RC-WIFI CONTROLLER USER MANUAL

In the rapidly growing Internet of Things (IoT), applications from personal electronics to industrial machines and sensors are getting wirelessly connected to the Internet. Controlling motors and hobby devices have been neglected in this advancement. Now that almost everyone owns some form of portable communication device, it is only logical do to away with the bulky RC transmitter that uses Joysticks and switches. The touch screen on modern devices can replace almost any mechanical control input device.

At the heart of the RC-WIFI controller is a B/G/N WIFI Access point. The controller is basically a WIFI to Serial converter that receives and transmits OSC (open sound control protocol) data from any source that can send data on a UDP port. This data can address and control 8 Servos and 2 logic devices (216 Servos with the Maestro Expansion). The controller comes with a 2.4 db antenna and 10cm of cable and connector.

This device will NOT control Digital servos.This device can replace any Rc Wireless system like the Futaba transmitter and receiver. You can use most mobile devices like the iPad or Android device to control a large number of Rc Servos. You use visual controls on the screen instead of a joystick to control Rc Servos and relays. This system uses the popular OSC Protocol. There are many MIDI Apps that adhere to this protocol. We suggest TB MIDI STUFF app, which is by far the best and most flexible. It lets you design Sliders, Buttons, XY Pads, Indicator Lights and assign data right on the iPad without the need for a computer. We are not connected to this developer and there are many more apps you could use. You can also use a PC, MAC or any device that is WIFI capable.

Features:

• Control 8 Rc Servo Motors from any Tablet, Phone or PC (Standard RC Servos, NOT Digital Servos)
• The power-up default position for each Rc Servo is programmable by the user.
• The Rc Pulse is settable to a 1 ms (1 to 2ms) range or 2 ms (0.5 to 2.5ms) range.
• There are 2 digital outputs that let you control relays or LED's.
• Data path is two-way and can send data from the RC-WIFI Controller back to the iDevice.
• One digital input lets you monitor a high or low condition on your Phone or Tablet.
• One analog input can remotely read the voltage of the system battery for monitoring.
• Multiple data sources like an iPad, Android Device or PC can send data simultaneously.
• A Safety Feature can be enabled. It will set all servos and outputs to their default position if radio contact is lost for 1.6 seconds or more.

• (Optional) Can be used as a wireless serial bridge. An Optional RS232 in/out port must be ordered.

Electrical Specs

Before you connect any wires, you must be aware of the electrical specifications. The controllers main power should be at least 6 volts and can be up to 15 volts. However, your main powersource is dependant on what kind of Servos you will be using . There are two types of uses, Model RC Servos or our RC Power Servo or a mix of both at the same time.

If you use it with any Hobby RC Servos or our RC Power Servos jumper must be on the **right side** and the input voltage should **not exceed 7.2 Volts**. (Some RC Servos run on 6 Volts and can be destroyed if connected to 7.2 volts. If you are not sure stay at 6 Volts)

If you use it exclusively with our RC Power Servos and you need to connect to a 12Volt source jumper must be on the **left side**. Only If you have no Model RC Servos connected, the WIFI controller can be connected to a 12 Volt DC source. This allows you to connect to the same power source as our RC Power Servo and the 12V Motors.

Never connect to a higher than 6 or 7.2 volt source if jumper is on the right side and you use one or more RC Hobby Servos as it will destroy them if you have any connected.

Jumper on this side if your main power input is above 7.2 volts. Jump here if you use our Power Servo Controller and you like to connect to a 12V DC source. You can NOT connect standard RC Servos in this mode

Jumper on this side if you are only running standard RC- Servos or our Power Servo Controller and your main power is no more than 6 Volts

The power input to the PCB is then regulated to 5 Volts and 3 Volts respectively. The power to the servos is NOT regulated. Always make sure you connect POSITIVE to the correct terminal. The current you requrie depends on how many Rc Servos you connect and their current specs. Here is a list of accepted and recommended power sources.

6 volt Lead Acid or Lead Chell Battery.
4 X 1.5 volt Alcaline Batteries for a total of 6 volts
5 X 1.3 volt Lithium cells
7.2 volt Lithium Battery Pack.
Or any regulated 6 to 7 volt Power Supply.
Any 12 volt source if you **do not** use Hobby RC Servos

Power Source considerations

All RC Servos will be powered from this main power source. Read the specs of the Hobby RC Servos you want to use before you decide on a power source. The RC Pulse is 4 to 5 volts and the 3 pin connector complies with the Hobby RC standard, Positive on the center pin.

The RC WIFI Controller by itself will consume about 150 to 200 ma. RC Servos draw 100 to 250 ma. Before you decide on a power source, calculate how much current you need to make a stable system. Assuming your servos turn 50 % of the time and you connect 8 servos, your battery should be able to supply around 1800 ma. A 2.0 (AHR) , Amp Hours rated battery is recommended. That is 2.0 amps for 1 hour. If you use an AC Power Adapter, it should be rated at 6 volts, 1.5 amps or higher. We also advise that you should have an inline fuse of about 2 amps between battery and your power source.

Detailed Input and Output Functions explained.

2 Digital Outputs are 5 volt logic level and have a 470 ohm resistor in series. You can drive an LED direct without adding a resistor. Connecting a small mechanical or solid state relay here lets you drive 110 volt loads. The later is only recommended for the experienced experimenter.

Digital Input: One digital input that lets you monitor an ON/OFF condition. This should be connected to a mechanical Normally Open or Closed contact. You can NOT however connect this input to a more than 5 volt logic signal. The input has a 470 ohm resistor for current protection.

Analog Input : The analog converter resolution is 8 bits and transmits a value from 0 to 255. The Input has a 4:1 voltage divider and can measure voltages up to 20 volts which results in a value of 255. This results in 0.07 volts per count. We recommend connecting this input to the battery plus of your system for remote monitoring.
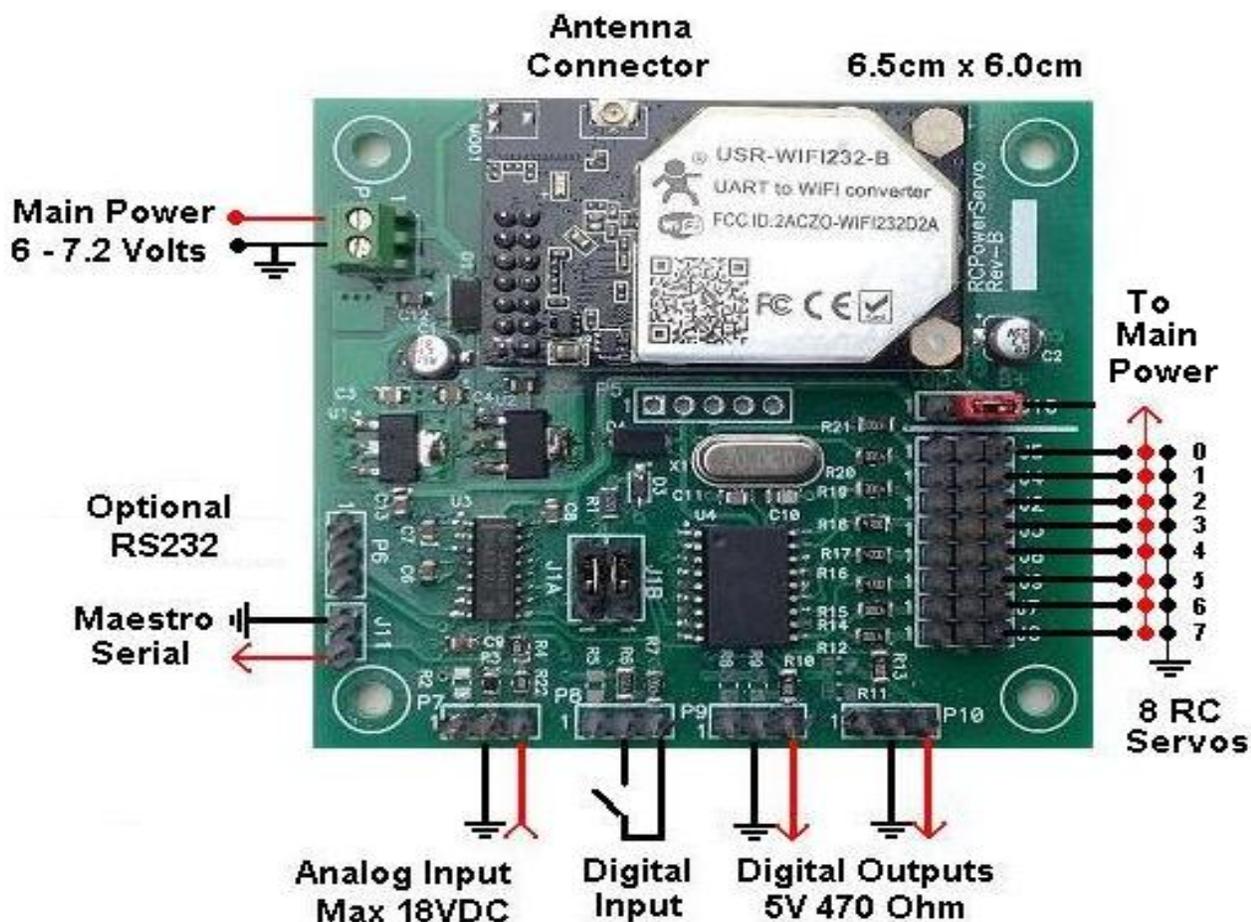
You should now be familiar with the hardware. Instructions on how to control the servos over WIFI differ, depending on your controlling device, iPad, PC, or Phone. Any software that is OSC compliant and capable of sending UDP data packets on port 8899 will do. OSC (Open Sound Control) is a communication standard used in stage productions.
For a detailed insight go to   opensoundcontrol.org/introduction-osc

RC-WIFI Controller Apps   **iPad, iPhone or Android Device**

Download any app that is able to transmit OSC data, like TB MIDI STUFF for IOS. There are free OSC apps but this one is by far the best and well worth $4.90 at the APP Store. If you have an Android device, TouchOSC is your best choice. How to setup TB MIDI STUFF is covered in a later section. Complete test pages for TB MIDI STUFF will be e-mailed with your purchase receipt.

RC-WIFI OSC Data Structure

Many apps are available for the iPad and Android device which are intended for the music enthusiast. We need one that supports the very popular OSC transmission protocol. For those who want to get a more comprehensive insight, go to this site for a detailed description.
http://opensoundcontrol.org/introduction-osc

The OSC communication is via a UDP port. There are a number of data types in the OSC protocol. Our controller will work with the following types.

Int16   16 bit big-endian two's complement integer
If your APP lets you choose the data type, you must use the integer type. Floating point type data is ignored.

A detailed analysis of the data stream for those who want to write their own transmission software is presented here. An OSC data packet, in our case, will always contain 16 bytes. Eight bytes for the OSC Address. This is our Device Address and Command ID. The other eight bytes contain the Servo Position or ON/OFF data in integer format. Every 16 byte OSC packet starts with a / character.

A typical OSC data packet sending a 2 byte integer value looks like this:
ASCII = /001T- - - ,i- - - - XX
DEC = 47 48 48 49 84 0 0 0 44 105 0 0 0 0 X X
HEX = 0x2F 0x30 0x30 0x31 0x54 0x00 0x00 0x00 0x2C 0x69 0x00 0x00 0x00 0x00 0xXX 0xXX

The first 5 bytes are ASCII characters.
XX = the 2 byte integer value and represents a Servo Position or ON/OFF value
All OSC data packets start with a / character, 47 decimal or 2F hexadecimal

NOTE: Other OSC Apps assume the / character that identifies the data as an OSC packet. You may have to omit entering this first character as part of your command data in other apps since it is added automatically. You may end up sending // and corrupt the data.

PC, Windows, Linux Users
You can use a PC to control the Rc Servos. Most console software will let you compose and send OSC data packets. If you are a software writer, you need to attach a UDP socket that sends and receives on port 8899.

The Command Structure

/001T   The first 5 bytes are used to identify the controller address, the servo number, and the command function. They are ASCII characters you type into an input box. The other 3 bytes remain true zero.
The /0 Is the device or controller address, and in this case, the data is intended for our WiFi-Controller.
A /1 is intended for the POLOLU Maestro Controller # 1. See later in another section.
The next 2 characters identify the Rc Servo Number or other control.

 /001T to /007T will address Servo 0 to 7 on the WiFi-Controller. The T is the function ID for the Target Position of a servo. .XX contains an integer value from 0 to 65535. This value data is generated by the control object like a slider or button on your tablet or phone and will rarely be larger than 255. Below is a list of the commands the RC- WIFI controller responds to. (For the POLOLU Maestro expansion read a later chapter)

/000T   to   /007T
This will position 8 different RC Servos to a position the OSC control generates (0-255)

/000T   sets the POSITION of Servo #0   connected to the RC-WIFI controller.
/001T   sets the POSITION of Servo #1   connected to the RC-WIFI controller.
/004T   sets the POSITION of Servo #4   connected to the RC-WIFI controller.
/007T   sets the POSITION of Servo #7   connected to the RC-WIFI controller.

/001D   and   /002D
These two commands can set 2 Digital output ports on the RC-WIFI controller to HIGH or LOW.
There is a 470 Ohm resistor in line on each output and is able to drive an LED without the current
limiting resistor. The OSC control generates (0) for OFF and (1) for ON

Setup Commands:

These commands are used to set flags in the controller. These settings are stored in internal
nonvolatile memory that are used when the controller powers up. All Setup commands have an X in
the 5th byte. One such command is to set the RC Pulse to either 1ms or 2ms width. If you are not
sure, leave it set to 1ms.

/F00X   set the controller to produce a 1ms RC Pulse
/F01X   set the controller to produce a 2ms RC Pulse
Most servos rotate 90 degrees if a 1ms pulse window is used. Some servos can rotate 180 degrees
when controlled with a 2ms pulse.

Another command sets one of 8 servos of your choice to that default position on power-up.
The Position Value is stored in non-volatile memory.
/D00X   set the present position of Servo 0 to be the default position.
/D01X   set the present position of Servo 1 to be the default position.
/D07X   set the present position of Servo 7 to be the default position.
On Power-up, all Servos will go to this default position that were set with this command.

At any time during operation you can force all servos to go to their default positions.
/S00X   set all 8 servos to their default positions that were set with the above command.

On power-up, all Control Objects in TBMIDI will synchronize to the default position they were last set
to.

Data from RC-WIFI controller to Controlling Device

Our RC-WIFI Controller can also send data out to the iPad, Android device or a PC. Whenever the RC-WIFI controller sends data out and that same command was attached to a control like a Slider, that slider will move to that position. All controls in TB MIDI can send data, but can only be received by the Controlling Device with the IP 10.10.100.100. All data packets sent from the RC WIFI Controller will always be sent to this IP address.

There are several indicator OSC messages that are sent out by the controller. Two of the inputs on the RC-WIFI controller can be monitored remotely. To make a connection to these 2 inputs, please read the section on Hardware.

One digital input on the WFI Controller lets you attach a switch.
/001P

This data is sent from the WIFI controller and can be attached to an indicator control on the iPad to monitor an ON or OFF condition. The OSC control receives a 0 value to indicate OFF and any value larger than 0 indicates ON.

One analog input lets you measure a voltage on the WIFI Controller.
/001A

This is the ID for the analog converter data and contains a value from 0 to 255
Our WIFI controller has one Analog input. It can be used to monitor the battery voltage on the RC WIFI controller or other source. You have to attach a wire to the plus line of your battery or other power source. The input is a divide by 4 value. Which means you can measure voltages up to 20 Volts. There are 255 measuring points, therefore, one value step = 0.078 volts. This data gets sent out when the voltage value changes on this input. If you do not use this feature, connect this input to any GND ground pin. If this input is floating, the controller will send data needlessly.

RC WIFI Safety Feature

Our RC WIFI Controller includes a safety feature that prevents your machine or robotic design from going a mock and cause injuries or damage. If for any reason you should loose radio contact with the RC WIFI Controller for 1.6 seconds, all connected servos will be set to their default position and On/Off devices will be set to off. This feature is off by default on power up and must be enabled. The following OSC
command must be sent to enable this feature.
/F11X

To disable this feature, this command must be sent.
/F10X

When this feature is enabled, the RC WIFI Controller will send a heartbeat data /000B to your Control Device at a 0.6 second interval. This data is then echoed back to the RC WIFI Controller. As long as the RC WIFI Controller receives this heartbeat data or any other valid OSC data packet, the controller will function normally. If for any reason the RC WIFI Controller does not receive any valid data from your Control Device or other source for a period of 1.5 seconds, the RC WIFI Controller assumes radio signal loss and will set all servos to the default position you have previously set.
Note: Once a Safety Timeout has occurred, you must re-enable this feature.

Notes on IP address resolving.

The RC WIFI Controller will always have IP 10.10.100.254. The WIFI name is RC-254. Many devices can send data (control servos) to this IP address. However, data from the WIFI controller is always sent to one controlling device that has IP 10.10.100.100. You can have many controlling devices (iPad, PC, etc) to position servos and so on. However, only one controlling device, like the iPad, with IP 10.10.100.100 is able to receive data listed above. The Controlling device that first logs on to the WIFI Controller RC-254, usually will get the IP 10.10.100.100. Only this device can then make use of the WIFI Safety feature since data is received and echoed back to the RC WIFI Controller. Any additional controlling devices will not receive this Heart Beat signal or other data.

QUICK Start Guide for TBMIDI STUFF

These instructions assume you have an iPhone or iPad and installed TB Midi Stuff. By now you have connected the power source. Also, use at least one RC Servo connected to the RC-WIFI controller, preferably on port 7. A vertical slider can be used to monitor the battery voltage sent from the RC WIFI controller.. In order to move a servo and make it work, you need some way of sending data to the RC WIFI Controller. You will need to purchase and download any APP that lets you send OSC data. There are several free apps, but the TB MIDI STUFF for IOS app is the one we suggest. To save you time, we have made up several template pages for the TB MIDI STUFF app. These pre-made pages contain control samples to turn your iDevice into a powerful control center. You can use these pages as a learning center for TB MIDI STUFF and get the basics on how to setup the controls and attach data to them.

To import these pages into TB MIDI STUFF, you must E-Mail these pages to yourself and be able to open the files on the device you want to use as the controller. After opening the E-Mail, press and hold your finger on one of the E-Mail attachments, a window will pop up and ask you Open With ? Select TB MIDI STUFF as your destination. This app will open automatically and import the page. Repeat this for all pages.

Once you have done this and applied power to the controller, you have to login to the WIFI module. Go to the SETTINGS page on your iPad. Then click on WI-FI and select RC-254 from the list of available networks. There is no login password for the controller, but you can add one later.

When you have successfully logged on, you can open the TB MIDI STUFF App. Before you can communicate with the RC-WIFI module, you have to make settings in TB MIDI STUFF.
Click on the Tool Wrench on the top right. A menu will pop up that you can scroll up and down.
In subgroup Midi Settings select WiFi Network: Session1 for both Midi IN and Midi Out.
In subgroup Persistence slide the knob next to "Restore last pages canvas at launch" to the right so the color changes to green.
In subgroup OSC , Enable field, slide the knob to the right so it will turn green.
In subgroup OSC , Host field ,type 10.10.100.254
In subgroup OSC , Outport field, type 8899
In subgroup OSC , Inport field, type 8899

At his point you should be able to control RC Servos from one of the sample pages. The sample controls are for servos attached to port 5, 6 and 7.

Step by Step How to design a slider in TB Midi app :

These instructions only apply to TBMIDI Stuff App. Every control object, a slider, button or knob, has two main values you have to set. One is the OSC data which is the position and address of the servo. You should ignore any reference to MIDI data.

This will show you step by step on how to make a new page and the settings for a Slider.
You have TBMIDI installed and running…..   Lets design a slider for servo #7

Tap on the + on the top line > Add a new page > Add Pages > Current Row >
Now you should see a blank page.

Tap on the + in the top line on the right > Select any slider
Position slider by dragging, sizing, etc. > Done > Save

When the Slider is visible on the screen > EDIT > Enter page Editor > Double Tab Slider
GLOBALS > Default Val =127
BEHAVIOR > Steps Count > Double Tap on slider > 255
OSC Messages > Add >
        Mode > Send and Receive
        Address >   /007T
        Argument Type > Tab on Float > change to Integer
        Filter same Value > Green
        Minimum Value > 1
        Maximum Value > 255
      On the very top Right > Done
Tab anywhere on the left of the page
Tab on Top Left > Done

Instructions for designing and setting control objects in TB MIDI.

These instructions assume you have loaded one of the sample control pages we supplied.

On the very top in any TBMIDI page, tab on **EDIT** > **Enter Page Editor.** Now double tab on a slider. The **Control Settings** page will pop up. Ignore any settings not mentioned here. First scroll down to **OSC Messages** and tab on it. Another window will pop up and display **/007T** or similar. Tab on the line to view detailed data. This is the OSC data assigned to a slider that will position a servo. The min value 0 and max value 255 represent the position range. 0 is the most right and 255 the most left turn position of your servo. You can change these values to suit your needs. You can also make a Servo run in the opposite direction by setting the High value to zero and the Low value to 255. Your servo will turn about 90 degrees with these settings.

Now tab **Done > Control Settings**. Scroll up to **Steps Count.**
This value represents how many steps the slider will resolve when you move it from one extreme end to the other. This is NOT the servo position. Each OSC data on a slider can send 255 positions for a 90 degree servo turn. That is 0.035 degrees per step. Most RC servos can not resolve such a small angle. So why send data more often than necessary. A **Steps Count** value of 127 will turn a servo by 127 steps or 0.07 degrees per step. This means the number of RC Servo positions will be divided by the control resolution value. If for example, your OSC data is 0 and 255 and you set the **Steps Count** to 4, then your servo will jump from position 0 to 85 to 170 to 255. If you like to set stops or travel limits for your servo, you have to alter the OSC data's top or bottom value. For example, 10 bottom value and 220 for top value. Your servo will now travel less than 90 degrees.

WIFI Module Setup

This section is for the advanced user that is familiar with WIFI networking. You can change the default network setup, or just the Name and add a Password. Once you have powered up the controller, a green light will go on and blink on the WIFI module. Now you have to log on to the WIFI module like any other network. It functions as an access point like the WIFI Router in your home.

To change any settings in the WIFI Module, your PC or Tablet must be connected to network name
 " RC-254 " This is the default name which you can change.
When your device tells you that you have connected successfully, you are ready to go.

In any Web Browser search bar type > **HTTP:// 10.10.100.254**   Wait for a window to pop up

If prompted...   Some of our controllers have no User Name or Password.

User Name: admin
Password: admin

If your log-on is successful, you should see a similar window like below.
You can change the default settings in the WIFI Module, like the Name, Password, IP Address, UDP port # etc. Make a written note of all settings before you make changes. Most settings are self-explanatory. If you don't understand what they are for, Do Not change them.

Anytime you have changed a setting, click <u>APPLY</u> at the bottom of the box before making more changes. After you are done making all the changes, go to <u>Device Management</u> and click on <u>Restart.</u>

AP Interface Setting > LAN Setup:
IP Address: 10.10.100.254
DHCP Type: Server
Security Mode: Disabled: Password not set – open WIFI.   Can be set by user

Application Setting > Network A Setting
Mode: Client
Protocol: UDP   Must stay at UDP, all OSC apps use UDP, not TCP/IP
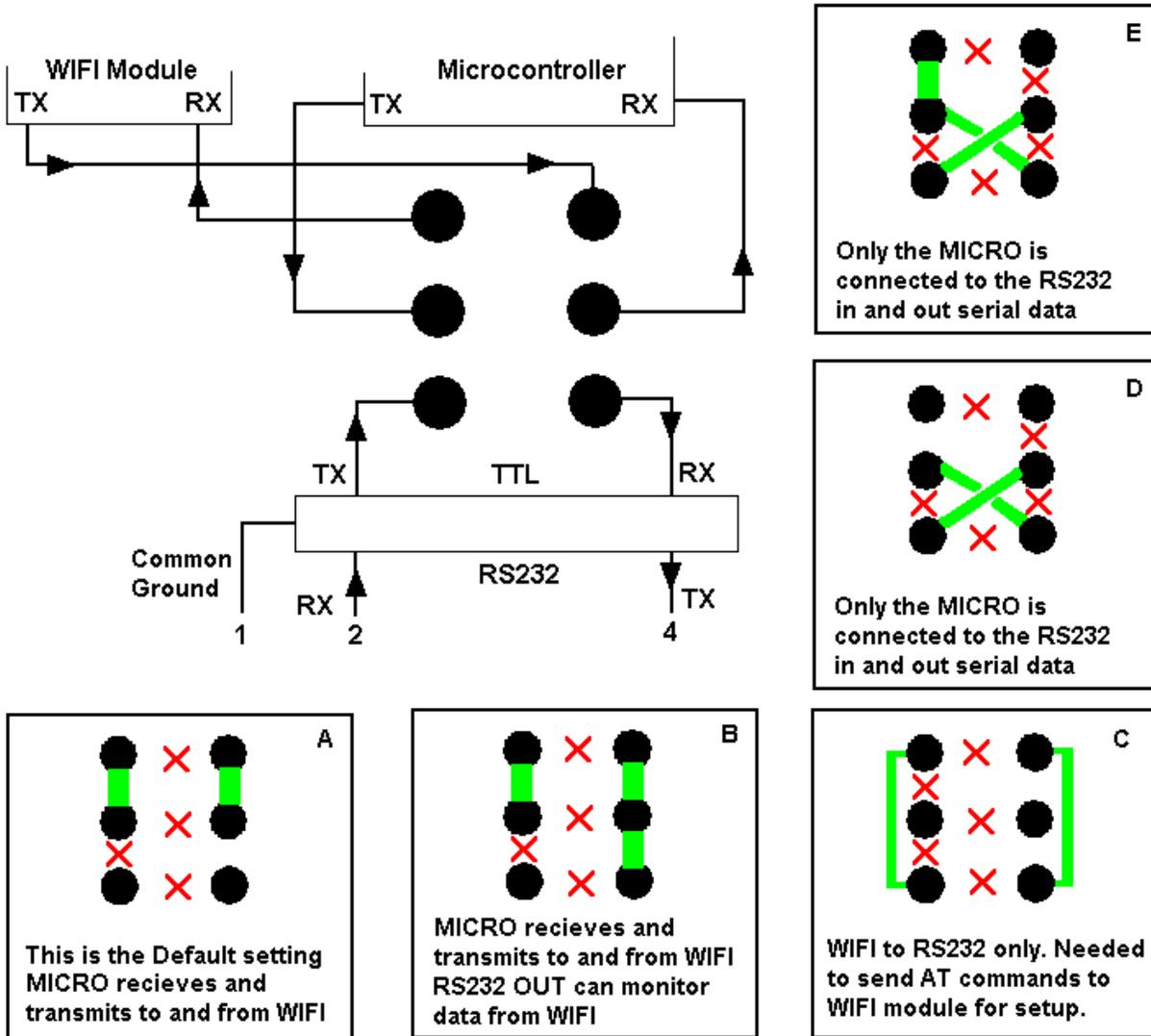Port: 8899
Server Address: 10.10.100.100

UART Settings:
Baud rate: 57.6KB   Must stay at   57.6KB

Serial I/O Map and Settings

WIFI Module
TX   RX

Microcontroller
TX   RX

TX   TTL   RX

Common
Ground

RS232

RX   TX

1   2   4

E — Only the MICRO is connected to the RS232 in and out serial data

D — Only the MICRO is connected to the RS232 in and out serial data

A — This is the Default setting MICRO recieves and transmits to and from WIFI

B — MICRO recieves and transmits to and from WIFI RS232 OUT can monitor data from WIFI

C — WIFI to RS232 only. Needed to send AT commands to WIFI module for setup.

An ✕ indicates that a jumper connection at this point is not allowed as it could damage the hardware !

Changing the Serial IN/OUT Jumpers is for the advanced user only.
Various serial port configurations are possible. The default setting is A. If you only need to control Rc Servos, disregard any other setting.