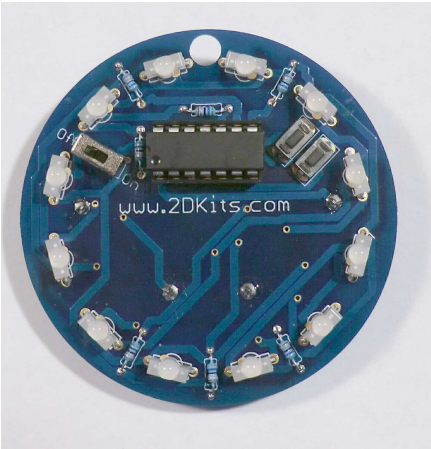
Kit 42 – 12 RGB Circle

The 12 RGB Circle is both one of the most beautiful blinkie kits, and also surprisingly straightforward to build considering its intermediate level parts count.

The heart of this blinkie is a 12F1824 PIC made by a company called Microchip. A PIC is a tiny, yet surprisingly powerful little computer.



By itself, the PIC can't do much – it needs some way to interact with the world – we are going to do this by giving it input and output:

- Input: two push buttons
- Output: 12 RGB (Red, Green, Blue) light emitting diodes (LEDs) – a total of 36!

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, purse, or drawer with a bunch of car or house keys, coins, etc. where it might short out.

As of this writing, this blinkie has 16 patterns stored in the PIC.

To change patterns, press and hold a push button for more than one second. One button counts to a higher numbered pattern, the other to a lower numbered pattern. The pattern number is shown in binary using the top right LED as 1, and the next one to the right as 2, on through 4, 8, and 16. So first and third = 1 + 4 = pattern 5.

Some Blinkie Pattern Examples:

- Pattern 2 is a "police" sort of pattern – repeating circling red followed by circling blue.
- Pattern 4 is a nice multi-colored sweeping fade.

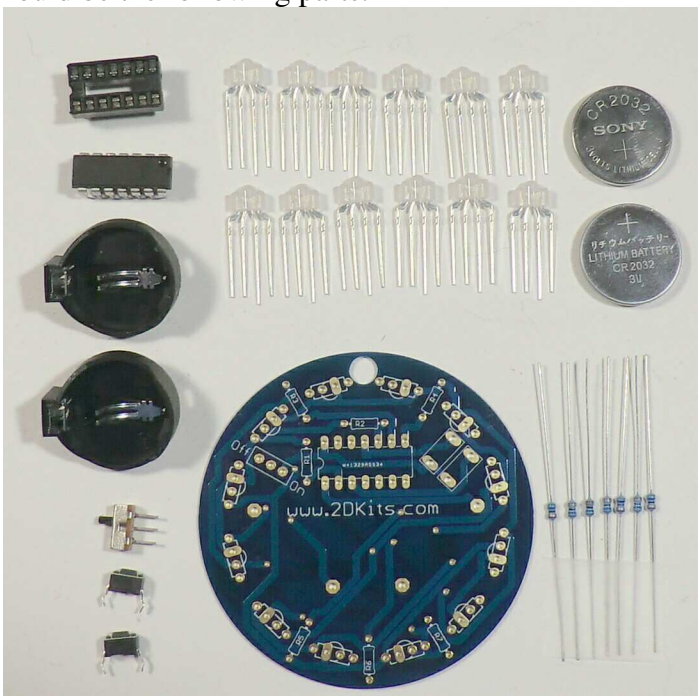
The blinkie has two display modes:

- Demo mode, where it will switch to the next stored pattern every minute. When it hits the highest pattern, it will start again with the first. If it is in demo mode, the very top most LED will be lit when the push button is held down. Hold **both** buttons down while powering on, to switch into and out of demo mode.
- 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.

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:

- 14 pin socket for the PIC
- 14 pin MicroChip 12F1824 PIC "computer"
- Two CR2032 battery holders
- Power switch
- Two push button switches
- Twelve RGB LEDs
- RGB Circle printed circuit board
- Two CR2032 3V batteries – If not with the kit, ask for them.
- Seven 56 ohm resistors (**green**, **blue**, **black**). Since they are all the same, "Don't worry about the colors".



Got everything to start? If not, give us a shout.

Soldering Hints

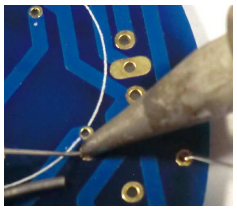
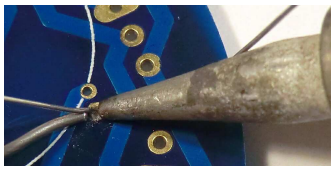
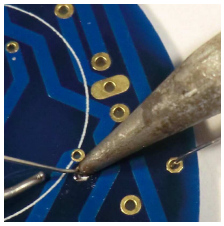
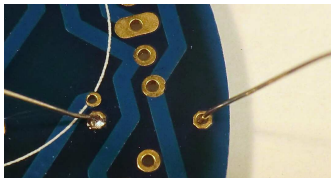
Soldering is not like gluing. The parts being soldered, such as an LED's wire (we'll call them "leads" – rhymes with "seeds" – from now on) and the circuit board's metallic pad, must get hot enough for the solder to melt and **wet** them. It creates an electrical connection and mechanical attachment. The solder has a core of rosin or flux to help "wet" the connection when soldering. The rosin is what "smokes" when you melt the solder. Try not to inhale this smoke.

Here's how to make a good solder connection between the hole in the board with it's electrical circuit pad, and the lead or pin sticking through it:

- Preparing the soldering iron:
  - Clean the tip by plunging it into the jar of stainless steel wool several times, or wiping on a damp sponge or thickly folded wet paper towel.
  - Check that the tip is clean and up to temperature by melting a little solder (a 2mm length) onto the tip. This is called "tinning" the iron, and will make soldering much easier.
  - If the solder doesn't melt, the iron may not be up to temperature – about 300ºC.
  - If the solder doesn't stick, repeat the cleaning process. If it STILL doesn't, contact a blinkie tech for some soldering iron tip cleaner – sort of a "detergent" for the tip.

Soldering a component to the circuit board:

This example will use "soldering a resistor on the board", as you will do as an assembly step.

1) Place the tip in contact with the component lead and the printed circuit board pad. Wait 2 seconds.	2) Feed a small amount of solder into the connection. It should melt within 2 seconds.	3) Pull the solder back, keeping the tip in contact until the solder flows around the connection.	4) Remove the iron, keeping the connection still for a few seconds for the solder to cool.
			

- Note in picture 4) above how little solder was used – just a small mound, covering the pad on the board, and coming up the lead just a tiny bit. Note ESPECIALLY how that prevents the solder overflowing into a nearby hole in the board, i.e. the one just above the left lead in picture 4).
- If a connection is moved before it cools, it will take on a dull, grainy 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, and hold it still until it cools.
- Keep the tip of the soldering iron clean. Do the "plunge into stainless steel wool" cleaning now and then, especially when having not soldering for a while.

Assembly

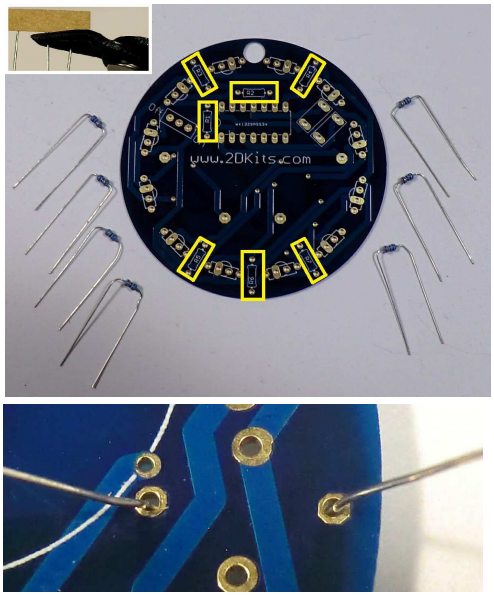
TIP: There is a **white outline** (called "silkscreen") of the part (battery holder, switch, LED, resistor, etc.) showing where you push its leads through the board. You will be soldering on the OTHER side of the board. Technically the white outline is called a "silk screen". The whole colored part of the board is called a "solder mask".

The **front** of the board has the silkscreen for the 12 LEDs around the outer part of it, for the 14-pin PIC socket, the power switch, and the two push button switches.

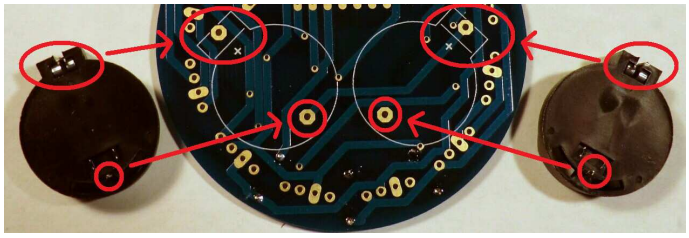
The **back** of the board has the outlines for the battery holders ONLY.

Because this board has very similar looking front and back, be SURE you look for the silkscreen outline when placing a part, and that there is no silkscreen outline on the side where you solder!

Orient the board front side up. You'll see the small resistor outlines – as highlighted in yellow in the picture below.

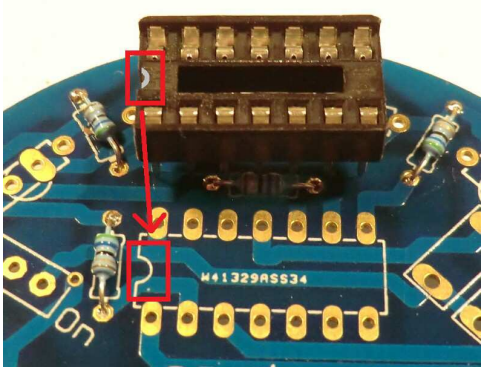


1. If your resistors are on tapes, snip the leads off the tape near the end as shown in the top-left inset picture.
2. Bend the leads as shown. Then insert one into each location (marked R1 through R7), highlighted in yellow in picture.
3. As each is inserted on the front side, make the 2 leads into a "V" on the back side to hold the resistor in place for soldering. See next lower picture for an example.
4. When they are all inserted, flip the board over to the back and solder all the leads to the circle pads they come up through. **Be careful** when soldering the left lead shown in the bottom picture – you don't want to have the solder flow into the tiny hole NEXT to the pad being soldered to. It connects a circuit from the top to the bottom, and is technically called a "via".
5. After soldering, trim the leads, being sure to hold them so they don't fly off.

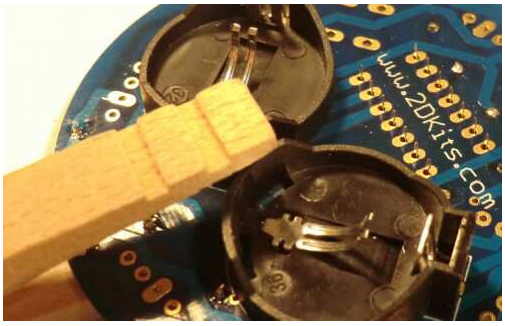


6. Flip the board to the back – where the battery holder silkscreen outlines are.
7. Insert the battery holders, square end with square silkscreen.
8. Holding them in place flip to the front for soldering.
9. Solder the two pins on each battery holder,

10. With the board front-side up, notice the notch at the left end of the PIC Socket silkscreen, then insert the 14-pin socket where the silkscreen shows, lining up the notches as below.



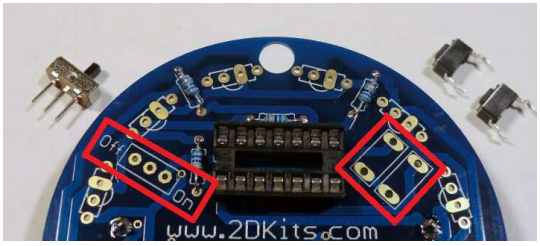
11. Flip the board to its back, holding the socket in place. To make the socket level for soldering, slide the back of the clothespin in as shown.



12. Solder just TWO pins of the socket – on opposite corners
    - Verify the socket is flat against the board, remelting a connection if you need to push it tight
    - Then solder the rest of the socket pins.

13. From the front, as shown, insert the two push buttons. They will snap into the holes, top-right in the picture. It is a tight fit, so some wiggling to get it to snap in properly may be necessary.

14. Insert the power switch in its three holes, then holding its leads on the back, flip the board over so the back faces up.

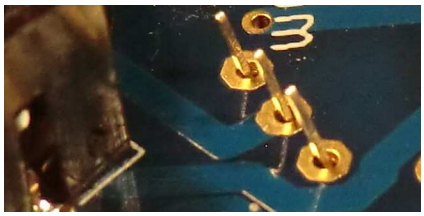


15. You can slide the board a little while it is resting on the switch handle, until the leads are perpendicular as shown in the picture.

16. Solder ONE lead, then make sure the switch is not crooked, remelting and moving if need be.

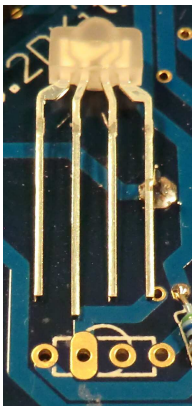
17. Then solder the other two switch pins.

18. Then solder the two pins on each of the two push buttons.



19. You will be inserting each LED into the board from the front side – where the silkscreen outline is. 12 of them are around the outer edge of the blinkie.

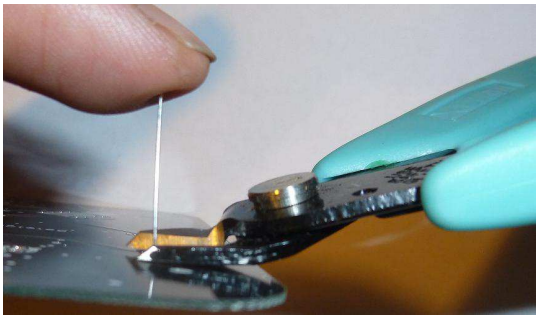
- Notice that the LED silkscreen has a "bump" in the middle of it facing the middle of the board, and that the LED has a corresponding "bump".
- Insert an LED, **LONG lead, BIGGER pad** – see picture at right.
- Now insert two more LEDS, so they are in in every 4th position – i.e. evenly spaced around the board.
- Flip the board so it stands on the 3 LEDs like a 3-legged table.
- As with the power switch, you can slide the board to change how perpendicular the LED's leads are. Do so one LED at a time, and solder ONE pin on each LED – say the LONG pin.



- Pick up the board and inspect that the LEDs are perpendicular and not angled. Double check by looking at each ones 4 leads – that they are perpendicular in BOTH directions, i.e. not angled inward nor outward.
- Then insert three more LEDS, align and solder one pin of each.
- Repeat this until you have all twelve LEDs each with one pin soldered, and ensure they're nicely lined up.
- Then solder all the LED leads.

20. When trimming the leads, be sure to catch them from flying off as shown in the picture.

21. Although the leads are short on the socket, push buttons, power switch, and two battery holders, you may want to trim them, they are a bit sharp.

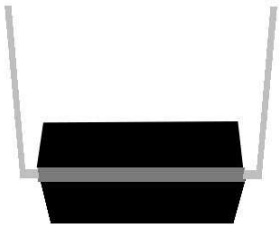


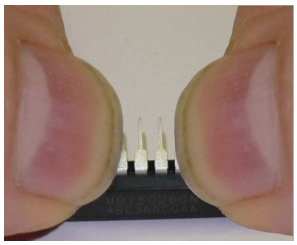
22. Verify the power switch is off, then insert the batteries.

- "**+**" side up
- Angle each battery down and in against the metal tab at the square end.
- Then push the battery in and down from the side opposite the square end.

Inserting the PIC chip

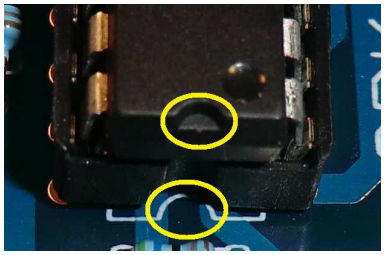
23. The PIC may come with the leads spread -- not parallel – (left drawing), making it hard to plug in. Fix this by placing the chip on the table as shown (right drawing), and push down and away from you a little to make the leads perpendicular.
- Then do this with the other side's leads.





24. The PIC chip is inserted so the **notch** on the end **lines up with the silk screened notch on the circuit board.**

- If you put the SOCKET in backwards, you are OK! Just make sure the PIC chip notch lines up with the silk screened notch on the board.
- If you can't SEE the notch, you can feel it with a fingernail.



25. Turn the power on and enjoy.

Troubleshooting

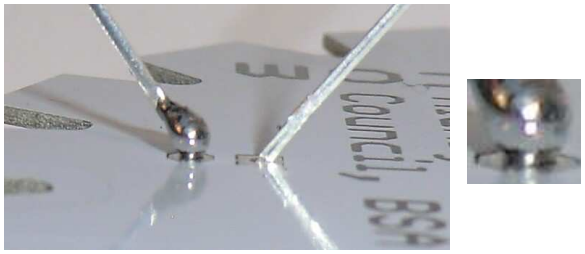
If one or more of the LEDs don't flash, then you'll need to do a little troubleshooting to finish your project. The following steps should isolate most problems.

If your LEDs blinked in testing, but not after soldering, you may have a solder bridge, as shown in the picture. Power flows through the **bridge**, instead of the LED. (Turn the power switch off!!!)

A bridge is easy to fix. You can often just remelt it and pull the tip of the soldering iron through the bridge, breaking it, then shake any captured solder off the iron. Or, remelt all the solder and tap the board on the edge to shake off the excess while it is still melted. ...Or ask for help.

A **good** solder connection is shown for comparison.

- **A common soldering problem** is to have solder on the lead but NOT connecting it to the pad. Notice the pad UNDER the solder in the picture:
- Remelt the connection, being sure to press DOWN on the pad with the soldering iron tip and wait for the solder to "puddle" around the pad and pin.



- 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 that every connection **is soldered!** We occasionally see missed pins on a socket, etc.
- 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 thousands of kits built, we've seen only a handful of 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.

Instructions by Ward Christensen, WardC@2dkits.com
Feedback encouraged.