

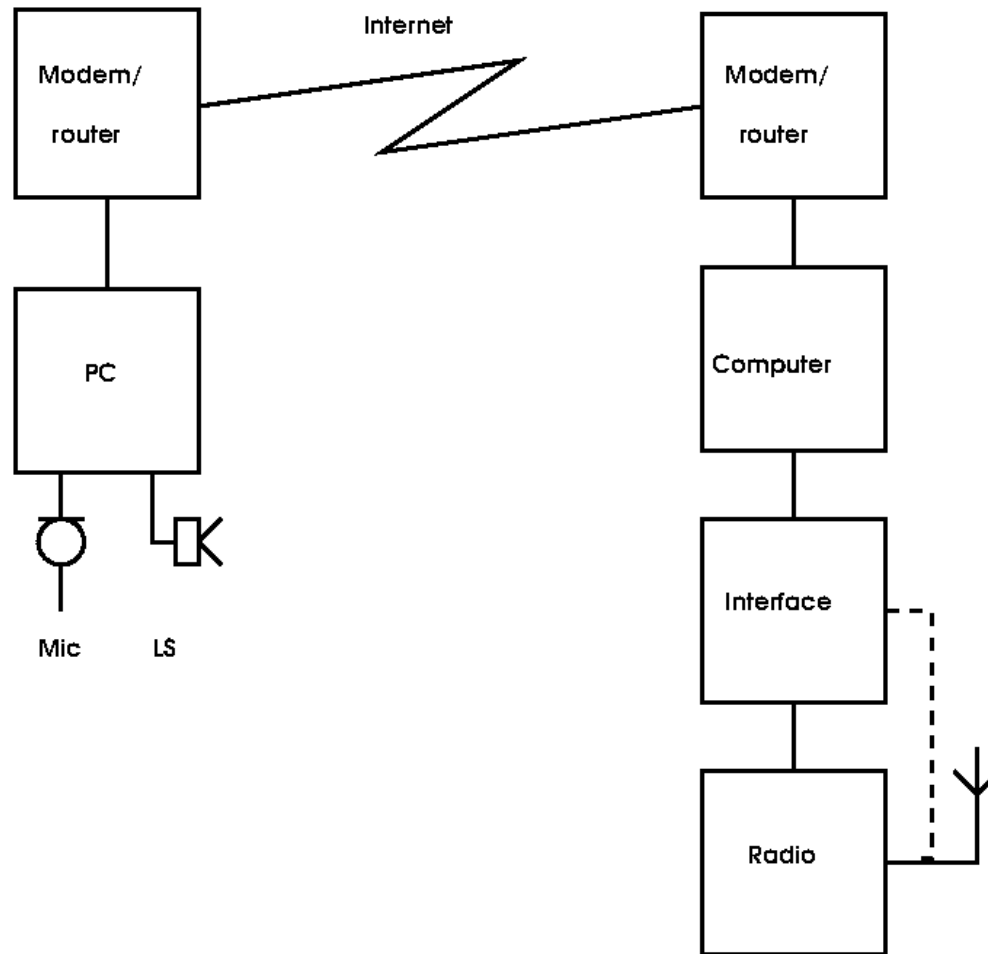
# Remote Station Operation

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# Background

- Recently been living in Peebles
- Location is low lying and electrically noisy
- Tried operating on 2 meters but difficult
- Also tried QO100 ???
- Toyed with Ideal of remote operation
- Had been using Raspberry Pi's to monitor GPSDOs remotely with RealVNC desktop
- Still wanted to get back on air in some form.

# Typical remote system



# Considerations for remote operation

- Choice of control computer
- Rig control – CAT or CI-V bus
  - Software choice
  - Suitable radio. I chose Icom IC706 Mk2 G ??????
- Audio channel required Tx and Rx
- Rotator control
- Mains supply control
- Internet aspects

# Computer controller

- Raspberry Pi is a pretty obvious choice
  - Low power consumption
  - Reasonably powerful
  - Easily connected to a network
  - Wide choice of open source software
  - Four USB ports for hardware connection
  - Capable of running as a remote desktop server

# Remote Desktop Software

- Remote control a requires a remote desktop
- A number of packages are available
- RealVNC supports Linux/Raspi and others
- Already had experience of RealVNC
- Allows connection to Raspi desktop from a remote PC/Apple/Phone/Tablet/Raspi
- Main drawback is no remote sound channel
  - But VOIP programs are available

# RealVNC

- RealVNC is a remote desk top package
- Run the server on Raspi connected to radio
- Run client (Viewer) on remote PC
- Both server and viewer are on the Raspi distributions
- RealVNC is cross platform
- RealVNC is commercial software but they allow hobby and educational use with some minor restrictions which are not an issue in this application

# Remote Desktop

The screenshot shows a remote desktop session with a blue background. The top taskbar includes icons for Raspberry Pi, network, file manager, terminal, and a camera. The system tray shows the 'V2' logo, a user icon, a refresh icon, a speaker icon, and the time '08:10'. Two windows are open:

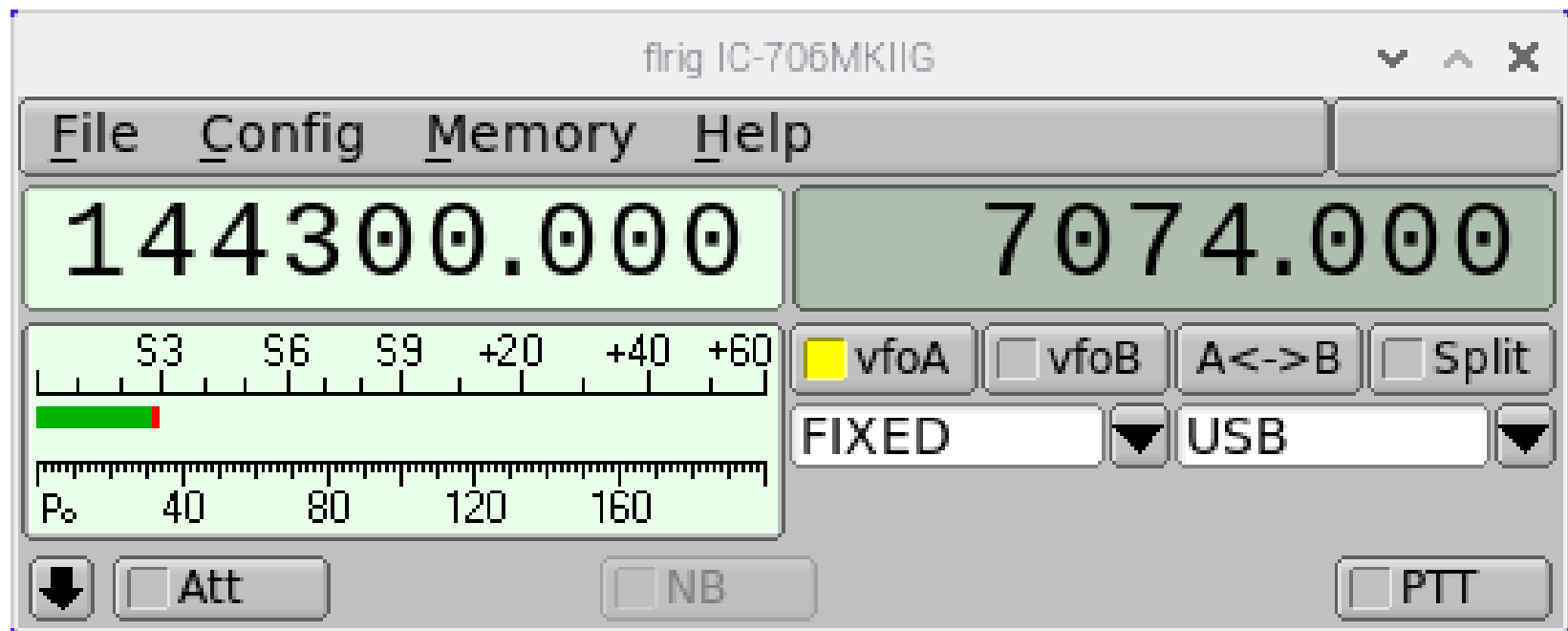
- frig IC-706MKIIG**: A software interface for a radio. It features a menu bar with 'File', 'Config', 'Memory', and 'Help'. The main display shows two frequency fields: '144300.000' and '7074.000'. Below these are several control buttons: 'vfoA', 'vfoB', 'A<->B', and 'Split'. A dropdown menu is set to 'FIXED' and another to 'USB'. At the bottom, there are buttons for 'Att', 'NB', and 'PTT'.
- MainWindow**: A window titled 'Rotator position display' showing 'Azimuth: 037 NE'. It contains a grid of buttons for selecting different azimuth positions: '<< CCW', '000', '045', '090', '135', '179', 'STOP', '360', '315', '270', '225', '181', and 'CW >>'. Below the buttons is a circular diagram representing the rotator, with cardinal directions 'N', 'E', 'S', and 'W' marked. A red arrow points from the center to the 037-degree position.



# Rig Control Software

- A wide choice
- A number of proprietary offerings but these are largely PC based
- W1HKJ's Flrig is linux based and runs well on Raspi and supports a wide range of radios and is well supported and in wide use.
- Has a nice simple GUI allowing access to all the remote features of the CI-V interface on the Icom IC706Mk2G.

# Flrig Interface



# Rig Control Hardware

- A number of USB to serial UART chips are available as pre-built modules
  - FTDI
  - CP2102
- I plonked for the CP2102
- IC706 does not do software PTT had to use the DTR connection to do a hardware PTT with a relay !!

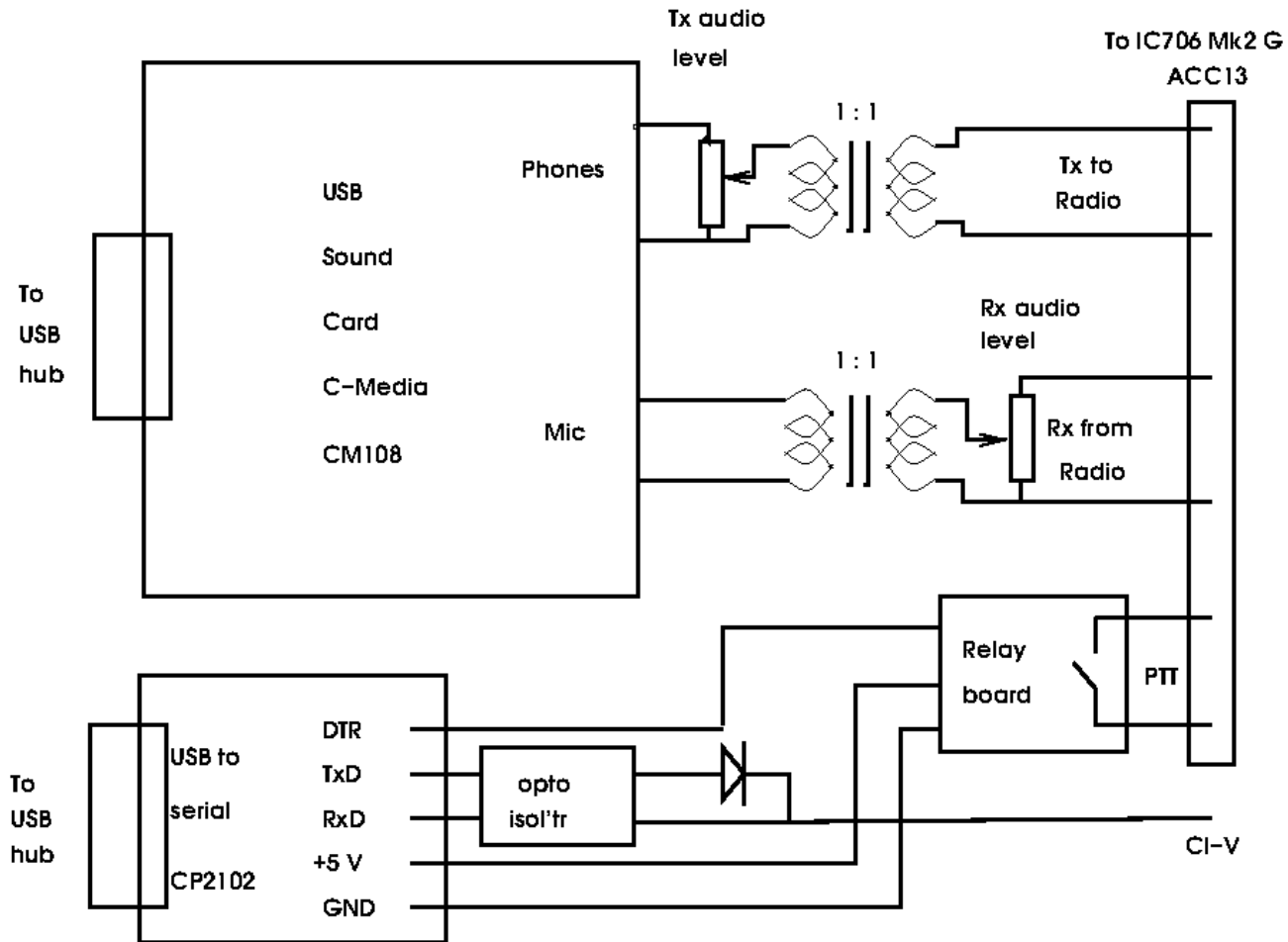
# Audio Software

- A number of VOIP packages are available
- I choose Mumble which is aimed at the gaming fraternity
- Widely used for audio in remote radio applications and can run on a variety of platforms
- Uses a server-client architecture
  - server runs on Raspi
  - Clients connect to “speak” to each other

# Audio Hardware

- Raspi has only primitive native sound
- Needs an external USB sound card
- After a few false starts I settled on a C-Media CM108
  - Cheap and cheerful
  - Readily available
  - Widely used for digi-modes and remote
- Well supported in Linux

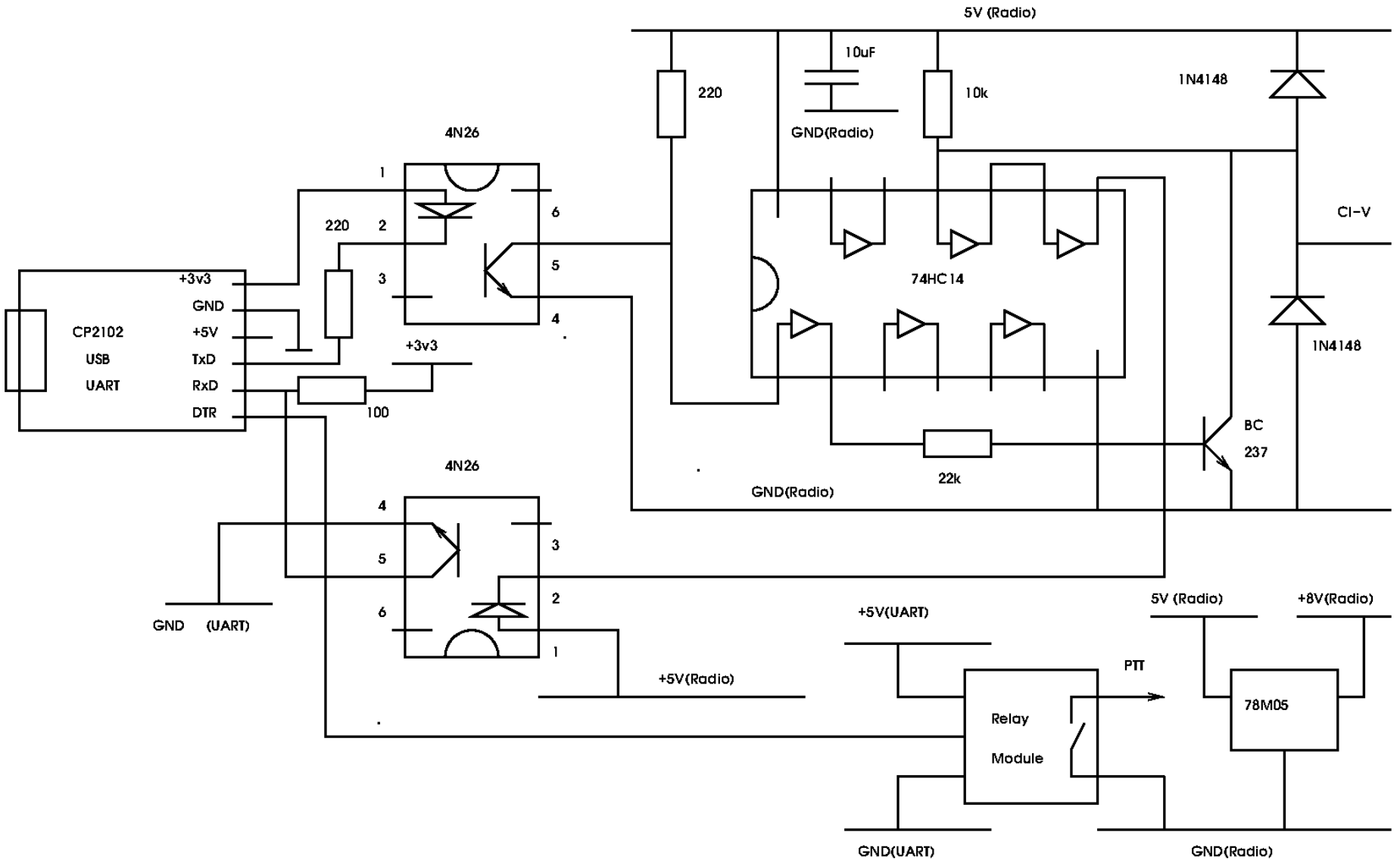
# Radio Controller



# Galvanic Isolation and Screening

- It is advisable to isolate the grounds of the computer and the radio
- Avoids hum/noise loops in audio
- Also reduces the risk of RF currents being induced in wiring loops causing mal-functions
- I found this on 40m. RF was crashing the Pi!!
- Use 1:1 transformers in audio paths
- Use opto-isolators and relays in PTT and CI-V
- Also shield all the control circuitry

# Isolated CI-V Interface to IC706Mk2G

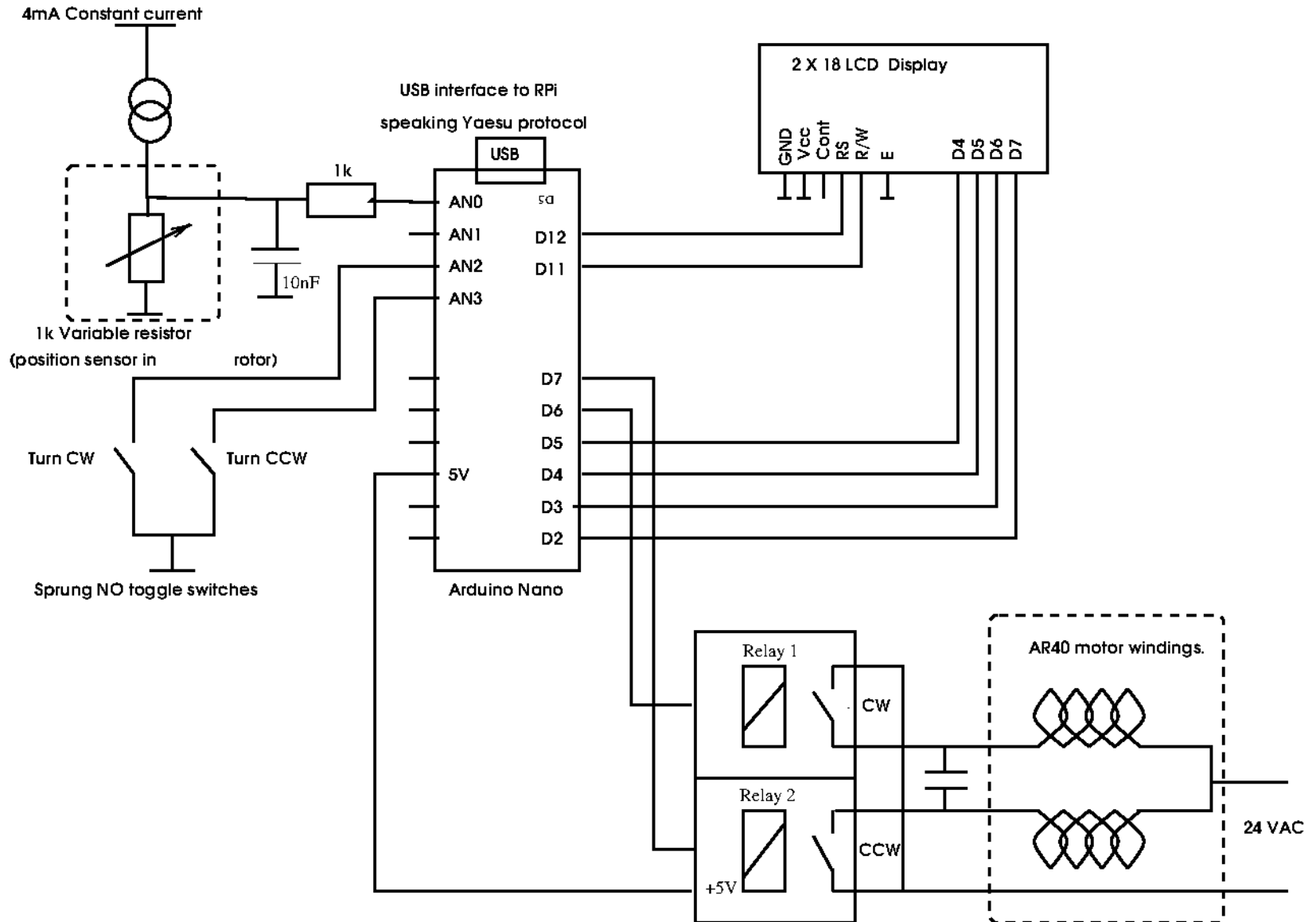




# Antenna Rotator Controller

- For VHF want to point antenna
- An interface from Raspi to my old CDE rotator required
- K3NG has written Arduino based code to provide computer control of a wide range of rotors. The code is very flexible and highly customisable to a wide range of requirements
- Arduino is used to provide control over USB
- Interface “speaks” Yaesu protocol to Raspi
- Rotor switched CW and CCW with two relays controlled from Arduino

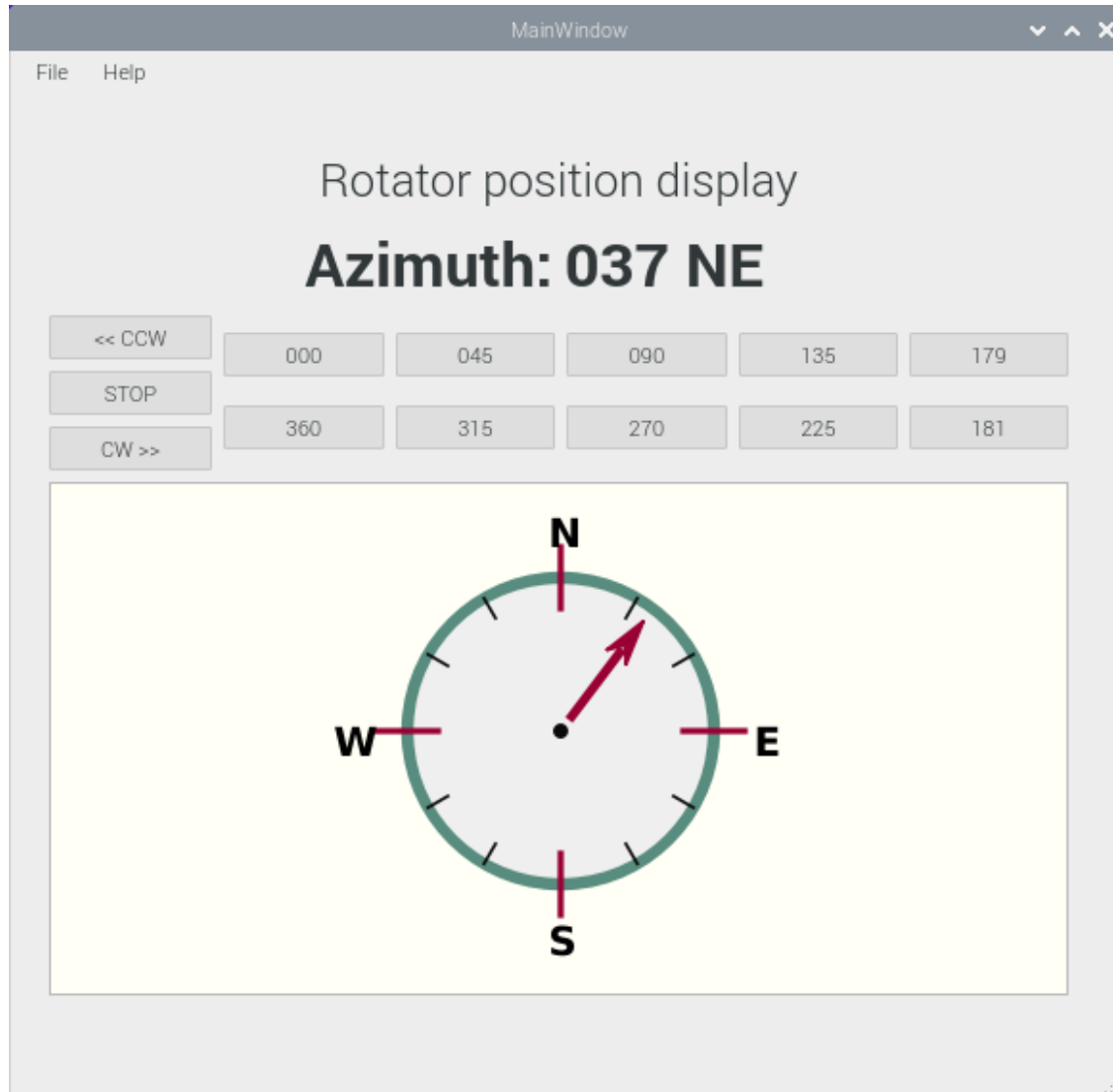
# Rotator Controller



# K3NG Rotor Control Programme

- Very extensive – can do Az/EI and moon tracking, here only Az is required
- Can be set up to do different protocols
- I used Yaesu as it works with various position display programmes
- Also used PyRotor written in Python from KK6DF, David Fanin
- Interfaces with the K3NG controller to give a nice compass rose type display on the Raspi desktop

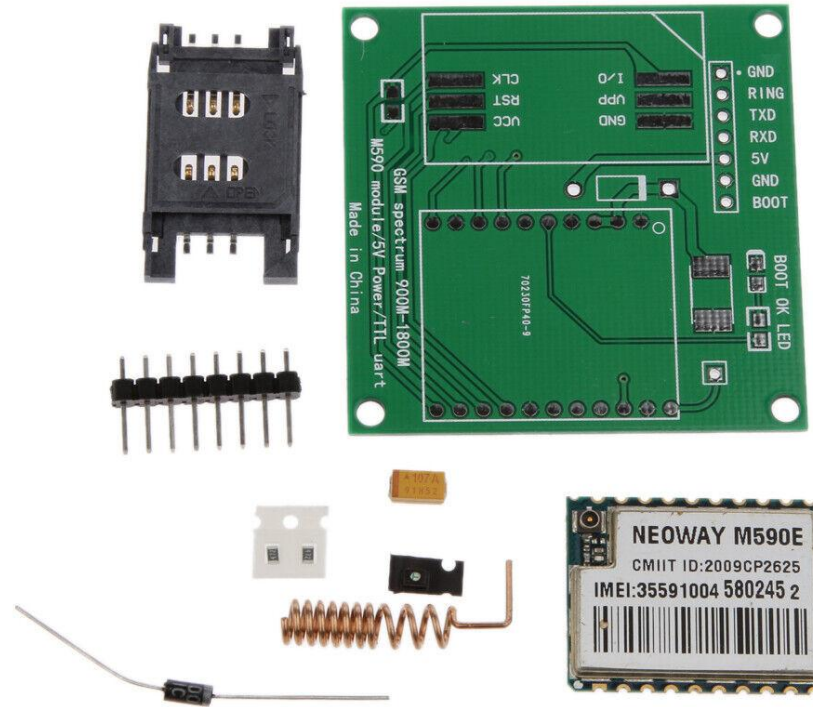
# Pyrotor Interface



# GSM Teleswitch

- Useful to be able turn power off and on remotely – crashes and economy
- Small GSM cell phone modules are available at very reasonable cost on Ebay
- Combined with an Arduino and a SIM card these make a useful teleswitch
- Examples of their use are on Youtube

# Neoway M590E Kit

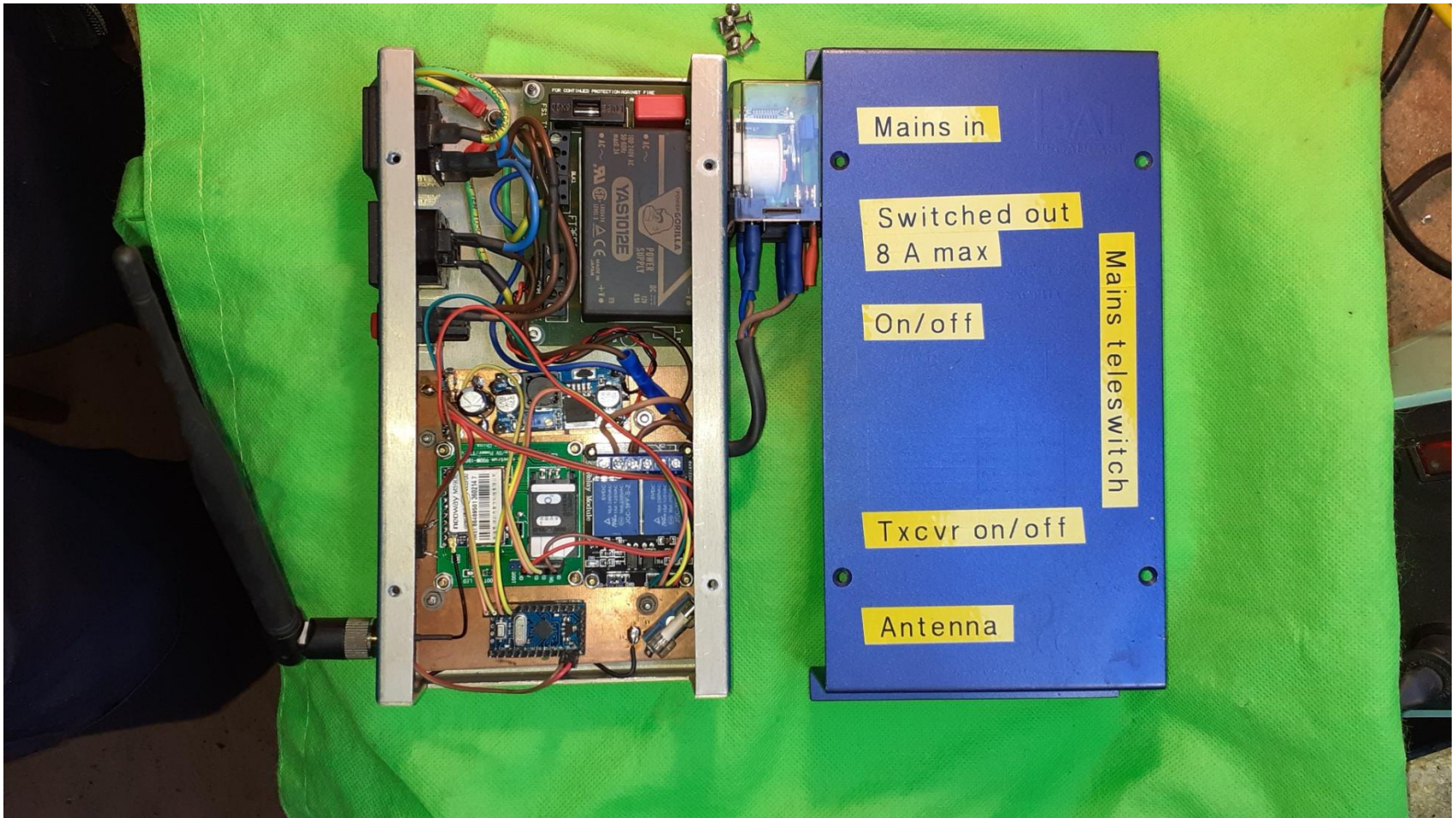


# Teleswitch box



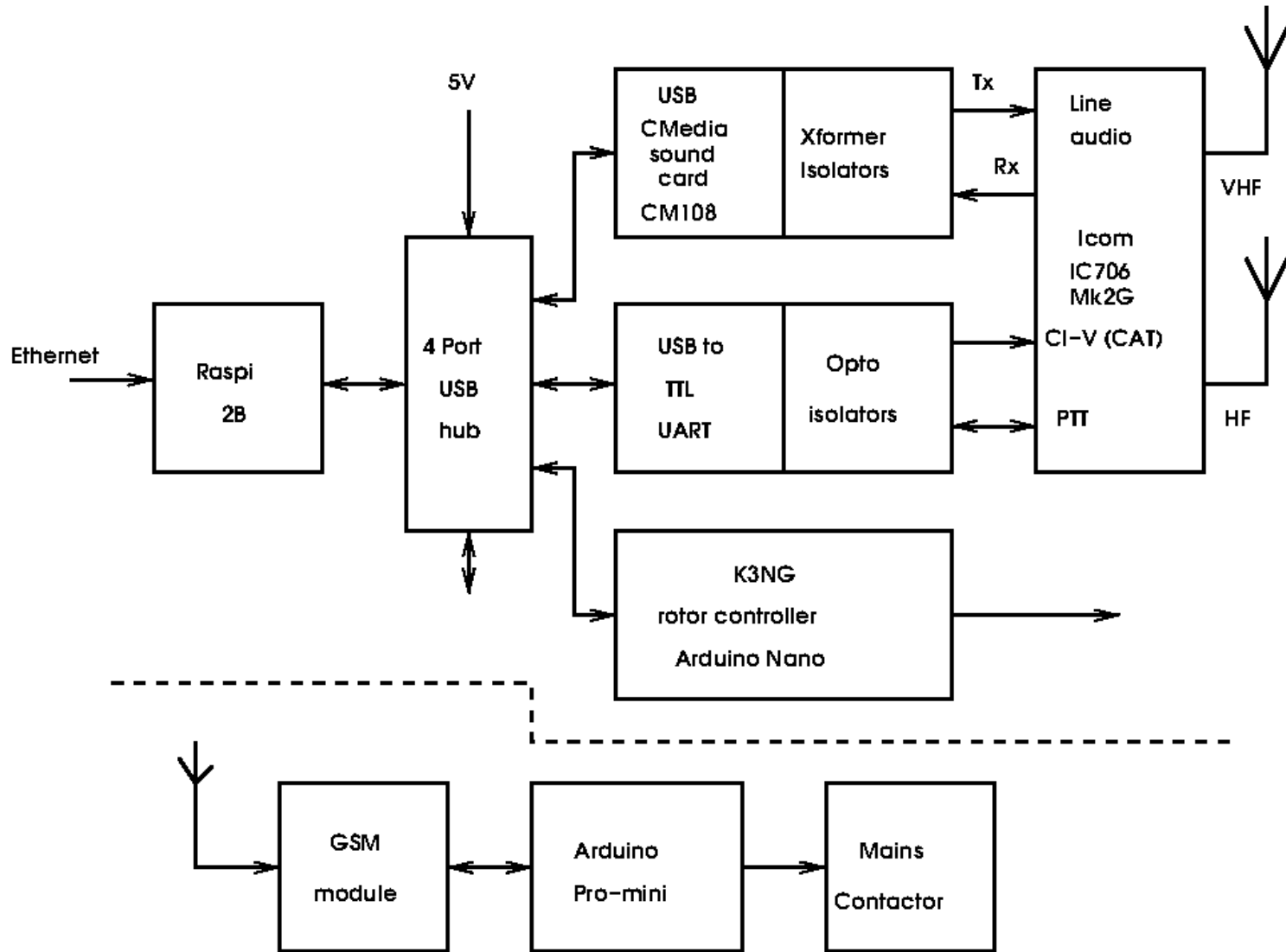


# Teleswitch "Insides"

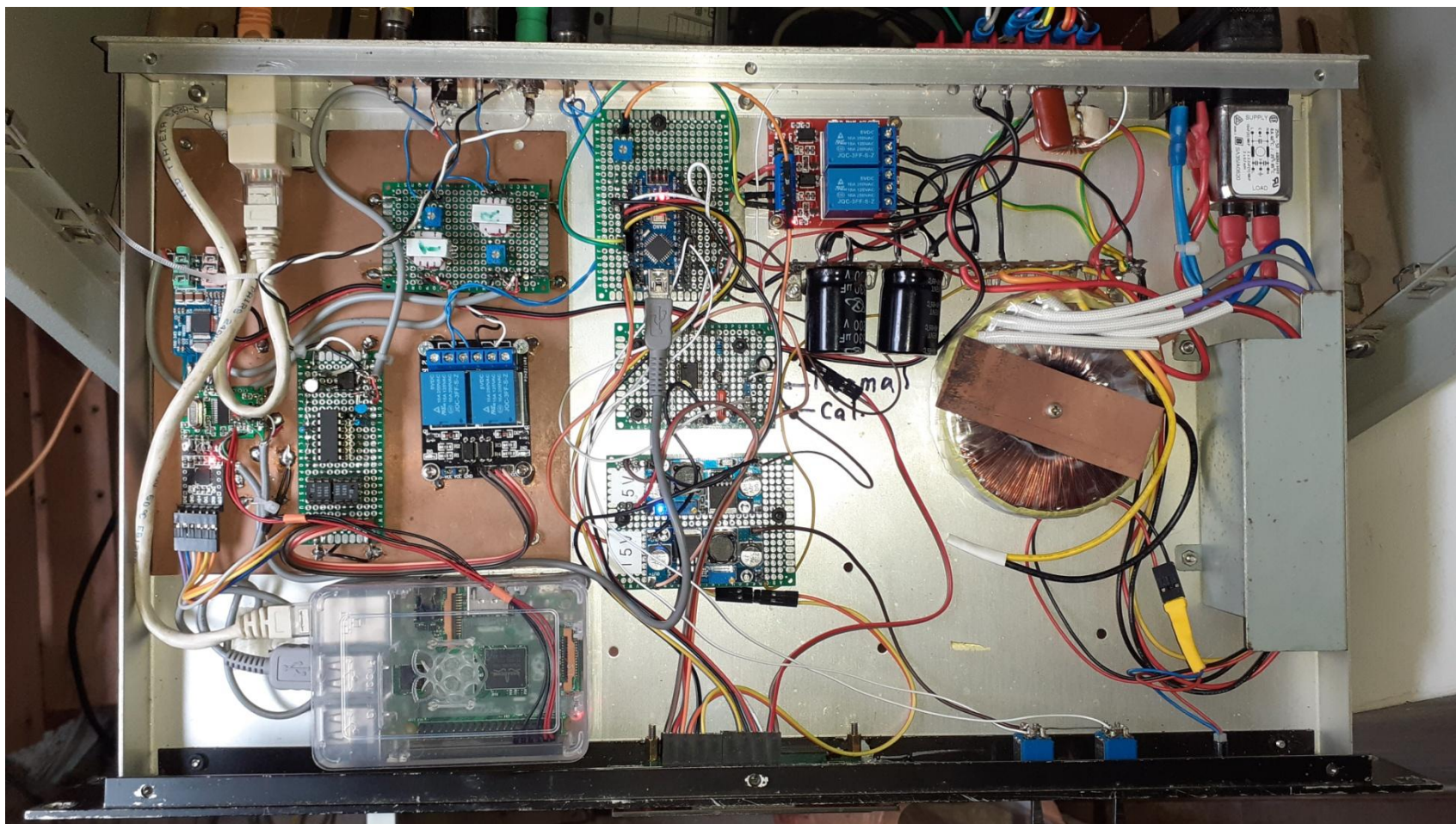




# Overall Block Diagram

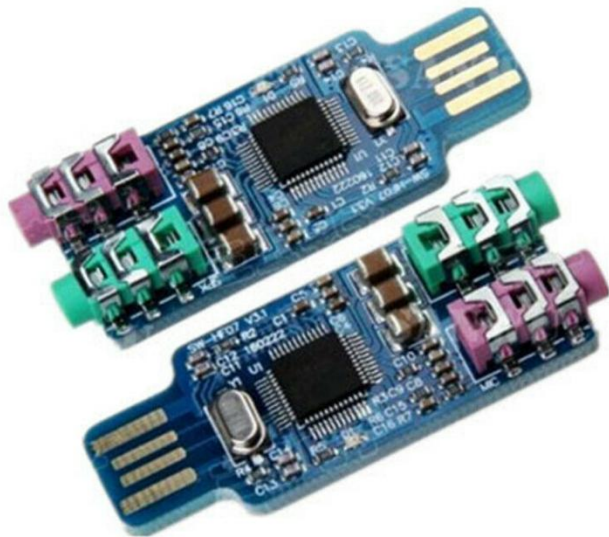


# Guts of Remote Radio Interface

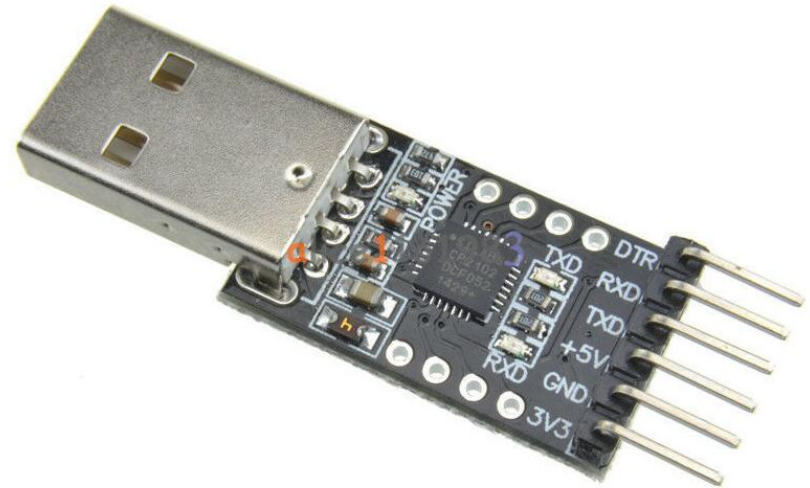


# Some “Ebay” Modules Used

**USB Sound Card**



**CP2102 USB UART**

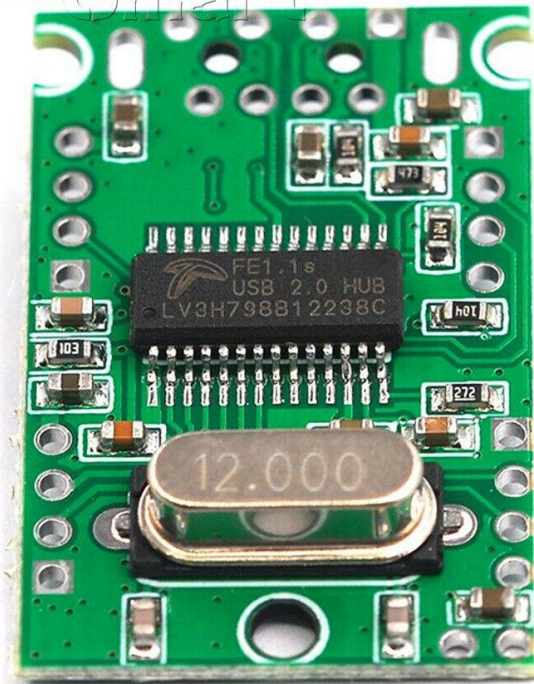




# More "Ebay" Modules

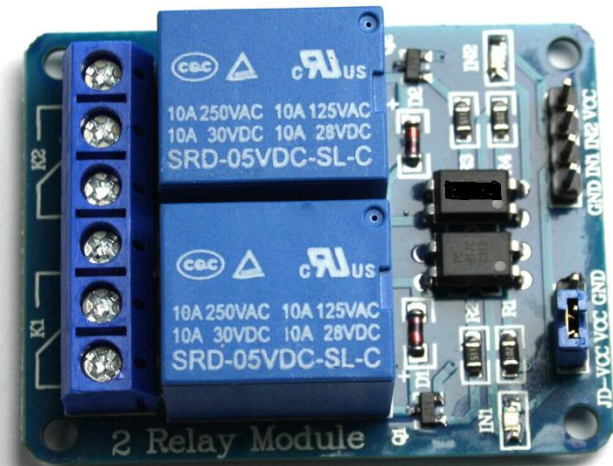
USB Hub

Smart



Relay

5 Volts 2 Relay Module



# Hardware in Rack Case



# Acknowledgements

- [RealVNC](#) for making remote desktop available
- David Freese, W1HKJ for [Flrig](#)
- Anthony Good, K3NG for [Arduino Rotator Controller](#)
- David Fanin, KK6DF for [Pyrotor](#)
- Jason A Oleham, KM4ACK Various Youtube videos on setting up Mumble for radio apps.

# Demonstration