

AC7103D Datasheet

Zhuhai Jieli Technology Co.,LTD

Version V1.4

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Revision History

Date	Revision	Description
2025.01.15	V1.0	Initial Release
2025.03.14	V1.1	Update IC Marking Information
2025.04.16	V1.2	Update Datasheet Format Update Package Information
2025.06.13	V1.3	Update Features_SYSTEM Update Features_Audio Update Audio DAC Characteristics
2025.08.29	V1.4	Update Features_Audio Update Pin Description(the differences in I/O Functions among different versions of chips)

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AC7103D Features

SYSTEM

- 32bit Single-core DSP 192MHz
- On-chip SRAM 240kbyte
- With IEEE754 Single precision FPU
- Support FFT/MATRIX/MAT
- I-cache and D-cache
- Support EMU
- Support MMU
- Support MPU
- Built-In Flash
- 24MHz crystal oscillator
- Internal RC oscillator, PLL

DSP Audio Processing

- SBC/AAC/LDAC/LHDC/LC3/CVSD/mSBC codec
- mSBC voice codec supported for BT phone
- PLC for voice processing
- Single/Dual MIC ENC
- Multi-band DRC
- Multi-band EQ
- Support spatial sound
- Support assistive listening
- Support Hi-Res Audio

ANC

- Wide band digital adaptive ANC
- Support hybrid/feedforward/feedback
- Support wind noise detection
- Support wide area tap
- Support Speak-to-Chat
- Support tip fit test & wear detection
- Input-to-output latency
 - ❖ 10us@SR=750kHz
 - ❖ 14us@SR=375kHz

Audio

- 1 x 24bit DAC
 - ❖ SNR 119dB
 - ❖ Noise 1uVrms
 - ❖ Supports differential mode
 - ❖ Sampling rate 8~384kHz

- 2 x 24bit ADC
 - ❖ SNR 100dB
 - ❖ Sampling rate 8~192kHz
 - ❖ Support analog/digital microphone
- 1 x I²S AUDIO Master/Slave interface
 - ❖ Sampling rate 8~384kHz
 - ❖ Support TX and RX
 - ❖ Support multi-slot mode(TDM)

Bluetooth

- Dual-mode BT6.0 with LE Audio (DN Q332415)
- Support AoA
- Support LE audio BIS/CIS
- Maximum transmitting power 13dBm
- Receiver sensitivity
 - ❖ -94dBm @BR
 - ❖ -95dBm @EDR $\pi/4$ DQPSK
 - ❖ -87dBm @EDR 8DPSK

Peripherals

- 1 x Full speed USB
- 1 x SD host controller
- 4 x Multi-function 32bit timer
- 2 x UART interface
- 1 x I²C Master/Slave interface
- 2 x SPI Master/Slave interface
- 1 x QDEC
- 1 x 10bit ADC(6 Channels)
- 4 x MCPWM
- 2 x LP_Touch with low power wake up
- 4 x IR RX
- 8 x GPIO Support function remapping

PMU

- Integrated battery charger up to 225mA
- 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

- TWS Power < 4.4mA
@AAC No-Load VBAT=3.7V

Packages

- QFN20L(3mm*3mm)

Temperature

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

Applications

- ANC TWS/OWS
- Bluetooth audio device

1 Block Diagram

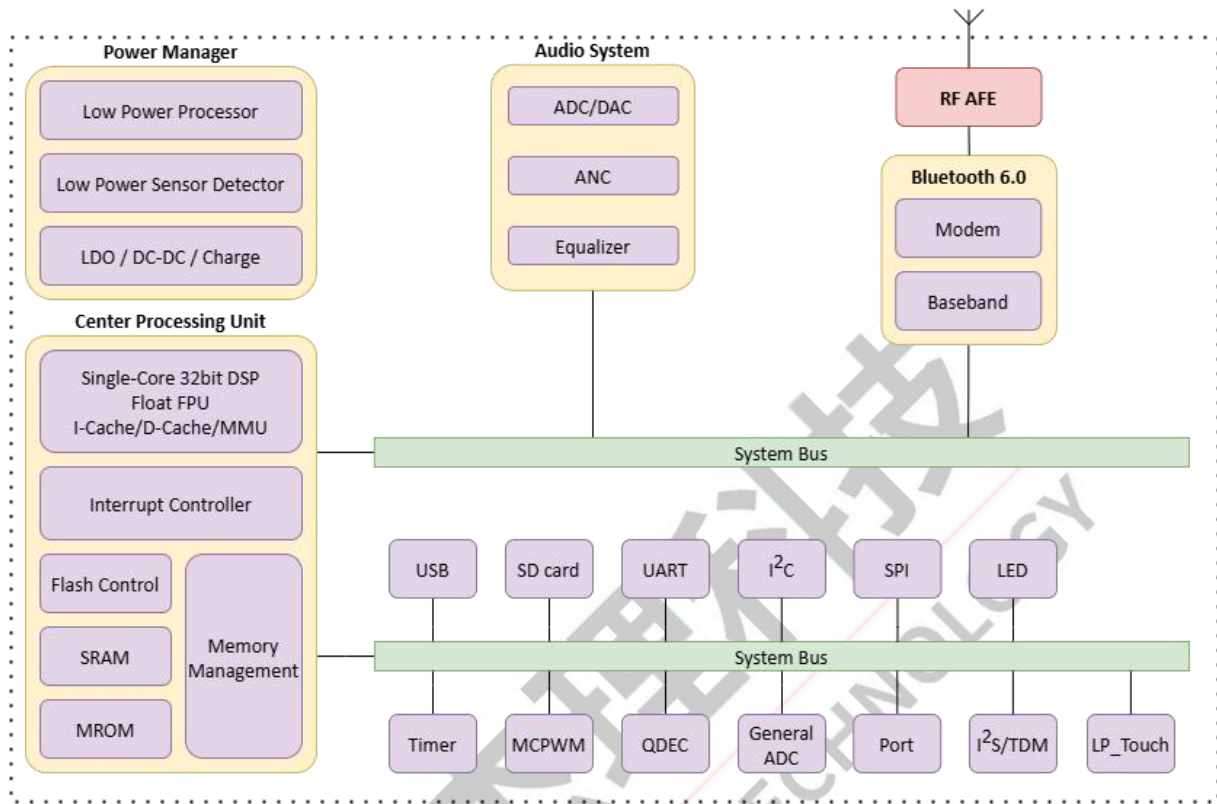


Figure 1-1 AC7103D Block Diagram

2 Pin Definition

2.1 Pin Assignment

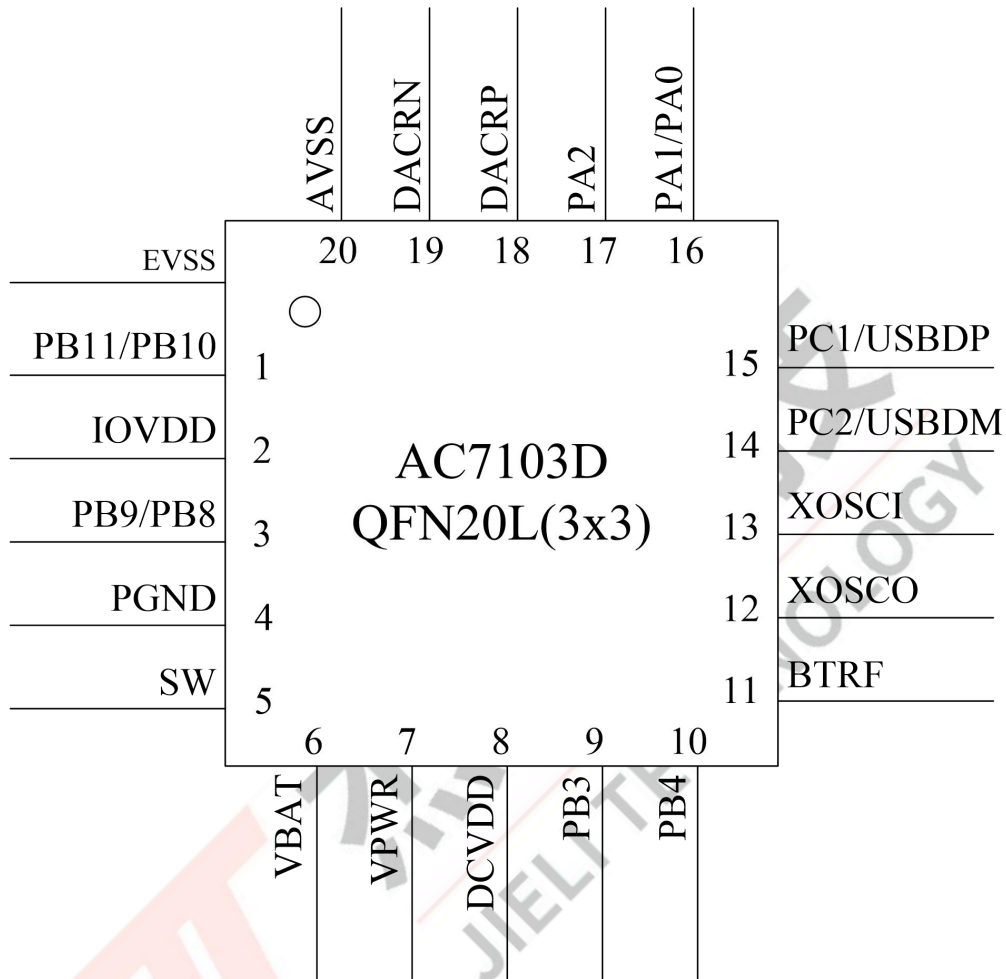


Figure 2-1 AC7103D Pin Assignment

2.2 Pin Description

Table 2-2-1 AC7103D Pin Description

Pin No.	Name	Type	IO Initial State	Description
1	PB11	I/O	Z	MICBIASB(MIC Bias Output) MIC_B0(MIC Input)
	PB10	I/O	Z	AIN_B0(Audio ADC Positive Input)
2	IOVDD	P	--	IO Power
3	PB9*	I/O	Z	Chip Version A/B/C : AIN_B1(Audio ADC Positive Input) AIN_BN(Audio ADC Negative Input)
				Chip Version D : AIN_BN(Audio ADC Negative Input)
	PB8*	I/O	Z	Chip Version A/B/C : ADC12(ADC Input Channel 12)
				Chip Version D : AIN_B1(Audio ADC Positive Input) ADC12(ADC Input Channel 12)
4	PGND	G	--	Ground of Buck DC-DC converter
5	SW	P	--	Buck DCDC Switch Port
6	VBAT	P	--	Battery Input
7	VPWR	P	--	Charge Power Input
8	DCVDD	P	--	1.25V DCDC Power
9	PB3	I/O	Z	LP_TOUCH4(TOUCH_CH4) ADC10(ADC Input Channel 10)
10	PB4	I/O	10kΩ Pull-up	Hold down 0 to reset LP_TOUCH5(TOUCH_CH5) ADCP0(GPADC Input Channel P0)
11	BTRF	RF	--	Bluetooth RF Antenna
12	XOSCO	O	--	Crystal Oscillator Output
13	XOSCI	I	--	Crystal Oscillator Input
14	PC2	I/O	Z	ADC1(ADC Input Channel 1)
	USBDM	I/O	15kΩ Pull-down	USB Negative Data ADC15(ADC Input Channel 15)
15	PC1	I/O	Z	ADC0(ADC Input Channel 0)
	USBDP	I/O	15kΩ Pull-down	USB Positive Data ADC14(ADC Input Channel 14)
16	PA1	I/O	Z	AIN_A0(Audio ADC Positive Input)
	PA0	I/O	Z	MICBIASA(MIC Bias Output) MIC_A0(MIC Input)

Pin No.	Name	Type	IO Initial State	Description
17	PA2*	I/O	Z	Chip Version A/B/C : AIN_A1(Audio ADC Positive Input) AIN_AN(Audio ADC Negative Input)
				Chip Version D : AIN_AN(Audio ADC Negative Input)
18	DACRP	P	--	Right Channel DAC Positive Output
19	DACRN	P	--	Right Channel DAC Negative Output
20	AVSS	G	--	Audio Ground

Note

- 1.IO initial state abbreviations Z--High resistance, H--High level, L--Low level, X--May be changed during power on.
- 2.Timer, MCPWM, QDEC, UART, LEDC, I²C, I²S, SPI,IR RX and SD functions can be remapped to any I/O.
- 3.* indicates that this pin function is related to the chip version.

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

2.3 Pin Specialist

Table 2-3 Pin keep Description

Pin	Description for IOVDD power off mode
PC1	Support driving and sampling external 100kΩ NTC resistance in single IO
PB4	10kΩ Pull-up and Hold down 0 to reset function can be disable by efuse in IO Initial State

3 Electrical Characteristics

3.1 Absolute Maximum Ratings

Table 3-1 Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
T _{opt}	Operating temperature	-20	+85	°C
T _{stg}	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	-0.3	4.5	V
VPWR		-0.3	6	V
IOVDD		-0.3	3.6	V
DCVDD		-0.3	1.55	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	±300V	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	--	V
	Loading current	IOVDD=3.0V@VBAT = 3.7V or VPWR=5V	--	--	120	mA
DCVDD	Voltage output	--	--	1.25	--	V
	Loading current	DCVDD=1.25V@IOVDD=3.0V in LDO mode	--	--	120	mA
		DCVDD=1.25V@VBAT=3.7V in DCDC mode	--	--	120	mA
Low Power mode						
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IOVDD	Loading current	IOVDD=3.0V@VBAT = 3.7V or VPWR=5V	--	--	10	mA

3.4 Battery Charge

Table 3-4 Charger Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
VPWR	Charge Input Voltage	4.5	5	5.5	V
CV	CV Mode Voltage Accuracy	4.175	4.2	4.225	V
		4.375	4.4	4.425	V
		4.475	4.5	4.525	V
CC	CC Mode Current	30	--	225	mA
I _{end}	End Of Charge Current	3	--	22.5	mA
V _{Trickl}	Trickle Charge Voltage	--	3	--	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~PA2 PB3,PB4,PB8,PB9,PB10,PB11 PC1,PC2 VPWR USBDP USBDM	-0.3	1.3	V
V _{IH}	High-Level Input Voltage	IOVDD = 3.0V	PA0~PA2 PB3,PB4,PB8,PB9,PB10,PB11 PC1,PC2 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~PA2 PB3,PB4,PB8,PB9,PB10,PB11 PC1,PC2	1(HD=0) 4(HD=1) 8(HD=2) 31(HD=3)	mA	
		IOVDD = 3.0V Voutput = 0.3V	USBDP USBDM	8	mA	
		IOVDD = 3.0V Voutput = 0.3V	VPWR	2	mA	
I _{OH}	Output Current	IOVDD = 3.0V Voutput = 2.7V	PA0~PA2 PB3,PB4,PB8,PB9,PB10,PB11 PC1,PC2	1(HD=0) 4(HD=1) 8(HD=2)	mA	

				31(HD=3)	
		IOVDD = 3.0V Voutput = 2.7V	USBDP USBDM	8	mA
		IOVDD = 3.0V Voutput = 2.7V	VPWR	2	mA
Internal Resistance Characteristics					
Symbol	Parameter	Conditions	IO	Typ	Unit
R _{pu}	Pull-up Resistance	IOVDD = 3.0V	PA0~PA2 PB3,PB4,PB8,PB9,PB10,PB11 PC1,PC2 VPWR	10k(PU=1) 200k(PU=2) 1M(PU=3)	Ω
		IOVDD = 3.0V	USBDP	1.5k 10k(PU=1) 200k(PU=2) 1M(PU=3)	Ω
		IOVDD = 3.0V	USBDM	180k 10k(PU=1) 200k(PU=2) 1M(PU=3)	Ω
R _{pd}	Pull-down Resistance	IOVDD = 3.0V	PA0~PA2 PB3,PB4,PB8,PB9,PB10,PB11 PC1,PC2 VPWR	10k(PD=1) 200k(PD=2) 1M(PD=3)	Ω
		IOVDD = 3.0V	USBDP USBDM	15k 10k(PU=1) 200k(PU=2) 1M(PU=3)	Ω

Note

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

3.6 Audio DAC Characteristics

Table 3-6-1 DAC Characteristics (HPVDD Under 1.25V)

Parameter	Conditions		Min	Typ	Max	Unit
Resolution	--		--	24	--	bits
Input Sample Rate	--		8	--	384	kHz
SNR ^①	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.25V Load=16Ω	--	116	--	dB
Dynamic Range	Differential Mode Fin=1kHz@-60dBFS	HPVDD=1.25V Load=16Ω	--	105	--	dB

	Fs=44.1kHz B/W=20Hz~20kHz A-Weighted					
THD+N	Differential Mode Fin=1kHz@-0.5dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.25V Load=32Ω	--	-80	--	dB
Noise Floor	Differential Mode Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.25V Load=16Ω	--	4.5	--	uVrms
Noise Floor with MUTE	Differential Mode Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.25V Load=16Ω	--	1	--	uVrms
Max Output Power	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted THD+N<0.1%	HPVDD=1.25V Load=16Ω	--	30	--	mW

Table 3-6-2 DAC Characteristics (HPVDD Under 1.55V)

Parameter	Conditions		Min	Typ	Max	Unit
Resolution	--		--	24	--	bits
Input Sample Rate	--		8	--	384	kHz
SNR ^①	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.55V Load=16Ω	--	119	--	dB
Dynamic Range	Differential Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.55V Load=16Ω	--	107	--	dB
THD+N	Differential Mode Fin=1kHz@-0.5dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.55V Load=32Ω	--	-80	--	dB
Noise Floor	Differential Mode Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.55V Load=16Ω	--	4.5	--	uVrms
Noise Floor with MUTE	Differential Mode Fs=44.1kHz B/W=20Hz~20kHz A-Weighted	HPVDD=1.55V Load=16Ω	--	1	--	uVrms
Max Output Power	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz	HPVDD=1.55V Load=16Ω	--	50	--	mW

	B/W=20Hz~20kHz A-Weighted THD+N<0.1%					
--	---	--	--	--	--	--

Note

1. 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	--	--	24	--	bits
Output Sample Rate	--	8	--	192	kHz
SNR	Differential input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	100	--	dB
	Single-ended input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	93	--	dB
Dynamic Range	Differential input Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	100	--	dB
	Single-ended input Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	93	--	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	--	-88	--	dB
Analogue Gain	--	-6	--	27	dB
Max Input Level	Differential input Mode ADC gain=0dB	--	0.56	--	Vrms
	Single-ended input Mode ADC gain=0dB	--	0.28	--	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	--	10	13	dBm
Maximum RF Transmit Power	EDR $\pi/4$ DQPSK EDR 8DPSK	--	10	--	dBm
Relative Transmit Power	EDR $\pi/4$ DQPSK EDR 8DPSK	--	1	--	dB
Maximum RF Transmit Power	BLE-1Mbps	--	10	--	dBm
1 σ of Maximum RF Transmit Power distribution	BR/EDR/BLE	--	2	--	dB

3.8.2 Receiver

Table 3-8-2 Receiver characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity	BR	--	-94	--	dBm
	EDR $\pi/4$ DQPSK	--	-95	--	dBm
	EDR 8DPSK	--	-87	--	dBm
	BLE-1Mbps	--	-97	--	dBm
	BLE-2Mbps	--	-93	--	dBm
1 σ of sensitivity distribution	BR/EDR/BLE	--	2	--	dB

4 Package Information

4.1 QFN20L_3×3mm

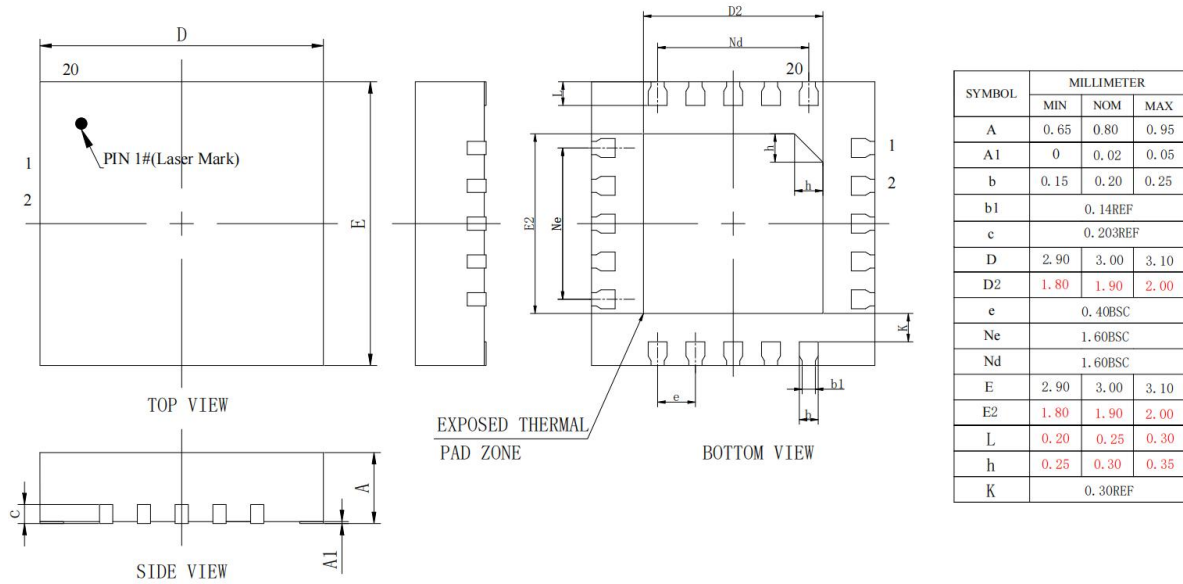


Figure 4-1 AC7103D Package

5 IC Marking Information

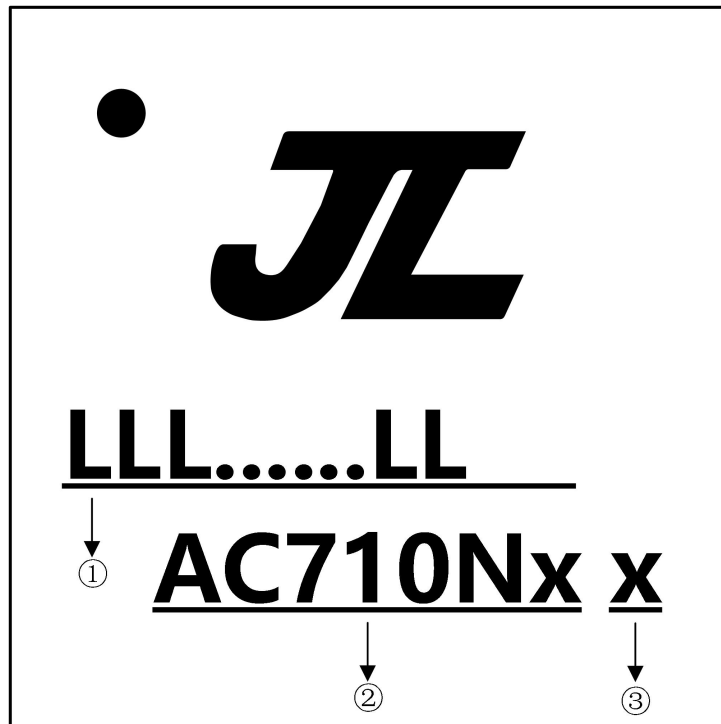


Figure 5-1 AC7103D Package Outline

- ① LLL.....LL Production Batch
- ② AC710Nx Chip Model
- ③ x Built-in flash size
 - 4 4Mbit Flash
 - 8 8Mbit Flash
 - 6 16Mbit Flash

6 Solder-Reflow Condition

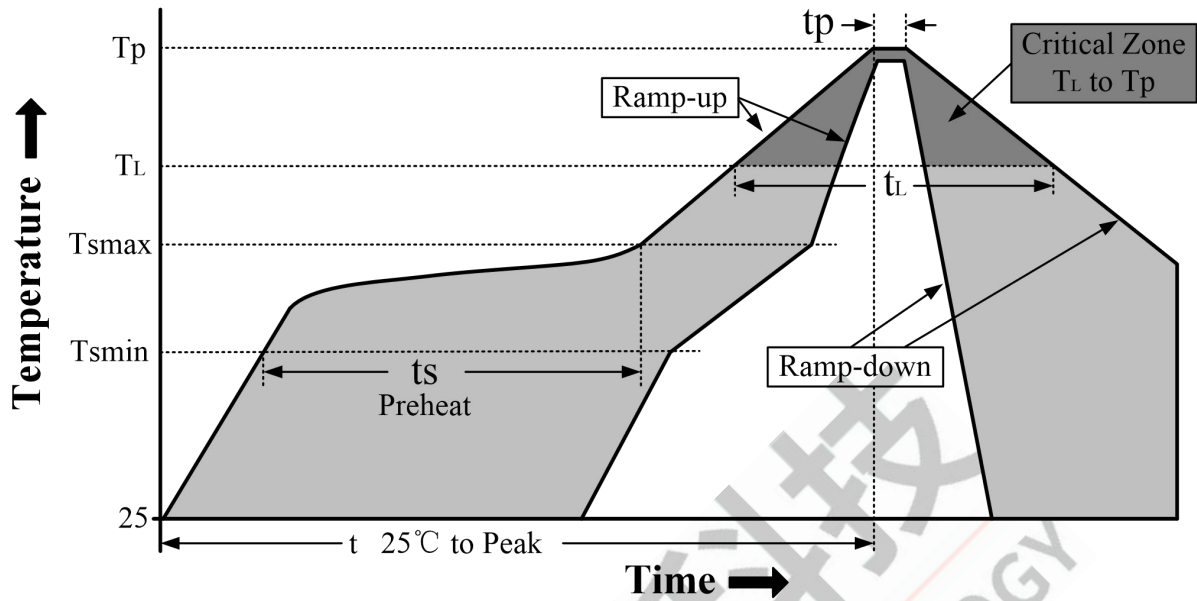


Figure 6-1 Classification Reflow Profile

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 (ts) 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 (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" 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
≥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.