Harry Leeming's

in the shop

This month Harry Leeming G3LLL looks at d.c. converter high tension supply problems and his vertical antenna tests.

Welcome to *In The Shop* (*ITS*) where I'm starting this time by asking a question – How do you get 900V from 12V? The question arose when '**Terry**' brought his FT-101E to me, it smelt like burnt toast and he wasn't surprised when I told him that the mains transformer was burnt out.

He then cheerfully announced that it did not matter, as he still had the direct current (d.c.) power lead, which he would plug in the back so that he could run it from a car battery. Terry was rather taken aback when I explained that this would not be possible as d.c. operation on this rig – needed a functioning mains transformer.

All high frequency (h.f.) rigs, with valves in the power amplifier (p.a.) stage, need a high tension (h.t.) supply of something in the region of + 500 to +1000V, together with several other positive and negative rails. The normal way to obtain these is via a transformer and rectifiers from the mains supply but semi-portable rigs, such as the FT-101 and TS-520, were also designed to operate from a 12V car battery.

The clever twist in the design of these is that the normal alternating current (a.c.) mains power transformer, besides performing its usual function, is wired so that when the rig is operated from a d.c. supply, it can also act as a the tuned circuit in a power oscillator. The circuit, **Fig. 1**, shows a typical design and shows how the TS-520 d.c. converter unit connects to the power transformer.

The 'chopper' transistors Q1 and Q2 are the active parts in the oscillator circuit, which runs at about 60Hz, to 'mimic' the mains supply in the USA and Japan – ours of course, is 50Hz. 'Chopping' the d.c. supply in this way enables the transformer to produce its normal output voltages when the rig is operating from d.c. Note that the transistors are very expensive 60A germanium types, as the voltage drop on silicon transistors is too high.

If you're seeking a cheap receiver – if you ask around there must be many rigs like the FT-101, in which the receiver operates from 12-14V, with burnt out transformers. All you need to do is to disconnect the existing power supply unit (p.s.u.) section, make up a lead with a 2A fuse in series and connect it to a 13.8V supply. You'll then have a receiver that performs much better on the Amateur bands than an average general coverage set!

What Voltage?

So, what voltage do we mean? The question is posed because I'm sure that you'll have noted that writers such as myself tend to use the terms 12V and 13.8V interchangeably, just to confuse you! However, this interchange ability has a history, which goes back as far as the early car radios.

Of course, the voltage supply in a car comes from the battery. When the car has been stationary, with the engine switched off for a few minutes, this falls to about 12V. Start the engine, 'rev' it up a little, and the voltage will rises to around 14V, and so in-car equipment should operate satisfactorily over this voltage range. This confusion about voltages can, as you'll will now read – cause problems.

The FC102 Pilot Lamps

The FC-102 antenna tuning unit (a.t.u.) is a rather attractive unit, which will handle the output of a linear amplifier and so quite a few people who did not possess FT102 rigs, purchased the a.t.u.. The FC-102 needs a d.c. supply to operate it and the socket on the rear of the rig is appropriately marked '12 V'.

Several of my customers bought them, connected the d.c. input to their shack's 13.8V bench p.s.u., and then complained that the pilot lamps either blew after only a few months, or went dim because the green plastic on them had lost its transparency. Eventually however, the 'penny dropped' and I realised that when Yaesu stamped the socket as '12V', that's what they meant, as the FT-102 provided only 12V on the socket – which was intended for connecting to the a.t.u..

Connecting the a.t.u. to 13.8V

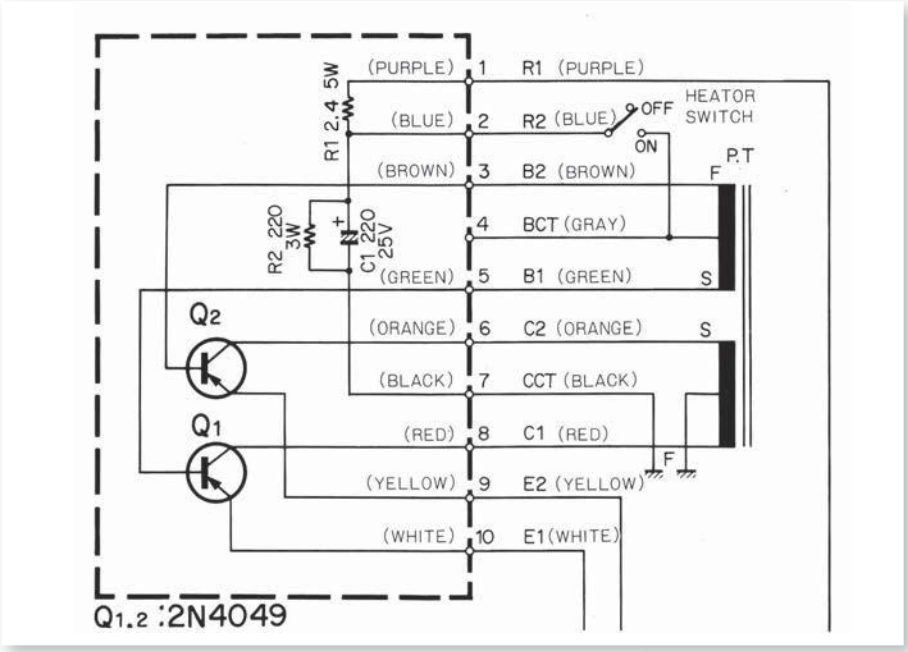

Fig. 1: The circuit, shows a typical design and shows how the TS-520 d.c. convertor unit connects to the power transformer.

Valved rigs often still need the mains transformer, even when running from a low voltage supply, in which case, the drain on the battery is higher than with a more modern rig, as some 500-900V must be produced for the valves to work reasonably efficiently.

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supply overruns it by 1.8V. Incidentally, connecting a resistor in series with the supply isn't a very good solution, as the voltage drop alters with the current variation, as different functions are selected on the FC-102. Instead, the simplest answer is to connect three 2A diodes in series with the positive supply lead, as per **Fig. 2**. These will drop around 0.7V each, irrespective of the current and so give out just under 12V and solve the problem.

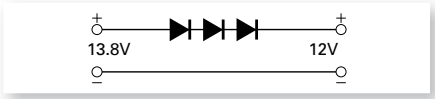

Fig. 2: Using series connected diodes to provide a voltage drop.

The Yaesu FT-747

I used to do quite a bit of static mobile operation many years ago, as the novelty of a mobile call enabled me to work quite a bit of DX. I was surprised as to how easy it often was to break in on a DX pile up, they often did not get my call the first time round but came back with 'QRZ the mobile'.

'**George**' also liked to motor to a quiet spot, switch on his FT-747 and work some DX – but he was having problems. Sometimes he got good reports but often his contacts complained that his s.s.b. transmissions were difficult to read and sounded like they had frequency modulation on them.

When George brought his rig to me for checking, initially I couldn't find anything wrong, gave it back to him as a 'no fault found' and suggested that as the FT-747 has a plastic case, he might be suffering from r.f. feedback. A few weeks later he was back again after having completed more tests.

He reported that everything seemed to be okay if he kept the car engine running – but that the f.m. returned within a few minutes of stopping it. And indeed, further tests in the workshop confirmed if I used the full length of the FT-747's supplied d.c. power cable, and reduced the output of my bench p.s.u. to 12V, the transmission did become distorted.

The Yaesu supplied d.c. power cord was rather long, had fuses in the negative and the positive wires and at full power with 12V going into the lead I found that not much more than 11V was arriving at the other end. The voltage regulators on the FT-747 only seemed to 'kick in' at about 11.5V and so on voice peaks the rig's internal voltage supplies were effectively un-stabilised, hence the f.m. and the distortion on transmission.

I eventually found that it was possible to considerably reduce the voltage drop by shortening the d.c. power cable and by only fusing the positive lead. After my suggestion George made up a very short thick lead, soldered just the one heavy duty 25A car fuse directly in the positive feed and installed a 100AH battery near to the rig. He then found that he could operate for a couple of hours or more, with excellent quality audio, was happy to work the world, without any need for the rig to be modified, or for the car engine to be left running!

Intermittent Heater Problems

'**Thomas**' E-mailed me, to report that he'd suffered from an intermittent fault on the heater supply to his FT-101E. The fault had eventually traced it to a dry joint in the link in the 11-pin auxiliary plug but, "It had blown his PA valves, and cost him nearly £100".

The problem mentioned by Thomas might sound impossible as disconnecting the heater supply to a valve will not destroy it – instead it will simply stop it functioning. However, trying to trace any intermittent fault on the transmit side of a rig will present hazards.

The usual methods of looking for intermittent faults, involves carefully prodding and poking at various parts while the equipment is operating. When dealing with a receiver there isn't too much to worry about, apart from your own personal safety. However, with a transmitter or a transceiver it's another story!

For example, should the transmitter suddenly start working, there's the danger that it might be set to run at full power, un-tuned into an unmatched load. You'll then have then only a few seconds to notice that the rig has started transmitting before the p.a. valves are destroyed.

A solid state rig may be a little more forgiving but it's still possible to do quite a lot of harm if you end up transmitting into an unmatched load for a length of time. So, when you're trying to trace such a fault – set the drive control at near minimum, or better still do all your tests in the s.s.b. mode, so that drive will only be produced when you speak into the microphone.

A Vertical Antenna?

Time to look at antennas now and most of us know that vertical systems work very well for some Amateurs. On the other hand some operators find that they are sensitive to local noise – and generate rather too strong a signal into local electronic equipment.

Antennas of all kinds are sensitive to location and once they have been installed and weathered, their value drops by 50% or more. So, when I was in business, I was therefore always reluctant to recommend something that might not work out.

I think that the simplest way to try out an antenna without committing yourself to a lot of needless expense, is to make a temporary one and see what the results are like. If you fancy trying out a vertical system, all you need to invest in is a couple of garden canes, and a length of wire as per **Fig. 3**.

This will enable you to knock together a temporary system for – let's say – 14MHz (20m) and it should perform just as well as the same

Problems.I like to hear about problems with older equipment, particularly pre-1990 Yaesu rigs. Please email me, (add some radio related term in the subject heading, to differentiate against spam), or write and enclose a stamped addressed envelope. Remember that electricity is dangerous, if you are not familiar with safety precautions you must never work on your equipment whilst it is plugged into the mains. (Switching off at the wall socket does not necessarily make equipment safe).

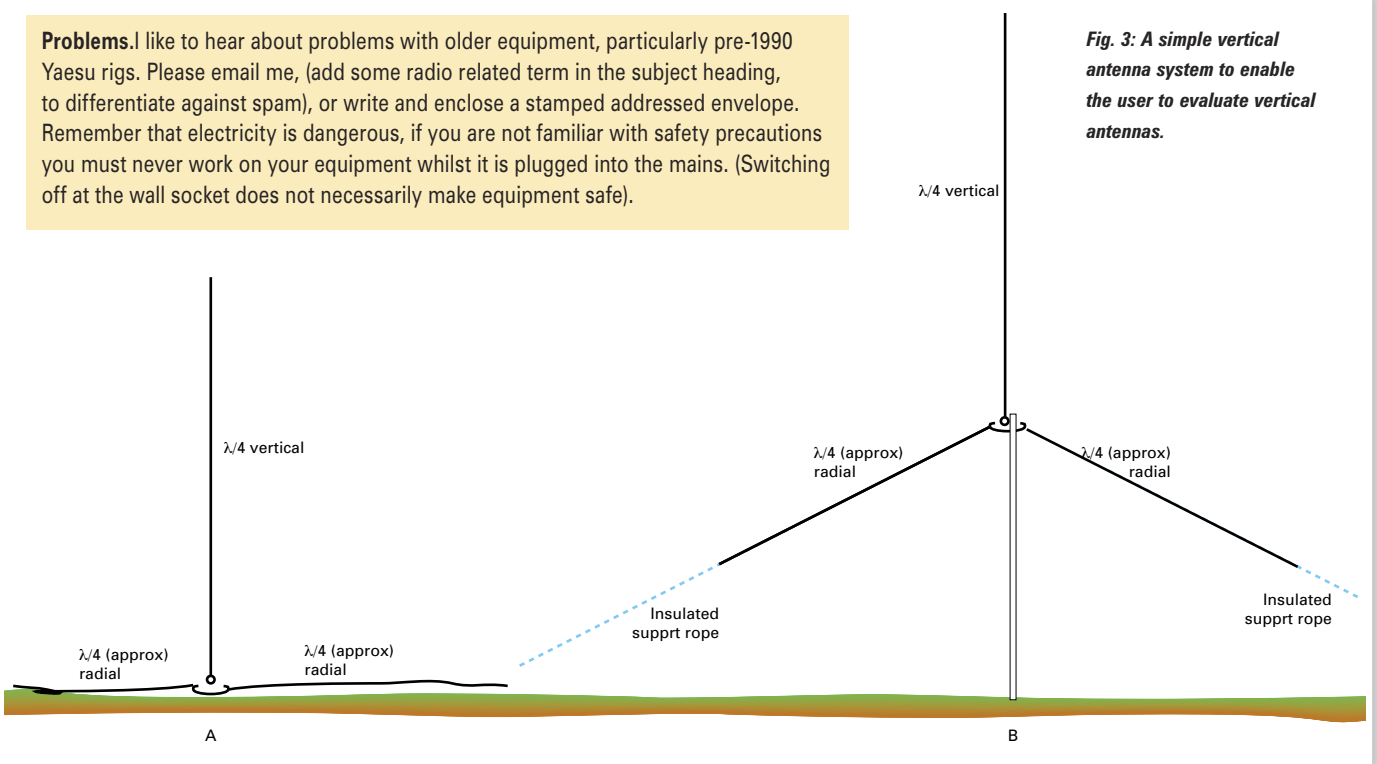

Fig. 3: A simple vertical antenna system to enable the user to evaluate vertical antennas.

section of a commercial multi-band system. Such a set-up might only survive the wind and the rain for a few months but by then you should know as to whether or not it's worth investing in a commercial system.

The system I've suggested can be mounted at ground level, using an earth rod and buried radials as per Fig. 3**a**. Alternatively, usually greater efficiency will result if the whole system is elevated as high as possible, as shown in Fig. 3**b**. The length of the radials isn't too critical – but the length of vertical section should be adjusted for the minimum standing wave ratio (s.w.r.), which should be about 1.5:1.

Rather Unpredictable

The results we can obtain using a vertical antenna system can be rather unpredictable, as the following incident well illustrates! Looking back 30 odd years ago the only satisfactory way I could work on h.f. was from the car. I had a 6ft long G-Whip mounted in the centre of the roof and used to go and park up on a bit of spare ground and operate static mobile.

I achieved some extremely good results, had my first ZL and VK (New Zealand and Australian) contacts and managed to cross the Atlantic on 3.5MHz (80m), but I still wondered just how 'inefficient' the whip was in comparison with a full sized antenna.

To find out more on the efficiency, one day I 'borrowed' an 18AVT, a 25ft high good quality 3.5– 28MHz (80 to 10m) multi-band vertical from the shop. I mounted this on a short stub mast hammered into the ground and ran a collection of radials out over the surface. On checking it out, I found the s.w.r. and the bandwidth to be much better than the G-Whip on all bands.

Next, I moved the car well away from the 18AVT and started to make some comparisons of performance. At first I thought that I must have got the feeders reversed on my two way switch – but no I hadn't! After double and triple checking there was no doubt about it, the G-Whip on the car roof was out-performing the ground mounted 18AVT by about an S-point on all the bands that were active ('open') that day.

Thinking to myself (at the time), I had only to look at the 18AVT and to compare the thickness of the trap coils to be assured that it must be a better antenna than the G-Whip! So what was happening?

Vertical Dipole

A quarter wave vertical aerial operates as the top half of a vertical dipole, the missing bottom half being formed by the 'reflection' from the ground, or in the ground plane. So, I could only presume that the body of my car formed a better ground plane than a dozen or so radials, hence the improved results. Unfortunately I could not think of a way of mounting the 18AVT on my car!

On the subject of radials it's worth noting that while 'the bit that sticks up in the air' might look the most impressive – with any quarter wave vertical system the ground plane is probably even more important.

I once read an article by an Amateur, who spent a considerable time measuring the increase in field strength as he gradually increased the number of radials. When he got up to 80 radials the signal was still getting stronger but at this point time and wire ran out!

While on this topic, the BBC have maps of the country showing ground conductivity, and they site their medium wave station there, not at the highest points! They then bury miles of copper wire in the vicinity.

The relationship between the height of the vertical masts Radio Amateurs are able to erect – and the wavelengths we use – are probably similar to what the BBC operates at on the medium wave band (It makes you think!). So, the next time you are thinking of moving house, how about telling the 'other half' that you'll have to check on the ground conductivity first? See you next month! ●