GARC Talk - 22 July 2011 by Peter Parker VK3YE

Introduction

(set up HF rig and antenna)

Good evening to you all – well Lou has got me in to talk about pedestrian mobile which I'll get to in a minute. But before we start I see that some of you have mugs in your hand.

Now does anyone have a spare mug – preferably empty?

Here's a signal you can hardly hear.

But when I put the speaker up to the mouth of the cup a certain distance it resonates. As the cup is closed it only needs to be half as long as if you used an open ended tube (draw on white board). If you have a lot of interference a home this can make the difference between hearing someone and not hearing them.

People make these things out of drain pipe but I've found a cup suprisingly good. Although this is audio frequency stuff there are parallels with tuned circuits, transmission lines and antennas that you might want to explore.

1. HF Pedestrian mobile

Now onto the main topic.

Equipment and batteries are now so good that 90% of the problem that a pedestrian mobile operator faces is the antenna. And with this it's easy and cheap to build your own.

The station you see here can do pedestrian mobile on all bands from 40 to 10 metres.

There's the usual FT-817. For batteries I use two nickel metal hydrides from Jaycar. These are 7.2v battery packs – sell for about $50 each – connected in series for 14.4 volts.

I use two antennas. The first is similar to the commercially available Miracle Whip. It does 40 – 10 metres. It's just a telescopic antenna with a tuned circuit matching unit at the bottom. I'll just pass it around.

(pass around)

It's nice and small but it helps to have a trailing radial.

And as with all pedestrian mobile antennas it's inefficient on bands like 40 metres. But 40 metres is an essential band to have despite this. It's got good activity and propagation characteristics. As you'll hear later on 10 and 17 metres are also good for pedestrian mobile. Plus 30 metres though activity is less. You can make contacts on 20 metres but it can be frustrating. And many VKs are Dxing so it's not as good as 40 metres.

The main antenna I use is a magnetic loop. It's bigger but more efficient. And there's no annoying ground radial.

Theres a good article in AR magazine about magnetic loops. You should read that as it tells you what to do. Unfortunately what you see here is an example of what not to do – there are so many compromises. But I've had to make them to suit available components and to make the antenna light enough to carry.

I do have another version of this loop at home. Same size but much heavier.
A good way to compare HF antennas is WSPR or weak signal propagation reporter. It's basically a beaconing system that you can get reports from all over the world. As these reports are expressed in dB and appear on a website you can compare antennas.

For example my heavier loop was about 6dB better than this one. But if it's too heavy to comfortably carry it's not much use – you might as well use an end-fed on a squid pole for even better results.

An efficient loop must have a very low resistance and efficient variable capacitor. Its bandwidth should only be a few kilohertz. Ideally then this antenna should be made out of copper pipe with a vacuum variable capacitor at the top.

But I wanted to make an antenna that could be carried and pulled apart. My first heavier loop used the braid of RG-213, which was very good. It used a variable capacitor – the old metal type with two gangs. It's a good idea to connect the gangs in series – leaving the frame unconnected to reduce losses.

It was a good antenna but too heavy so I built the lighter one here. This one just uses 3 metres of extension cable to a beehive trimmer capacitor at the top. By itelf this covers 20 through 10 metres, with 100pF switched in for 40 metres. I actually use two trimmers so I can have one permanenetly tuned to 40 metres. Unfortunately this misses 30 metres, but if you had a centre off switch you could add (say) a 47 pF capacitor to cover the band.

The dowelling and irrigation fittings allows it to be pulled apart.

I've taken this antenna to many portable locations around the bay – some very close to here. This video shows how it works in practice.

(play video – 2 min)

There's a few other topics to discuss tonight, and for now I'll pass around the antenna. And does anyone have any questions?

(questions)

2. Little transmitters

Tonight's second topic is unusual little transmitters.

If you can make contacts with QRP to a pedestrian mobile antenna, it's logical that a few milliwatts to a more efficient antenna at home should also work.

So I made up a low power beacon. It's crystal controlled, using a 7.159 MHz crystal from Rockby. And it runs off 5 volts from a USB port. It's actually a double

sideband rig – so I can modulate it with voice, digital modes, slow scan TV or even Morse made by generating audio tones in the computer.

There's just two transistors – both 2N2222s – for the crystal oscillator and power amplifier. Diodes are used for the balanced modulator.

I've found it can be heard anywhere around the bay, as this video demonstrates.

(play video – 2 min)

I took the easy way and used a USB port to run this transmitter. Other people might use solar power or a hand generator. But the ultimate has to be the human voice itself.

You might have come across a website or youtube videos featuring Mike Rainey AA1TJ who builds a lot of stuff. One of Mike's projects is the 'New England Code Talker'. This is a voice powered HF CW transmitter. He tried to span the Atlantic – I don't know if he succeeded – but he's certainly had contacts over several hundred kilometres. He gets about 15 or 20 milliwatts, which as you saw just before can be surpisingly effective.

It's very simple. You bellow into the speaker and a transformer steps up the voltage. This is rectified and directly powers a crystal oscillator transmitter. I measured about 3 or 4 volts.

I'll lose my voice if I test it too much, but here's my chance to look stupid.

(set up 7 MHz Rx and demonstrate code talker)

I'm not getting as much power as Mike so this version is still very much under construction. Mike has also built an AM version that might be worth looking up.

Third and final on the little transmitters theme is low interference potential devices.

A lot of you associate LIPDs with cordless headphones, machinery controllers and other stuff that interferes with repeaters on 70 centimetres. And in this context they can end up being high interference potential devices. That's the bad side of LIPDs.

There's also a good side – LIPDs can be useful for many amateur and non amateur applications. You can remote control antennas, monitor temperatures or link from a solar powered remote receiver in a quiet location.

When you get home tonight, jump on the ACMA website and look up the Low Interference Potential Device Class Licence 2000. Especially pay attention to the section on frequencies and power levels.

I think you'll be amazed. There are several megahertz of frequencies in the low VHF range that allow up to 100 milliwatts of power. Just below 41 MHz you can run much more. And there's even an HF LIPD band at 13.5 MHz, so LIPD Dx is not inconceiveable.

There's no forms, fees or restrictions on purpose. And you don't have to identify. Foundation licensees can't build amateur transmitters but I can't see any restrictions with LIPDs.

I should also point out the downsides. There's no interference protection. You must accept anyone else on your frequency. And you must stop transmitting if you interfere with primary or secondary users. So never use an LIPD for safety critical applications. But for hobby use they're great fun and if you pick a frequency carefully you won't have any problems. Also you are a bit restricted with gain antennas – unlike amateur licenses the power limits are EIRP so you have to drop the power if using a high gain antenna.

Here's some LIPD frequencies that allow 100 mW or more for all purposes

13.553 – 13.567 MHz
26.957 – 27.283 MHz (1 watt)
29.7 – 29.72 MHz
30 – 30.0625 MHz
30.3125 – 31 MHz
36.6 – 37 MHz
39-39.7625 MHz
40.25 – 40.66 MHz
40.66 – 41 MHz (1 watt)
70 – 70.24375 MHz
77.29375 – 77.49375 MHz
150.7875 – 152.49375 MHz
173.29375 – 174 MHz
10500 – 10550 MHz
24000 – 24250 MHz

LIPD frequencies around 30 to 40 MHz are really good. There's little interference and it's easy to build transmitters. Ordinary small signal transistors like the 2N2222 work fine.

And the crystals are easy to get. A common computer crystal is 18.432 MHz. Double it for 36.865 MHz, which happens to be in an LIPD band. Or you can start on that frequency. Rockby Electronics sells crystals for both frequencies cheaply.

(pass around LIPD transmitter)

As for range, I've been able to get 800 metres with a 1 transistor FM transmitter to a handheld receiver without really trying. My antenna at home was a vertical dipole about 7 metres high.

(play video)

I think several kilometres between houses should be easy with the full power limit. But you should be able to make it across the Bay if you take it portable. I live on the other side of it so get in touch if you'd like me to listen.

(Questions)

3. Software Defined Radio

(set up computer and SDR)

Next topic is software defined radio.

Hands up how many of you have one. And how many of you have built one?

You might be thinking this is all very complicated – computer programming, writing software and tiny surface mount components.

But the basics of SDR are very simple.

Think of the computer as an IF strip, demodulator and audio stage, with some fancy filtering. The IF is tunable – depending on the bandwidth of your sound card. 48 and 96 kilohertz seem to be the common ones. All the hardware does is convert your incoming signal on 80 or 40 metres down to this low IF. So in my case it's nothing more than a simple converter circuit, with an oscillator, mixer and a bit of audio or RF gain somewhere.

You can buy kits but I thought it would be fun to develop one myself.

To do this, there's three things you need.

Firstly you need a computer with a sound card. And it should preferably be a stereo sound card. Mine doesn't and I've had to sacrifice selectivity, which I'll get to in a minute. Also the computer needs a microphone input as you need lots of audio gain.

Secondly you need some software.

I tried several but my favourite is 'SDRadio' v0.99 by Alberto I2PHD. You get it from www.sdradio.eu That's www.sdradio.eu

Thirdly you need the hardware.

All I did was build a small direct conversion receiver for 80 and 40 metres.

(draw block diagram on the board)

There's not much to it – as mentioned before it's just a mixer, oscillator and some audio or RF amplification.

Everything else, including further audio amplification and selectivity, is done by the soundcard and software.

I should point out that this is the absolute simplest SDR you could build and it doesn't have single signal reception. You can make something that does but it's about 3 times more complicated and you need a computer with a stereo soundcard. All the kits and commercial ones feed slightly different signals into each channel, so allowing the opposite sideband to be rejected.

So I went with the quick and dirty option that I'll explain on the board.

(Draw on board – explain mixing, sum and products)

This is the local oscillator frequency – say 7.1 MHz. Incoming signals on 7090 and 7110 both appear as 10 kHz on the output. The soundcard can't discriminate between the two so you hear both.

If this was a direct conversion receiver you couldn't do anything about this.

But you can with this.

Just retune the local oscillator to (say) 7105. Now the 7110 signal is at 5 kHz and the 7090 signal shows up as 15 kHz.

So you are still hearing twice the noise as a single signal receiver, but you can easily adjust tuning to dodge interfereng signals on the image.

(now set up to demonstrate)

Though simple there's still features like variable selectivity and noise reduction handled in the software.

(play video – 2 min)

So that ends software defined radio – it's crude but it works.

4. RF Porta Tester

To build some of this gear it's nice to have a little instrument for RF testing. A bit like a multimeter but for RF.

It's amazing how many things you can do with 1 transistor, 1 IC, a meter movement and a few other bits. You can easily do 6 or 7 functions on it, eg

You can measure RF power
You can measure field strength
You can monitor transmissions – both AM and SSB
You can tune into AM radio and pick up WWV
It's dummy load
It's a signal generator and frequency reference

This underlies the point that although radio gear can be complicated, there are only a few basic stages needed that will do almost anything. These are amplifiers (RF or audio), oscillators, filters (eg tuned circuits), and output devices like speakers or meters).

(explain on board)

Something like this is an excellent first project and is cheap to build. The connections around the switch are a bit complicated, so it's a good idea to build and test each stage one by one.

Hand out circuits

Conclusion

Tonight I've talked about pedestrian mobile, little transmitters, SDRs and testing stuff you've built. I hope you've all gained something out of it.

Peter Parker VK3YE