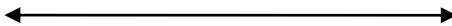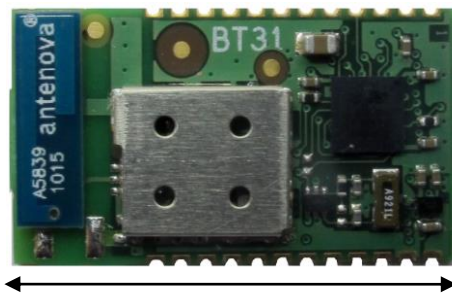Fast Track Your Wireless Project

自由无线 放飞梦想

BT 31 Data Sheet

Amp'ed RF Technology Inc.

Product Specification BT31

Bluetooth®

15mm x 27mm

Description

The BT31 OEM Bluetooth module, offers class 1 power output of up to +10dBm, 16 general purpose input/output lines, several serial interface options, analog-to-digital inputs, and up to 1.5M bps data throughput.

The BT31 is a surface mount PCB module that provides fully embedded, ready to use Bluetooth wireless technology. Our standard abSerial and Amp'edUP Stack are pre-flashed into the integrated flash memory, supporting the SPP profile Other popular Bluetooth profiles, such as OBEX, are also available.

Customized firmware for peripheral device interaction, power optimization, security, and other proprietary features may be supported and can be ordered pre-loaded and configured.

Bluetooth features

- FCC&Bluetooth licensed radio
- Bluetooth v3.0
- Class 1 radio
- Range up to 100m LOS
- 1.5Mbps data throughput
- 128-bit encryption security
- Multipoint capability up to 7 slaves
- FM Tx/Rx integrated radio

Hardware configuration

- Cortex-M3 microprocessor up to 72MHz
- 256K bytes flash memory
- 48K bytes RAM memory
- UART, up to 2Mbps
- SPI, I2C, I2S and PCM interfaces
- 16 general purpose I/O
- 4 x 12bit A/D inputs
- 2 DAC output

Embedded software

- Amp'edUP Bluetooth stack (SPP, OBEX, A2DP, HSP)
- Support Apple iOS/MFI Bluetooth devices
- abSerial, AT command set
- SDK, software Development Kit (Optional)
- BlueGuard, data encryption software (Optional)
- Mobile application software.(Optional)

Additional Documentation

- abSerial User Guide
- abSerial Reference Guide
- abSerial Configuration Guide

Features

Contents

1 Software Architecture

1.1 Lower Layer Stack

- Full Bluetooth v3.0 data rate
- Device power modes: active, sleep and deep sleep
- Wake on Bluetooth feature: optimized power consumption of host CPU
- Authentication and encryption
- Encryption key length from 8-bits to 128-bits maximum
- Persistent FLASH memory: for BD Address and user parameter storage
- All ACL packet types
- eSCO packet types (2-EV3,2-EV5,3-EV3,3-EV5)
- Point to multipoint and scatternet support: 3 master and 7 slave links allowed (10 active links simultaneously)
- Sniff mode fully supported to maximum allowed intervals
- Master slave switch: supported during connection and post connection
- Dedicated Inquiry Access Code: for improved inquiry scan performance
- Dynamic packet selection: channel quality driven data rate to optimize link performance
- Dynamic power control: interference reduction and link performance
- Bluetooth test modes: per Bluetooth specification
- 802.11b/g/n co-existence: AFH
- Vendor specific HCI commands to support device configuration and certification test modes
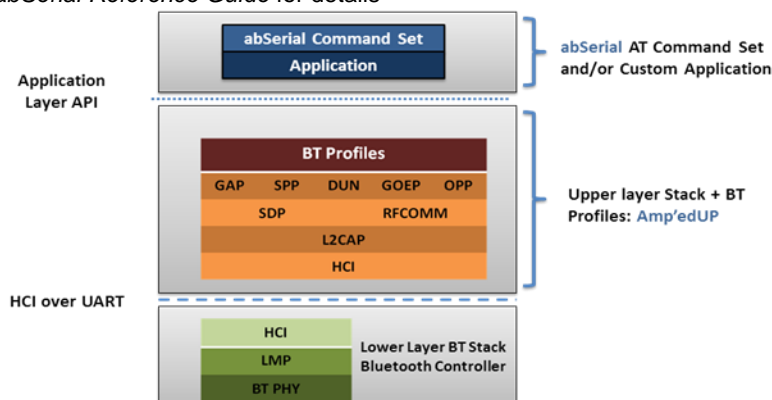
1.2 Upper Layer Stack: Amp'ed UP

- SPP, OBEX, SDAP, GAP, and DUN protocols
- RFComm, SDP, and L2CAP supported
- Multipoint with 7 simultaneous slaves

1.3 HCI Interface

- Bluetooth v3.0 specification compliant
- HCI UART transport layer (H4)

1.4 AT Command Set: abSerial

- Please see *abSerial Reference Guide* for details

2 Hardware Specifications

General Conditions (V_{IN}= 2.5V and 25°C)

2.1 Recommended Operating Conditions

Rating	Min	Typical	Max	Unit
Operating Temperature Range	-40	-	85	°C
Supply Voltage V_{IN}	2.1	2.5	3.6	Volts
Signal Pin Voltage	-	2.1	-	Volts
RF Frequency	2400	-	2483.5	MHz

2.2 Absolute Maximum Ratings

Rating	Min	Typical	Max	Unit
Storage temperature range	-55	-	+150	°C
Supply voltage, V_{IN}	-0.3	-	+ 5.5	Volts
I/O pin voltage, V_{IO}	-0.3	-	+ 5.5	Volts
RF input power	-	-	-5	dBm

2.3 Current Consumption

High speed CPU mode, 32 MHz ▪ UART supports up to 921 Kbps ▪ Data throughput up to 1.5 Mbps ▪ abSerial v1.4 (installed firmware) ▪ Shallow Sleep enabled		
Modes (Typical Power Consumption)	**Avg**	**Unit**
ACL data 115K Baud UART at max throughput (Master)	23.0	mA
ACL data 115K Baud UART at max throughput (Slave)	27.5	mA
Connection, no data traffic, master	9.1	mA
Connection, no data traffic, slave	11.2	mA
Connection in sniff (Tsniff=375ms)	490	µA
Standby, without deep sleep	8.6	mA
Standby, with deep sleep	60	µA
Page/Inquiry scan, deep sleep	520	µA
Bluetooth power down / CPU standby	6	µA

Standard CPU Mode, 8 MHz ▪ UART supports up to 115 Kbps ▪ Data throughput up to 200 Kbps ▪ abSerial v1.4 (installed firmware) ▪ Shallow Sleep enabled		
Modes (Typical Power Consumption)	**Avg**	**Unit**
ACL data 115K Baud UART at max throughput (Master)	16.7	mA
ACL data 115K Baud UART at max throughput (Slave)	18.0	mA
Connection, no data traffic, master	4.9	mA
Connection, no data traffic, slave	7.0	mA
Connection in sniff (Tsniff=375ms)	490	µA
Standby, without deep sleep	4.2	mA
Standby, with deep sleep	60	µA
Page/Inquiry scan, deep sleep	520	µA
Bluetooth power down / CPU standby	6	µA

Stereo Audio (A2DP) mode ▪ SBC Codec at 44.1KHz sample rate ▪ I2S Output		
Modes (Typical Power Consumption)	**Avg**	**Unit**
Sink, Streaming mode	39.0	mA

2.4 Selected RF Characteristics

Parameters	Conditions	Typical	Unit
Antenna load		50	ohm
Radio Receiver			
Sensitivity level	BER < .001 with DH5	-90	dBm
Maximum usable level	BER < .001 with DH1	0	dBm
Input VSWR		2.0:1	
Radio Transmitter			
Maximum output power	50 Ω load	+10	dBm
Initial Carrier Frequency Tolerance		0	kHz
20 dB Bandwidth for modulated carrier		935	kHz

2.5 I/O Operating Characteristics

Symbol	Parameter	Min	Max	Unit	Conditions
V_{IL}	Low-Level Input Voltage	-	0.6	Volts	V_{IN}, 2.1V
V_{IH}	High-Level Input Voltage	1.4	-	Volts	V_{IN}, 2.1V
V_{OL}	Low-Level Output Voltage	-	0.4	Volts	V_{IN}, 2.1V
V_{OH}	High-Level Output Voltage	1.8	-	Volts	V_{IN}, 2.1V
I_{OL}	Low -Level Output Current	-	4.0	mA	V_{OL} = 0.4 V
I_{OH}	High-Level Output Current	-	4.0	mA	V_{OH} = 1.8V
R_{PU}	Pull-up Resistor	80	120	KΩ	Resistor Turned On
R_{PD}	Pull-down Resistor	80	120	KΩ	Resistor Turned On

2.6 Pin Assignment

BT31

Name	Type	Pin #	Description	ALT Function	5V Tolerant	Initial state
UART Interface						
RXD	I	8	Receive data		Y	
TXD	O	6	Transmit data		Y	
CTS	I	9	Clear to send (active low)		Y	
RTS	O	10	Request to send (active low)		Y	
Boot Loader						
Boot 0	I	2	Reserved			
Power and Ground						
V_{DD}		24	V_{DD}			
GND		23	GND			
Reset						
RESETN	I	3	Reset input (active low for 5 ms);		2.5V max	
GPIO – General Purpose Input/Output						
GPIO [0]	I/O	16	General Purpose Input/Output	SPI MISO	Y	Input pull down
GPIO [1]	I/O	17	General Purpose Input/Output	SPI MOSI	Y	Input pull down
GPIO [2]	I/O	19	General Purpose Input/Output	SPI SS	Y	Floating
GPIO [3]	I/O	1	General Purpose Input/Output	SPI CLK	Y	Input pull down
GPIO [4]	I/O	18	General Purpose Input/Output	UART 2 RXD	Y	Input pull down
GPIO [5]	I/O	20	General Purpose Input/Output	UART 2 TXD	Y	Input pull down
GPIO [6]	I/O	22	General Purpose Input/Output	ADC 0	2.5V max	Input pull down
GPIO [7]	I/O	13	General Purpose Input/Output	ADC 1	2.5V max	Floating
GPIO [8]	I/O	4	General Purpose Input/Output	ADC 2	2.5V max	Floating
GPIO [9]	I/O	7	General Purpose Input/Output	ADC 3	2.5V max	Floating
GPIO [10]	I/O	5	General Purpose Input/Output		Y	Floating
GPIO [11]	I/O	11	General Purpose Input/Output	I2C SCL	Y	Input pull up
GPIO [12]	I/O	12	General Purpose Input/Output	I2C SDA	Y	Input pull up
GPIO [13]	I/O	15	General Purpose Input/Output		Y	Input pull up
GPIO [14]	I/O	14	General Purpose Input/Output		Y	Input pull up
GPIO [15]	I/O	21	General Purpose Input/Output	DAC	2.5V max	Input pull up

BT31-AUD

Name	Type	Pin #	Description	ALT Function	5V Tolerant	Initial state
UART Interface						
RXD	I	8	Receive data		Y	
TXD	O	6	Transmit data		Y	
CTS	I	9	Clear to send (active low)		Y	
RTS	O	10	Request to send (active low)		Y	
Boot Loader						
Boot 0	I	2	Reserved			
Power and Ground						
V_{DD}		24	V_{DD}			
GND		23	GND			
Reset						
RESETN	I	3	Reset input (active low for 5 ms);		2.5V max	
LPO						
LPO	I	25	LPO input			
GPIO – General Purpose Input/Output						
GPIO [0]	I/O	16	General Purpose Input/Output	SPI MISO	Y	Input pull down
GPIO [1]	I/O	17	General Purpose Input/Output	SPI MOSI	Y	Input pull down
GPIO [2]	I/O	19	General Purpose Input/Output	SPI SS	Y	Floating
GPIO [3]	I/O	1	General Purpose Input/Output	SPI CLK	Y	Input pull down
GPIO [4]	I/O	18	General Purpose Input/Output		Y	Input pull down
GPIO [5]	I/O	20	General Purpose Input/Output	DAC 1	2.5V max	Input pull down
GPIO [6]	I/O	22	General Purpose Input/Output	ADC 0	2.5V max	Input pull down
GPIO [7]	I/O	13	General Purpose Input/Output	ADC 1	2.5V max	Floating
GPIO [8]	I/O	4	General Purpose Input/Output	ADC 2	2.5V max	Floating
GPIO [9]	I/O	7	General Purpose Input/Output	ADC 3	2.5V max	Floating
GPIO [10]	I/O	5	General Purpose Input/Output		Y	Floating
GPIO [11]	I/O	11	General Purpose Input/Output	I2C SCL	Y	Input pull up
GPIO [12]	I/O	12	General Purpose Input/Output	I2C SDA	Y	Input pull up
GPIO [13]	I/O	15	General Purpose Input/Output		Y	Input pull up
GPIO [14]	I/O	14	General Purpose Input/Output		Y	Input pull up
GPIO [15]	I/O	21	General Purpose Input/Output	DAC 0	2.5V max	Input pull up

2.7 Layout Drawing
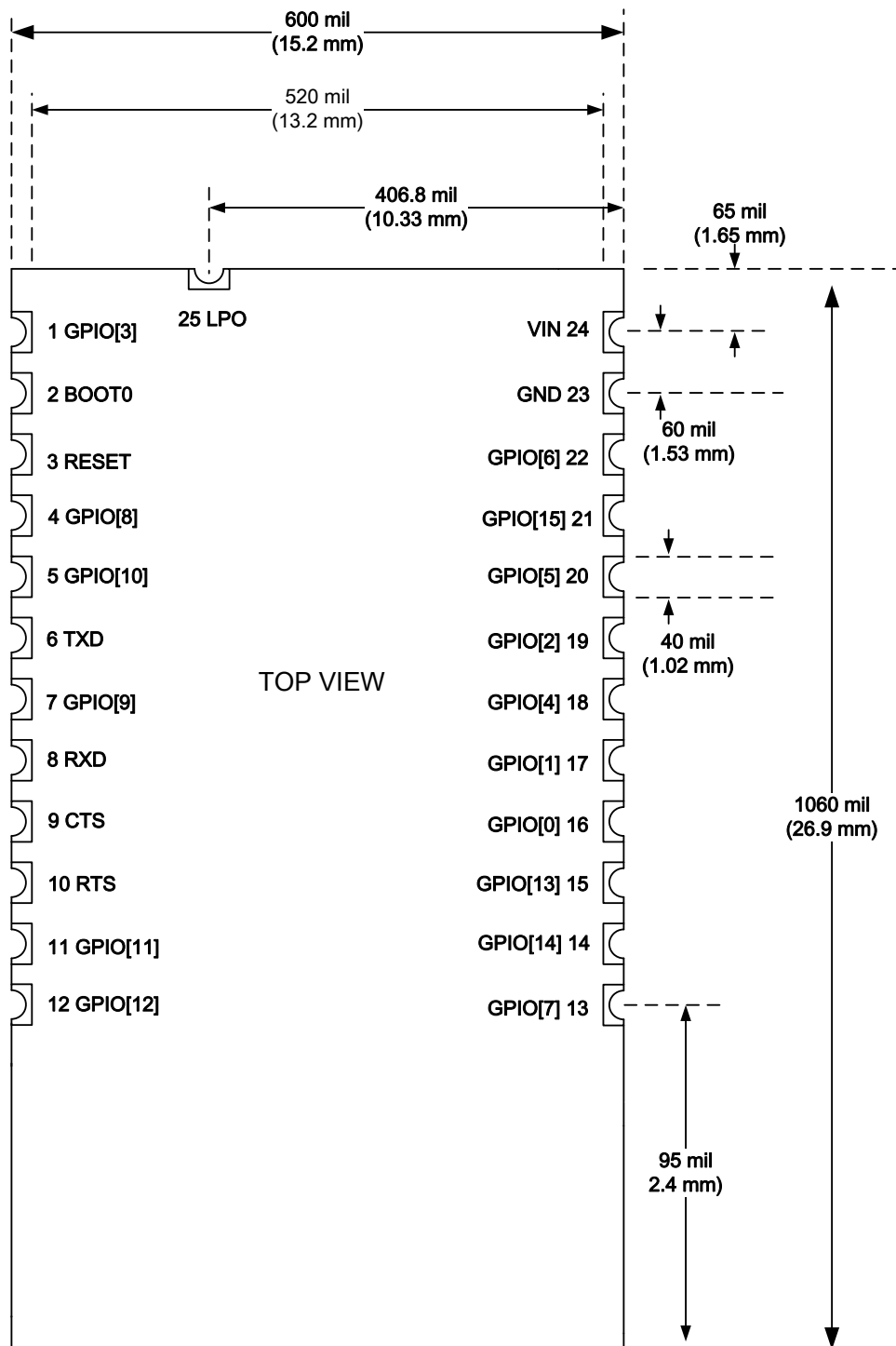
3   Module Block Diagram
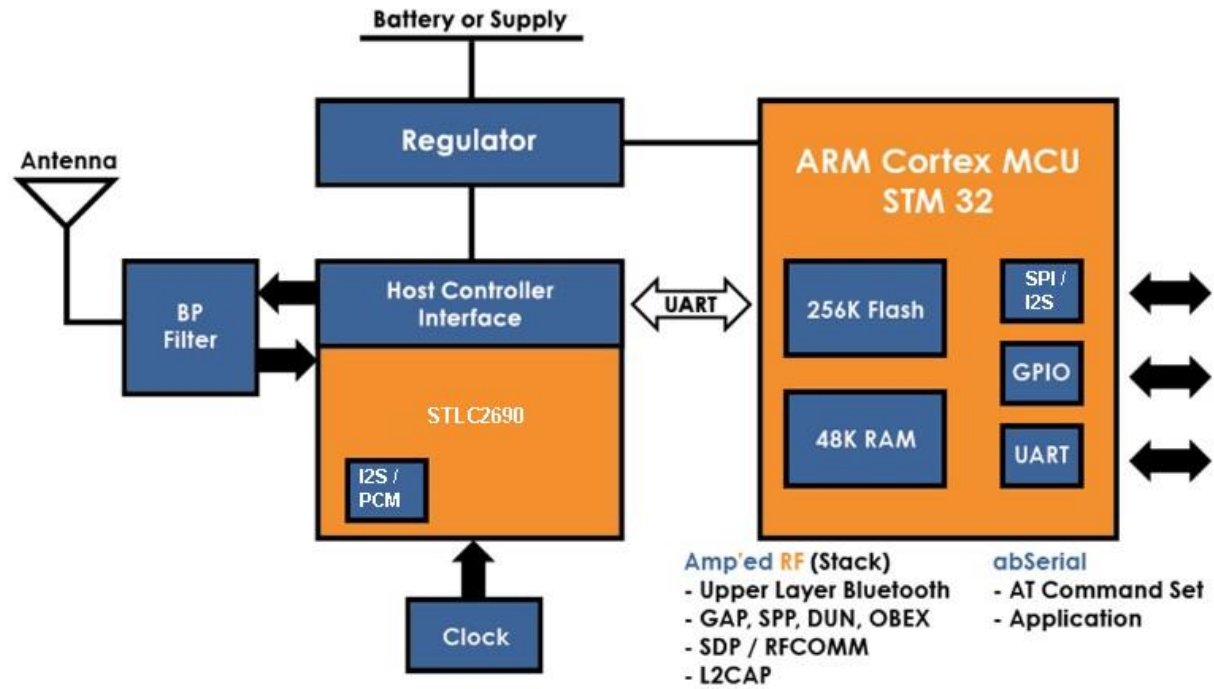
4 Hardware Design

Amp'ed RF modules support UART, USB, SPI, I2C and GPIO hardware interfaces. Note that the usage of these interfaces is dependant upon the firmware that is loaded into the module, and is beyond the scope of this document.

Notes

- All unused pins should be left floating; do not ground.
- All GND pins must be well grounded.
- The area around the antenna should be free of any ground planes, power planes, trace routings, or metal for 6 mm from the antenna in all directions.
- Traces should not be routed underneath the module.

4.1 Module Reflow Installation

The BT-31 is a surface mount Bluetooth module supplied on a 24 pin, 6-layer PCB. The final assembly recommended reflow profiles are:

For RoHS/Pb-free applications, Sn96.5/Ag3.0/Cu0.5 solder is recommended.

- Maximum peak temperature of 230° - 240°C (below 250°C).
- Maximum rise and fall slope after liquidous of < 2°C/second.
- Maximum rise and fall slope after liquidous of < 3°C/second.
- Maximum time at liquidous of 40 – 80 seconds.

4.2 GPIO Interface

All GPIOs are capable of sinking and sourcing 4mA of I/O current.

4.3 UART Interface

The UART is compatible with the 16550 industry standard. Four signals are provided with the UART interface. The TXD and RXD pins are used for data while the CTS and RTS pins are used for flow control.
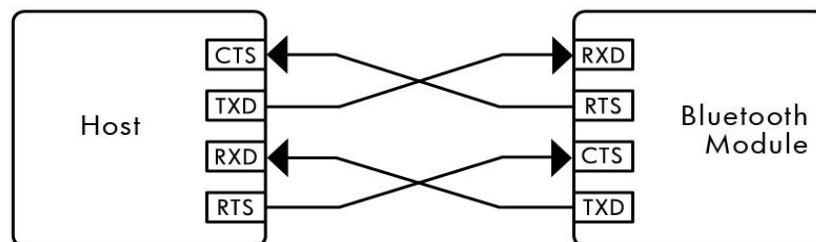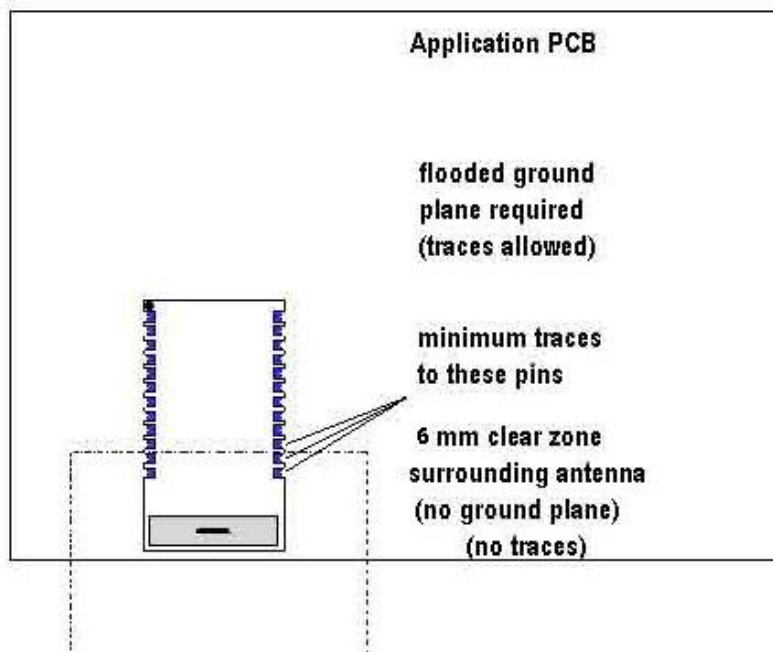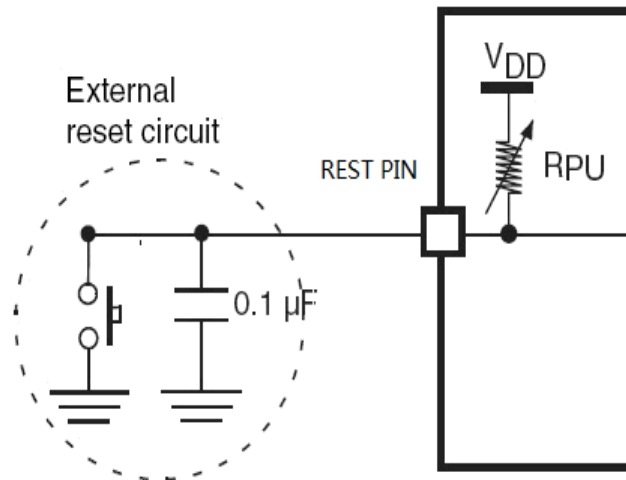

Connection to Host Device
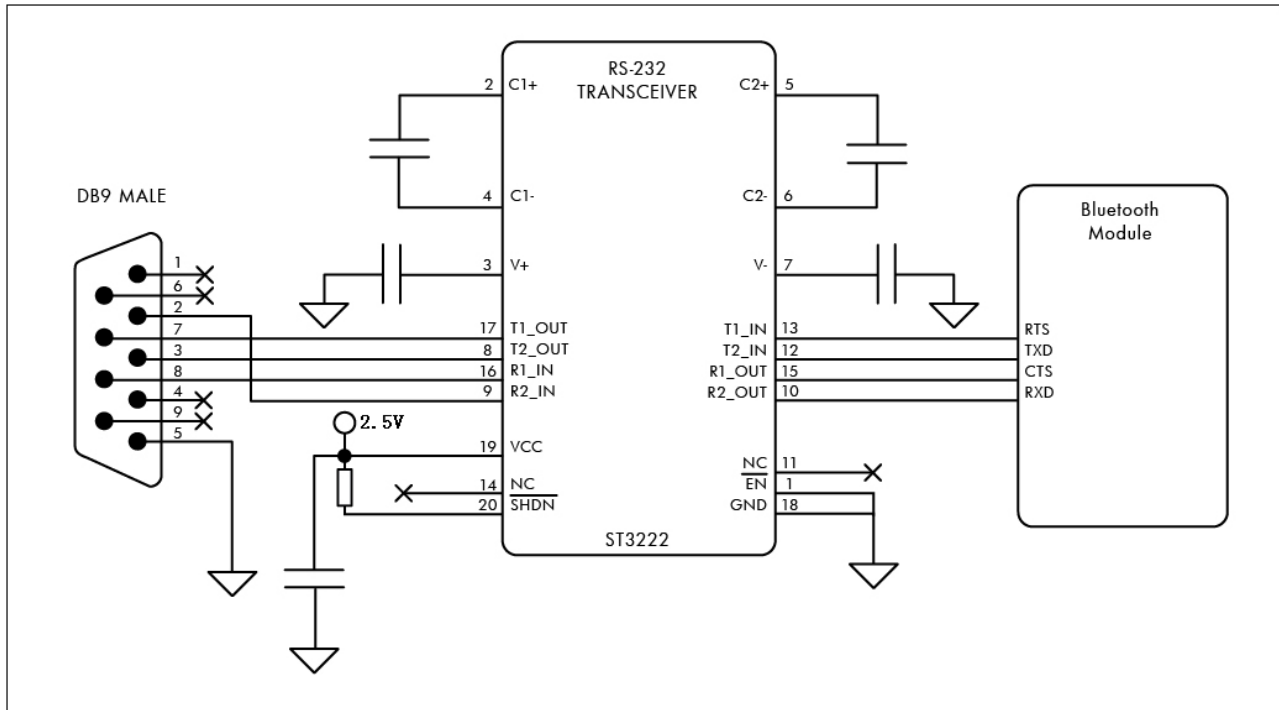
Typical RS232 Circuit

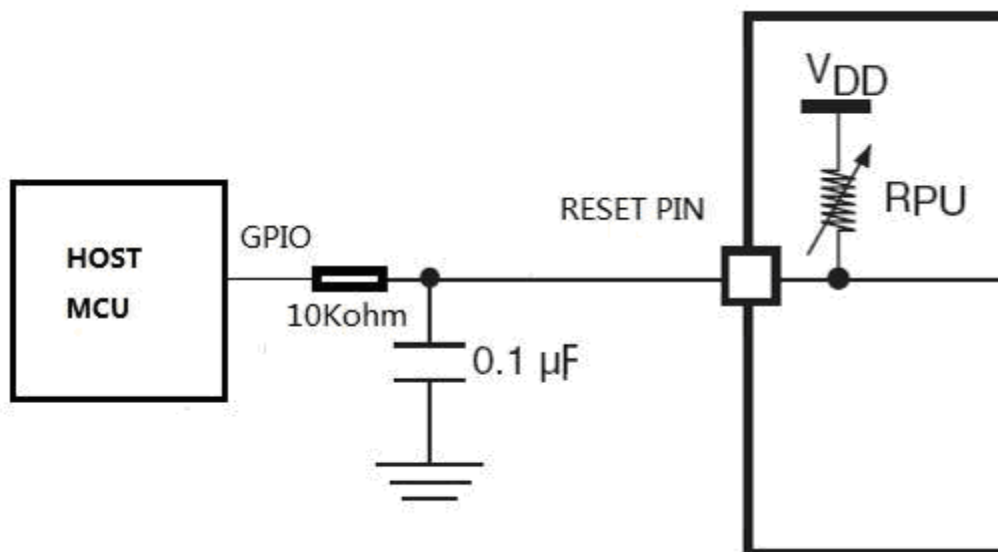## 4.4 PCB Layout Guidelines

4.5 Reset Circuit

Two types of system reset circuits are detailed below.

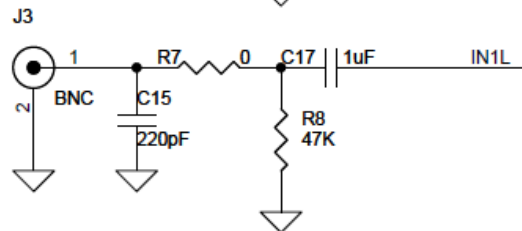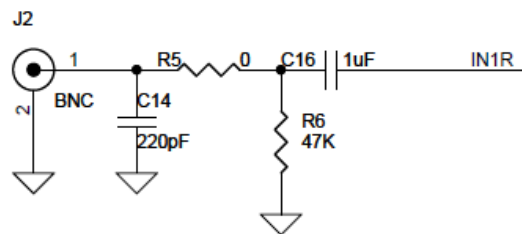### 4.5.1 External Reset Circuit:

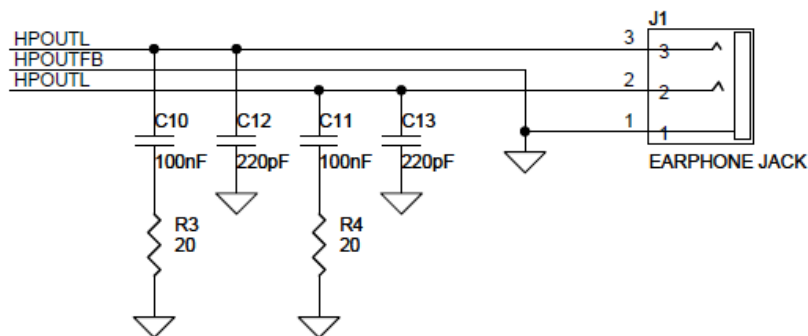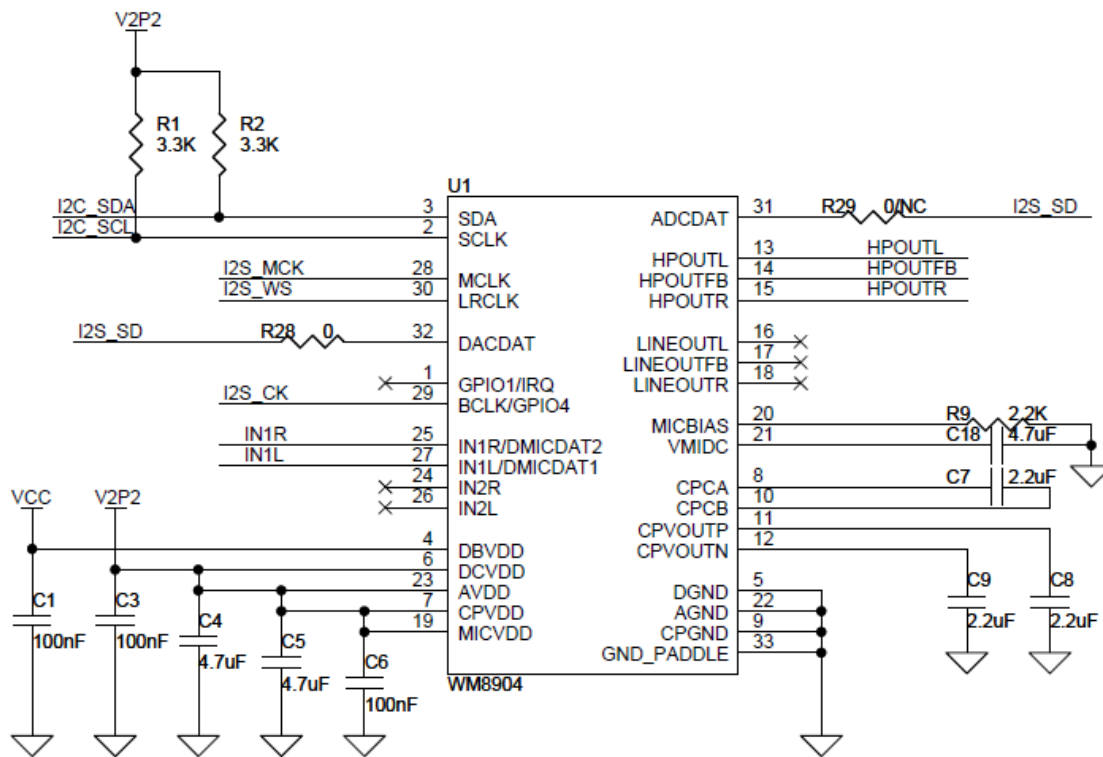Note: R_{PU} ranges from 30K ohm to 50K ohm internally.

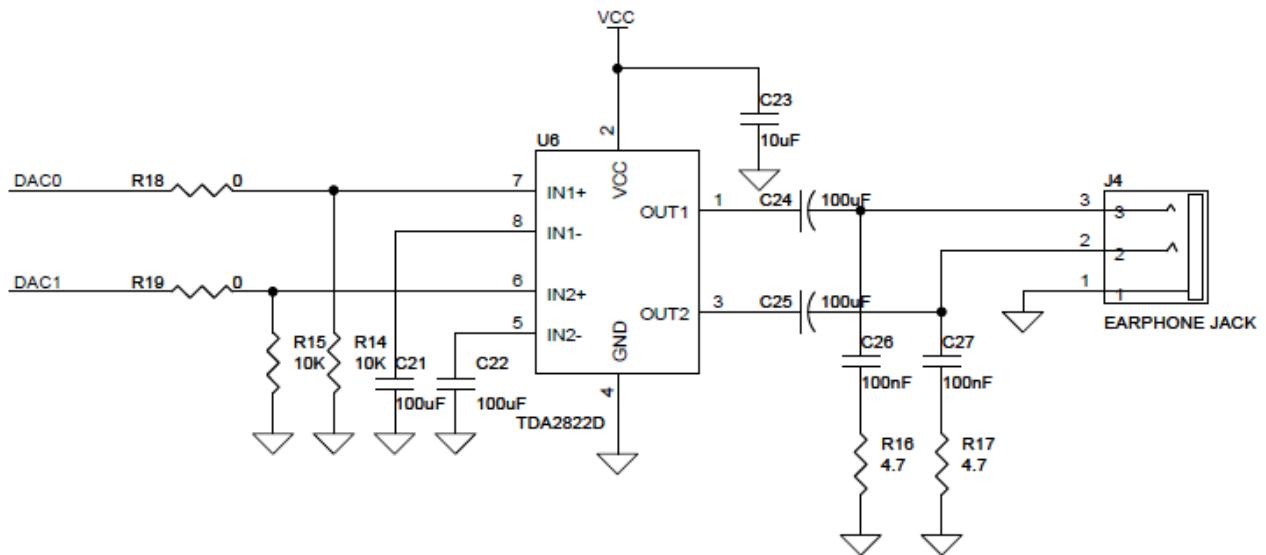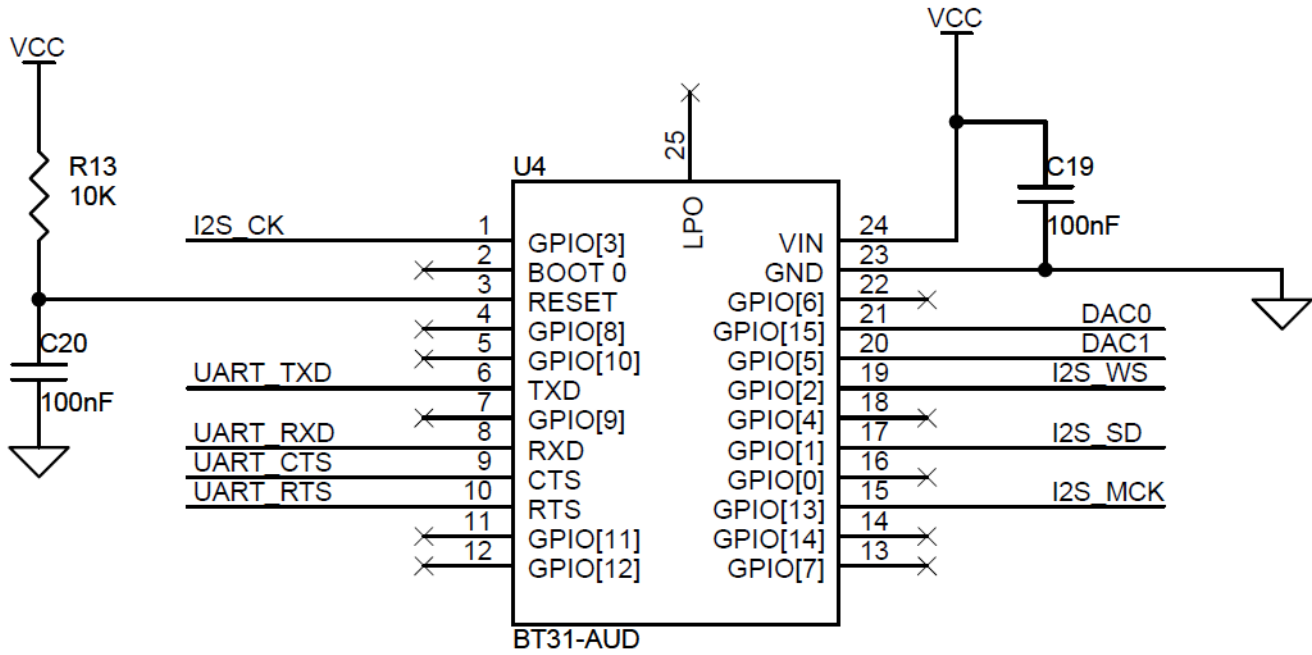### 4.5.2 Internal Reset Circuit:

Notes:

- R_{PU} ranges from 30K ohm to 50K ohm internally.
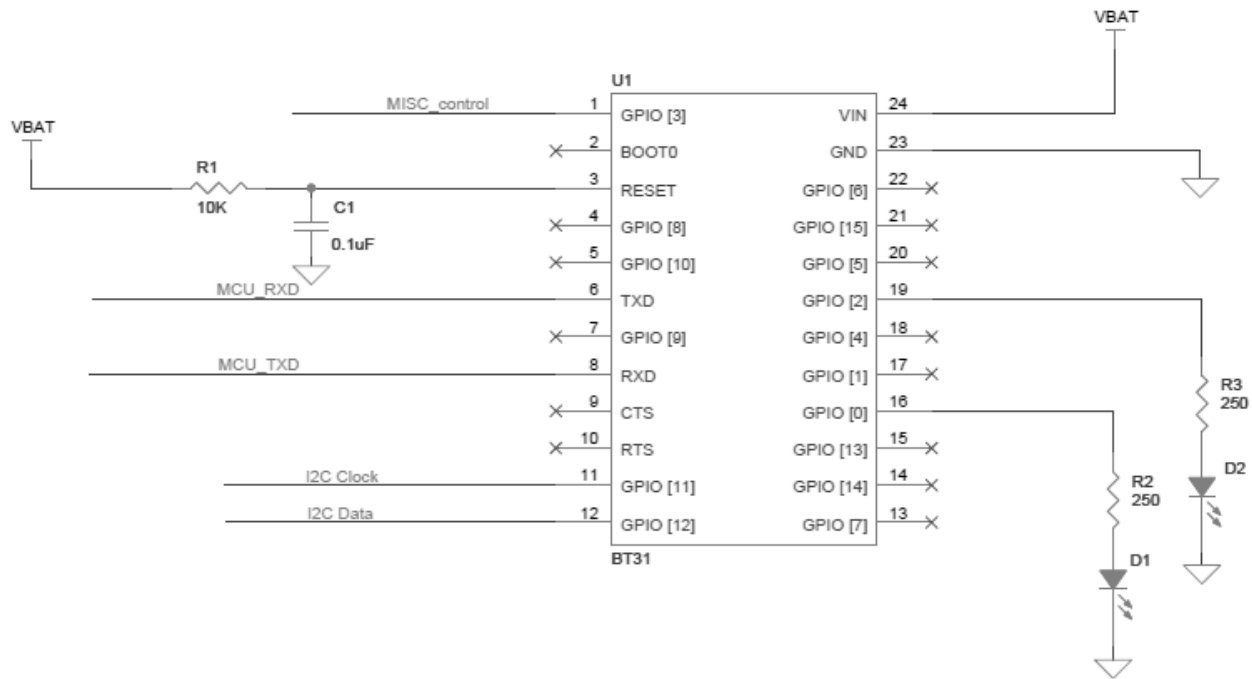- R_{RST} should be from 1K ohm to 10K ohm
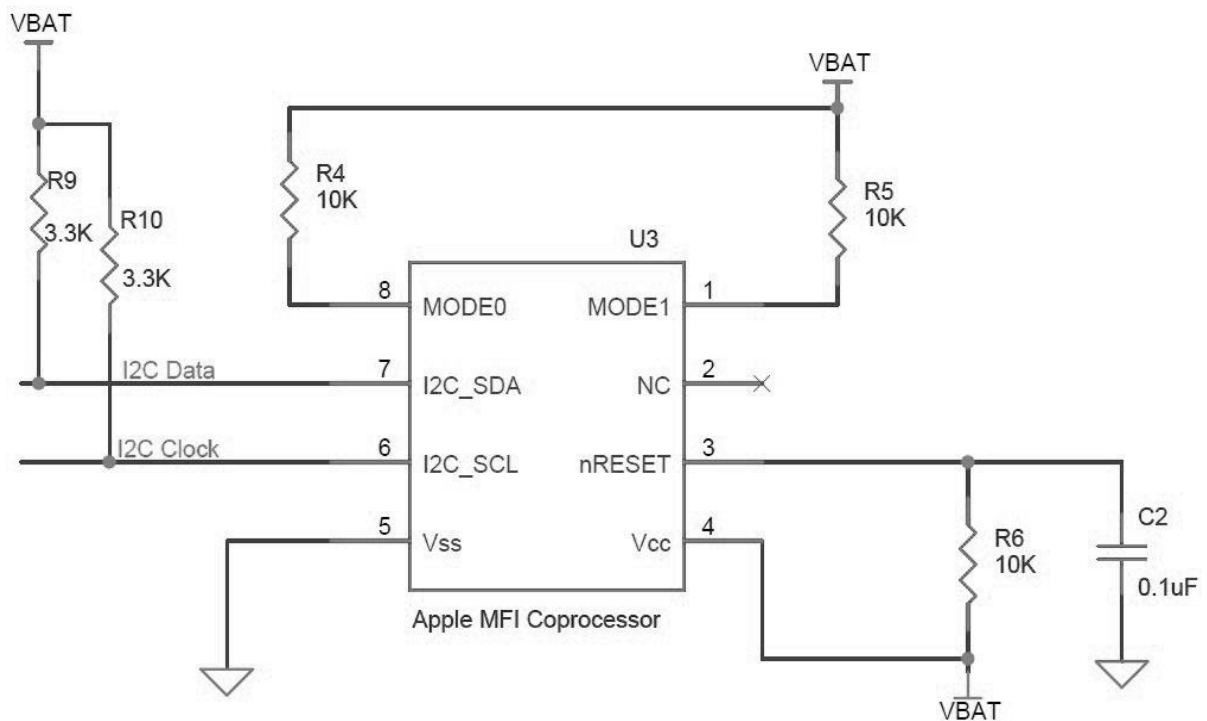
4.6 Audio application Reference Design
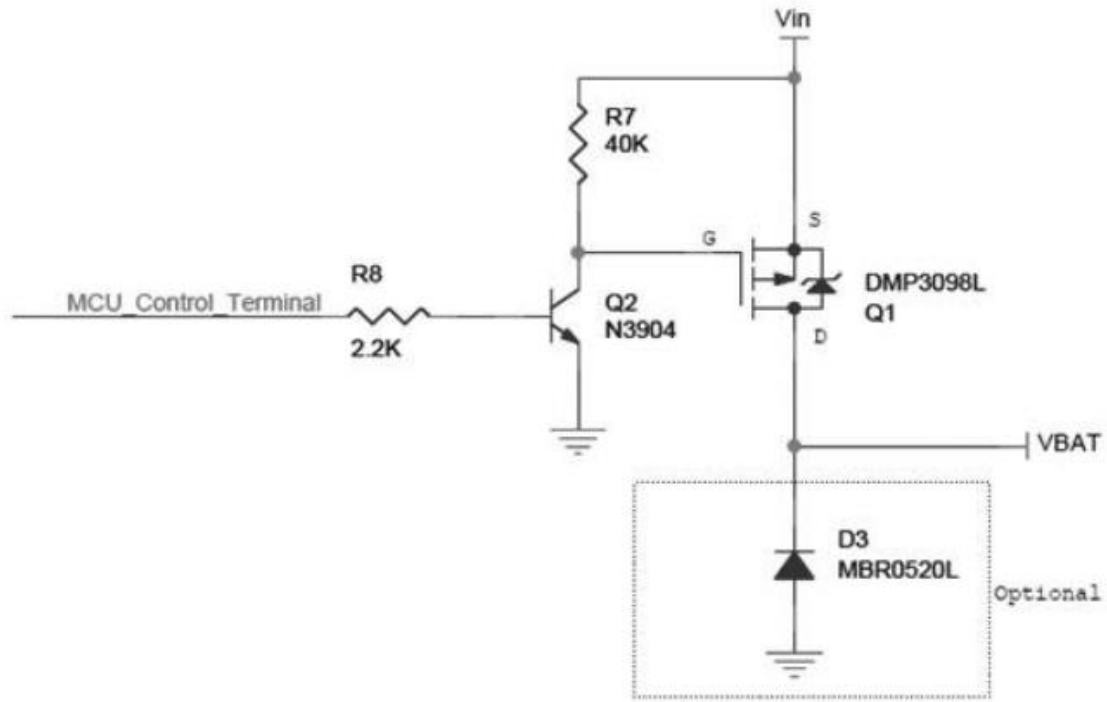

Part 1. WM8904

Part 2. BT Module

Part 3. Stereo DAC with Power Amp

4.7 Apple iOS CP Reference Design

Part 1. BT module

Part 2. Co-processor

Part 3. Power switch

5 Regulatory Compliance

FCC and IC

This module has been tested and found to comply with the FCC Part15 and IC RSS-210 rules. These limits are designed to provide reasonable protection against harmful interference in approved installations. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. 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.

Modifications or changes to this equipment not expressly approved by Amp'ed RF Technology may void the user's authority to operate this equipment.

5.1 Modular Approval, FCC and IC

FCC ID: X3ZBTMOD3
IC: 8828A-MOD3

In accordance with FCC Part 15, the BT31 is listed above as a Modular Transmitter device.

6 Label Instructions

The outside of final products that contain a BT31 device must display a label referring to the enclosed module. This exterior label can use wording such as the following:

Contains Transmitter Module
FCC ID: X3ZBTMOD3
IC: 8828A-MOD3

Any similar wording that expresses the same meaning may be used.

7 Ordering Information

Part Name	Description
BT31	Class 1 OEM Bluetooth Module
BT31-AUD	Supports stereo audio applications
BT31H	Same as BT31-AUD, but with standard (non-audio) firmware

8 Revision History

Data	Revision	Description
19-Jan-2011	1	First preliminary release
1-Aug-2011	2	Added FCC, IC regulatory information. Updated power consumption tables.
16-Nov-2012	3	Added BT31-AUD information. Updated Pin assignment; Reference circuit
17-Feb-2021	4	Added BT31H part number