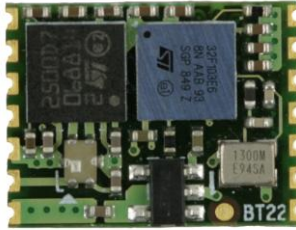


BT22 Datasheet

Amp'ed RF Technology, Co., Ltd.

BT22



10.4 mm x 13.5 mm

Description

Our micro-sized Bluetooth module is the smallest form factor available providing a complete RF platform. The BT22 is designed for maximum performance in a minimal space and includes 4 general purpose and A/D IO lines, several serial interface options, and up to 1.5M bps data throughput.

The BT22 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.

Features

Bluetooth features

- Bluetooth qualified
- Bluetooth v2.1+EDR
- Class 2 radio
- Range up to 30m LOS
- 1.5Mbps data throughput
- 128-bit encryption security
- Multipoint mode supported

Hardware configuration

- Cortex-M3 microprocessor up to 72MHz
- 256K bytes flash memory
- 48K bytes RAM memory
- UART, up to 2Mbps
- SPI and I2C interfaces
- 4 general purpose I/O
- 4x12bit A/D inputs

Embedded software

- Amp'edUP Bluetooth stack (SPP, OBEX, DUN)
- abSerial, AT command set
- Apple iOS support (Optional)
- SDK, Software Development Kit (Optional)
- BlueGuard, data encryption software (Optional)
- Mobile application software (Optional)

Additional Documentation

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

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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

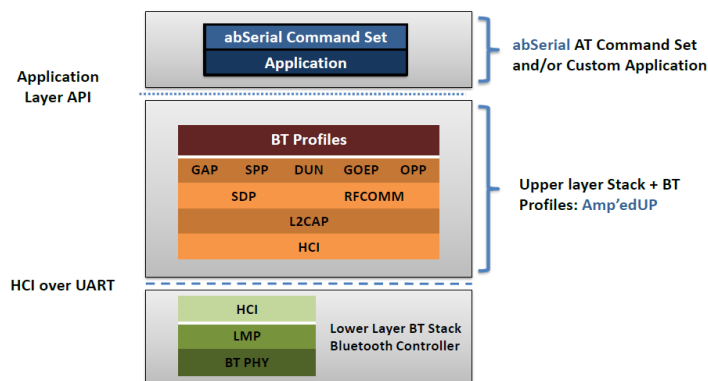
- SPP, OBEX, SDAP, GAP, and DUN protocols
- RFComm, SDP, and L2CAP supported
- Multipoint with 7 simultaneous slaves

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 $25^{\circ}C$)

2.1 Recommended Operating Conditions

Rating	Min	Typical	Max	Unit
Operating Temperature Range	-40	-	85	$^{\circ}C$
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 ■ UART supports up to 921 Kbps ■ Data throughput up to 1.5 Mbps ■ abSerial v1.3 (installed firmware) ■ Shallow Sleep enabled		
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	4.1	mA
Standby, without deep sleep	22.0	mA
Standby, with deep sleep	0.5	mA
Page/Inquiry Scan, with deep sleep	1.5	mA
Bluetooth power down / CPU standby	6	μA

Standard CPU Mode, 4 MHz ■ UART supports up to 115 Kbps ■ Data throughput up to 200 Kbps ■ abSerial v1.3 (installed firmware) ■ Shallow Sleep enabled		
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, master	3.6	mA
Standby, without deep sleep	11.5	mA
Standby, with deep sleep	0.5	mA
Page/Inquiry Scan, with deep sleep	1.4	mA
Bluetooth power down / CPU standby	6	μA

2.3 Selected RF Characteristics

Parameters	Conditions	Typical	Unit
Antenna load		50	ohm
Sensitivity level	BER < .001 with DH5	-85	dBm
Maximum usable level	BER < .001 with DH1	-9	dBm
Input VSWR		2.5:1	
Maximum output power	50 Ω load	+6	dBm
Initial Carrier Frequency Tolerance		0	kHz
20 dB Bandwidth for modulated carrier		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

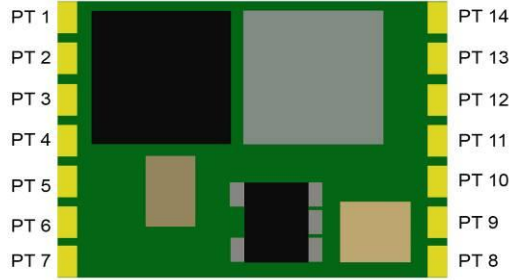
2.5 I/O Operating Characteristics

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	K Ω	Resistor Turned On
R_{PD}	Pull-down Resistor	80	120	K Ω	Resistor Turned On

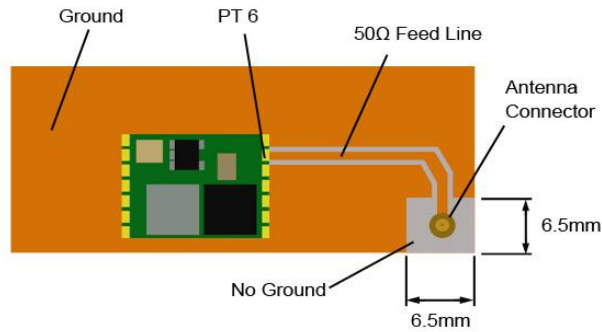
2.6 Pin Assignment

Name	Type	Pin #	Description	ALT Function
UART Interface				
RXD	I	13	Receive data	ADC 3
TXD	O	14	Transmit data	ADC 2
RTS	O	12	Request to send (active low)	ADC 0/I2C Data/Aux Uart Rx
CTS	I	11	Clear to send (active low)	ADC 1/I2C Clock/Aux Uart Tx
Antenna				
ANT	RF I/O	6	50 Ω Rx/Tx antenna port	
Reserved				
Boot 0	I	9	Boot 0 – reserved for production usage	
Power and Ground				
V_{in}		8	V_{in}	
GND		5, 7	GND	
Reset				
RESETN	I	10	Reset input (active low for 5 ms);	
GPIO – General Purpose Input/Output				
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

2.7 Pin Placement Diagram (Top View)

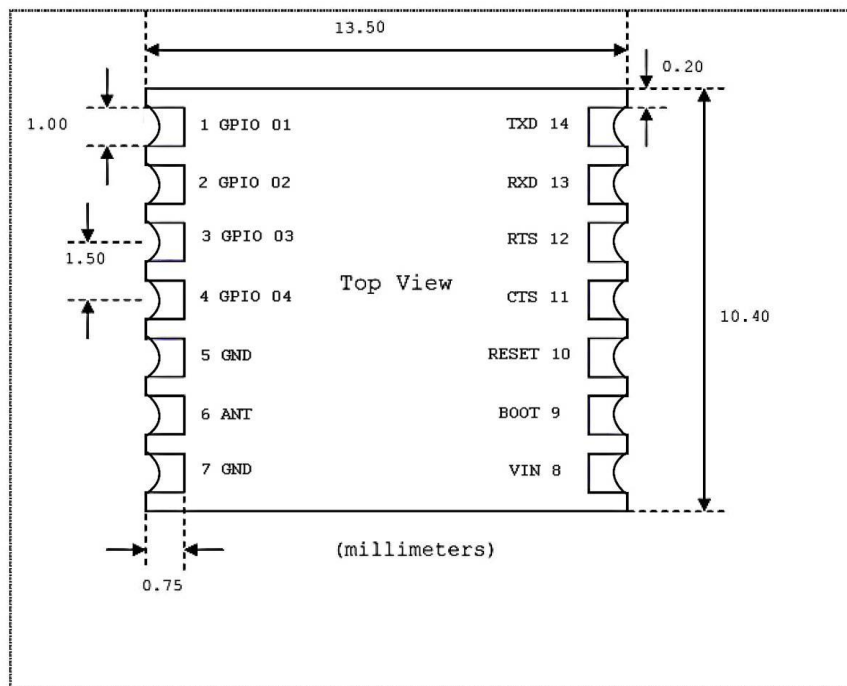


2.8 Ground Plane Diagram

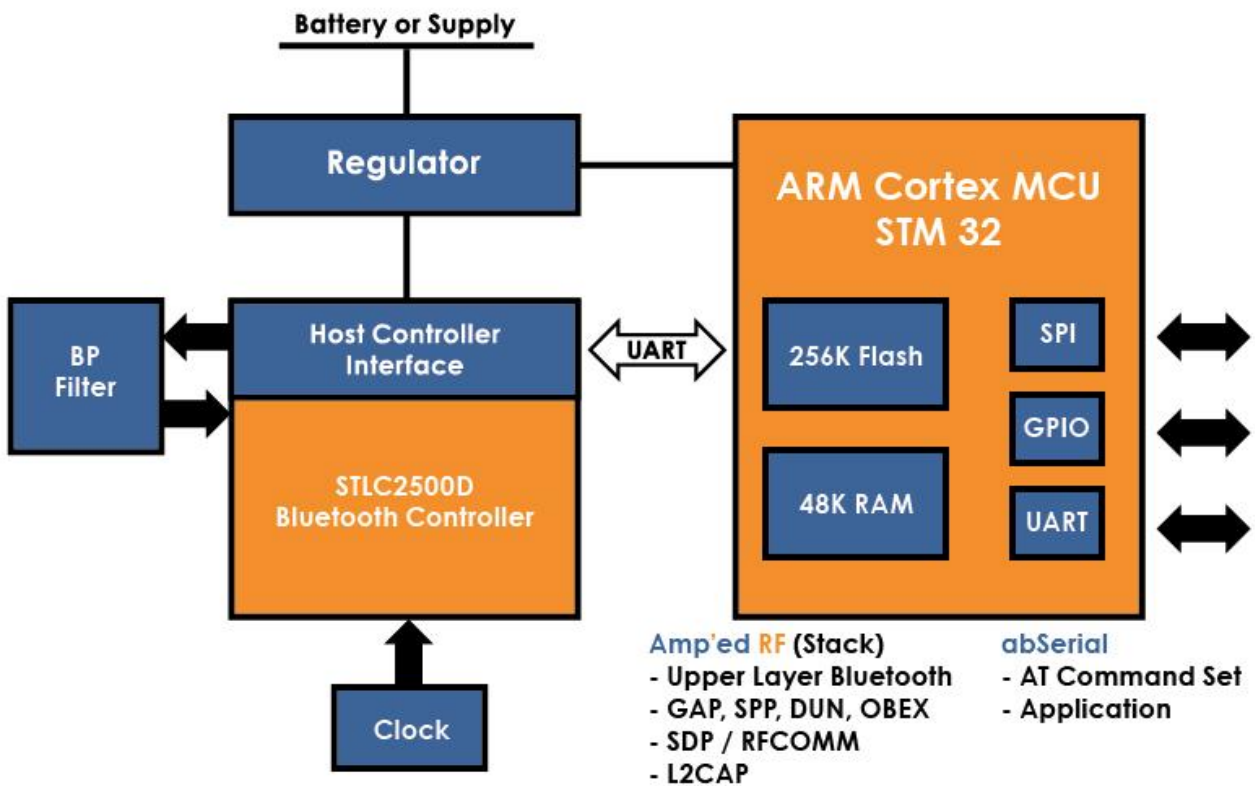


2.9 Layout Drawing, BT22

Size: 10.4 mm x 13.5 mm x 2.2 mm (height)



3 Hardware Block Diagram



BT22 Bluetooth Module Block Diagram

4 Hardware Design

Amp'ed RF modules support UART, 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 BT22 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.

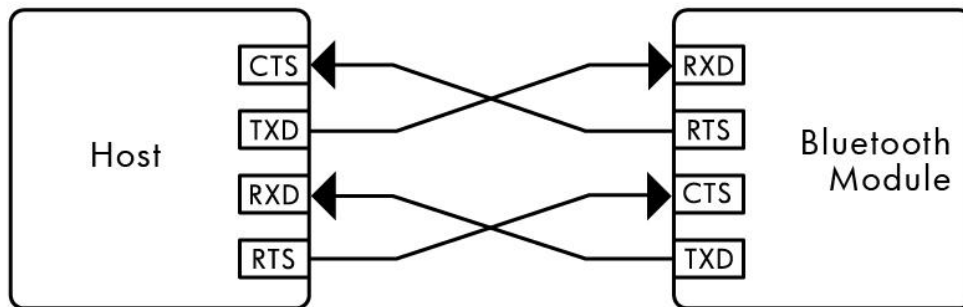
- Maximum peak temperature of 230° - 240°C (below 250°C).
- Maximum rise and fall slope after liquidous of < 2°C/second.
- Maximum rise and fall slope after liquidous of < 3°C/second.
- Maximum time at liquidous of 40 – 80 seconds.

4.2 GPIO Interface

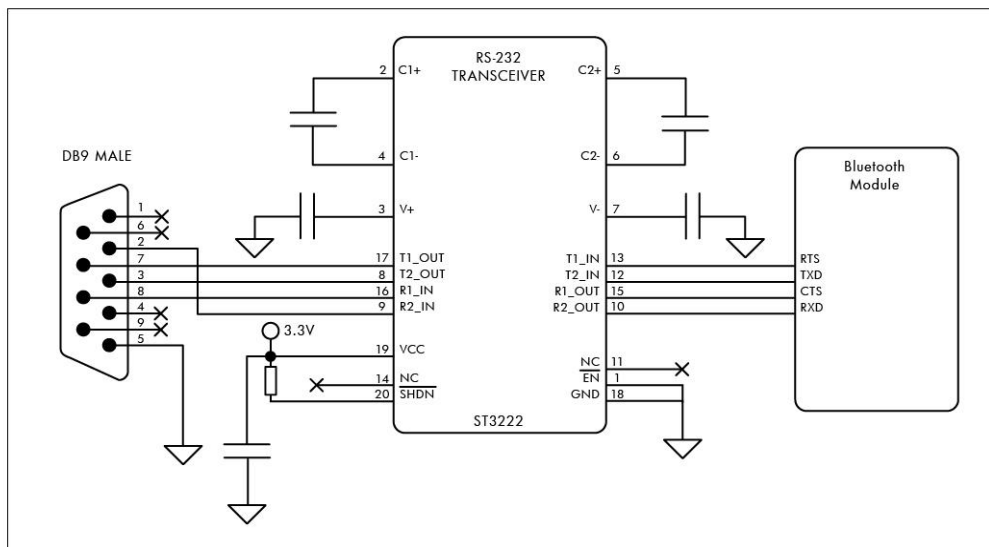
All GPIOs are capable of sinking and sourcing 4mA of I/O current. GPIO [1], GPIO [3], and GPIO [4] are internally pulled down, and GPIO [2] is internally pulled up, with 100KΩ (nominal) resistors.

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

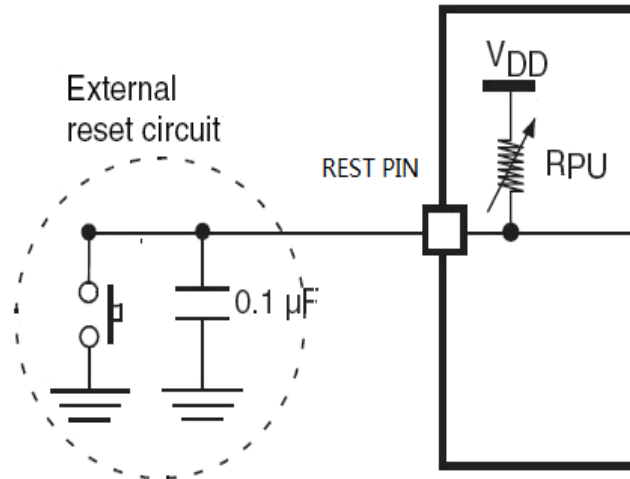


Typical RS232 Circuit

4.4 Reset Circuit

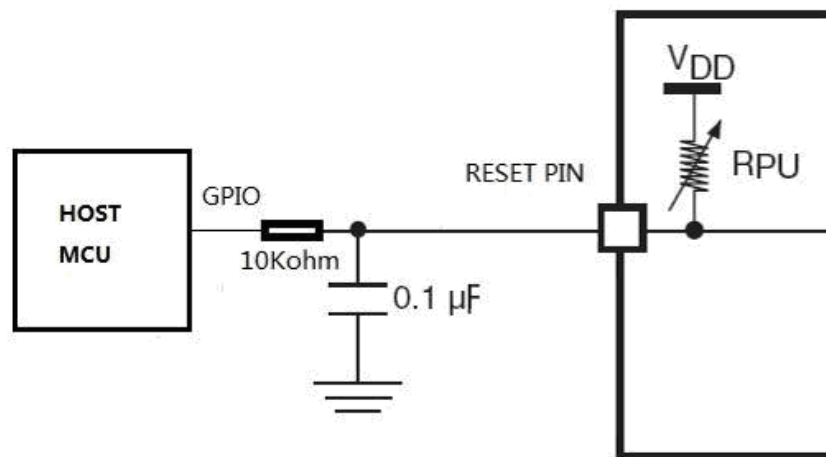
Two types of system reset circuits are detailed below.

4.4.1 External Reset Circuit:



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

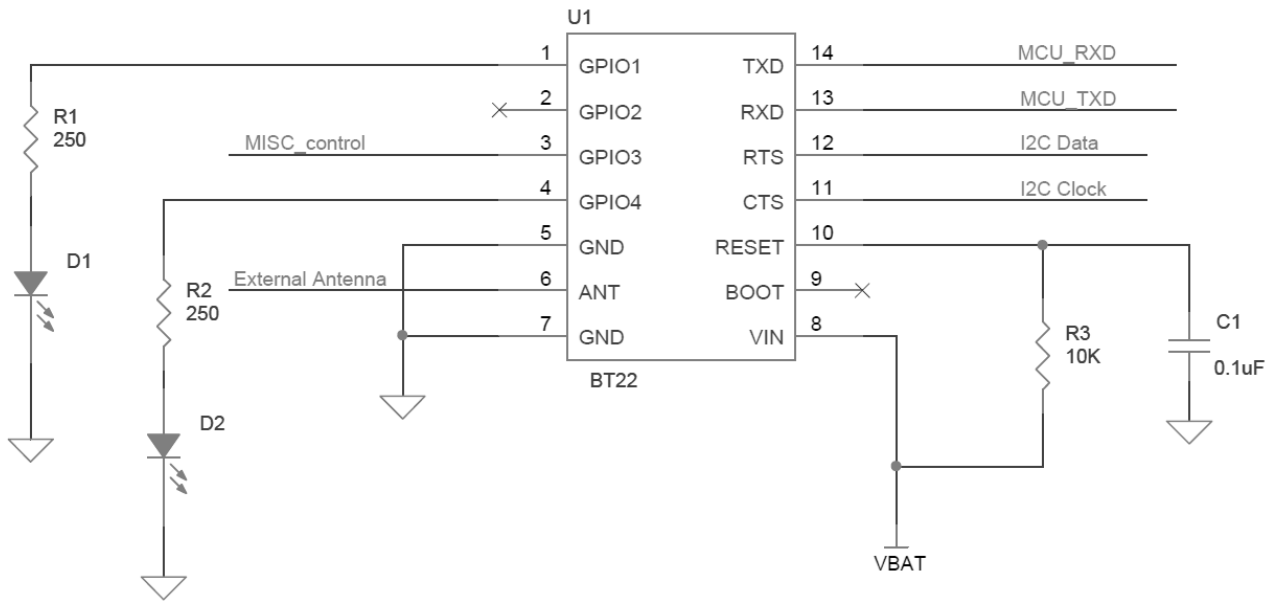
4.4.2 Internal Reset Circuit:



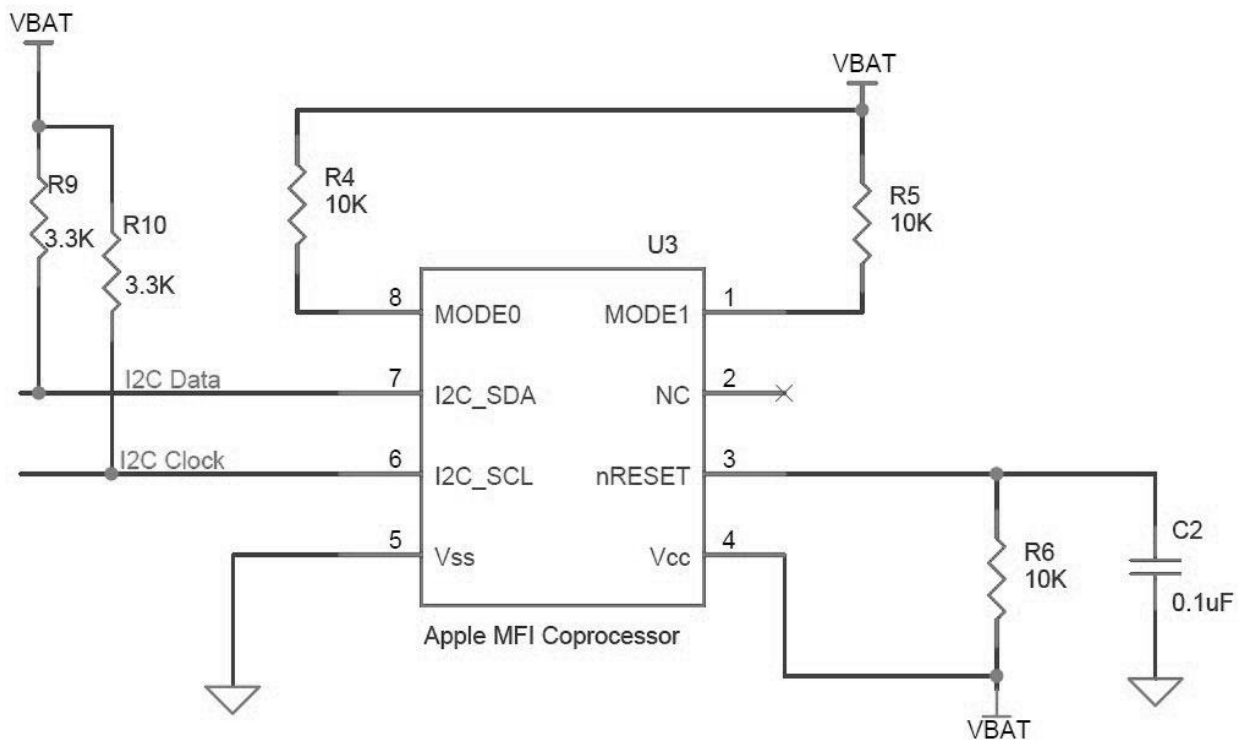
Notes:

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

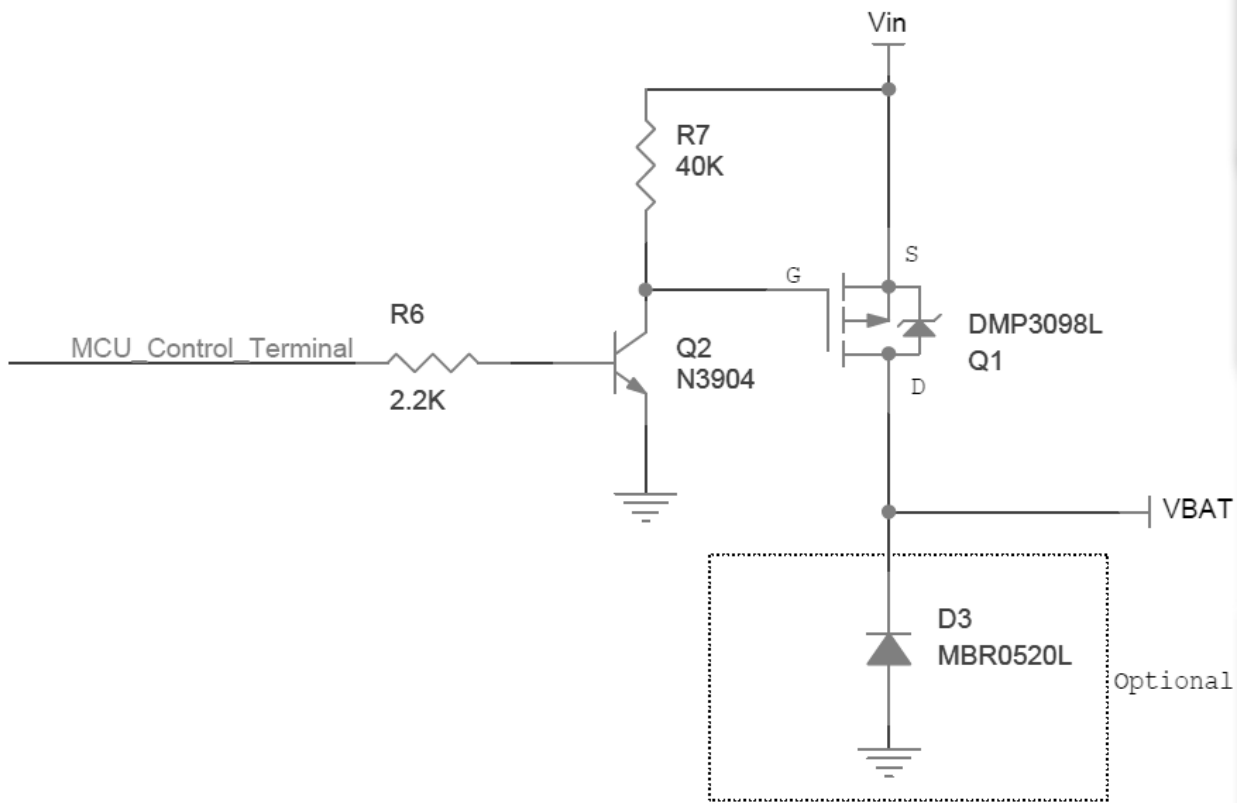
4.4.3 Apple iOS CP Reference Design



Part 1. BT module



Part 2. Co-processor



Part 3. Power Switch

5 Ordering Information

Part Name	Description
BT22	Standard version
BT22-LT	“Lite”; limited feature version

6 Feature Comparison

Features	BT22	BT22-LT
CPU Speed	72MHz Max.	36MHz Max.
CPU Memory	256K Flash, 48K RAM	128K Flash, 20K RAM
Bluetooth Profile Support	SPP, OBEX, HID, DUN	SPP only
Bluetooth Stack	Amp'edUP, BT v2.1	Amp'ed UP, BT v2.1
AT Command Interface	abSerial	abSerial
Apple iOS Support	Yes	No
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	4	4
A/D Lines	4	4

7 Revision History

Date	Revision	Description
22-Jan-2010	1	First release
18-May-2010	2	Added “Lite” option
25-Oct-2010	3	Added reset circuit
21-Mar-2011	4	Added iOS reference designs Updates per abSerial v1.3 FW