Assembly Manual

HF Linear Amplifier

K-6331

DICK SMITH ELECTRONICS PTY LTD

KIT

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Most high-power HF linear amplifiers cost an arm and a leg. This one costs around $300, boasts a power supply of up to 150W PEP, and includes switchable output filters.

If you've having trouble making some of those distant QSOs (contacts) or just want more power for your HF rig, this new HF Linear Amplifier is the answer. Installed between your rig and the antenna, it will boost your power output by 10-14dB — up to a maximum of 150W PEP (peak envelope power) in fact!

This unit can be used on any HF amateur band between 1.8 and 30MHz and will pump out a good clean signal with better than 30dB rejection of unwanted harmonics. That's made possible by the use of switchable low pass filters, a feature often missing from commercial linear amplifiers.

In fact, some commercial units deliver a third harmonic content that's almost as strong as the primary frequency. Such units represent a significant potential source of radio frequency interference (RFI).

How much input power can you feed into the new linear amplifier? Answer: you can use any HF transceiver with a power output of up to 15W CW (30W PEP). The only proviso is that a 2:1 attenuator must be included during construction for transceivers in the 10-15W range.

Figs.1 and 2 plot the performance of the unit. As can be seen from Fig.1, the output power is generally better than 110W for an input of 10W from 1.8 to 24MHz. Above that figure, the power output drops due to the ferrite material used in the input and output transformers.

Even so, a power output of about 50W is still available at 28MHz for 10W input.

Let's now take a look at the front panel. There are just three operating controls: an on/off switch; a switch to select between AM and SSB operating modes; and the band filter switch. A power LED, an on-air LED and a power meter complete the front panel line-up.

The rear panel carries the input and output sockets.

Inside the amplifier are two relays which switch the unit in and out of circuit. When power is applied (ie, the on/off switch is in the 'on' position), the amplifier is switched into circuit by the relays whenever the press-to-talk (PTT) button on the transceiver is pressed.

When the PTT button is subsequently released, the amplifier is switched out of circuit and the relay contacts now connect the transceiver output "straight through" to the antenna socket (on the back of the amplifier).

Finally, in addition to all of the above features, the unit is virtually "bulletproof". It is protected against reverse battery connection and battery overvolt-

The completed HF linear amplifier —150W PEP and switchable output filters.

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age; it automatically shuts down in the event of RF overdrive; and it shuts down if the antenna SWR becomes excessive (eg, if the antenna lead goes open circuit).

HOW IT WORKS

Fig.3 shows the circuit diagram. It looks complicated but can be broken down into four easily understood sections: a power booster (Q101 and Q102); a low-pass filter circuit; a VSWR-cum-power indicator circuit; and a carrier operated relay circuit.

The booster is based on two 2SC2290 RF power transistors arranged in a standard push-pull design and operating in class B mode.

Starting at the input, the RF signal from the transceiver is fed via relay contacts RL2a to the 2:1 attenuator network and thence to transformer T1. This scales the input impedance down by 16:1, from 50 ohms to around three ohms, to drive the power transistors (Q101 and Q102).

Base bias for the power transistors is provided by Q103 which is configured as a diode. Because it is thermally coupled to the heatsink, this arrangement also prevents thermal runaway of the power devices. The hotter the heatsink becomes due to dissipation in Q101 and Q102, the hotter Q103 becomes.

And the hotter Q103 becomes, the lower the voltage across it and therefore the lower the bias on the power transistors. Q101 and Q102 are thus automatically throttled back as the heatsink temperature rises.

Resistor R7 limits the bias current to about 100mA per device, while capacitors C107-C113 provide supply decoupling. Inductor L101 is designed to filter out RF in the bias supply to Q101 and Q102.

The collector outputs of the power transistors drive output transformer T2. This transformer steps up the output voltage and, in turn, drives the following low-pass filter stage. Trimmer capacitor TC101 and parallel capacitor C106 tune the output transformer primary to give maximum power transfer and to guard against output stage oscillation.

Negative feedback for the booster is derived from a single winding on the output transformer secondary and is applied to the bases of Q101 and Q102 via series RC networks. This helps maintain a low VSWR across the input transformer and also helps compensate for gain variations over the 1.8-30MHz range.

The low-pass filter stage consists of six independent sections arranged in standard Chebyshev configuration (L2-L13 and C14 to C41). The –3dB cutoff frequencies are listed in Table 1. Double-pole switch S3 selects the required filter and couples the RF energy to the following VSWR-cum-power indicator stage.

VSWR/POWER INDICATOR

The VSWR/power meter is fairly conventional. It employs a current transformer consisting of a centre-tapped secondary wound on a toroid, with the primary being a heavy gauge conductor through the middle. Diodes D10 and D11 rectify the voltage developed across L1 due to the forward power. The resultant DC signal is then applied to the meter movement via calibration trimpot VR1.

Trimmer capacitor TC1 is used to peak the circuit for a maximum reading on the meter.

Similarly, D12 and D13 rectify the voltage developed across L1 due to the reflected power. This signal is then applied via VR2 and R17 to the gate of SCR1 in the carrier operated relay circuit. More on this later.

CARRIER OPERATED RELAY

Q1, Q3 and Q4 form the relay switching circuit. This switches the amplifier into circuit on transmit, and switches the amplifier out of circuit during receive. Ignore Q2 and the two SCRs for the time being — they're in the protection business.

Here's how the circuit works: During receive, Q1 and Q3 are off. Thus, relay driver transistor Q4 is also off and the transceiver is connected directly to the output socket via relay contacts RL2a and RL2b.

When the transmit button is pressed, part of the signal passes via C1 to a diode pump consisting of D1 and D2. This charges C2 and provides base bias for Q1 which turns on. Thus, Q3 and relay driver Q4 also turn on and so power is applied to the amplifier circuit and to the on-air

TABLE 1

Band	-3dB Fc	Suitable For:
160 metres	2.5MHz	1.8 - 1.86MHz
80 metres	5MHz	3.5 - 3.8MHz
40 metres	10MHz	7 - 7.3MHz
20-30 metres	17MHz	10.1 - 14.35MHz
14-16 metres	26MHz	18 - 21.45MHz
10 metres	31MHz	28 - 29.7MHz

Table 1: 3dB cutoff frequencies for the filter switch settings.

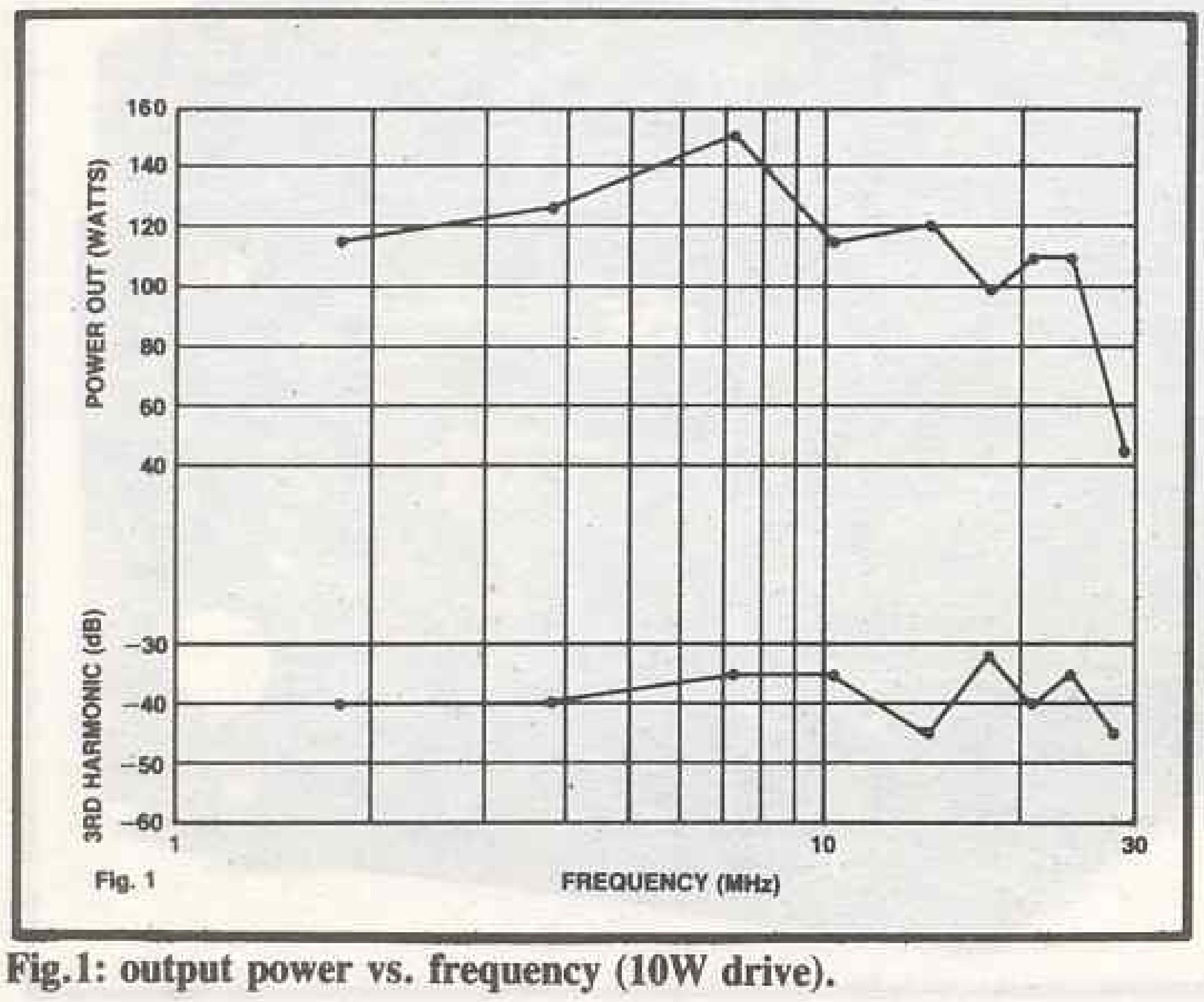


Fig.1: output power vs. frequency (10W drive).

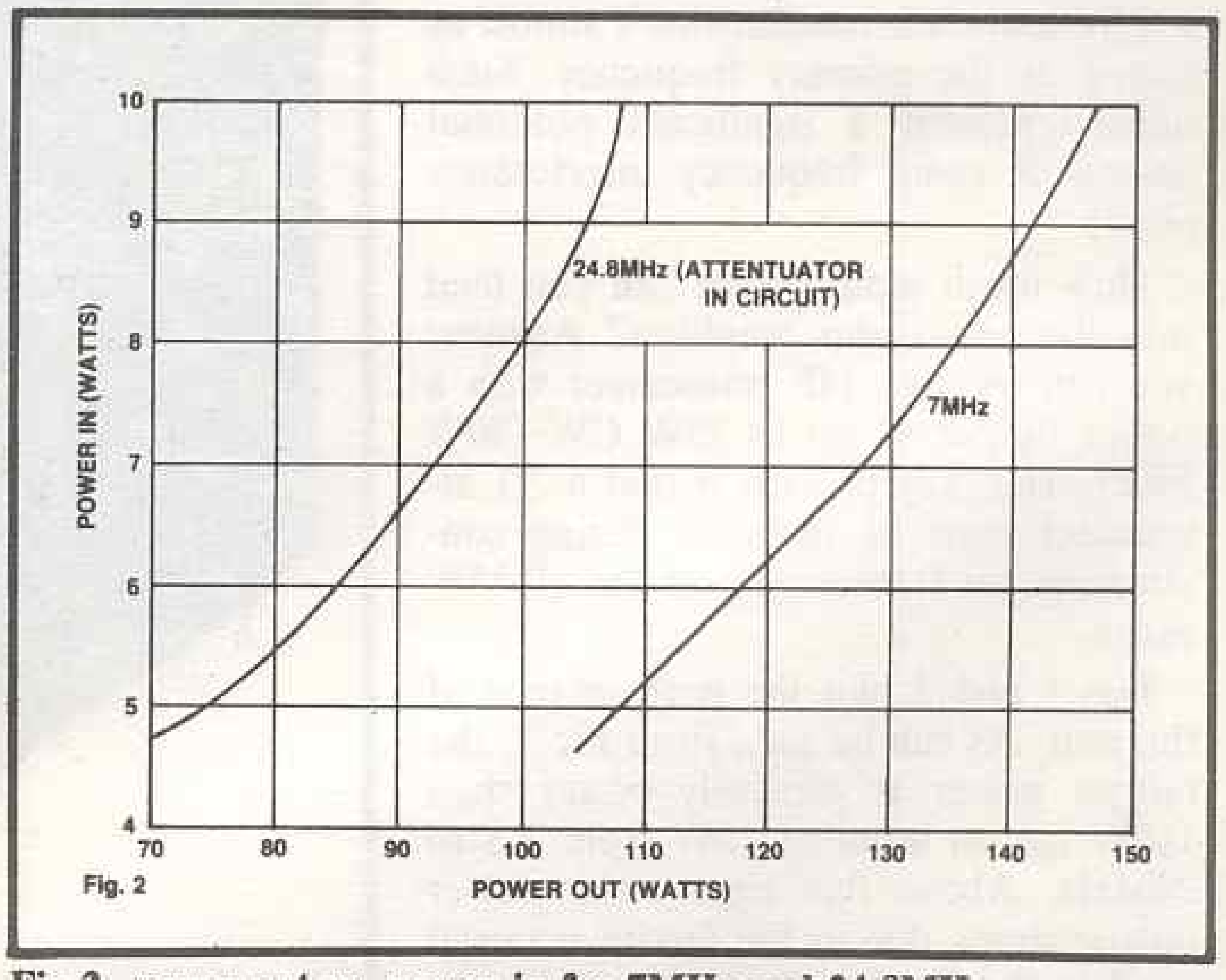


Fig.2: power out vs. power in for 7MHz and 24.8MHz.

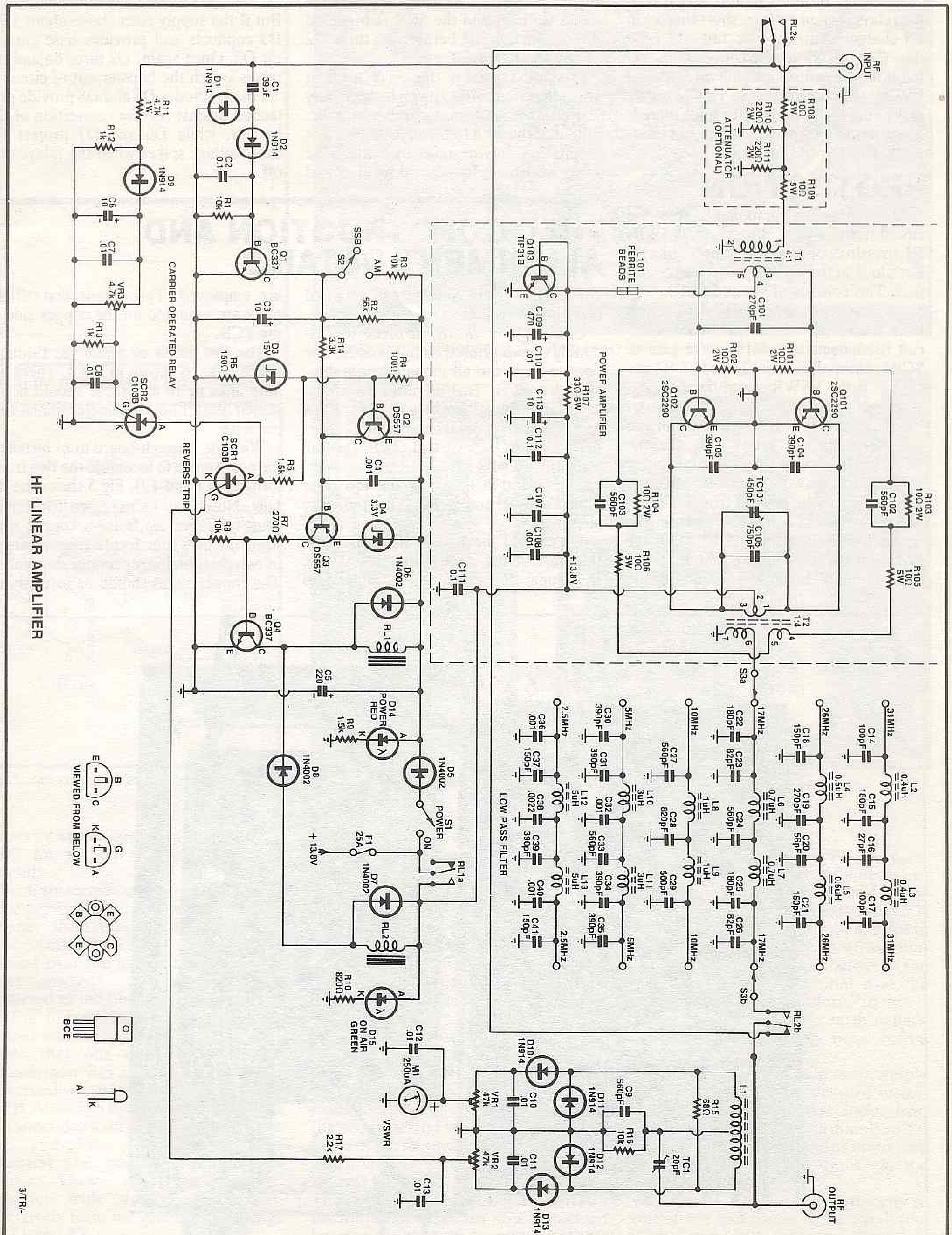


Fig.3: the circuit uses two RF transistors, Q101 and Q102, operating a standard class B push-pull mode.

LED (D15) via relay contacts RL1a.

At the same time, power is also applied to RL2 which turns on and switches the amplifier into circuit.

When the transmit button is released, the relays remain on for a short time until C3 charges sufficiently to turn Q3 (and thus Q4) off. Switch S2 considerably extends the relay dropout time for SSB and CW by switching out R3. This is necessary to prevent relay chatter since there is no carrier in SSB mode and only an intermittent carrier in CW mode.

PROTECTION

The remaining components shut the circuit down if there is excessive VSWR, RF overdrive or excessive supply voltage. Let's look at the VSWR protection circuit first. This consists of Q2 and SCR1.

As described previously, the output from the reverse side of the VSWR circuit is connected via R17 to the gate of SCR1. Normally, both Q2 and SCR1 are off but if the VSWR signal becomes excessive, the SCR turns on and provides base current for Q2. This turns Q2 on and Q3, Q4 and the relays off, thereby switching the booster out of circuit.

Q2 and SCR2 work in exactly the same way to protect the booster from RF overdrive. In this case, RF energy from the transceiver is first applied to a voltage divider consisting of R11 and R12. D9 then rectifies the divider output and charges C6. The higher the RF drive, the higher the voltage across C6.

This voltage is sampled by VR3 and applied to the gate of SCR2. If the RF drives becomes excessive, the voltage across C6 rises and the SCR is triggered into conduction. As before, this turns Q2 on and the relays off.

Trimpot VR3 sets the drive level at which the circuit trips. It can be set to any desired level up to a maximum of 15W. Note that the SCR1 and SCR2 protection circuits can only be reset by turning the power switch off for several seconds and then on again.

Zener diode D3 provides protection against excessive supply voltage. Because the supply voltage is usually around +13.8V, D3 is normally non-conducting. But if the supply rises above about 17V, D3 conducts and provides base current for Q2. Once again, Q2 turns on and the relays switch the booster out of circuit.

Finally, diodes D5 and D8 provide protection against reverse connection of the battery, while D6 and D7 protect Q4 from voltage spikes when the relays turn off.

FULL CONSTRUCTION AND ALIGNMENT DETAILS

The HF Linear Amplifier is supplied complete with pre-drilled metalwork.

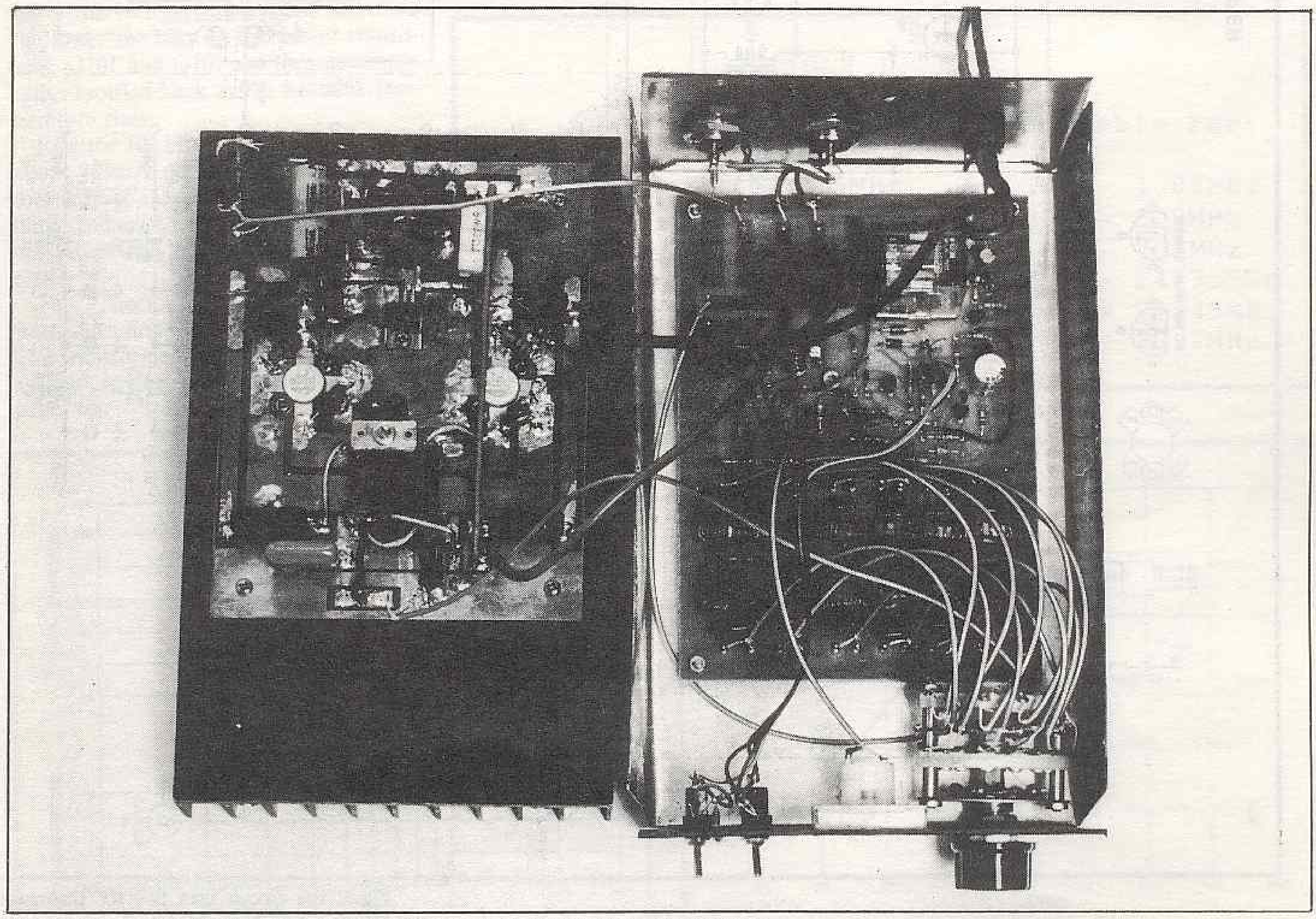
Construction mostly involves the assembly of two printed circuit boards. The booster parts are all mounted on a double-sided PCB. This in turn is mounted on a large finned heat-sink (220 x 136 x 38mm) which provides substantial heat sinking for the two RF power transistors.

The second PCB carries the low pass filter, VSWR and carrier operated relay circuitry.

Let's build the booster first. Because this part of the circuit operates at HF, traditional RF construction techniques are employed. This means that all the parts are mounted on the copper side of the PCB.

The first job is to install the through-board links as shown in Fig.4. There are nine links in all and these should be installed using 1.6mm-diameter tinned copper wire.

With the through-board links installed, the next step is to assemble the two transformers (T1 and T2). Fig.5 shows the details. Note that T1 uses two F16 ferrite rings on tubes made from copper shim while T2 uses four ferrite rings arranged in two pairs on longer copper shim tubes. The copper shims should be formed into



View inside the prototype. The RF transistors are bolted directly to the heatsink.

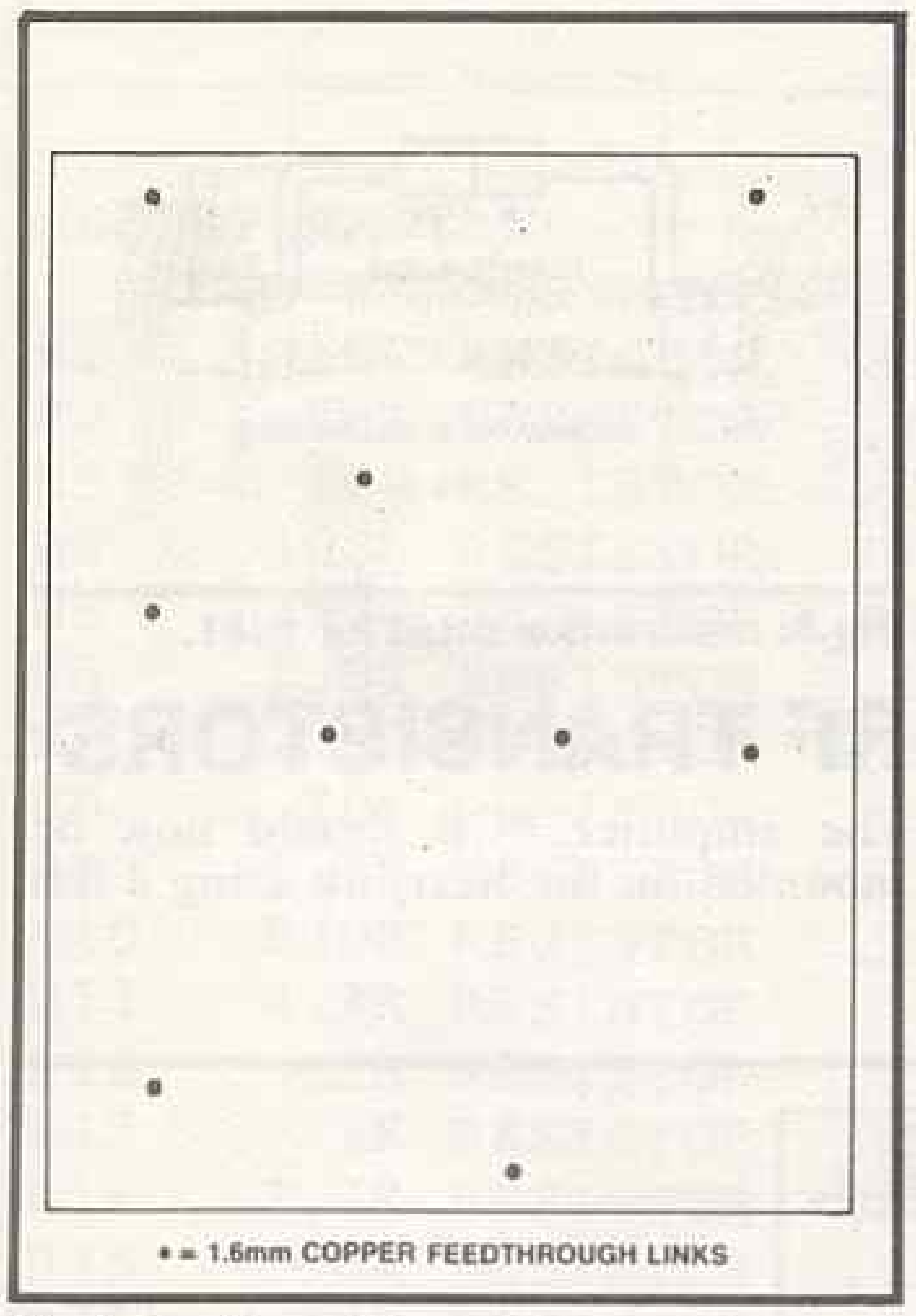
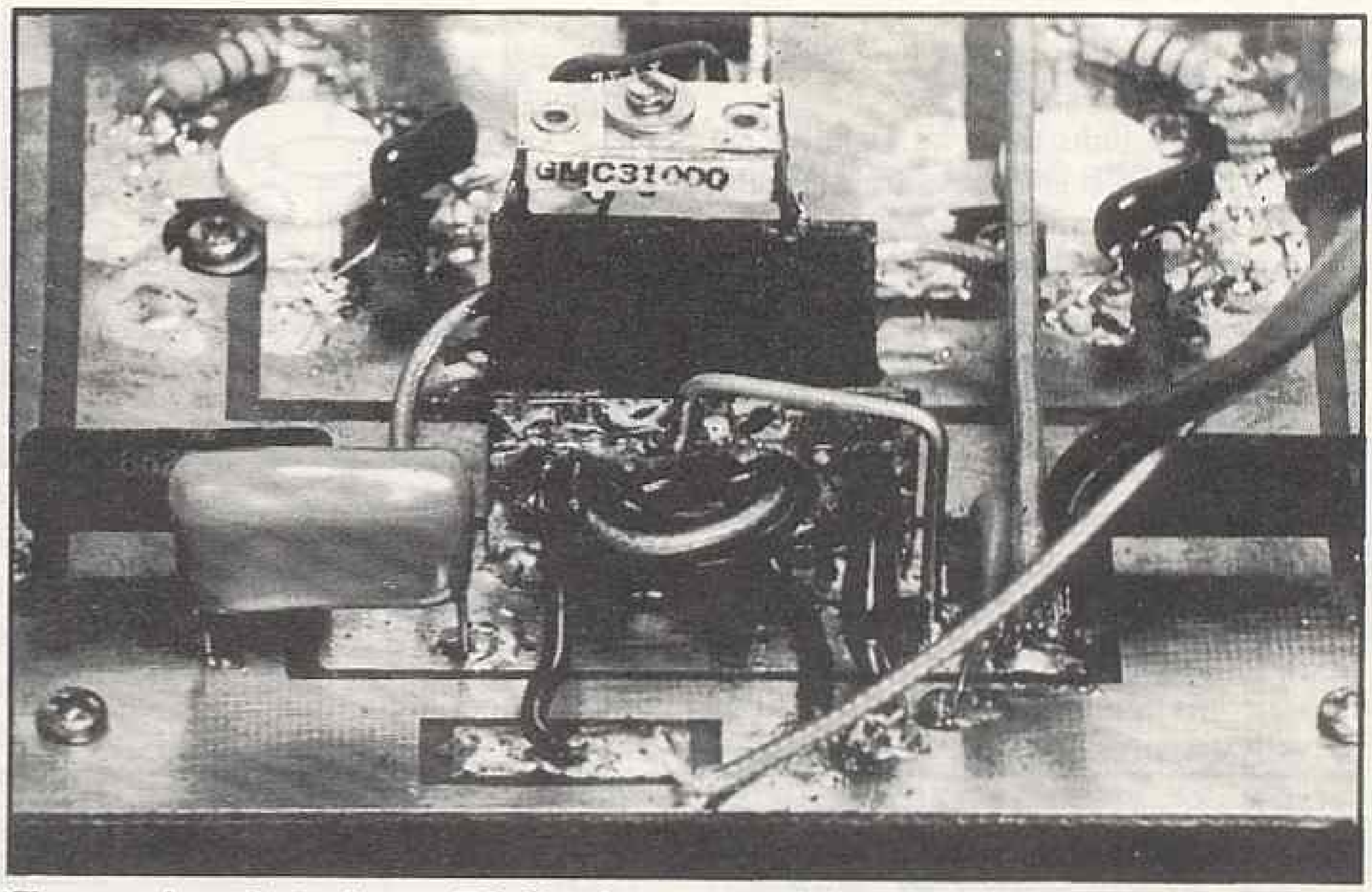


Fig.4: the through-board link locations.



Close-up view of transformer T2. Note heavy-gauge 1.6mm wire link to supply rail.

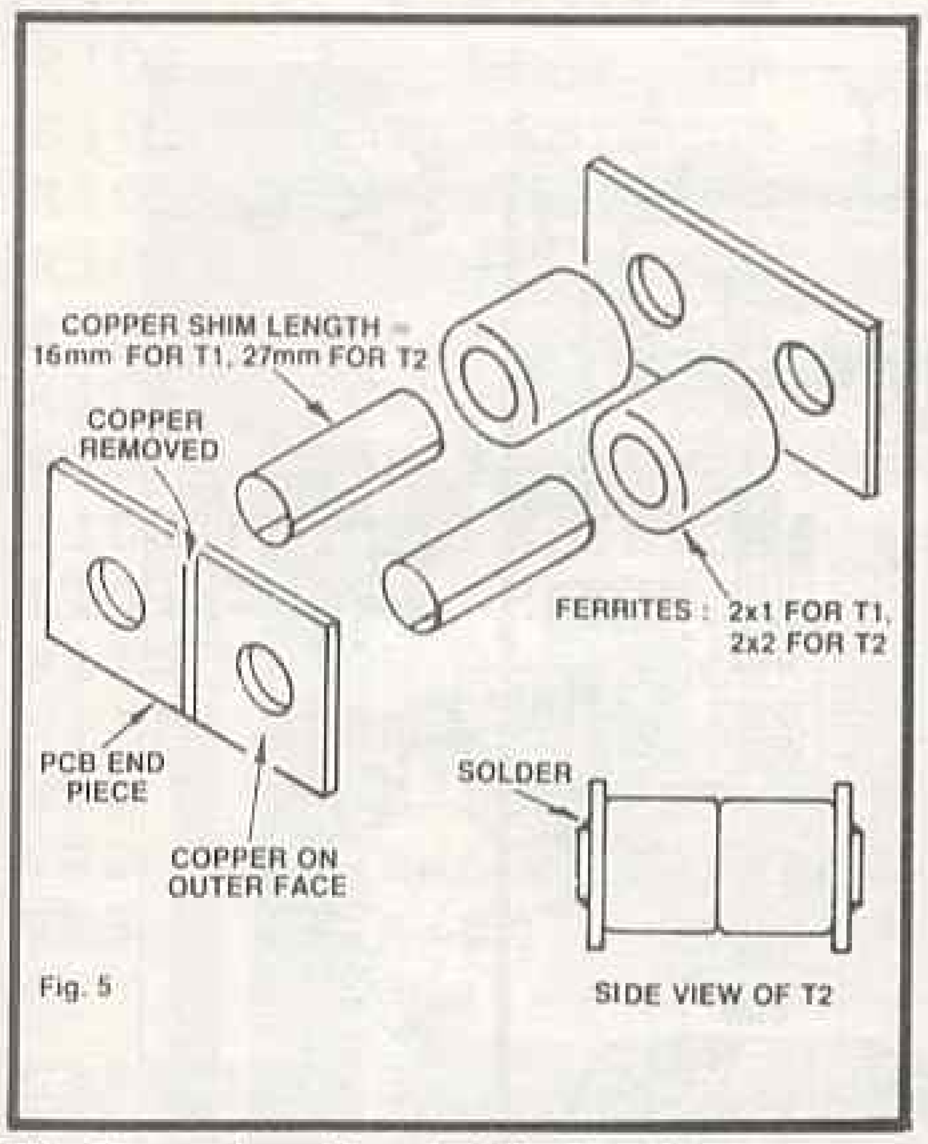
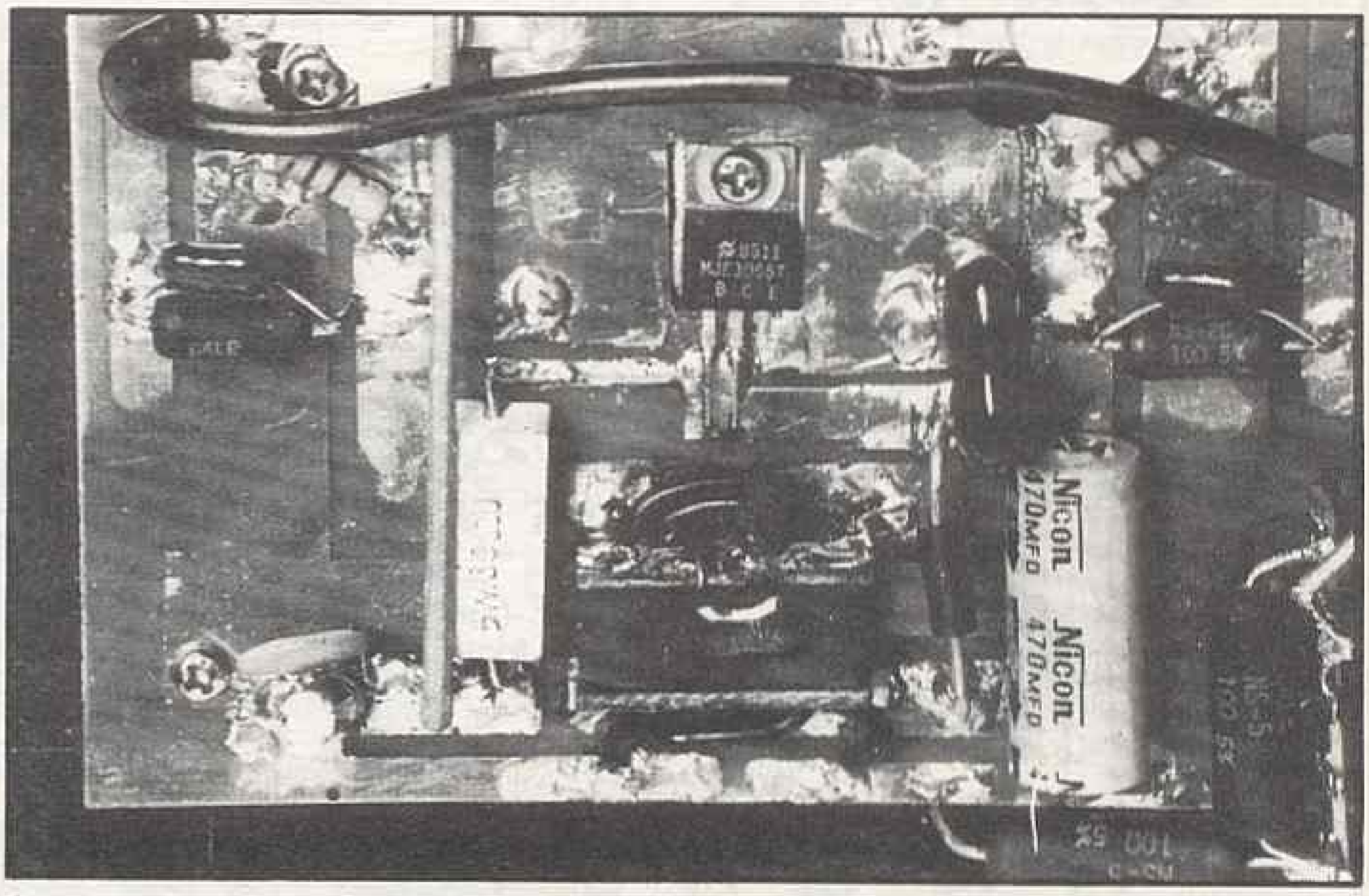


Fig.5: construction details for T1 and T2.



Close-up view of transformer T1. C101 is soldered directly to the PCB end piece.

tubes by wrapping them around a 6mm drill bit so that the ends over-lap slightly.

The transformer assemblies are held together by soldering the ends of the copper shim tubes to the PCB end pieces (after the ferrite rings have been placed over the tubes). Once this has been done, the two assemblies are soldered to the booster PCB as shown in Fig. 6. Installation of the windings comes later.

Note that one end-piece on each transformer has its two copper areas electrically connected together by the PCB. Although not strictly necessary, it is a good idea to bridge the pads of these two end-pieces using spare shim material and generous amounts of solder. These shorted end-pieces, together with the copper shims, effectively form the one-turn windings of T1 and T2.

The copper areas of the opposite end-pieces thus form the terminations of the one-turn windings. Care should be taken to ensure that these are each soldered to their respective pads and are not shorted.

Now for the windings. In the case of T1, this job simply involves threading four turns of insulated hook-up wire through the copper tubes to form the primary. Note that the leads should emerge from the end of the transformer adjacent to the edge of PCB. Terminate the leads as shown in Fig. 6.

The secondary of T2 is wound and terminated in exactly the same manner. Once this has been done, the one-turn feedback winding can be threaded through. Its leads should emerge from the opposite end of the transformer to those of the secondary (ie; the feedback leads should emerge from the end nearest the centre of the PCB).

The real job of installing the parts on the amplifier PCB can now be tackled but don't mount the transistors at this stage. It is a good idea to stand the resistors off the board by 3-4mm to allow for efficient air circulation. Apart from that, keep all component leads as short as possible.

Fig. 6 shows the amplifier PCB with the optional attenuator components in position. These components are mounted on five-way tagstrip which is secured to one of the corner mounting points of the PCB. Check to ensure that there is good contact between the tagstrip mounting terminal and the amplifier PCB earth pattern - in fact, it is a good idea to tin the earth pattern around the mounting hole before installing the tagstrip.

If you don't need the attenuator, simply leave the four resistors out of circuit and solder the shielded input lead directly to the primary terminals of T1. Be careful - the shield of this input lead must go to the earth track on the PCB.

Capacitor C101 is soldered directly to one of the end pieces of T1. Similarly, TC101 and C106 are soldered directly to T2 (see Fig. 7)

The only other capacitor requiring comment is C107. This has one of its leads soldered directly to the adjacent

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end piece of T2. The other lead is terminated on the PCB.

WIRE LINKS

Three wire links must be installed on the amplifier PCB and these are run using 1.6mm tinned copper wire. As shown in Fig.6, one of these links doubles as inductor L101 and requires the installation of two ferrite beads. These beads are secured with epoxy adhesive and should sit about 10mm proud of the PCB (Fig.8).

The long link between the positive supply and R107 is also mounted about 10mm proud of the PCB. This link is 123mm long and should be covered with spaghetti insulation to prevent accidental short circuits. The remaining link connects the end piece of T2 to the adjacent positive supply rail.

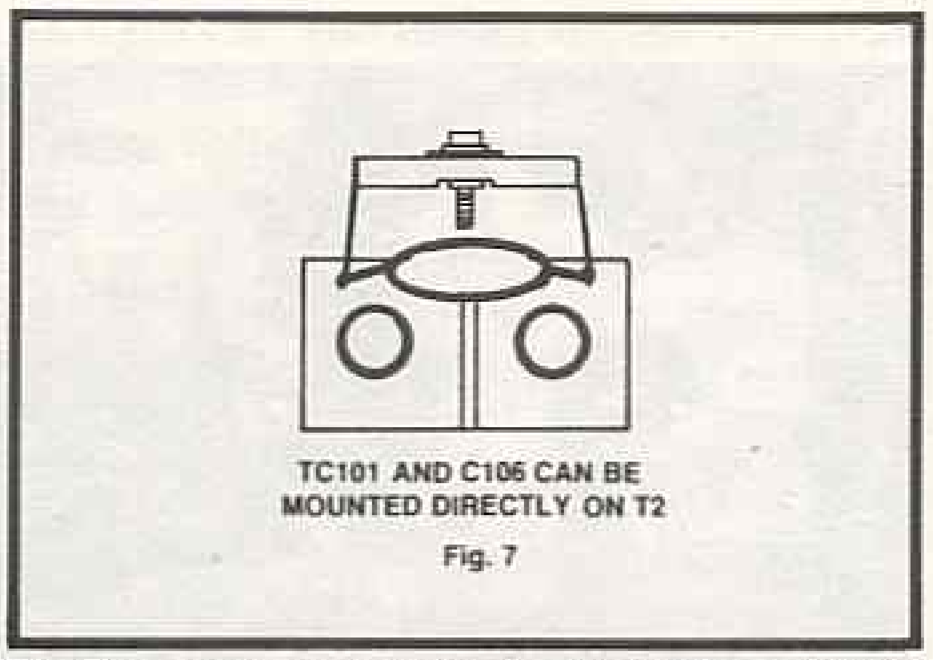


Fig.7: mounting details for TC101 and C106

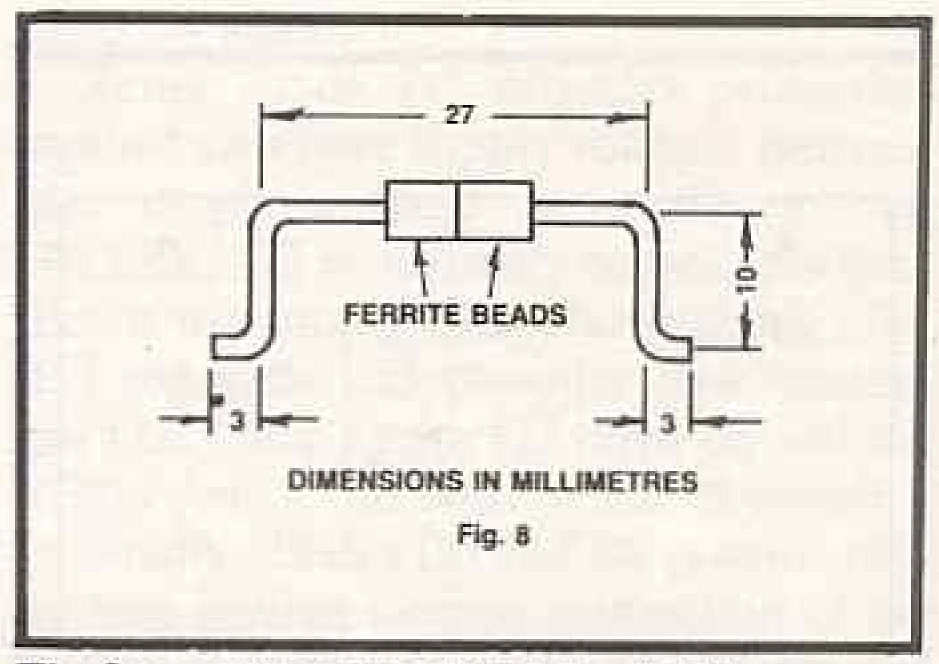


Fig.8: construction detail for L101.

RF TRANSISTORS

The amplifier PCB should now be mounted on the heatsink using 4 flat

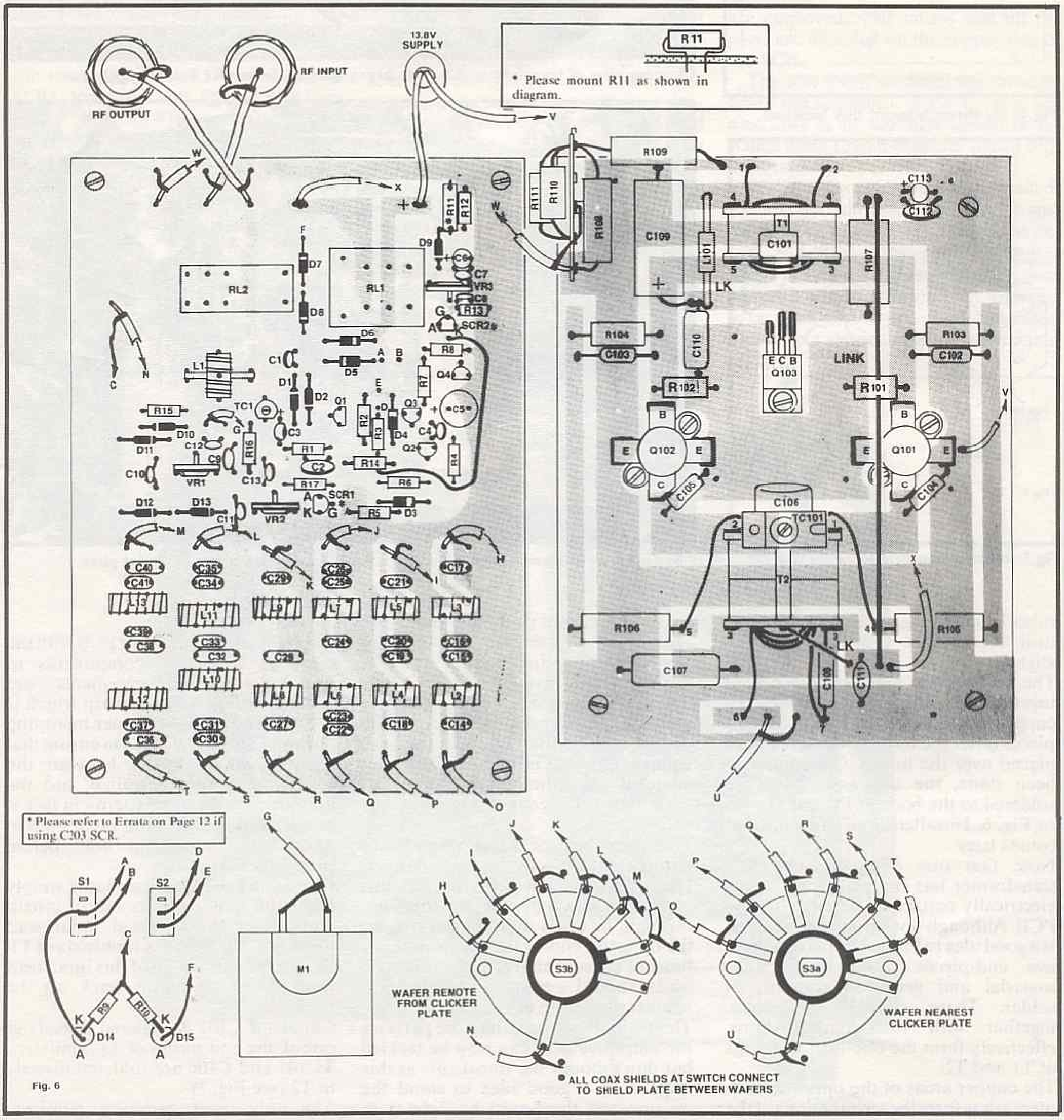


Fig.6: parts layout and wiring diagram. Follow the layout carefully and keep all leads as short as possible.

COMPONENT LOCATION

RESISTORS

R1	10K	RESISTOR	.25W
R2	56K	RESISTOR	.25W
R3	10K	RESISTOR	.25W
R4	100R	RESISTOR	.25W
R5	150R	RESISTOR	.25W
R6	1.5K	RESISTOR	.25W
R7	270R	RESISTOR	.25W
R8	10K	RESISTOR	.25W
R9	1.5K	RESISTOR	.25W
R10	820R	RESISTOR	.25W
R11	4.7K	RESISTOR	1W
R12	1K	RESISTOR	.5W
R13	1K	RESISTOR	.25W
R14	3.3K	RESISTOR	.25W
R15	68R	RESISTOR	.25W
R16	10K	RESISTOR	.25W
R17	2.2K	RESISTOR	.25W
R101	10R	RESISTOR	2W
R102	10R	RESISTOR	2W
R103	10R	RESISTOR	2W
R104	10R	RESISTOR	2W
R105	10R	RESISTOR	5W
R106	10R	RESISTOR	5W
R107	33R	RESISTOR	5W
R108	10R	RESISTOR	5W
R109	10R	RESISTOR	5W
R110	220R	RESISTOR	2W
R111	220R	RESISTOR	2W
VR1	47K/50K	TRIMPOT	
VR2	47K/50K	TRIMPOT	
VR3	4.7K/5K	TRIMPOT	

CAPACITORS

C1	39pF	CERAMIC	50V
C2	.1uF	CERAMIC	50V
C3	10uF	TANTALUM	25V
C4	.001uF	CERAMIC	50V
C5	220uF	ELECTRO RB	25V
C6	10uF	ELECTRO RB	25V
C7	.01uF	CERAMIC	50V
C8	.01uF	CERAMIC	50V
C9	560pF	CERAMIC	50V
C10	.01uF	CERAMIC	50V
C11	.01uF	CERAMIC	50V
C12	.01uF	CERAMIC	50V
C13	.01uF	CERAMIC	50V
C14	100pF	SILVER MICA	500V
C15	180pF	SILVER MICA	500V
C16	27pF	SILVER MICA	500V
C17	100pF	SILVER MICA	500V
C18	150pF	SILVER MICA	500V
C19	270pF	SILVER MICA	500V
C20	56pF	SILVER MICA	500V
C21	150pF	SILVER MICA	500V
C22	180pF	SILVER MICA	500V
C23	82pF	SILVER MICA	500V
C24	560pF	SILVER MICA	500V
C25	180pF	SILVER MICA	500V
C26	82pF	SILVER MICA	500V
C27	560pF	SILVER MICA	500V
C28	820pF	SILVER MICA	500V
C29	560pF	SILVER MICA	500V
C30	390pF	SILVER MICA	500V
C31	390pF	SILVER MICA	500V
C32	1000pF	SILVER MICA	500V
C33	560pF	SILVER MICA	500V
C34	390pF	SILVER MICA	500V
C35	390pF	SILVER MICA	500V
C36	1000pF	SILVER MICA	500V
C37	150pF	SILVER MICA	500V
C38	2200pF	SILVER MICA	500V
C39	390pF	SILVER MICA	500V
C40	1000pF	SILVER MICA	500V
C41	150pF	SILVER MICA	500V
C101	270pF	SILVER MICA	500V
C102	560pF	SILVER MICA	500V
C103	560pF	SILVER MICA	500V
C104	390pF	SILVER MICA	500V
C105	390pF	SILVER MICA	500V
C106	750pF	SILVER MICA	500V
C107	1uF	GREENCAP	100V
C108	1000pF	SILVER CAP	500V
C109	470uF	ELECTRO RT	25V
C110	.01uF	SILVER MICA	500V
C111	.1uF	CERAMIC	50V
C112	.1uF	CERAMIC	50V
C113	10uF	TANTALUM	25V
TC1	20pF	TRIMMER	
TC101	450pF	TRIMCAP	

SEMI-CONDUCTORS

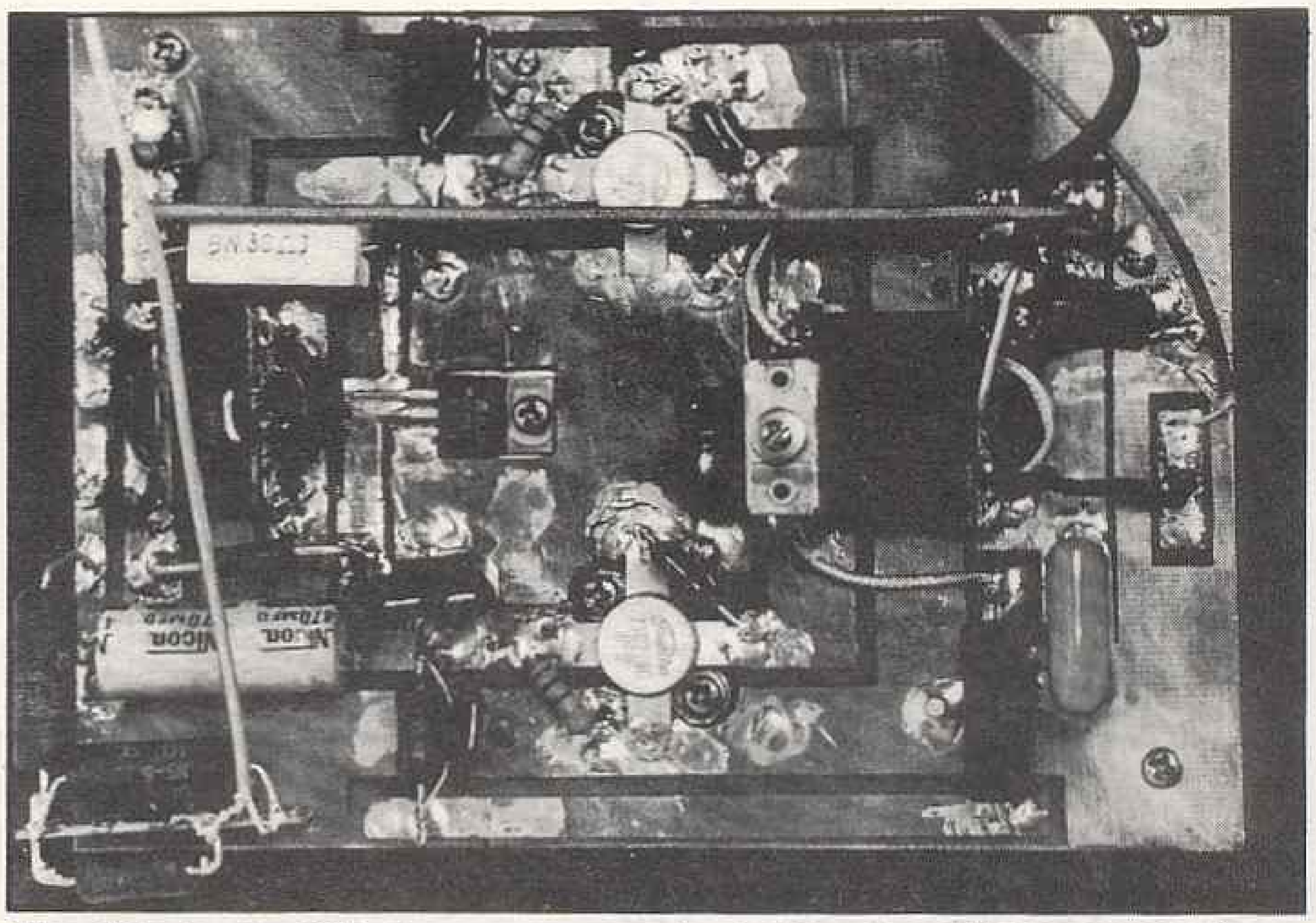
Q1	BC337	TRANSISTOR
Q2	BC557	TRANSISTOR
Q3	BC557	TRANSISTOR
Q4	BC337	TRANSISTOR
Q101	2SC2290	TRANSISTOR
Q102	2SC2290	TRANSISTOR
Q103	TIP31B/C	TRANSISTOR
D1	1N914	DIODE
D2	1N914	DIODE
D3	15V	ZENER 1W (1N4744)
D4	3.3V	ZENER 1W (1N4728)
D5	1N4002	DIODE
D6	1N4002	DIODE
D7	1N4002	DIODE
D8	1N4002	DIODE
D9	1N914	DIODE
D10	1N914	DIODE
D11	1N914	DIODE
D12	1N914	DIODE
D13	1N914	DIODE
D14	RED LED (Lge)	
D15	GRN LED (Lge)	
SCR1	C103B/C203	SCR 200V
SCR2	C103B/C203	SCR 200V

washers and machine screws. This done, you are ready to mount the RF power transistors.

First, tin the transistor leads and the corresponding pads on the PCB, then smear thermal grease on the underside of each transistor. The RF transistors can then be bolted to the heatsink and their leads soldered. Check to ensure that each transistor is correctly oriented before soldering - the collectors go to either side of the primary of T2.

Assembly of the amplifier PCB can now be completed by installing bias transistor Q103. Note that the metal tab of this transistor must be electrically isolated from the heatsink using a mica washer and insulating bush assembly. Fig. 9 shows the details.

As before, smear all mating surfaces with thermal grease before bolting the transistor to the heatsink. Finally, use your multimeter to check that the metal tab is indeed insulated from the heatsink before soldering transistor leads into place.



View of the booster PCB. Use generous amounts of solder when soldering component leads.

CARRIER OPERATED RELAY PCB

By comparison with the amplifier PCB, assembly of this PCB is quite straightforward. Begin by installing PC stakes at all external wiring points, plus an additional four PC stakes to support the heavy gauge lead which passes through L1. Note also that two PC stakes are used to terminate the incoming positive supply lead, while another two stakes are used to terminate the supply lead at the take-off point to the amplifier PCB.

The remaining parts can now be installed on the PCB as shown in Fig. 6. Take care with the orientation of the semi-conductors and the electrolytics.

Fig. 10 shows the winding details for current sensing transformer L1. This coil is wound bifilar on a yellow Amidon ferrite core using 0.6mm enamelled copper wire. To do this, fold the wire in half, then wind on 10 evenly spaced turns by passing the looped end through the ferrite core. When this is completed, cut the looped end and use your multimeter to identify the correct ends to be joined to form the centre tap.

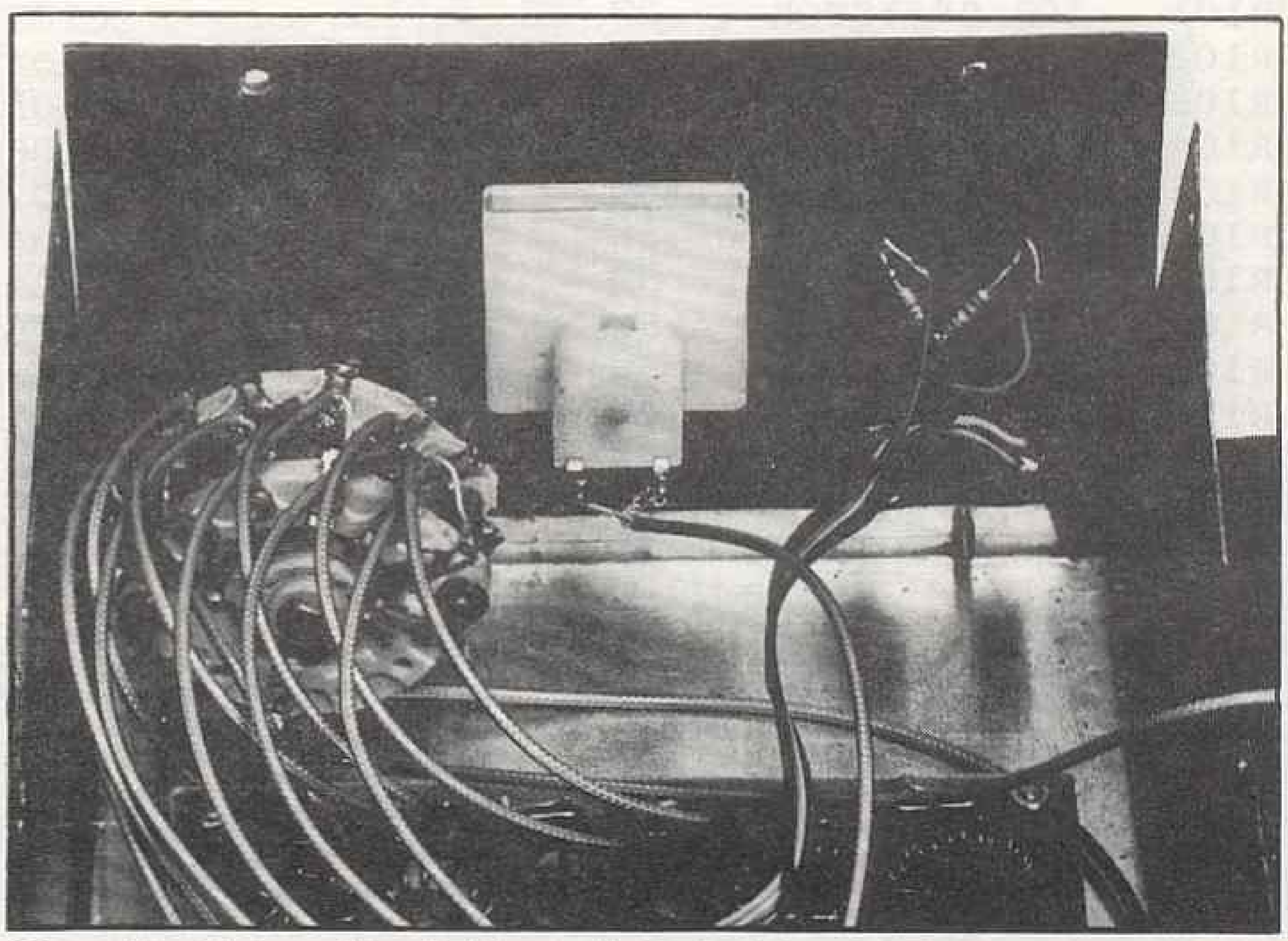
Clean and tin the leads from L1 before installing it on the PCB. Construction of the current sensing transformer can then be completed by installing the heavy-gauge (1.6mm) copper lead through the centre of the core as shown in Fig. 10.

Note, a link is required from the anode of SCR2 to the junction of R6 and SCR1 (anode). This may be done using the H/U wire supplied. Please refer to the overlay on Page 6.

FILTER COILS

Table 2 gives the winding details for the filter coils (L2-L13). These are all wound on Amidon ferrite ring cores using 0.8mm enamelled copper wire. Note that L2-L9 are wound on the smaller yellow cores while L10-L13 are wound on the red cores.

Keep the windings on each core as evenly spaced as possible and install each coil as it is completed to avoid possible confusion. Finally, install the assembled PCB on 6mm spacers in the U-shaped base section and secure using machine screws and nuts.



RF coaxial cable is used for all wiring to the bandswitch and to the power meter.

FINAL ASSEMBLY

Now for the final assembly. First, secure the meter to the front panel using epoxy adhesive, then mount the switches, LEDs and BNC sockets. The remainder of the wiring can then be installed as shown in Fig.6.

RG-178 RF coaxial cable is used for all wiring to the bandswitch, power meter and BNC sockets, and to the input of the main amplifier PCB. The wiring to the toggle switches and to the LEDs can be run using rainbow cable.

The two power supply leads must be run using the heavy-duty 20-amp insulated cable supplied with the kit. These leads pass through a cable restraint fitted to the rear panel. Following this, the positive lead is terminated directly to the carrier operated relay PCB while the negative lead is terminated on the amplifier PCB adjacent to the emitter of Q1.

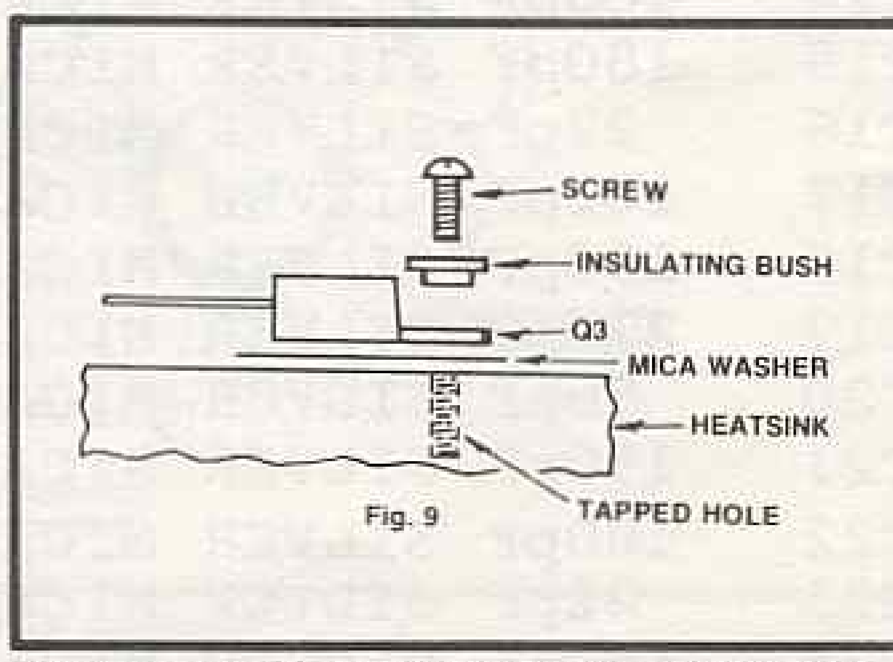


Fig.9: mounting details for transistor Q3.

Inductor	Core	Turns
L1	Amidon yellow	10 bifilar 0.6mm ECW
L2, L3 (0.4uH)	Amidon yellow	7 0.8mm ECW
L4, L5 (0.5uH)	Amidon yellow	8 0.8mm ECW
L6, L7 (0.7uH)	Amidon yellow	10 0.8mm ECW
L8, L9 (1uH)	Amidon yellow	13 0.8mm ECW
L10, L11 (3uH)	Amidon red	17 0.8mm ECW
L12, L13 (5uH)	Amidon red	27 0.8mm ECW
ECW = enamelled copper wire		

Table 2: winding details for current transformer L1 and filter coils L2-L13.

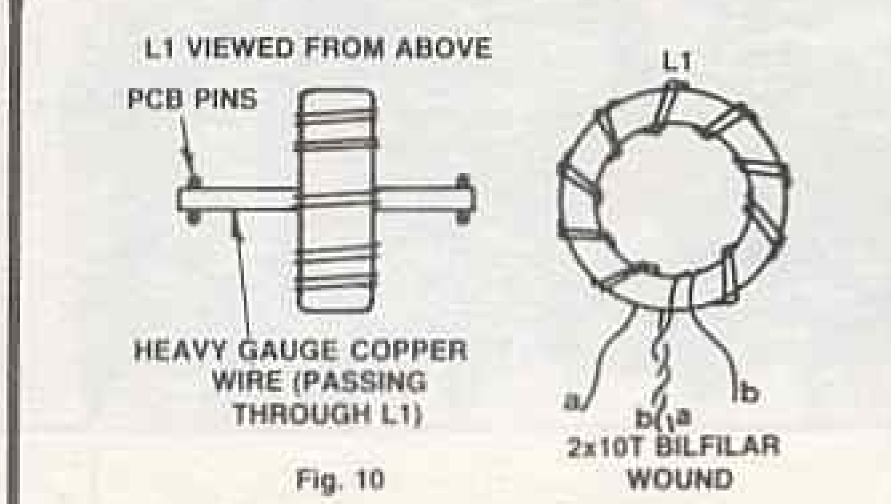
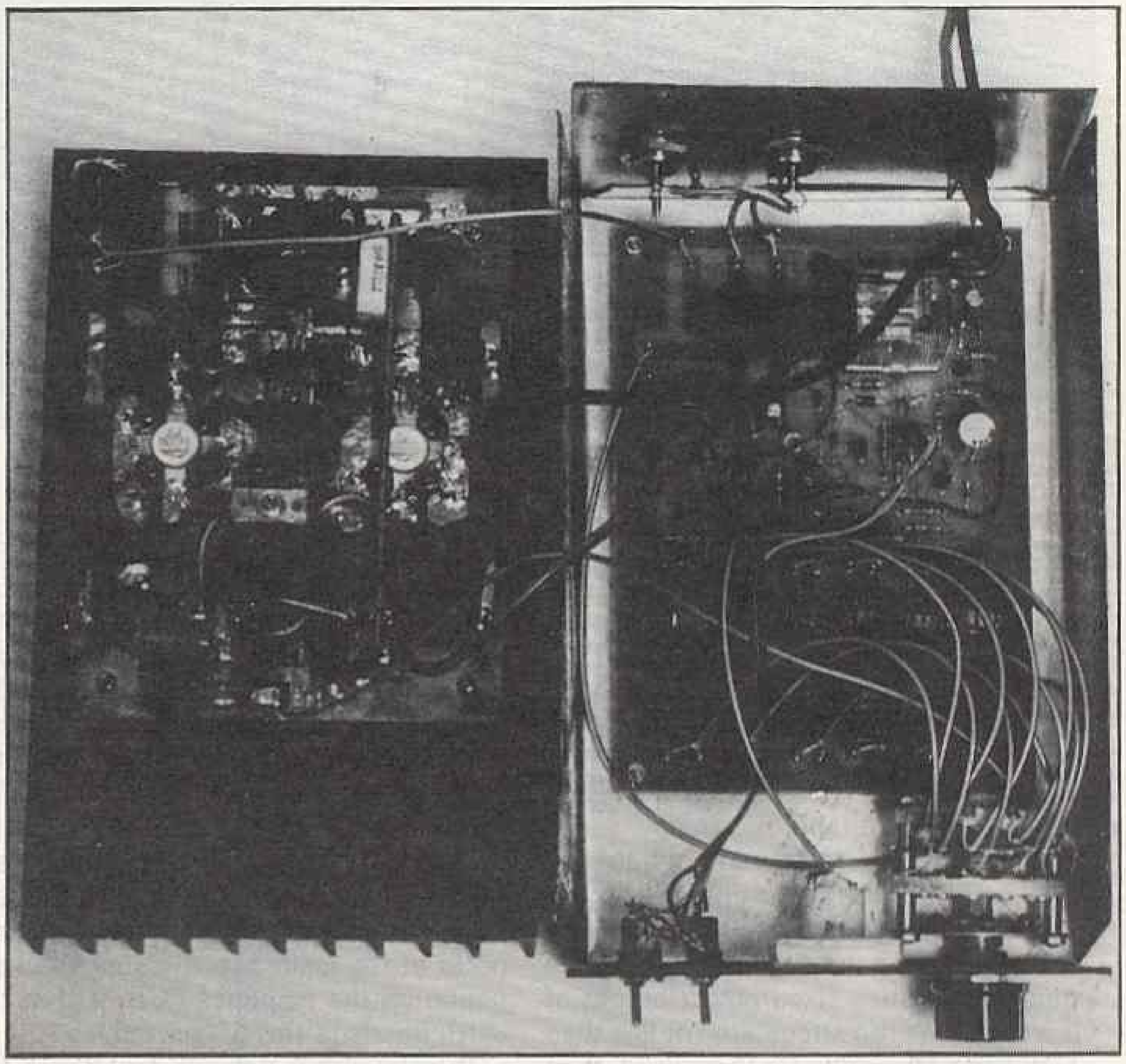


Fig.10: construction details for L1.



View inside the completed prototype. Note heavy-gauge cable for supply connections.

Note that the positive lead is fitted with an in-line fuseholder and 30-amp fuse. Note also that heavy-duty 20A cable is used for the positive supply lead to the amplifier PCB. Do not use conventional hook-up wire — its current-carrying capability is not good enough.

Once all the wiring has been completed, the front and rear panels can be fastened to the aluminium chassis using self-tapping screws. The project is now ready for alignment but first go back over your work and carefully check the wiring.

ALIGNMENT

Following construction, the HF Power Amplifier should be left open to allow for alignment. This process is quite easy but you do need access to some test equipment: (1) a 200W RF power meter; (2) a 200W dummy load; (3) a 13.8V 25A power supply; and (4) a HF transceiver.

Before commencing alignment, there are a few precautions to be observed. First, take care to avoid RF burns by keeping your fingers away from the output stage circuitry during transmit. Second, always use an insulated tool when making adjustments. And third, don't initially apply too much drive to the amplifier until the input protection circuitry has been adjusted.

The step-by-step alignment procedure is as follows:

(1) Set VR1, VR2 and VR3 on the carrier operated relay PCB fully clockwise.

(2) Connect the transceiver to the input socket of the amplifier. Check that the attenuator circuit has been included if the transceiver output is from 10-15W.

(3) Connect the output of the amplifier to the 200W dummy load and to the RF power meter.

(4) Set the band switch to coincide with the transceiver frequency.

(5) Connect the amplifier to the 13.8V power supply.

(6) With the power switch off, operate the transceiver and observe the RF power meter. Note: if the transceiver has a variable RF power output, then set this to either 5W (no attenuator) or 10W CW (with attenuator).

(7) Switch the amplifier on while maintaining transmission. The relays should operate and the RF output meter should indicate an increase in power.

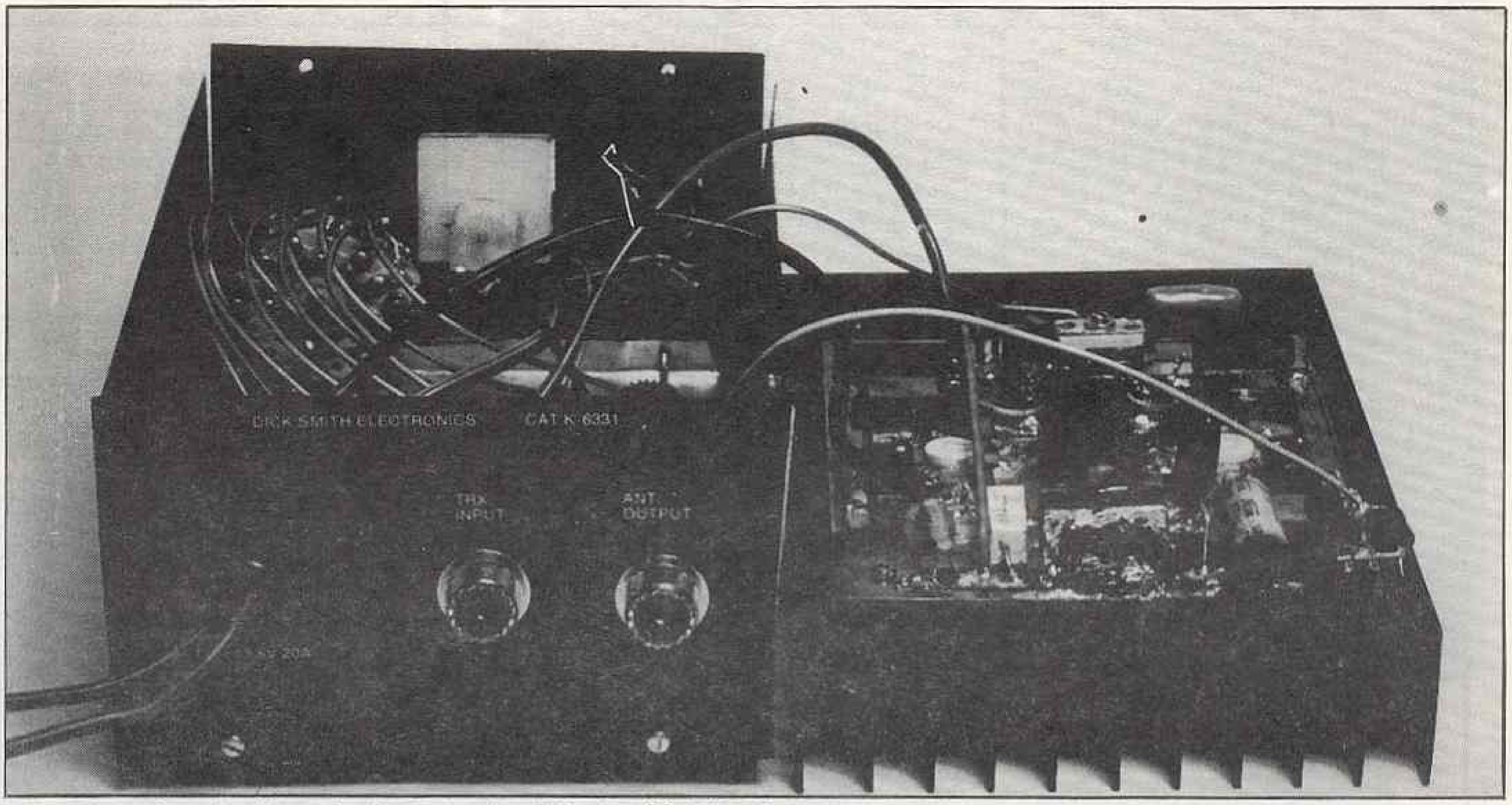
(8) Switch the amplifier off and repeat steps (4), (6) and (7) for different bands. Check that there is a power increase in each case.

(9) Transmit and adjust TC101 on the amplifier PCB for maximum RF power output. Repeat this procedure for other bands and adjust TC101 for best compromise.

(10) Continue transmitting into a dummy load and adjust VR1 until the relative output meter on the amplifier reads half scale. Now adjust TC1 for maximum deflection on the relative power meter. Finally, adjust VR1 for full scale deflection.

(11) Disconnect the dummy load and RF power meter. Transmit and slowly adjust VR2 until the relays trip and disengage the amplifier. Reconnect the dummy load and reset the amplifier by switching off briefly, then on again. Check that the unit now operates normally again.

 Text and Illustrations courtesy of Electronics Australia



The rear panel carries the cord grip grommet and the two SO-239 sockets.

Note: this adjustment should be carried out at the low frequency end of the transceiver's range. Also, if an SWR meter is available, VR2 can be adjusted so that the unit trips for a given SWR.

(12) Switch the HF Linear Amplifier off and set the transceiver to the high-frequency end of its range. Adjust the power output of the transceiver (where possible) to a suitable maximum — eg, 10W without the attenuator option and 17W with the attenuator option.

(13) Switch the amplifier on, transmit and adjust VR3 until the relays trip. If a transceiver with a fixed power output of less than 10W (no attenuator) or less than 17W (with attenuator) is to be used, then this adjustment can be ignored.

STABILITY

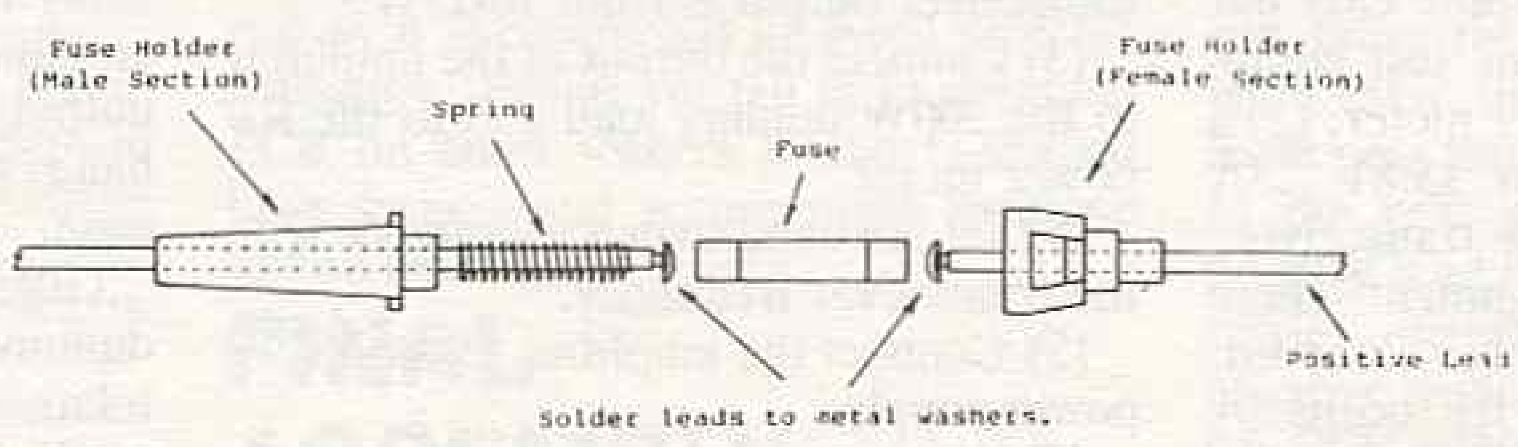
As with all other HF linear amplifiers, instability can be a problem if the unit is operated incorrectly. In particular, problems will be encountered if the amplifier is driven into a mismatched load, if there is too much RF drive, or if the filter setting is incorrect.

Other possible causes of instability include poor soldering around the feed-through holes and poor ground connections. These poor ground connections can occur at the main negative supply termination on the amplifier PCB, and at the earth braids of the coaxial cables.

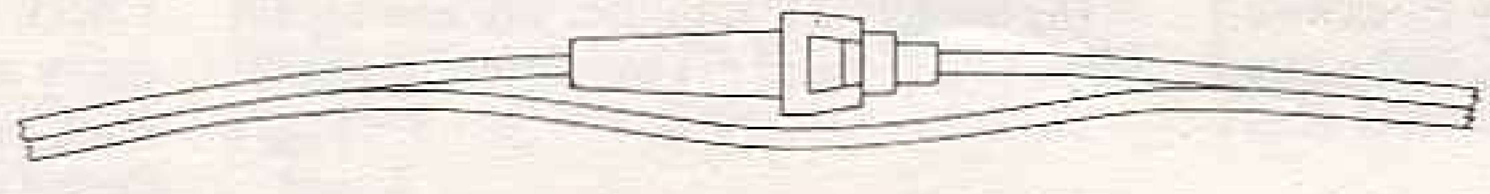
If instability is noticed, first check the low pass filter setting and the antenna. If these are OK, then either reduce the drive level somewhat or detune TC101 on the amplifier PCB until the instabilitity is eliminated.

Once the adjustments have been completed, the heatsink and case can be screwed together. The front and rear panels are fastened to the heatsink using self-tapping screws while machine screws are used to secure the sides. That completes the project — it may now be connected to a suitable HF antenna and used normally.

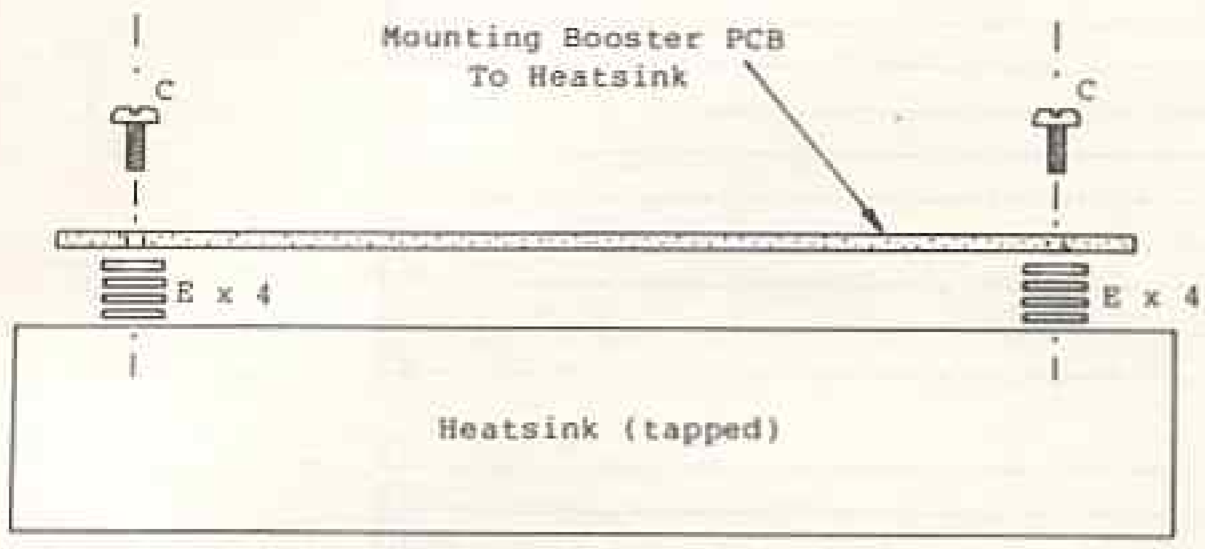
FUSE HOLDER ASSEMBLY

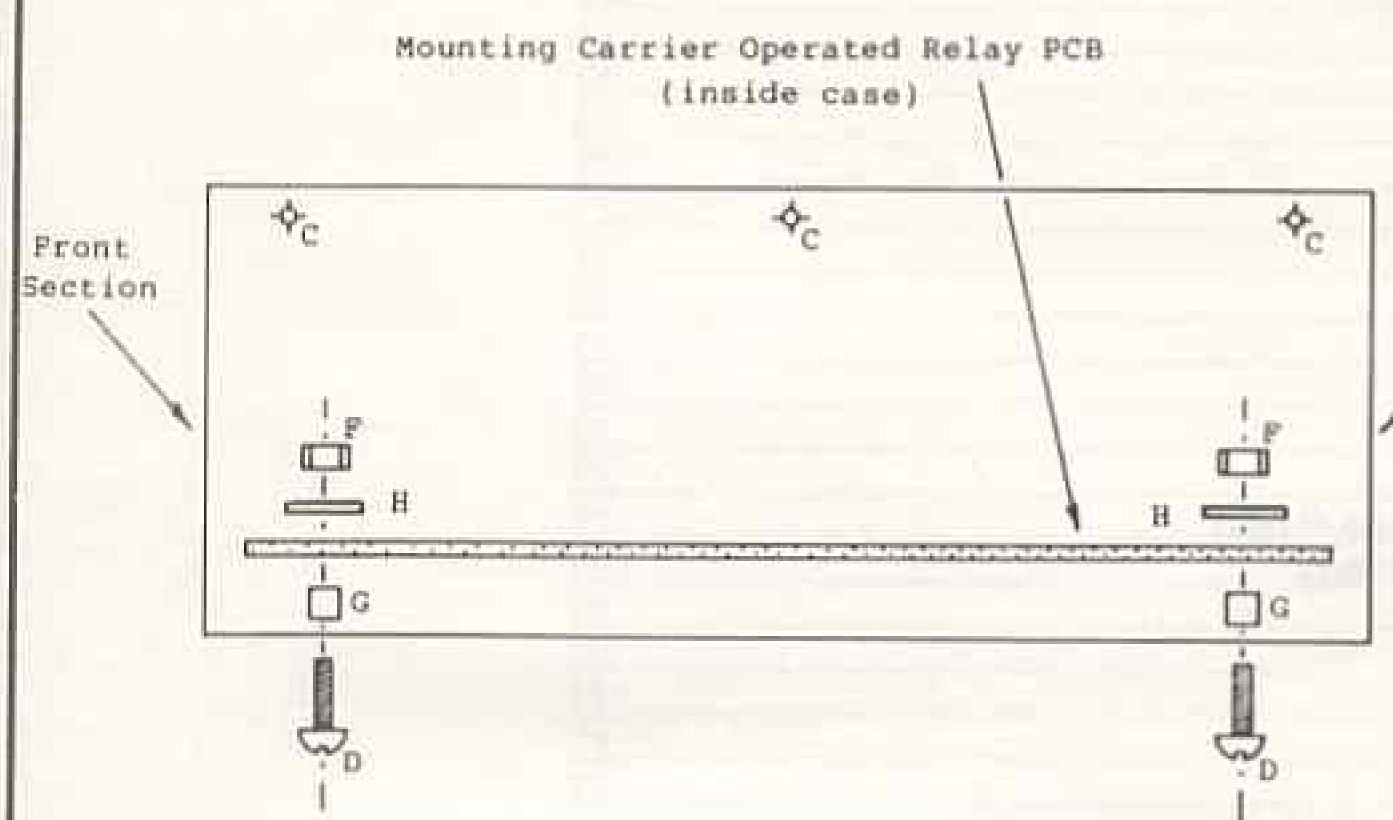


Note : The inline fuse holder is placed in series with the positive lead of the FIG.8 power cable.
The above diagram shows correct assembly details and placement of each item.
Below is a diagram showing the completed fuse holder and how it sits on the power cable.(Do not cut the negative lead).

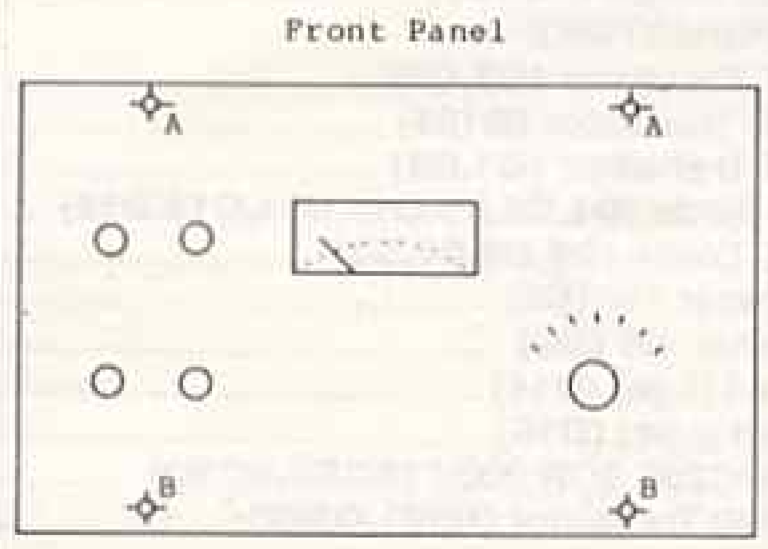


GUIDE TO SCREW ALLOCATION

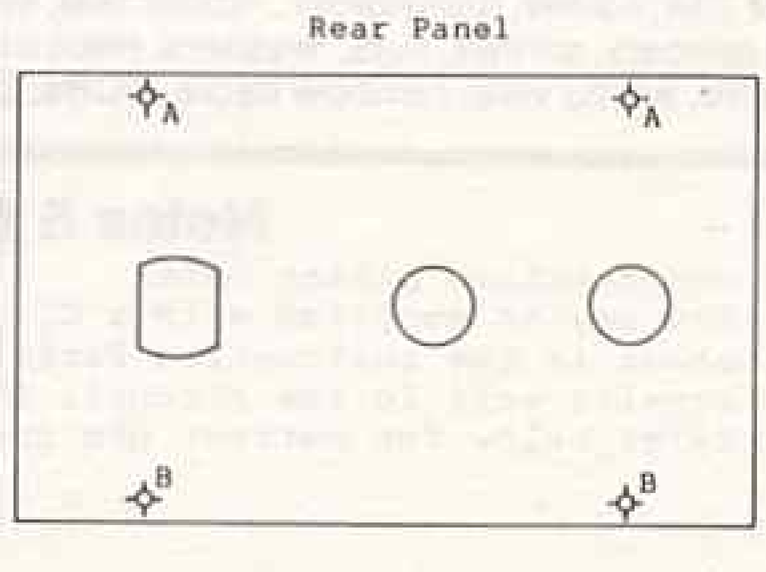


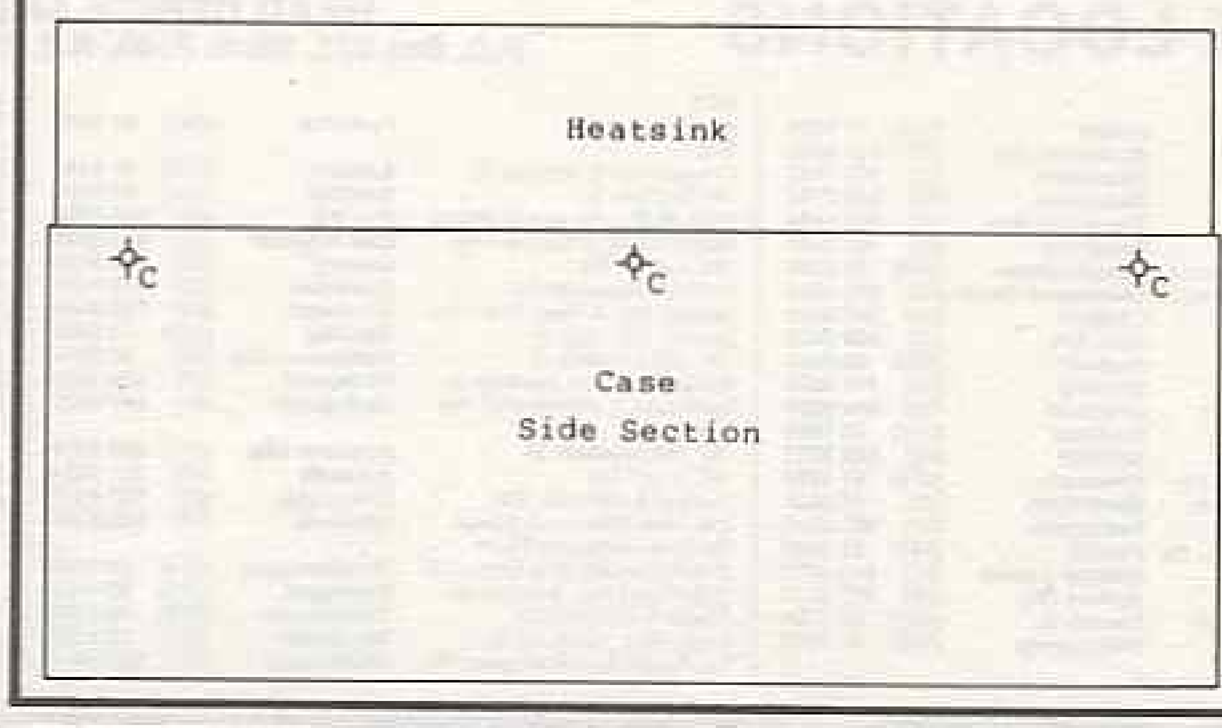


GUIDE TO SCREW ALLOCATION



CODE	DESCRIPTION
A	Screw Selftap 1/2" x No6
B	Screw Selftap 3/8" x No4
C	Screw Round Head 8mm x 3mm
D	Screw Round Head 1/2" x 1/8"
E	Washer 1/8"
F	Nut 1/8"
G	Spacer 1/4" x 4BA
H	Washer Shake Proof 1/8"





PARTS LIST

RESISTORS

- 1 x 68R Resistor .25W **(R15)** ☐
- 1 x 100R Resistor .25W **(R4)** ☐
- 1 x 150R Resistor .25W **(R5)** ☐
- 1 x 270R Resistor .25W **(R7)** ☐
- 1 x 820R Resistor .25W **(R10)** ☐
- 1 x 1K Resistor .25W **(R13)** ☐
- 2 x 1.5K Resistor .25W **(R6,R9)** ☐
- 1 x 2.2K Resistor .25W **(R17)** ☐
- 1 x 3.3K Resistor .25W **(R14)** ☐
- 4 x 10K Resistor .25W **(R1,R3,R8,R16)** ☐
- 1 x 56K Resistor .25W **(R2)** ☐
- 1 x 1K Resistor .5W **(R12)** ☐
- 1 x 33R Resistor 5.0W **(R107)** ☐
- 4 x 10R Resistor 2.0W **(R101,R102,R103,R104)** ☐
- 4 x 10R Resistor 5.0W **(R105,R106,R108,R109)** ☐
- 2 x 220R Resistor 2.0W **(R110,R111)** ☐
- 1 x 4.7K Resistor 1.0W **(R11)** ☐
- 1 x 4.7K/5K Trimpot **(VR3)** ☐
- 2 x 47K/50K Trimpot **(VR1,VR2)** ☐

CAPACITORS

- 1 x 1uF Greencap 100V **(C107)** ☐
- 1 x 39pF Ceramic 50V **(C1)** ☐
- 1 x 560pF Ceramic 50V **(C9)** ☐
- 1 x .001uF Ceramic 50V **(C4)** ☐
- 6 x .01uF Ceramic 50V **(C7,C8,C10,C11,C12,C13)** ☐
- 3 x .1uF Ceramic 50V **(C2,C111,C112)** ☐
- 1 x 20pF Trimmer **(TC1)** ☐
- 1 x 470uF Electro 25V RT**(C109)** ☐
- 1 x 10uF Electro 25V RB**(C6)** ☐
- 1 x 220uF Electro 25V RB**(C5)** ☐
- 2 x 10uF Tant 25V **(C3,C113)** ☐
- 1 x 450pF Trimcap **(TC101)** ☐
- 1 x 27pF Silver Mica 500V **(C16)** ☐
- 1 x 56pF Silver Mica 500V **(C20)** ☐
- 2 x 82pF Silver Mica 500V **(C23,C26)** ☐
- 2 x 100pF Silver Mica 500V **(C14,C17)** ☐
- 4 x 150pF Silver Mica 500V **(C18,C21,C37,C41)** ☐
- 3 x 180pF Silver Mica 500V **(C15,C22,C25)** ☐
- 2 x 270pF Silver Mica 500V **(C101,C19)** ☐
- 7 x 390pF Silver Mica 500V **(C30,C31,C34,C35,C39,C104,C105)** ☐
- 6 x 560pF Silver Mica 500V **(C24,C27,C29,C33,C102,C103)** ☐
- 1 x 750pF Silver Mica 500V **(C106)** ☐
- 1 x .01uF Silver Mica 500V **(C110)** ☐
- 1 x 820pF Silver Mica 500V **(C28)** ☐
- 4 x 1000pF Silver Mica 500V **(C32,C36,C40,C108)** ☐
- 1 x 2200pF Silver Mica 500V **(C38)** ☐
- 1 x Trimcap 20pF **(TC1)** ☐
- 1 x Trimcap 450pF **(TC101)** ☐

SEMI-CONDUCTORS

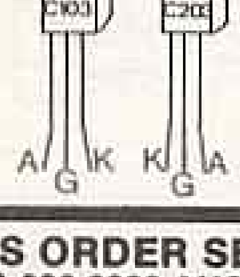
- 2 x BC557 Transistor **(Q2,Q3)** ☐
- 1 x TIP31B Transistor **(Q103)** ☐
- 2 x BC337 Transistor **(Q1,Q4)** ☐
- 7 x IN914 Diode **(D1,D2,D9,D10,D11,D12,D13)** ☐
- 4 x IN4002 Diode **(D5,D6,D7,D8)** ☐
- 1 x 3.3V Zener 1W **(D4)** ☐
- 1 x 15V Zener 1W **(D3)** ☐
- 1 x Red Led (Lge) **(D14)** ☐
- 1 x Grn Led (Lge) **(D15)** ☐
- 2 x C103B/C203 SCR 200V **(SCR1,SCR2)** ☐
- 2 x 2SC2290 Transistor **(Q101,Q102)** ☐

MISCELLANEOUS

Ferrite Beads **(L101)**, Meter 250uA FDS **(M1)**, knob, ferrite cores (6 x black, 9 x yellow, 4 x red), 2 x SPDT toggle switchs, sockets, tag strip, fuse, relay DPDT 12V, relay DPDT 12V 10A, solder, fuse holder, rubber feet, spaghetti tubing, cable clamp grommet, PCB transformer ends, ceramic rotary switch 2 pol. 6 pos., brass spacers, screws, nuts, washers, mica washer, nylon bush, silicon grease, 2 x led rings, 2 x led bezels, PCB pins, H/U wire, tinned copper wire, en/cu wire, rainbow cable, PCBs, case with front and rear panels, finned heat sink.

Notes & Errata

```
Constructors please note:
You may be supplied with a C203 SCR, instead of the C103 as
shown in the instruction Parts List. Both these devices work
equally well in the circuit. If using the C203 SCR, please
refer below for correct pin configuration.
```



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