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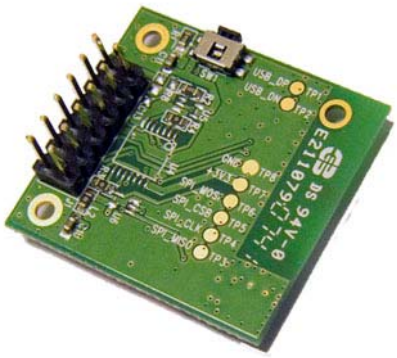
LM400 – Bluetooth Module General

The LM400 is designed to provide Bluetooth 2.0 + EDR function on a small form factor. The Bluetooth function is based on CSR BlueCore4-Ext Bluetooth System, which implements the full speed class 1 Bluetooth operations with full 7 slave piconet support. The interface of LM400 to host system is UART.



Contents

LM400 – Bluetooth Module General

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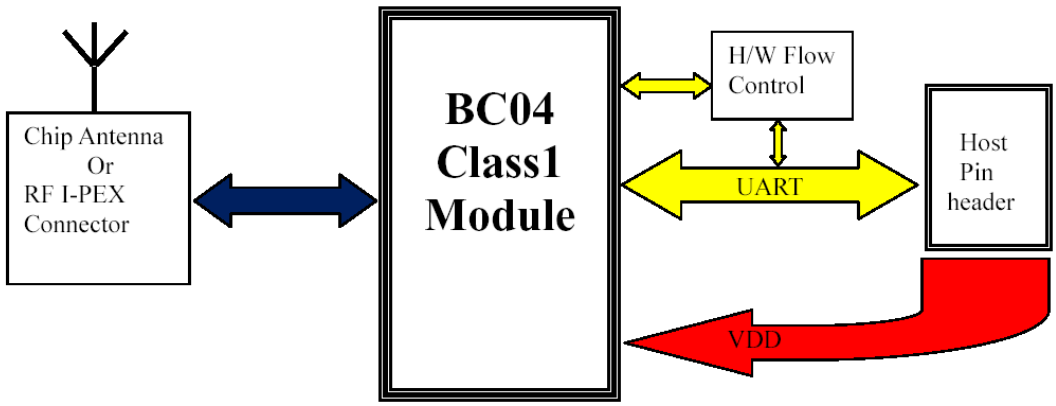
Features

- Bluetooth Ver. 2.0 + EDR certification
- Transmit Power up to +18dBm (class1)
- Low current consumption:
- Hold, Sniff, Park, Deep sleep mode
- 3.0V to 3.6V operation
- Full Bluetooth Data rate over UART and USB
- Support up to 7 ACL l inks and 3 SCO links
- Enhanced Data Rate (EDR) compliant for both 2Mbps and 3Mbps modulation modes
- Interface: USB, UART & PCM (for voice codec)
- SPP, HSP/HFP, HID, DUN firmware are available
- Support for 802.1 1 Co Existence
- RoHS Compliant
- Small outline: 28.3 X 30.0 X2.8 mm

Application

- Access point
- Domestics and Industrial applications
- Personal Digital Assistants (PDA)
- Serial Adapter
- GPS, PO S, Barcode Reader
- Digital camera, Printer& Cellular phone
- Cordless handset

Block diagram



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Electrical Characteristics

Absolute Maximum Ratings

Parameter	Min	Max
Storage Temperature	-40 °C	+85 °C
Supply Voltage (VDD)	2.7 VDC	3.6 VDC
Supply Voltage (VCC)	3.0 VDC	3.3 VDC
Other Pin Voltage	Vss -0.4 VDC	VDD +0.4 VDC

Recommended Operating Conditions

Parameter	Min	Max
Temperature	-10 °C	+70 °C
Supply Voltage for UART	3.0 VDC	3.6 VDC
Supply Voltage for USB	3.0 VDC	3.6 VDC

General Electrical Specifications

Parameter	Description	Min	Typical	Max
Carrier Frequency		2.402 GHz	-	2.480 GHz
RF Output Power	Measured in 50 Ω	15 dBm	16.5 dBm	18 dBm
RX sensitivity		-	-88 dBm	-86 dBm
Load Impedance	No abnormal Oscillation	-	-	5:1
Input Low Voltage	RESET, UART, GPIO, PCM	-0.30 VDC	-	0.80 VDC
Input High Voltage	RESET, UART, GPIO, PCM	0.7VDD	-	VDD+0.3 VDC
Output Low Voltage	UART, GPIO, PCM	-	-	0.4 VDC
Output High Voltage	UART, GPIO, PCM	VDD-0.4	-	-
Average Current Consumption	Receive DM1	-	114 mA	-

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Radio Characteristics – Basic Data Rate

Transmitter, VDD = 3.3 V, Temperature = + 20 °C

	Frequency (G Hz)	Min	Typical	Max	Bluetooth Specification	Unit
RF transmit power	2.402	15	16.5	18	-6 to +20	dBm
	2.441	15	16.5	18		dBm
	2.480	15	16.5	18		dBm
Initial carrier frequency tolerance	2.402	-	12	25	± 75	kHz
	2.441	-	10	25		kHz
	2.480	-	9	25		kHz
-20dB bandwidth for modulated carrier	2.402	-	890	1000	≤ 1000	kHz
	2.441	-	870	1000		kHz
	2.480	-	820	1000		kHz
Carrier Frequency Drift (single slot packet DH1)	2.402	-	± 10	± 20	≤ 25	kHz
	2.441	-	± 10	± 20		kHz
	2.480	-	± 10	± 20		kHz
Carrier Frequency Drift (five slot packet DH5)	2.402	-	± 10	± 20	≤ 40	kHz
	2.441	-	± 10	± 20		kHz
	2.480	-	± 10	± 20		kHz
Drift Rate	2.402	-	± 7	± 14	≤ 20	kHz/50µs
	2.441	-	± 7	± 14		kHz/50µs
	2.480	-	± 7	± 14		kHz/50µs
RF power control range		16	25	-	≥ 16	dB
$f1^{avg}$ "Maximum Modulation "	2.402	145	165	170	140< $f1^{avg}$ < 175	kHz
	2.441	145	165	170		kHz
	2.480	145	165	170		kHz
$f2^{maz}$ "Minimum Modulation "	2.402	115	150	-	>115	kHz
	2.441	115	150	-		kHz
	2.480	115	150	-		kHz
Adjacent channel transmit power F = F_0 ± 2MHz		-	-35	-20	≤ -20	dBm
Adjacent channel transmit power F = F_0 ± 3MHz		-	-45	-40	≤ -40	dBm
Adjacent channel transmit power F > F_0 + 3MHz		-	-50	-40	≤ -40	dBm
Adjacent channel transmit power F < F_0 - 3MHz		-	-50	-40	≤ -40	dBm

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Receiver, V DD =3.3 V Temperature = + 20 °C

	Frequency (G Hz)	Min	Typical	Max	Bluetooth Specification	Unit
Sensitivity at 0.1% BER (Single slot packets)	2.402	-	-88	-86	≤ -70	dBm
	2.441	-	-88	-86		dBm
	2.480	-	-88	-86		dBm
Sensitivity at 0.1% BER (Multi slot packets)	2.402	-	-88	-86	≤ -70	dBm
	2.441	-	-88	-86		dBm
	2.480	-	-88	-86		dBm
Maximum received signal level at 0.1% BER	2.402	-	-20	-10	≥ -20	dBm
	2.441	-	-20	-10		dBm
	2.480	-	-20	-10		dBm
C/I co-channel - 6 11 < 11 dB		-	6	11	≤ 11	dBm
Adjacent channel selectivity C/I F = F_0 + 1 MHz		-	-4	-	≤ 0	dBm
Adjacent channel selectivity C/I F = F_0 - 1 MHz		-	-4	-	≤ 0	dBm
Adjacent channel selectivity C/I F = F_0 + 2 MHz		-	-38	-	≤ -30	dBm
Adjacent channel selectivity C/I F = F_0 - 2 MHz		-	-23	-	≤ -20	dBm
Adjacent channel selectivity C/I F > =F_0 + 3 MHz		-	-45	-	≤ -40	dBm
Adjacent channel selectivity C/I F <= F_0 - 5 MHz		-	-44	-	≤ -40	dBm
Adjacent channel selectivity C/I F =F_{image}		-	-22	-	≤ -9	dBm
F_0 = 2441 MHz						
Maximum level of intermodulation interference (n = 5)		-	-30	-	≥ -39	dBm

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Radio Characteristics – Enhanced Data Rate

Transmitter, VDD = 3.3 V Temperature = + 20 °C

	Frequency (G Hz)	Min	Typical	Max	Bluetooth Specification	Unit
Maximum RF transmit power [1]	2.402	-	6	-	-6 to +20	dBm
	2.441	-	6	-		dBm
	2.480	-	7	-		dBm
Relative transmit power		-	-1.6	-	-4 to +1	dB
π /4 DQ PSK Maximum carrier frequency stability w_0		-	2	-	≤ ±10 for all blocks	kHz
π /4 DQ PSK Maximum carrier frequency stability w_i		-	6	-	≤ ±75 for all packets	kHz
π /4 DQ PSK Maximum carrier frequency stability $\lvert w_0 + w_i \rvert$		-	8	-	≤ ±75 for all blocks	kHz
8 DPSK Maximum carrier frequency stability w_0		-	2	-	≤ ±10 for all blocks	kHz
8 DPSK Maximum carrier frequency stability w_i		-	6	-	≤ ±75 for all packets	kHz
8 DPSK Maximum carrier frequency stability $\lvert w_0 + w_i \rvert$		-	8	-	≤ ±75 for all blocks	kHz
π /4 DQ PSK Modulation Accuracy	RMS DVEM	-	7	-	≤ 20	dBm
	99% DEVM	-	13	-	≤ 30	dBm
	Peak DEVM	-	19	-	≤ 35	dBm
8 DPSK Modulation Accuracy	RMS DVEM	-	7	-	≤ 13	dBm
	99% DEVM	-	13	-	≤ 20	dBm
	Peak DEVM	-	17	-	≤ 25	dBm
In-band spurious emissions	F> F_0 +3 MHz	-	<-50	-	≤ -40	dBm
	F< F_0 -3 MHz	-	<-50	-	≤ -40	dBm
	F= F_0 -3 MHz	-	-46	-	≤ -40	dBm
	F= F_0 -2 MHz	-	-34	-	≤ -20	dBm
	F= F_0-1 MHz	-	-35	-	≤ -26	dBm
	F= F_0+1 MHz	-	-35	-	≤ -26	dBm
	F= F_0+2 MHz	-	-31	-	≤ -20	dBm
	F= F_0+3 MHz	-	-33	-	≤ -40	dBm
EDR Differential Phase Encoding		-	No Errors	-	≥ 99	%

[1] Note :
Measurement made using a POWER_TABLE entery of TX_PRE 80, INT PA63, EXT PA255. This ensures that the Bluetooth requirements for ACP and those defined by the FCC and ETSI are satisfied over the operating temperature range of -5°C to + 45°C. Although the design is capable of generating in excess of + 18dBm, regulatory compliance over the full temperature range of -5°C to + 45°C will not be satisfied if the transmit power approaches this value.

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Receiver, VDD = 3.3 V, Temperature = + 20 °C

	Modulation	Min	Typical	Max	Bluetooth Specification	Unit
Sensitivity at 0.1% BER	π /4 DQ PSK	-	-87	-	≤ -70	dBm
	8 DPSK	-	-78	-		dBm
Maximum received signal level	π /4 DQ PSK	-	-8	-	≥ -20	dBm
	8 DPSK	-	-10	-		dBm
C/I co-channel at 0.1% BER	π /4 DQ PSK	-	10	-	≤ +13	dBm
	8 DPSK	-	19	-	≤ +21	dBm
Adjacent channel selectivity C/I F = F_0 + 1 MHz	π /4 DQ PSK	-	-10	-	≤ 0	dB
	8 DPSK	-	-5	-	≤ +5	dB
Adjacent channel selectivity C/I F = F_0 - 1 MHz	π /4 DQ PSK	-	-11	-	≤ 0	dB
	8 DPSK	-	-5	-	≤ +5	dB
Adjacent channel selectivity C/I F = F_0 + 2 MHz	π /4 DQ PSK	-	-40	-	≤ -30	dB
	8 DPSK	-	-40	-	≤ -25	dB
Adjacent channel selectivity C/I F = F_0 - 2 MHz	π /4 DQ PSK	-	-23	-	≤ -20	dB
	8 DPSK	-	-20	-	≤ -13	dB
Adjacent channel selectivity C/I F > =F_0 + 3 MHz	π /4 DQ PSK	-	-45	-	≤ -40	dB
	8 DPSK	-	-45	-	≤ -33	dB
Adjacent channel selectivity C/I F <= F_0 - 5 MHz	π /4 DQ PSK	-	-45	-	≤ -40	dB
	8 DPSK	-	-45	-	≤ -33	dB
F_0 = 2405, 2441, 2477 MHz						
Adjacent channel selectivity C/I F =F_{image}	π /4 DQ PSK	-	-20	-	≤ -7	dB
	8 DPSK	-	-15	-	≤ 0	dB

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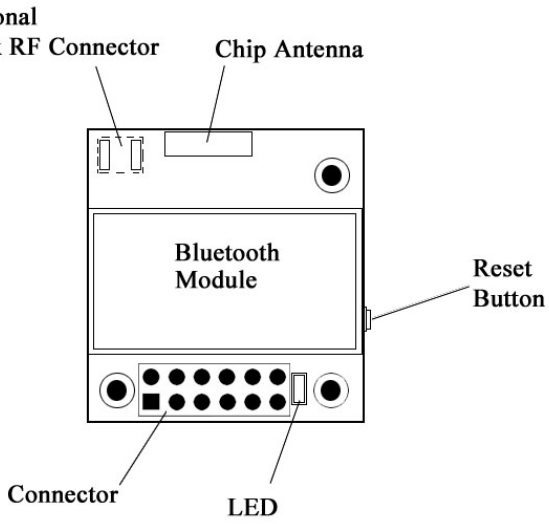
Hardware Structure

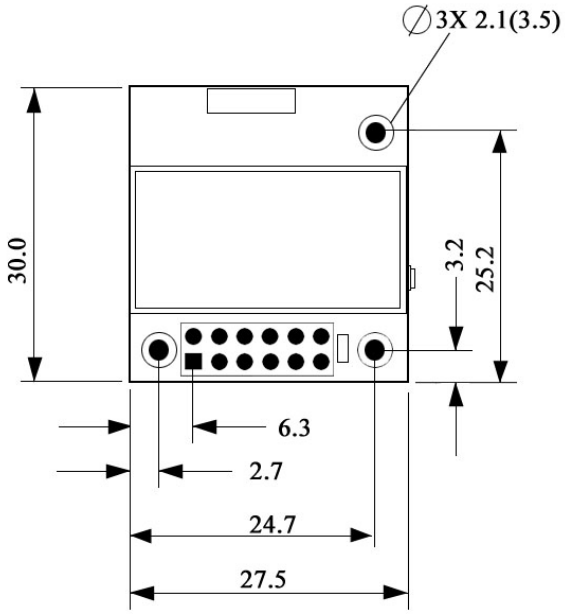
PCB Overwiev



Dimensions

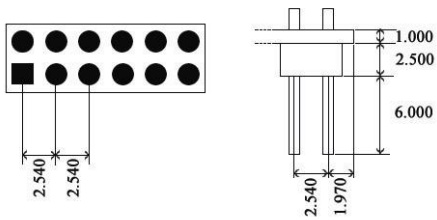
PCB

Unit: mm



PCB Connector

Unit: mm



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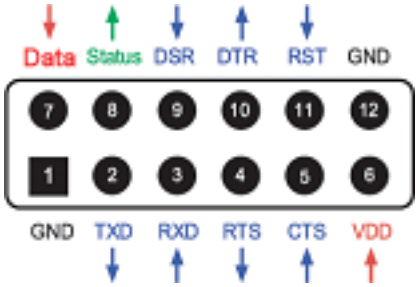
Pin Assignment (PCB Connector)



Pin No	Pin Name	Direction	Description	Signal Level
1	GND		Power Ground	Ground
2	TXD	Output	UART Data Out	TTL
3	RXD	Input	UART Data Input	TTL
4	RTS	Output	UART Ready to Send	TTL
5	CTS	Input	UART Clear to Send	TTL
6	VDD	Input	DC Input (3.0–3.3 V)	Power
7	Data led**	Input	Data Transfer (Active Low)	TTL
8	Status*	Output	Not Specified	TTL
9	DSR*	Input	Data Set Ready	TTL
10	DTR*	Output	Data Terminal Ready	TTL
11	RST	Input	Reset (Active Low)	TTL
12	GND		Power Ground	Ground

* = Not in use

** = Indicates transmitting/receiving data over an established Bluetooth connection

Reset Button

By pressing the Reset button you can

- disconnect and reconnect a wireless connection (short press)
- restore the default Baud Rate, 19 200 bps (> 3 s press)

LED

The LED indicates when a Bluetooth connection is established.

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Pin-out (module)

Pin No	Pin Name	Pin Type	Description
1	GND	GND	Common ground
2	PVCC	Power	Power Amp. Power Supply (3.3V)
3	AIO (0)	Bi -directional	Programmable I/O terminal , 32KHz sleep clock input
4	AIO (1)	Bi -directional	Programmable I/O terminal
5	PIO (0)	Bi -directional	Programmable I/O terminal , RX Enable
6	PIO (1)	Bi -directional	Programmable I/O terminal , TX Enable
7	PIO (2)	Bi -directional	Programmable I/O terminal , USB_PULL_UP , CLK_REQ_OUT
8	PIO (3)	Bi -directional	Programmable I/O terminal , USB_WAK E_UP , CLK_REQ_IN
9	PIO (4)	Bi -directional	Programmable I/O terminal , USB_O N , BT_Priority/Ch_Clk output for co-existence signalling
10	GND	GND	Common ground
11	PIO (5)	Bi -directional	Programmable I/O terminal , USB_DETAC H , BT_Active output for co-existence signalling
12	PIO (6)	Bi -directional	Programmable I/O terminal , CLK_REQ , WLAN_Active/Ch_Data input for for co-existence signalling
13	PIO (7)	Bi -directional	Programmable I/O terminal
14	PIO (8)	Bi -directional	Programmable I/O terminal
15	PIO (9)	Bi -directional	Programmable I/O terminal
16	RESET	CMOS input	Reset input of module, Active low reset
17	VCC	Power	Module power supply input
18	GND	GND	Common ground
19	GND	GND	Common ground
20	USB_DP	Bi-directional	USB data plus
21	USB_DN	Bi-directional	USB data minus
22	PCM_SYNC	Bi-directional	Synchronous data sync
23	PCM_IN	CMOS input	Synchronous data input
24	PCM_OUT	CMOS output	Synchronous data output
25	PCM_C LK	Bi -directional	Synchronous data clock
26	UART_RX	CMOS input	UART data input
27	UART_TX	CMOS output	UART data output
28	UART_RTS	CMOS output	UART request to send (active low)
29	GND	GND	Common ground
30	UART_CTS	CMOS input	UART clear to send (active low)
31	SPI_MOSI	CMOS input	Serial Peripheral Interface data input
32	SPI_CSB	CMOS input	Chip select for Synchronous Serial Interface (active low)
33	SPI_CLK	CMOS input	Serial Peripheral Interface clock
34	SPI_MISO	CMOS output	Serial Peripheral Interface data output
35	PIO (11)	Bi-directional	Programmable I/O terminal
36	PIO (10)	Bi-directional	Programmable I/O terminal
37	RF_IO	Analogue	Antenna interface
38	GND	GND	Common ground

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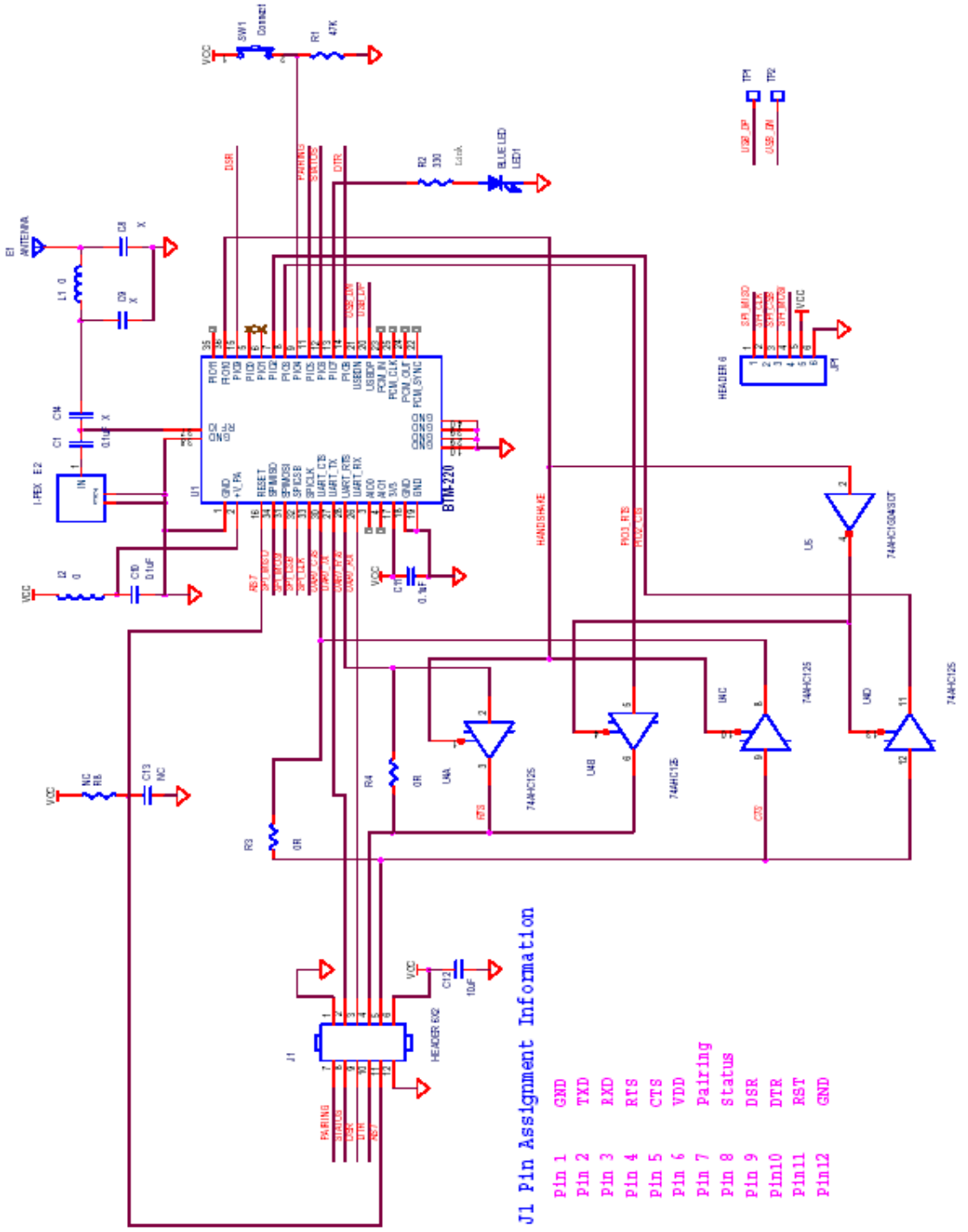
Schematic



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Configuration

You can reprogram the default settings on the module using AT commands (see section below *AT Command Set*) or the *Wireless Bluetooth Configuration Utility* firmware (see separate manual).

Factory Settings

- Baud rate: 19 200 bps
- Data bit: 8
- Parity: None
- Stop bit: 1
- Flow control: HW
- Others: See section *AT Command Set*

AT Command Set

The following is the AT command set for the module in the command mode (that is, when the module is in the disconnection state).

The commands will be preceded by "AT" to be executed. (Ex: To execute the address inquiry, "B?", use "**ATB?**")

All the commands and parameters are case insensitive.

Command	Description
+++	Escape sequence with guard time. When the device is in Data mode, it can be forced back into Command mode while maintaining the connection to the remote device. The characters should then be sent 1 second apart.
A	This command is used to establish a connection. Available only when the adapter is in the master role.
A	Connect the adapter to a specified Bluetooth device. Available only when "ATD=xxxxxxxxxxx" is executed.
A1-A8	Connect the adapter to a Bluetooth device in the neighborhood found through "ATF?"
B	This command is used to display the Bluetooth address of the local adapter.
B?	Inquire the Bluetooth address of the local adapter.
C	This command enable or disable flow control signals (CTS/RTS) of the UART port.
C0	Disable flow control.
(default) **C1**	Enable flow control.
C?	Inquiry of current setting.

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Command	Description
D	For security purpose, this command is used to specify a unique remote Bluetooth device to be connected. In the master role, the adapter pairs and connects with the designated remote slave address. If the adapter is in the slave mode, this command is a filter condition to accept the inquiry of the master device.
D=xxxxxxxxxxxx	"xxxx-xx-xxxxxx" is a string of 12 hexadecimal digits.
D0	Restore the status in which the adapter can connect with any remote address.
D?	Inquiry the designated address that can be paired and connected.
E	This command is used to specify whether the adapter echoes characters received from the UART back to the DTE/DCE.
E0	Command characters received from the UART are not echoed back to the DTE/DCE.
(default) **E1**	Command characters received from the UART are echoed back to the DTE/DCE.
E?	Inquire the current setting.
F	This command is used to search for any Bluetooth device in the neighborhood within one minute. If any device is found, its name and address will be listed. The search ends with a message “Inquiry ends. Xx device(s) found.” Available only when the adapter is in the master role and manually connected (see command “O”).
F?	Inquire Bluetooth devices in the neighborhood.
H	This command can drop the connection either in master or slave role. It is also used to specify whether the adapter can be discovered or connected by remote devices.
H	Drop current connection.
H0	The adapter enters the undiscoverable mode. If a pair has been made, the original connection can be resumed. But other remote master device cannot discover this adapter. Reboots when set.
(default) **H1**	The adapter enters the discoverable mode. Reboots when set.
H?	Inquire the current setting.
I	This command is used to inquire the firmware version and other settings.
I0	Inquire the version codes.
I1	Inquire all current settings.
I2	Inquire status on RSSI at Online Command Mode.

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Command	Description
K	This command is used to specify number stop bits of COM port.
(default) **K0**	One stop bit.
K1	Two stop bits.
K?	Inquire the current setting.
L	This command is used to specify the baud rate of COM port.
L0	4800 bps
L1	9600 bps
(default) **L2**	19200 bps
L3	38400 bps
L4	57600 bps
L5	115.2 kbps
L6	230.4 kbps
L?	Inquire the current baud rate.
M	This command is used to specify parity bit setting of COM port.
(default) **M0**	None parity bit.
M1	Odd parity.
M2	Even parity.
M?	Inquire the current setting.
N	This command is used to specify a name for the adapter. You can specify a friendly name using 0 to 9, A to Z, a to z, space and -, which are all valid characters. Note that “space” and “-” are not permitted first or last in the name. The default name is “Serial Adaptor”.
N=xxxxxx	"xxxxxx" is a character string with a maximal length of 16.
N?	Inquire the name of the local adapter.
O	This command directs the device to switch from Command mode to Online data mode. It is also used enable/disable auto-connection feature (available only when the adapter is in the master role).
O	Switch from Command mode to Online Data mode.
(default) **O0**	Automatically connect the adapter to a device specified by “ATD”, or any available device if “ATD” is not executed. Reboots when set.
O1	Disable auto-connection feature. After it is executed, you need to execute “ATA” to manually connect a remote device. Reboots when set.
O?	Inquire the current setting.

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Command	Description
P	This command is used to specify a PIN. The default PIN is “1234". Paired adapters should have a same PIN.
P=xxxx	"xxxx" is a 4–8-digit string.
P0	Cancel authentication by PIN.
P?	Inquire the current PIN.
Q	The command is used to set if result messages are prompted when AT commands are executed. The result messages are: OK/ERROR for command execution, or CONNECT/DISCONNECT for connection status.
(default) **Q0**	Result messages are prompted.
Q1	Result messages are not prompted.
Q?	Inquire the current setting.
R	This command is used to specify whether the adapter is in the master or slave role. If the device role is changed, the adapter will reboot and all paired addresses will be cleared.
R0	Set the adapter to the master role.
(default) **R1**	Set the adapter to the slave role.
R?	Inquire the current role of the adapter.
S	This command is used to enable/disable auto-power saving feature of RS232 driver.
S0	Disable RS232 force on (auto power down) mode.
(default) **S1**	Enable RS232 force on (auto power down) mode.
S?	Inquiry of current setting.
X	Disable/Enable escape sequence (+++).
X0	Disable escape sequence.
(default) **X1**	Enable escape sequence.
X?	Inquiry of current setting.
Z	This command is used to restore the default settings and originate a warm start.
Z0	Restore the default settings.