

# AC1123A Datasheet

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Version 1.0

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## Revision History

| Date       | Revision | Description     |
|------------|----------|-----------------|
| 2025.10.28 | V1.0     | Initial Release |
|            |          |                 |
|            |          |                 |



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# AC1123A Features

## SYSTEM

- 32bit Single-core DSP
- With IEEE754 Single precision FPU
- With I-cache and D-cache
- Support FFT/MATH
- Support MMU
- Support MPU
- Built-In Flash
- 24MHz crystal oscillator
- Internal RC oscillator, PLL
- 1 x SD host controller
- 2 x Multi-function 16bit timers
- 2 x Uart interface no support DMA
- 1 x Uart interface support DMA
- 1 x SPI Master/Slave interface
- 1 x 10bit ADC(5 Channels)
- 7 x GPIO Support function remapping
- 3 x LP\_Touch with low power wake up
- 1 x LED-IO specifically driving 2 LEDs

## DSP Audio Processing

- SBC/AAC codec
- mSBC voice codec supported for BT phone
- PLC for voice processing
- Single MIC ENC
- Multi-band EQ

## Audio

- 1 x 24bit DAC
  - ❖ SNR 117dB
  - ❖ Noise 1uVrms
  - ❖ Support differential mode
  - ❖ Sampling rate 8~384kHz
  - ❖ Drive speaker directly 50mW@16Ω
  - ❖ Support OWS dynamic power control
- 1 x 24bit ADC
  - ❖ SNR 94dB
  - ❖ Sampling rate 8~96kHz
  - ❖ Support analog/digital microphone

## Bluetooth

- Dual-mode BT6.0  
(DN Q334307)
- Maximum transmitting power 13dBm
- Receiver sensitivity
  - ❖ -95dBm @BR
  - ❖ -96dBm @EDR Π/4 DQPSK
  - ❖ -88dBm @EDR 8DPSK

## Peripherals

## PMU

- Integrated battery charger up to 250mA
- 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(3\*3mm)

## Temperature

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

## Applications

- TWS
- OWS
- Bluetooth audio device

# 1 Block Diagram

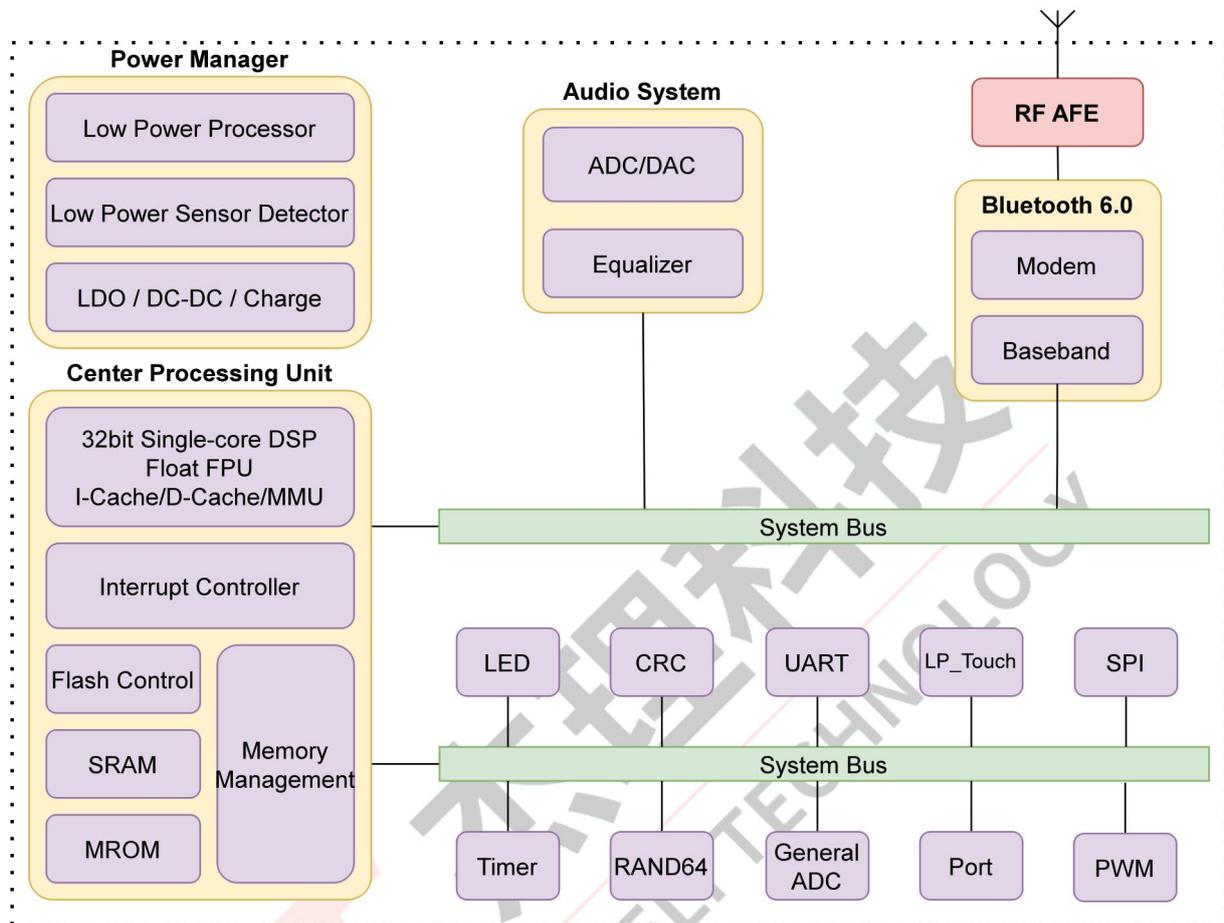


Figure 1-1 AC1123A Block Diagram

## 2 Pin Definition

### 2.1 Pin Assignment

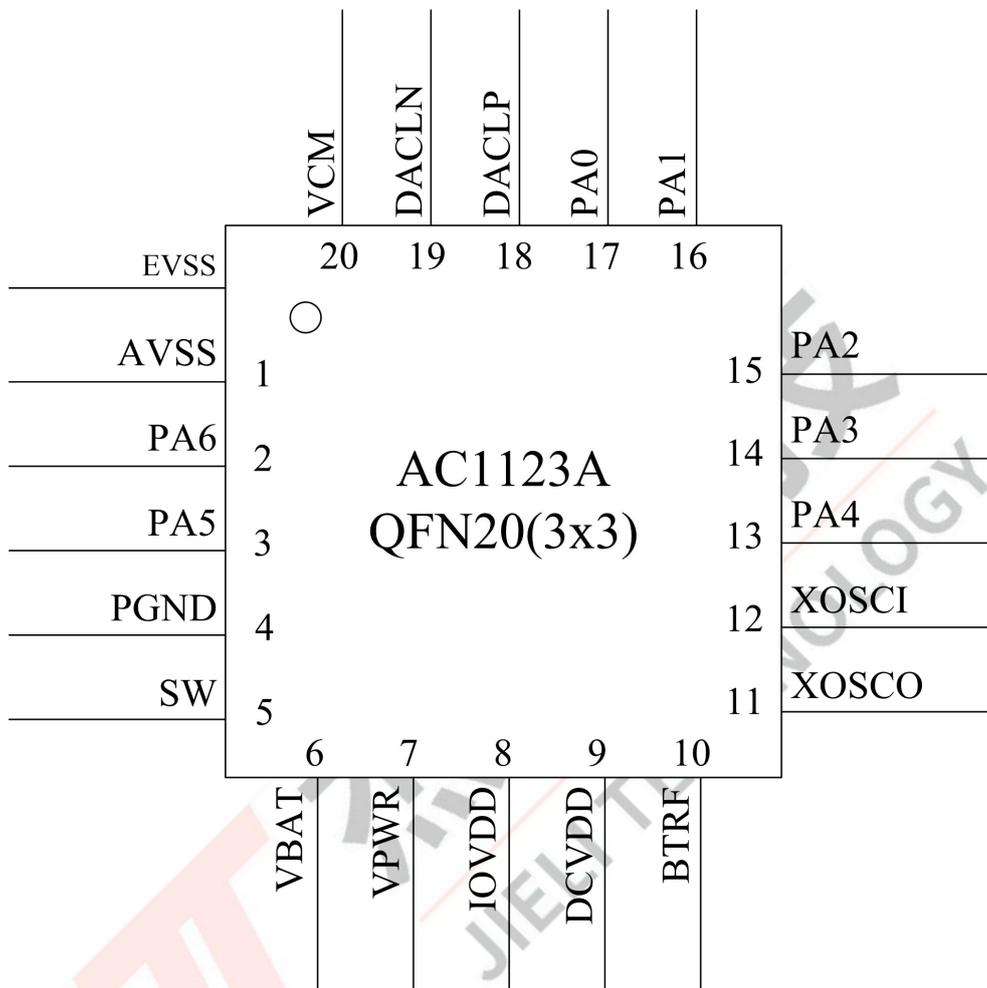


Figure 2-1 AC1123A Pin Assignment

## 2.2 Pin Description

Table 2-2-1 AC1123A Pin Description

| Pin No. | Name  | Type | IO Initial State | Description   |
|---------|-------|------|------------------|---|
| 1       | AVSS  | G    | --               | Audio Ground  |
| 2       | PA6   | I/O  | --               | LP_TOUCH1(TOUCH_CH1)  |
| 3       | PA5   | I/O  | 10kΩ Pull-up     | Hold down 0 to reset<br>MCLR(Device Reset)<br>LP_TOUCH0(TOUCH_CH0)                                |
| 4       | PGND  | G    | --               | Ground of Buck DC-DC converter  |
| 5       | SW    | P    | --               | Buck DCDC Switch Port   |
| 6       | VBAT  | P    | --               | Battery Input   |
| 7       | VPWR  | I/O  | Z                | Charge Power Input<br>LP_TOUCH3(TOUCH_CH3)  |
| 8       | IOVDD | P    | --               | IO Power  |
| 9       | DCVDD | P    | --               | DCDC Output   |
| 10      | BTRF  | RF   | --               | Bluetooth RF Antenna  |
| 11      | XOSCO | O    | --               | Crystal Oscillator Output   |
| 12      | XOSCI | I    | --               | Crystal Oscillator Input  |
| 13      | PA4   | I/O  | --               | ADC4(ADC Input Channel 4)   |
| 14      | PA3   | I/O  | --               | ADC3(ADC Input Channel 3)<br>LVD(External Low Voltage Detection Input)                            |
| 15      | PA2   | I/O  | 10kΩ Pull-down   | ADC2(ADC Input Channel 2)<br>MIC_A0(MIC Input)<br>MICBIASA(MIC Bias Output)                       |
| 16      | PA1   | I/O  | --               | ADC1(ADC Input Channel 1)<br>AIN_A0(Audio ADC Positive Input)                                     |
| 17      | PA0   | I/O  | --               | ADC0(ADC Input Channel 0)<br>AIN_A1(Audio ADC Positive Input)<br>AIN_AN(Audio ADC Negative Input) |
| 18      | DACLP | O    | --               | Left Channel DAC Positive Output  |
| 19      | DACLN | O    | --               | Left Channel DAC Negative Output<br>DAC VCMO Output   |
| 20      | VCM   | P    | --               | Audio Reference Voltage   |

**Note**

- 1.IO initial state abbreviations Z--High resistance, H--High level, L--Low level, X--May be changed during power on.
- 2.Timer, UART, 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          |

## 2.3 Pin Specialist

**Table 2-3 Pin keep Description**

| Pin       | Description for IOVDD power off mode                         |
|-----------|--|
| PA5、PA6   | keep IO state in IOVDD power off mode                        |
| VPWR      | Keep detection of charging insertion in IOVDD power off mode |
| Others IO | IO state loss in IOVDD power off mode                        |

### 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    | 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    |
| <b>Operating mode</b> |                 |                                       |     |      |     |      |
| Symbol                | Parameter       | Conditions                            | Min | Typ  | Max | Unit |
| IOVDD                 | Voltage output  | --                                    | --  | 3    | --  | V    |
|                       | Loading current | IOVDD=3.0V@VBAT = 3.7V                | --  | --   | 120 | mA   |
| DCVDD                 | Voltage output  | --                                    | --  | 1.25 | --  | V    |
|                       | Loading current | DCVDD=1.25V@VBAT=3.7V<br>in LDO mode  | --  | --   | 120 | mA   |
|                       |                 | DCVDD=1.25V@VBAT=3.7V<br>in DCDC mode | --  | --   | 120 | mA   |
| <b>Low Power mode</b> |                 |                                       |     |      |     |      |
| 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     | 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    |
| CC                  | CC Mode Current          | 20    | --  | 250   | mA   |
| I <sub>end</sub>    | End Of Charge Current    | 2.0   | --  | 25    | mA   |
| V <sub>Trickl</sub> | Trickle Charge Voltage   | --    | 3   | --    | V    |

### 3.5 IO Characteristics

Table 3-5 IO Characteristics

| Input Characteristics               |                          |                                |                 |   |      |      |
|-------------------------------------|--------------------------|--------------------------------|-----------------|---|------|------|
| Symbol                              | Parameter                | Conditions                     | IO              | Min                                       | Max  | Unit |
| V <sub>IL</sub>                     | Low-Level Input Voltage  | IOVDD = 3.0V                   | PA0~PA6<br>VPWR | -0.3                                      | 1.0  | V    |
| V <sub>IH</sub>                     | High-Level Input Voltage | IOVDD = 3.0V                   | PA0~PA6         | 2.0                                       | 3.3  | V    |
|                                     |                          | IOVDD = 3.0V                   | VPWR            | 2.0                                       | 5.5  | V    |
| Output Characteristics              |                          |                                |                 |   |      |      |
| Symbol                              | Parameter                | Conditions                     | IO              | Typ                                       | Unit |      |
| I <sub>OL</sub>                     | Output Current           | IOVDD = 3.0V<br>Voutput = 0.3V | PA0~PA6         | 1(HD=0)<br>4(HD=1)<br>8(HD=2)<br>31(HD=3) | mA   |      |
|                                     | Output Current           | IOVDD = 3.0V<br>Voutput = 0.3V | VPWR            | 2   | mA   |      |
| I <sub>OH</sub>                     | Output Current           | IOVDD = 3.0V<br>Voutput = 2.7V | PA0~PA6         | 1(HD=0)<br>4(HD=1)<br>8(HD=2)<br>31(HD=3) | mA   |      |
|                                     | Output Current           | IOVDD = 3.0V<br>Voutput = 2.7V | VPWR            | 2   | mA   |      |
| Internal Resistance Characteristics |                          |                                |                 |   |      |      |
| Symbol                              | Parameter                | Conditions                     | IO              | Typ                                       | Unit |      |
| R <sub>pu</sub>                     | Pull-up Resistance       | IOVDD = 3.0V                   | PA0~PA6<br>VPWR | 10k(PU=1)<br>200k(PU=2)<br>1M(PU=3)       | Ω    |      |
| R <sub>pd</sub>                     | Pull-down Resistance     | IOVDD = 3.0V                   | PA0~PA6<br>VPWR | 10k(PD=1)<br>200k(PD=2)<br>1M(PD=3)       | Ω    |      |

Note

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

### 3.6 Audio DAC Characteristics

**Table 3-6-1 DAC Characteristics(Output Power 30mW)**

| Parameter             | Conditions   | Min      | Typ | Max | Unit |       |
|-----------------------|--|----------|-----|-----|------|-------|
| Resolution            | --   | --       | 16  | 24  | bits |       |
| Input Sample Rate     | --   | 8        | --  | 384 | kHz  |       |
| SNR <sup>①</sup>      | Differential Mode<br>Fin=1kHz@0dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted               | Load=16Ω | --  | 117 | --   | dB    |
| Dynamic Range         | Differential Mode<br>Fin=1kHz@-60dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted             | Load=16Ω | --  | 106 | --   | dB    |
| THD+N                 | Differential Mode<br>Fin=1kHz@-0.5dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted            | Load=32Ω | --  | -85 | --   | dB    |
| Noise Floor           | Differential Mode<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted                                 | Load=16Ω | --  | 3.5 | --   | uVrms |
| Noise Floor with MUTE | Differential Mode<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted                                 | Load=16Ω | --  | 1.0 | --   | uVrms |
| Max Output Power      | Differential Mode<br>Fin=1kHz@0dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted<br>THD+N<0.1% | Load=16Ω | --  | 30  | --   | mW    |

**Table 3-6-2 Stereo DAC Characteristics(Output Power 50mW)**

| Parameter         | Conditions   | Min      | Typ | Max | Unit |    |
|-------------------|--|----------|-----|-----|------|----|
| Resolution        | --   | --       | 16  | 24  | bits |    |
| Input Sample Rate | --   | 8        | --  | 384 | kHz  |    |
| SNR <sup>①</sup>  | Differential Mode<br>Fin=1kHz@0dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted | Load=16Ω | --  | 119 | --   | dB |
| Dynamic Range     | Differential Mode<br>Fin=1kHz@-60dBFS<br>Fs=44.1kHz                            | Load=16Ω | --  | 108 | --   | dB |

|                       |   |          |    |     |    |       |
|-----------------------|---|----------|----|-----|----|-------|
|                       | B/W=20Hz~20kHz A-Weighted   |          |    |     |    |       |
| THD+N                 | Differential Mode<br>Fin=1kHz@-0.5dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted               | Load=32Ω | -- | -85 | -- | dB    |
| Noise Floor           | Differential Mode<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted                                    | Load=16Ω | -- | 3.5 | -- | uVrms |
| Noise Floor with MUTE | Differential Mode<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted                                    | Load=16Ω | -- | 1.0 | -- | uVrms |
| Max Output Power      | Differential Mode<br>Fin=1kHz@-0.2dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted<br>THD+N<0.1% | Load=16Ω | -- | 50  | -- | 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    | 24  | bits |
| Input Sample Rate | --   | 8   | --    | 96  | kHz  |
| SNR               | Differential input Mode<br>Fin=1kHz@0dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted<br>ADC gain=0dB   | --  | 94    | --  | dB   |
|                   | Single-ended input Mode<br>Fin=1kHz@0dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted<br>ADC gain=0dB   | --  | 94    | --  | dB   |
| Dynamic Range     | Differential input Mode<br>Fin=1kHz@-60dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted<br>ADC gain=0dB | --  | 94    | --  | dB   |
|                   | Single-ended input Mode<br>Fin=1kHz@-60dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted<br>ADC gain=0dB | --  | 94    | --  | dB   |
| THD+N             | Differential input Mode<br>Fin=1kHz@0dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted<br>ADC gain=0dB   | --  | -83   | --  | dB   |
|                   | Single-ended input Mode<br>Fin=1kHz@0dBFS<br>Fs=44.1kHz<br>B/W=20Hz~20kHz A-Weighted<br>ADC gain=0dB   | --  | -81   | --  | dB   |
| Analogue Gain     | --   | -3  | --    | 27  | dB   |
| Max Input Level   | Differential input Mode<br>ADC gain=0dB  | --  | 0.565 | --  | Vrms |
|                   | Single-ended input Mode<br>ADC gain=0dB  | --  | 0.282 | --  | 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<br>EDR 8DPSK | --  | 10  | --  | dBm  |
| Relative Transmit Power                              | EDR $\pi/4$ DQPSK<br>EDR 8DPSK | --  | 1   | --  | dB   |
| Maximum RF Transmit Power                            | BLE-1Mbps                      | --  | 10  | --  | dBm  |
| Maximum RF Transmit Power                            | BLE-2Mbps                      | --  | 10  | --  | dBm  |
| 1 $\sigma$ 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                | --  | -95   | --  | dBm  |
|  | EDR $\pi/4$ DQPSK | --  | -96   | --  | dBm  |
|  | EDR 8DPSK         | --  | -88   | --  | dBm  |
|  | BLE-1Mbps         | --  | -98.5 | --  | dBm  |
|  | BLE-2Mbps         | --  | -95.5 | --  | dBm  |
| 1 $\sigma$ of sensitivity distribution | BR/EDR/BLE        | --  | 2     | --  | dB   |

## 4 Package Information

### 4.1 QFN20\_3×3mm

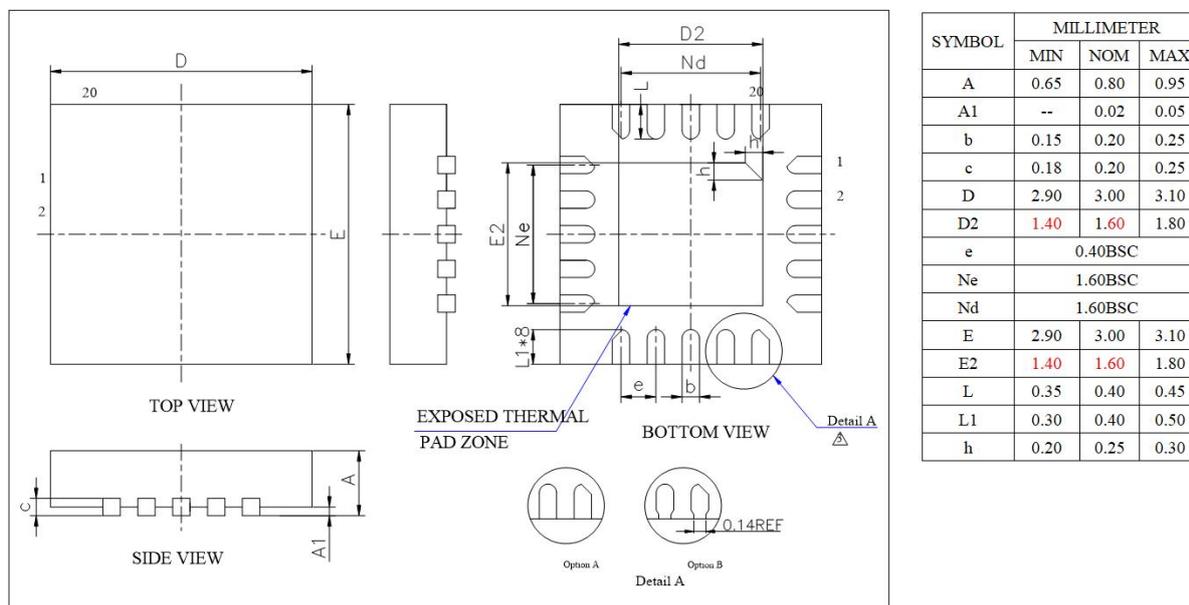


Figure 4-1 AC1123A Package

## 5 IC Marking Information

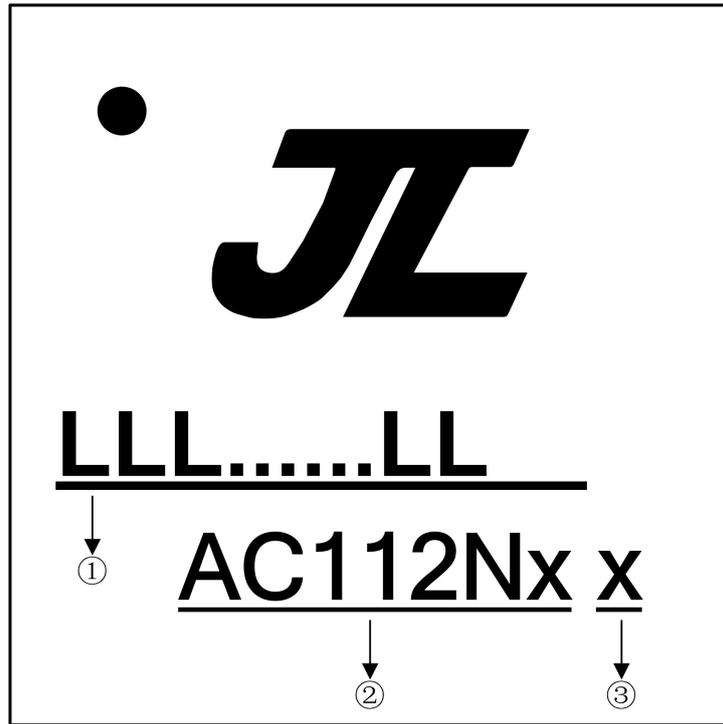


Figure 5-1 AC1123A Package Outline

- ① LLL.....LL Production Batch
- ② AC112Nx Chip Model
- ③ x Built-in flash size  
2 2Mbit Flash

## 6 Solder-Reflow Condition

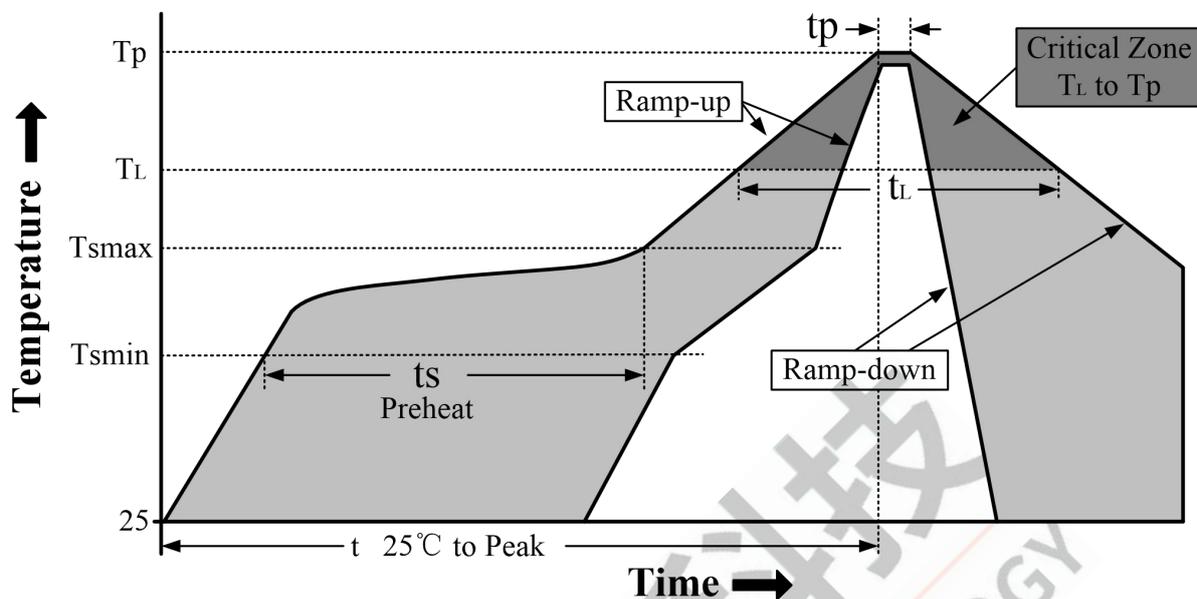


Figure 6-1 Classification Reflow Profile

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 ( $t_p$ ) <sup>2</sup> |  | 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 <sup>3</sup> | Volume mm <sup>3</sup> |
|-------------------|------------------------|------------------------|
|                   | < 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 <sup>3</sup><br>< 350 | Volume mm <sup>3</sup><br>350 - 2000 | Volume mm <sup>3</sup><br>> 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.

