

AD181A Datasheet

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Version: 1.0

Date: 2023.09.06

AD181A Features

CPU

- Single-core 32-bit CPU
- Maximum speed 160MHz
- Core inside tick timer
- Exception manage unit
- dtap debugger with 4 pc trace, 4 breakpoint, 1 watchpoint

Interrupt

- 64 interrupt sources with 8 levels of programmable priority
- Support external I/O interrupt
- With soft interrupt (virtual interrupt) function, priority can be configured

Memory

- On-chip SRAM
- Built-in flash memory controller

Clocks

- On-chip 16 MHz clock
- On-chip 200KHz lower-temperature-drift clock
- 32.768 KHz crystal oscillator

Audio APA

- Support for driving 4 or 8 ohm speaker
- Mono Class-D Speaker Amplifier
 - 0.5W/8 Ω @4.2V
 - 0.25W/8 Ω @3.0V
 - 0.7W/4 Ω @4.2V
 - 0.35W/4 Ω @3.0V

Peripherals

- One full speed USB(USB1.1) OTG controller
- Four multi-function 16-bit timers support capture and PWM mode

- Three UART Controllers supports DMA and Flow Control
- Two I2C controllers support master and slave modes
- Two SPI host controllers, support DMA
- One QDEC interface
- Support 8-bit parallel 8080 series MCU Interface
- Support segment code LCD screen driver interface
- Support Touch Key of pulse counter
- 15-channel 12-bit general purpose ADC
- Six pairs MCPWM, support dead zone
- A0:35/A4:39 Individually programmable and multiplexed GPIO pins
- Digital peripheral crossbar
- Up to 8 external interrupt / wake-up source (low power available,can be multiplexed to any I/O)
- Watchdog

PMU

- Less than 4uA soft off current
- RTC Alarm Wakeup
- VPWR range : 2.1V to 5.5V
- IOVDD range : 2.1V to 3.6V
- VLCD range : 3.0V to 4.4V

Packages

- LQFP48(7mm*7mm)

Temperature

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

Applications

- Sound Toy
- Audio player
- Universal Microcontroller

1 Block Diagram

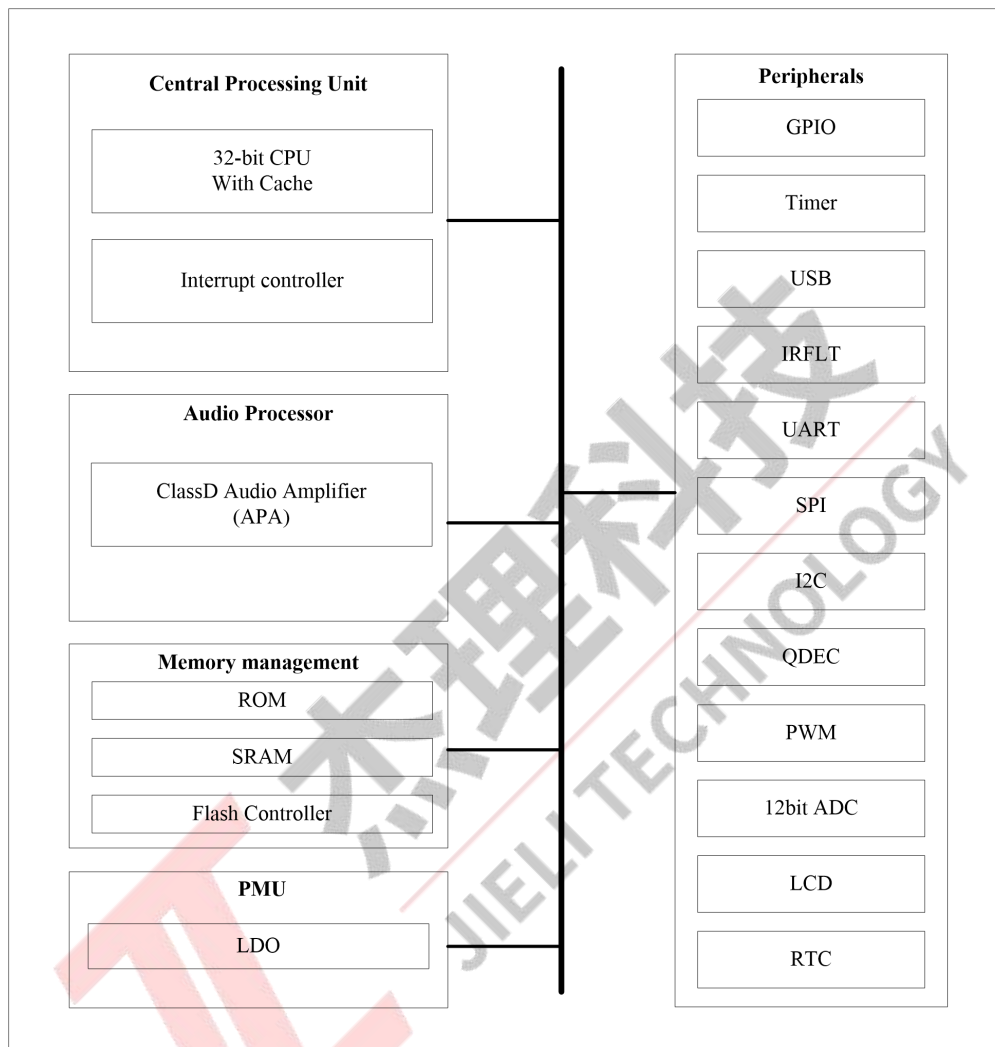


Figure 1-1 AD181A Block Diagram

2 Pin Definition

2.1 Pin Assignment

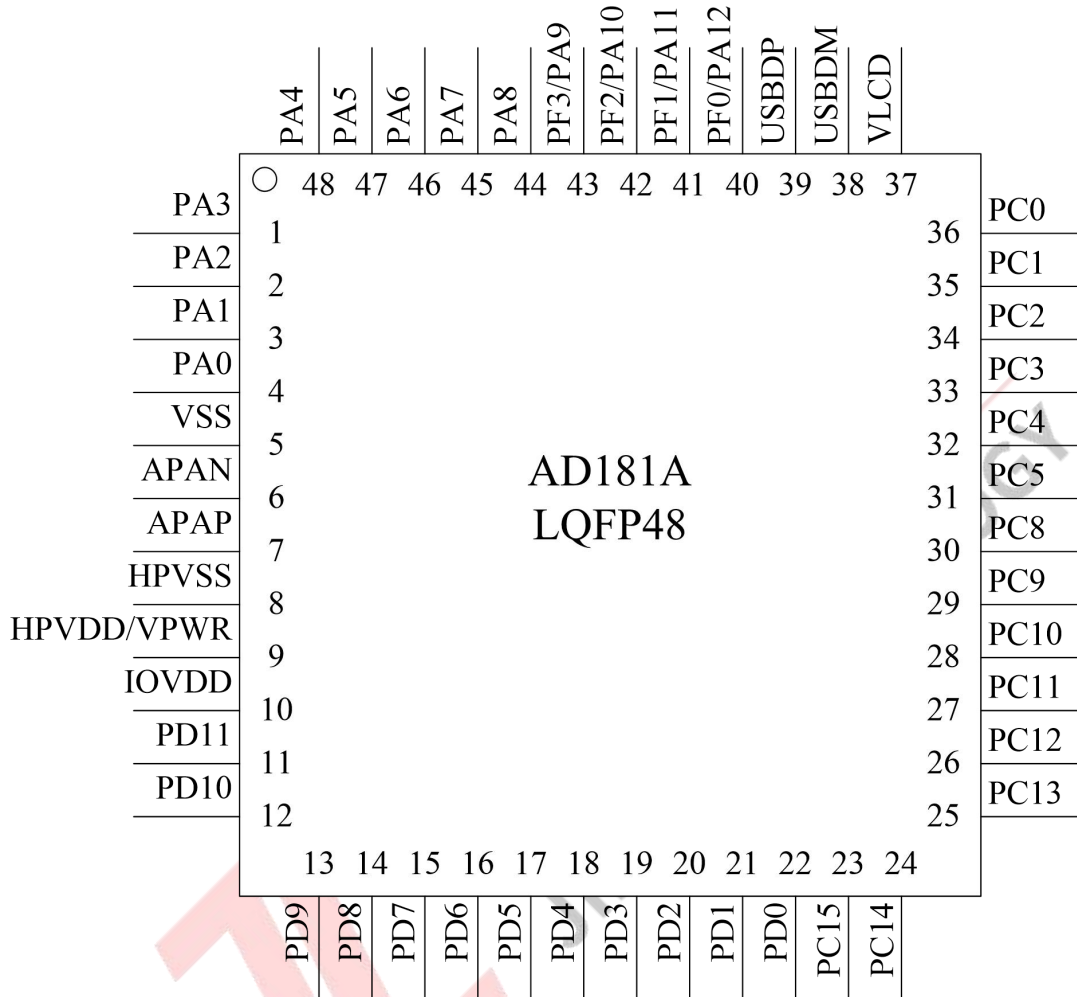


Figure 2-1 AD181A Package Diagram

2.2 Pin Description

Table 2-1 AD181A Pin Description

PIN NO.	Name	Type	Function	Other Function
1	PA3	I/O	GPIO	ADC3:ADC Input Channel 3;
2	PA2	I/O	GPIO	ADC2:ADC Input Channel 2;
3	PA1	I/O	GPIO	ADC1:ADC Input Channel 1;
4	PA0	I/O	GPIO (pull up)	Long press reset; ADC0:ADC Input Channel 0;
5	VSS	G		System ground;
6	APAN	O		Class-D APA Negative Output;
7	APAP	O		Class-D APA Positive Output;
8	HPVSS	G		Class-D APA Ground;
9	HPVDD	PI		Class-D APA Power supply;
	VPWR	PI		Power supply input;
10	IOVDD	PO	Power supply for GPIO	Built-in linear voltage regulator output;
11	PD11	I/O	LCDIO	Timer3_PWM:Timer3 PWM Output; LCD SEG23;
12	PD10	I/O	LCDIO	Timer2_PWM:Timer2 PWM Output; LCD SEG22;
13	PD9	I/O	LCDIO	Timer1_PWM:Timer1 PWM Output; LCD SEG21;
14	PD8	I/O	LCDIO	Timer0_PWM:Timer0 PWM Output; LCD SEG20;
15	PD7	I/O	LCDIO	PWMCH5L:Motor PWM Channel5(L); LCD SEG19;
16	PD6	I/O	LCDIO	PWMCH5H:Motor PWM Channel5(H); LCD SEG18;
17	PD5	I/O	LCDIO	PWMCH4L:Motor PWM Channel4(L); LCD SEG17;
18	PD4	I/O	LCDIO	PWMCH4H:Motor PWM Channel4(H); LCD SEG16;
19	PD3	I/O	LCDIO	PWMCH3L:Motor PWM Channel3(L); LCD SEG15;
20	PD2	I/O	LCDIO	PWMCH3H:Motor PWM Channel3(H); LCD SEG14;
21	PD1	I/O	LCDIO	LCD_RD:MCU8080_RD; LCD SEG13;
22	PD0	I/O	LCDIO	LCD_WR:MCU8080_WR; LCD SEG12;

23	PC15	I/O	LCDIO	LCD_D7:MCU8080_D7; LCD SEG11;
24	PC14	I/O	LCDIO	LCD_D6:MCU8080_D6; LCD SEG10;
25	PC13	I/O	LCDIO	LCD_D5:MCU8080_D5; LCD SEG09;
26	PC12	I/O	LCDIO	LCD_D4:MCU8080_D4; LCD SEG08;
27	PC11	I/O	LCDIO	FPIN0; LCD_D3:MCU8080_D3; LCD SEG07;
28	PC10	I/O	LCDIO	LCD_D2:MCU8080_D2; LCD SEG06;
29	PC9	I/O	LCDIO	LCD_D1:MCU8080_D1; LCD SEG05;
30	PC8	I/O	LCDIO	LCD_D0:MCU8080_D0; LCD SEG04;
31	PC5	I/O	LCDIO	LCD SEG01; LCD COM5;
32	PC4	I/O	LCDIO	LCD SEG00; LCD COM4;
33	PC3	I/O	LCDIO	LCD COM3;
34	PC2	I/O	LCDIO	LCD COM2;
35	PC1	I/O	LCDIO	LCD COM1;
36	PC0	I/O	LCDIO	LCD COM0;
37	VLCD	P		LCD Voltage;
38	UDBDM	I/O	USB Negative Data (pull down)	ADC14:ADC Input Channel 14;
39	USBDP	I/O	USB Positive Data (pull down)	ADC13:ADC Input Channel 13;
40	A0	PF0	I/O	SFCCS:SFC Chip Select; SPI0CS:SPI0 Chip Select;
	A4	PA12	I/O	ADC12:ADC Input Channel 12;
41	A0	PF1	I/O	SFCDI:SFC Data In; SPI0DI:SPI0 Data In;
	A4	PA11	I/O	ADC11:ADC Input Channel 11; LVD:Low Voltage Detect;
42	A0	PF2	I/O	SFCCLK:SFC Clk; SPI0CLK:SPI0 Clk;
	A4	PA10	I/O	ADC10:ADC Input Channel 10;
43	A0	PF3	I/O	SFCDO:SFC Data Out; SPI0DO:SPI0 Data Out;
	A4	PA9	I/O	ADC9:ADC Input Channel 9;

44	PA8	I/O	GPIO	ADC8:ADC Input Channel 8; OSC32KO:32.768KHz crystal oscillator output; TMR0CK;
45	PA7	I/O	GPIO	ADC7:ADC Input Channel 7; OSC32KI:32.768KHz crystal oscillator input;
46	PA6	I/O	GPIO (pull up)	MCLR:Low level reset; ADC6:ADC Input Channel 6;
47	PA5	I/O	GPIO	ADC5:ADC Input Channel 5;
48	PA4	I/O	GPIO	ADC4:ADC Input Channel 4;

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

CROSSBAR						
SPI1	SPI2	IIC0	IIC1	UART0	UART1	UART2
SPI1_CLK	SPI2_CLK	IIC0_CLK	IIC1_CLK	UART0_TX	UART1_TX	UART2_TX
SPI1_DI	SPI2_DI	IIC0_DAT	IIC1_DAT	UART0_RX	UART1_RX	UART2_RX
SPI_D0	SPI2_D0					UART2_CTS
SPI_DAT2						UART2_RTS
SPI_DAT3						

Input Channel x8			Output Channel x8			
WAKEUP0	Timer0	IRFLT	PWMCH0H	Timer0_PWM	CLK_OUT0	LCD_WR
WAKEUP1	Timer1	TOUCH_CAP	PWMCH0L	Timer1_PWM	CLK_OUT1	LCD_RD
WAKEUP2	Timer2	ICH_QDEC0	PWMCH1H	Timer2_PWM	CLK_OUT2	
WAKEUP3	Timer3	ICH_QDEC1	PWMCH1L	Timer3_PWM		
WAKEUP4	CAP0		PWMCH2H			
WAKEUP5	CAP1		PWMCH2L			
WAKEUP6	CAP2					
WAKEUP7	CAP3					

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
VPWR	Supply Voltage	-0.3	6	V
HPVDD	APA Power supplyVoltage	-0.3	6	V
VLCD	LCD Voltage	-0.3	4.4	
V _{IOVDD}	Voltage applied at IOVDD	-0.3	3.6	V
V _{GPIO}	Voltage applied on normal pin	-0.3	IOVDD+0.3	V
V _{LCDIO}	Voltage applied on special pin	-0.3	VLCD+0.3	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
VPWR	Voltage Input	2.1	3.7	5.5	V	—
HPVDD	APA Power supplyVoltage	2.1	3.7	5.5	V	—
VLCD	LCD Voltage	3.0	3.6	4.4	V	—
IOVDD	Voltage output	2.1	3.0	3.6	V	VPWR = 4.2V, 10mA loading
	Loading current	—	—	100	mA	IOVDD=3.3V@VPWR ≥ 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 and LCDIO input characteristics						
Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V_{IL}	Low-Level Input Voltage	-0.3	—	$0.3 \cdot IOVDD$	V	$IOVDD = 3.0V$
V_{IH}	High-Level Input Voltage	$0.7 \cdot IOVDD$	—	$IOVDD + 0.3$	V	$IOVDD = 3.0V$
GPIO output characteristics						
Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V_{OL}	Low-Level Input Voltage	—	—	$0.1 \cdot IOVDD$	V	$IOVDD = 3.0V$
V_{OH}	High-Level Input Voltage	$0.9 \cdot IOVDD$	—	—	V	$IOVDD = 3.0V$
LCDIO output characteristics						
Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V_{OL}	Low-Level Input Voltage	—	—	$0.1 \cdot VLCD$	V	$VLCD = 3.8V$
V_{OH}	High-Level Input Voltage	$0.9 \cdot VLCD$	—	—	V	$VLCD = 3.8V$

3.5 IO Output Drive Strength Pull Up/Down Characteristics

Table 3-5

Port	Drive Strength	Pull Up Resistance	Pull DownResistance	Test Conditions
PA0-PA12	00: 1.8mA 01: 6mA 10: 20mA 11: 45mA	10K/100K/1M	10K/100K/1M	$IOVDD = 3.3V$
PC0-PC5 PC8-PC15 PD0-PD11	8mA	10K/100K/1M	10K/100K/1M	$IOVDD = 3.3V$
DP	9mA	1.5K	15K	$IOVDD = 3.3V$
DM	9mA	180K	15K	$IOVDD = 3.3V$
APAP	300mA	-	-	$HPVDD = 3.7V$
APAN	300mA	-	-	$HPVDD = 3.7V$

Note1: precision of 10K/100K pull-up and pull-down resistor is $\pm 30\%$

Note2: precision of 1M pull-up and pull-down resistor is -50%, +100%

Note3: PA0 and PA6 default pull up, USBDM and USBDP default pull down

3.6 Audio APA Characteristics

Table 3-6

Parameter	MODE	Min	Typ	Max	Unit	Test Conditions	
Frequency Response		20	—	20K	Hz	$R_L=10K, VPWR=3.7V$	
Output Swing	Diff (N to P)	—	1.5	—	Vrms	$R_L=4\Omega$	$f=1kHz/0dB$ $VPWR=3.7V$
		—	1.8	—	Vrms	$R_L=8\Omega$	
		—	2.2	—	Vrms	$R_L=10K$	
	Single-ended	—	1.1	—	Vrms	$R_L=10K$	
Output power	Diff (N to P)	—	0.55	—	W	$R_L=4\Omega$	$f=1kHz/0dB$
		—	0.40	—	W	$R_L=8\Omega$	$VPWR=3.7V$
THD+N	Diff (N to P)	—	-39	—	dB	$R_L=4\Omega$	$f=1kHz/0dB$ A-Weighted $VPWR=3.7V$
		—	-43	—	dB	$R_L=8\Omega$	
		—	-68	—	dB	$R_L=10K$	
	Single-ended	—	-64	—	dB	$R_L=10K$	
S/N	Diff (N to P)	—	95	—	dB	$R_L=4\Omega$	$f=1kHz/0dB$ A-Weighted $VPWR=3.7V$
		—	95	—	dB	$R_L=8\Omega$	
		—	97	—	dB	$R_L=10K$	
	Single-ended	—	83	—	dB	$R_L=10K$	
Dynamic Range	Diff (N to P)	—	89	—	dB	$R_L=4\Omega$	$f=1kHz/-60dB$ A-Weighted $VPWR=3.7V$
		—	89	—	dB	$R_L=8\Omega$	
		—	89	—	dB	$R_L=10K$	
	Single-ended	—	81	—	dB	$R_L=10K$	

4 Package Information

4.1 LQFP48_7×7mm

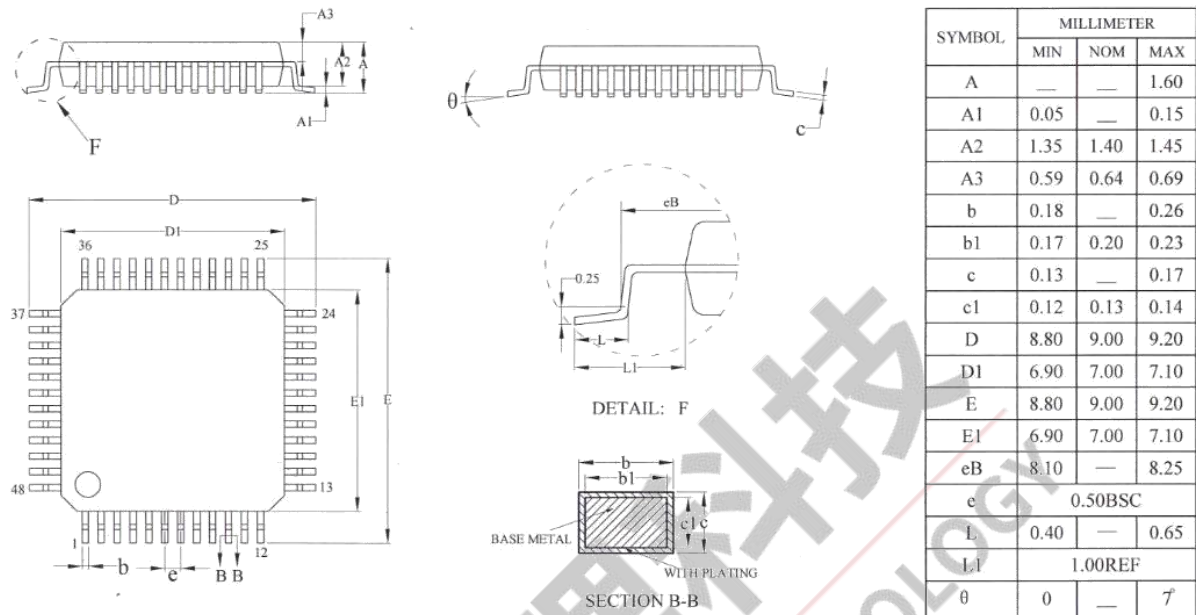
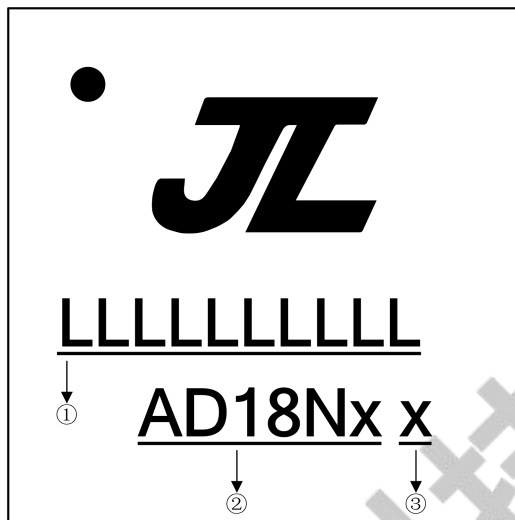


Figure 4-1 AD181A Package

5 IC Marking Information



① LLLLLLLLLL : Production Batch

② AD18Nx : 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

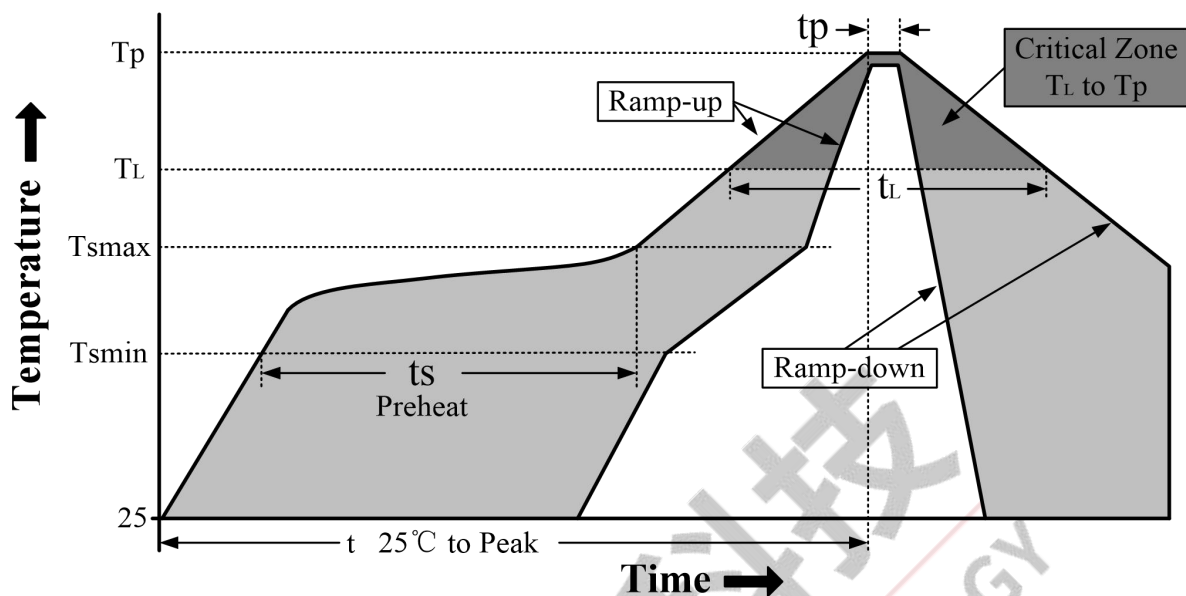


Figure 6-1 Classification Reflow Profile

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 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

7 Revision History

Date	Revision	Description
2023.09.06	V1.0	Initial Release.

