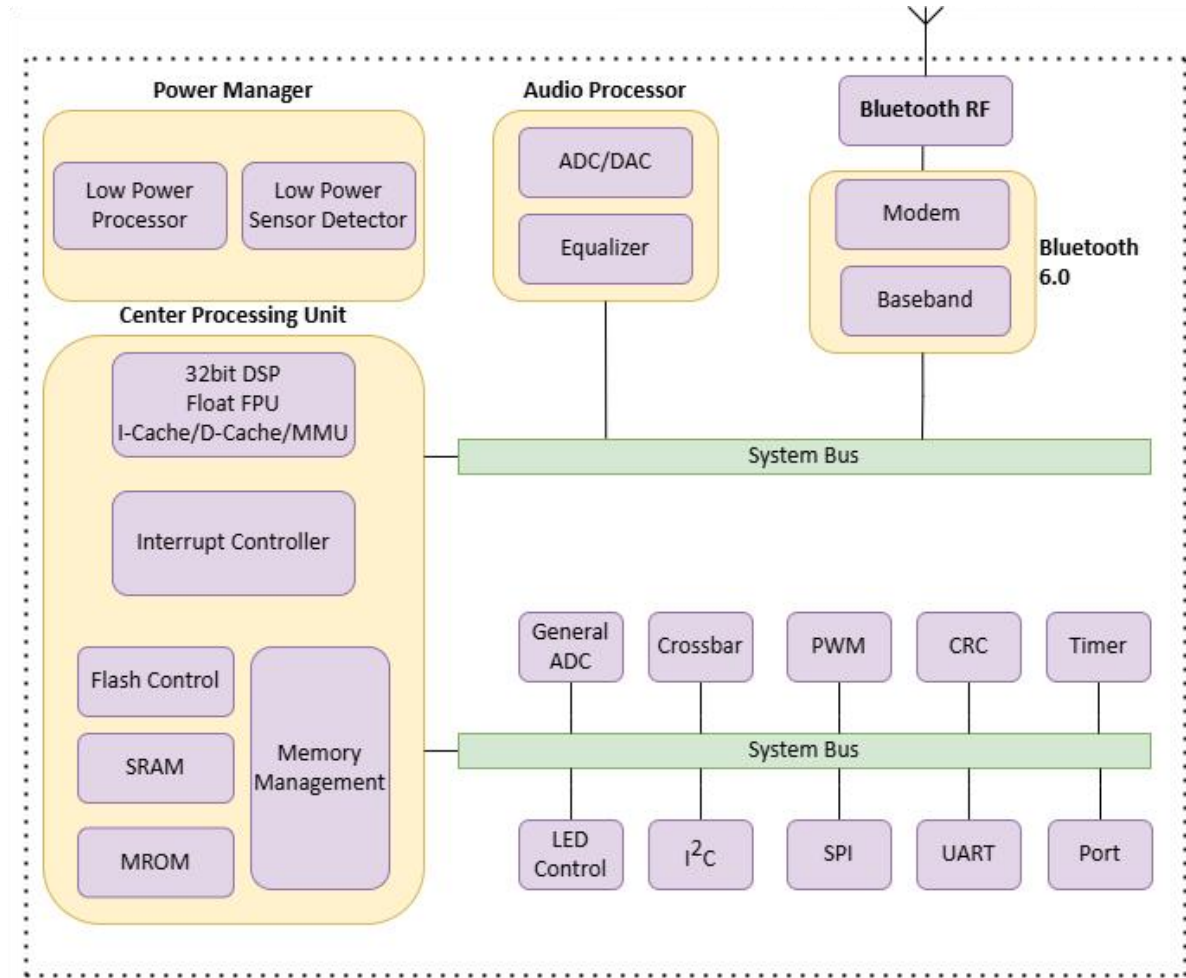


Figure 1-1 AC7053F Block Diagram

2 Pin Definition

2.1 Pin Assignment

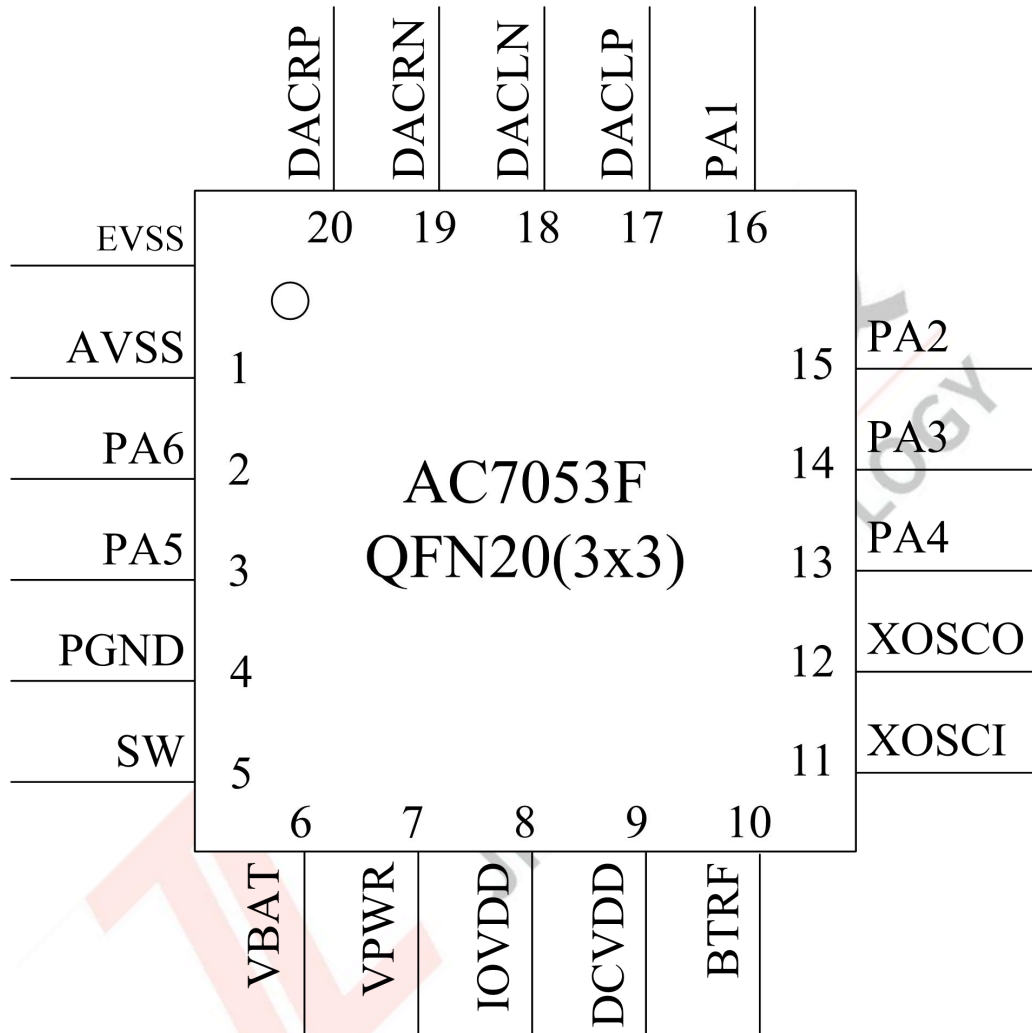


Figure 2-1 AC7053F Pin Assignment

2.2 Pin Description

Table 2-2-1 AC7053F Pin Description

Pin No.	Name	Type	IO Initial State	Description
1	AVSS	G	--	Audio Ground
2	PA6	I/O	Z	ADC6(ADC Input Channel 6) LP_TOUCH0(TOUCH_CH0)
3	PA5	I/O	Z	ADC5(ADC Input Channel 5) LP_TOUCH1(TOUCH_CH1)
4	PGND	G	--	DCDC Ground
5	SW	O	--	Buck DCDC Switch Port
6	VBAT	P	--	Battery Input
7	VPWR	I/O	Z	Charge Power Input
8	IOVDD	P	--	3.0V Power
9	DCVDD	P	--	1.35V Power
10	BTRF	RF	--	Bluetooth RF Antenna
11	XOSCI	I	--	Crystal Oscillator Input
12	XOSCO	O	--	Crystal Oscillator Output
13	PA4	I/O	Z	--
14	PA3	I/O	10kΩ Pull-up	ADC3(ADC Input Channel 3) LVD(External Low Voltage Detection Input) Hold down 0 to reset
15	PA2	I/O	10kΩ Pull-down	ADC2(ADC Input Channel 2) MICBIAS(MIC Bias Output) AIN_A3(Audio ADC Input)
16	PA1	I/O	Z	ADC1(ADC Input Channel 1) AIN_A0(Audio ADC Input)
17	DACL _P	P	--	Left Channel DAC Positive Output
18	DACL _N	P	--	Left Channel DAC Negative Output
19	DACR _N	P	--	Right Channel DAC Negative Output
20	DACR _P	P	--	Right Channel DAC Positive 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, SPI1, UART, I²C, IO_Wakeup functions can be remapped to any I/O.

Table 2-2-2 Pin Type Comments

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
DCVDD		-0.3	1.5	V
GPIO	Input voltage of GPIO (except PA4)	-0.3	3.6	V
HVTIO	Input voltage of HVT-IO (PA4)	-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	±8kV	All pins	JEDEC EIA/JESD22-A114
Machine Mode	±350V	All pins	JEDEC EIA/JESD22-A115
Charge Device Model	±2kV	All pins	ANSI/ESDA/JEDEC JS-002-2022

3.3 PMU Characteristics

Table 3-3 PMU Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VBAT	Power supply	--	2.7	3.7	4.5	V
VPWR	Power supply	--	4.5	5.0	5.5	V
Operating mode						
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IOVDD	Voltage output	--	--	3.0	--	V
	Loading current	IOVDD=3.0V@VBAT = 3.7V	--	--	50	mA
DCVDD	Voltage output	--	--	1.35	--	V
	Loading current	DCVDD12=1.35V@VBAT = 3.7V	--	--	120	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	--	150	mA
I _{end}	End Of Charge Current	2	--	15	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	PA1~PA6 VPWR	-0.3	1.4	V
V _{IH}	High-Level Input Voltage	IOVDD = 3.0V	PA1~PA3 PA5,PA6	1.7	3.3	V
		IOVDD = 3.0V	PA4 VPWR	1.7	5.5	V
Output Characteristics						
Symbol	Parameter	Conditions	IO	Typ	Unit	
I _{OL}	Output Current	IOVDD = 3.0V Voutput = 0.3V	PA1~PA3 PA5,PA6	3(HD=0) 9(HD=1) 21(HD=2) 54(HD=3)	mA	
		IOVDD = 3.0V Voutput = 0.3V	PA4	8	mA	
		IOVDD = 3.0V Voutput = 0.3V	VPWR	2	mA	
I _{OH}	Output Current	IOVDD = 3.0V Voutput = 2.7V	PA1~PA3 PA5,PA6	3(HD=0) 9(HD=1) 21(HD=2) 54(HD=3)	mA	
		IOVDD = 3.0V Voutput = 2.7V	PA4	8	mA	
		IOVDD = 3.0V Voutput = 2.7V	VPWR	2	mA	
Internal Resistance Characteristics						
Symbol	Parameter	Conditions	IO	Typ	Unit	

Symbol	Parameter	Conditions	IO	Typ	Unit
R _{pu}	Pull-up Resistance	IOVDD = 3.0V	PA1~PA6	10k(PU=1) 100k(PU=2) 1M(PU=3)	Ω
		IOVDD = 3.0V	VPWR	10k(PU=1)	Ω
R _{pd}	Pull-down Resistance	IOVDD = 3.0V	PA1~PA6	10k(PD=1) 100k(PD=2) 1M(PD=3)	Ω
		IOVDD = 3.0V	VPWR	10k(PD=1)	Ω

3.6 Audio DAC Characteristics

Table 3-6 Stereo DAC Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Resolution	--	--	16	--	bits
Output Sample Rate	--	8	--	96	kHz
SNR ^①	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Load=10kΩ	--	107	--	dB
Dynamic Range	Differential Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Load=10kΩ	--	99	--	dB
THD+N	Differential 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	--	7.3	--	uVrms
Noise Floor with MUTE	Differential Mode B/W=20Hz~20kHz A-Weighted Load=10kΩ	--	3.0	--	uVrms
Stereo crosstalk	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Load=10kΩ	--	-120	--	dB

Parameter	Conditions	Min	Typ	Max	Unit
Max Output Power	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Load=16Ω THD+N<0.1%	--	20	30	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	--	bits
Input Sample Rate	--	8	--	48	kHz
SNR	Single-ended input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	93	--	dB
Dynamic Range	Single-ended input Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	93	--	dB
THD+N	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	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	--	7	--	dBm
Maximum RF Transmit Power	EDR $\pi/4$ DQPSK	--	7	--	dBm
	EDR 8DPSK	--		--	
Relative Transmit Power	EDR $\pi/4$ DQPSK	--	-3	--	dB
	EDR 8DPSK	--		--	

3.8.2 Receiver

Table 3-8-2 Receiver Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity	BR	--	-92.5	--	dBm
	EDR $\pi/4$ DQPSK	--	-93	--	dBm
	EDR 8DPSK	--	-87	--	dBm

4 Package Information

4.1 QFN20_3x3mm

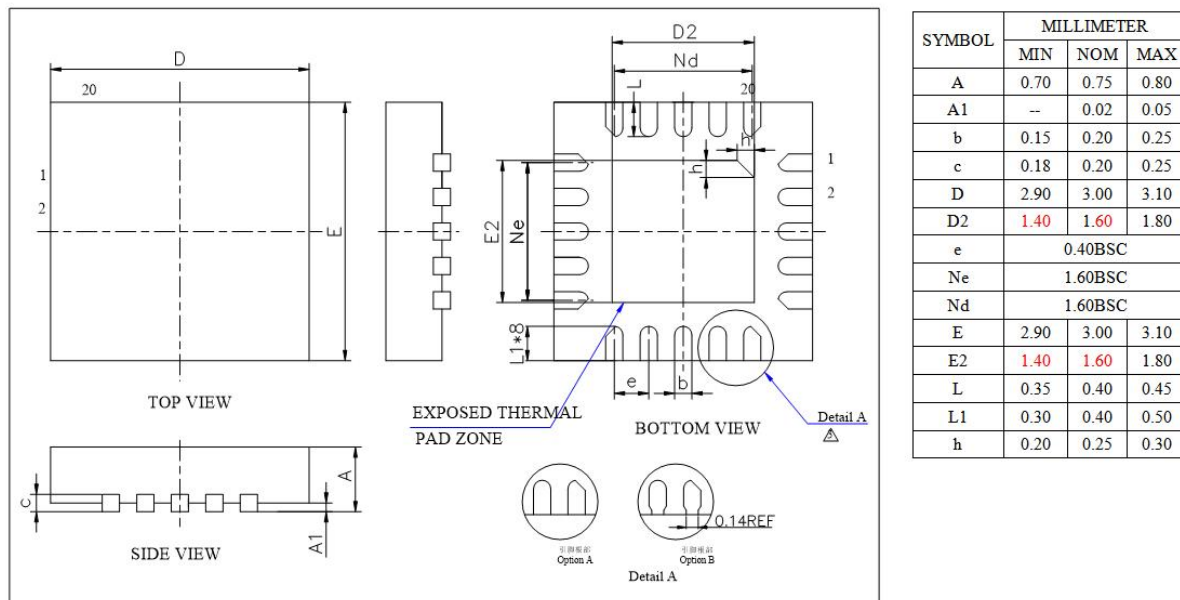


Figure 4-1 AC7053F Package

5 IC Marking Information

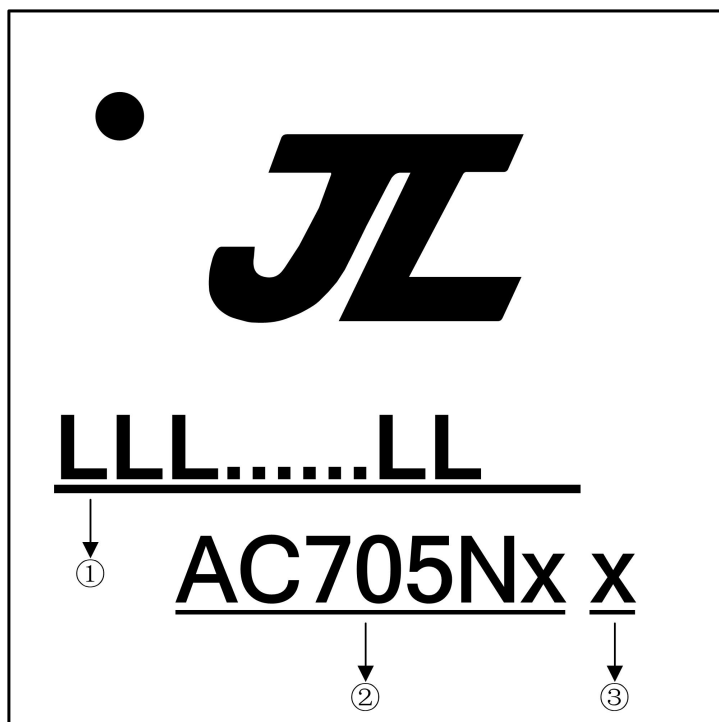


Figure 5-1 AC7053F Package Outline

- ① LLL.....LL LOT No. , It contains 7 to 18 alphanumerics
- ② AC705Nx Chip Model
- ③ x Built-in flash size
 - 0 No Flash Memory
 - 4 4Mbit Flash

6 Solder-Reflow Condition

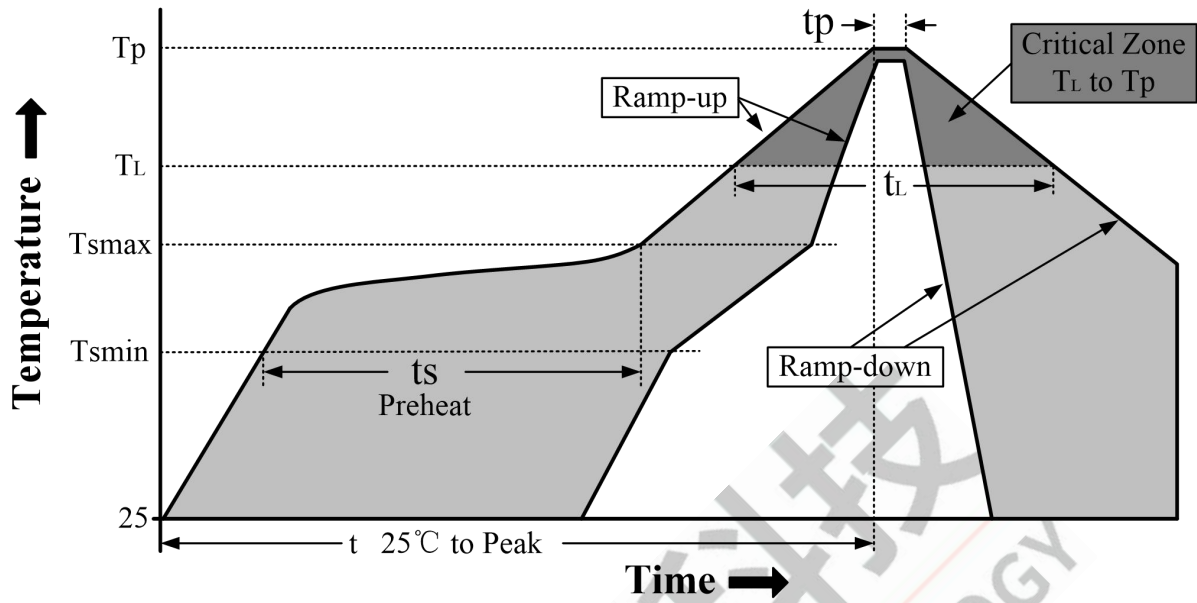


Figure 6-1 Classification Reflow Profile

Table 6-1 Classification Profiles

Profile Feature		Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat/Soak	Temperature Min (T _{sm})	100°C	150°C
	Temperature Max (T _{smax})	150°C	200°C
	Time (ts) from (T _{sm} 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 (tp) 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 (tp) specified for the reflow profiles is a “supplier” minimum 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°C	225 +0/-5°C

Package Thickness	Volume mm ³ < 350	Volume mm ³ ≥ 350
≥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.