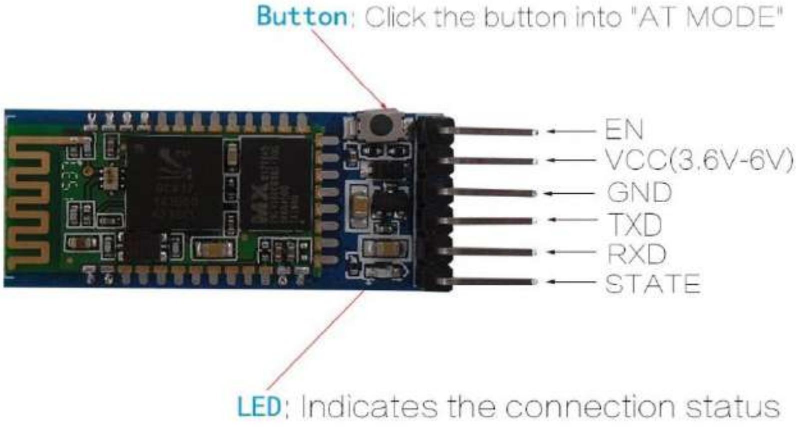
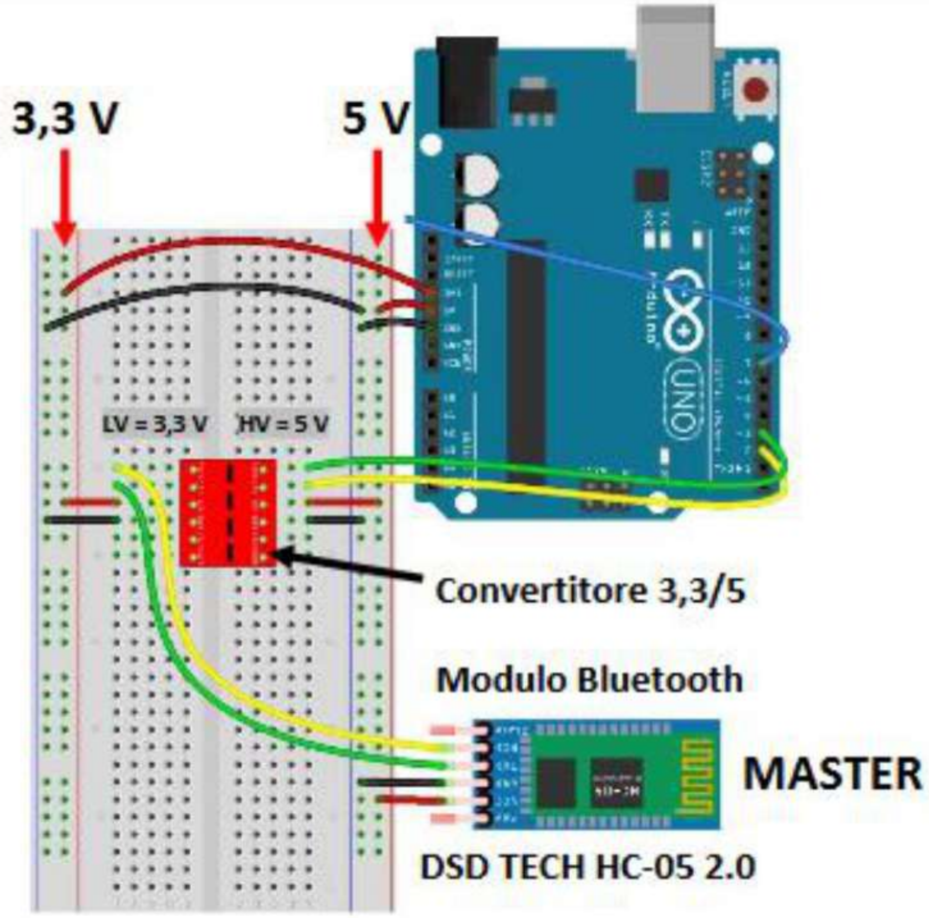
UNICAM Università di Camerino 1336	**School of Science and Technology** **Computer Science** **Embedded Systems Architecture** *Prof. Lorenzo Morresi*	MSc in Computer Science (LM-18) A.A. 2020-2021
Project Title	**Master-Slave bluetooth communication**	Sheet ARDUINO n_**17**
Description	Master/Slave communication between two Arduinos via Bluetooth. Two HC-05 boards will be setted in the AT mode for the Master and Slave configuration. The Master will send a sequence of characters that will allow a load placed on the Slave (LED) to switch on and off.	
Necessary materials	2 ARDUINO UNO BOARDs 2 HC-05 2.0 bluetooth modules (otherwise 1 HC-05 2.0 bluetooth module and 1 HC-06 2.0 bluetooth module) 2 Bi-directional logic Level Converter 3,3V – 5V 1 resistor – 220 Ω 1 LED red Suggestion for the purchase of materials on the link: https://morresi.wordpress.com/embedded-systems-architecture/	
	MASTER configuration	
Pictorial /Schematic **MASTER**	 Button: Click the button into "AT MODE" EN VCC(3.6V-6V) GND TXD RXD STATE LED: Indicates the connection status	



Sketch

DSD TECH HC-05 MODULE

Setting up

```
#include <SoftwareSerial.h>
SoftwareSerial BTSerial(2, 3);

void setup(){
  Serial.begin(38400);
  baudBTSerial.begin(38400);
  }

void loop(){
  if(BTSerial.available()){
    Serial.write(BTSerial.read());
    }
  if(Serial.available()){
    BTSerial.write(Serial.read());
    }
   delay(10);
 }
```

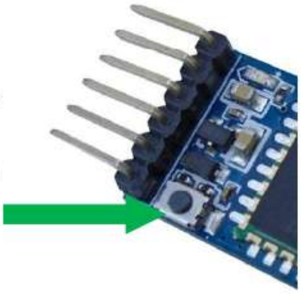
DSD TECH HC-05 MODULE
Setting up

AT mode

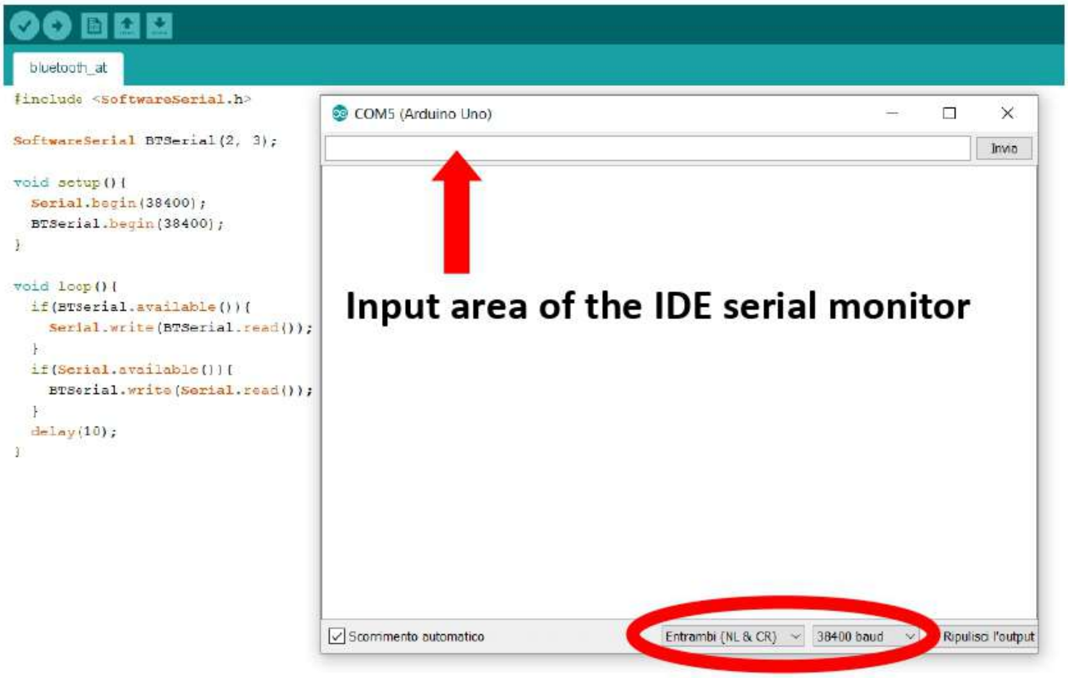
Once the setup sketch has been loaded, the red led of the bluetooth module will flash twice every two seconds. In this way, you are not yet in AT mode.

To enter AT mode, and therefore communicate with the Bluetooth module through the serial monitor, you have to:

1) disconnect the 5 V power supply connected to ARDUINO;
2) press and hold the button on the bluetooth module;
3) keeping the button pressed, reconnect the 5V power supply cable to the board;
4) if the procedure is successful, the red led on the bluetooth module will flash a single two-second flash every two seconds.



5) open the serial monitor from the ARDUINO IDE;
6) set the transmission speed to 38400 baud and select "both (NL & CR)"



```
#include <SoftwareSerial.h>

SoftwareSerial BTSerial(2, 3);

void setup(){
  Serial.begin(38400);
  BTSerial.begin(38400);
}

void loop(){
  if(BTSerial.available()){
    Serial.write(BTSerial.read());
  }
  if(Serial.available()){
    BTSerial.write(Serial.read());
  }
  delay(10);
}
```

☑ Scorrimento automatico   Entrambi (NL & CR)   38400 baud

7) check if the bluetooth module is in AT mode: type AT on the input area and press enter. The Bluetooth module must to respond with OK;
8) check the communication speed: type AT + UART on the input area and press enter. The Bluetooth module responds with the speed set by the manufacturer (which should be 9600 baud);
9) check the **ROLE** of the board: write AT + ROLE on the input area and press enter. If the Bluetooth module responds with **1**, the role is **MASTER**, if it responds with **0**, the role is **SLAVE**.
10) to change the role of the module: write **AT + ROLE = 1** on the input area and press enter if the card must work as a **MASTER**.
11) to enter the address of the Slave board: write AT + BIND = 98d3,31,300e42 on the input area and press enter. In this way, the input area of the serial monitor of the IDE master will communicate with the corresponding slave and this address.
This step is crucial for the functioning of the communication between the Master and the Slave. The request for the Slave address will be described in the next section. Check that the 4 + 2 + 6 characters of the address are separated by a comma!!
12) to **EXIT THE AT MODE**: write on the input area AT + RESET and press enter.
13) If the AT mode is not active, the LED red should flash quickly.

Sketch

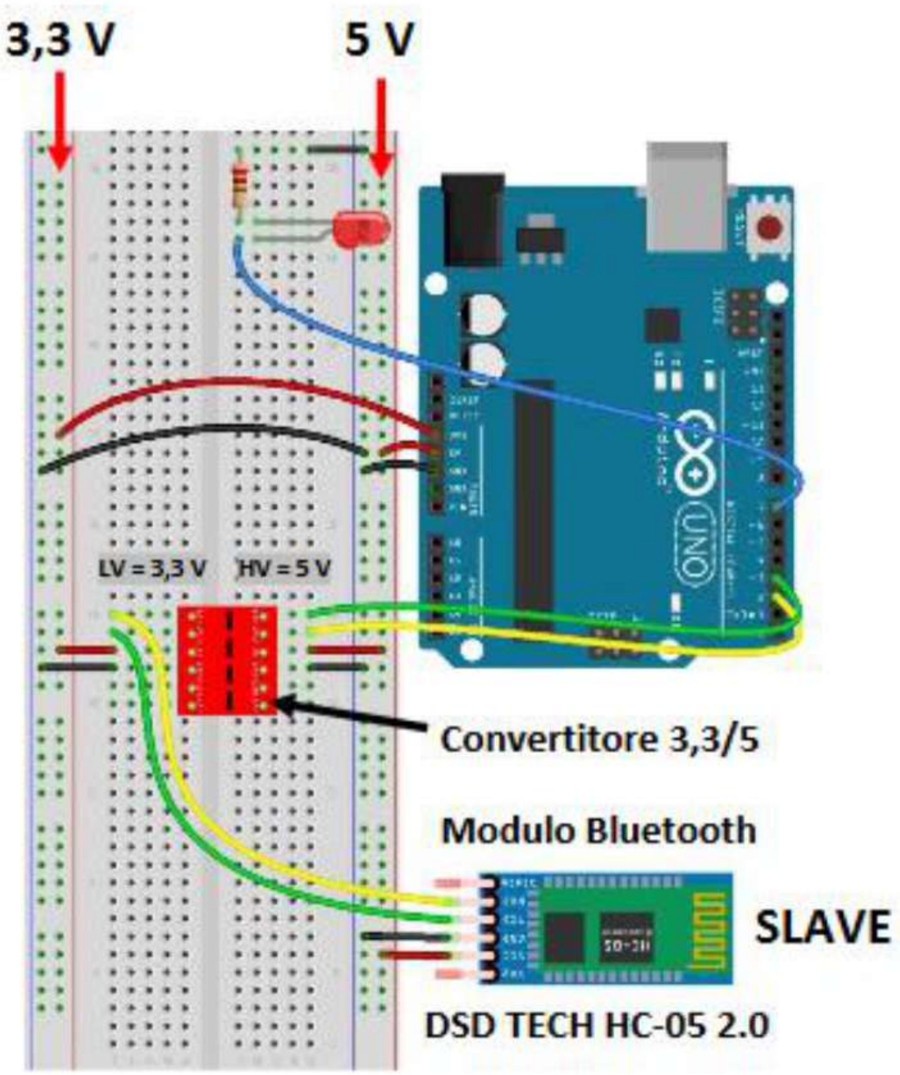
Character sequence sending

```
//MASTER
#include <SoftwareSerial.h>
SoftwareSerial BTSerial(2, 3);// RX, TX

void setup(){
  BTSerial.begin(9600); /*use the same UART value read at point #8 of the previous
section */
  delay(100);
}

void loop(){
  BTSerial.write('1');//switch on LED character
  delay(1000);
  BTSerial.write('0');//switch off LED character
  delay(1000);
}
```

SLAVE configuration

Pictorial /Schematic

SLAVE



Sketch

DSD TECH HC-05 MODULE

```
#include <SoftwareSerial.h>
SoftwareSerial BTSerial(2, 3);

void setup(){
```

Setting up

```
 Serial.begin(38400);
 baudBTSerial.begin(38400);
}

void loop(){
 if(BTSerial.available()){
  Serial.write(BTSerial.read());
 }
 if(Serial.available()){
  BTSerial.write(Serial.read());
 }
delay(10);
}
```

DSD TECH HC-05 MODULE

Setting up

AT mode

Once the setup sketch has been loaded, the red led of the bluetooth module will flash twice every two seconds. In this way, you are not yet in AT mode.

To enter AT mode, and therefore communicate with the Bluetooth module through the serial monitor, you have to:

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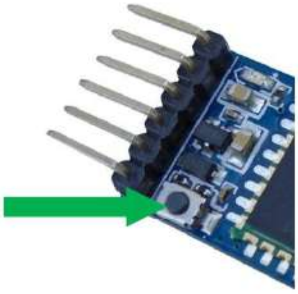

5) open the serial monitor from the ARDUINO IDE;
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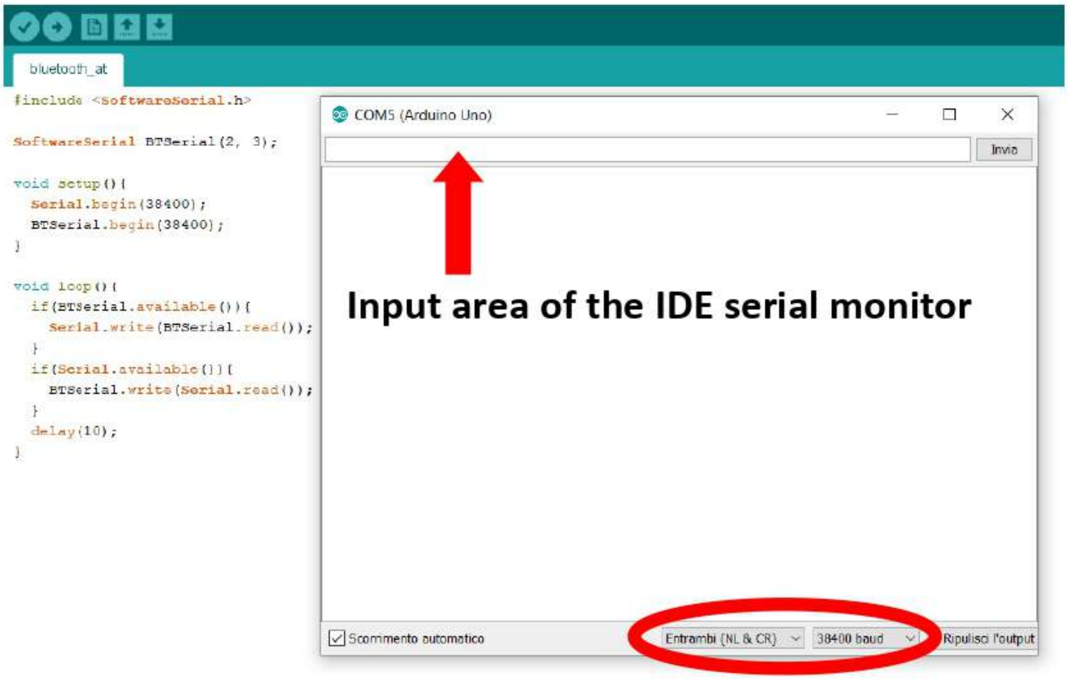


```
#include <SoftwareSerial.h>

SoftwareSerial BTSerial(2, 3);

void setup(){
  Serial.begin(38400);
  BTSerial.begin(38400);
}

void loop(){
  if(BTSerial.available()){
    Serial.write(BTSerial.read());
  }
  if(Serial.available()){
    BTSerial.write(Serial.read());
  }
  delay(10);
}
```

☑ Scorrimento automatico | Entrambi (NL & CR) | 38400 baud

7) check if the bluetooth module is in AT mode: type AT on the input area and press enter. The Bluetooth module must to respond with OK;
8) check the communication speed: type AT + UART on the input area and press enter. The Bluetooth module responds with the speed set by the manufacturer (which should be 9600 baud);
9) check the <u>**ROLE**</u> of the board: write AT + ROLE on the input area and press enter. If the

Bluetooth module responds with **1**, the role is **MASTER**, if it responds with **0**, the role is **SLAVE**.

10) to change the role of the board: write **AT + ROLE = 0** on the input area and press enter if the card must work as a **SLAVE**.

11) Request for the address of the Slave board: write AT + ADDR on the input area and press enter. Check that the address is made up of 4 + 2 + 6 characters.

For example, an answer might be: + ADDR: 98d3 II 31 II 300e42. Then typy the address 98d3,31,300e42 in the #11 BIND procedure of the Master.

12) to **EXIT THE AT MODE**: write on the input area AT + RESET and press enter.

13) If the AT mode is not active, the LED red should flash quickly.

Sketch

Character sequence reading

```
/SLAVE
#include <SoftwareSerial.h>
SoftwareSerial BTSerial(2, 3);// RX, TX

void setup(){
 BTSerial.begin(9600); /*use the same UART value read at point #8 of the previous
section */
 delay(100);
 pinMode (7, OUTPUT);
}

void loop() {
 if (BTserial.available()) {
   char c = BTserial.read();
    if (c == '1') {
      digitalWrite(7, HIGH);
    }
   if (c == '0') {
     digitalWrite(7, LOW);
   }
  }
}
```

Powering and RX / TX connection of the Bluetooth HC-05 module

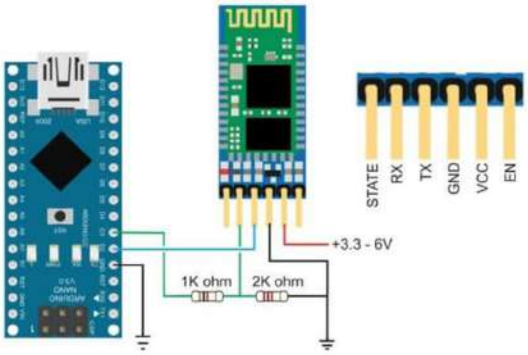
The DSD TECH HC-05 module can be powered at 5V (Vcc = 5V).

ATTENTION: the reading of the RXD pin signals occurs with a maximum high digital level of 3.3 V !!!

DO NOT CONNECT THE RXD OF THE BLUETOOTH MODULE DIRECTLY WITH THE TX PIN OF ARDUINO, since the latter works at 5V and therefore could demage the DSD TECH HC-05 module.Therefore, two solutions can be used:

1) use a bidirectional logic level converter from 3.3V to 5V as the one used in this project; or, if the logic level converter is not available,

2) use a voltage divider as shown in the figure



HC-05 Data Sheet

Bluetooth to Serial Port Module

HC-05 Data Sheet

1、Overview

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.

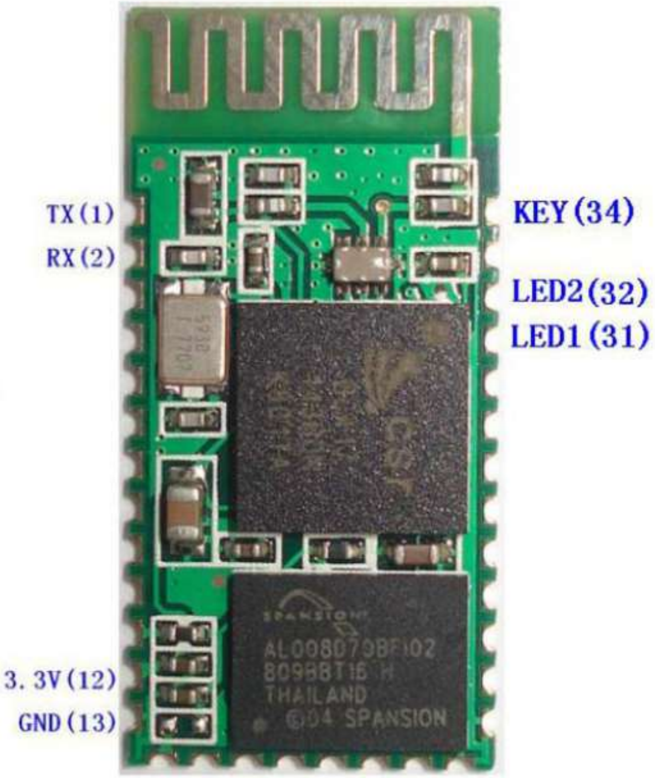
Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore BC417143 chip. It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

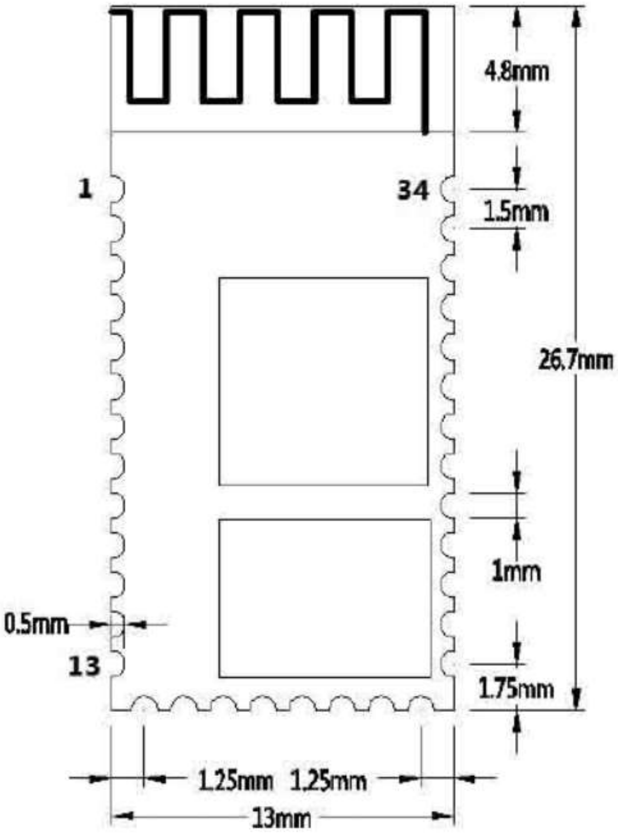
2、Feature

- Sensitivity (Bit error rate) can reach -80dBm,The change range of output's power: -4 - +6dBm.
- Has an EDR module; and the change range of modulation depth: 2Mbps - 3Mbps.
- Has a build-in 2.4GHz antenna; user needn't test antenna.
- Has the external 8Mbit FLASH
- Can work at the low voltage (3.1V~4.2V). The current in pairing is in the range of 30～40mA.
- PIO control can be switched.
- This module can be used in the SMD.
- It's made through RoHS process.
- The board PIN is half hole size.
- Has a 2.4GHz digital wireless transceiver.
- Bases at CSR BC04 Bluetooth technology.
- Has the function of adaptive frequency hopping.
- Small (27mm×13mm×2mm)
- Peripherals circuit is simple.
- It's at the Bluetooth class 2 power level.
- Storage temperature range: -40 ℃ - 85℃，work temperature range: -25 ℃ - +75℃
- Any wave inter Interference: 2.4MHz，the power of emitting: 3 dBm.
- Bit error rate: 0. Only the signal decays at the transmission link, bit error may be produced. For example, when RS232 or TTL is being processed, some signals may decay.

3、Product's picture

HC-05 Data Sheet

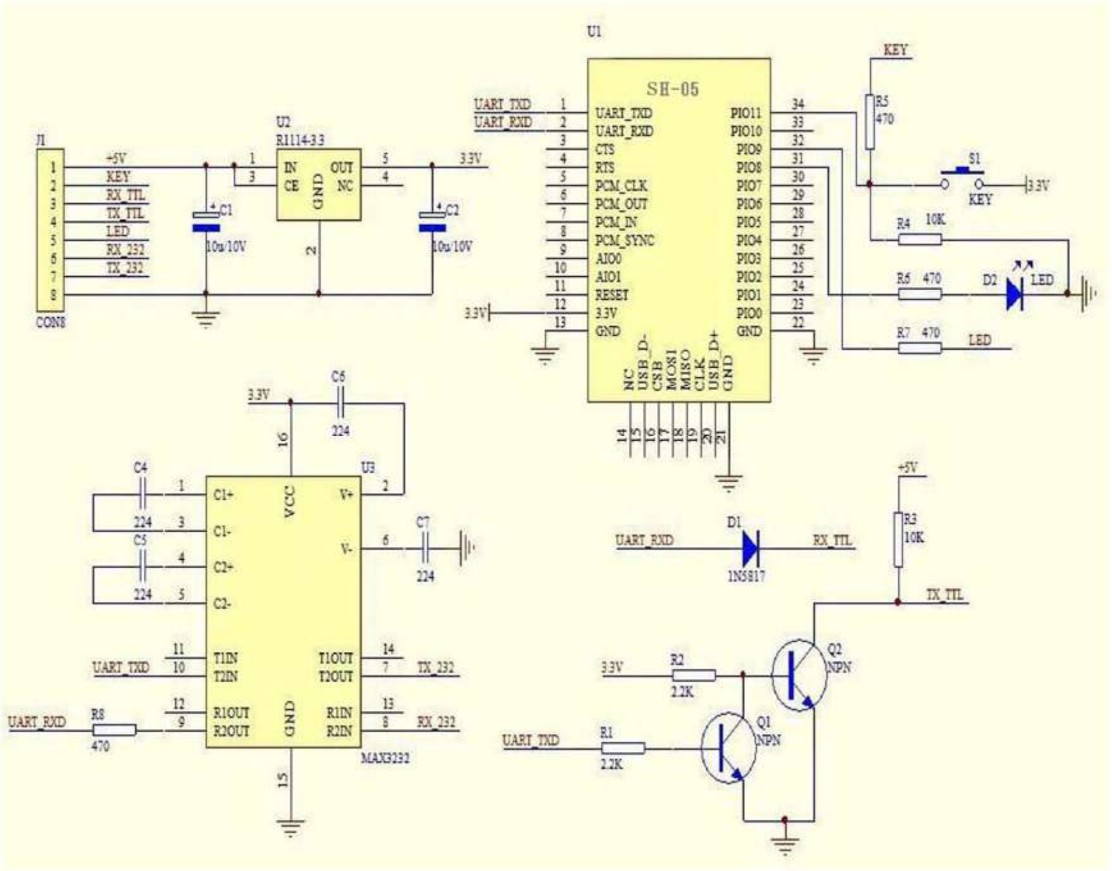




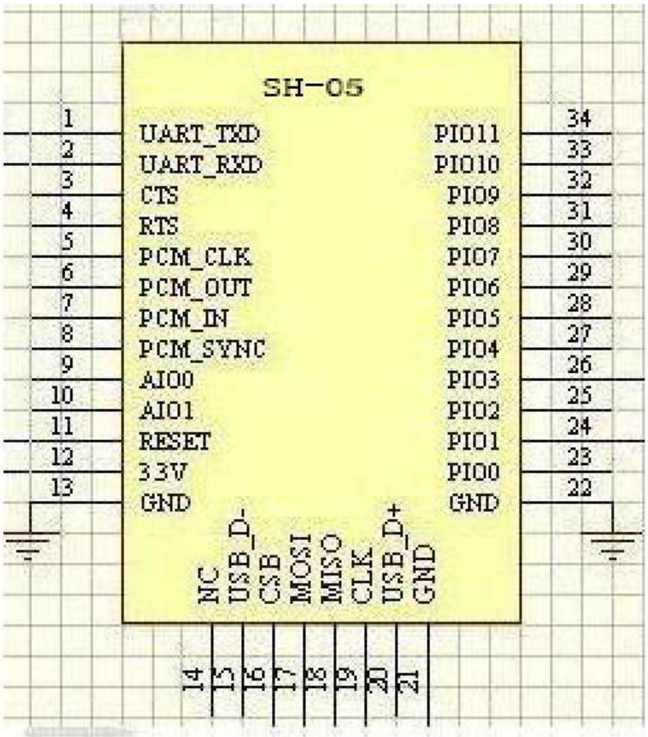
4、Application fields

- Bluetooth Car Handsfree Device
- Bluetooth GPS
- Bluetooth PCMCIA , USB Dongle
- Bluetooth Data Transfer
- Bluetooth Arduino module

5、Block diagram



6、 PINs description



PIN Name	PIN	Pad type	Description	Note
UART_TX	1	CMOS output, Tri-stable with weak internal pull-up	UART Data output	
UART_RX	2	CMOS input with weak internal pull-down	UART Data input	
UART_CTS	3	CMOS input with weak internal pull-down	UART clear to send, active low	
UART_RTS	4	CMOS output, tri-stable with weak internal pull-up	UART r qu st to send, active low	
PCM_CLK	5	Bi-Directional		
PCM_OUT	6	CMOS output		
PCM_IN	7	CMOS Input		
PCM_SYNC	8	Bi-Directional		
AIO0	9	Bi-Directional		
AIO1	10	Bi-Directional		
RESETB	11	CMOS Input with RESETB 11 weak intemal pull-down		

VCC	12	3.3V		
GND	13	VSS	Ground pot	
1V8	14	VDD	Integrated 1.8V (+) supply with On-chip linear regulator output within 1.7-1.9V	
USB_-	15	Bi-Directional		
SPI_CSB	16	CMOS input with weak internal pull-up	Chip select for serial peripheral interface, active low	
SPI_MOSI	17	CMOS input with weak internal pull-down	Serial peripheral interface data input	
SPI_MISO	18	CMOS input with weak internal pull-down	Serial peripheral interface data Output	
SPI_CLK	19	CMOS input with weak internal	Serial peripheral interface clock	
USB_+	20	Bi-Directional		
GND	21	VSS	Ground pot	
GND	22	VSS	Ground pot	
PIO0	23	Bi-Directional RX EN	Programmable input/output line, control output for LNA(if fitted)	

PIO1	24	Bi-Directional TX EN	Programmable input/output line, control output for PA(if fitted)	
PIO2	25	Bi-Directional	Programmable input/output line	
PIO3	26	Bi-Directional	Programmable input/output line	
PIO4	27	Bi-Directional	Programmable input/output line	
PIO5	28	Bi-Directional	Programmable input/output line	
PIO6	29	Bi-Directional	Programmable input/output line	
PIO7	30	Bi-Directional	Programmable input/output line	
PIO8	31	Bi-Directional	Programmable input/output line	LED
PIO9	32	Bi-Directional	Programmable input/output line	LED
PIO10	33	Bi-Directional	Programmable input/output line	
PIO11	34	Bi-Directional	Programmable input/output line	KEY

7、AT Command

More information about command set is provided at hc-05-at-command.pdf.

HC-03/05 Embedded Bluetooth Serial Communication Module

AT command set

Last revised: April, 2011

HC-05 embedded Bluetooth serial communication module (can be short for module) has two work modes: order-response work mode and automatic connection work mode. And there are three work roles (Master, Slave and Loopback) at the automatic connection work mode. When the module is at the automatic connection work mode, it will follow the default way set lastly to transmit the data automatically. When the module is at the order-response work mode, user can send the AT command to the module to set the control parameters and sent control order. The work mode of module can be switched by controlling the module PIN (PIO11) input level.

Serial module PINs:

1. PIO8 connects with LED. When the module is power on, LED will flicker. And the flicker style will indicate which work mode is in using since different mode has different flicker time interval.
2. PIO9 connects with LED. It indicates whether the connection is built or not. When the Bluetooth serial is paired, the LED will be turned on. It means the connection is built successfully.
3. PIO11 is the work mode switch. When this PIN port is input high level, the work mode will become order-response work mode. While this PIN port is input low level or suspended in air, the work mode will become automatic connection work mode.
4. The module can be reset if it is re-powered since there is a reset circuit at the module.

========================Notification ========================

1. How to get to the AT mode.

Way 1:

Step 1: Input low level to PIN34. Step 2: Supply power to the module. Step 3: Input high level to the PIN34. Then the module will enter to AT mode. The baud rate is as same as the communication time, such as 9600 etc.

Way 2: Step 1: Connect PIN34 to the power supply PIN. Step 2: Supply power to module (the PIN34 is also supplied with high level since the PIN34 is connected with power supply PIN). Then the module will enter to AT module. But at this time, the baud rate is 38400. In this way, user should change the baud rate at the AT mode, if they forget the communication baud rate.

How to get to the communication mode: Step 1: Input low level to PIN34. Step 2: Supply power to the module. Then the module will enter to communication mode. It can be used for pairing.

2. How to set this module be the master role.

Step 1: Input high level to PIO11.

Step 2: Supply power to the module. And the module will enter to the order-response work mode.

Step 3: Set the parameters of the super terminal or the other serial tools (baud rate: 38400, data bit:8, stop bit:1, no parity bit, no Flow Control)

Step 4: Sent the characters "AT+ROLE=1\r\n" through serial, then receive the characters "OK\r\n". Here, "\r\n" is the CRLF.

Step 5: Input low level to PIO, and supply power to the module again. Then this module will become master role and search the other module (slave role) automatically to build the connection.

3. Notes.

(1) HC-03 and HC-05's command should end up with "\r\n". It means when you finish programming, you should add terminator ("ENTER" or "0x0d 0x0a") to the program. It's different from HC-04 and HC-06 (They don't need terminator).

(2) The most common commands for HC-03 and HC-05 are: AT+ROLE (set master –slave), AT+CMODE(set address pairing) , AT+PSWD (set password).

If you want the master module has the function of remembering slave module, the most simply way is: First, set AT+CMODE=1. Make the master module pair with the slave module. Second, set AT+CMODE=0. Then the master module just can make pair with that specified slave module.

(3) When PIN34 keeps high level, all commands can be used. Otherwise, only some of them can be used.

==

Detailed description of Command

(AT command is case- sensitive, should end up with terminator (“enter” or “\r\n”).)

1. Test

Command	Response	Parameter
AT	OK	None

2. Reset

Command	Response	Parameter
AT+RESET	OK	None

3. Get the soft version

Command	Response	Parameter
AT+VERSION?	+VERSION: <Param> OK	Param: Version number

Example :

```
at+version?\r\n
+VERSION:2.0-20100601
OK
```

4. Restore default status

Command	Response	Parameter
AT+ORGL	OK	None

The parameter of default status:

①. Device type: 0

②. Inquire code: 0x009e8b33

③. Module work mode: Slave Mode

④. Connection mode: Connect to the Bluetooth device specified

⑤. Serial parameter: Baud rate: 38400 bits/s; Stop bit: 1 bit; Parity bit: None.

⑥. Passkey: “1234”

⑦. Device name: “H-C-2010-06-01”

………..

5. Get module Bluetooth address

Command	Response	Parameter
AT+ADDR?	+ADDR: <Param> OK	Param: Bluetooth address

Bluetooth address will show as this way: NAP: UAP: LAP(Hexadecimal)

Example:

Module Bluetooth address: 12: 34: 56: ab: cd: ef

at+addr?\r\n

+ADDR:1234:56:abcdef

OK

6. Set/ inquire device’s name

Command	Response	Parameter
AT+NAME=<Param>	OK	Param: Bluetooth device name Default: “HC-05”
AT+NAME?	1. +NAME:<Param> OK----success 2. FAIL----failure	

Example:

AT+NAME=HC-05\r\n ---set the module device name: “HC-05”

OK

AT+NAME= “HC-05”\r\n ---set the module device name: “HC-05”

OK

at+name=Beijin\r\n ---set the module device name: “Beijin”

OK

at+name= “Beijin”\r\n ---set module device name : “Beijin”

OK

at+name?\r\n

+NAME: Bei jin

OK

7. Get the remote Bluetooth device’s name

Command	Response	Parameter
AT+RNAME?<Param1>	1. +NAME:<Param2> OK----success 2. FAIL----failure	Param1: Remote Bluetooth device address Param2: Remote Bluetooth device address

Bluetooth address will show as this way: NAP:UAP:LAP (Hexadecimal)

Example:

Bluetooth device address: 00:02:72: od: 22 : 24; device name: Bluetooth

at+rname? 0002,72,od2224\r\n

+RNAME:Bluetooth

OK

8. Set/ inquire module role

Command	Response	Parameter
AT+ROLE=<Param>	OK	Param: 0---- Slave role 1---- Master role 2---- Slave-Loop role Default: 0
AT+ ROLE?	+ ROLE:<Param> OK	

Role introduction:

Slave (slave role)----Passive connection;

Slave-Loop----Passive connection, receive the remote Bluetooth master device data and send it back to the master device;

Master (master role)----Inquire the near SPP Bluetooth slave device, build connection with it positively, and build up the transparent data transmission between master and slave device.

9. Set/inquire device type

Command	Response	Parameter
AT+CLASS=<Param>	OK	Param: device type Bluetooth device type is a 32-bit parameter indicates the device type and what type can be supported. Default: 0 More information is provided at the appendix 1(device type introduction).
AT+ CLASS?	1. + CLASS:<Param> OK----success 2. FAIL----failure	

For inquiring the custom Bluetooth device from around Bluetooth devices quickly and effectively, user can set the module to be non-standard Bluetooth device type, such as 0x1f1f (Hexadecimal).

10. Set/ inquire-Inquire access code

Command	Response	Parameter
AT+IAC=<Param>	1. OK----success 2. FAIL----failure	Param: Inquire access code Default: 9e8b33 The more information is provided at the appendix 2(Inquire access code introduction).
AT+ IAC?	+IAC: <Param> OK	

Access code is set to be GIAC type (General Inquire Access Code:0x9e8b33), and used for seeking (or being sought by) all the Bluetooth devices around.

For inquiring (or being inquiring by) the custom Bluetooth device from around Bluetooth devices quickly and effectively, user can set the inquire access code to be the other type number (not GIAC nor LIAC), such as 9e8b3f.

Example:

AT+IAC=9e8b3f\r\n

OK

AT+IAC?\r\n

+IAC: 9e8b3f

OK

11. Set/ inquire - Inquire access mode

Command	Response	Parameter
AT+INQM=<Param>,<Param2>,<Param3>	1. OK----success 2. FAIL----failure	Param: Inquire access mode 0----inquiry_mode_standard 1----inquiry_mode_rssi Param2: the maximum of Bluetooth devices response Param3:The maximum of limited inquiring time The range of limited time: 1~48 (Corresponding time:1.28s~61.44s) Default: 1, 1, 48
AT+ INQM?	+INQM:<Param>,<Param2>,<Param3> OK	

Example:

AT+INQM=1,9,48\r\n ----Set Inquire access mode: 1) has RSSI signal intensity indicator, 2) stop inquiring once more than 9 devices response, 3) limited time is 48*1. 28=61.44s.

OK

```
AT+INQM\r\n
+INQM:1, 9, 48
OK
```

12. Set/Inquire- passkey

Command	Response	Parameter
AT+PSWD=<Param>	OK	Param: passkey Default: “1234”
AT+ PSWD?	+ PSWD : <Param> OK	

13.Set/ Inquire- serial parameter

Command	Response	Parameter
AT+UART=<Param>,<Param2>,<Param3>	OK	Param1: baud rate(bits/s) The value (Decimal) should be one of the following: 4800 9600 19200 38400 57600 115200 23400 460800 921600 1382400 Param2:stop bit: 0----1 bit 1----2 bits Param3: parity bit
AT+ UART?	+ UART=<Param>,<Param2>,<Param3> OK	

		0----None 1----Odd parity 2----Even parity Default: 9600, 0, 0

Example:

Set baud rate to be 115200, stop bit to be 2 bits, parity bit to be even parity.

```
AT+UART=115200,1,2,\r\n
OK
AT+UART?
+UART:115200,1,2
OK
```

14. Set/ Inquire - connection mode

Command	Response	Parameter
AT+CMODE=<Param>	OK	Param: 0----connect the module to the specified Bluetooth address. (Bluetooth address can be specified by the binding command) 1----connect the module to any address (The specifying address has no effect for this mode.) 2----Slave-Loop Default connection mode: 0
AT+ CMODE?	+ CMODE:<Param> OK	

15. Set/Inquire - bind Bluetooth address

Bluetooth address will show as this way: NAP: UAP:LAP(Hexadecimal)

Command	Response	Parameter
AT+BIND=<Param>	OK	Param----Bluetooth address needed to be bind Default address: 00:00:00:00:00:00
AT+ BIND?	+ BIND:<Param> OK	

Bluetooth address will show as this way: NAP:UAP:LAP(Hexadecimal)

This command is effective only when the module wants to connect to the specified Bluetooth address.

Example:

The module is at connection mode which connects to specified Bluetooth address, and the specified address is 12:34:56:ab:cd:ef.

Command and the response show as follow:

```
AT+BIND=1234, 56, abcdef\r\n
OK
AT+BIND?\r\n
+BIND:1234:56:abcdef
OK
```

16. Set/Inquire - drive indication of LED and connection status

Command	Response	Parameter
AT+POLAR=<Param1>, <Param1>	OK	Param1:The value is 0----PI08 outputs low level and turn on LED 1----PI08 outputs high level and turn on LED Param2:The value is 0----PI09 output low level, indicate successful connection 1----PI09 output high level, and
AT+ BIND?	+ POLAR=<Param1>, <Param1> OK	

		indicate successful connection Default: 1, 1

HC-05 Bluetooth module definition: The output of PI08 drives indication of LED work mode; the output of PI09 indicates the connection status.

Example:

PI08 outputs low level and turn on LED, PI09 outputs high level and indicates successful connection.

Command and response show as follow:

```
AT+POLAR=0, 1\r\n
OK
AT+POLAR?\r\n
+POLAR=0, 1
OK
```

17. Set PIO single port output

Command	Response	Parameter
AT+PIO=<Param1>,<Param2>	OK	Param1: PIO port number(Decimal) Param2: PIO port status 0----low level 1----high level

HC-05 Bluetooth module provides the user with the ports (PI00~PI07 and PI010) which can extern another input and output ports.

Example:

1. PI010 port outputs high level

```
AT+PI0=10, 1\r\n
OK
```

2. PI010 port outpust low level

```
AT+PI0=10, 0\r\n
OK
```

18. Set PIO multiple port output

Command	Response	Parameter
AT+MPIO=<Param>	OK	Param: Mask combination of PIO ports number (Decimal)

HC-05 Bluetooth module provides the ports (PI00~PI07 and PI010) which can extern another input and output ports to the user.

(1) Mask of PIO port number = (1<<port number)

(2) Mask combination of PIO ports number= (PIO port number mask 1|PIO port number mask 2|……)

Example :

PI02 port number mask=(1<<2) =0x004

PI010 port number mask =(1<<10)=0x400

Mask combination of PI02 and PI010 port number=(0x004|0x400)=0x404

Example:

1. PI010 and PI02 ports output high level

AT+MPI0=404\r\n

OK

2. PI04 port output high level

AT+PI0=004\r\n

OK

3. PI010 port output high level

AT+PI0=400\r\n

OK

4. All ports output low level

AT+MPI0=0\r\n

OK

19. Inquire PIO port input

Command	Response	Parameter

AT+MPIO?	+MPIO: <Param>
	OK
		Param----PIO port value (16bits)
		Param[0]=PI00
		Param[1]=PI01
		Param[2]=PI02
		……
		Param[10]=PI010
		Param[11]=PI011

HC-05 Bluetooth module provides the user with the ports (PI00~PI07 and PI010) which can extern another input and output ports.

20. Set/ Inquire page scan and inquire scan parameter

Command	Response	Parameter
AT+IPSCAN=<Param1>, <Param2>, <Param3>,<Param4>AT+IPSCAN?	OK +IPSCAN: <Param1>,<Param2>, <Param3>,<Param4> OK	Param1:time interval of inquiring Param2: duration in inquiring Param3: time interval of paging Param4: duration in paging The above parameters are decimal. Default:1024,512,1024,512

Example:

```
at+ipscan=1234,500,1200,250\r\n
OK
at+ipscan?
+IPSCAN:1234,500,1200,250
```

21. Set/ Inquire—SHIFF energy parameter

Command	Response	Parameter
AT+SNIFF=<Param1> ,<Param2>, <Param3>,<Param4>	OK	Param1: maximum time Param2: minimum time Param3: test time Param4: limited time The above parameters are decimal. Default : 0,0,0,0
AT+IPSCAN?	+SNIFF: <Param1>,<Param2>,<Param3>,<Param4>	

22. Set/ Inquire safe and encryption mode

Command	Response	Parameter
AT+SENM=<Param>,<Param2>,	1. OK----success 2. FAIL----failure	Param: the value of safe mode: 0----sec_mode0+off 1----sec_mode1+non_secure 2----sec_mode2_service 3----sec_mode3_link 4----sec_mode_unknown Param2: the value of encryption mode: 0----hci_enc_mode_off 1----hci_enc_mode_pt_to_pt 2----hci_enc_mode_pt_to_pt_and_bcast Default: 0,0
AT+ SENM?	+SENM:<Param>,<Param2>, OK	

23. Delete authenticated device in the Bluetooth pair list

Command	Response	Parameter
AT+PMSAD=<Param>	OK	Param: Bluetooth device address

Example:

Delete the device (address: 12:34:56:ab:cd:ef) in the blue pair list

```
at+rmsad=1234,56,abcdef\r\n
OK                ---- successful deletion
Or
at+rmsad=1234,56,abcdef\r\n
FAIL              ----There is no the Bluetooth device whose address is 12:34:56:ab:cd:ef
                      in the pair list.
```

24. Delete all authenticated devices in the pair list

Command	Response	Parameter
AT+RMAAD	OK	None

Example:

Move all devices away from the pair list.

```
at+rmaad\r\n
OK
```

25. Seek the authenticated device in the Bluetooth pair list

Command	Response	Parameter
AT+FSAD=<Param>	1. OK----success 2. FAIL----failure	Param: Bluetooth device address

Example:

Seek the authenticated device (address: 12:34:56:ab:cd:ef) in the pair list

```
at+fsad=1234,56,abcdef\r\n
OK            ----the Bluetooth device whose address is 12:34:56:ab:cd:ef is found.
at+fsad=1234,56,abcde0\r\n
FAIL          ----There is no the Bluetooth device whose address is 12:34:56:ab:cd:e0 in
                  the pair list.
```

26. Get the authenticated device count from the pair list

Command	Response	Parameter

AT+ADCN?	+ADCN:<Param> OK	Param: Authenticated Device Count

Example:

```
at+adcn?
+ADCN:0                ----There is no authenticated device in the pair list.
OK
```

27. Get the Bluetooth address of Most Recently Used Authenticated Device

Command	Response	Parameter
AT+MRAD?	+ MRAD : <Param> OK	Param: the Bluetooth address of Most Recently Used Authenticated Device

Example:

```
at+mrad?
+MRAD:0:0:0              ----There is no device that has been used recently.
OK
```

28. Get the work status of Bluetooth module

Command	Response	Parameter
AT+STATE?	+ STATE: <Param> OK	Param: work status of module Return value： “INITIALIZED” ----initialized status “READY” ---- ready status “PAIRABLE” ----pairable status “PAIRED” ----paired status “INQUIRING” ----inquiring status “CONNECTING”----connecting status “CONNECTED”----connected status “DISCONNECTED”----disconnected

		status “NUKNOW”----unknown status

Example:

```
at+state?
+STATE:INITIALIZED          ----initialized status
OK
```

29. Initialize the SPP profile lib

Command	Response	Parameter
AT+INIT	1. OK----success 2. FAIL----failure	None

30. Inquire Bluetooth device

Command	Response	Parameter
AT+INQ	+INQ: <Param1>,<Param2>,<Param3>, …… OK	Param1: Bluetooth address Param2: device type Param3: RSSI signal intensity

Example 1:

```
at+init\r\n              ---- Initialize the SPP profile lib( can’t repeat initialization)
OK
at+iac=9e8b33\r\n        ----Inquire Bluetooth device has an access code
OK
at+class=0\r\n           ----Inquire the Bluetooth device type
at+inqm=1,9,48\r\n       ----Inquire mode: 1) has the RSSI signal intensity indication, 2)
                             stop inquiring if more than 9 Bluetooth devices response, 3)
                             limited time in inquiring is 48*1.28=61.44s.
At+inq\r\n               ----inquire the Bluetooth device around
+INQ:2:72:D2224,3E0104,FFBC
```

```
+INQ:1234:56:0,1F1F,FFC1
+INQ:1234:56:0,1F1F,FFC0
+INQ:1234:56:0,1F1F,FFC1
+INQ:2:72:D2224,3F0104,FFAD
+INQ:1234:56:0,1F1F,FFBE
+INQ:1234:56:0,1F1F,FFC2
+INQ:1234:56:0,1F1F,FFBE
+INQ:2:72:D2224,3F0104,FFBC
OK
```

Example 2:

at+iac=9e8b33\r\n ----inquire the Bluetooth device has an access code

OK

at+class=1f1f\r\n ----inquire the Bluetooth device whose device type is 0x1f1f

OK

at+inqm=1,9,48\r\n ----inquire mode: 1) has the RSSI signal intensity indication, 2) stop inquiring if more than 9 Bluetooth devices response, 3) limited time in inquiring is 48*1.28=61.44s

At+inq\r\n ----filter and inquire the Bluetooth device around

```
+INQ:1234:56:0,1F1F,FFC2
+INQ:1234:56:0,1F1F,FFC1
+INQ:1234:56:0,1F1F,FFC1
+INQ:1234:56:0,1F1F,FFC1
+INQ:1234:56:0,1F1F,FFC2
+INQ:1234:56:0,1F1F,FFC1
+INQ:1234:56:0,1F1F,FFC1
+INQ:1234:56:0,1F1F,FFC0
+INQ:1234:56:0,1F1F,FFC2
OK
```

Example 3:

```
at+iac=9e8b3f\r\n          ---- inquire the Bluetooth device whose access code is 0x9e8b3f
OK
at+class=1f1f\r\n          ----inquire the Bluetooth device whose device type is 0x1f1f
OK
at+inqm=1,1,20\r\n         ----inquire mode: 1) Has the RSSI signal intensity indication,
                               2) stop inquiring if more than 1 Bluetooth device response,
                               3) limited time in inquiring is 20*1.28=25.6s
At+inq\r\n                 ----filter and inquire the Bluetooth device around
+INQ:1234:56:ABCDEF,1F1F,FFC2
OK
```

31. Cancel Bluetooth device

Command	Response	Parameter
AT+INQC	OK	None

32. Set pair

Command	Response	Parameter
AT+PAIR=<Param1>,<Param2>	1. OK----success 2. FAIL----failure	Param1: Bluetooth address of remote device Param2: limited time of connection (second)

Example:

Make pair with the remote Bluetooth device(address:12:34:56:ab:cd:ef), the limited time is 20s.

```
At+pai=1234,56,abcdef,20\r\n
OK
```

33. Connect device

Command	Response	Parameter
AT+LINK=<Param>	1. OK----success 2. FAIL----failure	Param: Bluetooth address of remote device

Example:

Connect with the remote Bluetooth device (address: 12:34:56:ab:cd:ef)

```
at+fsad=1234,56,abcdef\r\n        ----To check  whether the Bluetooth device (address:
                                      12:34:56:ab:cd:ef)  is in the pair list or not.
OK
at+link=1234,56,abcdef\r\n        ----The Bluetooth device (address: 12:34:56:ab:cd:ef)
                                      is in the pair list. The connection can be built
                                      directly without inquiring.
OK
```

34. Disconnection

Command	Response	Parameter
AT+DISC	1.+DISC:SUCCESS----successful Disconnection OK 2.+DISC:LINK_LOSS----lose the connection OK 3.+DISC:NO_SLC----No SLC connection OK 4、+DISC:TIMEOUT----disconnection timeout OK 5、+DISC:ERROR----disconnection error OK	None

35. Enter to energy mode：

Command	Response	Parameter

AT+ENSNIFF=<Param>	OK	Param: Bluetooth address of device

36. Exit energy mode

Command	Response	Parameter
AT+EXSNIFF=<Param>	OK	Param: Bluetooth address of device

Appendix 1：Introduction of AT command error code

The form of error ---- ERROR:(error_code)

error_code(Hexadecimal)	Note
0	AT command error
1	Default result
2	PSKEY write error
3	Too long length of device name (more than 32 bytes).
4	No device name
5	Bluetooth address: NAP is too long.
6	Bluetooth address: UAP is too long.
7	Bluetooth address: LAP is too long.
8	No PIO number's mask
9	No PIO number
A	No Bluetooth devices.
B	Too length of devices
C	No inquire access code
D	Too long length of inquire access code
E	Invalid inquire access code
F	The length of passkey is 0.
10	Too long length of passkey (more than 16 bytes)
11	Invalid module role
12	Invalid baud rate
13	Invalid stop bit
14	Invalid parity bit
15	Authentication device is not at the pair list.
16	SPP lib hasn't been initialized.
17	SPP lib has been repeated initialization.
18	Invalid inquire mode
19	Too long inquire time
1A	No Bluetooth address
1B	Invalid safe mode
1C	Invalid encryption mode

Appendix 2: The introduction of devices

The Class of Device/Service(CoD) is a 32 bits number that of 3 field specifies the service supported by the device. Another field specifies the minor device class, which describes the device type in more detail

The Class of Device /Service (CoD) field has a variable format. The format is indicated using the 'within the CoD .The length of the Format Type field is variable and ends with two bits different from'11'.The version field starts at the least significant bit of the CoD and may extend upwards. In the 'format#1' of the CoD (format Type field =00), 11 bits are assigned as a bit –mask (multiple bits can be set) each bit corresponding to a high level generic category of service class. Currently 7 categories are defined. These are primarily of a' public service' nature. The remaining 11 bits are used for indicating device type category and other device-specific characteristics. Any reserved but otherwise unassigned bits, such as in the Major Service Class field, should be to 0.

Figure 1.2: The Class of Device/Service field (format type). Please note the krder in which the octets are sent on the air and stored in memory. Bit number 0 is sent first on the air .

1. MAJOR SERVICE CLASSES

Bit no Major Service Class

13 Limited Discoverable Mode [Ref #1]

14 (reserved)

15 (reserved)

16 Positioning(Location identification)

17 Networking (LAN, Ad hoc, …)

18 Rendering (Printing ,Speaker,…)

19 Capturing (Scanner, Microphone,…)

20 0bject Transfer (v-Inbox, v-Folder,…)

21 Audio (Speaker, Microphone, Headset service,…)

22 Telephony (Cordless telephony, Modem, Headset service,···)

23 Information (WEB-server, WAP- server,···)

TABLE 1.2:MAJOR SERVICE CLASSES

[Ref #1 As defined in See Generic Access Profile, Bluetooth SIG]

2. MAJOR DEVICE CLASSES

The Major Class segment is the highest level of granularity for defining a Bluetooth Device. The main function of a device is used for determining the major Class grouping. There are 32 different possible major classes. The assignment of this Major Class field is defined in Table1.3.

1 2 1 1 1 0 9 8 Major Device Class

0 0 0 0 0 Miscel laneous [Ref #2]

0 0 0 0 1 Computer (desktop, notebook, PDA, organizers,···)

0 0 0 1 0 Phone (cellular ,cordless ,payphone, modem,···)

0 0 0 1 1 LAN/Network Access point

0 0 1 0 0 Audio/Video (headset, speaker, stereo, video display, vcr ···)

0 0 1 0 1 Periphereal (mouse, joystick, keyboards.···)

0 0 1 1 0 Imaging (printing, scanner, camera, display,···)

1 1 1 1 1 Uncategorized, specific device code not specified

X X X X All other values reserved

TABLE 1.3: MAJOE DEVICE CLASSES

[Ref #2:Used where a more specific Major Device Class is not suited (but only as specified as in this document) .Devices that do not have a major class assigned can use the all-1 code until' classified']

3. THE MINOR DEVICE CLASS FIELD

The' Minor Device Class field' (bits 7 to 2 in the CoD), are to be interpreted only in the context of the Major Device Class (but interpreted of the Service Class field). Thus the meaning of the bits may change, depending on the value of the ' Major Device Class field'. When the Minor Device Class field indicates a device class ,then the primary decvice class should be reported, e. g . a cellular phone that can work as a cordless handset should

4. MINOR DEVICE CLASS FIELD–COMPUTER MAJOR CLASS

Minor Device Class

7 6 5 4 3 2 bit no of CoD

0 0 0 0 0 0 Uncategorized, code for device not assigned

0 0 0 0 0 1 Desktop workstation

0 0 0 0 1 0 Server-class computer

0 0 0 0 1 1 Laptop

0 0 0 1 0 0 Handheld PC/PDA(clam shell)

0 0 0 1 0 1 Palm sized PC/PDA

0 0 0 1 1 0 Wearable computer (Watch sized)

X X X X X X All other values reserved

TABLE 1.4: SUB DEVICE CLASS FIELD FOR THE' COMPUTER 'MAJOR CLASS

5. MINOR DEVICE CLASS FIELD – PHONE MAJOR CLASS

Minor Device Class

7 6 5 4 3 2 bit no of CoD

0 0 0 0 0 0 Uncategorized, code for device not assigned

000001 Cellular

0 0 0 0 1 0 Cordless

0 0 0 0 1 1 Smart phone

0 0 0 1 0 0 Wired modem or voice gateway

0 0 0 1 0 1 Common ISDN Access

0 0 0 1 1 0 Sim Card Reader

X X X X X X All other values reserved

TABLE1.5: SUB DEVICE CLASSES FOR THE'PHONE' MAJOR CLASS

6. MINOR DEVICE CLASS FIELD –LAN/NETWORK ACCESS POINE MAJOR

CLASS

Minor Device Class

7 6 5 bit no of CoD

0 0 0 Fully available

0 0 1 1 – 17% utilized

0 1 0 1 7 - 33% utilized

0 1 1 3 3 – 50% utilized

1 0 0 5 0 – 67% utilized

1 0 1 6 7 – 83% utilized

1 1 0 8 3 – 99% utilized

1 1 1 No service available [REF #3]

XXX All other values reserved

TABLE1.6: THE LAN/NETWORK ACCESS POINE LOAD FACTOR FIELD

[Ref #3:"Device is fully utilized and cannot accept additional connections at this time, please retry later"]

The exact loading formula is not standardized. It is up to each LAN/Network Access Point implementation to determine what internal conditions to report as a utilization of communication requirement is that the box .As a recommendation, a client that locates multiple LAN/Network Access Points should attempt to connect to the one reporting the lowest load.

Minor Device Class

4 3 2 bit no of CoD

0 0 0 Uncategorized (use this value if no other apply)

XXX All other values reserved

TABLE1.7:RESERVED SUB-FIELD FOR THE LAN/NETWORK ACCESS POINE

7. MINOR DEVICE CLASS FIELD – AUDIO/VIDEO MAJOR CLASS

Minor Device Class

7 6 5 4 3 2 bit no of CoD

0 0 0 0 0 0 Uncategorized, code not assigned

0 0 0 0 0 1 Device conforms to the Headset profile

000010 Hands-free

0 0 0 0 1 1 (Reserved)

0 0 0 1 0 0 Microphone

0 0 0 1 0 1 Loudspeaker

0 0 0 1 1 0 Headphones

0 0 0 1 1 1 Portable Audio

0 0 1 0 0 0 Car audio

0 0 1 0 0 1 Set-top box

0 0 1 0 1 0 HiFi Audio Device

001011 VCR

0 0 1 1 0 1 Camcorder

0 0 1 1 1 0 Video Monitor

0 0 1 1 1 1 Video Display and Loudspeaker

0 1 0 0 0 0 Video Conferencing

0 1 0 0 0 1 (Reserved)

0 1 0 0 1 0 Gaming/Toy [Ref #4]

X X X X X X All other values reserved

[Ret #4: Only to be used with a Gaming/Toy device that makes audio/video capabilities available via Bluetooth]

TABLE 1.8: SUB DEVICES FOR THE ’AUDIO/VIOEO’MAJOR CLASS

8. MINOR DEVICE CLASS FIELD – PERIPHERAL MAJOR CLASS

Minor Device Class

7 6 bit no of CoD

0 1 Keyboard

1 0 Pointing device

1 1 Combo keyboard /pointing device

X X X All other values reserved

TABLE1.9: THE PERIPHERAL MAJOR CLASS KEYBOARD/POINTING DEVICE

FIELD

Bits 6 and 7 independently specify mouse, keyboard or combo mouse/keyboard devices. These may be combined with the lower bits in a multifunctional device.

Minor Device Class

5	4	3	2	bit no of CoD
0	0	0	0	Uncategorized device
0	0	0	1	Gamepd
0	0	1	1	Remote control
0	1	0	0	Sensing device
0	1	0	1	Digitizer tablet
X	X	X	X	All other values reserved

TABLE1.10: RESERVED SUB-FIELD FOR THE DEVICE TYPE

9. MINOR DEVICE CLASS FIELD – IMAGING MAJOR CLASS

Minor Device Class

7	6	5	4	bit no of CoD
X	X	X	1	Display
X	X	1	X	Camera
X	1	X	X	Scanner
1	X	X	X	Printer
X	X	X	X	All other values reserved

TABLE 1.11: THE TMAGING MAJOR CLASS BITS 7 TO 7

Bits 4 to 7 independently specify bi splay, camera, scanner or printer. These may be combined in a multifunctional device.

Minor Device Class

3	2	bit no of CoD
0	0	Uncategorized, default
X	X	All other values reserved

TABLE 1. 12: THE IMAGING MAJOR CLASS BITS 2 AND 3

Bits 2 and 3 are reserved

Appendix 3: (The Inquiry Access Codes)

The General-and Device-Specific Inquiry Access Codes (DIACs)

The Inquiry Access Code is the first level of filtering when finding Bluetooth devices. The main purpose of defining multiple IACs is to limit the number of responses that are received when scanning devices within range.

0. 0x9E8B33 ---- General/Unlimited Inquiry Access Code(GIAC)
1. 0x9E8B00 ---- Limited Dedicated Inquiry Access Code(LIAC)
2. 0x9E8B01 ～ 0x9E8B32 RESERVED FOR FUTURE USE
3. 0x9E8B34 ～ 0x9E8B3F RESERVED FOR FUTURE USE

The Limited Inquiry Access Code(LIAC)is only intended to be used for limited time periods in scenarios where both sides have been explicitly caused to enter this state, usually by user action. For further explanation of the use of the LIAC, please refer to the Generic Access Profile.

In contrast it is allowed to be continuously scanning for the General Inquiry Access Code (GIAC)and respond whenever inquired.