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AK1050D Mobile Multimedia Application Processor

Specification

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Document Revision History

The following table provides revision history for this release. This history includes technical content revisions only and not stylistic or grammatical changes.

VERSION	DESCRIPTION	DATE COMPLETED
2.0.0	**Initial release**	July, 2017
2.1.0	**Section 1** Modified the introduction of AK1050D.	December, 2017
2.2.0	**Section 1** Modified the introduction of AK1050D.	March, 2018

About This Manual

This document is the electrical and mechanical specification data sheet for the AK1050D processor. This specification contains mechanical data, package signal locations, and electrical specifications (simulated).

Definitions, Acronyms, and Abbreviations

Unless otherwise specified, all the acronyms and abbreviations used in this manual are defined hereunder.

ADC	Analog to Digital Converter
AHB	Advanced High-performance Bus
ASIC	Application-Specific Integrated Circuit, refers to all the functional blocks of the processor
CMOS	Complimentary Metal-Oxide Semiconductor
CRC	Cyclic Redundancy Check
DAC	Digital to Analog Converter
DMA	Direct Memory Access
DTE	Data Terminal Equipment
ECC	Error Correction Code
FIFO	First In First Out
GPIO	General Purpose Input/Output
TWI	Two Wire Interface
JTAG	Joint Test Action Group
LCD	Liquid Crystal Display
LSB	Least Significant Bit
MMC	Multimedia Card
MMU	Memory Management Unit
MSB	Most Significant Bit
PCM	Pulse Code Modulation
PGA	Programmable Gain Amplifier
PWM	Pulse-Width Modulator
PLL	Phase Locked Loop
RAM	Random Access Memory
ROM	Read Only Memory
SD	Secure Digital
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
XTAL	Crystal

1 Introduction

AK1050D is an Anyka's highly integrated and cost effective system-on-chip solution based on Bluetooth 5.0/4.2/3.0/2.1+EDR. Positioning at Bluetooth applications such as Bluetooth stereo speakers, earphones, AK1050D satisfies the market with high performance, low cost, and low power consumption.

AK1050D uses ARM926EJ-S core and integrates audio codec, Bluetooth RF, Bluetooth baseband, USB 2.0 Host/Slave controller, power management unit (PMU), and 512KB SPI Flash into a single chip, offering high multimedia performance and high system integration at reduced power consumption and cost of bill-of-materials (BOM). A set of peripheral interfaces, including UART, IrDA, TWI, and USB2.0, feature AK1050D with high extensibility and flexibility.

1.1 Features

- ARM926EJ-S core, 16KB I cache and 4KB D cache
- Up to 200MHz CPU CLK and 100MHz system operating frequency
- Bluetooth Baseband
- Bluetooth RF
- Advanced power management module
- Supports little-endian only
- Software TWI
- Three ADCs, 2 Sigma-Delta ADC for voice/music recording; 1 SAR ADC for analog keypad, battery measurement, and general purpose
- Two Built-in Sigma-Delta DACs
- Headphone driver output
- Two UARTs: UART0 and UART2
- Built-in SPI NOR Flash
- One USB2.0 Full-Speed Host & Slave interface
- 9 GPIOs, all shared with other pins
- On-chip PLL
- Five PWM outputs
- Three General Purpose timers

- One Watchdog timer
- Two bootstrap modes: SPI NOR Flash Boot and USB Mass Storage Boot
- Package: 32-pin QFN

1.2 Applications

- Bluetooth stereo earphones
- Bluetooth stereo speakers

1.3 Product Documentation

The following document(s) is (are) required for a complete description of the AK1050D and are necessary to design properly with the device.

- *AK1050D Programmer's Guide*

1.4 Ordering Information

PART NUMBER	PACKAGE TYPE	OPERATING VOLTAGE	ORDER NUMBER
AK1050DN032	32-PIN QFN	I/O: 3.3V, core: 1.2V	-

1.5 Part Number Information

As shown in Figure 1-1, the Part Number information consists of three lines. The first line symbolizes ANYKA; the second line indicates the product ID, while the third line is production lot number, which is reserved by the producer for specific purposes.

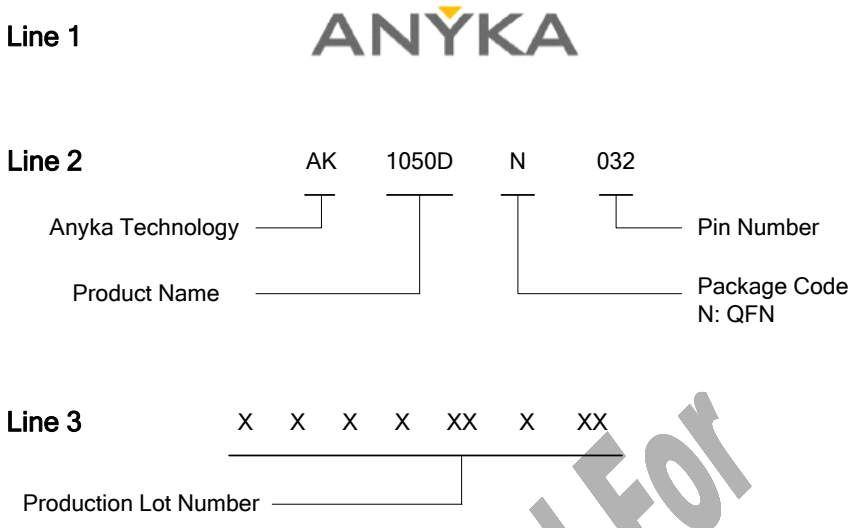


Figure 1-1 Part Number Information

2 Signals and Connections

2.1 Pin Definitions

Table 2-1 identifies and describes the AK1050D signals that are assigned to package pins. I: input; O: output; IO: input/output; PWR: power supply; GND: ground; A: analog; D: digital. PU: pull-up; PD: pull-down.

Table 2-1 AK1050D Functional Pin Definitions

PIN	PIN NAME	TYPE	WAKEUP	RESET	PIN MUX	DESCRIPTION
1	USB_DP	IO/A	NO	-	-	USB Data pin (Data+)
2	VDD33	PWR/A	NO	-	-	3.3V IO power supply
3	VDD12	PWR/A	NO	-	-	1.2V power supply for core and PLL
4	GPIO[6]/ UART0_TXD	IO/D	YES	GPIO[6], I/PU	GPIO[6]	General purpose input/output port with wakeup function. GPIO[6] is specially used as a boot mode select pin during system startup.
					UART0_TXD	Transmit pin of UART0
5	GPIO[7]/ UART0_RXD/ IrDA_RX/ PWM1	IO/D	YES	GPIO[7], I/PU	GPIO[7]	General purpose input/output port with wakeup function
					UART0_RXD	Receive pin of UART0
					IrDA_RX	IrDA data input
					PWM1	Pulse-Width Modulated output signal
6	GPIO[11]/ PWM5/ UART2_TXD	IO/D	YES	GPIO[11], I/PU	GPIO[11]	General purpose input/output port with wakeup function
					PWM5	Pulse-Width Modulated output signal
					UART2_TXD	Transmit pin of UART2
7	GPIO[22]/ PWM3/ UART2_RXD	IO/D	YES	GPIO[22], I/PU	GPIO[22]	General purpose input/output port with wakeup function
					PWM3	Pulse-Width Modulated output signal
					UART2_RXD	Receive pin of UART2
8	GPIO[24]/ PWM0/ AIN1	IO/AD	YES	GPIO[24], I/PD	GPIO[24]	General purpose input/output port with wakeup function
					PWM0	Pulse-Width Modulated output signal
					AIN1	A/D input node for general purpose analog input, it could be used for analog keypad input
9	GPIO[17]/ PWM2/	IO/D	YES	GPIO[17], I/PU	GPIO[17]	General purpose input/output port with wakeup function
					PWM2	Pulse-Width Modulated output signal
10	AIN0/ GPIO[10]	I/AD	YES	AIN0	AIN0	A/D input node for general purpose analog input, it could be used for analog keypad input. This pin supports wakeup function.
					GPIO[10]	General purpose input/output port
11	NC	-	-	-	-	Leave this pin unconnected.
12	NC	-	-	-	-	Leave this pin unconnected.

PIN	PIN NAME	TYPE	WAKEUP	RESET	PIN MUX	DESCRIPTION
13	MIC1_P/ GPI[5]	I/AD	NO	MIC1_P	MIC1_P	Microphone1 left channel input (positive) to ADC3
					GPI[5]	General purpose input port
14	MIC1_N/ GPI[6]	I/AD	NO	MIC1_N	MIC1_N	Microphone1 left channel input (negative) to ADC3
					GPI[6]	General purpose input port
15	VDD_MIC	IO/A	NO	-	VDD_MIC	3.0V microphone bias output
16	VCM3	IO/A	NO	-	VCM3	3.0V reference voltage for audio codec
17	VCM2/ RESET	IO/A	NO	-	VCM2	1.5V audio codec common mode voltage. It is recommended to connect to a 4.7uF capacitor between this pin and GND
					RESET	Reset pin, active low
18	HP_RP	O/A	NO	-	-	Right channel of headphone output (positive)
19	HP_RN	O/A	NO	-	-	Right channel of headphone output (negative).
20	HP_LN	O/A	NO	-	-	Left channel of headphone output (negative)
21	HP_LP	O/A	NO	-	-	Left channel of headphone output (positive)
22	HPVDD	PWR/A	NO	-	-	3.3V headphone power supply
23	XTAL26MO	O/A	NO	-	-	External 26MHz crystal output
24	XTAL26MI	I/A	NO	-	-	External 26MHz crystal input
25	VDD12_OSC_ VCO	PWR/A	NO	-	-	1.2V power supply for crystal oscillator
26	VDD12RF	PWR/A	NO	-	-	1.2V Bluetooth RF power supply
27	BT_TX/RX	IO/A	NO	-	-	Bluetooth: radio signal (RX/TX)
28	VCC33_RF	PWR/A	NO	-	-	3.3V Bluetooth RF power supply
29	ONOFF	I/A	YES	-	-	System on/off signal
30	VBAT	I/A	NO	-	-	Battery voltage input
31	VIN_CHG	I/A	YES	-	-	Voltage input of battery charger
32	USB_DM	IO/A	NO	-	-	USB Data pin (Data-)
33	GND	GND	NO	-	-	Power ground. Connect this pin to the ground on the Printed Circuit Board.

Notes:

1. As shown in the **WAKEUP** column of the table above, YES denotes the corresponding GPIO or dedicated pin is a wakeup pin, which can be applied to wakeup the processor from standby. NO denotes the corresponding pin is not a wakeup pin.
2. The pull-up/pull-down resistance range of GPIOs or specified pins are shown in the following table. The pull-up/pull-down function attached to GPIOs can be enabled / disabled by software.

Table 2-2 Resistance range of pull-up and pull-down pins

PIN NAME	PU/PD	PU/PD RESISTOR
GPIO[7], GPIO[11], GPIO[22]	PU	70KΩ ± 40%
GPIO[24], GPIO[17]	PU/PD programmable	PU: 70KΩ ±40% PD: 300KΩ ±40%
USB_DP, USB_DM	PU/PD programmable	PU: 1.5K +/- 15% PD: 15K+/- 15%
GPIO[6], GPIO[10]	PU	62KΩ~ 112KΩ

Note: AIN0/GPIO[10] is open-drain output when it is worked as GPO. In this case, an external pull-up resistor is required to connect to VDD33/VBAT.

3. Table 2-3 shows the drive strength of GPIOs and SPI pins.

Table 2-3 AK1050D GPIO Drive Strength (3.3V power supply)

PARAMETER	PIN	DRIVE STRENGTH		
		MINIMUM	TYPICAL	MAXIMUM
Low level output current (I_{ol}@VOL = 0.4V)	GPIO[10](default as AIN0)	-	-	1.5mA
	GPIO[24], GPIO[22], GPIO[17], GPIO[11], and GPIO[7:6]	-	6mA	-
High level output current (I_{oh}@VOH = 2.4V)	GPIO[10](default as AIN0)	-	-	1.5mA
	GPIO[24], GPIO[22], GPIO[17], GPIO[11], and GPIO[7:6]	-	10mA	-

Table 2-4 classifies the AK1050D signals according to different modules.

Table 2-4 AK1050D Functional Pin Classification

Module	PIN NAME
1. System Control(3)	ONOFF
	XTAL26MI
	XTAL26MO
2. USB Interface(2)	USB_DM
	USB_DP
3. Bluetooth(1)	BT_TX/RX
4. IrDA(1)	IrDA_RX
5. PWM(5)	PWM0
	PWM1
	PWM2
	PWM3
	PWM5
6. GPIO(11)	GPIO[24]
	GPIO[22]
	GPIO[17]
	GPIO[10:11]
	GPIO[6:7]
	GPI[5:6]
7.Audio Analog Interface(6)	AIN0
	AIN1
	HP_LP
	HP_LN
	HP_RN
	HP_RP
	MIC1_P
	MIC1_N
8. UART(4)	UART0_TXD
	UART0_RXD
	UART2_TXD
	UART2_RXD
9. PMU (2)	VBAT
	VIN_CHG
10. Power and Grounds (10)	HPVDD
	VDD12
	VDD33
	VCM3/VDD_MIC
	VCM2
	VIN LDO12
	VDD12_OSC_VCO
	VDD12RF
	VCC33_RF
	VSS
	GND

2.2 Shared-pin List

In order to reduce pin numbers, many pins are shared by more than one function blocks that would not be implemented at the same time. The table below lists the shared pins. All the shared pins are configured by Shared-Pin Control Register.

Table 2-5 AK1050D Shared-pin List

Shared-pin	MODULE	PIN Name	RESET
4	GPIO	GPIO[6]	GPIO[6]
	UART	UART0_TXD	
5	GPIO	GPIO[7]	GPIO[7],
	UART	UART0_RXD	
	IrDA	IrDA_RX	
	PWM	PWM1	
6	GPIO	GPIO[11]	GPIO[11]
	PWM	PWM5	
	UART	UART2_TXD	
7	GPIO	GPIO[22]	GPIO[22]
	PWM	PWM3	
	UART	UART2_RXD	
8	GPIO	GPIO[24]	GPIO[24]
	PWM	PWM0	
	SAR ADC	AIN1	
9	GPIO	GPIO[17]	GPIO[17]
	PWM	PWM2	
10	SAR ADC	AIN0	AIN0
	GPIO	GPIO[10]	
13	Analog	MIC1_P	MIC1_P
	GPI	GPI[5]	
14	Analog	MIC1_N	MIC1_N
	GPI	GPI[6]	

3 Electrical Specifications

3.1 Maximum Ratings

Stresses greater than those listed may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions outside those indicted in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended period may affect reliability.

Table 3-1 AK1050D Maximum Ratings

PARAMETER	SYMBOL	MINIMUM	MAXIMUM	UNIT
VDD12 supply voltage relative to GND	VDD12	-0.3	1.4	V
VDD33 supply voltage relative to GND	VDD33	-0.3	4.0	V
AVDD_MIC supply voltage relative to GND	AVDD_MIC	-0.3	4.0	V
AVCC_USB supply voltage relative to GND	AVCC_USB	-0.3	4.0	V
AVCC supply voltage relative to GND	AVCC	-0.3	4.0	V
HPVDD supply voltage relative to GND	HPVDD	-0.3	4.0	V
VDD12_RF supply voltage relative to GND	VDD12_RF	-0.3	1.4	V
VCC33_RF supply voltage relative to GND	VCC33_RF	-0.3	4.0	V
VBAT supply voltage relative to GND	VBAT	-0.3	4.5	V
VIN_CHG supply voltage relative to GND	VIN_CHG	-0.3	5.5	V
Storage Temperature	T_S	-40	125	^{O}C

3.2 Recommended Operating Range

Table 3-2 Recommended Operating Range

PARAMETER	SYMBOL	MINIMUM	TYPICAL	MAXIMUM	UNIT
VDD12 supply voltage relative to GND	VDD^2	1.08	1.2	1.35	V

PARAMETER	SYMBOL	MINIMUM	TYPICAL	MAXIMUM	UNIT
VDD33 supply voltage relative to GND	VDD33	2.97	3.30	3.63	V
AVDD_MIC supply voltage relative to GND	AVDD_MIC	2.97	3.0	3.63	V
VCCA_USB supply voltage relative to GND	VCCA_USB	2.97	3.30	3.63	V
AVCC supply voltage relative to GND	AVCC	2.85	3.0	3.1	V
HPVDD supply voltage relative to GND	HPVDD	3.2	3.3	3.6	V
VDD12_RF supply voltage relative to GND	VDD12_RF	1.15	1.3	1.4	V
VCC33_RF supply voltage relative to GND	VCC33_RF	2.8	3.0	3.30	V
VBAT supply voltage relative to GND	VBAT	3.5	-	4.5	V
VIN_CHG supply voltage relative to GND	VIN_CHG	3.5	-	5.0	V
Operating Temperature Range	T_O	0		75	^OC

Notes:

1. In normal mode, the recommended operating range of VDD12 is given in the table.
2. In standby mode, VDD12 is recommended to set at 1.1V to save power.

3.3 Electrical Characteristics of PMU

Table 3-3 Electrical Characteristics of LDO12

Typical values are at T_A = +27°C and all Current Values are dynamic, unless other-wise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vin	Input voltage	-	2.5	3.3	3.7	V
Vout (accuracy)	Output voltage	Default	-3	-	+3	%
Vout	Output voltage	-	-	1.2	1.35	V
Iout	Output current	-	-	100	150	mA
∆ Vout,	Load regulation	T=27 ℃, Vin=3.3V,	-	38	-	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
△ Vout/△ Iout		@Iout=1 to 100mA	-	330	-	mΩ
△ Vout, △ Vout/△ Vin	Line regulation	Iout=1mA @Vin=3.0V to 3.7V	-	3	-	mV
			-	0.2	-	%
		Iout=100mA @Vin=3.0V to 3.7V	-	8	-	mV
			-	0.5	-	%
Icc	Vin Quiescent Current	No load	-	50	-	μA
Ipd	Power-down current	-	-	0.1	-	μA

Table 3-4 Electrical Characteristics of LDO33

Typical values are at T_A = +27°C and all Current Values are dynamic, unless other-wise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vin	Input voltage	-	3.5	3.7	5.0	V
Vout (accuracy)	Output voltage	Default	-3	-	+3	%
Vout	Output voltage	-	-	3.3	-	V
Iout	Output current	-	-	-	250	mA
△ Vout, △ Vout/△ Iout	Load regulation	T=27 ℃, Vin=3.8V, @Iout=1 to 100mA	-	40	-	mV
			-	340	-	mΩ
△ Vout, △ Vout/△ Vin	Line regulation	Iout=1mA @Vin=3.5 to 5V	-	3	-	mV
			-	0.2	-	%
		Iout=250mA @Vin=3.5V to 5V	-	10	-	mV
			-	0.5	-	%
Icc	Vin Quiescent Current	No load	-	50	-	μA
Ipd	Power-down current	-	-	0.1	-	μA

Table 3-5 Electrical Characteristics of LDO33RF

Typical values are at T_A = +27°C and all Current Values are dynamic, unless other-wise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vin	Input voltage	-	3.2	3.8	4.5	V
Vout (accuracy)	Output voltage	Default	-3	-	3	%
Vout	Output voltage	-	-	3.0	-	V
Iout	Output current	-	-	50	80	mA
Δ Vout, Δ Vout/Δ Iout	Load regulation	T=27 ℃, Vin=3.8V, @Iout=1 to 50mA	-	10	-	mV
			-	500	-	mΩ
Δ Vout, Δ Vout/Δ Vin	Line regulation	Iout=1mA @Vin=3.8 to 4.5V	-	5	-	mV
			-	0.2	-	%
		Iout = 50mA @Vin=3.8V to 4.5V	-	20	-	mV
			-	0.5	-	%
Icc	Vin Quiescent Current	No load	-	50	-	μA
Ipd	Power-down current	-	-	0.1	-	μA

Table 3-6 Electrical Characteristics of LDO12RF

Typical values are at T_A = +27°C and all Current Values are dynamic, unless other-wise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vin	Input voltage	-	2.5	3.3	3.7	V
Vout (accuracy)	Output voltage	Default	-3	-	3	%
Vout	Output voltage	-	1.1	1.3	1.4	V
Iout	Output current	-	-	80	100	mA
Δ Vout, Δ Vout/Δ Iout	Load regulation	T=27 ℃, Vin=3.8V, @Iout=1 to 100mA	-	38	-	mV
			-	330	-	mΩ
Δ Vout, Δ Vout/Δ Vin	Line regulation	Iout=1mA @Vin=3.3 to 3.7V	-	3	-	mV
			-	0.2	-	%

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		Iout=100mA	-	8	-	mV
		@Vin=3.3V to 3.7V	-	0.5	-	%
Icc	Vin Quiescent Current	No load	-	50	-	μA
Ipd	Power-down current	-	-	0.1	-	μA

3.4 DC Electrical Characteristics

Table 3-7 DC Electrical Characteristics

PARAMETER	SYMBOL	MINIMUM	TYPICAL	MAXIMUM	UNIT
Input High Voltage	VIH	2.0	-	VDD33+0.3	V
Input Low Voltage	VIL	-0.3	-	0.8	V
Output High Voltage	VOH	2.4	-	-	V
Output Low Voltage	VOL	-	-	0.4	V
Input Leakage Current	IL	-	-	±1	μA
Tri-state Output Leakage Current	IOZ	-	-	±1	μA
Input capacitance	CI	-	-	8	pF
Output capacitance	CO	-	-	8	pF
Microphone Input Resistance	Rmic	-	5K	-	Ω
Headphone output load resistance	RHP	-	32	-	Ω

3.5 AC Electrical Characteristics

Table 3-8 32K/26M Oscillator Signal Timing

PARAMETER	MIN.	TYP.	MAX.	UNIT
XTAL32K Startup Time	-	500	-	ms
XTAL26M Startup Time	-	8	-	ms

3.6 Bluetooth RF Characteristics

Table 3-9 RF TX Characteristics

PARAMETER	MIN.	MIN..	TYP.	MAX.	REFERENCE
Output Power	dBm	-3	2	6	-
Power Control	dB	-	24	-	>=16
Frequency Range	GHz	2.4	-	2.4835	2.4~2.4835
Initial Carrier Frequency Tolerance	KHz	-50	-	50	-75~75
Carrier Frequency Drift	KHz/50us	-	5	20	<=20

Table 3-10 RF RX Characteristics

PARAMETER	UNIT	MIN.	TYP.	MAX.	REFERENCE
Sensitivity	dBm	-	-80	-	<=-70
Maximum Input Level	dBm	-20	-	-	>=-20

3.7 Analog Interface Characteristics

Table 3-11 Analog Interface Characteristics

PARAMETER	SYMBOL	MINIMUM	TYPICAL	MAXIMUM	UNIT
Microphone Input Resistance	Rmic	-	5K	-	Ω
Headphone output load resistance	RHP	-	External connected	-	Ω

3.8 Power-down and Sniff Supply Current

Table 3-12 Power-down and Sniff Supply Current

PARAMETER	MINIMUM	TYPICAL	MAXIMUM	UNIT
Supply current in power down mode	-	0	-	μA
Supply current in sniff mode	-	1	-	mA

Notes:

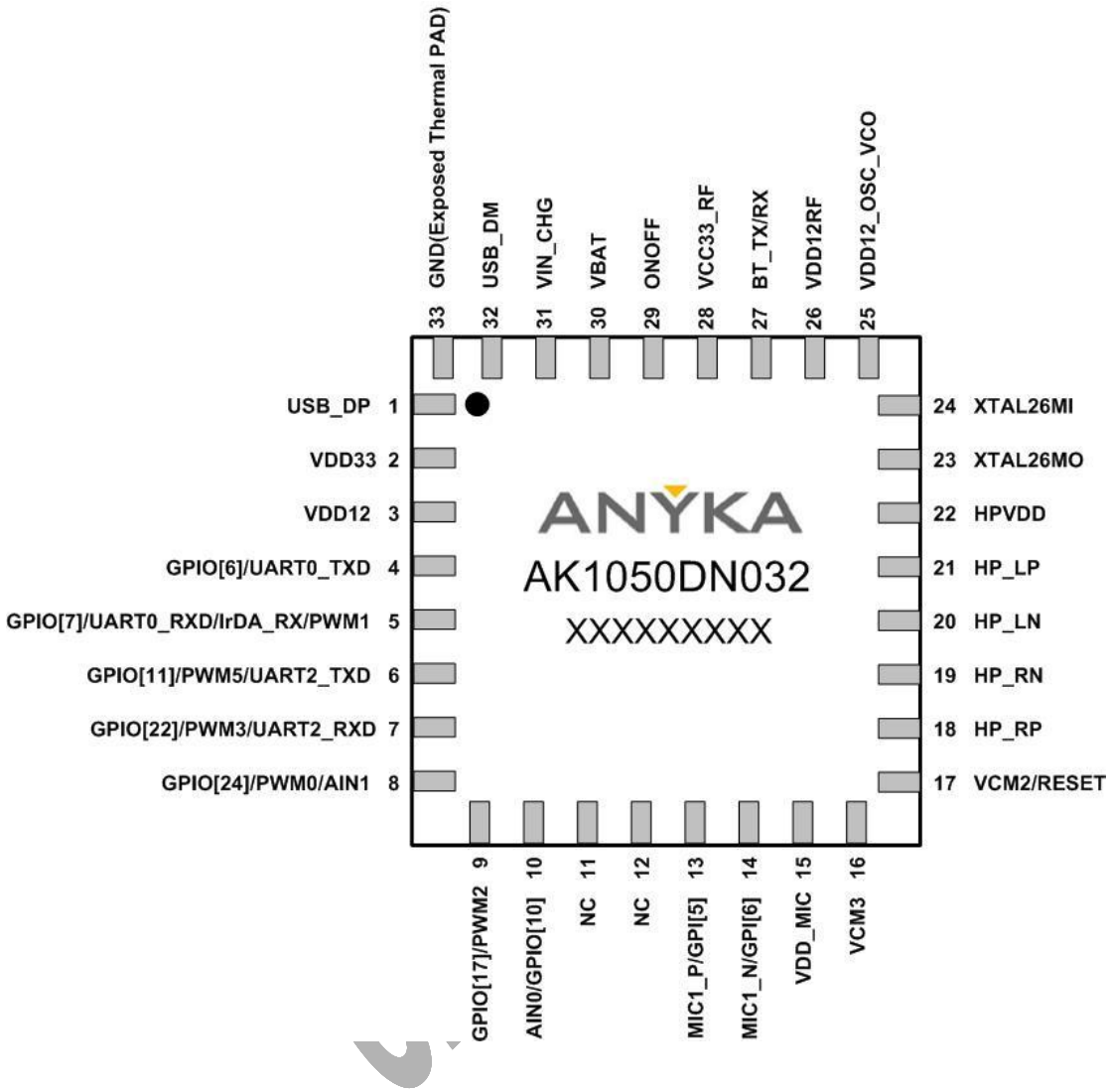
1. Power-down: All the modules are powered off.

2. Sniff: If Bluetooth module works in deep-sleep state of the sniff interval, the PLL is powered down and other modules (including CPU core) are clocked off. If Bluetooth module works in wakeup state of the sniff interval, Bluetooth module manages data transmission between slaves and masters, while other modules are clocked off.

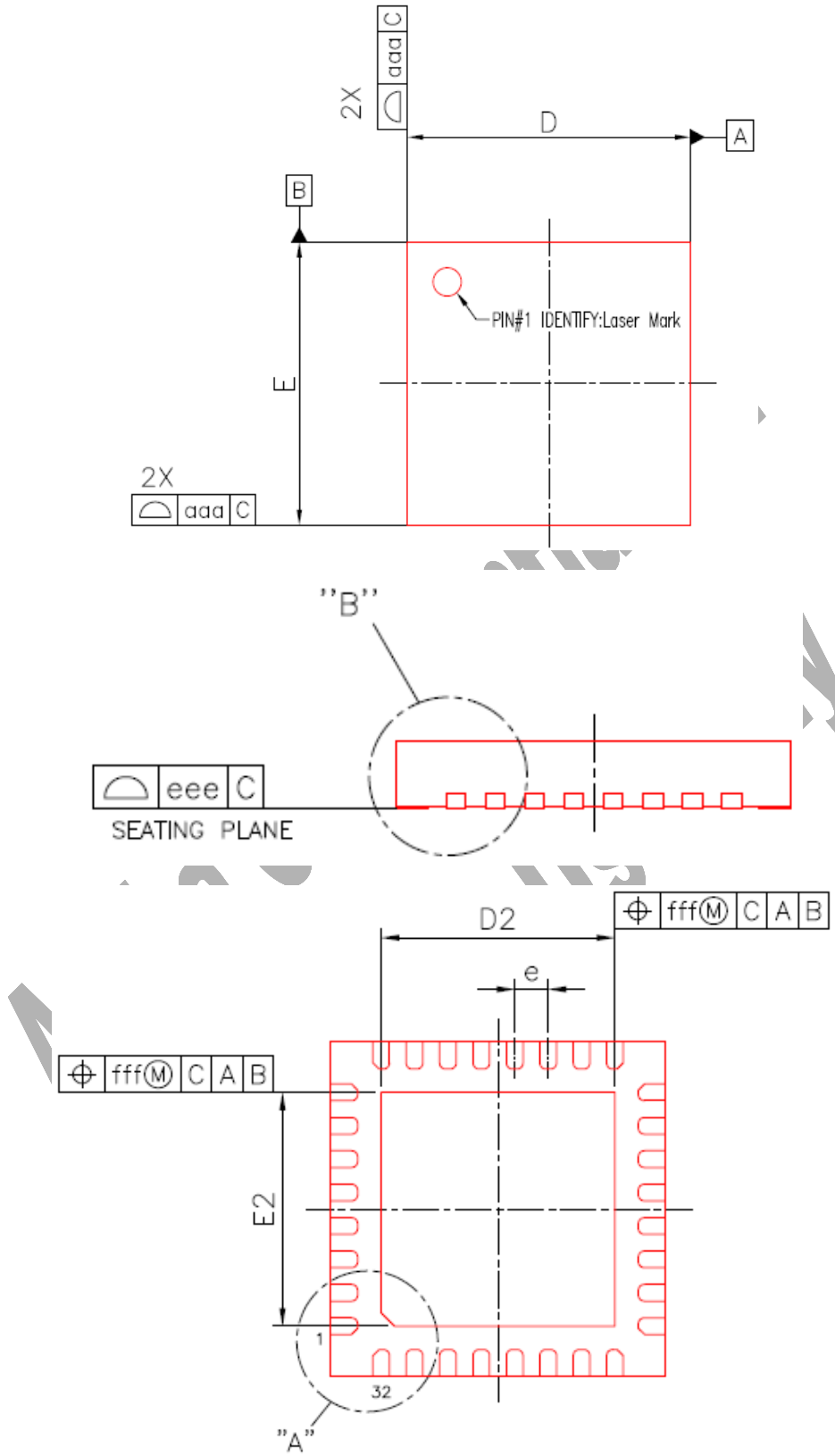
4 Package Information

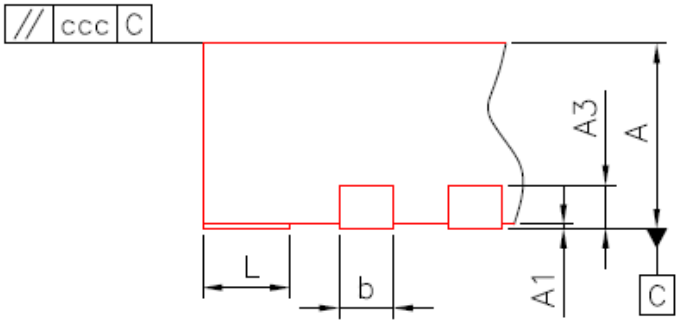
AK1050D is packaged in a 32-pin QFN with 5mm x 5mm x 0.85mm.

4.1 Pin Assignment



4.2 Package Information





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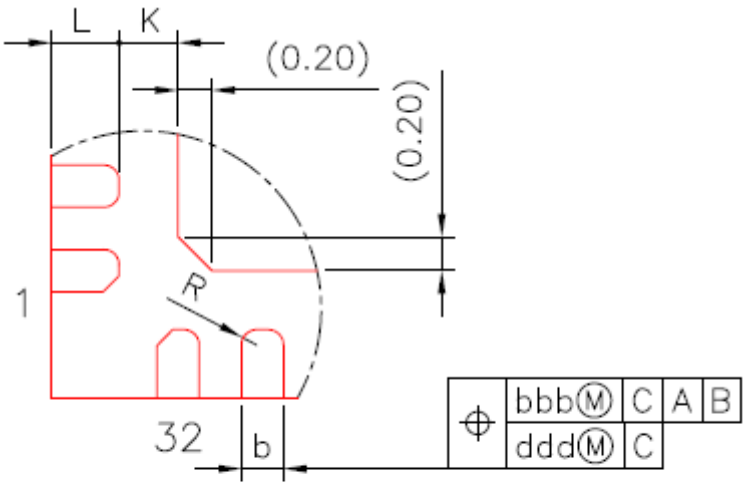

DETAIL : "A"

Symbol	DIMENSION (millimeter)		
	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
A3		0.20REF	
b	0.18	0.25	0.30
D/E		5.00BSC	
D2/E2	3.35	3.50	3.65
e		0.50 BSC	
L	0.35	0.40	0.45
K	0.20	-	-
R	0.09	-	-
aaa		0.15	

Symbol	DIMENSION (millimeter)		
	MIN	NOM	MAX
bbb		0.10	
ccc		0.10	
ddd		0.05	
eee		0.08	
fff		0.10	

5 Reflow Profile

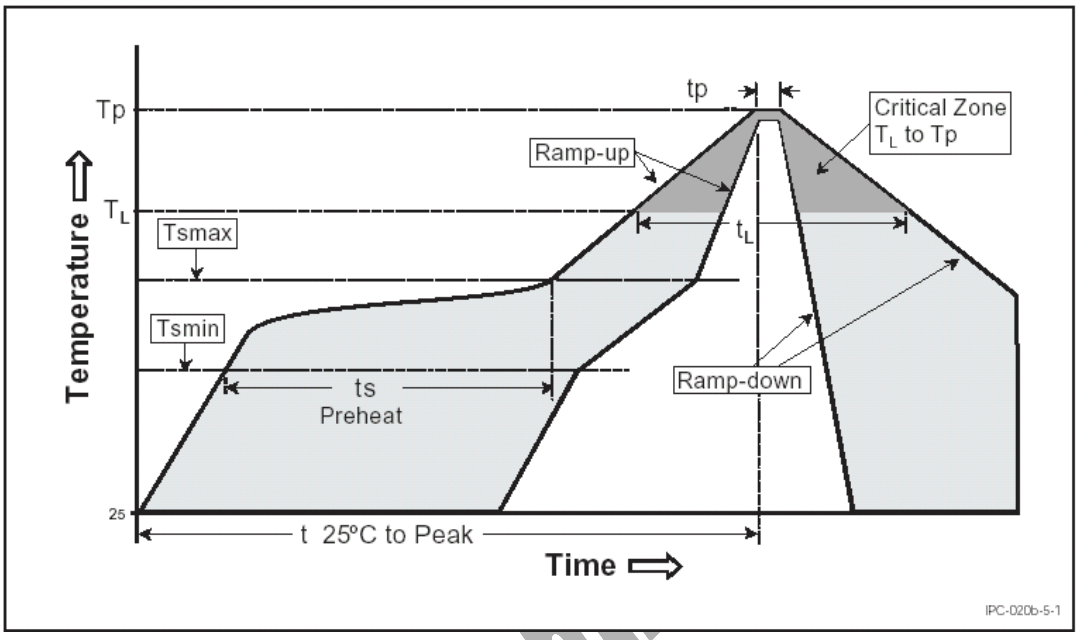

Figure 6-1 Recommended Reflow Profile

Table 6-1 Reflow Profile Condition

Profile Feature	Pb-Free Assembly
Average ramp-up rate (Ts_{max} to T_P)	2 ℃/second max
Preheat -Temperature Min(Ts_{min}) -Temperature Max(Ts_{max}) -Time (min to max) (ts)	150 ℃ 200 ℃ 60 – 180 seconds
Time maintained above: -Temperature (T_L) -Time (t_L)	217 ℃ 60 – 150 sec onds
Peak Temperature (T_P)	245+5/-5 ℃
Time within 5℃ of actual Peak Temperature(tp)	30 seconds max
Ramp-down Rate	3℃/second max

Profile Feature	Pb-Free Assembly
Time 25℃ to Peak Temperature	8 minutes max

Note: All temperatures refer to topside of the package, measured on the package body surface.

6 Storage and Baking

1. Shelf life in sealed bag: 12 months at < 30℃ and < 60% relative humidity (RH).
2. After bag is opened, device that will be subjected to reflow solder or other high temperature process must be:
   a) Mounted within: 168 hours of factory conditions < 30℃/60% RH or
   b) Stored at < 20% RH.
3. Devices require bake, before mounting, if:
   a) Humidity indicator card reads >= 20% when read at 25±5℃;
   b) 2a or 2b are not met.
4. If baking is required, device may be baked for 12 hours at 125℃±5℃.