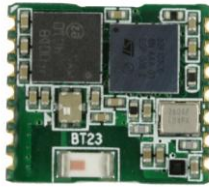


## **BT23 Datasheet**

Amp'ed RF Technology, Co., Ltd.

## BT23 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 BT23 is designed for maximum performance in a minimal space and includes 6 general purpose and ADC/DAC IO lines, several serial interface options, and up to 1.5M bps data throughput.

The BT23 is a surface mount PCB module that provides fully embedded, ready to use Bluetooth wireless technology. The reprogrammable flash memory contains embedded firmware for serial cable replacement using the Bluetooth 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.

### Additional Documentation

- **BT HW Design Guide**
- **BT Getting Started Guide**
- **abSerial User Guide**
- **abSerial Reference Guide**
- **abSerial Configuration Guide**

### Features

#### Bluetooth Radio

- Fully embedded Bluetooth v2.1 Serial and OBEX Profiles
- Class 2 radio
- Complete RF ready module
- 128-bit encryption security
- Range up to 25m LOS
- FCC & Bluetooth qualified
- Multipoint mode supported

#### ST Micro ARM Cortex microprocessor up to 72MHz

#### Memory

- 256K bytes flash memory
- 48K bytes RAM memory

#### Data Rate

- 1.5M bps typical data rate
- EDR supported

#### Serial Interface

- UART, up to 2M baud
- Buffered SPI interface
- I2C interface

#### General I/O

- 6 general purpose I/O
- 4x12-bit A/D input
- 1 DAC output
- 1 LPO input

#### User Interface

- AT command set
- Firmware upgrade over UART

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# 1 Software Architecture

## 1.1 Lower Layer Stack

- Full Bluetooth v2.1 enhanced data rate (EDR)
- 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
- ACL (Asynchronous Connection Less) packet types: DM1, DH1, DM3, DH3, DM5, DH5, 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5, AUX1
- SCO and eSCO (Synchronous Connection Oriented) packet support.
- Point to multipoint and scatternet support: 3 master and 7 slave links allowed (10 active links simultaneously)
- Sniff, and hold modes: 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
- Bluetooth test modes per Bluetooth v2.1 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

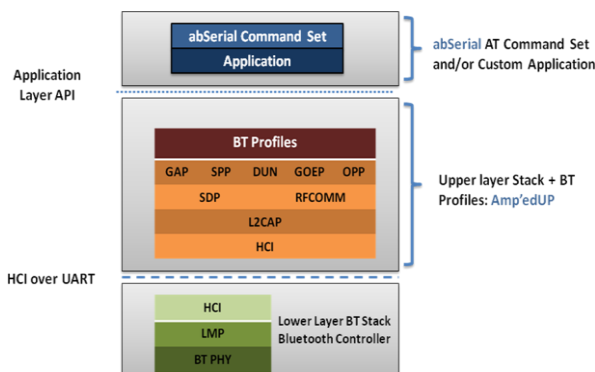
- SPP, OBEX, SDAP, GAP, and DUN protocols
- RFCOMM, SDP, and L2CAP supported
- Multipoint with 7 simultaneous slaves

## 1.3 HCI Interface

- Bluetooth v2.1 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 ( $V_{IN}$ = 3.0V and 25°C)

### 2.1 Recommended Operating Conditions

Rating	Min	Typical	Max	Unit
Operating Temperature Range	-40	-	85	°C
Supply Voltage $V_{IN}$	2.7	3.0	3.6	Volts
Signal Pin Voltage	-	3.0	-	Volts
RF Frequency	2400	-	2483.5	MHz

### 2.2 Current Consumption

High speed CPU mode, 32 MHz <ul style="list-style-type: none"> <li>▪ UART supports up to 921 Kbps</li> <li>▪ Data throughput up to 1.5 Mbps</li> <li>▪ abSerial v1.3 (installed firmware)</li> <li>▪ Shallow Sleep enabled</li> </ul>		
Modes (Typical Power Consumption)	Avg	Unit
ACL data 115K Baud UART at max throughput (Master)	30.5	mA
ACL data 115K Baud UART at max throughput (Slave)	33.0	mA
Connection, no data traffic, master	29.7	mA
Connection, no data traffic, slave	31.5	mA
Connection, 375ms sniff, slave (external LPO required)	4.1	mA
Standby, without deep sleep	22.0	mA
Standby, with deep sleep, no external LPO	0.5	mA
Standby, with deep sleep, with external LPO	80	uA
Page/Inquiry Scan, with deep sleep, no external LPO	1.5	mA
Page/Inquiry Scan, with deep sleep, with external LPO	1.0	mA
Bluetooth power down / CPU standby	25	µA

Standard CPU Mode, 4 MHz <ul style="list-style-type: none"> <li>▪ UART supports up to 115 Kbps</li> <li>▪ Data throughput up to 200 Kbps</li> <li>▪ abSerial v1.3 (installed firmware)</li> <li>▪ Shallow Sleep enabled</li> </ul>		
Modes (Typical Power Consumption)	Avg	Unit
ACL data 115K Baud UART at max throughput (Master)	25.6	mA
ACL data 115K Baud UART at max throughput (Slave)	25.8	mA
Connection, no data traffic, master	11.4	mA
Connection, no data traffic, slave	16.5	mA
Connection, 375ms sniff, slave (external LPO required)	3.6	mA
Standby, without deep sleep	11.5	mA
Standby, with deep sleep, no external LPO	0.5	mA
Standby, with deep sleep, with external LPO	80	uA
Page/Inquiry Scan, with deep sleep, no external LPO	1.4	mA
Page/Inquiry Scan, with deep sleep, with external LPO	0.9	mA
Bluetooth power down / CPU standby	25	µA

### 2.3 Selected RF Characteristics

Parameters	Conditions	BT Spec	Typical	Unit
Antenna load			50	ohm
<b>Radio Receiver</b>				
Sensitivity level	BER < .001 with DH5	≤ -70	-85	dBm
Maximum usable level	BER < .001 with DH1	≥ -20	-9	dBm
Input VSWR			2.5:1	
<b>Radio Transmitter</b>				
Maximum output power	50 Ω load	-6 to +4	+6	dBm
Initial Carrier Frequency Tolerance		± 75	0	kHz
20 dB Bandwidth for modulated carrier		≤ 1000	932	kHz

### 2.4 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

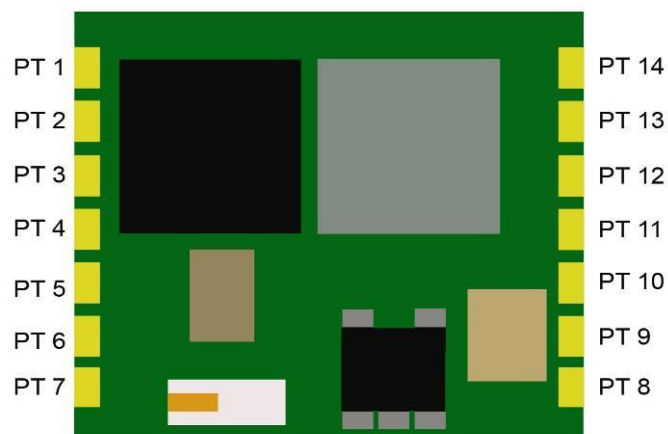
### 2.5 I/O Operating Characteristics

Symbol	Parameter	Min	Max	Unit	Conditions
$V_{IL}$	Low-Level Input Voltage	-	0.9	Volts	$V_{IN}, 3.0V$
$V_{IH}$	High-Level Input Voltage	2.1	-	Volts	$V_{IN}, 3.0V$
$V_{OL}$	Low-Level Output Voltage	-	0.4	Volts	$V_{IN}, 3.0V$
$V_{OH}$	High-Level Output Voltage	2.2	-	Volts	$V_{IN}, 3.0V$
$I_{OL}$	Low -Level Output Current	-	8.0	mA	$V_{OL} = 0.4 V$
$I_{OH}$	High-Level Output Current	-	8.0	mA	$V_{OH} = 2.2 V$
$R_{PU}$	Pull-up Resistor	80	120	KΩ	Resistor Turned On
$R_{PD}$	Pull-down Resistor	80	120	KΩ	Resistor Turned On

## 2.6 Pin Assignment

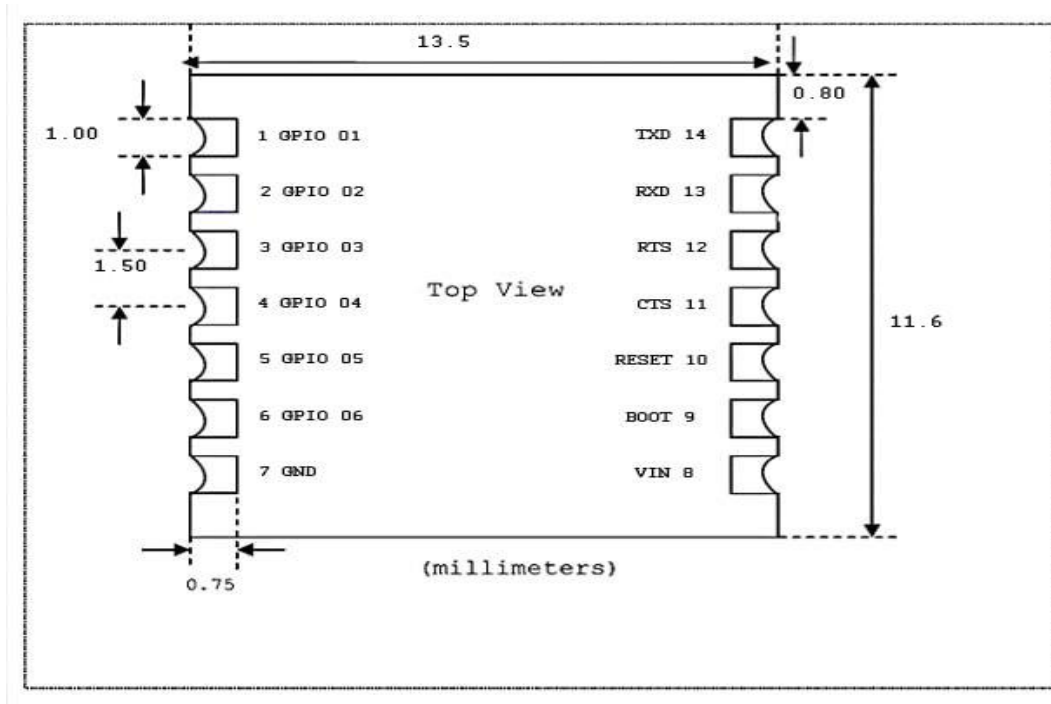
Name	Type	Pin #	Description	ALT Function
<b>UART Interface</b>				
RXD	I	13	Receive data	ADC 3
TXD	O	14	Transmit data	ADC 2
RTS	O	12	Clear to send (active low)	ADC 0/I2C Data/Aux Uart Rx
CTS	I	11	Request to send (active low)	ADC 1/I2C Clock/Aux Uart Tx
<b>Reserved</b>				
BOOT 0	I	9	Boot 0	
<b>Power and Ground</b>				
V <sub>in</sub>		8	V <sub>in</sub>	
GND		7	GND	
<b>Reset</b>				
RESETN	I	10	Reset input (active low for 5 ms);	
<b>GPIO – General Purpose Input/Output</b>				
GPIO [1]	I/O	1	General Purpose Input/Output	SPI MISO
GPIO [2]	I/O	2	General Purpose Input/Output	SPI MOSI/I2S_SD
GPIO [3]	I/O	3	General Purpose Input/Output	SPI SCLK/ I2S_CK
GPIO [4]	I/O	4	General Purpose Input/Output	SPI SS/I2S_WS
GPIO [5]	I/O	5	General Purpose Input/Output	
GPIO [6]	I/O	6	General Purpose Input/Output	DAC

## 2.7 Pin Placement Diagram (Top View)

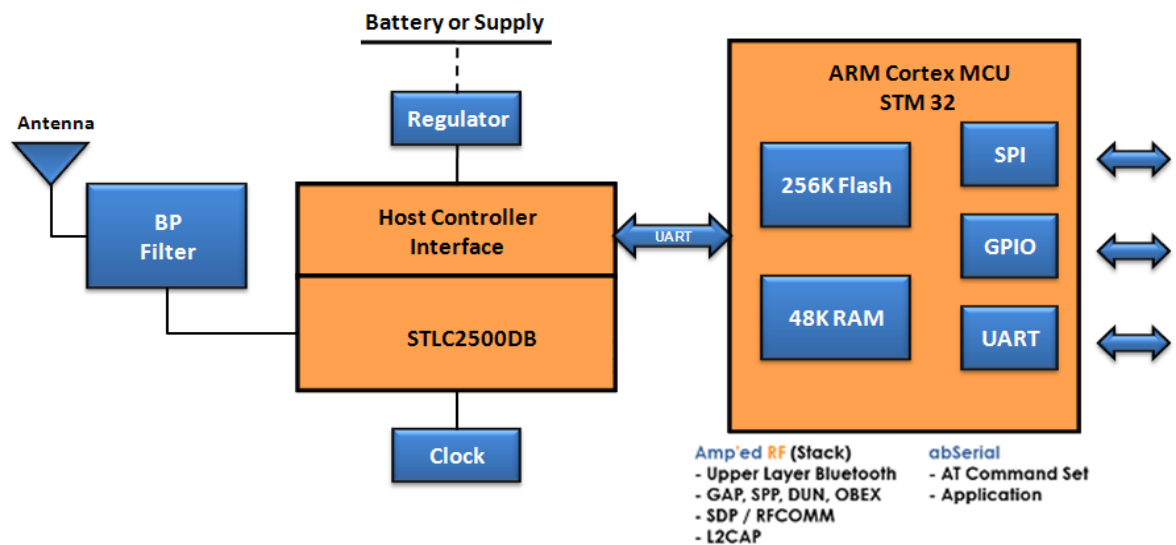


### 2.8 Layout Drawing, BT23

Size: 11.6 mm x 13.5 mm x 2.2 mm (height)



### 3 Hardware Block Diagram



BT 23 Bluetooth 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 dependant 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

- 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 6.5 mm in all directions.
- Traces should not be routed underneath the module.

### 4.1 Module Reflow Installation

The BT23 is a surface mount Bluetooth module supplied on a 14 pin, 6-layer PCB. The final assembly recommended reflow profiles are:

For non Pb-free applications, Sn63Pb37 solder is recommended.

- Maximum peak temperature of 208° - 210°C (below 220°C).
- Maximum rise and fall slope after liquidous of < 2°C/second.
- Maximum rise and fall slope after liquidous of < 2°C/second.
- Maximum time at liquidous of 50 – 90 seconds.

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

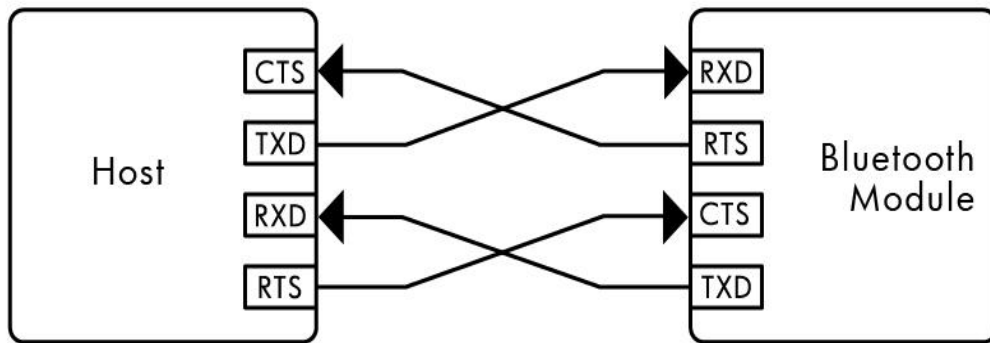
- Maximum peak temperature of 230° - 240°C (below 250°C).
- Maximum rise and fall slope after liquidous of < 2°C/second.
- Maximum rise and fall slope after liquidous of < 3°C/second.
- Maximum time at liquidous of 40 – 80 seconds.

### 4.2 GPIO Interface

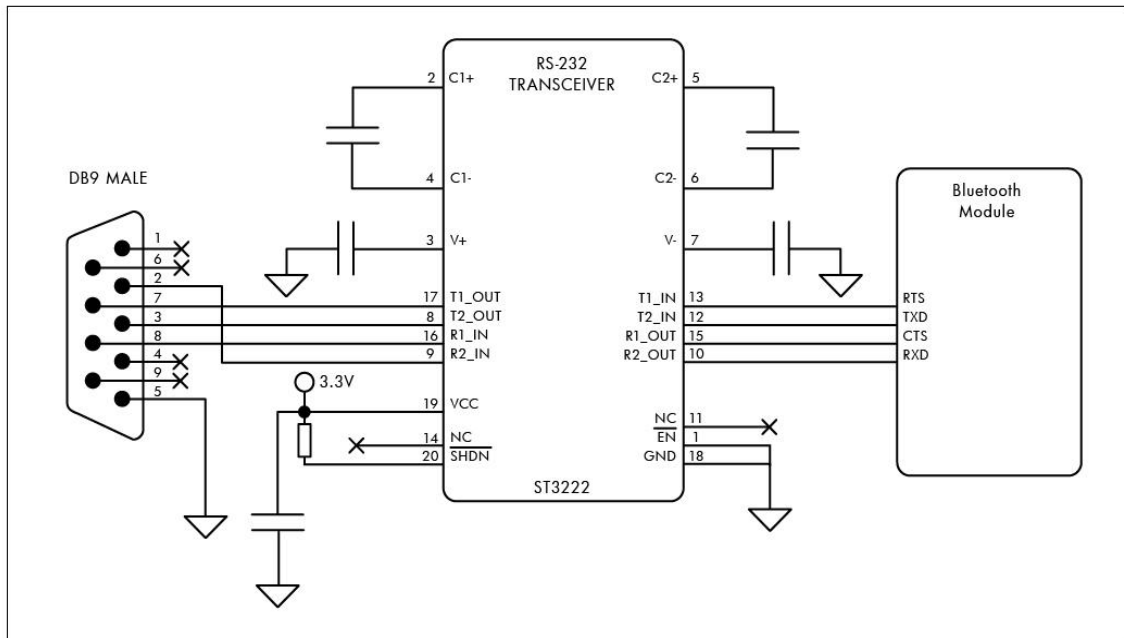
All GPIOs are capable of sinking and sourcing 4mA of I/O current. GPIO [1] to GPIO [6] are internally pulled down with 100KΩ (nominal) resistors.

### 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

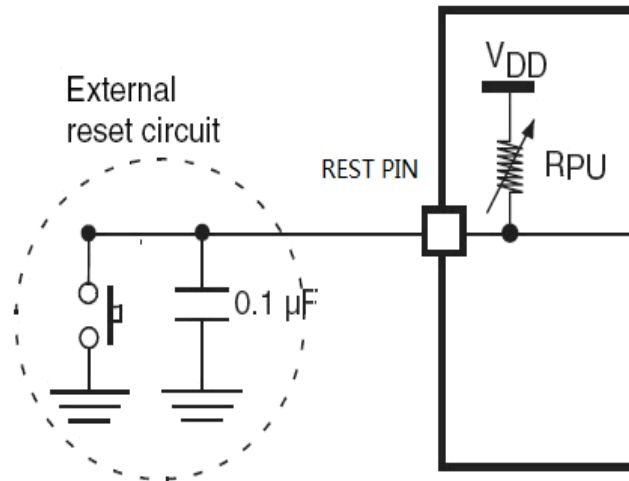


Typical RS232 Circuit

#### 4.4 Reset Circuit

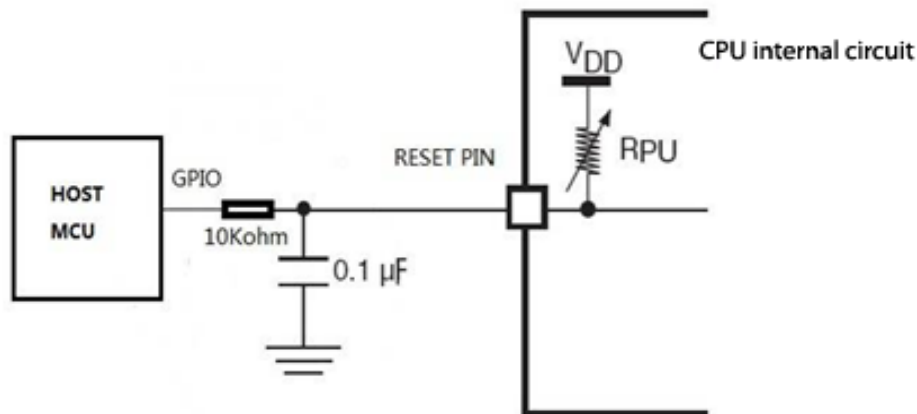
Two types of system reset circuits are detailed below.

##### 4.4.1 External Reset Circuit:



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

##### 4.4.2 Internal Reset Circuit:

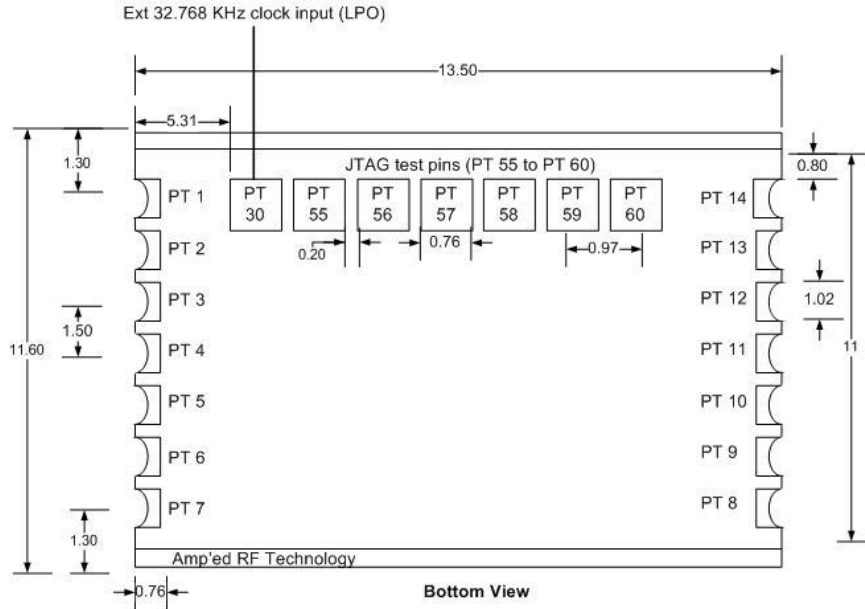


Notes:

- $R_{PU}$  ranges from 30K ohm to 50K ohm internally.
- $R_{RST}$  should be from 1K ohm to 10K ohm

### 4.5 External LPO Input Circuit

An optional low power oscillator input may be added to allow deep sleep and sniff modes.



#### LPO Parameters:

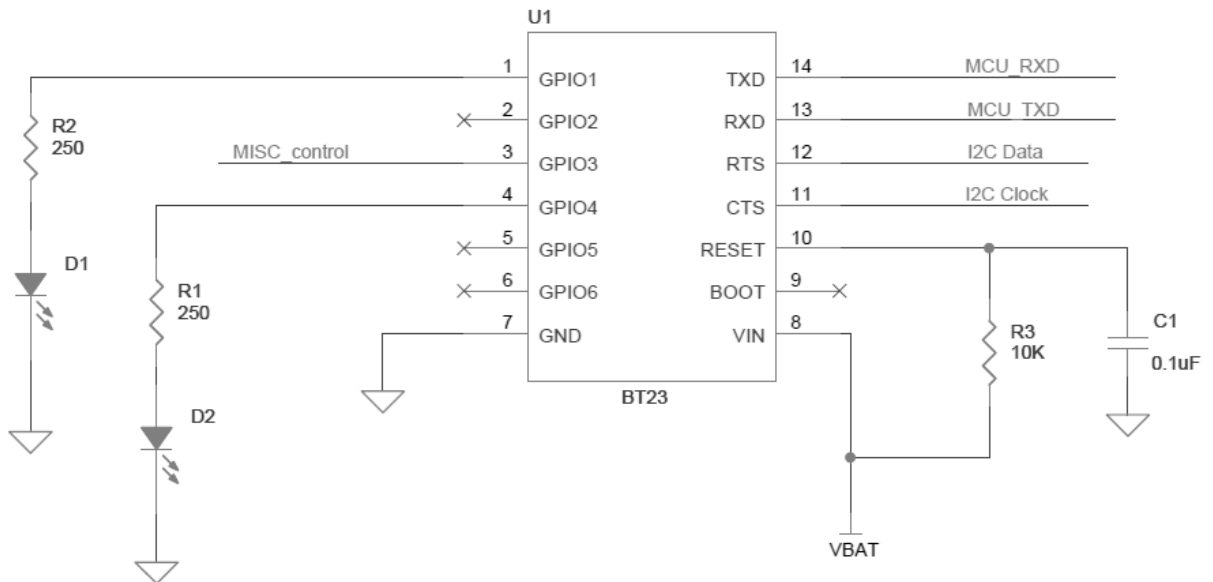
Frequency: 32.768 KHz  
 Tolerance: 150 ppm  
 Voltage Levels  
     Low: 0.9 V  
     High: 1.8 V  
 Input Capacitance: 2.5 pF maximum

#### Configurations:

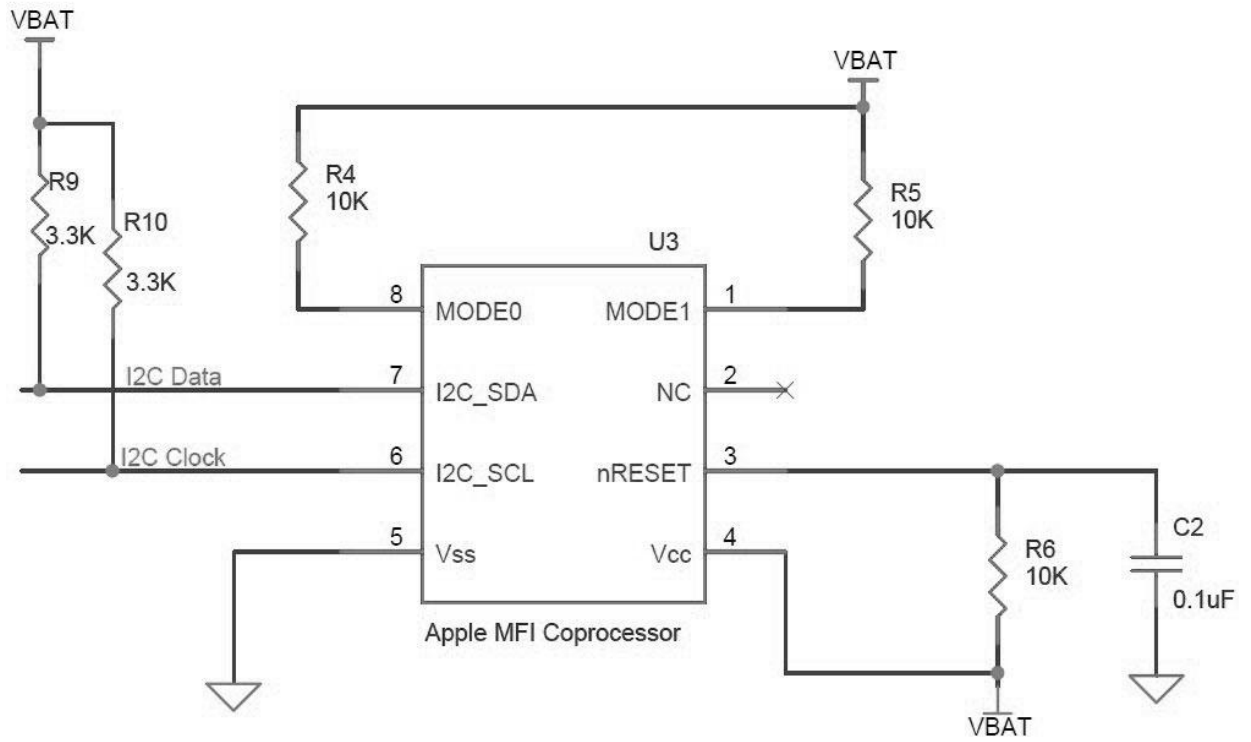
See configuration guide:  
 UseExtLPO  
 AllowSniff

**Note:** PT30 located on the bottom of the module

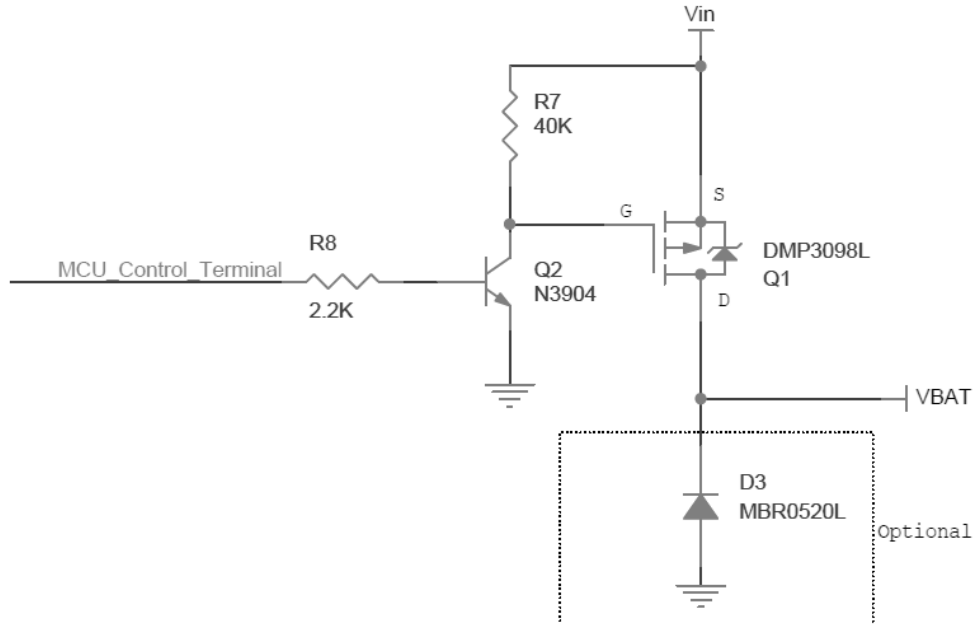
### 4.6 Apple iOS CP Reference Design



#### Part 1. BT module



**Part 2. Co-processor**



**Part 3. Power switch**

## 5 FCC 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.

### 5.1 Modular Approval, FCC and IC

FCC ID: X3ZBTMOD2

IC: 8828A-MOD2

In accordance with FCC Part 15, the BT23 is listed above as a Limited Modular Transmitter device.

### 5.2 FCC Label Instructions

The outside of final products that contain a BT23 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: X3ZBTMOD2

IC: 8828A-MOD2

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

## 6 Ordering Information

Part Name	Description
BT23	Standard version
BT23-LT	“Lite”; limited feature version

## 7 Feature Comparison

Features	BT23	BT23-LT
CPU Speed	72MHz Max.	36MHz Max.
CPU Memory	256K Flash, 48K	128K Flash, 20K
Bluetooth Profile	SPP, OBEX, HID,	SPP only
Bluetooth Stack	Amp'edUP, BT	Amp'ed UP, BT
Apple iOS Support	Supported	Not Supported
AT Command	abSerial	abSerial
Multiple Connections	7 Max.	2 Max.
Link Throughput	2M bps Max.	300K bps Max.
Serial Interface	UART, I2C, SPI	UART, I2C, SPI
General I/O Lines	6	6
A/D Lines	4	4
DAC Lines	1	0

## 8 Revision History

Date	Revision	Description
22-Jan-2010	1	First release
15-June-2010	2	Added “Lite” option, added IC certification
27-Jan-2011	3	Added reset circuit and external LPO input circuit
9-March-2011	4	Updated LPO specifications. Update power consumption per abSerial FW v1.3