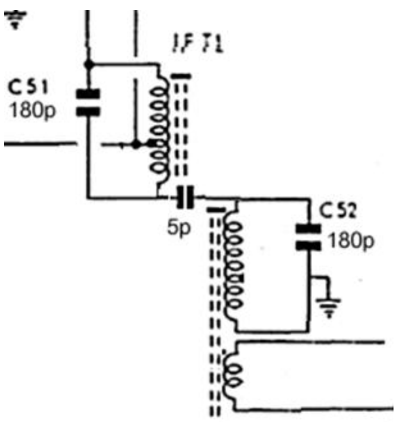
Restoration of the IF Section of an Eddystone EC10 - by Paul Galpin, ZS2PG

Background

Last year I bought myself a non-working EC10. I knew it was non-working because intermediate frequency transformer IFT1 was totally missing!

I had read the "replacement IFTs" article by Jim Duckworth (Lighthouse Issue 66, p15, appended for reference and basic circuit shown below, left), using TOKO EZ transformers, and I had contacted BEC in Harrogate to source them. Unfortunately they no longer held any stock of the transformer type No. RLC 252142NO that Jim had used. In fact they had no record of any 10EZ stocks at all. But the very helpful guy there had a good look around and found that they had a few remaining (about 100) of the Type RMC-402503NO (see 10EZ Series Data Sheet appended to this article) – photo, right. So I ordered 8 of these, just to be sure.[1]



Inspection and Test

Eventually, after the Christmas/New Year fuss had died down, and the guests and relatives departed, I decided that I must get it sorted. To help, I borrowed a working EC10 from ZS2H, OM Barry, for comparison.

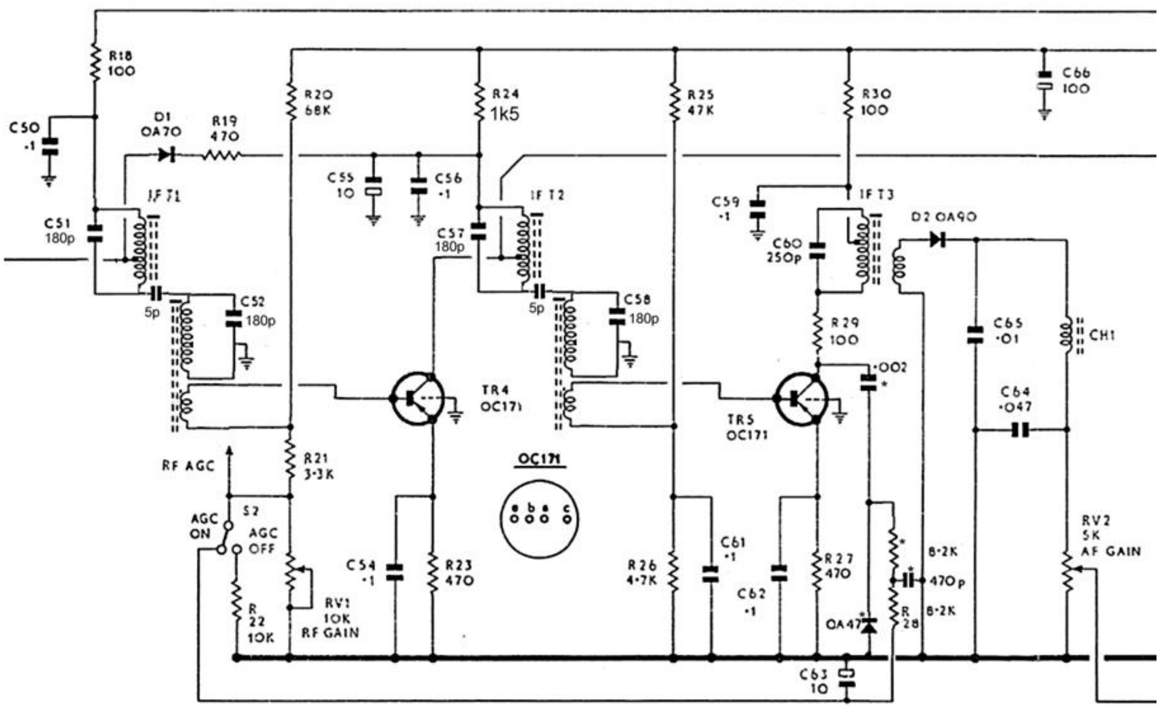
Inspection and test of my EC10 showed that (a) IFT1 was missing, (b) IFT2 sort of worked, but didn't give consistent results, and (c) IFT3 was totally mashed up inside its can. After a little experimenting with IFT2, the central shaft of that suddenly shattered. OK, back to basics......

The 'Fix'

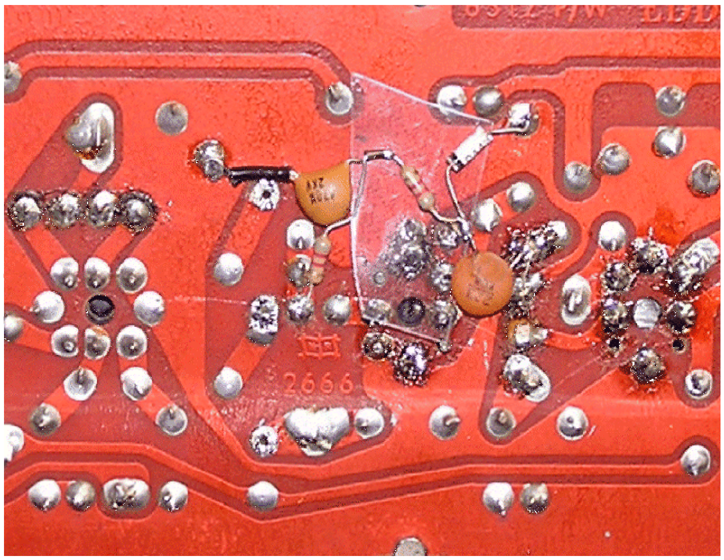
Two of the 'Duckworth filter assemblies' were built (photo, right), and I used one of the EZ transformers to replace IFT3, which feeds the detector. Switched on, and the set sprang to life! Unfortunately it seemed to want to live as a signal generator, rather than as a receiver, so I had to tame it down somehow. Experimenting showed that the oscillation only occurred on the upper range of the RF gain control, and that

[1] Try also JAB Electronics, http://www.jabdog.com/

audio, and AGC output from the detector were both pretty low. Comparing the two sets, the modified one had much more IF signal voltage at the collector of TR5 for the same signal into the aerial socket. Obviously, it seemed to me, I had too much gain with the new IF arrangement, and the 10EZ windings ratio was not correct for the audio/AGC side. A copy of the original EC10 circuit is appended for reference and comparison.

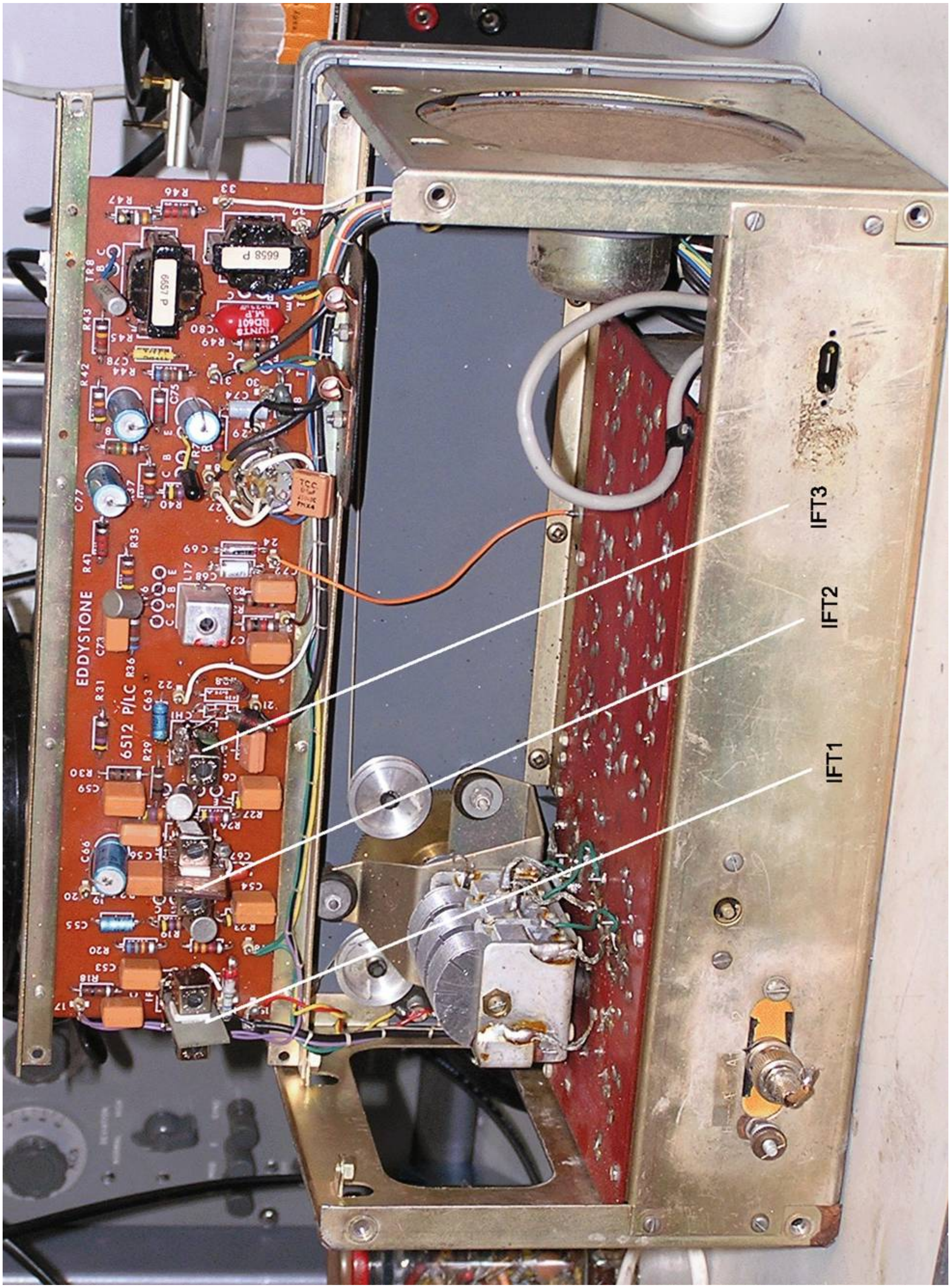


To improve the AGC action, I decide to take a feed from TR5 collector. This to serve the double purpose of getting more volts, and damping down the oscillations. (see modified circuit diagram, above). Trial and error gave me another 8k2 to go with R28. The final result gives me audible AF signal at a higher setting of the volume control than the standard set, but the maximum volume is still enough for me. Oscillation now only occurs when receiving a strong station, with AGC off, and RF gain at maximum.

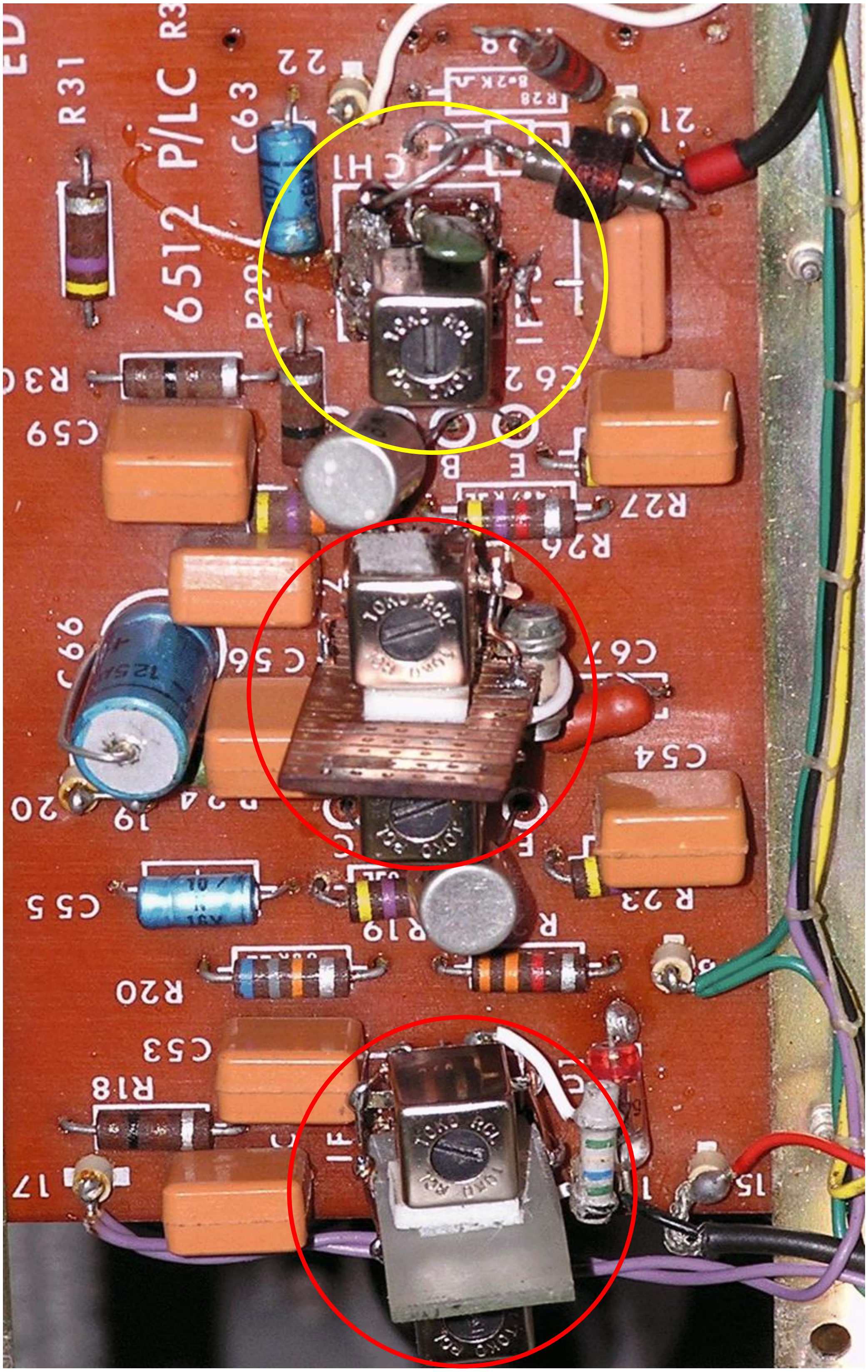


Underside of circuit board showing modifications to the AGC circuit

Paul Galpin, ZS2PG
February, 2009

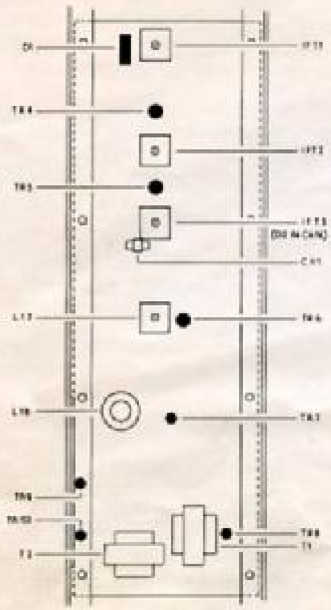


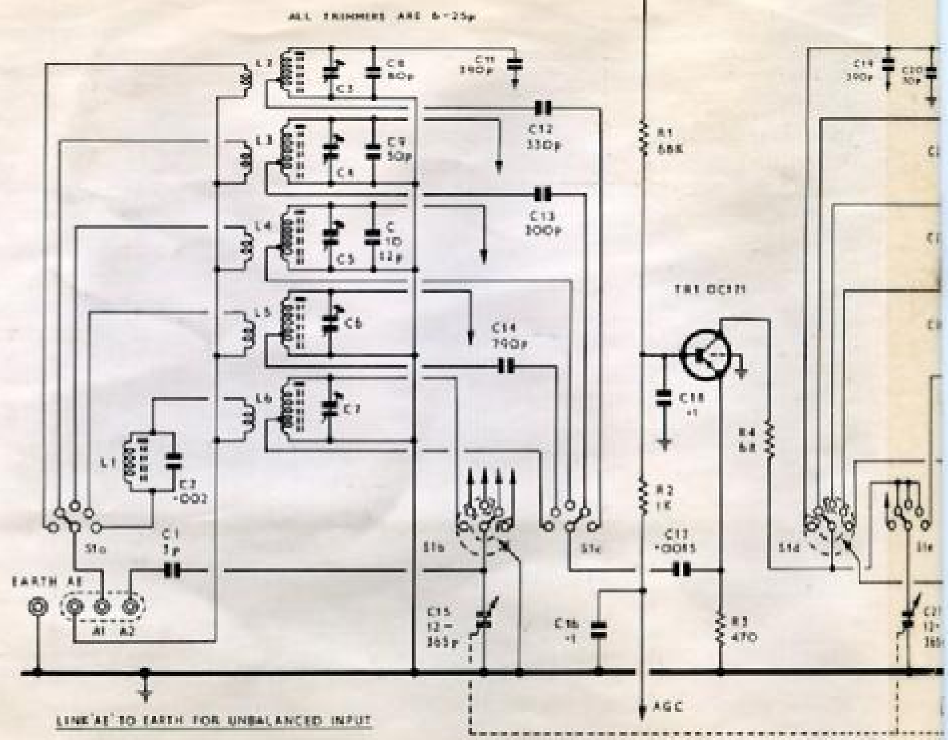
The IF/AF board in its servicing position showing the location if the IF transformers



Close-up of the 'Duckworth filter assemblies' (circled red) and final IF transformer (circled yellow)

Layout of IF Printed Board



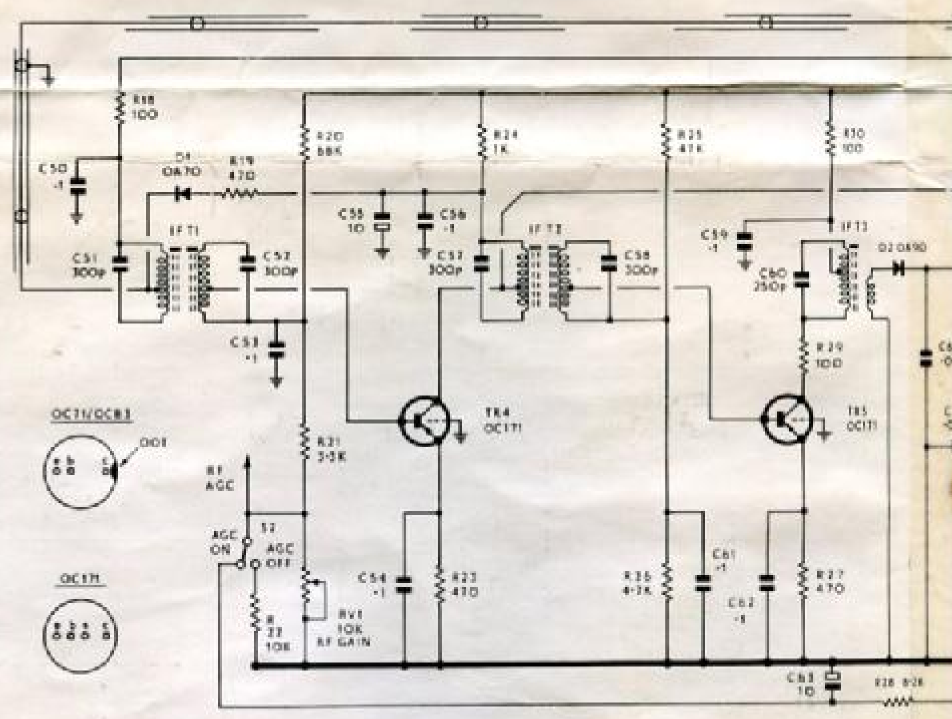


LIST OF COMPONENT VALUES

RESISTORS

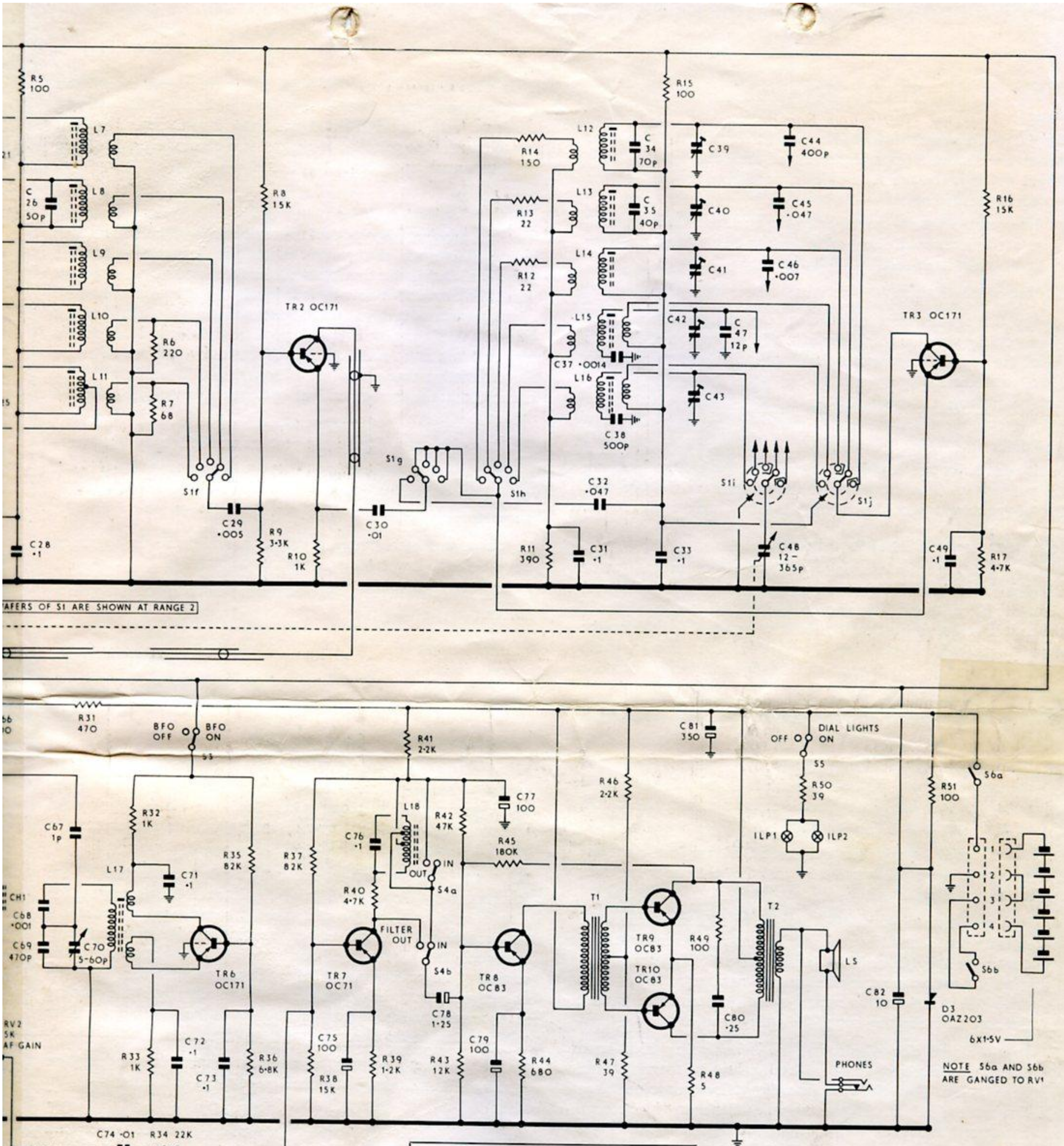
All 10% ½ watt unless otherwise indicated.)

R1, R20	68,000Ω
R2, R10, R24, R32, R33	1,000Ω
R3, R19, R23, R27, R31	470Ω
R4, R7	68Ω
R5, R15, R18, R29, R30, R49, R51	100Ω
R6	220Ω
R8, R16, R38	15,000Ω
R9, R21	3,300Ω
R11	390Ω
R12, R13	22Ω
R14	150Ω
R17, R26, R40	4,700Ω
R22	10,000Ω
R25, R35, R42	47,000Ω
R28	8,200Ω
R34	22,000Ω
R37	82,000Ω
R36	6,800Ω
R39	1,200Ω
R41, R46	2,200Ω
R43	12,000Ω
R44	680Ω
R45	0·18MΩ
R47, R50	39Ω 5%
R48	5Ω 5% wirewound. 3W.
RV1	10,000Ω potentiometer.
RV2	5,000Ω potentiometer.



CAPACITORS

C1 : 3pF Tubular Ceramic ±0·5pF 750V DC wkg.
C2 : 0·002uF Polystyrene ±5% 125V DC wkg.
C3–7, 21–25, 39–43 : 6–25pF Ceramic Trimmer.
C8 : 80pF Silvered Mica ±10% 350V DC wkg.
C9, 26 : 50pF Tubular Ceramic ±10% 750V DC wkg.
C10, 47 : 12pF Tubular Ceramic ±10% 750V DC wkg.
C11, 19 : 390pF Polystyrene ±5% 125V DC wkg.
C12 : 330pF Polystyrene ±5% 125V DC wkg.
C13 : 200pF Polystyrene ±5% 125V DC wkg.
C14 : 790pF Polystyrene ±5% 125V DC wkg.
C15, 27, 48 : 3-gang Air-spaced Variable 12-365pF.
C16, 18, 28, 31, 33, 49, 50, 53, 54, 56, 59, 61, 62, 71, 72, 73, 76 : 0·1uF Polyester ±20% 250V DC wkg.
C17 : 0·0015uF Tubular Ceramic +50%—25% 750V DC wkg.
C20, 34 : 70pF Tubular Ceramic ±10% 750V DC wkg.
C29 : 0·005uF Tubular Ceramic ±10% 750V DC wkg.
C30, 74 : 0·01uF Metallised Paper ±20% 200V DC wkg.
C32, 45, 64 : 0·047uF Polyester ±20% 250V DC wkg.



"N.B.—R35 should read 47K"

C35 : 40pF Tubular Ceramic ±10% 750V DC wkg.
C36 : Reference not allocated.
C37 : 0·0014uF Polystyrene ±5% 125V DC wkg.
C38 : 500pF Silvered Mica ±2% 350V DC wkg.
C44 : 400pF Silvered Mica ±2% 350V DC wkg.
C46 : 0·007uF Polystyrene ±5% 125V DC wkg.
C51, 52, 57, 58 : 300pF Polystyrene ±5% 60V DC wkg.
C55, 63, 82 : 10uF Tubular Electrolytic +50%—10% 16V DC wkg.
C60 : 250pF Polystyrene ±5% 60V DC wkg.
C65 : 0·01uF Metallised Paper ±20% 150V DC wkg.
C66, 75, 77, 79 : 100uF Tubular Electrolytic +100%—20% 15V DC wkg.
C67 : 1pF Tubular Ceramic ±0·5pF 750V DC wkg.
C68 : 0·001uF Polystyrene ±5% 125V DC wkg.
C69 : 470pF Polystyrene ±5% 125V DC wkg.
C70 : 5-60pF Air-Spaced variable.
C78 : 1·25uF Tubular Electrolytic +100%—10% 16V DC wkg.
C80 : 0·25uF Metallised Paper ±20% 150V DC wkg.
C81 : 350uF Tubular Electrolytic +100%—20% 12V DC wkg.

A replacement double-tuned IF module for the EC10

By Jim Duckworth

A long felt need

As correspondence to the Newsletter has shown over the years, the EC10 IF's are easily damaged and impossible to replace with original items.

The coil formers are particularly 'thin skinned' and you don't have to be especially kak-handed to plunge a screwdriver through them (That's my story anyway, after damaging mine!).

About two years ago I discussed this problem with Graeme at the NEC and made some general committal noises about having a go at a replacement module.

I had just completed an add-in ceramic IF filter option for the EC10 (featured around then in the journal), and so was very familiar with the standard IF circuit board.

A double tuned module based on coupling up two standard single tuned IF's in their cans, is a well established concept using 'top capacity' coupling.., no rocket science needed here!

Several large American manufacturers such as Zenith and Philco used such modules in high end portables as did our own Perdio for a first IF in their 'Super Seven' series.

I viewed the problem as perhaps more of a mechanical engineering one than electrical, i.e how to get them mounted in the same space as the long thin standard ones in a way which allowed easy access for alignment and connection to the same PCB pads.

In recent correspondence with Graeme I received a gentle 'prod' on the subject so I got to work and here is the result.

A bit of background info and theory

It's as well to understand the basic workings of the double tuned bandpass circuit and the device it's hooked up to. i.e. the OC171, so we can select suitable single tuned ones to do the same job as the original.

Valve broadcast receivers used double tuned IF's universally, normally critically coupled to give the superior flat top response and steep side 'skirts' for adjacent channel rejection (compared with a single tuned circuit). These benefits were well worth the effective halving of the anode load and 6db insertion loss thus incurred.

Furthermore the very high/infinite grid impedance on the secondary and the high values of an RF pentode AC output resistance (Ra) - typically 1 meg ohm or greater - on the primary, modified the basic transformer response very little. Also the extremely low anode to grid internal feedback capacitor (Cga) did not need neutralising.

The arrival of the transistor changed all of this! The 0C44/45 generation had input and output resistances of around 1K and 25k respectively meaning both the collector and obviously the base, had to be tapped into the transformer windings to preserve any reasonable selectivity characteristic and the high collector to base feedback capacitor (cbc around l0pf) needed neutralising.

Unfortunately this 'tapping in' incurred huge insertion losses on the collector side making a double tuned transformer unaffordable for gain, also for space reasons (in pocket radios). So single tuned IF's became the norm.

The arrival of the diffused base OC170

series of Germanium transistors with very useful gain up into the VHF band, and a very high collector AC resistance of around 500k ohms at standard broadcast IF frequencies, brought double tuned IF transformers back into use.

The combination of two double tuned and one single tuned transformer in the EC10 is typical of better designs of that time. There was a twist in all this however! Although the OC171 collector to base feedback capacity was low at around 2pf, it was still too high to allow all of the primary winding to be in circuit without instability.

To avoid neutralising this small amount, it became standard practice to 'mismatch the transistor for stability', so the collector was tapped into the primary winding to achieve this and I chose a replacement transformer bearing this in mind.

The base resistance was only a little higher than the 0C45 at around 1.5k ohm so needing a low impedance secondary winding as before.

With the standard transformer design of the EC10, coupling between the primary and secondary takes place via mutual inductance inside the can. The two windings would be spaced to typically achieve a slightly higher than critical coupling where the two humps just appear, allowing the single tuned third IF to neatly plug the gap in the middle.

We can achieve exactly the same effect by using a small capacitor to couple the energy between the the windings in two separate screened cans. The value to achieve critical coupling is approximately the main IF tuning cap value divided by the 'Q' ,which for the chosen Toko IFT's would give us around 3-4pf as a starting point.

On with the job!

So the chosen transformer was from the Toko 10EZ range - see 'notes' on sheet (1) for exact details. It is available off the shelf (or was at the time of writing) for only 70p from the UK major Toko Distributor, BEC, who gave me a good service and only operate a £5 minimum order charge.

I bought enough for the two double tuned positions with some spares. If single tuned IFT3 fails then one suitable for matching the detector must be chosen (or scavenged from an old Tranny!), which is relatively straightforward and not considered in this article.

My design is suitable for both the first and second IF positions. IFT1 in the mixer collector has an extra large stability margin as the output and input frequencies are different, but this is worthwhile as too high a mixer gain will often kick the others into instability.

The connection diagram for the two Toko transformers is shown in sheet (1), along with the transformer orientation sketch. The mechanical design and assembly is shown in the sheet (2) pictures.

I pondered at great length over this, toying at first with the idea of retaining the existing IFT base with its pins and somehow mounting the two new IF's horizontally on a new vertical chassis attached to this base.

However, I could not make this sufficiently rugged — the paxolin base is very flimsy. Instead I decided to mount the two cans vertically on each side of a small matrix board chassis, designed to plug into the PCB holes for the can lugs and with an integral bolt going through the central core adjustment hole.

Also to orientate the cans and 'extend' their leads to go exactly through the existing holes for correct connections. This arrangement has the added bonus of tuning both IF cores from the top.

The pictures in sheet (2) show how it's done.

Fig 1 shows the basic chassis. This is cut from 0.1" matrix board with an array of 6x9 holes available for use (no copper — a useful size piece is available from Maplin for 99p). The sturdy mounting wires on each side of the board which go through the PCB IF screening-can lug holes are 20SWG tinned copper.

The central attaching bolt is 4mm, with its slot deepened and widened slightly with a standard hacksaw, so the board pushes firmly into it and is cemented with a small fillet of Araldite. This is a nice fit through the PCB core adjustment hole but you must make up a cardboard insulating washer to stop the nut shorting on the PC board track side.

Figs 2-4 show the cans mounted with lugs bent at right angles to attach them with 24swg wire - one piece going through the board for each side, soldered in the middle onto the main earth pin wire, which is 'bowed out' to allow this. In addition each can is mounted with double sided sticky tape on the board side.

This retains them nicely and allows for future removal if necessary. Take great care to use the orientation as shown, and if you crop the unused secondary pins on the primary side, as I did, check at least three times before doing it.

24SWG wires are attached to the pins in use, which should be carefully crimped before soldering and positioned to line up with the appropriate board holes. Done carefully this assembly is very sound electrically and mechanically.

On the prototype I made provision for two pins on the matrix board, see Fig 4, to attach a small air spaced trimmer to determine the final value of the coupling capacitor. You need not do this, rather soldering the small fixed final capacitor value 4.7 or 5pf between pins (1) on each transformer.

Installation and alignment

Fig 5, sheet (2), shows the module in situ on the EC10 circuit board. It is first secured with the central bolt then soldered in. I preset the variable coupling trimmer to a measured 4pf and switched on.

Hey presto, I was straight on the air with good alignment as my set had previously been at 455kHz to suit my ceramic filter module (now completely removed), which seemed to suit the realignment of the Toko transformers.

I did a standard sig gen alignment around 465kHz. The Toko transformers aligned beautifully with no trace of instability. They will cover 470kHz at their limits but I preferred to inset this. I then turned loose my custom IF aligner/calibrator/ wobbulator unit recently fabricated using fets (in an old Eddystone diecast box of course!) to determine the final value of the coupling capacitor.

Wobbulators can mislead unless used with very great care, but mine had been run in on a variety of other sets confirming a slow sweep speed of 200Hz as the best to use along with a very low input signal.

I quickly established that a small degree of overcoupling gave the best-shaped response and output using a coupling capacitor value of around 5pf. So I hard wired this value in place, see Fig 5. You can use 4.7 pf if buying from new.

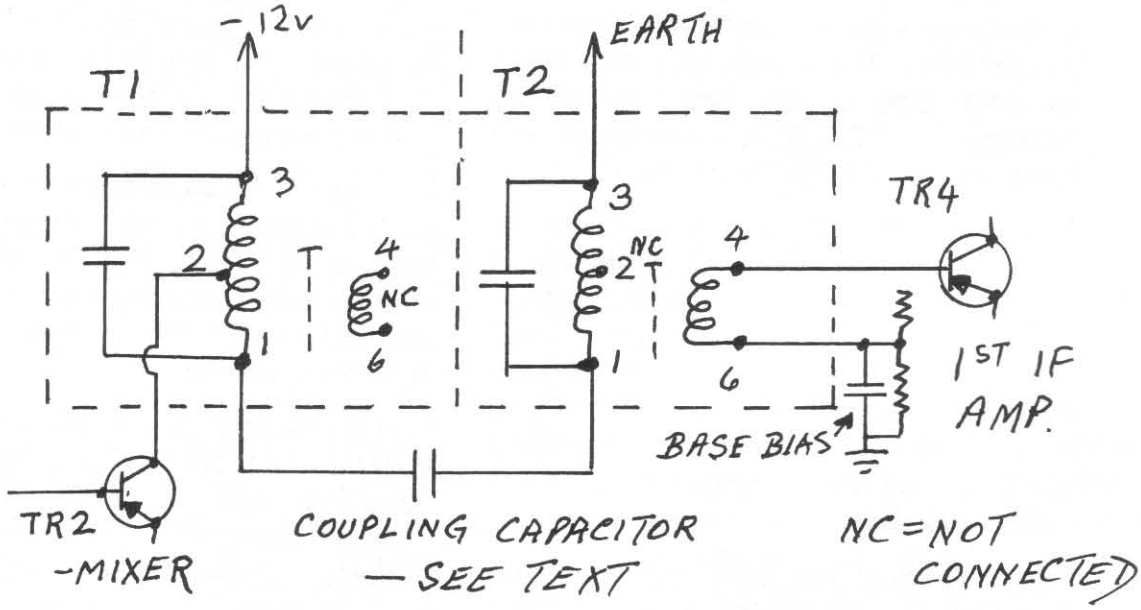
In practical use, tuning across the bands, the selectivity and tuning characteristic was excellent, at least as good, if not better than before. So I can recommend this solution. Don't let your EC10 sit there mute for want of a double tuned IF transformer! JD. March 2001

PICS →

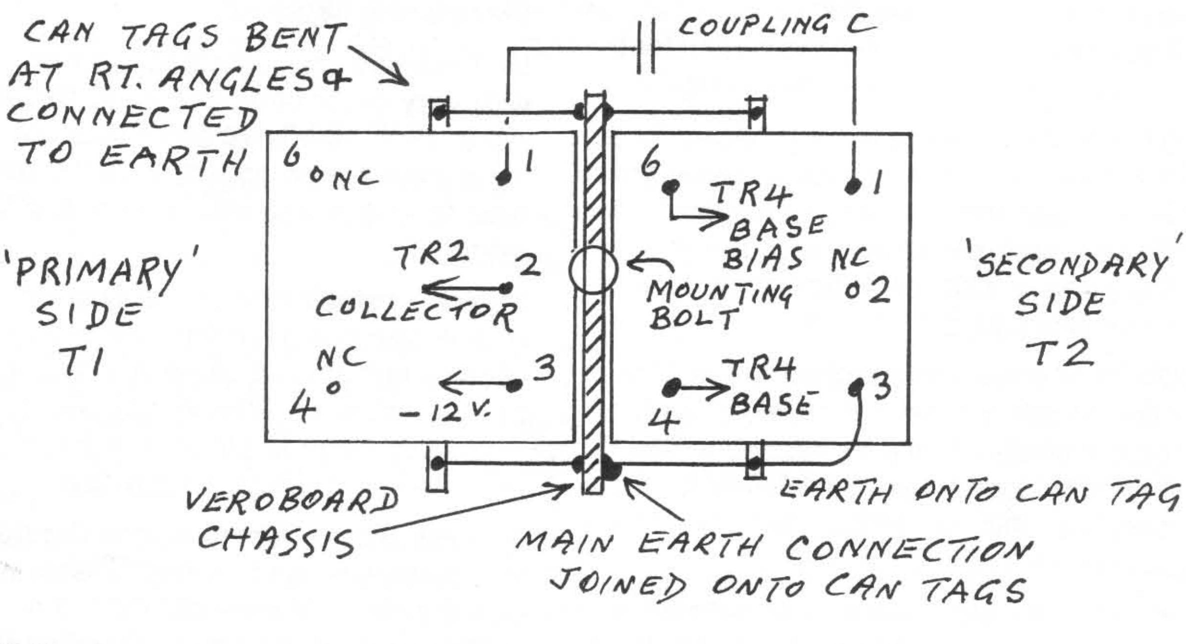
SHEET (1)

CIRCUIT DIAGRAM AND CONNECTIONS OF T1, T2 TO MAKE

A REPLACEMENT DOUBLE-TUNED I.F. MODULE



UNDERSIDE MODULE VIEW SHOWING ORIENTATION OF T1, T2 (not to scale)



NOTES

- T1 & T2 are TOKO type RLC-252142NO 10EZ.
- BEC product code 352142. BEC Distribution, phone – 01753 549502
- VERROBOARD chassis is standard 0.1 matrix board – no copper
- Main earth pin wire is 20 swg, the rest is 24 swg
- See TOKO products on BEC website: www.bec.co.uk

J.D. 3/01

EC10 Double Tuned IFT module assembly

Sheet (2)

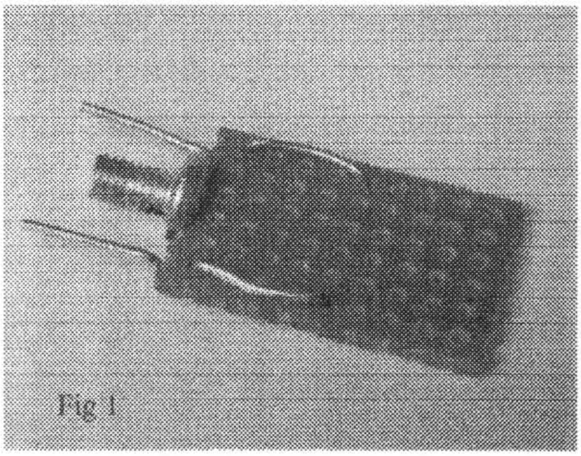


Fig 1

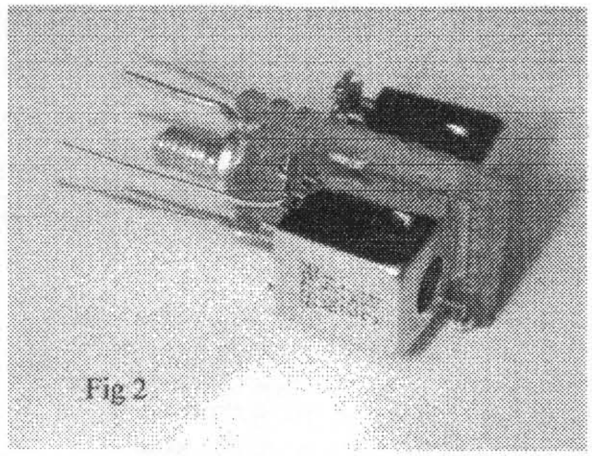


Fig 2

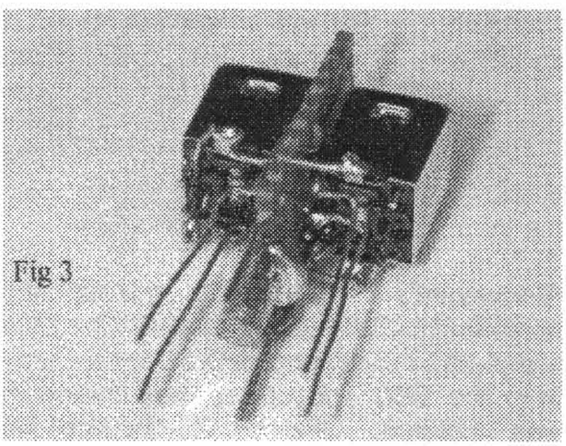


Fig 3

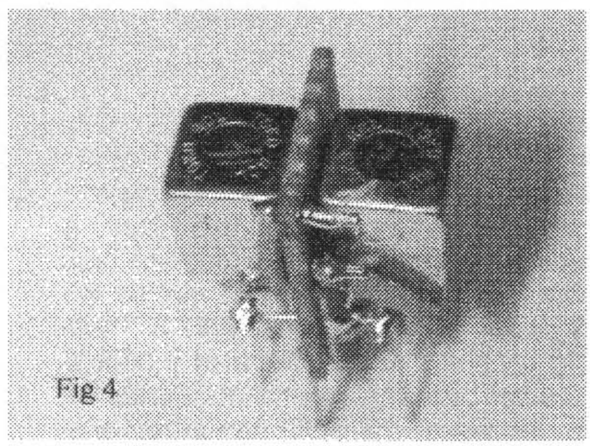


Fig 4

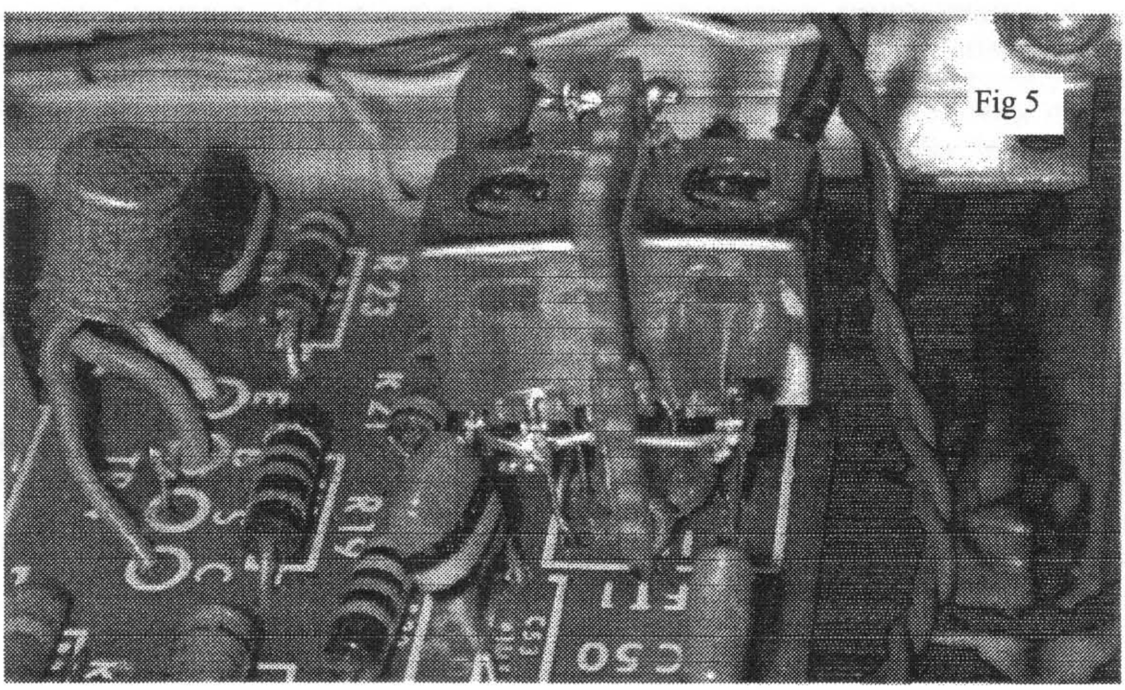


Fig 5