

AD239A Datasheet

Zhuhai Jieli Technology Co.,LTD

Version 1.0

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Revision History

Date	Revision	Description
2026.06.23	V1.0	Initial Release.



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AD239A Features

SYSTEM

- 32bit Dual-Issue DSP 288MHz
- With IEEE754 Single precision FPU
- Support FFT/MATH
- Support NPU
- I-cache and Ro-cache
- On-chip SRAM 184kbyte (share Cache 32k)
- Support MMU
- Support MPU
- NOR Flash controller
- Internal RC oscillator, PLL

Audio

- 1 x 16bit DAC
 - ❖ SNR 110dB
 - ❖ Noise 6uVrms
 - ❖ Sampling rate 8~96kHz
- 1 x 16bit Class-D Speaker Driver
 - ❖ SNR 105dB
 - ❖ Sampling rate 8~96kHz
 - ❖ Drive speaker directly 1.2W@4Ω
- 1 x 16bit ADC
 - ❖ SNR 93dB
 - ❖ Sampling rate 8~96kHz
- I²S/PDM AUDIO Master/Slave interface

Peripherals

- 1 x Full speed USB
- 1 x SD host controller
- 3 x Multi-function 16bit timer
- 1 x Advance multi-function 16bit timer
- 2 x UART interface
- 1 x I²C Master/Slave interface
- 3 x SPI Master/Slave interface
- 1 x Rotate Decoder
- 1 x 10bit GPADC(16 Channels)
- 13 x GPIO Support function remapping
- 6 x LP_Touch with low power wake up

PMU

- Soft off current: <3uA
- Music mode: <6mA@HSB 96M
- LVD range(3bit):1.7V~2.4V, step100mV
- HPVDD range 1.8V to 5.5V
- VPWR range 1.8V to 5.5V
- IOVDD range 2.1V 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

- Voice controller
- Audio player
- Sound toy

1 Block Diagram

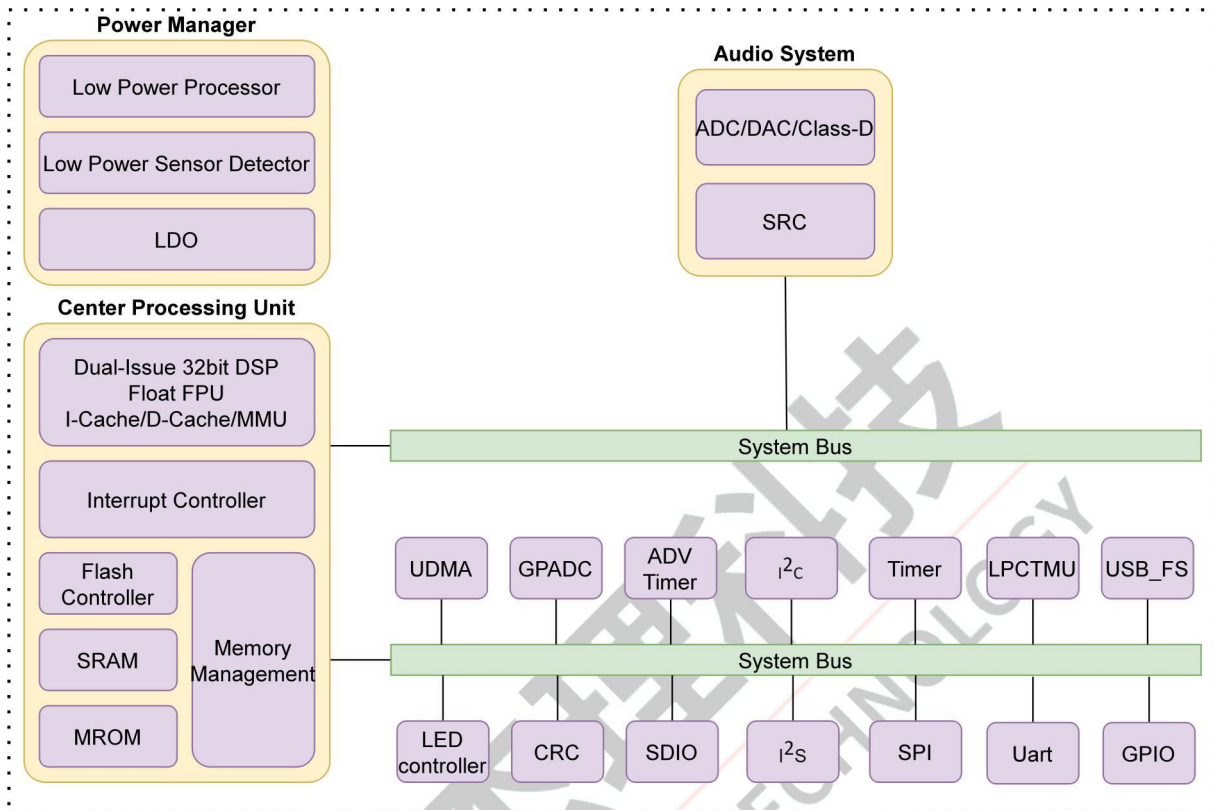


Figure 1-1 AD239A Block Diagram

2 Pin Definition

2.1 Pin Assignment

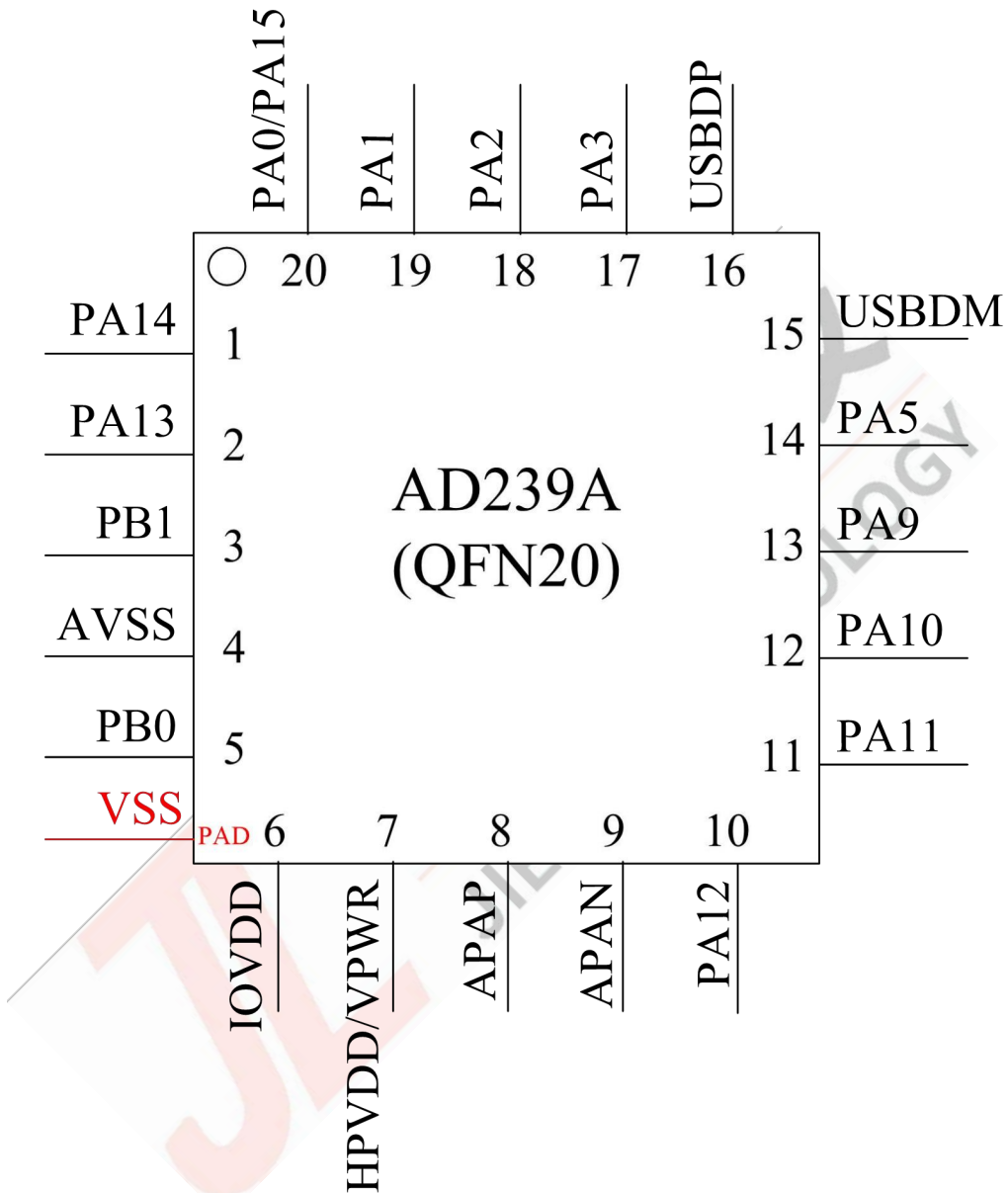


Figure 2-1 AD239A Pin Assignment

2.2 Pin Description

Table 2-2-1 AD239A Pin Description

Pin No.	Name	Type	IO Initial State	Description
1	PA14	I/O	Z	AIN_A1(Audio ADC Positive Input)
2	PA13	I/O	Z	MIC_A0(Audio Mic Input) MICBIAS(MIC Bias Output)
3	PB1	I/O	Z	DACLN(Left Channel DAC Negative Output) ADC14(ADC Input Channel 14)
4	AVSS	G	--	Audio Ground
5	PB0	I/O	Z	DACLP(Left Channel DAC Positive Output) ADC13(ADC Input Channel 13) LVD(External Low Voltage Detection Input)
6	IOVDD	P	--	IO Power
7	VPWR	P	--	Chip main power supply
	HPVDD	P	--	Audio Power
8	APAP	O	--	Class-D Speaker Driver Positive Output
9	APAN	O	--	Class-D Speaker Driver Negative Output
10	PA12	I/O	Z	ADC11(ADC Input Channel 11) LP_TOUCH6(TOUCH_CH6)
11	PA11	I/O	Z	ADC10(ADC Input Channel 10) LP_TOUCH5(TOUCH_CH5)
12	PA10	I/O	Z	ADC9(ADC Input Channel 9) LP_TOUCH4(TOUCH_CH4)
13	PA9	I/O(HVT)	10kΩ Pull-down	1/2 Voltage to ADC Firmware Download Interface
14	PA5	I/O	Z	ADC7(ADC Input Channel 7)
15	USBDM	I/O	15kΩ Pull-down	USB Negative Data ADC5(ADC Input Channel 5)
16	USBDP	I/O	15kΩ Pull-down	USB Positive Data ADC4(ADC Input Channel 4)
17	PA3	I/O	Z	ADC3(ADC Input Channel 3) LP_TOUCH1(TOUCH_CH1) SPI2_DATA1
18	PA2	I/O	Z	ADC2(ADC Input Channel 2) LP_TOUCH0(TOUCH_CH0) SPI2_DATA0
19	PA1	I/O	Z	ADC1(ADC Input Channel 1) SPI2_CLK
20	PA0	I/O	10kΩ Pull-up *Note1	ADC0(ADC Input Channel 0) Hold down 0 to reset *Note1

Pin No.	Name	Type	IO Initial State	Description
	PA15	I/O	Z	AIN_AN(Audio ADC Negative Input)
PAD	VSS	G	--	Ground

Note

1. 10kΩ Pull-up and Hold down 0 to reset function can be disable by efuse in IO Initial State.
2. The GPIO is uncontrollable during the initial process.
3. IO initial state abbreviations Z--High resistance, H--High level, L--Low level, X--May be changed during power on.
4. Timer, AdvTimer, Rotate Decoder, UART, I²C, I²S, SPI1/2 and SDIO 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
NIO	NOR Flash IO	O	Output

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
VPWR	Supply Voltage	-0.3	6	V
HPVDD		-0.3	6	V
IOVDD		-0.3	3.6	V
GPIO	Input voltage of GPIO (except PA7/PA8/PA9)	-0.3	3.6	V
HVTIO	Input voltage of HVT-IO (PA7/PA8/PA9)	-0.3	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	±1kV	All pins	ANSI/ESDA/JEDEC JS-002-2022

3.3 PMU Characteristics

Table 3-3 PMU Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VPWR	Power supply	--	1.8	5	5.5	V
Operating mode						
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IOVDD	Voltage output	--	--	3	--	V
	Loading current	IOVDD=3.0V@VPWR = 3.7V	--	--	120	mA
Low Power mode						
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IOVDD	Loading current	IOVDD=3.0V@VPWR = 3.7V	--	--	10	mA

Note

1. When powered by two dry batteries, the VPWR needs to be merged with IOVDD.

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	PA0~PA3,PA5,PA9~PA15 PB0~PB1 USBDP USBDM	-0.3	1.3	V
V _{IH}	High-Level Input Voltage	IOVDD = 3.0V	PA0~PA3,PA5,PA10~PA15 PB0~PB1 USBDP USBDM	1.7	3.3	V
		IOVDD = 3.0V	PA9	1.7	5.5	V
Output Characteristics						
Symbol	Parameter	Conditions	IO	Typ	Unit	
I _{OL}	Output Current	IOVDD = 3.0V Voutput = 0.3V	PA0~PA3,PA5 PA10~PA15 PB0~PB1	1(HD=0) 4(HD=1) 8(HD=2) 31(HD=3)	mA	
		IOVDD = 3.0V Voutput = 0.3V	PA9	1(HD=0) 4(HD=1) 8(HD=2) 9(HD=3)	mA	
		IOVDD = 3.0V Voutput = 0.3V	USBDP USBDM	10	mA	
I _{OH}	Output Current	IOVDD = 3.0V Voutput = 2.7V	PA0~PA3,PA5 PA10~PA15 PB0~PB1	1(HD=0) 4(HD=1) 8(HD=2) 31(HD=3)	mA	
		IOVDD = 3.0V Voutput = 2.7V	PA9	1(HD=0) 4(HD=1) 8(HD=2) 9(HD=3)	mA	
		IOVDD = 3.0V Voutput = 2.7V	USBDP USBDM	10	mA	
Internal Resistance Characteristics						
Symbol	Parameter	Conditions	IO	Typ	Unit	
R _{pu}	Pull-up Resistance	IOVDD = 3.0V	PA0~PA3,PA5,PA9~PA15 PB0~PB1 USBDP USBDM	10k(PU=1) 200k(PU=2) 1M(PU=3)	Ω	
			USBDP	1.5k	Ω	

			USBDM	180k	Ω
R _{pd}	Pull-down Resistance	IOVDD = 3.0V	PA0~PA3,PA5,PA9~PA15 PB0~PB1 USBDP USBDM	10k(PD=1) 200k(PD=2) 1M(PD=3)	Ω
			USBDP USBDM	15k	Ω

Note

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

3.5 Audio DAC Characteristics

Table 3-5 Mono DAC Characteristics Under VPWR 3.7v

Parameter	Conditions	Min	Typ	Max	Unit
Resolution	--	--	16	--	bits
Output Sample Rate	--	8	--	96	kHz
Output Resistance	--	--	/	--	Ω
SNR ^①	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10k Ω	--	110	--	dB
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10k Ω	--	100@VCM cap 95@VCM capless	--	dB
Dynamic Range	Differential Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10k Ω	--	110	--	dB
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10k Ω	--	100@VCM cap 95@VCM capless	--	dB
THD+N	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10k Ω	--	-80	--	dB
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10k Ω	--	-75	--	dB
Noise Floor	Differential Mode B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10k Ω	--	6	--	μ Vrms
	Single-ended Mode B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10k Ω	--	16	--	μ Vrms

Parameter	Conditions	Min	Typ	Max	Unit
Max Output Amplitude	Differential Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10kΩ	--	2	--	Vrms
	Single-ended Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =10kΩ	--	1	--	Vrms

Note

- ① SNR is the ratio of output level with a 1kHz full-scale input to output level with MUTE on.

3.6 Class-D Speaker Driver Characteristics

Table 3-6 Class-D Speaker Driver Characteristics Under HPVDD 3.7v

Parameter	Conditions	Min	Typ	Max	Unit
Resolution	--	--	16	--	bits
Output Sample Rate	--	8	--	96	kHz
SNR	Differential Mode Fin=1kHz@0dBFS Fs=48kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =8Ω	--	105	--	dB
Dynamic Range	Differential Mode Fin=1kHz@0dBFS Fs=48kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =8Ω	--	85	--	dB
THD+N	Differential Mode Fin=1kHz@0dBFS Fs=48kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =8Ω	--	-36	--	dB
Noise Floor	Differential Mode B/W=20Hz~20kHz A-Weighted Equivalent load impedance =8Ω	--	15	--	uVrms
Max Output Power	Differential Mode Fin=1kHz@0dBFS Fs=48kHz B/W=20Hz~20kHz A-Weighted Equivalent load impedance =4Ω	--	0.5	1.2	W

3.7 Audio ADC Characteristics

Table 3-7 Audio ADC Characteristics Under VPWR 3.7v

Parameter	Conditions	Min	Typ	Max	Unit
Resolution	--	--	16	--	bits
Input Sample Rate	--	8	--	96	kHz
SNR	Differential input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	93	--	dB
	Single-ended input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	92@VCM cap 89@VCM capless	--	dB
Dynamic Range	Differential input Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	93	--	dB
	Single-ended input Mode Fin=1kHz@-60dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	92@VCM cap 89@VCM capless	--	dB
THD+N	Differential input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	-80	--	dB
	Single-ended input Mode Fin=1kHz@0dBFS Fs=44.1kHz B/W=20Hz~20kHz A-Weighted ADC gain=0dB	--	-80	--	dB
Analogue Gain	--	-3	--	27	dB
Max Input Level	Differential input Mode ADC gain=0dB	--	0.6	--	Vrms
	Single-ended input Mode ADC gain=0dB	--	0.3	--	Vrms

4 Package Information

4.1 QFN20(3mm*3mm)

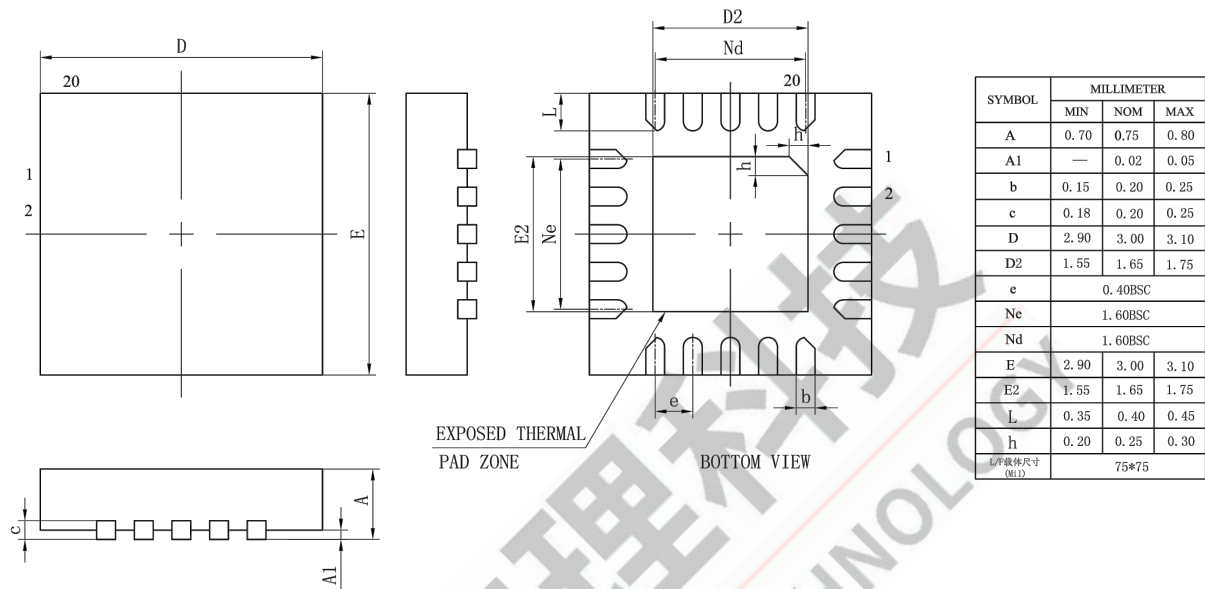


Figure 4-1 AD239A Package

5 IC Marking Information

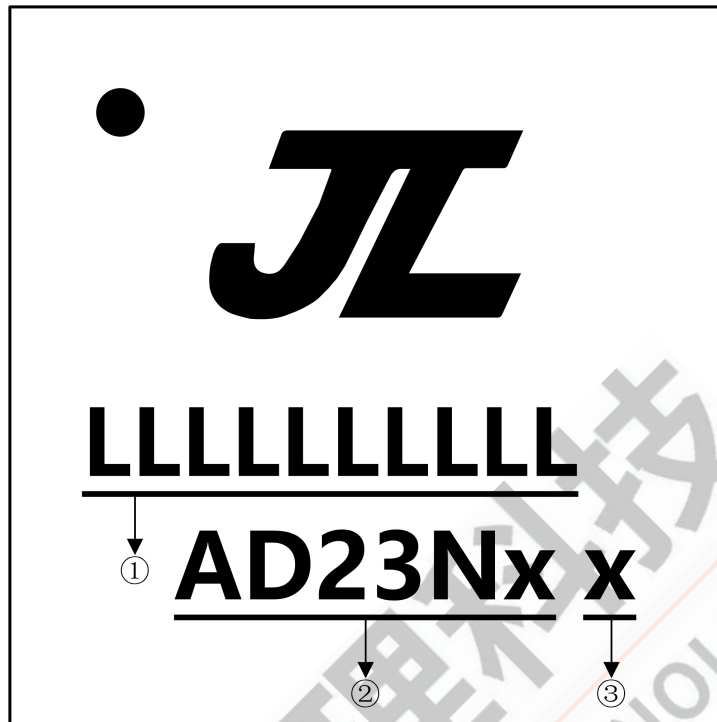


Figure 5-1 AD239A Package Outline

- ① LLLLLLLLLL Production Batch
- ② AD23Nx 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
 - 5: 64Mbit Flash
 - 7: 128Mbit Flash

6 Solder-Reflow Condition

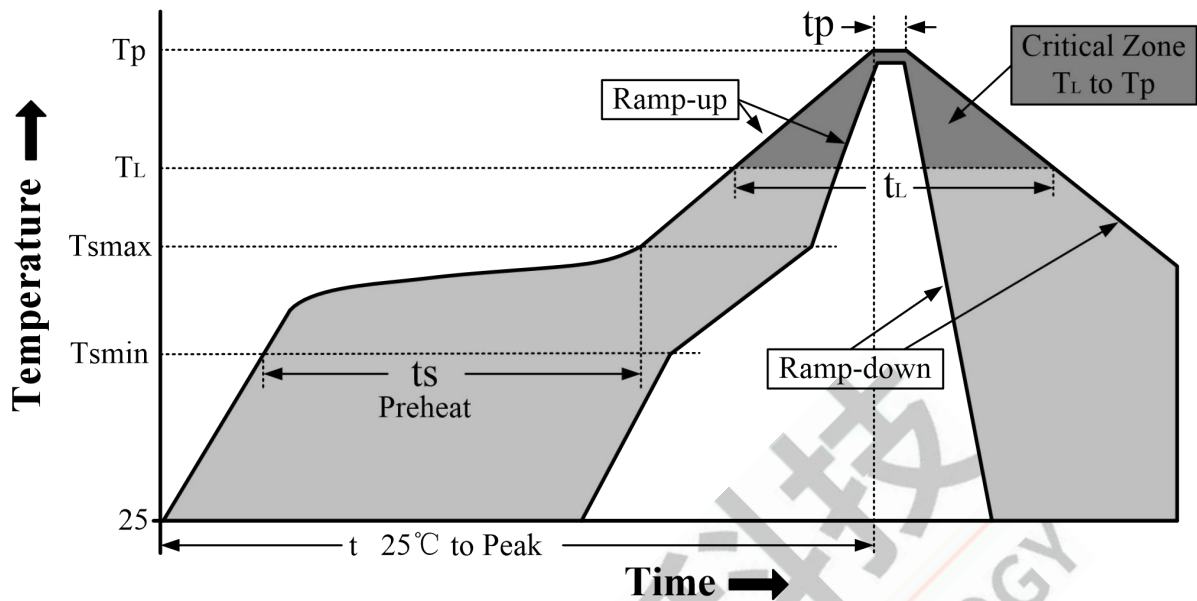


Figure 6-1 Classification Reflow Profile

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

AD23N 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.

Please refer to IPC/JEDEC J-STD-033 for baking procedure if necessary.