RDA5869 Data Sheet

Bluetooth® Single-Chip for Headset/hand-free applications

Rev.1.3–10.2012

1 General Description

The RDA5869 is a highly-integrated mixed-signal SOC integrated with 2.4GHz RF transceiver compliant with Bluetooth core 2.1 and ARM7-based microprocessor baseband. It is ideal for wireless headset/hand-free device applications

The radio part of RDA5869 has been designed to provide low power, low cost, and robust applications for communications in the globally available 2.4 GHz unlicensed ISM band.

This single-chip RDA5869 is implemented in a standard digital 55nm CMOS process technology and requires minimal external components to provide total solutions especially for headset applications. The chip is packaged as 32- pin, 4 mm × 4 mm QFN.

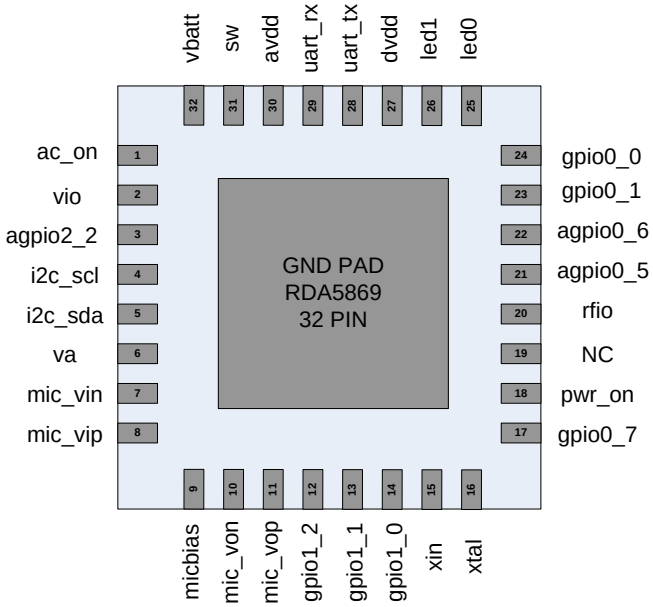

Figure 1-1. RDA5869 Top View

1.1 Features

- Fully integrated CMOS radio and ARM7-based baseband with on-chip ROM and RAM
- Compliant with Bluetooth 2.1 specification
- internal LDO and DC-DC buck
- on-chip voice codec with differential microphone in and speaker out ports
- Supporting 26MHz DCXO /TCXO
- Internal 32k LPO.
- Low power consumption
- Extremely small size chip package with minimum external components
- Supports for EEPROM
- Integrated internal programmable 8K-bit efuse
- LED control interface with programmable flash mode
- Friendly UART/I2C interface
- Integrated charger circuit

1.2 Applications

RDA5869 is tailored for the mono-headset bluetooth earphone applications.

2 Table of Contents

3 Function Description

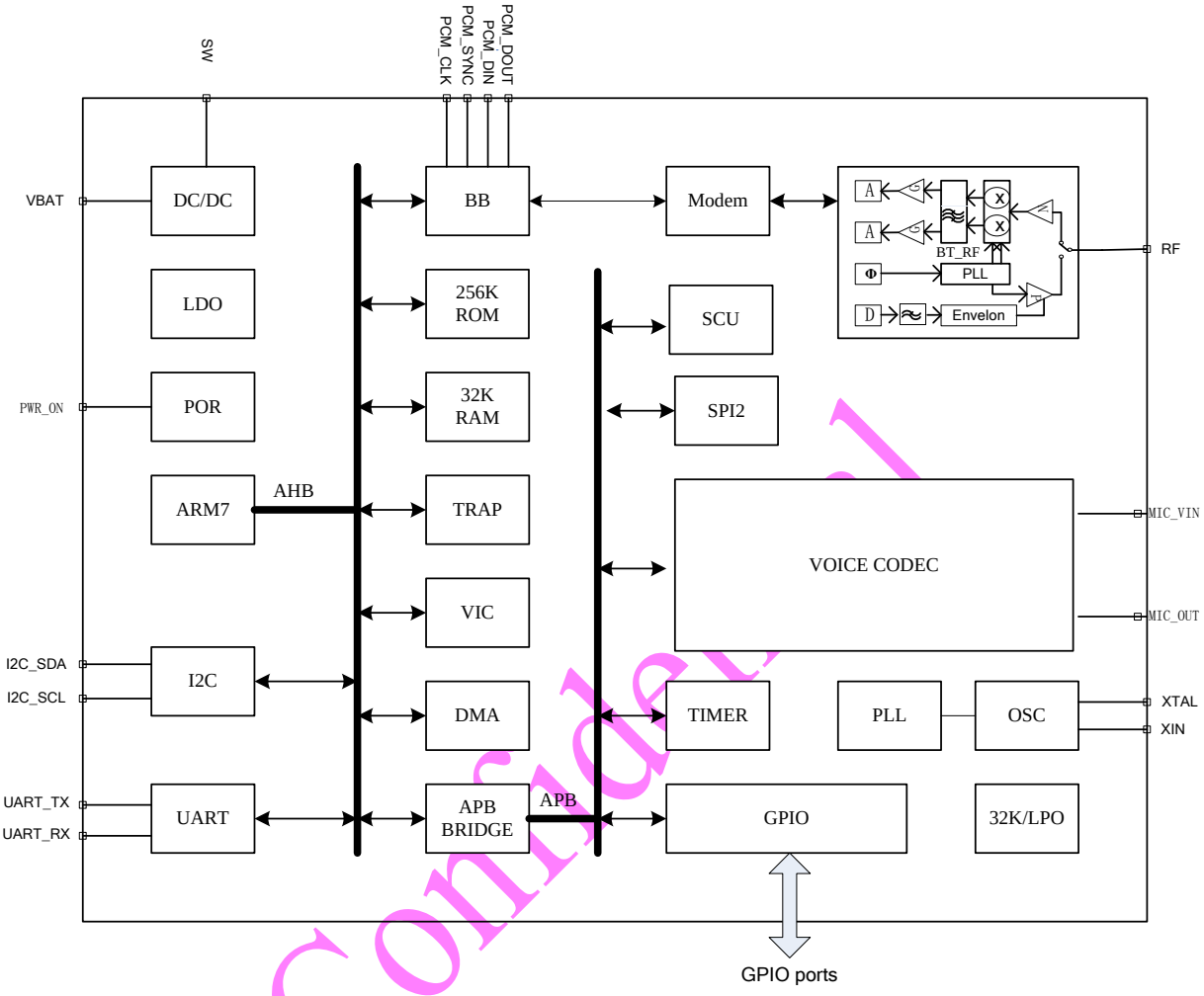

Figure 3-1. RDA5869 Functional Block Diagram

3.1 Radio

- Build-in TX/RX switch and on-chip balun
- Fully integrated frequency synthesizer without any external component
- Support DCXO or external reference clock direct input
- Programmable output power control meets Class 2 or Class 3 requirements
- High performance in receiver sensitivity
- Integrated channel-select filter

3.2 Auxiliary features

- On-chip low-dropout regulator to support battery power supply directly
- High power efficiency integrated DC-DC buck
- On-chip software controlled power management

3.3 Baseband

- Internal RAM allows fully-speed data transfer, mixed voice and data, and fully piconet operation
- Logic for forward error correction, header error control, access code correlation, CRC, demodulation , encryption bit stream generation, whitening and transmit pulse shaping
- Support eSCO and AFH
- Support up to Bluetooth v2.1

3.4 Voice codec

- Support A-law, μ-law and CVSD digitized audio CODEC in PCM interface
- Differential microphone analog input ports
- Differential analog speaker output ports

3.5 Interface

- Provides UART HCI interface, up-to 4Mbps
- Provides I2C interface for host to do configuration
- Provides PCM audio interface
- Provides 3-wire and 2-wire WIFI co-existence handshake interface

3.6 Bluetooth Stack

- Compliant with Bluetooth 2.1 specification

- Bluetooth HID profile version 1.0 compliant

3.7 Microprocessor Unit

The RDA5869 microprocessor unit executes software from the link control (LC) layer up to the application layer components that ensure adherence to the Bluetooth Human Interface Device (HID) profile. The microprocessor is based on an ARM7, 32-bit RISC processor with embedded ICE-RT debug and JTAG interface units. There is 256 KB of ROM for program storage and boot-up, 32 KB of RAM for scratch-pad data, and patch RAM code.

The internal boot ROM provides power-on reset flexibility, which enables the same device to be used in different HID applications with an external serial EEPROM. At power-up, the lowest layer of the protocol stack is executed from the internal ROM memory.

External patches may be applied to the ROM-based firmware to provide flexibility for bug fixes and feature additions. The device can also support the integration of user applications.

3.8 EEPROM Interface

The EEPROM can contain customer application configuration information including: application code, configuration data, patches, pairing information, BD_ADDR, baud rate, and so on.

Native support for the Microchip® 24LC128, Microchip 24AA128, and ST Micro® M24128-BR is included.

3.9 LED and PWM

The rda5869 has 2 internal LEDs and PWM. The PWM module consists of the following:

- LED 0-1 and PWM
- Each of the two LED and PWM channels contains the following registers:

– 16-bit initial value register (read/write)

– 16-bit toggle register (read/write)

4 Electrical Characteristics

Table 4-1 DC Electrical Specification (Recommended Operation Conditions):

SYMBOL	DESCRIPTION	MIN	TYP	MAX	UNIT
VBAT	Supply Voltage from battery or LDO	3.5	4.0	4.2	V
T_{amb}	Ambient Temperature	-20	27	+50	℃
V_{IL}	CMOS Low Level Input Voltage	0		0.3*VIO	V
V_{IH}	CMOS High Level Input Voltage	0.7*VIO		VIO	V
V_{TH}	CMOS Threshold Voltage		0.5*VIO		V

Notes:

1. VIO=2.8~3.3V
2. Battery minimum storage voltage=2V (typical, normal temperature).

Table 4-2 DC Electrical Specification (Absolute Maximum Ratings):

SYMBOL	DESCRIPTION	MIN	TYP	MAX	UNIT
T_{amb}	Ambient Temperature	-20		+60	°C
I_{IN}	Input Current	-10		+10	mA
V_{IN}	Input Voltage	-0.3		VIO+0.3	V
V_{lna}	LNA Input Level			+5	dBm

Table 4-3 DCDC Power consumption specification

(VBAT = 4.0 V, VIO = 2.8V, T_A = +27℃, RF 3.3dBm, DCDC mode unless otherwise specified)

STATE	DESCRIPTION	Condition	TYP	UNIT
Headset voice			22	mA
Headset SNIFF	500ms cycle	NO INQUIRE and PAGE SCAN	0.8	mA
HCI only active			4.2	mA
Both SCAN	1.28S cycle	INQUIRE and PAGE SCAN	0.75	mA
DeepSleep			250	μA
internal LDO off	LDO_ON off		25	μA

Table 4-4 Battery Charger specification

(AC_ON = 5 V, VIO = 2.8V, T_A = +27℃,LDO off mode unless otherwise specified)

STATE	Condition	MIN	TYP	MAX	UNIT
Input voltage		4.5	5	6	V
Trickle Charging mode current	Vbatt < 3V		52		mA
Constant current charging mode current	3V < Vbatt < 4.2V		126		mA
Float voltage			4.2		V
Sleep mode current			6		uA

Table 4-5 Efuse specification

(VIO = 5V, T_A = +27℃, writing mode unless otherwise specified)

STATE	Condition	MIN	TYP	MAX	UNIT
Efuse writing voltage range		3.5	4	5	V
Read mode VIO voltage		2.7	3	3.3	V

5 Radio Characteristics

Table 5-1 Receiver Characteristics ------ Basic Data Rate

(VBAT = 4.0 V, TA = 27°C, unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
General specifications						
Sensitivity @0.1% BER			-87	-82	/	dBm
Maximum received signal@0.1% BER			10	/	/	dBm
C/I c-channel			/	+10	/	dB
Adjacent channel selectivity C/I		F=F0 + 1MHz	/	-20	/	dB
		F=F0 - 1MHz	/	-15	/	dB
		F=F0 + 2MHz	/	-35	/	dB
		F=F0 - 2MHz	/	-35	/	dB
		F=F0 + 3 MHz	/	-35	/	dB
		F=F0 - 3MHz	/	-36	/	dB
Adjacent channel selectivity C/I		$F=F_{image}$	/	/	0	dB
Out-of-band blocking performance		30MHz–2000MHz	-15	/	/	dBm
		2000MHz–2400MHz	-25	/	/	dBm
		2500MHz–3000MHz	-25	/	/	dBm
		3000MHz–12.5GHz	-15	/	/	dBm

Notes:

Table 5-2 Transmit Characteristics ------ Basic Data Rate

(VBAT = 4.0V, TA = 27 °C, unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
General specifications						
Maximum RF transmit power			/	3.3	5	dBm
RF power control range			10	/	/	dB
20dB band width			/	0.9	/	MHz
Adjacent channel transmit power		F=F0 + 1MHz	/	-20	/	dBm
		F=F0 - 1MHz	/	-20	/	dBm
		F=F0 + 2MHz	/	-40	/	dBm
		F=F0 - 2MHz	/	-40	/	dBm
		F=F0 + 3MHz	/	-48	/	dBm
		F=F0 - 3MHz	/	-48	/	dBm
		F=F0 + >3MHz	/	-50	/	dBm
		F=F0 - >3MHz	/	-50	/	dBm
$\triangle f1_{avg}$ Maximum modulation			141	156	164	kHz
$\triangle f2_{max}$ Minimum modulation			/	141	/	kHz
$\triangle f2_{avg}/\triangle f1_{avg}$			/	0.9	/	/
ICFT			/	-1	/	kHz
Drift rate			-1.4	0.9	+1.2	kHz/50us
Drift (1 slot packet)			/	4	/	kHz
Drift (5 slot packet)			/	4.4	/	kHz

Notes:

1. power control range could be tuned for 20dB.

6 Voice Codec Characteristics

Table 6-1 microphone input characteristics

(VA=2.7V, VIO = 2.8V, T_A = +27℃)

Description	Condition	MIN	TYP	MAX	UNIT
Input voltage scale at max gain		/	6	/	mV
Input voltage scale at min gain		/	300	/	mV
Gain resolution		/	2	/	dB
THD@1kHz	Gain=0dB,300mVpp input	/	60	/	dB
Bandwidth		/	2.8	/	kHz

Table 6-2 speaker output characteristics

(VA=2.7V, VIO = 2.8V, T_A = +27℃)

Description	Condition	MIN	TYP	MAX	UNIT
Output voltage full scale swing	Load=32ohm, 0.1THD	/	0.64	1.8	Vpp
Output -3dB bandwidth			2		kHz
THD@1kHz	full scale output = 1.8Vpp	/	60	/	dB
Gain resolution			2		dB

Table 6-3 auxiliary ADC characteristics

(VIO = 2.8V, T_A = +27℃)

Description	Condition	MIN	TYP	MAX	UNIT
resolution		/	8	/	bits
Minimum input voltage		/	20	50	mV
Maximum input voltage		/	/	1.5	V
LSB		/	5	/	mV
bandwidth		/	10	/	kHz

7 Pins Description

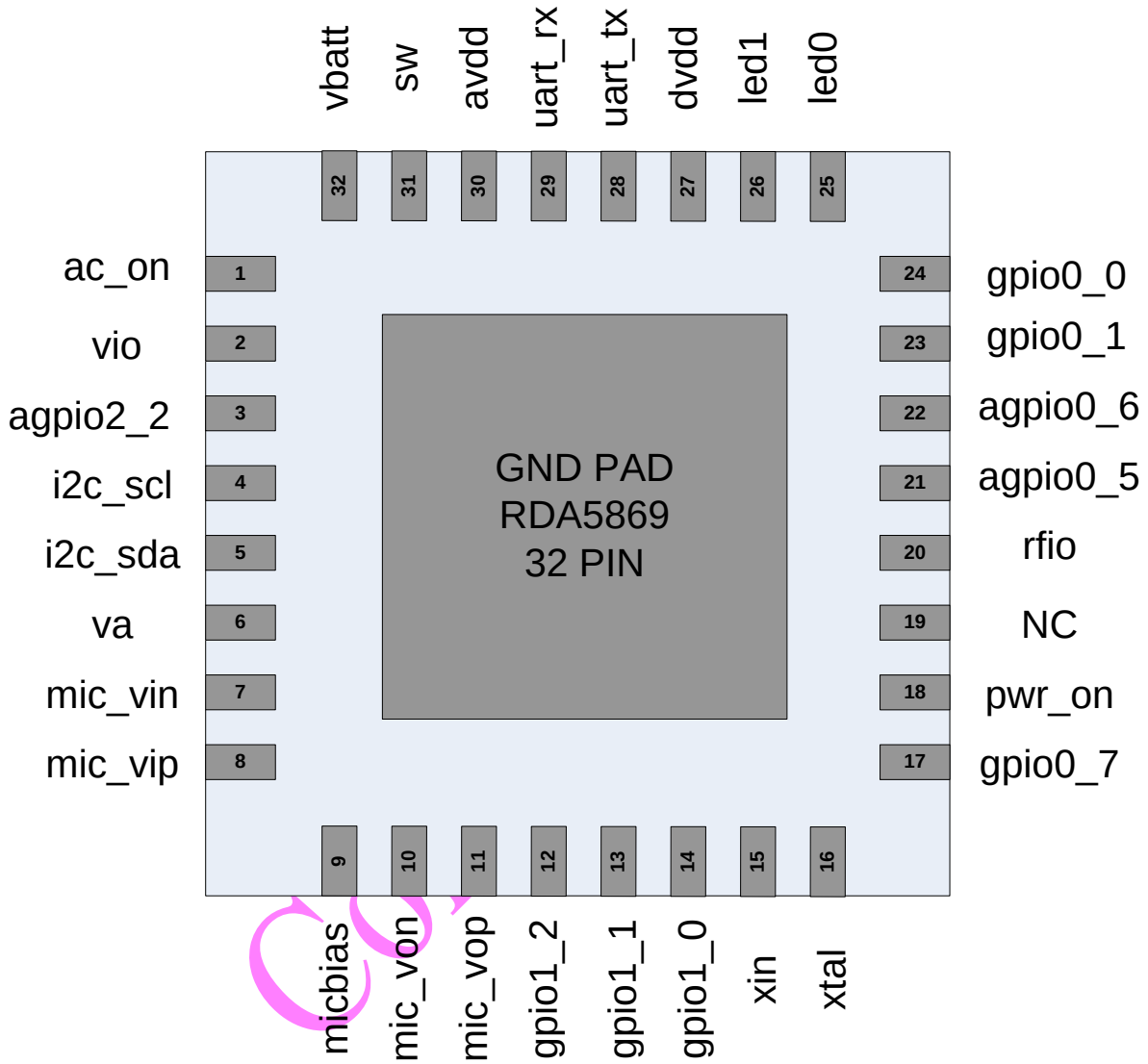

Figure 7-1. RDA5869 Top View

Table 7-1 RDA5869 Pins Description

PIN	NO.	DESCRIPTION
AC_ON	1	Charger DC voltage supply (5V)
VIO	2	External decouple capacitor port or power supply for ext IO (3V)
AGPIO2_2	3	Programmable analog/digital general purpose I/O port
I2C_SCL	4	I2C interface Clock signal
I2C_SDA	5	I2C interface Data signal
VA	6	External decouple capacitor port for codec voltage supply
MIC_VIN	7	Negative analog input from the microphone
MIC_VIP	8	Positive analog input from the microphone
MICBIAS	9	Voltage output for codec external components
MIC_VON	10	Negative analog output to the speaker
MIC_VOP	11	Positive analog output to the speaker
GPIO1_2	12	Programmable digital general purpose I/O port. PCM_CLK
GPIO1_1	13	Programmable digital general purpose I/O port. PCM_SYNC
GPIO1_0	14	Programmable digital general purpose I/O port. PCM_DIN
XIN	15	26Mhz crystal input or external clock input
XTAL	16	26Mhz crystal input
GPIO0_7	17	Programmable digital general purpose I/O port. PCM_DOUT
PWR_ON	18	Power on enable(effective 3V)
NC	19	Non-connected
RFIO	20	Bluetooth RF signal I/O port
AGPIO0_5	21	Programmable analog/digital general purpose I/O port
AGPIO0_6	22	Programmable analog/digital general purpose I/O port
GPIO0_1	23	Programmable digital general purpose I/O port
GPIO0_0	24	Programmable digital general purpose I/O port
LED0	25	LED 0 control
LED1	26	LED 1 control
DVDD	27	Decouple Capacitor (1.2V)
UART_TX	28	UART data output
UART_RX	29	UART data input
AVDD	30	IO power supply (1.8V)
SW	31	Internal DC/DC switch voltage output
VBAT	32	Battery power supply

8 Application Circuit

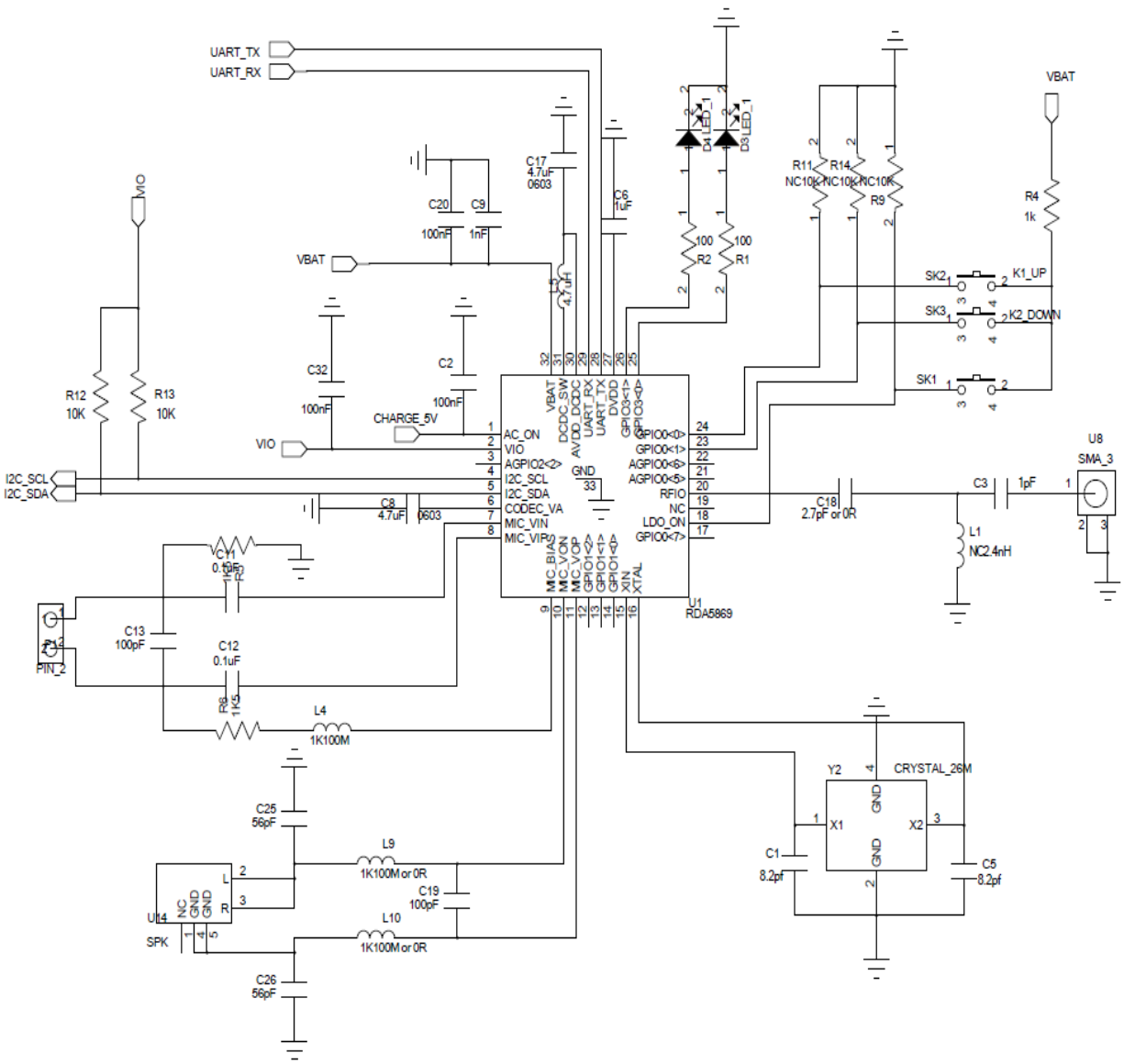

Figure 8-1 Application diagram

9 Package Physical Dimension

The package is lead-free and RoHS-compliant.

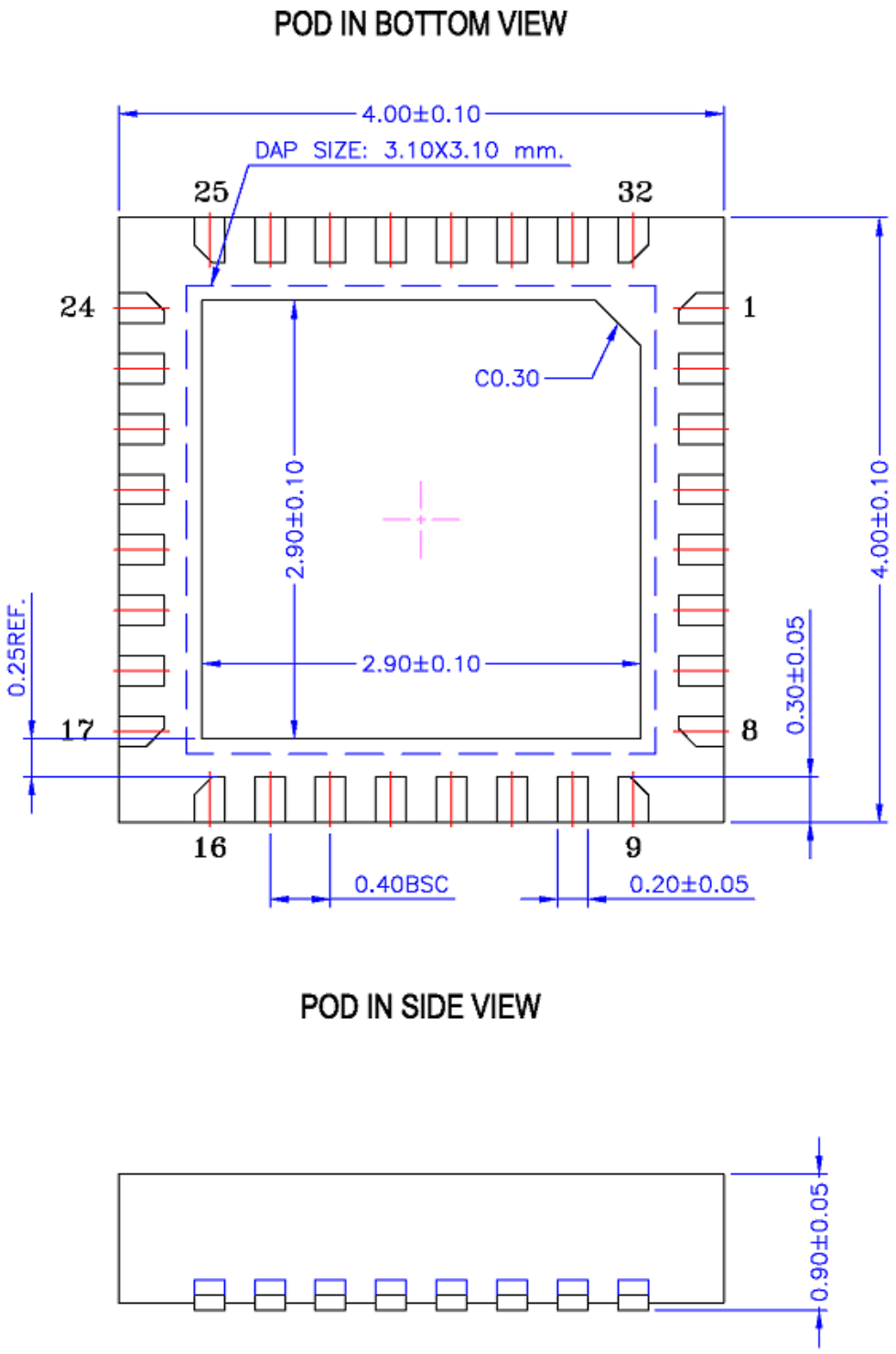

Figure9-1. 32-Pin 4x4 Quad Flat No-Lead (QFN)

10 PCB Land Pattern

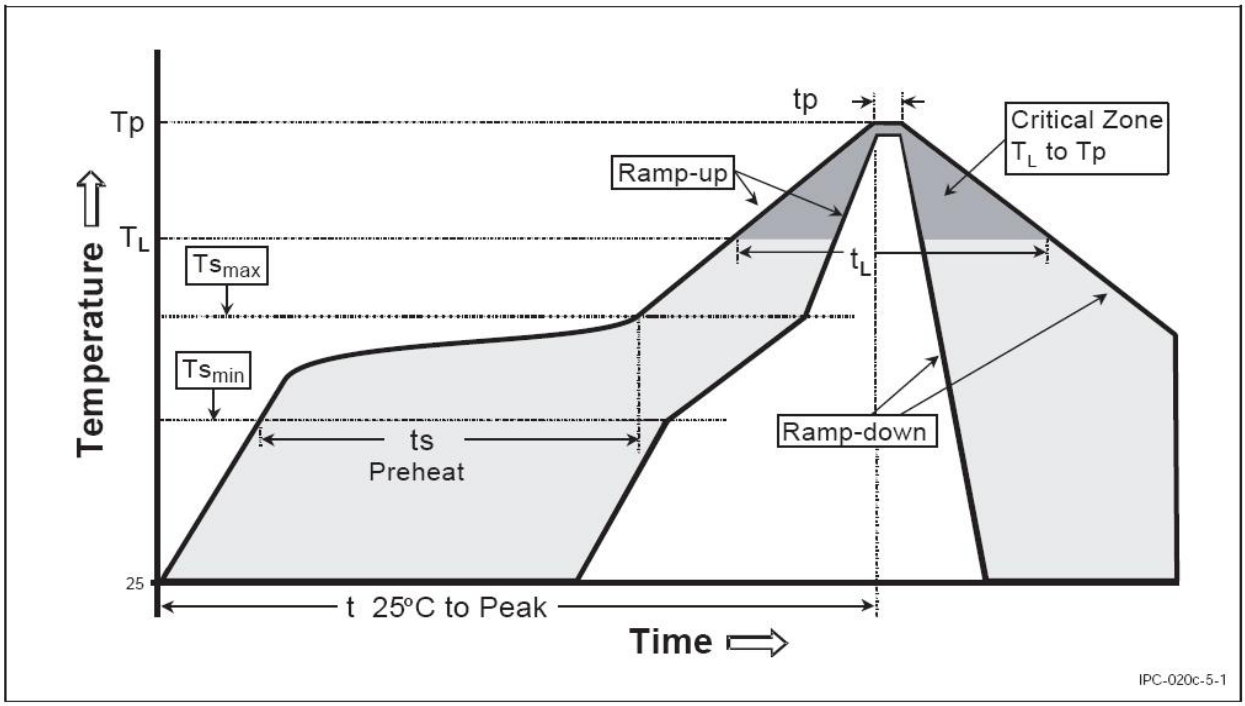

Figure 10-1.Classification Reflow Profile

Table 10-1 Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average Ramp-Up Rate (TSmax to Tp)	3 ℃/second max.	3 ℃/second max.
Preheat -Temperature Min (Tsmin) -Temperature Max (Tsmax) -Time (tsmin to tsmax)	 100 ℃ 100 ℃ 60-120 seconds	 150 ℃ 200 ℃ 60-180 seconds
Time maintained above: -Temperature (TL) -Time (tL)	 183 ℃ 60-150seconds	 217℃ 60-150 seconds
Peak /Classification Temperature(Tp)	See Table 9-2	See Table 9-3
Time within 5 oC of actual Peak Temperature (tp)	10-30 seconds	20-40 seconds
Ramp-Down Rate	6 ℃/second max.	6 ℃/seconds max.
Time 25 oC to Peak Temperature	6 minutes max.	8 minutes max.

Table 10-2 Pb-free Process – Package Peak Reflow Temperatures

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

Table 10-3 Pb-free Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm3 ＜350	Volume mm3 350-2000	Volume mm3 ＞2000
＜1.6mm	260 + 0 ℃ *	260 + 0 ℃ *	260 + 0 ℃ *
1.6mm – 2.5mm	260 + 0 ℃ *	250 + 0 ℃ *	245 + 0 ℃ *
≥2.5mm	250 + 0 ℃ *	245 + 0 ℃ *	245 + 0 ℃ *
*Tolerance : The device manufacturer/supplier shall assure process compatibility up to and including the stated classification temperature(this mean Peak reflow temperature + 0 ℃. For example 260+ 0 ℃) at the rated MSL Level.			

Note 1: All temperature refer topside of the package. Measured on the package body surface.

Note 2: The profiling tolerance is + 0 ℃, - X ℃ (based on machine variation capability)whatever is required to control the profile process but at no time will it exceed – 5 ℃. The producer assures process compatibility at the peak reflow profile temperatures defined in Table 13-3.

Note 3: Package volume excludes external terminals(balls, bumps, lands, leads) and/or non integral heat sinks.

Note 4: The maximum component temperature reached during reflow depends on package the thickness and volume. The use of convection reflow processes reduces the thermal gradients between packages. However, thermal gradients due to differences in thermal mass of SMD package may sill exist.

Note 5: Components intended for use in a “lead-free” assembly process shall be evaluated using the “lead free” classification temperatures and profiles defined in Table13-1, 13-2, 13-3 whether or not lead free.

RoHS Compliant

The product does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated biphenyl ethers (PBDE), and are therefore considered RoHS compliant.

ESD Sensitivity

Integrated circuits are ESD sensitive and can be damaged by static electricity. Proper ESD techniques should be used when handling these devices.

11 User Manual of Software

RDA5869 has two incompatible modes / protocol for different using propose. And it can be controlled by the software.

SPP/OPP Mode

This mode is using for transfer data, user defined command or protocol and some similar proposes by UART.
The commands and events of this mode as follow:

Command	DATA
Start SPP Profile	0x01 0x01 0xFE 0x01 0x10
Send Data	0x01 0x02 0xFE (Data Length (One byte)) Data

Event	DATA
Receive Connection	0x04 0xFF 0x08 0x60 (State: 0x01 for connection 0x00 for disconnection) (Address (Six bytes))
Receive Data	0x04 0xFF (Data Length + 1 (One byte)) 0x61 Data

Mono-Headset Mode

This mode is using for mono-headset Bluetooth earphone.
The function, statue and action as follow:

FUNCTION	STATUE	ACTION	LED	SPEAKER
Power On	Power off	Long Press Power 3s	Blue Flush 1s	One Long
Pair	Power off	Long Press Power 6s	Blue Red Long Flush	One Short
Pair Success	Power On		Blue Flush 2s	
Power off	Power On	Long Press Power 5s	Blue Flush 2s	One Long
Unconnected	Power On		Red Flush 1s (Cyc. 11s)	
Connected	Power On		Blue Flush 1s (Cyc. 11s)	
Low Power	Power On		Red Flush 1s (Cyc. 2s)	
Auto Power off	Power On	Unconnected 15min		
Active A Call	Receive A Call	Press Power	Blue Flush 1s (Cyc. 3s)	
Release A Call	Active Call	Press Power		
Reject A Call	Receive A Call	Long Press Power 3s		

12 Change List

REV	DATE	AUTHER	CHANGE DESCRIPTION
V1.0	1/18/2012	Xu Donglin	Initial version.
V1.1	5/16/2012	Xie Zichen	Add user manual
V1.2	9/10/2012	Xu Donglin	Update the parameters.
V1.3	10/29/2012	Yang Guanghui	Define multi-function port

13 Contact Information

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