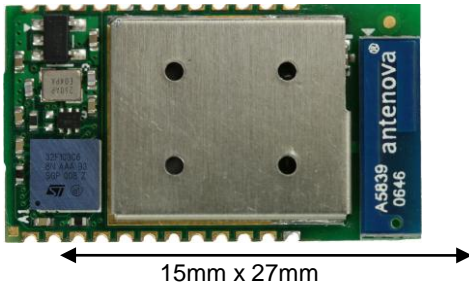


BT 11 Data Sheet

29 July 2011

Amp'ed RF Technology Inc.

Product Specification



Description

With class 1 power of up to +17dBm, the BT11 module has one of the best ranges in the industry.

The BT11M/L module includes 16 general purpose input/output lines, several serial interface options, analog-to-digital inputs, and up to 2M bps data throughput.

The BT11M/L 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 Hardware Design Guide**
- **abSerial User Guide**
- **abSerial Reference Guide**

Features

- **Bluetooth Radio**
 - Fully embedded Bluetooth v2.1+EDR with profiles
 - Class 1 radio
 - Complete RF ready module
 - 128-bit encryption security
 - Range up to 120m LOS
 - FCC & Bluetooth qualified
 - Integrated antenna or with coaxial external connector
- **ST Micro Cortex-M3 microprocessor up to 72MHz**
- **Memory**
 - 256K bytes flash memory
 - 48K bytes RAM memory
- **Data Rate**
 - 2M bps maximum data rate
 - Multipoint capability up to 7 slaves
- **Serial Interface**
 - UART, up to 2M bps
 - SPI interface
 - I2C interface
 - USB v2.0
- **General I/O**
 - 16 general purpose I/O
 - 4x12-bit A/D inputs
 - 1 DAC output
- **User Interface**
 - AT command set (abSerial)
 - Firmware upgrade over UART

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1 Software Architecture

1.1 Lower Layer Stack

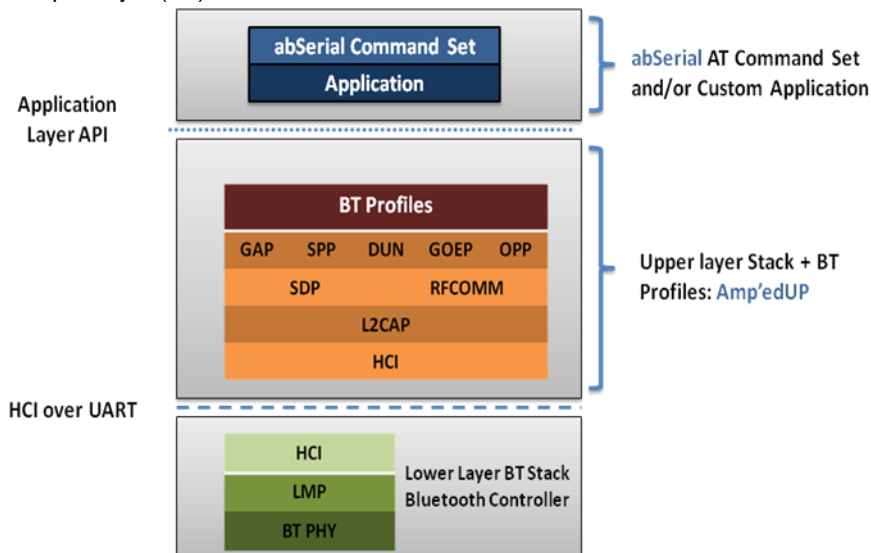
- Full Bluetooth v2.1+EDR data rate (3M bps maximum)
- Device power modes—active, sleep and deep sleep
- Wake on Bluetooth feature—optimized power consumption of host CPU
- Authentication and encryption
- Encryption key length from 8-bits to 128-bits maximum
- Persistent FLASH memory—for BD Address and radio parameter storage
- All 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 (Synchronous Connection Oriented) packet types (HV1, HV2, HV3)
- Point to multipoint and scatternet support—3 master and 7 slave links allowed (10 active links simultaneously)
- Park, 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
- Dynamic power control—interference reduction and link performance
- Bluetooth test modes—per Bluetooth specification
- 802.11b co-existence—AWMA and 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)



2 Hardware Specifications(BT 11M)

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 Absolute Maximum Ratings

Rating	Min	Typical	Max	Unit
Storage temperature range	-55	-	+150	$^{\circ}C$
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

High speed CPU mode <ul style="list-style-type: none"> ▪ CPU 32 MHz ▪ UART supports up to 921 Kbps ▪ Data throughput up to 2 Mbps ▪ abSerial v1.4 (installed firmware) ▪ Shallow Sleep enabled 		
Modes (Typical Power Consumption)	Avg	Unit
ACL data 115K Baud UART at max throughput (Master)	24.0	mA
ACL data 115K Baud UART at max throughput (Slave)	26.0	mA
Connection, no data traffic, master	12.45	mA
Connection, no data traffic, slave	16.90	mA
Connection in sniff ($T_{sniff}=375ms$), no data traffic, master	4.1	mA
Connection in sniff ($T_{sniff}=375ms$), no data traffic, slave	4.9	mA
Standby, without deep sleep	11.2	mA
Standby, with deep sleep	60	μA
Page/Inquiry scan, deep sleep	1.1	mA
Bluetooth power down / CPU standby	6	μA

Standard CPU Mode <ul style="list-style-type: none"> ▪ CPU 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)	19.7	mA
ACL data 115K Baud UART at max throughput (Slave)	22.5	mA
Connection, no data traffic, master	13.5	mA
Connection, no data traffic, slave	18.5	mA
Connection in sniff ($T_{sniff}=375ms$), no data traffic, master	1.6	mA
Connection in sniff ($T_{sniff}=375ms$), no data traffic, slave	1.8	mA
Standby, without deep sleep	4.2	mA
Standby, with deep sleep	60	μA
Page/Inquiry scan, deep sleep	800	μA
Bluetooth power down / CPU standby	6	μA

2.4 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	50	150	K Ω	Resistor Turned On
R _{PD}	Pull-down Resistor	50	150	K Ω	Resistor Turned On

2.5 Selected RF Characteristics

Parameters	Conditions	BT Spec	Typical	Unit
Antenna load			50	ohm
Radio Receiver				
Sensitivity level	BER < .001 with DH5	≤ -70	-88	dBm
Maximum usable level	BER < .001 with DH1	≥ -20	-9	dBm
Input VSWR			2.5:1	
Radio Transmitter				
Maximum output power	50 Ω load	<+20	+8	dBm
Initial Carrier Frequency Tolerance		± 75	0	kHz
20 dB Bandwidth for modulated carrier		≤ 1000	932	kHz

3 Hardware Specifications(BT 11L)

General Conditions ($V_{IN}= 3.0V$ and $25^{\circ}C$)

3.1 Recommended Operating Conditions

Rating	Min	Typical	Max	Unit
Operating Temperature Range	-40	-	80	$^{\circ}C$
Supply Voltage V_{IN}	2.7	3.0	3.6	Volts
Signal Pin Voltage	-	3.0	-	Volts
RF Frequency	2400	-	2483.5	MHz

3.2 Absolute Maximum Ratings

Rating	Min	Typical	Max	Unit
Storage temperature range	-55	-	+150	$^{\circ}C$
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

3.3 Current Consumption

High speed CPU mode <ul style="list-style-type: none"> ▪ CPU 32 MHz ▪ UART supports up to 921 Kbps ▪ Data throughput up to 2 Mbps ▪ abSerial v1.4 (installed firmware) ▪ Shallow Sleep enabled 		
Modes (Typical Power Consumption)	Avg	Unit
ACL data 115K Baud UART at max throughput (Master)	59.0	mA
ACL data 115K Baud UART at max throughput (Slave)	56.0	mA
Connection, no data traffic, master	21.0	mA
Connection, no data traffic, slave	28.0	mA
Connection in sniff ($T_{sniff}=375ms$), no data traffic, master	5.1	mA
Standby, without deep sleep	31	mA
Standby, with deep sleep	240	μA
Page/Inquiry scan, deep sleep	2.0	mA
Bluetooth power down / CPU standby	6	μA

Standard CPU Mode <ul style="list-style-type: none"> ▪ CPU 4 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)	25.6	mA
ACL data 115K Baud UART at max throughput (Slave)	25.8	mA
Connection, no data traffic, master	11.9	mA
Connection, no data traffic, slave	16.9	mA
Connection in sniff ($T_{sniff}=375ms$), no data traffic, slave	3.6	mA
Standby, without deep sleep	5.4	mA
Standby, with deep sleep	240	μA
Page/Inquiry scan, deep sleep	1.8	mA
Bluetooth power down / CPU standby	6	μA

3.4 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	50	150	KΩ	Resistor Turned On
R _{PD}	Pull-down Resistor	50	150	KΩ	Resistor Turned On

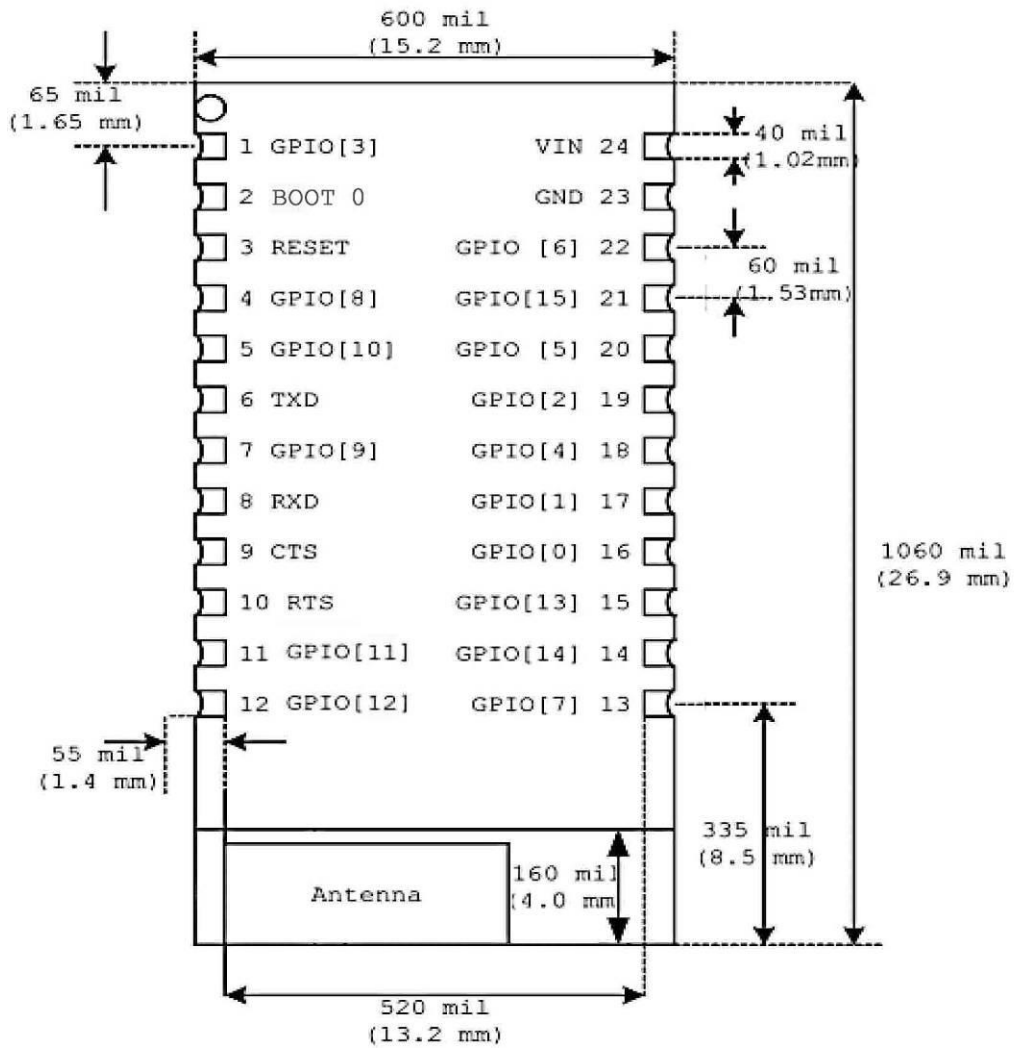
3.5 Selected RF Characteristics

Parameters	Conditions	BT Spec	Typical	Unit
Antenna load			50	Ohm
Radio Receiver				
Sensitivity level	BER < .001 with DH5	≤ -70	-94	dBm
Maximum usable level	BER < .001 with DH1	≥ -20	-9	dBm
Input VSWR			2.5:1	
Radio Transmitter				
Maximum output power	50 Ω load	<+20	+15	dBm
Initial Carrier Frequency Tolerance		± 75	0	kHz
20 dB Bandwidth for modulated carrier		≤ 1000	932	kHz

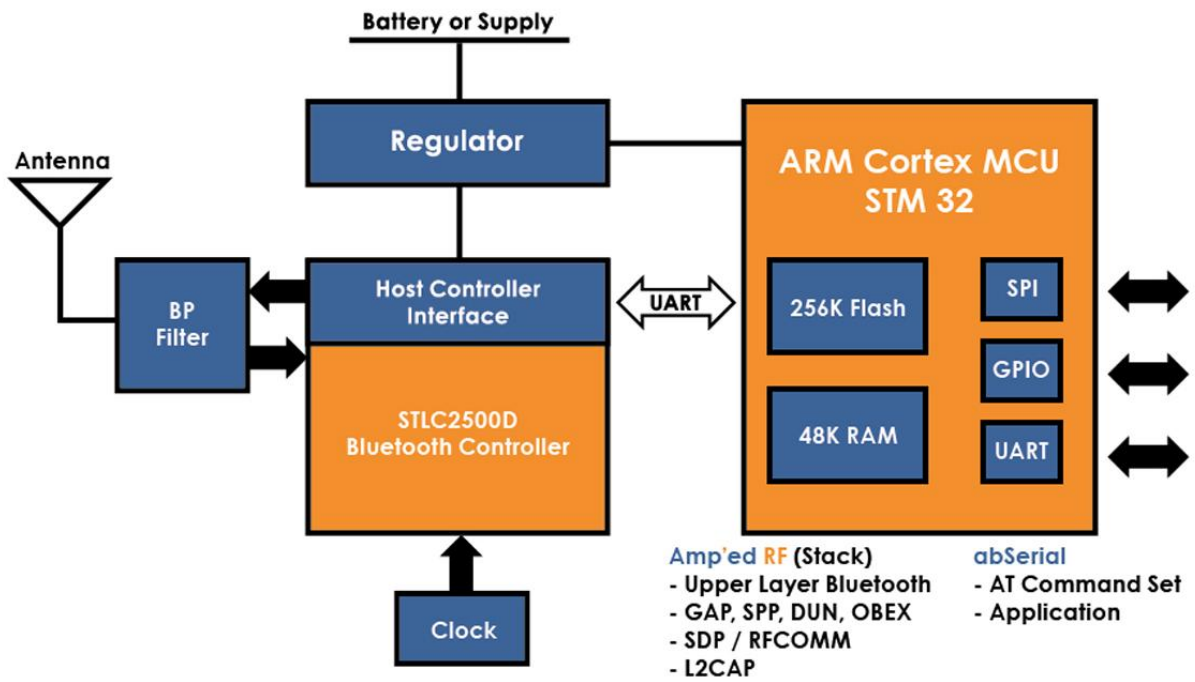
3.6 Pin Assignment

Name	Type	Pin #	Description	ALT Function
UART Interface				
RXD	I	8	Receive data	
TXD	O	6	Transmit data	
CTS	I	9	Clear to send (active low)	
RTS	O	10	Request to send (active low)	
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);	
GPIO – General Purpose Input/Output				
GPIO [0]	I/O	16	General Purpose Input/Output	SPI MISO
GPIO [1]	I/O	17	General Purpose Input/Output	SPI MOSI
GPIO [2]	I/O	19	General Purpose Input/Output	SPI SS
GPIO [3]	I/O	1	General Purpose Input/Output	SPI CLK
GPIO [4]	I/O	18	General Purpose Input/Output	UART 2 RXD
GPIO [5]	I/O	20	General Purpose Input/Output	UART 2 TXD
GPIO [6]	I/O	22	General Purpose Input/Output	ADC 0
GPIO [7]	I/O	13	General Purpose Input/Output	ADC 1
GPIO [8]	I/O	4	General Purpose Input/Output	ADC 2
GPIO [9]	I/O	7	General Purpose Input/Output	ADC 3
GPIO [10]	I/O	5	General Purpose Input/Output	
GPIO [11]	I/O	11	General Purpose Input/Output	I2C SCL
GPIO [12]	I/O	12	General Purpose Input/Output	I2C SDA
GPIO [13]	I/O	15	General Purpose Input/Output	
GPIO [14]	I/O	14	General Purpose Input/Output	
GPIO [15]	I/O	21	General Purpose Input/Output	DAC

4 Layout Drawing (BT 11L/M)



5 Hardware Block Diagram



BT-11M/L Bluetooth Module Block Diagram

6 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.

6.1 Notes

- All unused pins should be left floating; do not ground.
- All GND pins must be well grounded.
- The area around the module should be free of any ground planes, power planes, trace routings, or metal for 8 mm from the antenna in all directions.
- Traces should not be routed underneath the module.

6.2 Module Reflow Installation

The BT-11M/L is a surface mount Bluetooth module supplied on a 24 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.

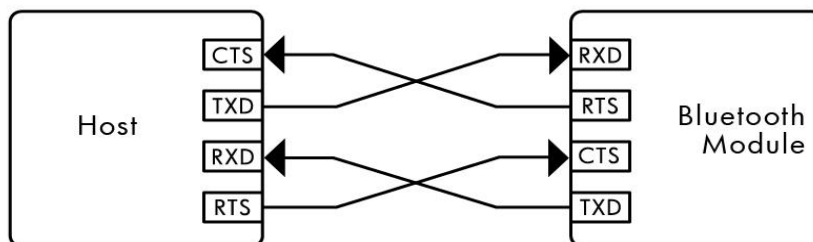
- Maximum peak temperature of 230° - 240°C (below 250°C).
- Maximum rise and fall slope after liquidous of < 2°C/second.
- Maximum rise and fall slope after liquidous of < 3°C/second.
- Maximum time at liquidous of 40 – 80 seconds.

6.3 GPIO Interface

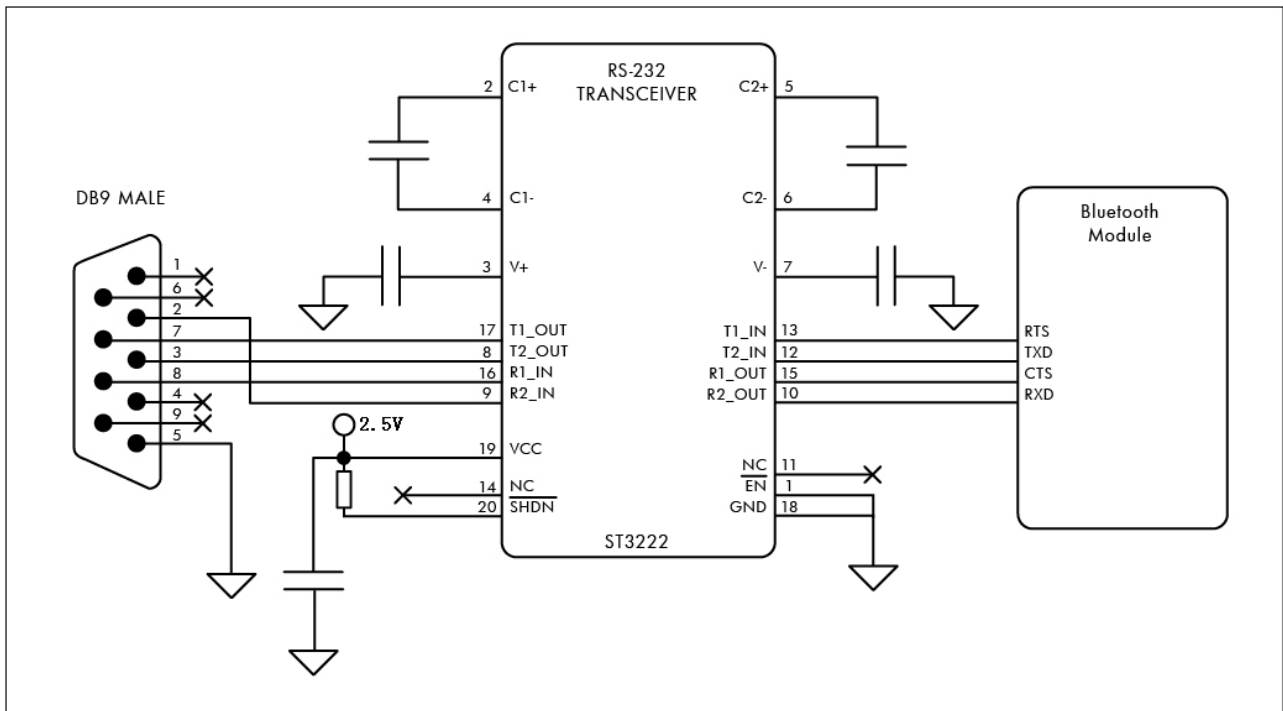
All GPIOs are capable of sinking and sourcing 8mA of I/O current. GPIO [0] to GPIO [7] are internally pulled down with 100KΩ (nominal) resistors GPIO [8] to GPIO [15] are internally pulled up with 100KΩ (nominal) resistors.

6.4 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.

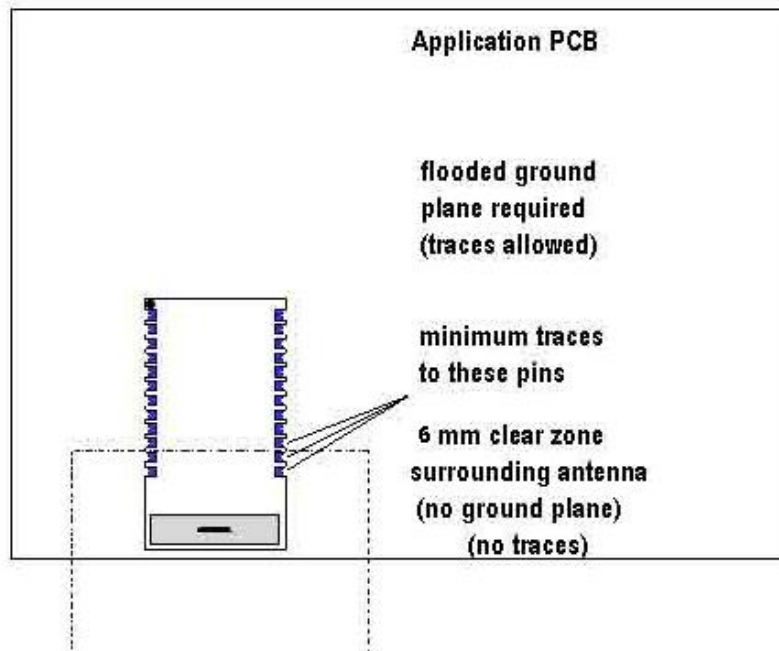


Connection to Host Device



Typical RS232 Circuit

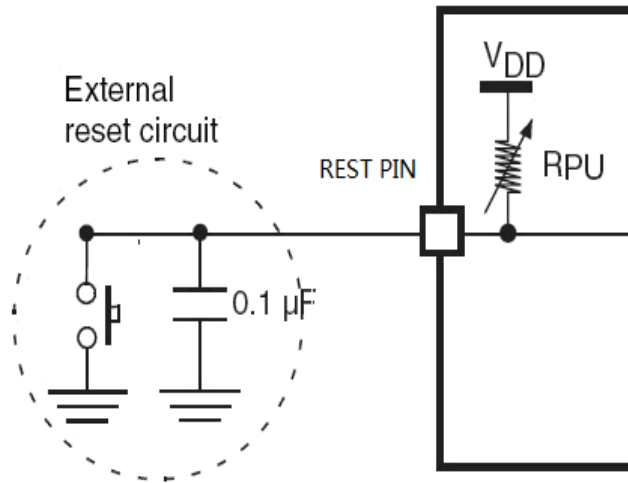
6.5 PCB Layout Guidelines



6.6 Reset Circuit

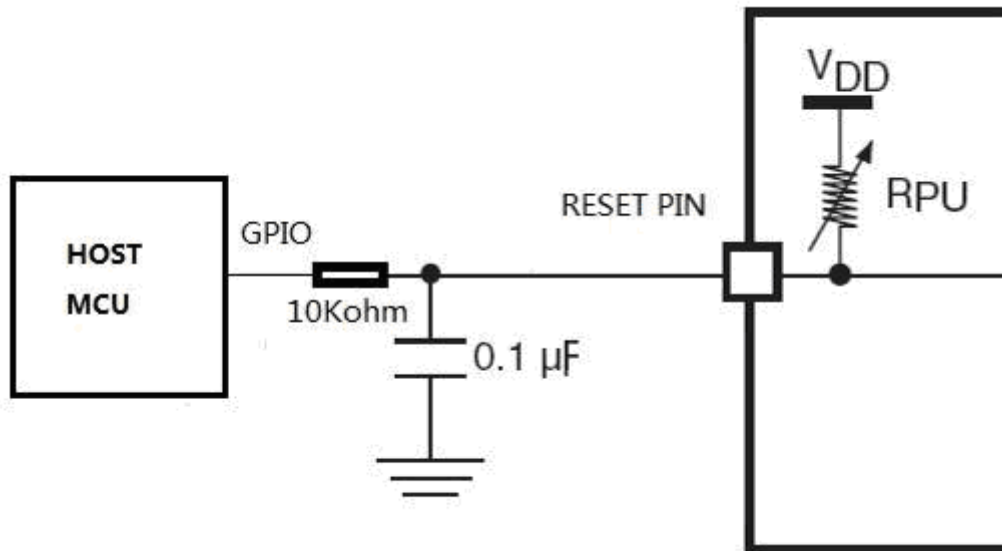
Two types of system reset circuits are detailed below.

6.6.1 External Reset Circuit:



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

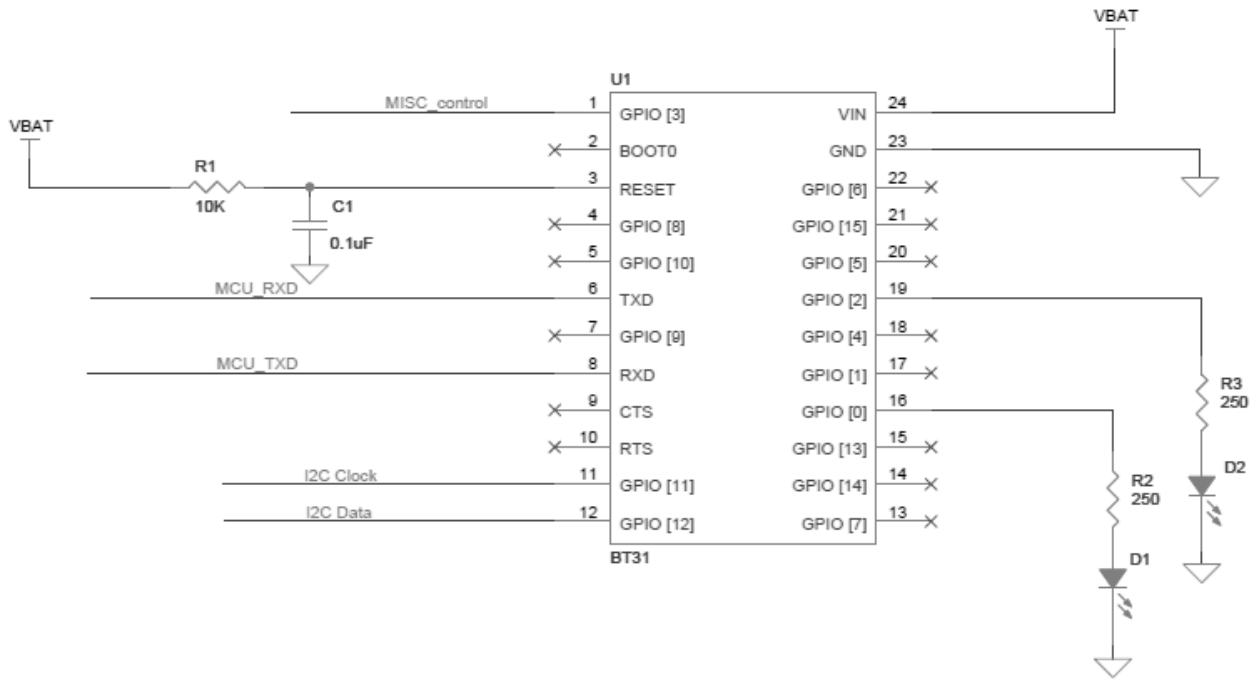
6.7 Internal Reset Circuit:



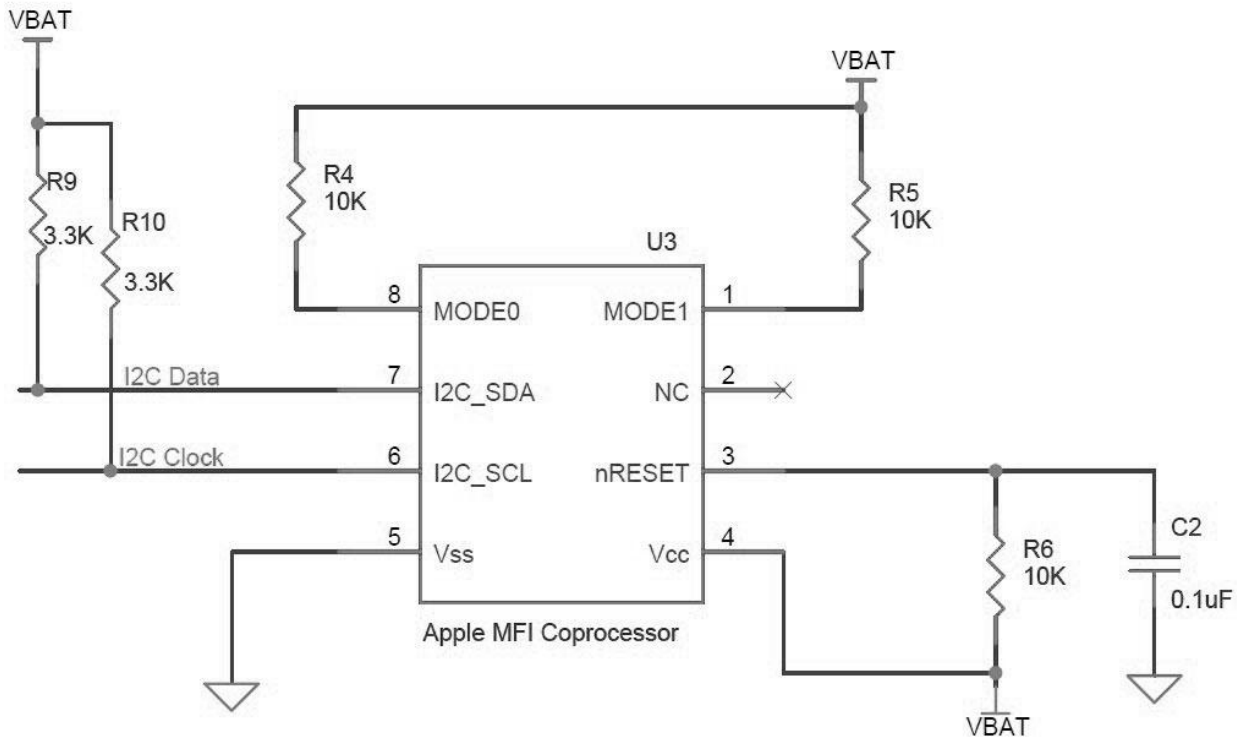
Notes:

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

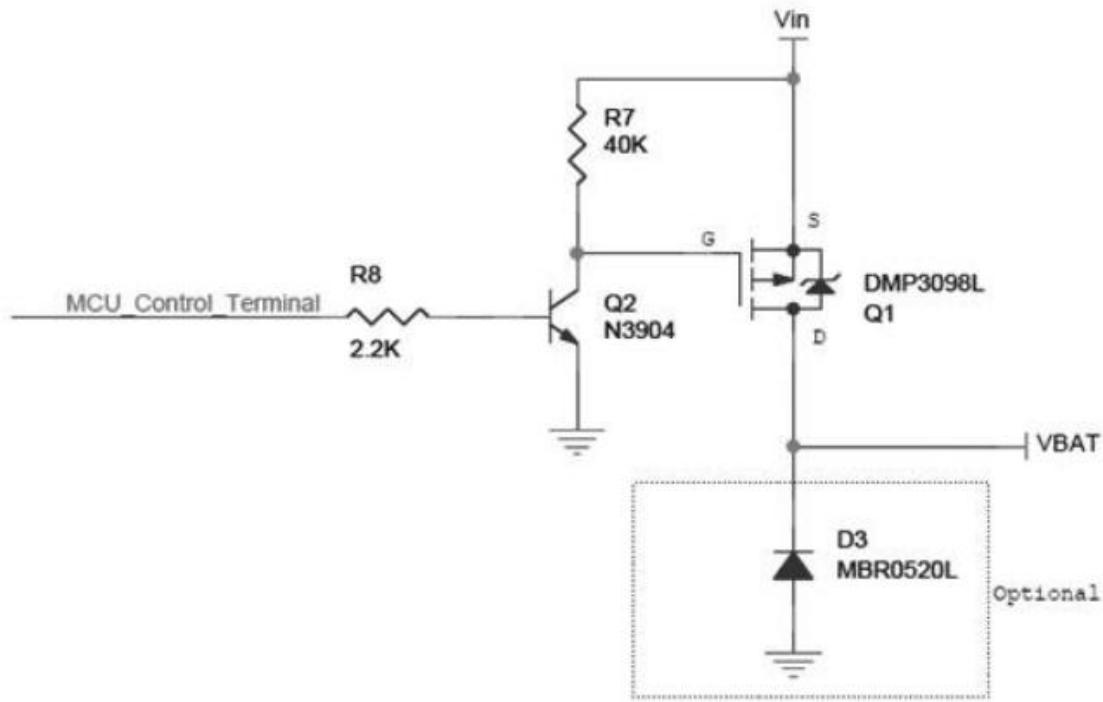
6.8 Apple iOS CP Reference Design



Part 1. BT module



Part 2. Co-processor



Part 3 Power Switch

7 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.

7.1 Modular Approval, FCC and IC

FCC ID: X3ZBTMOD1
 IC: 8828A-MOD1

In accordance with FCC Part 15, the BT11 is listed above as a Modular Transmitter device.

8 Label Instructions

The outside of final products that contain a BT11 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: X3ZBTMOD1
 IC: 8828A-MOD1

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

9 Ordering Information

Part Name	Description
BT11M	Class 1.5
BT11MU	Class 1.5, without LPO
BT11L	Class 1, long range
BT11L-EXT	Class 1, long range, with external antenna U.FL connector
BT11M-LT	Class 1.5, “Lite”; limited feature version
BT11L-LT	Class 1, “Lite”; limited feature version

10 Feature Comparison

Features	BT11x	BT11x-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
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	16	16
A/D Lines	4	4
DAC Lines	1	0

11 Revision History

Date	Revision	Description
22-Jan-2010	1	First release
18-June-2010	2	Added "Lite" option and IC regulatory ID
21-Jul-10	3	Updated RF parameters for BT11L rev1.2C