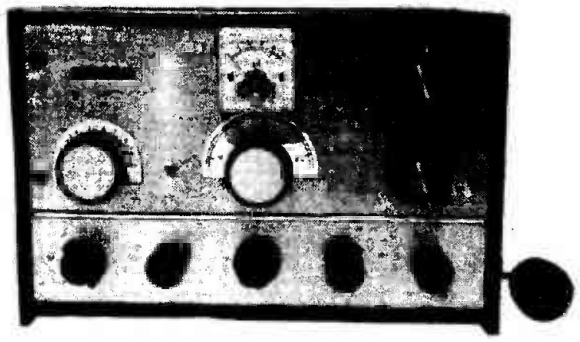
TRANSMITTER-RECEIVER



FOR 160 METRES

– Part 2

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In this concluding article our contributor gives final details on the 160 metre transmitter-receiver. Also described is a suitable power supply unit.

TOP OF CHASSIS

Capacitors VC2-VC3 and VC4 are mounted to the flat plate, as shown in Fig. 3 (published last month). A spindle coupler and a short length of ¼in. rod allows VC2-VC3 to be set back, as illustrated.

The v.f.o. box is made from a 9 by 2in. 'Universal Chassis' side. Two V-cuts are made in each flange 2⅝ins. from the ends. The chassis side is then bent to the shape shown in Fig. 3, forming a 'box' about 2⅝ by 3¾ by 2ins. deep. The sharp bends required are best made by clamping the chassis side between two blocks of wood, one narrow enough to go between the flanges and set level with the bending line. A flat metal plate measuring about 2½ by 3½ins., which functions as a cover, is cut out and drilled for self-tapping screws which are later driven into matching holes in the flanges.

VC4, L4, TC4 and C16 are inside the box. TC4 is supported with stout wires and can be adjusted through a hole in the box top. The wires are 14 or 16 s.w.g. and are very short. In the prototype the v.f.o. proved to be perfectly stable and reliable. The connections to the Denco coil used for L4 should be soldered quickly and a heat shunt is advisable, as the plastic in which the coil pins are held may otherwise melt and become deformed. The same remarks apply to all the other Denco coils employed in the transmitter-receiver.

A bracket for the tuning indicator is cut from scrap or a spare 'Universal Chassis' side and is screwed to the front panel by two of the chrome 6BA bolts referred to a little earlier. The bracket is as illustrated in Fig. 3 and its flange has two holes at 2½in. centres for the mounting bolts. The valveholder should take up a position such that the tuning indicator display is centred behind the rectangular aperture in the front panel. The valveholder should be orientated such that the display is forward. Wiring to the indicator is as shown in Fig. 3. Three leads pass through a chassis grommet, one to the 6.3 volt line at pin 4 of V1, one to the a.g.c. circuit and one to h.t. positive.

VC6-VC7 is fixed to the front panel by short bolts passing into its threaded holes. Before mounting, its two sets of fixed vanes should be connected together and two insulated leads connected to the rear fixed vanes. These leads will later connect to L6 and to S1(a).

VC5 is bolted to the panel above VC6-VC7, and is set back a little with extra nuts, washers or spacers. A lead (not shown in Fig. 3) runs from the frame of VC5 to the frame of VC6-VC7, and then to the chassis at the adjacent tagstrip.

Capacitors C25, C26 and choke RFC2 are supported by this tagstrip, as shown in Fig. 3. A lead from pin 1 of V8 runs through an adjacent chassis hole and connects to the junction of C26 and RFC2.

L6 is wound on a former 3½ins. long and 1in. in diameter, and consists of 70 turns of 22 s.w.g. enamelled wire, wound side by side. The coil is fixed by a bracket to the chassis, and the lower end of the coil should be about 1in. clear of the chassis surface. The top end of the coil connects to VC5, and the bottom end is connected to the wire previously fitted to VC6-VC7 fixed vanes.

The two leads from the speaker, when this is fitted, pass through a hole in the chassis to the secondary of T1.

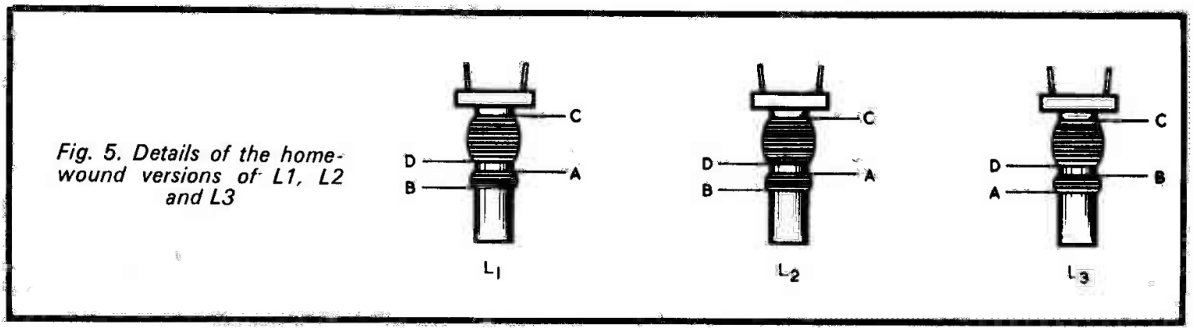


Fig. 5. Details of the home-wound versions of L1, L2 and L3

BELOW THE CHASSIS

The wiring and components below the chassis are illustrated in Fig. 4 (published last month). A tagstrip near the back anchors power leads and other connections. The power input is carried by a four-core lead providing 300 volts nominal l.t., a common chassis connection and two 6.3 volt supplies. The tags 'X' of V1 to V5 are wired together and to the tagstrip, and these valves require 6.3 volts at 1.41 amps. Tags 'Y' of the remaining valves are similarly wired together and to the tagstrip, and these require 6.3 volts at 2.26 amps.

The non-earthy leads to VR2 run close to the chassis underside. The speaker transformer, T1, is bolted to the rear flanged member over V9 valveholder and is not shown in Fig. 4. Its primary connects to tag 1 of IFT1 and to pin 1 of V4.

All the points marked 'MC' are tags bolted tightly to the chassis. Several of the coils have trimmers soldered across two of their tags. If Denco coils are used here, stout wire may be soldered to the appropriate pins and the trimmers soldered to these wires.

COILS

Details of the coils are given in the Table and Fig. 5. It will be seen that L1, L2 and L3 may be either home-wound, as in Fig. 5, or modified Denco coils. If the home-wound coils are employed, chassis holes are required at the lower ends of their formers to allow access to their cores. The outer ends of the formers are covered by trimmers. The Table also includes the modulation choke L7. The 'Hygrade' choke referred to is an R.S. Components part. It may be obtained from Chromasonic Electronics, 56 Fortis Green Road, London, N10 3HN, or from Home Radio (Components) Ltd., who list it under Cat. No. CLF25.

TABLE
Details of Inductors

Coils L1, L2 and L3 may either be modified Denco components or home-wound. All Denco coils are valve types.

Denco Versions

L1. Aerial Coil. Denco Blue Range 2 with 32 turns removed from tuned winding. A pin 8, B pin 9, C pin 6, D pin 1.

L2. Mixer R.F. Coil. Denco Yellow Range 2 with 32 turns removed from tuned winding. A pin 9, B pin 8, C pin 6, D pin 1.

L3. Oscillator Coil. Denco Red Range 2 with 20 turns removed from tuned winding. A pin 8, B pin 9, C pin 1, D pin 2.

Home-Wound Versions

All home-wound versions are wound with 34 s.w.g. enamelled wire on 7mm. by 27mm. formers with dust cores and 4-way tagboards. Details are given in Fig. 5.

L1. C–D 130 turns wound over $\frac{7}{16}$in.
A–B 60 turns wound over $\frac{1}{8}$in.
Spacing between windings, $\frac{1}{16}$in.

L2. Same as L1 except A–B 50 turns wound over $\frac{1}{8}$in.

L3. C–D 115 turns wound over $\frac{7}{16}$in.
A–B 50 turns wound over $\frac{1}{8}$in.
Spacing between windings $\frac{1}{16}$in.

L4. Denco White Range 2 with small winding removed.

L5. Denco Yellow Range 2 with small winding removed.

L6. 70 turns 22 s.w.g. enamelled wire on 1in. diameter former. See text.

L7. 'Hygrade' 10H 90mA choke, or 80–100mA pentode output speaker transformer primary, secondary unused.

V.F.O. STAGE

In the transmitter v.f.o. circuit, C17 and C18 swamp out stray circuit capacitances and, providing the connecting leads in this stage are thick and are kept short, the frequency stability should be found more than sufficient. A check of v.f.o. frequency coverage can be made by applying h.t. to this stage and listening to the carrier on a receiver.

When construction is completed and the v.f.o. box lid has been screwed on, coverage is adjusted by means of TC4 and the core of L4. These adjustments should result in the range of 1.8 to 2.0MHz being provided without using the extreme open and closed settings of VC4. The threaded section of L4 core is then locked by passing a nut over it and tightening this against the plastic of the coil former.

A pointer or cursor is fitted to the flange of the slow motion drive and markings are made on a thin card scale fixed to the panel. Accurate calibration is easy if a 100kHz crystal marker is available for use with the receiver. Tune the latter to 1.8MHz by means of the crystal, and tune the v.f.o. to zero beat, marking its scale 1.8MHz. Repeat for 1.9 and 2.0MHz. Then tune the station receiver to the marker harmonic on 3.7MHz, tune the v.f.o. until its second harmonic is at zero beat, and mark the scale for 1.85MHz. Repeat for 1.95MHz, with the receiver set at 3.9MHz. The 10kHz points can be filled in by estimate.

BUFFER AMPLIFIER

The buffer amplifier may be checked with both V7 and V8 plugged in. S2(a)(b) is set to 'Net', thereby allowing no h.t. supply to V8. Clip a current reading meter across R24, with negative to point 'G' and positive to chassis. Set the v.f.o. to 1.9MHz and adjust the core of L5 for maximum grid current in V8. This will be about 2 to 3mA. R.F. output tests show that there is no loss of efficiency provided grid current is not less than about 2mA or more than 4mA, and the current should be within these figures across the band. If grid current is excessive, increase R21 to 47kΩ, 68kΩ or 100kΩ as necessary. The grid current tends to depend somewhat on the actual valves employed and the h.t. voltage.

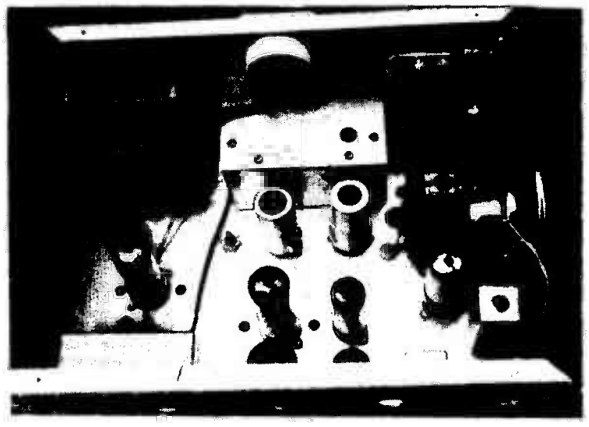
POWER AMPLIFIER

The power amplifier stage is most easily tested by coupling the output to a 250 volt 15 watt household lamp. This may be temporarily connected across VC6-VC7. Alternatively, the lampholder can be connected to a coaxial plug, which is then inserted into the aerial socket.

Set both VC5 and VC6-VC7 to maximum capacitance. Switch to 'Transmit' and rotate VC5 for resonance as shown by a dip in anode current. Gradually reduce the capacitance of VC6-VC7 whilst at the same time readjusting VC5 for minimum anode current. The minimum anode current at resonance, as indicated by meter M1, will increase, and the lamp will light more brightly. Load in this way for about 33mA at 300 volts h.t., or 40mA at 250 volts h.t., to obtain the 10 watt input.

Commencing this operation with VC5 at maximum capacitance ensures that L6 is not accidentally resonated at 80 metres. This is possible in some circumstances, with V8 acting as a doubler, but the transmitter is not intended to be operated in this manner.

In use, the power amplifier is brought into circuit by means of S1(a)(b). Initially, set S2(a)(b) to 'Net' to enable the v.f.o. to be tuned to receiver frequency, then return this switch to its original setting. S1(a)(b) then provides complete change-over from reception to transmission.



A further view above the chassis. The tuning indicator can be seen at the right

COMPONENTS – POWER SUPPLY

Resistors
(All 10%)

R1	220kΩ 1 watt
R2	270Ω 2 watts
R3	270Ω 2 watts

Capacitors

C1	32μF electrolytic, 450 V.Wkg.
C2	8μF electrolytic, 450 V.Wkg.

Inductors

L1	Smoothing choke, 10H at 120mA, 200Ω, Parmeko P3142 or similar
T1	Mains transformer, secondaries 300–0–300V 120mA, 6.3V 2A, 6.3V 2A, 6.3V 2.5A. Electrovoice type 195A (Home Radio Cat. No. TM9)

Rectifiers

D1	Silicon rectifier, 1A, 1,000 p.i.v.
D2	Silicon rectifier, 1A, 1,000 p.i.v.

Fuse

F1	250mA cartridge fuse and holder

Switch

S1	s.p.s.t. toggle

MODULATOR

The modulator incorporating V9 and V10 can be checked with the transmitter output feeding in to a lamp, as just described. The signal may be picked up on the station receiver. The r.f. gain control of the latter will probably need to be set at minimum to avoid overloading, and it may also be necessary to disconnect the receiver aerial, substituting a short wire.

Speech in the microphone should sound clear and strong on the receiver, and the lamp brilliance should increase during speech. Avoid acoustic feedback, evident as a howl, from the receiver back to the microphone, by turning down the receiver a.f. gain and keeping the speaker and microphone well separated.

RECEIVER R.F. STAGE

L1 is above the chassis, and VC1 is simply peaked for best reception, thus allowing compensation for changes to the aerial. The core of L1 and trimmer TC1 should be set up such that VC1 covers the 1.8 to 2.0 MHz range comfortably.

As the tuning range is only 1.8 to 2.0MHz, no tracking difficulties arise between L2 and L3. If the full swing of VC2-VC3 gives a larger coverage than is required, slightly reduce the inductance of L2 and L3 by means of their cores and increase the capacitance of TC2 and TC3. When coverage is suitable, tune in a signal near 1.8MHz and adjust L2 core for the best indication in the tuning indicator. Then tune to a signal near 2.0MHz and adjust TC2 for best results. These adjustments are repeated several times.

The v.f.o. can assist in initially finding the receiver range. If S2(a)(b) is set to 'Net', the receiver may be tuned to v.f.o. frequency with the aid of the tuning indicator.

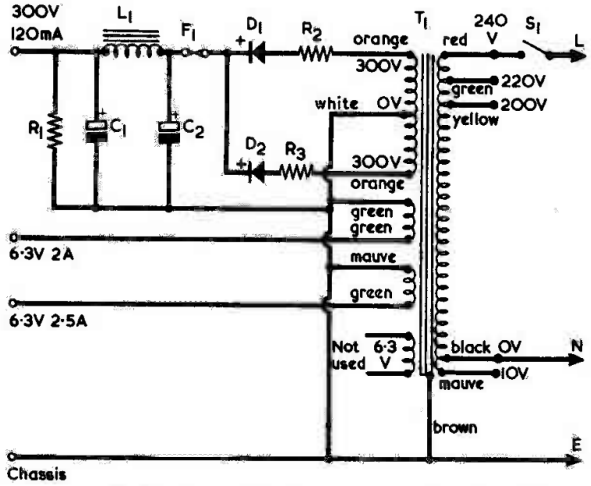


Fig. 6. The circuit of the power supply unit employed by the author. As is explained in the text, other power supply units offering similar outputs may be used instead

Finally, a pointer or cursor is fitted to the flange on the slow-motion drive for VC2-VC3. This is then fitted with a scale similar to that for VC4.

I.F. AMPLIFIER

The specified i.f. transformers are supplied pre-aligned and will require only a slight adjustment after they have been wired in. A correct type of core adjusting tool should be employed. A stable signal should be tuned in correctly, and the i.f. transformer cores are then adjusted for best indication in V5.

WORKING NOTES

Any usual type of Top Band aerial can be used. This will generally be end-fed and may operate directly from the transmitter or be used with a tuner or matching device. If the end fed wire is reasonably long and will load the transmitter without a matching unit, the latter is unnecessary. Such a unit is, however, necessary with a whip or short wire.

A coaxial lead from the transmitter-receiver may run to a standing wave ratio indicator, matching unit or r.f. meter, when one or more of these are employed. Transmitter loading with an aerial follows the same procedure as that described for testing with a lamp load.

POWER SUPPLY

The power supply unit actually used by the author is shown in Fig. 6. Other supply units with adequate h.t. and heater outputs would be just as suitable. The mains transformer specified has a 6.3 volt 2.5 amp heater winding and this supplies the transmitter heaters, which require 2.26 amps. Another 6.3 volt winding is rated at 2 amps and is used for the receiver heaters, where the total current is 1.41 amps. A third 6.3 volt winding on the transformer is ignored.

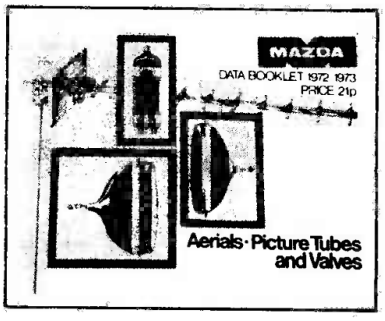
The h.t. output from the supply unit in Fig. 6 allows the transmitter to be operated with the full permitted input of 10 watts.

The transmitter-receiver has also been used successfully with smaller power supplies. A 300 volt 100mA supply is about adequate, while a 275 volt 100mA supply gives good results. A 250 volt 100mA supply is somewhat on the small side, whilst a 250 volt 80mA supply is the minimum recommended. These lower output supplies have no effect on reception, but with less than about 275 volts at 100mA available the p.a. has to be run at substantially less than 10 watts input. This input is achieved with a p.a. supply of 33mA at 300 volts, or 40mA at 250 volts. An input of 50mA at 200 volts would also represent 10 watts, but it will be found that efficiency and r.f. output fall off at such a low voltage. ■

MAZDA BOOKLET

Did you know that the world's first valve for amateur constructors, produced in 1922, was the type AR bright emitter triode? And that the SP61, used in quantity by the R.A.F. in the R1132 receiver, helped to win the Battle of Britain? And that the T31, Britain's first thyratron designed specifically for 405 line timebases, appeared in 1936? And that the world's first ever commercial valve manufactured for sale was the type A, which was made in 1906 at Ponders End?

These facts appear in the Obsolete Valves section of the 168-page Mazda Pocket Data Booklet for 1972–1973, whose cover you can see in the accompanying photograph. However, they take up only a minute fraction of a comprehensive booklet which gives essential data on Mazda valves and picture tubes. Included are current types as well as obsolescent and obsolete types, and there is data on four new types of colour tube, three new types of monochrome tube and three new valve types. A further feature of the booklet is an eight-page section covering Mazda u.h.f. aerials and their lashing kits.



Currently available is the 1972–1973 Mazda Pocket Data Booklet. Priced at 21p, this gives concise details of valves, picture tubes and Mazda u.h.f. aerials

The booklet has been specifically compiled for use in maintenance work by the radio trade and will be particularly helpful for the service engineer and the enthusiast who repairs present-day as well as vintage receivers. There is a cover charge of 21p, and discounts apply to the Radio and TV trade when purchasing from a Mazda wholesaler. Further details are available from the Publicity Department, Thorn Radio Valves and Tubes Limited, Mollison Avenue, Brimsdown, Enfield, Middlesex, EN3 7NS.