

Technical Description

Equipment Under Test (EUT) is a Bluetooth Keyboard. After pairing with a mobile device (such as smartphone), the EUT act as a wireless keyboard. The Bluetooth module in the EUT is operating in the frequency range from 2402MHz to 2480MHz (79 channels with 1MHz channel spacing). The EUT is powered by USB port (5VDC) and/or 3.7VDC internal rechargeable Li-ion battery.

2.4GHz Bluetooth Module:

Modulation Type: GFSK

Antenna Type: Integral, Internal (PCB Trace)

Frequency Range: 2402MHz - 2480MHz, 1MHz channel spacing, 79 channels

Nominal field strength is 91.8dB μ V/m @ 3m

Production Tolerance of field strength is +/- 3dB

Antenna gain is 0dBi

The functions of main ICs are mentioned below.

- 1) RDA5871 (U1) acts as the 2.4GHz radio core of Bluetooth which is also integrating with built-in interface for keyboard.
- 2) The 26MHz crystal (Y1) provides system clock for RDA5871 (U1).
- 3) 24C64 (U2) is 64kbit serial flash EEPROM for parameter storage.
- 4) EM4054 (U3) is Li-ion battery charger IC

Channel Frequency Table of Bluetooth Module

CH. NO.	FRE.	Hex Value		CH. NO.	FRE.	Hex Value		CH. NO.	FRE.	Hex Value		CH. NO.	FRE.	Hex Value
CH0	2402MHz	0		CH26	2428MHz	1A		CH52	2454MHz	34		CH78	2480MHz	4E
CH1	2403MHz	1		CH27	2429MHz	1B		CH53	2455MHz	35				
CH2	2404MHz	2		CH28	2430MHz	1C		CH54	2456MHz	36				
CH3	2405MHz	3		CH29	2431MHz	1D		CH55	2457MHz	37				
CH4	2406MHz	4		CH30	2432MHz	1E		CH56	2458MHz	38				
CH5	2407MHz	5		CH31	2433MHz	1F		CH57	2459MHz	39				
CH6	2408MHz	6		CH32	2434MHz	20		CH58	2460MHz	3A				
CH7	2409MHz	7		CH33	2435MHz	21		CH59	2461MHz	3B				
CH8	2410MHz	8		CH34	2436MHz	22		CH60	2462MHz	3C				
CH9	2411MHz	9		CH35	2437MHz	23		CH61	2463MHz	3D				
CH10	2412MHz	A		CH36	2438MHz	24		CH62	2464MHz	3E				
CH11	2413MHz	B		CH37	2439MHz	25		CH63	2465MHz	3F				
CH12	2414MHz	C		CH38	2440MHz	26		CH64	2466MHz	40				
CH13	2415MHz	D		CH39	2441MHz	27		CH65	2467MHz	41				
CH14	2416MHz	E		CH40	2442MHz	28		CH66	2468MHz	42				
CH15	2417MHz	F		CH41	2443MHz	29		CH67	2469MHz	43				
CH16	2418MHz	10		CH42	2444MHz	2A		CH68	2470MHz	44				
CH17	2419MHz	11		CH43	2445MHz	2B		CH69	2471MHz	45				
CH18	2420MHz	12		CH44	2446MHz	2C		CH70	2472MHz	46				
CH19	2421MHz	13		CH45	2447MHz	2D		CH71	2473MHz	47				
CH20	2422MHz	14		CH46	2448MHz	2E		CH72	2474MHz	48				
CH21	2423MHz	15		CH47	2449MHz	2F		CH73	2475MHz	49				
CH22	2424MHz	16		CH48	2450MHz	30		CH74	2476MHz	4A				
CH23	2425MHz	17		CH49	2451MHz	31		CH75	2477MHz	4B				
CH24	2426MHz	18		CH50	2452MHz	32		CH76	2478MHz	4C				
CH25	2427MHz	19		CH51	2453MHz	33		CH77	2479MHz	4D				

Single-Chip Bluetooth® Human Input Device for Keyboard

Rev.1.1–9.2012

1 General Description

The RDA® RDA5871 is a Bluetooth 2.1- compliant, stand-alone baseband processor with an integrated 2.4 GHz transceiver. It is ideal for wireless input device applications including game controllers, keyboards, remote controls and mouse. Built-in firmware adheres to the Bluetooth Human Interface Device (HID) profile.

The RDA5871 radio has been designed to provide low power, low cost, and robust communications for applications operating in the globally available 2.4 GHz unlicensed ISM band. It is fully compliant with Bluetooth Radio Specification 2.1.

The single-chip Bluetooth transceiver is a monolithic component implemented in a standard digital CMOS process and requires minimal external components to make a fully compliant Bluetooth device. The RDA5871 is available in one package option, a 48-pin, 6 mm × 6 mm QFN.

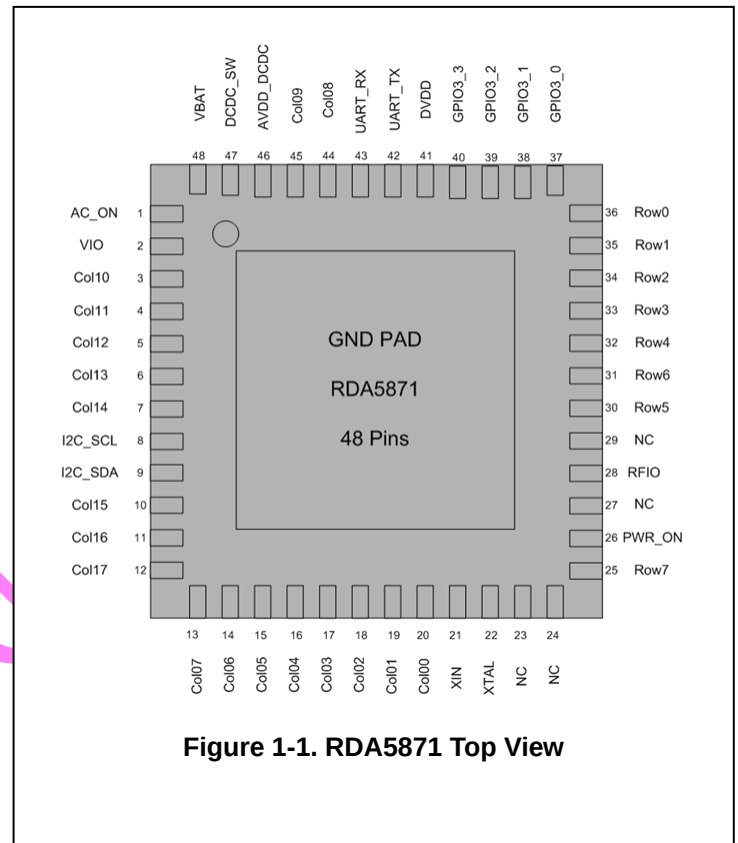


Figure 1-1. RDA5871 Top View

1.1 Bluetooth Features

- On-chip support for common keyboard and mouse interfaces eliminates external processor
- Bluetooth HID profile version 1.0 compliant
- CMOS single-chip fully-integrated radio and baseband
- Integrated battery charger
- Compliant with Bluetooth 2.1 specification
- ARM7-based microprocessor with on-chip ROM and RAM
- Meet class 2 and class 3 transmitting power requirement
- Supporting 26MHz DCXO /TCXO
- Low power consumption
- Minimum external component
- Internal 32k LPO.
- Support for EEPROM
- Build-in code patching which supports up to 16 KB patching code.
- Built-in four 8-bit resolution ADC channels
- Programmable keyscan matrix interface, up to 8 × 18 key-scanning matrix

1.2 Applications

RDA5871 is the SOC tailored for the wireless bluetooth keyboard.

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2 Table of Contents

1	General Description	1
1.1	Bluetooth Features	1
1.2	Applications	2
2	Table of Contents.....	2
3	Function Description.....	3
3.1	Radio	4
3.2	Auxiliary features.....	4
3.3	Baseband.....	4
3.4	Interface	4
3.5	Bluetooth Stack.....	4
3.6	Microprocessor Unit	4
3.7	LED and PWM.....	5
3.8	EEPROM Interface.....	5
3.9	Keyboard scanning-matrix.....	5
4	Electrical Characteristics	6
5	Radio Characteristics.....	8
6	Pins Description.....	10
7	Application Circuit.....	13
8	Package Physical Dimension	14
9	PCB Land Pattern.....	15
10	Change List.....	17
11	Contact Information	18

3 Function Description

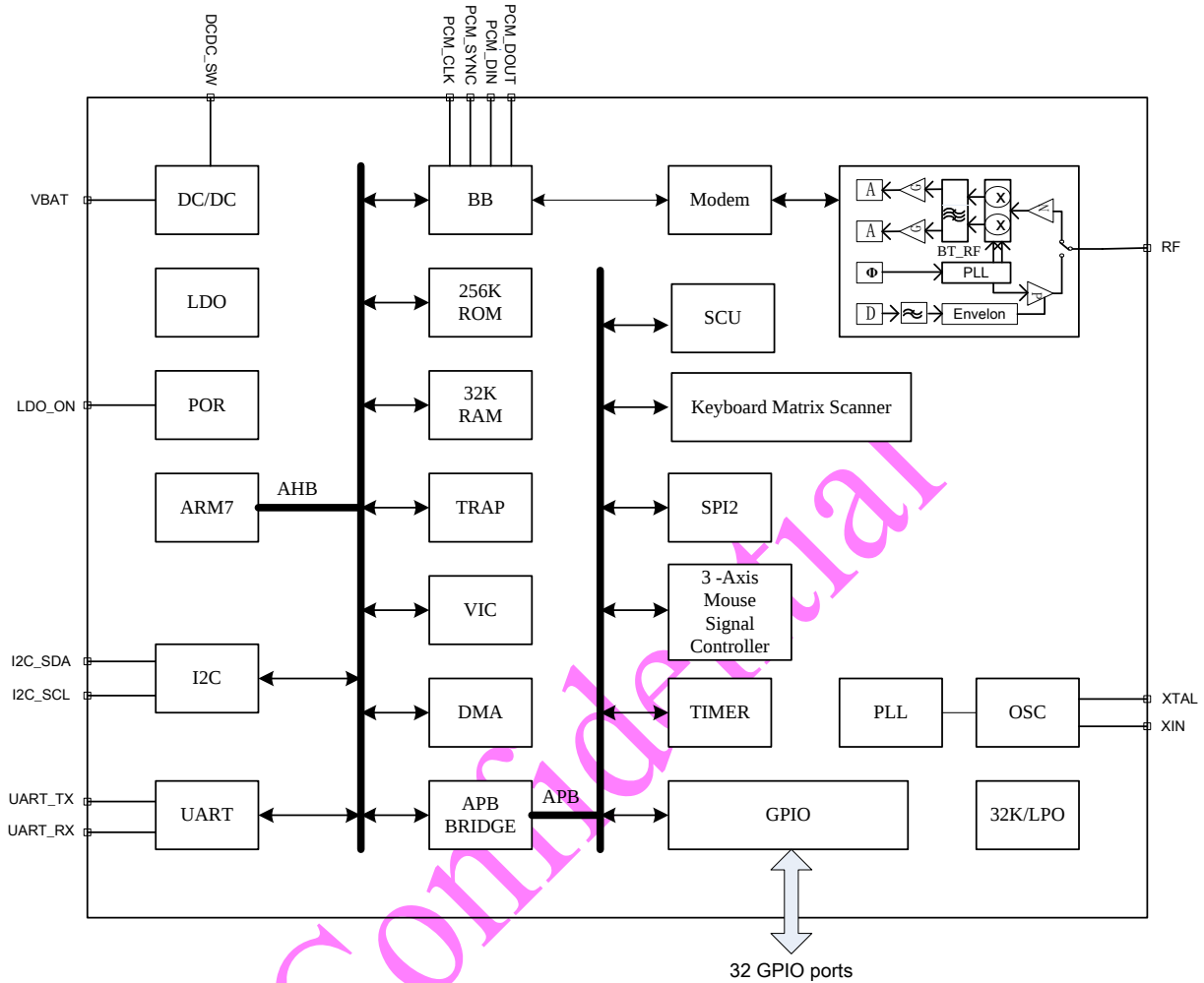


Figure 3-1. RDA5871 Functional Block Diagram

3.1 Radio

- ◆ Build-in TX/RX switch
- ◆ Fully integrated 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 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

3.5 Bluetooth Stack

- ◆ Compliant with Bluetooth 2.1 specification
- ◆ Bluetooth HID profile version 1.0 compliant

3.6 Microprocessor Unit

The RDA5871 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.

3.7 LED and PWM

The rda5871 has 4 internal LED driver circuits and PWM. The PWM module consists of the following:

- ◆ LED 0-3 and PWM
- ◆ Each of the four LED and PWM channels contains the following registers:
 - 16-bit initial value register (read/write)
 - 16-bit toggle register (read/write)

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 Keyboard scanning-matrix

With 8 rows and up to 18 columns scanning-matrix, rda5871 can support most applications for bluetooth keyboard.

4 Electrical Characteristics

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

SYMBOL	DESCRIPTION	MIN	TYP	MAX	UNIT
V _{BAT}	Supply Voltage from battery or LDO	3.5	4.0	4.2	V
T _{amb}	Ambient Temperature	-20	27	+50	°C
V _{IL}	CMOS Low Level Input Voltage	0		0.3*V _{IO}	V
V _{IH}	CMOS High Level Input Voltage	0.7*V _{IO}		V _{IO}	V
V _{TH}	CMOS Threshold Voltage		0.5*V _{IO}		V

Notes:

1. V_{IO}=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		V _{IO} +0.3	V
V _{Ina}	LNA Input Level			+5	dBm

Table 4-3 DCDC Power consumption specification

(V_{BAT} = 4.0 V, V_{IO} = 2.8V, T_A = +27°C, RF 3.3dBm, DCDC mode unless otherwise specified)

STATE	Condition	MIN	TYP	MAX	UNIT
Keyboard input active		6	7	/	mA
connected SNIFF	500ms cycle		1.1		mA
Both SCAN	INQUIRE and PAGE SCAN 1.28S cycle		0.8		mA
DeepSleep			250		μA
internal LDO off			25		μA

Table 4-4 Battery Charger specification

(AC_ON = 5 V, V_{IO} = 2.8V, T_A = +27°C, LDO off mode unless otherwise specified)

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

Table 4-5 Efuse specification(V_{IO} = 5V, T_A = +27°C, 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

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5 Radio Characteristics

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

(VBAT = 4.0 V, TA = 27°C, dcdc mode 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
$\Delta f_{1_{avg}}$	Maximum modulation		141	156	164	kHz
$\Delta f_{2_{max}}$	Minimum modulation		/	141	/	kHz
$\Delta f_{2_{avg}}/\Delta f_{1_{avg}}$			/	0.9	/	/
	ICFT		/	-4	/	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 Pins Description

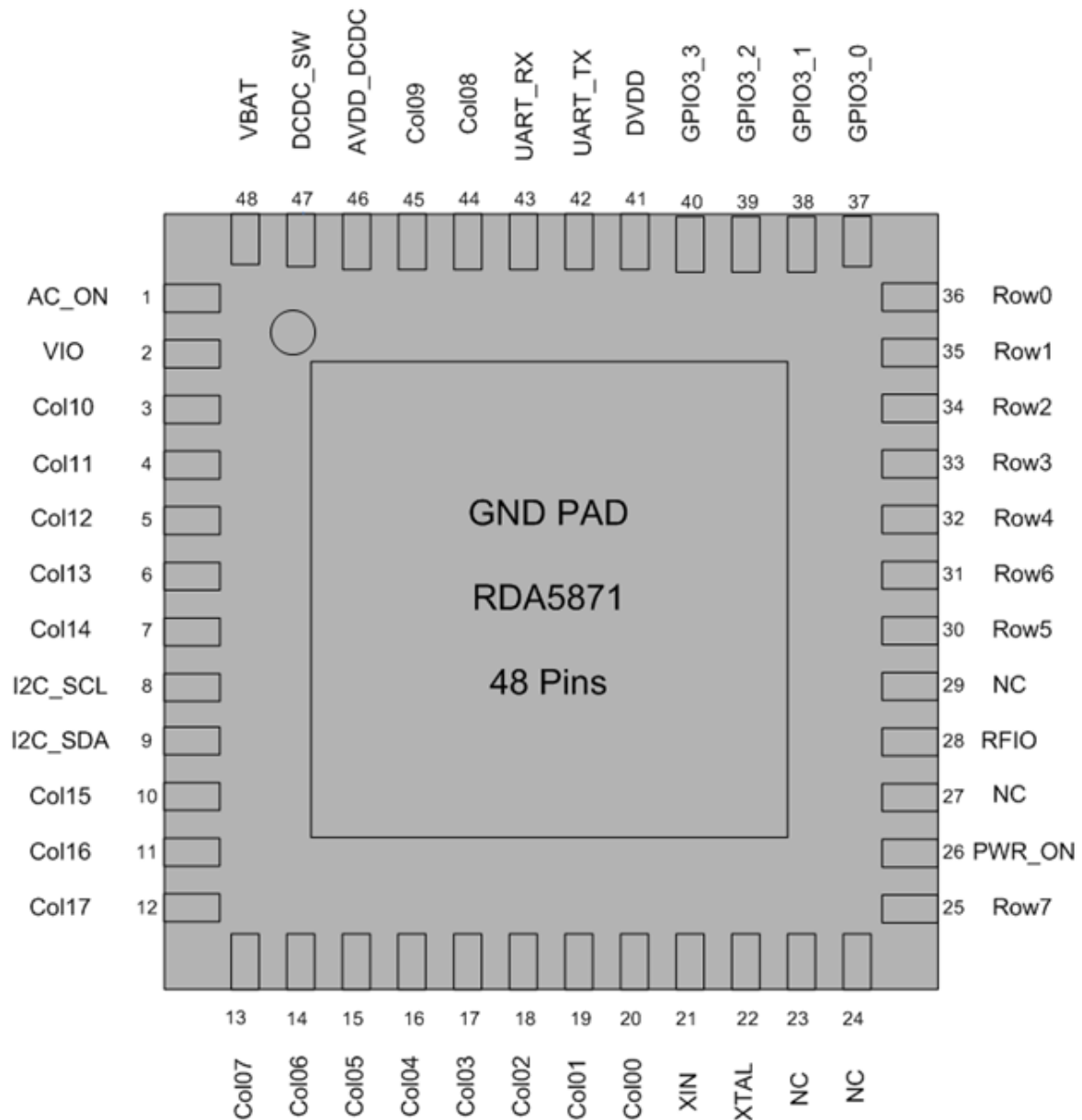


Figure 6-1. RDA5871 Top View

PIN	NO.	DESCRIPTION
AC_ON	1	Charger supply (5V)
VIO	2	power supply for ext IO (3V)
Col10	3	Column 10 of Scan Matrix
Col11	4	Column 11 of Scan Matrix
Col12	5	Column 12 of Scan Matrix
Col13	6	Column 13 of Scan Matrix
Col14	7	Column 14 of Scan Matrix
I2C_SCL	8	I2C interface Clock signal
I2C_SDA	9	I2C interface Data signal
Col15	10	Column 15 of Scan Matrix
Col16	11	Column 16 of Scan Matrix
Col17	12	Column 17 of Scan Matrix
Col07	13	Column 07 of Scan Matrix
Col06	14	Column 06 of Scan Matrix
Col05	15	Column 05 of Scan Matrix
Col04	16	Column 04 of Scan Matrix
Col03	17	Column 03 of Scan Matrix
Col02	18	Column 02 of Scan Matrix
Col01	19	Column 01 of Scan Matrix
Col00	20	Column 00 of Scan Matrix
XIN	21	For 26Mhz crystal input or external clock input
XTAL	22	For 26Mhz crystal input
NC	23	Not connected
NC	24	Not connected
Row7		Row 7 of Scan Matrix
PWR_ON	26	Digital power supply (3V)
NC	27	Not connected
RFIO	28	Bluetooth Radio signal
NC	29	Not connected
Row5	30	Row 5 of Scan Matrix
Row6	31	Row 6 of Scan Matrix
Row4	32	Row 4 of Scan Matrix
Row3	33	Row 3 of Scan Matrix
Row2	34	Row 2 of Scan Matrix
Row1	35	Row 1 of Scan Matrix
Row0	36	Row 0 of Scan Matrix
LED0	37	LED 0
LED1	38	LED 1
LED2	39	LED 2
LED3	40	LED 3
DVDD	41	Decouple Capacitor (1.2V)
UART_TX	42	UART data output
UART_RX	43	UART data input
Col08	44	Column 08 of Scan Matrix

PIN	NO.	DESCRIPTION
Col09	45	Column 09 of Scan Matrix
AVDD_DCDC	46	IO power supply (1.8V)
DCDC_SW	47	Internal DC/DC switch voltage output
VBAT	48	Bluetooth power supply

Table 6-1 RDA5871 Pins Description

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8 Package Physical Dimension

The package is lead-free and RoHS-compliant.

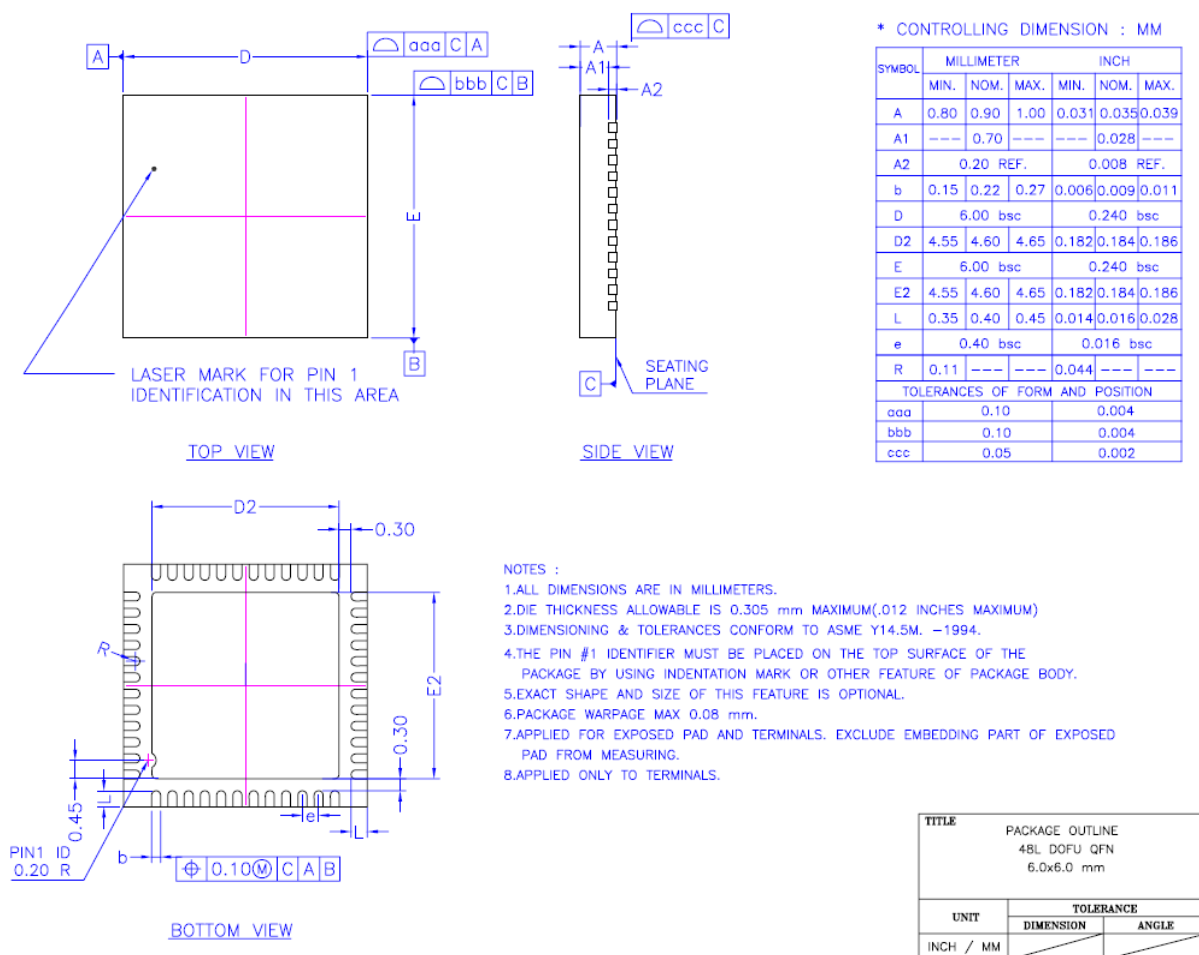


Figure8-1. 48-Pin 6x6 Quad Flat No-Lead (QFN)

9 PCB Land Pattern

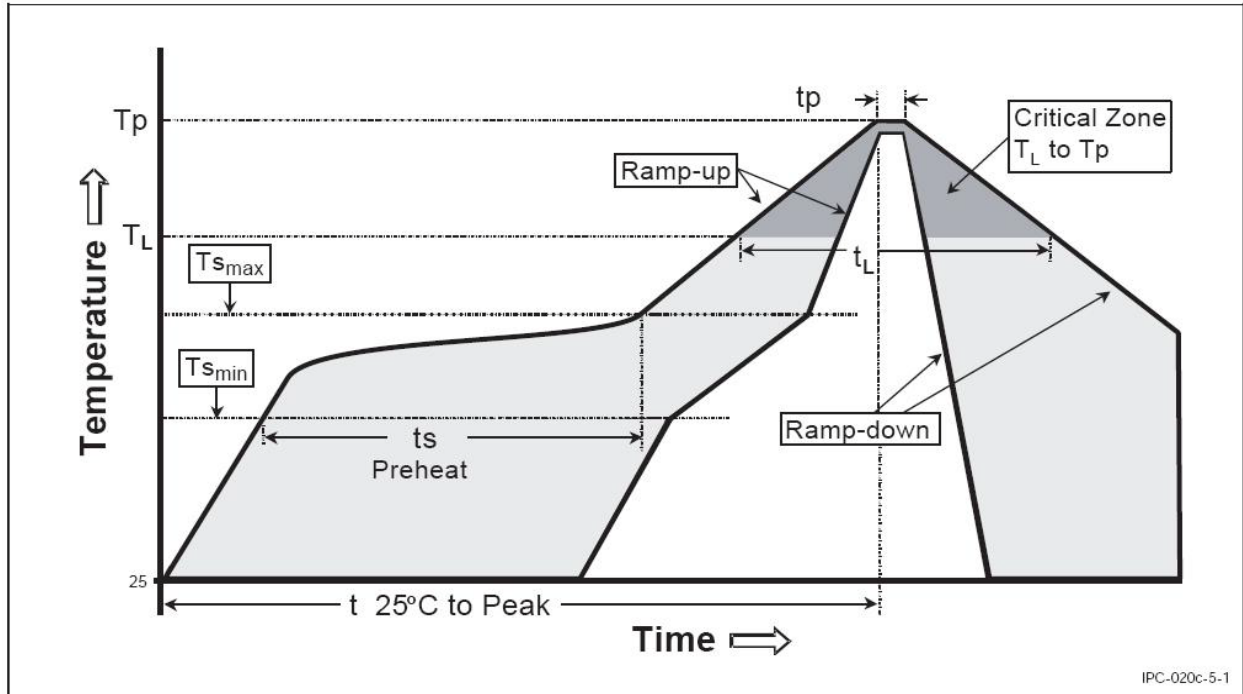


Figure 9-1. Classification Reflow Profile

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average Ramp-Up Rate (T_{Smax} to T_p)	3 °C/second max.	3 °C/second max.
Preheat		
-Temperature Min (T_{smin})	100 °C	150 °C
-Temperature Max (T_{smax})	100 °C	200 °C
-Time (t_{smin} to t_{smax})	60-120 seconds	60-180 seconds
Time maintained above:		
-Temperature (T_L)	183 °C	217°C
-Time (t_L)	60-150seconds	60-150 seconds
Peak /Classification Temperature(T_p)	See Table 9-2	See Table 9-3
Time within 5 oC of actual Peak Temperature (t_p)	10-30 seconds	20-40 seconds
Ramp-Down Rate	6 °C/second max.	6 °C/seconds max.
Time 25 oC to Peak Temperature	6 minutes max.	8 minutes max.

Table 9-1 Classification Reflow Profiles

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

Table 9-2 Pb-free Process – Package Peak Reflow Temperatures

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

Table 9-3 Pb-free Process – Package Classification Reflow Temperatures

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

Note 2: The profiling tolerance is + 0 °C, - X °C (based on machine variation capability) whatever is required to control the profile process but at no time will it exceed – 5 °C. 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 still 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 Table 13-1, 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.

10 Change List

REV	DATE	AUTHER	CHANGE DESCRIPTION
V1.0	11/15/2011	Zhang Wei	Initial version.
V1.1	09/12/2012	Xu Donglin	Update the parameters

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11 Contact Information

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