COMPREHENSIVE MULTI-BAND RECEIVER

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PART 2

RF AMPLIFIER

The circuit for this stage is sbown in Fig. 5. The 6BA6 is to tbe rigbt of the ganged capacitor, Fig. 3, and L1 is to tbe left, near the panel. In Fig. 5, L1 is a "Blue" coil, and L2 the existing mixer "Yellow" coil.

Leads run from VC6 and VC7 througb the cbassis as in Fig. 3. The aerial trimmer VC8 is fixed to tbe panel in tbe position shown in Fig. 4, near the holder for L1. Arrange the valve and coil bolders to allow sbort leads, with separation of grid and anode circuits, and earth the central spigot of the valve-holder to the chassis.

The primary of L2 was originally earthed. Pin 8 is now disconnected from the chassis and wired to C1, Fig. 4, shown as C4 in tbe r.f. stage circuit Fig. 5. Pin 9 is disconnected from the aerial socket and connected to pin 5, V1, Fig. 5.

A piece of co-axial cable is now used for the aerial circuit. Its inner conductor runs from tbe aerial socket to pin 8 of L1. The outer conductor is connected to tbe earth socket, chassis, and also to the chassis near L1.

Add the r.f. gain control in the position shown, and disconnect R7 of tbe i.f. amplifier from the cbassis, wiring it to VR1 and R4, Fig. 5.

RF AMPLIFIER ALIGNMENT

Insert a set of three coils. VC8 sbould peak quite sharply near the h.f. end of each band, unless the aerial is very long. Adjust the core of L1, in tbe way already described for L2, so tbat little or no adjustment of VC8 is required near the l.f. end of the band.

There is no loss of efficiency if VC8 and VC3 can both be used to peak up signals throughout each band, and are not fully open or fully closed. But correct adjustment of the cores will make it unnecessary to adjust these trimmers frequently, except to peak up weak signals, or wben changing the aerial or coils.

When dealing with the highest frequency range, note that it is possible to tune L1 or L2 to tbe wrong side of tbe oscillator frequency, at tbe b.f. end of the band. This effect is possible when trimming any circuit of this type, witb an i.f. near 465kHz. L1 and L2 should be tuned l.f. of the oscillator frequency, and the second cbannel, or unwanted response, will be about 930kHz h.f. of this, and will be found as a weaker signal, if a generator is used for alignment.

On the lower frequencies it is not possible to set L1 or L2 to tbe wrong side of the oscillator frequency.

CARRIER OSCILLATOR/PRODUCT DETECTOR

Fig. 6 shows tbe circuit of tbese sections. The product detector V1 occupies tbe position near tbe last i.f.t. as in Fig. 3. Tbe carrier oscillator is constructed completely in the hox whicb is later holted to the left of tbe chassis, Fig. 3. It is possihle to use the carrier oscillator for the reception of both c.w. and s.s.b. using the diode detector D1 but reception is much improved hy switching it out and bringing in the product detector V1.

The 3-way rotary switcb controls operation of the receiver. Section S1 allows the diode detector D1 to supply signals for a.m. reception, or switches to C5 for s.s.b., c.w. and "Calibrate." Section S1b applies h.t. to hotb stages in the s.s.h./c.w. and "Calibrate" positions.

A 7×2in "universal cbassis" flanged side is taken and its flanges cut away 2in from eacb end. It is then given rigbt-angle bends 2in from eacb end, to make an open hox 2in high, 3in wide, and 2in deep. A plate 3×2in is cut and bolted to the front flanges.

Tbe valveholder and CO coil are located as in Fig. 3, and all components in the hox in Fig. 6 are assembled and wired, with tag strips to anchor b.t. circuits and other

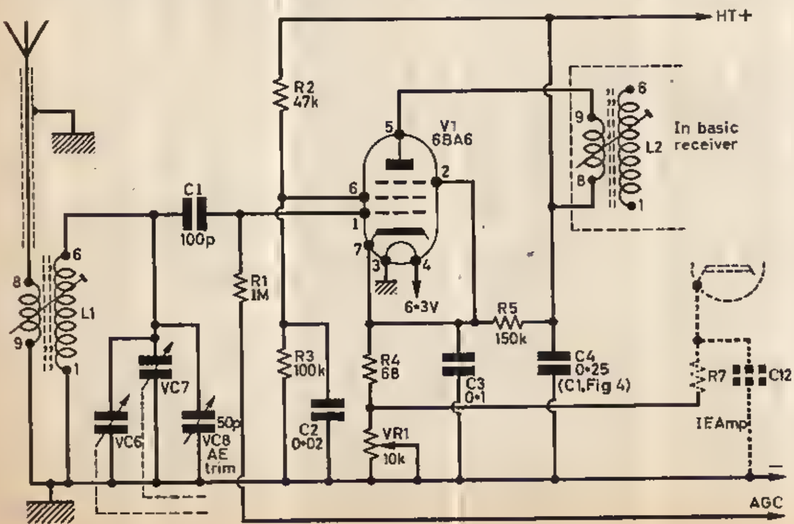


Fig. 5: Circuit of the r.f. amplifier, to give increased sensitivity.

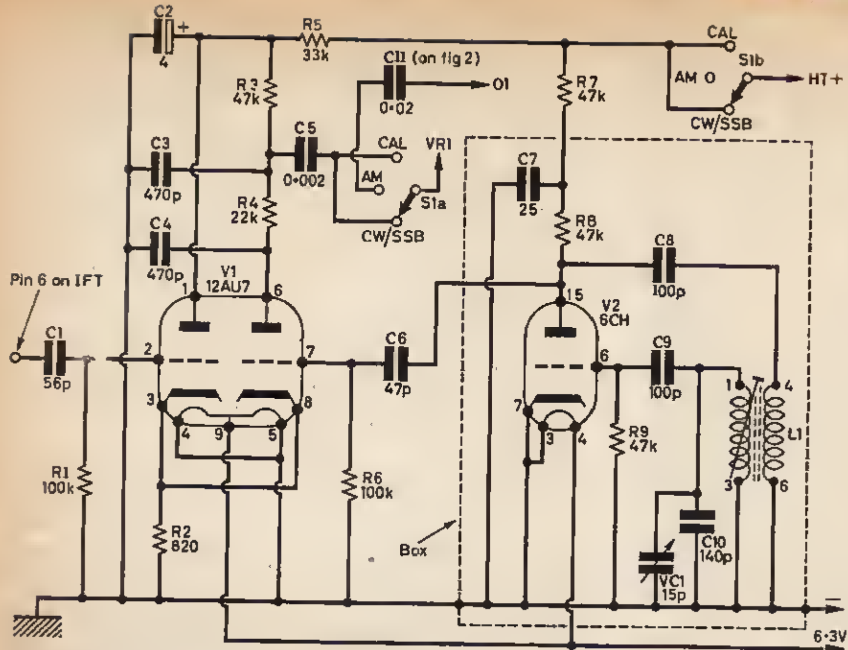


Fig. 6: Circuit of the carrier oscillator and product detector to permit reception of s.s.b. and c.w. signals.

components. A blue lead is run out from pin 4 for heater, a yellow lead from tag 1 for C6, and a red lead from C7 for h.t. circuits.

A back plate 3×2in with a ½in flange to bolt to the chassis is hent up, or cut from a spare 3in wide "universal chassis" member. It is drilled so that it can he attacbed to the back of the CO box with four self-tapping screws into the flanges of the latter.

The CO hox is placed so that the hush and spindle of VC1, Fig. 6, project tbrougb a clearance bole in the receiver panel. It is fixed here by two holts through the lower flanges of the hox and chassis. The hack plate described is then screwed on from behind, and is bolted to the receiver chassis.

When VC1 is balf closed the knob pointer or mark should he vertical.

Tbe function switch is put in the position shown, and h.t. and beater circuits connected.

Most of tbe small components for the product detector are supported hy the valveholder pins, and an adacent tag strip. The lead from C5 to S1 runs against the chassis. Keep grid circuits away from leads carrying heater current.

After connecting C1 realign the last i.f.t. in the way explained. Tune in any transmission, with the switch at the "AM" position and place VC1 in the central position, as mentioned earlier.

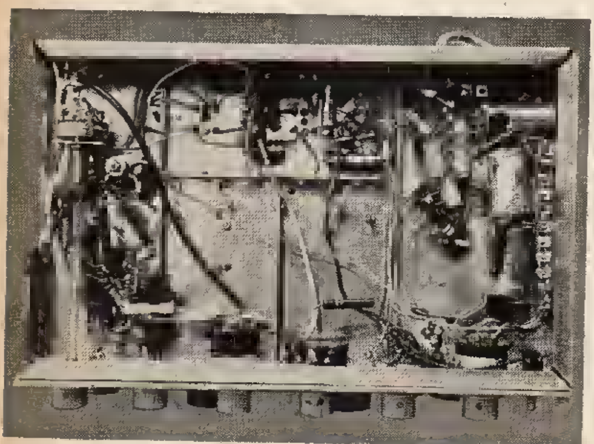
Switch to SSB/CW and rotate the core of the CO coil until a strong heterodyne is produced. This is an audio tone whicb falls in frequency as the correct core position is reached. Passing this position results in the tone beginning again and rising in frequency. The correct core setting is the central, zero heat setting. An audio tone which rises in pitcb can then be produced by rotating VC1 either way.

When receiving s.s.b. the carrier oscillator has to replace the suppressed carrier, heing adjusted slightly one way or the other, as necessary by VC1. The sidehand normally employed depends on the amateur band in use, hut the adjustment of VC1 will soon hecome clear.

For c.w. reception, use VC1 to ohtain the most suitahle pitch, placing the CO either above or below the c.w. as found to give least interference.

CRYSTAL FILTER

This incorporates an extra stage of i.f. amplification, 3-position selectivity switch, and variable phasing control using the circuit in Fig. 7. It provides



This photograph of the underneath of the receiver can be compared with Fig. 4 (Part 1).

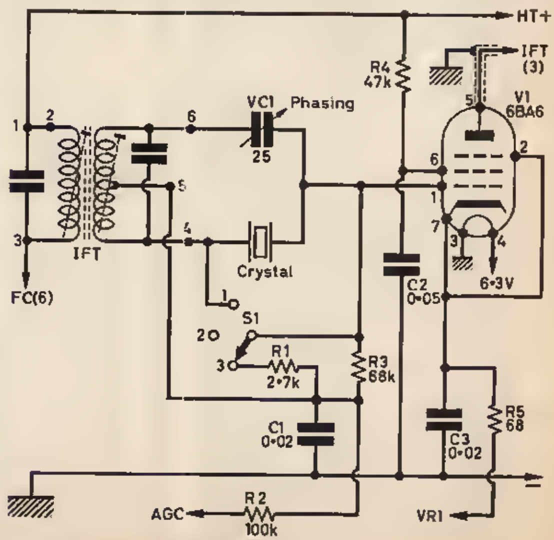


Fig. 7: For increased gain and selectivity this crystal filter unit can be fitted.

★ components list

RF STAGE:—

R1 1MΩ ½W R3 100kΩ ½W R5 150kΩ 1W
R2 47kΩ 1W R4 68Ω ½W All 10% tolerance

VR1 10kΩ wire wound potentiometer, linear.

C1 100pF SM C3 0·1μF
C2 0·02μF disc C4 (C1, Fig. 4)
VC6 Front section of bandset capacitor
VC7 Front section of bandspread capacitor
VC8 50pF variable

L1 From basic receiver (L2)
L2 Miniature plug-in coils (Denco 'Yellow' Ranges 2, 3, 4 and 5)

Miscellaneous:
V1, 6BA6. Valveholders B7G (1) with screen, B9A (1).

CARRIER OSC/P. DETECTOR:

R1 100kΩ ½W R4 22kΩ ½W R7 47kΩ ½W
R2 820Ω ½W R5 33kΩ 1W R8 47kΩ ½W
R3 47kΩ ½W R6 100kΩ ½W R9 47kΩ ½W

C1 56pF SM C6 47pF SM
C2 4μF 350V C7 0·25μF 350V
C3 470pF C8 100μF SM
C4 470pF C9 100pF SM
C5 2000pF C10 140pF SM
VC1 15pF variable

V1 12AU7 V2 6C4

Miscellaneous:
Valveholders, B9A (1), B7G (1) with screen. S1a/b/c 3 pole 3 way wafer switch (S1c is for crystal marker). Universal chassis flanged members 7×2in (1) 4×3in (Home Radio). L1, BFO2/465 (Denco).

CRYSTAL FILTER:

R1 2·7kΩ ½W R3 68kΩ ½W R5 68Ω ½W
R2 100kΩ ½W R4 47kΩ ½W

C1 0·02μF C2 0·05μF C3 0·02μF
VC1 25pF variable

Miscellaneous:
V1, 6BA6. Crystal, 465kHz (see text). IFT, IFT11/465/CT (Denco). S1, 1 pole 3 way wafer switch. Valveholder B7G and screen. Bushes (2) DL52C, couplings (2) DL60, ¼in dia. polystyrene rod (Denco). Universal chassis side 7×2in (1), 4×3in (1) (Home Radio).

CRYSTAL MARKER:

R1 470kΩ ½W R3 100kΩ ½W
R2 10kΩ ½W R4 22kΩ ½W

C1 220pF SM C3 0·02μF disc
C2 0·02μF disc C4 100pF SM
VC1 100pF variable

Miscellaneous:
Crystal, 1MHz. Valve, EF91. Valveholder, B7G. Universal chassis side 4×3in (Home Radio). Crystal holder.

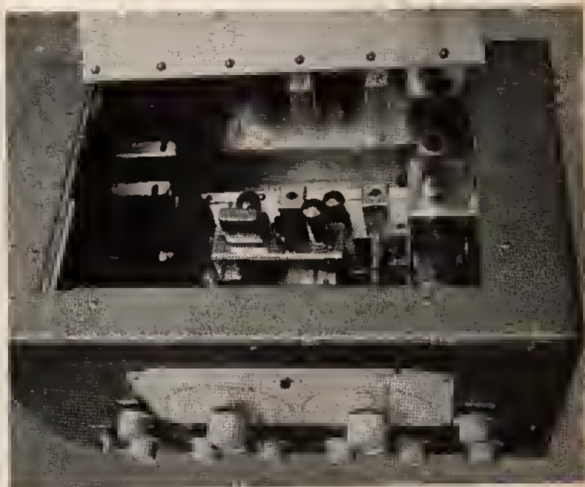
additional gain, and a very great increase in selectivity.

The i.f.t. has a centre-tapped secondary, and VC1 can be adjusted to balance stray capacitance in the crystal and wiring, or to give a rejection notch either side of the crystal frequency. With the switch in position 1, the crystal is out of circuit, and selectivity is that provided by the three i.f.t.'s. With position 2, the crystal is in use working into the relatively high impedance of R3. For position 3, the crystal provides maximum selectivity. Position 1 is suitable for general reception and position 2 is used for other signals except when severe interference from adjacent transmissions is troublesome.

A 3×2×2in box is made in the same way as described for the carrier oscillator. The circuit in Fig. 7 is built entirely in this box, which is then bolted to the chassis, and closed by a plate fixed to the back with self-tapping screws.

The i.f. transformer is situated above a hole in the main chassis, so that its lower core can be adjusted.

VC1 must be insulated from the front of the box, and it is also mounted so as to avoid unnecessary



stray capacitance to the metal. This was done by punching a 1in hole in the box and bolting a $\frac{1}{16}$in strip of paxolin across inside, with a hole to take the capacitor bush. The spindle is extended by using a small coupling and length of ¼in diameter insulated rod, which runs through a bush at the panel.

The 3-way switch is situated immediately under the box, on a chassis bracket and an extension spindle is also fitted.

The exact frequency of the crystal is not too important, provided it falls near the frequency of the i.f.t.'s (465kHz). A 464kHz surplus crystal was used and a 455kHz crystal, available as a spare for a well-known communications receiver, also tried. No difficulty arose in adjusting the i.f.t.'s to 455kHz.

A wire-ended crystal can be supported between pin 4 and VC1. Other crystals may need fixing to an insulated strip or bracket.

Coloured leads pass down through the chassis to identify heater and other circuits. R2 runs to the common a.g.c. line. R5 is connected to the r.f. gain control, which now adjusts the bias of all i.f. stages.

RF leakage round the filter will degrade the very high selectivity so the lead from the f.c. anode to i.f.t. primary is screened from the valveholder right up to the pin of the i.f.t. The anode lead of V1, Fig. 7, is similarly screened.

ALIGNMENT WITH FILTER

Alignment should be checked with a meter, such as used earlier when adjusting the i.f.t. cores. A multi-range meter clipped in to read cathode current of one of the stages receiving a.g.c. is suitable, adjustments being directed towards securing minimum current.

Set the phasing control about half open and the selectivity switch at 1. Tune in a strong transmission. Switch to position 2 and tune slowly across the signal, observing the tuning meter. There will probably be one normal response on the meter, observed as a steady rise and fall while tuning through the signal. A second response should be found, very much sharper, and probably giving only a small dip on the meter. This is the crystal frequency. Leave the tuning at this frequency, and adjust all the i.f.t. cores for best results (lowest meter reading). Switching from 1 to 2 and tuning should show that the i.f.t.'s are now virtually on the crystal frequency.

The phasing control is now adjusted slowly to find the exact point where selectivity is greatest and the

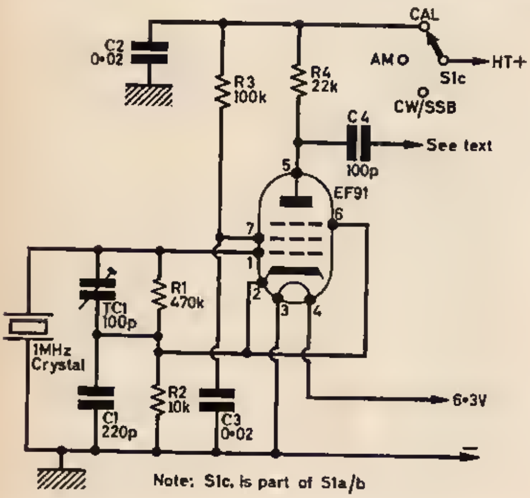


Fig. 8: As a finishing touch this 1MHz crystal marker will provide calibration points throughout the range of the receiver.

response peak (or meter movement) approximately symmetrical a each side of the signal. Repeat this with the switch at 3, and adjust all the i.f.t. cores slightly, if necessary, with a signal tuned in precisely. Adjust the pointer of the phasing control so that it is vertical without moving the control itself.

With the switch at 2 or 3, slight adjustments of VC1 one way or the other will produce a rejection notch which can be moved across the i.f. passband. This should be found to eliminate any interfering signal which is so near the wanted signal that it produces a heterodyne.

CRYSTAL MARKER

Fig. 8 is the circuit of the harmonic marker, which provides crystal-controlled "pips" from 1MHz to 30MHz. TC1 allows a slight shift in crystal frequency, so that the unit can be set to zero beat with MSF on 5MHz. HT is applied to the EF91 only when the function switch is in the "Calibrate" position.

The marker is assembled on a sub-chassis which is 1¾in. high, 4in. wide, and 1¼in. deep made from a single "universal chassis" member 4×3in cut to leave two pieces, one 4×1¾in and the other 4×1¼in. The flange of the smaller piece is bolted to the straight edge of the larger piece, which can later be attached to the chassis by its flange. After wiring, it is bolted 3½in from the rear edge of the chassis, behind the bandspread capacitor.

The EF91, TC1, and crystal holder are mounted in line on the top of the sub-chassis with TC1 insulated from the metal. This may be done by punching a hole which adequately clears the bush, and using two washers of $\frac{1}{16}$in paxolin.

A small tag strip anchors C2, R3 and R4, and a flexible lead to pass to the function switch. C4 is similarly anchored, and a rigid insulated wire a few inches long is soldered here and runs near the ganged tuning capacitor. This was found to give adequate coupling into the receiver.

A blue lead from pin 4 passes to the heater circuit. The chassis return is formed by bolting the marker to the receiver chassis.

Initially place TC1 about half closed. With the function switch at "Calibrate" the 5th harmonic at 5MHz can be located with the appropriate coils in place. Switch off the marker and tune in MSF, which will probably be found on almost exactly the same frequency. If necessary, TC1 is rotated so that the marker harmonic is on the same frequency. Turning TC1 either way from this position will cause a flutter, rising to a low pitched growl or audio tone, the correct setting for VC1 being the central, zero position.

The marker can be used for calibration, enabling the 1MHz tuning points to be marked in, from 1MHz to 30MHz.

It also allows exact positioning of the bandset capacitor, so that frequencies in a narrow band can be read with the bandspread tuner. To do this, turn the bandspread pointer to the nearest MHz reading, and adjust the handset capacitor for zero beat. This assures exact reading on the bandspread dial, which is not possible if the bandset capacitor is adjusted visually. This procedure is used at 4MHz, 7MHz, 14MHz, 21MHz and 28MHz, for the 80, 40, 20, 15 and 10 metre amateur bands.

GENERAL NOTES

A piece of thin perspex 8¼×3½in is used to cover the scales, held with chrome bolts. The perspex was held slightly clear of the panel by ½in wide strips of card at the bottom and each side. This allows slightly thinner card to be slid in, so that a separate pair of scales can be used with each set af coils. There is sufficient space to take all the four ranges on a single permanent card, if preferred.

The case top was cut to give an opening lid about 11½×7in. A line scribed ¾in from the back, 1½in from the front, and 1¾in from each side. A small drill is used to start a metal saw, to remove this piece. Strips about 1in wide are bolted on inside the cabinet, for the piece removed to close upon, and it is secured along the back with a piano type hinge.

Several ½in holes are punched in the case bottom, and along the back, for ventilation. Openings 3½×1½in are cut for the aerial and other connections and the mains cord. This can be done by punching pairs of 1½in diameter holes, and sawing between them. ■