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amateur radio circuits book

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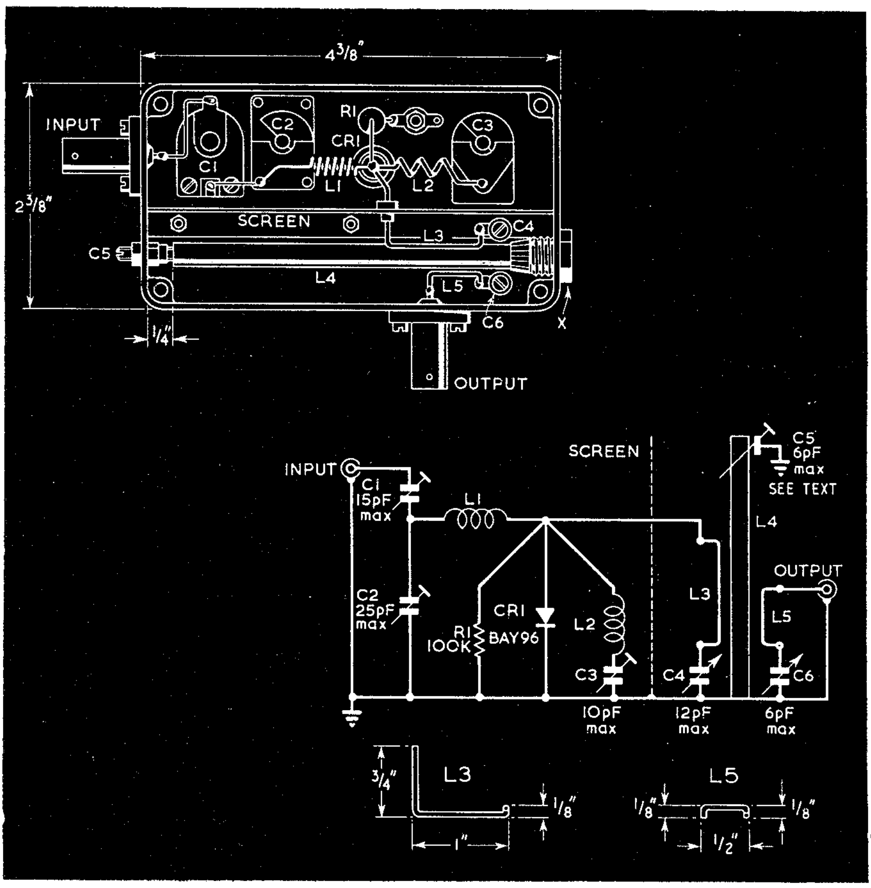

Amateur Radio Circuits Book

Compiled by G. R. Jessop, C. Eng., MIERE, G6JP

RADIO SOCIETY OF GREAT BRITAIN
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Foreword to Second Edition

In preparation of the second edition of this collection of circuits pertaining to Amateur Radio, a considerable number of new circuits has been reviewed, a representative selection included and a number of those in the first edition replaced. The circuits cover a wide variety of applications in radio equipment. They are mainly in the form of single stage diagrams accompanied by typical component values, but in a few cases some additional information has been included where this extra data is essential. Several complete circuits are included where elaboration is desirable for clarity.

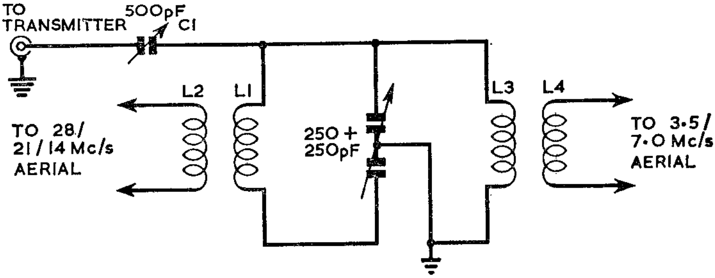
As far as possible, valve and semiconductor alternatives are provided, and in a few cases constructional data has also been included.

It is hoped that this enlarged edition more completely covers the needs of the home constructor and experimenter. The author wishes to acknowledge the considerable assistance given by the following members of the Society's Technical Committee: Mr. B. Armstrong, G3EDD, Mr. G. Fox, G3AEX, Mr. J. Mathews, G6LL and Mr. G. D. Roe, G3NGS.

Suggestions for further improvement of future editions will, of course, be welcomed by the author and publisher.

G. R. Jessop, G6JP

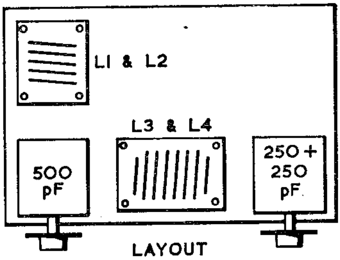
AERIAL MATCHING



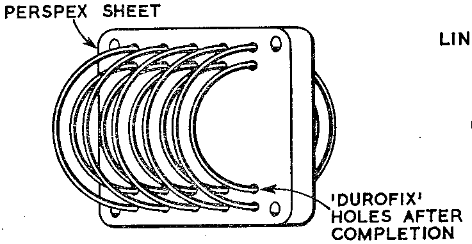
L1 AND L2 — 5 TURNS
L3 AND L4 — 8 TURNS

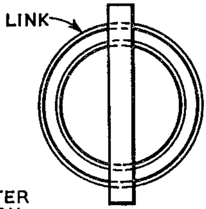
L1 AND L3 ARE ARRANGED TO BE INSIDE L2 AND L4 RESPECTIVELY

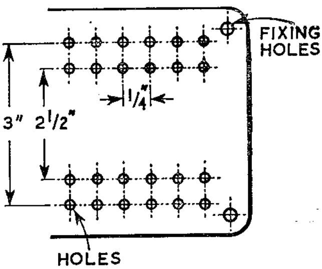
NOTE THAT BOTH SIDES OF C1 ARE ABOVE EARTH

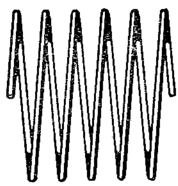


LAYOUT



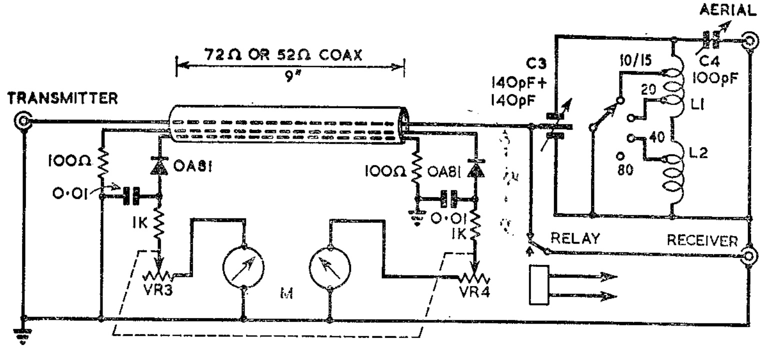




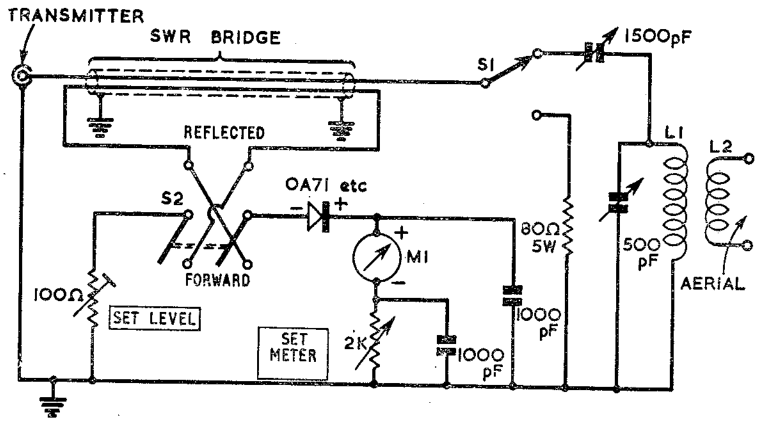


A Z-match tuning unit for coupling a transmitter to an aerial. The circuit can be conveniently arranged as in the layout diagram. The coils should be $2\frac{1}{2}$ in. and 3 in. diam., as shown in lower diagrams, and 14 s.w.g. wire is suitable. The coils should preferably be wound first, with $\frac{1}{4}$ in. spacing between turns, and then threaded on to the former. This matches into 600 ohm lines.

AERIAL MATCHING



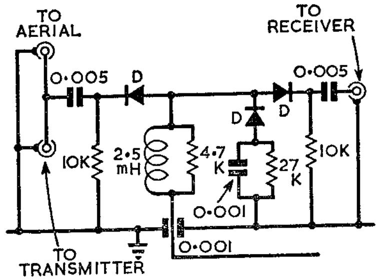
An h.f. bands matching unit for 10–80m incorporating a standing wave indicator for 50 or 75 ohm cable. M can be a cross-arm aircraft indicator with two 500 μA movements or separate meters. VR3, VR4, 3000 ohm potentiometers on same shaft. RL, aerial changeover relay with make contact; L1, 10 turns, 16 s.w.g., 1½ in. diam. with taps at 3 turns for 10 and 15m and 7 turns for 20m; L2, 24 turns (Command transmitter coil), tapped at 17 turns for 40m. The r.f. pick-up wires are of 22 s.w.g. enamelled wire threaded under the outer sheath of the coaxial line without any twists.



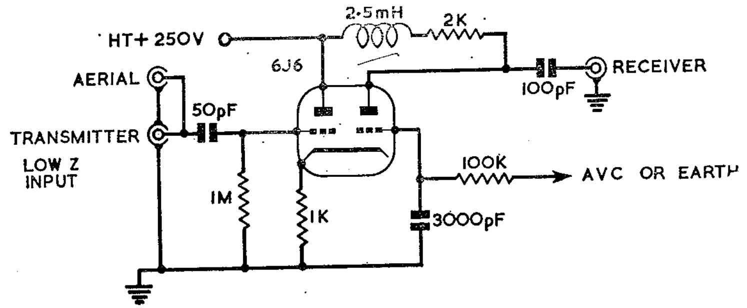
A Top Band Z-match coupler.
- L1 40 turns, 18 s.w.g. enam., close wound, 1½ in. diam.
- L2 25 turns, 18 s.w.g. enam., close wound on top of L1, interleaved with suitable insulation.
- M1 0–500 μA f.s.d.
- S1 s.p.d.t. switch.
- S2 d.p.d.t. switch.

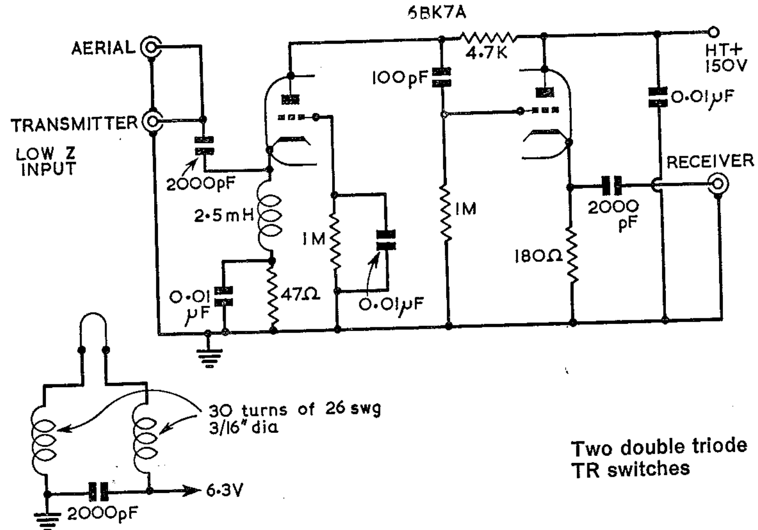
The s.w.r. bridge consists of 3 ft. of semi-air-spaced 75 ohm coaxial feeder, with a 22 s.w.g. enam. coupling wire inserted under the outer braid. Care should be taken to ensure that the coupling wire is parallel to the inner wire of the coaxial cable.

AERIALS—TR Switches

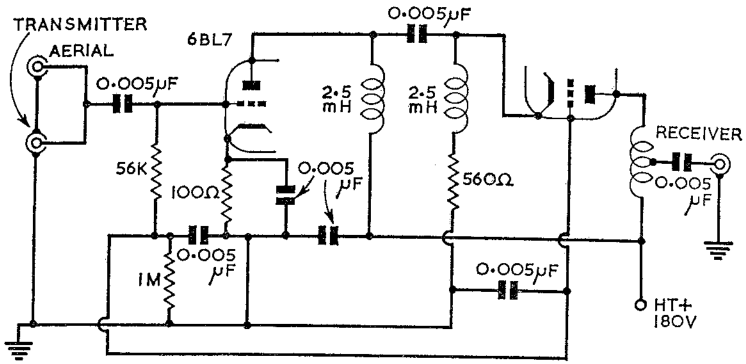


A semiconductor diode TR switch. The bias for good isolation is + 20 volts for receive and —350 volts for transmit. D, 1N2071 or equivalent silicon power rectifier of 600 p.i.v. rating.
With all TR switches care should be taken to make sure that TVI is not caused.

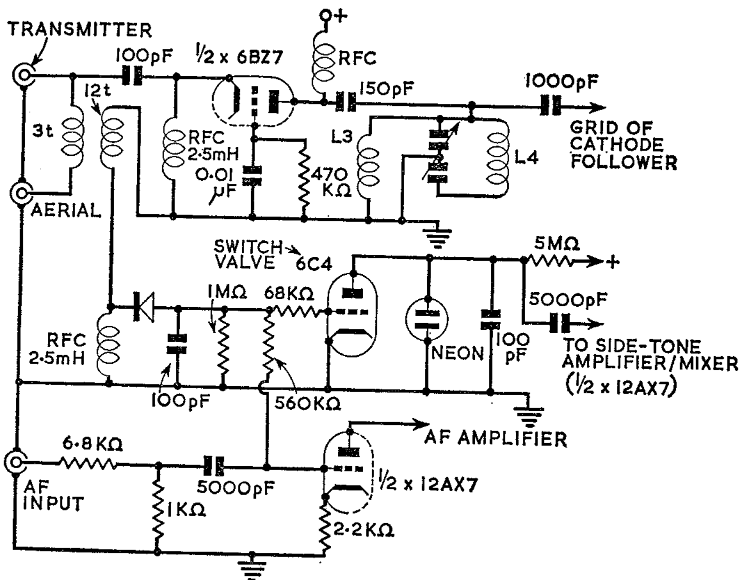




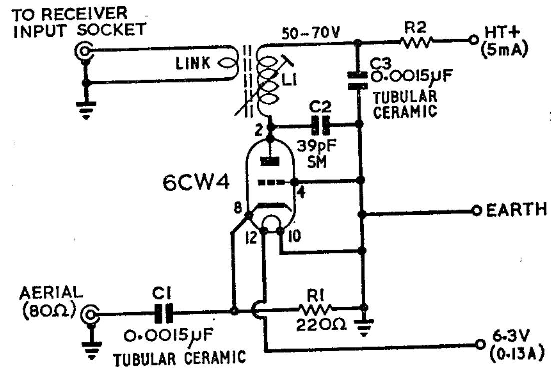
Two double triode TR switches



A TR switch. In this diagram, the output coil must suit the band in use and the tap position must be adjusted to match the receiver input. With all TR switches care should be taken to make sure that TVI is not caused.



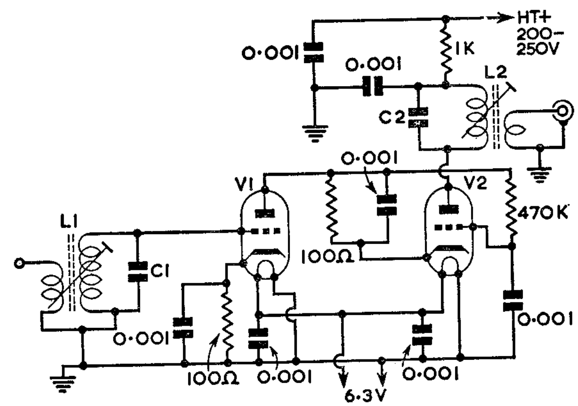
A TR switch, with sidetone generator and a.f. muting. L3, L4 form a multiband tuner with a broadcast type twin gang variable capacitor as the tuning capacitance across L4. The diode may be a 1N34, but any r.f. diode should be satisfactory. Similarly, the sidetone neon, originally an NE-2, is not critical. The 3 turn aerial coupling coil should be less than ¼ in. diam. The 12 turn coil is wound over the 3 turn coil with ⅛ in. clearance. L3, 23 turns, 16 t.p.i., ½ in. diam. L4, 19 turns, 32 t.p.i., 1 in. diam.



H.f. band preamplifier using a grounded grid triode.

C1, 3	0·0015 μF tubular ceramic.
C2	39 pF silvered mica.
R1	220 ohms.
R2	selected to suit the h.t. voltage.
L1	(14 Mc/s) 16 turns, 24 s.w.g. enam. copper, ½ in. diam.; (21 Mc/s) 12 turns; (28 Mc/s) 8 turns. The link winding is wound over the h.t. end of L1, and consists of 2–4 turns, depending on the desired output impedance; former, S34 (Salford Electrical Insts.).

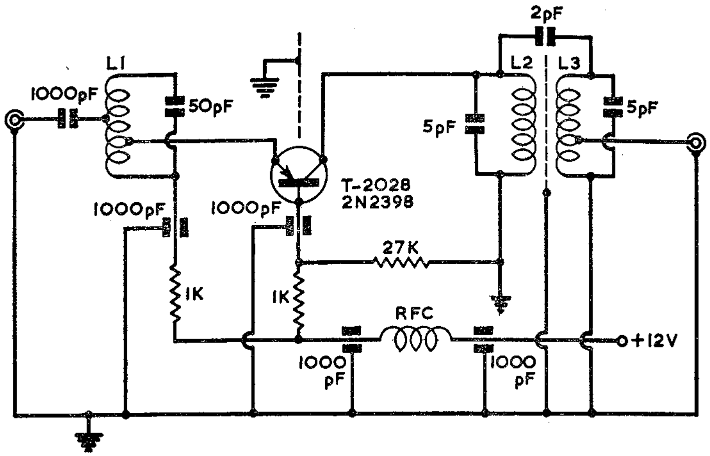
A gain of the order of 10db at a noise factor of about 3db may be expected with this amplifier.



Cascode preamplifier for 21 or 28 Mc/s.

C1, 2	(21 Mc/s) 15 pF; (28 Mc/s) 5 pF.
L1, 2	18 turns, 36 s.w.g. enam., ¼ in. diam., slug tuned. Link windings 1½ turns each.
V1, 2	6CW4.

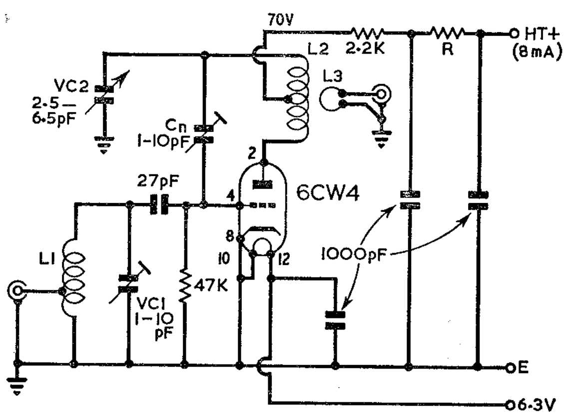
For 15m, align L1 and L2 to 21·25 Mc/s; and 10m, align L1 to 28·5 Mc/s, and L2 to 29 Mc/s.



Transistor preamplifier for 144 Mc/s.

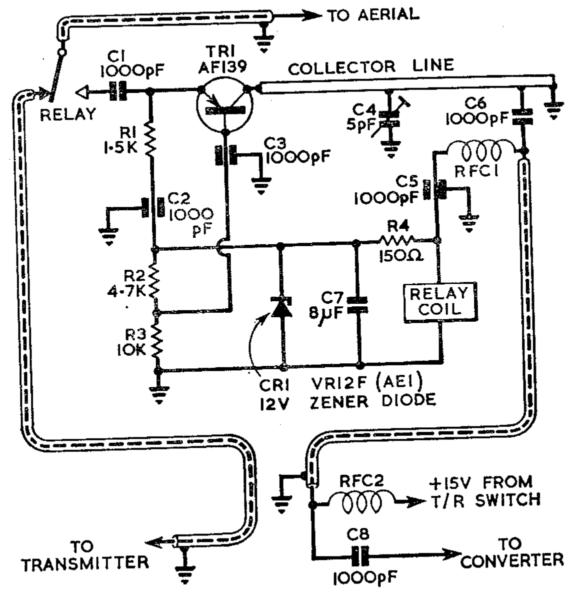
- L1 4 turns, 20 s.w.g., emitter tap at 1 turn, aerial tap at $1\frac{1}{2}$ turns, $\frac{1}{4}$ in. diam.
- L2 3 turns, 18 s.w.g., $\frac{5}{16}$ in. diam.
- L3 3 turns, 18 s.w.g., tapped at $\frac{5}{8}$ turns, $\frac{5}{16}$ in. diam.
- RFC 19 in. 26 s.w.g., $\frac{3}{16}$ in. diam.

In the above circuits, the input connection to L1 should be adjusted for the best noise factor. This will not necessarily be the same point as maximum gain.

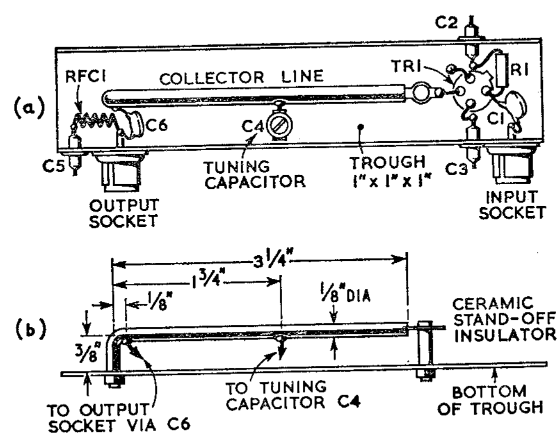


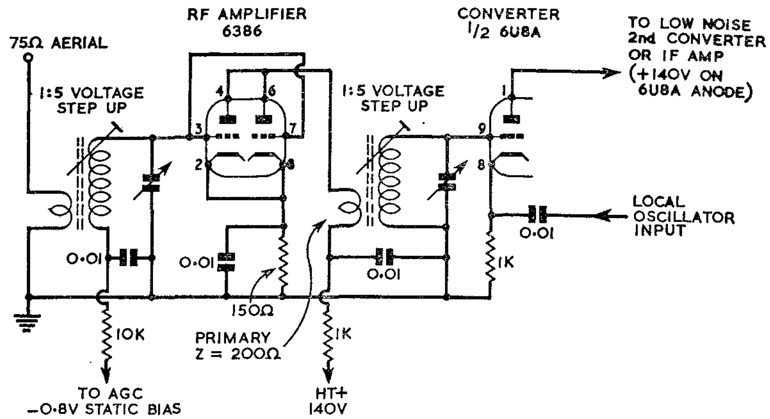
A bridge neutralised Nuvistor preamplifier for 144 Mc/s.

- L1 5 turns, 20 s.w.g. tinned copper, tapped at $1\frac{3}{4}$ turns, $\frac{1}{4}$ in. i.d., $\frac{3}{4}$ in. long.
- L2 8 turns, 16 s.w.g. enam. copper, tapped at $4\frac{1}{2}$ turns from anode end, $\frac{3}{8}$ in. i.d. 1 in. long.
- L3 1 turn link of insulated wire around centre of L2.
- R to suit h.t. supply voltage.

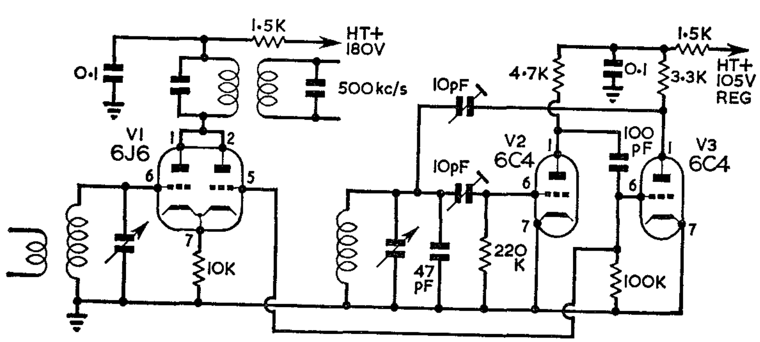


A 432 Mc/s mast-head preamplifier. This can provide a performance better than that normally attainable by eliminating the (typically) 2·5db feeder " attenuator " ahead of a preamplifier. Care is necessary to ensure that the transmitter output does not damage the transistor. This risk can be eliminated by using a suitable length of coaxial cable between the relay and feeding into C1. About 4 in. should be correct length. The r.f. chokes RFC1 and RFC2 must be effective or there will be some loss of performance.



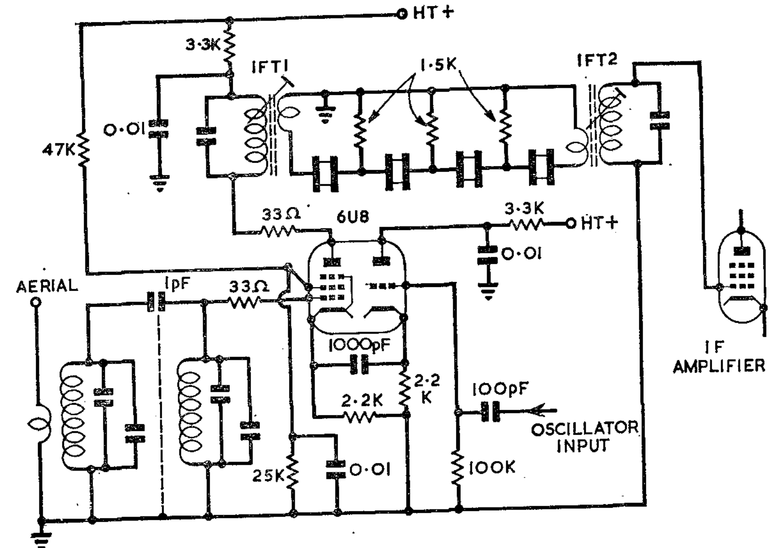


Low noise triode preamplifier-mixer with good cross-modulation characteristics. The aerial coil should have a 75 ohm primary, and a 1:5 turns ratio, while the mixer coupling coil should have a primary impedance of the order of 200 ohms, with a turns ratio of 1:5. The r.f. stage has an overall gain of 4. In this type of circuit it is essential that the primary of the mixer coupling is low impedance to prevent instability.

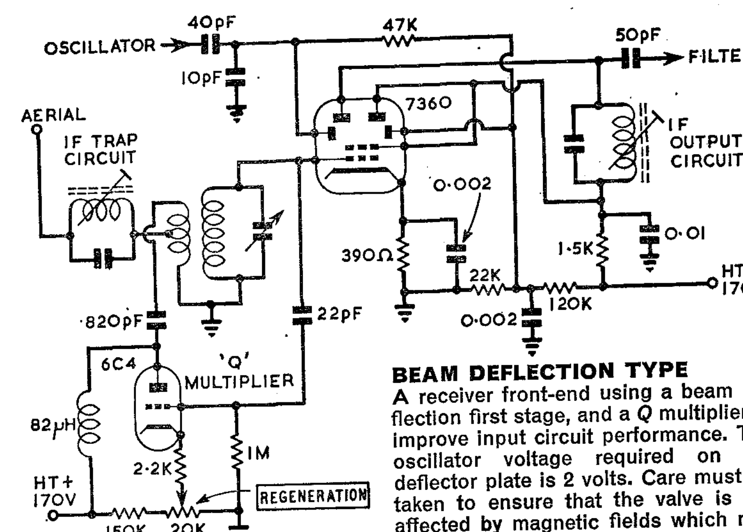


Triode mixer with Franklin local oscillator, suitable for a receiver front end or converter on the h.f. bands. V2 and V3 can be a 12AT7 double triode. The value of the two feedback capacitors (10 pF) should be adjusted to as low a value as possible consistent with free oscillation. The 47 pF capacitor across the tuned circuit may be of suitable temperature coefficient to reduce frequency drift.

RECEIVING—Converters

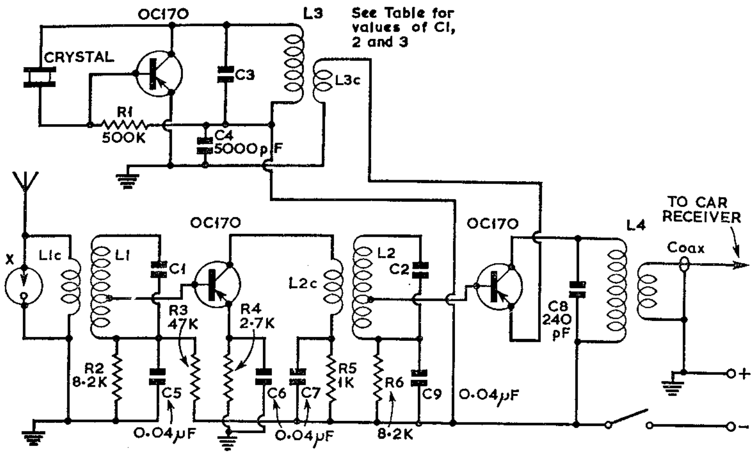


Bandpass input circuit, which may comprise any number of circuits to achieve the required selectivity. I.f. transformers feeding into and out of the fixed crystal filter should have low impedance windings (about 10 per cent of the normal winding turns). A suitable i.f. for this arrangement is 1·6 Mc/s.



BEAM DEFLECTION TYPE

A receiver front-end using a beam deflection first stage, and a *Q* multiplier to improve input circuit performance. The oscillator voltage required on the deflector plate is 2 volts. Care must be taken to ensure that the valve is not affected by magnetic fields which may induce modulation hum.



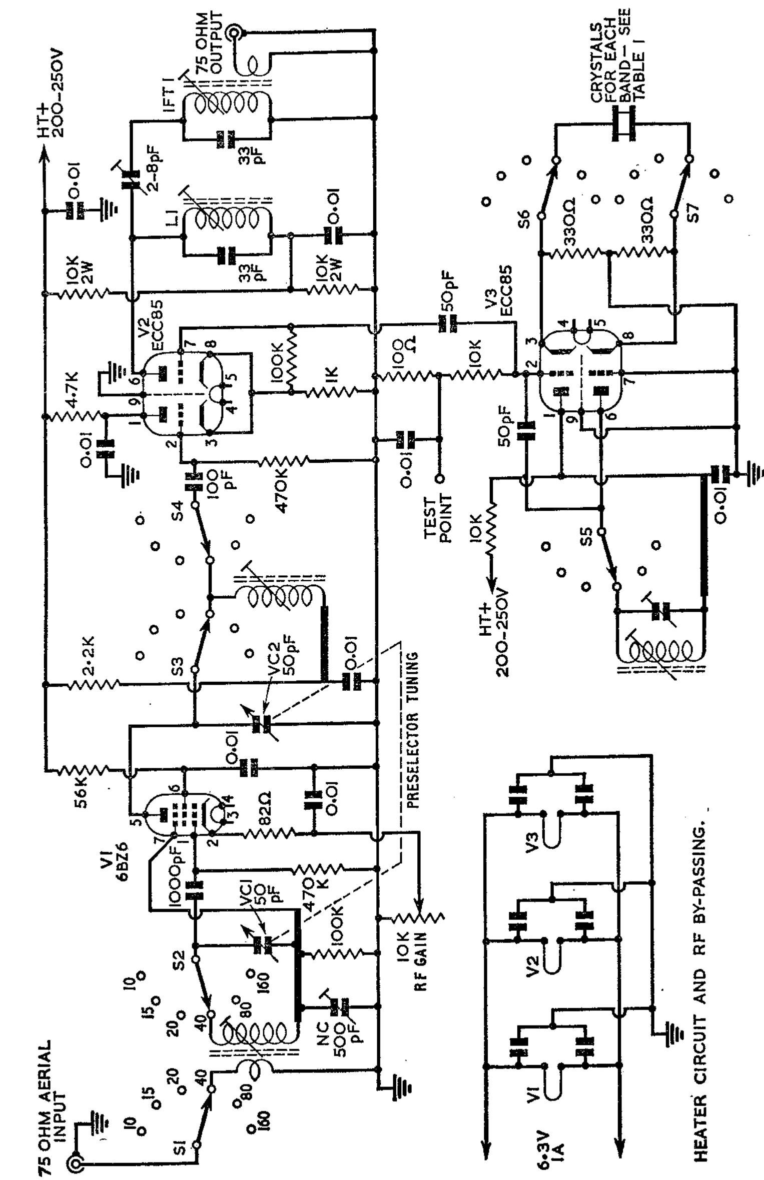
Transistor h.f. band converter suitable for use ahead of a car radio or other broadcast receiver. The circuit as shown is for single band operation and coil data is given below for most of the h.f. bands. Multiband operation can, however, be arranged by the introduction of suitable switches.

Band Mc/s	L1	L2		L1c	L2c	L3		L3C		C1, 2, 3 pF	Crystal kc/s	I.F. Range kc/s
	Turns	Wire	Tap	Turns	Wire	Turns	Wire	Turns	Wire			
1·8	140	40	25	10	36	100	36	10	36	40	2700	700–900
3·5	58	40	16	8	32	80	32	5	36	40	2850	650–950
14	23	24	6	5	24	26	24	3	24	15	4450*	650–1000
21	15	20	5	3	20	15	20	2	24	15	6783*	650–1100
28	12	20	4	2	20	12	20	2	24	15	9283*	650–1650

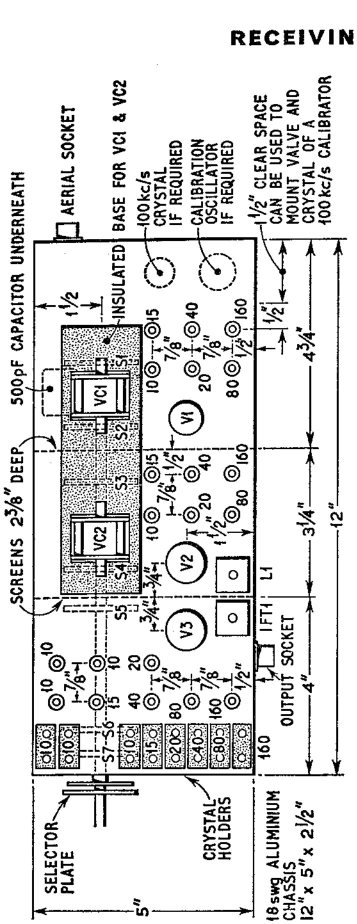
Coils wound on ½ in. formers with dust cores   * third overtone is used

L4 Standard broadcast band coil connected back to front to feed receiver by low impedance coaxial lead.

X Protective device to effectively short circuit the input in the presence of a local transmitter. A low voltage NE2 neon or a ZA6 Zener diode would be suitable.



The circuit of an h.f. amateur bands converter for attaching to the input of a general coverage receiver tuning from 5 to 5·5 Mc/s. All the coils, except L1 and IFT1, are manufactured by Electroniques (Prop. STC) Ltd. L1, 75 turns of 36 s.w.g. enamelled wire close wound on a 0·3 in. diam. former with dust core. IFT1 is identical to L1 except that it has a secondary winding of 3 turns of 24 s.w.g. enamelled wire tightly coupled at the cold end of the primary. For crystal frequencies, refer to Table 1 on page 18.

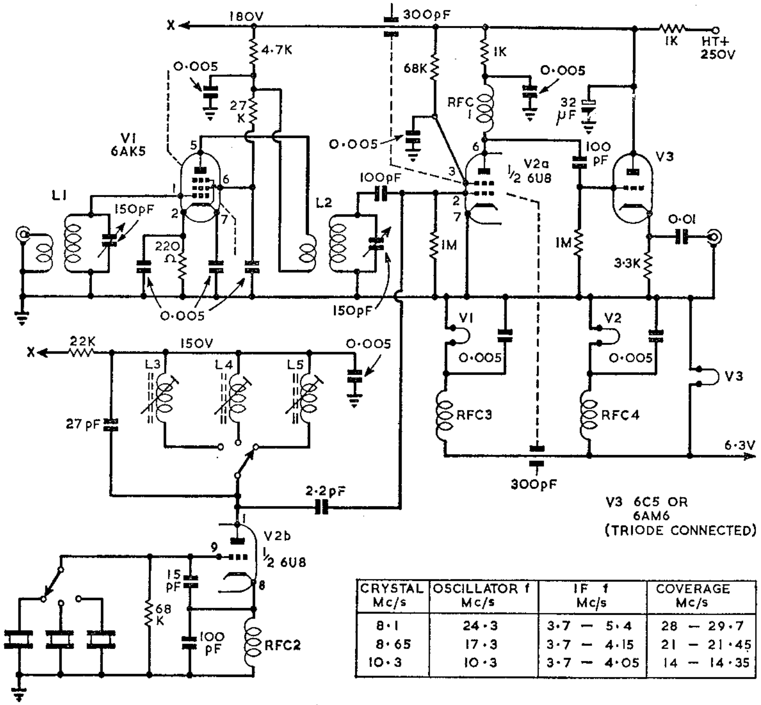


The top view of the chassis for the converter on page 17, showing the suggested positioning of the major components. Provision has been made for eight crystals and eight oscillator coils, which enable three 500 kc/s sections of the 10m band to be covered. If all the ranges are required, the switch banks S1 to S7 will be 1 pole, 8 way wafers, with the three 10m contacts of S1 to S4 strapped together, and connected to the appropriate 10m band coil. To align the bandpass coupler, unscrew the 2–8 pF trimmer, and adjust both dust cores of L1 and IFT1 for maximum output at exactly 5·25 Mc/s. Then increase the capacitance of the trimmer until the response at 5 and 5·5 Mc/s is not more than 3db down.

TABLE 1

Band	Mode	Output Frequency
160	Fundamental	7,000 kc/s
80	Fundamental	9,000 kc/s
40	Fundamental	12,500 kc/s
20	Third Overtone	19,500 kc/s
15	Third Overtone	26,500 kc/s
10	Third Overtone	33,500 kc/s
10	Third Overtone	34,000 kc/s
10	Third Overtone	34,500 kc/s

All crystals FT243 type holder with ½ in. pin spacing for series resonance operation.

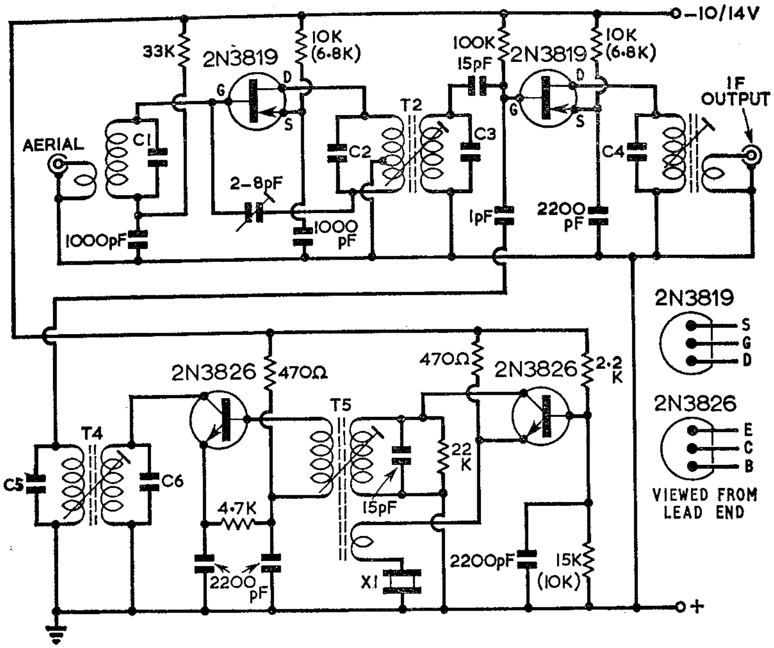


CRYSTAL Mc/s	OSCILLATOR f Mc/s	IF f Mc/s	COVERAGE Mc/s
8·1	24·3	3·7 — 5·4	28 — 29·7
8·65	17·3	3·7 — 4·15	21 — 21·45
10·3	10·3	3·7 — 4·05	14 — 14·35

Crystal controlled converter for 14, 21 and 28 Mc/s.

L1, 2	8 turns 16 s.w.g. ¾ in. diam. close wound. Coupling coil 3 turns, spaced 1 turn from main coil.
L3	10 turns 20 s.w.g. close wound.
L4	16 turns 20 s.w.g. close wound.
L5	27 turns 24 s.w.g. close wound.
RFC1, 2	2·5 mH choke.
RFC3, 4	31 turns 24 s.w.g. close wound.

L3, 4, 5 and RFC3, 4 wound on ⅜ in. formers with dust iron cores.

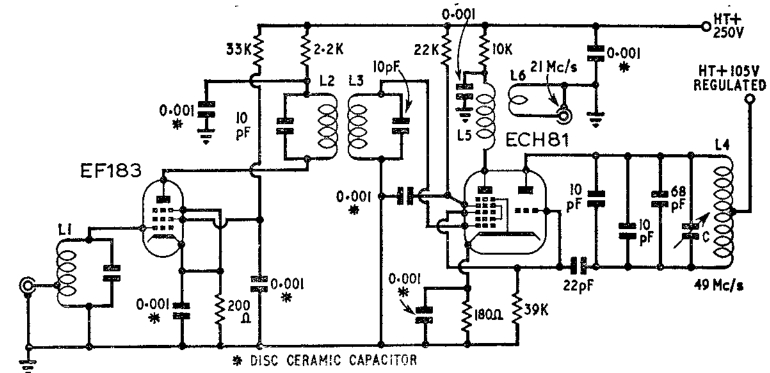


Converters for 70 Mc/s and 144 Mc/s using field effect transistors. These converters can be expected to have noise factors of the order of 3db or better, and to have excellent cross-modulation performance. Resistor values in parentheses are for a supply voltage of 9V. Positioning of the aerial coupling link is critical.

Data for I.F. Transformer T3

Tunable i.f. (Mc/s)	I.f. centre (Mc/s)	X1 Crystal freq. (Mc/s)	T3 primary inductance	Turns	S.w.g.	Former	75 ohm coupling turns	600 ohm coupling turns
Four Metres								
1·8-2·4	2·08	34·15	205 μH	66	36	Pot-core	5	13
2·1-2·7	2·38	34·00	158	58	36	Pot-core	4	11
4·1-4·7	4·40	33·00	46·8	31	32	Pot-core	2	6
7·1-7·7	7·40	31·50	16·5	19	28	Pot-core	1	3
9·1-9·7	9·40	30·50	10·3	15	28	Pot-core	1	3
C4, 22pF								
Two Metres								
1·8-3·8	2·62	35·55	369 μH	88	36	Pot-core	6	17
2·0-4·0	2·83	35·50	316	82	36	Pot-core	6	16
4·0-6·0	4·90	35·00	105	47	34	Pot-core	3	9
8·0-10·0	8·95	34·00	31·6	26	32	Pot-core	2	5
14·0-16·0	15·0	32·50	11·3	15	28	Pot-core	1	3
20·0-22·0	21·0	31·00	5·8	29 c/w	26	Aladdin former	2	5
24·0-26·0	25·0	30·00	4·1	27 c/w	26	Aladdin former	2	5
28·0-30·0	29·0	29·00	3·0	25 c/w	26	Aladdin former	2	5
C4, 6·8pF								

See facing page



Simple 70 Mc/s converter.

L1 7 turns, 18 s.w.g., tapped at 3 turns from earth, $\frac{3}{8}$ in. o.d.
L2, 3 6 turns, 24 s.w.g. on same former, spaced $\frac{3}{16}$ in. apart.
L4 3 turns, 16 s.w.g., centre tapped, $\frac{1}{4}$ in. diam. leads to C, $\frac{1}{2}$ in. long.
L5 28 turns, 24 s.w.g., $\frac{1}{4}$ in. diam. former.
L6 3 turns, 24 s.w.g. on same former as L5.
C trimmer of about 10 pF maximum to set oscillator at 49 Mc/s. Other capacitors across L4 should be of suitable temperature coefficient to reduce drift to a minimum.

Coil Data for Converter on page 20

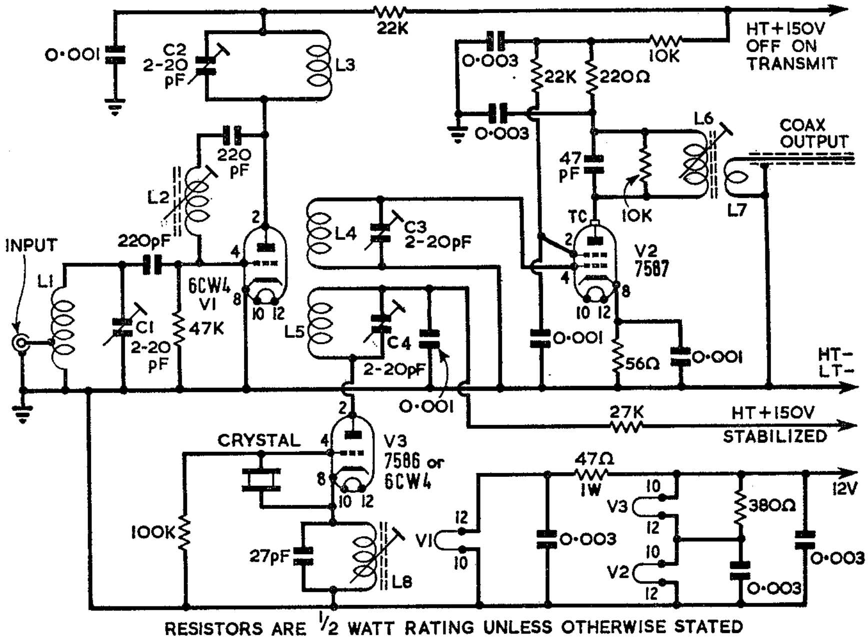
Four Metres

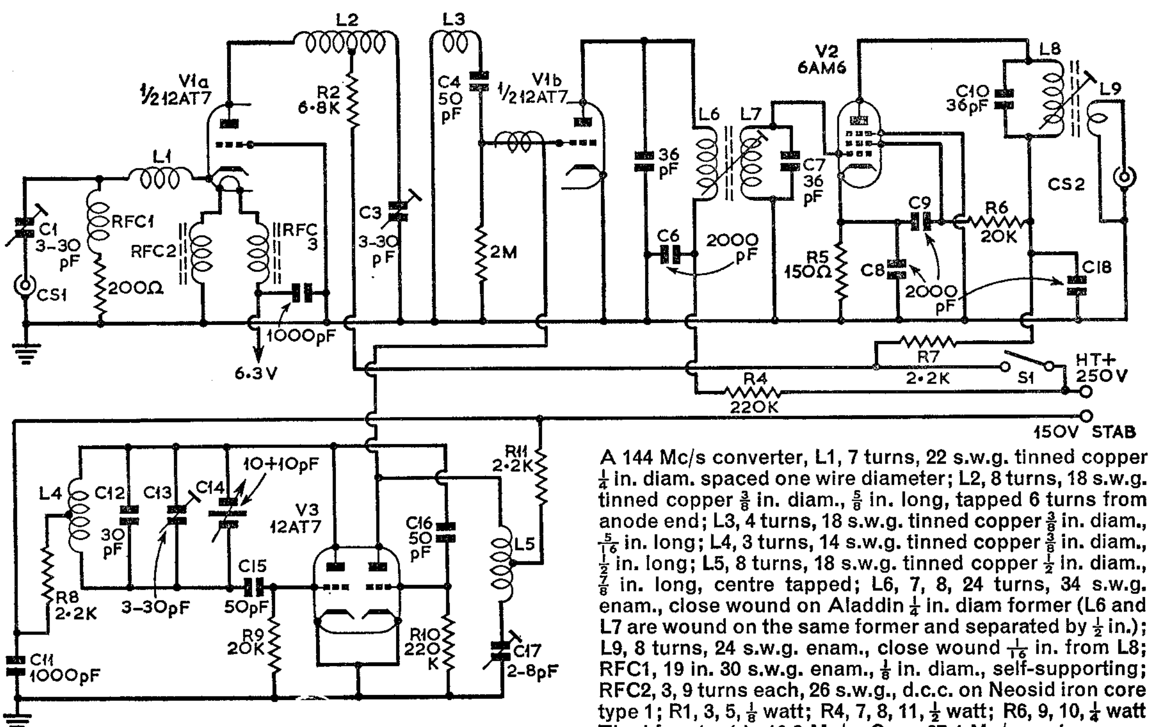
T1 Secondary: 8 turns, 22 s.w.g. enam., self-supporting (wound on $\frac{3}{8}$ in. mandrel). C1, 4·7 pF.
Primary: 3 turns, 22 s.w.g. enam., pushed into " cold " end of secondary.
T2 Primary: 6 turns, tapped 2 turns from earthy end, 22 s.w.g. enam., close wound on 0·3 in. Aladdin former. C2, 10 pF.
Secondary: 6 turns, 22 s.w.g. enam., close wound nearer chassis, spaced $\frac{3}{16}$ in. from primary. C3, 10 pF.
T3 See Table p. 20.
T4 Primary: 4 turns, 22 s.w.g. enam., close wound near chassis on 0·3 in. Aladdin former. C6, 33 pF.
Secondary: 4 turns, 22 s.w.g. enam., close wound, spaced $\frac{1}{4}$ in. from primary. C5, 33 pF.
T5 Main: 11 turns, 28 s.w.g. enam., close wound on 0·3 in. Aladdin former
Emitter: 1 turn, 28 s.w.g. enam., overwound at " cold " end of main winding.
Output: 2 turns, 28 s.w.g. enam., overwound at centre of main winding.

Two Metres

T1 Secondary: 4 turns, 22 s.w.g. enam., self-supporting (wound on $\frac{3}{8}$ in. mandrel). C1, not required.
Primary: 2 turns, 22 s.w.g. enam., pushed into " cold " end of secondary.
T2 Primary: 5 turns, tapped 2 turns from earthy end, 22 s.w.g. enam., close wound on 0·3 in. Aladdin former. C2, 2·2 pF.
Secondary: 5 turns, 22 s.w.g. enam., close wound nearer chassis, spaced $\frac{3}{16}$ in. from primary. C3, not required.
T3 See Table p. 20.
T4, 5 As for 4m, C5, C6 6·8pF.

Circuit of a Nuvistor converter for 70 Mc/s. C1, 2, 3 and 4 are 2–20 pF variable capacitors, and all 0·001 and 0·003 μF capacitors are disc ceramics. Resistors are $\frac{1}{2}$ watt rating except where indicated. L1, 8 turns, tapped at $2\frac{1}{2}$ turns from earthy end, 22 s.w.g., spaced wire diam. $\frac{1}{2}$ in. diam. former, $\frac{1}{2}$ in. leads; L2, 27 turns, 28 s.w.g., close wound, 0·3 in. diam. slug-tuned former; L3, 9 turns, 22 s.w.g., spaced wire diam., $\frac{1}{2}$ in. diam. former, 1 in. leads; L4, 7 turns, 22 s.w.g., spaced wire diam., $\frac{1}{2}$ in. diam. former, 1 in. leads; L5, (60 Mc/s), 6 turns, 22 s.w.g., spaced wire diam., $\frac{1}{2}$ in. diam. former, 1 in. leads. L6, for 10 Mc/s i.f., 34 turns, 28 s.w.g., close wound, 0·3 in. diam. slug-tuned former; L7, 4 turns, small diam. p.v.c. covered wire, wound over earthy end of L6; L8, 12 turns, 28 s.w.g., close wound, 0·3 in. diam. slug-tuned former. Crystal, 20 Mc/s.



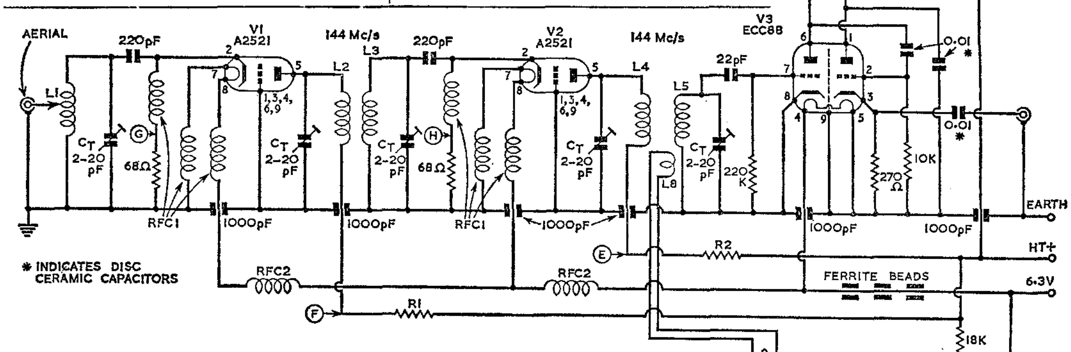


A 144 Mc/s converter, L1, 7 turns, 22 s.w.g. tinned copper $\frac{1}{4}$ in. diam. spaced one wire diameter; L2, 8 turns, 18 s.w.g. tinned copper $\frac{3}{8}$ in. diam., $\frac{5}{8}$ in. long, tapped 6 turns from anode end; L3, 4 turns, 18 s.w.g. tinned copper $\frac{3}{8}$ in. diam., $\frac{5}{16}$ in. long; L4, 3 turns, 14 s.w.g. tinned copper $\frac{3}{8}$ in. diam., $\frac{1}{2}$ in. long; L5, 8 turns, 18 s.w.g. tinned copper $\frac{1}{2}$ in. diam., $\frac{7}{8}$ in. long, centre tapped; L6, 7, 8, 24 turns, 34 s.w.g. enam., close wound on Aladdin $\frac{1}{4}$ in. diam former (L6 and L7 are wound on the same former and separated by $\frac{1}{2}$ in.); L9, 8 turns, 24 s.w.g. enam., close wound $\frac{1}{16}$ in. from L8; RFC1, 19 in. 30 s.w.g. enam., $\frac{1}{8}$ in. diam., self-supporting; RFC2, 3, 9 turns each, 26 s.w.g., d.c.c. on Neosid iron core type 1; R1, 3, 5, $\frac{1}{8}$ watt; R4, 7, 8, 11, $\frac{1}{2}$ watt; R6, 9, 10, $\frac{1}{4}$ watt The i.f. output is 10·2 Mc/s. Osc., 67·4 Mc/s centre.

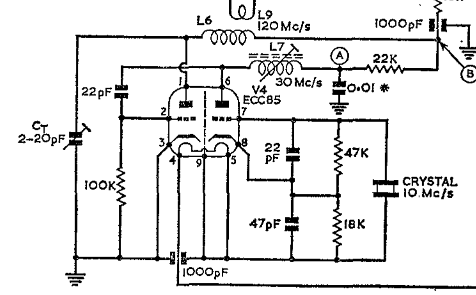
RECEIVING—Converters

Correct voltages at indicated test points.

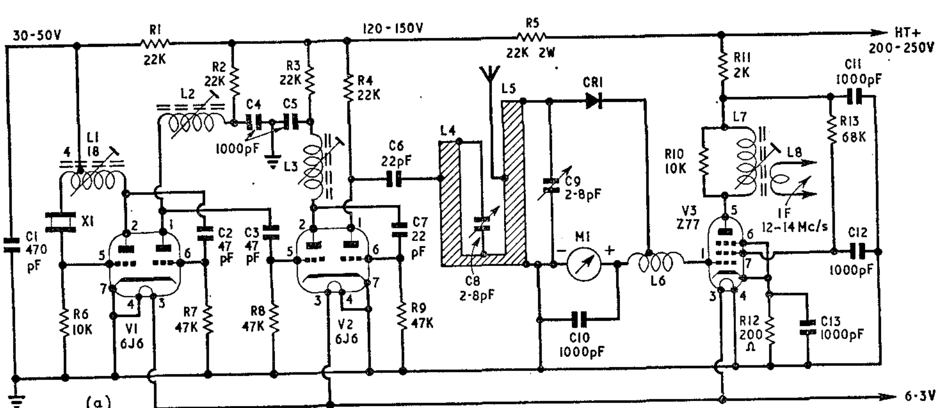
A	45– 50 volts	E	140–145 volts
B	75– 80 volts	F	140–145 volts
C	130–135 volts	G	0·95–1volt
D	25– 30 volts	H	0·95–1 volt

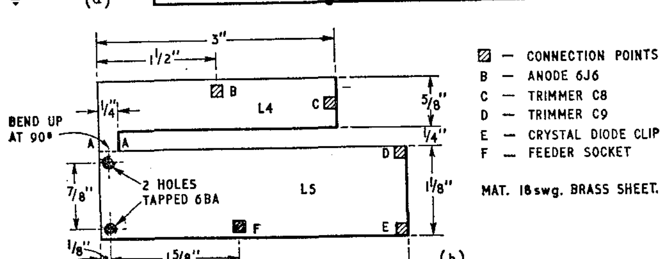


Coil	Turns	Wire	Spacing	I.D.	
L1	4	18e	wire dia.	7/16	adjust tap for optimum noise factor.
L2	4½	18e	wire dia.	7/16	spaced 1/16 to 1/8 in. apart.
L3	4	18e	wire dia.	7/16	
L4	4½	18e	wire dia.	7/16	
L5	4	18e	wire dia.	7/16	
L6	5	18e	wire dia.	7/16	
L7	19	18e	cls. wnd.	13/32	Neosid F804 with dust core.
L8	3	20 pvc	cls. wnd.	1/4	7/16 to 1/4 in. from earthy end of L5.
L9	2	20 pvc	cls. wnd.	1/2	wound over last turn of L6.
L10	30	26e	cls. wnd.	7·5 mm	Neosid former with core and can.



Grounded grid converter for 144 Mc/s. C_T, 2–20 pF concentric trimmers; R1, 2, selected to pass 15 mA; RFC1, 19 in. 26 s.w.g. wire on 3/16 in. former; RFC2, 19 in. 20 s.w.g. p.v.c. wire on 1/4 in. former; V1, 2, A2521; V3, ECC88; V4, ECC85; Crystal 10 Mc/s for 24–26 Mc/s i.f.



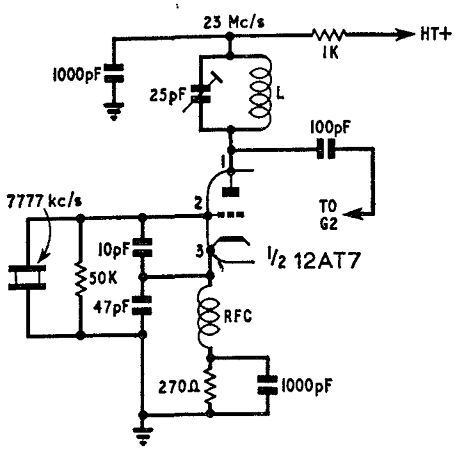


▨ — CONNECTION POINTS
B — ANODE 6J6
C — TRIMMER C8
D — TRIMMER C9
E — CRYSTAL DIODE CLIP
F — FEEDER SOCKET

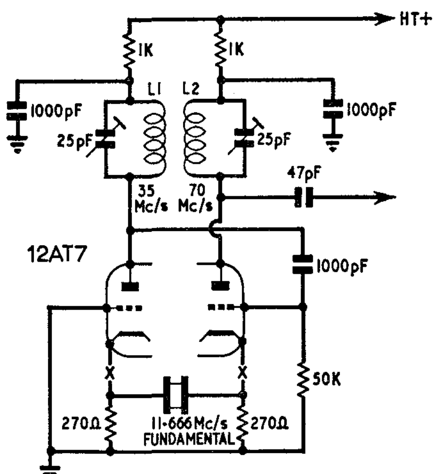
MAT. 18swg. BRASS SHEET.

Dimensions of the strip line L4 and L5 which is made from a single piece of 18 s.w.g. brass and spaced 1/16 in. from the chassis, fixed at right angles to each other in a corner of the chassis.

A simple 432 Mc/s converter. C1, 4, 5, 6, 10, 11, 12, 13, midget mica; C2, 3, 7, ceramicons; C8, 9, 3–8 pF Philips trimmers; CR1, silicon diode type CV102 or CV103; L1, 22 turns, 22 s.w.g. enam., close wound, tapped at four turns; L2, six turns, 20 s.w.g. enam., close wound; L3, two turns, 20 s.w.g. enam., close wound; L4, 5, see (b); L6, 22 turns, 32 s.w.g. d.s.c., close wound, centre tapped; L7, 37 turns, 32 s.w.g. d.s.c. close wound; L8, four turns, 32 s.w.g. d.s.c., wound at earthy end of L7 (all coils except L4, 5, are close wound on 3/8 in. diam. Aladdin formers, and should have high frequency cores); M1, 0–500 μA; X1, 35 Mc/s overtone crystal.



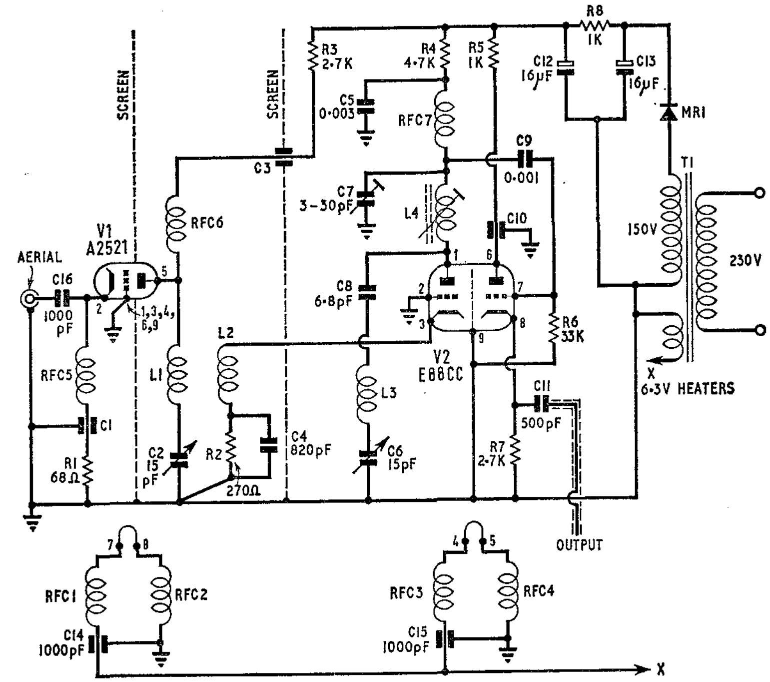
COLPITTS OSCILLATOR



BUTLER OSCILLATOR

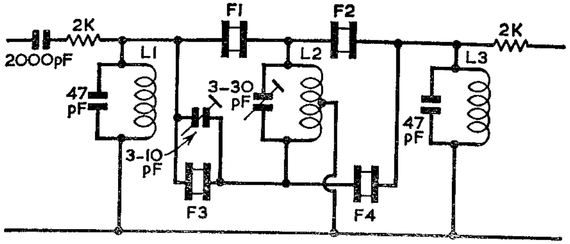
Alternative crystal oscillator circuits which may be used for the converter on page 25.

L	12 turns on $\frac{1}{4}$ in. diam former.
RFC	100 turns, close wound, on 1 M ohm resistor.
L1	10 turns on $\frac{1}{4}$ in. diam. former.
L2	5 turns on $\frac{1}{4}$ in. diam. former.
X, X	insert 10 ohm resistors here if oscillator fails to start or is unstable.

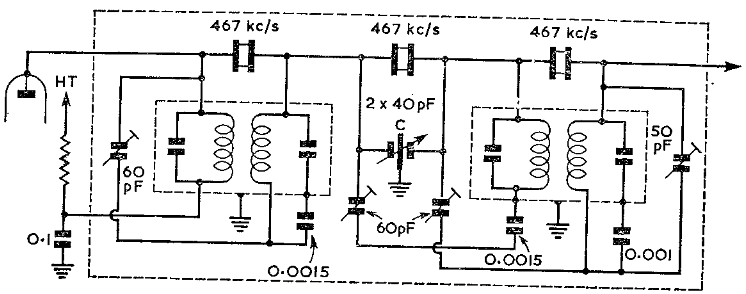


Tunable converter for amateur television reception in the 432 Mc/s band. V2 operates as a self-oscillating mixer and the second triode as a cathode follower. The oscillator tuned circuit L3-C6 should be mounted rigidly. With L4 as specified, the i.f. output is centred on 56 Mc/s (channel 3), but only minor alterations to this coil are needed to tune to a different channel in the same TV band.

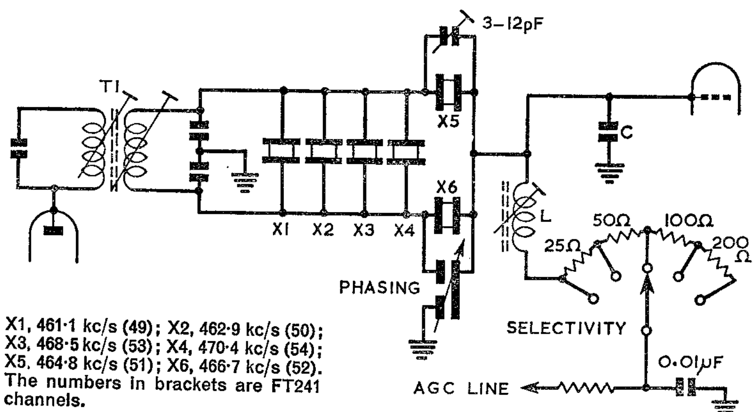
L1	4$\frac{1}{2}$ in., 14 s.w.g.
L2	3 in., 20 s.w.g., p.v.c. covered.
L3	2$\frac{3}{4}$ in., 14 s.w.g.
L4	5 turns, 26 s.w.g., $\frac{1}{4}$ in. diam. former with dust core.
RFC1, 2, 3, 4	10 in., 22 s.w.g., close wound, $\frac{3}{16}$ in. diam.
RFC5, 6, 7	10 in., 26 s.w.g., close wound, $\frac{3}{16}$ in. diam.



H.f. crystal filter using four crystals, such as FT243, between 5 Mc/s and 6 Mc/s. F1 = F2, F3 = F4 = F1 + (1·5 to 2·5 kc/s). L1 and L3 resonate at filter frequency, L2 being resonant when the trimmer is set at about half maximum value.



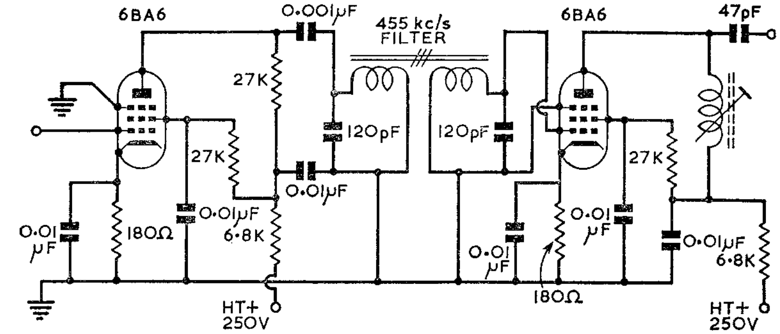
Variable bandwidth crystal filter using three crystals, suitable for receiver applications. C is the bandwidth control. The frequency may be within the range 400–500 kc/s.



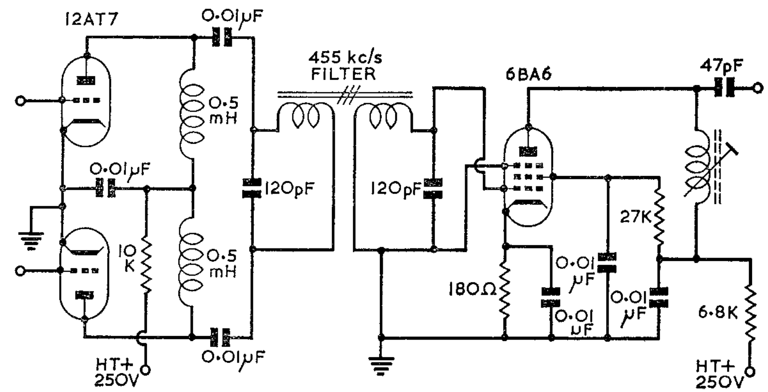
X1, 461·1 kc/s (49); X2, 462·9 kc/s (50); X3, 468·5 kc/s (53); X4, 470·4 kc/s (54); X5, 464·8 kc/s (51); X6, 466·7 kc/s (52). The numbers in brackets are FT241 channels.

A 455 kc/s variable selectivity half-lattice crystal filter designed to reduce irregularities in the passband. T1 and L C should be tuned to mid-filter frequency. The two capacitors forming a centre tap for T1 are each twice the value normally used to resonate the winding. The phasing capacitor is a 15 + 15 pF differential type.

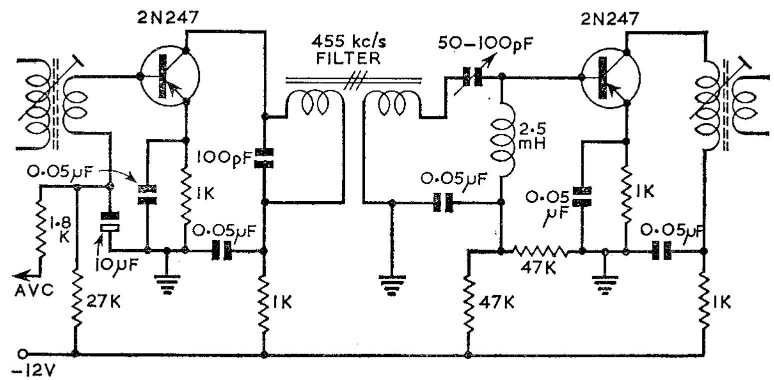
RECEIVING—I.F. Filters



INTERSTAGE FILTER

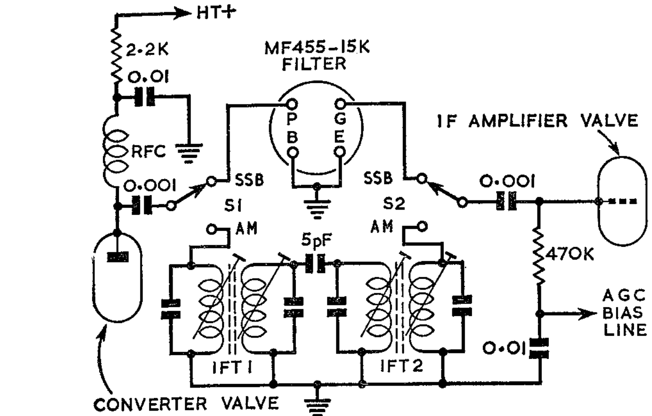


BALANCED INPUT FILTER

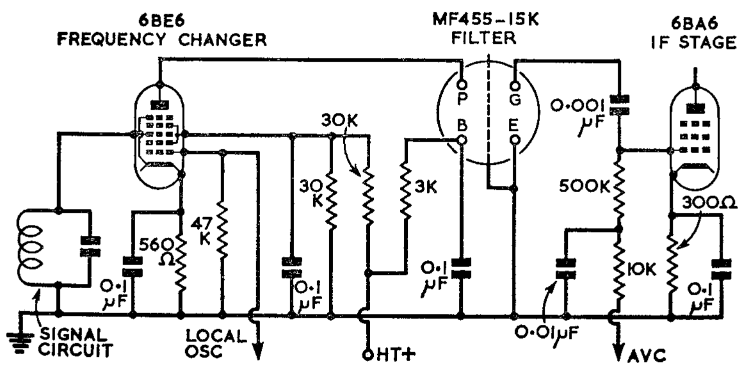


TRANSISTOR INTERSTAGE FILTER

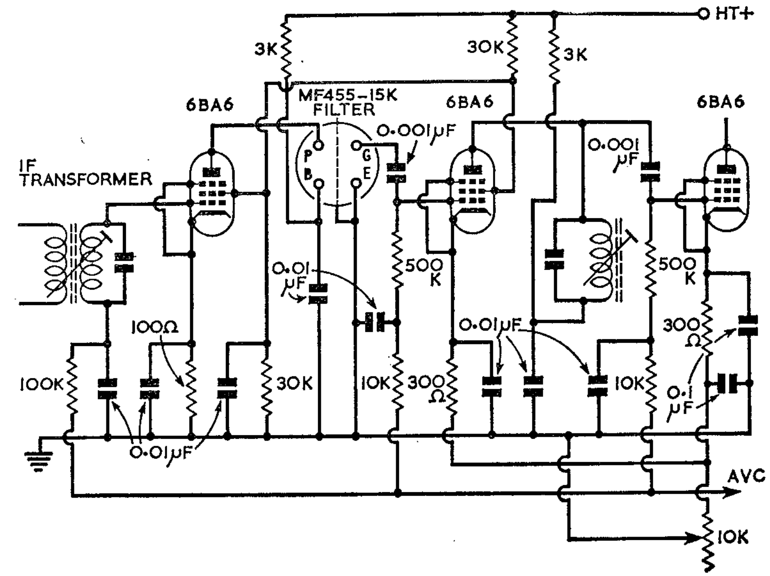
Three circuits suitable for use with Collins 455 kc/s mechanical filters. Note that the capacitors connected across or in series with the input and output circuits of the filter are necessary to resonate the circuits.



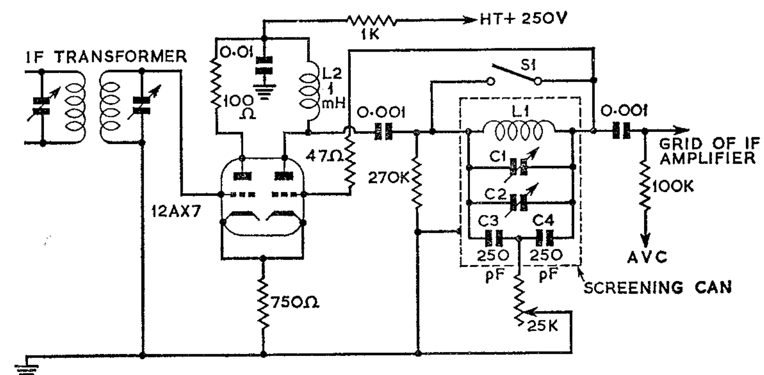
Suggested circuit for the use of the Kokusai filter in an existing communications receiver to improve the s.s.b. selectivity. IFT1 and IFT2 are standard Maxi-Q IFT 11/465 i.f. transformers or similar. S1 and S2 can be switch banks fitted to the existing selectivity switch assembly, and should be of the type incorporating shorting plates. The shorting plate must be earthed. If the filter selectivity is not to be degraded, the two banks must be isolated from each other with an earthed cross screen.



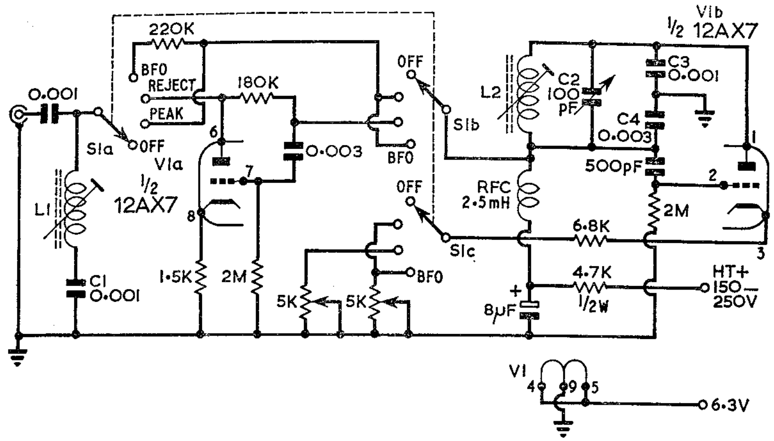
A method of using a Kokusai mechanical filter immediately following the frequency changer.



Using the Kokusai mechanical filter in the i.f. of a receiver. It is important that connections are made to the correct terminals of the mechanical filter.

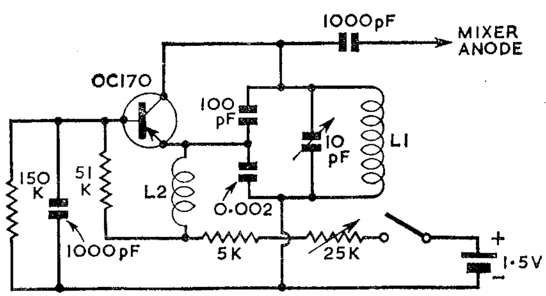


A T-notch filter. The connections between the grid of the first half of the 12AX7 and the i.f. transformer should be as short as possible. The circuit L1, C1, C2, C3 + C4 should be resonant at the i.f.

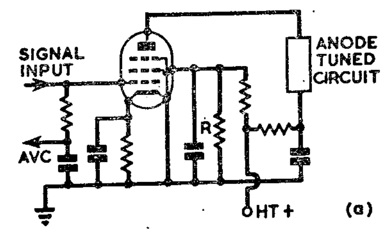


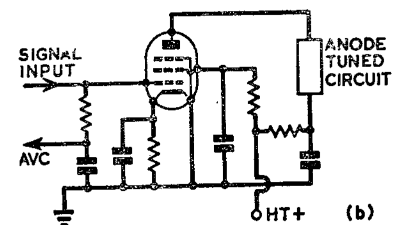
Circuit diagram of a *Q*-multiplier. Fixed capacitors, with the exception of C3 and C4, can be of the disc ceramic type. C3 and C4 should be close tolerance silvered mica types. Resistors, except where otherwise annotated, may be of ¼ watt rating. The constants shown against L1, L2, C3 and C4 are for an intermediate frequency in the range 450 to 470 kc/s. Values for other intermediate frequencies are given in the table. The function switch is a 3 pole, 4 way wafer type.

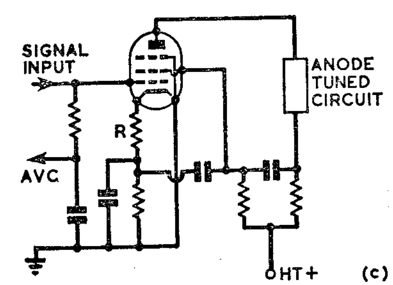
Intermediate Frequency	L1	L2	C3	C4
85 kc/s	15–60 mH	0·5–2·5 mH	2500 pF	7500 pF
465 kc/s	1·5–3·0 mH	120–150 μH	1000 pF	3000 pF
735 kc/s	750–1000 μH	70–100 μH	750 pF	2250 pF
915 kc/s	250–500 μH	60–90 μH	500 pF	1500 pF
1600 kc/s	50–120 μH	40–60 μH	250 pF	750 pF



Transistorized *Q*-multiplier using an OC170 or similar alloy diffused transistor. L1 should tune to the i.f. and be a high *Q* coil preferably wound in a ferrite pot core. L2 is 1 mH air wound. The values given apply to an i.f. of 1415 kc/s.



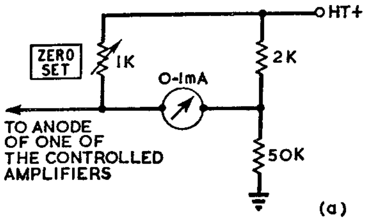


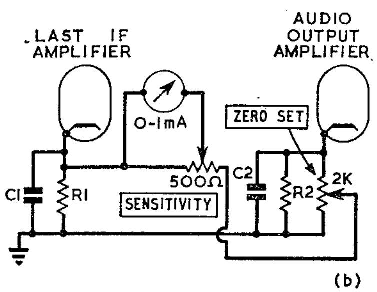


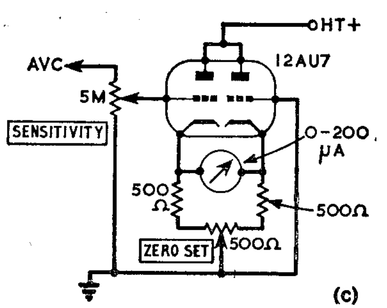
In (a) and (b) are shown typical connections for a pentode amplifier as used in r.f. and i.f. stages. Fixed Screen Voltage (a). In this case the screen voltage is provided by a potentiometer, which must itself pass sufficient current so that the variation of screen current due to changing a.g.c. voltage does not substantially change the screen voltage. The lower resistor (R) may of course be replaced by a gas filled voltage stabilizer.

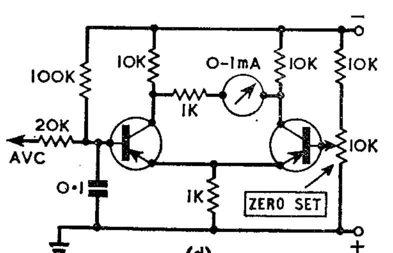
Sliding Screen Voltage (b). The actual voltage applied to the screen will in this case depend on the voltage drop caused by the screen current flowing through the resistor. An advantage of this arrangement over that given in (a) is that the grid control characteristic will be increased, and the power drain is significantly reduced.

Stabilised (c). In this arrangement the valve is approximately bridge neutralised and this allows stable operation of high slope pentodes such as the EF183 in high gain i.f. amplifier stages. The resistor R can be introduced to remove any tendency to oscillate by the introduction of feedback. This resistor is part of the total normal cathode bias resistor and is not additional.









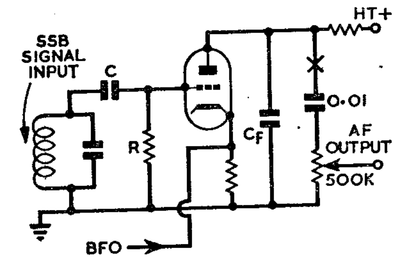
BRIDGE TYPE

A simple circuit for indication of signal level is shown in (a). The bridge circuit is completed by the amplifier valve, which is the variable element. The meter M shows the variation of the anode current passed by the valve compared with the fixed current passed by the potentiometer consisting of the 2 K ohm and 50 K ohm resistors. The arrangement can alternatively be connected to the screen grid of a controlled amplifier. Modified values will be required to suit the screen voltage. However, a disadvantage of both systems circuit is that the meter is at a high potential.

An alternative circuit (b) overcomes this problem. C1, R1 and C2, R2 are the normal bias components of the last i.f. amplifier and audio output amplifier respectively.

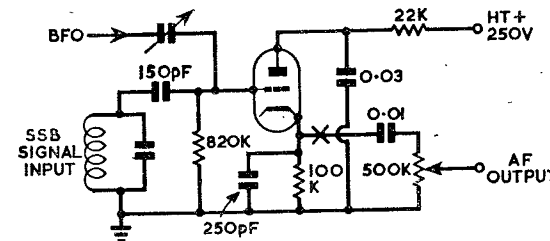
VOLTMETER TYPE

In (c) and (d) amplifier voltmeter circuits are used to read the a.g.c. voltage. If the supply voltage is fixed by a stabiliser, a highly accurate reading may be obtained. The transistors may be audio types.



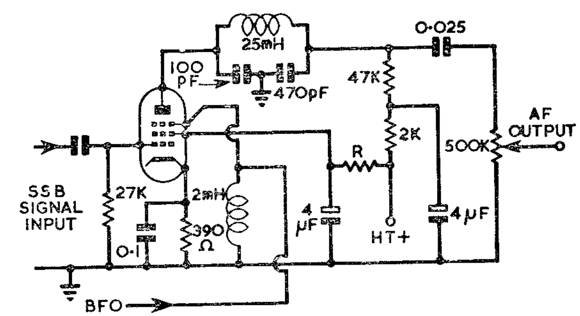
SIMPLE SINGLE TRIODE

In this simple single triode detector satisfactory mixing of the signal and local oscillator is achieved if a relatively high bias is used. For a 6C4, the cathode resistor should be about 2000 ohms, i.e., the value which would be used for class A amplification. The reactance of C should be approximately one tenth that of R. It may be necessary to insert a filter at point X in addition to the bypass capacitor Cf, to remove the unwanted product frequencies.



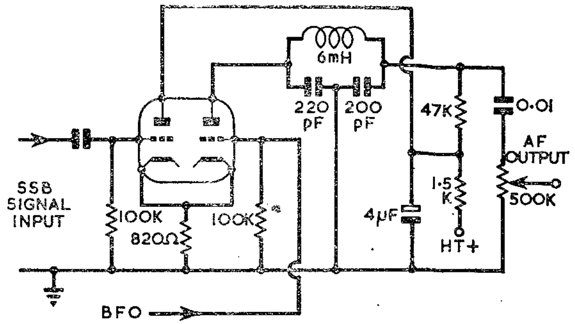
INFINITE IMPEDANCE SINGLE TRIODE

This circuiti s similar to that above, but mixing is carried out by injection of both the signal and b.f.o. into the grid, and the audio taken from the cathode. This has the advantage of relative freedom from distortion, although a limitation is lack of isolation between the signal and b.f.o. The triode may be a 6AT6, or one section of a 12AT7. It may be necessary to include a filter at point X to remove unwanted product frequencies.



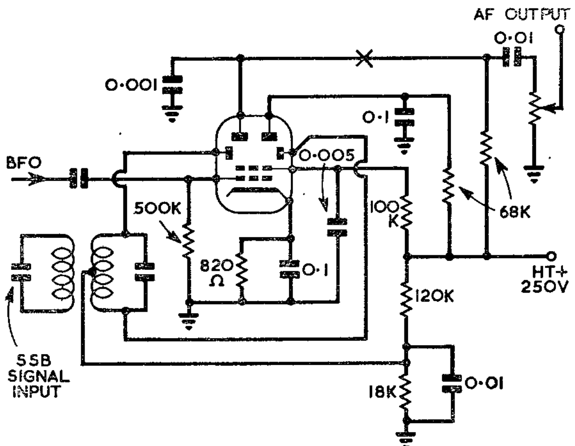
PENTODE

This circuit is capable of low distortion provided that the signal level and b.f.o. voltages are limited to 100 mV and 1·5 V respectively. In this condition i.m. distortion should be down to 45db with a conversion gain of five. Valves for this circuit must have good suppressor grid control, such as the 6AS6. Value of R to suit valve and h.t.



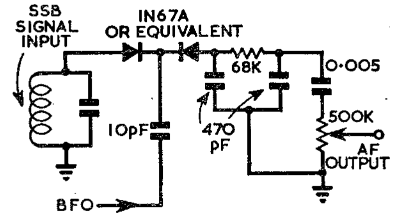
DOUBLE TRIODE

In this arrangement the first triode operates as a cathode follower, coupling the signal into the cathode of the second triode where it is mixed with the b.f.o. As with the pentode circuit, the pi-filter will eliminate the unwanted frequencies to give the required audio output. Intermodulation distortion in this circuit with typical inputs of 0·26 V signal and 4·5 V b.f.o. is usually better than 40db with a gain of about four. A 12AU7 or 12AT7 is suitable.



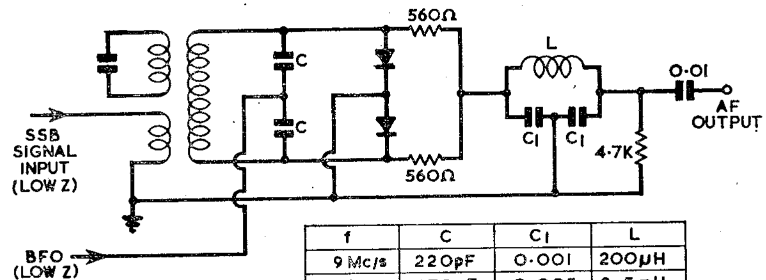
BEAM DEFLECTION VALVE

This circuit has a push-pull input and a single ended output using a 7360. Similar valves such as the 6AR8 and 6JH8 may be used with minor circuit changes. The signal input should be of relatively low impedance and the b.f.o. input limited to about 3·5 volts maximum. A gain of six is usually obtainable. A filter may be required at X to remove unwanted product frequencies. Care must be taken with beam deflection valves to ensure that they are not subjected to excessive magnetic fields, as this can affect the beam and thus induce hum.



DOUBLE DIODE

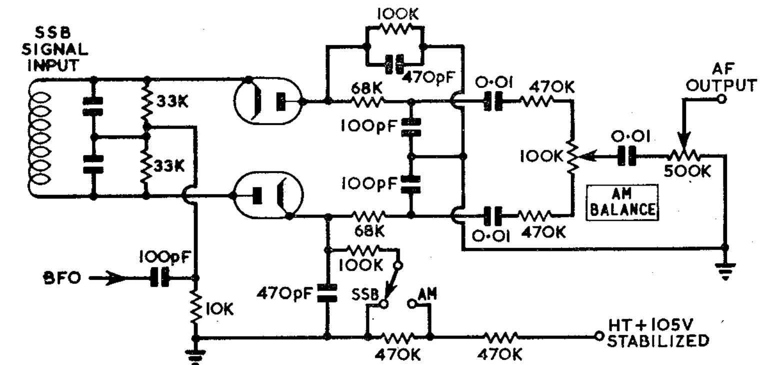
In this simple circuit, satisfactory performance will be obtained when the signal level is about 100 mV and the b.f.o. voltage 6 V. The RC filter will be sufficient to remove the unwanted spurious frequencies.



f	C	C1	L
9 Mc/s	220pF	0·001	200μH
455 kc/s	470pF	0·005	2·5 mH

LOW IMPEDANCE DOUBLE DIODE

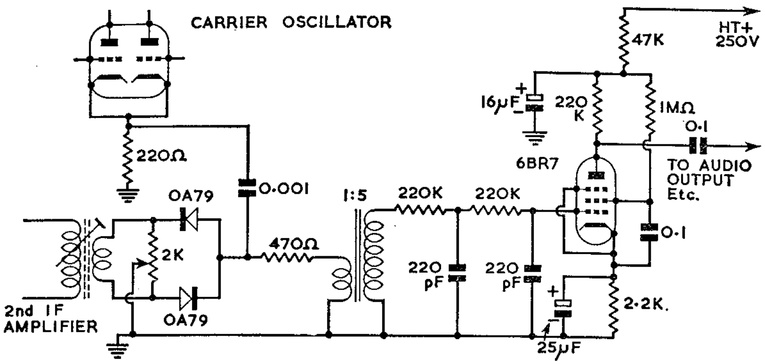
The diodes may be a matched pair of OA79.



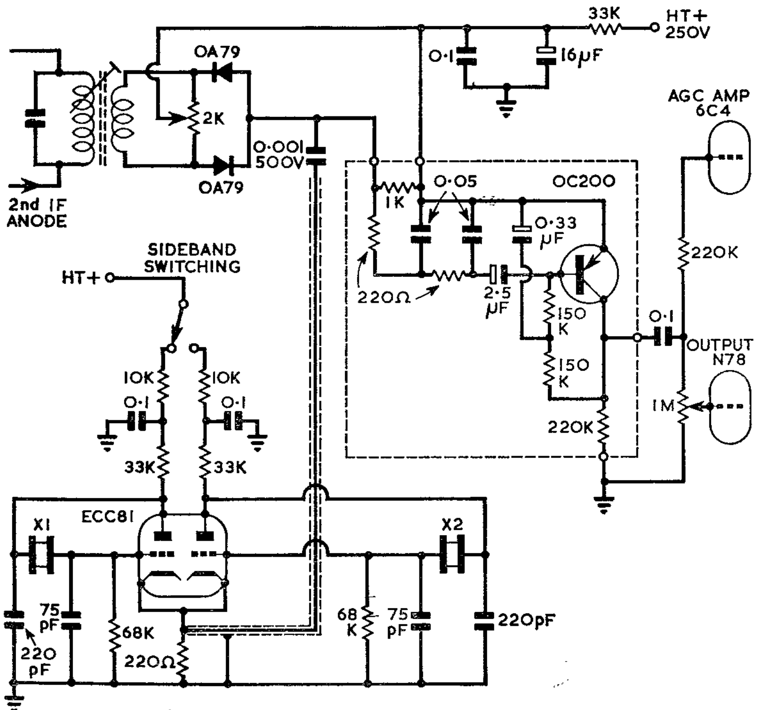
DOUBLE DIODE (THERMIONIC)

This circuit has a balance control to adjust for minimum A3 output. The valve may be a 6AL5, EB91, or equivalent.

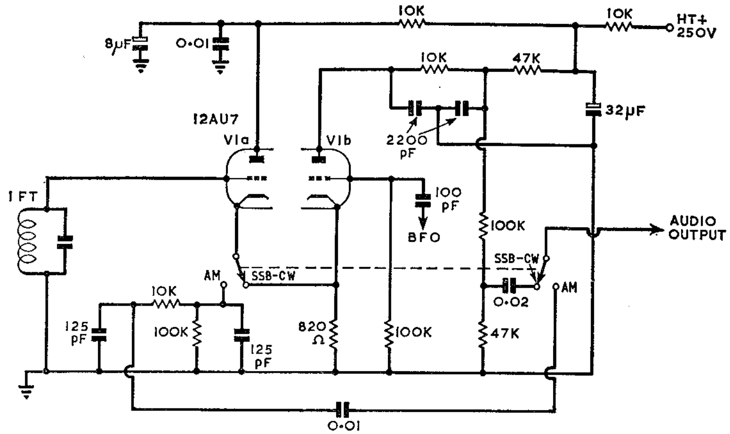
Two useful circuits using semiconductor product detectors with valve carrier oscillators for upper and lower sideband. X1 and X2 are sideband crystals.



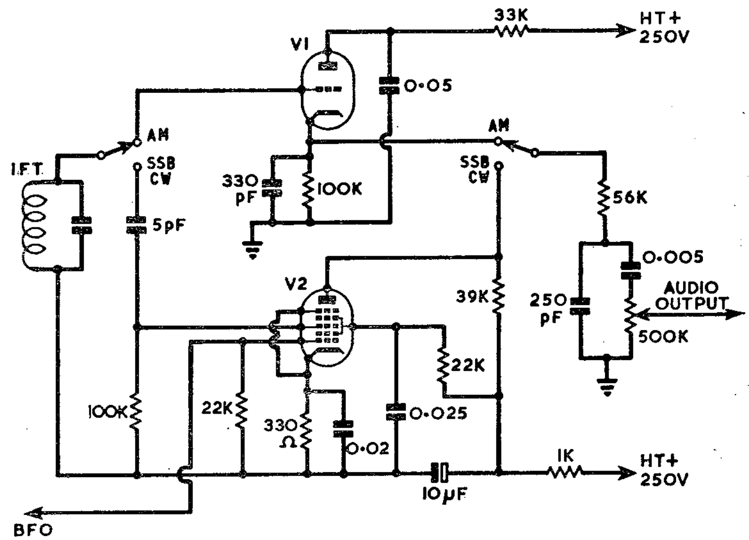
Product detector with valve amplifier fed from an audio transformer.



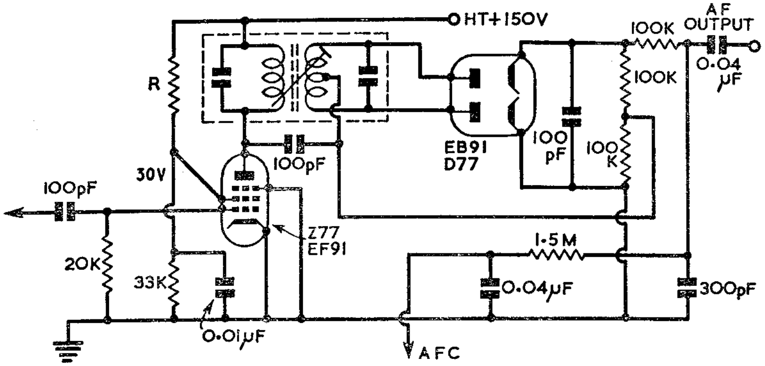
Product detector with transistor audio stage.



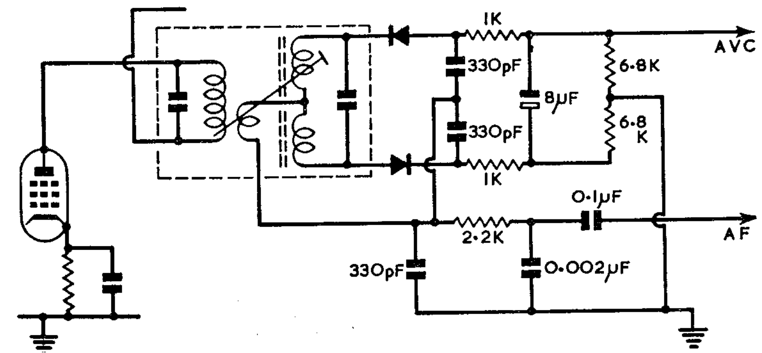
A combination detector using a double triode. In the a.m. switch position, triode (a) operates as an infinite impedance detector, and in the s.s.b./c.w. position the two triodes operate as a conventional cathode coupled double triode detector. About 2 volts of b.f.o. injection will normally give good quality speech.



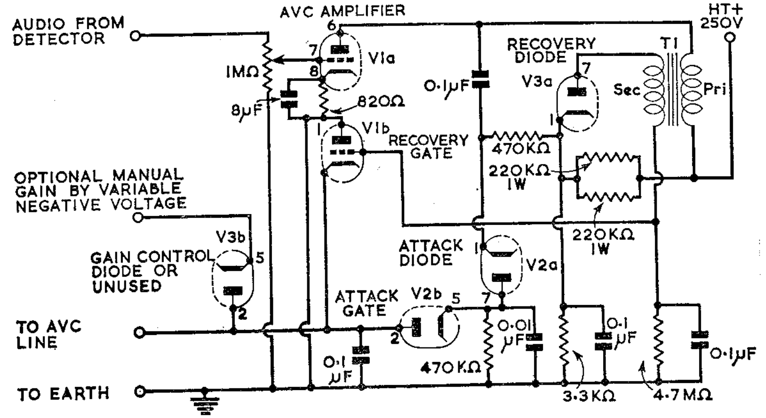
A combination detector using an infinite impedance detector for a.m. and a heptode product detector for s.s.b. and c.w. A self oscillating product detector may be arranged by including a conventional circuit in the cathode, but it would be necessary to switch off the b.f.o. for a.m. reception. V1, ½ 12AT7, V2, 6BE6 or 6BA7.



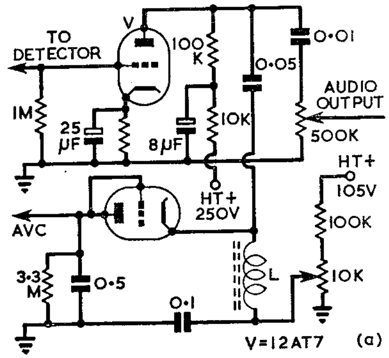
A limiter-discriminator for detecting f.m. signals. This circuit is designed to provide an a.f.c. bias voltage in addition to the audio output. The value of R is adjusted to provide satisfactory limiting, 150 K ohms being a suitable starting value.

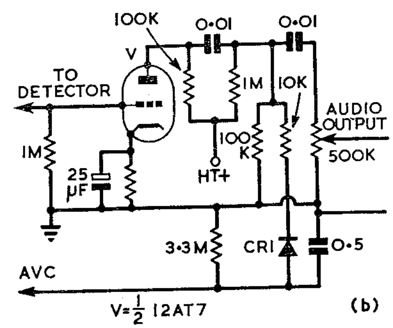


A ratio detector utilizing two semiconductor diodes. A suitable type is the GEX34 or OA79.



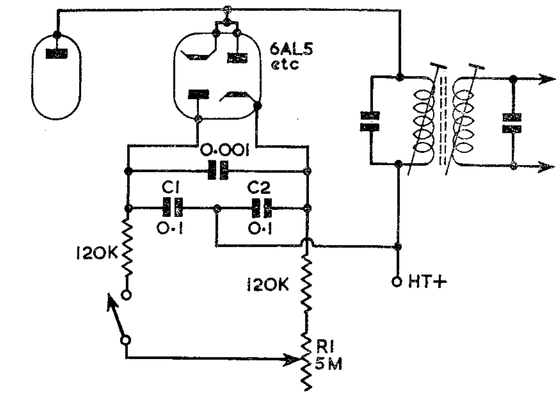
Amplified audio derived a.g.c. hang circuit. V1 is a 12AU7, and V2 and V3 are 6AL5s. T1, 3:1 ratio midget intervalve transformer.



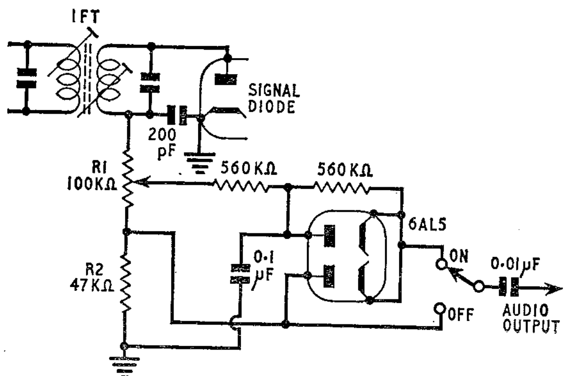


In these circuits the amplifier is used for both audio and a.g.c. In diagram (a), one triode is used as an amplifier and other is strapped as a diode. Any double triode such as a 12AT7 is suitable. The inductor L may be replaced by a step-up transformer if greater voltage output is required.

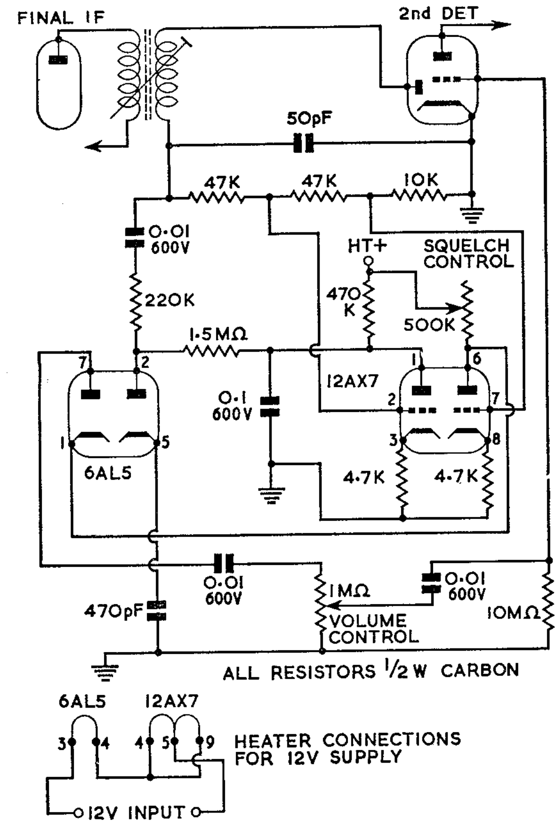
In diagram (b) a silicon diode is used for rectification. A suitable type is the OA200 or OA202. The time constant of the circuit is set by the 3·3 M ohm resistor and 0·5 μF capacitor. The values are typical and may be changed if desired. If less than full a.g.c. voltage is required for an early stage, this may be obtained by splitting the 3·3 M ohm resistor to form a potentiometer of the same total value.



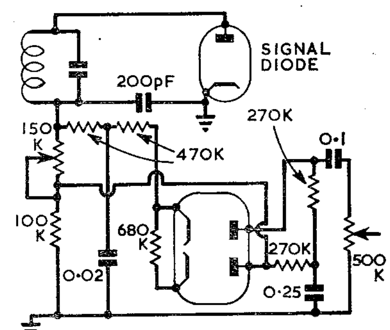
I.f. noise limiter. When R1 is switched into circuit, C1 and C2 charge to the average peak level with such polarity that they oppose. This type of limiter is best applied to an early stage of the i.f. amplifier.



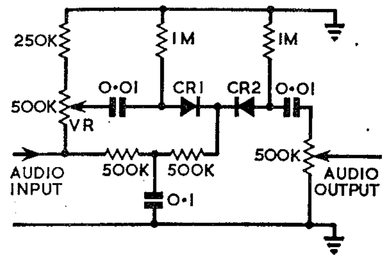
Dickert self-following noise limiter.



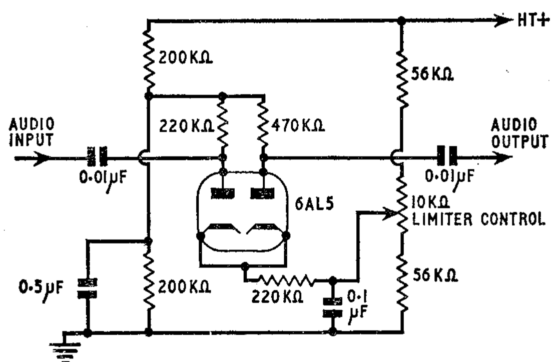
Combined full wave noise limiter and squelch circuit often referred to as a twin noise squelcher.



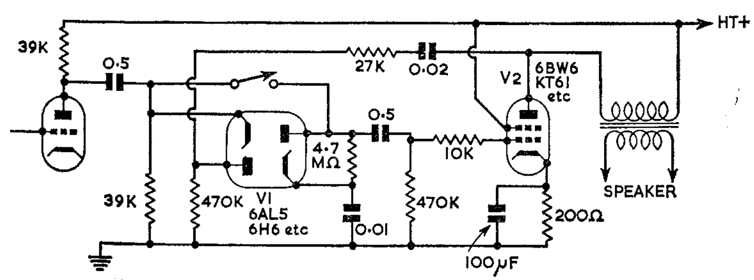
A positive and negative peak limiter with variable control to set a tthe modulation level at which clipping takes place. This arrangement is suitable for the reception of weak signals in the presence of considerable noise or signals of low modulation depth.



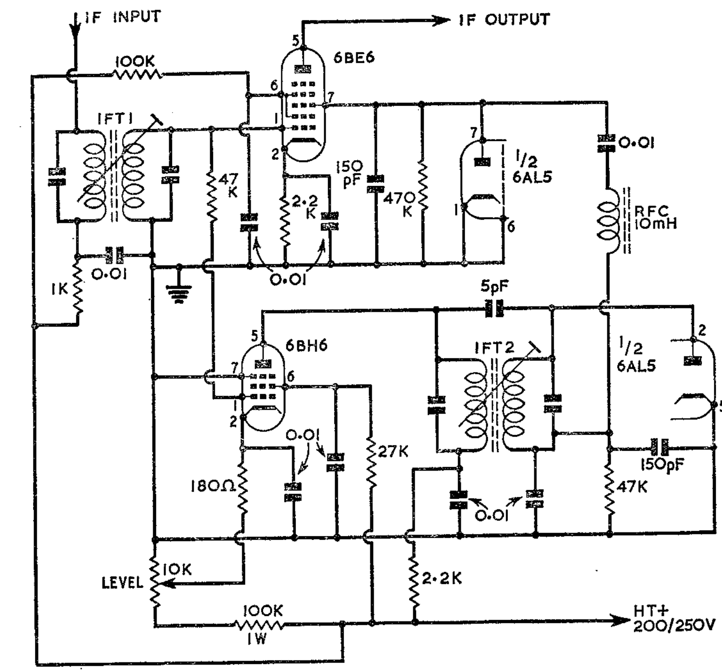
Audio peak clipping noise limiter. The diodes CR1 and CR2 should be a silicon high reverse resistance type. The clipping level is set by the potentiometer VR.



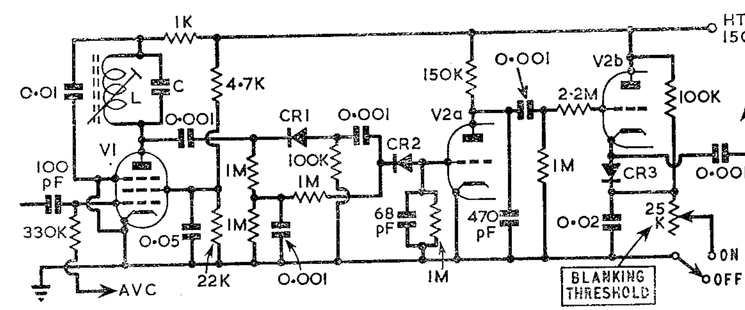
Negative and positive peak clipping noise limiter. The available range of bias voltage set by the limiter control can be adjusted by changing the fixed resistor values.



Audio follower noise limiter.

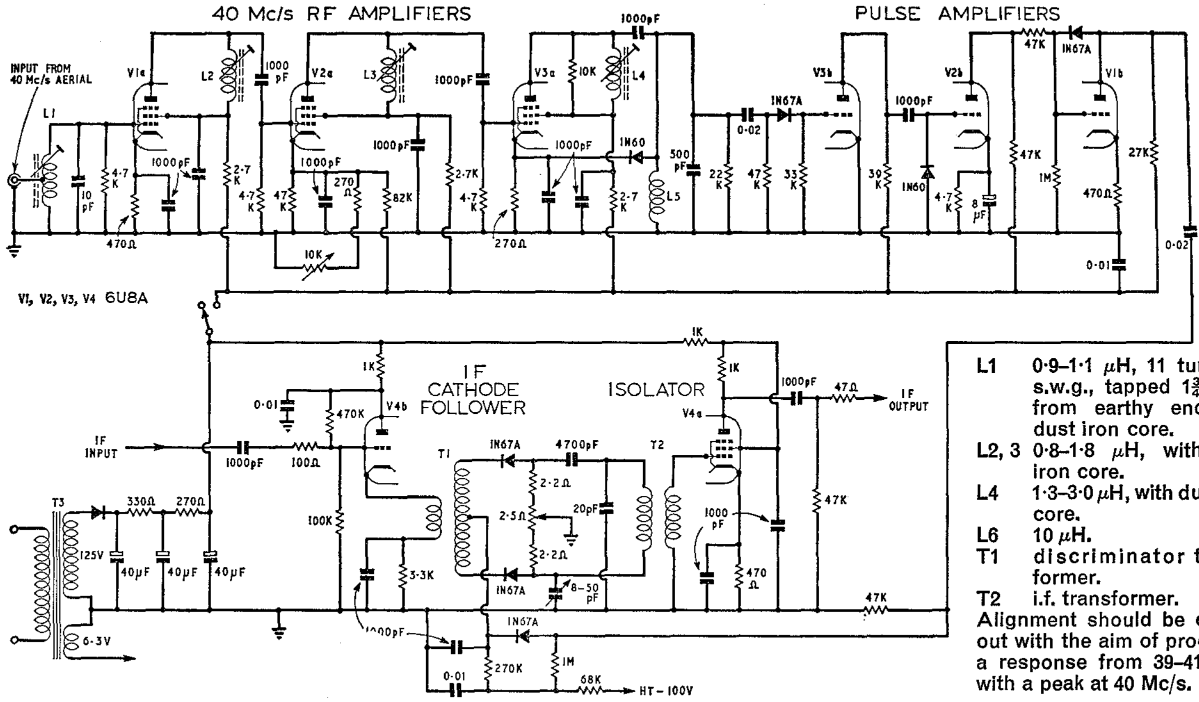


An i.f. noise blanker for insertion into the i.f. chain of an existing receiver. The transformers IFT1 and 2 should be of the same frequency as those of the main receiver.



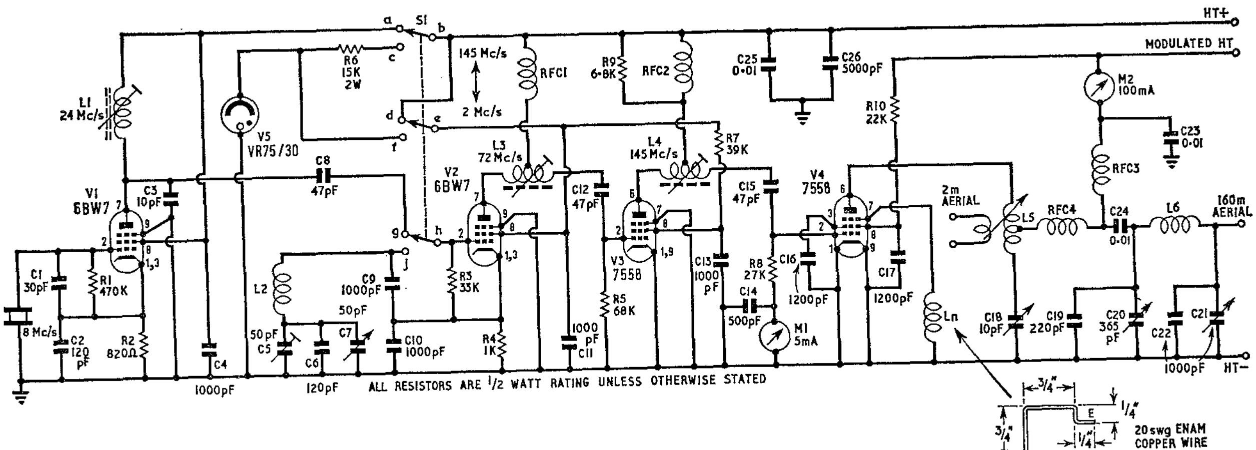
Noise blanker used in Drake R4 receiver. In this circuit the input is taken from the anode of the mixer and the output is connected to the anode of the last i.f. amplifier. These leads must be screened by using coaxial cable. A noise pulse produces a negative pulse on the grid of V2a and causes V2b to conduct. The anode of the last i.f. amplifier is then effectively earthed through the diode in the cathode circuit while V2b is conducting. The variable resistor sets the bias and thus the threshold level.

LC	i.f. tuned circuit (half a standard transformer).
CR1, 2, 3	1N625 or equivalent.
V1	6BA6.
V2	12AX7.



L1 0·9–1·1 μH, 11 turns, 30 s.w.g., tapped $1\frac{3}{4}$ turns from earthy end with dust iron core.
L2, 3 0·8–1·8 μH, with dust iron core.
L4 1·3–3·0 μH, with dust iron core.
L6 10 μH.
T1 discriminator transformer.
T2 i.f. transformer.
Alignment should be carried out with the aim of producing a response from 39–41 Mc/s with a peak at 40 Mc/s.

In the r.f. type of noise blanker a noise pulse is picked up by a completely separate aerial and wideband receiver, in this case tuned to 40 Mc/s a good general purpose vertical aerial is recommended. The receiver consists of three broadly tuned r.f. amplifiers followed, after rectification, by three pulse amplifiers. The output is fed into a gating circuit normally positioned in the first i.f. stage of a double conversion receiver, ahead of the selective filter and second i.f. amplifier. This type of noise blanker is particularly effective for short pulse-type of noise, such as that produced by ignition systems.



A combined 1·8 and 144 Mc/s transmitter.

L1 16 turns, 26 s.w.g. Aladdin 5961 former with dust iron core.
L2 95 turns, 38 s.w.g., close wound on ½ in. diam. former.
L3 21 turns, 26 s.w.g., tapped at 10 turns from anode end, Aladdin 5961 former with brass core.
L4 $6\frac{1}{2}$ turns, 20 s.w.g., tapped at $3\frac{3}{4}$ turns from anode end, Aladdin 5961 former with brass core.
L5 5 turns, 20 s.w.g., tapped at $2\frac{1}{2}$ turns from anode end, ½ in. diam., self supporting, ⅝ in. long.
L6 36 turns, 18 s.w.g., $1\frac{1}{2}$ in. diam., 2 in. long.
RFC1, 2 220 mH.
RFC3 2·5 mH.
RFC4 40 turns, 30 s.w.g. e.s.s., on Aladdin 5961 former.

For 144 Mc/s operation the output of V1, the crystal oscillator, is fed into V2 which operates as a tripler. This drives V3 which doubles to the final frequency to drive V4, the p.a. When switched to 1·8 Mc/s V2 is operated as the v.f.o. and V3 becomes an untuned buffer. An unusual feature of the p.a. circuit is the use of suppressor neutralising by the inductance Ln. This method is claimed to enable stable operation over a wider frequency range than would be possible by the conventional capacitance method.