RN52 Bluetooth® Audio Module

Features:

- Fully qualified Bluetooth® version 3.0 module,
- Fully compatible with Bluetooth version 2.1+EDR, 1.2, and 1.1
- Embedded Bluetooth profiles: A2DP, AVRCP, HFP/HSP and SPP
- Audio decoders: SBC, AAC, aptX
- Enhanced hands free voice capability narrowband and wideband codecs with cVc DSP
- Software configurable through commands over UART console interface
- Stereo analog differential audio output and input for highest quality audio
- External Audio CODECs Supported via S/PDIF and I2S Interface
- Integrated Amplifier for Driving 16Ω Speakers
- Dedicated GPIO pins enable MCUs to access control and status functions efficiently
- SPP data connection interface over UART
- Supports wireless iAP profile advertising which is discoverable by iOS devices (iAP protocol implementation on an external host microcontroller required)
- Certifications: FCC, IC, CE, Bluetooth SIG
- Postage Stamp sized form factor: 13.5 x 26.0 x 2.7 mm
- Castellated SMT pads for easy and reliable PCB mounting
- Environmentally Friendly, RoHS Compliant
- Bluetooth SIG QDID 58578

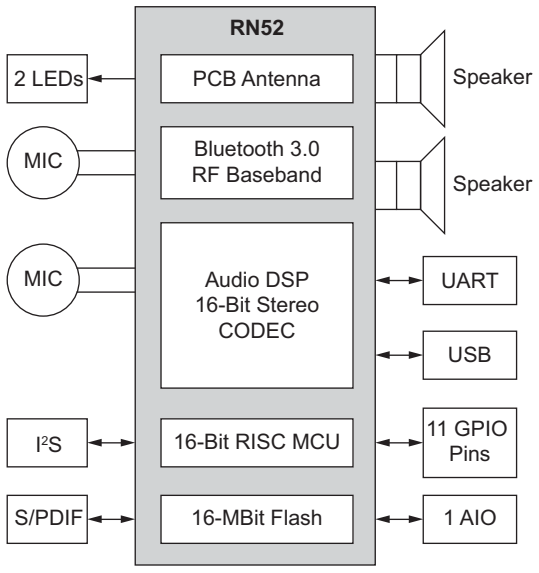
Applications:

- High-quality wireless stereo headsets
- Automotive hands free audio kits
- Wireless audio docking station for smartphones
- High-quality wireless speakers
- VoIP handsets
- Remote control for media player
- Medical data devices



Bluetooth® Audio Module (Part # RN52-I/RM)

RN52 Block Diagram:



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1.0 DEVICE OVERVIEW

Microchip's RN52 Bluetooth audio module provides a highly integrated solution for delivering high-quality stereo audio in a small form factor. It combines a class 2 Bluetooth radio with an embedded DSP processor. The module is programmed and controlled with a simple ASCII command set.

The RN52 module complies with Bluetooth specification version 3.0. It integrates an RF radio and a baseband controller making it a complete Bluetooth subsystem. The RN52 supports a variety of profiles including A2DP, AVRCP, HSP/HFP, SPP and iAP. It provides a UART interface, several user programmable I/O pins, stereo speaker outputs, microphone inputs, digital audio interface and a USB port. Standard RN52 and its variants support A2DP, AVRCP, HFP, SPP and iAP in the capacity of Bluetooth Slave role. RN52SRC supports A2DP, AVRCP, HFP in the capacity of Bluetooth Master role.

RN52 supports wireless iAP profile advertising which is discoverable by iOS devices. An external host microcontroller is required to implement the iAP protocol and communicate with the authentication coprocessor while using the RN52 as a data pipe only to transfer the iAP protocol data over Bluetooth back and forth with the Apple device. A PIC® microcontroller can be used to implement the iAP protocol using the Microchip MFi Library.

Table 1-1 provides the general specifications for the module. Table 1-2 and Table 1-3 provide the module's weight, dimensions and electrical characteristics.

TABLE 1-1: GENERAL SPECIFICATIONS

Specification	Description
Standard	Bluetooth® 3.0, class 2
Frequency Band	2.4 ~ 2.48 GHz
Modulation Method	GFSK, PI/4-DQPSK, 8 DPSK
Maximum Data Rate	3 Mbps
RF Input Impedance	50 ohms
Interface	UART, GPIO, AIO, USB, I2S, S/PDIF, speaker, microphone
Operation Range	10 meters (33 feet)
Sensitivity	-85 dBm at 0.1 % BER
RF TX Power	4 dBm

TABLE 1-2: WEIGHT AND DIMENSIONS

Specification	Description
Dimensions	26.0 mm x 13.5 mm x 2.7 mm
Weight	1.2 g

TABLE 1-3: ELECTRICAL CHARACTERISTICS

Specification	Description
Supply Voltage	3.0-3.6V DC
Working current	Depends on profiles, 30 mA typical
Standby current (disconnected)	< 0.5 mA
Temperature	-40ºC to +85ºC
ESD	JESD22-A224 class 0 product
Humidity	10% ~ 90% non-condensing

Figure 1-1 shows the module's dimensions and Figure 1-2 shows recommended landing pattern and layout.

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FIGURE 1-1: MODULE DIMENSIONS

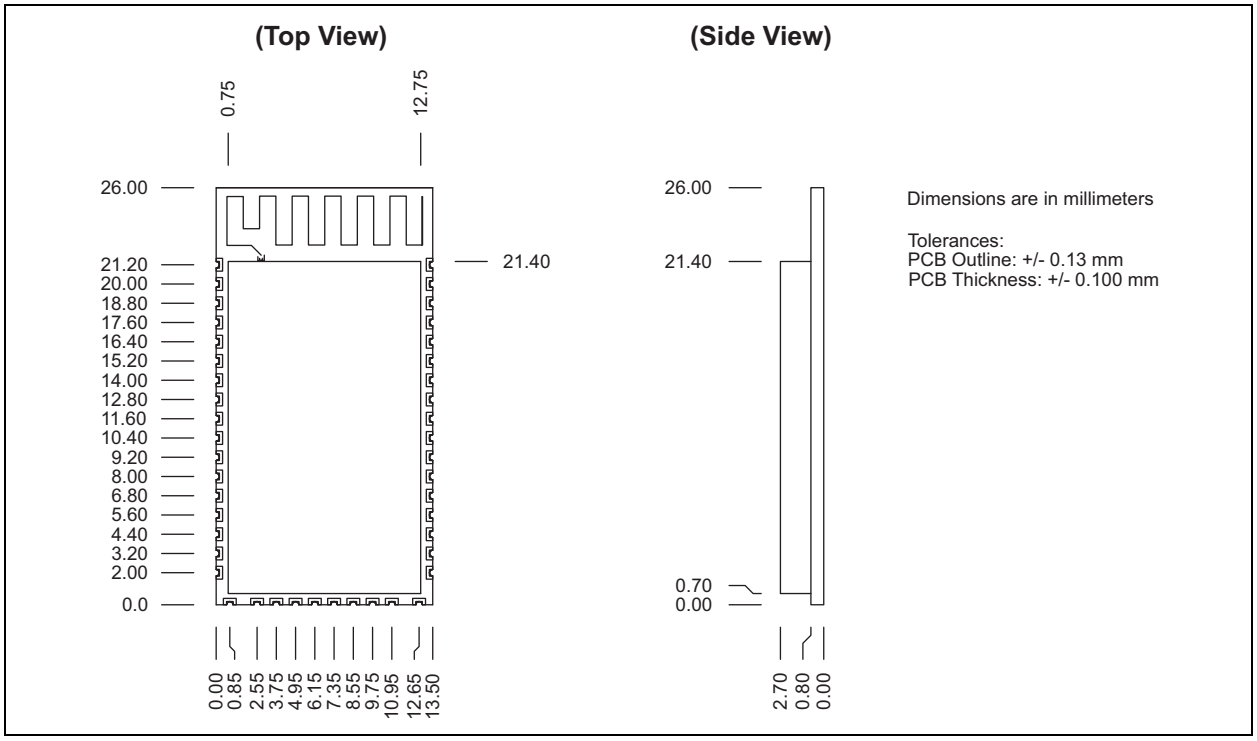


FIGURE 1-2: RECOMMENDED PCB FOOTPRINT

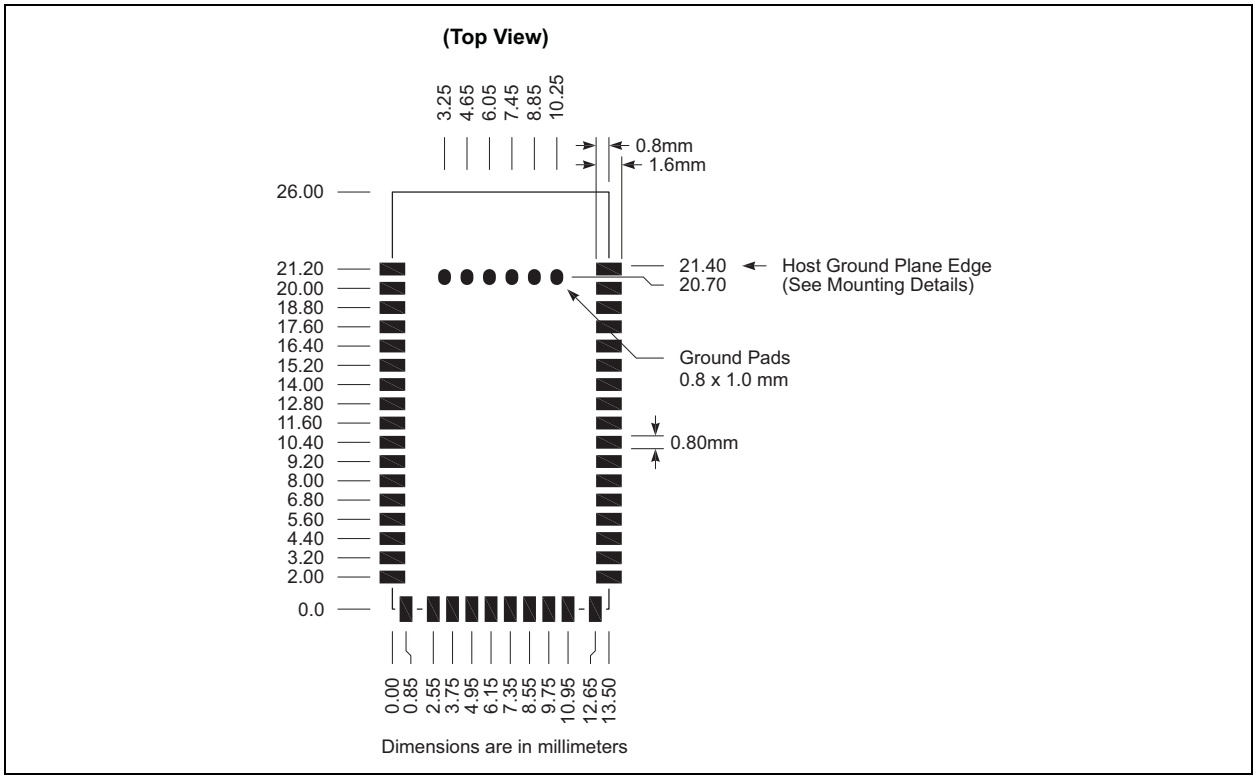


Figure 1-3 shows the pinout and Table 1-4 describes the module's pins.

FIGURE 1-3: PIN DIAGRAM

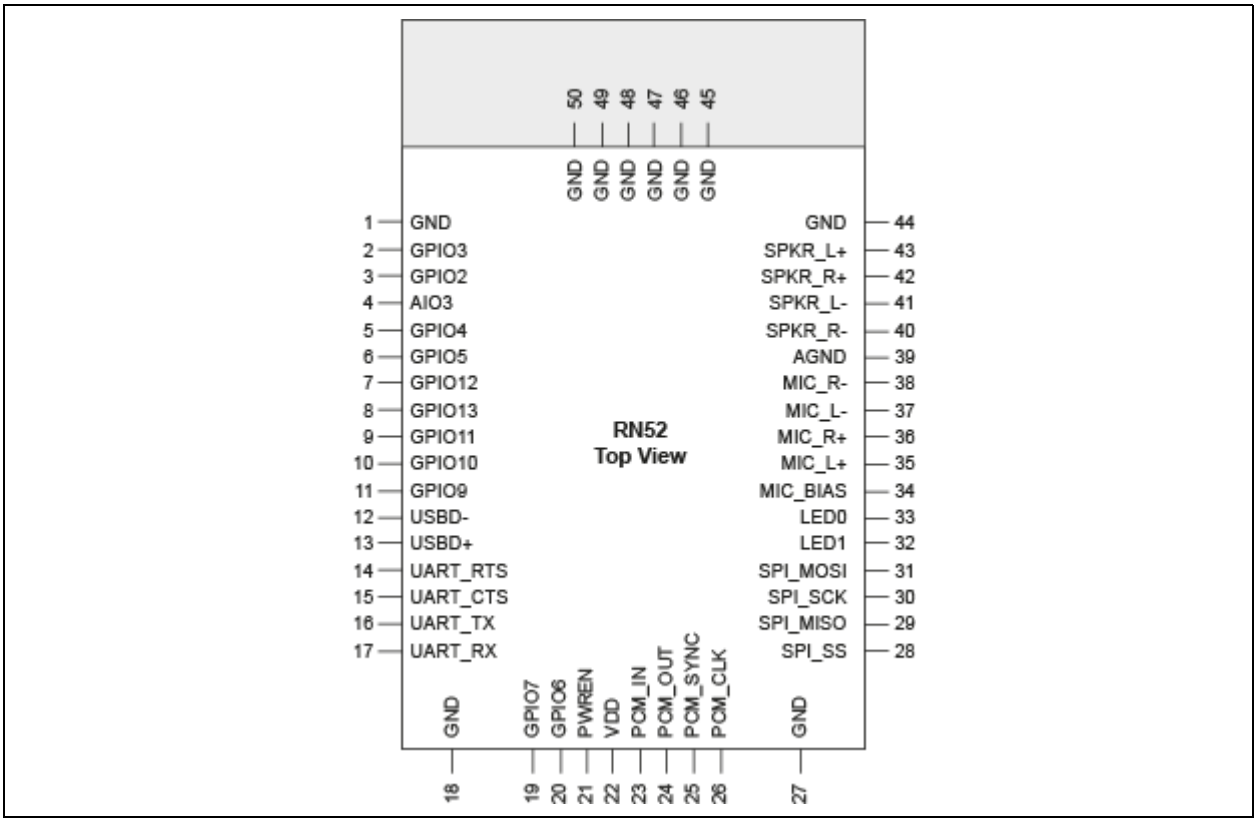


TABLE 1-4: PIN DESCRIPTION(1) (SHEET 1 OF 3)

Pin	Symbol	I/O Type	Description	Direction	Default
1	GND	Ground.	Ground.		
2	GPIO3	Digital	Driving this pin high during bootup will put the module in Device Firmware Update (DFU) mode. The device will enter DFU mode in 3 seconds. The pin should only be asserted high before the device enters DFU mode and not after. (USB device powers VBUS. PIO3 requires 47K to ground and 22K to USB VBUS if USB VBUS is supplying power to the main board.) During runtime, if the pin is driven high, the device will reset and reboot. Note: Device will reset within 500 ms after the IO is driven high. A reset pulse of 100 ms is recommended. If IO continues to be driven high after reset, the device will naturally enter DFU mode. The device will enter DFU mode in 3 seconds.	Input	Low
3	GPIO2	Digital	Reserved, event indicator pin. A microcontroller can enter Command mode and poll the state register using the Q action command	Output	High
4	AIO0	Bidirectional	Analog programmable input/output line	I/O	

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TABLE 1-4: PIN DESCRIPTION(1) (SHEET 2 OF 3)

Pin	Symbol	I/O Type	Description	Direction	Default
5	GPIO4	Digital	Factory Reset mode. To reset the module to the factory defaults, GPIO4 should be high on power-up and then toggle low, high, low, high with a 1 second wait between the transitions. During runtime, the module will enter voice command mode if this pin is driven low. Reserved. Not available for reconfiguring as a general purpose IO pin.	Input	Low
6	GPIO5	Bidirectional with programmable strength internal pull-up/down	Programmable I/O	I/O	High
7	GPIO12	Bidirectional with programmable strength internal pull-up/down	Programmable I/O	I/O	High
8	GPIO13	Bidirectional with programmable strength internal pull-up/down	Programmable I/O	I/O	High
9	GPIO11	Bidirectional with programmable strength internal pull-up/down	Programmable I/O	I/O	High
10	GPIO10	Bidirectional with programmable strength internal pull-up/down	Programmable I/O	I/O	High
11	GPIO9	Digital	When you drive this signal low, the module's UART goes into Command mode. If this signal is asserted high, the UART is in Data mode. Reserved	Input	High
12	USBD-	Bidirectional	USB data minus	I/O	
13	USBD+	Bidirectional	USB data plus with selectable internal 1.5 Kohm pull-up resistor	I/O	
14	UART_RTS	CMOS output, tri-state, with weak internal pull-up	UART request to send active low	Output	
15	UART_CTS	CMOS input with weak internal pull-down	UART clear to send active low	Input	
16	UART_TX	CMOS output, tri-state, with weak internal pull-up	UART data output	Output	
17	UART_RX	CMOS input with weak internal pull-down	UART data input	Input	
18	GND	Ground	Ground		
19	GPIO7	Bidirectional with programmable strength internal pull-up/down	Driving this pin low sets the UART baud rate to 9,600. By default, the pin is high with a baud rate of 115,200	I/O	High
20	GPIO6	Bidirectional with programmable strength internal pull-up/down	Programmable I/O	I/O	High
21	PWREN	Analog	Pull high to power up RN52	Input	Low
22	VDD	3.3-V power input	3.3V power input		
23	PCM_IN	CMOS input, with weak internal pull down	Synchronous data input, configurable for SPDIF_IN or SD_IN (I^2S)	Input	

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TABLE 1-4: PIN DESCRIPTION(1) (SHEET 3 OF 3)

Pin	Symbol	I/O Type	Description	Direction	Default
24	PCM_OUT	CMOS output, with weak internal pull down	Synchronous data output, configurable for SPDIF_OUT or SD_OUT (I^2S)	Output	
25	PCM_SYNC	Bidirectional with weak internal pull down	Synchronous data sync; WS (I^2S)	Output	
26	PCM_CLK	CMOS input, with weak internal pull down	Synchronous data clock; SCK (I^2S)	Output	
27	GND	Ground	Ground		
28	SPI_SS	CMOS input with weak internal pull-up	Chip select for Synchronous Serial Interface active low	Input	
29	SPI_MISO	CMOS output, tri-state, with weak internal pull-down	Serial Peripheral Interface (SPI) output	Output	
30	SPI_CLK	Input with weak internal pull-down	SPI clock	Input	
31	SPI_MOSI	CMOS input, with weak internal pull-down	SPI input	Input	
32	LED1	Open drain output	Drives an LED. For the RN-52-EK Board, this signal drives the red LED	Output	
33	LED0	Open drain output	Drives an LED. For the RN-52-EK Board, this signal drives the blue LED	Output	
34	MIC_BIAS	Analog	Microphone bias	Output	
35	MIC_L+	Analog	Microphone input positive, left	Input	
36	MIC_R+	Analog	Microphone input positive, right	Input	
37	MIC_L-	Analog	Microphone input negative, left	Input	
38	MIC_R-	Analog	Microphone input negative, right	Input	
39	AGND	Analog	Ground connection for audio		
40	SPK_R-	Analog	Speaker output negative (right side)	Output	
41	SPK_L-	Analog	Speaker output negative (left side)	Output	
42	SPK_R+	Analog	Speaker output positive (right side)	Output	
43	SPK_L+	Analog	Speaker output positive (left side)	Output	
44	GND	Ground	Ground		
45	GND	Ground	RF ground		
46	GND	Ground	RF ground		
47	GND	Ground	RF ground		
48	GND	Ground	RF ground		
49	GND	Ground	RF ground		
50	GND	Ground	RF ground		

Note 1: All GPIO pins default to input with weak pull-down.

2: Refer to the “Bluetooth Audio Module Command Reference User’s Guide” (DS50002154) and the “RN52SRC Bluetooth Audio Module Command Reference User’s Guide” (DS50002343) for more information about the behavior of the pin and optional features that can be enabled.

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1.1 Audio Interface Circuit Description

The RN52 audio interface circuit consists of:

- Analog audio interface with differential audio inputs and outputs
- Digital audio interface with configurable S/PDIF and I^2S interface (A2DP audio output only)

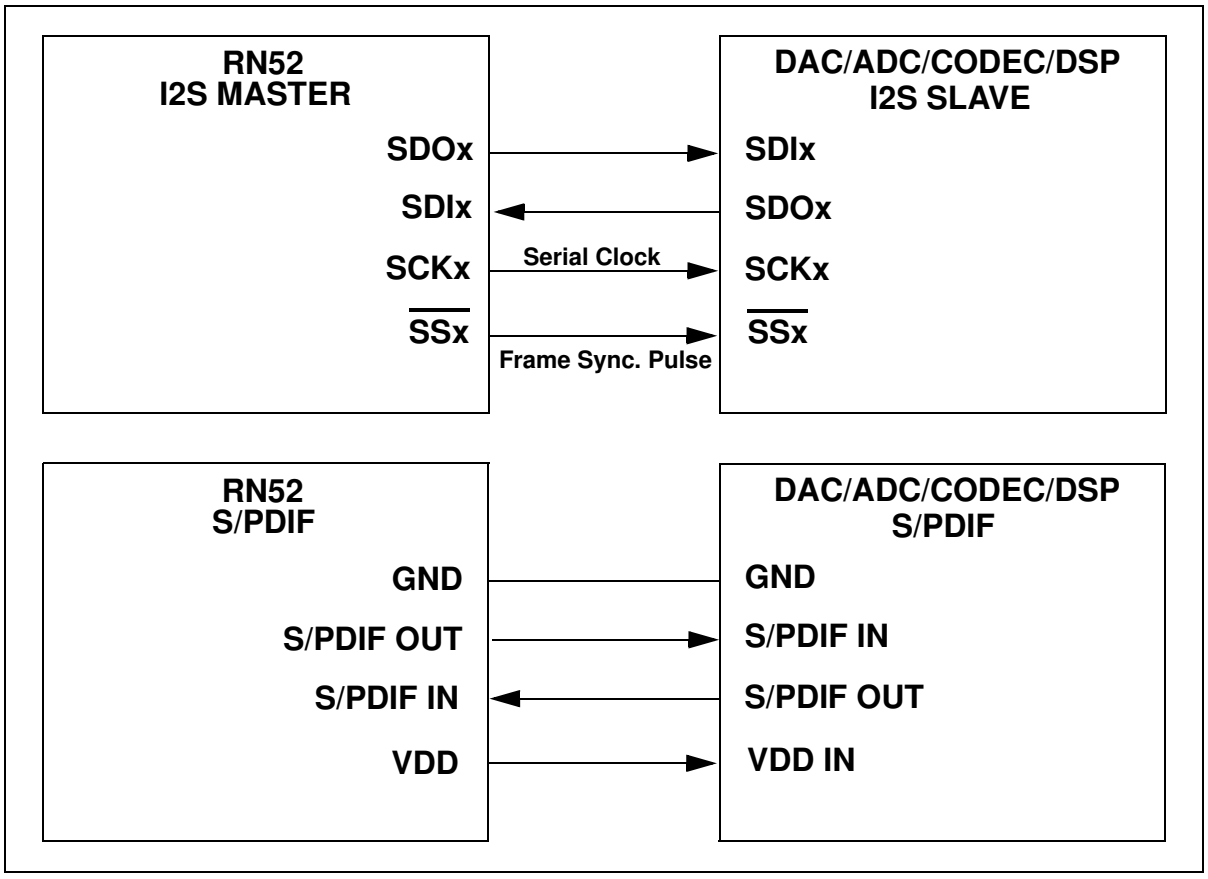
The audio input circuitry has a dual audio input that can be configured as single-ended or fully differential and programmed for microphone or line input. It has an analog and digital programmable gain stage so that it can be optimized for different microphones. See Figure 1-5.

1.1.1 DIGITAL AUDIO INTERFACE

The stereo audio CODEC interface has a digital audio interface. It supports the I2S and S/PDIF interfaces. The RN52 I2S interface is I2S Master and provides the bit clock and phase sync clock. The I2S or S/PDIF interface can be configured through command console. The typical application interface can be seen in Figure 1-4.

The audio resolution supported is 24-bit and the max channel size is 32-bit. The supported sample rates are 8KHz, 32KHz, 44.1KHz and 48KHz. The audio resolution and the sample rate can be configured using the UART console command. Refer the RN52 command specification for more information.

FIGURE 1-4: I2S AND SPDIF CONNECTIONS



1.1.2 ANALOG AUDIO INTERFACE

The audio input circuitry has a dual audio input that can be configured as single-ended or fully differential and programmed for microphone or line input. It has an analog and digital programmable gain stage so that it can be optimized for different microphones. The microphone inputs MIC_L+, MIC_L-, MIC_R+ and MIC_R- are shown in Figure 1-6.

The audio output circuitry consists of a differential speaker output preceded by a gain stage and a class AB amplifier. The speaker outputs SPK_L+, SPK_L-, SPK_R+ and SPK_R- are shown in Figure 1-6.

The fully differential architecture in the analog signal path results in low noise sensitivity and good power supply rejection while effectively doubling the signal amplitude. It operates from a 1.5V single power supply and uses a minimum of external components.

The typical application interface is shown in Figure 1-5.

FIGURE 1-5: RN52 AUDIO INTERFACE BLOCK DIAGRAM

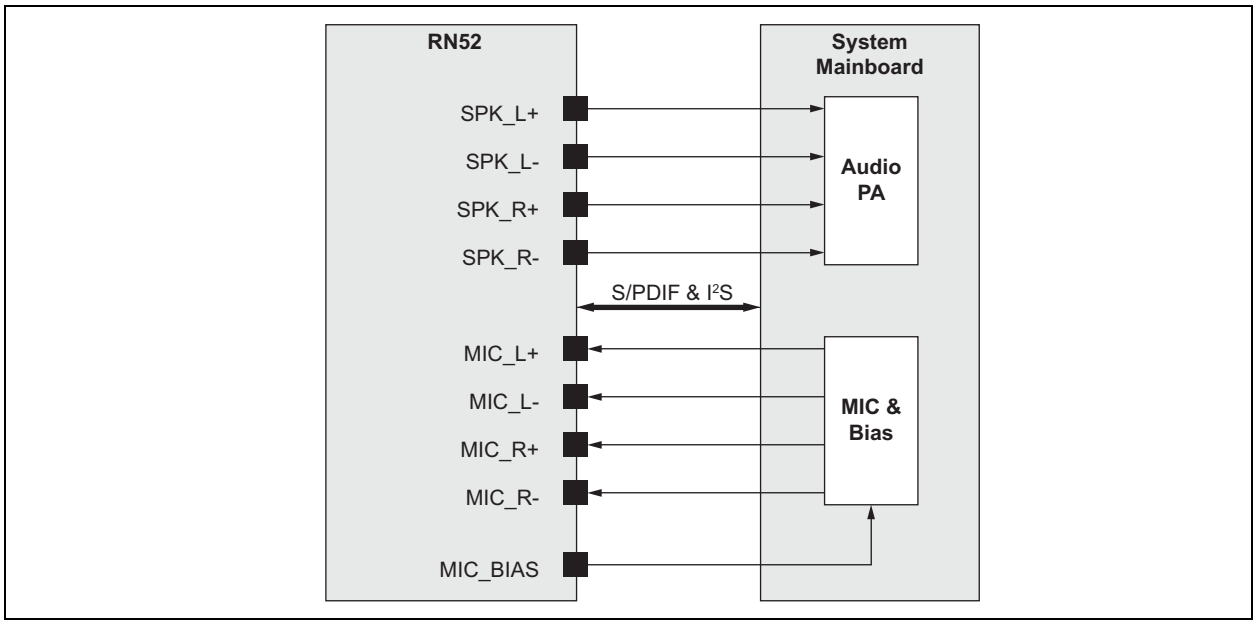
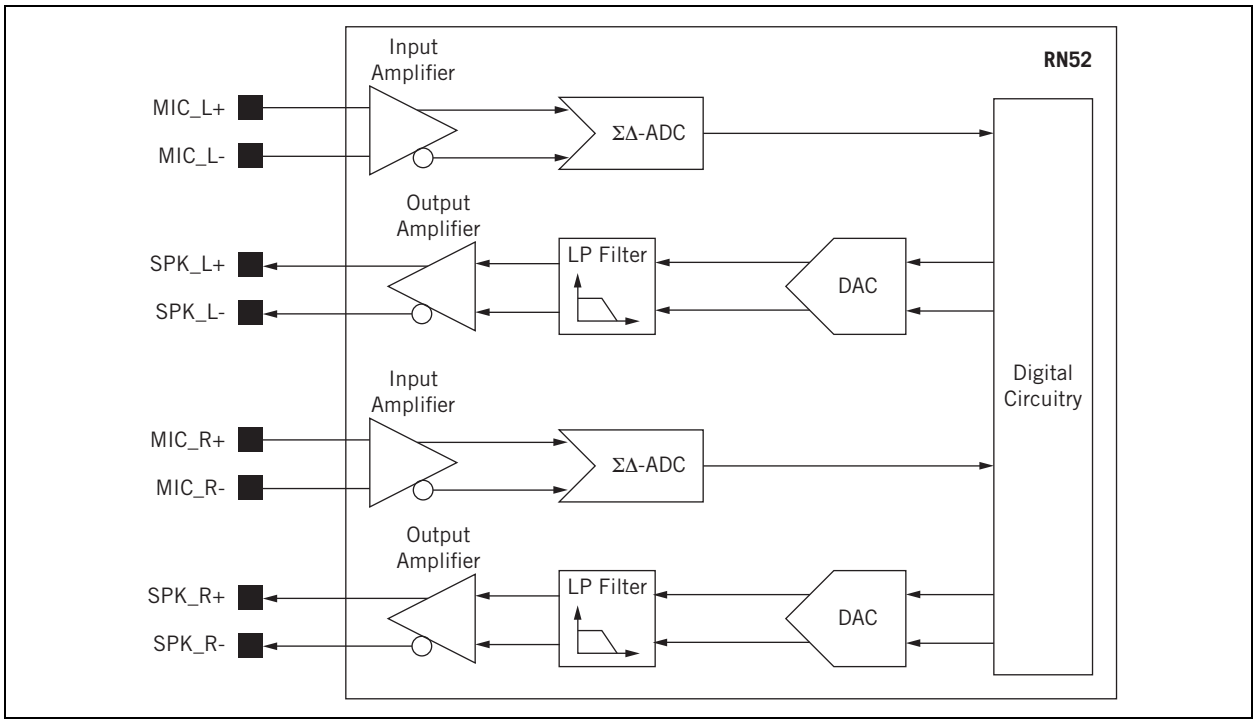


FIGURE 1-6: STEREO CODEC AUDIO INPUT/OUTPUT STAGES



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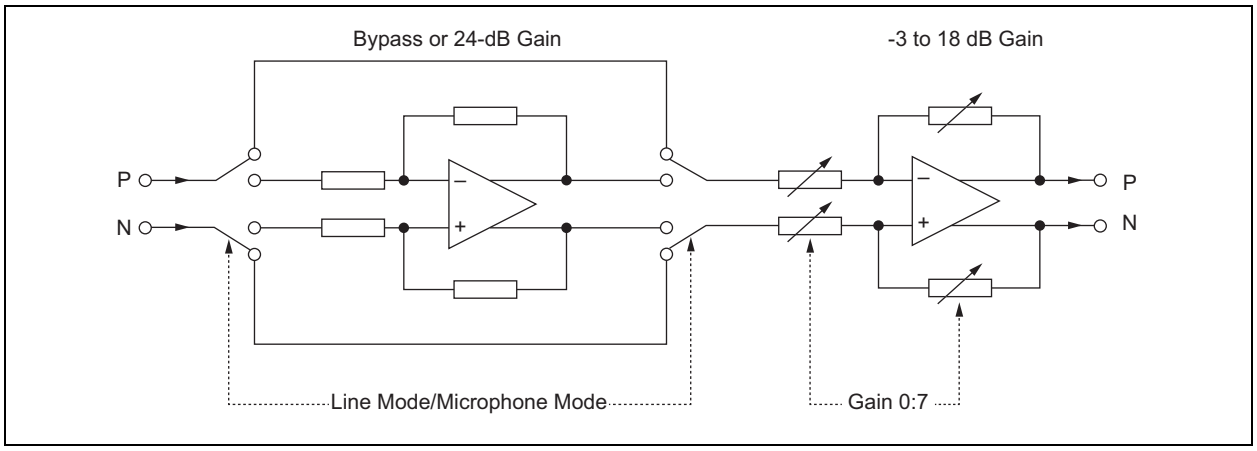
1.1.3 ANALOG-TO-DIGITAL CONVERTER (ADC)

The ADC consists of two second-order sigma delta (SD) converters, resulting in two separate channels with identical functionality. Each ADC supports the following sample rates:

- 8 kHz
- 16 kHz
- 32 kHz
- 44.1 kHz
- 48 kHz

The ADC analog amplifier is a two-stage amplifier. The first stage selects the correct gain for either microphone or line input. See Figure 1-7.

FIGURE 1-7: ADC ANALOG AMPLIFIER BLOCK DIAGRAM



1.1.4 DIGITAL-TO-ANALOG CONVERTER (DAC)

The DAC consists of two third-order SD converters, resulting in two separate channels with identical functionality. Each DAC supports the following sample rates:

- 8 kHz
- 16 kHz
- 32 kHz
- 44.1 kHz
- 48 kHz

1.1.4.1 Speaker Output

The speaker output is capable of driving a speaker with an impedance of at least 8 ohms directly. The overall gain of the speaker output is approximately -21 dB to 0 dB in 1.5 dB steps.

1.1.4.2 Microphone Input

The RN52 audio input is intended for use from 1 µA at 94 dB SPL to about 10 µA at 94 dB SPL, which requires microphones with sensitivity between –40 and –60 dBV. The RN52 microphone mode input impedance is typically 6 kohm. The line mode input impedance is typically between 6 kohm and 30 kohm. The overall gain of the microphone input is approximately -3 dB to 42 dB in 1.5 dB steps. MIC_BIAS requires a minimum load to maintain regulation. MIC_BIAS maintains regulation within 0.199 and 1.229 mA. Therefore, if you use a microphone with specifications below these limits, the microphone output must be pre-loaded with a large value resistor to ground.

TABLE 1-5: DIGITAL TO ANALOG CONVERTER

Parameter	Conditions		Min	Typ	Max	Unit
Resolution	—		—	—	16	Bits
Ouput Sample Rate, F_{sample}	—		8	—	48	kHz
Signal to Noise Ratio, SNR	f_{in} = 1 kHz B/W = 20 Hz→20 kHz A-Weighted THD+N < 0.01% 0dBFS signal Load = 100 kΩ	F_{sample}	—	95	—	dB
		8 kHz	—	95	—	dB
		16 kHz	—	95	—	dB
		32 kHz	—	95	—	dB
		44.1 kHz	—	95	—	dB
		48 kHz	—	95	—	dB
Analog Gain	Analog Gain Resolution = 3 dB		0	—	-21	dB
Output voltage full-scale swing (differential)			—	750	—	mV rms
Allowed Load		Resistive	16(8)	—	O.C.	Ω
		Capacitive	—	—	500	pF
THD + N 100 kΩ load			—	—	0.01	%
THD + N 16 kΩ load			—	—	0.1	%
SNR (Load = 16Ω, 0 dBFS input relative to digital silence)			—	95	—	dB

TABLE 1-6: ANALOG TO DIGITAL CONVERTER

Parameter	Conditions		Min	Typ	Max	Unit
Resolution	—		—	—	16	Bits
Input Sample Rate, F_{sample}	—		8	—	44.1	kHz
Signal to Noise Ratio, SNR	f_{in} = 1 kHz B/W = 20 Hz→20 kHz A-Weighted THD+N < 1% 150 mV_{pk-pk} input	F_{sample}				
		8 kHz	—	79	—	dB
		16 kHz	—	76	—	dB
		32 kHz	—	75	—	dB
		44.1 kHz	—	75	—	dB
Analog Gain	Analog Gain Resolution = 3 dB		—	—	42	dB
Input full scale at maximum gain (differential)			—	4	—	mV rms
Input full scale at minimum gain (differential)			—	800	—	mV rms
3 dB Bandwidth			—	20	—	kHz
Microphone mode input impedance			—	6.0	—	kΩ
THD + N (microphone input) @ 30 mV rms input			—	0.04	—	%

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1.2 General Purpose IO (GPIO) Ports

User programmable bidirectional GPIO ports are provided. The GPIO ports can be used as typical digital IO ports. The directionality of the GPIOs can be configured through console commands. The GPIOs can also be read or asserted using the console commands. The digital input and output voltage levels are provided in Table 1-7.

TABLE 1-7: DIGITAL INPUT AND OUTPUT VOLTAGE LEVELS

Voltage Information	Min	Typ	Max	Unit
Input Voltage Levels				
V_{IL} input logic level low	-0.3	—	0.25 x V_{DD}	V
V_{IH} input logic level high	0.625 x V_{DD}	—	V_{DD} + 0.3	V
Output Voltage Levels				
V_{OL} output logic level low, Iol = 4.0 mA	0	—	0.125	V
V_{OH} output logic level high, IOH = -4.0 mA	0.75 x V_{DD}	—	V_{DD}	V

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1.3 Power Consumption

The power consumption of the RN52 for various connection states are provided in Figure 1-8.

TABLE 1-8: POWER CONSUMPTION

Role	Connection	Audio Packet Type	Description	Current (mA)
—	Stand-by	—	Active connection	0.07
—	Page Scan	—	Interval = 1280 ms	0.5
—	Inquiry and Page Scan	—	Inquiry scan = 1280 ms Page scan = 1280 ms	0.88
RN52	A2DP	ACL	No Traffic	15
RN52	A2DP	ACL	Audio stream RX	21
RN52	A2DP	ACL	Sniff = 40 ms	1.7
RN52	A2DP	ACL	Sniff = 1280 ms	0.26
RN52	HFP	eSCO-EV3	—	26
RN52	HFP	eSCO-EV3	Setting S1	27
RN52	HFP	eSCO-2EV3	Setting S2	28
RN52	HFP	eSCO-2EV3	Setting S3	25
RN52	HFP	eSCO-EV5	—	22
RN52	HFP	SCO-HV1	—	42
RN52	HFP	SCO-HV3	—	28
RN52	HFP	SCO-HV3	Sniff = 30 ms	22
RN52SRC	A2DP	ACL	No traffic	4.4
RN52SRC	A2DP	ACL	Audio stream TX	9.2
RN52SRC	A2DP	ACL	Sniff = 40 ms	1.9
RN52SRC	A2DP	ACL	Sniff = 1280 ms	0.2
RN52SRC	HFP	eSCO-EV3	—	24
RN52SRC	HFP	eSCO-EV3	Setting S1	23
RN52SRC	HFP	eSCO-2EV3	Setting S2	22
RN52SRC	HFP	eSCO-2EV3	Setting S3	17
RN52SRC	HFP	eSCO-EV5	—	17
RN52SRC	HFP	SCO-HV1	—	42
RN52SRC	HFP	SCO-HV3	—	23
RN52SRC	HFP	SCO-HV3	Sniff = 30 ms	22

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2.0 APPLICATIONS

The following sections provide information on designing with the RN52 module, including restoring factory defaults, using the LED interface, minimizing radio interference, solder reflow profile, typical application, etc.

2.1 Minimizing Radio Interference

When laying out the host PCB for the RN52 module, the areas under the antenna and shielding connections should not have surface traces, ground planes or exposed via (see Figure 2-1). For optimal radio performance, the RN52 module's antenna end should protrude at least 31 mm beyond any metal enclosure. Figure 2-2 shows examples of good, bad, and acceptable positioning of the RN52 on the host PCB.

FIGURE 2-1: MINIMIZING RADIO INTERFERENCE

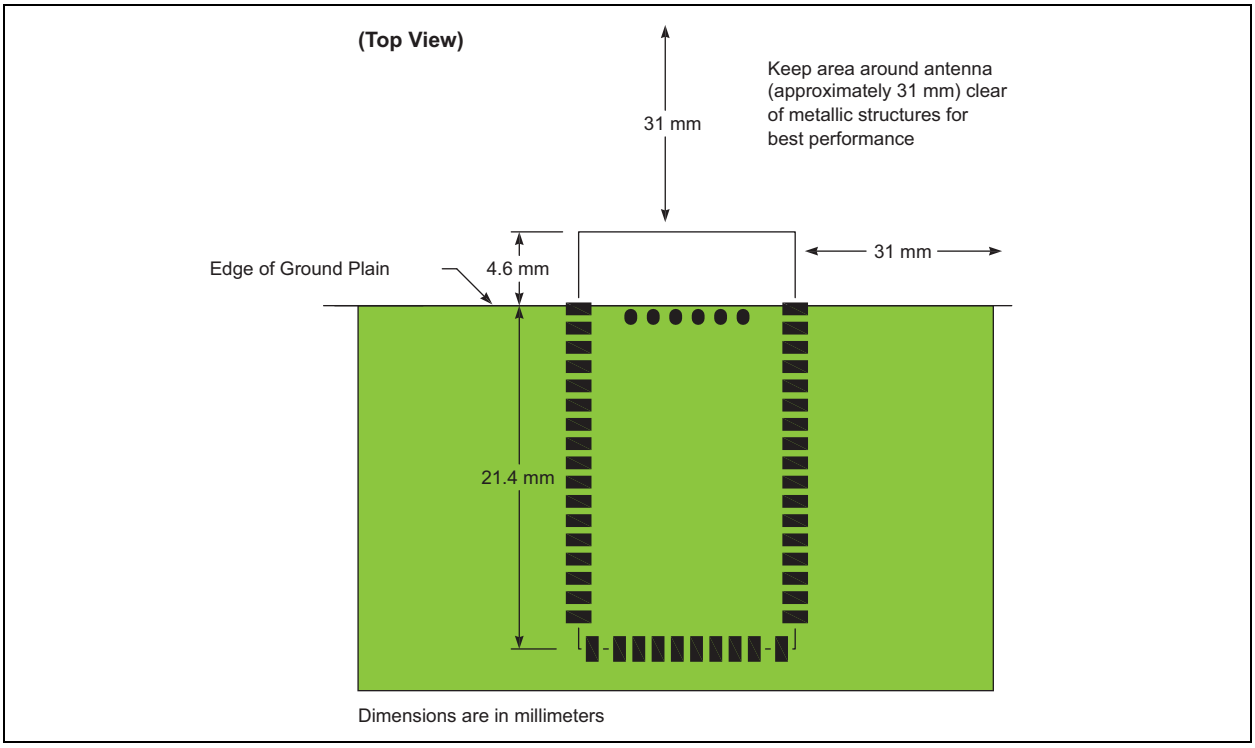
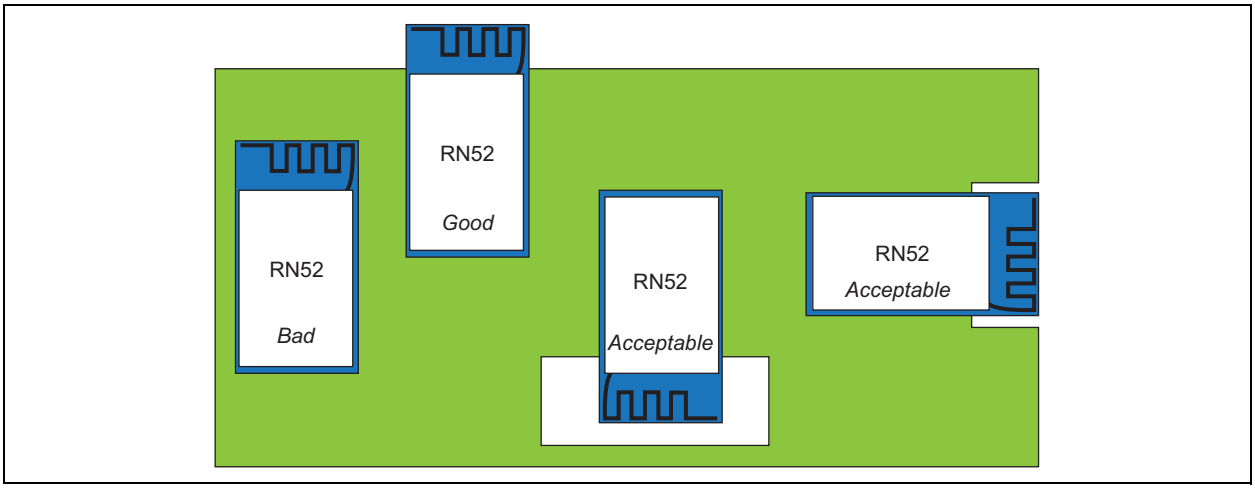


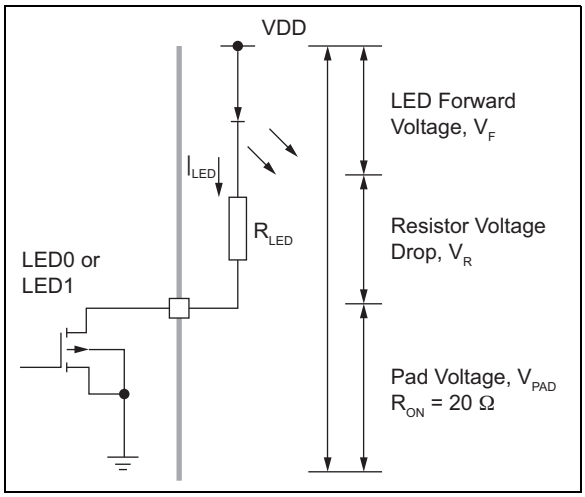
FIGURE 2-2: PCB EXAMPLE LAYOUT



2.2 LED Interface

The RN52 includes two pads dedicated to driving the LED indicators. The firmware can control both terminals, and the battery charger can set LED0. The terminals are open-drain outputs; therefore, the LED must be connected from a positive supply rail to the pad in series with a current limiting resistor. You should operate the LED pad (LED0 or LED1 pins) with a pad voltage below 0.5V. In this case, the pad can be thought of as a resistor, RON. The resistance, together with the external series resistor, sets the current, I_{LED}, in the LED. The current is also dependent on the external voltage, VDD, as shown in Figure 2-3.

FIGURE 2-3: LED INTERFACE



The LEDs can be used to indicate the module's connection status. Table 2-1 describes the LED functions.

TABLE 2-1: STATUS LED FUNCTIONS

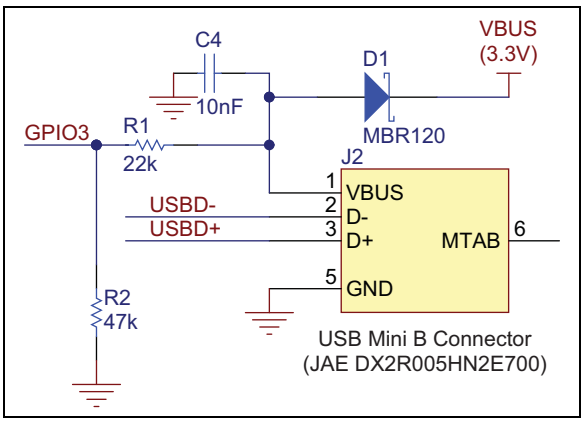
Blue LED	Red LED	Description
Flashing	Flashing	The RN52 module is discoverable.
Off	Flashing	The module is connected.
Flashing	Off	The module is connectable.

2.3 Device Firmware Updates

The module has a Device Firmware Update (DFU) mode in which you use the USB interface to update the firmware. Implementing the DFU feature is highly recommended because firmware updates offer new features and enhance the module's functionality. Follow the reference design shown in Figure 2-7 to support this mode.

Note:	A 47 KΩ pull-down resistor (R2 in Figure 2-4) is required on GPIO3 even if you do not use the USB for DFU.

FIGURE 2-4: USB DFU PORT AND GPIO3 SCHEMATIC



2.4 Restore Factory Defaults with GPIO4

The GPIO4 pin should be connected to a switch, jumper or resistor so it can be accessed. This pin is used to reset the module to its factory default settings, which is critical in situations where the module has been misconfigured. To reset the module to the factory defaults, GPIO4 should be high on power-up and then toggle low, high, low, high with a 1 second wait between the transitions.

2.5 Power Control and Regulation

The VDD pin controls the power to the RN52 module. The VDD pin should be used to turn the RN52 module on and off, if the hardware power cycle feature is desired.

The PWREN pin provides the power enable functionality. This pin is internally connected as an enable pin to the voltage regulator and can only be used to turn on the voltage regulator after VDD power is provided to the RN52 module. The PWREN pin cannot be used to turn the voltage regulator off.

On later versions of the firmware, the RN52 also provides a module reset GPIO pin, which resets the RN52 module when asserted high, and also provides a console command which can be used to perform a module reset.

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2.6 Solder Reflow Profile

The lead-free solder reflow temperature and times are:

- **Temperature** – 230° C, 60 seconds maximum, peak 245° C maximum
- **Preheat temperature** – 165° ± 15° C, 90 to 120 seconds
- **Time** – Single pass, one time

To reflow solder the module onto a PCB, use an RoHS-compliant solder paste equivalent to NIHON ALMIT paste or OMNIX OM-310 solder paste from Alpha metals. See Table 2-2.

Note: Use no-clean flux and DO NOT water wash.

TABLE 2-2: PASTE SOLDER RECOMMENDATIONS

Manufacturer	Part Number	Metal Composition	Liquidus Temperature
Alpha Metals http://www.alphametals.com	OMNIX OM-310	SAC305 (96.5% Sn, 3% Ag, 0.5% Cu)	~220°C
NIHON ALMIT Co. LTD http://almit.co.jp	LFM-70W INP	88% Sn, 3.5% Ag, 0.5% Bi, 8% In	~215°C

Figure 2-5 and Figure 2-6 show the solder reflow temperature profiles.

FIGURE 2-5: SOLDER REFLOW TEMPERATURE PROFILE

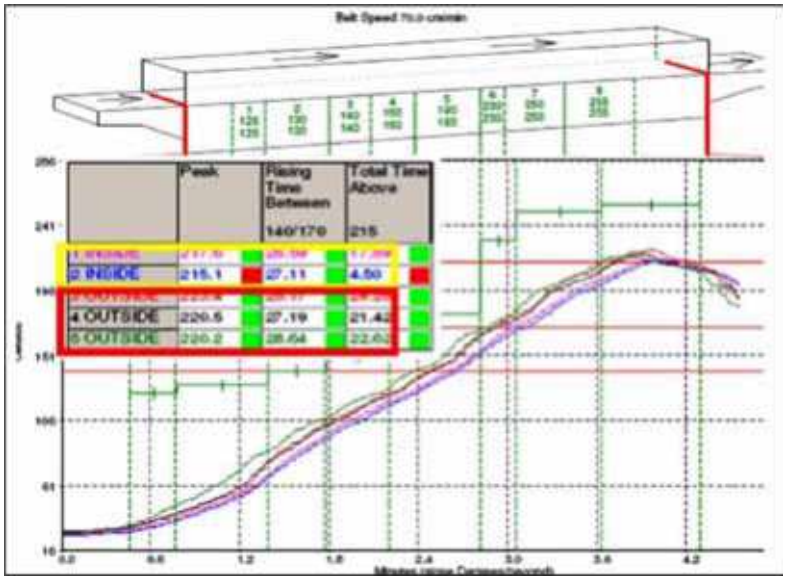
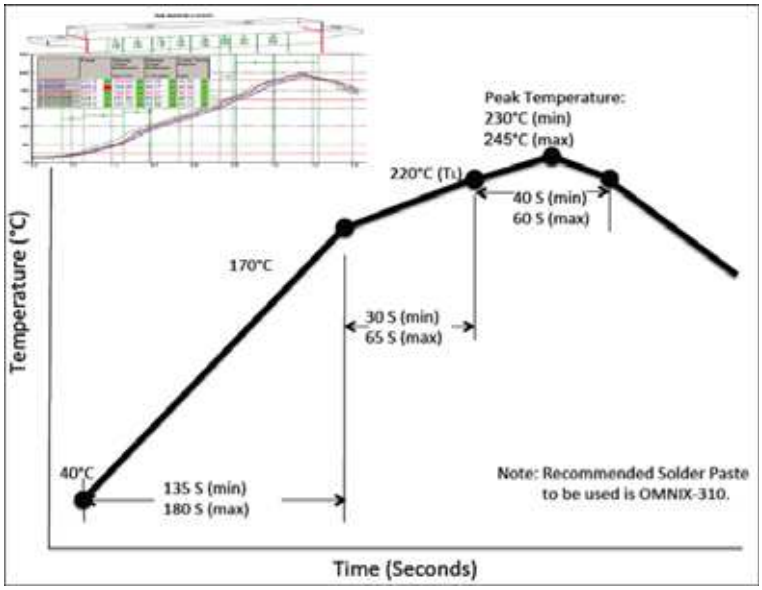


FIGURE 2-6: SOLDER REFLOW CURVE

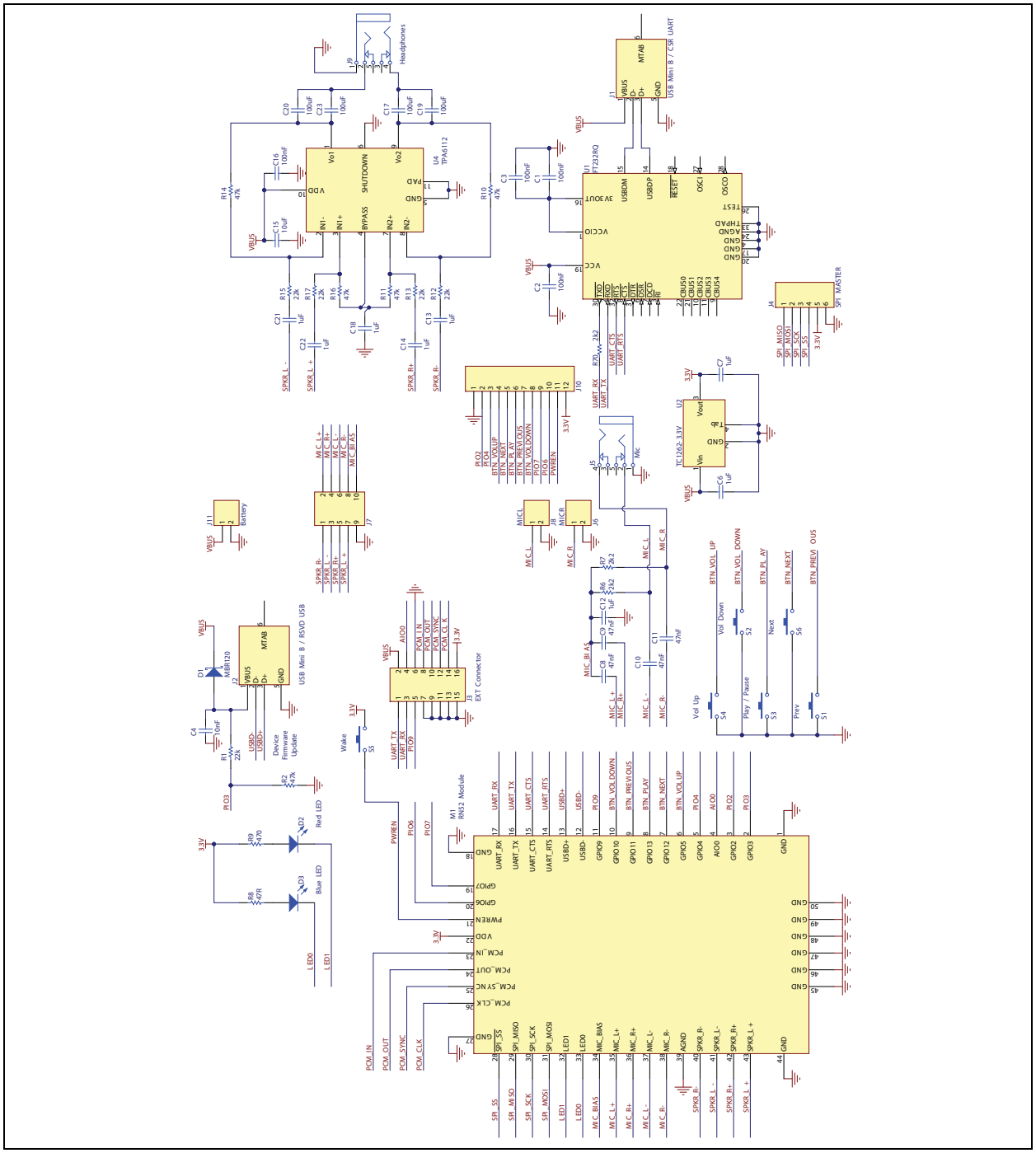


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2.7 Typical Application Schematic

Figure 2-7 shows a typical application circuit with LDO, stereo audio/microphone PA, USB/UART, AVRCP switches and LED0/LED1.

FIGURE 2-7: TYPICAL APPLICATION CIRCUIT FOR A2DP AUDIO STREAMING AND AVRCP REMOTE CONTROL



3.0 BLUETOOTH SIG CERTIFICATION

The RN52 Bluetooth Audio Module has been certified by Bluetooth SIG and the Qualified Design ID is 58578 and the Declaration ID is D023391. The Qualified Design Listing certificate can be accessed on www.microchip.com/rn52 or at the Bluetooth SIG listings website.

4.0 REGULATORY APPROVAL

This section outlines the regulatory information for the RN52 module for the following countries:

- United States
- Canada
- Europe
- Australia
- New Zealand

4.1 United States

The RN52 module has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” modular approval in accordance with Part 15.212 Modular Transmitter approval. Modular approval allows the end user to integrate the RN52 module into a finished product without obtaining subsequent and separate FCC approvals for intentional radiation, provided no changes or modifications are made to the module circuitry. Changes or modifications could void the user’s authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

The finished product is required to comply with all applicable FCC equipment authorizations regulations, requirements and equipment functions not associated with the transmitter module portion. For example, compliance must be demonstrated to regulations for other transmitter components within the host product; to requirements for unintentional radiators (Part 15 Subpart B “Unintentional Radiators”), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Verification, or Declaration of Conformity) (e.g., transmitter modules may also contain digital logic functions) as appropriate.

4.1.1 LABELING AND USER INFORMATION REQUIREMENTS

The RN52 module has been labeled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording as follows:

> Contains Transmitter Module FCC ID: T9J-RN52
>
> or
>
> Contains FCC ID: T9J-RN52
>
> This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

A user’s manual for the product should include the following statement:

> This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
>
> - Reorient or relocate the receiving antenna.
> - Increase the separation between the equipment and receiver.
> - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
> - Consult the dealer or an experienced radio/TV technician for help.

Additional information on labeling and user information requirements for Part 15 devices can be found in KDB Publication 784748 available at the FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) http://apps.fcc.gov/oetcf/kdb/index.cfm.

4.1.2 RF EXPOSURE

All transmitters regulated by FCC must comply with RF exposure requirements. OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, provides assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency

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(RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance.

If appropriate, compliance with exposure guidelines for mobile and unlicensed devices can be accomplished by the use of warning labels and by providing users with information concerning minimum separation distances from transmitting structures and proper installation of antennas.

The following statement must be included as a CAUTION statement in manuals and OEM products to alert users of FCC RF exposure compliance:

> To satisfy FCC RF Exposure requirements for mobile and base station transmission devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended.
>
> The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

If the RN52 module is used in a portable application (i.e., the antenna is less than 20 cm from persons during operation), the integrator is responsible for performing Specific Absorption Rate (SAR) testing in accordance with FCC rules 2.1091.

4.1.3 HELPFUL WEB SITES

Federal Communications Commission (FCC): http://www.fcc.gov

FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB): http://apps.fcc.gov/oetcf/kdb/index.cfm

4.2 Canada

The RN52 module has been certified for use in Canada under Industry Canada (IC) Radio Standards Specification (RSS) RSS-210 and RSSGen. Modular approval permits the installation of a module in a host device without the need to recertify the device.

4.2.1 LABELING AND USER INFORMATION REQUIREMENTS

Labeling Requirements for the Host Device (from Section 3.2.1, RSS-Gen, Issue 3, December 2010): The host device shall be properly labeled to identify the module within the host device.

The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labeled to display the Industry Canada certification number of the module, preceded by the words “Contains transmitter module”, or the word “Contains”, or similar wording expressing the same meaning, as follows:

> Contains transmitter module IC: 6514A-RN52

User Manual Notice for License-Exempt Radio Apparatus (from Section 7.1.3 RSS-Gen, Issue 3, December 2010): User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both:

> This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
>
> Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Transmitter Antenna (from Section 7.1.2 RSS-Gen, Issue 3, December 2010): User manuals for transmitters shall display the following notice in a conspicuous location:

> Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.
>
> Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

The above notice may be affixed to the device instead of displayed in the user manual.

4.2.2 HELPFUL WEB SITES

Industry Canada: http://www.ic.gc.ca/

4.3 Europe

The RN52 module is an R&TTE Directive assessed radio module that is CE marked and has been manufactured and tested with the intention of being integrated into a final product.

The RN52 module has been tested to R&TTE Directive 1999/5/EC Essential Requirements for Health and Safety (Article (3.1(a)), Electromagnetic Compatibility (EMC) (Article 3.1(b)), and Radio (Article 3.2) and are summarized in Table 3-1: European Compliance Testing. A Notified Body Opinion has also been issued. All test reports are available on the RN52 product web page at http://www.microchip.com.

The R&TTE Compliance Association provides guidance on modular devices in document Technical Guidance Note 01 available at http://www.rtteca.com/html/download_area.htm.

Note: To maintain conformance to the testing listed in Table 4-1, the module shall be installed in accordance with the installation instructions in this data sheet and shall not be modified.

When integrating a radio module into a completed product the integrator becomes the manufacturer of the final product and is therefore responsible for demonstrating compliance of the final product with the essential requirements of the R&TTE Directive.

4.3.1 LABELING AND USER INFORMATION REQUIREMENTS

The label on the final product which contains the RN52 module must follow CE marking requirements. The R&TTE Compliance Association Technical Guidance Note 01 provides guidance on final product CE marking.

4.3.2 ANTENNA REQUIREMENTS

From R&TTE Compliance Association document Technical Guidance Note 01:

> Provided the integrator installing an assessed radio module with an integral or specific antenna and installed in conformance with the radio module manufacturer's installation instructions requires no further evaluation under Article 3.2 of the R&TTE Directive and does not require further involvement of an R&TTE Directive Notified Body for the final product. [Section 2.2.4]

4.3.3 HELPFUL WEB SITES

A document that can be used as a starting point in understanding the use of Short Range Devices (SRD) in Europe is the European Radio Communications Committee (ERC) Recommendation 70-03 E, which can be downloaded from the European Radio Communications Office (ERO) at: http://www.ero.dk/.

Additional helpful web sites are:

- Radio and Telecommunications Terminal Equipment (R&TTE): http://ec.europa.eu/enterprise/rtte/index_en.htm
- European Conference of Postal and Telecommunications Administrations (CEPT): http://www.cept.org
- European Telecommunications Standards Institute (ETSI): http://www.etsi.org
- European Radio Communications Office (ERO): http://www.ero.dk
- The Radio and Telecommunications Terminal Equipment Compliance Association (R&TTE CA): http://www.rtteca.com/

TABLE 4-1: EUROPEAN COMPLIANCE TESTING

Certification	Standards	Article	Laboratory	Report Number	Date
Safety	EN 60950-1:2006+A11:2009+A1:2010	(3.1(a))	Worldwide Testing Services (Taiwan) Co., Ltd.	W6M21301-13004-L	2/23/2013
Health	EN 50371:2002-03			W6M21301-13004-50371	5/31/2013
EMC	EN 301 489-1 V1.8.1 (2008-04)	(3.1(b))		W6M21301-13004-E-16	2/7/2013
	EN 301 489-17 V2.1.1 (2009-05)				
Radio	EN 300 328 V1.7.1 (2006-10)	(3.2)		W6M21301-13004-T-45	5/31/2013
Notified Body Opinion	CE 0681	—	Eurofins Product Service GmbH	U9M-1304-2756-C-V01	6/13/2013

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4.4 Australia

The Australia radio regulations do not provide a modular approval policy similar to the United States (FCC) and Canada (IC). However, RN52 module RF transmitter test reports can be used in part to demonstrate compliance in accordance with ACMA Radio communications “Short Range Devices” Standard 2004 (The Short Range Devices standard calls up the AS/NZS 4268:2008 industry standard). The RN52 module test reports can be used as part of the product certification and compliance folder. For more information on the RF transmitter test reports, contact Microchip Technology Australia sales office.

To meet overall Australian final product compliance, the developer must construct a compliance folder containing all relevant compliance test reports, e.g. RF, EMC, electrical safety and DoC (Declaration of Conformity), etc. It is the responsibility of the integrator to know what is required in the compliance folder for ACMA compliance. All test reports are available on the RN52 product web page at http://www.microchip.com. For more information on Australia compliance, refer to the Australian Communications and Media Authority web site: http://www.acma.gov.au/.

4.4.1 HELPFUL WEB SITES

The Australian Communications and Media Authority: www.acma.gov.au/.

4.5 New Zealand

The New Zealand radio regulations do not provide a modular approval policy similar to the United States (FCC) and Canada (IC). However, RN52 module RF transmitter test reports can be used in part to demonstrate compliance against the New Zealand “General User Radio License for Short Range Devices”. New Zealand Radio communications (Radio Standards) Notice 2010 calls up the AS / NZS 4268:2008 industry standard. The RN52 module test reports can be used as part of the product certification and compliance folder. All test reports are available on the RN52 product web page at http://www.microchip.com. For more information on the RF transmitter test reports, contact Microchip Technology sales office.

Information on the New Zealand short range devices license can be found in the following web links:

http://www.rsm.govt.nz/cms/licensees/types-oflicence/general-user-licences/short-range-devices

and

http://www.rsm.govt.nz/cms/policy-and-planning/spectrum-policy-overview/legislation/gazette-notices/product-compliance/radiocommunications-radiostandards-notice-2010.

To meet overall New Zealand final product compliance, the developer must construct a compliance folder containing all relevant compliance test reports e.g. RF, EMC, electrical safety and DoC (Declaration of Conformity) etc. It is the responsibility of the developer to know what is required in the compliance folder for New Zealand Radio communications. For more information on New Zealand compliance, refer to the web site: http://www.rsm.govt.nz/.

4.5.1 HELPFUL WEB SITES

Radio Spectrum Ministry of Economic Development: http://www.rsm.govt.nz/.

5.0 ORDERING INFORMATION

Table 5-1 provides ordering information for the RN52 module.

TABLE 5-1: ORDERING INFORMATION(1)

Part Number	Description
RN52-I/RM	Standard application firmware (A2DP/AVRCP/SPP) (master).

Note 1: For other configurations, contact Microchip directly.

Go to http://www.microchip.com for current pricing and a list of distributors carrying Microchip products.

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6.0 REVISION HISTORY

Revision A (September 2015)

- This replaces Roving Networks document “RN52 Bluetooth Audio Module Data Sheet”, version 1.1r 3/20/13.

NOTES:

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Note the following details of the code protection feature on Microchip devices:

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