Modifying the Yaesu Musen FR-100B Receiver

R. D. CHAMPNESS,* VK3UG

THESE receivers are quite good as they stand in my opinion. It is because I find this receiver so satisfactory that I decided I would endeavour to make this good receiver even better. I have now incorporated 160 and 11 metres as well as fitting an n.b.f.m. detector and limiter. I have done one or two other minor modifications to do with the v.f.o. and S meter.

WARM-UP DRIFT

I will start with the minor modifications and then on to the more elaborate ones. An overseas Amateur suggested this first one and his claim seems to be substantiated. Wire a resistor of about 270 to 470 ohms in series with the cathode lead of the oscillator section of the v.f.o. valve. The resistor and L20 are then in series and the coil tap comes off the junction of these two components. This seems to reduce the drift of the v.f.o. during warm-up.

S METER

Another modification, which won't impress the chaps who like to give S9 plus plus plus readings on the S meter, is to de-sensitise it. To do this, put a 6.8K ohm resistor in place of the series meter resistor R44 (a 1K ohm resistor). Like most S meters, the Yaesu Musen is optimistic, even with this modification although it is much more realistic, and most ranges give a reading of S9 corresponding to 100 μV. I was lucky enough some time back to have access to an accurate signal generator and so I made a chart up so if necessary, I can give relatively accurate strength readings.

AUDIO

A simple way to reduce the high overall audio gain and to improve the audio quality is to remove the cathode by-pass capacitor on the 6AQ5 audio output valve. The distortion at 1 watt output is 4% and the frequency response is —3 dB. at 200 Hz. and 4,500 Hz. with 0 dB. at 1,000 Hz. reference. This is only the audio response and does not include the various filters.

SWITCH-ON SURGE

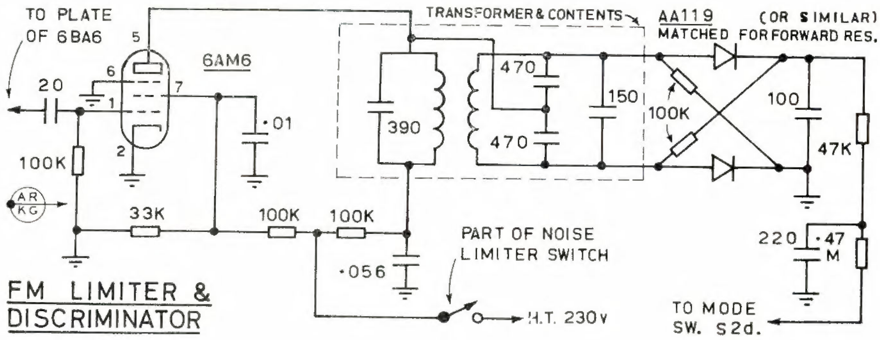
To reduce the switch-on surge and so allow a smaller fuse, a CZ9A thermistor was wired in series with one of the 240 a.c. leads. I can now use a ½ amp. fuse.

F.M. LIMITER AND DISCRIMINATOR

The FR-100B has provision for an f.m. limiter and discriminator, but, unfortunately, these don't seem to be available. The one I am about to describe is, I feel, slightly cheaper and they are all Australian parts.

To accommodate this section, the power supply filter choke was moved to the top of the chassis, between the 12AU7 and the 455 KHz. i.f. transformer near the power transformer. By doing this, much more space under the chassis was available for the f.m. system.

The 7-pin valve socket is mounted in the hole provided, but the discriminator transformer which I used was much smaller than the intended Yaesu unit. I made up a small plate for the transformer to sit on and then bolted this to the mounting holes of the original Yaesu transformer. The transformer I used was a type used in a Pye Victor MVF529 f.m. transceiver. The part number is 087-000-183. Possibly other makes could suit, but remember it must be 455 KHz. 30 KHz. channel unit.



FM LIMITER & DISCRIMINATOR

Having mounted the valve socket and transformer, the signal input and output sources must be located. The input to the 6AM6 comes via a 20 pF. from the plate circuit of the last i.f. amplifier —a 6BA6. This capacitor is actually already wired to a tag strip, ready for you to extend to the grid of the 6AM6. The output line is in the corner on a 3-lug tag strip near the discriminator transformer. Incidentally, the red pin of the discriminator transformer is the plate lead, and by continuity measurements, the other leads can be ascertained. This is a perfectly standard limiter-discriminator.

The resistor values should be adhered to but the screen and plate by-passes are not all that critical. The value of the 0.47 meg. resistor may need to be altered slightly to obtain a same level of audio from a signal deviated 3 KHz. compared to an a.m. signal modulated 100%.

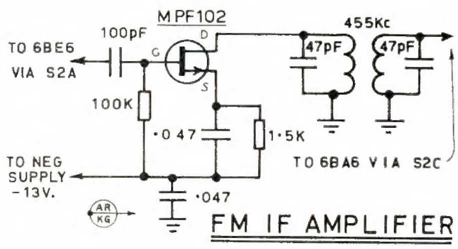
To check how well the f.m. system operates, should you have an f.m. carphone with 4 MHz. transmitter crystals, tune to the 7th harmonic in the 28 MHz. band and listen to the 3 KHz. deviated audio, it sounds very nice. You will have to couple a wire close to one of the multipliers about the envelope. This is also a good way of checking your f.m. transmitter.

EXTRA I.F. STAGE

I found on the lower bands that the i.f. system in the f.m. mode seemed to lack gain, the S meter would read several points lower on f.m. than on a.m. This I concluded was due to mismatching in the coupling system between the 6BE6 converter and the 6BA6 first i.f. I tried various coupling methods with partial success, but eventually concluded that an additional i.f. stage was needed.

Much to many solid state merchants' amazement, I imagine, I used an MPF-102 FET in an i.f. amplifier. The FET amplifier was wired into the circuit in only the f.m. position. The i.f. transformer is an old small A.W.A. battery receiver i.f.

The input of the amplifier goes to position 6 of S2A and the output to position 6 of S2C, removing the bridging wire between these two contacts. The amplifier provides a reasonable amount of gain and the selectivity of the complete i.f. strip in the f.m. condition is about ±10 KHz., so at least 7 or 8 KHz. deviation should be quite okay through this unit.



FM IF AMPLIFIER

The FET amplifier was built on a piece of veroboard about 1" square and the transformer was mounted alongside the mechanical filter. The value of the source resistor may need to be experimented with to get optimum gain. The supply voltage is taken from a small voltage doubler off the filament line.

ALIGNMENT

The alignment of the discriminator is a bit different from the f.m. carphones that most of us seem to have,

* 24 O'Dowds Road, Warragul, Vic., 3820.

so here is the alignment data. Adjust secondary top core of the discriminator for zero reading on the meter at the junction of the 47K and 470K resistors. Make sure that on adjusting core each side of zero, reading goes positive one way and negative the other. A 50 μA. meter will be satisfactory.

Detune to negative or positive side 20 μA. and screw in primary core (bottom core) until reading dips slightly. Re-adjust for zero reading and check that on shifting either side of 455 KHz. that meter alternates. If it does not seem very symmetrical, try adjusting again but take the secondary core in the direction giving opposite polarity to your original setting.

On doing this modification and fitting 160 metres I found that at about 1825 KHz. there was ferocious hash at about S7. I eventually traced this to the limiter, which acts as a class C stage and was generating harmonics, the 4th being in the middle of 160 metres. To overcome this, I had to switch off the limiter when it was not required.

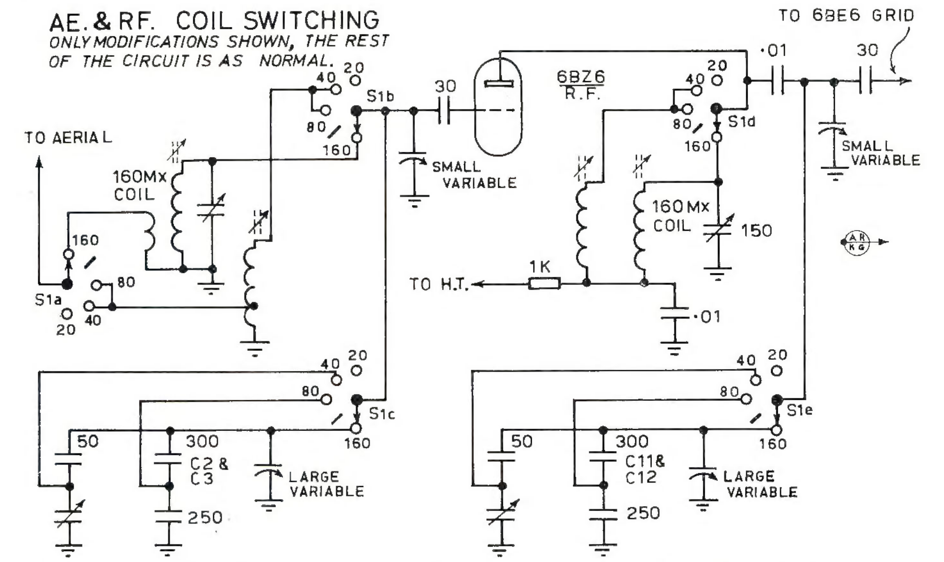
I was not particularly keen to belt a hole in the front panel to accommodate this switch and there was not any spare lugs on the mode switch. On examination of the noise limiter switch I found that it consisted of two sections paralleled. I freed one section of the switch of its a.n.l. duties and wired it to the h.t. supply for the limiter. With the a.n.l. off, the limiter has h.t. applied. My reasoning going as follows: that on f.m. the f.m. limiter will take care of all noise, I hope, and on a.m. in many cases the noise limiter is pretty nearly always required.

EXTENDING RANGE

I decided to fit 11 metres and 160 metres to the receiver and this is how it was done. On Band A I fitted 11 metres. A crystal of 16,425.6 KHz. was fitted to the appropriate socket, the appropriate oscillator coil wired in and the aerial and r.f. coils also wired as per instructions in the Yaesu manual. The performance is quite fair, although there is a slight spurious response possibly due to the crystal being on half the required output frequency.

The modifications for 160 metres are much more difficult to accomplish as three coils need to be wound and mounted and some alterations are necessary to the switching for 80 and 40 metres.

The simplest part to do is the fitting up of the crystal oscillator. A crystal of 7,453.5 KHz. is needed and is fitted into the position for Band C. I used Band C as it is the nearest to the 80 metre position seeing as the switch can go full circle. The Band C coil had to



Modifications to r.f. and aerial coils for operation on 160-80-40 metres. The switch position between 160 and 80 is the position on the switch where the common terminal of the switch contacts no other terminal, i.e. this occurs when the switch indicator dot is at 6 o'clock.

be rewound with 20 turns wire about 24 B. & S. and resonated with 100 pF. to tune 7½ MHz.

The 160 metre coils are wound on ¼" or 5/16" diameter slugged formers with 70 turns of 38 B. & S. enamelled wire wound over ½". I wound these two coils a bit higgle-piggle, but the cores will tune out any variation in inductance. The aerial coil primary consists of 10 turns about 24 gauge wire wound on at the cold end of the secondary. I fitted these coils in the bulkhead between the coil switching sections and the section housing the filter choke and filter capacitors.

One word of warning. **Do** take out all low frequency crystals in the set otherwise you may be unlucky like me and damage a couple beyond repair with the vibration of hole drilling and filing. **Be warned!**

The actual wiring alterations are perhaps better understood by studying the actual final circuit and comparing it with the original. In the original Yaesu circuit, switch S1 should progress from left to right as S1A, S1B, S1C, but in fact on the diagram it is shown as A-C-B.

Capacitor C2 is removed from its original position and paralleled with C3, and likewise C11 is removed and paralleled with C12. One additional 50 pF. capacitor for each section is now required in addition to the two coils. That is all the extra parts needed.

The wiring as I said will become evident on studying the circuit. Both 80 and 40 metres will need some re-alignment after this modification. The preselector is set at about position 1 on 160 metres and the coil cores are peaked for maximum response at 1500 KHz. The trimmers are peaked at 2.1 MHz. after peaking the preselector. The tuning range of the 160 metre coils is from 1.5 MHz. to 2.1 MHz., and the red dial calibrations give the tuned frequency.

Broadcast stations come in quite well between 1500 and 1600 KHz. The University of the Air is quite good on 1750 KHz. On the front panel of the receiver I have marked in red paint Band C with the numerals 160 and Band A the numerals 11 in black. This helps to identify the band, and it does not look unsightly if done neatly. The re-sale value of your receiver will not be spoilt by these modifications because the re-sale value of radio equipment is not high anyway, so why not make your equipment do what you want it to do.

I'll get an aerial up for 160 metres as soon as circumstances permit and put my 130 watt a.m. rig to some use. I hope these modifications are of interest, and some use to others.