

THE FL-50 S.S.B. TRANSMITTER

INTRODUCTION

During the past ten years or so Australia has seen the introduction of commercial Amateur equipment being handled in quantity by agents. This has aided an increase in the use of commercially manufactured equipment by Australian Amateurs. Equipment is available from various countries of manufacture, there being several competing with one another.

A relative newcomer to the Australian market, but no newcomer to Amateur equipment design and manufacture is the Japanese Yaesu Musen Company (pronounced Yaysou Moosen), whose Australian agent is Bail Electronic Services.

Yaesu Musen manufacture Amateur Radio equipment exclusively and they have a wide range of equipment with different capabilities and functions. The equipment reviewed here is one of their lower-cost lines meant for the Amateur on a low budget.

Several units of the FL-50 were made available by the agent. This was done to enable comparisons to be made between the performances of individual units. The FL-50 has been made to compete with the low cost market and sells at \$225 including sales tax. A matching v.f.o., the FV-50, is available for full band coverage.

GENERAL DESCRIPTION

As with most equipment, facilities and complexity are directly proportional to price. Thus some facilities that are incorporated in higher priced equipment are not included in this design. An internal v.f.o., v.o.x. and selectable sidebands are not incorporated features of this model. The power capability is also less than higher priced models. But nothing else, it seems, has been sacrificed to lower the price. The rest of the review will affirm this.

The FL-50 is a complete, five-band transmitter for s.s.b., c.w. and a.m. The transmitter has an internal v.x.o. which allows approximately 10 Kc. shift. Crystals are extra by order. The power input to the final is nominally 50w. (d.c.). Sideband generation is by the filter method using a five-crystal lattice filter on 5173.9 Kc. and a carrier crystal on 5172.4 Kc. This gives u.s.b. output. The correct sideband for the band in use is automatically selected by the proper heterodyne frequency in the v.x.o. or external v.f.o. (See block diagram.)

A calibrated meter (and switch) enables the cathode current of the p.a. to be read as well as r.f. output (from diode detector).

Transmitter control is normally p.t.t. via suitable push-button microphone. There is provision on the chassis for including v.o.x. circuitry if so desired.

Internal a.l.c. is taken from the p.a. and applied to the 5 Mc. amplifier (see block diagram). The p.a. uses a single 6JS6A tube.

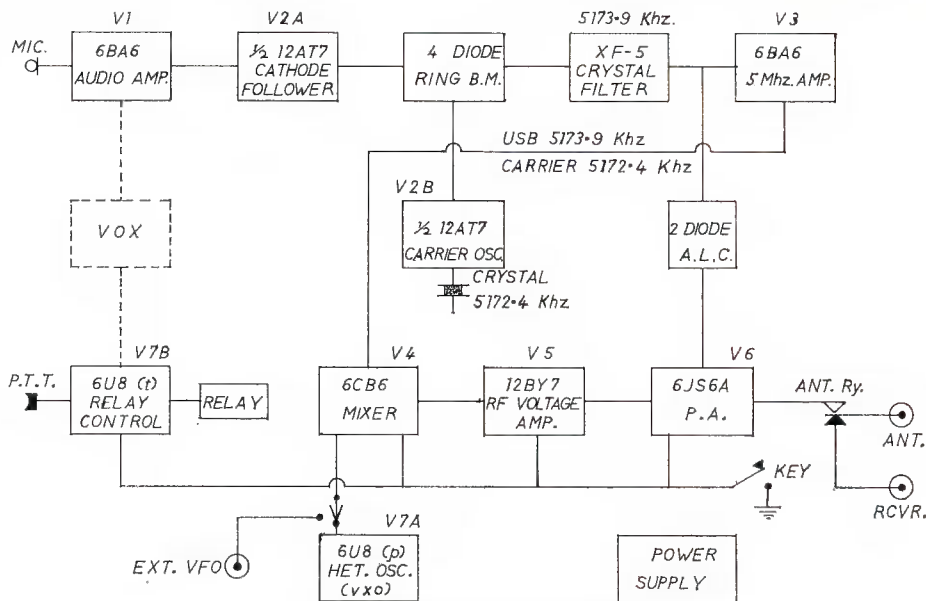
The carrier level control is a front panel control which enables carrier to be re-inserted at the grid of the 5 Mc. amplifier. Thus the level of carrier can be set to any desired level for tuning, and for a.m. or c.w. operation. Straight or break-in operation is available for c.w. work.

The rear apron has sockets for antenna (SO239) and receiver control, switched by an internal antenna (c/o) relay. Also sockets for FV-50 power and r.f. leads are mounted on rear chassis. The p.a. bias adjustment pot. is also on the rear apron.

gives a 0.005% stability figure but if crystals of greater stability are used (i.e. 0.001%) then this is achieved.

The output frequency of the crystal oscillator, and thus the transmitter, varied slightly between individual units. This was attributed to the fact that different 6U8A tubes have different input capacities coupled with different stray (wiring) capacitance in the different units. It was rarely more than 5 Kc. from the marked crystal frequency.

A socket on the front panel facilitates changing of crystals. A switch next to



BLOCK DIAGRAM OF FL-50 TRANSMITTER

CRYSTAL OR V.F.O. RANGE	
3.5 Mc. Band	8,672.4 Kc. to 8,747.4 Kc.
7 " "	12,172.4 " " 12,272.4 " "
14 " "	8,827.6 " " 9,177.6 " "
21 " "	15,827.6 " " 16,277.6 " "
28 " "	22,827.6 " " 24,527.6 " "

POWER SUPPLY	
	Measured
High Voltage	Plus 500V. Plus 480V.
Low Voltage	Plus 250V. Plus 225V.
Regulated	Plus 150V. Plus 150V.
Regulated	Minus 100V. Minus 100V.

HANDBOOK TECHNICAL SPECIFICATIONS

Type of Emission: c.w., a.m. and s.s.b. (l.s.b. on 80 and 40 metres, and u.s.b. on 20, 15 and 10 metres).

Operation: Push to talk.

Power input: 50w. d.c.

Output Impedance: 50 to 120 ohms.

Frequency Range: 3.5-3.8 Mc., 7-7.5 Mc., 14-14.5 Mc., 21-21.5 Mc., 28-30 Mc.

Frequency Stability within 0.005%.

Carrier Suppression: -50 db.

Sideband Suppression: -50 db.

Distortion Products: -30 db.

Audio Response: 300 to 2,700 c.p.s., ripple within ±3 db.

Power Requirement: a.c. 100/110/117/200/220/234v., 50/60 c.p.s., approx. 100 vA.

Cabinet Size: 6" x 13" x 10½".

Net Weight: 23 lbs.

V.X.O.

The stability of the crystal used is the main factor here. The handbook

this socket enables an external v.f.o. to be switched in.

The shift attainable with ordinary HC6/U crystals is generally around 10 Kc. A variable capacitor coupled to a large hand-span knob on the front panel facilitates this. Special low capacity crystals are obtainable which enables the frequency to be pulled 20 to 50 Kc. They have to be "tailor-made" though for individual units for reasons given above.

CARRIER AND UNWANTED SIDEBAND SUPPRESSION

One unit was checked, on 21 Mc., and the following figures obtained relative to full power output.

Carrier Suppression:
Switch on, -58 db.
After 15 minutes, -63 db.

Unwanted Sideband:
Switch on, -50 db.
After 15 minutes, -50 db.

The carrier suppression on other units was as good as or only slightly degraded (6-8 db.) from these figures.

The unwanted sideband suppression was as good as this, with minor fluctuations, for other units.

Carrier suppression was measured relative to full power output with audio applied. The carrier suppression was degraded about 4-5 db. with two-tone signal applied.

These figures are very good and show that the handbook specifications are somewhat conservative.

Many higher priced transmitters do not claim or attain these figures for carrier and unwanted sideband suppression.

DISTORTION PRODUCTS

All distortion products were more than 36 db. below full output on two-tone test signal. This is very good.

R.F. POWER OUTPUT

The following figures are an average for the units measured:—

80 Metres	62 Watts
40 "	64 "
20 "	62 "
15 "	57 "
10 "	56 "

Average p.e.p. output = 60.2 watts.

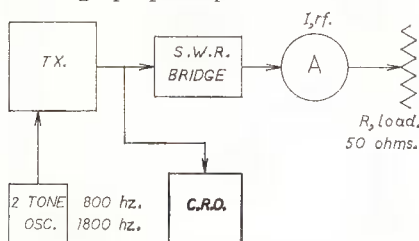


Fig. 1.—Power Measurements.

The single 6JS6A p.a. appears to be doing a good job. It appears to be operating in class AB2 and measurements indicate that the anode efficiency is around 60 to 65%.

This indicates a well-designed p.a. and efficiently constructed tank circuit.

Power output was measured as shown in Fig. 1.

The method used was:

- (1) Transmitter tuned up as per the handbook.
- (2) Two-tone oscillator then applied.
- (3) Tuning touched up.
- (4) Two-tone level adjusted so that pattern on c.r.o. is not quite flat-topping.
- (5) Measurement of I_{RF} then taken.
- (6) Calculate P_m :
$$P_m = I_{RF}^2 \times R_L$$
- (7) Calculate p.e.p.:
$$\text{p.e.p. out} = 2 P_m$$

OVERALL FREQUENCY RESPONSE

This was measured by applying an accurate audio oscillator to the mic. input and setting the transmitter to maximum output with a 1 Kc. signal applied to the audio. The output of the transmitter was then measured and subsequent readings referred to this.

The results are shown in Graph 1 for one unit that was measured. It can be seen that the response "rolls off" a little sooner than expected on the low frequency side as the -3 db. point is at 650 c.p.s. rather than around 300 c.p.s. as mentioned in the handbook specifications. This may be owing to the carrier crystal being a little low in frequency.

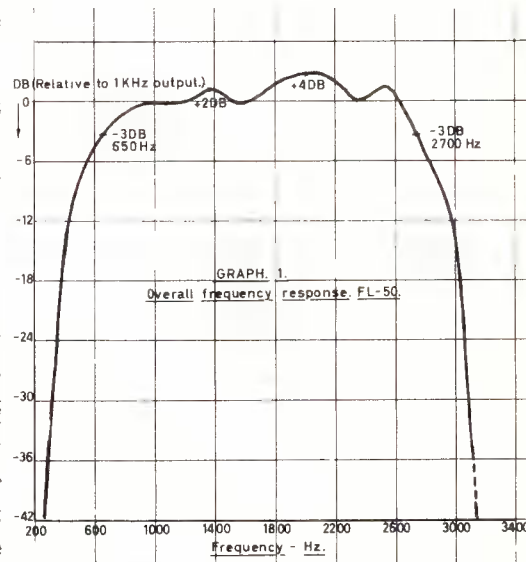
The upper -3 db. point is at 2700 c.p.s. as per the handbook.

The ripple is well within ± 3 db. as mentioned in the handbook specifica-

tions (i.e. 6 db. peak-to-trough). In this case, the ripple is only 4 db. peak-to-trough or ± 2 db. ripple.

The bandwidth is a little narrower than expected, but is nevertheless very good. On-the-air reports give "good quality", "easy to resolve" to "excellent".

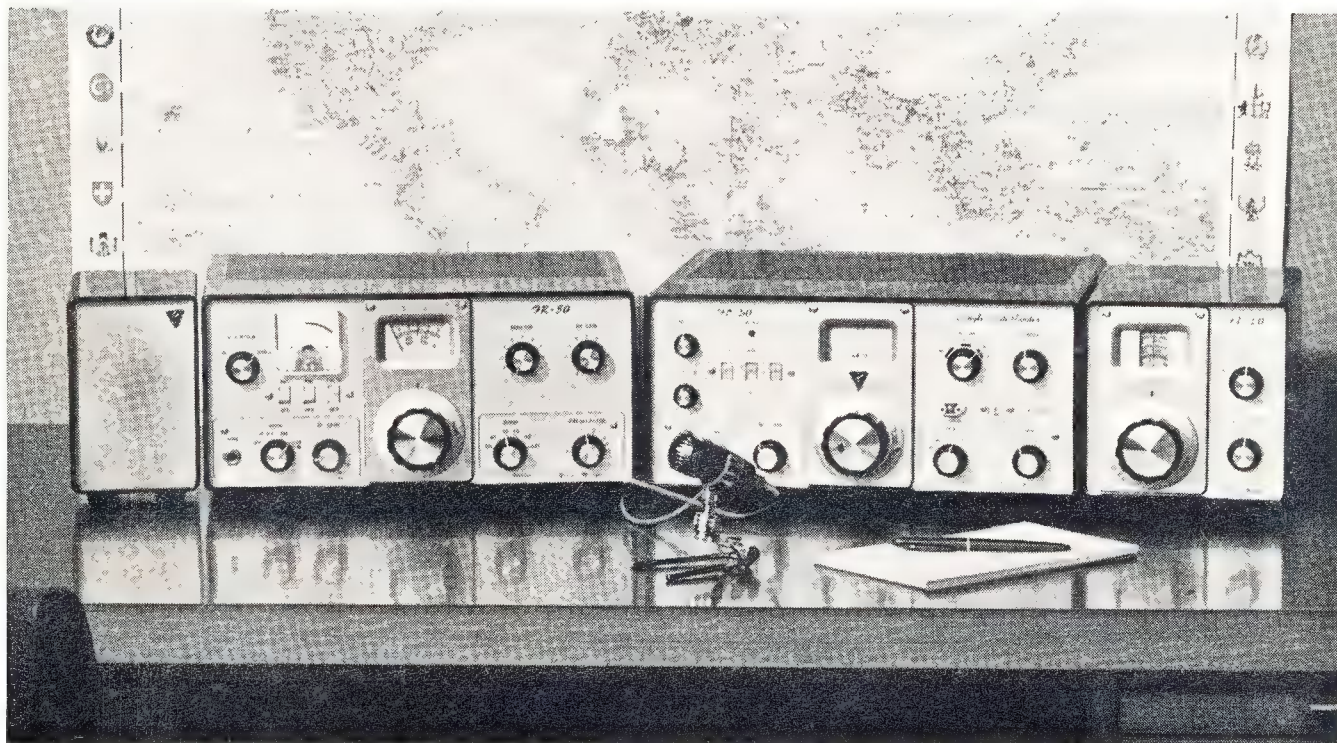
These results indicate a well designed and constructed crystal filter.



T.V.I.

It appears that this little rig does not radiate spurious signals which are sufficiently strong to cause t.v.i.! Need I say more?

The FL-50 is a straightforward, single conversion design and, as such, reduces the possibilities of spurious output signals to a minimum.



The Yaesu Musen "50" Series (left to right): SP-50 Spaker, FR-50 Receiver, FL-50 Transmitter, and FV-50 VFO.

POWER SUPPLY

The power supply is in-built on the same chassis so that a completely self-contained unit results. This appears to be a feature with all Yaesu equipment.

One transformer provides all the necessary voltages. The a.c. input is nominally 234v. for Australian conditions, but other taps are available to provide 100/110/117/200/220 volts at 50 or 60 c.p.s. The power drain on the mains is approximately 100 watts.

The rectifiers are all solid state and adequate protection is provided. Both transient and surge suppression components are included.

A regulated 150 volts is supplied from a gas tube regulator for the oscillators and p.a. screen.

A neon regulates the bias supply and also serves as an "on-air" indicator.

All the filter capacitors have about a 1.7 times safety factor on the voltage rating. The amount of capacitance used ensures low ripple content.

The choke used is also of adequate proportions. The regulation of the main h.t. is very good, being approximately 8%. When the key is up the p.a. h.t. is 480 volts, with key down and full power output, this drops to 440 volts. The drop is about half this on speech peaks.

After some considerable time of operation the power transformer is warm to the touch but not hot.

All in all, it appears that the power supply has been well designed and is of adequate proportions.

The main h.t. can be halved by a very simple modification to bring the h.t. down to about 250v. The transmitter may then meet the requirements for low power operation if required for special cases. The agent will perform the modification upon request.

CONSTRUCTION

I was very impressed with the construction of these units. The layout is neat and logical. The wiring is very neat and looms are used for the long runs of wiring. All the components are mounted on tag-strips or socket lugs and are at right angles to a chassis wall and parallel to the bottom.

All components are easily accessible and readily identifiable. The valves are clearly marked on the chassis. The chassis is punched steel which has been cad-plated, passivated and lacquered.

The tank coil is a large (1½") diameter ceramic former with heavy gauge plated copper wire wound on it. It is mounted well clear of the chassis on two stand-offs. The bandswitch has ceramic p.a. sections. All this ensures high efficiency in the tank circuit.

The front panel is satin finished aluminium and the layout of the controls is balanced and pleasing. The front panel could do with some brackets behind it for support, although wiggling it around during transmitter operation has no effect. It doesn't wiggle much anyway.

The sideband generator is mounted on a printed circuit board. This board ("F" type s.s.b. generator) is available separately for those who wish to roll their own.

The overall construction is very robust and very neat. Yaesu are to be commended on this point.

ON THE AIR

The unit is very easy to use. Tuning and loading is smooth and not critical on all bands. The rig can be tuned in a minute or less. The audio gain is ample for quite a number of different high impedance mikes.

The carrier control is also very smooth and easy to adjust, as is the bias control on the rear apron.

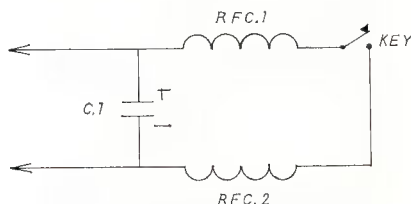


Fig. 2.—Suggested Keying Filter.
C1 2-8 uF. 350v.w. electrolytic.
RFC1, RFC2—Aegis Type C4.

The small switches are easy to operate with one finger and once switched, **cannot be knocked** into alternate position.

Audio quality reports are consistent for different units and very encouraging. For example, "very natural", "easy to resolve", "very good" and even an "excellent".

A.m. quality is reasonable but not as good as a proper a.m. transmitter because only one sideband and carrier are transmitted by the FL-50 on a.m. (usual system with most s.s.b. rigs).



Fig. 3.—Keying Waveform of FL-50.

With a key with no filtering, the keying characteristics tend to show "clicks" and "thumps". The agent attaches some supplementary operating notes to each handbook and a filter is suggested in these notes. Fig. 2 is taken from these notes and gives the envelope as seen on a c.r.o. (Fig. 3). This gives an excellent character. No chirp is evident on the transmission either.

The type of keying used is grid bias keying; the keyed stages being the r.f. stages.

THE HANDBOOK

The handbook is well presented and includes a very clear description of the circuit operation. All the information necessary for alignment and trouble shooting is included as well as a very comprehensive voltage chart.

A large, clear, easy to read circuit diagram is included, along with circuit diagrams for the crystal filter and v.o.x., with or without anti-trip. The crystal filter curve is also supplied.

The agent has included two pages of supplementary notes. One page is all about the FV-50 remote v.f.o. The other page gives more detailed operating information and hints.

No list of mechanical parts is included nor installation information. This, though, is a minor point.

Unfortunately, it is not a printing but a dyeline copy type, but is nevertheless clear and easy to read.

THE GUARANTEE

There is a 90-day guarantee on components and workmanship excepting valves. (Receiving valves used in transmitters are not normally guaranteed), the usual provisions apply regarding transport charges and misuse. Incidentally, spares for all valves, including the 6JS6A, along with just about anything else are available from the agent. He also does pre-sales inspections and servicing as well as after sales service. Included in this is the installation of a 3-core a.c. power cable and plug to replace the 2-core cable originally fitted.

CONCLUSIONS

At \$225, this little transmitter is a bargain. There has been no corner cutting or skimping on component tolerances in this design. Robust construction and careful circuit design makes for an efficient little rig. It has circuit features that are included in many higher priced rigs and a quality to equal them.

I feel that the lack of v.o.x. facilities will not be missed as many operators prefer push-to-talk operation. But if you wish for v.o.x. then it can be easily installed. (A suggested circuit is included in the handbook.)

From Table 1 it can be seen that the handbook specifications are generally equalled or exceeded.

One rarely sees such robust construction and generous design in low cost Amateur equipment. Along with that, the performance is excellent and the Yaesu Company should be commended for this.

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Specification	Handbook	Measurement
Stability	within 0.005%	Depends on Crystal
Carrier Suppression	—50 db.	—63 db.
Sideband Suppression	—50 db.	—50 db.
Distortion Products	—30 db.	—36 db. or greater
Audio Response	300 to 2700 c.p.s. ±3 db. ripple	650 to 2700 c.p.s. ±2 db. ripple
Power Input	50 watts d.c.	52 watts (average) d.c.

Table 1.