AD174A Datasheet

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AD174A Features

CPU
- 32bit DSP
- Maximum speed 160MHz
- Interrupts with 8 priority level

Memory
- Optional built-in flash memory

Clocks
- On-chip 16 MHz clock
- On-chip 200KHz lower-temperature-drift clock

Audio APA
- Support for driving 4 or 8 ohm speaker
- Mono Class-D Speaker Amplifier
  - 0.42W/8 Ω @3.7V
  - 0.17W/8 Ω @2.4V
  - 0.62W/4 Ω @3.7V
  - 0.25W/4 Ω @2.4V

Peripherals
- Three multi-function 16-bit timers, support capture and PWM mode
- Two UART Controllers(UART0/1) supports DMA and Flow Control
- One IIC Master controller

- Two SPI Master / Slaver controller with DMA SPI0 support 4bit,SPI1support 2bit
- 13-channel 10-bit general purpose ADC
- 4-channel Advance PWM controller
- A0:13/A4:16 Individually programmable and multiplexed GPIO pins
- Digital peripheral crossbar
- Support Touch Key of pulse counter
- Up to 8 external interrupt / wake-up source (low power available,can be multiplexed to any I/O)
- Watchdog

PMU
- Less than 2uA soft off current
- VBAT range : 2.0V to 5.5V
- IOVDD range : 2.0V to 3.4V

Packages
- TSSOP20

Temperature
- Operating temperature: -40℃ to +85℃
- Storage temperature: -65℃ to +150℃

Applications
- Sound Toy
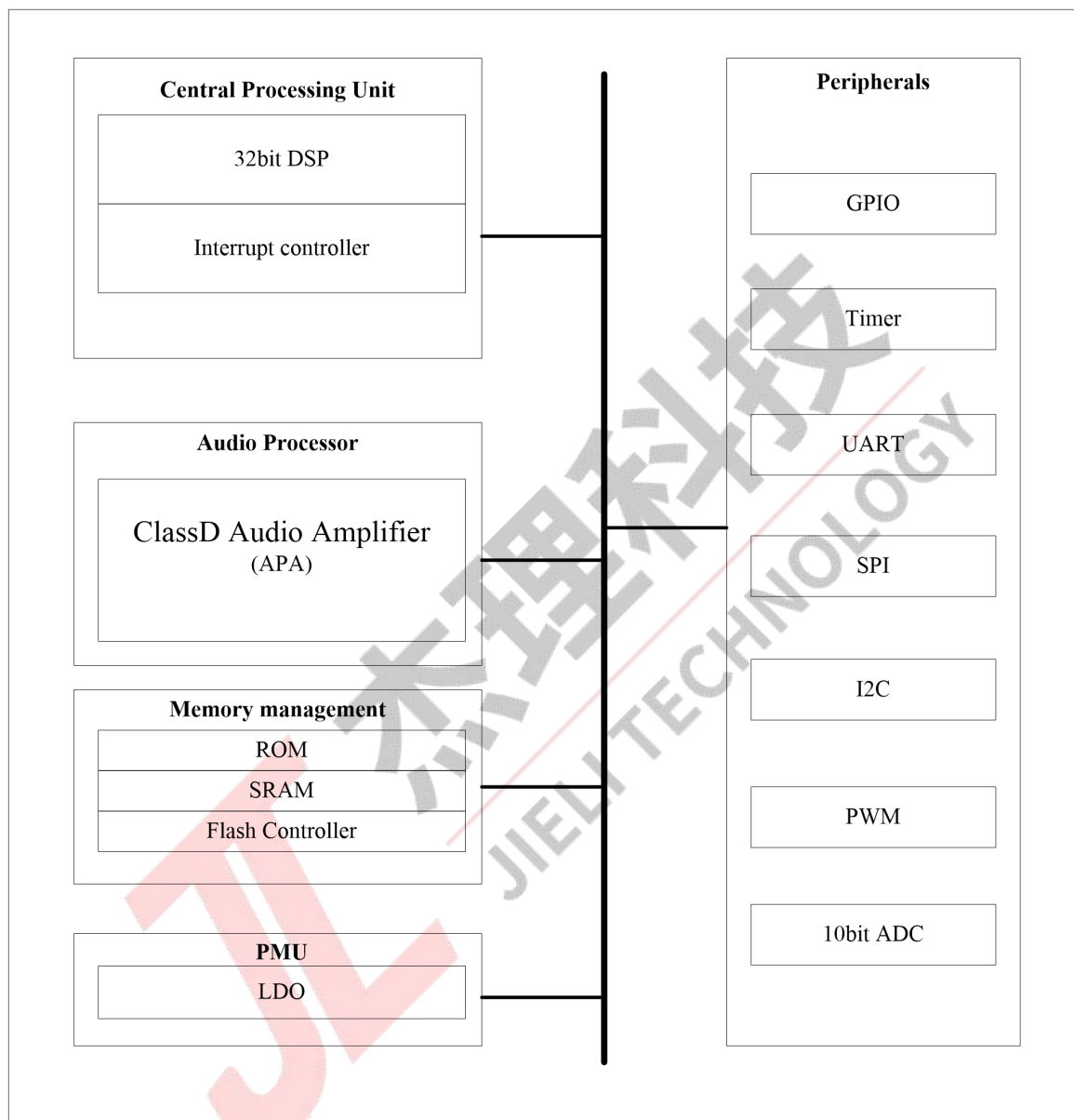- Audio player
- Universal Microcontroller

1   Block Diagram

Figure 1-1   AD174A Block Diagram

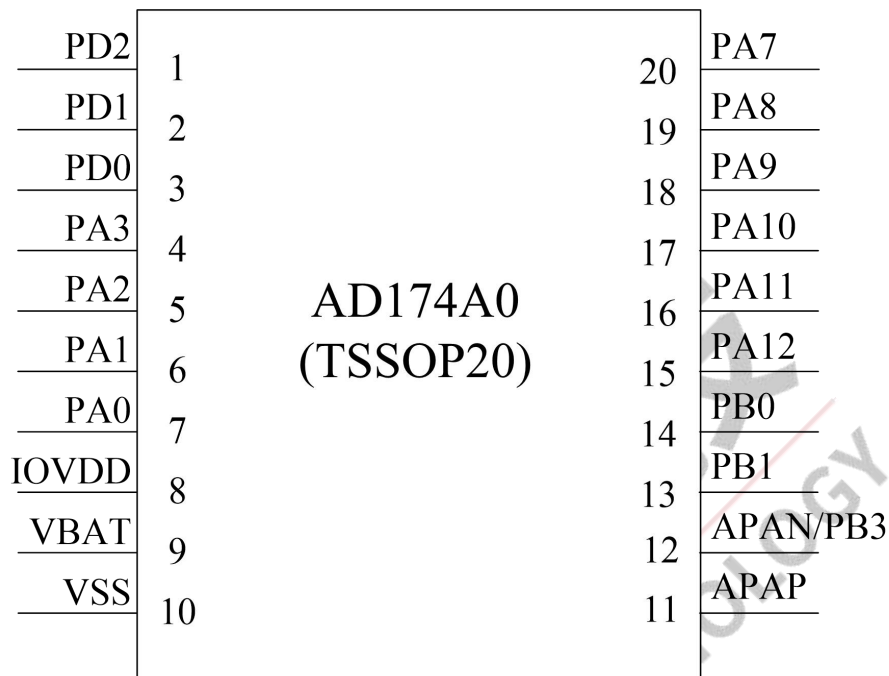# 2 Pin Definition

2.1 Pin Assignment

```
        ┌──────────────────────┐
  PD2  ─┤ 1                 20 ├─ PA7
  PD1  ─┤ 2                 19 ├─ PA8
  PD0  ─┤ 3                 18 ├─ PA9
  PA3  ─┤ 4                 17 ├─ PA10
  PA2  ─┤ 5   AD174A0       16 ├─ PA11
  PA1  ─┤ 6   (TSSOP20)     15 ├─ PA12
  PA0  ─┤ 7                 14 ├─ PB0
 IOVDD ─┤ 8                 13 ├─ PB1
 VBAT  ─┤ 9                 12 ├─ APAN/PB3
  VSS  ─┤ 10                11 ├─ APAP
        └──────────────────────┘
```

Figure 2-1   AD174A0 Package Diagram

```
        ┌──────────────────────┐
  PA6  ─┤ 1                 20 ├─ PA7
  PA5  ─┤ 2                 19 ├─ PA8
  PA4  ─┤ 3                 18 ├─ PA9
  PA3  ─┤ 4                 17 ├─ PA10
  PA2  ─┤ 5   AD174A        16 ├─ PA11
  PA1  ─┤ 6   (TSSOP20)     15 ├─ PA12
  PA0  ─┤ 7                 14 ├─ PB0
 IOVDD ─┤ 8                 13 ├─ PB1
 VBAT  ─┤ 9                 12 ├─ APAN/PB3
  VSS  ─┤ 10                11 ├─ APAP
        └──────────────────────┘
```
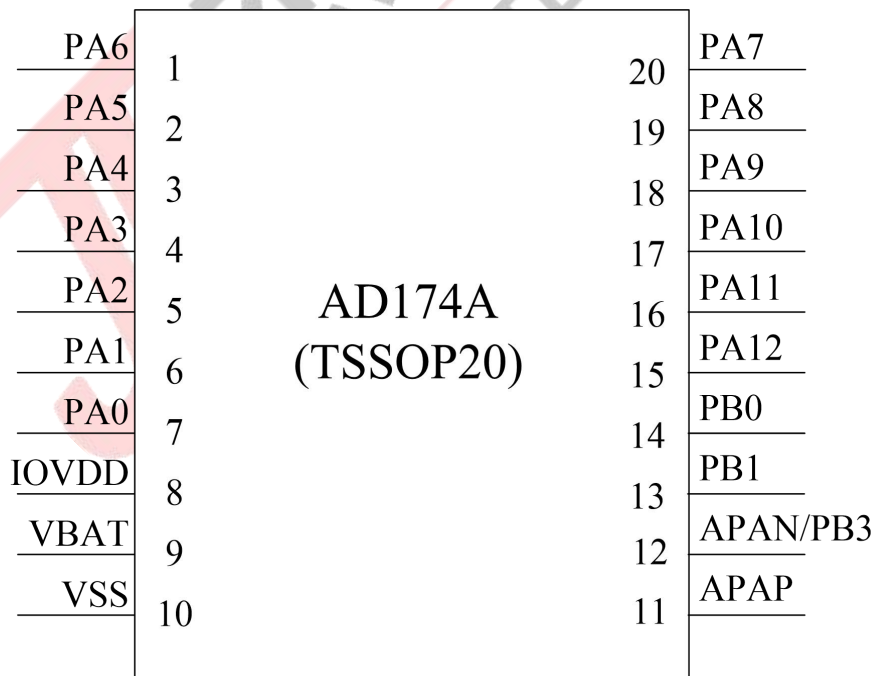
Figure 2-2   AD174A2/4 Package Diagram

2.2 Pin Description

Table 2-1　AD174A Pin Description

PIN NO.	Name		Type	Function	Other Function
1	A0	PD2	I/O	GPIO	SFCCS:SFC Chip Select;
	A2/4	PA6	I/O	GPIO (pull down)	ADC6:ADC Input Channel 6;
2	A0	PD1	I/O	GPIO	SFCDO:SFC Data Out; ADC13:ADC Input Channel 13;
	A2/4	PA5	I/O	GPIO	ADC5:ADC Input Channel 5; PWMCK1;
3	A0	PD0	I/O	GPIO	SFCCLK:SFC Clk;
	A2/4	PA4	I/O	GPIO	ADC4:ADC Input Channel 4; PWMCK0;
4	PA3		I/O	GPIO	ADC3:ADC Input Channel 3; CAP0:Timer0 Capture; PWM0:Timer0 PWM Output;
5	PA2		I/O	GPIO	ADC2:ADC Input Channel 2; TMR0:Timer0 Clock Input;
6	PA1		I/O	GPIO	ADC1:ADC Input Channel 1; LVD:Low Voltage Detect；
7	PA0		I/O	GPIO (pull up)	Long press reset; ADC0:ADC Input Channel 0;
8	IOVDD		PO	Power supply for GPIO	Built-in linear voltage regulator output;
9	VBAT		PI		Power supply input;
10	VSS		G		System ground;
11	APAP		O		Class-D APA Positive Output;
12	APAN		O		Class-D APA Negative Output;
	PB3		I/O	5V tolerant IO	
13	PB1		I/O	5V tolerant IO	Serial port code upgrade pin;
14	PB0		I/O	5V tolerant IO	
15	PA12		I/O	GPIO	ADC12:ADC Input Channel 12;
16	PA11		I/O	GPIO	ADC11:ADC Input Channel 11;
17	PA10		I/O	GPIO	ADC10:ADC Input Channel 10;
18	PA9		I/O	GPIO (pull down)	ADC9:ADC Input Channel 9;
19	PA8		I/O	GPIO (pull down)	ADC8:ADC Input Channel 8;
20	PA7		I/O	GPIO (pull down)	ADC7:ADC Input Channel 7;

Pin Type	Description	Pin Type	Description
P	Power	I/O	Input or Output
PI	Power Input	I	Input
PO	Power Output	O	Output
AO	Analog Output	G	Ground

CROSSBAR						
SPI0	**SPI1**	**IIC**	**UART0**	**UART1**	**PWMCH0**	**PWMCH1**
SPI0_CLK	SPI1_CLK	IIC_CLK	UART0_TX	UART1_TX	PWMCH0L	PWMCH1L
SPI0_DI	SPI1_DI	IIC_DAT	UART0_RX	UART1_RX	PWMCH0H	PWMCH1H
SP0_D0	SPI1_D0					
SP0_DAT2						
SP0_DAT3						

Input Channel x6			Output Channel x8		
WAKEUP	Timer1	IRFLT	PWM1	CLK_OUT0	APA_DOP
PWMFP0	Timer2	TOUCH_CAP	PWM2	CLK_OUT1	APA_DON
PWMFP1	CAP1	UART1_CTS	UART1_RTS	CLK_OUT2	
EXT_CLK	CAP2				

3   Electrical Characteristics

3.1 Absolute Maximum Ratings

Table 3-1

Symbol	Parameter	Min	Max	Unit
Topt	Operating temperature	-40	+85	°C
Tstg	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	-0.3	6	V
V_{IOVDD}	Voltage applied at IOVDD	-0.3	3.6	V
V_{GPIO}	Voltage applied to GPIO	-0.3	IOVDD+0.3	V
V_{HVIO}	Voltage applied to High Voltage Resistant IO	-0.3	+5.5	V

Note : The chip can be damaged by any stress in excess of the absolute maximum ratings listed below

3.2 ESD Protectio

Table 3-2

Parameter	Typ.	Test pin	Reference standard
Human Body Mode	±4KV	All pins	JEDEC EIA/JESD22-A114
Machine Mode	±200V	All pins	JEDEC EIA/JESD22-A115
Charge Device Model	±2KV	All pins	JEDEC EIA/JESD22-C101F
Latch up	±200mA	All GPIO pins	JEDEC STANDARD NO.78E
	1.5xVopmax	All power pins	

Note : 1.5xVopmax = 1.5 times maximum operating voltage.

3.3 PMU Characteristics

Table 3-3

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
VBAT	Voltage Input	2.0	3.7	5.5	V	_
IOVDD	Voltage output	2.0	3.0	3.4	V	VBAT = 4.2V, 10mA loading
	Loading current	_	_	100	mA	IOVDD=3.3V@VBAT ≥ 3.6V
V_{LVD}	Voltage input	1.8	2.5	2.5	V	Low-Voltage Detection of IOVDD

3.4 IO Input/Output Electrical Logical Characteristics

Table 3-4

GPIO input characteristics						
Symbol	**Parameter**	**Min**	**Typ**	**Max**	**Unit**	**Test Conditions**
V_{IL}	Low-Level Input Voltage	-0.3	–	0.3* IOVDD	V	IOVDD = 3.0V
V_{IH}	High-Level Input Voltage	0.7* IOVDD	–	IOVDD+0.3	V	IOVDD = 3.0V
High Voltage Resistant IO input characteristics						
Symbol	**Parameter**	**Min**	**Typ**	**Max**	**Unit**	**Test Conditions**
V_{IL}	Low-Level Input Voltage	-0.3	–	0.3* IOVDD	V	IOVDD = 3.0V
V_{IH}	High-Level Input Voltage	0.7* IOVDD	–	+5V	V	IOVDD = 3.0V
Resistant IO output characteristics						
Symbol	**Parameter**	**GPIO**	**Typ**	**Unit**	**Test Conditions**	
V_{OL}	0.1*IOVDD Drive current	PA0~PA12	HD=1 : -7 HD=2 : -22 HD=3 : -27	mA	IOVDD = 3.0V	
		PB0,PB1 PB3	-7			
	0.1*HPVDD Drive current APA IO total current limit of 400mA	APAN APAP	-400		VBAT=3.7V	
V_{OH}	0.9*IOVDD Drive current	PA0~PA12	HD=1 :7 HD=2 : 24 HD=3 : 56	mA	IOVDD = 3.0V	
		PB0,PB1 PB3	7			
	0.9*HPVDD Drive current APA IO total current limit of 400mA	APAN APAP	400		VBAT=3.7V	

3.5 Internal Resistor Characteristics

Table 3-5

Port	Internal Pull-Up Resistor	Internal Pull-Down Resistor	Comment
PA0~PA12,PB0,PB1,PB3	10K	200K	1. PA0 default pull up 2. PA6~PA9 default pull down 3. Internal pull-up/pull-down resistance │ accuracy ±20%

3.6 Audio APA Characteristics

Table 3-6

Parameter	MODE	Min	Typ	Max	Unit	Test Conditions	
Frequency Response		20	_	20K	Hz	R$_L$=10K,VBAT=3.7V	
Output Swing	Diff (N to P)	_	1.57	_	Vrms	R$_L$=4Ω	f=1kHz/0dB VBAT=3.7V
		_	1.83	_	Vrms	R$_L$=8Ω	
		_	2.22	_	Vrms	R$_L$=10K	
	Single-ended	_	1.11	_	Vrms	R$_L$=10K	
	Diff (N to P)	_	0.99	_	Vrms	R$_L$=4Ω	f=1kHz/0dB VBAT=2.4V
		_	1.17	_	Vrms	R$_L$=8Ω	
		_	1.44	_	Vrms	R$_L$=10K	
	Single-ended	_	0.72	_	Vrms	R$_L$=10K	
Output power	Diff (N to P)	_	0.62	_	W	R$_L$=4Ω	f=1kHz/0dB VBAT=3.7V
		_	0.42	_	W	R$_L$=8Ω	
		_	0.25	_	W	R$_L$=4Ω	f=1kHz/0dB VBAT=2.4V
		_	0.17	_	W	R$_L$=8Ω	
THD+N	Diff (N to P)	_	-31	_	dB	R$_L$=4Ω	f=1kHz/0dB A-Weighted VBAT=3.7V
		_	-35	_	dB	R$_L$=8Ω	
		_	-75	_	dB	R$_L$=10K	
	Single-ended	_	-70	_	dB	R$_L$=10K	
	Diff (N to P)	_	-31	_	dB	R$_L$=4Ω	f=1kHz/0dB A-Weighted VBAT=2.4V
		_	-36	_	dB	R$_L$=8Ω	
		_	-73	_	dB	R$_L$=10K	
	Single-ended	_	-70	_	dB	R$_L$=10K	
S/N	Diff (N to P)	_	97	_	dB	R$_L$=4Ω	f=1kHz/0dB A-Weighted VBAT=3.7V
		_	97	_	dB	R$_L$=8Ω	
		_	95	_	dB	R$_L$=10K	
	Single-ended	_	75	_	dB	R$_L$=10K	
	Diff (N to P)	_	94	_	dB	R$_L$=4Ω	f=1kHz/0dB A-Weighted VBAT=2.4V
		_	94	_	dB	R$_L$=8Ω	
		_	88	_	dB	R$_L$=10K	
	Single-ended	_	72	_	dB	R$_L$=10K	
Dynamic Range	Diff (N to P)	_	88	_	dB	R$_L$=4Ω	f=1kHz/-60dB A-Weighted VBAT=3.7V
		_	88	_	dB	R$_L$=8Ω	
		_	86	_	dB	R$_L$=10K	
	Single-ended	_	75	_	dB	R$_L$=10K	
	Diff (N to P)	_	87	_	dB	R$_L$=4Ω	f=1kHz/-60dB A-Weighted VBAT=2.4V
		_	87	_	dB	R$_L$=8Ω	
		_	85	_	dB	R$_L$=10K	
	Single-ended	_	74	_	dB	R$_L$=10K	

4 Package Information

4.1 TSSOP20

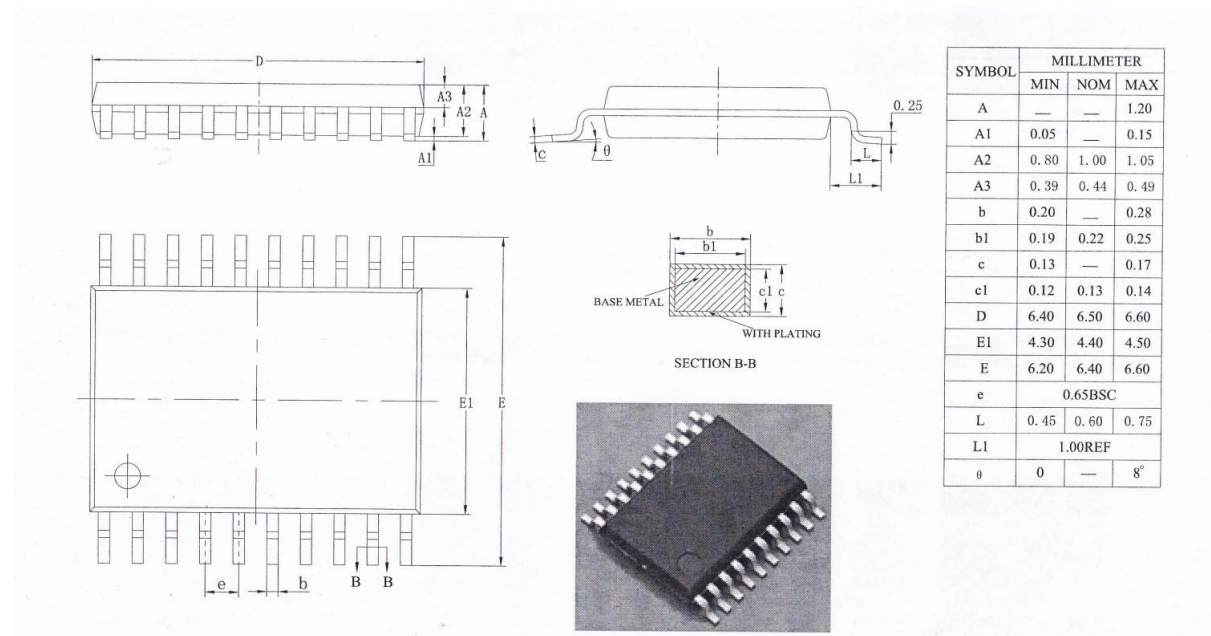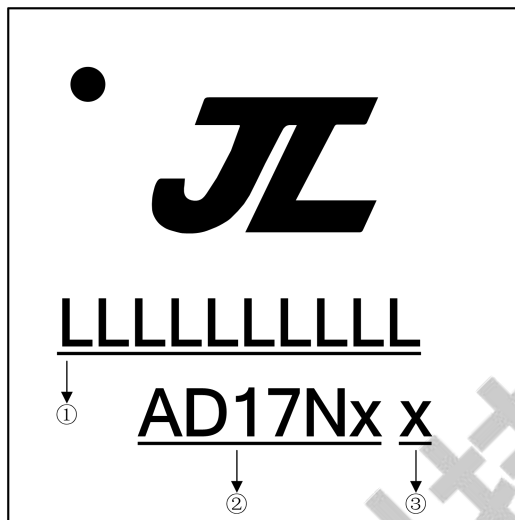| SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.80	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	6.40	6.50	6.60
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00REF		
θ	0	—	8°

Figure 4-1   AD174A Package

5 IC Marking Information

① LLLLLLLLLL : Production Batch
② AD17Nx : Chip Model
③ Built-in flash size
   0: No Flash Memory
   2: 2Mbit Flash
   4: 4Mbit Flash
   8: 8Mbit Flash
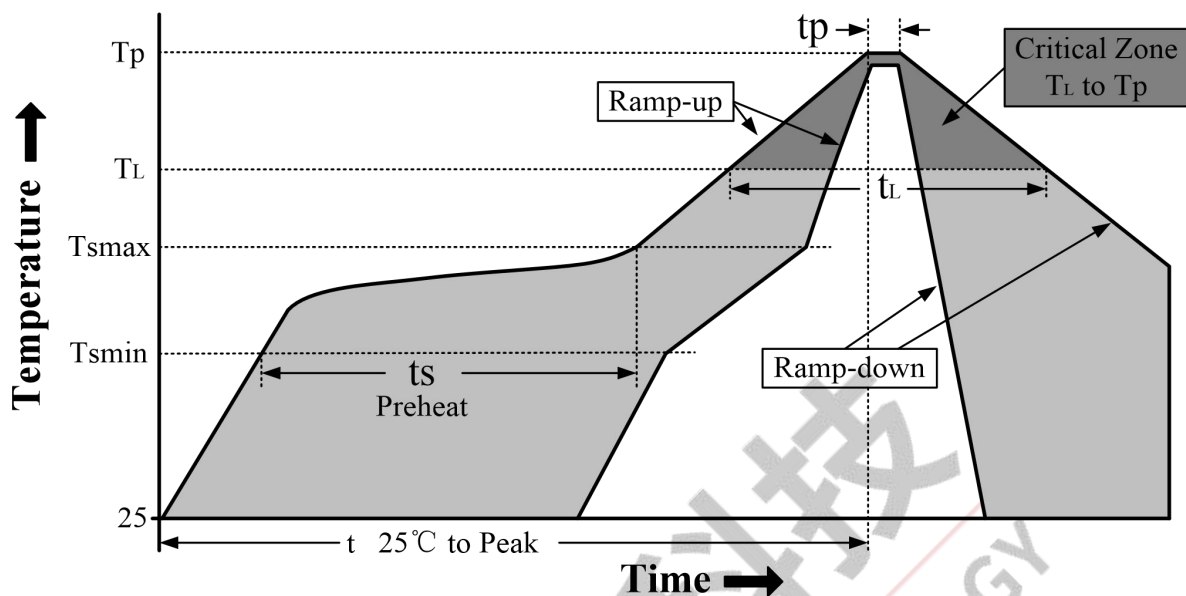   6: 16Mbit Flash
   3: 32Mbit Flash

6   Solder-Reflow Condition

Figure 6-1 Classification Reflow Profile

Classification Profiles   **Table 6-1**

Profile Feature		Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat/ Soak	Temperature Min (T_{smin})	100 ℃	150 ℃
	Temperature Max (T_{smax})	150 ℃	200 ℃
	Time (ts) from (T_{smin} to T_{smax})	60-120 seconds	60-180 seconds
Average ramp-up rate (T_{smax} to T_p)		3 ℃/second max	3 ℃/second max
Liquidous temperature (T_L)		183 ℃	217 ℃
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)		10-30 seconds	20-40 seconds
Ramp-down rate (T_p to T_L)		6 ℃/second max.	6 ℃/second max.
Time 25 ℃ 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.

Note 2: Time within 5℃ of actual peak temperature (tp) specified for the reflow profiles is a "supplier" minimum and "user" maximum.

SnPb - Classification Temperature   **Table 6-2**

Package Thickness	Volume mm³ < 350	Volume mm³ ≥ 350
<2.5 mm	240 +0/-5 ℃	225 +0/-5 ℃
≥ 2.5 mm	225 +0/-5 ℃	225 +0/-5 ℃

Pb-free - Classification Temperature   **Table 6-3**

Package Thickness	Volume mm³ < 350	Volume mm³ 350 - 2000	Volume mm³ > 2000
< 1.6mm	260 ℃	260 ℃	260 ℃
1.6 mm - 2.5mm	260 ℃	250 ℃	245 ℃
> 2.5mm	250 ℃	245 ℃	245 ℃

7 Revision History

Date	Revision	Description
2023.07.13	V1.0	Initial Release.
2023.09.28	V1.1	Update Pin Definition. Update Features modification. Increase AD174A0 package.