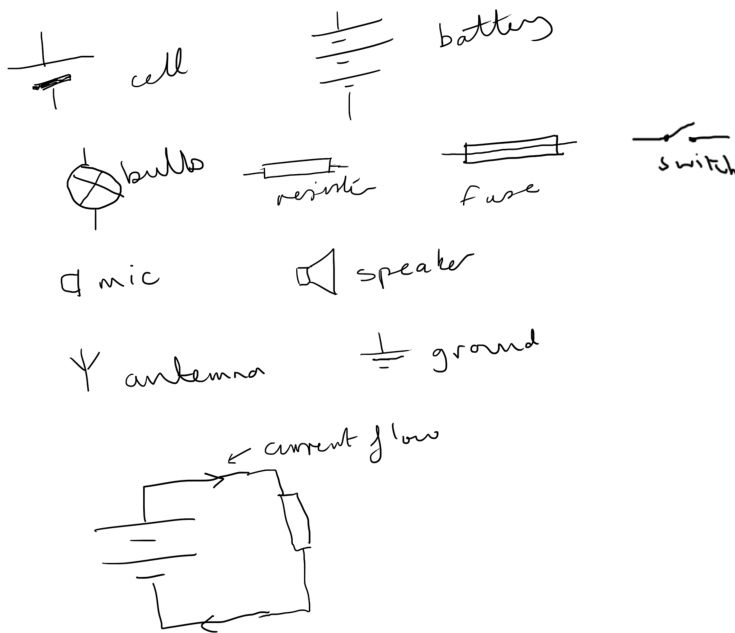


# Amateur Radio – Revision – Foundation – 2W0LGE

- Technical hobby
- Three levels – Foundation, Intermediate, Full (sometimes called advanced)
- Interested in how the radio works
- Many countries do not accept foundation
- Current Symbol = **I**
- Current Unit of Measure = **A**
- More current = larger wire
- Potential difference = **VOLTS** or **V**
  - Electrons have less energy leaving a device from when they entered, this is the PD.
- milli = 1/1000 th
- kilo = 1,000 x
- Mega = 1,000,000 x
  - eg. 1mA, 1kA, 1Mhz
- Electrical circuit is the way devices/components are connected
- Metals conduct, wood, plastic, rubber, glass, ceramic do not

These notes are taken from the 5<sup>th</sup> Rev of the Foundation Now book, with most of the waffle removed, in bullet form.



## Power

- Give the electrons more energy by increasing volts
- Give more current by increasing rate at which the electrons move
- It is a measure of how quickly the device transfers energy
- Power (watts) = Potential Difference (V) \* Current (I)

$P = VI$

## Resistance & Ohm's Law

- Omega  $\Omega$
- Measure of how difficult it is for electricity to flow
- Increase in V, increases I
- Increase in R, decreases I
- Directly proportional to V inversely proportional to R
- OHM's law

$$V = IR$$



## Frequency & Current

- DC – direct current
- AC – alternating current
- AC easier to generate
- Transformer used to change voltages etc
- AC changes polarity slowly
- Mains frequency is 50Hz

## Sound frequencies

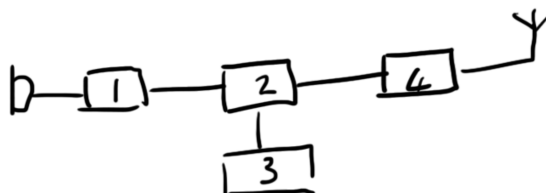
- Hearing – 100Hz to 15kHz
- Speech – ok from 300Hz to 3kHz
- Speaker leads use AC

## RF Frequencies (Radio Frequencies)

- Feed AC to antenna
- $\lambda$  lambda – wavelength
- Other users – frequency band table, amateurs are 144-146 on 2m band
- 3mHz – 30mHz – HF
- 30mHz – 300mHz – VHF
- 300mHz – 3000mHz – UHF

## Transmitters

- Generates radio waves
- If it has an issue can cause difficulty to other users
- Modulation = superimpose audio signal onto the radio signal



- 1 – audio stage
- 2 – modulator
- 3 – oscillator – frequency gen
- 4 – rf power amplifier

## Modulation

- Process of getting radio signal to carry audio
- AM + FM are methods of modulating the carrier
- Care with over modulation, as can interfere with adjacent channels – too much mic gain etc
- AM – amplitude modulation – amplitude changes with time, fixed frequency
- FM – frequency modulation – frequency changes with time, fixed amplitude (we tune to centre of frequency, it doesn't vary much)
- Excessive frequency deviation can cause problems for adjacent channels



## Receiver

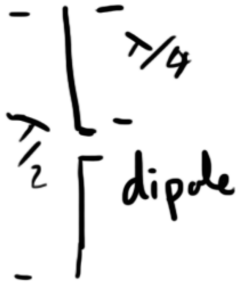
- Tune and pick up a weak signal, then amplify it
- The decoder (2) recovers original modulating signal and extracts the audio
- (2) is also called a de-modulator
- Detector must be correct for the mode (ssb, cw, fm, usb, lsb, etc)



## Feeders and Antennas

- Coax – screen confines the RF
- BNC / PL259 / SO239
- Antennas convert electrical signals to radio waves

### $\frac{1}{2}$ wave Dipole



- equal in all directions to the horizon



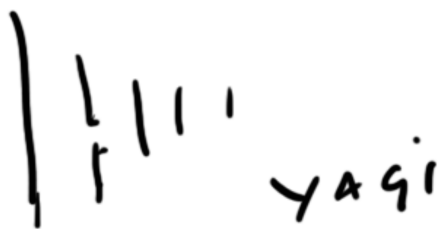
- horizontal but not off ends, so not omnidirectional

### $\frac{1}{4}$ wave ground plane



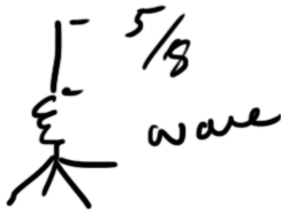
- vertical radiator
- omni directional equal to all horizontal directions
- radials are a mirrors

### Yagi



- Focuses RX and TX
- Directional
- Horizontal or vertical polarization
- Directors and reflectors
- Emitter is  $\frac{1}{2}$  wave dipole
- Emitter also known as driven element

## 5/8 wave ground plane



- better at directing signals to the horizon
- coil matches the coax
- vhf + uhf mostly due to size

## End Fed



- requires ATU
- feed far away from house due to radiated power

## Antenna Gain

ERP – effective radiated power

ERP = gain \* TX power

Where gain is...

**dbgain gain**

3	2
6	4
9	8
10	10

## Polarisation

- The same as the live element of the antenna, vertically or horizontally (mostly)
- Best to have both the TX and RX the same polarization

## Matching

- RF reflected down the feeder if not matched
- Low SWR
- Use an antenna at the wrong frequency and same problem
- Could damage the TX
- Use ATU to match and for the antenna to radiate well

## SWR

- Standing Wave Ratio
- Outbound waves hit reflected waves, creating waves that are 'STANDING'
- If unexpected increase in swr could be due to antenna damage
- Swr meter will show if correct match to antenna

## **Balun**

- Takes an unbalanced feeder and makes it balanced, ie from coax to dipole

## **Dummy Load**

- Good screen
- Absorbs RF
- Testing purposes

## **Propagation**

- Electromagnetic waves
- Straight lines unless reflected or refracted
- Spread out
- Strong close by, weak far away
- Can penetrate buildings, but depends on frequency
- HF tend to ignore buildings as they appear 'small'
- UHF/VHF blocked by buildings, but may pass in through large windows
  
- Get the UHF/VHF antenna as high as possible

## **Range**

- More range, with more power, although not 1:1
- Yagi to focus power
- At high frequencies buildings are large
- Hills and mountains cause shadows even to HF
- Curve of the earth gets in the way
- Perhaps 10-20km on the flat with vhf/ufh and 60-80 when on a hill
- Less than 1km on vhf/uhf when in buildings
- Outdoor better than indoor

## **Ionosphere**

- Conductive GAS  
70-400 km up
- UV interaction with air molecules in upper atmosphere
- Varies with TIME OF THE DAY, ie the amount of sun
- Varies with the season
- Refracts or bends the waves
- Well beyond horizon
- Bend is frequency dependent
- Highly ionized or 'strong' then will bend higher frequencies
- Day.. 30Mhz returned, Night, 3Mhz
- Summer the high / low is more modest
- Highest frequency returned is MUF, max usable frequency
- Might only be a few hours a day
- Band is said to be open
- Move up the band in the day, move down the bands in the day
- Sky wave paths, can hop over 4000+kms, and then re-bounce from earth and back up

## Licence Conditions

- 1) For self training, it is non-commercial and for leisure only
- 2) Three types, Foundation, Intermediate and Full. More facilities as you move up the grades, and ability to build and modify.
- 3) Call sign format.
  - a. Foundation M{}3 and M{}6
    - i. {} Region locator is as follows
      1. D – Isle of Man
      2. I – Northern Ireland
      3. J – Jersey
      4. M – Scotland
      5. U – Guernsey
      6. W – Wales
      7. NO ID for England
  - b. Intermediate 2E0 or 2E1. Replace E with region locator
  - c. Full M0 or M1, also G0-Gn. Insert region id as above
  - d. /M mobile
  - e. /A different postcode than licence
  - f. /P portable, such as camp site
  - g. **NOTE:** you don't need to use /M /A /P anymore, but is considered good practice
- 4) Station Identity
  - a. MUST use regional locator after UK suffix G M or 2
  - b. During CQ
  - c. Every 15 mins ← **not since 2015, check intermediate notes (essentially when practicable)**
  - d. When changing frequency
  - e. In the same MODE of TX that is being used for the communication
  - f. On the same frequency that is being used for the communication
- 5) Only send to other amateurs only or stations of amateurs
  - a. No encryption
  - b. May use recognizable codes
- 6) NO Broadcasting
  - a. Not allowed to send messages to anyone that 'happens' to be listening, unless it is a CQ
  - b. Must always address calls to a station
  - c. Can be a net, must have initial contact with all in net
  - d. Can broadcast via mailbox or bbs
- 7) Only the licensee can use the equipment or any other licensed amateur under supervision
  - a. Can pass messages onto other user services, or permit them to use the equipment
- 8) Change address.... Inform OFCOM
- 9) Ofcom has right to inspect, modify or shut down, or restrict use.
  - a. May shut you down if you breach Licence, or contribute to interference
- 10) Understand the schedule
  - a. The bands and status (ie primary secondary)

## **Operating Practices and Procedures**

- Band plans – gentleman’s agreement by the International Amateur Radio Society and RSGB – how best to share the available frequencies
- So as to share the band and know what areas can/cant be used
- Might be asked to keep a log by Ofcom
- Listen before making a cq call and check if clear

## **Transmitter Controls and Misc**

Power/Tuning/AF(Volume)/Squelch, Repeater Offset, RIT (receiver incremental tuning)

- VHF-UHF = calling frequencies
- HG = no calling frequencies
- Netting – them tuning in to us
- RST – reports, 59, 599. Readability and Signal, also Tone
- QSL cards – contact confirmation

## **Repeaters**

- Simplex and Duplex – the difference
- RV – channel numbers on the band plan
- Historic 1750Hz tone to activate, now use CTCSS (continuous tone coded signalling system)
- Repeater offset

## **Data**

- Terminal node controllers TNC
- Basically like a modem
- Text only
- Audio level issue and RF causing the TNC to get jammed on, check PTT line

## **Etiquette**

- No talking to unlicensed stations
- Ignore abuse
- Report repeated abuse to Amateur Radio Observation Service (Bedford)



## **EMC – Electromagnetic Compatibility**

- The avoidance of interference between two devices
  - Picked up by metal, wires, pipes
  - Equipment might not work as expected
  - RF onto mains cables ?
- 1) move antenna away and higher up, to counter direct pickup
  - 2) fit filters to power cables on TX, to counter RF on mains cables
  - 3) fit filters on other devices and move antenna away, to counter RF being directly picked up in devices and on cables to those devices
  - 4) earth RF pickup, fix earthing issues
- Why earth ?
    - 1) Safety
    - 2) RF earthing – path to ground for the RF to go not to interfere with other equipment
  - Reduce the RF on the coax to a balanced dipole by running feeder at 90 degrees
  - End fed antennas at end of garden
  - More power, more problems
  - How bad are the different modes?
    - FM – most benign as no level changes
    - SSB – worst as level changes over time
    - Data – not too bad as constant power
    - Morse – reasonable with smooth transitions
  - Balanced antennas less likely to be a problem, unlike end fed
  -

## **Immunity**

- The ability to withstand RF
- Most modern equipment has European EMC directive
- Ferrite ring filters, fit as close as possible
- Bad idea to use home made ferrite rings

## **Neighbours**

- Co-operate, then ask ofcom
- Perhaps get them to contact their equipment manufacture if they are sending out RF to you

## **Safety**

- High volts = bad
- High current = bad
- Use correct fuse
- PME = protective multiple earthing, affects manner in which devices are earthed
- CUT power first to shack if someone is down
- Mount feeders away from obstructions and away from being walked into
- Do not touch feeders or antennas when TX, RF burns
- Care form wind + lightning strikes
- May need planning
- Cables under carpet = bad news
- Trip hazards etc
- Metal objects on hands such as watches/rings

## Car Batteries

- High Current (main risk)
- Hydrogen – explosive
- Acid

## Headphones

- Hearing damage
- Electrical shock issue, remove when working/servicing

## Tools

- Care with tools, soldering irons, knives

## Licence Schedule

- Table A for foundation
- Bands + power
- Primary and secondary (secondary don't interfere with primary users)
- Maximum power permitted @ FEED POINT
- As a guestimate, 2/3 DC power to RF power amp

## Morse

- For difficult conditions
- Common language

## Phonetics

A	alpha	N	november
B	bravo	O	oscar
C	charlie	P	papa
D	delta	Q	quebec
E	echo	R	romeo
F	foxtrot	S	sierra
G	golf	T	tango
H	hotel	U	uniform
I	india	V	victor
J	Juliet	W	whisky
K	kilo	X	x-ray
L	lima	Y	yankee
M	mike	Z	zulu

## RST 5/9[9] --- readability / signal [/tone quality]

1	unreadable	1	faint
2	barely	2	v weak
3	difficult	3	weak
4	little difficulty	4	fair
5	totally readable	5	fairly good
		6	good
		7	moderately strong
		8	strong
		9	very strong