

In the Shop with Harry Leeming G3LLL

Harry G3LLL continues looking at how to solve the intermittent problems often found on FT-1000s and clarifies the various FT-101 marks and models.

Following on from last time (April issue) and the saga of the Yaesu FT-1000 with the intermittent connections, I had replaced a diode in the RX/TX switching circuit on the r.f. board of Tony's FT-1000 and then, a couple of days later, it was back with a permanent 'high' reading on the built-in s.w.r. meter and with an auto antenna tuning unit (a.t.u.), which would not tune. What was going on?

The FT-1000, like most rigs with an auto a.t.u., has a conventional s.w.r. bridge built into the output circuit of the p.a. stage. The reflected output of this is fed to the front panel s.w.r. meter and also to the logic that operates the a.t.u.

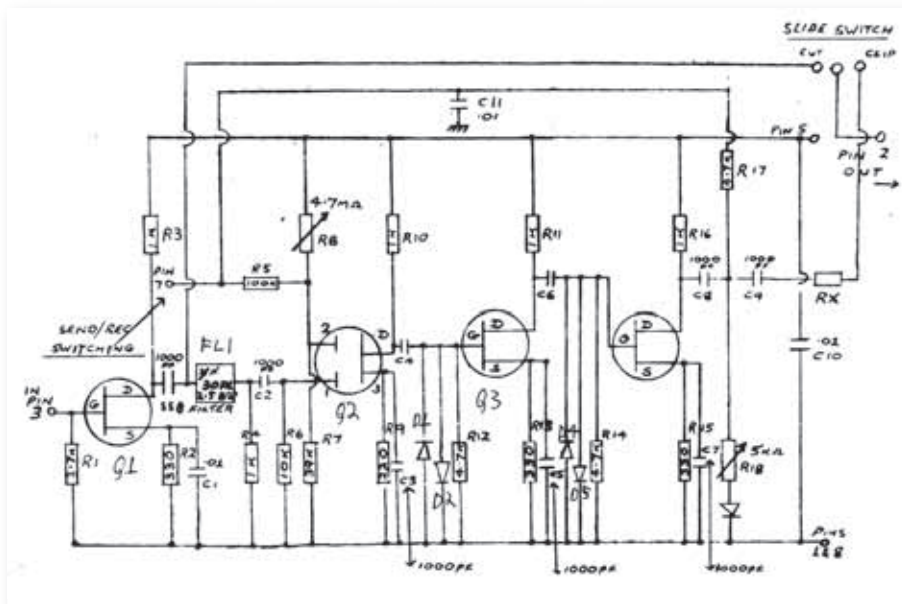
If the s.w.r. is high the bridge senses this and the reflected voltage goes high, shows on the meter, and feeds through to the a.t.u. The a.t.u. then knows that there's a mismatch and that it should alter its settings until the s.w.r. and the voltage is reduced. If, however, this voltage is high due to a fault in the s.w.r. bridge, the a.t.u.'s logic does not know what to make of it and so the a.t.u. thrashes around getting nowhere fast.

In the case of Tony's rig a diode in the s.w.r. bridge was leaky, resulting in a permanent output, hence the reading on the meter and the confused automatic tuning circuits. Replacing the diode and resetting the bridges balance was simple enough but why were the diodes going faulty in the first place? Obviously, something was 'popping' the diodes and so I gave Tony a call, to try and get some more information.

Tony had told me previously, that he had been getting flashes from his PL259 plug and so now I asked for more details of his antenna system. It turned out that as well as a G5RV, he had a couple of verticals for the h.f. end of the range and it was from the leads to these that the sparks had come. He explained that his area seemed prone to static-charged rain and that he had mounted his verticals on fibreglass poles.

On hearing this bells rang in my head, vertical antenna systems are sensitive to static rain at the best of times. For safety they should really be earthed but at least if they are on a metal pole during a rainstorm, static will be discharged to some extent by the wet chimney stack, or what ever else it is mounted on. A fibreglass pole provided

Fig. 1: The circuit diagram of Harry G3LLL's discontinued add-on unit for the FT-101 (lifted directly from Harry's workshop notebook).



no such leakage and as an FT-1000 makes a rather expensive 'static discharger', I advised Tony to rethink his antenna arrangements.

Speech Processing Without Objectionable Distortion

As I have said previously, any attempt to clip speech, so as to increase the average output, normally results in harmonic distortion. But there are ways round this problem.

First, there's digital processing. Digital techniques can be used to delay speech for a fraction of a second, so that the gain can be turned down just before a peak arrives. To provide intelligent compression.

Split band speech processing. This method uses band-pass filters that split the audio up into several different frequency bands, say 300 to 600Hz, 600 to 1200Hz, and 1200 to 3000Hz. Each band is clipped or compressed separately and then recombined. The idea is that a strong 500Hz peak is clipped, the audio distortion in the harmonics at 1000, 1500, 2000Hz and so on will be outside the pass-band of the 300-600Hz filter and so will not be heard. Digital and split-band processing can be used together and promises to be very effective.

Speech Processing At RF

Several articles appeared in the Amateur

Radio press expressing the virtues of r.f. speech processing in the early 1970s and after experimenting with a second-hand Yaesu FT-101, I took the plunge and developed a plug-in unit for use with the FT-101 MkI, MkII and B. It was quite a success and sold well in the UK and via the FT Club in the USA.

Yaesu eventually entered the market, designed their own unit and brought out the FT-101E, which incorporated an r.f. speech processor. Since then, many Yaesu h.f. transceivers have incorporated r.f. clipping in one kind or another but how does it work?

The diagram, **Fig. 1**, (from my workshop notebook) shows the circuit of my discontinued add-on unit for the FT101, which with the addition of a few links, plugged into the v.f.o. socket on the rear of the rig. When the rig was in the transmit mode 13V was applied to pin 7, setting the unit at maximum gain. The 3.18MHz double sideband suppressed carrier signal, was re-routed from the rig's balanced modulator via a spare pin on the v.f.o. socket and applied to the processors input at pin 3.

The signal was then amplified by Q1 and applied to the s.s.b. crystal filter FL1, which takes the amplified signal and converts it to s.s.b. The peaks of the s.s.b. signal coincide with the voice peaks and these are amplified by Q2. They are then clipped by D1 and D2

to an extent dependant on the setting of the rig's microphone gain control. Q3 then provides about 8db more gain, so that D3 and D4 provide extra clipping.

As the clipping is done at 3.18MHz, the harmonic distortion products are all above 6MHz. The clipped signal is amplified by the Q4 and then set to the correct level by the output level control R18, which is only comes into operation in the transmit mode. Signals then go back into the rig and are cleaned up and all harmonic distortion removed, by the rig's own s.s.b. filter. This is a brief description of my unit but most r.f. speech processors work on similar lines, the only real difference being that my long since discontinued unit, remained in circuit on receive, to give extra selectivity (R8 was the receive gain adjustment), whilst most are only in circuit on transmit.

While r.f. speech processing may be a considerable improvement on audio clipping, as it removes harmonic distortion from the clipping process, it is still subject to intermodulation distortion.

As r.f. clipping does not optimise the audio frequency response, it's very important that a good microphone with a 'bright' response is used to make the most of any rig with built in r.f. speech processing. The older Yaesu microphones, for instance, as issued with the FT-101E and the FT-101ZD, are rather short of 'top' and don't produce the best results with a European male voice.

The Datong RF Clipper

The once very common Datong r.f. Clipper unit in some ways combined the best of both worlds. As you will see from **Fig. 2** it's inserted between the microphone and the rig, just like an audio clipper. The audio is first of all passed through a filter that emphasises the higher frequencies and is then converted into an s.s.b. signal at about 20kHz.

The s.s.b. signal is then clipped, filtered and demodulated, producing clean punchy audio, that is then applied to the rig's microphone socket. The Datong unit is no longer made but is often available second-hand. I still use one myself.

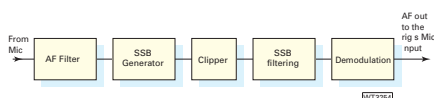


Fig. 2: The Datong r.f. Clipper unit.

Which FT-101 is Which?

Yaesu had a habit of making substantial changes to their equipment without

changing the model number and this often means that people who are trying to make a purchase of second-hand equipment, don't know exactly what they are buying. So, I will try and clarify the various FT-101marks and models for you.

The original FT-101 (MkI) brought out in 1971 seems to have been aimed at the USA market as a second rig for the Amateur who moved around and liked portable or mobile operation. It had a very sensitive receiver that was excellent when used with a mobile



whip but had a bipolar transistor as the first mixer and tended to overload if used with a full sized antenna. This version of the FT-101 did not have the 1.8MHz (160m) band option factory fitted.

Some dealers fitted 1.8MHz as a modification on the AUX position but it is not marked on the range switch. The earliest of the MkIs are fitted with a pair of normal audio output transistors, later production models have a

large Sanyo output chip in their place.

The FT101MkII arrived about 18 months later. The only sign on the front that indicated that it was a MkII, was that '160m' was factory inscribed on the range switch. The MkII was fitted with a field effect transistor (f.e.t.) as the first mixer and had less receive gain; hence was much more suited to home operation, as it did not overload to the same extent as the MkI when used with a decent antenna.

The receive audio gain was rather low on the first samples and Yaesu added a small audio pre-amplifier, which is mounted at the rear of the mode switch. Also in the FT-101 MkII the noise blanker circuit was removed from the i.f. board and an improved (but still not very good) one was mounted on top of the v.f.o.

Yaesu gradually modified the circuit to improve performance, and eventually altered the cosmetics slightly, renaming it the FT-101B in 1974. The FT-101B has an improved s.s.b. filter and a few extra coloured i.e.ds. About half way through the production run, the large STK401 audio output i.c. was replaced by a much smaller AN214. This had more gain and so the pre-amplifier was no longer needed and was removed.

Around this time, the late Milton Lowens of The International FT club, visited Yaesu, and took with him a sample of my r.f. clipper. They seemed to take the hint as they then brought out the FT-101E in 1975.

The earliest FT-101E MKI did not have an external level control for use with the speech processor. This was rather a bad omission, as if the speech processor was set up as recommended on 14MHz (20m), it resulted in the rig having too much drive on

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Harry's waiting to hear from You!

As I am now retired, I like to hear about problems with older equipment, particularly pre-1990 Yaesu rigs. If you want a direct reply please remember to send me your E-mail address or enclose a stamped addressed envelope. Send your letters to the address above.

Remember the mains supply is potentially lethal. Unless you really know what you are doing, always pull the mains plug out, do not just switch off at the wall socket, when working on equipment.

some bands and not enough on others.

The FT-101E MkI was replaced in 1976 by the MkII version, which was fitted with a dual control pot in the clarifier position. The rear of this controls the processor output, and enables the right amount of drive to be set on each band. Later versions of the FT-101E were made, with minor alterations to the circuit, the last few of which were labelled FT-101F in the USA. The original series of FT-101 was eventually discontinued in 1978, and replaced with the FT-101ZD, this being an entirely different design.

The Best Buy?

As to which is the best FT version to buy it really really depends on the condition, as from the MkII onwards, (apart from the addition of a speech processor in the FT-101E), the basic circuit and performance did not change all that much. The original MkI is not really recommended, due to overload problems with the receiver and you should avoid paying a premium for the speech processor in the FT-101E MkI, as it does not work very well. As with any elderly rig, try and avoid purchasing one that has been used for many years by a heavy smoker, as nicotine does nothing for a rig's (or a person's) health and reliability.

Finally, if you do come across a mint FT-101, do not switch it on until you have checked that it is fitted with a 2.5 or 3A quick blow fuse and that C13 has been replaced or you may end up with a burnt out un-repairable wreck. You have been warned! (More about this next time.). Cheerio for now.