PW 'STOUR' TOP-BAND TRANSCEIVER

PART 5

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Following the detailed descriptions of Boards 6, 7, 8 and 9 presented in Part 4 we continue with details of the v.f.o. and Filter Boards

Board 10—VFO Board

The v.f.o. contains the following circuitry.
(1) 10Tr1 a 2N3819 oscillator.
(2) 10Tr2 a 2N3819 buffer.
(3) 10Tr3 a further buffer amplifier.

Circuit Description

Transistor 10Tr1, a 2N3819 f.e.t., operates as a grounded drain Colpitts oscillator. This stage is run with a fairly low drain current to minimise the drift on the v.f.o. frequency. No special temperature compensating components were used and the short term drift under normal operating conditions, from switch on, was about 1·5kHz which in practice proved adequate. (The author's commercial rig drifted about the same amount.)

Capacitor 10C5 is a dual-gang 40pF variable capacitor, a portion of which is used in the main tuning, determined by the setting of 10C6. With careful adjustment of 10C4 and 10C6 the frequency and range of the v.f.o. may be determined. The range that the v.f.o. will cover, 7·0–7·3MHz or, as in our case, 7·0–7·5MHz, depends on the setting of 10C6. The particular frequency range covered, 7·0–7·5MHz or 7·1–7·6MHz, may be set by 10C4. The two adjustments are interrelated but gradual tweaking of these two trimmers will give the desired coverage. In the prototype the v.f.o. was made to cover 7MHz to 7·5MHz. This could be decreased but adequate bandspread was available and gave coverage of 1·5MHz–2·0MHz on receive. During transmit the maximum bandwidth is controlled by the available bandwidth from the filters.

It should be noted that without the r.i.t. circuitry connected the v.f.o. is unstable. If r.i.t. is not required components 10C1, 10D1, 10R1, 10C2 and 10RFC1 should be removed. The r.i.t. components are located on a tag strip away from the v.f.o. and may be positioned in any convenient location. The control is d.c. activated and screened cable is not required between the r.i.t. components and point A on the v.f.o. board. With the components shown a frequency variation of ± 2·5kHz is available.

The r.i.t. switching is *controlled* by a relay as shown in the diagram and is so arranged that the control potentiometer is inoperative during transmit. Solid state switching could of course be used to replace the relay contacts, but as there were spare contacts available it was not thought worthwhile. The r.i.t. may be switched in or out during receive.

The oscillator is source coupled into the gate of 10Tr2 via 10C13, a 10pF silver mica capacitor. Transistor 10Tr2, a grounded drain buffer amplifier, is used to isolate the oscillator stage and to afford some voltage gain. Transistor 10Tr2 couples into 10Tr3 via 10C15, a 100pF ceramic capacitor.

A further common emitter buffer amplifier, 10Tr3, has its gain controlled by 10R11, an 18Ω resistor. The output from 10Tr3 is taken from

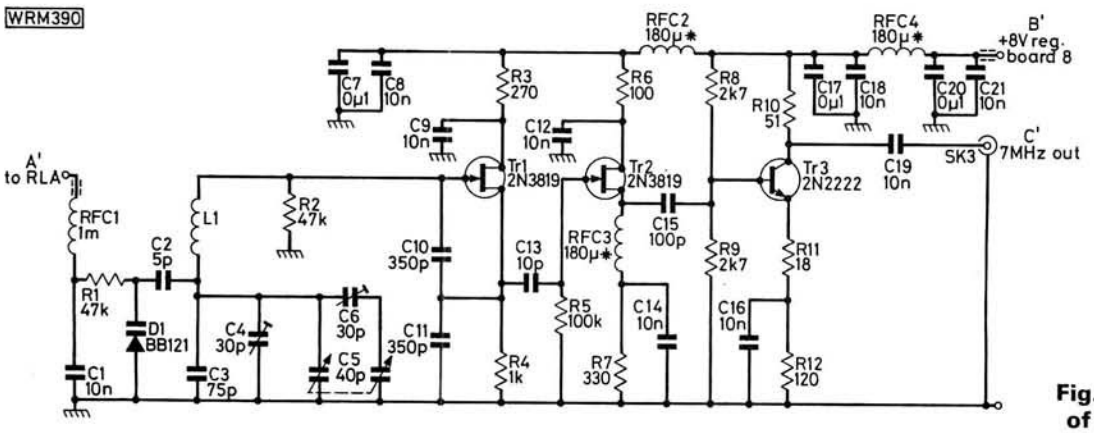


Fig. 32: Circuit diagram of the v.f.o. (Board 10)

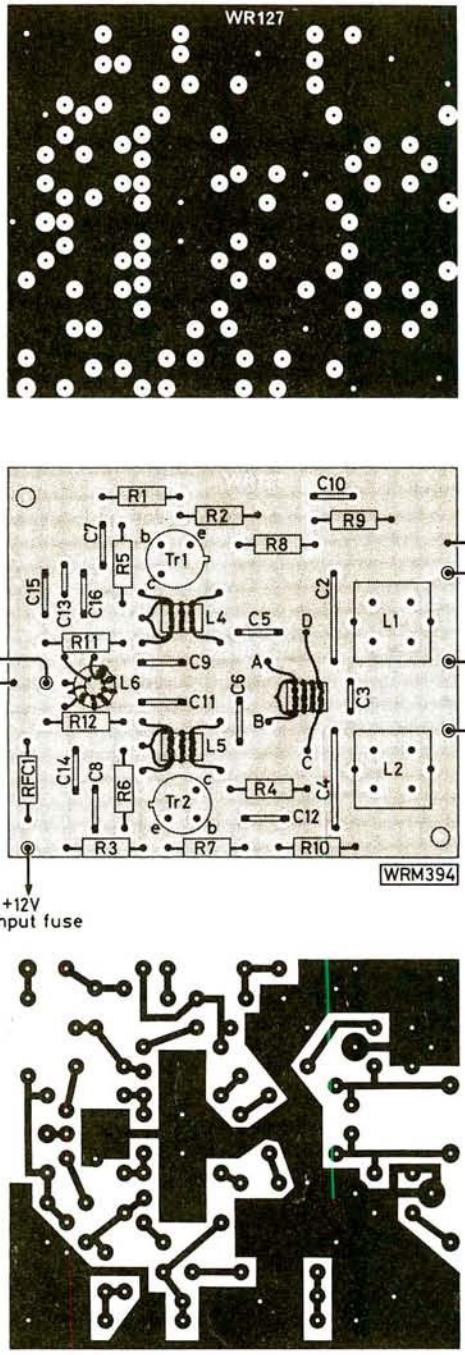


Fig. 33: Component overlay, track pattern and ground-plane of Board 6 shown here full size

its collector via 10C19 to the output socket on the v.f.o. compartment.

Further amplification of the 7MHz v.f.o. was required but as the next stage needed to handle a substantially larger current it was felt that it should not be included in the v.f.o. box due to the heat generated. This stage was in fact located on the mixer board where any such heat generated would not present any problem.

Constructional Details

The original v.f.o. was built in a similar manner to the final version but an aluminium box was used for the enclosure. This proved to be totally unsatisfactory due to movement of the box causing considerable differences in v.f.o. frequency. It is strongly recommended that a die-cast box is used for the housing of this board. All "off board" wiring i.e. wires to 10L1, and any external connections, should be of 20 s.w.g. or larger to avoid any mechanical movement which would in turn cause a change in v.f.o. frequency. The coil itself should be tightly wound on a good quality former and fixed with Araldite or similar adhesive at the top and bottom, again to ensure mechanical stability.

★ components

BOARD 10

Resistors

¼W 5% Carbon Film

18Ω	1	R11
51Ω	1	R10
100Ω	1	R6
120Ω	1	R12
270Ω	1	R3
330Ω	1	R7
1kΩ	1	R4
2·7kΩ	2	R8,9
47kΩ	2	R1,2
100kΩ	1	R5

High stability ¼W 1%

510Ω	2	R16,17
4·7kΩ	2	R14,15

Potentiometer

1kΩ lin.	1	R13

Capacitors

Disc Ceramic

10nF	9	C1,8,9,12, 14,16,18, 19,21
0·1µF	3	C7,17,20

Silver Mica

5pF	1	C2
10pF	1	C13
75pF	1	C3
100pF	1	C15
350pF	2	C10,11

Two-gang Variable Air-spaced

40 + 40pF	1	C5

Air-spaced Trimmers

30pF	2	C4,6

Semiconductors

Transistors

2N2222	1	Tr3
2N3819	2	Tr1,2

Diodes

BB121 varicap	1	D1

Inductors

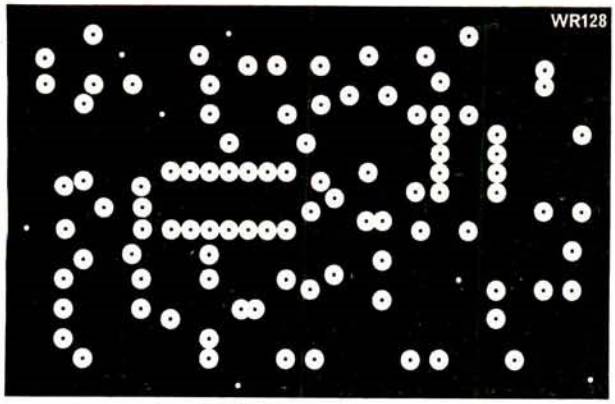
Radio Frequency Chokes

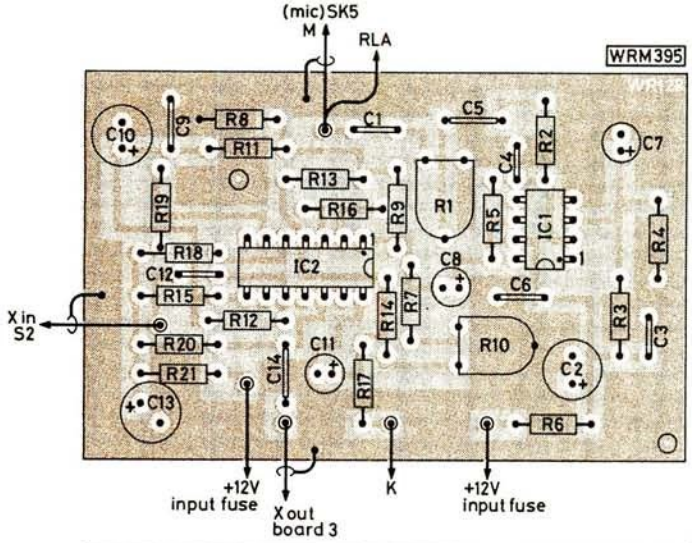
180µH	3	RFC2,3,4
1mH	1	RFC1

Miscellaneous

Single sided p.c.b. (1).

Note: Component refs. in text are pre-fixed with the board ref. 10.





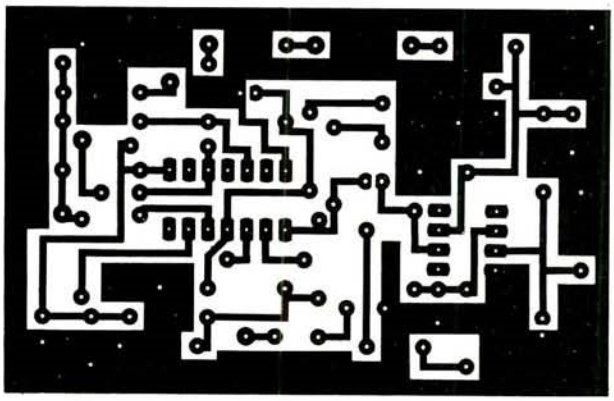


Fig. 35: Component overlay, track pattern and ground-plane of Board 7 shown full size

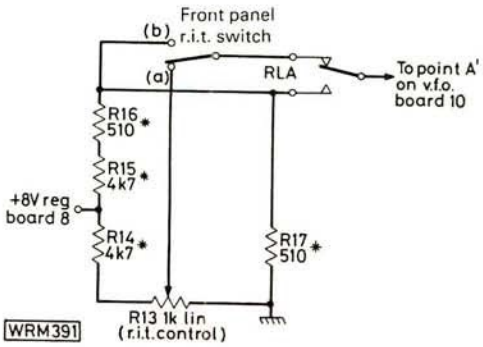


Fig. 34: Sub-circuit of the r.i.t. Points (a) and (b) refer to the switching diagram

The board itself is a single sided glass fibre p.c.b. and should be mounted at all three points as shown. It is important to use single sided p.c.b. to avoid changes in capacitance between tracking and ground plane.

All three transistors should be mounted as close to the board as possible and silver mica capacitors must be used where shown; substituting with the cheaper ceramic types will degrade the stability of the unit.

The main tuning capacitor 10C5 should be firmly secured to the top of the v.f.o. box with holes drilled in the box to allow connections to the fixed vanes. On the prototype the slow motion drive was secured to the box itself and not to the front panel. Any leverage on the tuning knob then tended to move the whole unit, producing very little or no detectable change in frequency. It is worth mentioning that a good quality two gang unit should be purchased for 10C5, with bearings at both ends of the rotor if possible. It is important that the trimmers 10C4 and 10C6 are air-spaced and that they may be adjusted with the lid in position. Holes will have to be drilled to allow for this and the v.f.o. should be set up with the lid of the box secured. In this way the v.f.o. becomes a separate detachable unit with no change in frequency noticeable when enclosed and secured inside the final cabinet. There is nothing worse than having an otherwise stable v.f.o. moving frequency whenever the cabinet casing is removed.

A worthwhile improvement on the prototype would be to encase the variable itself which at the present is left sitting on top of the v.f.o. box.

The following components are not located on the p.c.b.

(1) 10C20, a 0·1μF decoupling capacitor. This component is soldered between the feedthrough capacitor and an earth tag mounted on the fixing of the feedthrough.

(2) 10C3 which is soldered between the bottom of 10L1 and an earth tag.

(3) 10C5.

(4) 10C4 and 10C6.

Due to the physical size of the box used 10C10 and 10C11 were made up from two smaller values each in parallel, i.e. a 200pF and 150pF capacitor. Space is provided on the board for two components in each

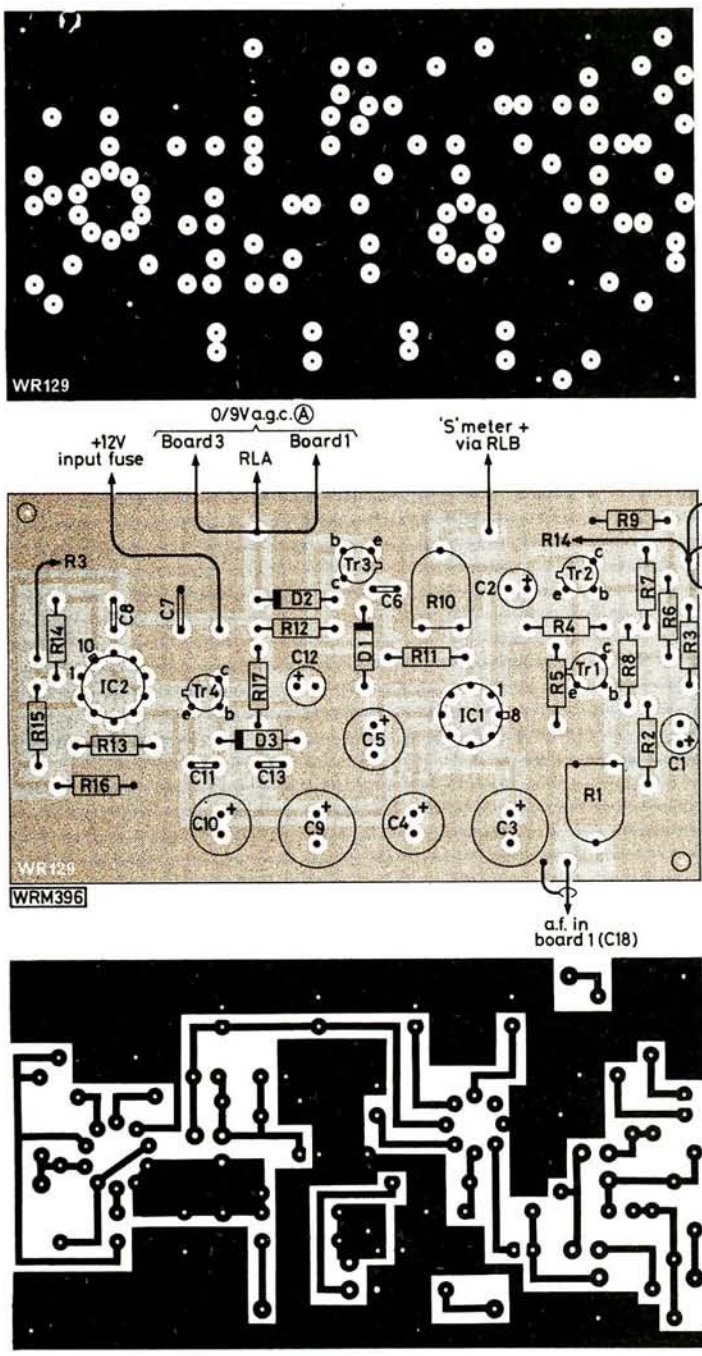


Fig. 36: Component overlay, track pattern and ground-plane of Board 8 shown full size

case. The 350pF capacitors originally purchased by the author were too high and prevented the lid of the v.f.o. box being mounted. If smaller units are available then a single 350pF may be used in each case. However, as stated earlier, it is essential that silver mica capacitors are used.

All components should be mounted with as short a lead length as practicable to ensure best mechanical stability.

Readers who intend to operate the Stour should be in possession of the appropriate licence issued by the Home Office to those who have passed the City and Guilds Radio Amateurs' Examination. Details may be obtained from: The Home Office, Radio Regulatory Department, Amateur Licensing Section, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

Summarising Design Considerations for a Stable VFO

(1) Use a stabilised supply to the v.f.o.
(2) Use at least two buffer amplifiers to ensure that "pulling" of the oscillator does not occur.
(3) Operate the oscillator itself at the lowest possible power level.
(4) Ensure all connections are as rigid as possible, using heavy gauge wire where necessary.
(5) Enclose the unit to avoid air flow over tuned circuit components.
(6) Use highest quality components for all tuned circuit elements.
(7) All variable capacitors must be air spaced.
(8) Decouple the oscillator and buffers well to avoid f.m. due to stray r.f. pick-up via h.t. lines.

Connections to VFO Board

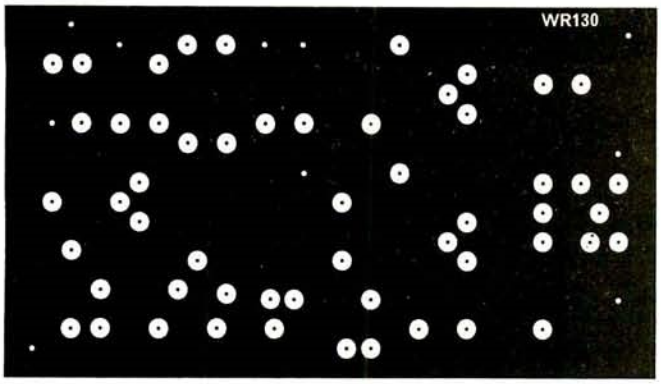
(1) A connects to the r.i.t. circuitry via relay connections as shown in Fig. 34, using ordinary connecting wire.
(2) B connects to 8V stabilised line on a.g.c. board.
(3) C connects to mixer board (v.f.o. in to 4C10).

Filter Boards F1, F2 and F3

The filter boards F1, F2 and F3 are shown in Figs. 37 and 38. These consist of two band-pass filters and one low-pass filter respectively. Due to the broad-band response of the r.f. amplifiers **under no circumstances should the transceiver be used without all three filters present.**

No p.c.b. information is given as the size of the components used will much depend on available silver mica capacitors and the way in which large values are made up. For example, C1 in filter F1 was made up from a 390pF plus a 33pF and a 6·8pF all in parallel. As long as a close value is obtained to the one specified, in this case 430pF, it does not matter how these values are obtained. The p.c.b. layout is not at all critical and the author used an old board for F3, soldering the components to the track side where plenty of isolated connections existed. Inductors L7 and L8 in filter F3 should be mounted at right angles to each other.

As no test equipment was available to align the band-pass filters they were aligned at the centre frequency,



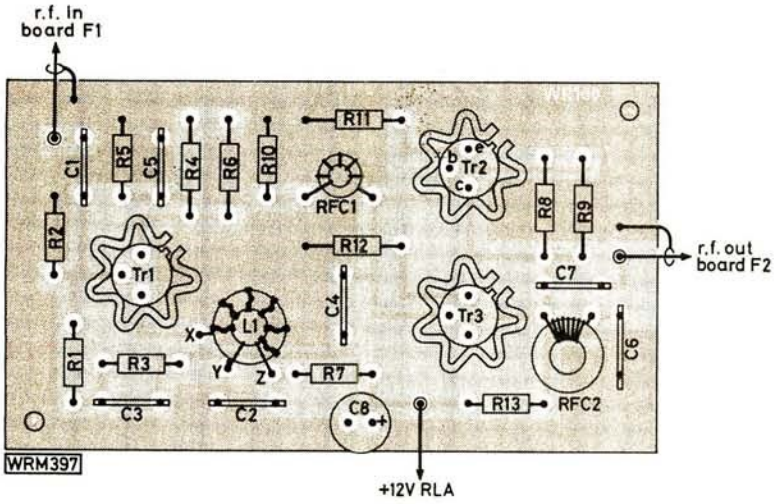
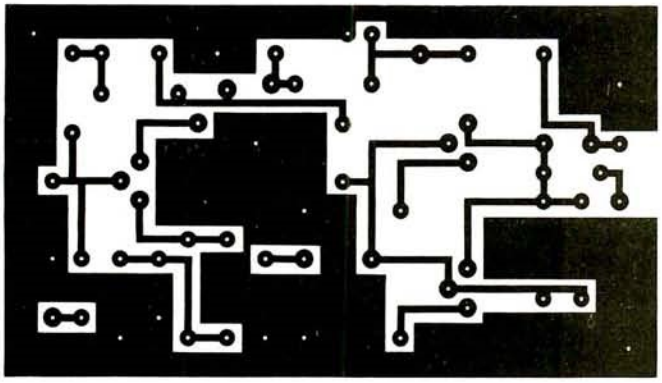


Fig. 39: Component overlay, track pattern and ground-plane of Board 9 shown full size



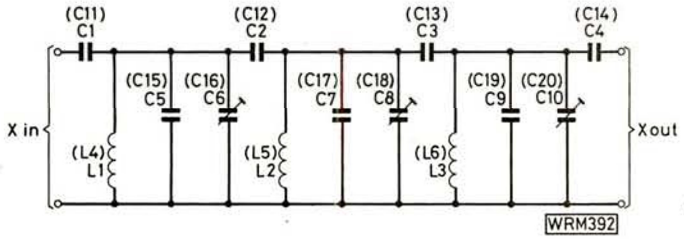


Fig. 37: Circuit diagram of Filter Boards 1 and 2

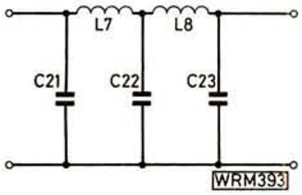


Fig. 38: Circuit diagram of Filter Board 3

★ components

FILTER BOARDS 1, 2, 3

Capacitors

Silvered Mica

82pF	2	C12,13
100pF	1	C3
200pF	1	C2
300pF	2	C15,19
382pF	1	C5
350pF	1	C9
404pF	1	C14
430pF	2	C1,11
432pF	1	C4
620pF	2	C7,17
1600pF	2	C21,23
3200pF	1	C22

Miniature Single Turn

2–60pF	6	C6,8,10, 16,18, 20

Inductors

38 turns 24 s.w.g. en. cu. on Neosid 28–522–31 toroid	6	L1,2,3,4, 5,6
20 turns 22 s.w.g. en. cu. wound on a 16mm dia. insulated tubular former (4·02μH)	2	L7,8

Miscellaneous

Double sided p.c.b. (3).

1·9MHz, and then the trimmer capacitors were tweaked to produce a fairly flat response over the whole of the 1·8 MHz–2·0MHz band. This was accomplished by running full c.w. mode into a dummy load whilst monitoring the p.a. current and swinging the v.f.o. through the necessary range, the aim being to obtain a steady current over the entire band. There is approximately a 2dB loss in power over the original mid-band setting but this is not important.

When the filters are first peaked on the centre frequency there may be too much drive present. This will then give false readings when trying to obtain the flat response. It is therefore suggested that the p.a. current is adjusted to read 3–4 amps maximum when the filters are peaked at the centre frequency (1·9MHz). This may easily be accomplished by inserting a resistor in series with the 9MHz injection into the mixer board, assuming the transceiver is running on the "tune" position.

Next month the final part, mechanical details and switching diagram