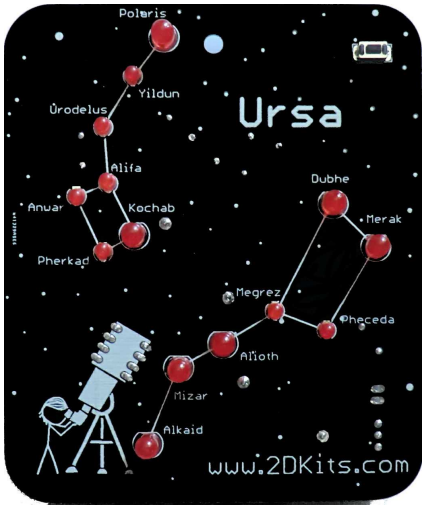
Kit 39 – Ursa – The Dippers

This blinkie has Light Emitting Diodes (LEDs) for the stars in the constellations Ursa Major (Latin: The great or bigger bear) and Ursa Minor (Latin: The smaller bear). These are better known as the "Big Dipper" and the "Little Dipper". Lots of information is at: http://www.constellation-guide.com

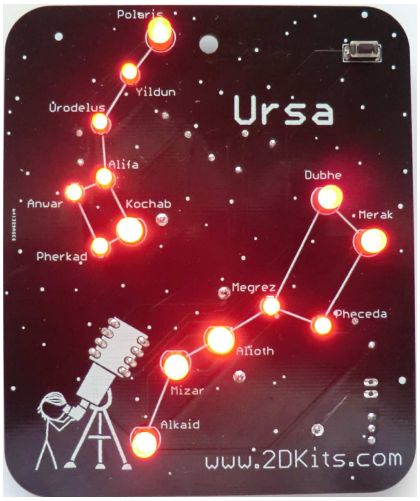
The best known star is Polaris, better known as the North Star. It is found by following the two pointer stars in Ursa Major, opposite its handle, about five times the distance away that the two pointer stars are from each other. Polaris is currently about 1° off of True North. Why "currently"? Because as the earth precesses, Polaris makes a little circle in the heavens, returning to the same place in 25,000 years.

Speaking of "North", Magnetic north is based upon the iron core of the earth, and changes significantly. As of July, 2018 for Chicago Illinois, a magnetic compass points almost 4° West of True North

This blinkie has fourteen LEDs: seven 5mm LEDs representing the brightest stars, and seven 3mm LEDs representing the less bright stars in the constellations. It has an on-off switch, and a push button switch to change among LED patterns. A small computer chip made by MicroChip, called a PIC, makes it work.



By building this blinkie, we hope you have a lot of fun, and learn how easy it is to assemble and solder a circuit, and gain a desire to learn more!



Use

Once built, the use of this blinkie is fairly straightforward. Don't get it wet. Don't stick it in a pocket, drawer, purse, etc. with a bunch of keys, coins, etc where it might short out.

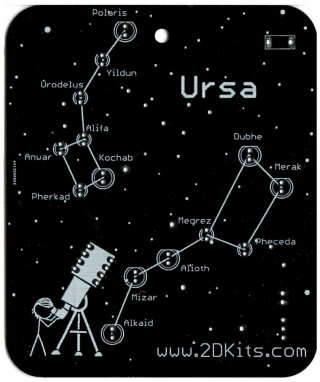
This blinkie has fifteen patterns stored in the PIC. To change patterns, press and hold the push button. You will see LEDs count up in a binary sequence. Each unique number represents a stored pattern. If the push button is released, the pattern associated with that particular binary number will then be displayed on your blinkie.

The blinkie has two display modes: 1) Demo mode, where it will switch to a different stored pattern every minute, and 2) Normal mode, where will continue to display the current pattern until a new pattern is selected via the push buttons. To toggle between the modes, hold down the push button while turning on the power. Demo mode is remembered (on/off) even when powered off. If it is in demo mode, when the push button is held down, the very bottom most LED will be lit.

Now, on to the assembly: First, open up the kit and review the contents. Looking from top to bottom, and left to right there should be the following parts:

- Five 56 ohm resistors (**green**, **blue**, **black**)
- 2 CR2032 battery holders
- Power switch
- Push button switch
- 8 pin socket
- 8 pin 16F18313 PIC
- Pin back to attach Ursa to your clothing
- A bag containing:
  - 7 3mm LEDs
  - 7 5mm LEDS
- Ursa circuit board

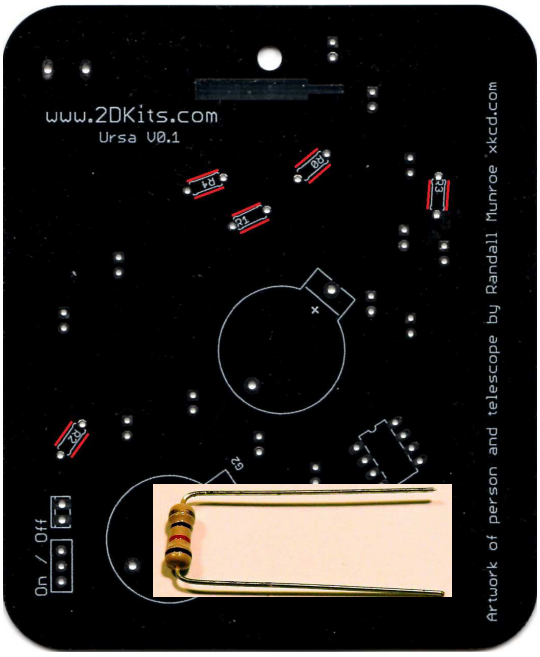
Not shown: 2 CR2032 3V batteries. They will be handed out separately – so they will be "fresh".



Assembly

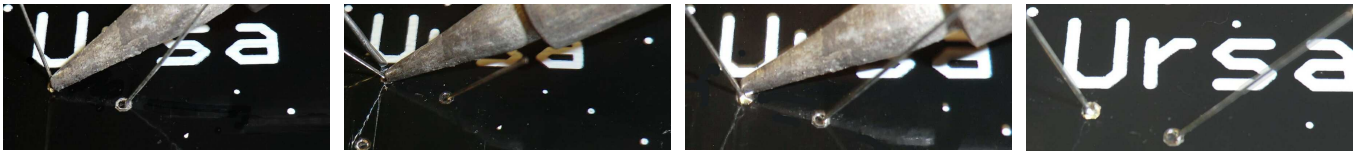
These instructions will tell you how to install each part, but here's a **TIP**: look at the board, you will see an outline in white (called "Silk screening") showing where and on which side a part is placed. For example, the front has all the LEDs and the push button switch. The back has the resistors, battery holders, power switch, and the socket for the PIC chip. The small 2-pin outline near "off" is not used.

1. Installing the resistors:
- Bend the leads (wires) as shown in the inset.
- Insert a resistor on the back side of the circuit board, at each of the locations (marked R0, R1, R2, R3, and R4)
- These are highlighted in **RED** in the picture.
- After inserting each, pull the leads to make the resistor tight against the circuit board if you need to, **then bend the leads into a "V"** (see below) so they will stay in. This also makes them easier to solder:



Since you are about to do your first soldering, here's a **quick soldering review.**
- Is the iron up to temperature?
- Clean the tip by plunging it into the stainless steel wool several times.
- Tin it by applying a little solder to the tip – If it doesn't stick, ask a blinkie tech for help.

Four Steps to Soldering



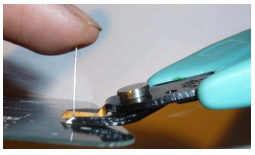
1) Heat pad and lead for 1-2 seconds

2) Add a LITTLE solder so it melts and flows in.

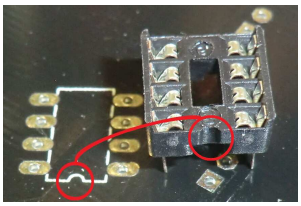
3) Remove the solder, **but not the Iron,** until solder flows around the pad and lead

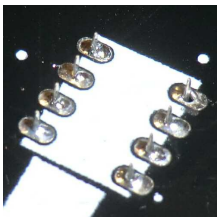
4) Remove the iron. Note that the pad is fully covered by solder, which goes up the lead a little

2. Flip the board over to the back and solder the 10 resistor leads as shown above.
- After soldering, trim the leads. Be sure they don't "fly off" - hold or put a finger over as shown in picture:

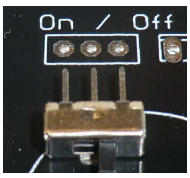


3. Insert the 8 pin socket from the side that has the silk screen outline. Make sure the notch on the socket matches the silk screen outline. The notch will face the battery. Flip the board over to the front and solder the leads. Them flip the board over to the back.

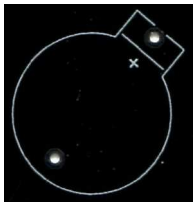


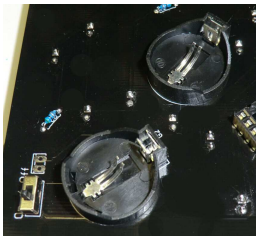


4. Insert the power switch at its outline as shown then:
- Hold the leads and flip the board over to the front
- Ensure the leads are vertical as shown
- Solder ONE switch lead, then check that the switch is not crooked, remelting the solder and moving if crooked.
- solder the other two leads.

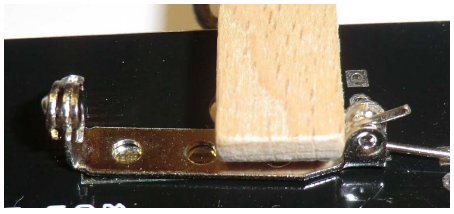


5. Insert both battery holders.
- Be sure to line up the **square end** of each holder with the **square end** silk screen outline – also marked as "+".
- Flip the board over to the front and solder the leads, pressing down to keep the battery holders tight to the board.

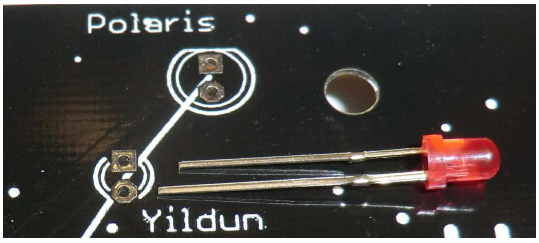




6. Place the pin back on its solder outline, and hold it at one side with a clothespin as shown. Place the soldering iron tip in the hole and touching the pin. Heat for at least 20 seconds, then feed in some solder. Let it cool, then move the clothespin over the soldered hole, and solder the other end of the pin via the hole there.



If you are doing the multi-colored LEDs to approximate the star colors, see the steps on the **last page** to determine which LED to put where, and do them one at a time using steps 8 and 9

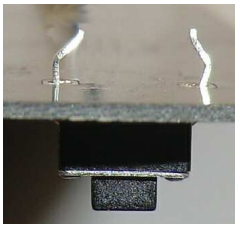


7. Take the LEDs out of the bag.
- Set the 7 large ones aside for step **9**.

8. Insert each of the 7 small LEDs into the board from the front side, where the smaller LED outlines are.
- The **long lead** must go in the **round hole** as lined up in the picture.
- Form leads into a "V"
- Solder when all are inserted
- Trim the leads

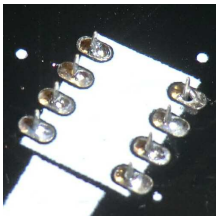
9. Repeat the above steps with the 7 large LEDs you set aside, again the **long** lead in the **round** hole.

10. Insert the push button over its outline on the FRONT side of the board.
- Press to snap it into the holes. It is a tight fit, so some wiggling may be necessary. The right hand picture shows an edge-on view of the inserted switch.
- Flip the board over to the back and solder the leads.

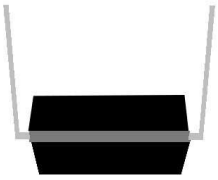


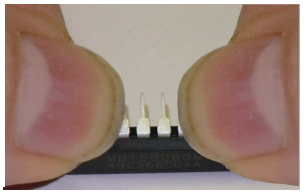
Side view of push button

11. You may wish to trim the pointy pins on the socket (shown at right), push button, power switch, and battery holders. Again, make sure they don't "fly off".
- Careful! Do NOT trim the solder itself – that could pull off the solder and circuit pad and ruin the blinkie!

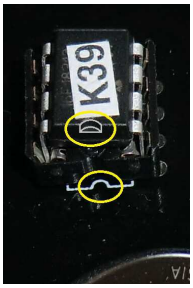


12. The PIC **may** come with the leads spread -- not parallel -- (left drawing), making it hard to plug in. Fix by placing the chip on the table as shown (right drawing), and push down and away from you a little to make the leads perpendicular.
- Then do this with the other side's leads.





13. Insert the PIC so the notch on the top of one end lines up with the notch in the silk screen. It will be facing the battery holder. See top photo at right. **Tip:** If you can't see the notch, you can feel it with your fingernail.



14. Verify the power switch is in the off position. Insert the batteries. The plus "+" faces up. The batteries need to be angled in against the metal on the squared end, and pushed in and down on the side opposite the square end. Repeat with the other battery holder. See bottom photo at right.

15. Turn the power switch to on and enjoy. Make sure it also turns off. If not, ask a blinkie tech for help. The switch body is too close to the board.

Troubleshooting

If one or more of the LEDs don't flash, then you'll need to do a little troubleshooting to finish your project. The following steps should isolate most problems.

- Recheck your solder connections. 80% of all problems are traced to this. Cold solder connections and broken connections will cause erratic performance or failure. Remelt any questionable solder connections until they flow and look shiny and secure.
- Check for bits of solder, lead ends, or other foreign matter which may be lodged in the wiring.
- LEDs were reversed.
- Batteries incorrectly inserted. The "+" side of the battery should always be inserted facing up.
- Bad part – it does happen. In the hundreds of boards assembled, we've seen two or three parts fail. Send us email, and we will send a replacement part.
- A part got lost/melted/damaged/destroyed while building the kit. It happens – you're not the first (or second, or fiftieth). Let us know, and we'll see what we can do.

Soldering Hints

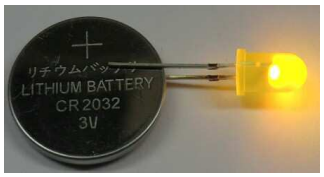
- Soldering is not like gluing; the solder forms an alloy with the metals to be connected that creates a stable electrical path and a certain amount of mechanical attachment. For the small connections on this project, a 25 or 30 watt soldering iron works well. Rosin core solder is used – the acid core solder sold for plumbing would eat your components in a short time.

Here's how to make a good connection:

- Prepare the connection. Bend the component lead slightly after it passes through the printed circuit board (this helps hold it in place while soldering).
- Prepare the tip. The soldering iron should be up to temperature. Clean the tip by quickly brushing it against a dry wire pad, or damp sponge, or damp cloth. Melt a little solder (a 2mm length) onto the tip so it's shiny. This is called "tinning". The solder coating helps conduct heat when soldering.
    1. Place the tip in contact with the component lead and the printed circuit board pad.
    2. Place the solder against the connection directly opposite the tool. It should melt within 2 seconds, and flow around the connection. If it takes longer than that, you're not getting enough heat into the connection.
    3. Remove the solder
    4. Keep the soldering iron in place until the solder flows freely and completely covers the connection. If the heat is removed too soon, the solder will tend to "ball up" and not stick well to the conductors. The solder connection should look "wet", covering the pad and a little up the lead, in a tiny mound shape.
- Let the connection cool without movement. This usually takes only a few seconds.
- If a connection is moved before it cools, it will take on a dull, satin look that is characteristic of a cold solder connection. A cold solder connection is fragile and conducts poorly – remelt the connection until the solder flows freely, remove the iron, and hold it still until it cools.
- Keep the tip of the soldering iron clean. Wipe off flux and excess solder regularly in the steel wool, or a damp sponge or cloth, and re-tin if needed.

Astronomic (multi-colored) LEDs:

The stars in the Ursa constellation are not all the same class, or color. To somewhat simulate this we have put together a package of LEDs of various sizes, and colors when they light up.

The blinkie kit Astronomic pack of LEDs may have many **clear** LEDs, so you need to find the color of each by lighting each up. Do this by placing the LONG lead of an LED on the + side of a battery, and the short lead on the other side, as shown:	

Here are the star names as printed on the blinkie, the size of the LED, and its color. Go through every LED you have and insert it in the blinkie, **on the front**, **long lead, round hole, short lead square hole.**

Do all the 3mm LEDs first, as they will all be level on the table, front down, as you solder the leads. **Then repeat with all the 5mm LEDs,** and finally the 10mm LED.

Dubhe	5mm	Yellow
Merak	3mm	White
Phecda	5mm	While
Megrez	5mm	White
Alioth	5mm	White
Mizar*	3mm	White
Alkaid	5mm	Blue
Polaris	10mm	Yellow
Kochab	5mm	Orange
Pherkad	5mm	White
Urodelus*	3mm	Yellow
Akhfa	5mm	White
Anwar	3mm	Yellow
Yildun	5mm	White

* just for your information, these are double, or binary stars.