Installation Instructions for the

N6MTB KX3 3S LiPO battery conversion kit.

For board version 2.0

Kit Contents:

1 - #4-40 ½" countersunk head Phillips screw

1 - #2-56 5/16" pan head Phillips screw

1 – Battery and Charger PCB holder, 3D printed

1 – Battery retainer board, 3D printed

1 – KX3 3S LiPO battery charger PCB

1 – 2x3 connector and wiring harness, assembled

1 – Single conductor wiring hardness

1 – segment of heatshrink tubing

1 – Antistatic bag

1- External Charging Indicator, assembled which includes: subminiature LED, panel mount, spacer, washer, nut and prewired harness.

1 – 2.1mm x 5.5mm DC Barrel Plug

Not Included in the Kit: A 3S 18650 LiPO battery. This kit was designed around the form-fit factor of the Elecraft KXBT2 battery pack used in the KX2 and KH1 radios. At $89.95 plus shipping there are better options. I highly recommend the 3500mah 3S LiPo back from LiION Warehouse. It is the same form-fit as the Elecraft battery, but has more capacity and is way cheaper ($27 + shipping). You will need to install a 2.1 x 5.5mm DC Barrel Plug on it. One is included in the kit. All of my tests were done with both of these battery packs. There are numerous other 3S1P 18650 battery packs in a flat-pack layout with wiring coming out of one corner that would also work with this kit but I know for certain these two do. Be extremely diligent if you go with a different battery pack other than the two mentioned above.

Disclaimer and Warning:

While this kit has gone through many tests and every board has been tested to verify proper charging rate and more importantly that it stops charging at the proper cutoff point.

With that said, this is an install it yourself kit, and if you don't do it right you could let out the magic smoke that makes amateur radio possible with the KX3. I'm sure Elecraft would say you void your warranty by installing this kit. You should follow electrostatic discharge protection procedures and use an ESD mat. <Insert other various legal mumbo jumbo here> These directions assume you are familiar the KX3 radio and have some basic soldering skills.

Battery Pack Preparation:

If you are using the official Elecraft KXBT2 battery pack you do not need to do any of these steps as that battery back comes with a 2.1mm x 5.5mm DC barrel plug installed. If you are using the 3500mah 3S LiPo back from LiION Warehouse that I recommended above (or potentially another 3S LiPO battery pack), then you will need to install 2.1mm x 5.5mm barrel plug. One is included with this kit. You will be soldering this connector onto a live battery so you do not want to accidently short out the battery. Here are some precautions I suggest. The battery will come with both leads insulated with either tape or head shrink and both leads cut to the same length. Leave them that way until to start with.

1. Remove the backshell from the DC barrel connector.
2. Thread the two wire through the back of the backshell. Do one wire at a time.
3. Slide a small piece of heat shrink over the red wire. Internal space in the backshell and getting two heat shrunk leads into the backshell once soldering in place is too much for the wires of my recommended battery.
4. The red wire is going to be solder onto the short tab of the connector (center of connector).
5. Tin both the connector and red lead. High heat and being quick is the key to not melting the wire insulation or the internal plastic of the connector.
6. Trim the red lead if needed, you really wan the insulation to start right at the end of the short tab of the connector.
7. Once the red wire is soldered in place and cooled, slide the heat shrink over the wire and cover as much off the short tab as possible. Heat shrink the tubing in place. <Note: The KX3 is a $2,000+ radio. If you are trying to heat shrink this tubing with a $2 mini-Bic lighter, stop what you are doing, go down to Harbor Freight and invest 20-30 bucks in a corded heat gun. You can thank me later.>
8. Moving onto the black wire (with the tape/heat shrink still on the tip), line of the wire to the connector and trim the wire back so that there is enough reach just behold the hole of the long top. Trim at that mark.
9. Now strip back enough insulation so that that large wings at the end of the long tab can be bent and grab onto the insulation while the wire can be soldered onto the long tab.

Note, the wire does not need to go through the hole in the long tab. It just needs to be soldered to the long tab.

10. Solder the wire to the long tab. Again, Plenty of heat and speed is your friend here.
11. Now position the wire into wings at the end of the tab and bend then around the wire and insulation.
12. Use a multimeter set for DC, verify that you have positive voltage from the center pin to the outer shell (red lead to center, black to shell). <Note: Most LiPo batteries are shipped fully charged, you could see as little as 10.9V on a battery fresh in from the mail.>
13. Slide the backshell over the connector and screw it down.

Kit Installation Directions:

1. Disconnect any cables from your radio and open up your KX3 like you would for changing out the internal AA batteries.
2. Remove the AA batteries if installed
3. While not absolutely necessary, separating the two halves of the radio by disconnecting the jumper (See Figure 1-D) between the CP board (See Figure 1-E) and the RF board (See Figure 1-B). Be careful not to damage it. I recommend disconnecting just one side, by removing the CP board end of the cable
4. Disconnect the battery holder harness (two red and two black wires) plug from P4 on the CP board (See Figure 1-E)

5. On the RF board, remove the four countersunk Phillips screws affixing the two AA battery holders to the RF board (See Figure 1-A). Save at least one of these four screws.
6. Carefully remove the two AA battery holders and attached cable assembly from the RF board and set aside.

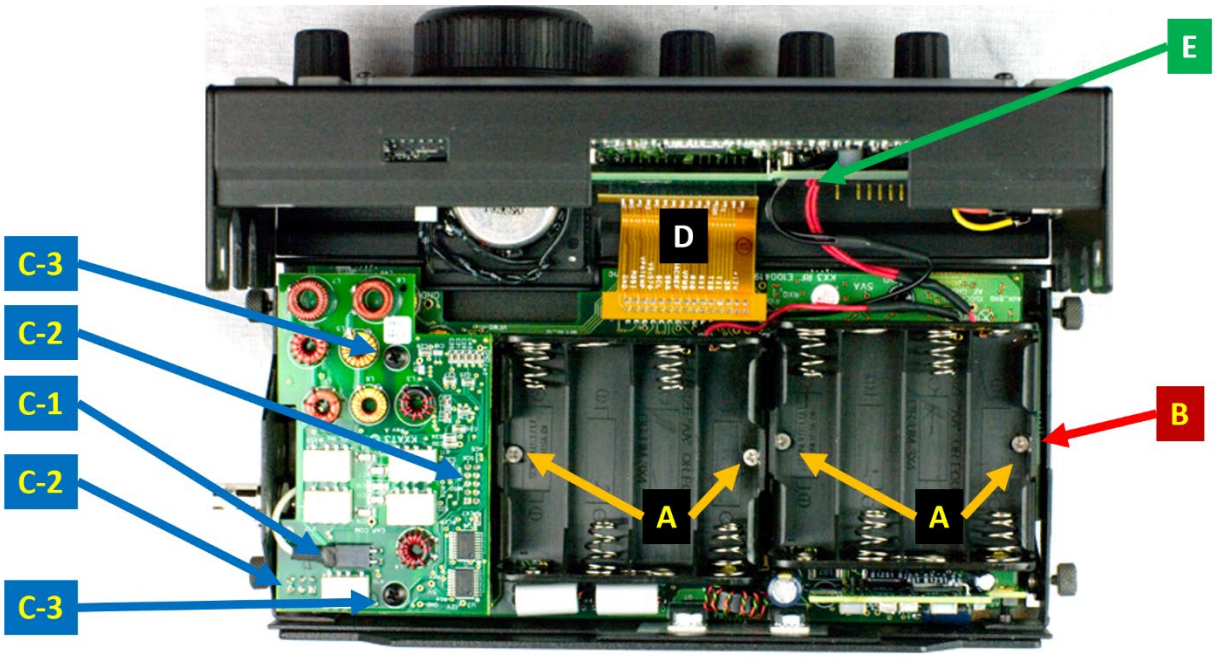

Figure 1 – RF Board – Top-Down View

7. On the CP board remove the two retaining screws (Figure 2-B and 2-C) for either the battery retainer board or the battery charger board. Be careful not to drop the screws/washers into the radio. Retain the screw for the standoff near the board edge (by the external jacks) Figure 2-B.
8. Carefully remove the board from the P3 connector of the CP board(See Figure 2-A). The anti-static bag that the KX3 LiPO charger board came in is large enough to store the removed board.
9. Remove the PCB standoff and washer near the center of the CP board, by the speaker. The standoff is what the retaining screw at Figure 2-C goes into. (This standoff is being removed as a new shorter standoff has been incorporated into the new retainer board) *(This completes the removal portion of the mod)*

Figure 2 – The RF Board

10. Take the 3D printed battery retainer and align the standoff holes from the removed board. Install the screw saved in step 7 into the standoff near the connectors (Figure 2-B).
11. Install the 4-40 ½" countersunk Phillips head screw supplied with the kit in the standoff hole near the speaker (At Figure 2-C)

    Notice that the battery retainer board is not rigid as mounted and has a little slack/flex between the mounting points (Figure 2-B and C). This is part of the clearance needed for the battery.
12. Retrieve the red wire jumper supplied with the kit. It has a single-pin connector in the middle. Separate the connector. You will need to trim the jumper to suit. I recommend trimming the female side of the jumper to about 3".
13. Strip back and small amount of the wire and solder it to the backside of the center pin of the EXT DC jack (J1). It is extremely helpful to use a small amount of flux, plenty of heat and work quickly to avoid have the jack plastic melting.

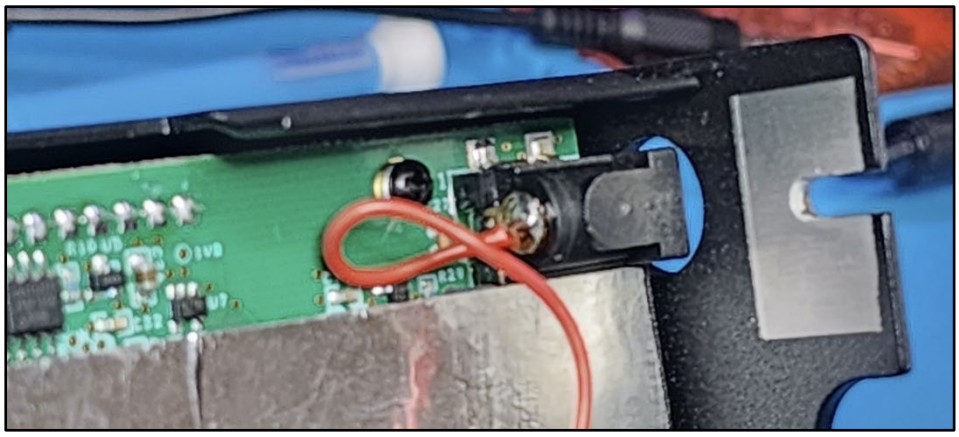

Figure 3 (Back side of the External DC jack

14. Retrieve the 3D printed battery holder supplied with the kit and align with the outer mounting holes in the RF board.
15. Using one of the screws you saved in step 5, install it in the mounting hole near ATU board (See Figure 1-A).
16. Retrieve the 2-56 5/16" screw and the KX3 LiPo charger board supplied with the kit. Slip the PCB into the slot and on the right-hand side of the battery holder board. Align the PCB, mounting board and the RF board so the they supplied screw can be installed. You do not need to fully tighten down the screw at this point.
17. Retrieve the supplied four-conductor wiring harness from the kit. Position the CP and RF halves of the radio into the position they will be in when fully connected to one another. At least partially plug in the 2x3 connector into the P4 for jack of the CP board. Arrange/route the harness so that the connector can be plugged and unplugged but not have an excessive amount of slack while reaching the connection points B1, B2, G1 and G2 connection on the PCB. See figure 4 for an example. When you are satisfied with the routing, mark the conductor lengths and set the hardness aside.
18. Retrieve the male half of the single connector wire you separated from the female half in step 12. Reconnect it to the female half and figure out your desired routing. See figure 4 for an example. When you are satisfied with the routing mark the conductor and set aside.
19. Remove the retaining screw for the PCB and remove the PCB.
20. Trim the conductors to your marked lengths. Solder the wires to the board. On the 2x3 connector harness, the two red wires will connect to B1 and B2. The two black wires will go to G1 and G2. Solder the single conductor jumper to either the E2 or E3 terminal.
21. **OPTIONAL EXTERNAL LED**: If you are **not** going to be installing the optional external charging LED skip ahead to step 32.
22. If you do not have the ATU option installed skip to step 24.
23. Removing the ATU: Remove the two Phillips screws and their associated washers from the top of the board. There two connectors on the underside of the board as well a two-prong connector on the top. Slowly pull the board up from each side. You have to pull the board up at least part of the way off the underside connectors in order for top side connector to clear the case for its removal. Once you have the top side connector disconnected, remove the ATU board completely and set it aside.
24. Using a pair of needle nose pliers (Or maybe a couple of jewelers screwdrivers) depress the latching flanges of the cover of the unused SMA antenna jack and work the cover out of the hole.
25. The optional external charging LED comes pre-wired with a two-conductor harness. Screw off the retaining nut, washer and spacer. Slide them off/over the harness.

26. We are going to test fit the LED at this stage. Thread the harness through the unused hole. Ensure that the LED will fit through the opening. Some radios may have a burr or excessive paint in the opening that may need to be removed. Carefully remove any burrs or excessive coating build to allow the LED to go through the opening.
27. Once the LED will fit through the opening, carefully slide it all the way in while making sure it will not contact any of the nearby inductors. There are some small variances in how these are mounted at the factory. If clearance is an issue, pull the LED and harness out of the case and install the spacer on the LED, then reinsert the harness and LED. The spacer should be on the outside of the case. This provides a couple millimeters of space saving in this area. (It also removes the external recess of the charge LED on the exterior of the radio increasing the viewing angle of the LED. Once satisfied with the fitment of the LED, pull the LED body back out of the case.
28. Slide the washer and nut back over the harness.
29. When you get the washer and nut at the inward side of the case, move the LED into the hole and thread the washer/nut on as you go. Be mindful of the inductors nearby on the RF board. Once you have the nut fully on, tighten the nut (no need to go all mongo mode here). The two-conductor harness is plenty long so you can route multiple ways. I routed the hardness straight across the RF board underneath ATU at this point. I then routed it along edge of the case by the PA and the Roofing filters. See Figure 4. If you do not have an ATU board installed skip to step 30.
30. Reinstall the ATU: Carefully align the two-prong connector on the top of the board and get it started. Align the connector pins on the underside of the ATU and get them started. Slide the ATU board the rest of the way onto the underside connectors. Push the two-prong connector the rest of the way in. You make have to a fiddle back at forth them all started.
31. Reinstall the two screws and washers on the top of the ATU board.
32. Once you have the routing of the external LED harness to your liking, trim the harness to line up with CHRG LED solder pad and strip the ends of the two conductor.
33. The LED cathode is the green wire and it goes to the square pad (ground). The Anode is the white wire and it goes to the round pad. Solder the wires to the appropriate location.
34. **INSTALL the PCB:** Align PCB and the battery holder board to the mounting hole in the RF board and secure them in place with the provided #2-56 panhead screw.
35. **FINAL HOOKUP**: Take the piece of heat shrink provided with the kit and slide it onto one half of the red single connector harness. Connect the two halves and then slide the heat shrink over the junction. The purpose of the heat shrink is to provide insulation at the junction, not really to hold the connector together. The heat shrink is long enough to go past the ends of both connector halves and secure the connection. I recommend

positioning the heat shrink so it covers both halves but does not go beyond the edge of one side. This method provides the insulation function while allowing you to disconnect/connect the harness when you like. If you don't think you will ever need to disconnect the board in the future, you could center the heatshrink so that it will both insulate and further secure the connection. Whichever you chose, shrink the tubing while being mindful not to cook anything nearby.

36. Plug the 2x3 connector into the P4 jack on CP board. The plug is keyed with the two red wire being towards you and the two black wires being nearest the CP board.
37. Install your 3S LiPo battery and plug it into the PCB barrel jack.
38. **Close up the radio**: For the first time you put the two halves of the radio back together you will need to "train" the wires to fold and lay in the open areas of the internals above the charging PCB. There are two areas of concern. First you do not want any of the wiring getting between the battery in the RF board half and the battery retainer in the CP board half. There is no unused space between the battery and the retainer board with this design. Second, you do not want any of the wiring to get pinched between the case as it is assembled. Figure 4 is the two halves before being closed for the first time.
    a. Before you attempt to close up the two halves, rotate the barrel plug on the battery so that battery leads angle over the charger PCB.
    b. Bring up the two halves to the "starting to overlap" position.
    c. Look into the space between the halves, using a pencil, bamboo skewer or any other slender tool (A head lamp or good shop lighting helps as well) to clear any of the wiring from the case edges and the space between the battery and the retainer board.
    d. Check several times as you mesh the two halves together.
    e. For the final millimeter or two of closure you may have to give a very slight bit of a squeeze to the two halves. This is from the flex of the battery retainer board mentioned in step 11. **YOU should not need any significant pressure and you should certainly not force the two halves together.** If you feel much resistance back off, inspect and restart at step 36-A again.
    f. Tighten down the side screws of the case.

Figure 4 – The two halves about to go together and the wiring laid into place

Radio Setup

Turn on your radio. If you are still reading at this point you probably did not let the magic smoke out, Congrats! There are a couple of settings that are needed in the radio and several behaviors to discuss.

Let the radio know the NiMH charger board has been removed Press and hold **<DISP>**. Rotate the VFO B (small) knob through the menu options until you get to BAT CHG. Rotate the Main VFO knob until the NOT INST is shown. Press <DISP> to exit the menu system.

With this modification the RTC starts at 00:00:00 when the radio is powered on and will reset on every power cycle.

PS (Power Supply) will display the battery voltage minus about 0.4 to 0.5V (The voltage difference is from forward bias voltage of the D2 diode on the charger PCB.

BT (Battery) will read N/A as this charger mod does not provide that data to the radio.

NOTE: If you leave the BAT CHG setting at CHG OFF, the radio will display show BT as the battery voltage, and PS as the battery voltage as well. There is really not harm to be done by setting BAT CHG to off. If you set to BAT CHG to 4, 8, 12 or 16 Hr and press display you will get error message D=009 ERR BC3 and the screen may flash. Turning your radio off and on may clear the error, but your radio may display not0-40C BAT CHG while turned off. Going back into the menu at the BAT CHG setting and spinning the VFO left and then pressing DISP will set the radio back to the not inSt BAT CHG setting. The take away here is just put the BAT CHG setting to not inST position.

Battery Minimum Warning: The recommended battery warning voltage for the stock NiMH AA battery configuration is 8.5V. For a 3S LiPO battery this kit is designed for the 10V default value is fine. Keep in mind that that the actual battery voltage is 0.4 to 0.5V more than what the radio reports due to D2 “OR” diode on the charging PCB. You can refer to 3S column on the chart to the right to pick a voltage that equates to your comfort level for when you want the low-battery warning. A setting of 10V will equate to either 10.4 or 10.5V of the battery which is about 3% charge. A setting 10.78 in the menu would result with the warning occurring at about the 20% mark

To make the change, Press and Hold **<DISP>** to enter the configuration menu. Rotate the **VFO B** (small) knob until BAT MIN is displayed. Then rotate the **VFO A** (large main) knob left or right to your desired voltage level. You can select between 8.2 and 13.0. Keep in mind to 0.4 to 0.5V

Lipo Voltage Chart						
Voltage	1S	2S	3S	4S	5S	6S
Voltage	3.7V	7.4V	11.1V	14.8V	18.5V	22.2V
Fully Charged Voltage	4.2V	8.4V	12.6V	16.8V	21V	25.2V
Relationship of Voltage and Capacity						
Capacity %	1S	2S	3S	4S	5S	6S
100	4.2	8.4	12.6	16.8	21	25.2
95	4.15	8.3	12.45	16.6	20.75	24.9
90	4.11	8.22	12.33	16.45	20.56	24.67
85	4.08	8.16	12.25	16.33	20.41	24.49
80	4.02	8.05	12.07	16.09	20.11	24.14
75	3.98	7.97	11.95	15.93	19.92	23.9
70	3.95	7.91	11.86	15.81	19.77	23.72
65	3.91	7.83	11.74	15.66	19.57	23.48
60	3.87	7.75	11.62	15.5	19.37	23.25
55	3.85	7.71	11.56	15.42	19.27	23.13
50	3.84	7.67	11.51	15.34	19.18	23.01
45	3.82	7.63	11.45	15.26	19.08	22.89
40	3.8	7.59	11.39	15.18	18.98	22.77
35	3.79	7.57	11.36	15.14	18.93	22.72
30	3.77	7.53	11.3	15.06	18.83	22.6
25	3.75	7.49	11.24	14.99	18.73	22.48
20	3.73	7.45	11.18	14.91	18.63	22.36
15	3.71	7.41	11.12	14.83	18.54	22.24
10	3.69	7.37	11.06	14.75	18.44	22.12
5	3.61	7.22	10.83	14.43	18.04	21.65
0	3.27	6.55	9.82	13.09	16.37	19.64

delta between the radio reading and the actual battery reading. When you at your desired voltage level, press <**DISP**>.

Finally, Go Play Radio!