

# HAMTRONICS® LNW-144, LNW-160, LNW-220 RECEIVER PREAMP: ASSEMBLY, INSTALLATION, & MAINTENANCE

## FUNCTIONAL DESCRIPTION.

The LNW Preamp was designed as a miniature low noise receiver pre-amp. Being only 5/8" x 1-5/8", the LNW conveniently mounts inside many radios.

Models are offered for various vhf & uhf bands. This manual covers models shown in table 1.

The LNW uses a dual-gate mosfet for low noise figure and good stability under a wide range of load conditions. Typical noise figure is 1.2 dB and the output 1 dB compression point typically is +5dBm.

Model	Tuning Range	Gain	3dB BW
LNW-144	120-150 MHz	16dB	±5 MHz
LNW-160	150-200 MHz	16dB	±10 MHz
LNW-220	200-270 MHz	16dB	±12 MHz

## ASSEMBLY.

The following instructions will help you build your preamp with a minimum of effort. It is a miniature unit, though, so precise construction is necessary to get all the parts in the proper positions.

The steps which follow are meant to serve as a general guide as to the construction sequence and critical operations. It is assumed that you are an experienced vhf/uhf kit builder and do not need basic kit building instructions. If this is not the case, consider having someone more experienced help you.

During construction, refer to the diagrams and parts list for details.

*Note that not all the holes in the board are used for this model. Other frequency ranges use slightly different circuitry. The illustrations clearly show the locations of the parts to be installed and the empty holes.*

a. The side of the pc board which has mostly ground plane is the top of the board. The bottom of the board has several conductor patterns for circuit connections.

b. Install feedthrough capacitors C5 and C8 as shown in figures 1 & 3. Insert them from the BOTTOM of the board with the tapered part toward the board. Hold the soldering iron at the base of the capacitor until the

solder on the capacitor melts. Once the solder melts at one point, it is easy to get all the solder to be molten at one time by running the iron around the edge of the capacitor. Then, the ft capacitor will settle onto the board. If necessary to seat it, you can press *lightly* on the metal base of the capacitor with the soldering iron once the solder is melted; but do not press on the ceramic center of the capacitor.

Note that there may be a third 1/8 inch hole on the board, which is not used in this model. The source of the fet is connected directly to ground; so the hole next to the source is not used. *An extra feedthrough capacitor is supplied in case you damage one.*

*CAUTION: The small geometry and high impedances make FET's heat and static sensitive; so be careful. It is good to wear a grounded wrist strap, or at least discharge your hand to a grounded metal object just before picking up the transistor, and the use of a grounded soldering iron is mandatory. A heat sink is not necessary while soldering, but be careful not to apply any more heat than necessary. You should not be overly anxious about blowing out the fet if you observe the precautions above. The transistors are all factory tested and wrapped in anti-static bags to ensure that they arrive in good condition. There is no warranty coverage for damage which occurs in construction or handling; but replacement transistors are moderately priced.*

c. Figure 2 shows the placement of Q1 on the board. The drain is the long lead. Figure 1 shows how to form the leads.

Pick up the transistor and orient it as shown in figure 2 with lettering up. Make sure you know which lead is which. Gently bend the source, gate 1, and drain leads down at a 90° angle as shown in figure 1. Then, bend the bottom of the source lead out away from the transistor to form an "L" shaped foot. When formed properly, the transistor will sit flush with the board as shown. (The gate 2 lead is not bent.)

Insert the drain and gate 1 leads

through the holes in the board. The foot formed in the source lead should rest on the top of the board as shown in figures 1 and 2. Tack solder the foot of the source lead to the board. Check that the transistor is down against the board as shown in figure 1. Check again that the transistor is oriented properly with the lettering up and the long lead in the hole for the drain. Then, solder the gate 1 and drain leads to their pads under the board. Trim off end of drain lead below board.

*Note: The feedthrough capacitors have a hollow center which is metalized through from end to end. Therefore, in order to make a connection to the feedthru capacitor, simply insert a short length of the lead into the hollow center of the feedthru and solder to the metalization. It is not necessary for the lead to go all the way to the other end because there is metalization to conduct from one end to the other.*

Also note that the feedthru capacitor by the transistor is not used as a feedthru cap in the normal sense; it is merely used as a very good vhf/uhf bypass capacitor and tie point.

d. Install vertical resistors R1 and R2 in the holes shown in figure 2. Solder their bottom leads. Then, refer to figure 1 and bend the top leads over, inserting them into the center of ft capacitor C5. Trim these leads off at the bottom. Bend the fet gate 2 lead over to touch the top of the ft capacitor, and then solder all three leads to the metalization in the center of the capacitor. It is not necessary to completely fill the capacitor

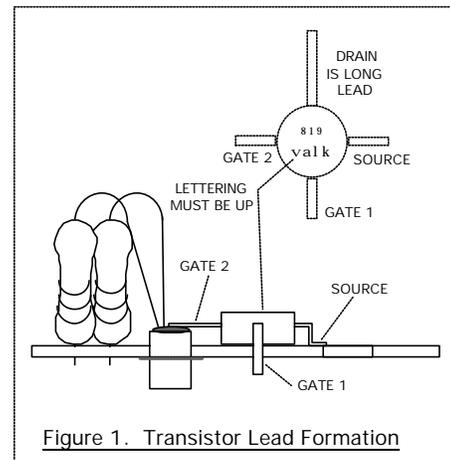


Figure 1. Transistor Lead Formation

with solder as long as the three leads are all soldered at the top.

e. Solder metal shield to ground plane on top of pc board in position shown in figure 2. Keep the shield as close as possible to the transistor to leave room for output coil L2. First, tack solder the shield to the board at each end. Once the shield is aligned properly, run a bead of solder the whole length of the shield. Then, run a second bead of solder on the other side of the shield. Soldering on both sides of the shield provides maximum mechanical support for the shield.

f. Install output coil L2 in the position shown. Form the lead to be soldered to the pc board so the coil fits within the edges of the board. Insert the other lead in the center of ft cap C8. Solder both leads of L2.

g. Install C1, C2, and C3, keeping leads short as possible. C2 should have the rounded end to ground.

h. Install C7 and U1 in the holes shown. The leads of C7 must be formed to the narrower spacing of the pads on the board.

i. Turn the preamp over, and orient it as shown in figure 3. Position ferrite bead Z1 as shown. Note that positioning the body of the bead against the feedthrough capacitor prevents its leads from shorting to anything. Solder one lead to the inside metalization of ft cap C8, and tack solder the other lead to the pad for the left-hand lead of U1 as shown. If there already is solder on the bottom of C8, melt it and slide the lead in.

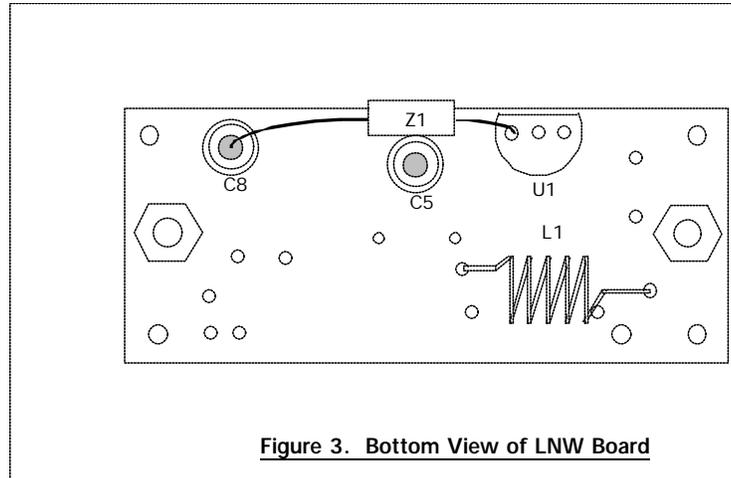
j. Using #22 bus wire supplied and the shank of a 1/8 inch drill bit as a tool, wind coil L1 as shown. (It doesn't matter which direction you wind.) Consult the parts list for the correct number of turns. Count complete turns, from bottom to bottom. For reference, the sample in figure 3 shows 5 turns.

After winding, use a knife to separate the turns so they are not shorting together. The turns should be barely spaced apart, just enough to prevent shorting. Then, form the ends of the leads so that the wire coming off the bottom of the coil is bent to go directly over to the holes in the board. The bottom of the coil

should be 1/16 inch from the surface of the board.

*Be sure that the coil leads are in-*

the rf amplifier or first mixer of the receiver to minimize feedback effects.



**Figure 3. Bottom View of LNW Board**

stalled in the correct holes: the one on the left should connect to the junction of C1, C2, and gate 1 of the transistor; the one on the right should connect to the ground plane. Then, solder both leads.

k. This completes construction. Look over all components and solder connections. Check for shorts or parts in the wrong places.

### INSTALLATION.

The preamp can be mounted to any flat surface. Simply drill two 1/8 inch holes 1-7/16 inch apart, and attach the preamp with the 4-40 screws and standoffs or spacers as desired.

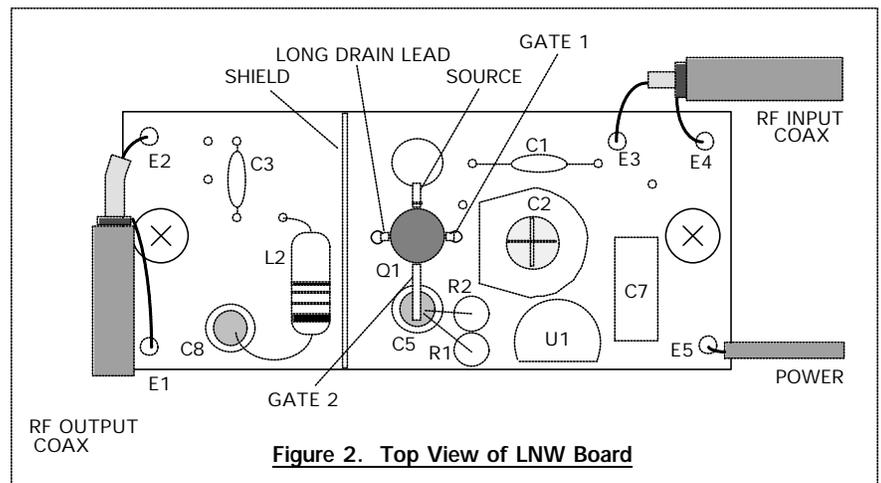
Complete shielding of the preamp is not required. However, some care should be given to selection of the mounting location with regard to feedback from adjacent receiver circuits or rf pickup if mounted very close to a transmitter circuit. Because the unit is small, make sure that it isn't installed tight against

Connect the input and output terminals in the receive signal path with miniature coax, such as RG-174/u, as shown in figure 2. Be sure to keep the stripped pigtails as short as possible to maintain a 50Ω path. Connections are made by inserting the stripped ends of the pigtails into the pads on the board and soldering. Normally, the preamp is mounted in some sort of enclosure with UHF or similar connectors on the enclosure and miniature coax installed between the preamp and the large coax connectors. In some cases, the output of the preamp can go directly to the receiver with the miniature coax.

⊗ **Caution:** Don't connect the preamp in the transmit signal path.

Connect power supply lead to E5. The LNW requires filtered +10 to 15 Vdc. Current drain is about 10 mA.

Caution is advised in selecting a power source. Solid state amplifiers can be damaged by large voltage transients and reverse polarity. Al-



**Figure 2. Top View of LNW Board**

though protection is provided in the LNW in the form of a voltage regulator ic, avoid such conditions as a matter of principle. Care should be taken especially to install a reverse diode across any inductive devices, such as relays, on the same B+ line to absorb transients.

## ALIGNMENT.

Factory assembled preamps are tuned at the center of the band. The bandwidth is wide enough so that retuning normally is not necessary because of frequency. However, you may want to retune the input circuitry to optimize noise figure with the unit connected to your antenna. Simply retune the input variable capacitor for best reception of weak signals. No test equipment is necessary. If you happen to have access to a signal generator and sinadder, they may be used; otherwise, just do it by ear.

## TROUBLESHOOTING.

Since the unit is fairly simple, troubleshooting usually is limited to checking the dc voltages on the transistor. These will vary somewhat; however, in general, the gate-2 voltage should be about 4 Vdc, and the drain should be at about 8 Vdc. The source and gate 1 should be at ground potential.

If the dc voltages are OK but the unit is no longer amplifying, assuming there are no problems in the coax cabling, the transistor may have been damaged by transmitter rf or lightning discharge at the antenna. Such damage often does not cause a change in the dc characteristics of the transistor.

If the drain voltage is much lower than 8 Vdc, first disconnect ferrite bead Z1 to see if the transistor is shorting the output of the voltage regulator. In the case of a severe voltage transient or reverse B+ voltage, it is possible to also damage the voltage regulator.

If the unit is amplifying OK but you are experiencing intermod, you may be overloading your receiver by adding gain ahead of the rf stage. Low noise preamps are effective in improving sensitivity of receiver systems in weak signal areas. However,

it is normally considered inadvisable to use a preamp, even with a well designed receiver, in very strong signal areas, such as the center of a city or other locations with high powered transmitters in the area.

Adding gain ahead of a receiver degrades the selectivity of a receiver by an equivalent amount by boosting undesirable signals as well as desirable ones. In severe cases, strong signals which do not cause intermod by themselves will create intermod in the rf stage or mixer of your receiver after being amplified an additional 20 dB.

If you use a preamp with a repeater receiver, you will need to have additional rejection in your duplexer to attenuate your transmit signal that much more to prevent desense.

## TRANSISTOR REPLACEMENT.

Transistor replacement is complicated a little by the fact that the pc board has plated-through holes. You must remove all the solder from the drain and gate-1 leads before trying to pull the transistor off the board. This can be done with solder-wick or a vacuum desoldering tool, as long as you remove all the solder within the holes. Then, melt the solder on the top of ft cap C5, and lift the gate-2 lead of the transistor.

⊗ *CAUTION: The small geometry and high impedances make fet's heat and static sensitive; so be careful. It is good to discharge your hand to a grounded metal object just before picking up the transistor, and the use of a grounded soldering iron is mandatory. A heat sink is not necessary while soldering, but be careful not to apply any more heat than necessary.*

You should not be overly anxious about blowing out the transistor if you observe the precautions above. The transistors are all factory tested and wrapped in foil to ensure that they arrive in good condition. There

is no warranty coverage for damage which occurs in handling.

Refer to ASSEMBLY section of manual for details of how to install a transistor.

## REMOVING OTHER PARTS.

Because the pc board uses plated through holes, all of the solder within the holes must be removed before a lead can be removed from the board. This can be done with solder-wick or a vacuum desoldering tool, as long as you remove all the solder within the holes.

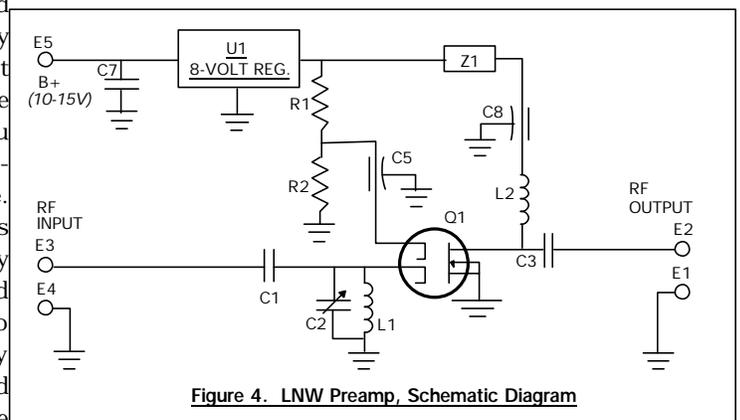


Figure 4. LNW Preamp, Schematic Diagram

## PARTS LIST.

<u>Ref #</u>	<u>Description</u>
C1	6 pf disc (LNW-144 & 160) 2 pf disc (LNW-220)
C2	20 pf cer. variable (144 & 160) 4.5 pf cer. variable (LNW-220)
C3	.001 $\mu$ f disc (1nK or 1nM)
C4	not used
C5	.001 $\mu$ f feedthrough capacitor
C6	not used
C7	0.15 $\mu$ f mylar capacitor
C8	.001 $\mu$ f feedthrough capacitor
L1	#22 bus wire 1/8 inch i.d. with turns barely spaced apart. LNW-144 & LNW-220: 5 turns LNW-160: 4 turns
L2	0.33 $\mu$ H molded coil (orn-orn-sil-red)
Q1	N.E.C. 3SK122 mosfet
R1-R2	100K
U1	78L08 Voltage Regulator IC
Z1	Ferrite Bead