SHF SYSTEMS 902K ASSEMBLY AND OPERATIONAL GUIDE

OVERVIEW

This manual describes the construction and operation of the SHF 902K linear transverter kit, designed by Richard Campbell KK7B. This transverter features an integral, on-board local oscillator. No additional modules are required to get the transverter on the air.

902 K

The SHF 902 K is a complete, single board transverter allowing linear operation across the amateur 900 MHz band. It features an on-board local oscillator and produces about +13 dBm output for 0 dBm i-f drive in the range 144-148 MHz. Barefoot receive noise figure is 4 dB with an rf - i-f gain of 40 dB. As supplied, the 902 K i-f frequency of 144 MHz corresponds to a tx/rx frequency of 902 MHz. Optional LO crystals are available to correspond 144 MHz to 904 MHz.

CIRCUIT

The 902 K consists of a crystal controlled Butler oscillator at a nominal frequency of 94.75 MHz, a x8 diode multiplier and filters, and separate receive and transmit mixers with i-f at two meters. The LO frequency of 758 MHz is applied to Mini-Circuits SBL -1X mixers. On the transmit side, the resulting signal at 902 MHz is filtered and amplified by two MMIC stages, producing about +13 dBm (20 mW) output. On receive, two MMIC gain stages drive the mixer to produce i-f output at two meters. The only tuning required is the LO frequency trimmer capacitor. A nominal 6 dB pad is specified between TX i-f input to the SBL-1X mixer, and between the mixer and RX i-f port. On the TX side, no more than 0 dBm of two meter power should be applied to the pad.

CONSTRUCTION

The two SBL-1X mixers are installed on the groundplane side of the board. All remaining components are surface mounted on the component side of the board. Using the provided outline of the component side, position the Parts Placement sheet over the outline, aligning the reference dots in the corners. It is then obvious where each component is installed. Assemble the oscillator first, proceeding "up" the board to the multiplier/filter, then "right" to the transmit converter, and "down" to the receive converter. The only tight spot on the board is in the area of the crystal. Insure that the 15 pF disk ceramic and Q1 are installed on the outside of their respective pads, allowing room for the crystal. The provided piece of double sided tape can be used to secure the crystal to the board.

The original design employed SRA mixers with different pinouts than the SBL-1X mixers. Refer to the detailed insert "A" when installing the mixers from the bottom of the board. After firmly pressing in the mixer, solder the leads to their respective pads on the component side of the board, then apply a dot of solder between the mixer can and the groundplane in two places to secure the SBL-1X.

Detail "B" illustrates the construction of the TX and RX 6 dB pads.

The schematic diagram and parts placement overlay indicate a MAR 6 or 0685 MMIC following the RX mixer. This is not required, and is deleted from the PC board provided.

MiniCircuits MAV-11 MMIC devices may be provided in your kit instead of MSA 1104 devices.

OPERATION

Power required is 13.8 V at 750 mA maximum. Power is applied in three places: to the LO, TX mixer, and RX mixer. Power the LO continuously, and switch the mixers depending upon mode. An external antenna relay, as well as i-f switching, is required. No tuning, other than LO netting, is required. Detail "C" indicates where to apply power to the board. Any modern two meter transceiver can be used as an i-f rig. On transmit, insure that no more than 0 dBm (1 mW) is applied to the TX i-f pad. If excess i-f drive is a problem, the values and power rating of the three resistors must be modified to insure that no more than -6 dBm reaches the SBL-1X i-f port. Appropriate values for 50 ohm PI-Network attenuators may be found on page 25-38 of the 1989 ARRL Handbook for the Radio Amateur. The TX section of the transverter will produce +13 dBm (20 mW) at 1 dB compression. This power level, combined with an appropriate antenna such as the Down East Microwave 3333LY loop yagi, will result in good line of sight contacts. The single board transverter, antenna, and battery supply is a natural contest "rover" combination. Have fun!

ADDITIONAL 902K NOTES

Here are some additional construction tips concerning the SHF 902K kit.

INDUCTORS:

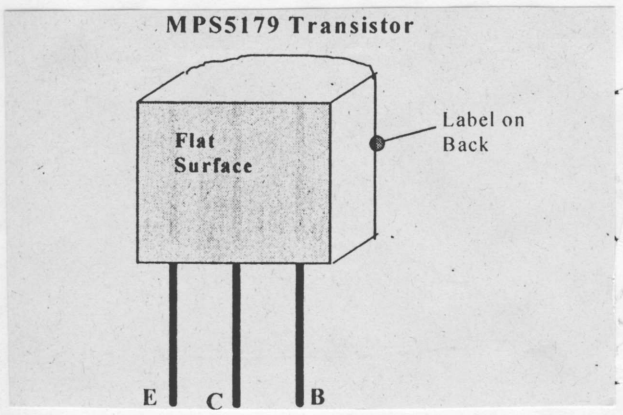
All builder wound inductors consist of 7 or 8 turns of #24 wire on a nominal .1" form. The wire is supplied, and a good form to use is a 7/64" drill bit which checks in at slightly over .1" in diameter. Insure that the coil is close wound. $L_1 = 10t$

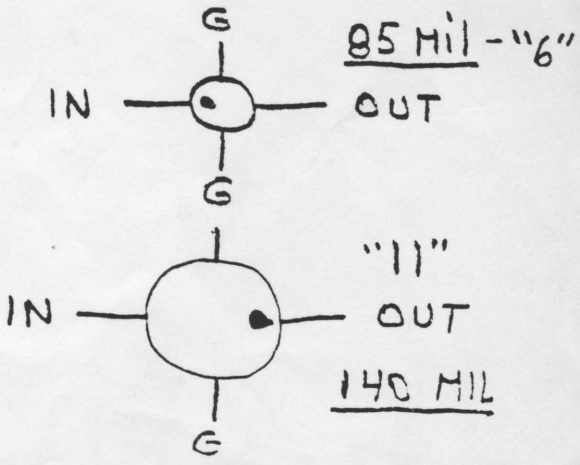
TRANSISTORS:

Two transistors are employed in the LO. I have been providing type MPS5179 with the kit and will continue to do so as I have a good supply. However, they must be prepared prior to installation, and the instructions are not clear in this area. Checking Fig. 1, view the transistor from the bottom. Position the tab to your left. The lead directly under the tab is a ground and should be cut off flush with the case, leaving the standard three leads. Form the leads as shown, with the base lead bent under the case. Be careful not to short the base lead to either emitter or collector. The transistor is then ready to solder to the board.

MMIC:

The kit uses only two types of MMIC devices, MSA-1104 or MAV-11 and MSA-0685 or MAR-6. In all cases, the small, 85 mil packages are the "6" device, and the larger 140 mil packages are the "11" device. A word about polarity - in all cases the small 85 mil packages have a dot on the case denoting the INPUT lead. That lead may also be "slashed". The large "11" devices have the dot on the OUTPUT lead. Check before installing!





902K PARTS LIST

RESISTORS

1 - 47
2 - 100
4 - 100 1/2 W
1 - 100 1/8 W
2 - 470
3 - 560
1 - 820
1 - 1K
1 330

CAPACITORS

3 - .001 disc
5 - .01 disc
4 - .1 disc
14 - 22 pF chip
2 - 15 pF disc
1 - 10 pf disc
1 - 39 pF disc
1 - 2-10 pF trimmer

INDUCTORS

1 - .33 uH moulded choke
4 - 8 turn, .1" form, close wound #24 (wire supplied)
1 - 10 turn, " (L1) "

MMIC

4 - MAR-6 or MSA-0685
4 - MAV-11 or MSA 1104

PAD RESISTORS

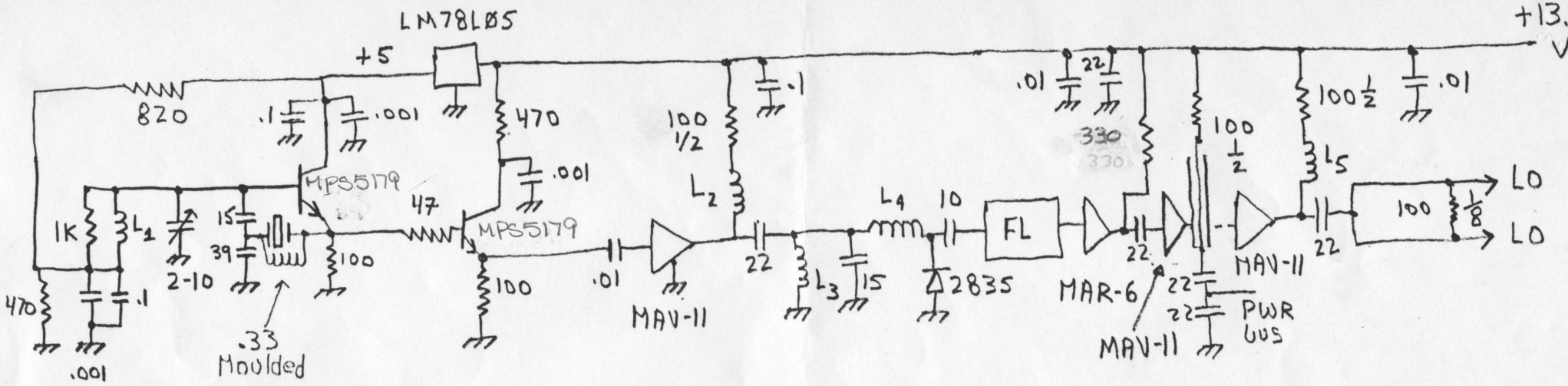
2 - 33
4 - 150 for 6 dB pad

MISC

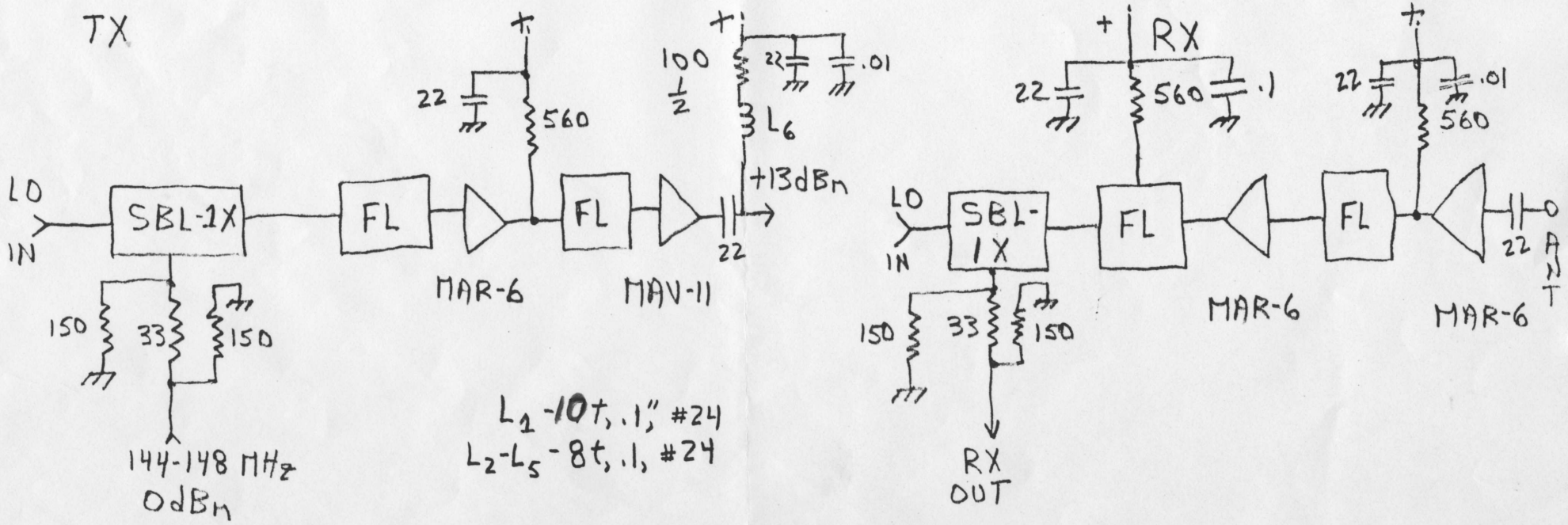
2 - NPN transistor, MPS5179
1 - HP '2835 diode
2 - SBL-1x mixer OR EMA 220X
1 - 78L05 +5V regulator
1 - 94.75 MHz LO crystal
1 - PC board
1 - instruction manual
- additional notes

NOTE: all resistors are 1/4 ohm unless noted, all capacitor values are uF unless noted.

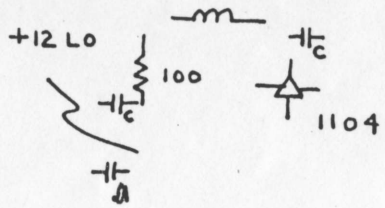
Some non-critical values are approximate, for example, a 12 pF disc may be provided instead of a 10 pF disc.

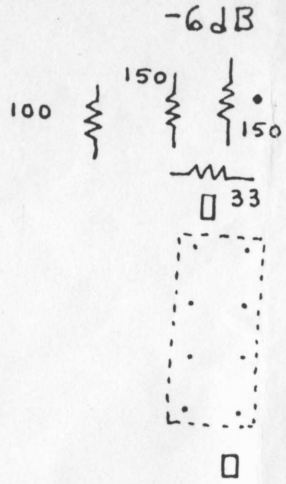


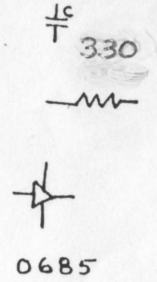
902 K LO

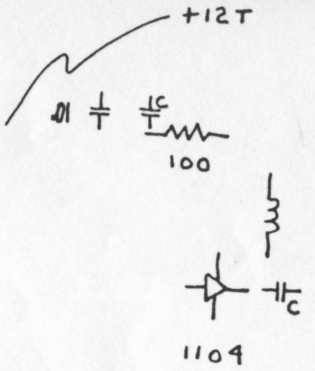


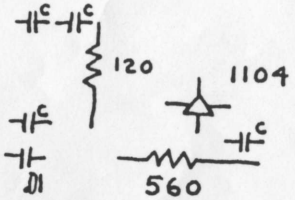
902K TX-RX MIXER









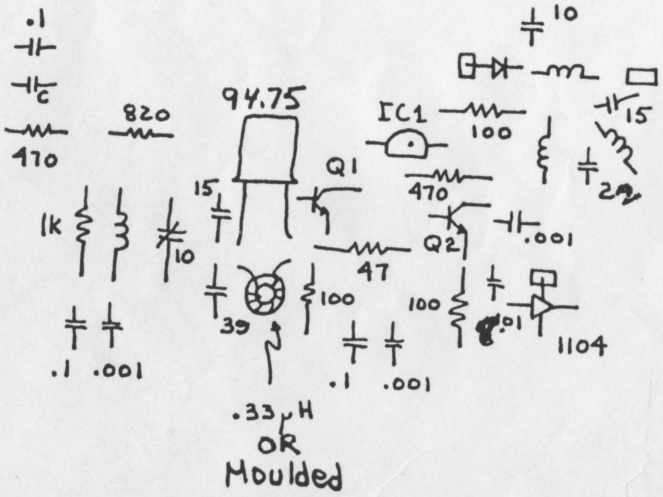


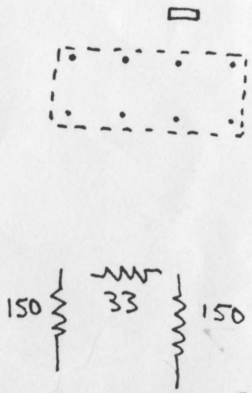
900 MHz Transverter Parts Placement

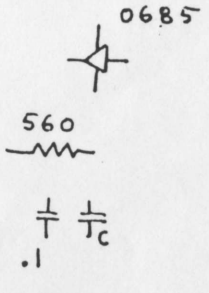
Notes: All chip caps $\frac{1}{T_C}$ are 22p OR 12 pF CC

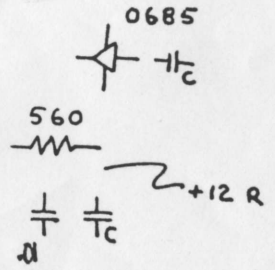
correct except mixer placemat

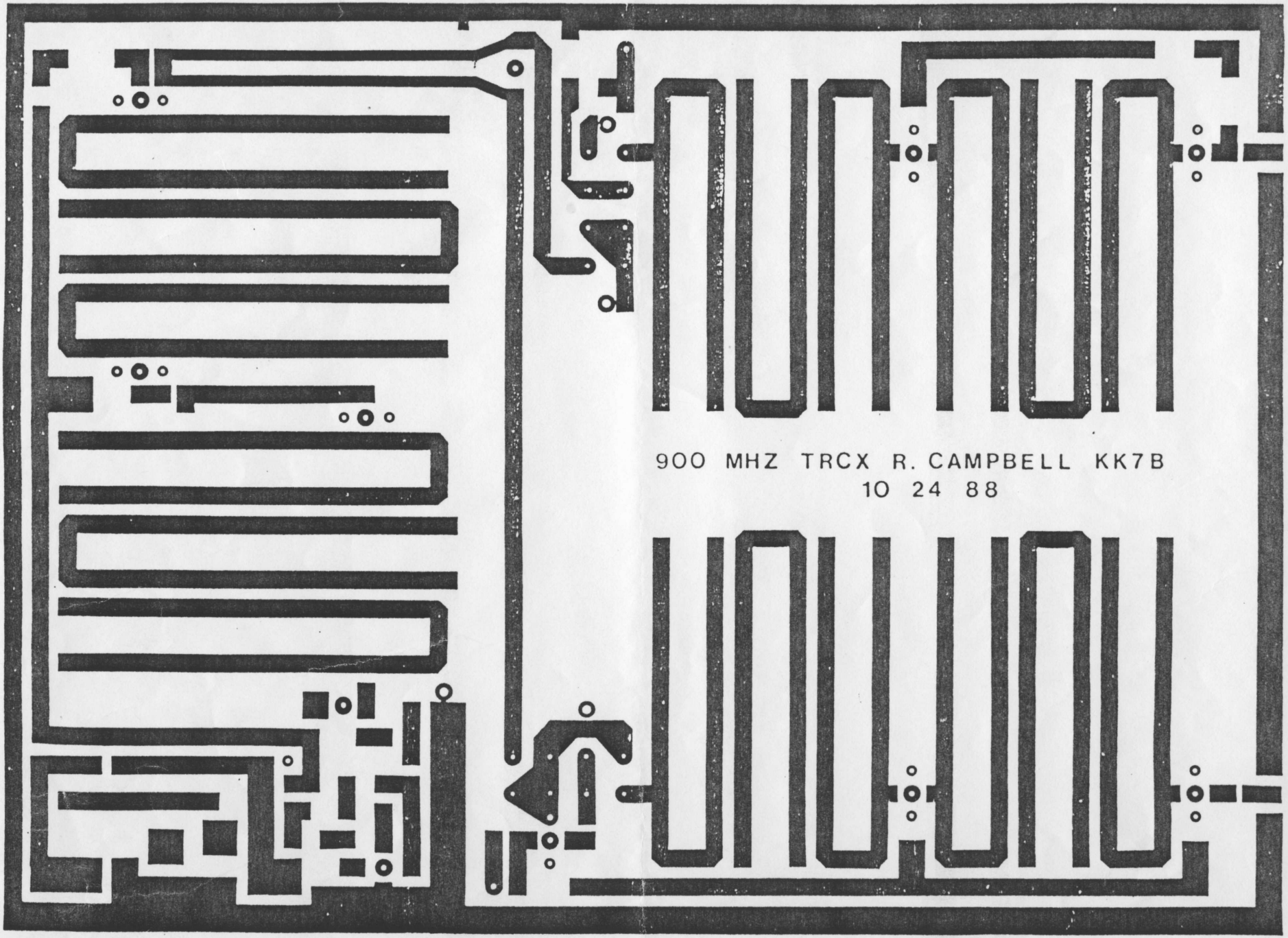
See Appendix B



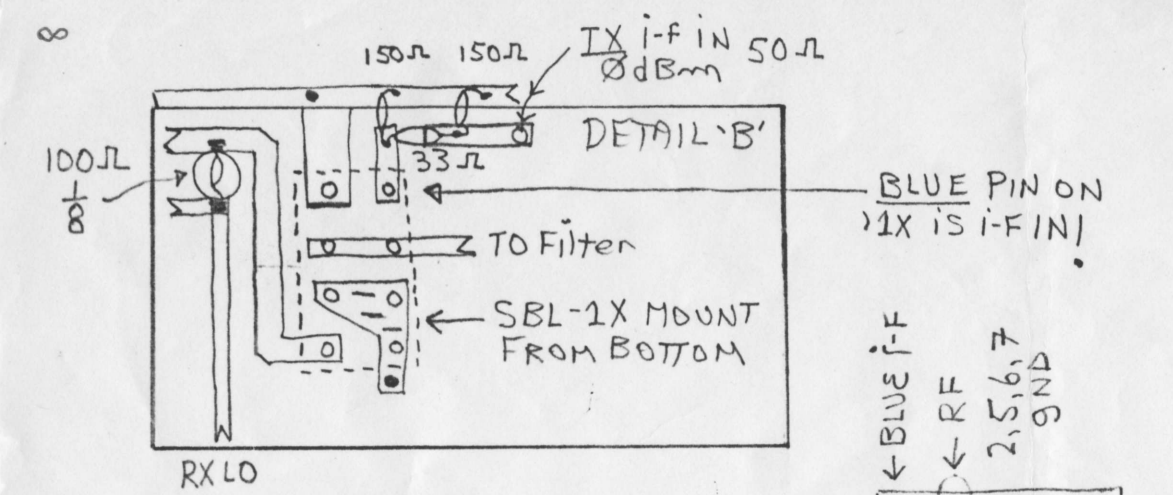




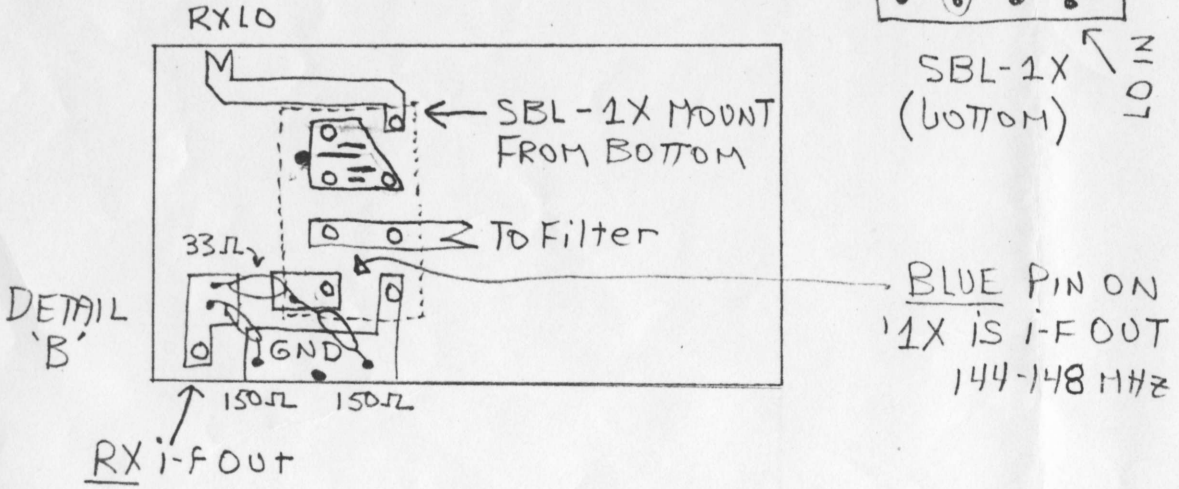




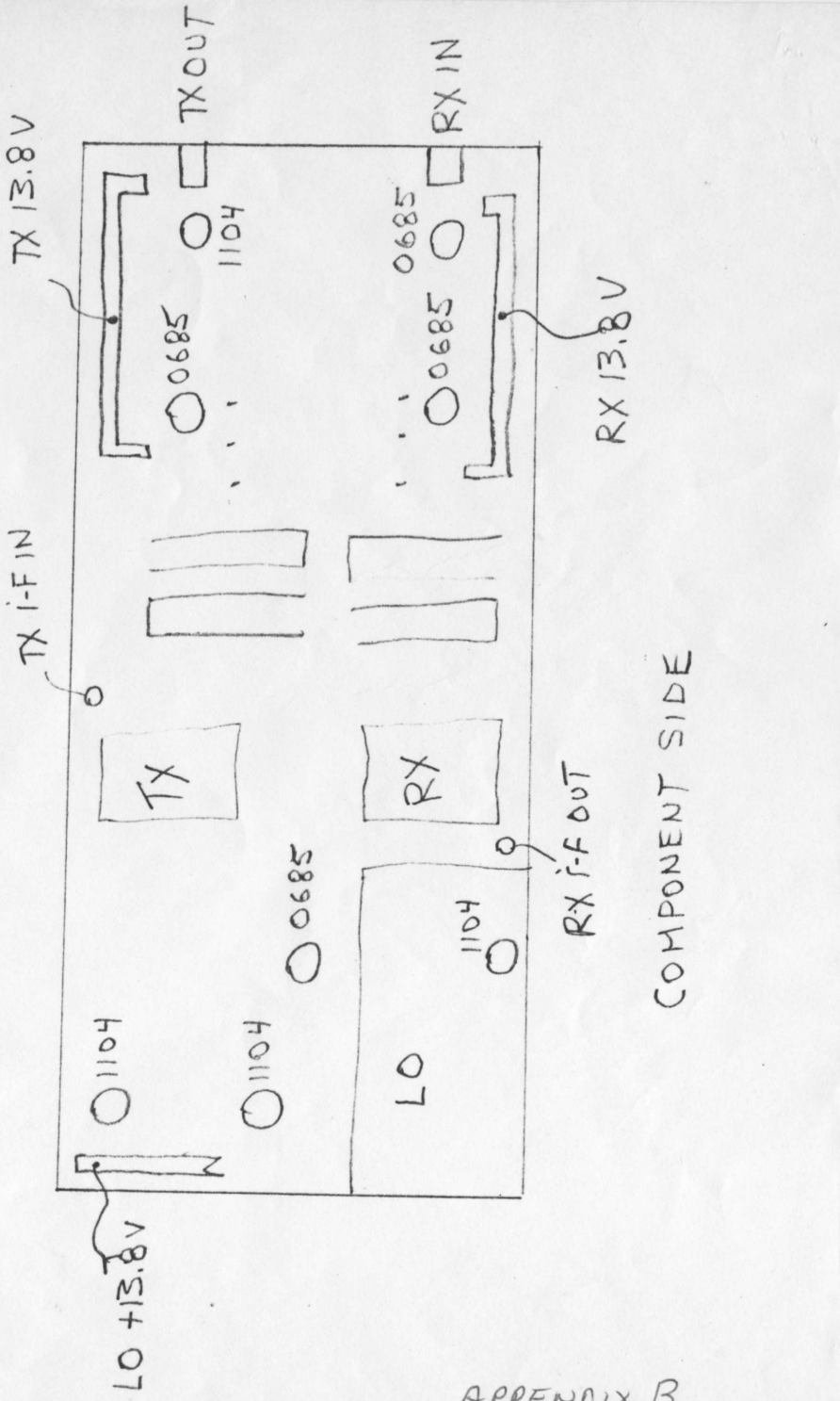
Actual board size 5" x 7"



DETAIL 'A'



DETAIL 'A' - SBL-1X INSTALLATION
DETAIL 'B' - 6dB PAD INSTALLATION
DETAIL 'C' - XVTR POWER POINTS, FEATURES



APPENDIX B
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designed by R. CAMPBELL
KK7B