Hands Electronics
Tegryn Llanfyrnach Dyfed
SA35 0BL Tel 01239 698 427

Thank you for purchasing one of our kits. We hope it will give you many hours of service once built. Our aim is to provide satisfaction and service. If you have any problems with the construction or use of the equipment, please ring, or write to us. We will do all we can to help.If you are new to construction we suggest you read carefully the about part identity and soldering contained in the tools and construction section.

Sheldon Hands

Tools and Construction Practice

We recommend the following tools to make your HANDS kit

15/25w soldering iron
small electrical screwdriver
4 inch phillips screwdriver
small side cutters
electricians pliers
snipe nosed pliers
small half round file
multimeter

Below are some notes on construction practice with a heavy emphasis on soldering. You must use solder with a non-corrosive flux. Acid cored solder MUST NOT be used. A 60/40 type will be ideal. The secret of good soldering is to have the correct temperature at the joint. Make sure the tip of the iron is clean, if necessary clean it on a damp sponge. Do not carry solder on the iron to the joint, by the time you get it there the flux will have burnt or vaporised. Although it seems to contradict the above, do lightly tin the iron before making a joint. This will aid the heat transfer and lessen the chance of damage to the track or component through prolonged application of the iron.When you are ready to make the joint, apply the iron and the solder at the same time. Do not apply too much solder, a thin gauge helps in this respect. Humps of solder on a joint either means you did not leave the iron on the joint long enough or you used too much solder.

Try to get a medium coating over the track and the component lead. If you use too much heat you may damage the track or the component. We suggest you try some test joint on scrap wire, you will find it inspires confidence! When the board is complete check for solder bridges and dry joints, an Ohmmeter can be used for checks.

Most large parts in the kit are readily identifiable, but value identification systems are varied and may pose a problem. For wire ended resistors (ie not SMD) a colour code chart is included at the back of the manual. Most supplies of resistors are coded with 3 bands for the value ,i.e. 1st fig, 2nd fig, 3rd multiplier. But we increasingly receive resistors with a 4 band code this then becomes 1st fig, 2nd fig, 3rd fig, 4th multiplier e.g 1k5 = brown, green, black, brown = 1 5 0 0 .

Capacitor identification for electrolytics is straight forward but ceramic caps may pose a problem. Where n values are used n10 = 100pf and 1n = 1000pf, those with just a 3 digit number use the first 2 numbers as figures and the 3rd indicating the number of zeros, i.e. 102 = 1000pf. For those with a 3 digit number followed by letters treat as a 3 digit number, where only 2 digits and a letter are used this indicates the value is less then 100pf i.e. 82J = 82pf and 4.7C = 4.7pf. The polystyrene capacitors up to 999pf have only the numeric value , above this value N values are used ie 1200pf = 1.2n

Inductor value systems are as varied as capacitors but generally there are two common types for the low current ones. The first uses coloured bands with the same colour values as resistors, the inductors are the same length as a 0.25w resistor but much thicker with flat ends where the lead exits the body. If checked with an ohmmeter they will show very low resistance values. The second type have the value marked on them with an alpha-numeric code in uh e.g. 2R2K=2.2uh and 220J=22uh. For the high current inductors the an idenitity code is printed on the top.To avoid confusion the parts list has the value and the code for each component.

Circuit Description

The RTXAMP is a 3 stage wide band linear amplifier designed for ssb/cw use from 1.8- 30 mhz. An onboard dc switching circuit controls the base bias and allows sequenced control.

RF drive is applied via the RF IN pin to the first stage amplifier TR1, a 2N3866 run in class A. Negative feedback via R4 and a peaking capacitor C2 ensure a flat gain response from 1.8- 30 mhz.

The second stage amplifier is a push-pull pair comprising of TR2/3. The transistors are 2SC2166's run in AB1. Operating bias is provided by the circuit around TR8,9. TR8 is mounted on the case of TR2 in order that some measure of temperature compensation takes place of the bias voltage. RV1 sets the bias voltage and hence the standing current of the second stage amplifier. The bias voltage is feed to the bases of the amplifier transistors via rf chokes RFC1/2.

Drive is coupled to the second stage by T1 which acts as a phase splitter. L1/R9 and L2/R10 connected from base to collector of TR2/3 respectively and C8 in parallel with T2 flatten the frequency response of the stage.

The third stage amplifier uses a similar configuration to the second stage. The transistors are a pair of 2SC1969's originally developed for CB service at 27 mhz where they are rated for 18w output each. In the RTXAMP we suggest that they are de rated to a max of 18 watts output for the pair.

In order that the amplifier does not cause large surge currents during switching the 1st stage amplifier and the bias supply are separately switched. As the subsequent amplifier stages are effectively cut off when the bias voltage is zero, the 2nd and 3rd stages may be permanently connected to the +ve line. The switching circuit uses the +12v transmit line of the preceding RF driver to turn on TR6. This pulls the base voltage low on TR7 which then turns on switching the 13.8v line to the bias supply and 1st amplifier.

Construction

- ✓ Glue together with plastic or epoxy cement 4 of the five very large ferrite beads to make a two hole balun core T3, similar to the core of T1. Only light gluing is required as it is only required for the convenience of winding the inductor.

- ✓ Fit the pcb pins as listed below. Insert them from the track side and press home with a hot soldering iron, then solder the pin to the track. Always support the pcb around the circumference of the pin with an old cotton or solder reel during this operation.

- ✓ RF IN, RF OUT, +12VT, 12V PER, RFC3/6[2 OFF]

- ✓ Fit and solder R1-23. Where the ground ledged is shown cut one lead of the resistor back to 3mm and solder it to pcb groundplane. The groundplane is the continuous tinned area on the top surface of the pcb.

- Using the 24swg tinned copper wire fit ground links between the emitter pads on the underside of the pcb and the top groundplane for TR2,3,4,5. It is important that the link is bent flush to the pad on the underside for the installation of the transistor.

- Fit and solder RFC1/2/4/5 [brown body with resistor style colour bands]

- Fit and solder RFC 7,8,9. [self colour ready made bead on a lead]

- Fit and solder the 10n and 100n disc ceramic decoupling capacitors and C2 the 270pf disc. Where the ground ledged is shown solder one end of the capacitor to the groundplane as you did for the resistors. The ground lead should be bent as close as possible to body of the capacitor to insure adequate bypassing.

- Fit and solder the tantalum capacitors C4/10/15/23. All the capacitors have ground connections, again make sure leads are short and tidy.

- Fit and solder C18 and 21. Bend the negative ground lead at a right angle tight underneath the body of the capacitor. Trim the lead and solder to the groundplane.

- Fit and solder RV1 and 2.

- Make up T1 on the two hole balun core. Cut 150mm of the 32swg wire (.28mm). Insert the wire through one tube of the core and back down the opposite tube. This is one turn on the core. Make a total of 6 turns and cut and trim the winding so you have 2 tails of 10mm each. Clean the ends of enamel and tin both tails with solder.

- Cut a 100mm length of the 32swg for the secondary winding. Insert the wire into one tube from the opposite end to the tails of the primary. Bring the wire back through the other tube to form 1 turn of the secondary. Wind on a further turn for a total of 2 turns for the secondary. Cut and trim the tails to 10mm and clean the enamel from the wire, do not tin the wire yet as this will serve as an identification of the windings. Fit the completed inductor to the board with the tinned connections (6 turns) located each end of the pads adjacent to R5. The 2 un-tinned connections (2 Turns) are adjacent to RFC1/2.. Solder the tails to pads on the track side, remember to tin the bare connections.

- Make up T2 on the remaining very large ferrite bead. Cut 2 X 40mm of the solid core 0.6mm PVC covered wire and remove 10mm of the insulation on each [cut against the wire, do not stretch the insulation]. Join the bare ends together by wrapping one end round the other and soldering together, leaving a 5mm tail of single strand for insertion onto the pcb. Insert the ends of the wire into opposite ends of the core to form a two turn winding with a centre tap. Remove 5mm of the insulation from each end of the winding. Cut another 30mm of 0.6mm wire for the secondary winding which is just 1 turn. Install the completed inductor on the board as shown on the winding diagram and solder to the track pads. If necessary trim the winding tails and insulation so that the inductor sits correctly on the pcb.

- Make up T3 on the large balun core formed from the previously glued large beads. Cut 2 x 50mm of the 0.6mm solid core wire and remove 10mm of the insulation on each [cut against the wire, do not stretch the insulation].Join the bare ends together by wrapping one end round the other and soldering together, leaving a 5mm tail of single strand for insertion onto the pcb. Insert one end of the wire into each tube to form a single turn centre tapped winding. Trim the ends of the wire to 7mm and remove 5mm of the insulation. Starting at the centre tapped end wind on 2 turns for the secondary with the remaining wire. Trim the ends of the wire to 7mm and remove 5mm of the insulation. Install the completed inductor as shown on the winding diagram, soldering the wire tails to the track pads.

- Fit and solder TR9/11. The metal insert should face RV1,RV2

- Fit and solder TR7. Insert the transistor until the shouldered part of the lead touches the pcb. The thick line of the pcb layout diagrame indicates the side for the metal insert on the transistor, which face towards RV1,2.

- Fit and solder TR2/3. Cut the transistor leads back to the length of the wide part of the lead. Fit the transistors on the underside of the board so that the face with the identification number is fitted through the square cutout and almost flush with the groundplane. Check that you are able to locate the leads on the track ends and emitter pads with no gap between the body and pcb at this point. If necessary file the slot for alignment. When aligned solder the leads to the tracks and pad making sure that no excess solder shorts the EBC connections.

- Fit and solder TR4/5 as you did for TR2/3.

- Fit and solder TR1 with the plastic 4 hole spacer between the transistor and the groundplane. Remove the pegs from the spacer before installation with a sharp knife to ensure minimum lead length.

- Fit and solder the temperature sensing transistors TR8/10. The flat front face of the transistor mates with the top face of one of the power transistor pairs via a bed of heat sink compound. For installation bend all 3 leads at a sharp right angle 4mm from the transistor body. Place some of the white heatsink compound on the face of the transistor, insert the leads in the pad holes and push down until the transistor is in firm contact with the power transistor. Check that the base and collector connections do not foul the groundplane then solder the leads to the track pads. Finally solder the emitters to the ground plane.

- Fit and solder TR6 making sure that the transistor outline agrees with the board legend. Make and fit RFC3/6/7/8/9. Cut 5 X 25mm lengths of the 24swg tinned copper and wrap and solder a wire to ONE of the two RFC pcb pins. Thread two ferrite beads on each wire and then solder the free end to the other pcb pin.[do not solder RFC3/6 until the alignment stage]. As some types of bead are conductive make sure that they are clear of the pcb.

- Fit and solder the mica capacitors C8/13. Fit and solder L1/2.

Test and Alignment

Check the pcb for solder splashes, bridged tracks and dry joints. Check carefully the area around the power transistor connections as it is easy to bridge the tracks here. If you suspect a dry joint check you may check the connection with a multimeter on its ohm's range between the track and the component lead on the ground plane side.

Temporally attach the amplifier to a heatsink. Place the completed amplifier on the flat surface of the heat sink so that the power transistor tabs are above the centre channel. Mark and drill the holes for the transistor mounting bolts. Fit Mica spacers with heatsink compound on both faces and attach the amplifier to the heatsink using the bolts and the shouldered washers [the shouldered washers centralise the bolt so that it is insulated from the tab]. Using an ohmmeter check that all 4 power transistor tabs are insulated from the heatsink. It is recommended that TR1 is also fitted with a samll push on heatsink.

Terminate the RF output pin with a 15w 50Ω load via a power meter. Alternatively a simple diode probe may be attached to the load as a power monitor [see diagram in appendix]. With RFC3/6 disconnected attach a power supply of a max of 13.8v to the 12v PERM pin with the neg return connected via the groundplane.

Connect the supply via a multimeter on its amperage range, there should be no current consumption. Switch the amplifier to tx by connecting the +12VT to the 12 volt supply line. The current consumption should be less than 200ma. If the consumption is greatly in excess of this re-check for faults.

Return the amplifier to standby by removing the supply at the +12VT line. Connect normally to the 12V PERM line and install the multimeter still on it's current range between RFC3 and its input pin. Turn RV1/2 fully clockwise, then key the +12vt line. Now set the standing current of TR2/3 by adjusting VR1 until the meter reads 20ma.

The operation of temperature adjuster TR8 can be checked by bringing the tip of a hot iron near to the transistor. As the case warms the current should be driven down. Disconnect the supply and solder RFC3 permanently into circuit.

Re-connect the multimeter to RFC6 and follow the previous procedure to set the standing current on TR4/5. Adjust RV2 for 100ma. Once the adjustments are completed solder RFC6 permanently into circuit.

Re-connect to the supply via the multimeter on its amperage range and key the 12VT line. Leave on for 10 minutes and check that the current consumption does not rise dramatically. Connect a drive source to the RF input on its lowest power setting, preferably using speech. Modulate the drive and check for power output adjusting the level as required. In the absence of an oscilloscope or analyzer check on a monitor receiver for any distortion or other problems.

If all is normal the amplifier may be placed in service. When in service it is important that a lowpass filter follows the amplifier to improve the harmonic attenuation.

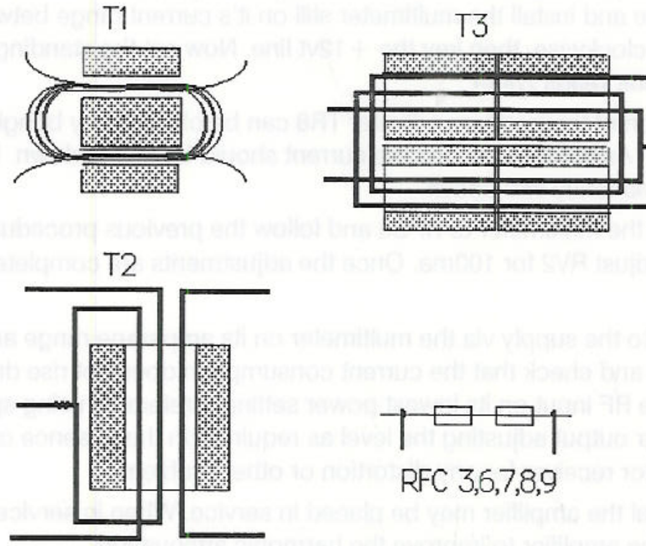
Resistor Colour Code

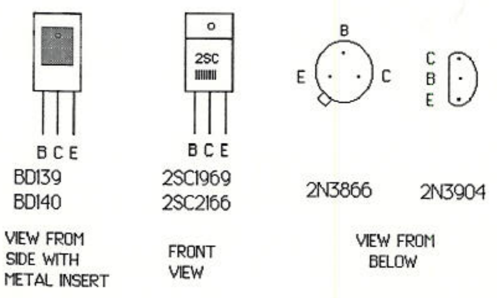
Colour	Band 1 1st fig	Band 2 2nd fig	Band3 multiplier
Black		0	X 1
Brown	1	1	X 10
Red	2	2	X 100
Orange	3	3	X 1000
Yellow	4	4	X 10,000
Green	5	5	X 100,000
Blue	6	6	X 1,000,000
Violet	7	7	X 10,000,000
Grey	8	8	
White	9	9	

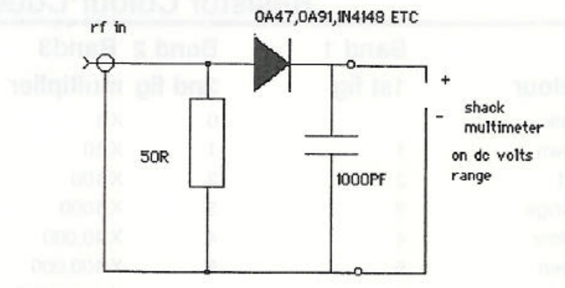
PARTS LIST RTXAMP

R1,5	100R
R13,14	100R large body .5w
R2	680
R 3	high gain 5R6 low 12R
R4	4K7
R6	56R
R7,8	33R
R9,10	120R
R11,12	22R
R15,18,21,22	10K
R16	150R .5W
R19	100R .5W
R20	560R
R17	330R
R23	1K
RV1,2	100R
C1,5,6,7,11,12 16,17,19,20, 25	10N [103]
C2	270P [270]
C3,9,14,24	100N [104]
C8	68P SM
C4,10,15,23	10MFD 16V TANT
C13	220P SM
C18,21	220MFD
C22	deleted
T1	28-43002402
T2,3	26-43006301
RFC3,6	2x 26-43000101 FERRITE
RFC7,8,9	PRE-FORMED LEADED
RFC1,2,4,5	100UH AXIAL CHOKE
L1,2	1.8uH 7BS [1R8]
TR1	2N3866
TR2,3	2SC2166
TR4,5	2SC1969
TR7	BD140
TR6	BC548
TR8,10	2N3904
TR9,11	BD139

WINDING DIAGRAM

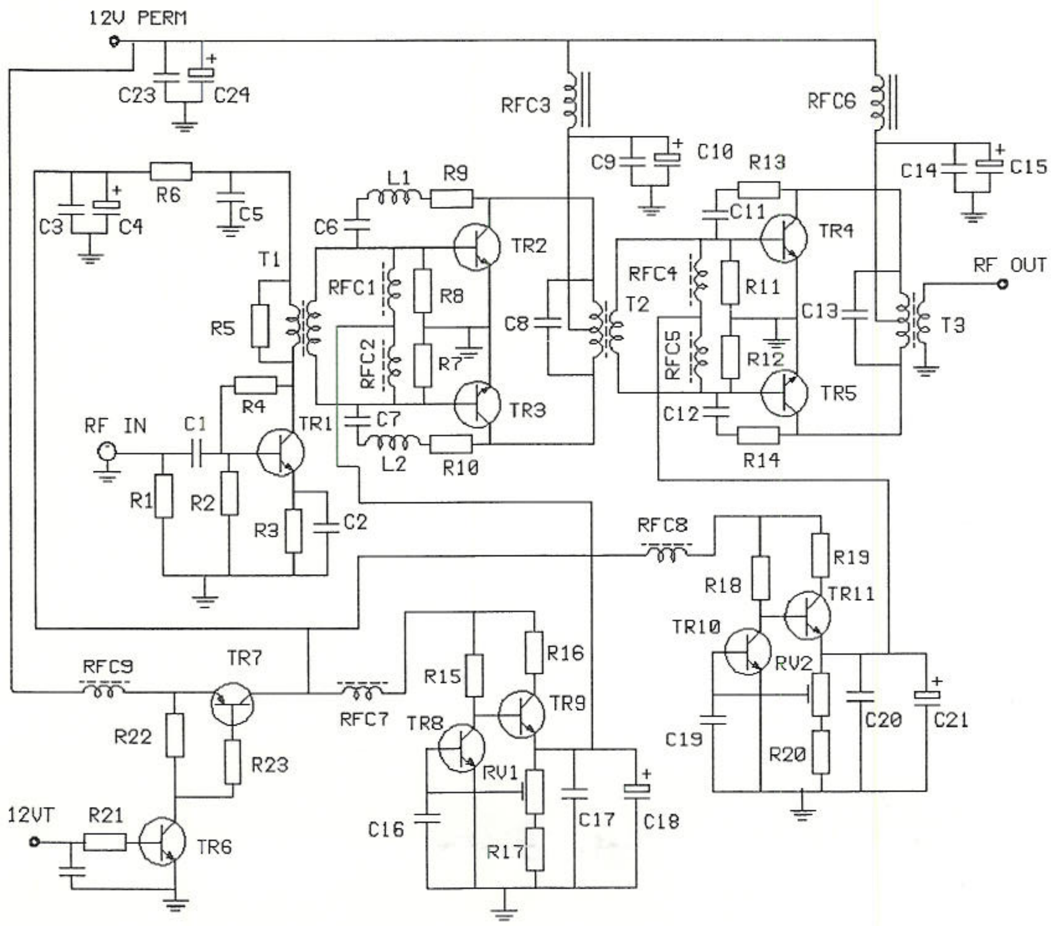






POWER MONITOR

CIRCUIT DIAGRAM



RTX AMP

PCB LAYOUT