

Forum:[Hack Forums](#)

Thread: [\[TUTORIAL\] Ras FM, \(V\)HF Transmitter \[GO HAM!\]](#)

slober - October 28, 2013, 6:04 am

Ras FM

what is a FM?

Security on FM

FM vs AM

FM Usage

FM on the rasp.

You're voice on the rasp

Make you're own audio files:

Enjoy

what is a FM?

FM stands for Frequency modulation it's the encoding of information in a carrier wave

FM radio was developed in the United States by Edwin Armstrong

the first commercial FM broadcast was on March 1, 1941 by W47NV in Nashville, Tennessee

commercial FM broadcasting uses part of the VHF band (the FM broadcast band) this band goes only from 87.7 to 108.0 MHz

the pi can use 1Mhz up to 250Mhz so.... you can send on the whole HF 3-30MHz) a part of the VHF (30-300MHz) and a part of the MF band (300 kHz to 3 MHz)

Security on FM

it's not really security but worth mentioning ^^

if you're sending on a FM band

Quote:Wikipedia:

Broadcast signal intrusion is a term given to the act of hijacking broadcast signals of radio and television stations. Hijacking incidents have involved local TV and radio stations as well as cable and national networks.

Punishments:

United States

According to the Federal Communications Commission, [...] when Congress passed a bill that would penalize violators with fines peaking to \$250,000 and/or a maximum of 10 years in prison if convicted.[...] Hijacking a signal of any kind is a felony in the United States.

How it's done?

well simply said you're sending a stronger signal then the radio station so.... you can take over an area (10cm to 100m) depending on the antenna and the strength of your signal

use a empty frequency and don't use big antennas this will not only give you a longer range but also better audio quality

so it can be cracked but i go to jail better then nothing right?

FM vs AM

[img]http://illumin.usc.edu/assets/media/481/Image%201.gif[/img]

as you can see in the picture above AM modify the AMplitude the band isn't as wide as FM and AM circuits are often less complex but they are much more vulnerable to natural interference,.... AM signals travel also further than FM and AM can travel easier through objects than FM

FM modifies the Frequency the Amplitude stays the same, FM has better audio quality, has a wider band,...

Quote: <http://www.youtube.com/watch?v=D65KXwfDs3s>
<http://www.youtube.com/watch?v=jqGAneO79IY>

the video above gives a nice explanation on FM and AM
the second video gives an explanation about AM

FM Usage

uh audio duh..

except for audio you can also send data through it but at really really slow rates so just audio here ?

FM on the rasp.

Step 1

download the PiFM files and put them on your raspberry pi

Code <http://www.icrobotics.co.uk/wiki/images/c/c3/Pifm.tar.gz>

Step 2

Wire it!

you need to use 1 alligator clip, your finger, or a 20cm wire, female jumper wire,.... this will be your antenna wire it to GPIO pin 4

Pins on the rasp.:

Spoiler ([Click to View](#))

[img]http://www.megaleecheer.net/sites/default/files/images/raspberry-pi-rev2-gpio-pinout.jpg[/img]

!!!GPIO 4 NOT PIN4!!!

Step 3

Code `sudo ./pifm sound.wav 95.5` `sudo ./pifm` for running the FM sound.wav is your soundfile 95.5 is the MHz you're transmitting on

Make a backup file before you alter stuff
save your changes!

Trouble shooting:

if the commands won't work try putting sudo before it

Your voice on the rasp

the raspberry hasn't any mic jacks i tested this with a ROG Spitfire usb soundcard and it worked great ^^

Code `sudo arecord -fS16_LE -r 22050 -Dplughw:1,0 - | sudo ./pifm - 98.0 22050`
Code explained

Code `arecordProgram` we are using to record audio.

-Code `fS16_LE`Output 16-bit data. Needed this way for PiFM to read it.

Code `-r 22050`This specifies sampling rate to output recording. 22,050 is a good balance for speed and quality.

Code `-Dplughw:1,0`

This is where you may need to modify. The '1' specifies card number and '0' is the device number I think. To find this out for your device, use

Code `arecord -l`to see all of the audio devices connected.

Code `-`Here it means to print output to standard out.

Code `|`Pipe the standard out from previous command to next command's standard input.

Code `sudo ./pifm - 98 22050`the pifm code

thank these guys ^^

Spoiler ([Click to View](#))

<http://www.raspberrypi.org/phpBB3/viewtopic.php?t=33526>

Make you're own audio files:

Step1:

download FormatFactory / Audacity or another nice audio program :)

i will use FormatFactory

Step 2

Download you're MP4,MP3,... file with the audio you want to use

start format factory and select WAV browse the file and go to the convert settings all the audio files needs to be 16 bit mono wav format. sampled at 22050 Hz

Quote:all the audio files need to be 16 bit mono wav format. sampled at 22050 Hz

Step3:

upload it to your raspberry pi and get sending :)

Enjoy

so enjoy it ? you now have you're ow raspberry FM transmitter

Sources used:

Spoiler ([Click to View](#))

<http://www.megaleecher.net/sites/default/files/images/raspberry-pi-rev2-gpio-pinout.jpg>

http://www.icrobotics.co.uk/wiki/index.php/Turning_the_Raspberry_Pi_Into_an_FM_Transmitter

http://en.wikipedia.org/wiki/Radio_frequency

http://en.wikipedia.org/wiki/FM_broadcasting

http://en.wikipedia.org/wiki/Broadcast_signal_intrusion

<http://www.youtube.com/watch?v=D65KXwfDs3s>

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EDIT 29/10/2013 Extra explanation about using format factory

Spoiler ([Click to View](#))

i'm using dutch software so... but i hope this helps i also added this to the main tutorial ^-^

format favtory can be downloaded at

<http://format-factory.en.softonic.com/>

step1:

open Format factory

<http://prntscr.com/20kw1x>

step2:

<http://prntscr.com/20kwhe>

step3:

<http://prntscr.com/20kx0w>

step4:

<http://prntscr.com/20ky9x>

Step5:

<http://prntscr.com/20kzfm>

step6:

upload the converted file to your raspberry pi

mexy - October 28, 2013, 6:57 am

While I guess it "works" don't expect to be getting any good range from this. Your power output must be ridiculously small from a GPIO (3.3V and current in the mA) to a jumper lol.

slober - October 28, 2013, 7:09 am

(Oct 28, 2013 06:57 AM)mexy Wrote: [\[CITE\]](#) While I guess it "works" don't expect to be getting any good range from this. Your power output must be ridiculously small from a GPIO (3.3V and current in the mA) to a jumper lol.

i get 20m range on 95.2 with just a jumper wire (this is in my house with walls etc....)
the range isn't great just like you said it's only a 3.3V signal but the pi isn't exactly meant to do FM transmitting this could be a fun way trolling people in the car when you're in a traffic jam,....

the maximum with Clear line of sight is about 100m

also this is a really really simple setup so if you have a rpi you could just try it yourself ^-^

whyitell - October 29, 2013, 9:42 am

This was a really fun project, thanks for this. I am sure I will be able to find some 'fun' uses for this ?

Actually I need help with the converting thing, I cant get it right. Whenever I change the sample rate it sounds way to slow.

slober - October 29, 2013, 12:37 pm

(Oct 29, 2013 09:42 AM)whyitell Wrote: [\[CITE\]](#) This was a really fun project, thanks for this. I am sure I will be able to find some 'fun' uses for this ?

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it should be sampled at 16 bit mono wav format. sampled at 22050 Hz

it's really important you sample it at 22050 a lower sample rate give much faster (higher pitch) audio a higher sample rate a heavier deeper audio

i'm using format factory here are a few screenshots:

Spoiler ([Click to View](#))

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Step5:

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EDIT 29/10/2013 21:25 GMT +1 Also added mic support ^^ to the tutorial now you can transmit real time voice over the HF VHF band

whyitell - October 29, 2013, 1:28 pm

(Oct 29, 2013 12:37 PM)slober Wrote: [\[CITE\]](#) it should be sampled at 16 bit mono wav format. sampled at 22050 Hz

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upload the converted file to your raspberry pi

EDIT 29/10/2013 21:25 GMT +1 Also added mic support ^^ to the tutorial now you can transmit real time voice over the HF VHF band

I had it like that, exactly the same setting but it had loads of static. It worked perfectly with sound.wav but not with any of my drum and bass.

slober - October 29, 2013, 1:37 pm

just send a pm to you i would love to help you further with this problem =)

i really hope i can help you solving this do you have the same problem with other mp3's?
Spoiler ([Click to View](#)) i shall try to keep this project/tutorial up to date with new finds

whyitell - October 29, 2013, 1:44 pm

(Oct 29, 2013 01:37 PM)slober Wrote: [\[CITE\]](#) just send a pm to you i would love to help you further with this problem =)

i really hope i can help you solving this do you have the same problem with other mp3's?
Spoiler ([Click to View](#)) i shall try to keep this project/tutorial up to date with new finds
I tried with 3 different songs and all of them were extremely stacticy, so I sent you all of them.

slober - October 29, 2013, 1:58 pm

don't expect hi quality you're sending through a wire and using a credit card size computer ^^
i replied you're pm and send you the audio files i really hoped it helped

whyitell - October 29, 2013, 3:57 pm

(Oct 29, 2013 01:58 PM)slober Wrote: ([CITE](#)) don't expect hi quality you're sending through a wire and using a credit card size computer ^^

i replied you're pm and send you the audio files i really hoped it helped
If only there was a way of playing files without all the converting fuss, I was looking at this but I dont really understand it.

Spoiler ([Click to View](#))

I use the transmitter with the vlc media player, which allows me to transmit almost anything (internet radio stream, mic, music from my NAS-Drive).

How i did it:

You need:

-VLC Media player ("sudo apt-get install vlc")

-PiFM (

http://www.icrobotics.co.uk/wiki/index.php/Turning_the_Raspberry_Pi_Into_an_FM_Transmitter)

Make a FIFO-File:

CODE: SELECT ALL

Quote:mkfifo /tmp/radio

Open two terminals

Terminal 1:

CODE: SELECT ALL

Quote: vlc YOUR_FILE_STREAM_OR_DEVICE_HERE vlc://quit --intf=dummy --no-sout

-smem-time-sync

--sout='#transcode{acodec=s16l,ab=32,samplerate=44100,channels=1}:std{access=file,mux=dummy,dst=-}' > /tmp/radio

Terminal 2 (cd into the PiFM dir):

CODE: SELECT ALL

Quote:sudo ./pifm /tmp/radio YOUR_FREQ 44100

--

Possible Uses:

-wireless Speaker system (as almost all FM Devices have no sound delay)

-local radio station for your neighborhood (legal issues)

-Broadcast current readings from sensors (In conjunction with espeak)

-Probably more...

slober - October 29, 2013, 4:32 pm

Basicly you're making a FIFO First in First out file (buffer file)

then you're running vlc and put your audio file through a converter and spit it out into the FIFO after that it goes finally to your Pifm

i'm trying this method now haven't used it before if this works i will definitely add this to the tutorial

Spoiler ([Click to View](#))

having some problems with dns on my new wireless modem so it can take a while ^^

Code Temporary failure resolving 'mirrordirector.raspbian.org'
0% [Connecting to mirrordirector.raspbian.org]

whyitell - October 30, 2013, 10:27 am

Did you manage to get it working, and if you use that way do you not have to convert it?

slober - October 30, 2013, 12:20 pm

(Oct 30, 2013 10:27 AM)whyitell Wrote: [\[CITE\]](#) Did you manage to get it working, and if you use that way do you not have to convert it?

I didn't get it to work, had some network problems so i can't really download the needed packages, my modem/router i got from my isp a week back hate raspberry pi's

if you follow the steps you don't need to convert the audio files like said on

DogTired - October 31, 2013, 2:52 pm

I don't have a RaspPi but I adore your Tutorial!

Straight to the point and easy explained! AWESOME! Really good :)

Regards
DaBootO

z30n1c - November 18, 2013, 2:32 pm

How do you send to a range for example 106.1 - 106.5? Great tut thanks

Odin the Wanderer - November 18, 2013, 3:15 pm

Nice thread bro, I am going to get my HAM licence in February

???I?? - November 18, 2013, 3:37 pm

Just ordered my Raspberry PI the B 512MB version, gonna try this as soon as i get it :)

slober - November 19, 2013, 11:47 am

(Nov 18, 2013 03:32 PM)z30n1c Wrote: [\[CITE\]](#) How do you send to a range for example 106.1 - 106.5? Great tut thanks

you can't send on multiple frequencys at the same time it would be to hard for the pi and it just isn't possible hardware wise also the code isn't meant to do that.

in theory it is possible if you use a normal audio output and wire it through a fm transmitter or fm transmitters in your case tuned to the diffrent frequencies

(Nov 18, 2013 04:15 PM)Odin the Wanderer Wrote: [\[CITE\]](#) Nice thread bro, I am going to get my HAM licence in FebruaryHAM is nice i have my (basic ON3)license since last year march ^^
but don't have the money for buying a proffesional installation due to sriect euope regulations and taxes :s

allowd to send on at 10w for everything lower then 24890KHz and 50w for the other ones:

Spoiler [\(Click to View\)](#)

1810 – 1875 kHz

3500 – 3800 kHz

7000 – 7100 kHz

10100 – 10150 kHz

14000 – 14350 kHz

18068 – 18168 kHz
21000 – 21450 kHz
50 – 52 MHz
144 – 146 MHz
430 – 440 MHz

(Nov 18, 2013 04:37 PM)wesley023_ Wrote: [\[CITE\]](#) Just ordered my Raspberry PI the B 512MB version, gonna try this as soon as i get it :)
nice, it's really worth the money i'm hoping to use the transmitter in the future as a FM file transmitter estimated speed 9600bits a second max :) thats euh 1200bytes and euh aprox. 1.2Kb/s using a prof antenna and amplifier estimated range 10KM ^^

RuffledUp - August 25, 2014, 7:45 am

Seeing as the pi is creating square waves then broadcasting that directly without any filter present on the transmitter, won't this cause harmonic interference across other frequencies in the sidebands? Which would be a bad thing. :D

slober - August 25, 2014, 10:50 am

(Aug 25, 2014 07:45 AM)RuffledUp Wrote: [\[CITE\]](#) Seeing as the pi is creating square waves then broadcasting that directly without any filter present on the transmitter, won't this cause harmonic interference across other frequencies in the sidebands? Which would be a bad thing. :D
You'll get interference --> You shouldn't even be transmitting on some of these bands (1-250MHz) without having a proper HAM license

Due to its weak output power interference isn't a really big deal most of the people don't have a 1/4 dipole (75cm @ 100MHz) so the range is further limited of course it can cause problems.
the power output is around 10mW

Some interesting links about legality:

<http://raspberrypi.stackexchange.com/questions/19817/problems-with-pifm-legality>
<http://www.raspberrypi.org/forums/viewtopic.php?f=63&t=72766>

RuffledUp - August 25, 2014, 2:30 pm

Still, without a filter even if you were broadcasting on say 100Mhz because of the square wave and harmonic resonance you could possibly be broadcasting on say 50Mhz and 150Mhz or something like that. In reality you would probably find a signal anywhere across the frequency range.

slober - August 25, 2014, 3:05 pm

(Aug 25, 2014 02:30 PM)RuffledUp Wrote: [\[CITE\]](#) Still, without a filter even if you were broadcasting on say 100Mhz because of the square wave and harmonic resonance you could possibly be broadcasting on say 50Mhz and 150Mhz or something like that. In reality you would probably find a signal anywhere across the frequency range.

I didn't encounter any noticeable interference while using the PiFM library
Of course without a filter and good equipment it's impossible to send a clean signal out

The Raspberry PI isn't a (V)HF transmitter and it's definitely not designed to be one.

This doesn't mean that the project is (...). I would say that it's capable of doing some really interesting things. An introduction to the world of amateur radio.

Of course if you are interested in the world of Amateur radio and electronics in general you could

make your own filter circuit for a predefined frequency. This would require some research, electronic skills, parts and patience

DaKnOb - *August 26, 2014, 6:20 am*

Something not mentioned here but really important, despite the low power, picking up an antenna that is suitable for this purpose will help not get your Pi into trouble. Static can gather in an out of range antenna and destroy your "transmitter" (the GPIO pin). Despite the extremely low power (I think LPDs run at 10mW), there's still the danger..