KX-QRP 2nd L👀K Instructions
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The KX-QRP 2nd L👀K is an accessory for use with the Elecraft KX2 or KX3 Radios. These radios have the ability to decode RTTY, PSK and CW signals (without a computer) and display them on their front panel. The display is 7 characters and scrolls as new text is decoded. I wanted a way to display more characters, so I designed the **2nd L👀K**. It will be offered as a DIY kit to others that want a bigger display at a low price.

To see a color copy of these instructions visit - http://tiny.cc/2ndlook or scan QR code above. For more information or to order kits visit- www.k8zt.com/2ndlook

Alerts- for those of you that never read the instructions first!
- The Arduino, the LCD and the Digole i2c can be damaged by static electricity, excessive heat and/or trying to unsold a connection
- Make sure all pins are correctly aligned, use a magnifying device and always double check to make sure correct pins are seated in correct sockets (I know this well, simply shifting i2c to LCD conductor one position to right fried a line in my first display!)
- Join the email support group to ask fellow builders questions and share your ideas, photos, tips, etc.-- *kx-2nd-look@groups.io*
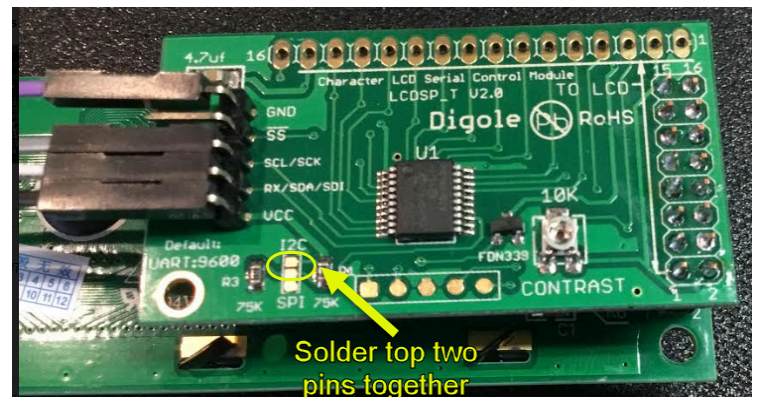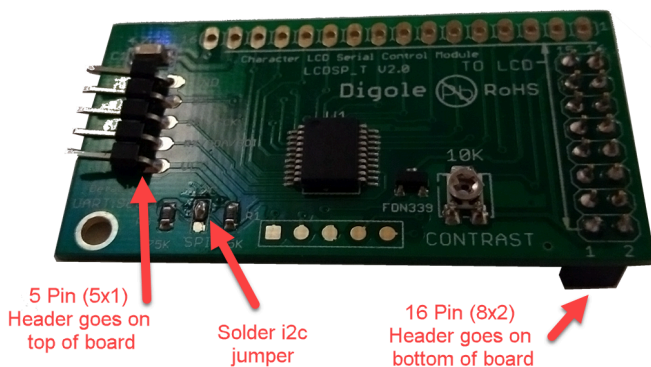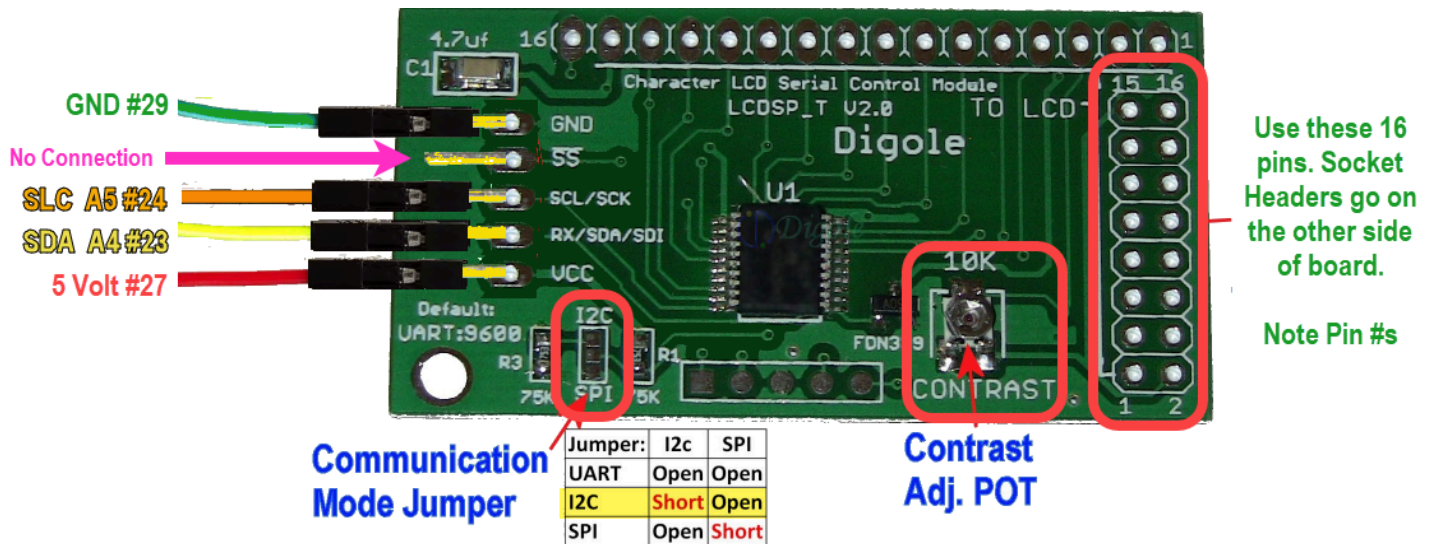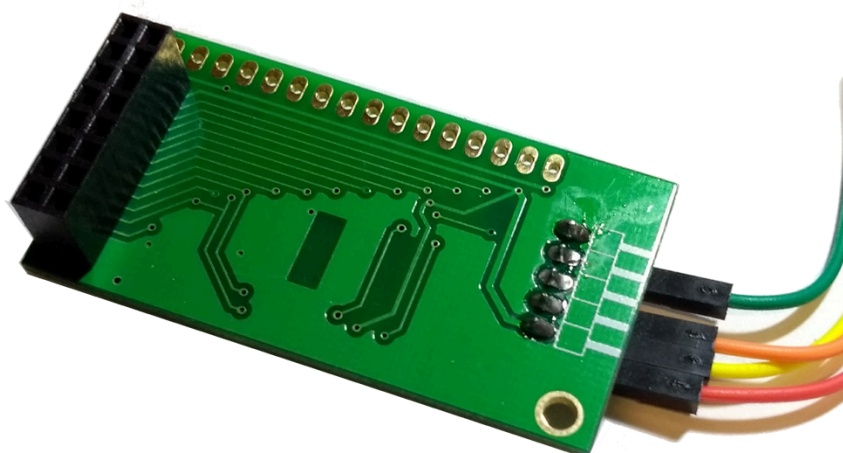
Assembly Instructions
1. Tools Needed
   a. Eye protection. Having a blob of hot solder or an end of a clipped wire hit your eye can be serious and no fun at all. If you don't believe me, inspect a well-used eye protector and you will probably see tiny solder splatters.
   b. Soldering iron, I strongly suggest a temperature controlled static free soldering station, even a $30 unit will probably outperform your simple soldering iron. If you are not ready to buy, borrow.
   c. Thin rosin core solder
   d. Side cutters (small size)
   e. Wire stripper
   f. Magnifying device
   g. Volt-Ohm Meter (that free one from Harbor Freight is just fine)

2. If you have never soldered or only large items you may want to:
    a. Watch three or more Youtube videos on soldering electronics. These are two pretty good ones - https://www.youtube.com/watch?v=oqV2xU1fee8 & https://www.youtube.com/watch?v=Qps9woUGkvI, but there are many other good ones. Watch at least three!
    b. Practice with some scrap items first
    c. If it is possible, find a mentor to assist you.
3. Check to make sure you have all the parts
    a. LCD display
    b. Arduino Nano
    c. Arduino Breakout Board
    d. i2c (Digole) LCD serial interface (backpack)
    e. Header Pins and Sockets
    f. 2 Resistors
        i. 3.9 kΩ (Orange-White-Red)
        ii. 10 kΩ (Brown-Black-Orange)
    g. Push Button Reset Switch
    h. 3.5mm (⅛") Stereo Jack
    i. 4 M-F Jumpers for LCD (Red, Green, Orange & Yellow or other colors)
    j. Connection Wire
4. Decide which option you prefer for connecting to the Arduino
    a. Using the Breakout board for wiring- allows easy replacement of the Arduino if necessary
    b. Wiring directly to Arduino allows a lower more compact profile to fit smaller cases but is much easier to damage your Arduino
5. Skip the next two steps if you chose the option B above.
    a. Solder the two header strips to both sides of the Arduino. Watch this video first- https://www.youtube.com/watch?v=37mW1i_oEpA and/or https://www.youtube.com/watch?v=3230nCz3XQA&t=55s. Make sure pins are 90° angles from the board. Tack solder just a single pin to first make sure everything is aligned then solder the rest of the pins. Repeat on the other side of the Arduino
    b. You do not need the 6 pin header on top, at end of the Arduino, do not attach if tight on space to install or you can remove if already installed by clipping off with side cutters
   c. Solder the socket headers on the breakout board

6. Next, we will prepare the i2c Board, if your kit has the 40 x 20 LCD it will be labeled "Digole". Again we want to make sure are headers are soldered in at 90° angles from the board (make sure you put them on the right side of the board!)
7. Install 16 pin header (make sure it is on the right side of the board)
8. Install 5 pin header (If you choose to, you can carefully bend 5 pins to provide more clearance after installing, some parts may arrive pre-bent).

Jumper:	I2c	SPI
UART	Open	Open
I2C	Short	Open
SPI	Open	Short

GND #29
No Connection
SLC A5 #24
SDA A4 #23
5 Volt #27

Communication Mode Jumper

Contrast Adj. POT

Use these 16 pins. Socket Headers go on the other side of board.

Note Pin #s

5 Pin (5x1) Header goes on top of board

Solder i2c jumper

16 Pin (8x2) Header goes on bottom of board

Solder top two pins together

9. If not already done, solder the upper small jumper on Digole board to select the i2c option

10. We will now plug the LCD into the i2c Backpack. It is extremely important that all pins are aligned properly (*shifting them one way or another will damage the LCD and/or the i2c!*) do not force them.

16 pin (8x2) Header

LCD Display

Digole i2c

5 pin (5x1) Header
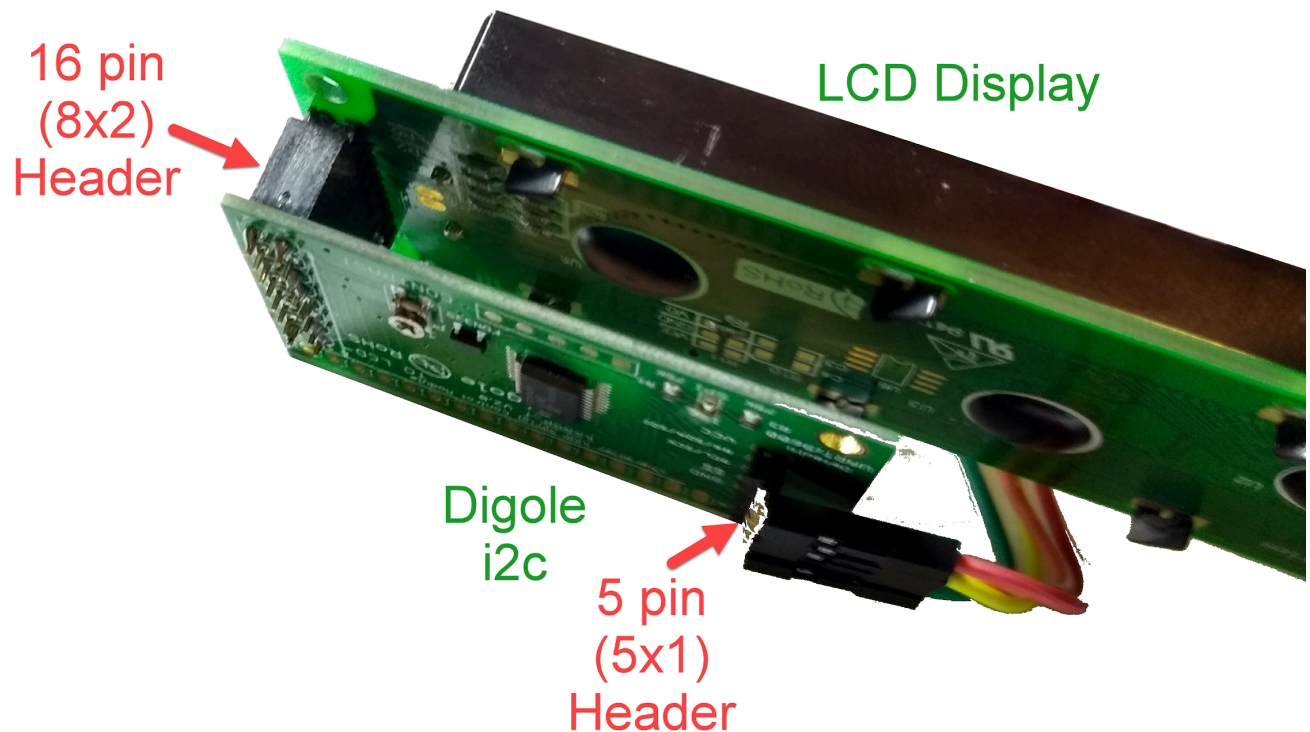
11. Plug the four color-coded M-F jumper cables onto connectors on i2c board. Again position is critical. (The cables you receive may vary in color combinations) *Please note there is one connector on the i2c that is not used.*
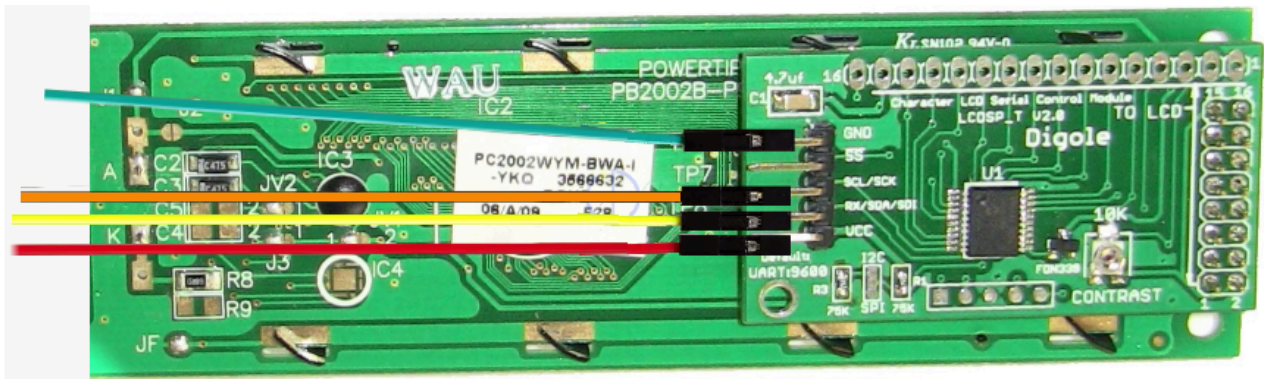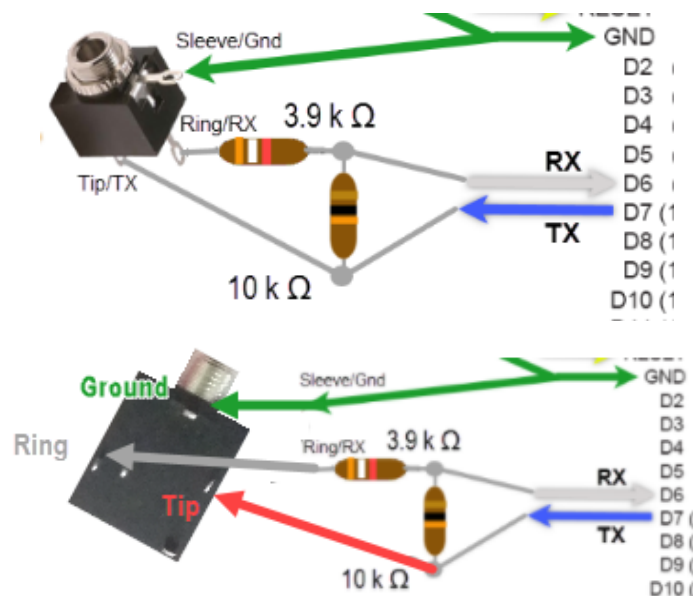
12. Prepare the pieces of wire (each ~4" long) by stripping end of insulation (if not already stripped) and tinning with solder (but not too much or it will not go in the hole).

13. We will now wire the Arduino (if you choose option A- "a Breakout board" you will be connecting to that; if you chose option "b" you will be soldering directly on the Arduino). In either case, ***it is absolutely critical that connections are made to the correctly numbered port of the Arduino, so use that magnifying device and double check before soldering and after soldering.*** Use the included pictorial drawing to guide you
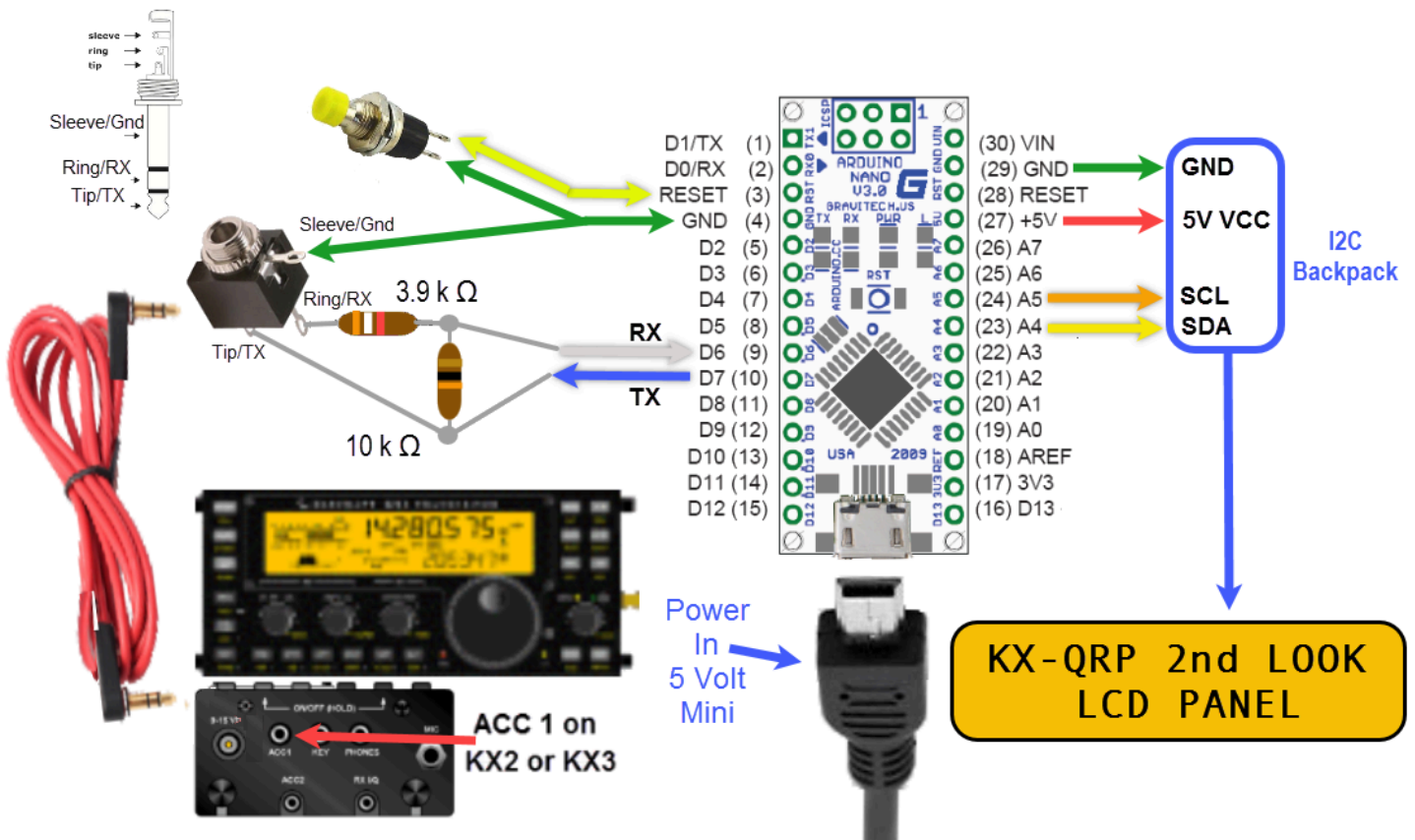
a. I2c Interface cables *(If your colors are not Green, Red, Orange & Yellow, please substitute colors of your jumpers here)*
    i.   GND Green (_____) is pin #29 and is labeled GND
    ii. VCC Red (_____) is pin #27 and is labeled 5v and/or VCC
    iii. SCL Orange (_____) is Pin #24 and is labeled A5
    iv. SDA Yellow (_____) is Pin #23 and is labeled A4
b. Reset Button
    i.   Pin#3 labeled RESET
    ii. Pin#4 labeled GND (this connection is also shared with the Data Ground, so you will need to install both wires at the same time)
c. Data Wires
    i.   Ground- Pin #4 labeled GND (this connection is also shared with Data Ground, so you will need to install both wires at the same time)
    ii. RX Pin #9 labeled D6
    iii. TX Pin #10 labeled D7
d. Prepare the 3.5 mm Data Jack *(the jacks vary by vendor, if you are not sure of pins use a 3.5 plug and VOM to check)*
    i.   Solder one end of the 3.9 kΩ (Orange-White-Red) Resistor to the Ring Terminal of the jack
    ii. Solder one end of the 10 kΩ (Brown-Black-Orange) Resistor to the Tip(RX) terminal
    iii. Bend the free end of the 10 kΩ (Brown-Black-Orange) Resistor and solder it to the free end of the 3.9 kΩ Resistor (see drawing)
e. Wire Data Jack and Reset Switch-

i. Trim leads from steps above to the desired length, strip insulation from the end and tin. *(Both of these items are mounted through holes in the case so you will need to trim the wires to reach them without unmanageable wire length).*

ii. Connect wires to Reset Switch

    1. Solder wire from RESET (Pin #3) to one terminal on the switch

    2. Solder wire from GND (Pin #4) to the other terminal on the switch

iii. Connect the three data wires (from steps above) to the prepared 3.5 mm Data Jack

    1. Solder the wire from GND (Pin #4) to the Sleeve/Gnd terminal of the jack

    2. Solder the wire from D6 RX (Pin #9) to the joint where the two resistors meet

    3. Solder the wire from D7 TX (Pin #10) to the other side of the 10 kΩ (Brown-Black-Orange) Resistor which is attached to the Tip terminal of the jack

14. **Double check your work BEFORE applying power to the 2nd L👀K!**

  a. Make sure the connection of i2c to LED is properly seated and not offset

  b. Make sure the four colored wires are properly attached to the i2c and the other ends go to proper pins of Arduino

  c. Check all other connections to the Arduino

  d. Data Lines & Jack

    i. Insert a Male-Male 3.5 mm data cable into the **2nd L👀K's** Jack

    ii. Use your volt-ohm meter to check for continuity and proper wiring

      1. Set meter option to continuity or the lowest resistance level

      2. One-by-one hold one probe on each of the three parts (Tip, Ring & Sleeve) of the free end of the cable and the other probe on each of the jack terminals (Tip, Ring & Sleeve) in the 2nd

  e. Test the LCD by applying 5 Volts to the Arduino's Mini USB port the LCD should give you a power on message.

  f. If the LCD display is too light, too dark or shows no characters at all try carefully adjusting the small variable resistor on the i2c backpack with a non-metallic screwdriver. Do not turn too far.

  g. Press and release the Reset Button and the screen should again flash the power on message

15. This completes the construction and testing

16. If you have not already done so this is a good time to install your unit in a case or temporary case.
    a. Selecting/Preparing a Case of the **2nd L👀K**
    b. Minimum Dimensions- 185 mm long x 40 mm wide x 30 mm high (if you use the Arduino Breakout board you may need to increase the height)
    c. The case will need 3 to 9 holes depending on how you mount the LCD and Arduino.
        i. LCD Face 162mm x 32mm
        ii. LCD mounting holes 4–6 mm or standoff
        iii. Data Jack
        iv. Reset Button
        v. Arduino Mini USB power
        vi. Mounting holes of standoffs for Arduino or I have used thick double-sided tape
    d. If using a metal case make sure you insulate the LDC terminals on either side of the display and any other connection that could come in contact with metal.
    e. Some users have chosen to install the **2nd L👀K** in a larger case that combines other functions such as battery power supply for radio & **2nd L👀K**, external keyer, etc.

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17. If you plan to use your **2nd L👀K** with a K3 you will need to prepare a special cable to connect the unit to the radio. You will need a DB-9 Serial Connector, 3 conductor wire and a stereo 3.5mm plug.
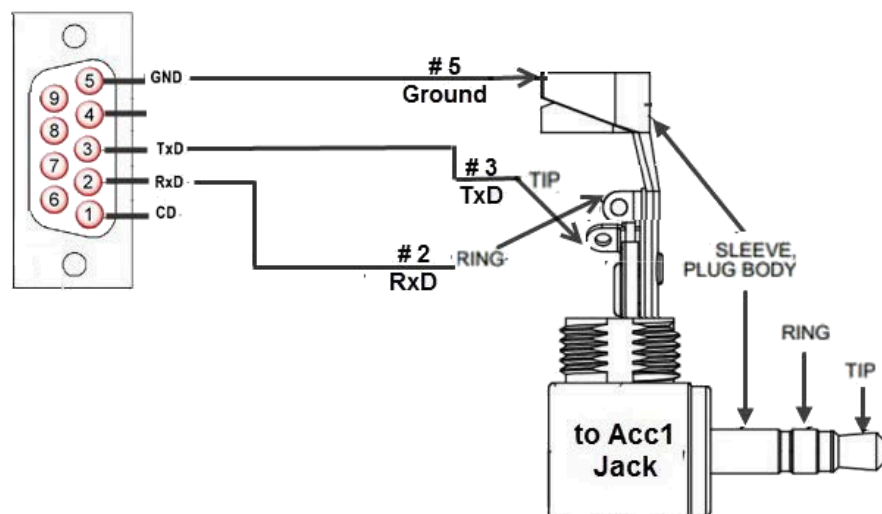
Download Arduino Sketch

1. If you have ordered the kit your Arduino should have been pre-programmed.
2. If you need to reload software sketch you can download it here-
   kx2nd-v17.10.17-k8zt.txt

Operation

1. Make sure your radio is turned off
2. Connect **2nd L👀K** to KX3 or KX2 via the ACC1 port using a 3.mm stereo cable (some have found it useful to use cables with chokes as used by many computer cables)
3. Turn the radio on, but do not turn on the 2nd L👀K yet
4. Set Baud Rate on the radio
   a. Press and hold the Display/Menu button to enter the Setup Menu
   b. Select "RS232" and set rate to 38400 baud
   c. Exit menu mode
5. If not already on, turn on the radio's Decode Text by pushing button
6. Connect an antenna to radio and select CW, RTTY or PSK (see the Elecraft instruction manual).
7. Tune in a station and test Text Decode on the face of the radio
8. Apply power to the **2nd L👀K** via USB cable
   a. Note there is no on/off switch so to reduce wear on the Arduino you may want to leave the USB plugged in at Arduino side and disconnect the other end of USB cable from the power source.
   b. Suitable 5 volt DC power sources for the 2nd L👀K include
      i. Cell phone battery/power bank
      ii. Cell charger (AC or car)
      iii. A USB port on a computer
9. When you power on the **2nd L👀K** it sends a command to the KX Radio of ***TT1;*** which turns on the data flow out of the radio and into the **2nd L👀K**. *Note-- If you need to turn off the radio you will need to send this command again. To do this either press Reset Button on the **2nd L👀K** or power **2nd L👀K** down and then on again.* (see *note below for K3 and K3s radios)
10. If you are receiving Decoded Text on your radio, it should begin to fill the 22nd character of the **L👀K** LCD display.

11. As new Decoded Text is displayed on the **2nd L👀K** it will fill the first line then the second line and then repeat overwriting previous characters with new ones.
12. Enjoy your new **2nd L👀K** especially when you missed something and want a **2nd L👀K** at text!
13. *** Note for K3 and K3s radios-***
    a. The sending of the TT1; command to the radio by the **2nd L👀K** may not work with these radios. You will instead need to program a Macro into your radio to accomplish this same function
    b. See User's Manual for complete steps, basically, you will:
        i. Using the Elecraft K3 Utility software
            1. Connect to radio
            2. Click on "Command Tester / Macro" tab
            3. Click on "Edit Macros"
            4. Enter into Macro #1 or another empty macro the text TT1;
            5. Save and upload this macro to the radio
        ii. From the Radio's Configuration menu assign the TT1 macro to one of the radio's front buttons (I used PF1)

Troubleshooting

1. If there is no backlight on the LCD when the unit is powered on-
    a. Double check your connections between the i2c and the LCD
    b. Double check the four colored wires connecting the i2c to the Arduino
    c. Carefully measure power out from pins #27 (Gnd) and #29 (5V). You should get a reading of 5 Volts
2. If there are no characters on LCD when the unit is powered on
    a. Double check your connections between the i2c and the LCD
    b. Double check the four colored wires connecting the i2c to the Arduino
    c. Check the Contrast Adjustment pot on Digole board
3. If you receive an LCD message of "Serial…"
    a. Make sure you remembered to solder across i2c mode jumper on the backpack itself

4. If there are characters on the LCD when the unit is powered on but it does not display incoming text from the Radio
    a. Make sure wiring between radio **2nd L👀K** is correct
    b. Make sure radio has received **TT1;** command from **2nd L👀K**
        i. Press Reset Button to resend the command to the radio or
        ii. Power **2nd L👀K** off and then on again
    c. Make sure RS232 menu item of the radio is set to 38400 Baud Rate
    d. Make sure decoded text characters are displaying on the radio
        i. If there are no decoded text characters appearing on the radio make it is a radio problem
            1. Make sure you have Text Decode turned on
            2. Make sure radio is set to appropriate mode (CW, RTTY or PSK)
            3. Make sure you are tuning radio properly (see Elecraft manual)
5. Characters and/or backlight of the LCD display keep flashing on and off
    a. Check connections of i2c to LCD
    b. Check connections of Arduino to i2c
    c. Check connections of power to the **2nd L👀K** unit itself and power source
    d. Check the Contrast Adjustment pot on Digole board
6. Nothing seems to work
    a. You can test the Arduino by plugging the of the end of the USB cable usually used for powering **2nd L👀K** into a computer running the Arduino Sketch Software, but this is beyond the scope of this guide.

7. If you need to reload the sketch into your Arduino *here is a link to the current version*. Please make sure you understand how to upload software to Arduino (there are a lot of great tutorials on the web) before attempting this.