

AC7073A Datasheet

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Version V1.2

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Revision History

Date	Revision	Description
2024.10.22	V1.0	initial version
2024.11.15	V1.1	Pin16 adds the FSPG2 function.
2025.01.17	V1.2	1.Upgrade the Bluetooth version to 6.0. 2.Modify the parameters of the Audio ADC.

Table of Contents

Revision History	1
Table of Contents	2
AC7073A Features	3
1 Block Diagram	4
2 Pin Definition	5
2.1 Pin Assignment	5
2.2 Pin Description	6
3 Electrical Characteristics	8
3.1 Absolute Maximum Ratings	8
3.2 ESD Ratings	8
3.3 PMU Characteristics	8
3.4 IO Characteristics	9
3.5 Audio ADC Characteristics	11
3.6 BT Characteristics	11
3.7 12bit GPADC Characteristics	12
4 Package Information	14
4.1 QFN20_3×3mm	14
5 IC Marking Information	15
6 Solder-Reflow Condition	16
7 Storage Condition	17
7.1 Moisture Sensitivity Level	17
7.2 Storage Alert	17

AC7073A Features

SYSTEM

- 32bit Dual-Issue DSP 288MHz
- On-chip SRAM 284kbyte
- With I-cache and D-cache
- With IEEE754 Single precision FPU
- With MATH coprocessor
- Support EMU / MPU
- Support MMU
- Built-In Flash
- 24MHz crystal oscillator
- Internal RC oscillator, PLL
- 4 x Multi-function 32bit timer
- 3 x UART interface
- 1 x I²C Master/Slave interface
- 3 x SPI Master/Slave interface
- 4 x MCPWM
- 1 x QDEC
- 1 x 12bit 1MSPS ADC (7 Channel)
- 9 x GPIO Support function remapping

DSP Audio Processing

- SBC/AAC/CVSD/mSBC codec
- mSBC voice codec
- PLC for voice processing
- Single MIC ENC
- Multi-band DRC
- Multi-band EQ

Audio

- 1 x 16bit ADC
 - ❖ SNR 98dB
 - ❖ Sampling rate 8~96kHz

Bluetooth

- BT6.0
(DN Q334307)
- Support AoA
- Maximum transmitting power 13dBm
- Receiver sensitivity
 - ❖ -98dBm @BLE-1Mbps
 - ❖ -95dBm @BLE-2Mbps

Peripherals

- 1 x Full speed USB
- 1 x SDIO host controller

Sensor Hub

- 32bit CPU 24MHz
- On-chip SRAM 32kbyte
- 2 x Multi-function 32bit timer
- 2 x UART interface
- 1 x I²C Master/Slave interface
- 1 x SPI Master/Slave interface
- 5 x LP_Touch with low power wake up

PMU

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

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

- Smart Ring
- Bluetooth IOT

1 Block Diagram

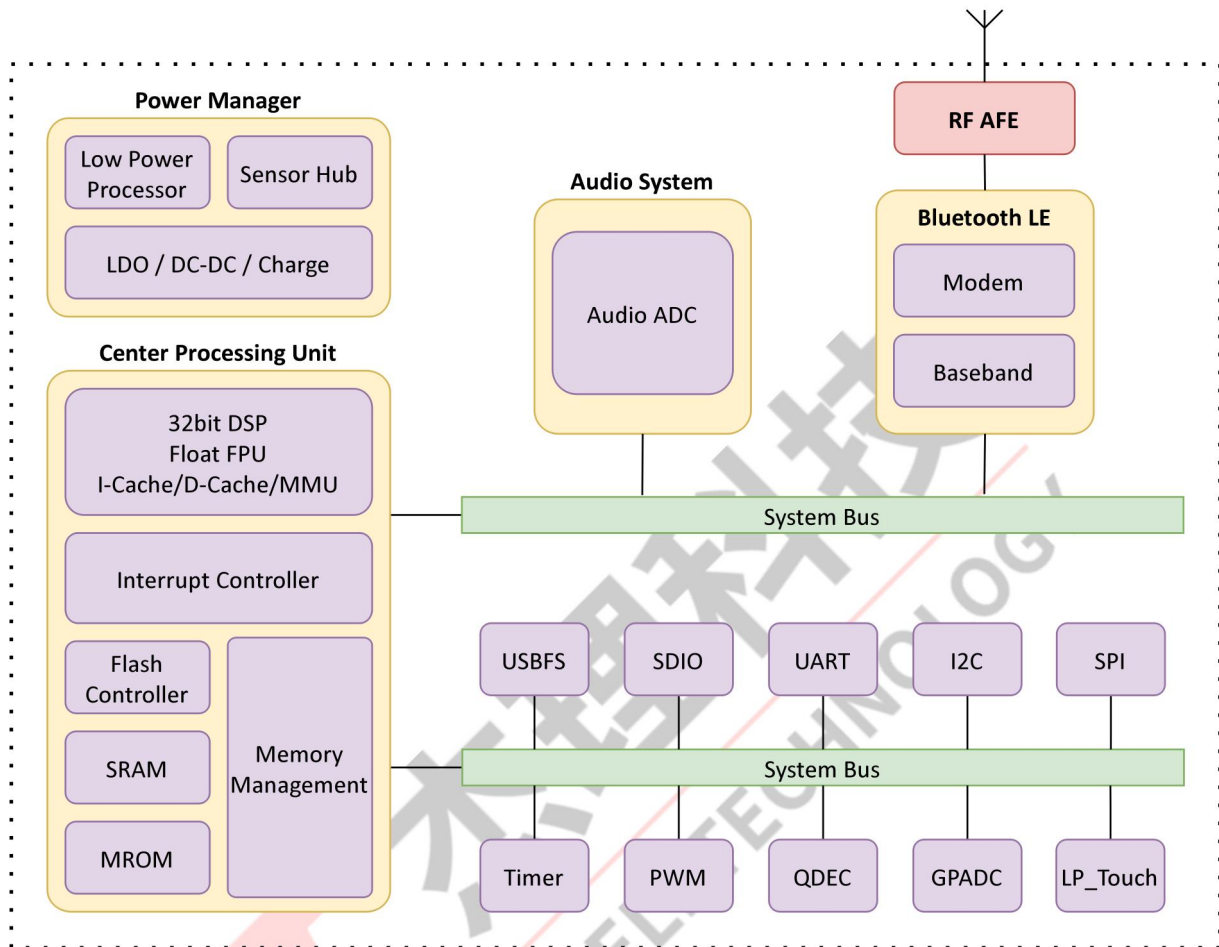


Figure 1-1 AC7073A Block Diagram

2 Pin Definition

2.1 Pin Assignment

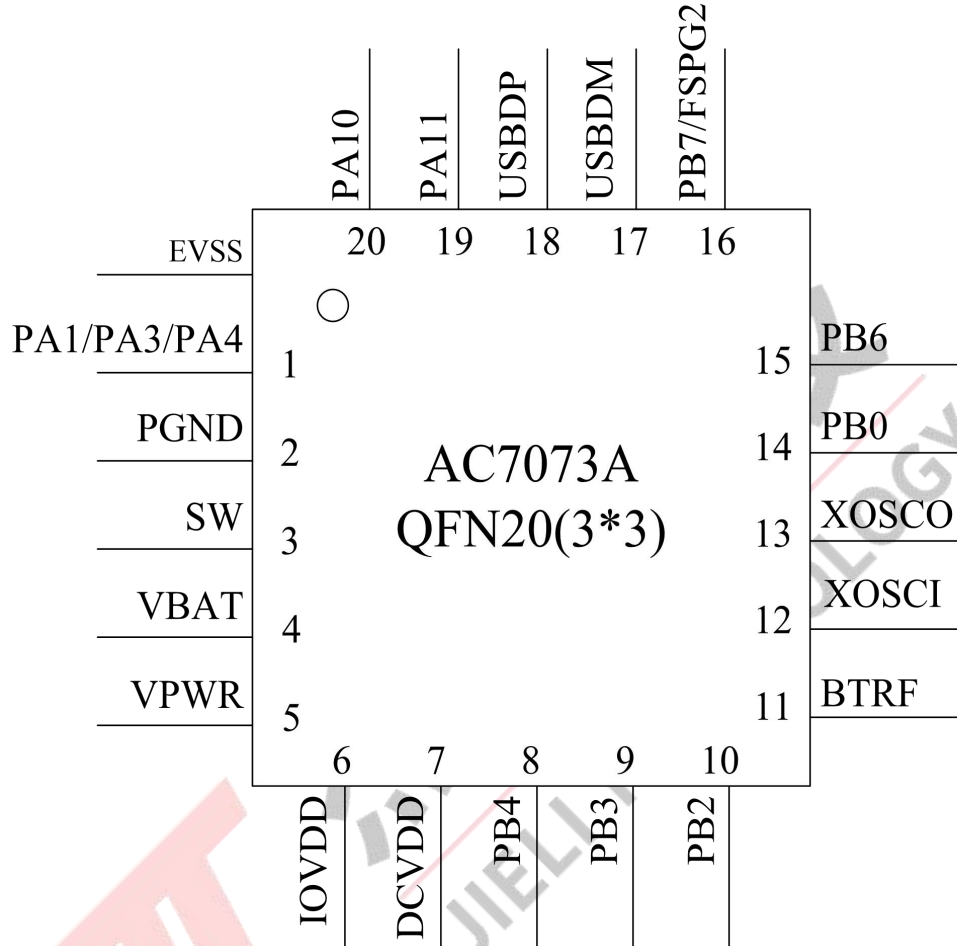


Figure 2-1 AC7073A Pin Assignment

2.2 Pin Description

Table 2-2-1 AC7073A Pin Description

Pin No.	Name	Type	IO Initial State	Description
1	PA1	I/O	Z	ADC1(GPADC Input Channel 1)
	PA3	I/O	Z	AIN_A1(Audio ADC Positive Input)
	PA4	I/O	Z	AIN_A0(Audio ADC Positive Input) MICBIAS(MIC Bias Output)
2	PGND	G	--	Ground of Buck DC-DC converter
3	SW	P	--	Buck DCDC Switch Port
4	VBAT	P	--	Battery Input
5	VPWR	P	--	Charge Power Input
6	IOVDD	P	--	IO Power
7	DCVDD	P	--	1.25V DCDC Power
8	PB4	I/O	Z	LP_TOUCH4(TOUCH_CH4) LVD(External Low Voltage Detection Input)
9	PB3	I/O	Z	LP_TOUCH3(TOUCH_CH3)
10	PB2	I/O	Z	LP_TOUCH2(TOUCH_CH2)
11	BTRF	RF	--	Bluetooth RF Antenna
12	XOSCI	I	--	Crystal Oscillator Input
13	XOSCO	O	--	Crystal Oscillator Output
14	PB0	I/O	Z	LP_TOUCH0(TOUCH_CH0) ADC7(GPADC Input Channel 7) Signal pin support external NTC (100kΩ@25℃)
15	PB6	I/O	Z/10kΩ Pull-up	MCLR(Device Reset,Default disable.) LP_TOUCH6(TOUCH_CH6)
16	PB7	I/O	10kΩ Pull-up	ADCP0(GPADC Input Channel P0) Hold down 0 to reset The Power key can wake up the IOVDD shutdown mode
	FSPG2	O	Z	The power gate is powered by IOVDD.
17	USBDM	I/O	15kΩ Pull-down	USB Negative Data ADC14(GPADC Input Channel 14)
18	USBDP	I/O	15kΩ Pull-down	USB Positive Data ADC13(GPADC Input Channel 13)
19	PA11	I/O	Z	ADC5(GPADC Input Channel 5)
20	PA10	I/O	Z	ADC4(GPADC Input Channel 4)

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, I²C, SPI and 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

Table 2-2-3 IO In Maskrom Flow Description

IO	Description
none	--

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	1.5	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	3.6	V
	Loading current	IOVDD=3.0V@VBAT = 3.7V or VPWR=5v	--	--	200	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

3.3.1 Battery Charge

Table 3-3-1 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
		4.325	4.35	4.375	V
		4.475	4.50	4.525	V
CC	CC Mode Current	40	--	300	mA
I _{end}	End Of Charge Current	4	--	30	mA
V _{Trikl}	Trickle Charge Voltage	--	3	--	V

3.3.2 FSPG2 Characteristics

Table 3-3-3 Power Gate Characteristics

Symbol	Parameter	Conditions	Typ	Unit
R _{pd}	Pull-down Resistance	IOVDD = 3.0V	10k(PD=1) 100k(PD=2) 1M(PD=3)	Ω
I _{max}	Max current at turn on state	IOVDD = 3.0V	30	mA

3.4 IO Characteristics

Table 3-4 IO Characteristics

Input Characteristics						
Symbol	Parameter	Conditions	IO	Min	Max	Unit
V _{IL}	Low-Level Input Voltage	IOVDD = 3.0V	PA1~PA11 PB0~PB7 USBDP USBDM VPWR	-0.3	1.3	V
V _{IH}	High-Level Input Voltage	IOVDD = 3.0V	PA1~PA11 PB0~PB7 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	PA1~PA11 PB0~PB7	4(HD=0) 8(HD=1) 16(HD=2) 32(HD=3)		mA

		IOVDD = 3.0V Voutput = 0.3V	USBDP USBDM	8	mA
		IOVDD = 3.0V Voutput = 0.3V	VPWR	2	mA
		IOVDD = 3.0V Voutput = 2.7V	PA1~PA11 PB0~PB7	4(HD=0) 8(HD=1) 16(HD=2) 32(HD=3)	mA
I _{OH}	Output Current	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	PA1~PA11 PB0~PB7 VPWR	10k(PU=1) 100k(PU=2) 1M(PU=3)	Ω
		IOVDD = 3.0V	USBDP	1.5k	Ω
		IOVDD = 3.0V	USBDM	180k	Ω
R _{pd}	Pull-down Resistance	IOVDD = 3.0V	PA1~PA11 PB0~PB7 VPWR	10k(PD=1) 100k(PD=2) 1M(PD=3)	Ω
		IOVDD = 3.0V	USBDP USBDM	15k	Ω

Note

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

3.5 Audio ADC Characteristics

Table 3-6 Audio ADC Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Resolution	--	--	16	--	bit
Output Sample Rate	--	8	--	96	kHz
SNR	Single-ended input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	96	--	dB
Dynamic Range	Single-ended input Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	95	--	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		27	dB
Max Input Level	Single-ended input Mode ADC gain=0dB	--	1	--	Vrms

3.6 BT Characteristics

3.6.1 Transmitter

Table 3-7-1-1 Transmitter characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Maximum RF Transmit Power	BLE-1Mbps	--	10	13	dBm

3.6.2 Receiver

Table 3-7-2 Receiver characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity	BLE-1Mbps	--	-98	--	dBm
	BLE-2Mbps	--	-95	--	dBm

3.7 12bit GPADC Characteristics

Table 3-8-1 12bit GPADC Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
AVDD(ADC Supply Voltage)	AVDD=IOVDD	1.8	3	3.6	V
I _{AVDD} (Current of the ADC on AVDD)	Single-ended f _{ADC} =12MHz AVDD=AVREF=3V	--	310	--	uA
	Diff-ended with DiffAMP f _{ADC} =12MHz AVDD=AVREF=3V	--	780	--	uA
f _{ADC} (ADC Clock Frequency)	--	0.25	--	12	MHz
T _s (ADC Sampling Time)	--	1.5	--	--	1/f _{ADC}
ADC Conversion Time	Including Sampling Time	8	14	14	1/f _{ADC}
ADC Input Voltage Range	--	0	--	AVREF	V
ADC Internal Sample and Hold Capacitor	--	--	--	5	pF
Sampling Switch Resistance	--	--	--	1	kΩ
External Input Impedance	T _s =1.5/f _{ADC}	--	--	1.5	kΩ
	T _s >=50/f _{ADC}	--	--	50	kΩ
ADC Resolution	Programmable	6	12	12	bit
INL	AVDD=3V, f _{ADC} =12MHz	-1	--	3	LSB
DNL	AVDD=3V, f _{ADC} =12MHz	-1	--	1	LSB
ADC Offset Error	AVDD=3V, f _{ADC} =12MHz	--	--	2.4	LSB
Gain Error	AVDD=3V, f _{ADC} =12MHz	--	--	5.8	LSB
ENOB(Effective number of bits)	Single-ended AVDD=AVREF=3V f _{IN} =1kHz, f _{ADC} =12MHz	--	10.6	--	bit
	Diff-ended with DiffAMP AVDD=AVREF=3V f _{IN} =1kHz, f _{ADC} =12MHz	--	11	--	bit

Table 3-8-2 12bit ADC Characteristics

T _{sample} (1/f _{ADC})	T _{sample} (us)	Max.Rext-input(kΩ)
1.5	0.125	1.5
2.5	0.209	3.3
3.5	0.291	5.0
4.5	0.375	6.7
6.5	0.542	10.1
8.5	0.708	13.6
12.5	1.042	20.4
16.5	1.375	27.3
24.5	2.042	41.0
32.5	2.708	54.8
48.5	4.042	82.3

Tsample(1/f _{ADC})	Tsample(us)	Max.Rext-input(kΩ)
64.5	5.375	109.7
128.5	10.708	219.7
256.5	21.375	439.5
1024.5	85.375	1758.5
4096.5	341.375	7034.7

4 Package Information

4.1 QFN20_3×3mm

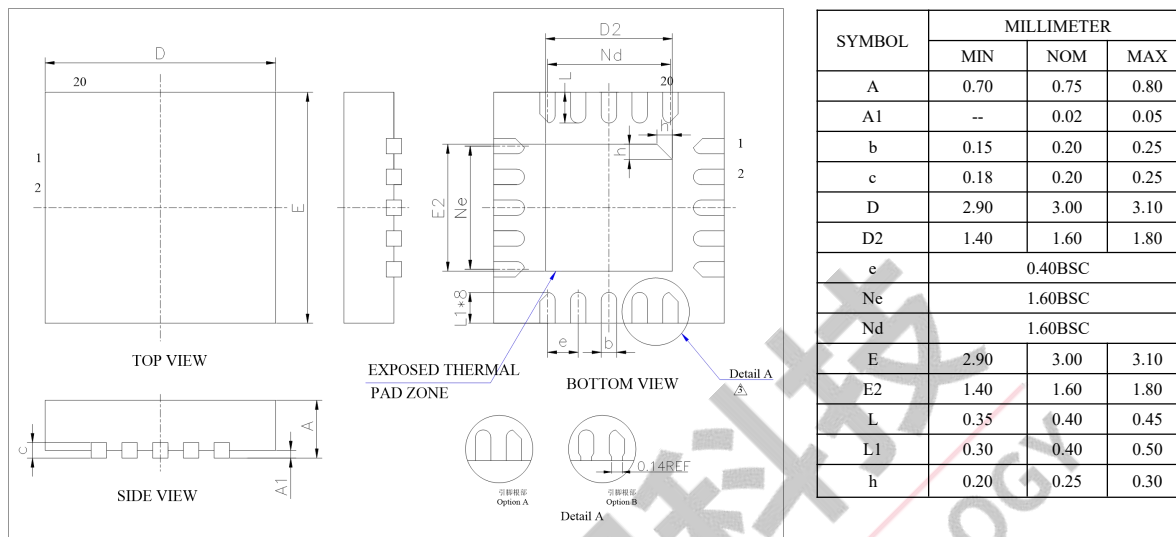


Figure 4-1 AC7073A Package

5 IC Marking Information

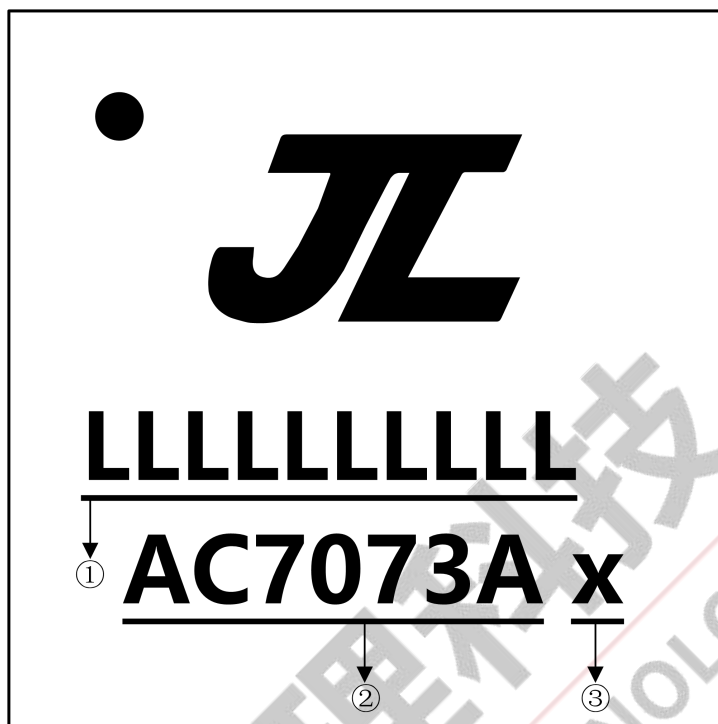


Figure 5-1 AC7073A Package Outline

- ① LLLLLLLLL: Production Batch
- ② AC7073A: Chip Model
- ③ x: Built-in flash size
 - 0: No Flash Memory
 - 2: 2Mbit Flash
 - 4: 4Mbit Flash
 - 8: 8Mbit Flash

6 Solder-Reflow Condition

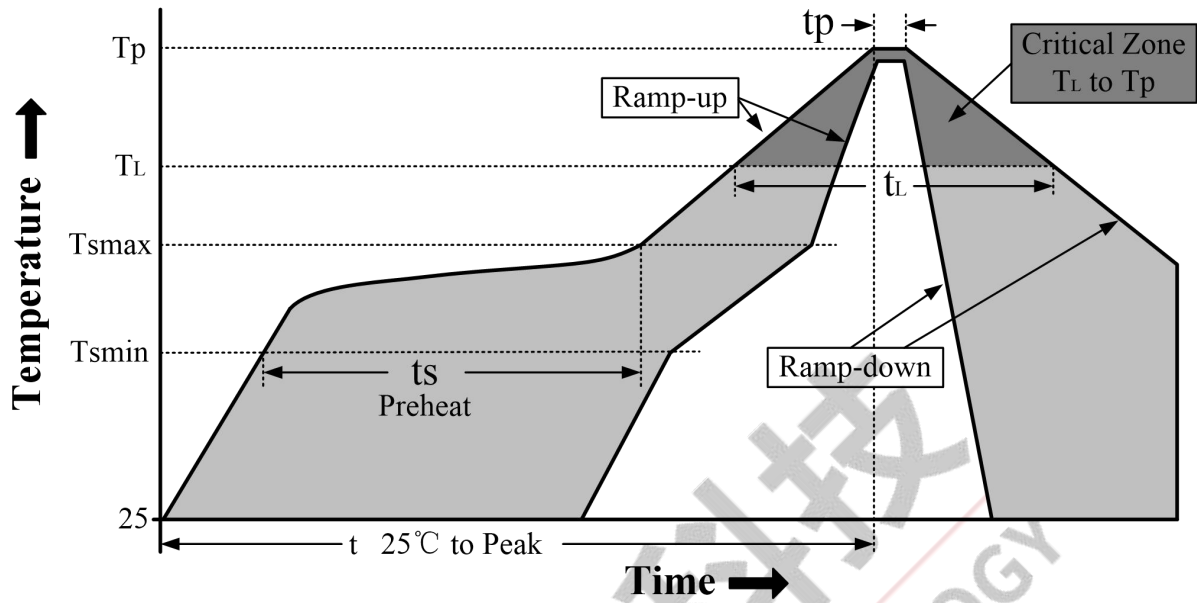


Figure 6-1 Classification Reflow Profile

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 < 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.

7 Storage Condition

7.1 Moisture Sensitivity Level

AC707N is qualified to moisture sensitivity level MSL3 in accordance with JEDEC J-STD-033.

7.2 Storage Alert

1. Calculated shelf life in sealed bag 12 months at <40°C and 90% relative humidity (RH).
2. Peak package body temperature≤260°C.
3. After bag is opened,devices that will be subjected to reflow solder or other high temperature process must be mounted within 168 hours of factory conditions≤30°C/60%RH or stored per J-STD-033.
4. Devices require bake before mounting if humidity indicator card reads> 10% for level 2a-5a devices or>60% for level 2 devices when read at 23±5°C,or 3a or 3b are not met.
5. Please refer to IPC/JEDEC J-STD-033 for baking procedure if necessary.