

WCS-232 v6.0

User Manual



WCS-232 User Manual

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Notice to Users

For applications that system failure might cause serious consequences, it is necessary to use a backup system or safety device to protect people and property from serious consequences. It is the user's responsibility to protect the consequences of system failure.

Safety Precaution

Electricity

The provided AC adapter must be used. Unauthorized power adapter is not recommended as it may cause electrical failure. Do not twist, fold, or place heavy objects on the power cable as fire may damage it. Do not touch the power plug and the adapter with wet hands. If wet, smoky, or smelly, turn off the product immediately and remove the AC adapter. Misuse can cause fire.

Product

WCS-232 meets the RS232 standard. WCS-232 complies with the RS232 standard. Improper use may damage the customer's equipment. Do not drop the product and do not use it in humid or dusty environment. Do not press buttons or disassemble the product with excessive force, and do not place heavy objects on the product.

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1. Introduction

1.1 Overview

WCS-232 V6.0 (hereafter WCS-232) is a wireless serial terminal device with Bluetooth 2.0+EDR, an NFC(Near-Field Communication) technology. You can connect it with other Bluetooth devices that support serial port profiles.

WCS-232 provides a communication distance of 100 meters when using antenna.

WCS-232 is a compact design that can be applied to various equipment and environments.

With FHSS(Frequency Hopping Spread Spectrum) applied, it reduces over-air hijacking and provides Bluetooth standard encryption.

It can be set up with AT commands through programs such as HyperTerminal. User-friendly software, WCSConfig can also be used for easy setup in Windows environment. It can also be set through its own pairing button and dip switch.

***Note:** Bluetooth 2.0 supports the AFH function. AFH is a technology that mitigates interference between WiFi and Bluetooth, and automatically avoids communication channels used by WiFi.

However, AFH does not provide complete noninterference between WiFi and Bluetooth, depending on the operating environment, such as the number of equipment used and the distance between them.

1.2 Package

1.2.1 Components

WCS-232 V6.0

- WCS-232 V6.0 2EA
- Stub Antenna 2EA
- DC Adapter 2EA
- USB Power Cable 2EA
- DC Power Cable 2EA
- DB9 Male-Female Gender Changer 2EA

1.3 Specification

| Category | WCS-232 |
|----------------------------|--|
| Serial Interface | DB9 female serial port for data communication and setup Serial UART speed up to 921.6Kbps CTS/RTS flow control, DTR/DSR for loop-back & full transfer |
| Bluetooth Interface | Bluetooth v2.0 + EDR |
| | Serial Port Profile |
| | Class 1 |
| | Communication Distance: 100m |
| Configuration | WCSCfg, Modem AT Command |
| LED | Mode, Connect, Serial Rx/Tx |
| Power | -Supply Voltage: 5V ~ 12VDC -Power Consumption: 80mA@5VD Max |
| Hardware | -Operating Temperature: -40 ~ 85°C (-40 ~ 185°F) -Storage Temperature: -40 ~ 85°C (-40 ~ 185°F) -Humidity: 90% (Non-condensing) * The performance might be degraded at high or low temperature. |
| | - Dimension(L x W x H): 76 x 31 x 16mm (2.99 x 1.22 x 0.63in) - Weight: 24g (0.85oz) |
| Certification | FCC(A), CE, KC, Japan MIC |
| Warranty | Five Year Warranty |

2. Get Started

Following items are required to get started.

- DC power adapter, USB power cable or DC power cable (included in the package)
- PC with RS232 serial port
- Terminal emulation program running on PC

2.1 Panel Layout

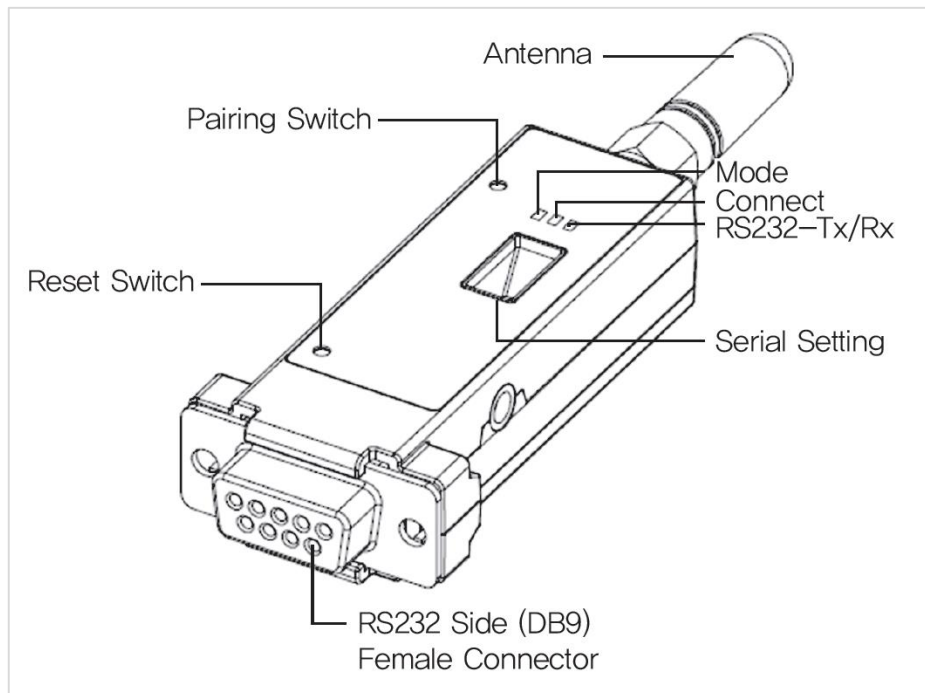


Figure 0-1 WCS-232 panel layout

2.2 Connecting Hardware

2.2.1 Connecting Power

WCS-232 can be powered by a DC power adapter, USB power cable or DC power cable included in the package. Connect the power supply as shown below to supply power into WCS-232 using one of them. When the power is normally supplied, the mode lamp turns green depending on the condition.



Figure 0-2 Connecting power to WCS-232

2.2.2 Connecting WCS-232 to Serial Device

Connect the WCS-232 to a serial device as shown below.



Figure 0-3 Connecting WCS-232 to a serial device

3. Configuration

3.1 Operation Mode

Several Bluetooth settings must be made on the WCS-232 prior to setting up the serial port. The user should understand the following Bluetooth connection modes:

- The Bluetooth device works as a master or slave. The master device attempts to connect to another Bluetooth device, while the slave device waits for access. Bluetooth connections are always paired with the master and slave.
- Slave has two modes: Inquiry Scan and Page Scan. The Inquiry scan mode waits for an inquiry packet from another Bluetooth device, and the Page scan mode waits for a connection packet.
- All Bluetooth devices have unique 12-digit address called BD(Bluetooth Device) address.

✖ **WCS-232 is released as a basic 1 set in a 1:1 paired state.**

WCS-232 operates in four modes: Each mode is indicated by the LED described in the following sections.

| Mode | Description |
|---------------|---|
| Mode 0 | The mode used to control WCS-232 directly with the AT command. After power on or software initialization, it waits for AT command input without any response, neither master nor slave is assigned. The extended AT commands set provided allow WCS-232 to perform functions such as search and connection. If you want to change the settings of WCS-232, it must be in MODE 0 state. |
| Mode 1 | The mode that attempts to connect to the last connected Bluetooth device. It becomes the master device and will attempt to connect to the Bluetooth device which has the last successfully connected BD address. For initial use or after hardware initialization, Mode 1 is meaningless as there is no BD address memory of the last connected Bluetooth device, and mode does not switch to Mode 1 from other modes. The change to Mode 1 is made after a successful connection to a specific Bluetooth device that which was tried to connect to in Mode 1. Once switched to Mode 1, it only tries to connect to the Bluetooth device which has DB address memory according to powering off and or software initialization. WCS-232 set to Mode 1 is not detected or connected by another Bluetooth device. |
| Mode 2 | The mode that waits for a connection from the last connected Bluetooth device. It becomes the slave device and will wait a connection from the Bluetooth device which has the last successfully connected BD address. Like Mode 1, if there is no BD address memory, the mode cannot be switched to Mode 2. Once switched to Mode 2, it only waits and allow the connection from the Bluetooth device which has BD address memory according to powering off and off or software initialization. The WCS-232 set to Mode 2 cannot be detected by another Bluetooth devices and only connected to a Bluetooth device with BD address memory. |
| Mode 3 | The mode waiting for connections from other Bluetooth devices. |

| | |
|--|--|
| | Similar to Mode 2, but it allows connections to all Bluetooth devices other than Bluetooth device with specific DB address. It can be searched and connected to other Bluetooth devices. General Bluetooth device is usually in Mode 3 status. |
|--|--|

Table 0-1 WCS-232 operation mode

3.2 LED

RS232-Tx, RS232-Rx flashes when data is transmitted. For small data, it may be hard to recognize the quick flashing.








| Mode | Mode LED | Connect LED |
|---------------------|---|--|
| Mode 0 | Green  | |
| Mode 1 | Green (Every 1 second)  | |
| Mode 2 | Green (Every 3 seconds)  | |
| Mode 3 | Green (Every 3 seconds)  | |
| Connection (Single) | | Green (Every 1 second)  |
| Connection (Multi) | Green  | Green (Every 1 second)  |

Table 0-2 The WCS-232 LED Indicators

3.3 Serial Port

The following are the serial port settings that can be selected from WCS-232. WCS-232 cannot be set with a setting which is not in the table.

| Serial Port Settings | Values |
|-----------------------|--|
| Baud rate | 1200, 2400, 4800, <u>9600</u> , 14400, 19200, 38400, 57600, 115200, 230400, 460800, 921600 |
| Data bite | <u>8</u> |
| Parity | <u>No parity</u> , Even parity, Odd parity |
| Stop bit | <u>1</u> , 2 |
| Hardware Flow Control | Use, <u>No Use</u> |

Table 0-3 WCS-232 serial setup

***Note:** The selected items in the box are the factory default value of serial port.

3.4 Data Bit

Data bits of WCS-232 only supports 8-bit.

If the host serial port has 7-bit data bit and Even/Odd parity, data bits can be considered and used as 8-bit combining the data bit and parity bit and set parity to No parity.

3.5 Hardware Flow Control

WCS-232 is a device that is mounted on a host and transmits data wirelessly. WCS-232 has a buffer inside, and stores data received from the host in this buffer and exports it repeatedly until successful transfer. Therefore, if the wireless environment is not good, the transmission is repeated and the communication delay occurs.

If the buffer is full of data that has not yet been sent but additional data is received from the host, WCS-232 will malfunction due to the buffer overflow. To prevent the overflow of limited buffers, WCS-232 works in the following structure:

When using flow control, when the buffer is full, WCS-232 internally disables RTS, so that no more data is received from the host until the amount of data occupying the buffer falls below a certain level. If flow control is not used, when the buffer is full to a certain level, it empties the buffer for the next data received from the host, which means data loss.

If the volume of data is not big, the probability of buffer overflow is low. But the greater the amount of data, the higher the risk of overflow. Therefore, flow control is recommended to prevent data loss due to overflow.

***Note:** The flow control does not work in Multi-drop mode.

3.6 Factory Reset

To reset all settings to the factory default value, press the reset button in Figure 3-1 for 1 second. The reset button only works when power is on.

3.7 Dip Switch

The WCS-232 has four dip switches which can control the flow control and communication speed(bit/sec).

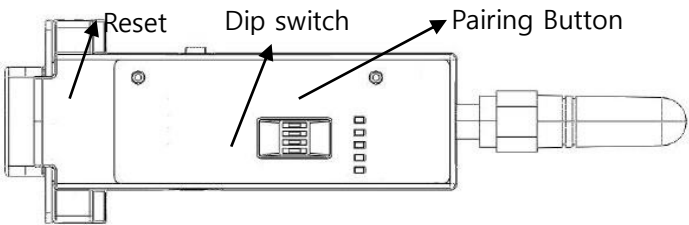


Figure 0-1 WCS-232 Dip Switch

From the front, the upper three dip switches are used for bit/sec settings, and the bottom dip-switch is used for flow control settings. If the setting values are out of dip switch setting range, it must be set using WCSConfig or terminal program, and the dip switch combination must be set according to SW Config before use. If set as, the communication speed will be initialized to 9600.

| Bit/Sec | 2400 | 4800 | 9600 | 19.2K | 38.4K | 57.6K | 115.2K | S/W Config |
|---------|------|------|------|-------|-------|-------|--------|------------|
| | | | | | | | | |

Table 0-4 Bit/Sec setup with dip switch

| Hardware Flow Control | Disuse | Use |
|-----------------------|--------|-----|
| | | |

Table 0-5 Hardware flow control setup with dip switch

***Note:** Communication speed of 1200 and bit/sec of 230k cannot be set with dip switch. At this time, please set the dip switch to S/W Config and set using WCSConfig or AT Commend. Please refer to WCSConfig manual and Appendix B.3.4 AT+UARTCONFIG, Baudrate, Parity, Stopbit.

3.8 Pairing Button

3.8.1 1:1 Connection

WCS-232 can be automatically connected with a pairing button without a PC. In this manual, a pair of WCS-232 is marked as WCS-232#1 and WCS-232#2 for a convenience of explanation.

*The pairing button only operates in single connection mode.

- Step1.** Turn WCS-232#1 and WCS-232#2, press the reset button for more than 2 seconds for factory reset. Mode LED turns on.
- Step2.** Press the pairing button of WCS-232#1 and WCS-232#2 for more than 2 seconds. The Mode LED flashes green 3 times every 3 seconds. Check it and leave the power on.
- Step3.** Press the pairing button of WCS-232#2 once again for more than 2 seconds and check if the Mode LED flashes every 1 second.
- Step4.** Once connected, the Connect LED of WCS-232#1 and WCS-232#2 flashes once every 1 second. In this state, wait for WCS-232#1 and WCS#2 connection. In normal cases, the connection takes within 30 seconds. However, it may take more time depending on the surrounding wireless environment.
- Step5.** Not a pair of WCS-232 are set to always-auto connect status. You can plug two WCS-232s into each host devices such as a virtual serial cable.

***Caution:** When connecting using the pairing button, response function sending messages such as OK, ERROR, CONNECT and DISCONNECT will be deactivated.

| WCS-232#1 | Status | LED | WCS-232#2 | Status | LED |
|---|--------|--|--|--------|--|
| 1. Press the reset button for more than 2 seconds | Mode 0 | Mode LED turns on | 1. Press the reset button for more than 2 seconds | Mode 0 | Mode LED turns on |
| 2. Press the pairing button for more than 2 seconds | Mode 3 | Mode LED flashes 3 times every 3 seconds | 2. Press the pairing button for more than 2 seconds | Mode 3 | Mode LED flashes 3 times every 3 seconds |
| | | | 3. Re-press the pairing button for more than 2 seconds | Mode 1 | Mode LED flashes every 1 second |
| 4. Connection complete | Slave | Connect LED flashes every 1 second | 4. Connection complete | Master | Connect LED flashes every 1 second |

Table 0-6 Connection process using pairing button

3.8.2 1:Other Bluetooth Device Connection

The pairing button on WCS-232 makes easy connection between WCS-232 and other Bluetooth devices.

Step1. Turn on WCS-232#1 and press the reset button for more than 2 seconds for factory reset. The Mode LED turns on.

Step2. Press the pairing button on WCS-232#1 for more than 2 seconds. Mode LED flashes green 3 times for 3 seconds. Check it and leave the power on.

Step3. Through software or use interface of the Bluetooth device, search and connect WCS-232#1.

Step4. When the connection between WCS-232#1 and the user's Bluetooth device is complete, the Connect LED on WCS-232#1 flashes every 1 second. Then it can communicate with the connected Bluetooth device.

Step5. Even rebooting WCS-232#1, it turns to the status waiting for connection from the last connected Bluetooth device. It can be reconnected from the user Bluetooth device.

| WCS-232#1 | Status | LED | Other Bluetooth Device | Status |
|---|--------|--|---------------------------------|--------|
| 1. Press the reset button for more than 2 seconds | Mode 0 | Mode LED turns on | | |
| 2. Press the pairing button for more than 2 seconds | Mode 3 | Mode LED flashes 3 times every 3 seconds | | |
| | | | 3. Search and connect WCS-232#1 | |
| 4. Connection complete | Slave | Connect LED flashes every 1 second | 4. Connection complete | Master |

Table 0-7 Connection process with other Bluetooth device using pairing button

3.8.3 1:4 Connection

WCS-232 also supports multiple connections up to 1:4 in Multi-Drop mode using pairing buttons. In this manual, one master WCS-232 and four slave WCS-232s are marked as master, slave1, slave2, slave3 and slave4.

Step1. Turn the master on and press the reset button for more than 2 seconds for factory reset. Repeat the same action for slave1, slave2, slave3, and slave4 to be connected to the master. The Mode LED turns on.

Step2. Press the pairing buttons of slave1, slave2, slave3 and slave 4 for more than 2 seconds to change to Mode 3 before connecting. Mode LED flashes green 3 times every 3 seconds.

Step3. Press the pairing button of master for more than 2 seconds to change to Mode 3. Mode LED flashes green 3 times every 3 seconds.

Step4. To connect to slave1, press the pairing button of the master for more than 2 seconds to search and connect

slave1. Once connected to slave1, the Connect LED on the master flashes every 1 second.

Step5. To connect to slave2, press the pairing button of the master for more than 2 seconds to change to Mode 3.

The Mode LED flashes green 3 times every 3 seconds.

Step6. Press the pairing button of the master again for more than 2 seconds to search and connect slave2. Once connected to slave2, the Connect LED on the master flashes every 1 second. Now the master and the slave1, slave2 are connected.

Step7. To connect to slave3, press the pairing button of the master for more than 2 seconds to change to Mode 3. Mode LED flashes green 3 times every 3 seconds.

Step8. Press the pairing button of the master again for more than 2 seconds to search and connect slave3. Once connected to slave3, the Connect LED on the master flashes every 1 second. Now the master and the slave1, slave2, slave3 are connected.

Step9. To connect to the last slave4, press the pairing button of the master for more than 2 seconds to change to Mode 3. Mode LED flashes green 3 times every 3 seconds.

Step10. Press the pairing button of the master again for more than 2 seconds to search and connect slave4. Once connected to slave4, the Connect LED on the master flashes every 1 second. Now the master and the slave1, slave2, slave3, slave4 are all connected.

Step11. If all four slave connections are made and the power is turned off and on, it will automatically reconnect and operate in Multi-Drop mode.

| Master | Status | LED | Slave | Status | LED |
|---|--------|--|--|--------|--|
| 1. Press the reset button for more than 2 seconds | Mode 0 | Mode LED turns on | Press the reset button of slave1,2,3,4 for more than 2 seconds | Mode 0 | Mode LED turns on |
| | | | 2. Press the pairing button of slave1,2,3,4 | Mode 3 | Mode LED flashes 3 times every 3 seconds |
| 3. Press the pairing button for more than 2 seconds | Mode 3 | Mode LED flashes 3 times every 3 seconds | | | |
| 4. Press the pairing button for more than 2 seconds | Mode 1 | Mode LED flashes every 1 second | | | |
| 5. Slave1 connected | Mode 1 | Connect LED flashes every 1 second | Slave1 connected | Mode 2 | Connect LED flashes every 1 second |
| 6. Press the pairing button for more than 2 seconds | Mode 3 | Mode LED flashes every 1 second | | | |
| 7. Press the pairing button for more than 2 seconds | Mode 1 | Mode LED flashes every 1 second | | | |

| | | | | | |
|--|--------|---|------------------|--------|------------------------------------|
| 8. Slave2 connected | Mode 1 | Connect LED flashes every 1 second MODE LED turns on | Slave2 connected | Mode 2 | Connect LED flashes every 1 second |
| 9. Press the pairing button for more than 2 seconds | Mode 3 | Mode LED flashes every 1 second | | | |
| 10. Press the pairing button for more than 2 seconds | Mode 1 | Mode LED flashes every 1 second | | | |
| 11. Slave3 connected | Mode 1 | Connect LED flashes every 1 second MODE LED turns on | Slave3 connected | Mode 2 | Connect LED flashes every 1 second |
| 12. Press the pairing button for more than 2 seconds | Mode 3 | Mode LED flashes every 1 second | | | |
| 13. Press the pairing button for more than 2 seconds | Mode 1 | Mode LED flashes every 1 second | | | |
| 14. Slave4 connected | Mode 1 | Connect LED flashes every 1 second MODE LED turns on | Slave4 connected | Mode 2 | Connect LED flashes every 1 second |

Table 0-8 Multi-connection process using pairing button

***Note:** During master's attempt to connect to the slave after switching to multi connection mode, master's Mode LED turns off so it can be seen as single connection mode.

3.9 Remote Setup Mode

WCS-232 supports setup mode through remote access. After accessing to WCS-232 through Bluetooth, without sending any data, send the escape character (default value: +) three times in a row to operate in remote setup mode.

Once accessed to remote setup mode, enter the password using “AT+PASS” command. The default password is “0000” and can be changed using “AT+CHPASS” command after password authentication. If an incorrect password entry occurs three times during the password authentication process, or if three inputs occur without entering password, it will terminate automatically. It will also terminate automatically if there is no input for 2 minutes after accessing remote mode.

When the password authentication process is normally completed, the message “Remote Configuration Enabled” will displayed and can be set remotely. The commands “ATH”, “ATO”, “ATD”, “AT+BTSCAN”, “AT+BTINQ?” and “AT+BTCANCEL” are not available in remote mode.

Example of running remote setup mode

```
CONNECT 000195000001
+++
Please Enter Password
AT+PASS=0000
Remote Configuration Enabled
AT+BTINFO?
000195000001.WCS232v2.0.3-095515.MODE0.CONNECT.0.0.HWFC
```

3.10 Utility

The setup utility can be downloaded from SystemBase website(www.sysbas.com).

| Program | Purpose | Supported OS |
|---------|---------------|--------------------------|
| WCSCfg | Configuration | MS Windows 98SE or above |

Table 0-9 Configuration Program

3.11 WCSConfig

WCSConfig is a setup program for WCS-232 in Microsoft Windows environment.
Plug WCS-232 into the serial port of a PC, turn the power on and run WCSConfig.

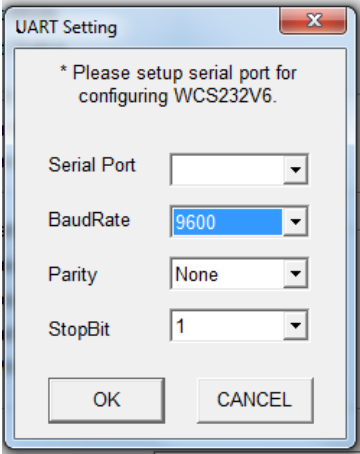


Figure 0-2 Serial Port Setting

Check the serial port settings and click **OK** button to display the main screen which displays the current WCS-232 setup information. If the serial communication settings differ from WCS-232, then an error message may appear or it may not operate properly.
With WCS-232 connected, a warning window appears asking you to disconnect. Then press **Disconnect** button to disconnect.

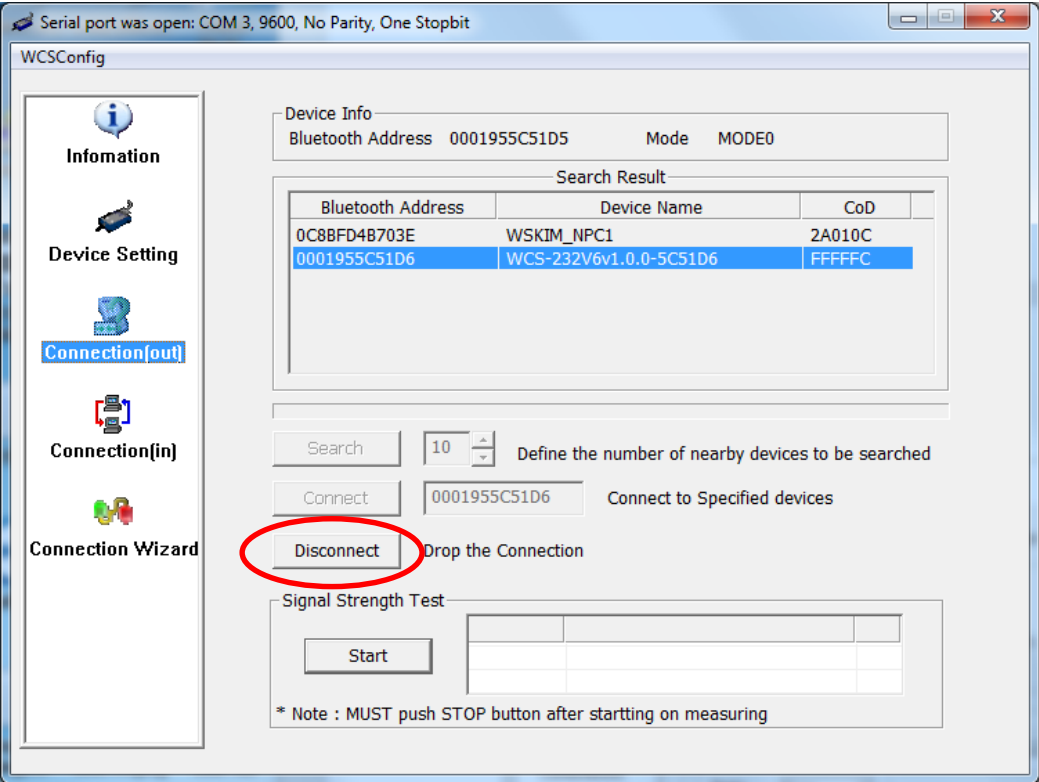


Figure 0-3 Disconnect screen

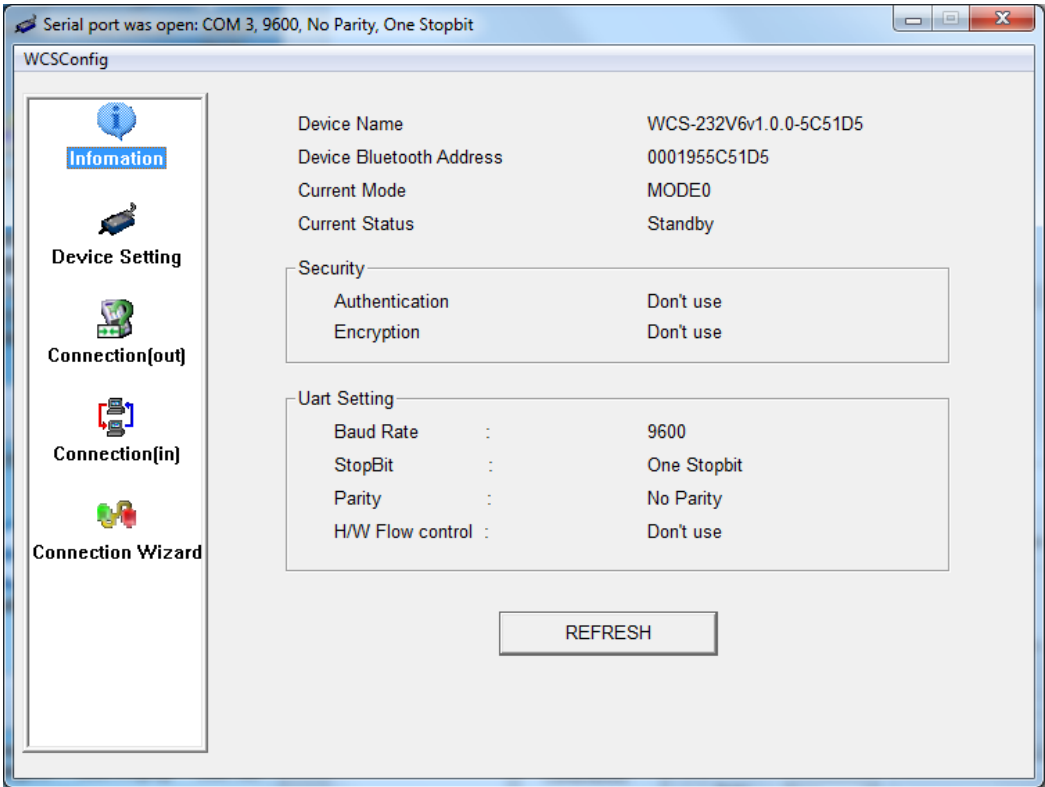


Figure 0-4 Information screen

By selecting the WCSConfig menu from the upper left menu bar, you can select [Start Configuration](#) or [WCSConfig](#) to re-bring the WCS-232 setting value or reset the communication port without re-running the program.

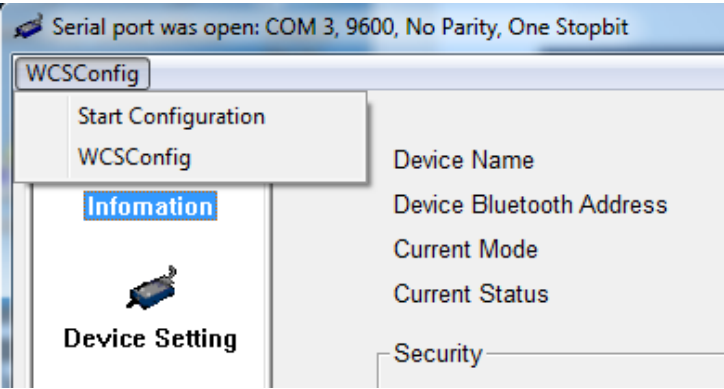


Figure 0-5 WCSConfig menu

Click [Device Setting](#), [Connection\(out\)](#), [Connection\(in\)](#), [Connection Wizard](#) icons on the left to move onto each screens. Click the [Device Setting](#) icon to display a screen where you can change the settings as follows.

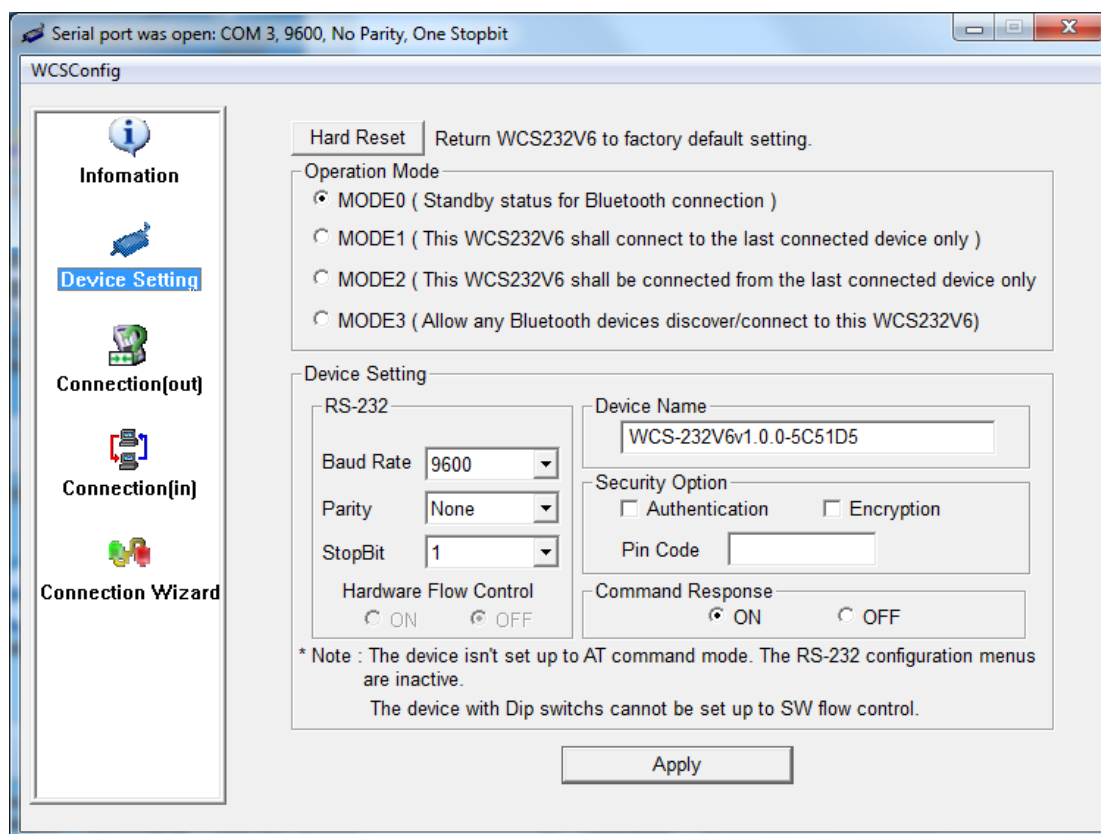


Figure 0-6 Device Setting screen

WCS-232 supports Authentication and Encryption. When turning the authentication option, you must enter pin code. At this point, the master and the slave device share the pin code. To connect WCS-232 to another Bluetooth device which requires the authentication, you must know the pin code of the device. Most Bluetooth devices have a default pin code of 1234 or 0000. For WCS-232, the default pin code is [1234](#).

Encryption is a feature that enhances wireless security, which makes master and slave devices transmitting encrypted data. If one side requests the encryption, the other device accept the request.

The command response options have four responses, 'OK', 'ERROR', 'CONNECT', and 'DISCONNECT', depending on the change in WCS-232 operation mode or use commands, which in some cases affects host device. To prevent this, user can turn the response function on and off. When pairing with dip switch, the response function is automatically turned off.

For WCS-232, the hardware flow control option can only be turned on and off with the dip switch. Also in dip switch mode, use cannot set Parity and Stop Bit(They must be set after changing to SWconfig mode). Like this, options that cannot be set will be disabled depending on the model. Only pressing [Apply](#) button will actually reflects the changed settings to WCS-232.

When selecting [Connection\(out\)](#) icon, a screen will appear to search for nearby Bluetooth devices as follows.

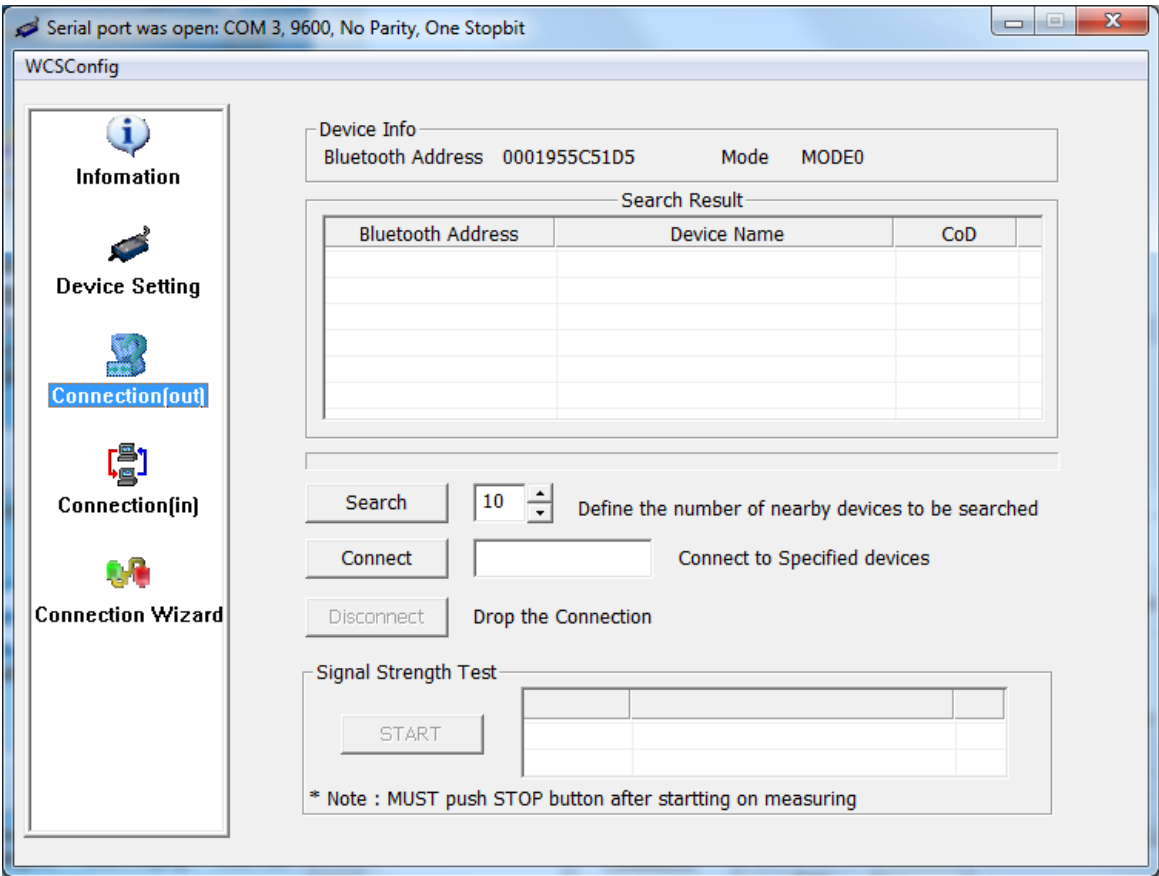


Figure 0-7 Connection(out) screen

Click [Search](#) to search for nearby Bluetooth devices. Select one of the detected devices and click [Connect](#) button to attempt to connect to the device. The counterpart Bluetooth device must be in connectable mode from external. You can disconnect normally with [Disconnect](#) button. Once connected, press [Start](#) button to make sensitivity measurements.

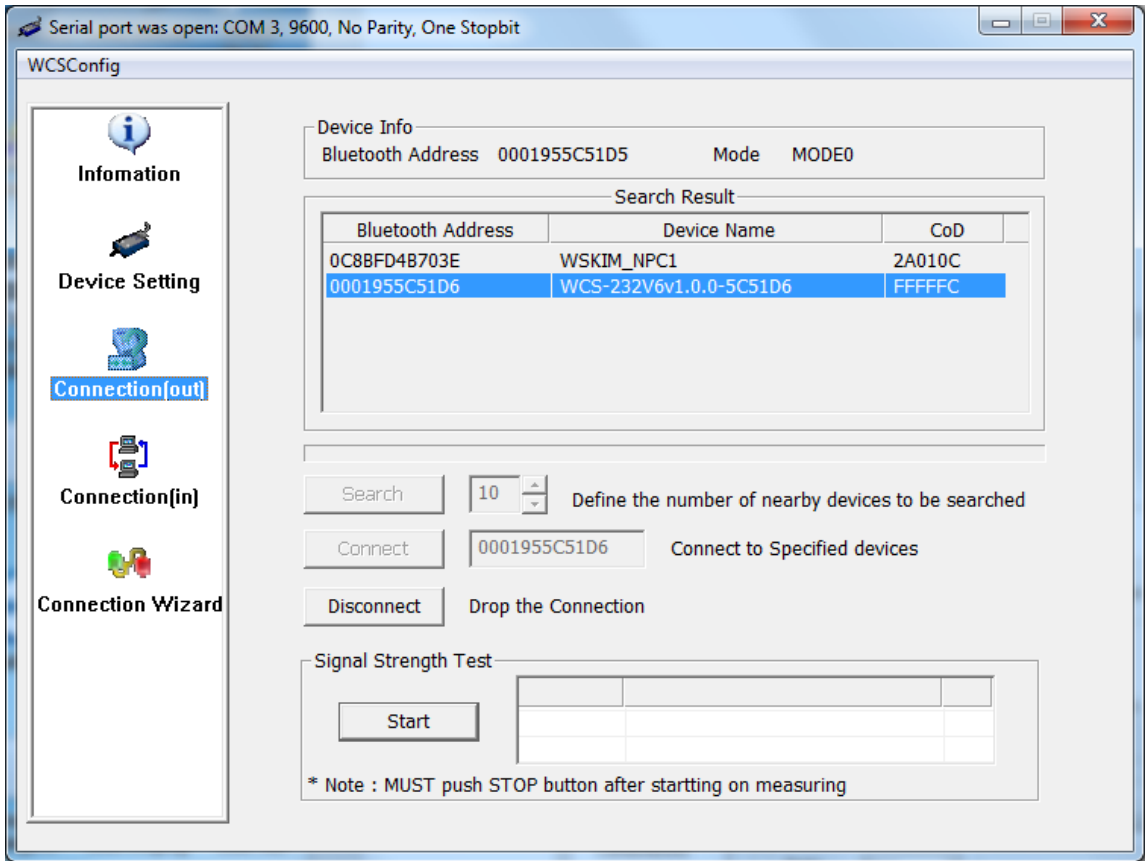


Figure 0-8 Sensitivity measurement

Sensitivity measurements show Link Quality and RSSI value. The closer the Link Quality to 255 and the closer the RSSI to 0, the better the sensitivity. After the test, you must press [Stop](#) button to stop.

Clicking the [Connection\(in\)](#) icon makes WCS-232 waiting for a connection from another Bluetooth device for a specified time. If you set the wait time to 0, it will remain on connection standby status until you click [Cancel](#) button.

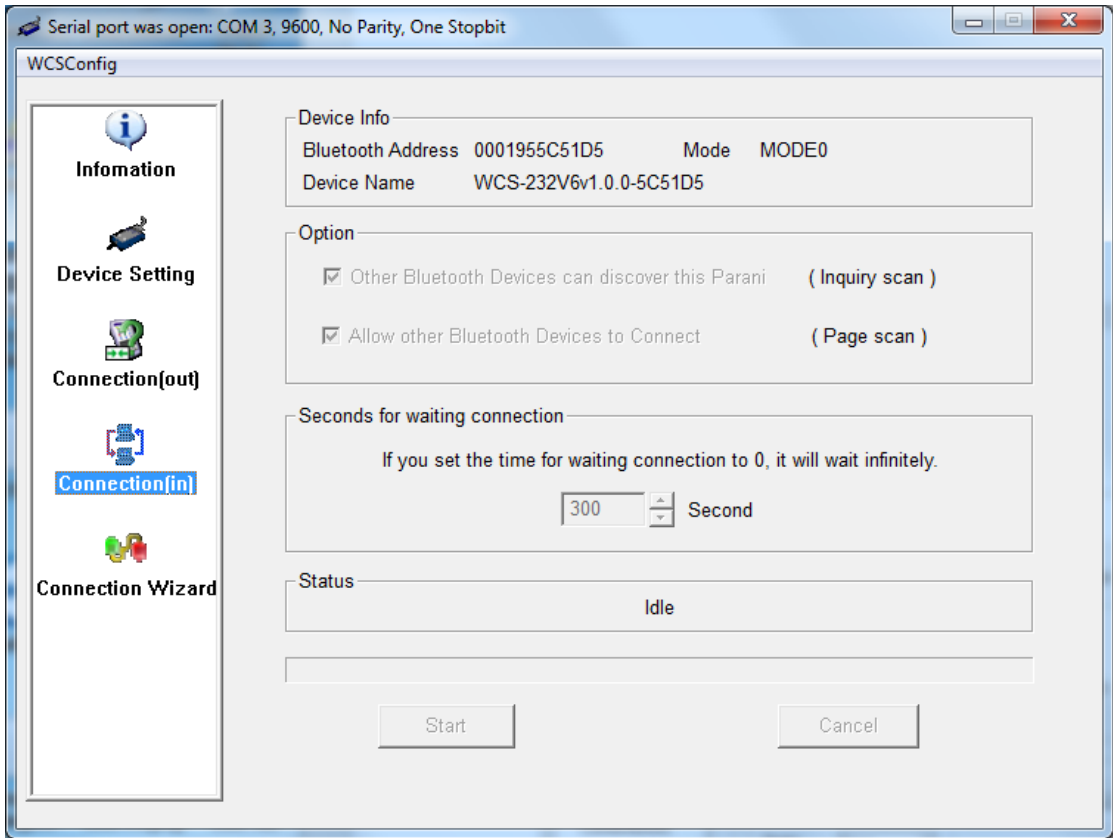


Figure 0-9 Connection(in) screen

Click [Connection Wizard](#) icon to view the pairing menu screen as follows.

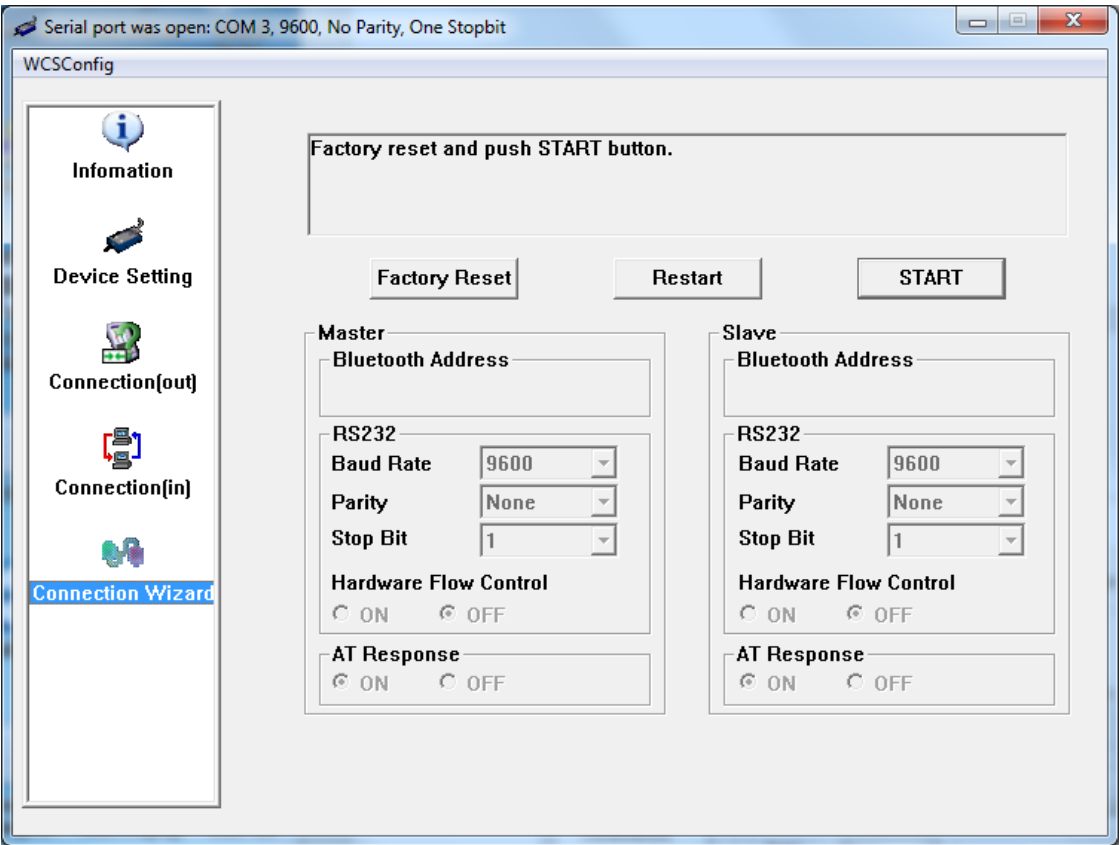


Figure 0-10 Connection Wizard screen

In this manual, two WCS-232 devices are described as WCS-232#1 and WCS-232#2.

Step1. Connect WCS-232#1, set up as a master and click [Start](#) button.

Step2. Remove WCS-232#1, connect WCS-232#2, set up as a slave and click [Next](#) button. At this point, place dip switch in ATcomd mode. Flow control can also be set with the dip switch only.

Step3. Remove WCS-232#2 and click Finish button. If the Connect LEDs of WCS-232#1 and WCS-232#2 turn on, the setup is complete. Now WCS-232#1 and WCS-232#2 is automatically connected(for the WCS-232 series with a pairing button equipped, you do not need to use the Connection Wizard function).

3.12 Terminal Program

A terminal program is a program that controls or sets up serial ports. There are commercial programs such as TeraTerm™ in addition to HyperTerminal provided by MS Windows. In terminal program, WCS-232 can be controlled and set up with AT commands. This manual describes the methods using HyperTerminal. If the HyperTerminal is not installed, it can be installed in [Control Panel – Add/Remove Program](#). Please refer to MS Windows Help for more information.

Go to [Start-Program-Accessories-Communications-HyperTerminal](#) and select HyperTerminal. After running it, select the serial port to which WCS-232 is connected. Enter the same settings as in WCS-232 in the serial Port Settings window as follows. If the setting is not correct, an error message appears or do not operate properly.

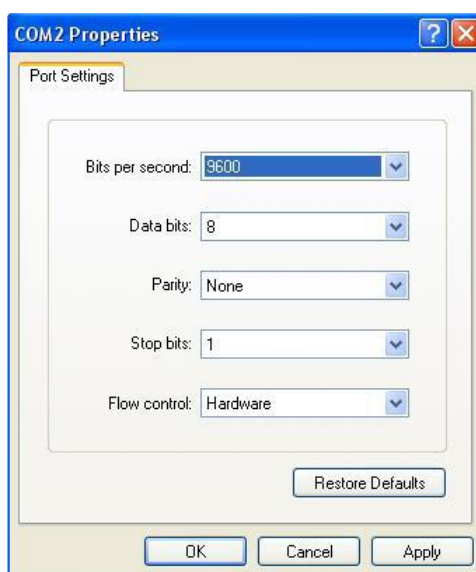


Figure 0-14 HyperTerminal

Plug WCS-232 into a serial port on the host computer and power it on. Check if the Mode LED is illuminated (Please refer to 3.2).

Go to [File-Properties-Settings-ASCII Setup](#) and select “[Echo Typed Characters Locally](#)” option to see the characters you enter on the host PC keyboard on the terminal screen. You can now change the WCS-232 settings by entering AT commands. Please refer to Appendix. A for extended AT commands provided by WCS-232.

Example of using AT commands

```
at+btinfo?  
  
00015B446655,WCS232v2.0.0-446655,MODE0,STANDBY,0,0,NoFC  
  
OK  
atd 000195000001  
OK
```

4. Multiple Connection Mode

4.1 Overview

WCS-232 supports multiple connection up to 1:4. There are two supported modes: Multi-Drop mode and Node Switching mode.

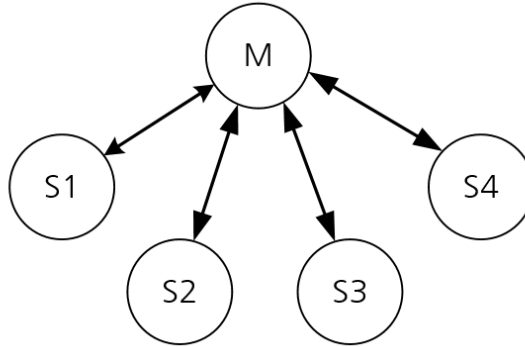


Figure 4-1 Multi-Drop mode

Multi-Drop mode supports real-time two-way communication between one master and up to four slaves simultaneously, as shown in figure 4-1(Please refer to 3.8.3 1:4 Connection for connection method).

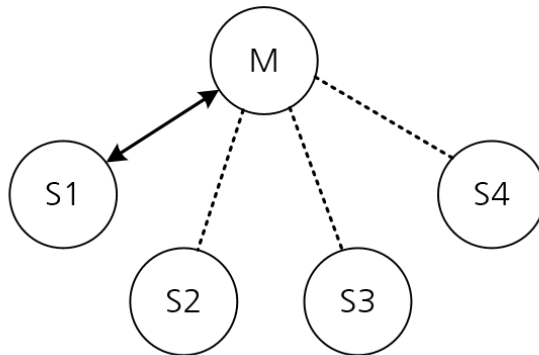


Figure 4-2 Node Switching mode

Node Switching mode maintains all slave connections but the actual communication is made in 1:1 as shown in Figure 4-2. Once the connection with slave is complete, it operates in command mode, and slave-master communication changes will be made using AT Commands.

In communication after connecting

ATO1 – Communicating with slave1

+++

OK

4.2 Configuration

All slaves must be in connection standby state (Mode 3 or 2) and master attempts to connect to each slave.
First, switch to the desired multiple access mode with **AT+MULTI,x** command, which will be automatically reboot after performing.

| | |
|-------------------|------------------------|
| AT+MULTI,0 | Single Connection mode |
| AT+MULTI,1 | Multi-Drop mode |
| AT+MULTI,2 | Node Switching mode |

Table 4-1 AT+MULTI,x

| Manual Connection | Automatic Connection |
|---------------------|--|
| ATD000195000001 | ATS46=000195000001 |
| CONNECT000195000001 | OK |
| +++ | ATS54=000195000002 |
| OK | OK |
| ATD000195000002 | ATS55=000195000003 |
| CONNECT000195000002 | OK |
| +++ | ATS56=000195000004 |
| OK | OK |
| ATD000195000003 | AT+MULTI,1 or AT+MULTI,2 |
| CONNECT000195000003 | OK |
| +++ | AT+BTMODE,1 |
| OK | After reboot, master attempts connection automatically |
| ATD000195000004 | |
| CONNECT000195000004 | |
| +++ | |

Table 4-2 Multi connection mode settings

Enter slave address to four S-Registers(S46, S54, S55, S56), set master to Mode 1 to keep the connection stable.
After rebooting, if the registry contains an accessible slave address, the message AUTO CONNECT will be displayed behind the corresponding TASK.

| |
|-------------------------|
| TASK1 OK – AUTO CONNECT |
| TASK2 OK |
| TASK3 OK – AUTO CONNECT |

4.3 AT Commands

AT commands available in multi connection mode are shown below.

4.3.1 AT+MULTI,n

Select a multiple connection mode. Please refer to Table 4-1 for more information.

4.3.2 AT+MLIST?

It shows the current mode, connection status and slave address.

```

at+mlist?

CURRENT MODE: MULTI DROP

TASK1 - 000195000001

TASK2 - 000195000002

TASK3 - DISCONNECT

TASK4 - 000195000004
    
```

4.3.3 ATHx, ATHbdaddr

In multi connection mode, you can selectively disconnect all or certain slave connections through ATH commands.

| | |
|--------------------------------------|--|
| ATH | Disconnect all slaves |
| ATHx (ATH1, ATH2, ATH3, ATH4) | Disconnect only the slave with corresponding TASK |
| ATHbdaddr (ATH000195000001) | Disconnect only the slave with corresponding address |

Table 4-3 ATH

4.3.4 ATOx, ATObdaddr

In multi connection mode, you can resume communication with the last communicated slave or specific slave using ATO commands(only applicable in Node Switching mode).

| | |
|--------------------------------------|--|
| ATO | Resume communication with the last slave you were communicating with |
| ATOx (ATO1, ATO2, ATO3, ATO4) | Resume communication with the slave of the corresponding TASK |
| ATOaddr (ATO000195000001) | Resume communication with the slave of the corresponding address |

Table 4-4 ATO

4.4 Notes

-In Multi-Drop mode, communicating large amounts of data without flow control can result in data loss. Especially, bidirectional communication can cause frequent disconnection and reboots to maintain multiple connections. Therefore, sufficient environment testing is required before application.

- It is recommended not to include unused addresses in S-Register 46, 54, 55 or 56. Continuous attempts to connect to inaccessible slave can lead to poor product performance. Disconnect message may be continuously displayed by performing force connection stop for connection stability.

-Node Switching mode provides almost same performance as 1:1 single connection mode.

-Hardware flow control is recommended for both Multi-Drop and Node Switching modes.

5. Certification

5.1. 5.1 FCC

FCC Part 15 Subpart C Section 15.247

FCC ID: PRO-WCS-232V6

5.1.1. FCC Compliance Statement

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.

This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antennae
- Increase the separation between the equipment and the receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

5.1.2. RF Exposure Statement

The equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum 20cm between the radiator and your body.

5.1.3. FCC Caution

Any changes or modifications to the equipment not expressly approved by the party responsible for compliance could void user's authority to operate the equipment.

5.2. CE



EN 301 489-1 V2.1.1

EN 301 489-17 V3.1.1

EN 300 328 V2.1.1

EN 62311:2008

EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013

This device can be operated in at least one Member State without infringing applicable requirements on the use of radio spectrum."

- RF Range: 2402 ~ 2480MHz (Bluetooth)

- Max. Output Power (E.I.R.P.) for Bluetooth: 17.00dBm

5.3. KC

Type Approval (Type Certification)

Certification No: R-C-STB-WCS-232V6

5.4. Japan MIC

Type Approval (Type Certification)

Certification No: 022-200012

5.5. SIG

Specification Version: 2.0/2.0 + EDR

QDID: B016862

6. RF Information

6.1. Radio Frequency Range

2.402 ~ 2.480GHz

6.2. Number of Frequency Channels

79 channels

6.3. Transmission Method

FHSS (Frequency Hopping Spread Spectrum)

6.4. Modulation Method

GFSK (Gaussian-filtered Frequency Shift Keying)

Pi/4 DQPSK (pi/4 rotated Differential Quaternary Phase Shift Keying)

8DPSK (8 phase Differential Phase Shift Keying)

6.5. RF Power

+17dBm

6.6. Receive Sensitivity

-88dBm

6.7. Power Supply

5 ~ 12VDC

Appendix A: Connection

A.1. Serial Port Pin Specifications

WCS-232 is a DCE device manufactured based on RS232 standard. It uses DB9 Female connector for serial communication interface.

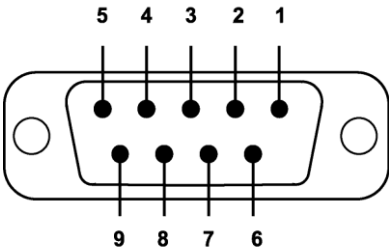


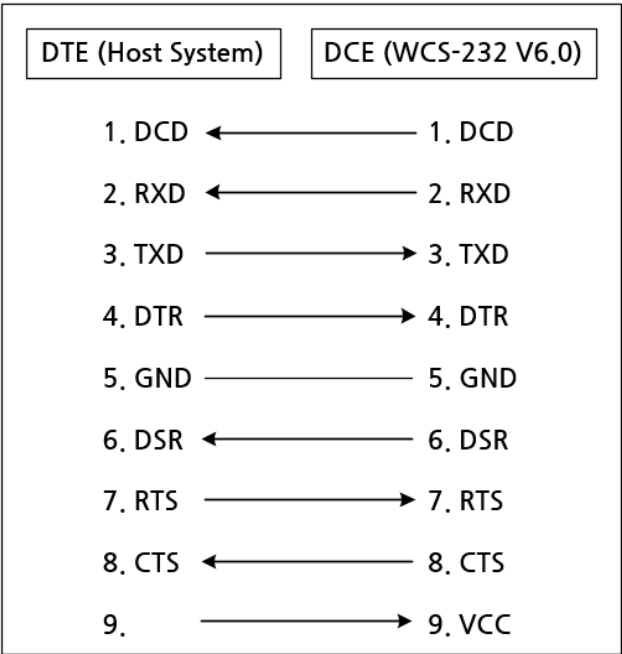
Figure A-1 DB-9 Pin Assignment

| Pin # | Signal | Direction | Description |
|-------|--------|-----------|--|
| 1 | DCD | Output | Data Carrier Detect(Bluetooth connection status) |
| 2 | RxD | Input | Receive Data |
| 3 | TxD | Output | Transmit Data |
| 4 | DTR | Output | Data Terminal Ready |
| 5 | GND | - | Signal Ground |
| 6 | DSR | Input | Data Set Ready |
| 7 | RTS | Output | Request To Send |
| 8 | CTS | Input | Clear To Send |
| 9 | VCC | Input | Power Input (5V ~ 12V) |

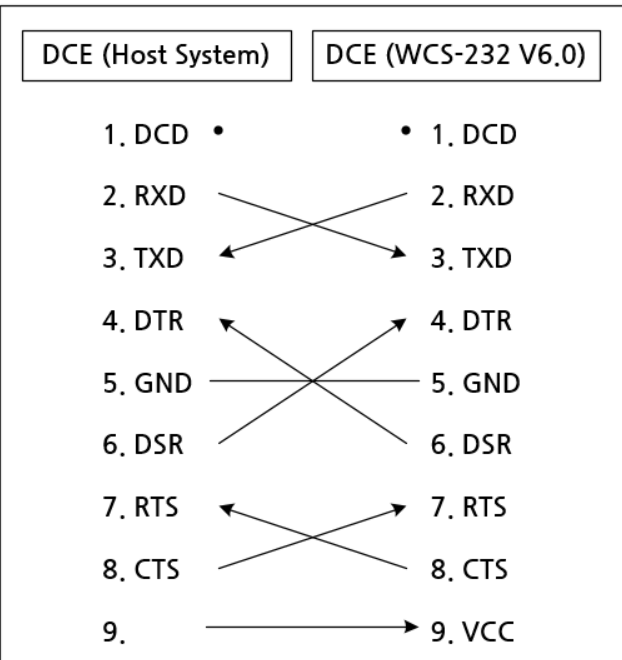
Table A-1. DB-9 female pin assignment

A.2. Serial Wiring

A.2.1. With DTE Host



A.2.2. With DCE Host



Appendix B: AT Commands

B.1. Terms

B.1.1. AT Command

WCS-232 can change or control the setting values using AT commands.

Users can implement wireless serial communication by sending appropriate AT commands to WCS-232 mounted on the host computer via a regular terminal program or own created program. WCS-232 interprets received AT commands to perform actions and sends the results back to the host.

B.1.2. AT Response Message

WCS-232 outputs four messages, 'OK', 'ERROR', 'CONNECT' and 'DISCONNECT' for responses to AT commands and status changes.

B.1.3. Operation Mode

| Mode | Description |
|--------|--|
| Mode 0 | AT command standby mode for changing settings |
| Mode 1 | Attempts a specific connection(last connection) |
| Mode 2 | Waits for a connection from a particular connection(last connection) |
| Mode 3 | Allows or waits for random searches or connections |

B.1.4. Operating status

| Mode | Description |
|---------|---|
| Standby | Waiting for AT commands |
| Pending | Waiting for a search, trying a search, waiting for a connection, trying a connection, etc |
| Connect | Bluetooth connected |

B.1.5. Security

| Security | Description |
|----------------|---|
| Authentication | Set the authentication password(Pin Code) |
| Encryption | Encrypt data for transmission |

B.1.6. Sign

The following signs are used for the convenience of explanation.

| Signs | Meaning | ASCII Code |
|--------------|-----------------------------|------------|
| ↵ | Carriage return | 0x0D |
| ↵ | Line feed | 0x0A |
| ↵↵ | Carriage return + Line feed | |
| 112233445566 | Bluetooth device address | |
| N or m | One digit decimal number | |
| to | Timeout in seconds | |

B.2. Command Category

| Command Category | | Index | AT Commands |
|----------------------|---------------|-------|--------------------------|
| RESET | | 1 | ATZ |
| | | 2 | AT&F |
| SERIAL PORT | | 3 | AT |
| | | 4 | AT+UARTCONFIG,b,p,s |
| BLUETOOTH | Information | 5 | AT+USEDIP? |
| | | 6 | AT+BTINFO? |
| | | 7 | AT+BTINQ? |
| | | 8 | AT+BTLAST? |
| | | 9 | AT+BTVER? |
| | | 10 | AT+MLIST? |
| | Mode | 11 | AT+BTMODE,n |
| | | 12 | AT+MULTI,n |
| | Status | 13 | +++ |
| | | 14 | AT+SETESC,nn |
| | | 15 | ATO |
| | | 16 | AT+BTCANCEL |
| | | 17 | AT+BTSCAN |
| | | 18 | AT+BTSCAN,n,to |
| | | 19 | AT+BTSCAN112233445566,to |
| | Connection | 20 | ATD |
| | | 21 | ATD112233445566 |
| | | 22 | ATH |
| | Security | 23 | AT+BTKEY=\$string |
| | | 24 | AT+BTSD? |
| | | 25 | AT+BTCSD |
| | | 26 | AT+BTFP,n |
| | | 27 | AT+BTSEC,a,e |
| | Miscellaneous | 28 | AT+BTNAME=\$string |
| | | 29 | AT+BTLPM,n, |
| | | 30 | AT+BTRSSI,n |
| REMOTE CONFIGURATION | | 31 | AT+PASS="nnnnnnnn" |
| | | 32 | AT+CHPASS="nnnnnnnn" |
| S-REGISTER | | 33 | AT&V |
| | | 34 | ATSnn? |
| | | 35 | ATSnn=mm |

B.3. Command Description

B.3.1. ATZ↵

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Reset software |
| Description | Same effect as turning the power switch off and on. The connection to other Bluetooth devices is disconnected and all work in progress stops. The status after a reboot is determined by the operation mode set. Some AT commands requires software reset to take effect. |

B.3.2. AT&F↵

| | |
|--------------------|--|
| Response | ↵OK↵ |
| Function | Reset hardware |
| Description | Same effect as pressing the reset button. Returns all set values to factory default. All stored data such as BD address will be deleted. |

B.3.3. AT↵

| | |
|--------------------|--|
| Response | ↵OK↵ |
| Function | Check the connection with the host |
| Description | Check if it is connected properly with the host. The serial port settings must match as well as the physical connection between the host and WCS-232. If not connected properly, no response or abnormal character strings output. |

B.3.4. AT+UARTCONFIG,Baudrate,Parity,Stopbit↵

| | |
|------------------|---|
| Response | ↵OK↵ |
| Function | Set serial port |
| Parameter | Baudrate = 1200/2400/9600/14400/19200/38400/57600/115200/230400/460800/ 921600 (Default=9600) Parity=N/E/O (Default=N) Stopbit=1/2 (Default=1) |

| | |
|--------------------|--|
| Description | Factory default values are 9600, N, 1. The dip switch must be set to SWConfig mode for application. You must reset software or turn the power off and on to take effect after the change. The flow control option can only be changed with the dip switch. |
| Example | AT+UARTCONFIG,115200,N,1 |

B.3.5. AT+USEDIP?↵

| | |
|--------------------|---|
| Response | ↵m↵ |
| Function | Set the Baud rate and verify whether it is in use with the dip switch |
| Description | m=0: If the transmission speed combination of the dip-switch is 'SWConfig'. m=1: If the transmission speed combination of the dip-switch is set to a specific transmission speed |

B.3.6. AT+BTINFO?↵

| | |
|--------------------|---|
| Response | ↵112233445566,DeviceName,Mode,Status,Auth,Encryp,FlowControl↵ ↵OK↵ |
| Function | Display Bluetooth related setting values |
| Description | Used to refer to Bluetooth settings. It displays BD address, device name, operation mode, operating status, whether authentication, encryption or hardware flow control is enabled. Initial value of FriendlyName is as 'WCSv2.0.0-445566'. WCS stands for WCS-232, v2.0.0 for firmware version, and 445566 for the back six digits of the BD address. Mode=MODE0/MODE1/MODE2/MODE3 Status=STANDBY/PENDING/CONNECT Auth=0/1 (disable/enable) Encrypt=0/1 (disable/enable) FlowControl=HWFC/NoFC (enable/disable) |

B.3.7. AT+BTINQ?↵

| | |
|-----------------|---|
| Response | ↵112233445566,FriendlyName,CoD↵ ↵112233445566,FriendlyName,CoD↵ ↵112233445566,FriendlyName,CoD↵ ↵OK↵ |
| Function | Search for peripheral Bluetooth devices waiting to be scanned |

| | |
|--------------------|--|
| Description | Search peripheral Bluetooth devices and displays their BD address, name and class information of devices. Only Bluetooth devices which are in standby will be detected. Up to 15 peripheral Bluetooth devices will be searched for approximately 30 seconds, and 'OK' response message will be output when the search is complete. The default value is 15, and stored in S-Register no.24. Not available in Remote mode. |
|--------------------|--|

B.3.8. AT+BTLAST?↵

| | |
|--------------------|---|
| Response | ↵112233445566↵ |
| Function | Display the address of the most recently connected Bluetooth device |
| Description | Used to refer to the address of the most recently connected Bluetooth device. |

B.3.9. AT+BTVER?↵

| | |
|--------------------|-------------------------|
| Response | ↵WCS-232v2.0.0↵ ↵OK↵ |
| Function | Show firmware version |
| Description | Show firmware version. |

B.3.10. AT+MLIST?↵

| | |
|--------------------|---|
| Response | ↵CURRENT MODE:SINGLE CONNECTION MODE↵ ↵OK↵ |
| Function | Display the current multi connection mode and connected slave addresses |
| Description | Displays the current multi connection mode(SINGLE CONNECTION MODE, MULTI-DROP MODE, NODE SWITCHING MODE) and address of connected slave |
| Example | AT+MLIST? CURRENT MODE: MULTI-DROP MODE TASK1 – 000195000001 TASK2 – DISCONNECT TASK3 – DISCONNECT TASK4 – 000195000004 |

B.3.11. AT+BTMODE,n↵

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Set operation mode |
| Parameter | n=0: MODE0 (Default) n=1: MODE1 n=2: MODE2 n=3: MODE3 |
| Description | To take effect after setting operating mode, you must reset software or turn the power off and on. If you switch the mode in Pending state, first switch to Standby status with AT+BTCANCEL command and then switch the mode. |
| Example | AT+BTMODE,2 ↵OK↵ ATZ |

B.3.12. AT+MULTI,n↵

| | |
|--------------------|---|
| Response | (If n=0) ↵OK↵ (If n=1 or n=2) ↵TASK1 OK↵ TASK2 OK↵ TASK3 OK↵ TASK4 OK↵ |
| Function | Change multi connection mode |
| Parameter | n=0: Single Connection Mode (Default) n=1: Multi-Drop Mode n=2: Node Switching Mode |
| Description | Change the settings between the default single connection mode, Multi-Drop mode and Noe Switching mode. |

B.3.13. +++↵

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Switch the operating status from online to command waiting status |
| Description | When in online status, all data received from the host is sent to the counterpart Bluetooth |

| | |
|--|---|
| | <p>device. AT command is not entered in online status. The only accepted command is '+++' and this character string is not printed on the screen.</p> <p>When WCS-232 receives the '+' character from the host, it stops sending and waits for the next character. If the second character is '+' and the third character is '+', then it switches to Command Standby status. If the second or third character is other than '+', the transfer resumes from the first '+' character. If there is a '+++' character string in the transmission data, there may be an unintended change in operation status.</p> <p>Also, when the data transmission has stopped receiving the '+' character at last, WCS-232 does not send data and wait, so you should check for abnormal operation possibilities. In this case, AT+SETESC command can solve the problem by changing '+' to another character.</p> <p>'+' is the Escape sequence character set as default. Not available in Remote mode.</p> <p>*Caution: In low-power mode, the '+++' string cannot switch the mode from online to command standby. Input of '+++' string in low-power mode in online state can cause unexpected errors.</p> |
|--|---|

B.3.14. AT+SETESC,nn↵

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Change escape sequence character |
| Description | <p>Escape sequence character is used to switch from online to command standby status, and '+' is set to the initial value. When three ESCAP sequence characters are received in a row, the operating status switches.</p> <p>nn is the ASCII code decimal value of the Escape sequence character you want to change, and must be the printable character present on the keyboard.</p> |
| Example | <p>AT+SETESC,42</p> <p>↵OK↵</p> |

B.3.15. ATO↵ (ATOx, ATObdaddr)

| | |
|-----------------|---|
| Response | - (none) |
| Function | <p>-Change operating status from command waiting status to online status</p> <p>-Change to online status with specific slave in multi connection mode</p> <p>In multi connection mode, ATO command resumes communication with last communicated</p> |

| | |
|--------------------|--|
| | slave. Use ATOb (x=1-4) command to resume communication with a specific slave, and ATObddd command to resume communication with the slave with a corresponding address. |
| Description | Use the command when you want to switch from the online state to command standby state using Escape sequence character, and then re-switch to online state, send and receive data. Not available in Remote mode. |
| Example | ATO ATO4 ATO000195000001 |

B.3.16. AT+BTCANCEL↵

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Terminate the processing task |
| Description | Force terminate search attempts, search wait, connection attempt and connection wait operations. If the operation ends normally, it turns to the command standby state. Not available in Remote mode. |

B.3.17. AT+BTSCAN↵

| | |
|--------------------|---|
| Response | ↵OK↵ ↵CONNECT 112233445566↵ |
| Function | Turn into search/connection standby state |
| Description | By turning into search standby state and connection standby state, it allows other Bluetooth devices to search for and connect it. This command has the same effect as AT+BTSCAN,3,0. When disconnected, it returns to search/connection standby state. Therefore, you must use the AT+BTCANCEL command to change to the command standby state. If the connection is successfully made, it outputs the 'CONNECT' response message and the counterpart BD address. Not available in Remote mode. |

B.3.18. AT+BTSCAN,n,to↵

| | |
|--------------------|---|
| Response | OK CONNECT 112233445566 or OK ERROR |
| Function | Search or wait for a connection for a certain period of time |
| Parameter | n=1: Allows Inquiry scan n=2: Allows Page scan n=3: Allows both of Inquiry scan and Page scan to= Time duration in seconds |
| Description | <p>Make search standby or connection standby for a given time.</p> <p>n=1: Leave on search standby. It can be searched by another Bluetooth device, but cannot be connected.</p> <p>n=2: Leave on connection standby. It cannot be detected by other Bluetooth devices but can be connected.</p> <p>n=3: Leave on search standby and connection standby. It can be detected and connected by other Bluetooth devices.</p> <p>The to unit is seconds, and if the connection has been failed or disconnected again after the connection, it switches to command standby state. However, in the case of to=0, it will remain on standby until a connection is made from another Bluetooth device, and after disconnecting, it will remain on search standby and/or on connection standby, not returning to the command standby state.</p> <p>If the connection is successful, it outputs a 'CONNECT' response message and the counterpart BD address, and if it fails to connect within time, it outputs a 'ERROR' response message. Not available in Remote mode.</p> |
| Example | AT+BTSCAN,2,30 |

B.3.19. AT+BTSCAN112233445566,to

| | |
|--------------------|---|
| Response | OK CONNECT 112233445566 or OK ERROR |
| Function | Wait for a connection from Bluetooth devices with specific addresses |
| Parameter | 112233445566=BD address to= time duration in seconds |
| Description | Use to allow connections from specific Bluetooth devices only. Wait for connection during |

| | |
|----------------|---|
| | <p>to. If the connection has not been made, or has been disconnected after the connection, it will be in a command waiting state. If you type to=0, you will be in the connection waiting state indefinitely until the connection is made, and if disconnected even after the connection, it will not return to the command waiting state and will be in the connection waiting state.</p> <p>If the connection is successful, it outputs a 'CONNECT' response message and the counterpart BD address, and if it fails to connect within time, it outputs a 'ERROR' response message. Not available in Remote mode.</p> |
| Example | AT+BTSCAN000B530011FF,30 |

B.3.20. ATD↵

| | |
|--------------------|---|
| Response | <p>↵OK↵</p> <p>↵CONNECT 112233445566↵</p> <p>or</p> <p>↵OK↵</p> <p>↵ERROR↵</p> |
| Function | Reconnect to the most recently connected Bluetooth device |
| Description | <p>It stores the address of the most recently connected Bluetooth device, so you can simply try to reconnect without entering the address.</p> <p>If the connection is successful, it outputs a 'CONNECT' response message and the counterpart BD address, and if it fails to connect within time, it outputs a 'ERROR' response message. Not available in Remote mode.</p> |

B.3.21. ATD112233445566↵

| | |
|--------------------|---|
| Response | <p>↵OK↵</p> <p>↵CONNECT 112233445566↵</p> <p>or</p> <p>↵OK↵</p> <p>↵ERROR↵</p> |
| Function | Connect to a Bluetooth device with a specific address |
| Parameter | 112233445566 = BD address |
| Description | <p>Attempt to connect by specifying the address of a particular Bluetooth device. The Bluetooth device you are trying to connect to must be in the connection standby state for the connection to be made. The connection attempt will be made for about 5 minutes and automatically performs the authentication procedure when the authentication is required during the connection process.</p> <p>If the connection is successful, it outputs a 'CONNECT' response message and the</p> |

| | |
|----------------|--|
| | counterpart BD address, and if it fails to connect within time, it outputs a 'ERROR' response message. Not available in Remote mode. |
| Example | ATD000B530011FF |

B.3.22. ATH+ (ATHx, ATHbaddr)

| | |
|--------------------|--|
| Response | ↵OK↵ ↵DISCONNECT↵ |
| Function | Disconnect Disconnect with the entire or specific slave in multi connection mode |
| Description | <p>Use if you want to disconnect the current connection normally. If power of one side is turned off unilaterally or if the connection is disengaged abnormally outside the communication distance, the counterpart will take time of Supervision Timeout(S-Register 37) to detect the disconnection.</p> <p>When disconnected, a 'DISCONNECT' response message outputs. Depending on the status at the time of disconnection, this message may not be output. It can also force block the output. (S-Register 10)</p> <p>You can use ATHx (x=1-4) command to disconnect only from the slave of the corresponding task in multi connection mode. Use ATHbaddr command to disconnect the slave with the corresponding Bluetooth address in multiple connection modes. Not available in Remote mode.</p> |
| Example | ATH ATH1 ATH000195000001 |

B.3.23. AT+BTKEY=\$string↵

| | |
|--------------------|--|
| Response | ↵OK↵ |
| Function | Change pin code |
| Parameter | \$string= New pin code (Default="1234") |
| Description | <p>A password (passkey or Pin-code) is a string that is easy for the user to identify, based on which an authentication key is generated and used for the actual authentication process.</p> <p>The initial value of the password is '1234' and a string of up to 16 characters can be used.</p> |
| Example | AT+BTKEY="apple" |

B.3.24. AT+BTSD?

| | |
|--------------------|--|
| Response | ±112233445566± ±OK± |
| Function | Outputs a list of devices sharing authentication key |
| Description | Shows a list of addresses of Bluetooth devices that share authentication keys with WCS-232. The authentication keys for the Bluetooth devices listed are stored and managed inside the WCS-232 and can store up to seven keys. |

B.3.25. AT+BTCSD

| | |
|--------------------|---|
| Response | ±OK± |
| Function | Delete the list of authentication keys (Link key) sharing devices |
| Description | Delete the list of Bluetooth devices that share the authentication key. This command deletes the content stored in flash memory. As the list is still stored in main memory, it becomes effective after a software reset or power off and on. |

B.3.26. AT+BTFP,n

| | |
|--------------------|--|
| Response | ±OK± |
| Function | Create the authentication key each time |
| Parameter | n=0: Inactivate (Default) n=1: Activate |
| Description | If authentication is enabled, create and save authentication keys based on stored passwords. On subsequent connections, the stored authentication key will go through the authentication process, which is used to increase the security level by regenerating the authentication key each time of connection. n=0: Disables this function. n=1: Enables this feature. |

B.3.27. AT+BTSEC,Authentication,Encryption

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Set authentication and data encryption |
| Parameter | Authentication=0: Inactivate (Default) Authentication=1: Activate Encryption=0: Inactivate (Default) Encryption=1: Activate |
| Description | Determine whether to use security feature when connecting. Bluetooth authentication is to determine whether to connect by referring to a link key that identifies each other at the time of connection. Encryption is to protect data by encrypting wireless data transmitted and received between Bluetooth devices. WCS-232 is designed to automatically handle complex Bluetooth authentication and encryption, so user should only choose whether to use authentication and encryption. Bluetooth encryption cannot be selected separately and it is only valid when using Bluetooth authentication at the same time. |

B.3.28. AT+BTNAME=\$string↵

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Change device name |
| Parameter | \$string= New device name (Default="WCSv2.0.0-445566") |
| Description | Give WCS-232 a device name which is easy for users to identify. This device name is useful for searching for Bluetooth devices on other Bluetooth devices. Name can be up to 30 characters in combination of alphabet and number. |
| Example | AT+BTNAME="My-WCS-232" |

B.3.29. AT+BTLPM,n↵

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Set low power mode type and usage status |
| Parameter | n1=0: Disable Low power (Default) n1=1: Enable Low power |
| Description | Sets whether to enable low power mode. |

B.3.30. AT+BTRSSI,n (In single connection mode only)↵

| | |
|--------------------|--|
| Response | OK 0,255,0,0 (repeatedly) (0, LinkQuality, 0, RSSI) |
| Function | Test sensitivity |
| Parameter | n=0: Stop sensitivity test n=1: Start sensitivity test |
| Description | Use in command standby mode by Escape sequence character such as +++ after the Bluetooth connection has been established. The closer the LinkQuality is to 255, the closer the RSSI is to 0, the better the sensitivity. |
| Example | +++ AT+BTRSSI,1 OK 0,255,0,0 |

B.3.31. AT+PASS=\$string↵

| | |
|--------------------|---|
| Response | Remote Configuration Enabled OK |
| Function | Enter the password used in Remote Settings mode |
| Parameter | \$string= Password (Default="0000") |
| Description | Enter the password for authentication in Remote Settings mode |
| Example | AT+PASS=1234 |

B.3.32. AT+CHPASS=\$string↵

| | |
|--------------------|---|
| Response | OK |
| Function | Enter the password for authentication in Remote Settings mode |
| Parameter | \$string= New password |
| Description | Change the password used in Remote Settings mode. The password can be set up to 8 digits. |
| Example | AT+CHPASS=12345678 |

B.3.33. AT&V↵

| | |
|-----------------|---|
| Response | S0:m0;S1:m1; ...Sn:mn OK |
|-----------------|---|

| | |
|--------------------|---|
| Function | Output all S-Register values |
| Description | The S-Register is where the WCS-232 stores various settings and parameters, which is permanently preserved in flash memory unless it hardware reset is performed. |

B.3.34. ATSnn? ↵

| | |
|--------------------|--|
| Response | ↵value↵ ↵OK↵ |
| Function | Displays specific S-Register values |
| Parameter | nn= S-Register address |
| Description | Outputs a S-Register value with nn address |

B.3.35. ATSnn=mm ↵

| | |
|--------------------|---|
| Response | ↵OK↵ |
| Function | Change specific S-Register values |
| Parameter | nn= S-Register Address mm= New S-Register Value |
| Description | Change the value of S-Register with nn address to mm. 'ERROR' will be output for S-Register that cannot be changed by the user. |
| Example | ATS10=0 |

B.4. Command Validity Depending On Operating status

| AT Command | Operating status | | |
|--------------------------|------------------|---------|---------|
| | Standby | Pending | Connect |
| AT | ○ | ○ | |
| ATZ | ○ | ○ | |
| AT&F | ○ | ○ | |
| AT+BTINQ? | ◎ | | |
| ATD112233445566 | ◎ | | |
| ATD | ◎ | | |
| AT+BTSCAN | ◎ | | |
| AT+BTSCAN,n,to | ◎ | | |
| AT+BTSCAN112233445566,to | ◎ | | |
| AT+BTCANCEL | | ○ | |
| +++ | | | ○ |
| AT+SETESC | ◎ | | |
| ATO | ● | | |
| ATH | ● | | |
| AT+BTSEC,Auth,Encr | ◎ | | |
| AT+BTLAST? | ○ | ○ | |
| AT+BTMODE,n | ◎ | | |
| AT+BTNAME="Name" | ◎ | | |
| AT+BTKEY="nnnn" | ◎ | | |
| AT+BTINFO? | ○ | | |
| AT+BTLPM,n | ◎ | | |
| AT+BTSD? | ○ | ○ | |
| AT+BTCSD | ◎ | | |
| AT+BTFP,n | ◎ | | |
| AT+UARTCONFIG,b,p,s | ◎ | | |
| AT+USEDIP? | ○ | ○ | |

| | | | |
|----------------------|---|---|--|
| AT+BTVER? | ○ | ○ | |
| AT+BTRSSI,n | ● | | |
| AT+PASS="nnnnnnnn" | ○ | ○ | |
| AT+CHPASS="nnnnnnnn" | ○ | ○ | |

- © Valid only when not connected to other Bluetooth devices.
- Valid only when connected to another Bluetooth device.

Appendix C: S-Register

S-Register is a space where parameters related to the function of WCS-232 are stored, and the changed values are stored in flash memory and are preserved permanently unless user resets the hardware. S-Register values can be changed directly by users using ATS related commands. If you enter an incorrect value, it can have a devastating consequences on WCS-232 so please be careful when making changes.

Use S-Register changes only in command standby mode. If possible, do not have values other than S-Register mentioned below. WCS-232 must be rebooted after the S-Register change.

C.1. S1: Force to Reconnect (default: 1)

S1=0, WCS-232 in mode 1 does not attempt to reconnect after the disconnection from the other party

S1=1, WCS-232 in mode 1 attempt to reconnect after the disconnection from the other party

C.2. S3: Stream UART Policy (default: 0)

S3=0, prioritize Throughput

S4=1, prioritize Latency, starts transmission as soon as the data received in UART

Determines the policy for UART stream data. Determine the policy with Throughput priority if 0, and Latency priority if 1. If Latency is priority, it starts sending data as soon as it is received in UART to minimize delay. Therefore, you can set the value to 1 if you want to transfer small data(ex. 1byte) quickly.

C.3. S4: Enable Remote Name Query (default: 1)

S4=0, ask only the Bluetooth address of peripheral Bluetooth device when searching

S4=1, ask information(Bluetooth address, device name/type) of peripheral Bluetooth device when searching

Determine whether to ask the name of the peripheral Bluetooth device when searching. If set to 1, ask the Bluetooth address, device name and device type of the peripheral Bluetooth devices when searching. If set to 0, this function will be disabled and the searching speed will be increased. If there is a number of peripheral Bluetooth devices and can only search with Bluetooth address, you can turn off this function.

C.4. S6: Enable Low Power Mode (default: 0)

S6=0, disable low power mode

S6=1, enable low power mode

When enabling low power mode, it will enter a low power state if there is no data communication for a certain period of time and wake up when there is data communication again.

C.5. S10: Enable Response Message (default: 1)

S10=0, WCS-232 does not send response message to the host

S10=1, WCS-232 sends response message to the host

Sets whether WCS-232 sends messages to the host such as OK, ERROR, CONNECT and DISCONNECT. If set to 1, send response messages to the host. If you do not want these messages to be sent to the host during Bluetooth connection, set to 0 to disable this function.

C.6. S11: Enable Escape (default: 1)

S11=0, does not allow escape sequence character (operating status cannot be changed)

S11=1, allows escape sequence character (operating status can be changed from online to command standby)

Controls the Escape sequence character function. If set to 1, the escape sequence character can be used in online status, and it can be changed to the command standby status. If set to 0 to disable this function, it cannot be changed to command standby status from online status. Also, it is effective in transmission and reception side by omitting the detection process of the Escape sequence character for data received from UART.

C.7. S12: Clear Data Buffer When Disconnected (default: 1)

S12=0, WCS-232 does not clear the data buffer received from host system when disconnected.

S12=1, WCS-232 clears the data buffer when disconnected.

If set to 1, it clears the data stored in the internal buffer of WCS-232 received from the host when disconnected.

C.8. S13: Enable DCD Signal (default: 1)

S13=0, DCD signal off

S13=1, DCD signal on

C.9. S14: Enable DTR Transfer (default: 1)

S14=0, use DTR/DSR signal as loop-back.

S14=1, send DTR signal to the remote DSR.

C.10. S15: Enable Disconnect by DTR (default: 0)

S15=0 connection cannot be deleted

S15=1 Bluetooth connection can be disconnected when DTR signal is off

Disconnect the WCS-232 using the DTR signal. If the DTR signal is turned off when set to 1, the Bluetooth connection will be disconnected.

C.11. S22: Faster Connection (default: 0)

S22=0, none

S22=1, page scan

S22=2, inquiry scan

S22=3, page/inquiry scan

Access time is increased by an average of 1.5 seconds.

C.12. S23: Intercharacter Timeout Setting (default: 0)

S23=0, Not used

S23=1: 1 x S26

S23=2: 10 x S26

S23=3: 100 x S26

C.13. S24: Maximum Number of Inquiry Result (default: 15)

The maximum number of Bluetooth devices that can be found when performing a search function. If set to 0, no limits on number.

C.14. S26: Intercharacter Timeout (default: 0)

Set the inter-character time interval used to separate data sent from the serial port. If no additional data is received over this time, data is sent to the client.

S23=1 x S26=50 : Timeout-> 50msec

S23=2 x S26=50 : Timeout-> 500msec

S23=3 x S26=3 : Timeout-> 300msec

| Intercharacter Timeout | * Optimal Value(S23 x S26) |
|------------------------|----------------------------|
| 50ms | 180 |
| 100ms | 235 |
| 200ms | 340 |

This is a minimum time setting value when separating and sending 10bytes of data without being lumped. Reducing this value may result in sending data massed together in 20, 30, and 40 bytes.

C.15. S28: Escape Sequence Character (default: 43)

Indicates the decimal value of the Escape sequence character. Default value is 43, indicating '+'.

C.16. S31: Page Timeout (default: 20)

Indicates the Timeout value used when attempting connection by ATD command. It can be set per 5 seconds. If the value is 0, it continuously attempts to connect without rebooting.

C.17. S33: Inquiry Timeout (default: 30)

Indicates the searching time, which can be set per seconds.

C.18. S37: Supervision Timeout (default: 5)

This is the time takes to process the connection termination of there is no Bluetooth communication. Units are seconds and default value is 5. If this value is set to small, Bluetooth connection can be detected as quickly as possible. But even if the connection is temporarily unavailable due to external factors, it will terminate the connection as regarding the connection lost. Also, it must also be bigger than Slave Disconnect Timeout(S57) value (slave follows

the setting value of the master).

C.19. S43: COD (default: 001F00)

Means the type of Bluetooth device and can be changed.

C.20. S44: COD Filter (default: 0)

Filters the type of Bluetooth device when searching for peripherals. If set to 0, it searches for all devices. If set to 3E0100, only search Bluetooth device with COD value of 3E0100.

C.21. S45: Inquiry Access Code (default: 0x9E8B33)

The default IAC value of all Bluetooth devices is 0x9E8B33. Only devices matching this value can be searched. For example, if you set this value to 9E8B10, only Bluetooth devices with the Inquiry Access Code set to 9E8B10. The IAC value can be entered from 0x9E8B00 to 0x9E8B3F.

C.22. S46: BD Address of Last Connected Device

Stores the address of the Bluetooth device that was last connected in single connection mode.

Stores the address of the Bluetooth device that was last connected to TASK1 in multi connection mode.

C.23. S48: Low Power Max Interval (default: 5000)

Max interval value to be used in low power mode. The unit is 625 μ sec ($5000 \times 0.625 = 3125$ msec).

C.24. S49: Low Power Min Interval (default: 4500)

Min interval value to be used in low power mode. The unit is 625 μ sec. ($4500 \times 0.625 = 2812$ msec)

Reducing interval increases power consumption and increasing takes more time to wake up from low power mode.

C.25. S52: Low Power Timeout (default: 5)

The low power timeout value and the unit is seconds. The default is 5 seconds.

If there is no data communication for the set time, it enters low power mode and wakes up from low power mode when the data comes in again.

C.26. S54: BD Address of Last Connected Device

Stores the address of the Bluetooth device that was last connected to TASK2 in multi connection mode.

C.27. S55: BD Address of Last Connected Device

Stores the address of the Bluetooth device that was last connected to TASK3 in multi connection mode.

C.28. S56: BD Address of Last Connected Device

Stores the address of the Bluetooth device that was last connected to TASK4 in multi connection mode.

C.29. S57: Slave Disconnect Timeout (default: 3)

Sets the amount of time the master waits without sending data when the slave cannot receive data in multi-mode. No data will be sent to other normal slaves during this time. If the slave cannot receive data after the specified, time, it disconnects the slave. However, when slave starts receiving data before the set time pass, it stops waiting without sending the data and starts to communicate normally. The setting value must be bigger than 0 and smaller than Supervision Timeout(S37). (Unit: seconds)

C.30. S58: MAX TX POWER (default: 0)

Sets the maximum wireless output value. After setup, it will reboot and apply the changes automatically. (There may be some errors depending on devices)

| Setting Value | dBm |
|---------------|--------------------------------|
| 0 | Use default chip setting value |
| 1 | -12 |

| | |
|---|----|
| 2 | -8 |
| 3 | -4 |
| 4 | 0 |
| 5 | 4 |
| 6 | 8 |
| 7 | 12 |
| 8 | 16 |

C.31. S59: Current Slave in Communication (default 0)

Stores the slave number currently communicating in node switching mode. It is automatically saved when communicating with the slave and you can modify this value when you want to communicate with a particular slave immediately after the master reboot. Input values range from 0 to 4. Value 0 means an initial state that has never been connected and communicated with any slave. At this time, it communicates with the first connected slave.

C.32. S60: Reconnect Time Interval (default 5)

Sets the time interval for reconnecting attempt when the slave is disconnected during multi connection communication. Units are seconds and it attempts to connect every two times the actual input value. Input value is at least 5. If you set the input value to 5, it performs a reconnection attempt every 10 seconds after the slave disconnection. It also performs automatic reconnection only when the master is set to Mode 1.

Appendix D: Troubleshooting

D.1. No Data Transmission

D.1.1. COM Port Settings

- Check if you have set the same baud rate for WCS-232 and host. If you do not know the setting value, initialize it with the reset button and try again.

WCS-232 only supports 8 data bit. If the host supports 7 data bit, even or odd parity, and only use WCS-232 for both sending and receiving, use WCS-232 as initial state(8 data bit, No parity). However, it cannot be applied to 7-bit devices such as USB dongles.

- Please make sure that parity and stop bit of WCS-232 are set to the same as the host. WCS-232 supports No/Even/Odd parity and 1/2 stop bit.

- Among the control signal lines defined in the RS-232 standard, RTS(Request to Send) and CTS(Clear to Send) are used for hardware flow or hardware handshaking purpose between two serial devices. Typically, the RTS and CTS signal lines are connected to the CTS and RTS signal lines of a counterpart equipment respectively.

RTS is an output signal line that tells the other device that it is ready to receive data. For example, if a DTE device and a DCE device are connected via serial line, the DTE device will make the RTS signal line active to notify the DCE device that it is ready to receive data. If the receive buffer is full and no longer able to receive data, it makes the RTS signal line inactive to prevent the DCE device from transmitting data.

CTS is an output signal line that verifies if the data can be sent to the other device. For example, if the DTE device and DCE device are connected via serial line, the DTE device examines the CTS signal and attempts to send data. If CTS signal is inactive, it means that there is no room in the receive buffer of the DCE device, so it stops sending data until the CTS signal becomes active. If the DCE device has room in the receive buffer and makes its RTS signal active, the CTS signal of the connected DTE device becomes active and DTE device starts to send data to DCE device.

WCS-232 is basically set to use hardware flow control over RTS and CTS signals. If the device you want to connect to WCS-232 does not support or disabled the hardware flow control, you must set hardware flow control disabled in WCS-232. Flow control can only be set with dip switch.

- WCS-232 does not support RS-232 break signal. Therefore, you cannot use it for products that require break signal.

D.1.2. Pin Assignment

Data transmission devices based on serial communication are divided into DTE(Data Terminal Equipment) devices and DCE(Data Communication Equipment) devices. Generally, terminal devices such as PCs are DTE, whereas data relay devices such as modems are DCE.

For products comply with the RS-232 standard,

- 1) If you want to use a DTE device in conjunction with a DCE device, you should either connect the two devices directly or use a straight cable. This means that the control signal lines including the TX and RX signal lines should be directly connected.
- 2) On the other hand, if you are connecting two same types, DTE and DTE, or DCE and DCE devices, use a cross cable(also called a Null Modem cable). This cable allows the control lines including the TX and RX signal lines to be crossed between the two devices.

WCS-232 is a DCE device that is designed to be mounted directly to a PC. Therefore, when connecting to a DTE device, it should be mounted directly to the serial port of the DTE device or connected using a straight cable. When connecting to a DCE device such as a modem or equipment which is commonly used connected to a PC, cross cable should be used.

If you are connecting to a product that does not comply with the RS-232 standard, please refer to Appendix A Connection to connect with WCS-232.

D.2. Data Loss or Malfunction

D.2.1. Hardware Flow Control

WCS-232 transfers data from the host to the counterpart Bluetooth device. If the wireless communication environment is not good, packet retransmission repeats and data accumulates in the buffer, also causing communication delays. Without hardware flow control, buffer overflow may occur if WCS-232 continues to receive data from the host with internal buffer is full at a certain level. To prevent this, WCS-232 is designed to empty the buffer, which means data loss. Therefore, it is recommended to use hardware flow control when transferring large amount of data or when the wireless environment is not good.

D.2.2. Response Message

WCS-232 outputs message such as OK, ERROR, CONNECT, DISCONNECT to the host according to changes by AT commands or itself. These messages may cause unexpected malfunctions in the host device. At this time, please turn off the response feature(Please refer to S-Register 10).

D.3. Transmission Delay

D.3.1. Wireless Conversion Delay

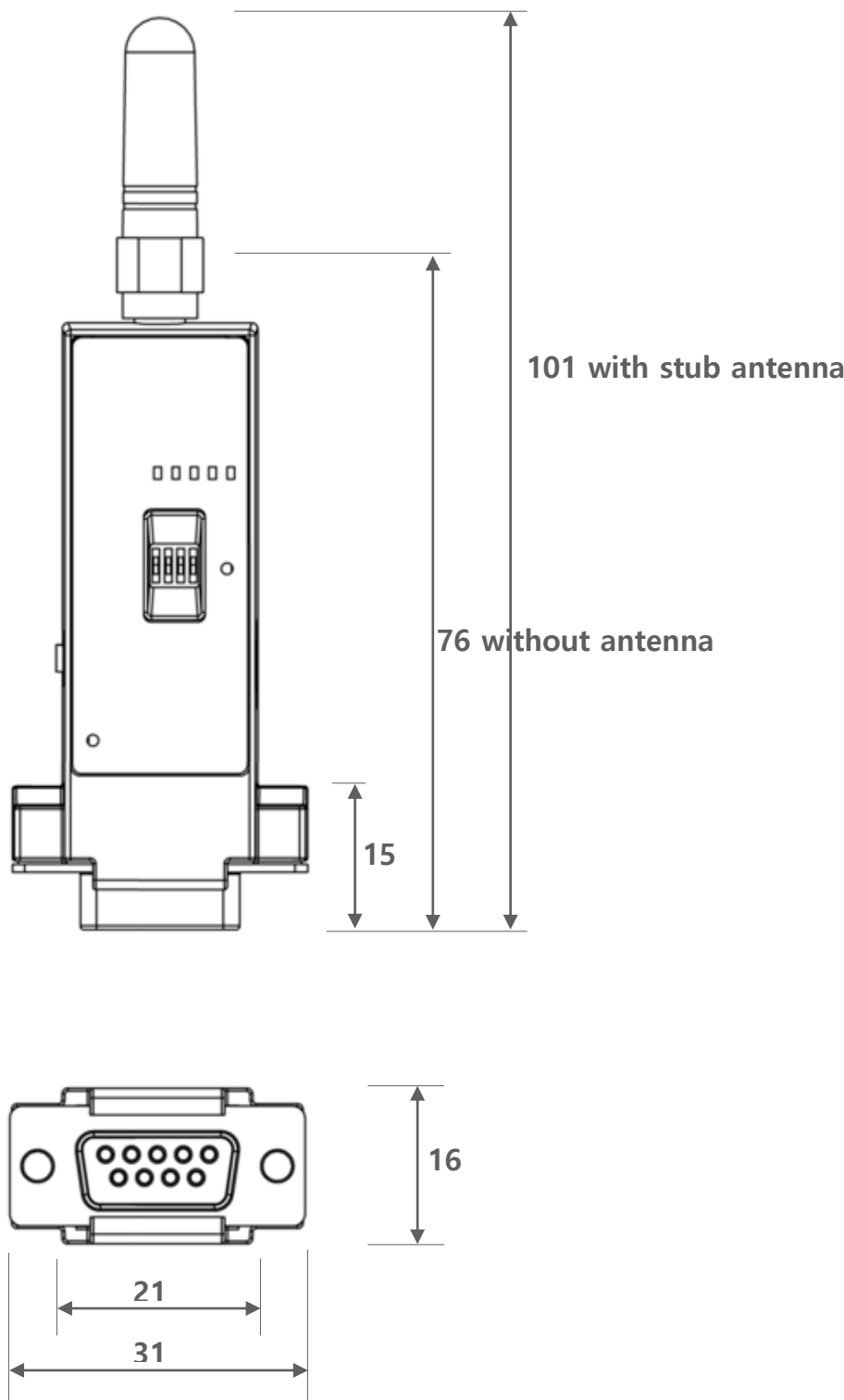
WCS-232 has a time lag about 30msec to wirelessly transmit data received from the host. This time difference may increase depending on the wireless communication environment. Also, WCS-232 initiates wireless conversion as soon as data comes in serial and transmits it. This allows continuous data to be split and sent to the receiving side. To prevent this, WCS-232 provides Intercharacter Timeout feature, which is sending data only when there is no incoming data in serial for a period of time(Please refer to S-Register 23, 26).

D.3.2. Wireless Environment

By using 79 channels, Bluetooth can be used without interference as much as possible. However, data loss and errors can occur if large data is sent and received using too much Bluetooth equipment in a limited space. Also, WCS-232 can avoid interference with WiFi using AFH function, but the effectiveness can be reduced depending on the number or distance of equipment used(AFH is automatically applied).

Appendix E: WCS-232 Dimension

E.1. Dimension



***Note:** This product is an industrial Bluetooth device and should be used at least 20cm apart from the installation environment and human body.

Appendix F: Warranty Policy

F.1. Warranty Policy

The product has passed the rigorous quality control and inspection process.

SystemBase warrants that from the date of purchase by customer, and continuing for a period of five(5) year, the Hardware will be free from defects in material and workmanship, under normal use. The warranty is limited to the repair and/or replacement parts at SystemBase's option, of the defective product during its warranty period.

Customer should obtain a Return Material Authorization(RMA) number from technical support team prior to returning the defective product to SystemBase. Shipping cost to SysemBase and to customers shall be borne by customer and SystemBase respectively.

Warranty does not apply if a product

- (a) has passed the warranty period
- (b) has been arbitrarily installed, operated, modified, disassembled, and repaired or maintained without any instructions supplied by SystemBase
- (c) has been using peripheral devices that are not provided by SystemBase
- (d) has been subjected to electrical stress, over-currents of the power used or poor equipment connection
- (e) has been subjected to abnormal physical stress, misuse, negligence or accident
- (f) has been subjected to natural disasters such as fire, chloride damage, flood, lightning and earthquake

For RMA, product must be in the same condition as when the product was shipped, without any damage or loss of goods and components.

For more information, please find RMA Policy on SystemBase website.



If you have any inconvenience while using the product, please contact us.

Email:

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Working Hour

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