CONVERTING THE FT401 TO 160 Mx AND 11 Mx

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This article will show owners of the popular FT400/401/560/570 series of transceivers how to make their rig even more versatile. Two simple but effective procedures are described to allow the FT401 to be used on 160 Mx and 11 Mx. The procedure for the FT401 can be used on similar Yaesu transceivers such as the FT400 and the FT570. The operation on the other five bands is unaffected and no holes need be drilled.

GENERAL REMARKS

Two sets of step by step instructions have been devised to allow even an inexperienced owner to easily and quickly convert his FT401. Before presenting these instructions, which are self-explanatory, a few general comments need to be made.

Firstly, the part numbers quoted apply to the author's FT DX 401. Owners of other models should check their circuit diagram before proceeding. Although it is possible to improve on the conversions described here, it is likely that few amateurs would be prepared to go to the trouble necessary for what may be considered marginal advantages. For example, only the smaller sections of the pre-selector tuning capacitor are used on 1.8 MHz and this allows only an 80 kHz coverage. In VK, however, this does not seem to be a problem worth worrying about as there is still adequate gain to copy ZL stations above 1.9 MHz.

The 11 Mx conversion requires only a crystal and a few short lengths of wire. A light duty soldering iron, a Philips head screw driver, and a pair of side cutters are the only tools required. This conversion represents a good starting point for anyone who is afraid that he may spoil his new transceiver. It will take you about an hour and you will find it easy to make a very neat job. Use insulated wire for the links and keep all wiring away from the chassis as some of the links carry quite high voltages.

The 160 Mx conversion may take three or four hours and requires the addition of three coils and seven capacitors as well as some wire and a crystal. Both crystals were obtained from Max Howden and the coil formers from Bail Electronic Services.

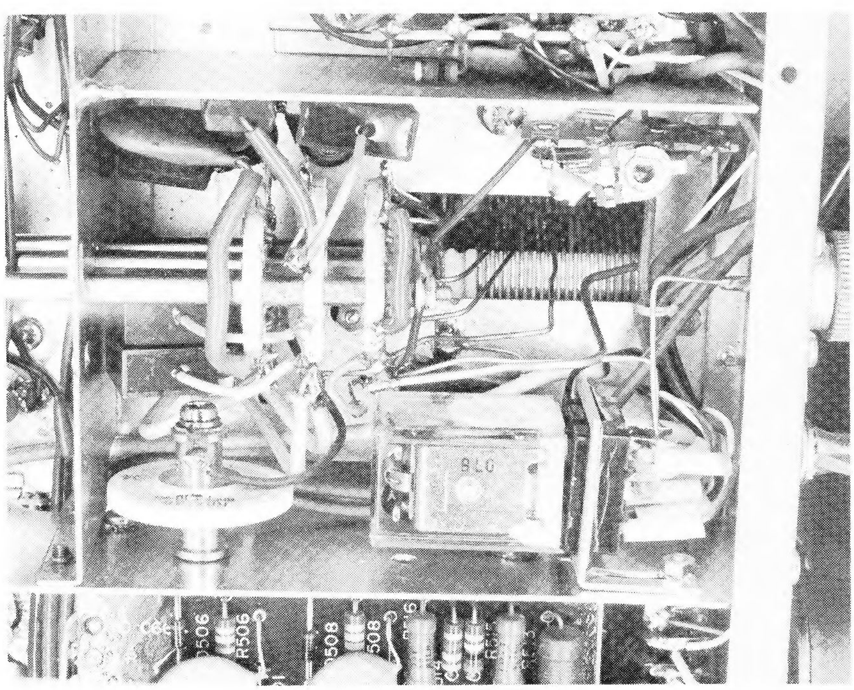
These formers should be obtained complete with slug and mounting clip. Alternatively, broadcast band coils could be used if of a suitable size and if they can be adjusted to resonate at 2 MHz with 220 pF across them. This will probably require stripping off a few turns. The coils described in the conversion can be made to resonate from 1.6 to 2 MHz by adjusting the slug.

It would be preferable to use close tolerance silver mica capacitors throughout. However, they may be difficult to buy now and, unless you are very lucky your junk box will not have all of the required values. Styroseal capacitors are recommended for the low level stages such as the RF amplifier, mixer and driver tuned circuits. The capacitors around the final loading circuit have to carry large circulating RF currents, and this should be kept in mind when choosing them. Under no circumstances use paper dielectric capacitors anywhere in the conversion. The 600 pF 1.5 kV ceramic capacitor was obtained from Bail Electronic Services. Suitable mica capacitors may still be available through disposal sources. Check all these capacitors before installation, however.

On 160 Mx the controls do not peak as sharply as on other bands. This is brought about by the bandspread effect associated with this conversion. The preselector covers only 80 kHz on 1.8 MHz compared to several hundred kHz on 3.5 MHz, thus more degrees of rotation are necessary to tune less kHz.

Although this may not apply to all units it was found necessary on the author's unit to shift the 80 Mx tank tap as described in step 13 of the 160 Mx conversion. It appears that the shorted section of the 160 Mx tank reduces the 80 Mx inductance slightly.

On the 11 Mx band the correct VFO scale is the black 0-500 one while on 160 Mx the red 500-1000 scale is the appropriate one.



PERFORMANCE

The on-the-air performance is excellent on 160 Mx and adequate on 11 Mx. No loss of performance on the other five bands occurs as a result of the conversions. Output power on 160 Mx was measured at 300 W PEP, the same as on 80 Mx. Noticeably lower input and output occurs on 11 Mx; however this does not seem to be of practical significance.

The reduced performance on 11 Mx is partly due to imperfect tracking of the ganged tuning capacitors over the range 27-30 MHz. If new coils were added for the receiver RF and mixer circuits and for the PA driver circuits, improvements in sensitivity and increased PA drive would result. However, for all but the most enthusiastic 11 Mx operator, the conversion described here should be adequate.

It is possible to increase the receiver and transmitter sensitivity on 160 Mx by increasing the value of the capacitor referred to in step 5, but unless the coils referred to in steps 7, 8 and 9 are shunted with resistors of about 20k ohms, the 'S' metre will give exaggerated readings and the carrier rejection figures will be degraded.

WARRANTY

Both conversions have been discussed with the Australian Agents for Yaesu. Although no major criticism was made of either conversion (some helpful suggestions were made regarding this article), it was pointed out that any modification to a set by anyone other than the agents would make the 90 day warranty void.

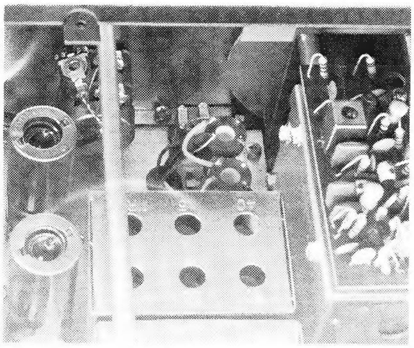
In the unlikely event of a constructor experiencing technical difficulties with either conversion, the author would be glad to correspond with him.

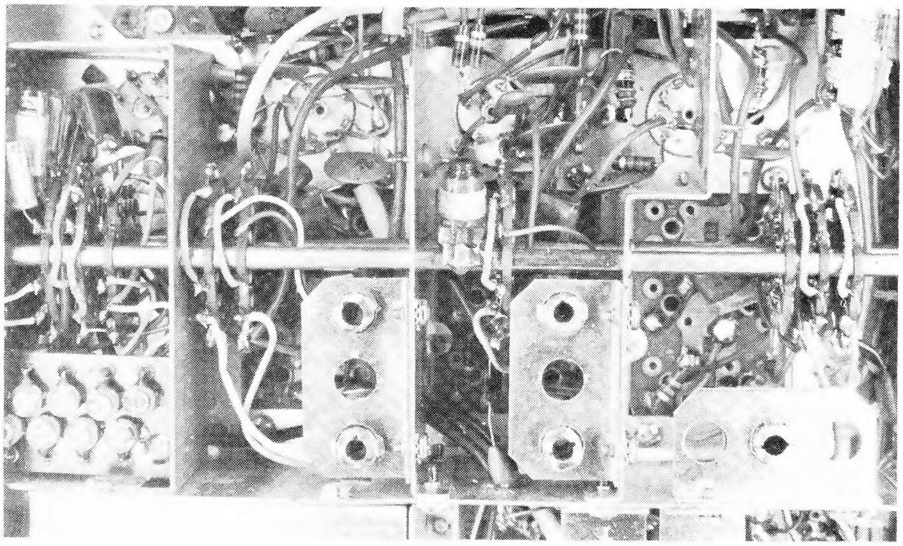
11 Mx CONVERSION

1. Remove top panel.
2. Turn transceiver upside down on a towel or blanket spread on the bench. Remove the bottom panel.
3. Check that the AUX 1 crystal socket is wired to switch wafers S1a and S1b. *(Note:* Switch S1 is the BAND switch. Wafter "a" Is nearest the front panel. Wafer "i" is not used and is located *in front* of wafer "h". That is, the positioning of the wafers from the front panel going towards the back is a, b, c, d, e, f, g, i, h, j, k, l, m).
4. Link AUX 1 contact to 10D contact on switch wafer S1c. This allows the 10 Mx crystal oscillator coil to be used for 11 Mx as well.
5. Wire in links from the AUX 1 contacts to the 10D contacts on switch wafers S1e, S1f, S1g, S1h, S1j and S1m. This connects the 10 Mx coils for the RF amp., mixer, driver and PA stages into circuit when the AUX 1 switch position is selected.
6. Turn transceiver up the right way and fit a 11.007 MHz crystal into the crystal socket (on the top of the chassis) furthest from the side panel. (V2 operates as an electron coupled tripler to 433.020 MHz. The equivalent shunt capacitance across the crystal is about 20 pF). A pair of tweezers may help as the crystal is a small type K and the sockets are placed close to the front panel.
7. Set BAND switch to AUX 1, connect a dummy load, switch the set on and allow 10 minutes warm up.
8. Set the LOADING control to 4 and the PLATE control between the 10 and 15 positions.
9. Turn up the audio gain, switch on the 25 kHz calibrator, and tune to the 27.125 MHz signal. Peak the preselector for maximum signal from the calibrator. Now peak using trimmer TC1108 (far left corner of pcb holding group of small trimmers under chassis near S1). This trimmer tunes the 33 MHz crystal oscillator plate circuit to resonance.
10. Switch to TUNE mode and advance MIC GAIN CARRIER control to obtain 100 mA plate current. Check that PRESELE control is at position that gives maximum current. Adjust PLATE and LOADING controls to obtain maximum output. Switch to receive. The conversion is now complete. Replace top and bottom panels. Connect a suitable antenna, trim all controls for optimum operation and start working those new stations.

160 Mx CONVERSION

1. Remove top panel.
2. Turn transceiver upside down on a towel or blanket spread on the bench. Remove the bottom panel.
3. Check that the AUX 2 crystal socket is wired to switch wafers S1a and S1b. (Refer to note in step 3 of 11 Mx conversion).
4. Wire a link from the AUX 2 contact to the JJY/WWV contact on wafer S1c. This allows the JJY/WWV crystal oscillator coil to be used for 160 Mx.
5. Add a 220 pF 600 V styroseal capacitor across TC1109. Solder one end to the earth tag near the tube socket and the other end to the AUX 2 contact on S1d.
6. Wind 3 new coils each of 55 turns using No. 42 SWG enamelled copper wire. (The gauge size is not critical and thicker wire could be used). Use nail polish to secure the windings. Leave 15 mm of space at the top of the former. Add a winding of 10 turns to the antenna coil. Wire a 220 pF 600 V styroseal capacitor across the main winding of each coil.





7. Remove the screws holding the coil bracket in the same compartment as switch wafers e and f. Relocate existing trap coil in left hand hole and mount new 160 Mx antenna coil in the right hand hole. Wire the common earth connection of the new coil to chassis (the large copper area of the pcb). Wire the antenna link to the AUX 2 contact of S1e and the top of the main winding to the AUX 2 contact of S1f. Replace bracket.
8. The new mixer coil is fitted into the next compartment in a similar manner. Solder one end to the AUX 2 contact of S1g and the other end to the + 180 V rail on the pcb. (Again this is the large copper area).
9. Fit the new driver plate coil into the compartment of wafer h. Connect one end to the AUX 2 contact of S1h and the other end to the + 300 V supply rail on the pcb.
10. Wire a 390 pF 600 V styroseal capacitor between the AUX 2 contact of S1j and the earth lug on the chassis. This is part of the 160 Mx PA neutralising circuit.
11. Solder a 600 pF 1.5 kV disc ceramic capacitor from the AUX 2 contact of S1k to ground. There is a self-tapping screw near the left front corner of the compartment which is well placed. Fit a tinned earthing lug under it for the 600 pF capacitor. You will need this earth point again later. This capacitor is in parallel with the PA tuning capacitor on 160 Mx.
12. Remove the antenna change over relay from its socket. Remove the 1000 pF capacitor (C86) which is wired to the 80 Mx contact on S1m. Connect a 500 pF 600 V mica or similar capacitor in parallel and connect the combination to AUX 2 contact of S1m. A single 1500 pF capacitor may be used if desired. This increases the loading capacitance of the PA pi network.

13. Locate the tinned copper lead from the 80 Mx tap on the final tank inductance. Clip it off where it connects to the wiper of S1m. Unsolder the other end from the 80 Mx tap. Using a screw driver, press the 80 Mx tap turn down in line with the other adjacent turns. Straighten out a paper clip and make a small 90° "hook" at one end. Using a pair of long nose pliers push this hook between the 80 Mx tap and the next winding (toward the back). Pull the next turn up to form the new 80 Mx tap. That is, we increase the 80 Mx PA tank by 1 turn. Tin the new tap and reconnect the 80 Mx lead. Solder the other end of this lead to the 80 Mx contact of S1m.

14. Wire in a new link of 16 or 18 SWG tinned copper wire from the far end of the tank coil to the wiper of S1m. We now have our new 160 Mx tank circuit.

15. Lift the lead from the half of the loading capacitor connected to the 80 and 40 contacts of wafer S11 to the wiper of S11. This means that both sections of this capacitor are in parallel on all bands. A slight change in the position of the LOAD control will be noticed on all bands.

16. Cut the link between the 40 Mx and 80 Mx contacts on S11. Wire in a new link between the 80 Mx and AUX 2 contacts. This keeps the 40 Mx loading capacitance at its original value and allows the 80 Mx loading capacitance to be used on 160 Mx as well.

17. Wire in a 1500 pF 600 V mica capacitator from the 80 Mx contact of S11 to ground. Use the earth lug installed previously. This restores the capacitance of the PA pi network loading circuit to its original value.

18. Replace the antenna change over relay.

19. Plug in a 7.520 MHz crystal. (Refer to step 6 of the 11 Mx conversion). Use the socket nearest the side panel.

20. Set the BAND switch to AUX 2, connect a dummy load, switch the set on and allow 10 minutes warm up.

21. Turn the audio gain up, switch on the 25 kHz calibrator and tune to the 1.825 MHz signal. Set the PRESELE control to 2. Peak signal to a maximum by adjusting the slugs in the RF and mixer coils. It should now be possible to peak the calibration signals from 1.800 MHz to 1.875 MHz using the PRESELE controls. If not, set slugs to peak at 1.800 with PRESELE fully in. Repeak PRESELE on 1.825 MHz. Peak 'S' metre indication of calibrators signal using TC1109. This adjustment is quite broad and is not critical.

22. Switch to TUNE mode and advance the MIC GAIN CARRIER control to obtain 100 mA plate current. The gain control should be in about the same position as for 80 Mx. Peak drive using driver plate coil slug. Check that PRESELE control is at (or very close to) position at which maximum drive is obtained. Adjust PLATE and LOADING controls to obtain maximum output. Switch to receive. The conversion is now complete. Replace top and bottom panels. All you need now is an antenna and probably an antenna coupler. (Start looking up those back issues of AR). ■

DC AMPLIFIER FOR SWR BRIDGE

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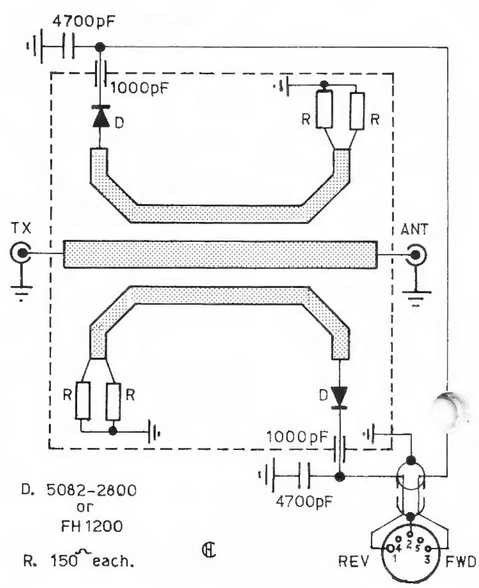
This project originated when the author wanted to use on HF, the VHF microstripline SWR bridge published in Electronics Australia April 1971. The coupled line length of 4.5 cm does not produce sufficient output voltage on the HF bands. The answer is to use a DC amplifier to amplify the voltage from the SWR bridge and the popular 741C IC operational amplifier was chosen to do the job.



Full scale deflection of the 1 mA meter was easily obtained right down to 40 m. In fact when operating a 250W PEP input transmitter on 40 m, it was necessary to turn the sensitivity control back to half its maximum setting. Even on 80 m it is possible to get nearly full scale deflection.

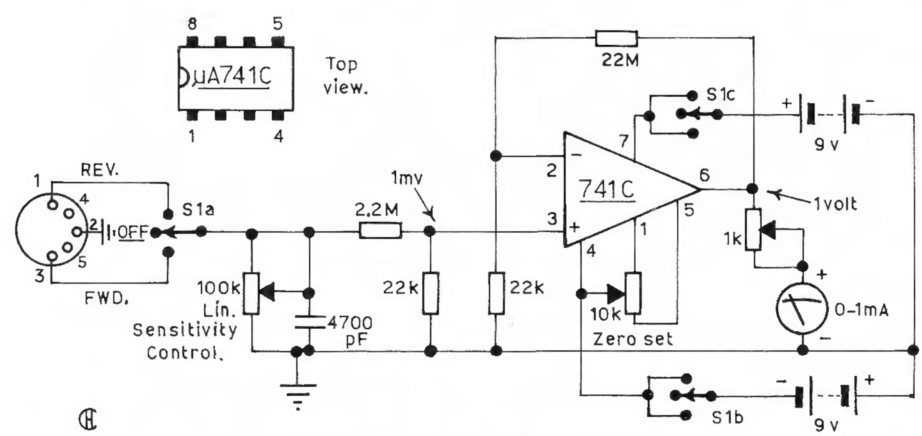
The 100K linear potentiometer which serves as the sensitivity control is in series with the hot carrier diode and improves the linearity of the diode output. It must be stressed that the unit must be completely shielded. (Yes, even the 1 mA meter.)

If this is not done the IC will pick up any RF floating around the shack and this will result in full scale deflection of the 1 mA meter.

A 0.1V signal from the SWR bridge will be reduced to approximately 1 mV by the voltage divider made up of the 2.2 m isolating resistor and the 22K resistor between pin 3 and earth. The gain of the 741C has been set at 1000 by means of the 22 m feedback resistor. Consequently the 1mV input at pin 3 will be amplified to 1V output across a 1K load at pin 6. The 1K load is made up of the internal resistance of the 1 mA meter and the 1K trim pot.

It is possible to increase the sensistivity 10-fold by reducing the 2.2 m isolating resistor to 220K. If this is done however the zero indication of the meter will vary slightly when the setting of the 100K sensitivity control is varied.

NOTE: Printed circuit boards for both the 50 ohm and 75 ohm versions of the microstripline SWR bridge are obtainable from the Victorian Disposals Committee. ■



DC AMPLIFIER FOR S.W.R. BRIDGE.