

AD178A Datasheet

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Version: 1.1

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AD178A 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
- One SPI Master / Slaver controller with DMA
- 2-channel 10-bit general purpose ADC
- 4-channel Advance PWM controller
- 4 Individually programmable and multiplexed GPIO pins
- Digital peripheral crossbar
- Support Touch Key of pulse counter
- Up to 4 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

- SOP8

Temperature

- Operating temperature: -40°C to +85°C
- Storage temperature: -65°C to +150°C

Applications

- Sound Toy
- Audio player

1 Block Diagram

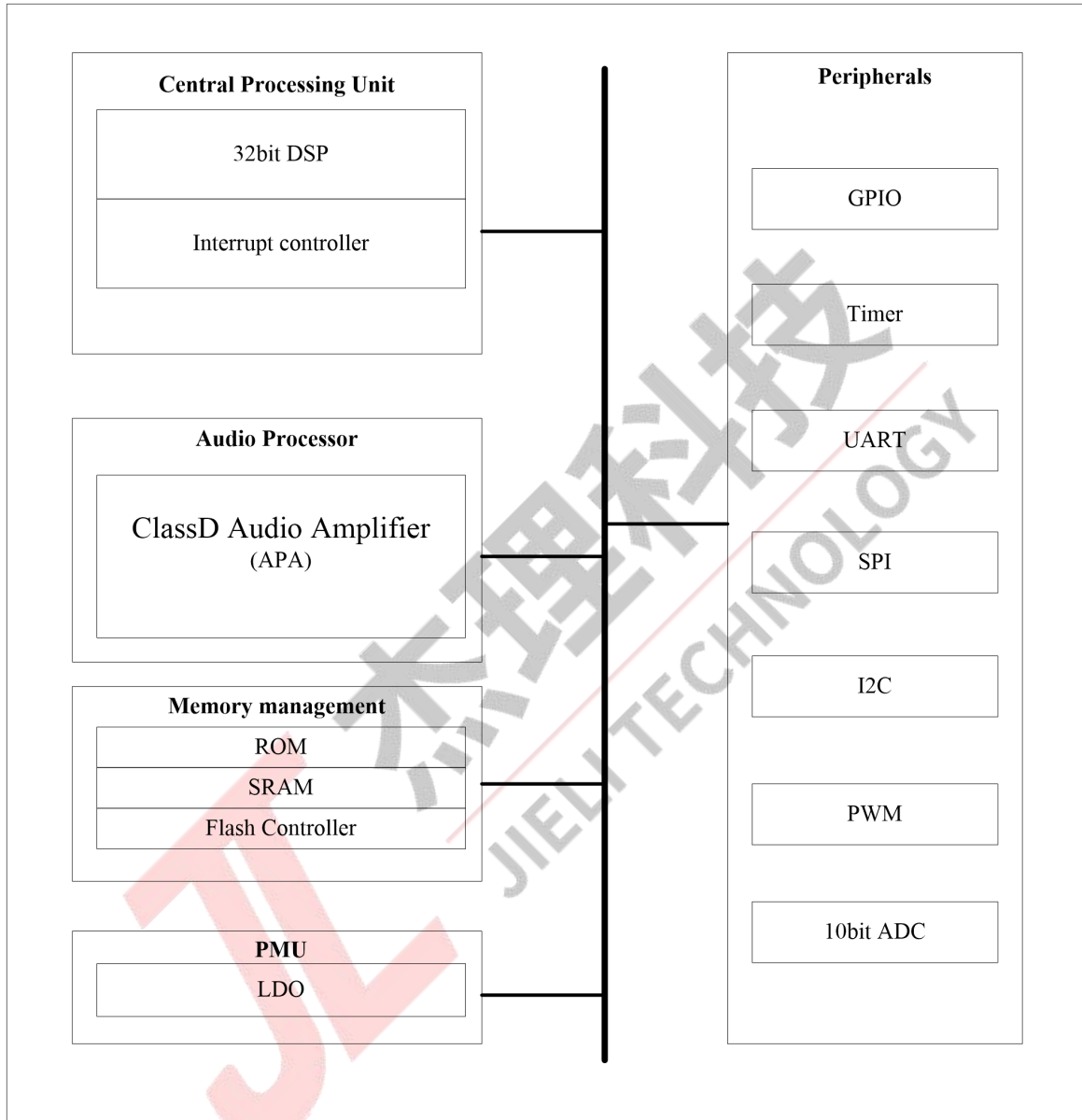


Figure 1-1 AD178A Block Diagram

2 Pin Definition

2.1 Pin Assignment

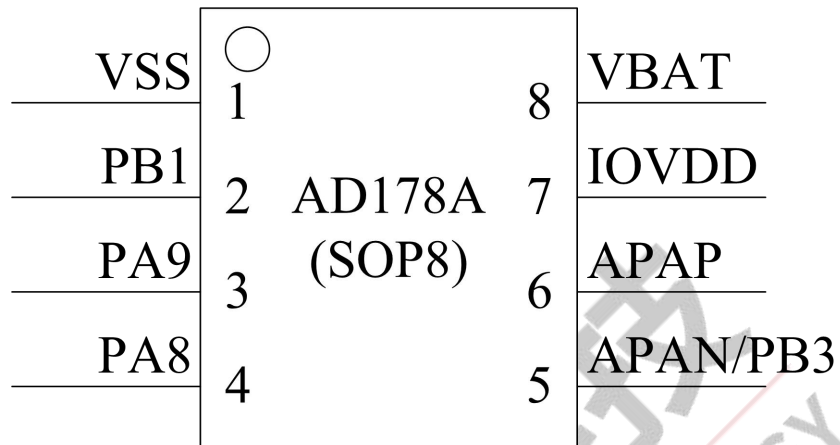


Figure 2-1 AD178A Package Diagram

2.2 Pin Description

Table 2-1 AD178A Pin Description

PIN NO.	Name	Type	Function	Other Function
1	VSS	G		System ground;
2	PB1	I/O	5V tolerant IO	Serial port code upgrade pin;
3	PA9	I/O	GPIO (pull down)	ADC9:ADC Input Channel 9;
4	PA8	I/O	GPIO (pull down)	ADC8:ADC Input Channel 8;
5	PB3	I/O	5V tolerant IO	
	APAN	O		Class-D APA Negative Output;
6	APAP	O		Class-D APA Positive Output;
7	IOVDD	PO	Power supply for GPIO	Built-in linear voltage regulator output;
8	VBAT	PI		Power supply input;

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
T _{opt}	Operating temperature	-40	+85	°C
T _{stg}	Storage temperature	-65	+150	°C
V _{BAT}	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
	1.5xV _{opmax}	All power pins	

Note : 1.5xV_{opmax} = 1.5 times maximum operating voltage.

3.3 PMU Characteristics

Table 3-3

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V _{BAT}	Voltage Input	2.0	3.7	5.5	V	–
IOVDD	Voltage output	2.0	3.0	3.4	V	V _{BAT} = 4.2V, 10mA loading
	Loading current	–	–	100	mA	IOVDD=3.3V@V _{BAT} ≥ 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	PA8,PA9	HD=1 : -7 HD=2 : -22 HD=3 : -27	mA	IOVDD = 3.0V	
		PB1,PB3	-7			
	0.1*HPVDD Drive current APA IO total current limit of 200mA	APAN APAP	-200		VBAT=3.7V	
V _{OH}	0.9*IOVDD Drive current	PA8,PA9	HD=1 : 7 HD=2 : 24 HD=3 : 56	mA	IOVDD = 3.0V	
		PB1,PB3	7			
	0.9*HPVDD Drive current APA IO total current limit of 200mA	APAN APAP	200		VBAT=3.7V	

3.5 Internal Resistor Characteristics

Table 3-5

Port	Internal Pull-Up Resistor	Internal Pull-Down Resistor	Comment
PA8,PA9,PB1,PB3	10K	200K	1. PA8~PA9 default pull down 2. 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, V _{BAT} =3.7V		
Output Swing	Diff (N to P)	–	1.57	–	V _{rms}	R _L =4Ω	f=1kHz/0dB V _{BAT} =3.7V	
		–	1.83	–	V _{rms}	R _L =8Ω		
		–	2.22	–	V _{rms}	R _L =10K		
	Single-ended	–	1.11	–	V _{rms}	R _L =10K		
	Diff (N to P)	–	0.99	–	V _{rms}	R _L =4Ω		f=1kHz/0dB V _{BAT} =2.4V
		–	1.17	–	V _{rms}	R _L =8Ω		
		–	1.44	–	V _{rms}	R _L =10K		
	Single-ended	–	0.72	–	V _{rms}	R _L =10K		
	Output power	Diff (N to P)	–	0.62	–	W	R _L =4Ω	
–			0.42	–	W	R _L =8Ω	V _{BAT} =3.7V	
–			0.25	–	W	R _L =4Ω	f=1kHz/0dB	
–			0.17	–	W	R _L =8Ω	V _{BAT} =2.4V	
THD+N	Diff (N to P)	–	-31	–	dB	R _L =4Ω	f=1kHz/0dB	
		–	-35	–	dB	R _L =8Ω	A-Weighted	
		–	-75	–	dB	R _L =10K	V _{BAT} =3.7V	
	Single-ended	–	-70	–	dB	R _L =10K		
	Diff (N to P)	–	-31	–	dB	R _L =4Ω	f=1kHz/0dB	
		–	-36	–	dB	R _L =8Ω	A-Weighted	
		–	-73	–	dB	R _L =10K	V _{BAT} =2.4V	
	Single-ended	–	-70	–	dB	R _L =10K		
S/N	Diff (N to P)	–	97	–	dB	R _L =4Ω	f=1kHz/0dB	
		–	97	–	dB	R _L =8Ω	A-Weighted	
		–	95	–	dB	R _L =10K	V _{BAT} =3.7V	
	Single-ended	–	75	–	dB	R _L =10K		
	Diff (N to P)	–	94	–	dB	R _L =4Ω	f=1kHz/0dB	
		–	94	–	dB	R _L =8Ω	A-Weighted	
		–	88	–	dB	R _L =10K	V _{BAT} =2.4V	
Single-ended	–	72	–	dB	R _L =10K			
Dynamic Range	Diff (N to P)	–	88	–	dB	R _L =4Ω	f=1kHz/-60dB	
		–	88	–	dB	R _L =8Ω	A-Weighted	
		–	86	–	dB	R _L =10K	V _{BAT} =3.7V	
	Single-ended	–	75	–	dB	R _L =10K		
	Diff (N to P)	–	87	–	dB	R _L =4Ω	f=1kHz/-60dB	
		–	87	–	dB	R _L =8Ω	A-Weighted	
		–	85	–	dB	R _L =10K	V _{BAT} =2.4V	
	Single-ended	–	74	–	dB	R _L =10K		

4 Package Information

4.1 SOP8

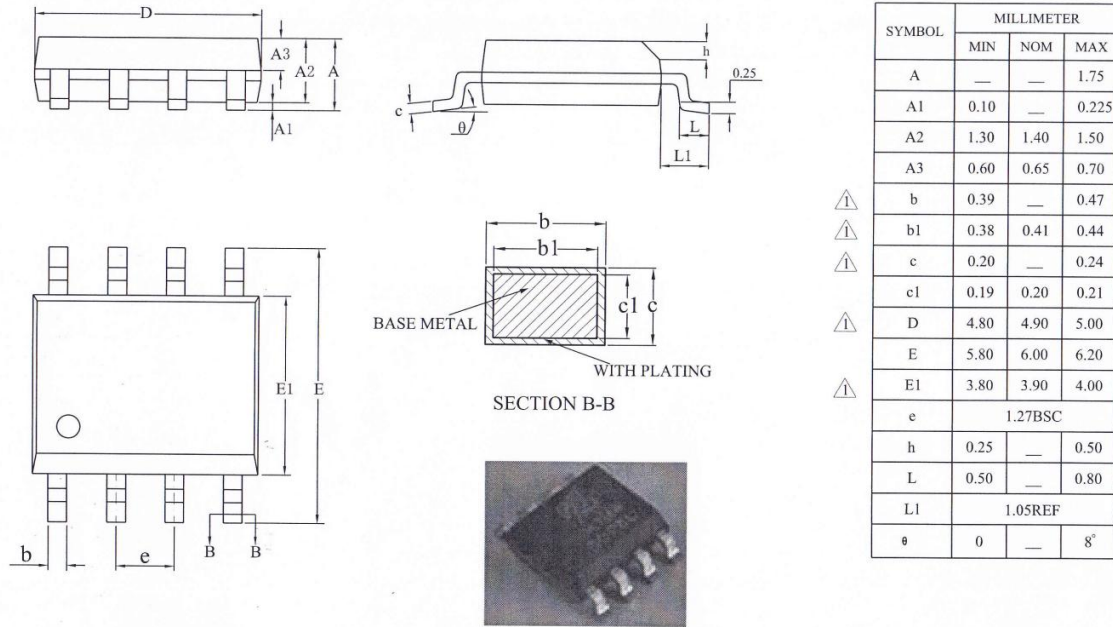
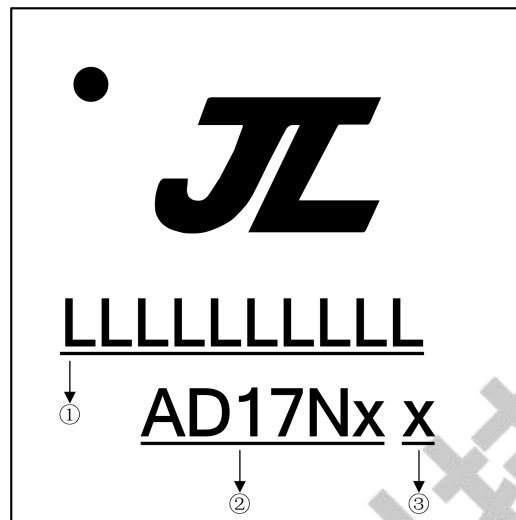


Figure 4-1 AD178A Package

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

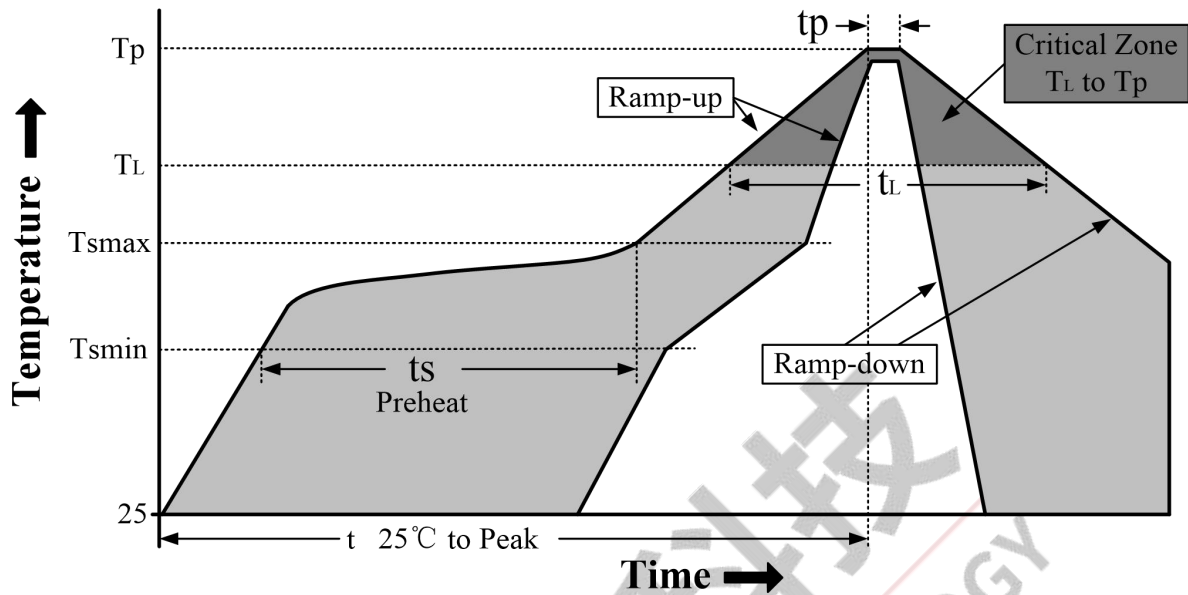


Figure 6-1 Classification Reflow Profile

Classification Profiles

Table 6-1

Profile Feature		Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat/ Soak	Temperature Min (T_{smin})	100 °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)		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.

Note 2: Time within 5°C of actual peak temperature (t_p) specified for the reflow profiles is a “supplier” minimum and “user” maximum.

SnPb - Classification Temperature

Table 6-2

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

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

Package Thickness	Volume mm³ < 350	Volume mm³ 350 - 2000	Volume mm³ > 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



7 Revision History

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

