BT53 Datasheet

Amp'ed RF Technology, Inc.

BT53 Product Specification

11.6mm x 13.5mm

Description

Our micro-sized Bluetooth module, with integrated antenna, is the smallest form factor available providing a complete RF platform. The BT53 is supports both Bluetooth Classic and Low Energy, version v4.0.

The BT53 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 SPPprofile. Other standard Bluetooth profiles 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.

BT53 Features

Bluetooth features

- FCC &Bluetooth licensed radio
- Bluetooth v4.0
- Class 1 radio
- Range up to 80m LOS
- 1.5Mbps data throughput
- 128-bit encryption security

Hardware configuration

- Cortex-M4microprocessor up to 84MHz
- 256K bytes Flash memory
- 64K bytes RAM memory
- UART, up to 2M baud
- SPI and I2C interfaces
- 7 general purpose I/O
- 4x12-bit A/D inputs
- 1 LPO input

Embedded software

- Amp'edUPdual mode Bluetooth stack: BT Classic and BT Low Energy
- 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

Table of Contents

1 Software Architecture

1.1 Lower Layer Stack

- Bluetooth v4.0, Classic and Low Energy
- 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 to 128 bits
- Persistent FLASH memory for BD Address and user parameter storage
- All ACL packet types.
- 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
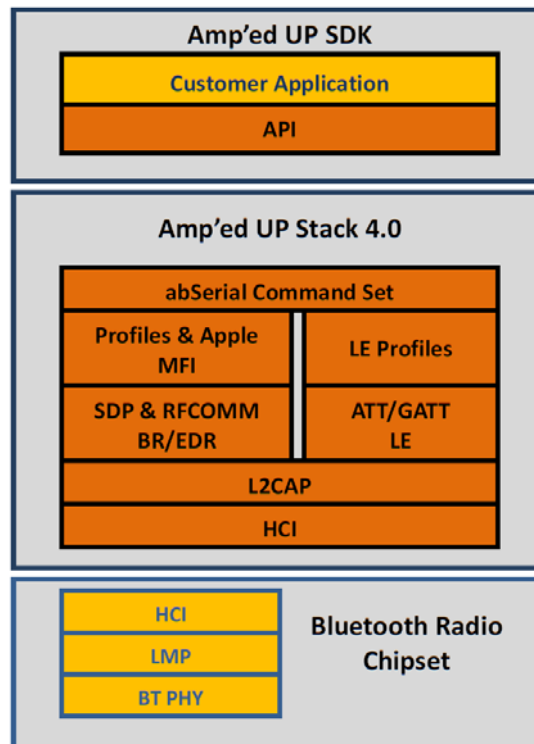
- SPP, GAP, ATT, GATT
- RFComm, SDP, and L2CAP

1.3 HCI Interface

- Bluetooth v4.0 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}	2.2	2.5	4.8	Volts
Signal Pin Voltage	-	1.9	-	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	-	+5.0	Volts
I/O pin voltage V_{IO}	-0.3	-	+5.5	Volts
RF input power	-	-	-5	dBm

2.3 Current Consumption

Standard CPU Mode, 8 MHz
- UART supports up to 115 Kbps
- Data throughput up to 200 Kbps
- abSerial v1.7 (firmware)
- Shallow Sleep enabled

Modes (Typical Power Consumption)	Avg	Unit
ACL data 115K Baud UART at max throughput (Master)	16.5	mA
ACL data 115K Baud UART at max throughput (Slave)	18.5	mA
Connection, no data traffic, master	5.2	mA
Connection, no data traffic, slave	7.4	mA
Connection, 375ms sniff, slave	590	μA
Standby, without deep sleep	4.9	mA
Standby, with deep sleep	140	uA
Page/Inquiry Scan, with deep sleep	720	μA
BLE Advertising, 1.28s, non-connectable	195	μA
BLE Advertising, 1.28s, discoverable	215	μA

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2.4 Selected RF Characteristics

Parameters	Conditions	Typical	Unit
Antenna load		50	ohm
Radio Receiver			
Sensitivity level	BER < .001 with DH5	-92	dBm
Maximum usable level	BER < .001 with DH1	0	dBm
Input VSWR		2.5:1	
Radio Transmitter			
Maximum output power	50 Ω load	+12	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

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2.6 Pin Assignment

Name	Type	Pin #	Description	ALT Function	5V Tolerant	Initial State
UART Interface						
RXD	I	13	Receive data		Y	
TXD	O	14	Transmit data		Y	
RTS	O	12	Request to send (active low)	I2C Data	Y	
CTS	I	11	Clear to send (active low)	I2C Clock	Y	
Reserved						
BOOT 0	I	9	Reserved			
Power and Ground						
VIN		8	VIN			
GND		7	GND			
LDOOUT		18	LDO OUTPUT 1.9V			
Reset						
RESETN	I	10	Reset input (active low for 5 ms)		2.5V max	
LPO						
LPO	I	15	Low power clock input (required)			
GPIO – General Purpose Input/Output						
GPIO [1]	I/O	1	General Purpose Input/Output	SPI MISO	Y	Input pull down
GPIO [2]	I/O	2	General Purpose Input/Output	SPI MOSI/I2S_SD	Y	Floating
GPIO [3]	I/O	3	General Purpose Input/Output	SPI SCLK/ I2S_SCK	Y	Input pull down
GPIO [4]	I/O	4	General Purpose Input/Output	SPI SS/I2S_WS	Y	Input pull down
GPIO [5]	I/O	5	General Purpose Input/Output	I2C Data	Y	Input pull down
GPIO [6]	I/O	6	General Purpose Input/Output	I2C Clock	Y	Input pull down
GPIO [7]	I/O	17	General Purpose Input/Output	ADC 0	Y	Input pull down
GPIO [8]	I/O	16	General Purpose Input/Output	ADC1	Y	Input pull down

2.7 Pin Placement Diagram (Top View)
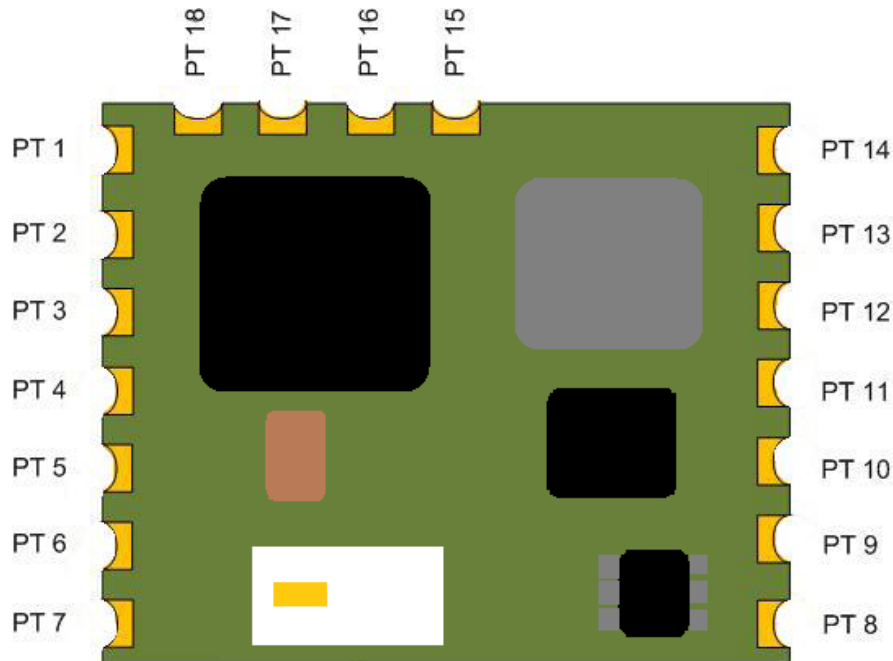
2.8 Layout Drawing

Size: 11.6 mm x 13.5 mm x 2.2 mm

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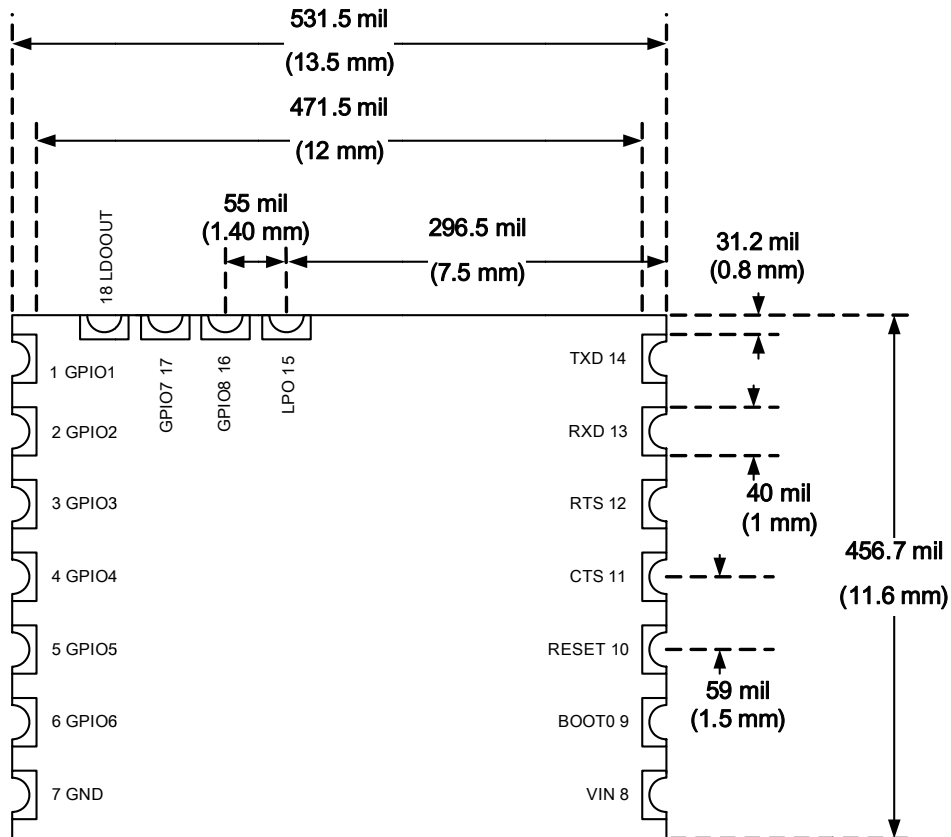
3 Module Block Diagram
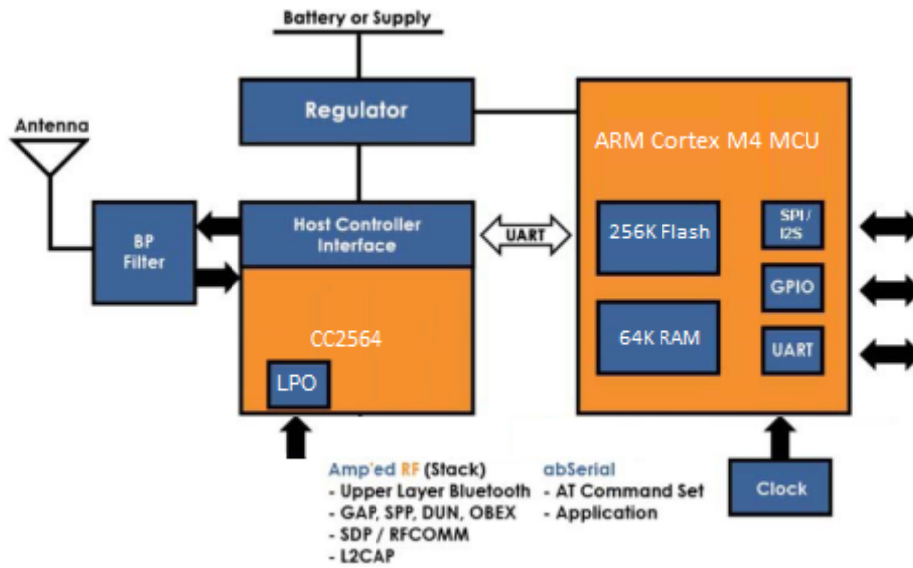
4 Hardware Design

Amp'ed RF modules support UART, USB, SPI, and GPIO hardware interfaces. Please note that the usage of these interfaces is dependent upon the firmware that is loaded into the module, and is beyond the scope of this document. The AT command interface uses the main UART by default.

Notes

- An external Low Power Oscillator is *required* on pin 15.

- 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 at least 6 mm in all directions.

- Traces should not be routed underneath the module.

4.1 Module Reflow Installation

The BT53 is a surface mount Bluetooth module supplied on a 18 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.

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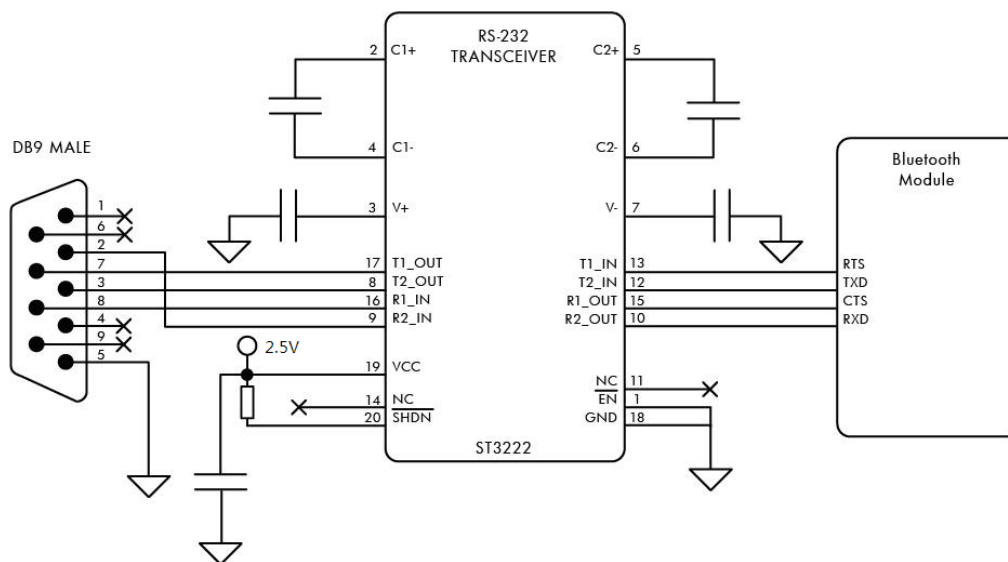地址：天津市华苑产业区海泰西路 18 号西 3B-202（300384）
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4.2 GPIO Interface

All GPIOs are capable of sinking and sourcing 6mA 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.
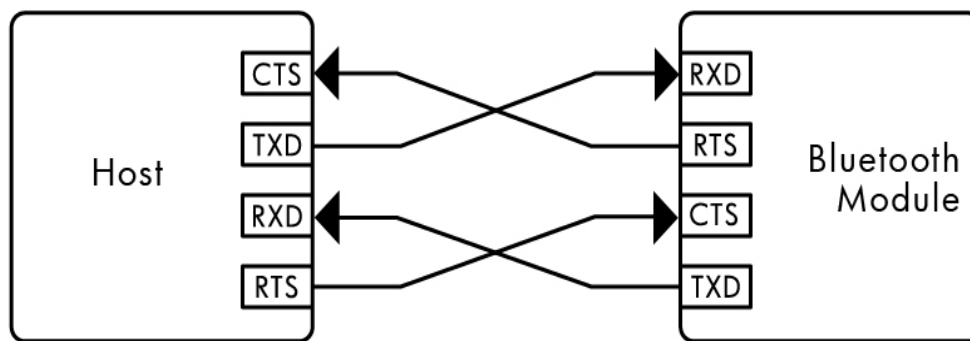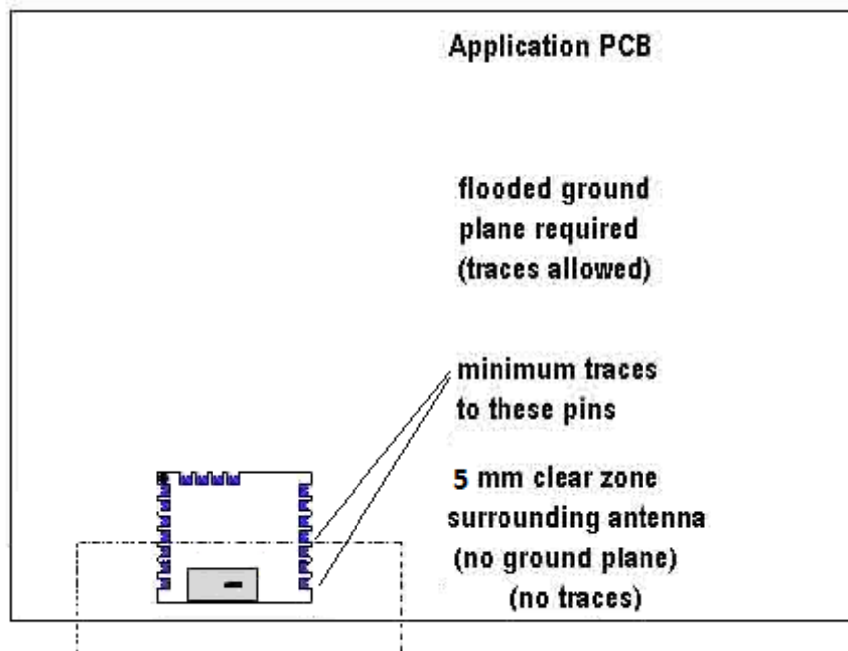

Connection to Host Device
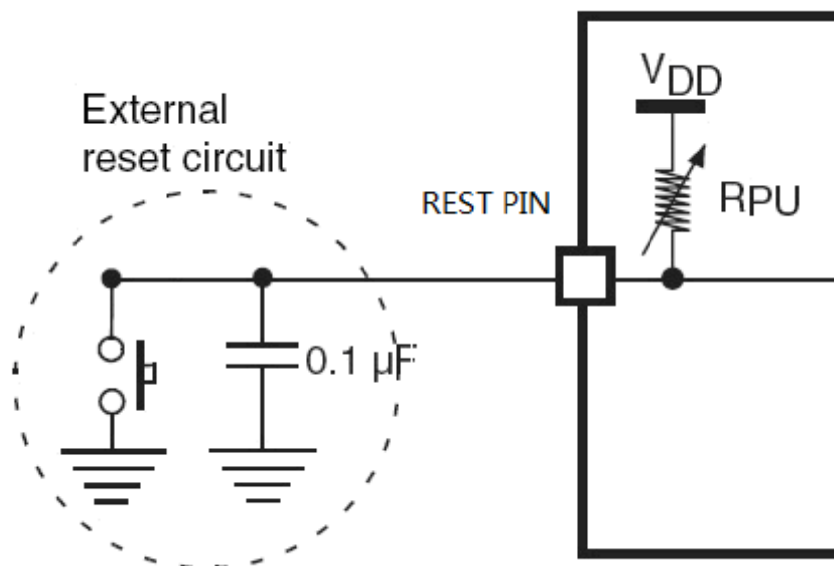

Typical RS232 Circuit
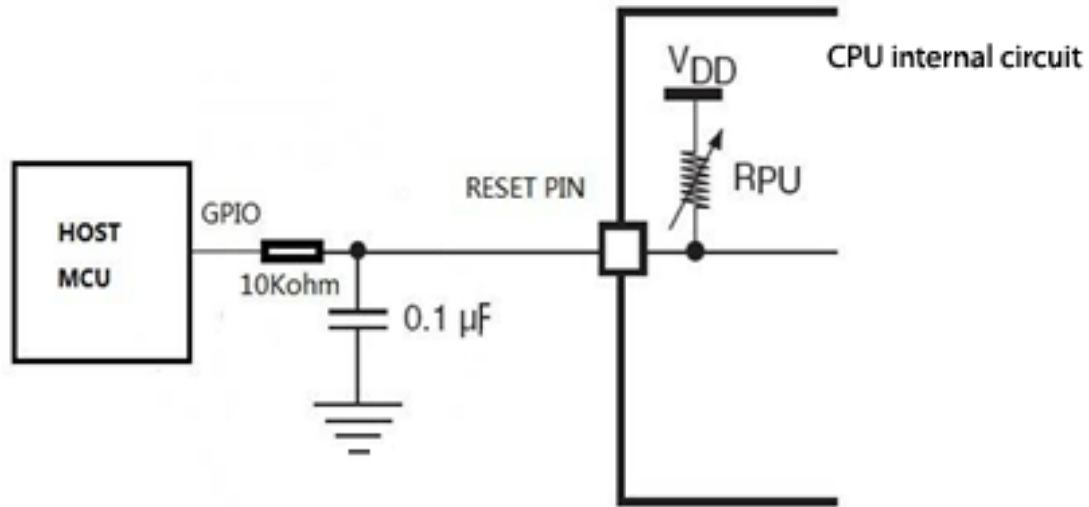
4.4 PCB Layout Guidelines

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 External LPO Input Circuit

An external source must supply the slow clock and connect to the LPO pin (for example, the host or external crystal oscillator). The source must be a digital signal in the range of 0 to 1.8 V.
The accuracy of the slow clock frequency must be 32.768 KHz ±150 ppm for Bluetooth use.

Ext 32.768 KHz Clock Input (LPO)
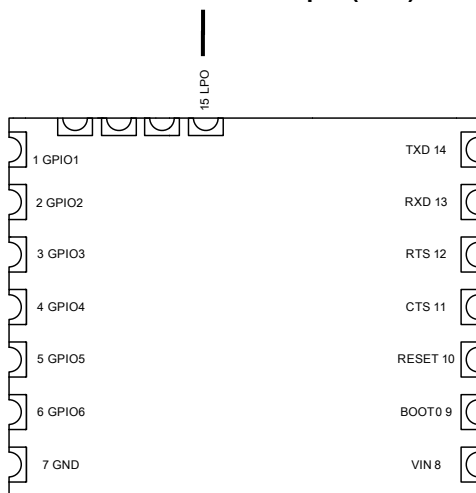
LPO Parameters:
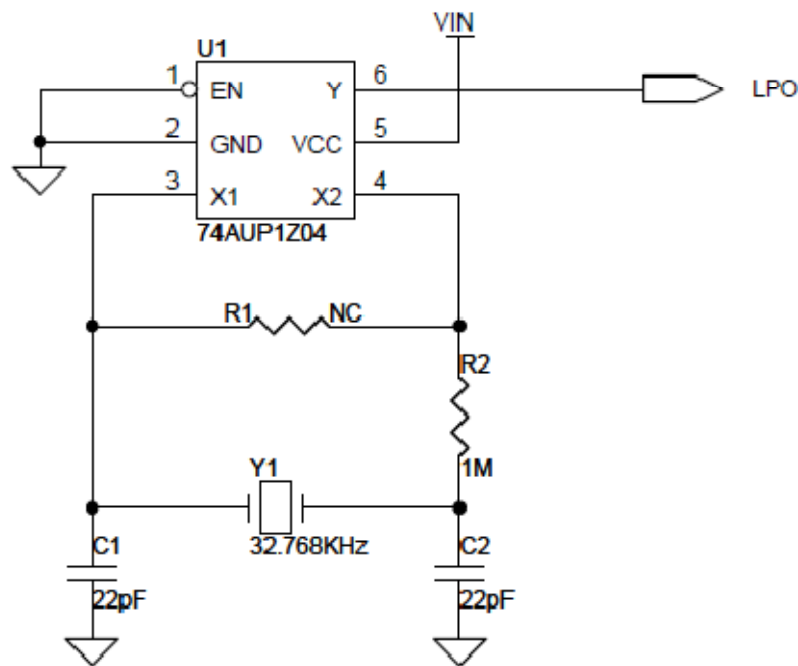
Frequency: 32.768 KHz

Tolerance: 150 ppm

Voltage Levels:

    Low: 0.1 V

    High: 1.8 V

Input Capacitance: 2.5 pF maximum

External LPO Reference Circuit

4.7 Audio Application Reference Design

TBD

5 Regulatory Compliance

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.

This Class B digital apparatus complies with Canadian ICES-003.

Cetappareilnumérique de la classe B estconforme à la norme NMB-003 du Canada.

The modular transmitter must be equipped with either a permanently affixed label or must be apable of electronically displaying its FCC identification number

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(A) If using a permanently affixed label, the modular transmitter must be labeled with its own FCC identification number, and, if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: X3ZBTMOD8" or "Contains FCC ID: X3ZBTMOD8."

(B) If the modular transmitter uses an electronic display of the FCC identification number, the information must be readily accessible and visible on the modular transmitter or on the device in which it is installed. If the module is installed inside another device, then the outside of the device into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC certified transmitter module(s)."

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.

5.1 Modular Approval, FCC and IC

FCC ID: X3ZBTMOD8

IC: 8828A-MOD8

In accordance with FCC Part 15, the BT53 is listed above as a Modular Transmitter device.

5.2 FCC Label Instructions

The outside of final products that contain a BT53 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: X3ZBTMOD8

IC: 8828A-MOD8

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

6 Ordering Information

Part Name	Description
BT53H	High performance version
BT53S	Audio application version

7 Feature Comparison

Features	BT53H	BT53S
CPU Speed	84MHz Max.	84MHz Max.
CPU Memory	256K Flash, 64K RAM	256K Flash, 64K RAM
Bluetooth Profile Support	SPP, IAP, OBEX	SPP, IAP, A2DP, HFP, AVRCP,HID, OBEX
Bluetooth Stack	Amp'edUP, BT v4.0 + BLE	Amp'edUP, BT v4.0 + BLE
Apple iOS Support	Supported	Supported
AT Command Interface	abSerial	abSerial
Multiple Connections	7 Max.	7 Max.
Link Throughput	1.5M bps max	1.5M bps max
Serial Interface	UART, I2S, I2C, SPI	UART, I2S, I2C, SPI
General I/O Lines	7	7
A/D Lines	4	4

8 Revision History

Data	Revision	Description
29Aug 2014	1	First release
18 Dec 2014	1.1	Added BT53S model

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