4D Wind Project DIY Guide

Contents

Introduction

AVS Forum members SOWK and SirMaster have created an incredible, immersive aspect to the home theater experience by adding wind with fans. I have experienced this first-hand at SOWK's theater, and it is incredible, immersive, and unique.

The wind effects are currently created by a few wind artists (SOWK, Brazen1, ???), but may be created by the end users as well. The effects are tailored to a specific title, frame by frame; the D-Box motion actuator system works the same way, as titles are individually coded. The goal is for the effect to be subtle, immersing you further into the film experience, and not taking you out of said experience.

A little explanation about the name is warranted. Most theaters have 2D (sight and sound), and adding wind would be third D. SOWKs theater features D-Box chairs, so since he already had the third D, adding the wind was his fourth D, hence the name of the project. They have created a thread on AVS Forum titled 4D Theater Wind Effect - DIY Home Theater Project, with a lot of information at the beginning of the thread.

Project Overview

One of the bigger challenges obtaining the Bill of Materials (BOM) for the project has been sourcing the proper fans. The project initially started with fans controlled via IR, and that required fans with discrete IR speed controls, not the typical IR controls that cycled through the various speeds. IR controlled fans with this specific IR control were rare, so the project is moving on to using fans with manual individual speed controls that can be controlled via a network-enabled relay.

While all this information is covered in the AVS forum thread above, here are the items required.

- A source device running MPC-BE / MPC-HC / Kodi / Plex
    - An HTPC is required for MPC-BE / MPC-HC
    - Kodi is the next best option, as it can be used on many android streaming devices. It works well with the Nvidia Shield.
    - While Plex works, it reports playback position in seconds, not milliseconds, so accuracy is reduced, and therefore, Plex is not preferred.

- A computer with Microsoft Windows OS to host the HTFanControl software.
    - Raspberry Pi support coming soon.

- Athom / Tasmota 4-channel AC relay for controlling manual three or four-speed fans.

- Manual three or four-speed fan.

    - Four-speed fans are difficult to find.

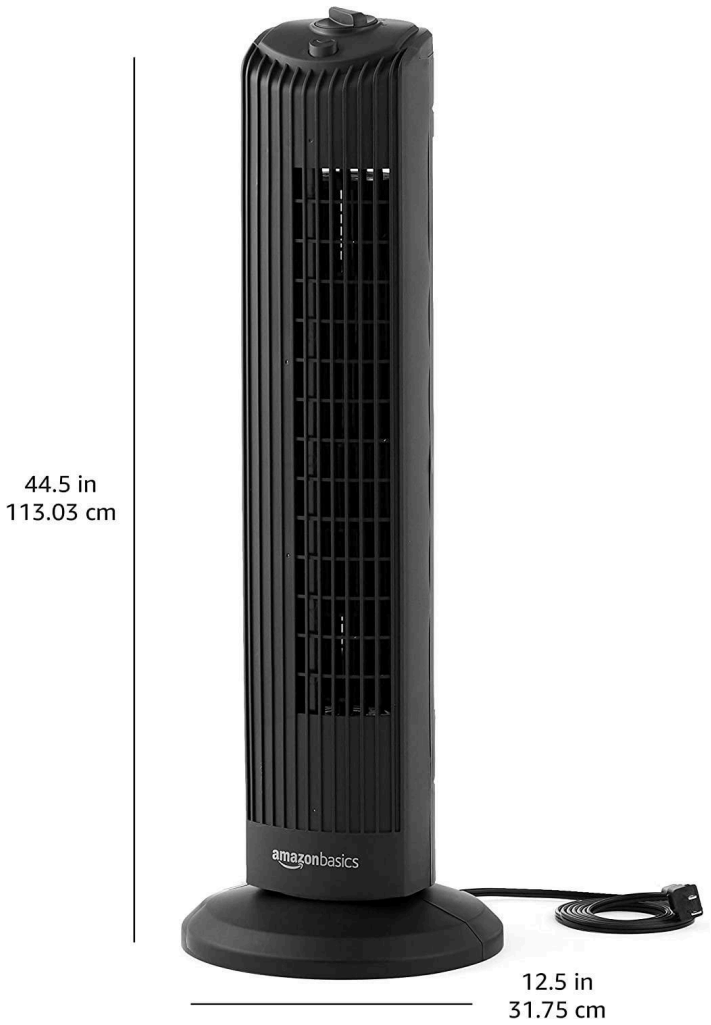
- Smart plugs to individually control power to multiple relays.

    - The fans add noise to the room, and increase ~3 dB with each additional fan. The intent with this additional hardware is to only use the fans for the seats that are occupied, and therefore minimize the additional noise. This will help to maintain immersion if wind is coded during quiet passages, by minimizing the noise level.
    - In a system with three fans for three front seats, really only two smart plugs would be required, as one fan would always be in use.

3-Speed Manual Fan Options

Amazon Basics Manual 28'' 3 Speed Oscillating Tower Fan with Mechanical Control

The Amazon Basics Manual 28'' 3 Speed Oscillating Tower Fan with Mechanical Control; it is available for $37.37 (02/2023) via Amazon at this link. It can be placed on the floor horizontally in front of the screen wall with an enclosure for a more stealth installation.



Honeywell HT-900 11 Inch Round Fan

The Honeywell HT-900 is an 11” round, manual three-speed fan; it is available for $15.99 (11/2021) via Amazon at this link. It can be placed on the floor in front of the screen wall and directed at the seating area with relative ease.

The decibel levels of one fan running from the MLP (about 11' from the fan) measured via the NIOSH app on an iPhone are below:

Room noise floor, without projector running: 28.2 dB
High speed 40.9 dB
Medium speed 37.1 dB
Low speed 33.5 dB

For air movement, they seem like a sufficient amount of air on all speeds at my seated listening position, based upon my memory from visiting the SOWK theater.

PELONIS 30 Inch Oscillating Tower Fan

The PELONIS 30 Inch Oscillating Tower Fan with 3 Speed Settings and Auto-off Timer is available for $44.99 (11/2021) via Amazon at this link. The tower style fans can be placed vertically on the floor on the side walls, or horizontally in front of the screen. For horizontal placement, it would be best to remove the base and build an enclosure like the example in the photo at the beginning of this guide; a close-up is provided below.

Holmes HTF3110A-BTM 31inch Oscillating Tower Fan

The Holmes HTF3110A-BTM 31inch Oscillating Tower Fan is available for $34.00 (11/2021) via Amazon at this link.

Relay Device Setup

ESP8266 chip-based device

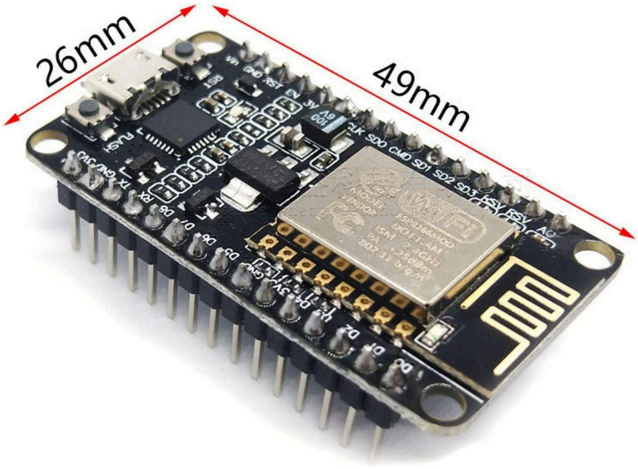
The athom 4-channel Wi-Fi Relay Module (ESP8266) can be purchased directly from the athom global store on AliExpress via this link for ~$18.00 + shipping, or via athom direct via this link for ~$20.00 + shipping. Please note it is available with or without a cover. This device is a Wi-Fi enabled 4-channel electric relay useful for controlling manual (not IR-controlled) three or four-speed fans. The application of this fantastic hardware solution is courtesy of AVS Forum member AndreNewman, and solved a major issue with the project, which was the ability to find IR-controlled fans with discrete IR codes.

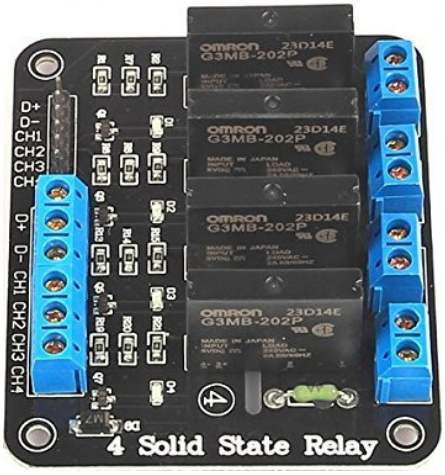
The relay features the ESP8266, a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability. The relay requires flashing with Tasmota open-source firmware for ESP devices, which provides a web interface for setup and configuration.

For this usage scenario, the HTFanControl software uses MQTT to remotely control the relay. MQTT is a lightweight, publish-subscribe network protocol that transports messages between devices. The MQTT protocol usually runs over TCP/IP, however, any network protocol that provides ordered, lossless, bi-directional connections can support MQTT. The MQTT protocol has 3 parts. The broker (mosquitto), the client (the tasmota relay), and the publisher (HTFanControl). The app is programmed so that you configure the MQTT topic and payload for the 5 fan commands (Off, Eco, Low, Medium, High).

The relay dimensions (L x W x D) are: 4.5” x 3.5” x 1.5”.

The Athom relays make an audible clicking sound when switching fan speeds, so if the relay will be installed inside your theater room, you may want to consider a solid-state relay. In February, 2023, there was no solid-state relay devices with an ESP8266 Wi-Fi chip built in, so I purchased the two items separately and connected them together. The ESP8266 ESP-12E NodeMcu Lua WiFi Module ($6.49 in 02/2023), and the SainSmart 5V 2A 4 Channel Solid State Relay Module ($15.99 in 02/2023)





Athom Tasmota 4-channel Wi-Fi relay module

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The relay features the ESP8266, a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability. The relay comes pre-installed with Tasmota open-source firmware for ESP devices, which provides a web interface for setup and configuration.

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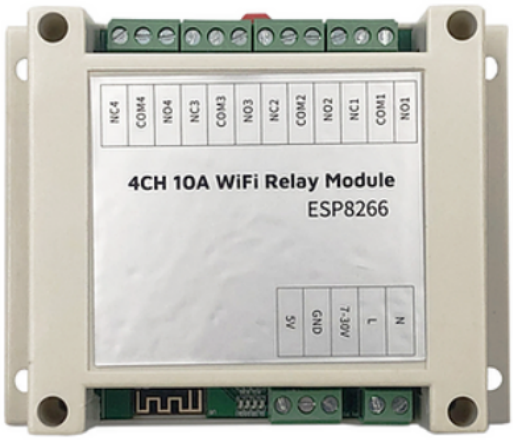
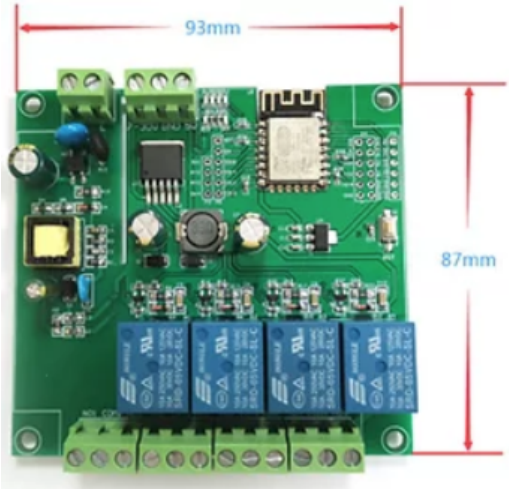




Flashing Tasmota on an ESP device with a built-in USB upload port

The Tasmota firmware can be flashed via a web-based application available on Github, or via an easier purpose-built app called Tasmotizer.

1. Download Tasmotizer https://github.com/tasmota/tasmotizer/releases, and launch it from the Downloads folder.

2. Connect the NodeMCU, D1 mini or M5Stack ESP device to your computer using USB to Micro USB cable. These devices have a USB upload port a serial-to-USB adapter built in.
    a. Use a USB **data cable**. Some USB cables are for charging only and do not connect the data lines needed to load the firmware onto the device.

3. Install the CP2102 driver, if necessary.
    a. Look in Device Manager, Universal Serial Bus Controllers, and if there appears an "Unknown USB Device", you should install the driver.
    b. Navigate to this link and download the driver for your operating system.
        i. I had to use the CP210x Windows Drivers with Serial Enumerator.
        ii. After installation, the device showed up in Device Manager, Ports:

4. Place the ESP into flashing mode.
    a. Ensure the USB cable is disconnected.
    b. Press and hold the "FLASH" button on the ESP device while connecting the USB cable.
    c. Release the "FLASH" button after a few seconds.
    d. If the flash button does not work and results in communication errors, alternatively, you can connect pin D3 (GPIO0) to a GND pin.
    e. Continue to the next step.

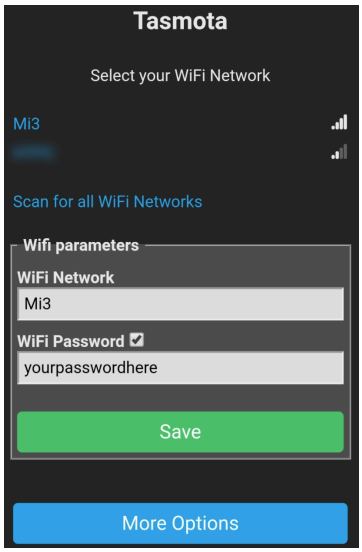
5. In Tasmotizer, select the following:
    a. Port.
    b. Image (Release XXX).
    c. Check the box for Self-resetting device, if applicable.
    d. Check the box for Erase before flashing.
    e. Click on the Tasmotize! Button.

6. Use Tasmotizer to perform configuration. These instructions were useful.
    a. Select the Send config button.
    b. Check the box to the left of "WiFi", then enter your SSID and Password.

Tasmota Setup & Configuration

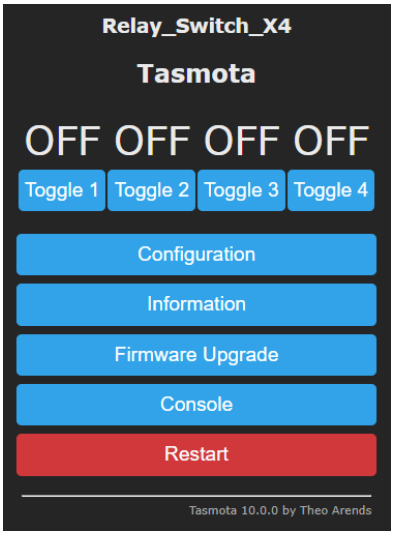
If you have a NodeMCU ESP8266 device, skip to step 6.
For the Athom Tasmota relay devices, initial setup is similar to many Wi-Fi only IoT devices.

1. Connect power to the relay via the “L” and “N” terminals.
    a. In simple electric circuits, the polarity of this connection does not matter, but in switched appliances, the on/off switch is wired to the hot side of the connection.
    b. Salvage a two-pole polarized power cord from an unused item or cut off the end of an extension cord, and strip both wires to expose the conductor.
    c. In the USA, the narrow blade in a polarized two-pole plug is “L” (aka hot), and the wider blade is the Neutral.
2. Plug in the relay to power.
3. On your computer or smart phone Wi-Fi settings, select the “tasmota…” device Wi-Fi.
4. The below Wi-Fi configuration page will open automatically.
    a. Enter your Wi-Fi credentials.

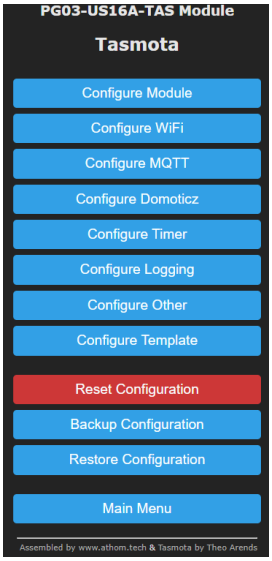


5. The device will connect to your Wi-Fi.
6. Log into your router to determine the IP address obtained via DHCP.
7. Use the IP address to log into the Tasmota interface.
    a. There is no option to set a fixed IP address in the device web UI, so a reservation must be made in the router if a fixed IP address is desired.

8. Upgrade the device firmware.
    a. From the Main Menu below, select “Firmware Upgrade”.
    b. Select “Start upgrade” in the top section, “Upgrade by web server”.

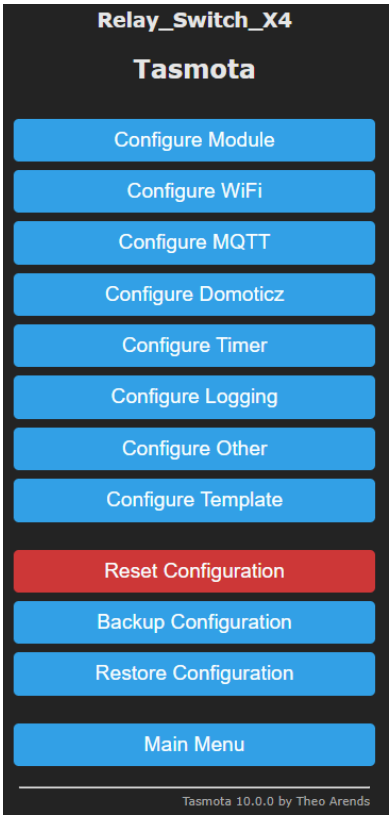


9. Change the Friendly Name, if desired.
   This makes it easier to manage multiple devices, as the name that appears at the top of all the web interface pages will be unique, instead of the default “Tasmota”.
    a. From the main menu, select “Configuration”.
    b. From the configuration page below, select “Configure Other”.

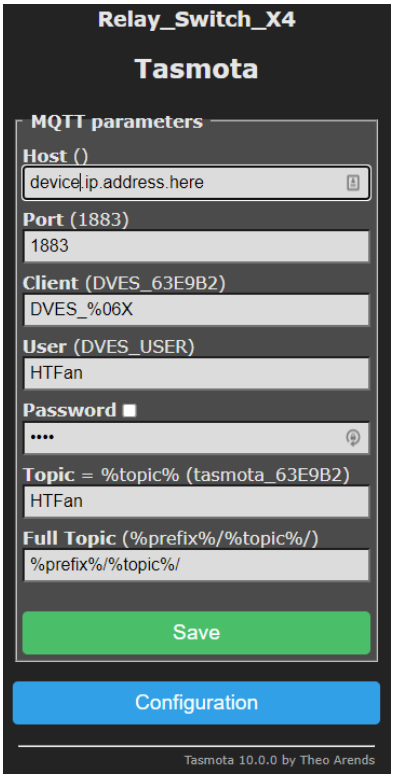


    c. Set the “Device Name (Tasmota)” to a unique name for the device.
    d. Select “Save”.
    e.

10. Configure MQTT.
    a. From the main menu, select “Configuration”.
    b. From the configuration page below, select “Configure MQTT”.

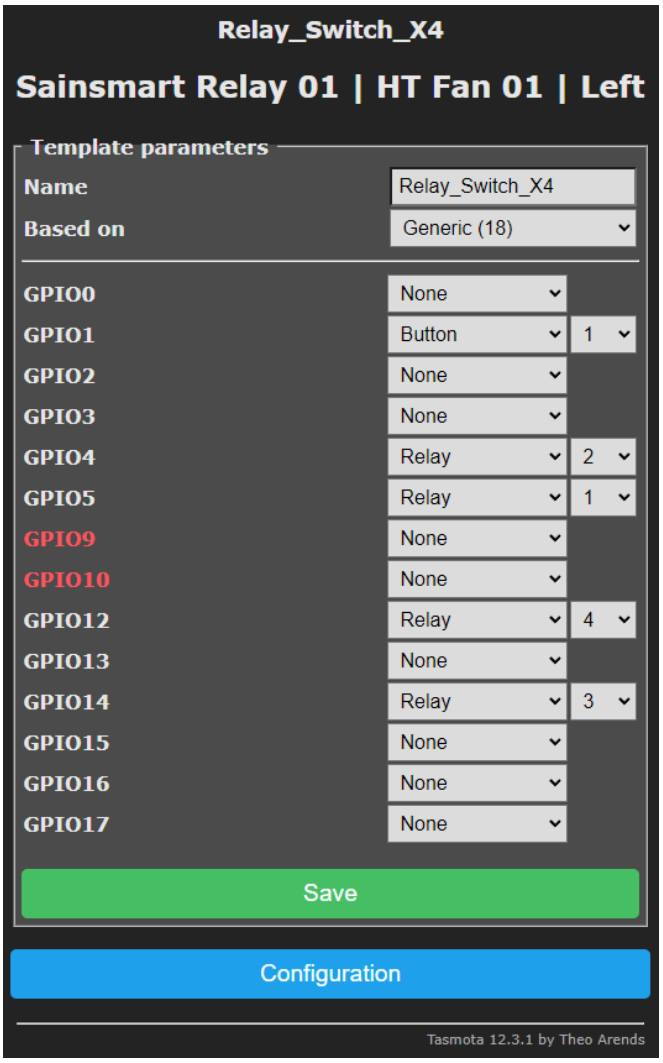


    c. Enter the following parameters:
        i. Host: Enter the IP address of the device hosting the HTFanControl software.
        ii. User: HTFan
        iii. Topic: HTFan
            a) HTFan is short but descriptive; the longer the Topic, the more traffic sent by MQTT.
    d. Select “Save” to save the configuration.
        i. The relay will restart.


Relay_Switch_X4
Tasmota
MQTT parameters
Host ()
device.ip.address.here
Port (1883)
1883
Client (DVES_63E9B2)
DVES_%06X
User (DVES_USER)
HTFan
Password
••••
Topic = %topic% (tasmota_63E9B2)
HTFan
Full Topic (%prefix%/%topic%/)
%prefix%/%topic%/
Save
Configuration
Tasmota 10.0.0 by Theo Arends

11. Configure the template (ESP8266 devices only) so the buttons can be set up. If you have an Athom Tasmota device, skip to the next step. Some ESP8266 pins output a 3.3V signal when the ESP8266 boots. This may be problematic if you have relays or other peripherals connected to those GPIOs. Additionally, some pins must be pulled HIGH or LOW in order to boot the ESP8266. Taking this into account, the safest ESP8266 pins to use with relays are: GPIO 5, GPIO 4, GPIO 14, GPIO 12 and GPIO 13. Source

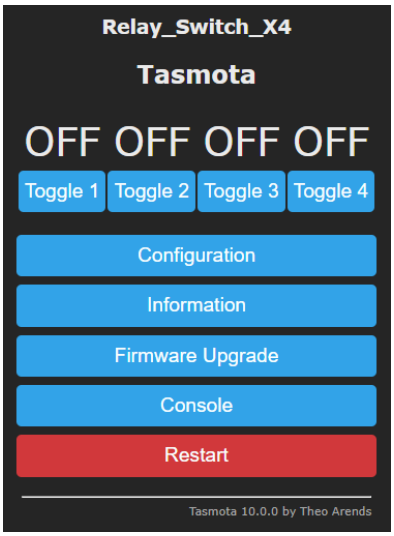
    a. From the main menu, select “Configuration”.
    b. From the configuration page, select “Configure Template”.
    c. Select the Generic (18) template from the drop-down menu, select another name, and configure the GPIOs as follows, which mirrors the configuration of an Athom 4-Channel relay:



    d. Click “Save”; the device will restart.

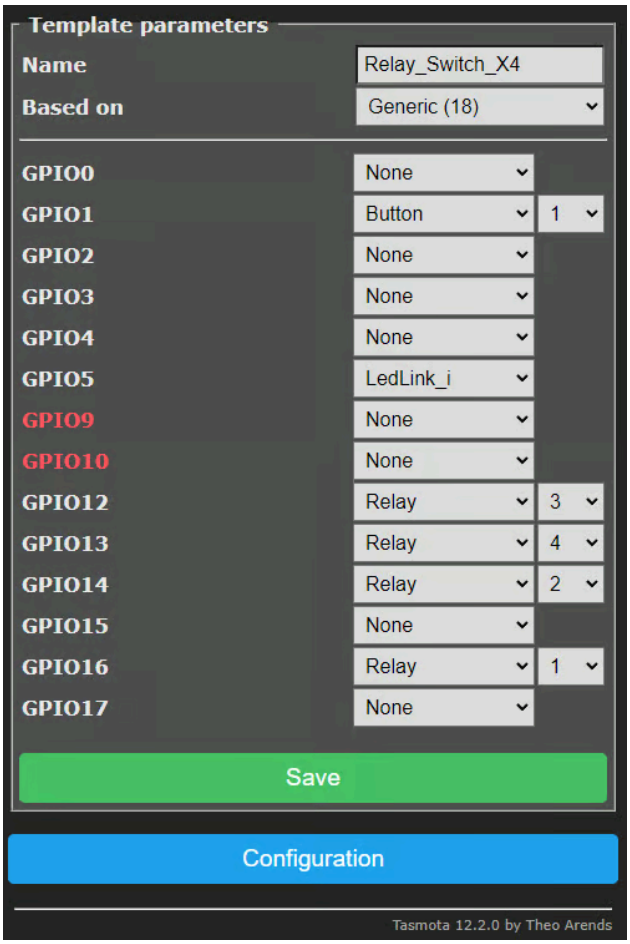
12. Configure the ESP8266 device module.
    a. From the main menu, select “Configuration”.
    b. From the configuration page, select “Configure Module”.
    c. In the Module type drop-down menu, select the recently configured template.
    d. Click on “Save”.

13. The Athom Tasmota 4-channel relay devices should come pre-configured, but in case the main menu does not look like this, it may not be.



    a. To resolve this issue, from the main menu, select “Configuration”.
    b. From the configuration page, select “Configure Module”.
    c. In the Module type drop-down menu, select "Relay_Switch_x4 (0)"
    d. Click on “Save”.
        i. If "Relay_Switch_x4 (0)" is not an option in the drop-down menu, you will need to configure it again by going on to the next step.

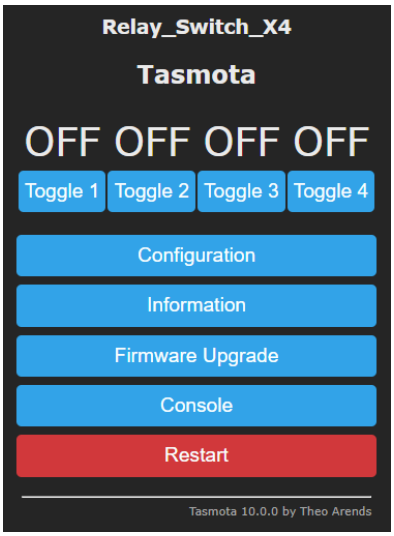
14. If "Relay_Switch_x4 (0)" does not appear as a template in the prior step, just re-configure it as follows.
    a. From the main menu, select “Configuration”.
    b. From the configuration page, select “Configure Template”.
    c. Select the Generic (18) template from the drop-down menu, type in the desired name, and configure the GPIOs as indicated below.



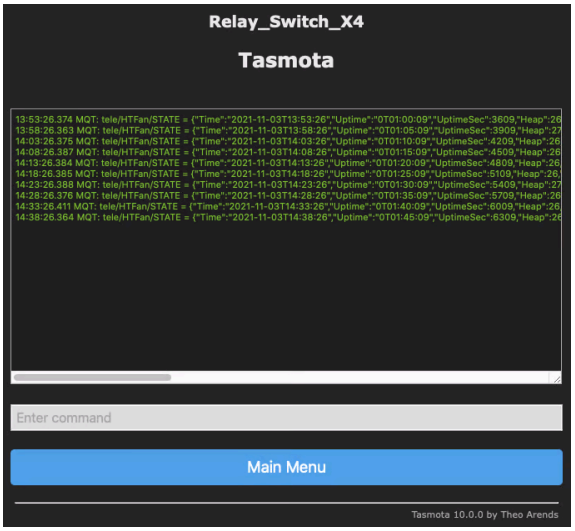
    d. Click on “Save”; the device will restart.

15. Configure the Athom device module.
    a. From the main menu, select “Configuration”.
    b. From the configuration page, select “Configure Module”.
    c. In the Module type drop-down menu, select the recently configured template.
    d. Click on “Save”.

16. Configure the Console.
    a. From the main menu, select “Console”.



    b. The Console menu has a command line and a log of events.
        i. There will be “Connection failed” messages if the HTFanControl software has not yet been configured.



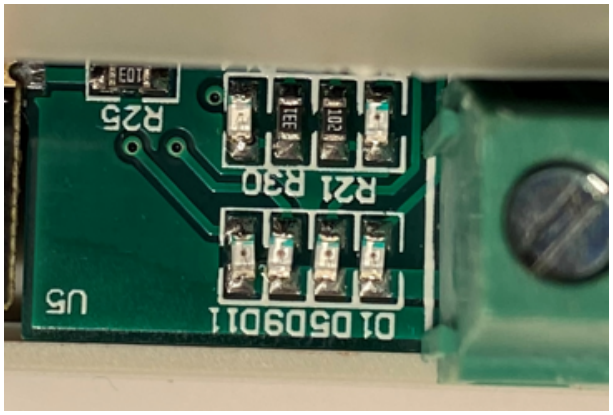
    c. The commands entered below instruct the controller to do the following:
        i. Interlock, so only one relay is ever on at once.
        ii. Reset relays on power cycle or reset so it does not retain the status.
        iii. Switch the relays via commands sent by MQTT.
    d. Enter each command string below, and then press “Enter” after each line.
        Interlock 1,2,3,4
        Interlock on

PowerOnState off
SetOption63 1
SetOption 0
Rule1 on event#s1 do power1 1 endon on event#s2 do power2 1 endon on event#s3 do power3 1 endon on event#s4 do power4 1 endon on event#s0 do power0 0 endon
Rule1 on
Restart 1

e. The device will reboot; it takes about 30 seconds.
f. After the device reboots, the various relay buttons (Toggle 1-4) can be tested.
g. Select “Main Menu”, and click on the “Toggle 1-4” buttons to test.
h. If the interlock configuration is working, when the toggle buttons for each relay are clicked, it turns the other relays off, so only one is on at a time.
i. To turn them all off, click the one that is currently on.

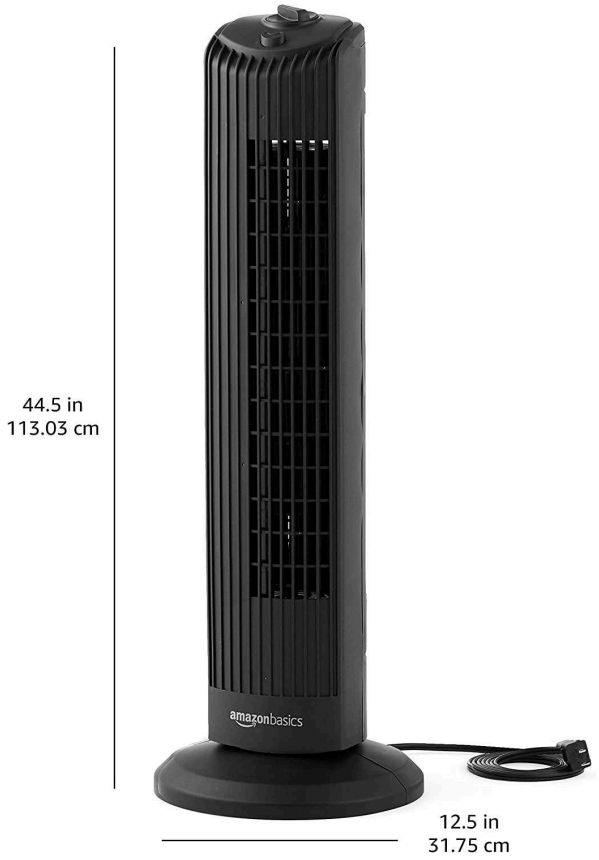
Troubleshooting

1. Here is a closeup of the LED array on the Athom unit. If you are experiencing issues with the relay, this may help identify a blinking LED to assist with searching for assistance. The two pictures are provided depending upon which way the relay is oriented when looking at the LEDs.



Fan Disassembly – Amazon Basics 3-Speed Manual Tower Fan

The Amazon Basics Manual 28'' 3 Speed Oscillating Tower Fan with Mechanical Control; it is available for $37.37 (02/2023) via Amazon at this link. It can be placed on the floor horizontally in front of the screen wall with an enclosure for a a stealthier installation. Horizontally-oriented tower fans allow for a wider horizontally, but narrower vertically column of air than round fan. They are also quieter than the standard round fan, but the air flow is at a lower CFM. The tower fans can be placed on the floor in front of the screen wall and directed at the seating area with relative ease. For, build a box to insert the fan.



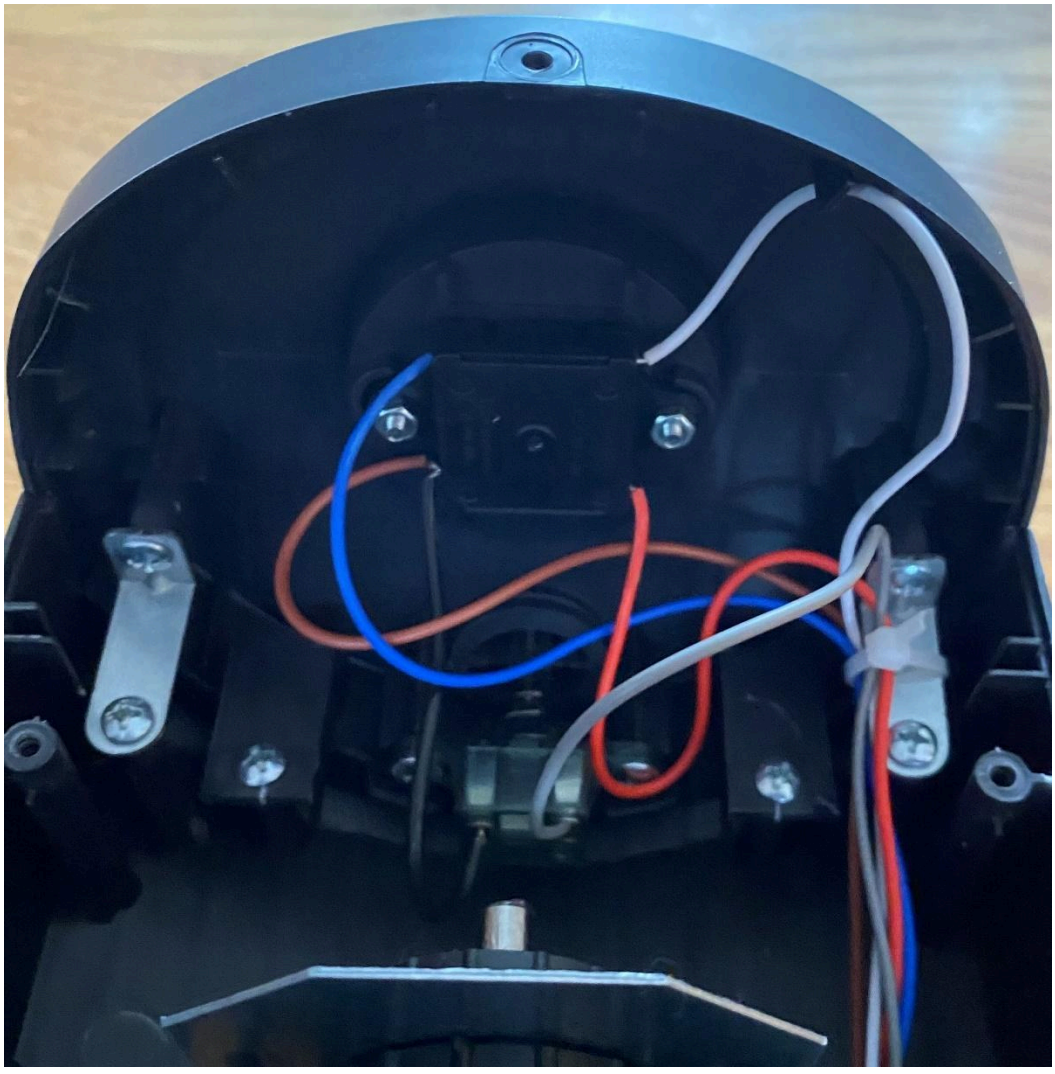
For disassembly, all screws are #2 Phillips head. Remove the back cover; there are 7 screws: 4 on the sides, 1 at the top, near the handle indentation, and 2 at the bottom, where the power cord exits.

Looking at the photo above, the fan speed and oscillation controls are on the left (aka top) of the fan, and the fan and oscillation motors are on the right. In the next steps, the speed switch will be removed, the wires cut from the oscillation switch, and the wiring will be pulled back from the left (top) section to the right (bottom) section of the fan, because all the wires required to connect to the relay will exit the right (bottom) of the fan.

The photo below shows the speed control and oscillation on/off switch wiring. For the speed control, starting from the lower-left corner, the terminals are:

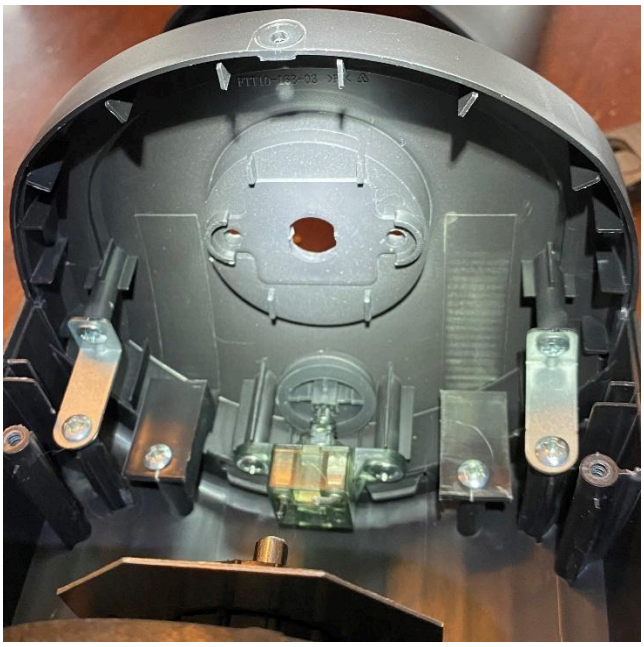
L – Brown wire (120 VAC Neutral) + Black wire (to oscillation on/off switch)
1 – Blue wire (Low Speed)
2 – White wire (Medium Speed)
3 – Red wire (High Speed)

The oscillation on/off switch has the black wire coming from the L terminal above, and the gray wire that connects to the oscillation motor at the bottom of the fand. The gray wire is not needed, so it can be cut off from the oscillation switch.



The speed control can either be removed (two cap screws with nuts) or left in place. To remove the wires from the terminals, insert a small flat-blade screwdriver to release the wire; they are held in place by spring tension.

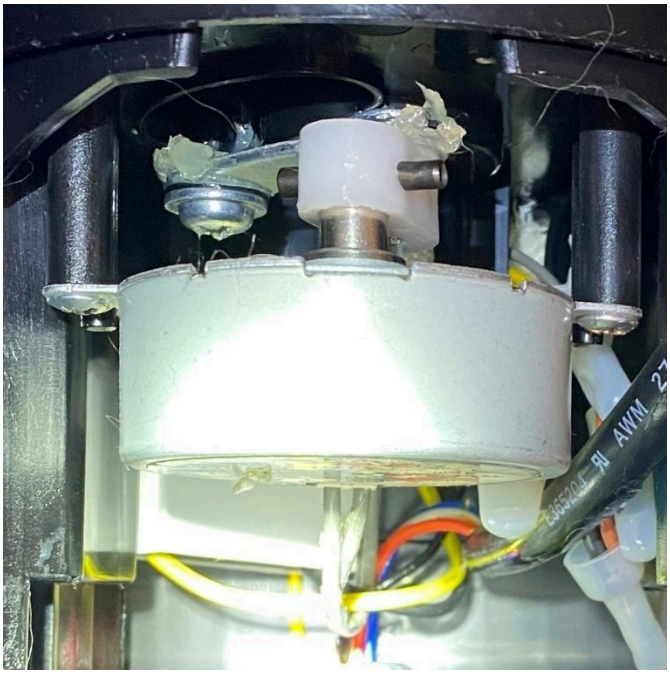
I chose to remove the switch and cut the wires from the oscillation on/off switch.



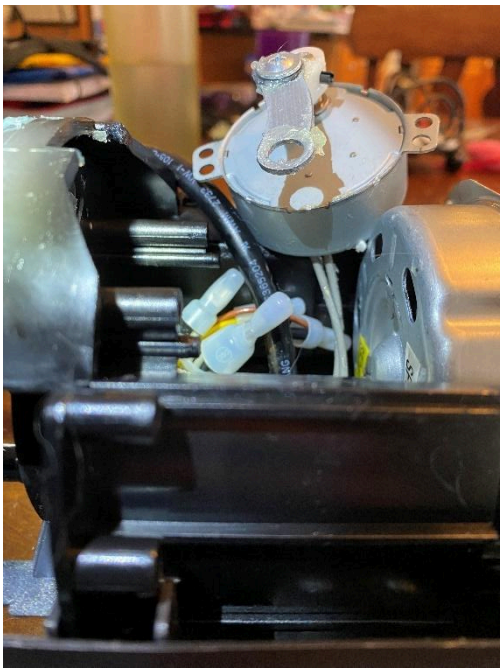
Next, the oscillation motor (smaller round motor in the photo below) and mechanism are removed. This could possibly be left in place, but further disassembly would probably still be required to be able to route the wires from the control area out the bottom of the fan. Since it was no longer needed, I removed both the motor and the mechanism.

Remove the three screws that secure the cover plate; it is already shown removed in the left photo below. Remove the three that secure the rotating base; it is shown removed in the right photo below.

Next, remove the two screws that secure the motor to the housing, and then the screw that attaches the linkage from the motor shaft to the rotating base. I attempted to remove the cotter pin on the motor shaft, but it did not budge, so I just had to twist the motor until I was able to get a screwdriver in position to the remove screw that attaches the linkage.

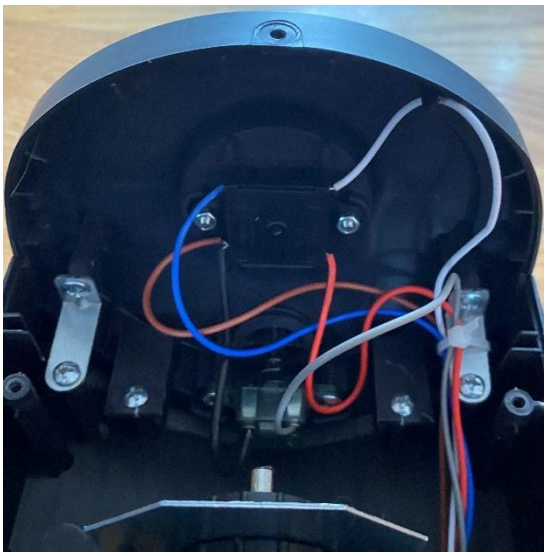


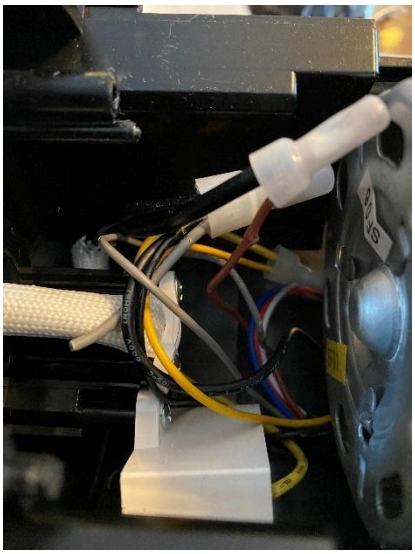
With the motor free of the linkage, the rotating base is freed, and the motor is ready for removal, after the wires are removed as described below. Do not cut the AC cord yet.



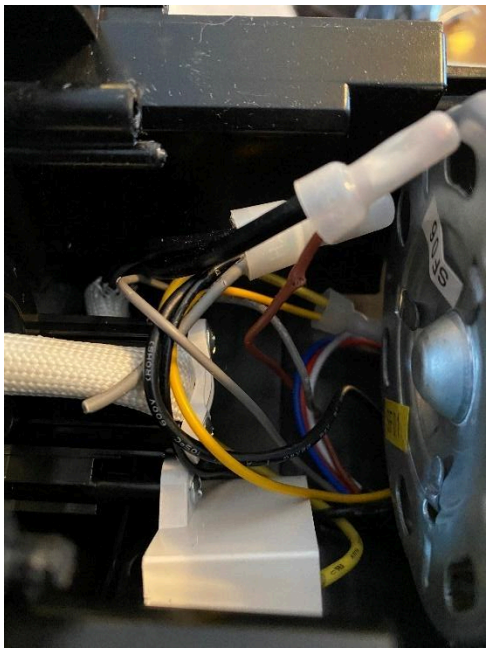
One of the gray wires for the oscillating motor is routed to the oscillating motor on/off switch in the control area at the top of the fan; left photo below. The other grey wire is crimped together with other power wires in the bottom section of the fan; right photo below. In the right photo, there is about 1” of wire remaining, which I then cut closer to the crimp connection after I was

able to move it around easier. Cut both gray wires for the oscillating motor. Consider leaving the maximum length of wire possible if you might use the motor in the future.



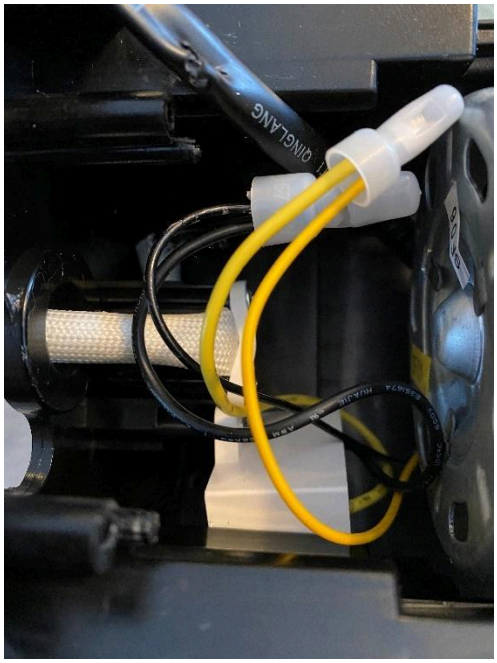


The black and brown wires in the foreground of the below photo are 120 VAC Hot. The black wire is the AC cord Hot conductor, and the brown wire is routed to the fan speed control in the control area at the top of the fan. Neither of these wire are necessary for this project, so the crimp connector can be cut off. The black wire can remain there, as it will not be connected to anything. The brown wire will be removed in the next step.



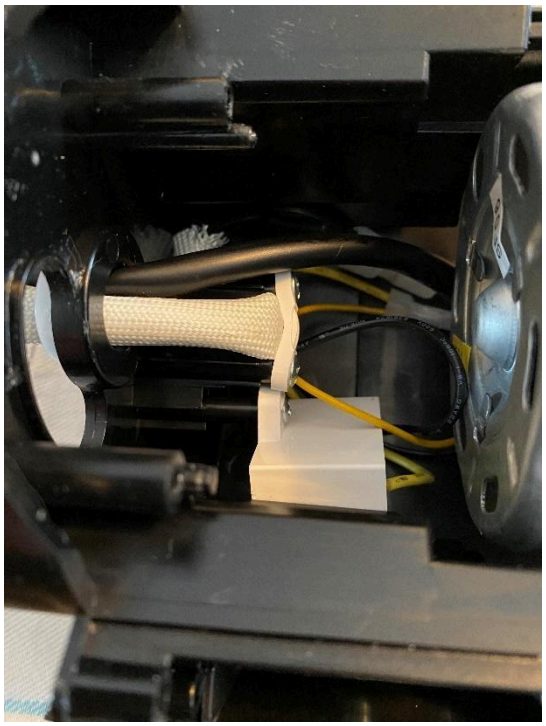
The wiring harness that routes wires from the bottom of the fan to the top can now be pulled out. It runs along the side of the fan, and the sheath is just held in place by plastic tabs. Just use your fingers or a blunt tipped instrument to work it free from the tabs.

The wiring sheath is shown routed past the two yellow wires in the photo below. This photo also represents the only two crimp connections in the bottom of the fan housing, for reference.



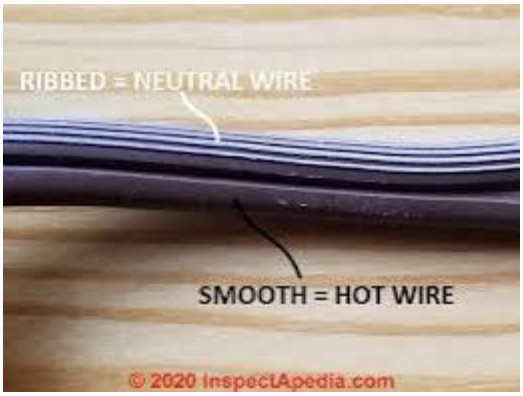
The brown and gray wires can be pulled through the sheath and removed, because only the red, white, and blue wires are required. Push the two remaining crimp connectors to the bottom and

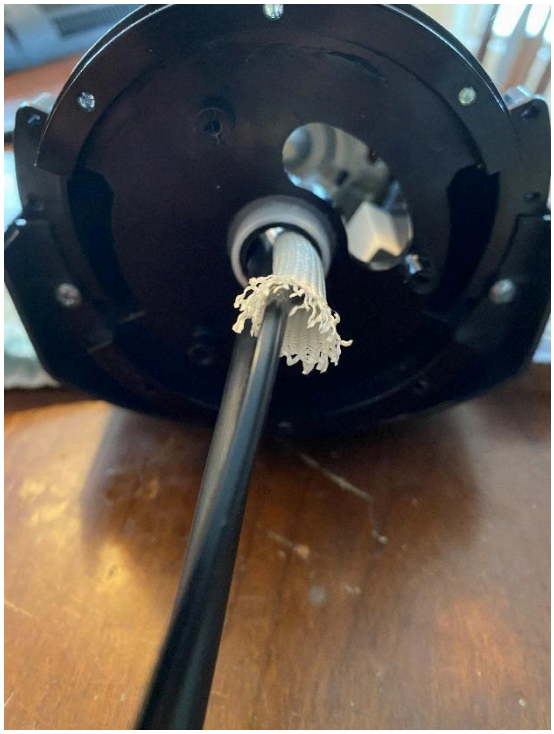
out of the way of the fan motor. Then the sheath can be routed through the same hole that the AC wires pass through.



The AC cord can be cut to the same length as the red, white, and blue wires. It can be cut shorter later if it is not required to be that long.

The AC cord only requires the Neutral wire, which is ribbed (not smooth). Therefore, the hot wire can be removed. I decided to use the existing wire retention clip, so I had to cut the hot wire back past the insulation in order to fit the wiring sheath, insulation material, and the Neutral wire in the retention clip. In the right photo below, the hot wire is cut back to about the point where it exits the hole.


RIBBED = NEUTRAL WIRE
SMOOTH = HOT WIRE
© 2020 InspectApedia.com



Here is the wiring fixed with the wire retention clip, as well as the other end of the wires shown for reference. It is ready to connect to the relay.

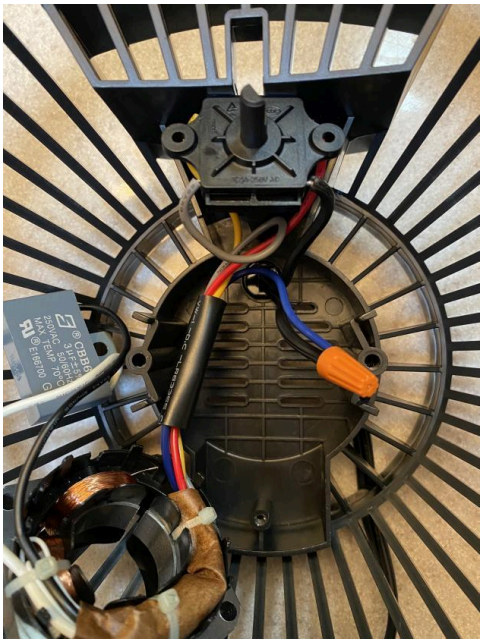
Fan Disassembly – Honeywell HT-900 Fan

The Honeywell HT-900 is an 11” round, manual three-speed fan; it was purchased for $15.99 (11/2021) via Amazon. As of 02/2023, it is not available directly from Amazon; only through 3rd party sellers. It can be placed on the floor in front of the screen wall and directed at the seating area with relative ease.

For disassembly, all screws are #2 Phillips head. There are six screws holding on the front half of the outer cover, 4 screws for the fan blade / armature assembly (only 2 need to be removed), 1 screw for the switch bracket / cover, and 1 screw for the capacitor bracket. Below are photos of the disassembled unit. There is 5/16” (2 cm) of clearance below the fan motor for making wire connections; note there is an extra sheath around the wires that were directly under the motor.

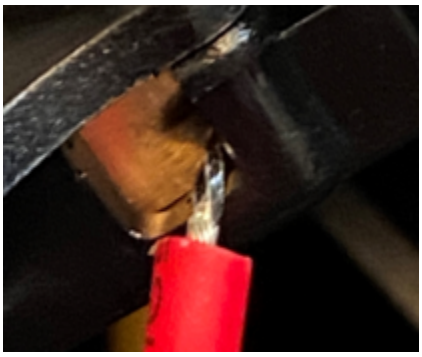
Switch still inside the slot

Switch outside of the slot



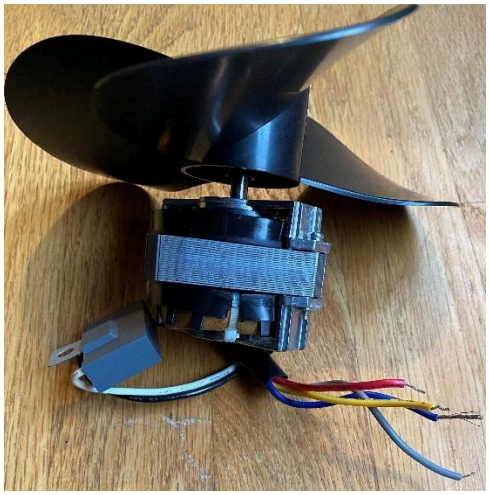
The pictures above were after disassembling the first fan. For disassembling the subsequent fans, I performed the following steps:

1. Remove the switch knob by inserting a small screwdriver underneath and prying up.
    a. It is held on by friction.
2. Removing the six screws holding on the front half of the outer cover.
3. Remove the screw holding in the capacitor.
4. Remove the screw holding in the switch bracket.
5. Remove the switch bracket.
6. Remove the 2 screws holding the fan blade/motor assembly to the plastic housing.
7. Pull the switch out from the slot.
    a. Move the fan blade / motor assembly out of the way as needed.
8. Remove the switch wires by inserting a small flat-blade screwdriver to release the wire.
    a. They are held in place by spring tension.



9. Remove the wire nut for the Neutral wires (blue to the fan, black to the electric plug).
10. Remove the fan blade / motor assembly.

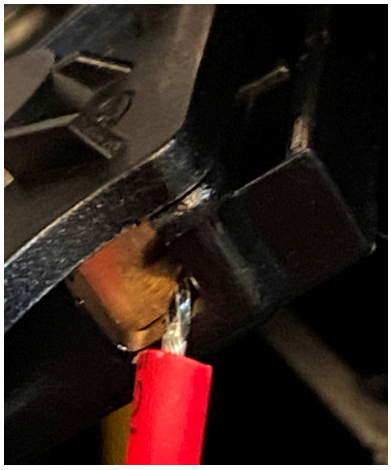
Fan blade / motor assembly

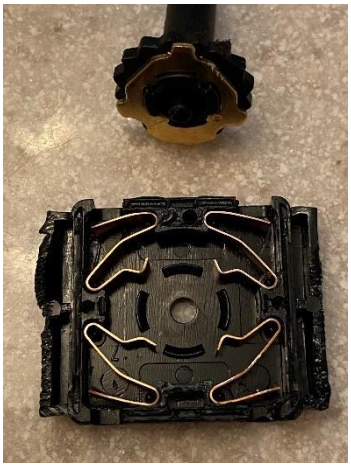


Empty fan housing with power cord removed

The wiring for this fan is as follows:
From the two-pole outlet plug to inside the fan is a 2 x 18 AWG (0.824 mm) stranded wire.
The wiring from the motor inside the fan is 22 AWG (0.34 mm) stranded wire.

The wires to the switch are held captive by the spring force of the metal contact, so insert a small screwdriver, push back the metal clip, and the wire can be pulled out. See photos below for details.

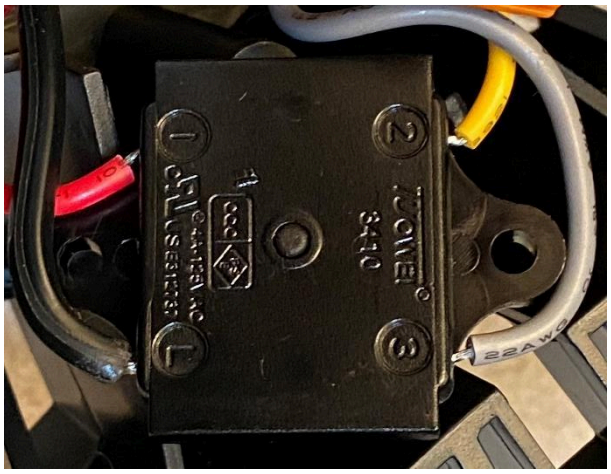




For the wiring, the switch is wired as follows:
Switch terminal L is Line (aka hot); black wire. The Neutral wire for power goes to the motor.
Switch terminal 1 is high speed; red wire.
Switch terminal 2 is medium speed; yellow wire.
Switch terminal 3 is low speed; grey wire.

Top of switch with knob removed

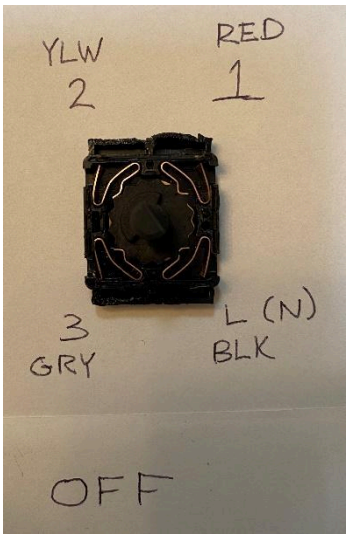
Bottom of switch showing terminal labels

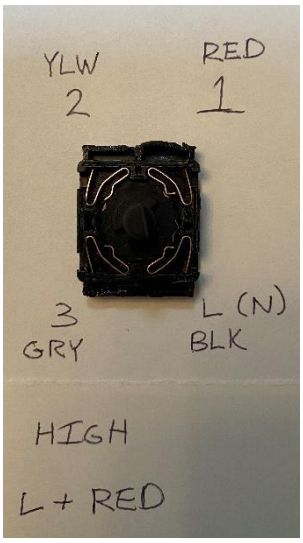


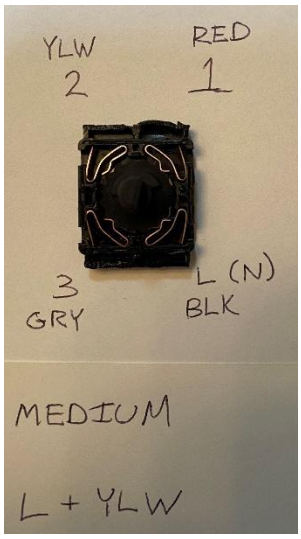
I disassembled the switch to see how the contacts are made for the various speeds, and confirming the correct wires for the various speeds. The switch terminal numbers 1-3 are marked for the switch position, not the fan speeds, as the switch position order is Off, High (1), Medium (2), Low (3).







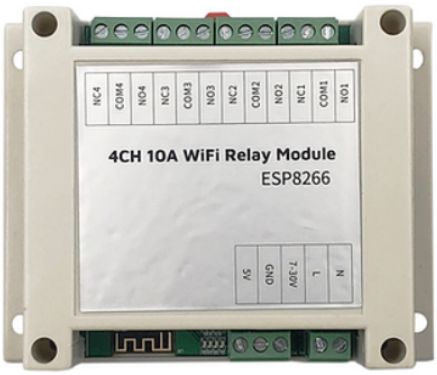


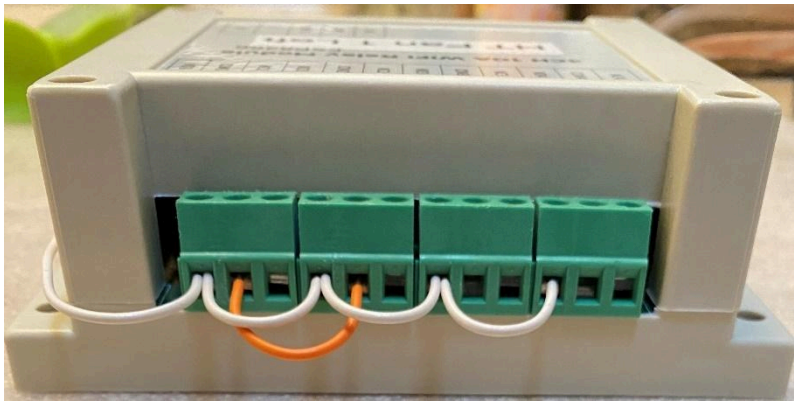


Wiring The Athom Relay – Amazon Basics 3-Speed Manual Tower Fan

Overview

The relay uses terminal contacts that are designed to secure one wire, so extreme care should be taken when using multiple wires. Two wires of the same gauge can be used when placed side by side, so there is even clamping force on the wires. See example below with 18 AWG solid wire used for the jumper wires; they fit in the terminals nicely side by side.





Wiring Recommendation

The recommended wiring schematic is designed for ultimate safety, as the relay uses dry contacts, which have a power going through them that is independent of the control circuit. The recommendation to wire the L terminal to the NO1 vice the COM1 terminal is to prevent someone from being shocked with electricity by accidentally touching the NC terminals.

The recommended method has the following basic connections:

- The L terminal to the wall power via the line (aka hot) plug of the two-pole plug, and to the NO1 terminal.

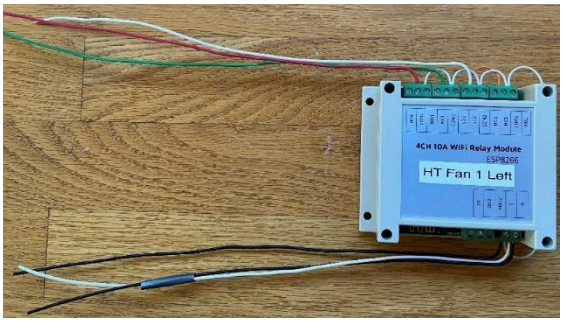
- The N terminal to the wall power via the neutral plug (the wider blade) of the two-pole plug and to the fan motor.
- The NO terminals 1-4 are connected together via jumper wires.
- The COM terminals 1-4 are used for the fan speed wires.

The chart below shows the connections for the Amazon Basics fan in more detail, with the specific colors used in red text. This is a spreadsheet that can be downloaded and modified for the end user's specific installation, if desired. Insert Link

Amazon Basics 3-Speed Manual Tower Fan Wiring Schematic

Input				Output				
Destination	Wire Color	Terminal Label	Terminal Description	Usage Description	Terminal Description	Terminal Label	Wire Color	Destination
				High Speed	Normally Closed	NC4		
					Common	COM4	RED	High speed fan wire (Red in the fan)
					Normally Open	NO4	WHT	To NO3
				Medium Speed	Normally Closed	NC3		
					Common	COM3	GRN	Medium speed fan wire (White in the fan)
					Normally Open	NO3	WHT	To NO4
							WHT	To NO3
				Low Speed	Normally Closed	NC2		
					Common	COM2	WHT	Low speed fan wire (Blue in the fan)
							ORG	If no Eco speed on fan, daisy chain: To COM1
		5V	5 Volts DC		Normally Open	NO2	WHT	To NO3
		GND	Ground				WHT	To NO1
		7-30V	7-30 Volts DC	ECO Speed	Normally Closed	NC1		
To AC power Line	BLK	L	120 VAC Line (aka hot)		Common	COM1	ORG	Eco speed fan wire If no Eco speed on fan, daisy chain: To COM2
To relay output NO1	WHT				Normally Open	NO1	WHT	To NO2
To AC power Neutral	WHT	N	120 VAC Neutral				WHT	To relay input L
To fan motor (Black in the fan)	BLK							
Input				Output				

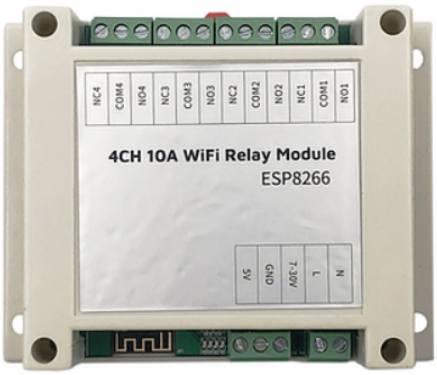
The photo below shows the jumper and pigtail wires installed per the above schematic. It may be confusing, as I was not always able to keep the same color of wire, but the pigtail wires were used due to the use of mixed gauges of wire for the various connections. The pigtail wires are all 18 AWG solid conductors, thereby ensuring the safest connection when using multiple wires on the terminal contacts. Wire the relay to the fan and test it. You can use the Tasmota web interface to test the different fan speeds. If everything is working, proceed to the Mosquitto Installation section.

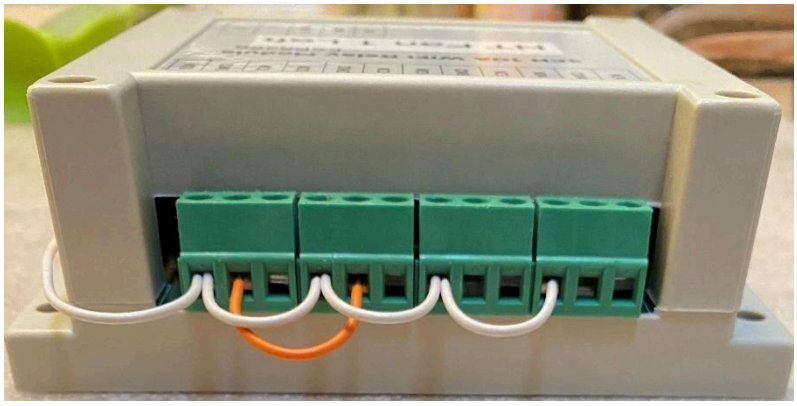

4CH 10A WiFi Relay Module
ESP8266
HT Fan 1 Left

Wiring The Athom Relay – Honeywell HT-900 Fan

Overview

The relay uses terminal contacts that are designed to secure one wire, so extreme care should be taken when using multiple wires. Two wires of the same gauge can be used when placed side by side, so there is even clamping force on the wires. See example below with 18 AWG solid wire used for the jumper wires; they fit in the terminals nicely side by side.





Wiring Recommendation

The recommended wiring schematic is designed for ultimate safety, as the relay uses dry contacts, which have a power going through them that is independent of the control circuit. The recommendation to wire the L terminal to the NO1 vice the COM1 terminal is to prevent someone from being shocked with electricity by accidentally touching the NC terminals.

The recommended method has the following basic connections:

- The L terminal to the wall power via the line (aka hot) plug of the two-pole plug, and to the NO1 terminal.

- The N terminal to the wall power via the neutral plug (the wider blade) of the two-pole plug and to the fan motor.
- The NO terminals 1-4 are connected together via jumper wires.
- The COM terminals 1-4 are used for the fan speed wires.

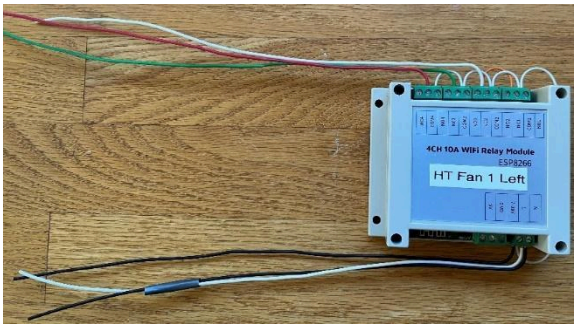
The chart below shows the connections for the HT-900 fan in more detail, with the specific colors used in red text. This is a spreadsheet that can be downloaded and modified for the end user's specific installation, if desired. Insert Link

Honeywell HT-900 Wiring Schematic

Input			
Destination	Wire Color	Terminal Label	Terminal Description
		5V	5 Volts DC
		GND	Ground
		7-30V	7-30 Volts DC
To wall power Line	BLK	L	120 VAC Line (aka hot)
To relay output NO1	WHT		
To wall power Neutral	WHT	N	120 VAC Neutral
To fan motor (Blue in the fan)	BLK		
Input			

Output				
Usage Description	Terminal Description	Terminal Label	Wire Color	Destination
High Speed	Normally Closed	NC4		
	Common	COM4	RED	High speed fan wire (Red in the fan)
	Normally Open	NO4	WHT	To NO3
Medium Speed	Normally Closed	NC3		
	Common	COM3	GRN	Medium speed fan wire (Yellow in the fan)
	Normally Open	NO3	WHT	To NO4
			WHT	To NO3
Low Speed	Normally Closed	NC2		
	Common	COM2	WHT	Low speed fan wire (Grey in the fan)
			ORG	If no Eco speed on fan, daisy chain: To COM1
	Normally Open	NO2	WHT	To NO3
			WHT	To NO1
ECO Speed	Normally Closed	NC1		
	Common	COM1	ORG	Eco speed fan wire If no Eco speed on fan, daisy chain: To COM2
	Normally Open	NO1	WHT	To NO2
			WHT	To relay input L
Output				

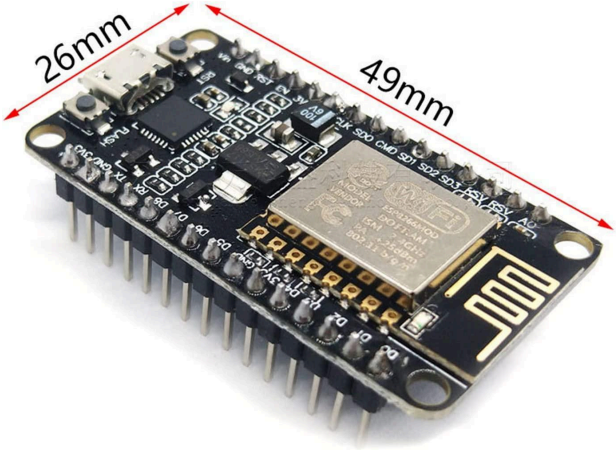
The photo below shows the jumper and pigtail wires installed per the above schematic. It may be confusing, as I was not always able to keep the same color of wire, but the pigtail wires were used due to the use of mixed gauges of wire for the various connections. The pigtail wires are all 18 AWG solid conductors, thereby ensuring the safest connection when using multiple wires on the terminal contacts. Wire the relay to the fan and test it. You can use the Tasmota web interface to test the different fan speeds. If everything is working, proceed to the Mosquitto Installation section.

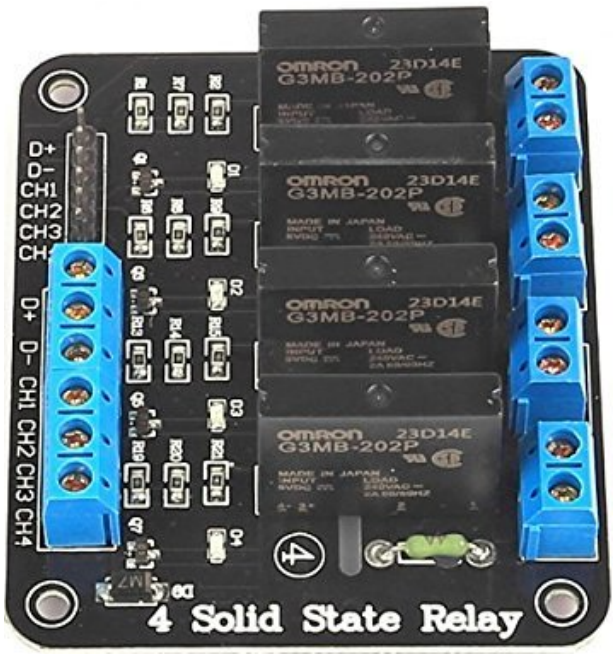


Wiring ESP8266 + Solid State Relay – Amazon Basics 3-Speed Manual Tower Fan

Overview

The process for connecting these two devices uses Dupont wires, or wires connected via soldering. The relay uses terminal contacts that are designed to secure one wire, so use wire nuts to join multiple wires to a single wire for connecting to the relay.




OMRON 23D14E
G3MB-202P
OMRON 23D14E
G3MB-202P
OMRON 23D14E
G3MB-202P
OMRON 23D14E
G3MB-202P
D+
D-
CH1
CH2
CH3
CH4
D+ D- CH1 CH2 CH3 CH4
4 Solid State Relay

Conecting the two devices together

Use Dupont Wires to connect the ESP8266 and the Solid-State Relay devices together. The ESP8266 should have already been flashed with the Tasmota firmware.

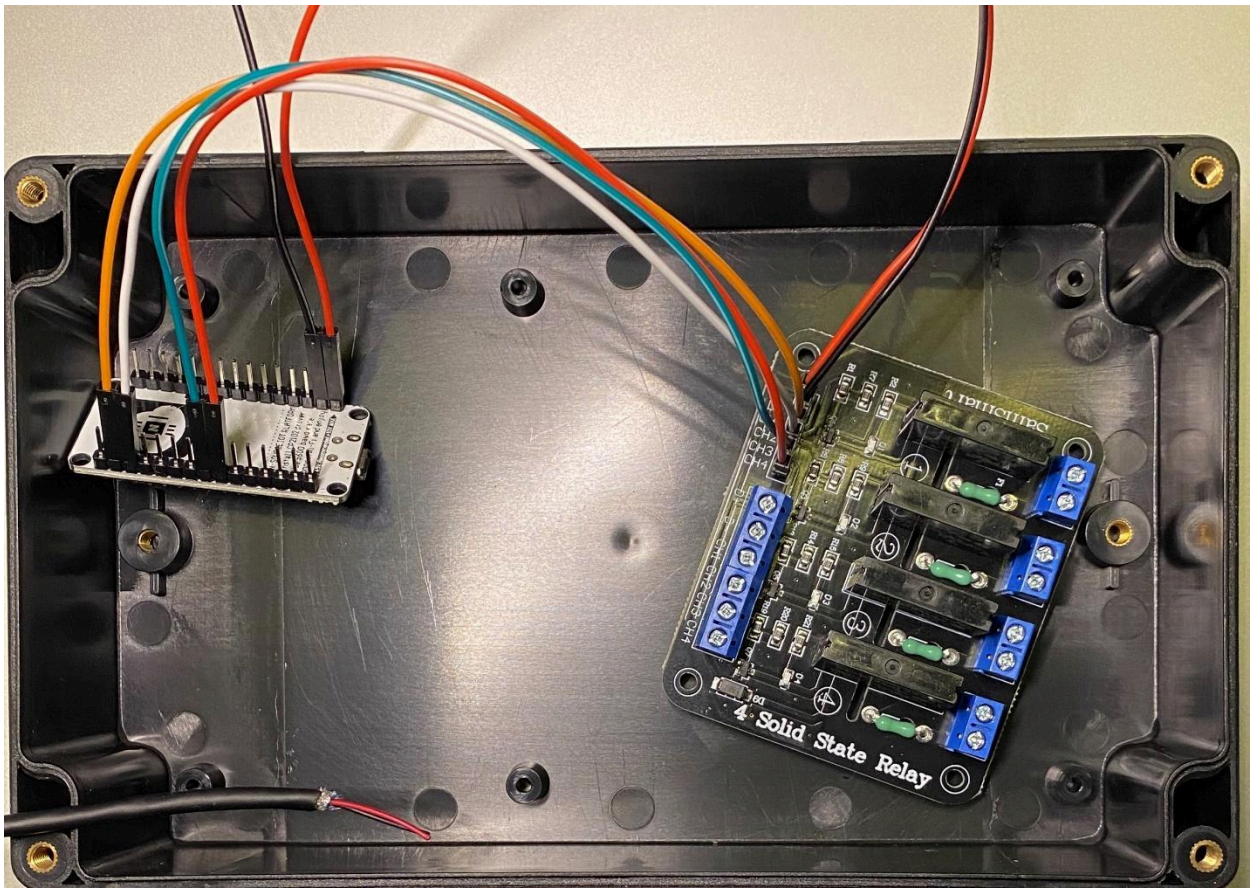
The chart below shows the connections for the Amazon Basic tower fan in more detail, with the specific colors used in red text. This is a spreadsheet that can be downloaded and modified for the end user's specific installation, if desired. Insert Link

Amazon Basics 3-Speed Manual Tower Fan Wiring Schematic

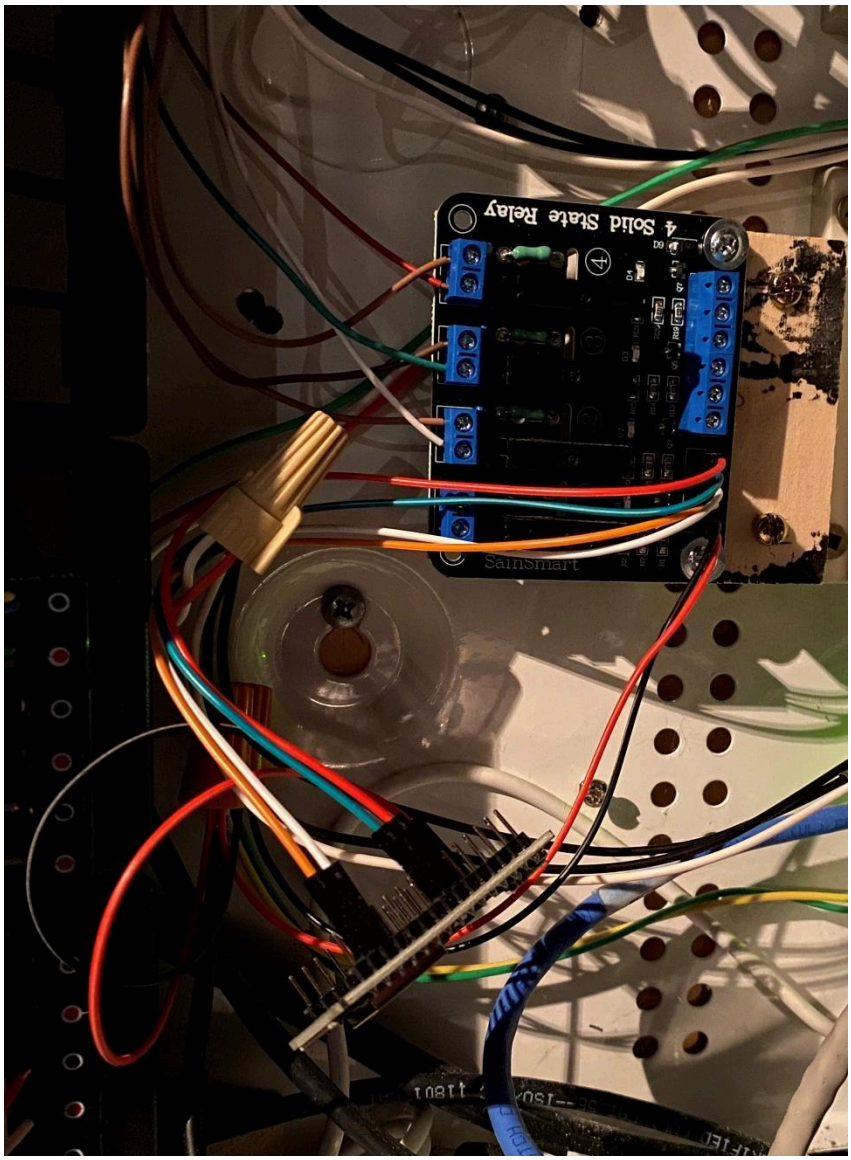
Input			
Destination	Wire Color	Terminal Label	Terminal Description
		5V	5 Volts DC
		GND	Ground
		7-30V	7-30 Volts DC
To AC power Line	BLK	L	120 VAC Line (aka hot)
To relay output NO1	WHT		
To AC power Neutral	WHT	N	120 VAC Neutral
To fan motor (Black in the fan)	BLK		
Input			

Output				
Usage Description	Terminal Description	Terminal Label	Wire Color	Destination
High Speed	Normally Closed	NC4		
	Common	COM4	RED	High speed fan wire (Red in the fan)
	Normally Open	NO4	WHT	To NO3
Medium Speed	Normally Closed	NC3		
	Common	COM3	GRN	Medium speed fan wire (White in the fan)
	Normally Open	NO3	WHT	To NO4
			WHT	To NO3
Low Speed	Normally Closed	NC2		
	Common	COM2	WHT	Low speed fan wire (Blue in the fan)
			ORG	If no Eco speed on fan, daisy chain: To COM1
	Normally Open	NO2	WHT	To NO3
			WHT	To NO1
ECO Speed	Normally Closed	NC1		
	Common	COM1	ORG	Eco speed fan wire If no Eco speed on fan, daisy chain: To COM2
	Normally Open	NO1	WHT	To NO2
			WHT	To relay input L
Output				

The photo below shows both the ESP8266 and the Solid-State Relay devices connected together with the Dupont wires and placed inside the project box prior to installation. The wire in the lower left corner is a USB power cable that will be used to power both the ESP8266 and the Solid-State Relay devices with 5 VDC from a USB power adapter. I used a spare USB Type A to Micro USB type B cable, and cut off the micro USB end, stripped the insulation, removed the shield and the two extra wires, leaving only the power and ground wires.



Below is a picture both the ESP8266 and the Solid-State Relay device installed inside my structured wiring enclosure. I decided not to use the project box, and just install it inside the enclosure. I just used a scrap piece of wood to mount the Solid-State Relay, and the ESP 8266 is just hanging there off the Dupont wires because it is so light.



Wire the relay to the fan and test it. You can use the Tasmota web interface to test the different fan speeds. If everything is working, proceed to the Mosquitto Installation section.

HT Fan Control & Mosquitto Installation – Raspberry Pi

Overview

If you are not using a Raspberry Pi, please skip to the next section for Windows installation. Purchase and assemble a Raspberry Pi; any model will work. The Tasmota relay is controlled using a protocol called MQTT, a mature real-time control protocol. The MQTT protocol has 3 parts. The broker (mosquitto), the client (the tasmota relay), and the publisher (HTFanControl). The app is programmed so that you configure the MQTT topic and payload for the 5 fan commands (Off, Eco, Low, Medium, High).

Program Setup

1. Before installing the programs, update the Raspberry Pi operating system by entering the following two commands in the Raspberry Pi terminal, or via SSH.

   sudo apt update

   sudo apt upgrade

2. After the OS has been updated, install the HTFan Control and Mosquitto apps by entering the below command.

   sudo wget https://raw.githubusercontent.com/nicko88/HTFanControl/master/install/install.sh && sudo bash install.sh

3. You will be prompted to answer "Y" to install both HTFanControl and mosquitto, which is the MQTT controller for the Athom Tasmota relays.
   a. HTFanControl is installed in the following folder: /opt/HTFanControl.
   b. Mosquitto is installed in the following folder: /etc/mosquitto.

4. The applications will be downloaded and installed automatically.

5. The web ui can now be accessed at http://Raspberry.Pi.IP.Address:5500/

   a. The settings are pre-populated for use with MQTT; only the IP Address of the media player hosting Kodi or MPC needs to be entered.

6. Verify Mosquitto is running by entering the below command.

   sudo systemctl status mosquitto

7. During installation, the "Pi" user is granted access to the root folder where HTFanControl is installed. This is useful for copying user-created wind tracks.

   a. For reference, the command is: sudo chown -R pi /opt/HTFanControl

8. To update the app, click on update at the bottom of the settings manually, enter the command below.

   sudo wget https://raw.githubusercontent.com/nicko88/HTFanControl/master/install/update.sh && sudo bash update.sh

9. If you ever need to uninstall HTFanControl and Mosquitto, enter the below command in the Raspberry Pi terminal application, or via SSH. You will be prompted to answer “Y” to uninstall both HTFanControl and mosquito.

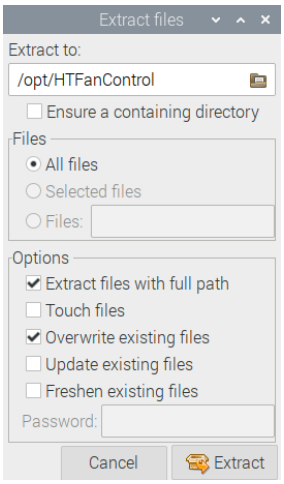
   sudo wget https://raw.githubusercontent.com/nicko88/HTFanControl/master/install/uninstall.sh && sudo bash uninstall.sh

10. To revert to a prior version, download the package and extract the .zip file.

    a. Change to the directory to download the package.
    cd opt/HTFanControl

    b. Download the desired release via the command:
    sudo wget
    https://github.com/nicko88/HTFanControl/releases/download/0.3.0/HTFanControl_RasPi.zip

    c. Extract the package using the file explorer. Navigate to opt/HTFanControl, and right click on the .zip file and select “Extract Here”, and use these options:



MQTT Broker Program Installation – Windows

Overview

The Tasmota relay is controlled using a protocol called MQTT, a mature real-time control protocol that is commonly used by some of the better IoT devices. The MQTT protocol has 3 parts. The broker (mosquitto), the client (the tasmota relay), and the publisher (HTFanControl). The app is programmed so that you configure the MQTT topic and payload for the 5 fan commands (Off, Eco, Low, Medium, High).

Mosquitto Program Setup

1. Eclipse Mosquitto is an open source (EPL/EDL licensed) message broker that implements the MQTT protocol versions 5.0, 3.1.1 and 3.1. It is available for all operating systems; download it here.
2. Click on the installation file and install it.
3. Navigate to the folder where the program was installed.
4. Locate and open the “mosquito.conf” file in Notepad.
5. As of mosquitto 2.0, to listen on addresses other than localhost, you need to have a config file with a "listener" line plus some authentication option. At its most wide-open, you could have a simple config file with only two lines:

   listener 1883
   allow_anonymous true

   It is, of course, better to restrict the listener to IP addresses and it's often better to use some kind of authentication mechanism rather than leaving your server wide open. Alternatively, the existing config file can be modified as indicated below.
6. In the beginning of the file, change the line “#allow_anonymous” to “allow_anonymous true”.
7. In the file, find the “Listeners” section.
   a. It is about 1/10 of the way down, or you can use the find function to search for “#listener”.
8. Change “#listener” to “listener 1883”
   a. This ensures that Mosquitto is listening on port 1883.
9. Save the modified “mosquito.conf” file.
   a. If there is a permission error when attempting to save the file, save it to your documents folder, then copy the file over to the folder where the program was installed.
10. Restart the computer for the changes to take effect.

MQTT Explorer Program

MQTT Explorer is another alternative program mentioned by @SirMaster. This program was not used in the authors system, so there are no further details.

HT Fan Control Program Installation – Windows

Overview

HTFanControl is hosted on Github at this link. Download the program, unzip it, and move it to a folder of your choice on the computer.

1. Launch the program for the first time, and it will create several folders and a .JSON file in the location where you decided to place the program.
2. Find the program icon  in the task bar, right click on it, and select:
    a. “Start HTFanControl Automatically”.
    b. “Open Web UI”.

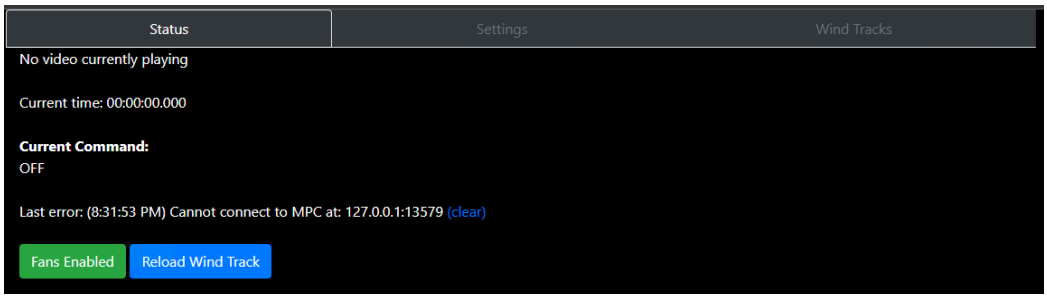
HT Fan Control Program Setup – Rasbperry Pi & Windows

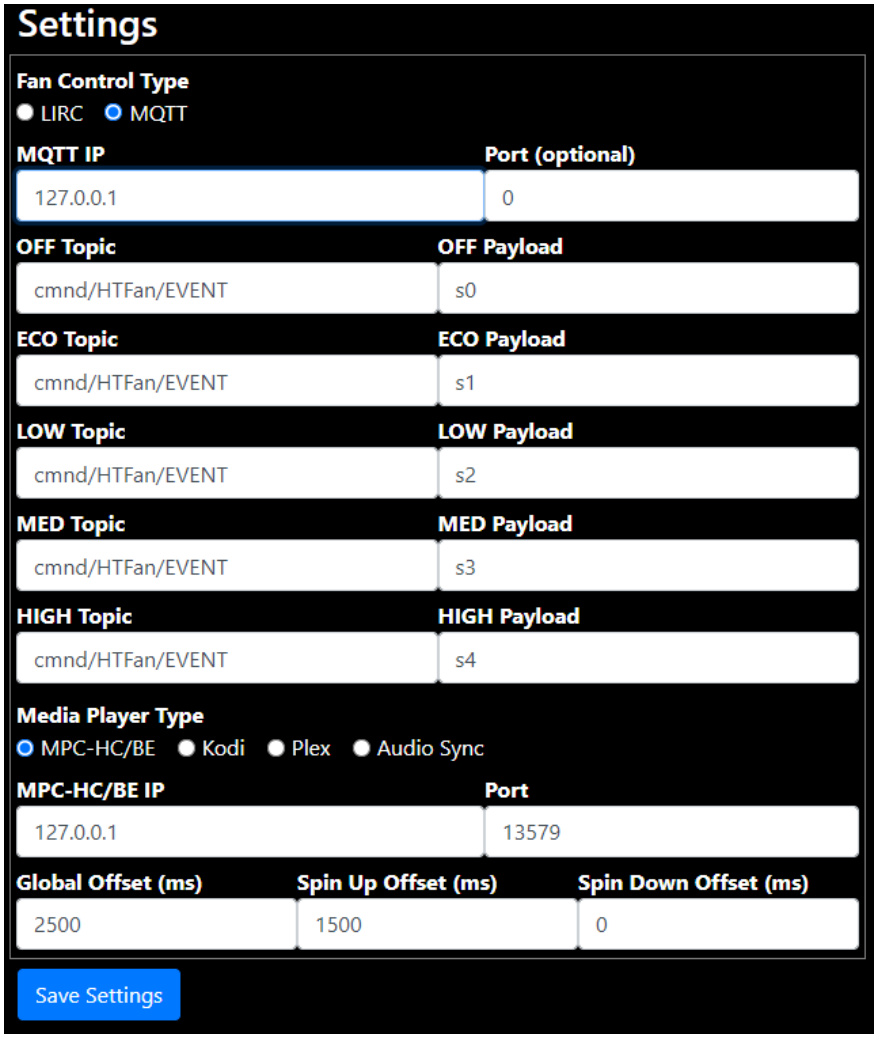
Overview

The HTFanControl User Interface is web-based, and therefore accessible from any mobile or desktop browser.

Program Setup

1. Select the “Settings” tab in the program Web UI.





2. Change the “Fan Control Type” to MQTT.
    a. This is the communication protocol used with the Tasmota relays.
3. Enter the following MQTT settings:
    - MQTT IP: 127.0.0.1 if the MQTT Broker is on the same computer.
    - Port (optional): Leave blank.
    - OFF Topic: cmnd/HTFan/EVENT OFF Payload: s0
    - ECO Topic: cmnd/HTFan/EVENT ECO Payload: s1
    - LOW Topic: cmnd/HTFan/EVENT LOW Payload: s2
    - MED Topic: cmnd/HTFan/EVENT MED Payload: s3
    - HIGH Topic: cmnd/HTFan/EVENT HIGH Payload: s4
4. Set up the Media Player Type according the particular use case scenario.
5. Select “Save Settings”, then confirm in the dialog pop-up by selecting “OK”.
6. Select the “Settings” tab in the program Web UI.
7. Select the “Fan Tester” tab in the program Web UI.
8. Test the various fan speeds.
9. Opening port 1883 in your firewall software may be required.

Fan & Relay Installation in The Theater

Overview

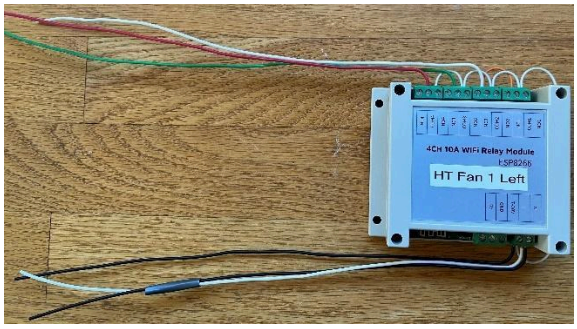
The relays make a fairly noticeable clicking sound which is pretty loud on the test bench; one was about a 6 dB increase over the noise floor at a distance of about 3 feet. One option to mitigate this sound in the permanent theater installation would be to cover it with a box lined with Linacoustic or some other sound-absorbing material.

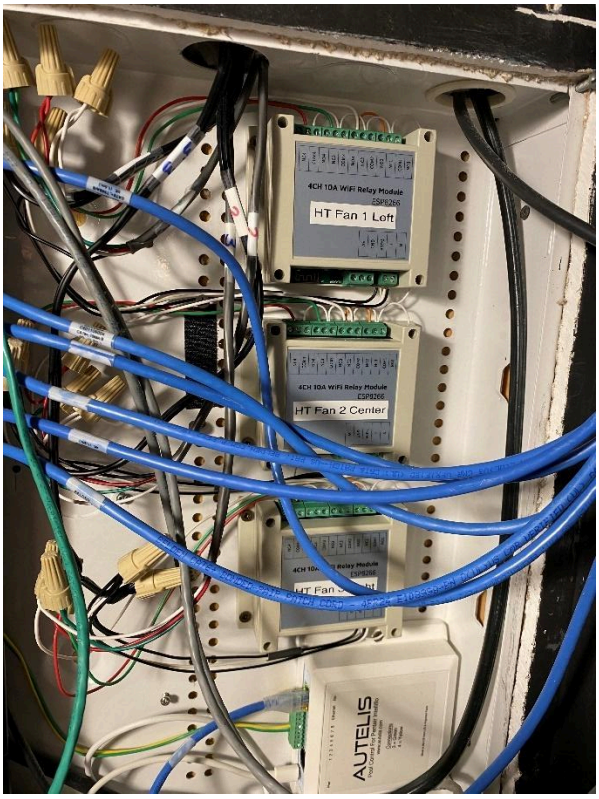
Another option is to locate the relay remotely, and extend the wires from the relay to the fan housing. Due to increased distance, the wire gauge should be increased. This calculator comes in handy to calculate the voltage drop for a given wire gauge, wire type, length, phase, voltage and load. For example, the Honeywell HT-900 fan is 0.25 A, and extending the wires 30 feet with 16 AWG copper wire only results in a 0.0624% drop in voltage, and 18 AWG copper wire only results in a 0.0624% drop in voltage.

As noted above, the relay uses terminal contacts that are designed to secure one wire, so extreme care should be taken when using multiple wires. Two wires of the same gauge can be used when placed side by side, so there is even clamping force on the wires. If using multiple gauges of wire, consider using pigtails and jumper wires of the same gauge on the relay terminal blocks, and then use a wire nut to properly terminate the different wire gauges. Below are pictures of my example.

Prior to installation

After installation



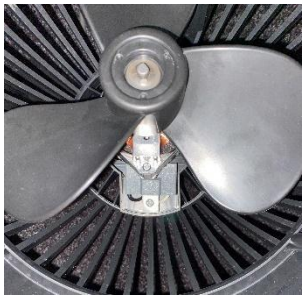


The wiring in the fan housing has an extra sheath around the wires that were directly under the motor, so it is best to keep that in place. If the terminations are to be made inside the fan, below is the area in which there is to work; the power wire has been removed in this example, due to remote installation of the relays.

There is 5/16” (2 cm) of clearance below the fan motor for making wire connections so use smaller wire nuts due to the clearance limitations. Alternatively, the area where the switch was installed can be used for wire nut storage and / or termination of wires. That is where I stored my wire nuts, and then I reinstalled the switch bracket / cover.

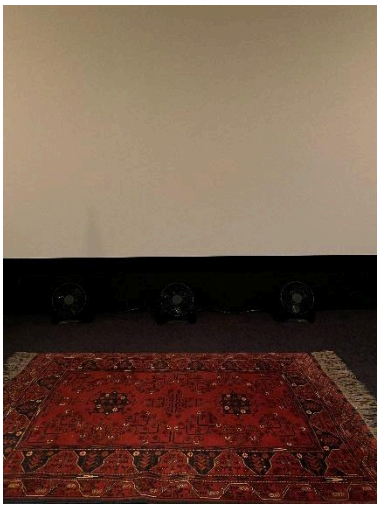
Fan blade / motor assembly removed Fan blade / motor assembly reinstalled

Capacitor reinstalled



Rear of fan

Fans installed below screen



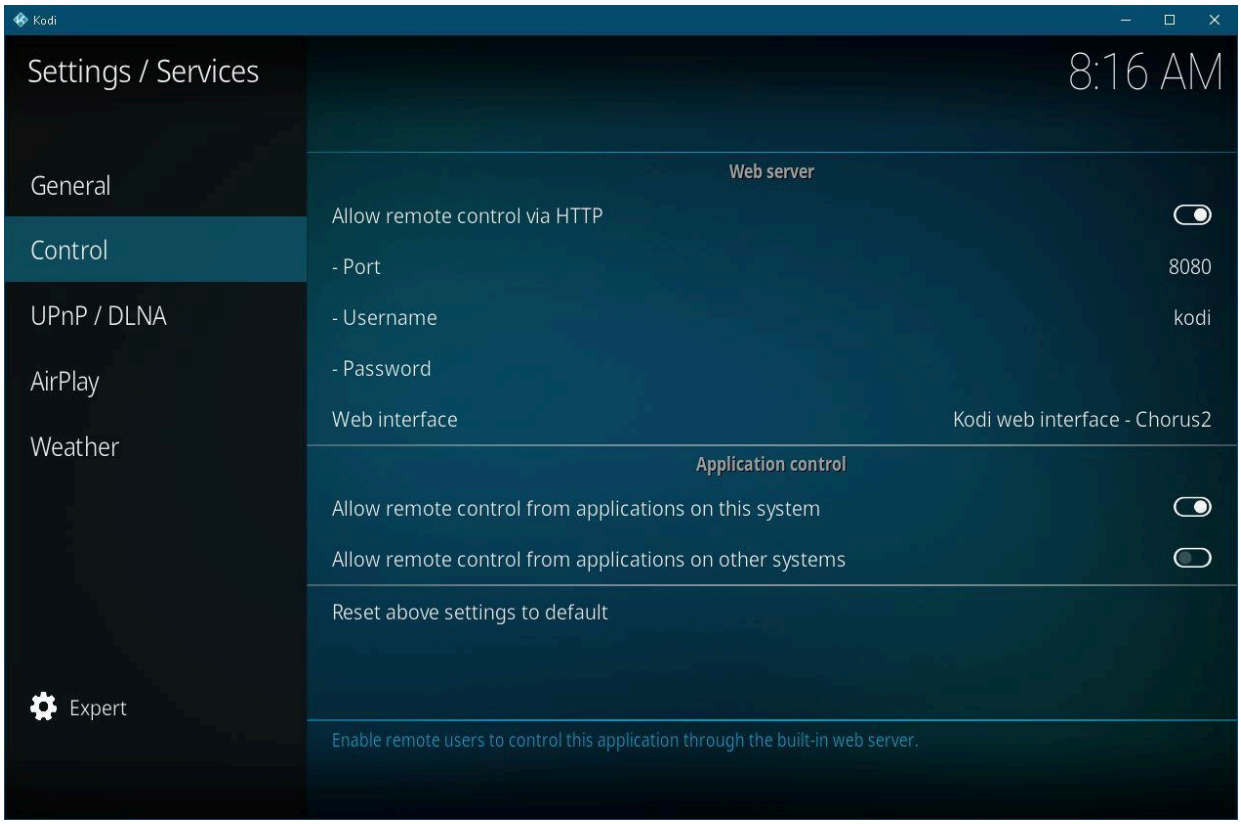
Media Player Setup

Overview

The source program file is played through a media player (MPC-BE / MPC-HC / KODI preferred), either via an HTPC or an Nvidia Shield. The HTFanControl program communicates with the media player to obtain the current time stamp of the source program file playing, and accesses the wind track .TXT file with the time stamps and fan commands. To enable this communication, the media player must be configured to allow remote control via HTTP.

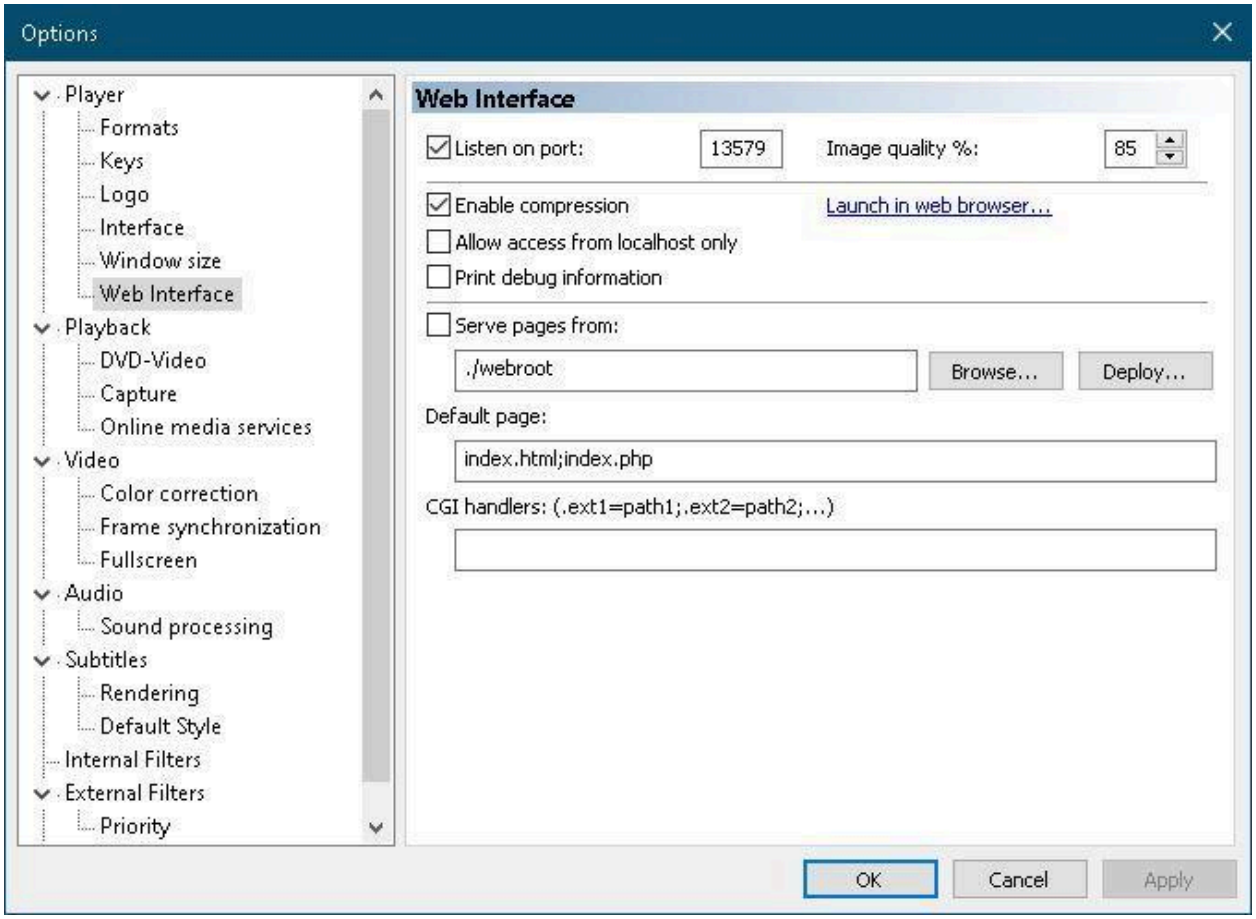
Kodi Setup

Menu > Settings > Services > Control
Change the settings view option if "*Basic*" is shown in the lower left corner; the "*Standard"* setting is the minimum required before proceeding.
Ensure that "Require authentication" is turned off; Username and password is not supported.
Turn on "Allow remote control via HTTP"
Exit to the main menu



MPC-BE & MPC-HC Setup

Menu > View > Options > Player > Web Interface > (Check) Listen on port: > Apply



Plex Setup

Setup in the HTFanControl WebUI

Fan Calibration

Overview

The HTFanControl program has user-adjustable offset settings designed to allow calibration so the wind from the fans arrive, changes strength, or stops at exactly the right moment. Movies are coded with the fan commands at the exact time stamp, and the user-adjustable offset settings (in milliseconds) calibrate the fans to the specific installation environment. For example, if you want the fans to turn on at time stamp 00:10:00 and the fans take 2 seconds for the wind to arrive, the program will start the fans at 00:09:58 via a startup fan delay.

Settings

Global Offset (ms)

This setting is allowing for compensation of the time it takes the air to move from the fan to the seat. In a 12-foot typical home theater seated distance, 1,000-1,500 ms works, as it takes about 1-1.5 seconds to move the air from the fan to the seat.

SpinDown Offset (ms)

This setting is allowing for compensation of the time it takes to stop feeling the wind after the fan is turned off. It turns off the fans a bit early so that the wind stops hitting you at the proper moment. Usually around 250 ms is a good starting point.

ECO SpinUp Offset (ms)

This setting is allowing for compensation of the time it takes the fan to start moving air when being turned from OFF to the indicated speed. Usually around 1,000 ms is a good starting point.

LOW SpinUp Offset (ms)

This setting is allowing for compensation of the time it takes the fan to start moving air when being turned from OFF to the indicated speed. Usually around 1,000 ms is a good starting point.

MED SpinUp Offset (ms)

This setting is allowing for compensation of the time it takes the fan to start moving air when being turned from OFF to the indicated speed. Usually around 1,000 ms is a good starting point.

HIGH SpinUp Offset (ms)

This setting is allowing for compensation of the time it takes the fan to start moving air when being turned from OFF to the indicated speed. Usually around 1,000 ms is a good starting point.

Calibration Files

AVS Forum member SOWK has created test files that can be used to accurately calibrate the above settings and dial it in perfectly. The below instructions are duplicated from the original post here.

1. Download the test files from here.
2. Extract “OffsetCalibration.zip”.
3. Place the wind track files into the HTFanControl windtracks folder; here is an example of how they are named:
    a. 0 Wind Track Global Offset Calibration.txt
    b. 0 Wind Track Speed 1 Eco Spinup Offset Calibration.txt
    c. 0 Wind Track Speed 2 Low Spinup Offset Calibration.txt
    d. 0 Wind Track Speed 3 Medium Spinup Offset Calibration.txt
    e. 0 Wind Track Speed 4 High Spinup Offset Calibration.txt

4. Place the following files into a location where they can be played via the media player.
    a. 0 Wind Track Global Offset Calibration.mkv
    b. 0 Wind Track Speed 1 Eco Spinup Offset Calibration.mkv
    c. 0 Wind Track Speed 2 Low Spinup Offset Calibration.mkv
    d. 0 Wind Track Speed 3 Medium Spinup Offset Calibration.mkv
    e. 0 Wind Track Speed 4 High Spinup Offset Calibration.mkv

Calibration Process

The goal of the calibration process is to adjust the fan to the installed environment, so that changes in wind strength at your seat correspond to on-screen events. These adjustments simply allow for calibration of the time it takes for the changes in the fans (turns on, off, or change speed) to reach the viewer. Perform the calibration by feel, using ear plugs to mitigate the sound of the fans. Make the adjustments in increments of 250 ms, as amounts below this are challenging to discern the difference. It is an iterative process: Adjust, test, and repeat.

Global Offset Calibration

Play “1 - Wind Track Global Offset Calibration.mkv”.

The test track alternates every 10 seconds between a Black full-field test pattern and the ECO fan command versus a white full-field test pattern and the HIGH fan command.

Adjust the Global Offset under the HTFanControl Web UI Settings menu until the change in wind strength at your seat corresponds to exactly when the full-field pattern changes.

Select “Save Settings”, then confirm in the dialog pop-up by selecting “OK”.

SpinUp Offset Calibration

Play “2 - Wind Track SpinUp Offset Calibration.mkv”.

The test track alternates every 10 seconds between a black test pattern and the OFF fan command versus a white test pattern and the HIGH fan command

Adjust the SpinUp Offset under the HTFanControl Web UI Settings menu until you feel the wind hit at your seat exactly when the full-field pattern changes from black to white.

Select “Save Settings”, then confirm in the dialog pop-up by selecting “OK”.

SpinDown Offset Calibration

Play “2 - Wind Track Spinup Offset Calibration.mkv”.

The test track alternates every 10 seconds between a black test pattern and the OFF fan command versus a white test pattern and the HIGH fan command

Adjust the SpinDown Offset under the HTFanControl Web UI Settings menu until you feel the wind stop at your seat exactly when the full-field pattern changes from white to black.

Select “Save Settings”, then confirm in the dialog pop-up by selecting “OK”.

Watching Movies

Overview

The wind effects are currently created by a few wind artists (SOWK, Brazen1, ???), but may be created by the end users as well. The effects are tailored to a specific title, frame by frame; the D-Box motion actuator system works the same way, as titles are individually coded. The goal is for the effect to be subtle, immersing you further into the film experience, and not taking you out of said experience.

Viewing Tracks

The wind tracks are hosted on Google Drive, and the titles can be viewed by visiting this link.

Downloading Tracks

The wind tracks are downloaded via the HTFanControl app. The app has a function that will automatically rename the wind track file to match the media file currently playing. The process is to start playing the desired movie and download the corresponding wind track in the app.