Core 64 Assembly Instructions

For Dual Board hardware version v0.3

2020-05-21 Draft Assembly Instructions Version v0.3.1

Inventory

Two major component kits are brought together to make one complete Core 64 Badge.

The kits is sold in three configurations:

1. Core 64 Core Board Only Starter Kit
2. Core 64 Logic Board and Finisher Kit
3. Core 64 Complete Kit (the Starter and Finished Kits together)
4. Core PCB Frame Assembly (all components needed to make the Core Board layer ready fore use)

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| --- | --- | --- | --- |
| Item No. | Description | Qty | Core 64 P/N |
| 1 | Core 64 Frame Board (PCB 85x85mm) with all SMD components pre-assembled | 1 pc |  |
| 2 | Magnet wire (grid 16x100mm + sense 750mm)  RED COLOR:  GREEN COLOR:  COPPER COLOR: | 2350 mm (92 in.) |  |
| 3 | Cores (64 needed, 6 spares included) | 70 pcs |  |
| 4 | Header Pins 1 row x 16 pin 0.1” SMD or TO | 2 pcs |  |
| 5 |  |  |  |
|  | \* Solder, flux, and other tools are not included |  |  |

1. Logic PCB (SMD is complete, some assembly required)
   1. Includes everything else (3D-printed LED Array holder, diffuser, screen protector, battery pack, headers, lanyard, stylus, magnet, Teensy LC, Pimoroni Unicorn Hat)

Tools Required

Ruler, scissors, wire cutter, forceps (tweezers or small needle nose pliers), soldering pencil, small gauge solder, flux pen, isopropyl alcohol, q-tips, kim wipes, multimeter,

Optional: magnifier, circuit board holder, flux remover,

Preparation

Clean all of the wire with IPA and a soft lint free wipe. This ensures there are no sticky spots or bits of fuzz that will make threading and weaving difficult. It’s a delicate process and you don’t want to tug hard to overcome sticky spots.

Cut 16 pcs of magnet wire, each 100 mm long. These are the grid wires.

Set aside the long uncut piece to be used as the sense wire later.

The first step, horizontal grid wires, is relatively simple. You will become familiar with how sensitive the wire is to be kinked, and how light the cores are. If you let go of one and it isn’t securely on the wire… it’s gone. Poof. Keep the wires straight, clean, and kink free.

The second step, vertical grid wires, is the hardest step. Plan to have a lot of patience in this step.

The third step is relatively easy compare to the second step, and the result will be very satisfying if you take your time and keep the wires aligned.

Core Board Assembly Procedure

Horizontal Grid Wires

For each grid wire, using your fingers, bend one end, at 1 cm long, at a right angle to the other 9 cm of wire. A soft bend is preferred instead of a sharp bend which can lead to the wire breaking off. This allows the board to be held up-side-down and the wires won’t fall out during solder. This also provides a length of wire to pull on during the last step of assembly, which is to straighten and tighten all of the grid wires. Don’t cut the extra wire off until all assembly is complete!

Place the Core 64 Frame Board up-side-down in a PCB work holder. The components will be facing up.

Insert the long end of the bent grid wire in hole YL0. The long end of the wire hangs straight down from the top face of the board for now, which is facing down.

The YL0 to 7 wires are all round solder pads. Skip the square sense wire solder pads for now. Those will be used after the 8x8 grid wires and cores are assembled.

Repeat this step for all YL# wires.

Solder the YL0 to 7 grid wires from the backside. Use flux and enough heat to ensure a good electrical connection is made and the burnt enamel on the magnet wire is displaced out of the solder joint. Plan to dwell with the solder pencil at the join for 5 seconds to ensure the enamel is burned away. We will verify the continuity later, and we will be reheating the some of the joints to tighten the grid of wires later.

Flip the board over so the top is up and the long ends of the grid wires are standing up. Clean any fuzz off the wires by gently pinching at the bottom of the wire and sliding your fingers up. You could also use IPA and q-tip to make sure there is no tape residue. This makes it easier to slide the cores on.

Sort the cores in groups of 8. I suggest two small groups of 4 to make the groups of 8. Carefully thread 8 cores onto each wire that is standing up. After each wire has 8 cores, carefully bend it over at the solder joint to head toward the YR0-7 holes. Count the cores on each wire to make sure there are 8 on each wire. Then insert the free end of the grid wire into the corresponding YR0-7 holes.

Admire your abacus.

Count the cores again. Make sure there are 8 on each wire, suspended in the middle and not caught under the wire near the first solder joint. It’s going to become difficult to back track from here forward. Take a break.

Flip the board over so you can solder on the back side again. Count ‘em again.

On the soldered end of the wire, push the wire down to be flush with the top of the board to prevent any cores from being able to slide on the wire and get caught between the top of the board and the wire.

Solder all 8 of the remaining wire ends. The initial soldering for all 8 can be “close enough.” Then go back and apply gentle tension with your fingers to pull the wire taught while reheating the solder joints to ensure a good connection. Continue to hold the wire 5 seconds after you remove the soldering pencil to avoid cold joints.

This is a good time to make grid wires look straight and tight (but not too tight or the wire will break). Aim for about 70% good enough because you will probably want to re-tighten them after the rest of the threading is completed. It is difficult to maintain tension during the rest of the process because the wire is so soft and if you bump it the tiniest bit, it’ll be deformed. That why the final tightening step is at the very end, just before cutting the excess grid wire.

Continuity check. From the solder joint at each end of each of the grid wires. Or at header pin holes.

Vertical Grid Wires

Now is where it starts to get interesting. We’re going to thread each vertical wire through 8 cores, with the cores in a specific pattern.

Clean the 8 vertical grid wires with IPA. Straighten them carefully. ANY kink in the wire will be a hinderance to thread the wire through the column. There is barely enough room for the wires to fit through the cores if they are all on-axis and it is made more difficult by the fact that the cores are off-axis. Use very little force, and a combination of pushing and pulling the wire to thread it.

Gently rotate the wire as you push it through the to help it overcome any sticky spots.

Solder one end of each wire without concern of a long dwell to burn the enamel.

Solder the opposite end of each wire, taking care to burn away the enamel and make a good connection.

Go back to the first end, tighten the wires with your fingers as you re-heat the joint and burn away the enamel.

Verify continuity from end to end, like the horizontal grid wires.

Take the time to make the grid nice and straight. If you get through the sense wire threaded smoothly, you won’t need to retighten the grid wires.

Sense Wire

Starting with a straight, smooth, and clean sense wire will be very rewarding at this stage. It prevents pulling the grid wires out of alignment. As you clean the wire, pay attention to ripples or wrinkles or kinks in the wire. Smooth out the entire length of the wire carefully because you will be pulling it through a lot of cores over and over. The upside is that you’ll be doing the pulling and pushing on-axis, and that makes up for the long and carefully weaving that is needed.

Start at the S2 sense pad [square] and thread the wire diagonally up and to the right, following the pattern shown here.

Keep the wire in a flat plane parallel to the core board when you turn around at the ends. Take care to prevent cross-over kinks as you pull the wire into the final position. The top of a ball point pen or mechanical pencil is very helpful to keep the wire going straight into the core as you pull it across the cores.

A close up of a logo

Description automatically generated

Continuity check. From the solder joint at each end of each of the grid wires. Or at header pin holes.

LED Array Assembly Procedure

A

B

OPTIONAL HEADERS

Cut the excess length off the pins before soldering the headers to the board to leave a smooth backside to the badge. Better to have the pins slightly recessed before they are soldered so the solder doesn’t stick out.

Core Logic Board,

X1, I2C OLED: Configure JP3 and JP4 to provide power to the proper pins for your OLED display.

X2, SD CARD: requires Adafruit \_\_\_\_\_

X3, QWIIC: for the Sparkfun Qwiic product line

X4, SAO\_1: