



**DEM 3-2ULNAK and CK**  
**10 GHz. PHEMT LNA amplifier kit and complete kit assembly guide**

**SPECIFICATIONS**

Noise Figure:	<1.1dB
Gain:	> 21 dB
Frequency Range:	10.000 - 10.500 GHz
Input Voltage:	7 - 16 VDC

**Description:**

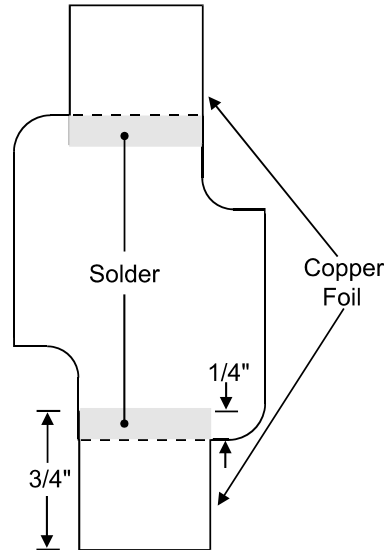
The 3-2ULNACK is a complete kit of our 3-2ULNA low noise amplifier designed by W5LUA and Down East Microwave Inc. It comes complete with a pre-drilled weather-proof enclosure, a machined pallet for mounting the PC board, SMA connectors and the standard 3-2ULNAK, PC board kit. When completed, the LNA may be mast mounted but it is a receive only preamplifier and would require coaxial relay switching for transceive operation. If assembling the "K" version, you will be using your own enclosure or a recommended "Brass box" enclosure, be sure of the order of assembly you chose. In most cases, the assembly of the circuit board into an enclosure is recommended to be completed before the components are assembled to the circuit board. Use this document as an assembly guide for component placement and testing.

Before starting assembly, read through the entire assembly guide. Review all of the assembly and test procedures. Have all of your questions answered by further reading, trial fitting, or calling DEMI for help. When you are sure of yourself, begin the assembly with confidence and have fun!

**Begin Assembly:**

The circuit board needs minor preparation. Find the circuit board and the machined pallet. Place the circuit board on top of the pallet so that the cut outs on the PCB are aligned with the cutouts on the pallet and the four mounting holes are aligned. Some of the edges of the PCB may extend beyond the pallet edges. They need to be trimmed on the RF connector ends only so that they do not extend past the edge of the pallet. Use a razor knife.

The next step is to attach the copper foil to the bottom side of the PCB. This is done to maintain proper grounding of the RF connectors to the circuit board through the enclosure. See figure 1 for the assembly details. The foil supplied is 1-1/2" x 3/4". Cut it in half to form two 3/4" square pieces. Solder the foil as shown. Be sure the foil is smooth and clean to start. Any bumps or crinkles in the foil on the bottom of the PCB will push the PCB up off of the pallet and not allow the RF connector to fit correctly. When you are finished soldering the foil, use a small file to make the bottom of the PCB smooth. Be careful not to tear the foil!



**FIGURE 1.**

After the foil attachment is complete, place the PCB on the pallet again and wrap the foil around the ends of the pallet. Center the PCB on the pallet side to side. The ends need to be flat and clean of all debris or it will either not fit into the enclosure or will not allow complete grounding of the pallet. Be sure the foil and board can be made flat to the pallet. Remove the board from the pallet and proceed with the PCB assembly.

### **PCB Assembly:**

Assembly is easy but follow standard ESD precautions. Use a grounded solder iron if possible. Be sure you are discharged of static before handling IC1, Q1, or U2. All other components are ESD resilient but are attached to the circuitry that contain them.

As you know by now, the 3-2ULNA PCB is very flexible. This flexibility is a problem in that it allows the components to fracture if the board does flex. This is why the PCB is mounted on a pallet. BUT! It's not that simple. If the PCB is mounted to the pallet, all of the ground connections may not be soldered correctly because of the heat transfer to the pallet. Therefore some ground connections must be made before the PCB gets attached to the pallet. Lay the PCB as flat as possible on your work area and using the component placement diagram and the 3-2ULNAK components parts list at the end of this document, begin to assemble the PCB by installing IC1 first. Pin 1 is marked on the placement diagram. Solder pin 3 first. This is the ground pin. Check for alignment of the other pins and if OK, proceed to solder the other 7 pins in any order. Check for solder shorts with Ohm meter. Next attach Q1 and U2. Follow the dots shown on the component placement, align and solder the source leads first. These are the leads on the ground vias. Check the alignment and then solder the other leads. Now install R2 and C3 being sure of the polarity of C3. Then place C2, C7, C8, C10, and C11 and solder the ground via ends only. If you solder both ends, they will break during the PCB installation to the pallet. Check all the solder connections on the bottom for solder leaching through the ground vias. As before, touch up with a sharp knife or file smooth. The PCB should now be mounted to the pallet and installed in the enclosure.

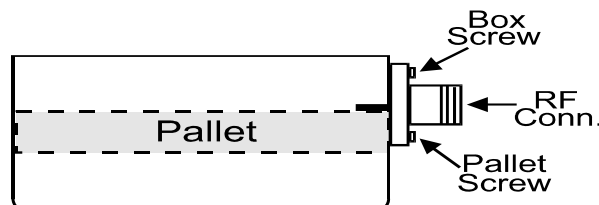


**Pallet and PCB Assembly:**

The mechanical fit is very important to the function of this LNA and everything should fit very snug. This is the reason for trial fitting the parts before final assembly. Insert both RF connectors in the holes on the enclosure. Trim the Teflon flush with the inside of the enclosure with a sharp knife. Clean off the rough edges and check the fit again. Re-trim if needed. Because the wall thickness may vary side-to-side note which connector goes where. Then cut the center pin of the connectors so that only 1/8" sticks out past the Teflon. File off rough edges if needed. The input connector may need to be a little shorter but will be addressed at the time of assembly.

Place the PCB on the pallet again and wrap the foil around the ends of the pallet. Center the PCB on the pallet side to side. Install the four 3-48 x 3/16" screws in the PCB mounting holes. Make them snug enough to hold the board in place but do not tighten the screws. Be sure the foil and board can be made to fit flat to the pallet. Drop the pallet into the enclosure for a trial fit. It is asymmetrical so it will fit in any direction but be sure that the side of the enclosure with the 8-32 hole in it is on the same side as IC1 and VR1. It should also be a snug fit. Be sure it drops in all of the way. If not check the foil for solder build-up or for pallet misalignment. Check for correct alignment of the connector holes and the RF circuit on the PCB. Insert the SMA connectors in the enclosure to verify that the pins line up with the circuitry. The pallet has some side to side "Slop" in the enclosure to ensure proper pin alignment. If you need to move the PCB on the pallet, loosen the mounting screws if necessary but retighten after the alignment is made. If everything looks like it will fit, install the two 3-48 x 3/16" box screws as shown in figure 2. and snug them. Check the length of the input connector pin. Verify that there is enough room to solder C1 to the pad. If not shorten the pin by the require length and install it with the 3-48 x 3/16" box screws. Align the pallet and PCB if required so that the pin of the connectors are on the input and output pads. Now tighten all PCB mounting screws. Then poke a hole in the copper foil through the SMA connector pallet screw holes with a sharp object or small drill bit before installing the pallet screws. If you install the screws and force it to penetrate the foil, it will cause the screw to bind and damage the threads in the pallet or break the screw. After the threaded holes are cleared of foil, install the 3-48 x 3/8" pallet screws. Check for alignment again and begin to tighten the input connector pallet screws first, pulling the pallet towards the enclosure and ensuring a tight fit. This is best for stability and noise figure. Then tighten the output connector pallet screws last. Re-tighten all of the screws including the PCB mounting screws and verify both pin alignments again.

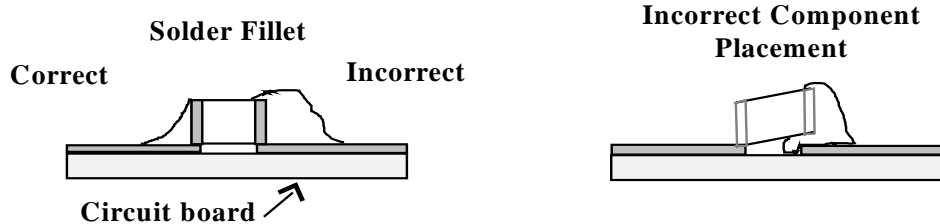
If you wish to weatherproof the SMA connectors, now is the time to do it. Remove them both and use a silicone sealant conservatively and be careful not to get any on the Teflon or the pin. Install the connectors again as described in the procedure above. Do not solder the pins!! When satisfied with the pallet installation, continue with the component assembly. Remember that all ground connections may be difficult to solder.



**Figure 2.**

Install all other components on the circuit board in any order except for R6. All ground connections have multiple ground vias and may be difficult to solder. Solder multiple

connection pads last. Review figure 3 for correct installation of surface mount components. Be sure to check the polarity of C5, C6, and C7 as shown on the component placement guide. Do not solder the connector pins. Install VR1 as shown in figure 4 as close to the pallet edge as possible.



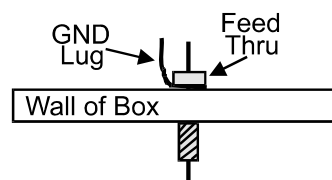
**FIGURE 3.**

Error! Not a valid link.

**FIGURE 4.**

When complete, check for missing solder, missing components, or shorts. R6 is still not installed. Feel free to use an ohmmeter for testing any connection. To Test Q1 with a ohm meter, verify that the drain lead is not shorted to the source. It should be between 6 and 15 ohms to ground. Be sure to Zero your meter first. The gate should be in the Kilo-ohm region. All other connections are as shown in the schematic.

Install the 8-32 Feed-thru connector and ground lug (see Figure 5) in the remaining hole of the enclosure. Again if you want a weatherproof enclosure, apply some sealant to the connector before installing. Connect the 1N4000 type diode between the DC feed-thru connector and the point on the component placement labeled "+DC Input". This is a reverse polarity protection diode.



**FIGURE 5.**

**Warning:** Do not tighten any screws after the center pins of the SMA connectors are soldered! If the connectors or PCB moves it will tear the center pin from the circuit board. Be sure that all screw are absolutely tight before soldering! If you are satisfied with the complete assembly, you may now solder the center pins of the SMA connectors.

**DC Testing :**

Preliminary testing is required before R6 is installed. Apply a DC input of +7 to +17 VDC to the feed through connector and ground lug. Measure +5VDC on the output side of VR1. Verify that the gate bias is functioning correctly. Measure the voltage on the Q1, C1 junction. It should be less than -0.8VDC (negative voltage!) Adjust R2 to obtain -0.4VDC. If



any of the voltages can not be obtained, trace the circuit for problems. There should be -5 VDC on pin 5 of IC1.

Now Check U2. Verify between 6.5 and 7.0 VDC on U2's output lead (junction of U2 and C12). If voltage is high, Check value of R7 and increase if possible. If all voltages check out on both gain stages, install R6.

**Final Testing:**

Install a 50 Ohm load to both input and output connectors. This can be a termination, an antenna, or a receiver. Apply the DC voltage to the feed through connector and verify that the drain lead of Q1 (junction of Q1 and R9) has voltage. It should be around 2 volts DC. The drain current produces a voltage drop across R5, R4, and R9 and should be approximately 20 mA. The voltage drop can now be adjusted by varying R5. As the gate voltage approaches 0VDC, the drain current will increase. If the gate voltage is adjusted more negative, the drain current will decrease. Adjust R2 for approximately 2.5 VDC on the drain lead of Q1.

**RF Testing:**

If the DC testing is correct, the LNA will be operating correctly and the RF adjustments should not be attempted unless you have a way of measuring Gain and/or Noise Figure. If you do have the equipment available, there may be adjustments such as "Snow flaking" and stub trimming to improve the performance of the LNA. The hot spots are indicated on the component placement diagram. If the LNA is assembled correctly and the bias is set correctly, the LNA will perform adequately with out further adjustments.

Component List: The white band is positive on the Tantalum chip capacitors. All capacitors are various sizes. The 1N4000 is connected to the input of VR1 for reverse voltage protection on the +DC supply line.

**3-2ULNAK**

C1 1.0pF 50 mil ATC	C8 0.01µF (0805)	Q1 ATF36077	R7 470Ω
C2 0.01µF (0805)	C10 0.1µF (1210)	R1 51Ω (0603)	R8 51Ω (0603)
C4 1.0pF 50 mil ATC	C11 0.01µF (0805)	R2 1K pot SMD	R9 12Ω (0603)
C5 10.0 µF Tant.	C12 1.0pF 50 mil ATC	R3 5.1KΩ	U2 MGA86576
C6 10.0 µF Tant.	D1 MMBD914	R4 51Ω (0603)	VR1 78L05
C7 1.0 µF Tant	IC1 7660 SMD	R5 100Ω	

**3-2ULNACK**

1 - Weather- proof enclosure complete w/ gasket	4 - 3-48 x 3/8" screws
1 - Machined aluminum pallet	8 - 3-48 x 3/16" screws
2 - SMA connectors	1 - #8 ground lug
1 - Copper foil 1.5" x .750"	4 - flat head cover screws
1 - #8-32 feed-thru connector	1- 1N4000 Diode

