



Harry Leeming's

in the shop

Harry G3LLL continues his discussion of expected signal levels, earthing, valved amplifiers, then remembers old customers!

Welcome to the shop where I'm carrying on to with the signals levels discussion from last month's column. Over the years I tried to make my own level charts for equipment that I very frequently serviced, but the problem was that I was usually too busy wanting to get on to the next job, and I did not have time to drag out an audio generator, wire up a microphone plug, and make accurate measurements using a wide-band 'scope before reassembling equipment after I had repaired it. As a compromise, I started making quick tests using a diode probe and my own built in audio generator, i.e. I whistled into the microphone.

A Few Readings

Next I'll outline a few radio frequency voltage readings from my notebooks. These are the actual readings taken using the simple diode probe, (which reads about 100mV low as explained previously). All with a loud whistle, with maximum microphone gain, speech processor off, this should give about 5V drive to 12BY7A with valve unplugged. Whilst the readings are by no means comprehensive, they give an idea as to what levels to expect.

FT-101E

Output of 3.18 MHz i.f. unit at pin 10, 25mV.

Input of mixer unit PB1082B at pin 5 about 250mV.

Output of mixer unit at pin 16, 1.5V.

FT-101ZDMk3 IF unit

Input of s.s.b. filter 700mV at Test point 2.

Output of s.s.b filter 200mV at Test point 3.

Input to Q05 250mV at Test point 4.
i.f. panel output with leads unplugged from r.f. unit 400mV at Test point 12.

FT-901

Output of carrier unit 100mV at Pin 4.

Output of speech processor unit, (processor switched off) 400mV at Pin 17.

r.f. unit input 400mV at J103 lead unplugged.

To Earth Or Not?

When I was writing about earth loops a few months back I mentioned the 'Double Insulation Standard', and so perhaps it's time to clarify as to what this is all about. Quite apart from its use from an r.f. point of view, an earth connection is normally used on mains operated equipment for safety reasons. This is especially important when electronic equipment is housed in a metal case, as this can be potentially dangerous; it only needs a capacitor to fail, a strand of wire to move a fraction, or some insulation to break down, and the case can become directly connected to the mains supply.

If however the equipment is fitted with a three-core mains lead, and this is correctly earthed, the result of a short to the case is the fuse 'blowing', or tripping an earth leakage cutout to protect the user.

The problems start when separate items are both earthed to the same supply as this can cause 'earth loops'. To get over this problem many items of new equipment now have the double insulated sign on them, see **Fig 1**. Items so marked do not need a safety earth, as they are so constructed (or certainly should be) so



Fig. 1: The symbol of a double-insulated electrical item.

that the failure of one part, or one bit of insulation, cannot make an external part become live. Remember, if you ever carry out any repairs on such equipment, that it's essential that you do not do anything to compromise the double insulation status.

The FT-102

A reader, I'll call him **Charley**, sent me an E-mail about his FT-102 which

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had suddenly stopped operating. On some bands he could tune into weak none Amateur signals, on others he received nothing, and the rig would not transmit at all, had I any ideas? Quite a few faults on the FT-102 seem odd, and potentially difficult to trace, but fortunately this one is simple.

The band switch on the FT-102 consists of three separate switches that are tied together with spindle couplers. These couplers aren't terribly reliable, and sometimes slip. This results in part of the switch being on one amateur band, and the rest either on another or somewhere between bands. If the slip has occurred between the front two sections the receiver and transmitter will fail, whereas the rear section slipping results in the rig operating satisfactorily on receive, but refusing to tune up on transmit.

The later fault has the potential to cause considerable damage if the user is not careful, as full drive is delivered to the output bottles making them take a lot of current. If the valves are operated in this way for more than a few seconds, all the power instead of going out of the antenna socket goes to the the anodes up, heating them up and the valves will be quickly destroyed. I have seen 6146s that have got so hot that the glass has melted, and collapsed inwards, making them look rather like squashed bananas. Valves so treated tend to go dead short and can cause so much damage that the rig ends up as a 'write off'.

The cure for the switch fault is to switch off the power for a few minutes, discharge the high voltage capacitors, then to look very carefully at the switch, and trace out as to

which band each section has selected, **Fig. 2**. Note that due to the slack in the spindle couplers, **band changing on the FT-102 should always be done in a clockwise direction**, and so when adjusting the couplers this must be taken into consideration.

Do take notice of the point about discharging the capacitors, by shorting the top caps of the valves to chassis. I was working on an FT-102, unplugged it from the mains, and went on a week's holiday. When I returned I carried on from where I was up to, put my hand in the p.a. cage, and nearly hit the roof as the capacitors were still charged. Perhaps Japanese capacitors are too good! Yes the FT-102 does have high value resistors in the p.s.u. to discharge the h.t. voltage, but they can go open circuit. Those on the rig in question had, and the burn on my fingers reminded me not to do that again!

Valved Audio Stages

When renovating old equipment, even experienced electronic technicians can be thrown because of their lack of familiarity with valves and of common faults in this kind of equipment. The diagram, **Fig 3**, shows a typical audio output and driver stage in which several very common faults can develop.

Distortion. The bias on the valves is created by the cathode current flowing through R275 and R272, this causes the cathodes to become a few volts positive. Having the cathodes positive with respect to chassis makes the

control grids, pins 3 and 1, negative with respect to them, and so controls the amount of current flowing. If the coupling capacitor C269 should become very slightly leaky, some of the positive voltage on pin 9 will be fed to the control grid, will make the valve flow too much current, and will result in distorted audio. This is a very common fault in capacitor coupled audio stages and should be the first thing checked.

Checking the capacitor on the ohms range of a meter is not a conclusive test, as the capacitor needs to have a resistance of several hundred meg Ohms if it is to be good enough for use in this position. The best way to check the capacitor is to remove the valve, and then to measure the voltage on pin-3. If there is a steady d.c. voltage at this point, then the capacitor needs replacing.

Another common cause of distortion and low gain is that the anode resistor, R273 in this circuit, has gone high in resistance. When I was servicing valved Hi-Fi equipment, after checking coupling capacitors one of the first thing I looked at when a stage was faulty was any 220kΩ anode resistors. For some odd reason this particular value seems prone to failure.

Low Gain

I have had quite a few valve receivers and transceivers bought to me where the audio is just a little on the low side. One where this is quite common is the Yaesu FR-400 receiver, which uses

a similar circuit to the Other Yaesu receive sections. All the voltages might be okay, the sound quality is good, but to get any volume one has to operate the set with the volume control flat out, what could cause this trouble?

The trouble seems to be related to the cathode decoupling capacitors, C270 and 268 on the circuit shown. They're electrolytic types and over the years the capacitors dry out, especially if they are in a spot that gets warm. When they lose their capacity the valve cathodes are no longer decoupled at audio, and the resulting negative feedback reduces the gain. Replacing these capacitors, or even connecting replacements temporally in parallel with them, brings the gain way up.

Transmitter microphone input and amplifier stages are also subject to similar faults; anode resistors go high, and coupling capacitors become leaky. Some rigs, such as the KW units, which to be fair are now over 30 years old, seem to have quite a bit of trouble in this department. When overhauling units such as these it's probably a good idea to swap all these parts without even bothering testing them.

Customer Ghosts

It is now over 10 years since we retired, and at Christmas **Brenda** and I were doing a bit of reminiscing. When we were children in the days before TV, (yes we are that old) a highlight of the year at the mission hall we attended was the Christmas Eve social, and then, on several occasions, the film based on Charles Dickens' book *Scrooge* was shown. The character 'Ghost of Christmass past' in this film made us start thinking about the many customers that had visited us in the shop (With apologies to Charles Dickens).

Over the years thousands of customers must have passed through our door, but of course a few stand out. Some became personal friends, and still send us Christmas cards, one or two are best forgotten – and then of course there were those who stood out for other reasons.

One of our customers we labelled 'Mr. Pieman', who lived a distance away from the shop, and would regularly appear just before or just after lunch. Before discussing what he wanted, he would sit down in the

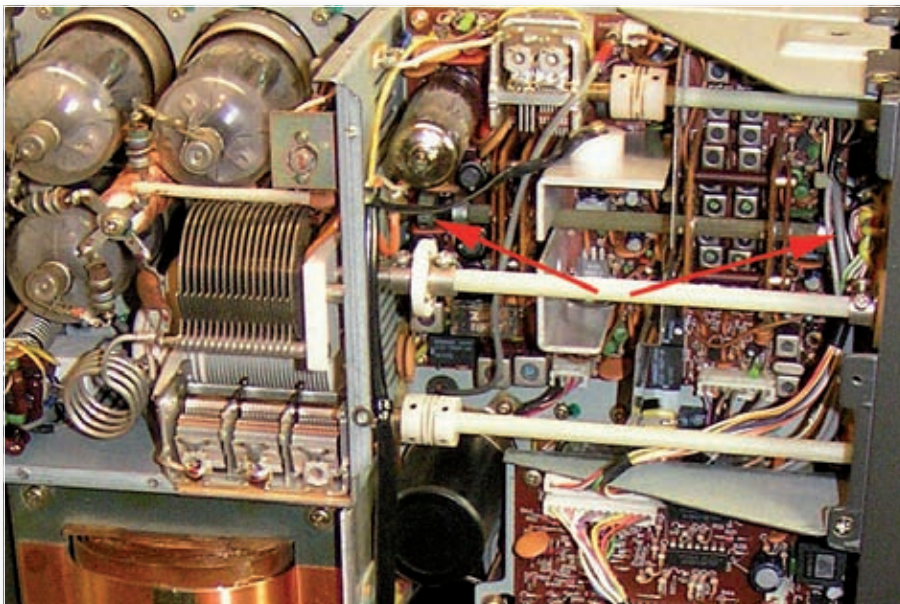
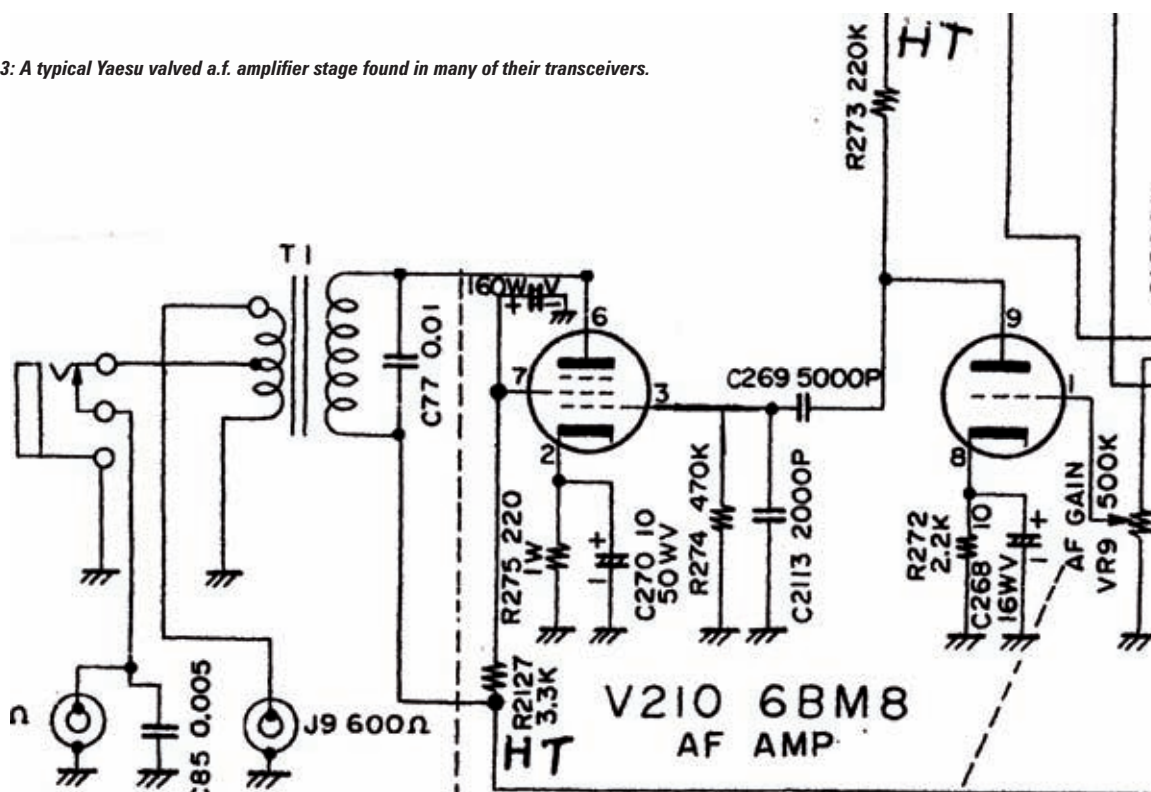


Fig. 2: The shaft controlling the band-selector switches on an FT-102. Other Yaesu rigs are similar.

Fig. 3: A typical Yaesu valved a.f. amplifier stage found in many of their transceivers.



only chair we had on the customer's side of the counter, produce a meat and potato pie and a flask of coffee and tuck in. It put us right off meat and potato pies!

Another customer went under the soubriquet of 'MI5' and if ever I put a piece of interesting and complicated looking second-hand test equipment in the window, or a computer, he would be in and more than likely would purchase it, 'for his project'. As he didn't have a car I was asked to drop off his purchases on the way home, and could not help noticing storage oscilloscopes, spectrum analysers, elaborate signal generators and other complicated equipment, which I would have struggled to find the on/off switch on, let alone operate.

My friend Eion ran a radio and TV repair shop across the road from our shop – he'd also had several visits from MI5. Eion had also tried to find out as to what MI5 wanted such equipment for. He didn't get any further than us, as MI5 would still only

drop hints like 'its for my project', 'can't be too careful' 'you never know who is listening', etc.

Some time before, MI5 had purchased a second hand computer from us with a 12 inch monitor, and about six months later he spotted a rather nice 15in computer monitor in our window. He came in and purchased it, "It will be better for my project". He asked me to deliver it, and so I went round on my way home, took it into his house, plugged it into his computer and switched on. The *Windows* screen came on and announced that it was up-dating its clock for summer time.

As it was then September and the clocks went forward in the spring, this meant that he had hardly ever switched the computer on since he bought it. I began to wonder if the signal generators, spectrum analyser, and other test equipment he'd acquired were likewise never switched on. Was it just that he liked to be surrounded by HI-Tech equipment?

We never did find out!

Sometimes, the 'phone would ring, Brenda would take it, and a voice would say "Its me, is he in". The gentleman concerned frequently 'phoned, and seemed totally oblivious to the fact that we had other customers, and that Brenda could not be expected to know as to who 'me' was. After a while she just started to pass the phone, and say that 'Mr Me' wanted to have a word. We have long since forgotten his real name, that is if we ever knew it, he is just down on our records and memories as 'Mr Me'!

'Mr Smelly' was another one! Quite a few of our customers would have done well to care more for personal hygiene, but Mr Smelly really stood out! I'll leave the details to your imagination, but every visit called for doors to be opened front and back, and Brenda to dash round with a can of air freshener. It's strange what we would put up with just to make money!

Ah well, they were happy days! ●

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)