Hands Electronics

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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
4inch 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.

Inductor value systems are as varied as capacitors but generally there are two common types. 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.

Circuit Description

General

The IF2 module is designed as a high performance IF amplifier and is suitable for 9 or 10.7 mhz . Diode switched RF input and outputs are available for connection to a companion RTXRF board and RTXVFO vfo system.

Receiver

For the receive system IF input at FL1 filter frequency is routed via D1 to the filter. R3 and R4 provide a resistive termination equal to impedance of the filter, whilst C2,3 isolate R2,5 which provide the dc return for the switching diodes D1,3 and 4.

IC1/2 are MC1350P IF amplifiers, IC1 is matched to the input filter FL1 with a broad band transformer T1. IC2 is coupled to IC1 via a tuned resonator L1/C10. IF gain control is by a positive voltage applied via D5 either via a simple divider from the 12VR line [IF gain potentiometer] or via an external AGC controller. Max gain occurs at around 5.8v with minium gain at 8v. With no connection to D5, gain is at a max due to R47/48.

Output from the IF amplifier is capacitive coupled to IC4 an NE602A which is used as a product detector. C19 couples the BFO injection voltage from the oscillators TR2 or TR3. The differential output pin 4 is used to supply audio for an offboard audio agc system , this is dc isolated by C80.

Detected audio from IC4 is coupled by C22 to the audio pre-amp IC5, C21 provides a path to ground for anyrf products in the output. The pre-amp feeds a passive filter comprising a third order 300hz Butterworth high pass section cascaded with fifth-order 3khz 1db passband ripple elliptic low pass section.

The filter output is coupled via an audio mute switch TR1 to the AF GAIN control. The mute is activated when the AF MUTE pin is grounded.

RV1 the AF GAIN controls the audio drive to IC6 the audio amplifier. Although a 20 watt ic, it is well under run in this application. For stability an output snubber C41/R29 is fitted. The LS OUT pin suits most 3-8Ω speakers.

Transmitter

IC7 is the Microphone amplifier , it uses the SL6270 VOGAD and provides up to a 60dB agc range. This can be preset with R33 or RV2 may be fitted to allow variable control. IC7 is designed to accept low impeadance microphones of around 500Ω

For conversion to dsb IC8 a SL1640 is used. This ic is inherently well balanced so no external potentiometers are provided. C61 and C52 couple the BFO and AF signals respectively into the ic. TR4 a J310 fet amplifies the suppressed carrier signal before it is routed to the side band filter FL1. Signal diodes D2 and D3 route the signal through the filter to the TX OUT pin.

Two separate switched BFO's are provided on the board. The oscillators are switched by applying +9v from regulator IC10 to the relevant carrier select line, CS1 or CS2. The oscillators use a 2N2222A in a circuit run at the lowest possible level to avoid carrier leakage. The oscillators occupy the centre of the pcb and may be screened is necessary, a silk screened box indicates the oscillator limits.

A seperate CW carrier insertion oscillator TR5 is provided on the board. The oscilator

is keyed in the negative line to ground via D6. The output is lowpass filtered by L6/67 and C81-3 to remove harmonics and routed to the TX out pin via C81. A dc supply for the CIO is taken from the CS9v line.

Construction

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

- 12VR,12VP,VR1,CS9,CS1,CS2,RV1,MUTE,AFB,12VT, AGC, CW, FIL,TX OUT, RX IN, KEY.

- Fit and solder R1-R47. Check the appendix for the correct way to fit components. Where you see a ground legend on a resistor this end is soldered to the top foil of the pcb termed GROUNDPLANE. The groundplane acts as a large heat sink so always tin the pcb with solder around the area of the connection first. Cut the ground side resistor lead back to about 3mm before fitting. If the connections are too long and obstruct another pad angle the component to a free area of groundplane.

- Fit and solder diodes D1-7 make sure that the cathode band on the diode agrees with the band on the board component outline.

- Fit and solder the ceramic disc capacitors. Many of these capacitors are connected to the ground plane, use the same technique for installation as you did for the resistors. To cascade a 2nd IF filter fit C4 at the A posisition and fit C4B -10n. When this option is installed and no external filter is fitted link the CW FIL pins

- Fit and solder RFC1,2,3,4

- Fit and solder L3,4,5,6,7

- Fit and solder L1. Solder the can tabs to both sides of the pcb.

- Fit and solder the electrolytic capacitors. Where the negative lead is made off to the groundplane, bend the lead at a right angle immediately under the body.

- Fit and solder IC1,2,4,5,7,8 be careful to observe the correct orientation of the device. The cut out in the component legend indicates the pin 1 end, also pin 1 is further identified by a square pad on the track side.

- Fit and solder IC3,9 and 10, be careful to observe the correct orientation of the device. The package outline must agree with the board ledgend. If IC3/9 are supplied as 5v remove the center leg ground plane and solder to track side with R26/49 installed.

- Fit and solder IC6. The Number 1 on the package indicates pin 1. This is idntified on the board ledgend by a notch and the number 1. Also pin 1 is further identified by a square pad on the track side.

- Fit and solder TR1/4. In practice these FET's are very robust but they are static sensitive devices, do not handle the leads directly and observe the normal precautions.i.e no nylon clothing, discharge your body static via a central heating and use a grounded soldering iron. Make sure the transistor shape agrees with the board outline.

- Fit and solder TR2/3/5. The can tab must agree with the tab on board outline.

- Fit and solder X1/2/3. Also solder the can corners to the groundplane.

- Fit and solder TC1/2/3

- Make up T1 on the 6.3mm ferrite core. Cut 30cm of the copper 32swg .Wind 20 turns through the core centre, clean the wire ends of enamel and then tin them with solder. Cut another length of 16cm and wind 11 turns over the previous winding and again clean and tin the ends. Install the completed transformer with the 20t between C5 and ground and 11t between C4 and ground. [make sure winding tails cannot short to groundplane]

- Clean the connection pins of FL1 and bolt the filter to the pcb. Solder the connection pins to the track pads.

- Check the completed board for dry joints, solder splashes and bridged tracks and pads. If you suspect a dry joint check with an ohmmeter between the track and the component lead on the groundplane side of the pcb.

Test and Alignment

The method of testing will be dependant on the available equipment. A satisfactory scheme is to use a general coverage receiver to monitor the 9mhz transmit frequency and a RF signal generator to provide a 9 mhz source for the receiver section. Alternatively if the RTXRF board has also been constructed this may be used for most checks with an amateur band only receiver. It is important that when testing a collection of boards ie vfo,mixer and IF, that the boards are properly terminated and bonded together.

- Connect RV1, a microphone and a loudspeaker to the board. Temporarily solder a wire bridge from the +9v pin to CS1/ 2 to active one of the carrier oscillators.

- Connect the board to a 13.8v supply via a multimeter on its current range, check that the current drawn is around 50ma. If the current is greatly in excess of this value check the board for possible faults. The three most likley possibles are, bridged tracks or pads, D1-4 installed wrong way round, IC or TR installed in correctly.

- Turn up the audio controls and check for an increase in noise. Inject a 9 mhz test signal at RX IN or connect a mixer board to provide off-air signals and check for de-modulation. Adjust L1 for max signal.

- If a frequency counter is available adjust X1 or 2 to their marked frequency with the trimmer TC1 or 2, the counter is best connected to pin3 of IC4.

- If no counter is available use a strong off air signal and adjust for TC1/2 for the best audio/ filter response. Do not be too critical as the main adjustment is best made in transmit mode.

- If necessary re-connect the multimeter to monitor supply current and key the ptt line. Expect a reading of 90ma. If the current is greatly in excess of this check the transmit section for faults.

- Apply audio via the microphone and monitor TX OUT at 9mhz or the frequency of the mixer output. Adjust TC1/2 for best audio versus filter response.

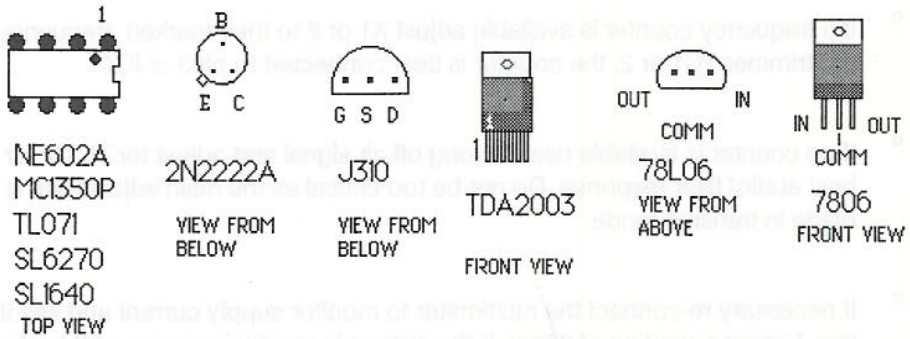
- Audio drive from IC7 to the balenced modulator is at maximum when RV2 or R33 are not installed by an internal parallel 10k resistor. A suitable value for RV2 is 47k. for pre-set use a fixed value of 4K7 at R33 works well.

- If you require higher ssb tx output from the IF strip TR4 may be impeadance matched to the FL1 filter. The Transformer should be wound on a BLN43002402 2 hole balun core . Wind with 32swg as 6 turns then center tap and further 2 turns. Remove R36 and fit the transformer with 6 turns from R36 12v side to the centertap hole and 2 turns to R36 C60 side. Cut the track section to isolate the center tap connection to C60 from TR4. Install RV2 and set as a 'MIC GAIN' control.

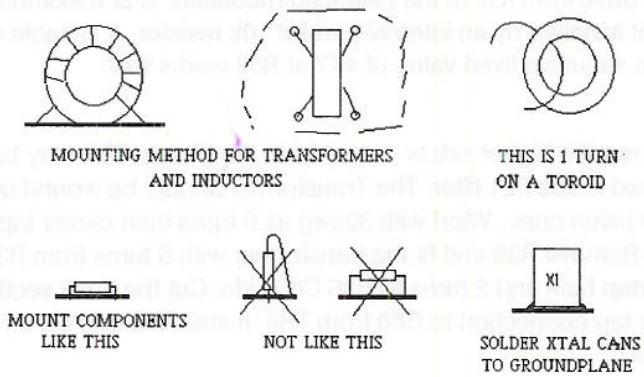
- To activate the CW 'listen thru' sidetone option cut the track between the QSK pin and the blank pad adjacent to isolate the filter switching from the 12VR line. Install link RXV and remove 12VR wire from pin and re-install at QSK pin. The RX IF is now only permantly but will be muted during SSB tx by the MUTE line. Filter RX/TX switching is now from the QSK pin activated from the 12volt receive line.

- Ground the key line and adjust TC3 for the CW cio frequency. For a beat note of 700hz this should be 9.0008 [ie rx bfo 9001500hz-700hz]

SEMICONDUCTOR PINOUTS



COMPONENT MOUNTING

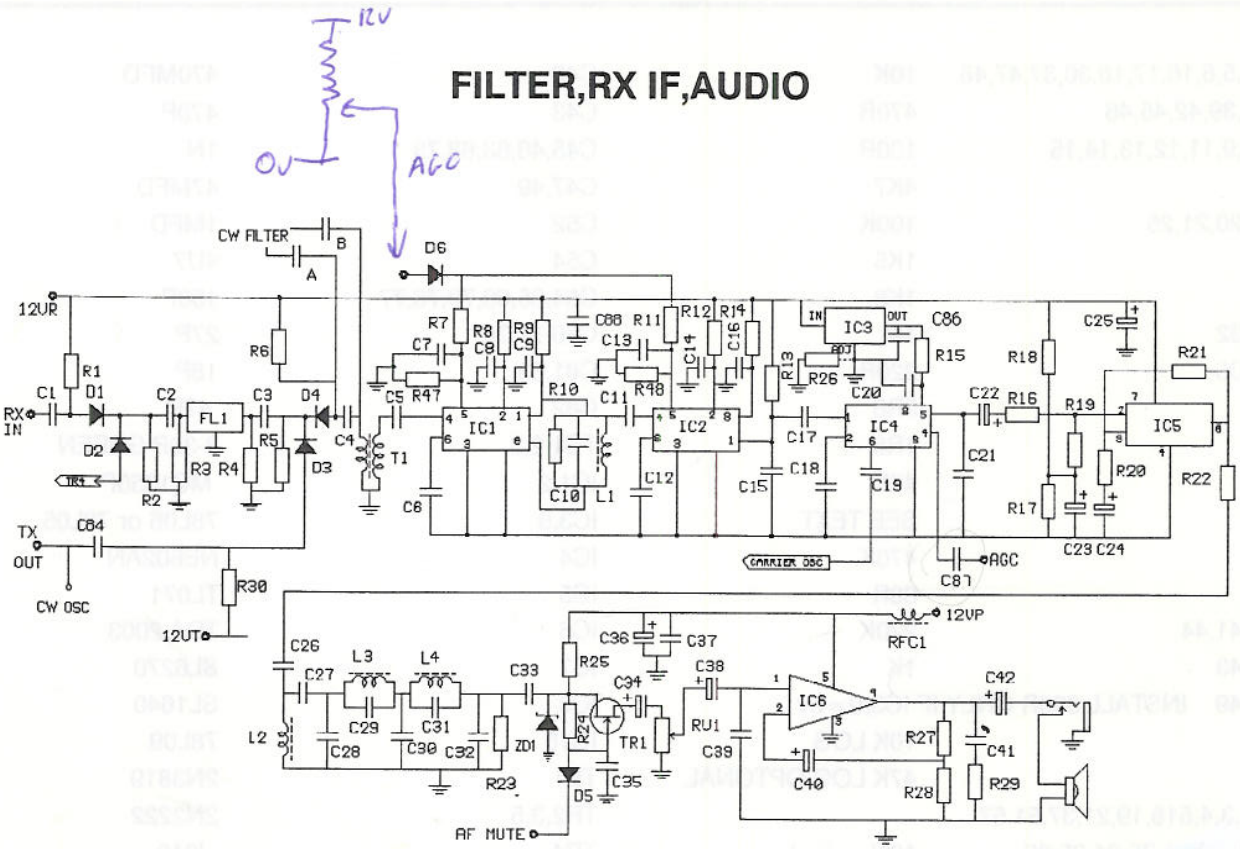


PARTS LIST IF2

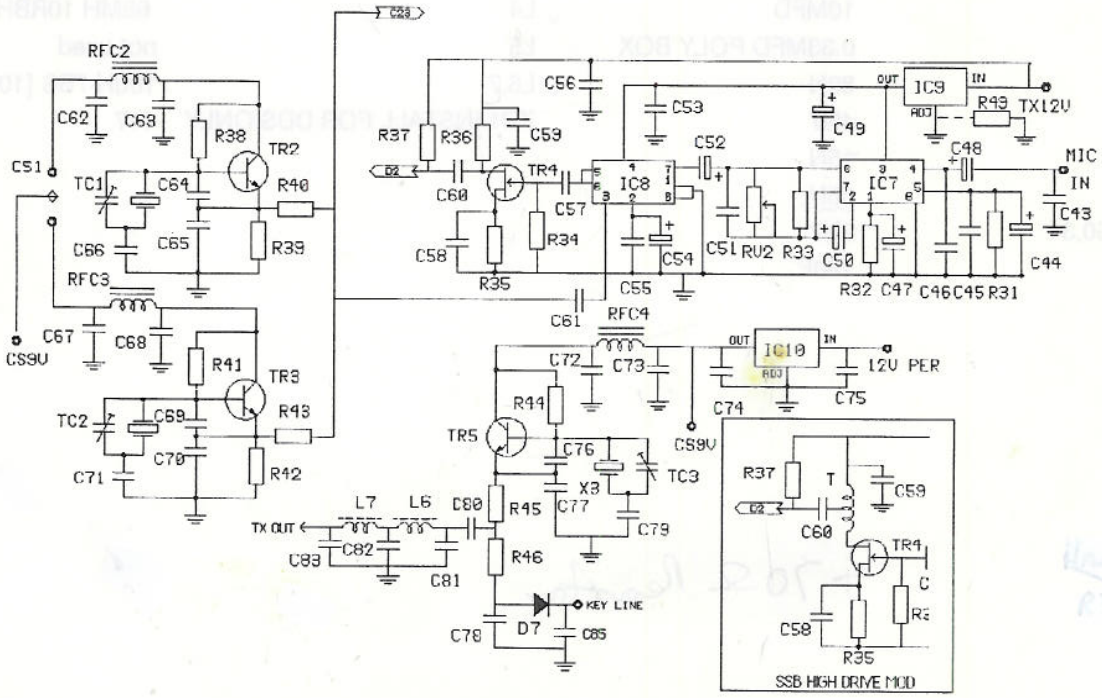
R1,2,5,6,16,17,18,30,37,47,48	10K
R3,4,39,42,45,46	470R
R7,8,9,11,12,13,14,15	100R
R10	4K7
R19,20,21,25	100K
R22	1K5
R23	1K8
R24,32	1M
R27,36	220R
R28	5R6
R29	1R8
R31	47K
R33	SEE TEXT
R34	470K
R35	68R
R38,41,44	220K
R40,43	1K
R26,49 INSTALL 390R ONLY IF IC3/9 = 5v	
RV1	10K LOG
RV2	47K LOG OPTONAL
C1,2,3,4,518,19,21,37,51 57	
58,59,60,61,75,84,85,86,	10N 103
C6,7,8,12,13,14,16	
20,30,33,35,41,53,55,56	
62,67,72,74,78,80,88	100N 104
C10	82P
C11,17	100P
C9,15	not used
C22,87	1MFD
C23,25,36,40	100MFD
C24	10MFD
C26,27	0.33MFD POLY BOX
C28	82N
C29	4N7
C31	15N
C32	68N
C38,48,44,50,34	2U2
C39	180P

C42	470MFD
C43	470P
C45,46,63,68,73	1N
C47,49	47MFD
C52	1MFD
C54	4U7
C64,65,69,70,76,77	150P
C66,71,79	27P
C81,83	18P
C82	47P
TC1,2,3	3-30P GREEN
IC1,2	MC1350P
IC3,9	78L06 or 78L05
IC4	NE602AN
IC5	TL071
IC6	TDA 2003
IC7	SL6270
IC8	SL1640
IC10	78L09
TR1	2N3819
TR2,3,5	2N2222
TR4	J310
D1,2,3,4	BA243
D5,6,7	1N4148
T1	K37X830
RFC1	0082K 8RBSH
RFC2,3,4	1MH 7BS
L1	292CNS T1040Z 7KM
L2	390MH 10RBH
L3	82MH 10RBH
L4	68MH 10RBH
L5	not used
L6,7	10uH 7BS [100J]
ZD1 INSTALL FOR DDS ONLY	4V7

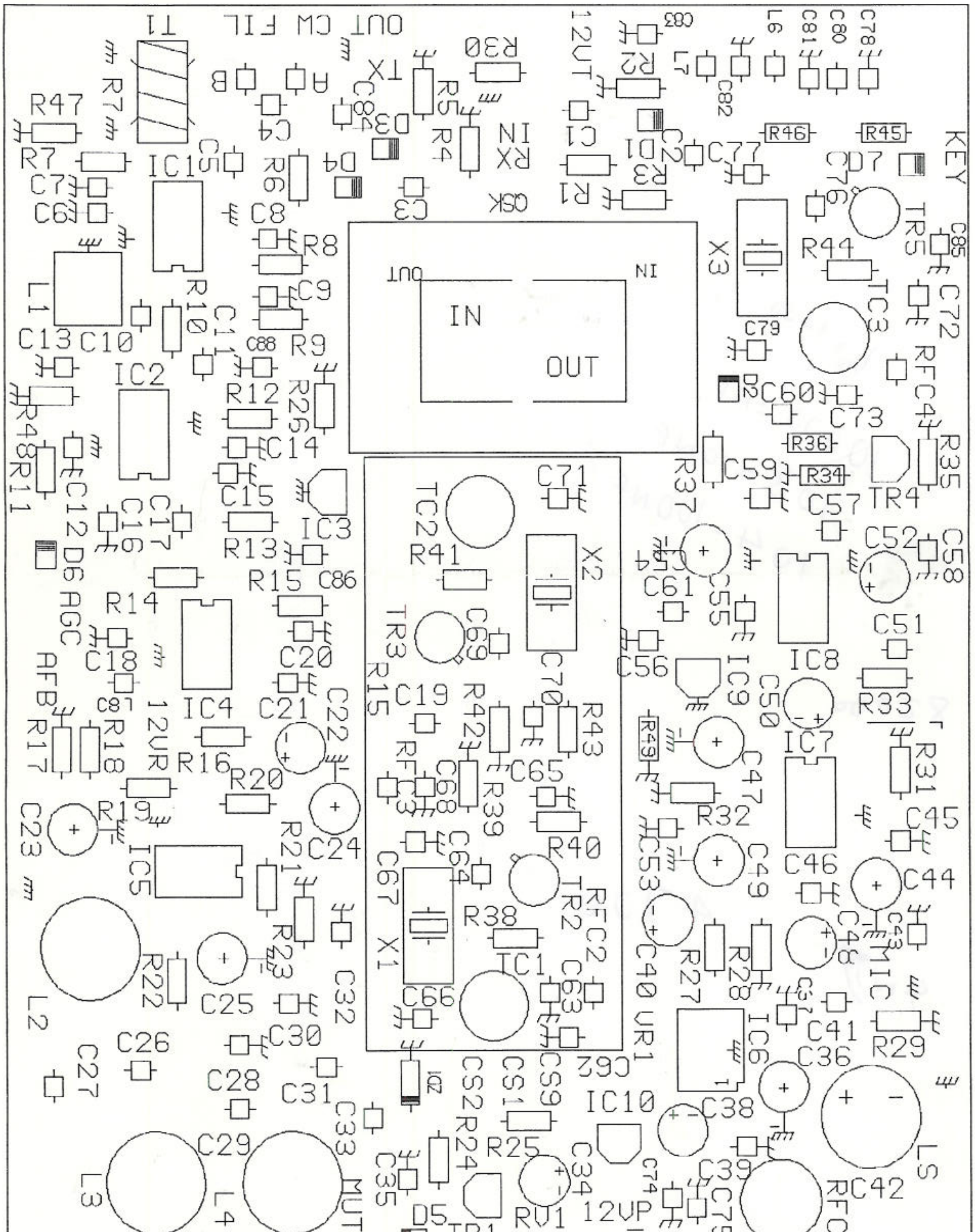
FILTER,RX IF,AUDIO



TX IF, BFO, CW CIO



PCB LAYOUT



T1
OUT CW FIL
R30
12VT
C83
L6
C81
C80
C78
R47
R7
B
A
TX
C84
R5
R2
L7
C82
C4
D3
R4
IN
RX
C1
D1
C2
C77
R46
R45
KEY
R7
IC1
C5
R6
D4
R3
R1
D7
C7
C6
C8
C3
QSK
C76
TR5
C85
R8
X3
R44
L1
R10
C9
OUT
IN
IN
OUT
TC3
C72
C13
C10
C11
C88
R9
C79
RFC4
IC2
R12
R26
D2
C60
C73
R48
R11
C14
R36
R35
C12
C16
C17
C15
IC3
R37
C59
R34
TR4
C71
TC2
C57
D6
AGC
R13
C52
C58
R41
X2
R15
C86
C61
C55
R14
C51
C69
TR3
IC8
C18
C20
C56
IC9
C50
AFB
R17
R18
12VR
IC4
C21
C22
R15
C19
R42
C70
R43
R49
R33
C87
R16
RFC3
C68
C65
C47
IC7
R31
R20
R39
R32
C45
C23
R19
R21
C24
C64
R40
C53
C49
C46
C44
IC5
C67
TR2
RFC2
C48
C43
R38
R23
X1
TC1
C40
R27
R28
MIC
L2
R22
C25
C32
C66
C63
VR1
C37
C41
C26
C30
C62
IC6
R29
C27
C36
C28
C31
CS2
CS1
CS9
IC10
C38
C33
R24
R25
C29
C34
C39
L3
L4
C35
MUTE
C74
C75
RFC1
C42
LS
D5
TR1
RV1
12VP
RXV

$1_{nF} = 1000$

10,000 = NF.

103 = 10NF

104 = 100NF

82000

4700

4NF

15N

15000