TECHNICAL REVIEW

By "A.R." Technical Assistants

THE YAESU FT75 TRANSCEIVER

● The Yaesu Company of Tokyo, Japan, has established itself over the last few years as one of the world leaders in the manufacture of Amateur equipment. Many items of Amateur gear designed and produced by Yaesu will go down in Amateur history. Their progressive approach to Amateur design is exemplified in the new FT75 transceiver. As the illustration shows, this little rig sets a new approach to the format of compact s.s.b. transceivers.

DESIGN FEATURES

The most obvious difference between the FT75 and more familiar transceivers is the size. It measures 210 mm. wide, 80 mm. high and 300 mm. deep. Converting to more familiar units, this works out at 8¼ by 3 by 12 inches. The total weight of the transceiver not including power supply is 3.8 kg., which is just under 8½ lbs. The transceiver is supplied with a push-to-talk 10K ohm dynamic microphone of excellent quality. Also supplied with the d.c. power supply is a mobile mounting cradle. On either side of the transceiver are slotted aluminium rails which are designed to slide into the mobile cradle to mount the transceiver firmly in position. Provision is made to clip the mobile power supply under the cradle.

An a.c. power supply with built-in speaker is available and is contained in a cabinet of identical type and size to the transceiver. The d.c. supply, which also has a built-in speaker, is somewhat smaller, at 8¼" wide, 2½" high and 6¾" deep. The weight including cables is 1.46 kg. or 3½ lbs. Both the transceiver and the a.c. power supply are finished in a speckled grey enamel. The transceiver front panel is finished in a smooth dark grey enamel with white lettering; the knobs are black with chrome inserts. Above each of the push-button controls is a miniature red indicator light. So much for the external finish. Let us look inside and see what makes it work.

TECHNICAL FEATURES

The FT75 differs from the normal transceiver in that it does not contain a v.f.o. Instead, a v.x.o. is provided. Readers may remember the older Yaesu FT50 transceiver and the FL50 transmitter, both of which also embodied this feature. The v.x.o. of the FT75 has been improved over the earlier models, and has provision for a total of fifteen crystals with push-button selection of three for each of the five bands covered. There is also a push-button to select an external v.f.o. to provide complete coverage of each band from 80 to 10 metres. The v.x.o. control allows a frequency variation of 3 kHz. on 80 metres, 6 kHz. on 40 metres, 3 kHz. on 20 metres, 20 kHz. on 15 metres, and 12 kHz. on 10 metres.

The unit is fully transistorised except for the transmitter driver and final stages. In all, it contains a total of 16 transistors, 6 FETs, 3 ICs, 23 diodes and, of course, the two valves. All the features normally expected in modern transceivers are incorporated. These include a noise blanker, and effective fast attack a.g.c. and squelch on reception. On the transmit side, provision is made for c.w. operation with a separate carrier generator. With s.s.b. operation an effective a.l.c. system is used to reduce the possibility of flat-topping. The transmitter is designed to run a power input of 50 watts on both c.w. and sideband. Other features include low level r.f. output for driving a transverter, switching for a linear amplifier and switching for remote band change of either a mobile or home station antenna.

All connectors used on the transceiver are top grade commercial quality which are well suited to rugged mobile and portable use. The microphone uses a five-pin screw-on type plug, while the main power connector is a sixteen-pin lock-on type. Antenna connection is via a standard Amphenol SO239 socket for which a matching PL259 plug is supplied. The controls of the FT75 are designed for the utmost simplicity of operation. Transmitter tuning is peaked with a preset adjustment for each band on the rear apron of the transceiver. The effectiveness of these adjustments will be discussed in a later section of this article. Transmit/receive operation is push-to-talk there is no provision for v.o.x.

CIRCUIT DESCRIPTION

The heart of any sideband transceiver is the filter. In the FT75 it is centred on a frequency of 5173 kHz. and has the following characteristics. Bandwidth at —6 dB. is 2.3 kHz., at —60 dB., 4.5 kHz. This gives a 6/60 dB. shape factor of 1.95, which is excellent by any standard. As the transmitter and receiver sections use very little common circuitry, we will look at them independently. Where there is a common path, some most interesting kinks are employed.

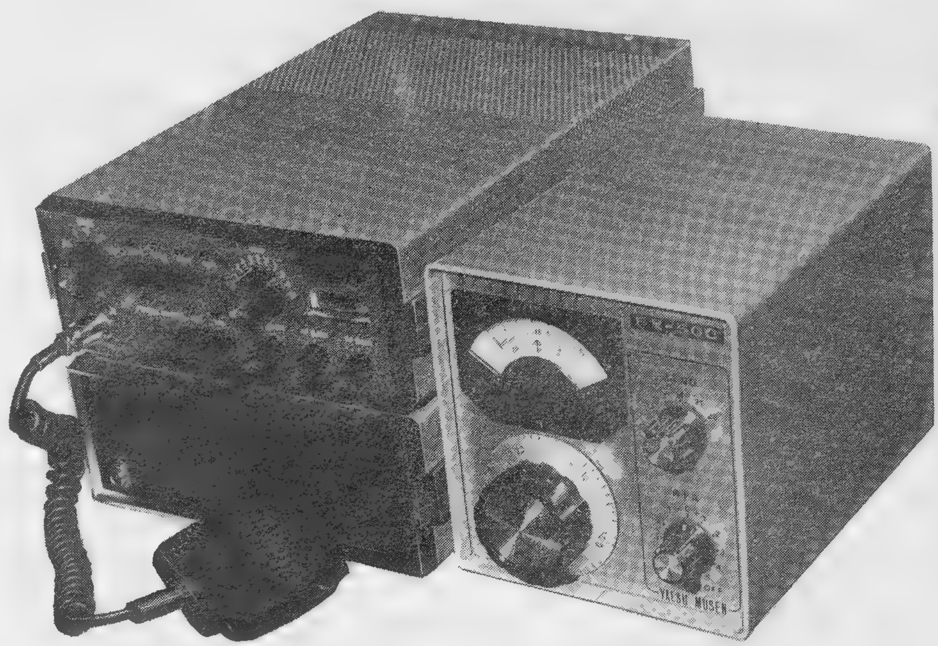
Careful design has been used in the receiver front-end and as we shall later see, this has really paid off. The r.f. stage uses a dual gate FET. Separate high Q coils for each band provide input coupling. Between the primary of each of these and the antenna input is one section of a two-gang r.f. gain potentiometer. This provides a degree of r.f. attenuation along with the more normal r.f. gain. An i.f. rejection trap is connected to the input gate of the r.f. stage and a.g.c. voltage is applied to the second gate. The output from the FET mixer goes to the first two receiver i.f. stages with the noise blanker connected around the second of these. The blanker uses quite simple circuitry with two diodes to generate the pulses and two transistors to amplify them. The filter comes next in line and it is interesting to note that the received signal goes through in the opposite direction to the transmit signal. Extensive use is made of diode switching to isolate the various functions. After two more stages of i.f., the second of which is an integrated circuit, the signal is fed to the transmitter balanced modulator, which is used as a product detector. Carrier re-insertion is provided by the transmitter carrier oscillator and the resultant audio output is fed to the audio amplifier—another integrated circuit—via a set of relay contacts so that the balanced modulator can be switched back to the transmit function.

The transmitter line-up is straight forward, but in order to facilitate tune up and c.w. operation a second carrier generator has been provided. This is on a frequency of 5173.2 kHz. which puts it right into the bandpass of the filter. This also gives an 800 Hz. offset for c.w. reception because the normal s.s.b. carrier oscillator is still used for reception. Two transmit i.f. stages are used to drive the transmit mixer, followed by the 12BY7A driver and the 12DQ6B final. The final matches into a fixed 52 ohm load. The circuit is quite normal except that a separate final tuning condenser is provided for each band. These are of the screwdriver adjust type. Metering for the final is provided on the edge type front panel meter in two ways. Either final cathode current or relative r.f. output. The functions are selected by a slider switch on the rear apron, the meter reverting to S units in the receive mode.

The frequency of the v.x.o. crystals are selected by taking either the sum or difference of the i.f. and output frequencies. For the various bands they work out as follows: 80 mx, 8672.4 kHz. to 8872.4 kHz.; 40 mx, 12172.4 kHz. to 12322.4 kHz.; 20 mx, 8827.4 kHz. to 9176.4 kHz.; 15 mx, 15827.6 kHz. to 16274.6 kHz.; 10 mx, 11413.8 kHz. to 12262.3 kHz. The crystal frequency is doubled on ten metres and because of the offset on c.w. a crystal chosen for this mode should be 1.2 kHz. higher. Four crystals are supplied with the FT75 as standard, and these are on output frequencies of 3536, 7085, 21400 and 28550 kHz. Other channels can, of course, be ordered from the distributor.

POWER SUPPLIES

The a.c. and d.c. supplies are designated FP75 and DC75 respectively. Both are arranged to deliver the following voltages: 300 or 400 volts high tension for the 12DQ6B final amplifier, 150 volts for the final screen and the 12BY7 driver plate and screen supply, 100 volts of bias for the transmitter valves and 13.5 volts d.c. for the transistorised section. The FP75 utilises one transformer of quite small dimensions. It is about the size of a normal 100 mA. transformer. Four secondary windings deliver the required output as follows: The 300/400 volts and the 150 volts derive from a bridge rectifier across a 115/140v. a side winding, the 150 volts from the centre tap in the usual way. A bridge rectifier across an 11 volt winding delivers 13.5 volts and a single diode in a half-wave circuit across a 100 volt winding provides the 100 volt bias. 12.6 volts a.c. for the transmitter filaments complete the supply. Apart from the transformer, all the components are mounted on a small printed circuit board. During the tests we carried out, the supply ran very cool even after many hours of operation.



The DC75 uses two type 2SD67E transistors to deliver the high voltage requirements. Only two secondary windings are required, one for the 100 volt bias and one for the 300/400/150 volt output. Both the transmitter filaments and the transistorised portion of the rig are supplied direct from the battery. The DC75 operates from a nominal 13.5 volt negative earth battery supply. An internal relay switches the high votlage supply on during transmit periods.

The power consumption of the FT75 with its associated power supplies for d.c. is 5.5 amps full output transmit, 3.5 amps. standby and 1.4 amps. receive with transmitter filaments off. On a.c., the power drain is 80 watts transmit and 50 watts standby.

THE FT75 ON AIR

For the on-air tests we were provided with the optional external v.f.o., the FV50C. It was thus possible to test the transceiver across the entire width of each band. The receiver proved to be a surprisingly good performer. Having had rather disappointing results from transistorised receivers in the past, the first test was to check for front-end overload and cross modulation. The 80 mx band was chosen on a night when a couple of the local Amateurs were operating. With the r.f. gain full on no trace of either cross modulation or overload could be detected. The a.g.c. action proved most pleasant in action. A very fast attack time eliminated all tendency to hardness, while the decay time was long enough to reduce pumping effects to a negligible amount. With a signal running an estimated 20 dB. over S9, the decay time was about four seconds. S meter readings on the FT75 under test appeared to be somewhat optimistic, but as an S meter sensitivity preset control is provided, owners will be able to adjust it to suit their personal taste.

It was noted that if one of the v.x.o. channels was switched in with the external v.f.o. connected, signals could still be heard on the v.f.o. frequency, indicating some stray coupling across the switch contacts. Under the same conditions a spurious signal was present in the transmit mode. It is therefore necessary to make sure the v.f.o. is disconnected when v.x.o. operation is used. The noise blanker proved to be only moderately effective. Noise of the sharp pulse type such as car ignition was reduced by about 15 to 20 dB. in level. The action of the blanker reduced the overall signal level by 3 dB., but did not introduce any noticeable distortion on the received signal.

The squelch control worked very well. As the control was advanced the threshold level was gradually increased up to a level where only an S9 plus signal would open it up. The slow decay on the a.g.c. meant that it could take two or three seconds for the squelch to operate. This seems to be a feature to which the operator would have to become accustomed to over a period of time.

Transmitter output (p.e.p.) was measured with the following results: 80 mx 30w., 40 mx 29w., 20 mx 28w., 15 mx 27w., and on 10 mx 33 watts.

At the same time tests were made to determine the bandwidth of the final amplifier. The 80 mx band was chosen because any specific frequency change here represents a greater percentage variation. The results were surprising. The output dropped off by 1.5 dB. when the frequency was changed by plus or minus 10 kHz. After this there was no detectable difference in output from one end of the band to the other. For this test the output was initially peaked on the v.x.o. frequency of 3565 kHz. The higher bands proved to be just as good with an even smaller drop in output off the resonant adjustment.

FV50C V.F.O.

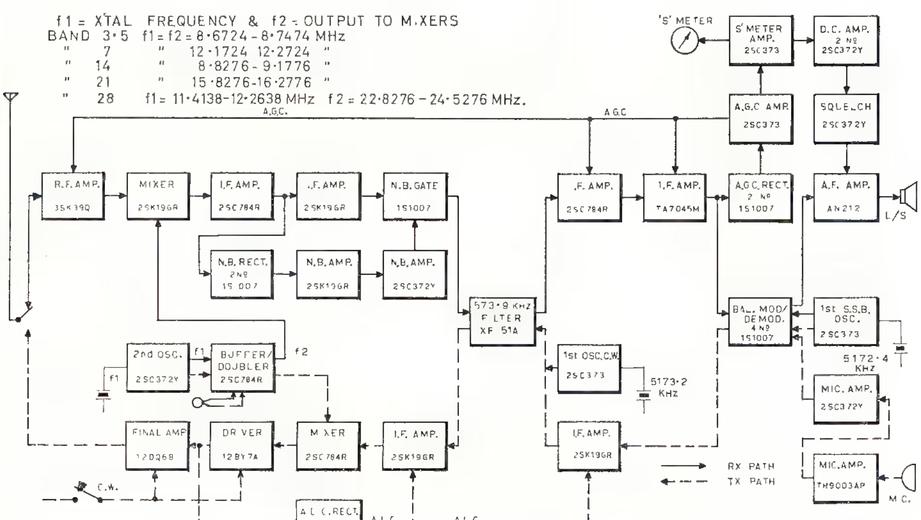
Looking back to the review of the Yaesu FL50 transmitter in the October 1968 issue of "Amateur Radio," mention was made of the FV50 v.f.o. but no data was published on the performance. Firstly a description of the unit. A separate tuned circuit is provided for each of the five bands, the output frequency being over the same range as the v.x.o. crystals except in the case of the ten metre band where the v.f.o. operates on twice the crystal frequency, that is from 22827.6 kHz. to 24524.6 kHz. The dial calibration is arranged so that there is an identical tuning rate on all bands from 80 to 15 metres. The ten metre band tunes at twice this rate, that is two kHz. for one on the lower bands.

Considering that the v.f.o. is switched and that frequencies of 8.6, 8.8, 12.1, 15.8 and 22.8 are involved, the stability is very good. Tests were made from a cold start on each band with the room temperature at 20 degrees C. On 80 mx there was a 1.25 kHz. drift over the first five minutes, and a further 0.5 kHz. over the next half hour. On 40 mx the drift was 4.5 kHz. over the first five minutes with 2.5 kHz. over the next 50 minutes back towards the starting frequency. On 20, 15 and 10 mx the drift averaged 1.25 kHz. over the first five minutes with a further 1 kHz. over the next half an hour. In view of the 40 metre performance, this unit was returned to the distributor and a second unit obtained. This one showed an improvement with a total drift of just over 1.5 kHz., most of which occurred over the first five minutes.

Dial linearity was fair. With the reading corrected at the low end of the band, an error of 4.5 kHz. and 6.5 kHz. occurred at the 100 and 200 kHz. calibration points on the 80 and 20 metre bands. 15 metres was somewhat better with an error of 1, 1, 3 and 6 kHz. at successive 100 kHz. points. 40 metres proved the best with less than 0.5 kHz. variation between each 100 kHz. point. The dial linearity was not checked on ten. Bump testing the cabinet of the v.f.o. produced no variation of beat note on 80, 40 and 20 metres, but there was some warble on 15 and 10 metres.

CONCLUSIONS

The FT75 transceiver is an excellent little rig. It will no doubt see most use as a compact, easy to operate mobile setup. However, it should not be overlooked as a home station for use where space is limited. The FT75 used in our tests was kindly supplied by Bail Electronic Services of 60 Shannon Street, Box Hill North, Vic., 3129, to whom all enquiries should be directed. ●



BLOCK DIAGRAM of FT-75

OBITUARY

GORDON COLE, VK2DI

New South Wales lost one of its prominent DX'ers when Gordon Cole, VK2DI, passed away on 13th July, 1972, due to a heart attack.

Gordon obtained his Amateur licence in November 1935 and broadcast operator's licence the following year. He joined one of the Sydney stations, working there on the technical side for a number of years.

For the past 17 years he combined his technical knowledge with commercial activity in the audio engineering field, which took him abroad on a number of occasions.

His Amateur station was at all times kept in first class order and being a perfectionist, it was difficult to distinguish between his home-brew and commercial equipment. His prowess as a DX'er is displayed in the following certificates: W.A.Z. No. 42, D.X.C.C. No. 168 with approx. 335 countries worked, D.U.F. No. 38, and Empire D.X.C.C. obtained in 1949.

Gordon served as Honorary Treasurer of the N.S.W. Division of the W.I.A. for two years—1945 and 1946.

We extend to his XYL Jean and family our sincere sympathy.

Two Big Wheels in Phase

or Muscle Mobile

By N. WESTE,* VK5ZFE

Not deterred by the recent oil strike and hence the ban on sale of petrol in VK5, a small R. & D. team in Adelaide decided to extend the capabilities of the average mobile Amateur. This was easier said than done. However, being recent engineering graduates, the problem as will be seen, was solved conclusively, the solution not deserving the fate which befell it.

It was not until the transceiver was being mounted on the treadly (state of the art term for novel method of conveyance) that the wonders of this solid state age were really brought home. No half ton lead acid cell for this gem, instead, a super-light energy source—two No. 509 cells—terrific! The mind may well boggle at such simplicity.

Finding a suitable antenna posed an interesting problem, as there were a number of avenues open to approach. The thing was to find the most effective system. Initially, the thoughts were fairly standard—a ¼ wave whip or half wave dipole poking out the back. An unforeseen problem occurred here during the road tests. Inquisitive motorists (there still were some) insisted on edging right up until they had the required effect of bending the elements. Thoughts on a Yagi version were shelved as a result of this.

A more fiendish idea had to be found. It came in a moment of inspiration. Why not commutate to the two wheels and stub match them to the transceiver? Unbelievable! Two big wheels in phase! The necessary adjustments were made and, with the aid of an r.f. bridge, 50 ohms non-reactive load resulted. Did the r.f. transistors like this? It was their first taste of 50 ohms. No more 5 to 1 s.w.r.'s, no more inductive indigestion or capacitive clots. This was heaven!

Being a mobile article, the results of field tests must be presented. It was at this point that the day turned black—to a certain extent anyway. Quite free of the mains and any source of a.c. ripple in the supply, reports of hum were received. The scourge of all power engineers—commutator action—had claimed its toll.

At this point most experimenters would have gone inside, put their feet up, degassed some 807s and discussed the pros and cons of methods used. Not this group—not on your Nelly—they started thinking. You may have heard of a think-tank, well, the word tank being barred, this was dubbed a think-tube.

Whatever its name, it had the required effect, when one participant eclipsed all other suggestions with one which should surely go down in the annals of engineering as an all time masterpiece.

By sectioning the frame below the seat, and inserting an insulating block here, the whole frame could be fed as a vertical dipole. (At this stage we would forgive the reader if he paused in wonder at such a startling innovation.) Quick calculations with the ever-present slide rule showed that the handle-bars occurred at a node, and hence in no way affected the performance of the antenna.

With this device the group was ready to claim world wide Amateur markets. However, the crunch had to come, the success had been so marked. On the day of commissioning the news came that petrol was available. Within minutes the gathered crowd had scattered, leaving only the dedicated R. & D. crew with their contribution to a pollution free world.

Do not lose faith fellow Amateurs, all was not lost. The chief engineer, an avid Amateur, did not waste this chance. Sitting at 50 feet at his home QTH are three super-elliots in phase.

His colleagues laugh, but he knows . . . one day . . .

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