Xiaomi MiJia QiCycle Folding Electric Bike Teardown

Teardown of the Xiaomi MiJia QiCycle smart, foldable e-bike to determine repairability and see what's inside.

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INTRODUCTION

We've been saying it for years: Any product that *can* have embedded electronics, *will* (eventually) have embedded electronics. Today we have a new cyborg hitting the teardown table: the Xiaomi MiJia QiCycle Folding Electric Bike. This is the first vehicle on our chopping block, so we're excited to dive into a whole new class of device. Has Xiaomi managed to make the ever-repairable bicycle smarter, without making it a nightmare for DIY tinkering? Let's get rolling on this teardown and find out!

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TOOLS:

- Pro Tech Toolkit (1)
- Universal Bit Kit (1)
- Jimmy (1)
- Tweezers (1)
- Spudger (1)
- Topeak PrepBox (1)

Toolkit

- Lezyne Portashop bicycle toolkit (1)
- CT-Worx Bicycle Multitool (1)

Step 1 — Xiaomi MiJia QiCycle Folding Electric Bike Teardown

- Look at you, little mobile friend. Quite stylish from the outside we take a look at the specs:
  - 250 W, 36 V high-speed motor M108RL from Ananda
  - 0.21 kWh battery (with 20 NCR18650PF Li-ion cells)
  - 45 km of biking power on a single charge
  - Shimano Nexus 3-speed gear hub
  - Torque measurement sensor adjusts power based on your pedaling
  - Trip computer combined with controller to provide real-time stats for speed, distance, power etc.

Step 2

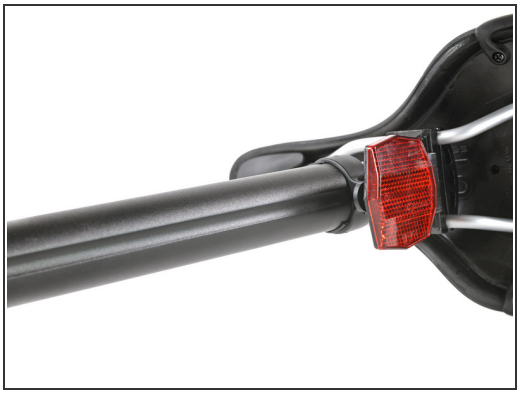
Before we get started. Did we mention that this thing is foldable?

- With a few simple movements it can be folded from ready-to-ride to compact-for-transport.
  - Even with a hub motor and battery, the QiCycle masses only 14.5 kg. That's about two dachshunds, or three cats.

Step 3

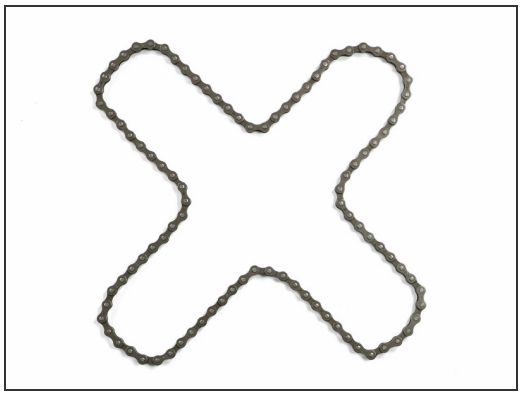
- For those of you not familiar with foldable electric bikes, here's another, the classic, yet analogue **Brompton folding bicycle**, for comparison. (It's a *bit* more macro than our usual comparisons.)
  - The QiCycle has a smaller wheelbase (870 mm) with smaller tires (16"). The fixed handlebar and saddle max out lower too (bad news, riders over 5'6"/170 cm).
- The built-in bike computer can switch between four power modes and monitors real-time riding data. (And a smartphone app has a ton of info, too).

Step 4



- Enough talk, lets strip this vehicle down starting with the easiest part: the saddle. Two quick-release clamps later it's free!
- The seat post locks the rear rocker arm in place, so once removed the bike can fold up.
  - The post is labeled with min and max height options, and has a groove along the back. The groove serves to align the post and keeps it from twisting, all bikes should have it!
- Next unscrew the fancy folding pedals. This mechanism reduces the overall width of the bike when folded.
  - Brompton bikes have had (even fancier) folding pedals for awhile now. Xiaomi may have sought some inspiration there.

Step 5



- The chain runs outside the rear rocker swing, and has a handy rear chain stretcher, making removal pretty simple.
- The chainring has 52 sprockets whereas the rear hub gear counts 14 sprockets. That gives us a ratio of 1:2.7 in first gear, 1:3.7 in second gear and 1:5 in third gear.
- The chain itself has 96 links. There's no master link for opening the chain but a standard chain tool can pop out any link.

Step 6



- Taking the crank arms off takes a little preparation, a cover must be removed before you can fit the crank puller on. But after that it pops out like any other bike's crank.
- The next piece of the power conveyance puzzle is the bottom bracket.
- Again we need a standard bike tool—the cartridge bottom bracket tool—to loosen this piece of hardware.
  - These tools may *sound* unusual, but they are very common for bike repair and maintenance. Good choice to stay standard, Xiaomi!

Step 7



- A nice feature for the QiCycle is this Shimano Nexus 3-speed hub. We easily dismount the bellcrank and take out the bolt which runs to the inside of the hub.
  - When dismantling the hub, the bike should be in 3rd gear. To adjust it, 2nd gear is the right one.
- At the opposite end of the bike, we pull off the rubber handle and remove the shifter grip.

Step 8



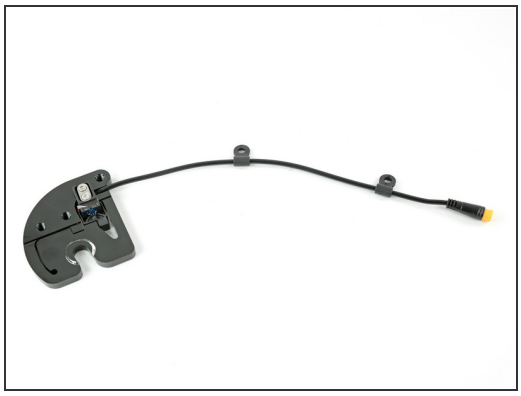
- The rear wheel has a hub roller brake, a style of drum brake. It is operated by hand brake lever so you can backpedal freely.

  This is an interesting choice, while it keeps the brakes protected from the elements, they are more likely to skid and overheat on long downhills. In the long run, these brakes should be nearly maintenance-free and only require some lubrication from time to time.

- We start to fish out the brake cable, but it looks like it's riveted to the hub assembly, and will stay attached at that end.

- So we loosen the bolt holding the hub to the frame and lift out the 16" wheel with its 28 spokes, 3-gear hub and roller brake, *and* its trailing brake cable...

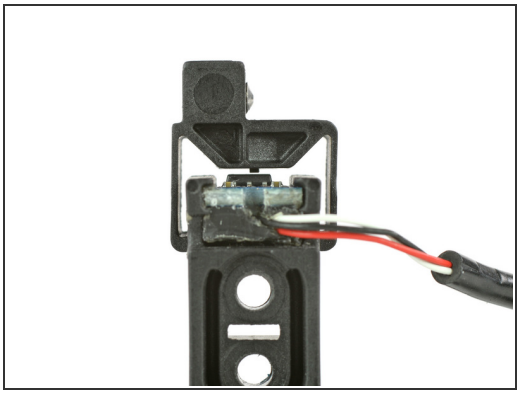
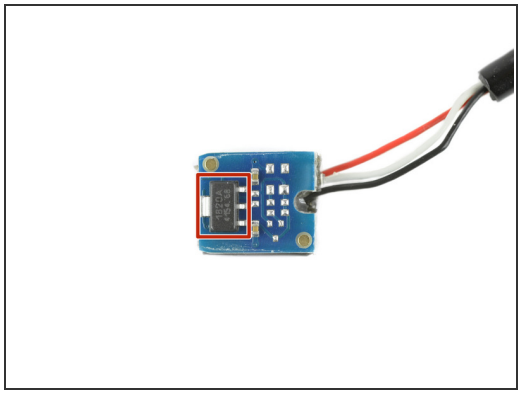
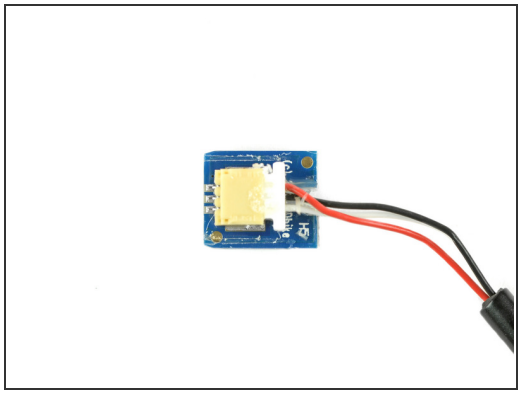
Step 9 — speed sensor


- Of course we wouldn't be tearing this bike down if it weren't a *smart* bike. So it's about time we check out the speed sensor.
- The cable connects under the seat then runs along the frame to the (modular) dropout.
- We're able to peel the cable out, and free the sensor assembly.

(i) The sensor system package that measures the crank torque of the cyclist is either the IDbike TMM4 or something very similar.

Step 10

- Pushing out the small circuit board, we get to the meat of this miracle measurer:
  - A 1820A programmable linear hall sensor

(i) This takes advantage of the Hall effect to track the wheel as it turns, using that to determine how fast you're traveling (and how hard you're working).

- The three wire system is connected with a simple JST connector, not solder. Now that's what we call modular.

Step 11


- Back to something more mechanical we unmount the front brake—a standard dual-pivot side-pull caliper brake.
- To find more electronic components we aim for the front wheel with its hub gear motor.
- A simple tug disconnects the hub motor cable so we can finally take out the front wheel.

(i) All told, it weighs 2.65 kg, that's nearly 20% of the bike's entire weight.

Step 12 — hub gear motor



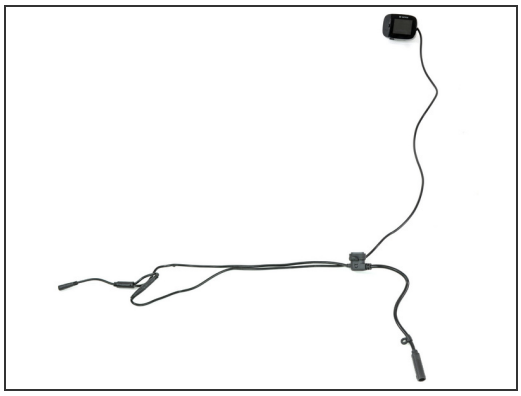
- With the cover lid unscrewed we can push out the source of rotary motion and discover a small circular board behind the rear cover of the motor.
- Besides distributing power it also has three sensors (every fourth coil) for measuring the speed.

(i) 12 coils on the outer ring make the 10 magnets on the center spindle go round and round–260 times per minute. The motor has a continuous output power of 180W and 7.3 Nm of torque.

- The three gears on the flip side are made of plastic to keep abrasion to a minimum.

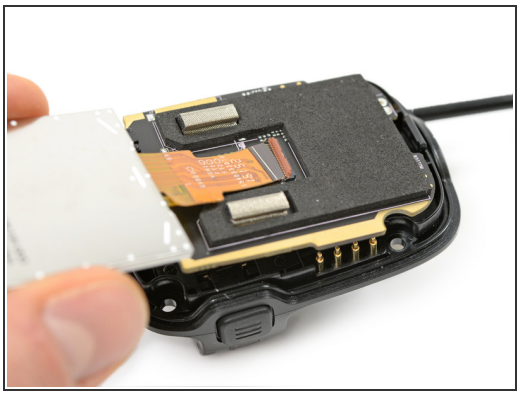
Step 13

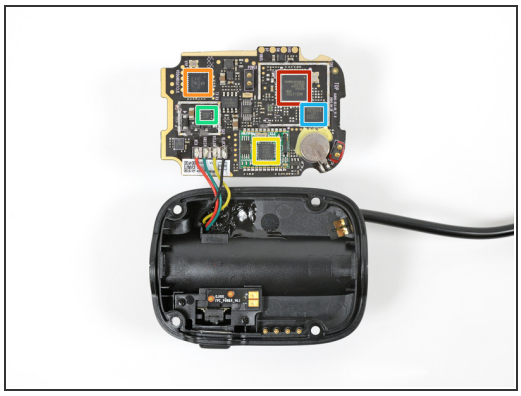




- And now, welcome to the middle of the teardown.
- We stripped the QiCycle of most of its bike parts. The aluminum skeleton we are left with weighs 5.5 kg which is over a third of the overall weight.
- We go ahead and pull the main plug from the top tube, enabling us to extract the nervous system linking all the electronic components.

Step 14



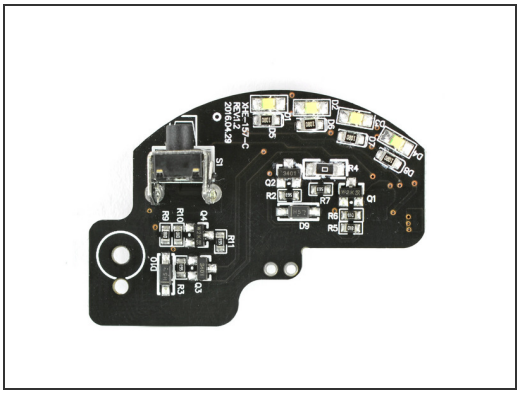


- Only 4 Torx screws hold the cover of the bike computer and the 160×128 pixel TFT screen is attached with a simple ZIF connector.
- On the flip side of the board we find the following chips:
  - MediaTek MT6261A ARM processor
  - Microchip PIC16LF1518-I/MV PIC controller
  - CSR 1010D A05U bluetooth smart IC for lighting
  - Texas Instruments TPS259240 eFuse with over voltage protection
  - Winbond 25Q128FV 128 Mb serial flash memory

Step 15

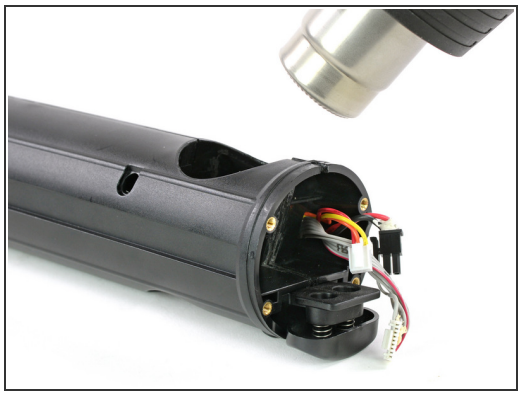
- We saved the best, or at least the most power-ful, for last—the battery tube!
- The tube can be removed single-handedly, with just the push of a button, and can be charged in 3 hours with the 5-pin connection on the side.
- A good amount of the bike's weight is this battery—it weighs 1.46 kg, fully charged of course. ;)
- The bike's battery capacity measures in at 5800mAh (208.8Wh). For your pointless comparison of the day, that's more than 5 iPad Pro 12.9"!

Step 16



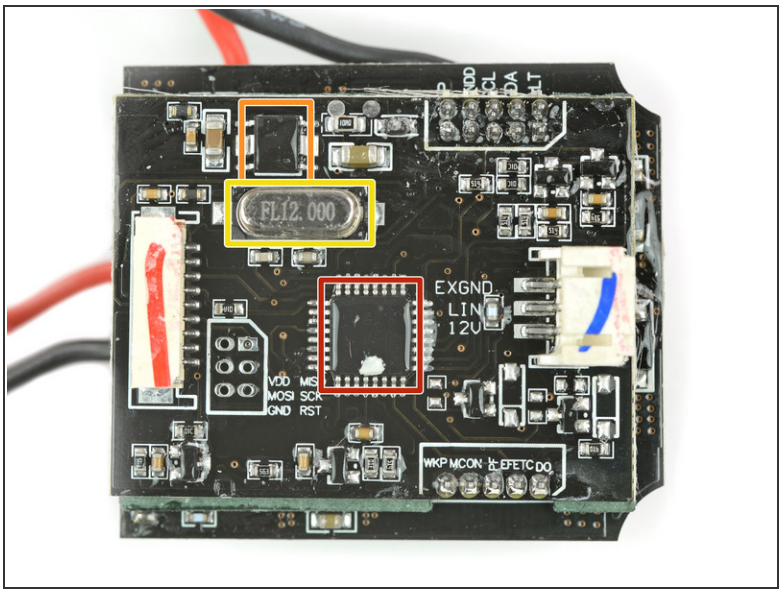
- We begin to pry out the rear light, a cable keeps it in place, but it does give us access to some hidden screws. This in turn grants us access to the internals.
- This massive umbilical leads from the charging port to the batteries and the BMS (Battery Management System) at the other end, and an LED board behind the rear light.
- We peel out said circuit board and discover some secrets. This guy controls the rear LED array, as well as some status LEDs along the top of the tube (probably to indicate battery activity).

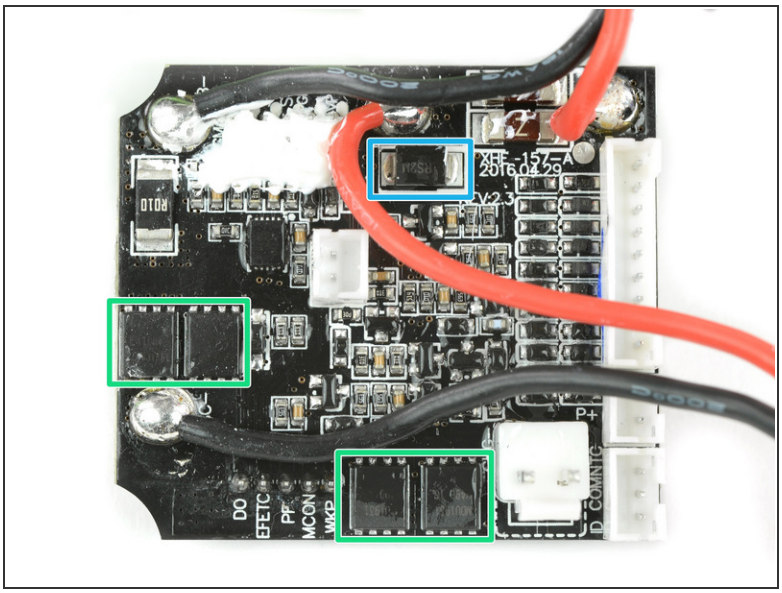
Step 17



- The main battery compartment is a tough nut to crack. Five screws (hidden by some hard to pry off covers) aren't all that hold this case together.
- As we finally succeed with some gentle heating and "good vibrations" we snap open the case, breaking one-time-use clips in the process. Bad news for battery cell replacements.
- We finally reach the prize: 20 Panasonic NCR18650PF Li-Ion batteries! Panasonic is a good (safe) brand, so recharging should be a breeze, even if individual replacement won't be.
  - The battery pack also has a battery management system (BMS) circuit board.

Step 18 — battery management system





- The board is packed with lots of resistors. What sticks out are these components:
  - An ATMEL MEGA 328P Battery Management MCU
  - S11428 33TVF
  - FL12.000 12 MHz quartz crystal oscillator
- On the flip side we find these:
  - Magnachip MDU1931 single n-channel trench MOSFET (x4)
  - RS2M rectifier

Step 19


- We return to the bike's body to do a bit more disassembly before tackling the final electronics.
- The bike's main hinge—the rear swing fork—is held to the top tube with a simple Allen bolt.
- When detached from the frame we can clearly see the tilted asymmetric hinge.

  This unique shape allows it to stay in line with the bike when riding, but swing right next to the front wheel when folded.

Step 20



- The second important compact-ifier is the foldable handle bar and stem. The mechanism itself is cool, and comes easily apart with the pull of a pin.
- To take the front fork off the hinge, we make use of the uncommon, but essential, 10 mm allen key, an essential for bike repairs.

  The front fork is cast as one single part of aluminum and weighs just 0.71 kg, that's not much more than a soccer ball!

Step 21


- What's left is the top tube, complete with the headlight and *the brain* (more on that later).

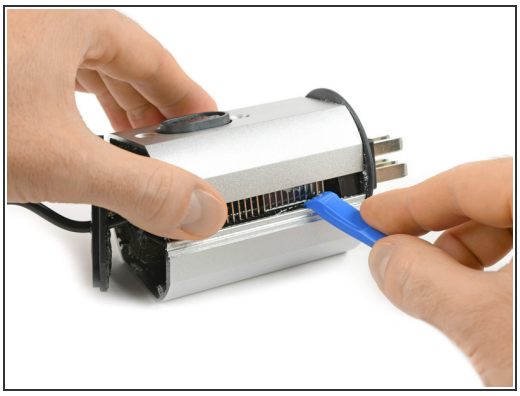
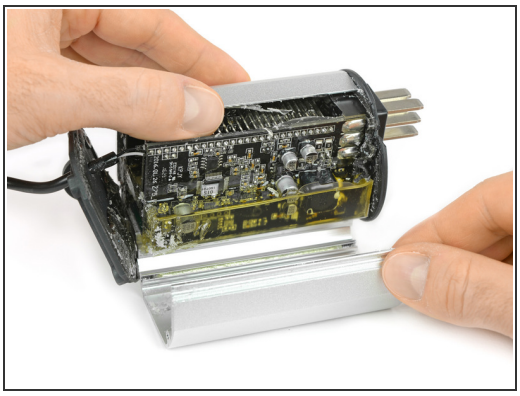
  ⓘ This aluminum center piece weighs only 1.36 kg!

- With a firm twist of the hand we can unlock the headlight and take it out of its recess.
- A single cable with a simple connector keeps this high-powered LED well... powered.

Step 22

- The ~~brain~~ control unit is mounted to a handy handle that attaches to the frame with two simple screws.
- Having removed the screws, we can grab the controller unit by the guide rail and slide it right out.
- This bike's brain is a single unit electric bike controller by Ananda, a manufacturer of many electric bike components.

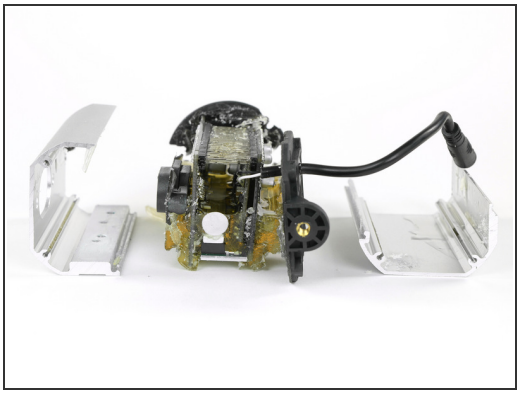
Step 23

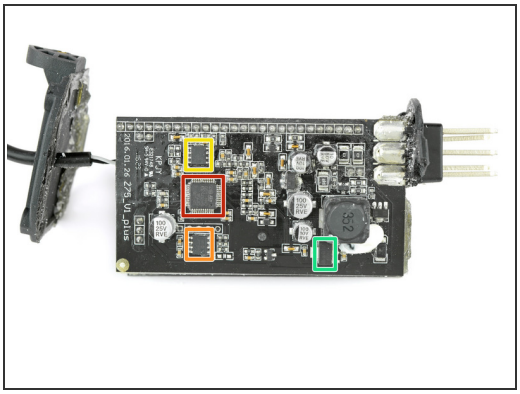




- Of course "single unit" doesn't mean much to us, we dive in past some standard Phillips screws, and work on prying the stubborn casing open.
  - We grab a Jimmy and iFixit Opening Tools and try to negotiate–without any success, even when heated.
- We turn our efforts to the side panel, and what we found inside will shock you (people always fall for that, right?)
- Three boards—bridged by an army of pins—are drowned in gobs of yellowish transparent rubber.

ⓘ We suppose this is to dampen vibration and help dissipate heat to the aluminum casing.

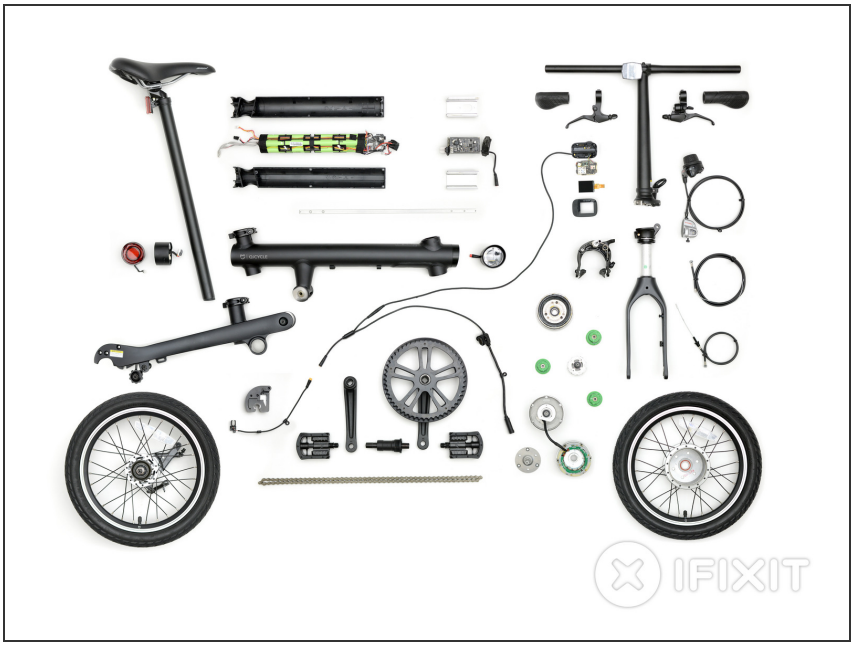
Step 24





- Most of the important components live on the battery pin board, we spy:
  - STM32100C8 micro controller with an ARM Cortex-M3 32-bit RISC core
  - MCP2003 LIN J2602 Transceiver
  - Diodes Inc AS358M low-power dual operational amplifiers
  - GH17M transistor
- The rest of the goop-covered boards mostly carry capacitors and other passive components.

Step 25



- And with that, this bike has been folded, unfolded, and torn totally down.
  - Except for the boring bike bits—we're only here for the "electric" parts after all.
- This layout might be a *bit* bigger than usual, feel free to take a closer look.

Step 26 — Final Thoughts

- The MiJia QiCycle Folding Electric Bike is the first of its kind we've scored, but it earned a **6 out of 10** on our repairability scale (10 is easiest to repair) based on the following points:
  - Standard bicycle components and tools are used throughout, making repair more accessible.
  - The battery assembly can be removed and replaced with ease.
  - The electronic components can be removed without compromising the bike, extending its life and making recycling easier.
  - The seatpost, frame, and front hub motor are nonstandard, making a replacement a bit more difficult when the manufacturer does not offer them.
  - The battery pack is a complex assembly that makes for wasteful replacement when individual components fail.

ⓘ This is the first vehicle we've scored on our repairability scale. This score is based on our experience of numerous teardowns, but it may change as we learn more about other e-bikes and hear about user experiences surrounding repair of these devices.

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