NEWSLETTER

www.g3mdg.org.uk
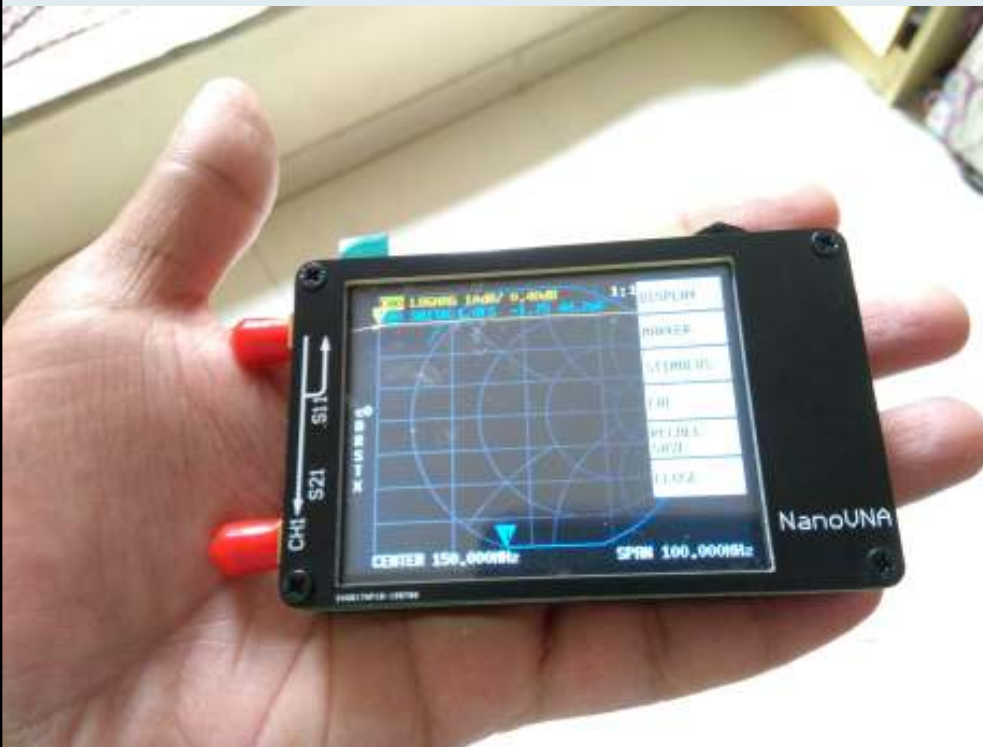
C.D.A.R.S.

MAY 2023 CHESHAM & DISTRICT AMATEUR RADIO SOCIETY MONTHLY NEWSLETTER

Peter (2E0PTH) introduces us to Micro Computers and Micro Controllers

Increase your power, or understand your antenna's efficiency better?

We meet the 2nd and 4th Wednesdays of the month at the Ashley Green Memorial Hall, Ashley Green, HP5 3PP

NanoVNA

Network Analysis on a budget

Licence changes?

There is speculation that transmitting power may be increased, do we really want more power, or should we be looking at our antenna efficiency?

"*Lower your power and raise your expectations*" Rich (AA4OO), someone who knows the value of an efficient antenna.

Morse Code

Ever wondered how they work out the 'words per minute' in Morse code.

This month marks the 232nd birthday of Samuel Morse

Antenna's

This month we look at tuning various antenna's with an SWR meter.

Your S-METER

What does your S-meter actually tell you?

SPOTLIGHT

This month it's Malcolm's (G3ZNU) QSO to Reunion Island, just off the South-East coast of Africa.

Want to write something for the newsletter?   Then you can contact me on bryanpage1@btinternet.com

If you have anything for sale, why not drop me an email and I'll put it in the 'For sale' page.

Morse links

If you're interested in Morse code, here are a few useful links:

FISTS CW Club

Promoting Morse Code for 36 years 1987-2023

https://fists.co.uk

Wikihow

How to learn Morse Code

https://www.wikihow.com/Learn-Morse-Code

The Ham Whisperer

Morse Code Course

http://www.hamwhisperer.com/p/morse-code-course.html

LEARN MORSE CODE

LEARN MORSE CODE in one minute !

http://www.learnmorsecode.com/

Welcome to LCWO.net

Learn Morse Code (CW) Online!

https://lcwo.net/

Tools for learning Morse Code

https://www.aa9pw.com/morsecode/

Celebrating the unique art form of Morse Code

https://cwops.org/

Morse Code by Ray Burlingame-Goff
(SK - 29th July 2021)

http://www.g4fon.net/

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Welcome

My thanks to Malcolm (G3ZNU) for this month's Spotlight, Reunion Island off the South-East coast of Africa, I doubt I'd get his antenna in my back garden!!

With my MetroVNA giving up the ghost I looked on the Internet for something to replace it, albeit on a temporary basis while the other one was being repaired. Internet searching led me to looking at the NanoVNA, a Chinese offering of considerably less cost (a few pence short of £46, and that included the case), I believe a couple of you may already have one. I have a lot to learn and have found a mixture of guides on the Internet, you can find my take on it in the Reviews section this month.

Bryan M0IHY

Martin Lynch & Son repaired the MetroVNA, surprisingly the repair comprised only of a new battery, and the fingers of the switch being tensioned (this was the main problem where it would occasionally flicker on and off), the cost £97+, when I asked their labour rate per hour I was told £72 (just £25 for the parts), expensive, but I'm glad I did it, now I have "old faithful" back in my kit. As for the NanoVNA, more on that next month and maybe not what you'd expect.

I read that Ofcom are considering making changes to our licences, nothing in concrete yet, but talks of raising power level has been spoken of in the talk groups. There is a healthy discussion on the subject on some of the amateur radio websites with some Intermediate licensee's wanting the power to be raised to 100W, giving the impression they think double the power, double the distance, because of this I've included "**What does your S-meter actually tell you**" and "**Antenna's, Tuning and SWR**" in this month's newsletter in an attempt at giving you a better understanding.

Thanks especially to Peter (2E0PTH) for his slides on Micro Computers and Micro Controllers, he's put a lot of work into this, a very interesting subject, with hopefully some of you biting the bullet and giving it a go.

Brill (Windmills on the Air) is just 2 weekends away (13th and 14th of May), hopefully the weather will hold out, remember me quoting my friend in Edmonton, Alberta, and her weather appearing on our doorstep some 7 days later? She told me last night they had unusually high temperatures for the time of year, 27°C, will we have this weather next week?

Bryan M0IHY

Chairmans Ramble

Dave (G8FMC)

Hi all; time for another 'Charman's Ramble'.

I have had a very busy month & I was completely oblivious to my deadline rushing up. I had completely forgotten about one of my regular 'chairman duties'! Thanks for the prompt Bryan.

Another well attended Pub meet on 12th April, which seemed to be enjoyed by all in attendance? This formula of alternating meetings at the Golden Eagle, then Ashley Green village hall, seems to be working quite well?

Our formal meeting on 26th April was very well attended by club members & a number of our Contest contributing Associate Members. Phil M0NVS, with support from Anthony G7LRQ, gave us a very interesting run-through on how to take advantage of the 'KST Client' facility in the latest version of the Minos VHF contest logging program.

By the time most of you read this, I may have given my chat via Zoom on 'More on HF Antennas'. This was originally scheduled for the 5th Wednesday on May 31st. However I messed up as I am away on a brief holiday break then, meeting up with my eldest daughter Sally & husband Simon at a Cotswold holiday park. (Sally & Simon in their small touring caravan & me in a luxury chalet!)

The 'HF Antenna' session is (was?) now on Wednesday 3rd May instead of the club net on the GB3TU Repeater, again via Zoom.

I cannot actually remember when I was last away on a proper holiday? Covid, being primary carer for my late wife Jean & not really wanting to go on holiday by myself since her passing, has meant that visiting friends or family has been the order of the day for some time. Some of you will be aware that Sally & Simon live up in NW Cumbria in the village of Bigrigg, which is just South of Whitehaven & just north of the Sellafield Nuclear establishment. (Which is right on the western most bit of land up there, looking out over the Irish sea). During my infrequent visits up there I have on the odd occasion operated as G8FMC/P in IO84FL. Very strong signals to Ian GM3SEK & Richard GD8EXI (annoyingly both in IO74!) from there.

Interestingly many people seem to have heard of Whitehaven, but are not quite sure where it is? Although in Cumbria, it is a whole different world to the Lake District & rather 'yesteryear'. Salaries & house prices etc. are very low. If you do not work at Sellafield (an awful lot do) then it is mainly farming, shops & small businesses, with a large number of folks on, or close to legal minimum wage. It has a certain charm & the port of Whitehaven was a major player many generations ago. However their average rainfall is a LOT, being significantly more than Cornwall! Being 300 miles = 6hrs travel away we do not often get to visit each other, so I am quite looking forward to my few days away in the Cotswolds.

Planning for the Brill Windmill event (Sat 13th & Sun 14th May) is moving forward & we are hoping for a good turnout & good weather. Matt M1DTG is the lead on this but with Roger M7RMF, assisted by Peter 2E0PTH looking after the 'Kit list'.

I am not there for Saturday, but am also hoping for good weather! As Bryan alluded to last month, I am ('Playing Biggles') in an open cockpit Tiger Moth aircraft, flying from Sywell in Northampton. I have also been seriously 'SKI-ING' (spending the kids inheritance) & should be in a two-seat Spitfire, flying from Duxford on Thursday 25th May. Again weather dependant. As a late good friend said; "there are no pockets in shrouds Dave", so I am squandering some of my inheritance now while I can still enjoy it.

73 all, Dave K, G8FMC

The NanoVNA Antenna Analyser

Credit: the Internet (various) and M0IHY

CH 0 - Port 1

CH 1 - Port 2
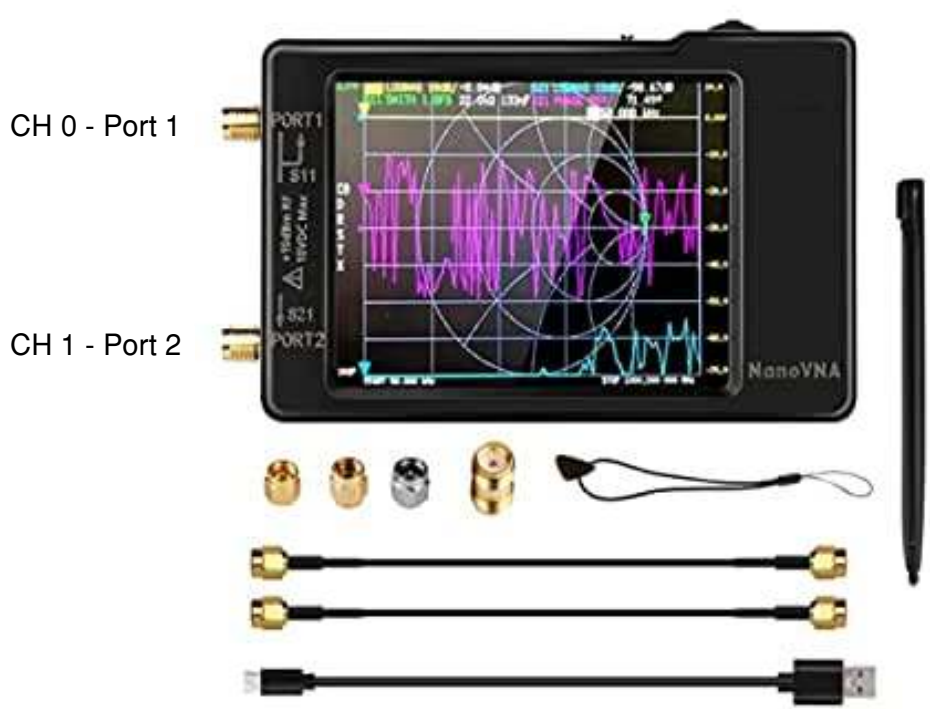
This is what you get in the box, and for the asking price of £39.61 it's quite a bit. The picture above shows the unit installed in the case, which cost just over £6.

1. The NanoVNA
2. A calibration set consisting of:
   Load (50ohm)
   Open circuit
   Short circuit
3. 1 * female - female SMA adapter
4. Plectrum for use with the touch screen
5. 2 SMA male-male cables
6. USB C-C lead
7. USB C to USB-2 lead
8. Stylus for use with the touch screen
9. Printed menu sheet
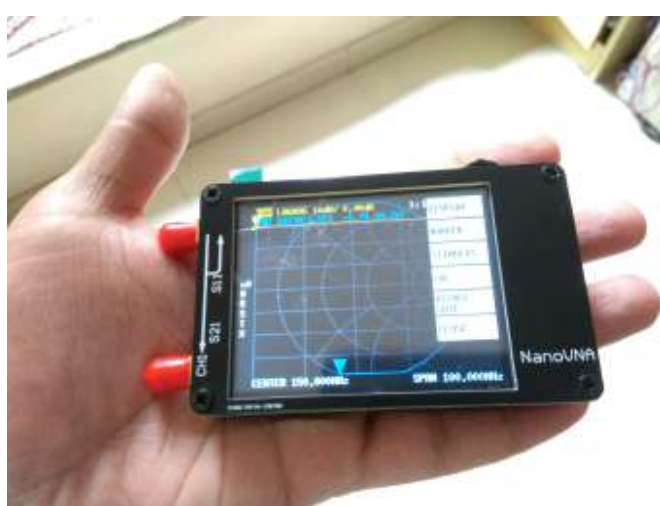
The actual uncased unit, small enough to put in the palm of your hand.

I've seen several comments regarding the robustness of the NanoVNA, mainly the fact it may not survive a field day, which makes sense, it's a delicate measuring instrument and as such should be treated accordingly and not just 'thrown' in your kit box. Care should be taken when connecting it to an antenna, I use a PL259 to SMA lead which will allow a little strain relief to the onboard SMA connectors.
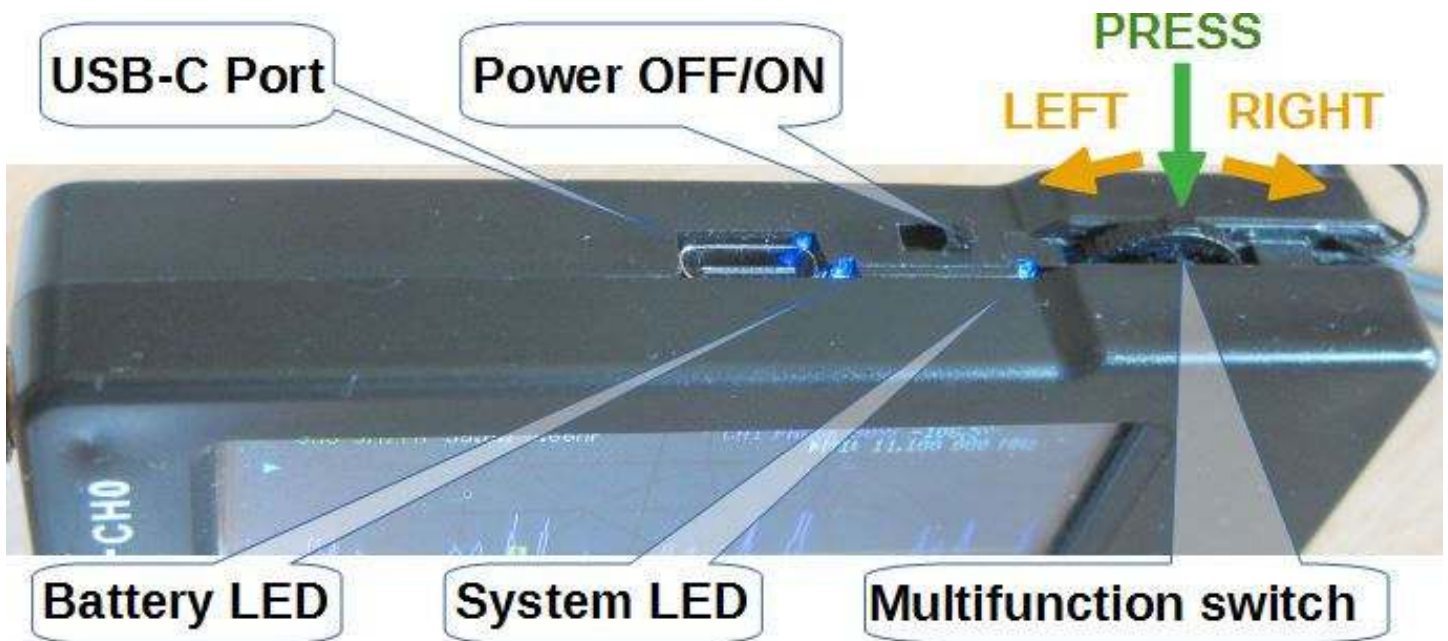
The basic controls

On turning the unit on you will notice how cluttered the screen is with information, we will deal with this later.

The Multifunction switch
Menu's can be opened by pressing down on the multifunction switch. When a menu is active you scroll down the items by moving the switch to the right, moving the switch to the left scrolls upwards. When you have the menu option you require, press the multifunction switch to select that option.

You may find it better to use the stylus, or plectrum. Simply tap the screen and the menu appears on the right, from there you can tap the required menu option to take you to other options.

Charging the unit.
The USB-C port is used to charge the battery and send data to a PC. It doesn't matter how the USB cable is inserted.

Charge the battery by connecting the USB-C port of the NanoVNA to a PC or via a 5V charger. The battery LED is an indication of the battery charging, it flashes when the battery is charging and is steady when the battery is charged (as reported by others, mine went out when it was charged).

When charging the battery, the NanoVNA can be turned off or on.

On turning the NanoVNA off the LED light will remain on for a short period, this is normal. The System LED will flash during normal operation.

NanoVNA's Ports

NanoVNA has two ports labelled: CH0 (Port 1) and CH1 (Port 2) (See previous page).

- On CH0 NanoVNA measures the reflected signals from the DUT (Device Under Test) e.g. antenna.
- On CH1 NanoVNA measures the signals that have passed through the DUT (e.g. filter).

Please note: Your VNA may have different menus due to different versions of the firmware.

There are a few things to do before we can use the unit, so lets get started...

Menu and option access

To bring the Main Menu up, either click the multifunction switch, or tap the screen with the stylus.

To select a menu option, either rotate the multifunction switch to the left (up), or right (down) to get to the option and click the multifunction switch, or tap the option with the stylus.

Touch screen calibration

Options (starting from Main Menu)			Purpose
1	CONFIG	TOUCH CAL	-	To calibrate the screen
2	CONFIG	TOUCH TEST	-	To test the screen
3	CONFIG	SAVE	-	Save the screen configuration

The NanoVNA is controlled by selecting a command from the menu. For proper operation, the touch screen should be calibrated and the calibration should be stored in the NanoVNA memory.

The touch screen is of resistive technology and needs the right amount of stylus pressure to work properly.

We need to calibrate and save the touchscreen coordinates, the following are instructions/menu options to achieve this.
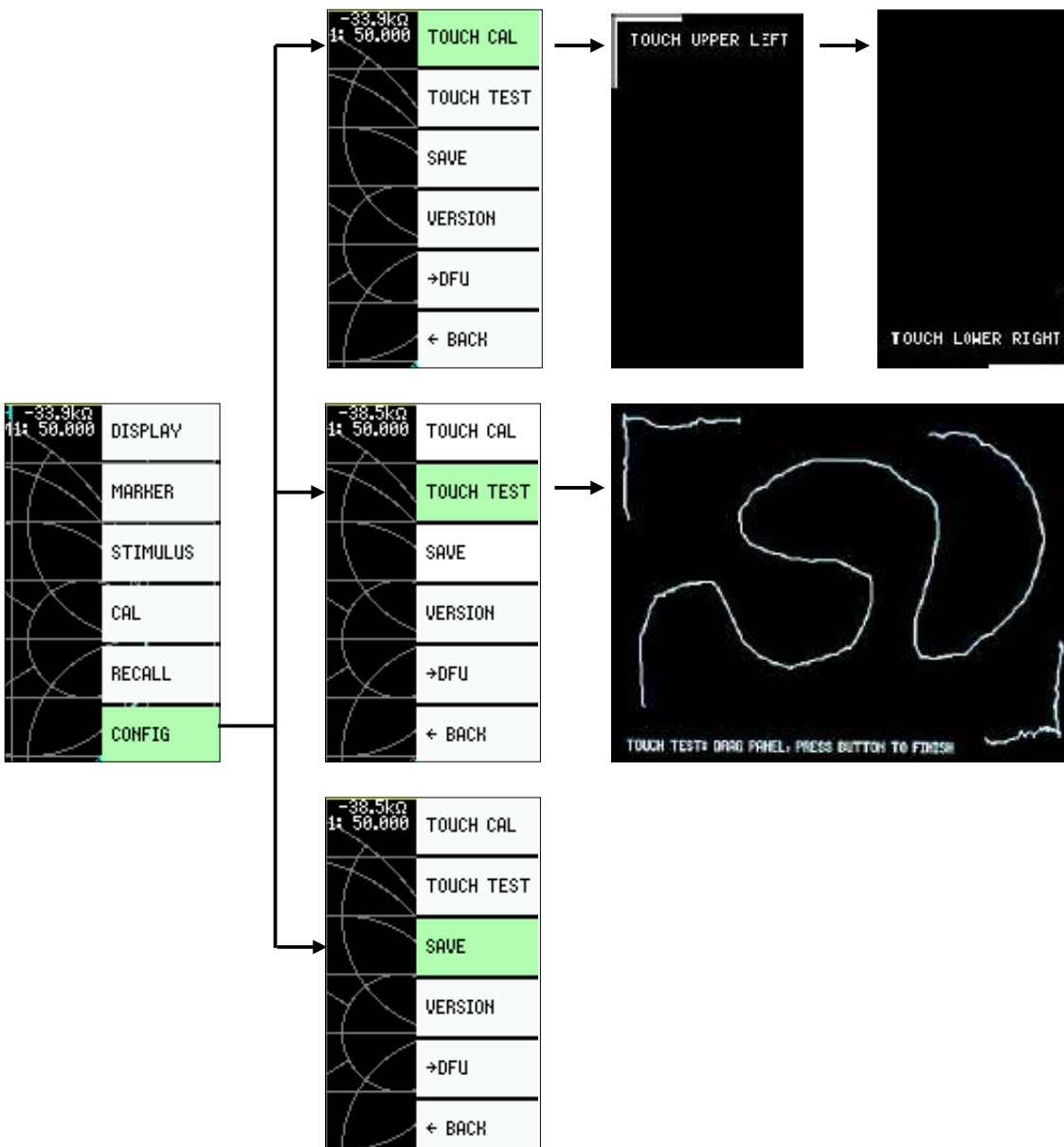
Measurement configuration - Trace

| Options (starting from Main Menu)		Purpose	
1	DISPLAY	TRACE	-	To set active, deselect, or remove a trace from the screen.
2	DISPLAY	FORMAT	-	To select the format of the active trace, LOGMAG, PHASE, DELAY, SMITH, SWR

The NanoVNA can display up to four traces (four traces or three traces plus a Smith Chart simultaneously), TRACE 0, TRACE 1, TRACE 2 and TRACE 3 but only one is the active trace, we can select the trace(s) that are displayed.
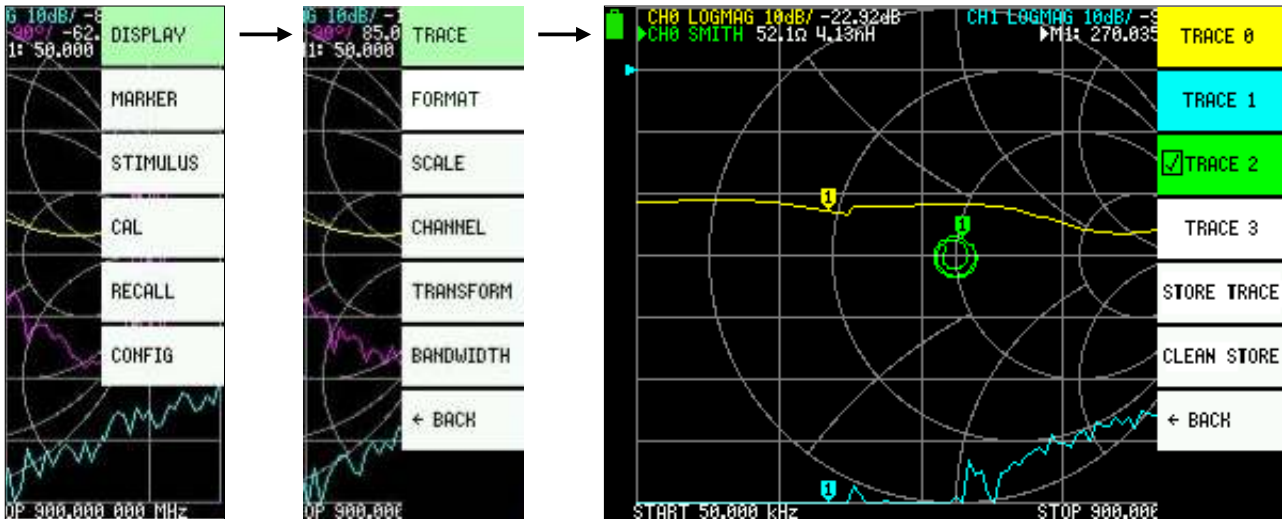
Note: The active trace is TRACE 2, this is marked with a tick against the menu option and a triangle (the same colour as the menu option) against the trace/channel information at the top of the screen (in some cases it may be an inverted image). Also note that TRACE 3 (phase) is missing from the display.

To deselect an active trace - tap the trace, the tick is removed from the option along with the triangle from the trace/channel information at the top of the screen.

To activate an inactive trace - tap the trace, a tick will appear against the option and a triangle against the trace/channel information at the top of the screen.

To remove a trace from the display - tap the trace until its background goes white, its trace/channel information will be removed from the top of the screen and the trace removed from the screen (as in the picture above).

Measurement configuration - Trace Format

Each trace has its own format. Format is a type of measurement that the trace will display on the screen, such as LOGMAG, PHASE, DELAY, SMITH and SWR etc. To set or change the trace format we have to activate the trace as above.
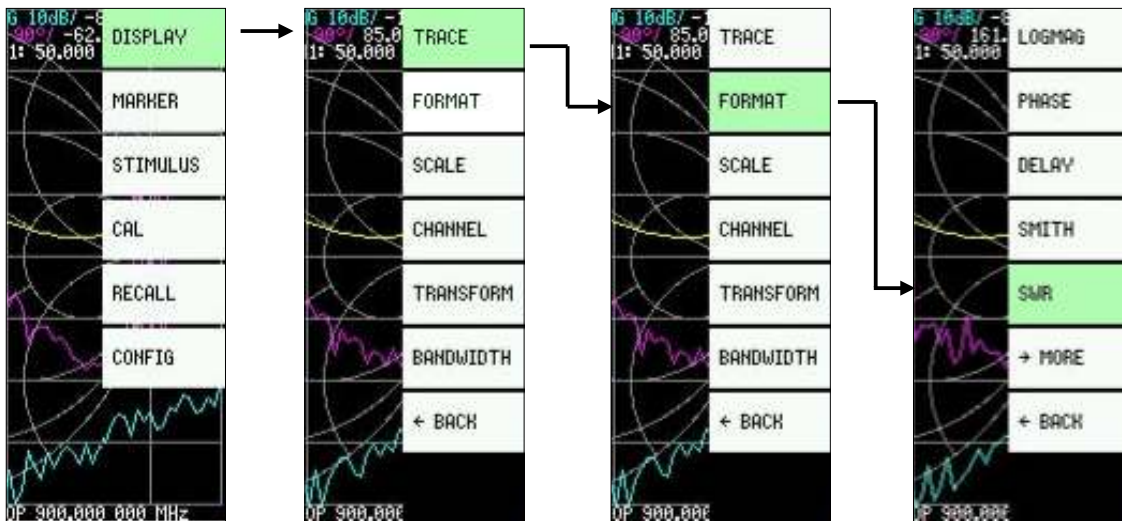
In our example above we have chosen SWR for our TRACE format, whatever format is chosen, it will be displayed against the trace/channel information at the top of the screen.

Measurement configuration - Trace Channel

Options (starting from Main Menu)			Purpose
1	DISPLAY	CHANNEL	-	To select the trace channel
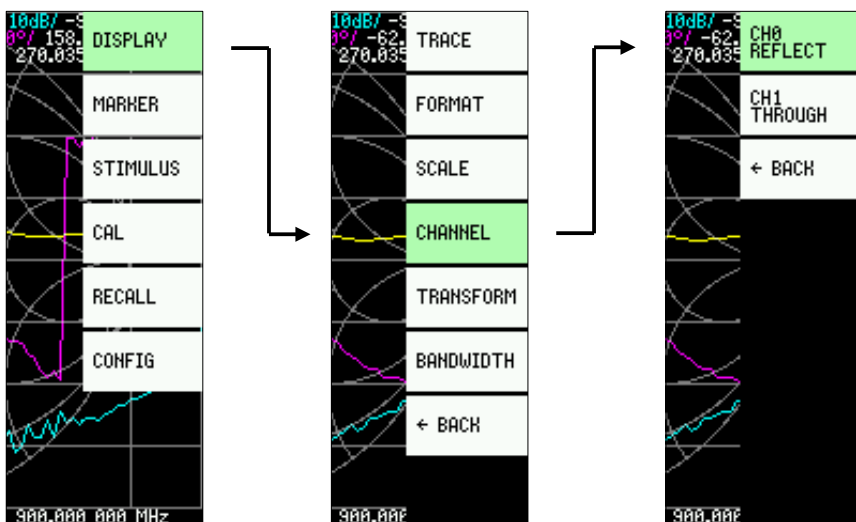
Now, select CH0 REFLECT or CH1 THROUGH - in the example above CH0 REFLECT has been chosen.

Measurement configuration - Scale

Options (starting from Main Menu)					Purpose
1	DISPLAY	SCALE	SCALE/DIV	-	To set the scale per division of the screen
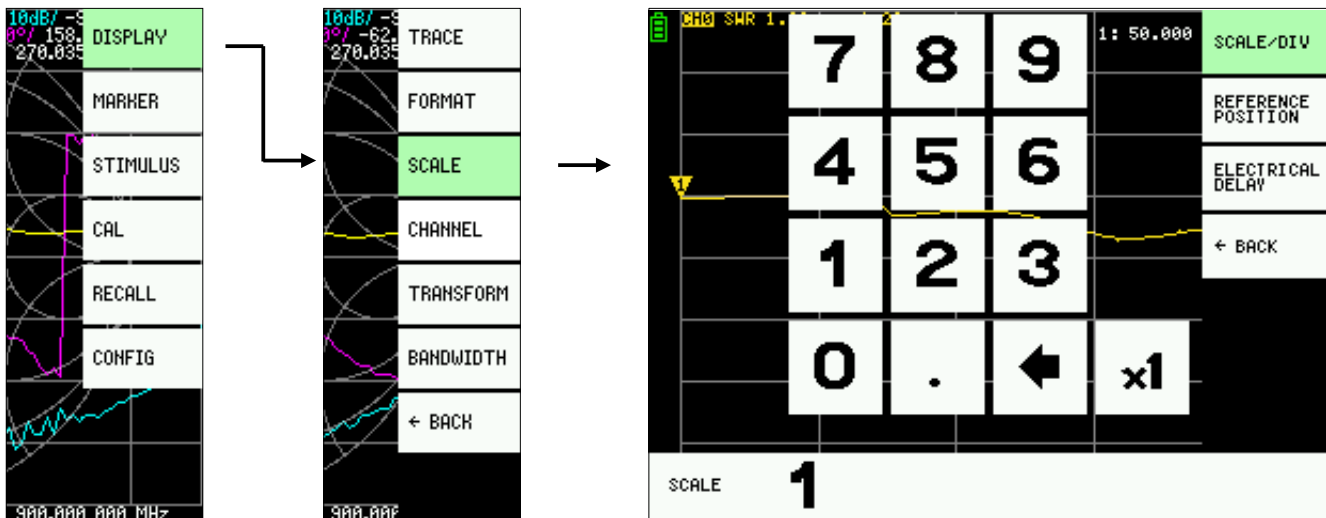
The NanoVNA screen is divided into 8 horizontal sections. The SCALE/DIV defines a number of units of measure per division (between each horizontal line on the screen). In the picture below we see that the SWR is on a scale of 1 and the resistance, R, and reactance, X, are on a scale of 20.

Selecting **DISPLAY - SCALE - SCALE/DIV** opens the keypad screen as in the top right picture. Tap a number to enter the number(s) you want. Finally tap on x1 to set the scale and close the keypad screen. To exit the keypad screen without changing anything, delete the entry with the back key. When all characters are deleted, the back key closes the keypad screen.

Measurement configuration - Reference Position

| Options (starting from Main Menu)					Purpose
1	DISPLAY	SCALE	REFERENCE POSITION	-	To set the reference position of the trace

The reference position of a trace is one of the horizontal lines on the screen. There are 9 horizontal lines. The bottom line is line number 0, and the top line is line number 8. The reference position of the corresponding trace is indicated by a triangle along the left edge of the screen (see picture below).
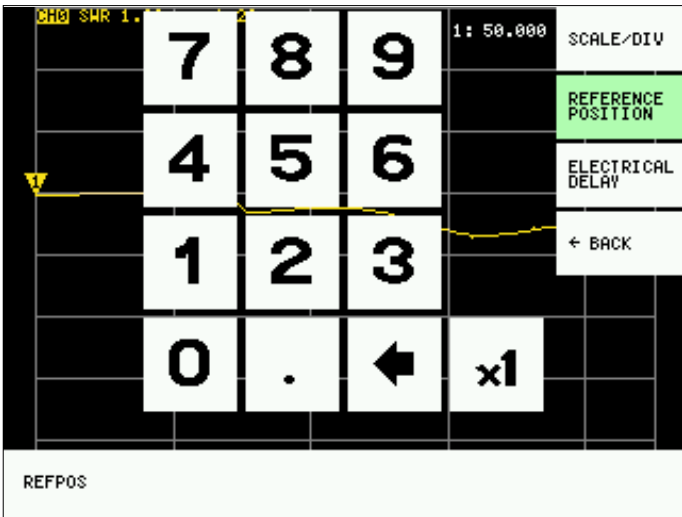

In the keypad screen tap a number for the reference position you want and then tap on x1 to close the keypad screen.

To exit the keypad screen without changing anything, delete the entry with the back key. When all characters are deleted, the back key closes the keypad screen.

Measurement configuration - Stimulus Frequency

Options (starting from Main Menu)		Purpose
1	STIMULUS	-	To set the start and stop frequency range.
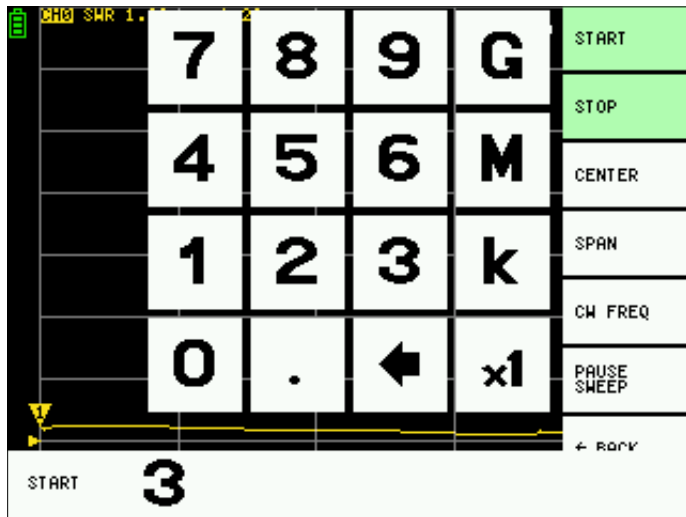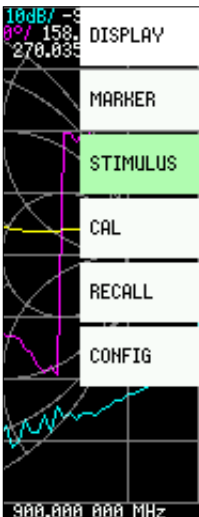
Stimulus frequency is the frequency range at which we measure, from the initial to the final frequency. We can set the frequency range by setting the START and the STOP frequency separately.

The keypad screen is similar to those for a reference position or scale.

Note the letters G, M and k on stimulus frequency keyboard screen. G = GHz, M = MHz, k = kHz. Each letter multiplies the current input by the appropriate unit and terminates input immediately. For example, for 3.5 MHz, tap 3 . 5 and then tap the letter M. This multiplies the current input by Megahertz unit and terminates input.

For frequency in Hertz, enter the value and tap x1.

To set the STOP frequency, open STIMULUS | STOP, the procedure is the same as for the START frequency.

To exit the keypad screen without changing anything, delete the entry with the back key. When all characters are deleted, the back key closes the keypad screen.

CALIBRATION

The proper NanoVNA calibration is absolutely crucial for correct measurement.

For one port measurement, e.g. SWR, we only need OSL (OPEN, SHORT, LOAD) calibration. The first three steps as described below.

For two port measurement, e.g. filter, we need full calibration. All five steps as described below.
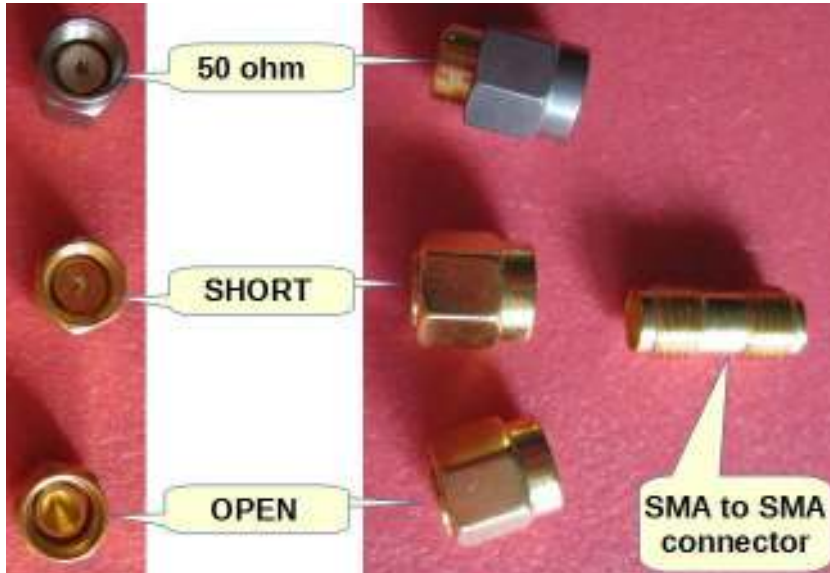
Calibrate the NanoVNA with the calibration standards that came with the device: OPEN, SHORT and 50 ohm .
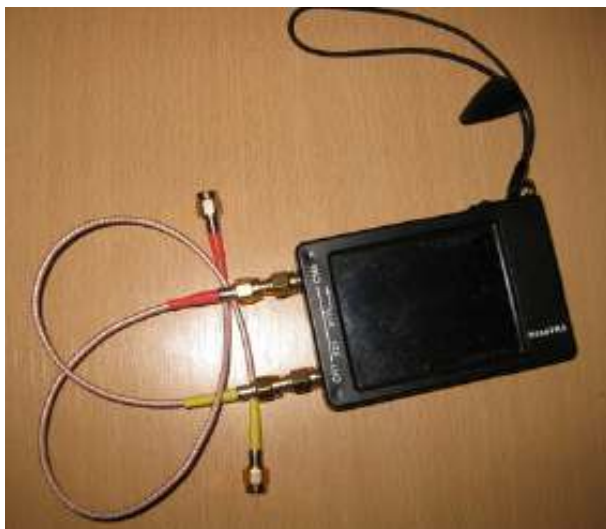
Use a short flexible cable such as the RG174 to relieve the mechanical stress on the SMA connector on the NanoVNA This means that the calibration must be done **at the end of that cable**, not on the NanoVNA.

If you use cable as above, connect it to the CH0 of the NanoVNA. To the other end of the cable connect the SMA female to female connector.

Before calibration we have to configure: TRACE(s) we want to display, TRACE, FORMAT, SCALE, REFERENCE POSITION, CHANNEL and STIMULUS frequency
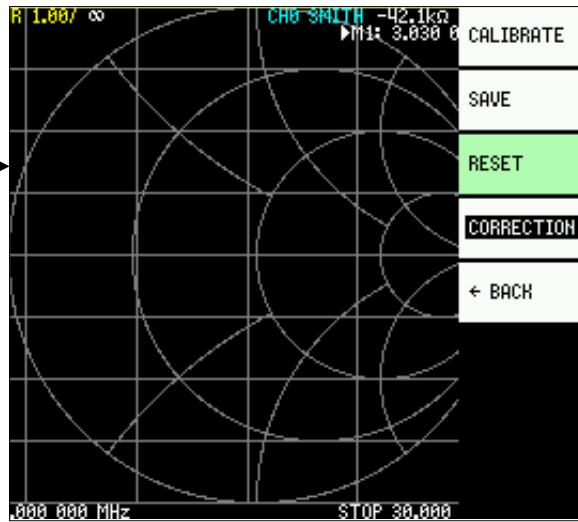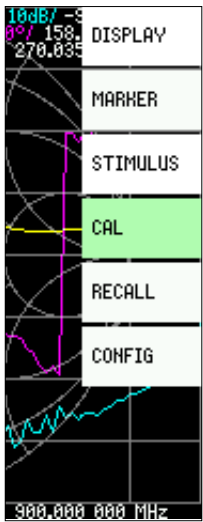
1. Reset the current calibration state – tap on **RESET**.
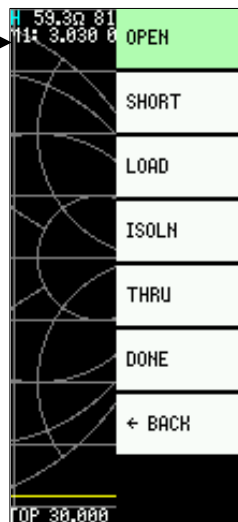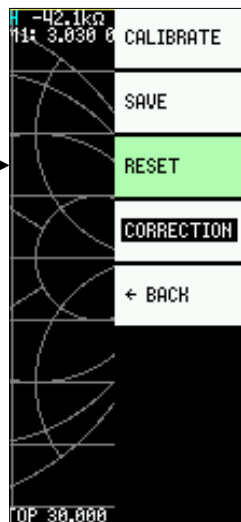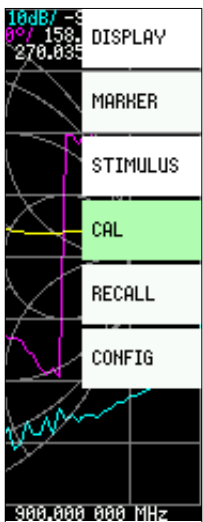
2. Connect *OPEN* calibration standard to the other end of the cable connected to CH0 port and tap on **CALIBRATE**, then tap on **OPEN**.
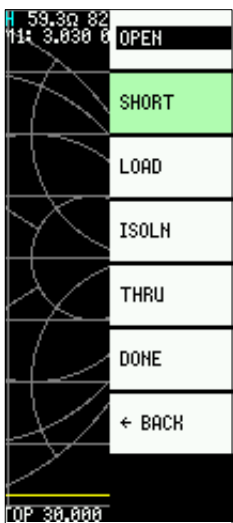
3. After one second OPEN is highlighted in black and SHORT is green (selected).

    Now, connect *SHORT* calibration standard and tap on **SHORT**.
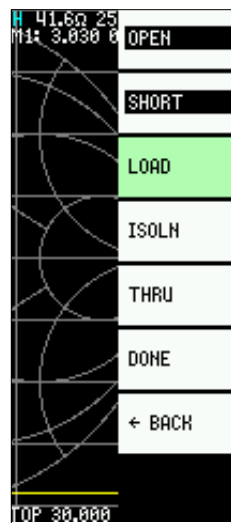
4. When SHORT is highlighted in black and NanoVNA is ready for the next calibration step, connect *LOAD* calibration standard and tap on LOAD

5. Now, connect LOAD calibration standard to CH1. If using short pigtail cable on CH1, connect LOAD calibration standard to the other end of the cable and tap on ISOLN.
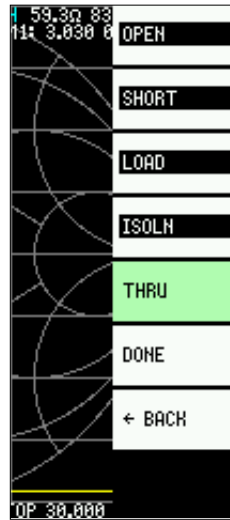
6. Connect a cable between the CH0 and CH1 ports, and execute THRU.

   If you use cables, connect the cables with SMA female -female adapter.

7. Finish calibration, tap on DONE
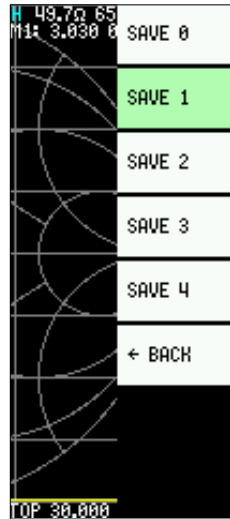
8. The calibration must be stored in one of the NanoVNA memories named SAVE 0 to SAVE 4. Select the desired memorylocation and tap it. In the picture selected it's location is SAVE 1.

9. Notice the calibration status indicators, C1 D R S T X characters, vertically along the left edge of the screen. This indicates that the NanoVNA has been calibrated and is using calibration settings from a memory location number 1

10. NanoVNA has five memory locations where we can save calibration settings for later use. Note that after switching on, NanoVNA always loads the calibration from memory location 0.

    Remember, before any calibration we have to reset the existing calibration. After the reset we see that the calibration indicators have gone away (see above). Only then we can proceed with the calibration.

VERIFY THE CALIBRATION

It is wise to check that the calibration is well done. If you did not select one of the traces to be Smith Chart already, temporarily change one trace to Smith Chart.

Ensure you have an active trace, if not, follow **Measurement configuration - Trace** to set an active trace, then **Measurement configuration - Trace Format** to set the trace to Smith Chart.
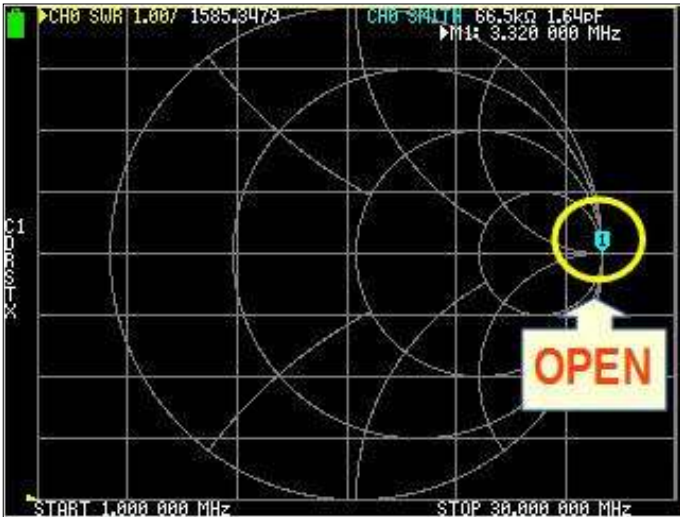
Connect the OPEN calibration standard. The marker on the Smith Chart should be all the way to the right.
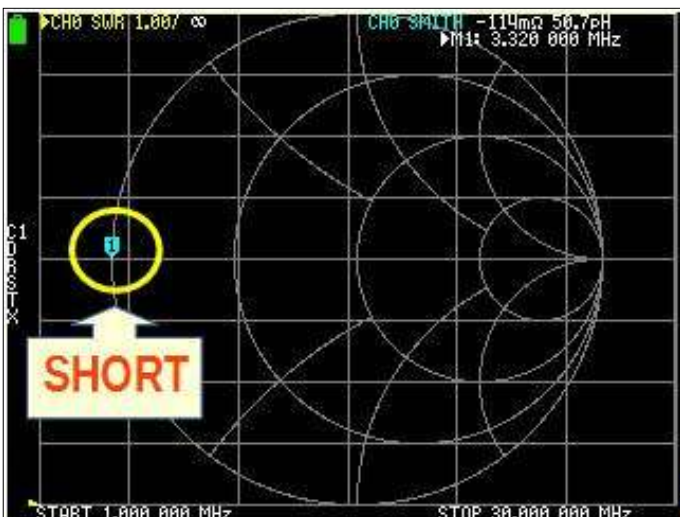
Connect the SHORT calibration standard. The marker on the Smith Chart should be all the way to the left.
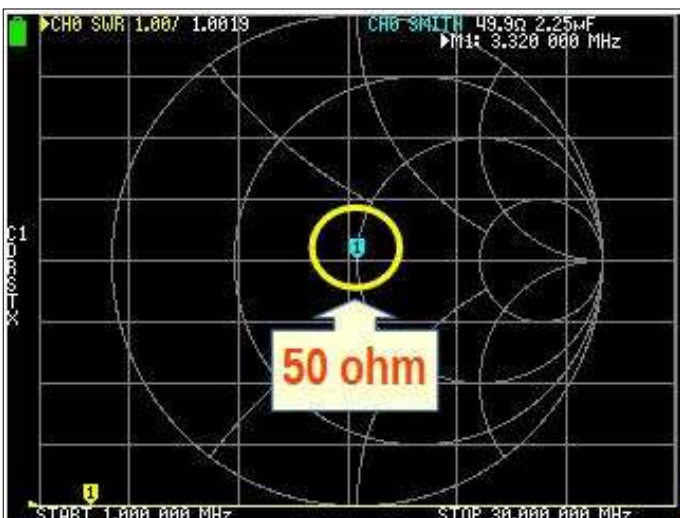
Connect the 50 OHM calibration standard. The marker should be at the center of the Smith Chart.

RECALL THE CALIBRATION

When you save a calibration, it also saves all configuration settings, (frequency range, the settings for each trace, channel, and whch measurement the trace shows, e.g. LOGMAG or SWR), so you can easily recall the whole setup.

To open saved calibration and configuration settings, select RECALL from the home menu (see below) and then select the previously saved calibration.

When powered on, the Nano VNA automatically loads the calibration saved in position RECALL 0.

Next month I hope to cover the installation of the firmware upgrade.

Ed: To ensure I got it right, I've followed my instructions to set my VNA up and all works well.

Bryan M0IHY

What does your S-meter actually tell you?

Credit: Wikipedia

An **S meter** (signal strength meter) is an indicator often provided on communications receivers, such as amateur radio or shortwave broadcast receivers. The scale markings are derived from a system of reporting signal strength from S1 to S9 as part of the R-S-T (**R**eadability - **S**trength - **T**one) system. The term S unit refers to the amount of signal strength required to move an S meter indication from one marking to the next.

Technical description

Analogue S meters are actually sensitive microammeters, with a full scale deflection of 50 to 100 µA. In AM receivers, the S meter can be connected to the main detector or use a separate detector at the final IF stage. This is the preferred method for CW and SSB receivers. Another approach in the days of electronic tubes (valves) was to connect the S meter to the screen grid circuit of the final IF amplifier tube. A third option is to connect the S meter to the AGC line through a suitable level conversion circuit.

In FM receivers, the S meter circuit must be connected to the IF chain before any limiter stages. Some specialised integrated circuits for FM reception like CA3089 and CA3189 provide a DC signal to drive a 100 µA S meter.

IARU Region 1 Technical Recommendation R.1

In the 1930's, it was already agreed that S9 corresponds to 50 µV at the input terminal of the receiver, but this was not a measure of the power received as the input impedance of receivers was not standardised.

The International Amateur Radio Union (IARU) Region 1 agreed on a technical recommendation for S Meter calibration for HF and VHF/UHF transceivers in 1981.

IARU Region 1 Technical Recommendation R.1 defines S9 for the HF bands to be a receiver input power of -73 dBm. This is a level of 50 microvolts at the receiver's antenna input assuming the input impedance of the receiver is 50 ohms.

For VHF bands the recommendation defines S9 to be a receiver input power of -93 dBm. This is the equivalent of 5 microvolts in 50 ohms.

LCD emulation of an S meter on the Ten Tec Jupiter transceiver

The recommendation defines that a difference of one S-unit corresponds to a difference of 6 decibels (dB), equivalent to a voltage ratio of two, or power ratio of four.

Signals stronger than S9 are given with an additional dB rating, thus "S9 + 20dB", or, verbally, "20 decibels over S9", or simply "20 over 9" (or even the simpler "20 over").

Examples

A weak signal with signal strength of S2 corresponds to received power of -115 dBm or 0.40 microvolts RMS in 50 ohms on HF.

A strong signal with signal strength of S8 corresponds to received power of -79 dBm or 25 microvolts RMS in 50 ohms on HF.

Some signal generators are calibrated in dB above 1µV and have an output in emf. For example to set an HF receiver's S-reading to S9 set the signal generator output to 34 dB above 1µV.

S-reading	HF micro-V (rms, Relative to 50 ohms)	dBm	Signal Generator emf dB above 1 micro-V
S9+10 dB	160.0	-63	44
S9	50.2	-73	34
S8	25.1	-79	28
S7	12.6	-85	22
S6	6.3	-91	16
S5	3.2	-97	10
S4	1.6	-103	4
S3	0.8	-109	-2
S2	0.4	-115	-8
S1	0.2	-121	-14

Accuracy

Most S meters on traditional analog receivers are not calibrated and in practice can only provide a relative measure of signal strength based on the receiver's AGC voltage. Some S meters on traditional analog receivers are calibrated to read S9 for an input of -73 dBm but do not provide the correct 6 dB per S unit correspondence.

Often the correlation between a radio listener's qualitative impression of signal strength and the actual strength of the received signal on an analog receiver is poor, because the receiver's AGC holds the audio output fairly constant despite changes in input signal strength.

Software Defined Radios (SDR's) acquire and process signals differently, and determine S-readings by direct measurement of RF signal amplitude. Consequently, many SDR systems with bit depths of 14-bits or more are accurately calibrated from one end of the S scale to the other right out of the box. In cases where this is not so, a few minutes with a signal generator to set the reference level are all that is required. Low bit depth SDR's such as an 8-bit design can be somewhat accurate, but as they distinguish much coarser differences in input levels, precision at the low end of the S scale will suffer.

Even with a high quality SDR, it is worth keeping in mind that the S meter is measuring the strength of the signal at the 50 ohm input of the receiver, not at the antenna. For example, if the radio's input is 50 ohms, but the antenna's impedance is significantly higher, power transfer from the antenna into the radio will suffer, and signal levels will be lower than if they were fed to an input with a matching high impedance. Many antennas vary in impedance over various frequency ranges, particularly in the case of wideband designs. What is useful to know is that the relative signal strengths at any one frequency will remain meaningful, even if they are not from one frequency to another.

Antennas, tuning and SWR

Credit: The Internet (part of an article by L.D.Blake (VE3VDC)), common sense and some from me.

The definition of resonance for an antenna is that **its impedance is purely resistive where the capacitive reactance (X_C) is equal and opposite of its inductive reactance (X_L)**. The current and voltage are therefore in phase at the antenna feed point.

The majority of our transceivers are efficient and similar in both transmission and reception characteristics, and because of this the differences are so minimal that you should pay close attention to how well your antenna system works.

The efficiency of your antenna depends on many factors, nearby objects, feed line efficiency, weather, terrain and more. We can't control all the factors, but what we can control is the antenna and its feed line.

You can use an SWR meter to test and tune an antenna system, it will tell you the resonant frequency of the antenna, which in turn tells you to lengthen your antenna (resonant frequency higher than wanted), or shorten it (resonant frequency lower than wanted), remember, a higher than wanted frequency needs the antenna to be lengthened whilst a lower than wanted frequency requires the antenna to be shortened.

Standing Wave Ratio (SWR) is a measure of antenna efficiency.

The result of transmitting RF into your coax is Electro-Magnetic energy being radiated into space. If the antenna is not efficient some of the radiated energy is reflected back along your feed line to the transmitter, because of this the reflected power adds nothing to your transmitter signal and is, essentially, a waste of energy.

The difference between transmitted energy (Forward) and unradiated energy (Reflected) is measured and expressed as a ratio, this can be calculated as:

SWR = Forward + Reflected / Forward - Reflected

Most SWR meters are pre-scaled and therefore let you read this ratio directly from their faces. On a single needle meter the ratio is read directly after calibrating it for Forward energy. On dual needle meters the SWR is read from markings at the intersection of the two needles.

The table shows the losses in radiated Electro-Magnetic energy with increasing SWR ratios. The goal is always a 1:1 SWR, which means your antenna is effectively putting all of the RF energy into the air. In most cases SWR under 1.5:1 is considered acceptable, striving for less will give you even better efficiency.

As SWR increases not only do you begin to notice decreases in performance, but levels of standing waves on your coax increase and may contribute to "RF in the shack" problems and interfere with other electronics in your immediate area. When troubleshooting RFI problems the stations most prone to cause interference to televisions, phones, etc. are the ones with high SWR readings from their antenna systems.

In severe cases transmitters have actually been damaged by high SWR. Modern transmitters are far more prone to fail with high levels of returned energy than valve transmitters ever were. While most mid to high end radios do incorporate some kind of built in high SWR protection, most entry level and many older radios do not. This is why most SWR meters have a red marking from about 3:1 up. It's there to warn you

SWR	LOSS(%)	ERP(%)
1.0:1	0.0	100.0
1.1:1	0.2	99.8
1.2:1	0.8	99.2
1.3:1	1.7	98.3
1.4:1	2.8	97.2
1.5:1	4.0	96.0
1.6:1	5.3	94.7
1.7:1	6.7	93.3
1.8:1	8.2	91.8
2.0:1	11.1	88.9
2.2:1	14.1	85.9

SWR	LOSS(%)	ERP(%)
2.4:1	17.0	83.0
2.6:1	19.8	80.2
3.0:1	25.0	75.0
4.0:1	36.0	64.0
5.0:1	44.4	55.6
6.0:1	51.0	49.0
7.0:1	56.3	43.8
8.0:1	60.5	39.5
9.0:1	64.0	36.0
10.0:1	66.9	33.1

that it may be unsafe to operate your transmitter at anything but minimum power.

Feedline Issues

The most common feed line (coaxial cable), delivers energy to an antenna in an unbalanced or "unequal" state. RF is delivered to the antenna along the central core. In a perfect system with a 1:1 SWR there will be no current flowing on the coax shield at all. All RF power from your transmitter is radiated away by the antenna. However, antennas are seldom perfect and quite often there is current flowing on the shield of the coax.

The worst of these conditions occurs when feeding a balanced antenna such as a dipole or loop antenna with coax, there is a natural mismatch in feed methods, balanced antenna: unbalanced feed line, that just begs for problems.

The illustration on the right shows the end of a piece of coax where it connects to a dipole antenna. The arrows represent a moment in time.

The blue arrows represent antenna currents. If the antenna cannot get rid of all of the RF energy current will flow on the inside of the coax shield. This is normal and in this condition the currents are fully contained within the coax.

When a balancing mismatch occurs, it is entirely possible for current to flow on the outside of the coax shield, as shown by the red arrow, this undesirable current is not contained inside the coax and can radiate from the coaxial feedline, getting into nearby electronics in very undesirable ways. This is called "common mode" current since it is actually in phase with the center lead of the coax.
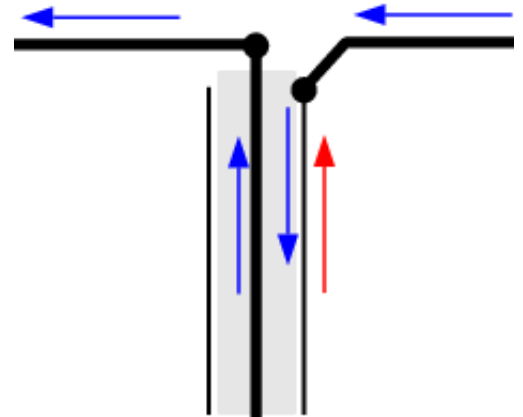
This can also happen with unbalanced antennas as well. This most often occurs where the antenna or its support structure is not grounded or when the antenna's "ground plane" is less than adequate.

If you are having common mode current problems you will notice the SWR of your antenna system changing when it rains, or when the coax is moved or touched. In severe cases, touching your radio equipment can affect the SWR of your antenna. A very simple way to test for common mode currents is to suspend your coax away from the antenna's support structures, take a reading and then see if the SWR changes when you place it against the support structures.

Fortunately there are relatively easy fixes for this problem...

Balanced antenna's

Feeding a balanced antenna such as a dipole or loop, you should always use a balun designed for the range of frequencies in use. A balun is a transformer mechanism that takes the naturally unequal signal from coax and transforms it to a balanced 2 wire signal delivering equal but opposite energies to both sides of the antenna. You are thus feeding a balanced antenna with a balanced signal which should keep both feed line and antenna happy.

Unbalanced antennas

If you are feeding an unbalanced antenna such as a mobile whip, groundplane or colinear antenna you can add a common mode choke. This can often be as simple as a few coiled up turns of coax positioned near the antenna. The choke forms an inductor with the outside of the coax shield making it an uninviting place for current to flow. (The internal signals should not be affected) The size of the coil and the number of turns is best determined experimentally; use just enough to eliminate the problem.

An excellent article on the construction of common mode chokes can be found at https://www.hamuniverse.com/balun.html. Despite their larger sizes on HF, the VHF and UHF versions are

actually quite compact. As the photo on the left shows, for 2 meter antenna projects simply wind 5 turns of the RG-8x coax right around the mast pipe.

It is a good idea to use common mode chokes or baluns on all your projects. While not absolutely necessary in all cases, this is a simple precaution that harms nothing if not needed.

Getting Ready

Whenever possible you want to adjust the antenna in-situ on its mounting structure, this way you are considering other unavoidable local objects.

Mobile antennas

Because of highly variable conditions, mobile antennas absolutely must be tuned in-place on the vehicle. You should park the vehicle as far from any buildings, light posts or metallic objects as possible. Always take your measurements with all doors or hatches closed.

Portable antennas

Need to be tuned "in the clear", suspended from a non-conductive cord or standing on a non-conductive mount with as much free space around them as you can get. Those with fold-down stands should be tuned on their mounting structure, simulating real-world conditions.

Omni directional base station antennas

If they can't be tuned in-situ, they should be mounted on a temporary structure, and as far from nearby objects as is convenient.

Directional antennas

These should be pointed straight up with their reflectors as far above ground as is convenient.

General

Always keep yourself, pets and others well back from antennas while tuning. Beyond the risk of RF burns, there is the matter their body capacity is going to upset your readings. It is best to run a length of feedline to the antenna and set up a testing station, where you take your readings at least 1/4 wavelength away.

Safety first: NEVER activate your transmitter while anyone or anything is touching the antenna!

Tuning Goals

The primary goal in tuning an antenna is to make it usable all across the band's it is designed for.

Antennas are resonant devices. That is to say they work best at a single frequency. As you move above or below the resonant frequency the efficiency rolls off, producing standing waves. In order to achieve the goal of usability, you will want to tune the antenna for equal SWR readings at each end of the band. Below is a plot of the SWR for a theoretical well tuned antenna.

You want to end up with equal SWR readings at each end of the band you are tuning for. So long as the antenna's design is basically sound, the lowest SWR will naturally occur inside the band, at the antenna's resonant frequency.

Most antennas behave a little differently below resonance than above, hence the 1:1 point not being in the centre of the frequency range, the important goal is equality at the band edges, this ensures the antenna is usable all across the entire band.
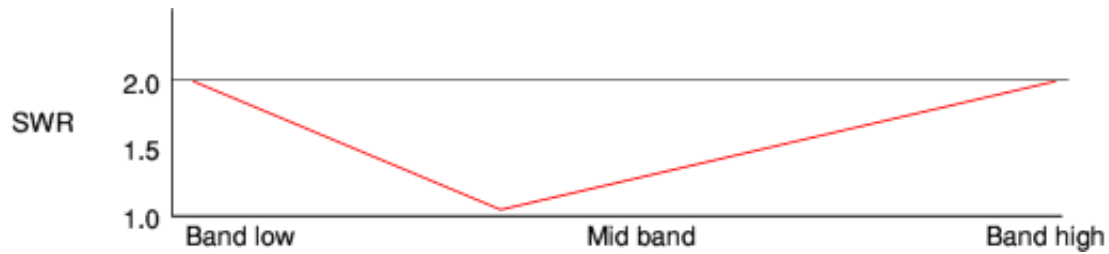
Equality at band edges.

Connecting the SWR meter

Your SWR meter needs to be connected into the coax between your radio and antenna. For this you will need your meter and a short jumper of coax with the correct connectors on it (usually PL-259s).

Connect one end of the jumper to the back of your radio. Now connect the other end to the "Transmitter" socket on the SWR meter. The antenna's coax now connects to the "Antenna" socket on the meter.

Make sure all connectors are done up tightly.

Most SWR meters will not be damaged if you get them backwards but they will not give you accurate readings as the forward and reflected functions will be reversed.

The operation of SWR meters varies a bit from model to model, so make sure you read the instructions for your meter carefully before proceeding.

Testing and Adjusting

To reduce the risk of interference with other hams or nearby equipment you should always use your transmitter's minimum power setting when adjusting SWR.

The actual adjustments you will make depend entirely on the type of antenna you are tuning. Those with impedance matching devices are more complex than those with simple top whips. Multi-band antennas introduce a whole new level of complexity. But it's all doable.

The general measuring procedure is always the same...

1. Set your radio to CW or FM mode (not SSB).
2. Tune to the low edge of the band you are adjusting for.
3. Transmit and calibrate your SWR meter (single needle meters only)
4. Transmit and take an SWR reading and write it down.
5. Tune to the high edge of the band you are adjusting for.
6. Transmit and calibrate your SWR meter (single needle meters only)
7. Transmit and take an SWR reading and write it down.

These readings will tell you if the antenna is too long or too short:
• If the low edge has the lower SWR the antenna is too long.
• If the high edge reads lower the antenna is too short.

The adjustments you make based on this information will depend on the type of antenna you are adjusting:

Whips, Mobiles and Ground planes
Adjusted by changing the length of the radiating element(s). There is usually a provision to slide the element(s) in and out for tuning. If the antenna reads too long, adjust the element shorter. If it reads too short, make it longer.

Wire Antennas, Dipoles and Loops
Wire antennas should always be deliberately cut too long at the start. The only adjustment you have here is to

clip a little bit off the end (preferably fold it over, which allows you to reverse any change). Be careful to keep the sides of dipoles the same length and make sure the feed points of loops stay centered. Cut carefully and in small increments (see note above about folding over). If you get too short, making them longer is going to be a huge undertaking that might well result in antenna failure once the weather gets at your splices.

Antennas with Gamma, Y or T Matches

These antennas require multiple adjustments. The best plan here is to set everything on the manufacturer's recommended starting points then move the matching device's rods a little bit, test again and see if you went the right way. Once you know the correct direction, adjust the matching device for the lowest SWR. Then, once you find the lowest SWR by this means, try adjusting the length of the driven element to get the SWR equal at the band edges. This might send you back to re-adjusting the matching device. With patience, each cycle will result in smaller movements as you zero in on the perfect settings.

J-Pole Style Antennas

These are also antennas with matching devices. Fortunately they are a lot easier to adjust than a beam. Here you move the coax up and down on the matching stub to find the lowest SWR. If the antenna reads too long or too short after adjusting the stub, you can try adjusting the length of the long radiating element a little bit.

Ring Matched Antennas

These antennas use a sliding contact on a ring device. The general procedure is to set the radiating element at the factory recommended length and then adjust the sliding contact for the lowest SWR. If the antenna reads too long or too short you can generally adjust the length of the radiating element a little bit to even out the ends of the band.

Dual/Multi Band Antennas

These antennas are a fair bit more complex to adjust. Here you adjust the length of the shortest section for the highest frequency band. Then move to the next section along the antenna for the next lower band and so on, moving to longer sections for lower frequencies, until you have all sections matched. You may need to go back and forth a few times to get everything working right. Also note that multiband antennas use coils and chokes along their length so these adjustments can be quite sensitive.

The Environment

Once you have your antenna all tuned up, don't forget weatherproofing, any place water can get in will cause problems, use tape on your connectors, put weather caps on tubes, apply liquid rubber to exposed RF connections, etc.

In Summation

An SWR meter is an essential tool for every ham. While tuning antennas is sometimes a tedious task, the good news is that after properly tuning and weatherproofing an antenna, the SWR seldom changes on its own.

A carefully tuned antenna will always outperform a poorly tuned one.

Micro Computers & Micro Controllers

Credit: Peter (2E0PTH)

Slide 01 - Introduction

Micro Computers
Micro Controllers

●●●

Peter 2E0PTH
Chesham and District Amateur Radio Society
22-03-23

Slide 02 - Microcomputer - Microcontroller

	Microcomputer	Microcontroller
Interfaces	Screen, Keyboard & Mouse Mass storage? Network USB	GPIO Network? USB?
Operating System	Linux Windows	None

Notes: The table is an attempt at categorising the range of processors available. On the one hand there is the Raspberry Pi which runs an operating system and has connections for screen, keyboard and mouse. On the other hand there simpler processors with no screen, keyboard, etc., no operating system but invariably have plenty of GPIO (General Purpose Input/Output) pins.

It 's a blurred distinction between microcomputers and microcontrollers, e.g. Raspberry Pi runs an operating system and has plenty of GPIO pins.

Slide 03 - Microcomputer - Raspberry Pi

Raspberry Pi 3   Raspberry Pi Zero

Notes: Raspberry Pi 3B about £40, Raspberry Pi Zero about £16. Both in short supply at the time of writing (March 2023)

Slide 04 - Microcomputer - Raspberry Pi

Raspberry Pi in the shack - the usual suspects:

Decoding Data Modes
Software Defined Radio (SDR)
Logging
Amateur Satellite Tracking
ADS-B Flight Tracker
Digital Voice (DV) Hotspot

Notes: A Google search for "Raspberry Pi in the shack" will list numerous uses.

Mike Richards (G4WNC) often writes articles in RadCom about the Raspberry Pi

Slide 05 - Microcomputer - Raspberry Pi

Raspberry Pi projects

Software Defined Radio (SDR
ADS-B Flight Tracker
Pi Hole - Ad blocker
Home Automation
Pi Cam - Wildlife & security camera
Digital signage (kiosk mode)
Retro Radio
Remote Audio and CAT control
Text to speech

Notes: This is a list of projects I've done using a Raspberry Pi. The last two were experiments rather than complete projects. We'll look at the two highlighted in green, Digital Signage and Retro Radio.

Slide 06 - Raspberry Pi - Kiosk Mode

Also called digital signage

Raspberry Pi, usually running a web browser
Network connection
Screen
No keyboard
No mouse

https://www.raspberrypi.com/tutorials/how-to-use-a-raspberry-pi-in-kiosk-mode/
https://pimylifeup.com/raspberry-pi-kiosk/

Notes: It can display a single web page which is updated at regular intervals or can display a sequence of web pages. Examples:

1. Arrivals & departures boards at Pizza airport.
2. A dashboard I've done for a charity, it displays a spreadsheet of orders outstanding and stock levels in the warehouse.

The two links are for tutorials showing how to create a kiosk of digital signage. The tutorials overlap but both explain each step of the process and how to alter the functionality.

Slide 07 - Raspberry Pi - Kiosk Display
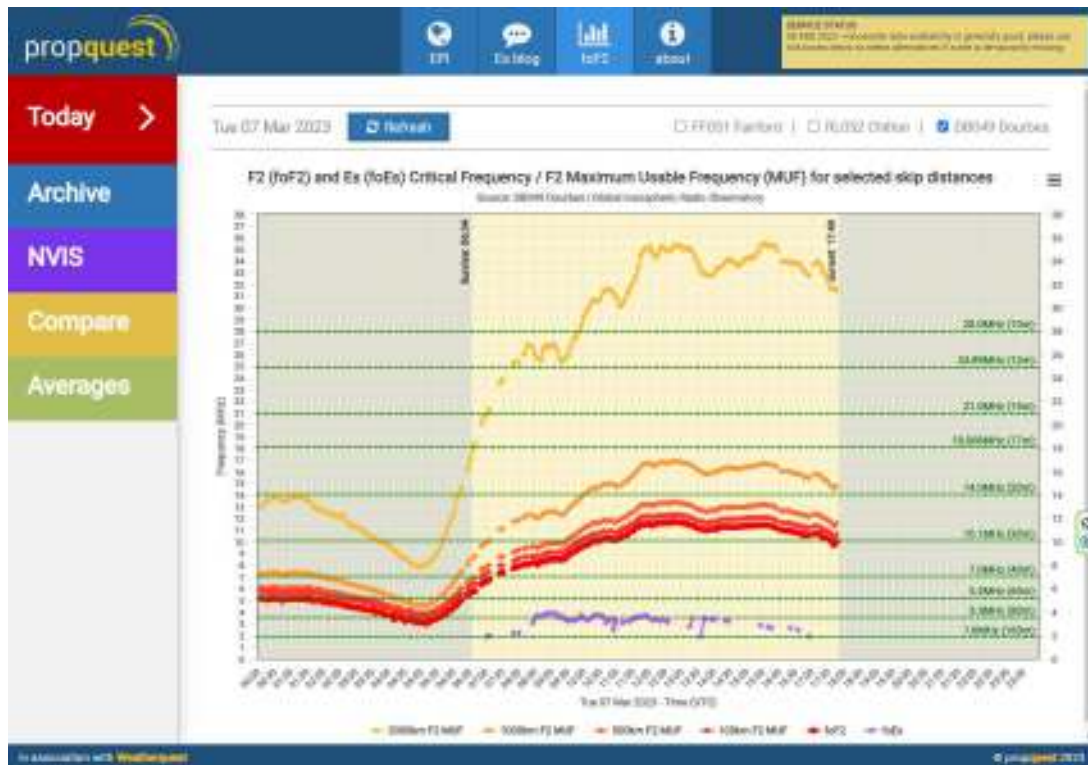
Notes: If you have spare screen why not get it to display something useful.

This project is easy, takes about 2 hrs if you follow the tutorials:
https://www.raspberrypi.com/tutorials/how-to-use-a-raspberry-pi-in-kiosk-mode/ and
https://pimylifeup.com/raspberry-pi-kiosk/

No programming or soldering is required.

Slide 08 - Raspberry Pi - Retro Radio

Notes: The aim was to create a radio that looked and sounded like Grandfathers radio, a bit of nostalgia.

There are fewer and fewer MW stations these days and the level of man-made interference is increasing so I used a Raspberry Pi Zero to handle the streaming and a traditional valve amplifier for the audio output.

I've included this project as it illustrates one method of interfacing digital and analogue signals to the Raspberry Pi. It also covers the need for a clean shutdown.

Slide 09 - Raspberry Pi - Retro Radio
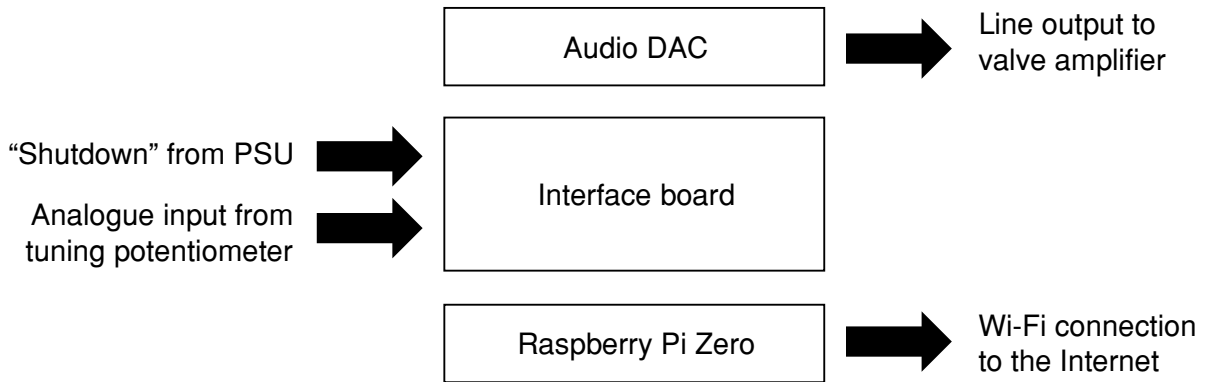
Notes: Linux systems, including the Raspberry Pi, don't take kindly to power cuts; the SD card can be corrupted. To avoid this problem issue a shutdown command before removing the power. In this project, a analogue circuit detects the voltage of the 21V unregulated supply beginning to sag. When the level drops below a set threshold (19V) a digital input to the Raspberry Pi is pulled low. A script running on the Raspberry Pi detects the input going low and initiates a shutdown. The combination of the four large reservoir capacitors and the switched mode regulator give the Raspberry Pi just enough time to shutdown before the 5V supply collapses.

Slide 10 - Raspberry Pi - Retro Radio

Tuning Method
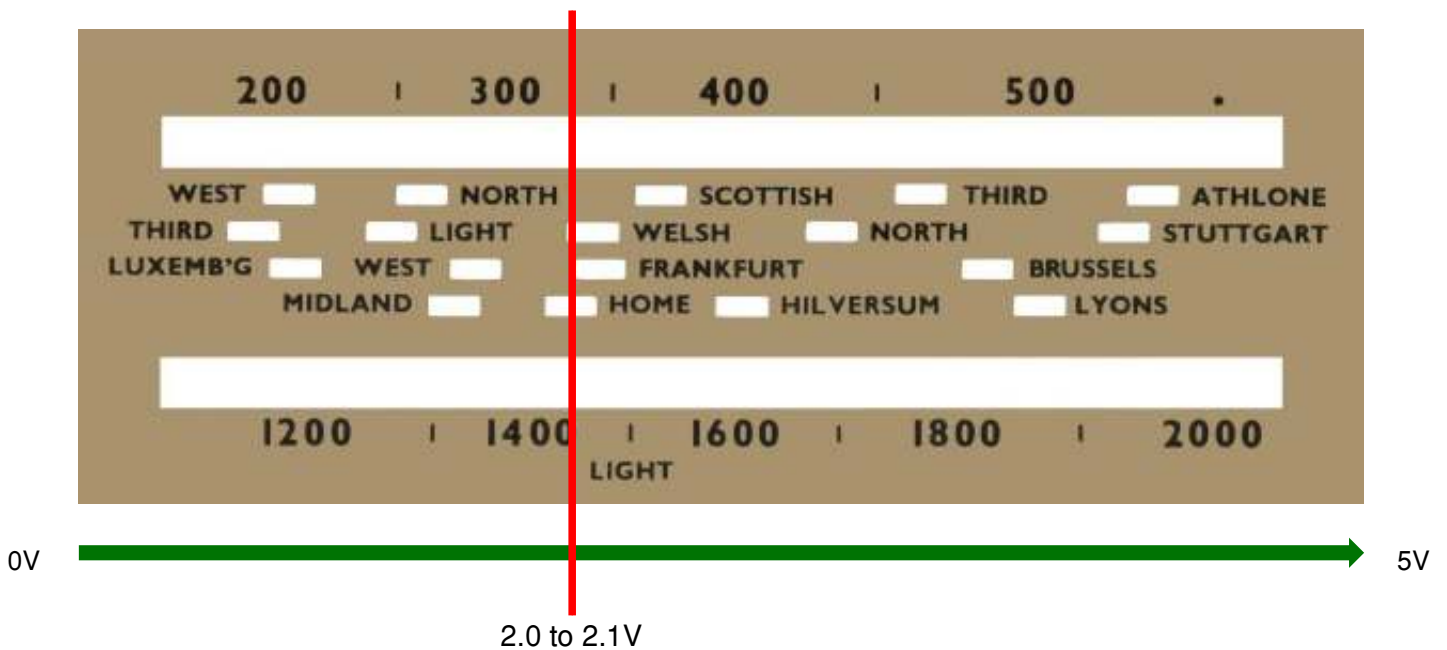
Notes: A system of pulleys, not shown in the picture, operates the tuning dial and a standard 270 degree rotation potentiometer located front centre of the chassis. The output of the potentiometer varies between 0 and 5V. The Raspberry Pi reads the voltage via an ADC converter in the interface board. When the cursor is aligned with a station the Raspberry Pi streams the radio station. In the example above Radio 4 would be played. If the cursor is not aligned with a station a recording of white noise and crackles is played.

This project requires some effort, software needs to be written, there is a small amount of soldering for the Raspberry Pi and a lot of soldering for the valve amplifier. In addition, time needs to be spent making a authentic wooden cabinet and metal bashing for the chassis .

Slide 11 - **Micro Controllers**

Arduino and look alikes, e.g. Pololu A-Star 32U4 Micro, e.g. Scales Interface

ESP8266, e.g. Environment monitor, Recorded announcement

PICAXE, e.g. Power sequencer

Raspberry Pico

Notes: There is a wide variety of microcontrollers available, popular ones are the Arduino and its clones, various processor boards based on the ESP8266 chip, PIC microcontrollers and the recent Raspberry Pico.

The Arduino has plenty of GPIO (General Purpose Input/Output pins) and extensive software library. The ESP8266 is relatively cheap, on board Wi-Fi and has a reasonable number of GPIO pins.

PIC microcontrollers are cheap, the range of processors offer differing number of GPIO pins and processor speeds.

Slide 12 - **Arduino Micro Controllers**
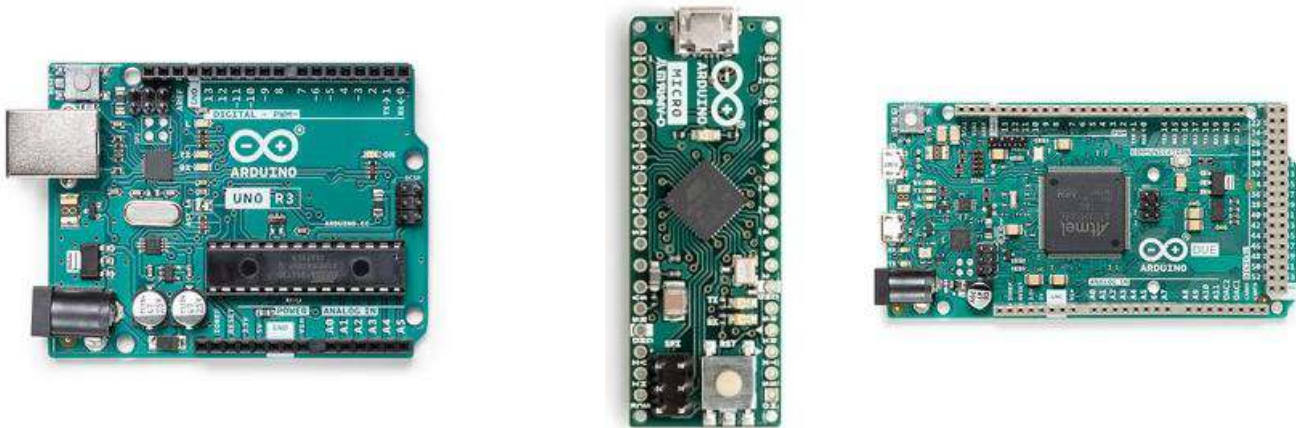
Notes: Official Arduino boards, from left to right, Uno £25, Micro £17 and Due £35. The Arduino is an open source project and there are many clones and look alikes.

Slide 13 - **Microcontrollers - Pololu A-Star 32U4 Micro**
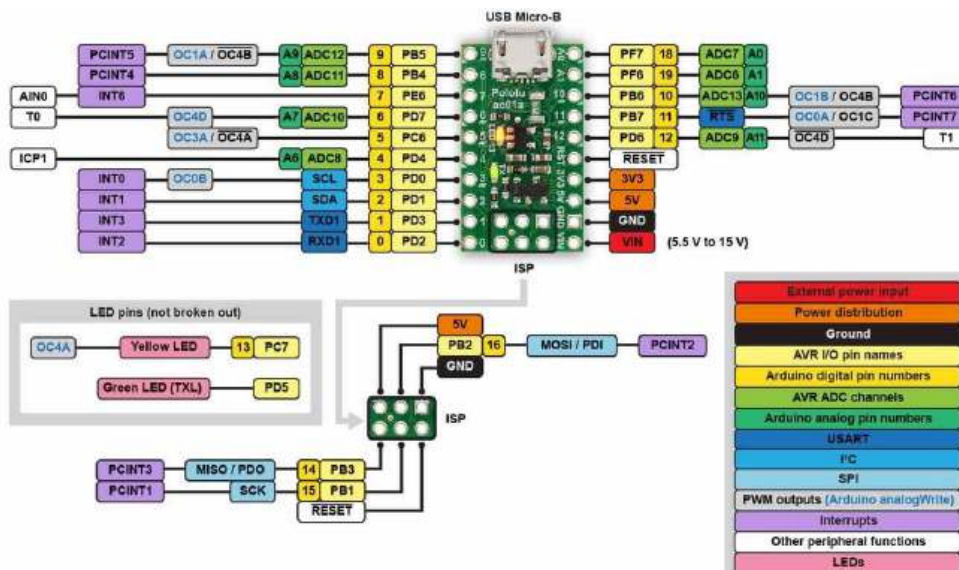
Notes: The 32U4 microcontroller is relatively fast and powerful. The pinout shows the various features - 3 types of serial I/O, 8 analogue input channels, 15 digital I/O pins and a USB port. The microcontroller can be powered from the USB port or an external 5.5V - 15V supply. There is an onboard voltage regulator which provides the 3.3V and 5V supplies.

I selected this microcontroller for a project as it is one of a few that can have the USB port configured so the processor looks like an external keyboard. It cost about £9 two years ago, it now costs approximately £18.

Slide 14 - Microcontrollers - Pololu A-Star 32U4 Micro

Scales Interface
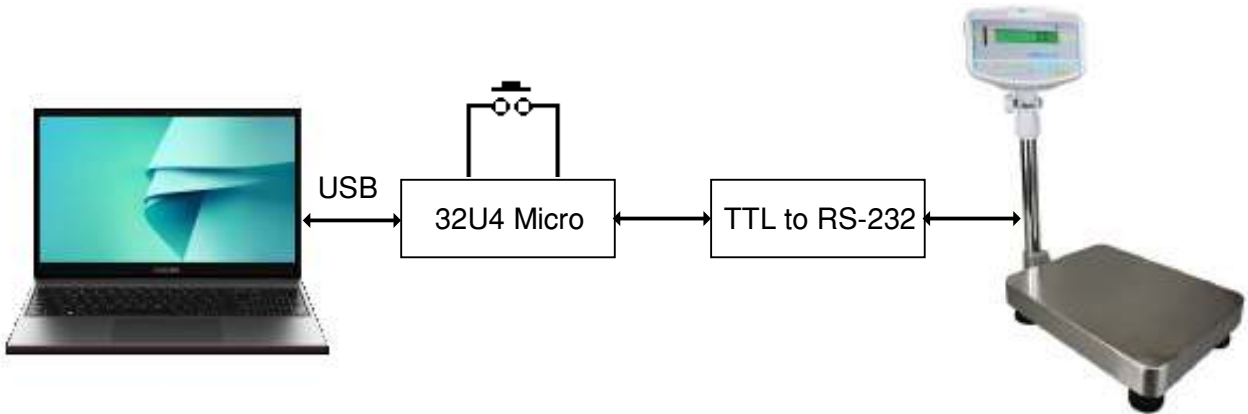
Notes: I've included this project as it illustrates how to emulate an external keyboard. The requirement was to automate the weighing of goods and enter the weights into a spreadsheet. The scales have a RS-232 interface which is intended to drive a PC or printer. Unfortunately spreadsheets don't understand serial communications (RS-232), this interface resolves that. The laptop thinks it has an external keyboard attached and the scales think it has a PC or printer attached.

When the button is pressed the microcontroller sends a print command to the scales. This triggers the items to be weighed and a "printout" is returned to the microcontroller. The weight is extracted from the other text in the printout and is then sent to the laptop as a series of keystrokes.

When interfacing to external devices with an RS-232 interface an level shifting circuit is required. The serial interface or UART on most microcontrollers operates over a 0V to 3.3V range. External equipment usually require a -5V to +5V range, older equipment such as the scales in this instance require the full -12V to +12V range.

This project requires software to be written as well as a small amount of soldering.

Slide 15 - Microcontroller - ESP8266

Wemos D1 Mini
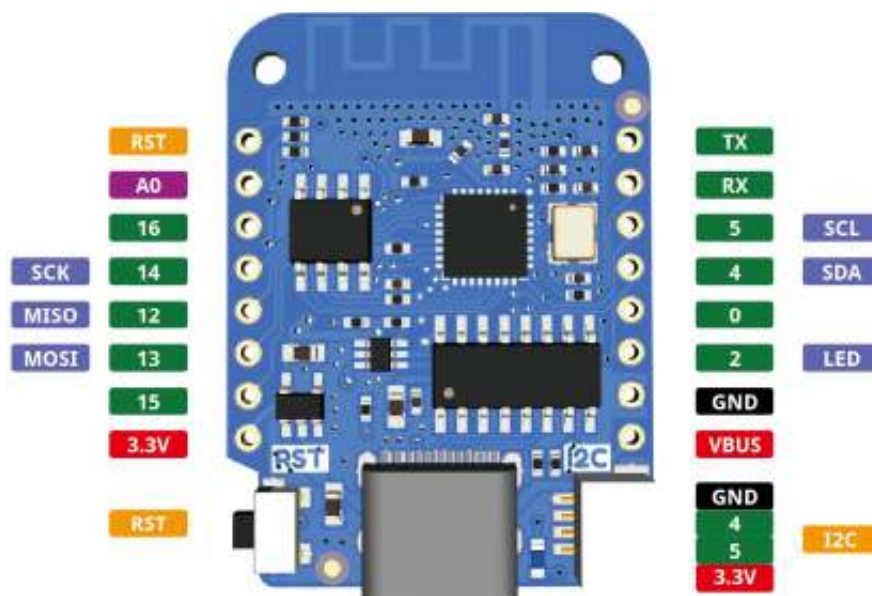
Notes: The processor has a USB port and Wi-Fi but has less GPIO pins than the 32U4. It does support I2C and SPI buses which can be used for I/O expansion. The microcontroller can be powered from the USB port or an external 5V supply. There is an onboard voltage regulator that provides the 3.3V supply.

Expect to pay anything from £1 (China) to £5 (UK or European source).

Slide 16 - Microcontroller - ESP8266

Recorded announcement
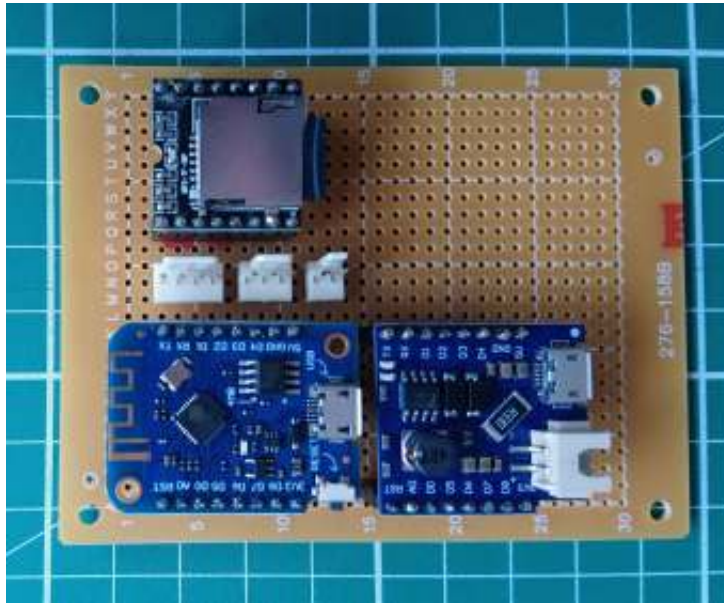
Notes: This project came about when I became fed up of calling "CQ contest 2E0PTH" during the FMAC contests. When it's finished this will sit between the microphone and transceiver. Pressing a button will activate the PTT and play one of four pre recorded messages. The project is based on a MP3 player and a ESP8266 microcontroller. The MP3 player is intended to be used standalone with push buttons to control which message (track) is being played. Unfortunately the player is designed to move on to the next track once the current one has finished. To reliably control which of the four tracks is being played I've used an ESP8266 which reads the track selection switch and the play button. The MP3 player is the top left of the image, the ESP8266 is bottom left and the module bottom right is a LiPo battery interface that boosts the 3.3V to 5V and looks after the charging of the battery. I need to build the analogue interface to the transceiver to complete the project.

Slide 17 - Microcontroller - PICAXE

https://picaxe.com/what-is-picaxe/
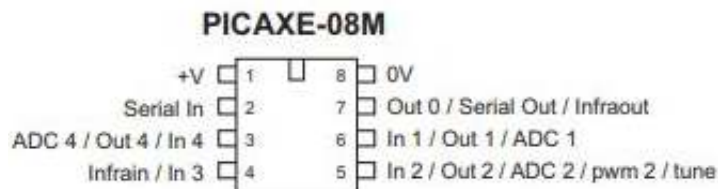
Notes: PICAXE is a PIC processor that has been programmed with a Basic interpreter. It has very limited I/O capabilities.

The processor chip costs approximately £2, the project board costs £3.00.

Slide 18 - Microcontroller - PICAXE

Power sequencer
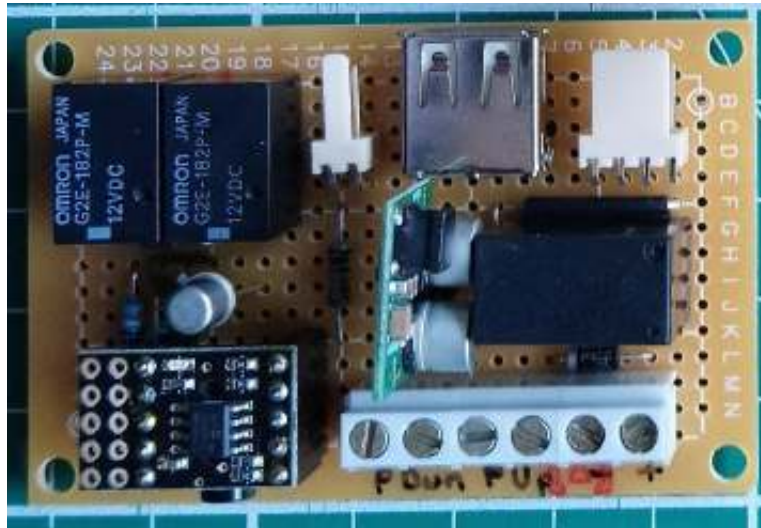
Notes: The power sequencer is part of a bigger project. It's function is to control the power up & down of a Raspberry Pi as well as an emergency stop for two motors.

When the On button is pressed the switched mode regulator supplies 5V to the PICAXE and Raspberry Pi. The PICAXE latches the 12V relay so the supply is maintained when the button is released. When the Stop button is pressed a shutdown signal (relay contacts closing) is sent to the Raspberry Pi and a signal (2nd set of relay contacts closing) is sent to the motor controller to stop the motors. After 20 seconds have elapsed the 12V relay is released, this causes the 5V supply to the PICAXE and Raspberry Pi to collapse.

Slide 19 - Microcontroller Interfacing
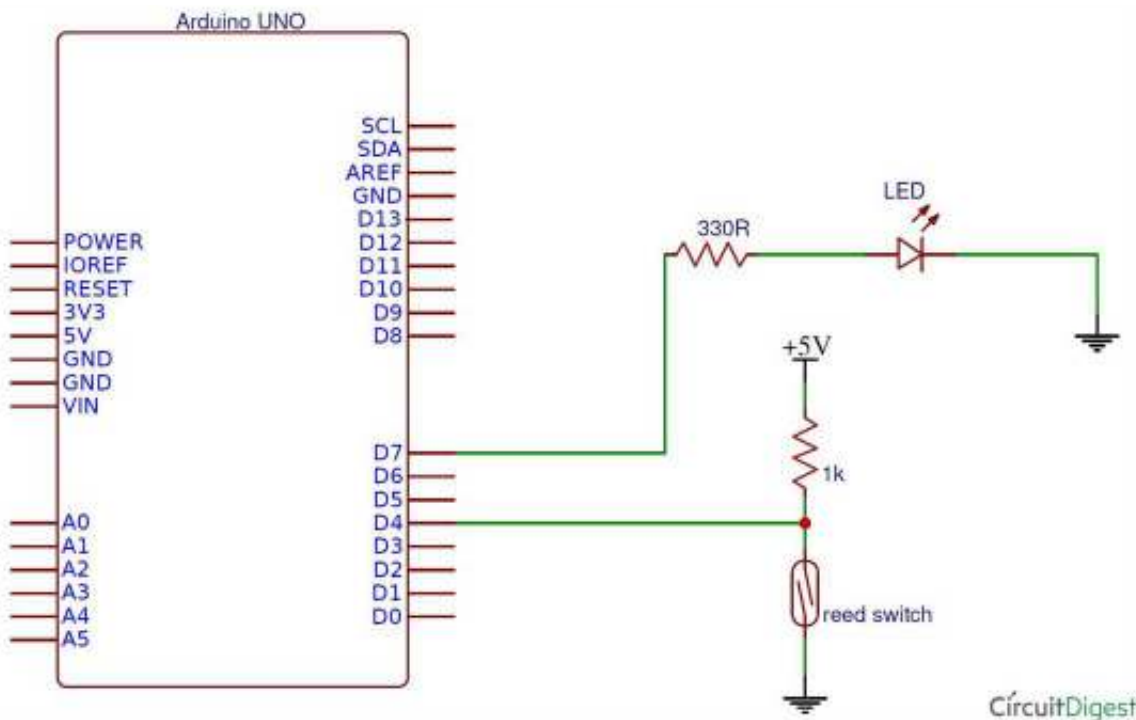
Notes: Most microcontrollers can source or sink a 10 to 20mA load, this is sufficient to illuminate a LED or drive a similar load. A mentioned before the output voltage swing is usually 0V to 3.3V. To read the state of a switch a pull up resistor with the switch wired to short the input to ground is commonly used. Some microcontrollers have built in pull up resistors.

Slide 20 - Microcontroller Interfacing
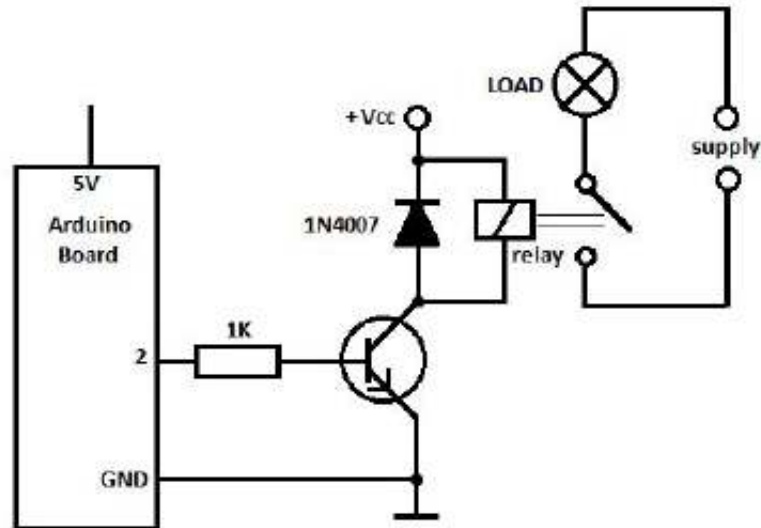
Notes   To drive larger loads, or loads that run off higher voltage supplies, e.g. motors, relays, etc. a single transistor driver can be used.

Slide 21- Microcontroller Interfacing - I2C

Allows a master device to communicate with multiple slave devices.

I2C is used to connect devices like microcontrollers, EEPROMs, I/O interfaces, sensors and other peripheral devices in an embedded system.

Intended for short distance communications within a single device.

Bus architecture with 2 wires, SDA (data) and SDC (clock). Asynchronous, half duplex. Invented in 1982 by Philips Semiconductors.
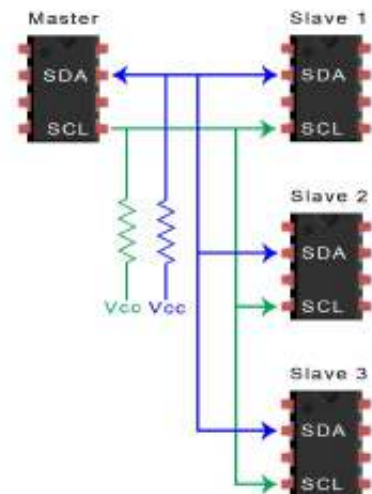
Notes   A number of microcontrollers support the I2C interface which allows the microcontroller to talk to a wide variety of other devices, e.g. ADC chips, memory chips, sensors, etc. Another communication interface is the SPI bus, a full duplex serial interface using 3 wires. Invented by Motorola in the 1980's

Slide 22- Writing software for microcontrollers

IDE - Integrated Development Environments

PICAXE IDE - Proprietary. Basic programming language

Arduino IDE - Open Source.
       C programming language.
       Supports multiple processors and development boards.

Raspberry Pi IDE -
       Geany - Supports many programming languages
       Thonny - Python programming language

Notes: An IDE (Integrated Development Environment) is a software application that provides all the essential functions to develop software . Usually, IDEs consist of a source code editor, a debugger, and build automation (code compilation, automated testing, etc.).

Slide 23 - PICAXE IDE

Main window pane is for editing code.

Keywords are automatically coloured blue, comments are green.

The toolbar at the top has options to compile the code, download it to a device as well as some simple debugging tools.

Don't forget to select the device type before attempting to compile or download the code.
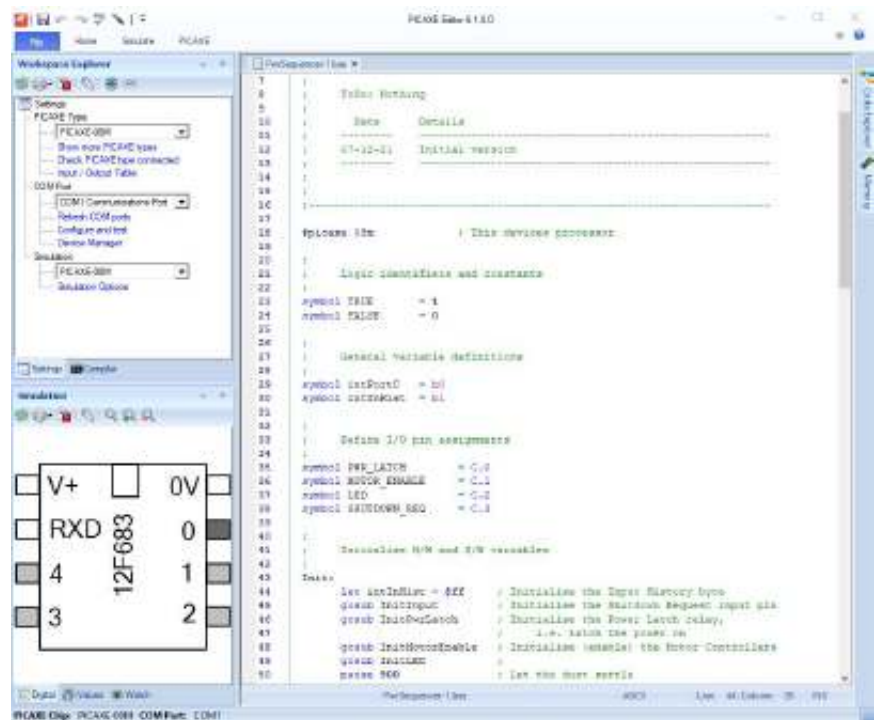
Slide 24 - Arduino IDE

Main window pane is for editing code.

Keywords are automatically coloured red.

Select the device type as the first step after opening the IDE (Tools Board). Then select the COM port the board is attached to (Tools   Port)

Compiler and download output is shown in the bottom pane. Alternatively the serial output can displayed in this pane.

The icons below the toolbar allow the code to be compiled and download to a device.
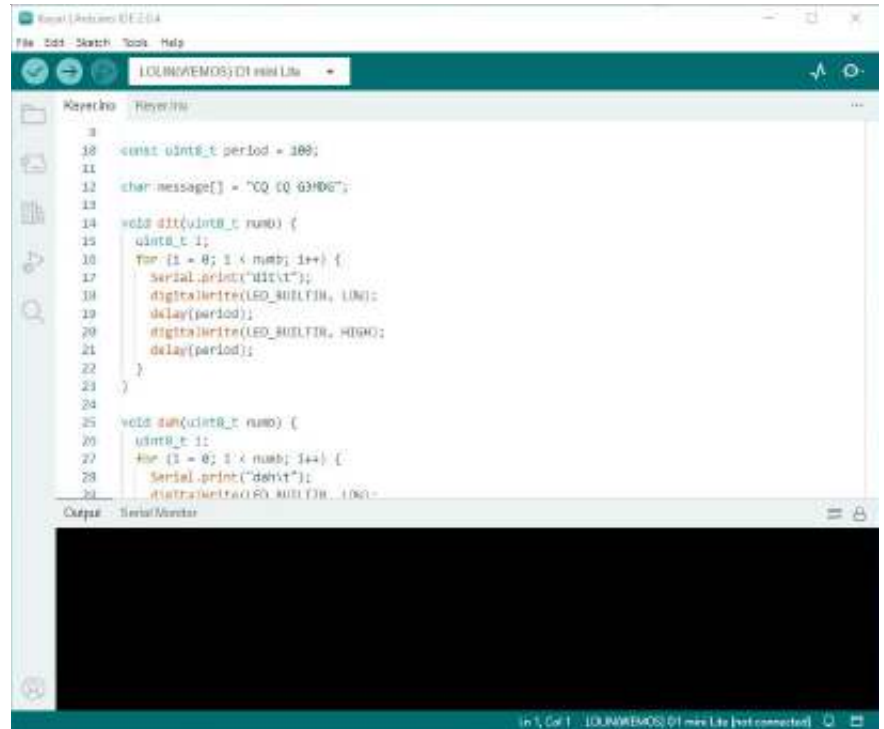
Slide 25 - Writing software for microcontrollers

Start with something simple, get it working and then expand it.

Test at each stage of development.

Use examples and libraries where available. The Arduino has an extensive range of libraries for various sensors and software algorithms.

Don't forget, contacts bounce. Applies to switches, relays, rotary encoders, etc.

A short delay after startup is recommended. This allows time for GPIO signals to stabilise.

CW corner

Representation, timing, and speeds

International Morse code is composed of five elements:

1. short mark, dot or dit (•): "dit duration" is one time unit long
2. long mark, dash or dah (–): three time units long
3. inter-element gap between the dits and dahs within a character: one dot duration or one unit long
4. short gap (between letters): three time units long
5. medium gap (between words): seven time units long (formerly five)

Transmission

Morse code can be transmitted in a number of ways: Originally as electrical pulses along a telegraph wire, but later extended to an audio tone, a radio signal with short and long tones, or high and low tones, or as a mechanical, audible, or visual signal (e.g. a flashing light) using devices like an Aldis lamp or a heliograph, a common flashlight, or even a car horn. Some mine rescues have used pulling on a rope - a short pull for a dot and a long pull for a dah.

Morse code is transmitted using just two states (on and off). Morse code may be represented as a binary code, and that is what telegraph operators do when transmitting messages. Working from the above ITU definition and further defining a bit as a dot time, a Morse code sequence may be made from a combination of the following five bit-strings:

1. short mark, dot or dit (•): 1
2. longer mark, dash or dah (–): 111
3. intra-character gap (between the dits and dahs within a character): 0
4. short gap (between letters): 000
5. medium gap (between words): 0000000

Note that the marks and gaps alternate: Dits and dahs are always separated by one of the gaps, and that the gaps are always separated by a dit or a dah.

Morse messages are generally transmitted by a hand-operated device such as a telegraph key, so there are variations introduced by the skill of the sender and receiver — more experienced operators can send and receive at faster speeds. In addition, individual operators differ slightly, for example, using slightly longer or shorter dahs or gaps, perhaps only for particular characters. This is called their "fist", and experienced operators can recognize specific individuals by it alone. A good operator who sends clearly and is easy to copy is said to have a "good fist". A "poor fist" is a characteristic of sloppy or hard to copy Morse code.

Cable code

The very long time constants of 19th and early 20th century submarine communications cables required a different form of Morse signalling. Instead of keying a voltage on and off for varying times, the dits and dahs were represented by two polarities of voltage impressed on the cable, for a uniform time.

Timing

Below is an illustration of timing conventions. The phrase morse code, in Morse code format, would normally be written something like this, where – represents dahs and • represents dits:

```
– –   – – –   • – •   • • •   •     – • – •   – – –   – • •   •
 M      O       R       S     E       C        O       D     E
```

Next is the exact conventional timing for this phrase, with ■ representing "signal on", and ▨▨▨ representing "signal off", each for the time length of exactly one dit:

Key down	-	■	
Intra character spacing (key up)	-	■	
Letter spacing (key up)	-	■	
Word spacing (key up)	-	■	

Spoken representation

Morse code is often spoken or written with dah for dashes, dit for dots located at the end of a character, and di for dots located at the beginning or internally within the character. Thus, the following Morse code sequence:

```
M        O         R         S      E       (space)      C           O        D         E
- -     - - -     · - ·     · · ·   ·                   - · - ·     - - -    - · ·     ·
```

is spoken (or sung):

Dah dah   dah dah dah   di dah dit   di di dit   dit,   Dah di dah dit   dah dah dah   dah di dit   dit.

For use on radio, there is little point in learning to read written Morse as above; rather, the sounds of all of the letters and symbols need to be learned, for both sending and receiving.

Speed in words per minute

All Morse code elements depend on the dot / dit length. A dah is the length of 3 dits (with no gaps between), and spacings are specified in number of dit lengths. An unambiguous method of specifying the transmission speed is to specify the dit duration as, for example, 50 milliseconds.

Specifying the dit duration is, however, not the common practice. Usually, speeds are stated in words per minute. That introduces ambiguity because words have different numbers of characters, and characters have different dit lengths. It is not immediately clear how a specific word rate determines the dit duration in milliseconds.

Some method to standardize the transformation of a word rate to a dit duration is useful. A simple way to do this is to choose a dit duration that would send a typical word the desired number of times in one minute. If, for example, the operator wanted a character speed of 13 words per minute, the operator would choose a dit rate that would send the typical word 13 times in exactly one minute.

The typical word thus determines the dit length. It is common to assume that a word is 5 characters long. There are two common typical words: **paris** and **codex**. **paris** mimics a word rate that is typical of natural language words and reflects the benefits of Morse code's shorter code durations for common characters such

as **e** and **t**. codex offers a word rate that is typical of 5 letter code groups (sequences of random letters). Using the word **paris** as a standard, the number of dit units is 50 and a simple calculation shows that the dit length at 20 words per minute is 60 milliseconds. Using the word codex with 60 dit units, the dit length at 20 words per minute is 50 milliseconds.

Because Morse code is usually sent by hand, it is unlikely that an operator could be that precise with the dit length, and the individual characteristics and preferences of the operators usually override the standards.
For commercial radiotelegraph licenses in the United States, the Federal Communications Commission specifies tests for Morse code proficiency in words per minute and in code groups per minute. The FCC specifies that a "word" is 5 characters long. The Commission specifies Morse code test elements at 16 code groups per minute, 20 words per minute, 20 code groups per minute, and 25 words per minute. The word per minute rate would be close to the paris standard, and the code groups per minute would be close to the codex standard.

While the Federal Communications Commission no longer requires Morse code for amateur radio licenses, the old requirements were similar to the requirements for commercial radiotelegraph licenses.

A difference between amateur radio licenses and commercial radiotelegraph licenses is that commercial operators must be able to receive code groups of random characters along with plain language text. For each class of license, the code group speed requirement is slower than the plain language text requirement. For example, for the Radiotelegraph Operator License, the examinee must pass a 20 word per minute plain text test and a 16 word per minute code group test.

Based upon a 50 dit duration standard word such as paris, the time for one dit duration or one unit can be computed by the formula:

$$T = \frac{1}{200} W$$

where: **T** is the unit time, or ***dit*** duration in milliseconds, and **W** is the speed in wpm.

High-speed telegraphy contests are held; according to the Guinness Book of Records in June 2005 at the International Amateur Radio Union's 6th World Championship in High Speed Telegraphy in Primorsko, Bulgaria, Andrei Bindasov of Belarus transmitted 230 Morse code marks of mixed text in one minute.

Alternative display of common characters in International Morse code
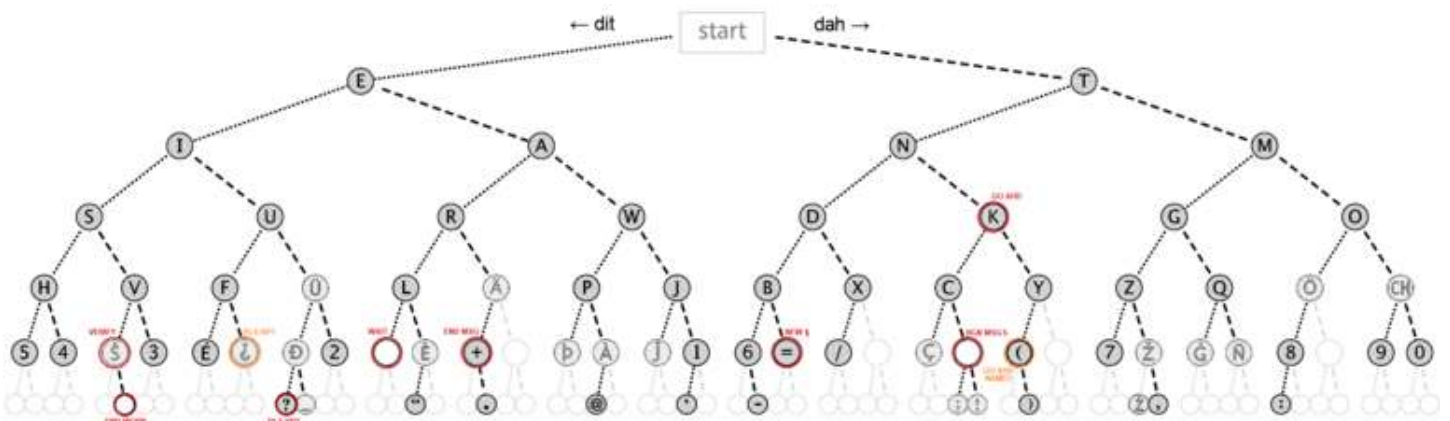
Some methods of teaching Morse code use a **dichotomic** search table.

International Morse code **binary search** tree: The graph branches left for each dit and right for each dah until the character representation is reached. Official **ITU** codes are shown as black letters on dark grey, and are complete, including punctuation; some non-ITU extensions are in grey letters on light grey, but are not exhaustive. ITU **prosigns** are circled in red with red text; unofficial prosigns are orange.

Spotlight - Reunion Island

QSO with FR4OO, Rene Paul Payet, Reunion Island

Band:	10m	**QTH:**	Sainte-Clotilde, Réunion Island	
Mode:	FT4	**Coordinates:**	21°06'52"S 55°31'57"E	
Date:	27th March 2023	**Time Zone:**	UTC+4	
Time:	11:35z	**Population:**	873,102	
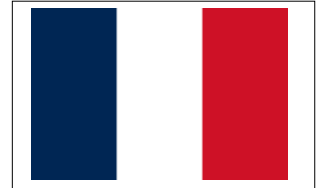
Flag

Coat of arms

10m is getting pretty active as the sunspot cycle swings in our favour. Most days (barring outbursts from the sun causing radio blackouts) propagation is good to the Americas and to east Asia.

I was alerted by G1YBB that FR4OO in Reunion Island was active on 10m FT4, so swiftly tuned there to find the frequency full of EU and DX stations. And quite soon I spotted Rene Paul FR4OO working a succession of stations, including several from the UK. It look a little while to get an acknowledgement from him, not least because with each QSO, he was changing frequency. Rather than sticking on one frequency he appeared to be QSYing to the frequency of the station he was working (tip: don't do that!).

FR4OO's Quad antenna

Reunion is another of those isolated volcanic islands – in this case east of Madagascar and west of Mauritius. It was formed something like 3 million years ago and remained in blissful isolation until 1507 when the Portuguese "discovered" it. It didn't become inhabited until the 17th Century when people from France and Madagascar settled there. It became an important stopping point for trade ships plying the route between Europe and the far East, but its importance for trade diminished when the Suez Canal was opened. It remains of some strategic importance to France.

Politically Reunion is an overseas Department of France, similar to a number of other islands colonised by France. Hence French laws and regulations apply there, with a regional and departmental council as the local executive. It's even in the Eurozone!

As with many volcanic islands, most of the population lives on coastal areas around the central volcano. Rene Paul lives in the northern city of Saint-Denis, the island's capital, which has a population of some 153,000.

Rene Paul's QRZ.com page shows a very substantial cubical quad antenna, which accounts for his good signal into Europe. His logbook on QRZ.com shows he is very active, especially on FT4, so worth a look when conditions are right.

Malcolm G3ZNU

Contest Corner

May

HF			
Day	Date (2023)	Time UTC	Contest Name
Mon	08 May	1900-2030	80m CC SSB
Wed	17 May	1900-2030	80m CC DATA
Mon	22 May	1900-2030	RSGB FT4 Contest
Thu	25 May	1900-2030	80m CC CW

VHF			
Day	Date (2023)	Time UTC	Contest Name
Tue	02 May	1800-1855	144MHz FMAC
Tue	02 May	1900-2130	144MHz UKAC
Wed	03 May	1900-2100	144MHz FT8 AC
Sat-Sun	06-07 May	1400-1400	May 432MHz-245GHz Contest
Sat	06 May	1400-2200	432MHz Trophy Contest
Sun	07 May	800-1400	10GHz Trophy Contest
Tue	09 May	1800-1855	432MHz FMAC
Tue	09 May	1900-2130	432MHz UKAC
Wed	10 May	1900-2100	432MHz FT8 AC
Thu	11 May	1900-2130	50MHz UKAC
Sun	14 May	900-1200	70MHz Contest CW
Tue	16 May	1900-2130	1.3GHz UKAC
Thu	18 May	1900-2130	70MHz UKAC
Sat-Sun	20-21 May	1400-1400	144MHz May Contest
Sun	21 May	1100-1500	1st 144MHz Backpackers
Tue	23 May	1830-2130	SHF UKAC
Sun	28 May	1400-1600	70MHz Cumulatives # 3

June

HF			
Day	Date (2023)	Time UTC	Contest Name
Sat-Sun	03-04 Jun	1500-1500	NFD
Mon	05 Jun	1900-2030	80m CC DATA
Wed	14 Jun	1900-2030	80m CC CW
Thu	22 Jun	1900-2030	80m CC SSB
Mon	26 Jun	1900-2030	RSGB FT4 Contest

VHF			
Day	Date (2023)	Time UTC	Contest Name
Tue	06 Jun	1800-1855	144MHz FMAC
Tue	06 Jun	1900-2130	144MHz UKAC
Wed	07 Jun	1900-2100	144MHz FT8 AC
Thu	08 Jun	1900-2130	50MHz UKAC
Sat	10 Jun	1400-1510	Platinum Jubilee VHF
Sun	11 Jun	900-1300	2nd 144MHz Backpackers
Tue	13 Jun	1800-1855	432MHz FMAC
Tue	13 Jun	1900-2130	432MHz UKAC
Wed	14 Jun	1900-2100	432MHz FT8 AC
Thu	15 Jun	1900-2130	70MHz UKAC
Sat-Sun	17-18 Jun	1400-1400	50MHz Trophy Contest
Tue	20 Jun	1900-2130	1.3GHz UKAC
Sun	25 Jun	900-1200	50MHz Contest CW
Sun	25 Jun	1400-1600	70MHz Cumulatives # 4
Tue	27 Jun	1830-2130	SHF UKAC

For sale and wanted

If anybody has anything for sale, or wants anything, then this is the place to ask, photo's and descriptions will help, email me at bryanpage1@btinternet.com.

The following are antenna's being sold by Phil (M0NVS), please contact him if you're interested, his email address can be found on https://www.qrz.com

Any other business

Ofcom Hints at Licence Changes (as reported in Essex Ham)

Ofcom has hinted at potential changes to the amateur radio licence in their Plan of Work 2023-24 document released at the end of March 2023.

The two notable paragraphs are:

"WTA (Wireless Telegraphy Act) licence simplification. Alongside our move to a new licensing platform, we will review our licensing processes and documentation to ensure we have an efficient approach, reducing the burden on our licensees as far as possible and simplifying their engagement with us. A key part of this program will be our review of Amateur licensing"

"Amateur radio licences review. We will consult on proposals to simplify our licensing framework for amateur radio licensing and incorporate new areas of amateur radio activity. Our aim is to provide clear updated rules which afford radio amateurs greater freedom to operate, drawing on feedback provided by the sector"

What happens next?

It appears that there will be a public consultation in Q1 2023–24 (Between April and June 2023), followed by a statement in Q4 2023–24 (between January and March 2024)

What could change?

The information released so far is minimal, so could be anything and are open to interpretation. Just for fun, here are a few possibilities – we'd love you to add some of your own thoughts in the comments section below.

- **"Simplifying the framework"** – A reduction in the number of licence levels would certainly achieve this, perhaps with the removal of "Intermediate" and the return to a two-tier system?

- **"Licencing Platform – Reducing the burden"** – Could that hint at the end of the requirement to revalidate via the Ofcom site every 5 years?

- **"New areas of activity"** – Could this mean a relaxing of the rules regarding Digital Voice, Hotspots, Gateways and Remote Operation?

- **"Clear, updated rules"** – Perhaps some specific guidance on some of the more vague terms "as frequently as practicable", "from time to time", etc. Or perhaps changes to kit construction at Foundation? Or changing the references to "Radio Equipment"?

- **"Greater freedom to operate"** – Increased power? More bands? Few restrictions in the Schedule? Less restrictions for gateways, beacons, repeaters, remote and unattended operation?

Some wilder theories:

- The dropping of mandatory Regional Secondary Locators (for Scotland, Wales, N. Ireland) would simplify the framework and increase freedom

- "Greater freedom to operate" could point to relaxing the supervision rules, construction, testing requirements, or allowing Foundation and Intermediate to send greetings messages. Or a change to identification frequency (once per 60-minute period?)

Syllabus changes?

There is currently a disconnect between the licence (Ofcom) and the syllabus (RSGB). It is RSGB, not Ofcom, that imposes that newcomers to the hobby must understand: resistors in series and parallel, the human hearing range, the height of the Ionosphere and how to draw a block diagram of a transmitter. "Greater freedom to operate" could mean that Ofcom asks RSGB to reduce the focus on electronics, particularly at the lower levels. Most newcomers don't build their own transmitters, so does a licence holder really need to memorise the resistor colour code or understand Fourier transform?

If Ofcom was to suggest a simplification of the syllabus, might they go further and remove the monopoly that RSGB has on exams? Could we see a time where online course providers not only run courses, but also exams?

Foundation to Intermediate Progression
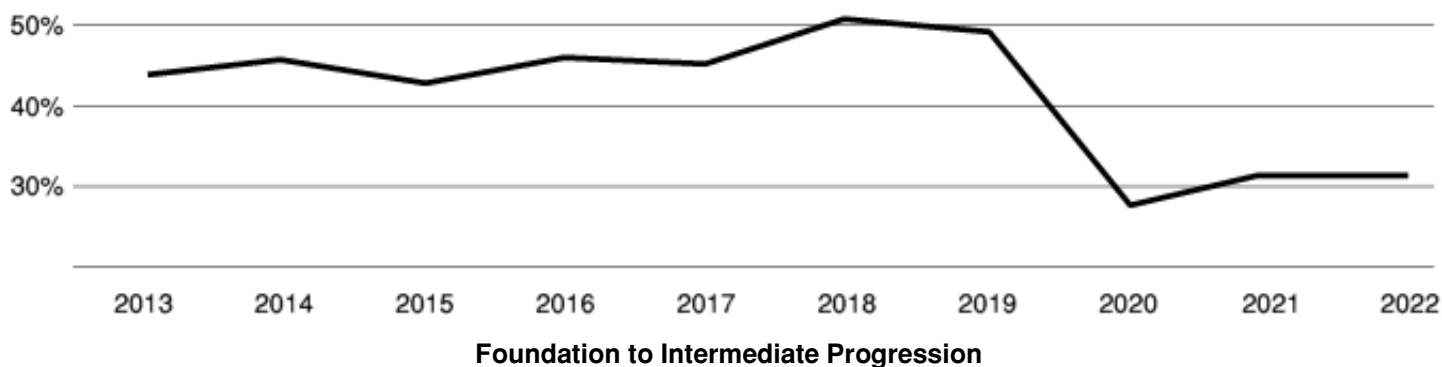
Or, could we see a move towards an "operator licence" and a "constructor licence"?

Alternatively, could Ofcom decide that the RSGB's 2019 syllabus changes were excessive? Since the new syllabus rolled out, we've seen a steep drop in people moving from Foundation to Intermediate, and with the new Intermediate now containing a significant amount of "Full" theory drop down to make the exam harder, people staying put at Foundation is a worrying trend. Whilst RSGB appears keen on adding in extra theory to our primarily practical hobby, perhaps Ofcom would like to see more people enter the hobby and progress as operators, not theorists?

The **Plan of Work 2023-24 document** can be found at:

https://www.ofcom.org.uk/consultations-and-statements/category-2/ofcoms-plan-of-work-2023-24?showall=1%22

*Ed: I note in the section **"Greater freedom to operate"** in **What could change?** the mention of "increased power". In the 17th of April edition of the https://www.amateurradio.com online blog Rich (AA4OO) signs off by saying "Lower your power and raise your expectations", anyone can throw masses of power out into the ether and judging by some of the comments regarding the proposed changes by Ofcom on some of the amateur radio websites it would appear there are a couple of people who don't understand that getting your antenna right Is a better answer.*

When the "Air Miles" contest was run I had a section that gave the miles-per-watt of a QSO, it was interesting to see how often there was less than 1 mile per Watt (in other words, using 100W and achieving less than 100 miles distance).

I take my hat off to those who achieve QSO's with efficient antenna's and minimal power.