HALEHOUND CYD

This documentation will assist you getting started with your very own HaleHound CYD. There are a few variations of this project, but this will focus on HaleHound Versions. The differences here will depend on what version of the CYD that you have or plan to buy. By no means is this a beginner soldering project, but don·t worry, there·s a community here to support.

Before you begin:

========== DISCLAIMER & RESPONSIBLE USE ==========

IMPORTANT: READ THIS SECTION CAREFULLY This firmware and associated tools are provided strictly for: [+] AUTHORIZED PENETRATION TESTING Use only on networks and systems you own or have explicit written permission to test. [+] SECURITY RESEARCH For studying wireless vulnerabilities and developing defensive measures in controlled environments. [+] EDUCATIONAL PURPOSES Learning about wireless security, RF protocols, and ethical hacking methodologies. [+] PROFESSIONAL SECURITY ASSESSMENTS Conducted by qualified professionals with proper authorization and scope agreements. [+] HAM RADIO AND RF EXPERIMENTATION In compliance with local regulations and licensing requirements. THE FOLLOWING USES ARE PROHIBITED: [-] Unauthorized access to wireless networks or systems [-] Disruption of legitimate wireless communications [-] Jamming or interfering with emergency services or aviation [-] Any activity that violates local, state, federal, or international law [-] Malicious attacks against individuals or organizations [-] Use against systems without explicit written authorization

REGULATORY NOTICE:

- Certain functions may be restricted or prohibited in your jurisdiction.
  - RF transmission capabilities must comply with local regulations.
  - Users are responsible for obtaining necessary licenses (e.g., HAM radio)
  - Some features may violate FCC Part 15 or equivalent regulations.

LEGAL NOTICE: Unauthorized access to computer systems and wireless networks is a crime in most jurisdictions. Jamming or interfering with wireless communications may violate federal law (e.g., 47 U.S.C. SS 333). Users are solely responsible for ensuring compliance with all applicable laws and regulations. The author assumes NO LIABILITY for any misuse, damage, or legal consequences arising from the use of this firmware or hardware. By using this firmware, you acknowledge that:

- You understand the legal implications of wireless security testing.
  - You will obtain proper authorization before any testing.
  - You accept full responsibility for your actions.
  - The author bears no responsibility for unauthorized use.
  - You will comply with all applicable RF and wireless regulations.

HARDWARE DISCLAIMER - This firmware is designed for specific ESP32-based hardware configurations. Improper use may result in:

- Damage to your ESP32 device or connected peripherals.
  - RF interference with nearby devices
  - Violation of radio frequency regulations
  - Voiding hardware warranties

The author provides no warranty for hardware compatibility or safety. Users assume all risk when flashing and operating this firmware. SUPPORTED HARDWARE:

- ESP32-2432S028 (CYD 2.8" - primary, fully tested)
    - ESP32-3248S035 (CYD 3.5" - pin defines ready, untested)
    - CC1101 HW-863 SubGHz module
    - NRF24L01+PA+LNA 2.4GHz module
    - GT-U7 / NEO-6M GPS module
    - ATGM336h GPS
    - MicroSD card (built-in CYD slot)

Always verify pin mappings and hardware compatibility before use

PREFACE

Some assumptions are made when you are starting this project.

- You have a soldering Iron, Flux, Solder
- You know the basics of electronics and voltage vs amps.
- You have a method of stripping wires.
- You understand what it is that you are making.
- You are responsible for yourself and your safety during this process.
- You will test connections BEFORE you glue them.

WHAT YOUR KIT INCLUDES

- E07 CC1101 Module
- E01 NRF24 Module
- 2 JST wire sets
- SPI 2.8/3.5 CYD
- PN532 RFID Module
- 5v USBC Charge controller with 5v Boost
- 5v to 3.3v Buck Converter
- Perf board or Cinder Ferret
- 2 SMA antenna Connectors
- Case and Screws
- 1.25 JST connectors for Ebytes

STEP 1. THE BASICS

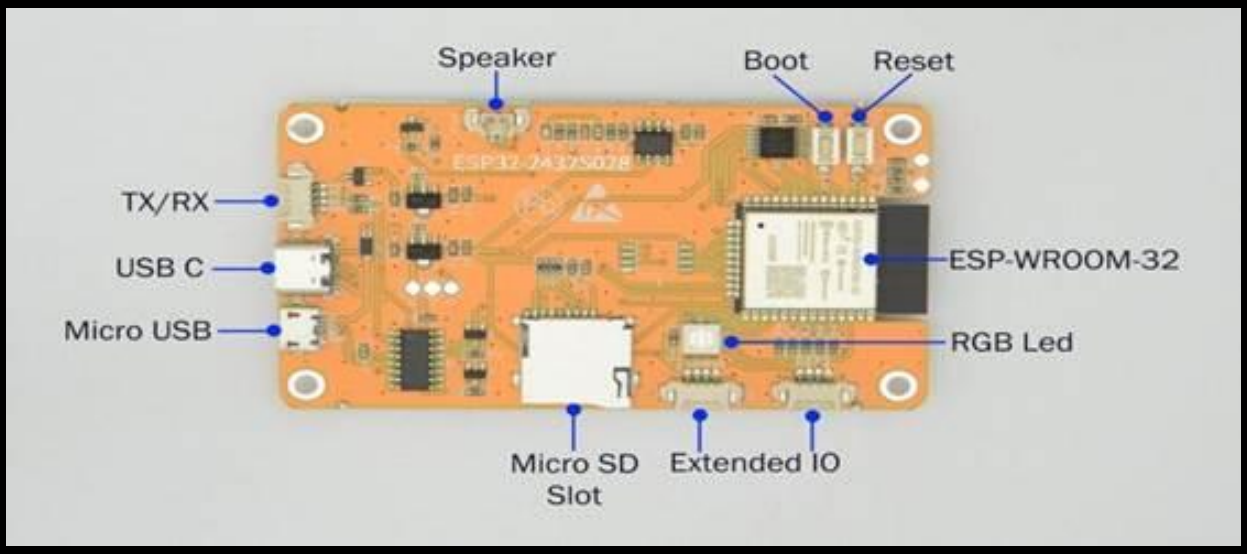
There are a few components we need to go over.

1. The CYD · This is your ESP32 Based Cheap Yellow Display that comes in 2.8 and 3.5 for this project. (For the purpose of this tutorial ill focus on the SPI Versions)
2. NRF24 · This is your 2.4 GHZ Radio Module
3. CC1101 · This is your Sub-GHZ Radio Module (300-915MHZ)
4. PN532 · RFID/NFC Module
5. ATGM336h - GPS
6. Boost Converter · Steps 3.7-4.2v to 5v
7. Charge controller · Charges Lion Battery

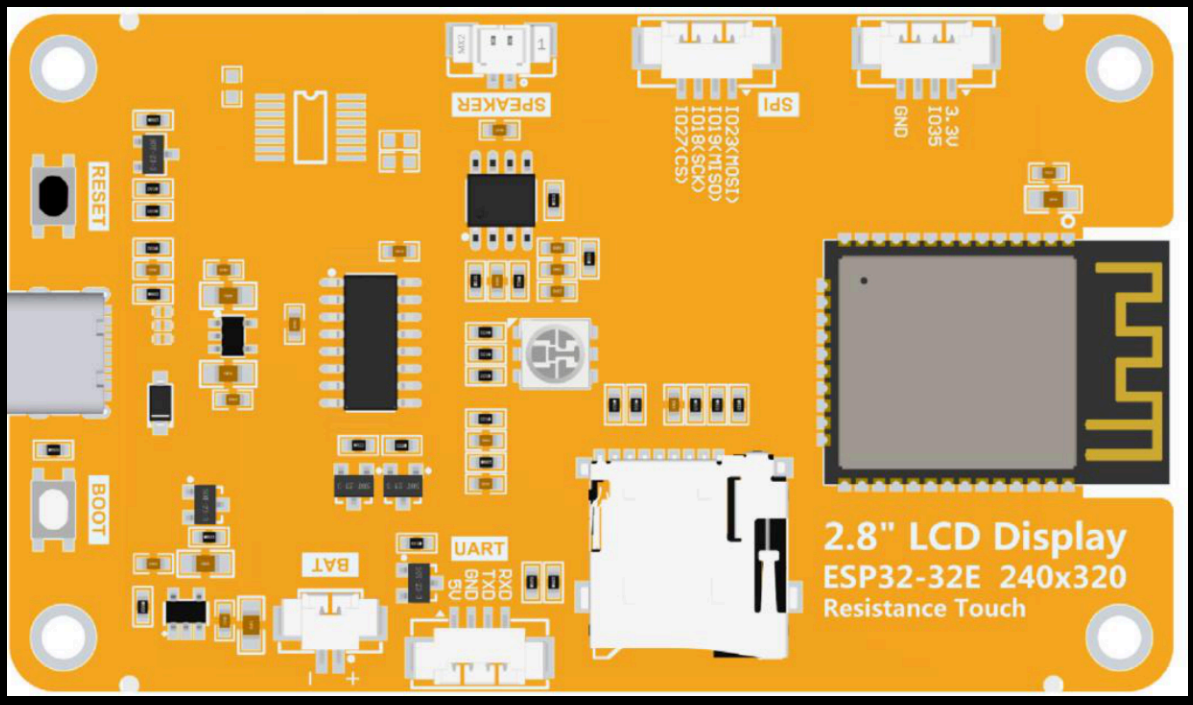
8. Buck Converter · Steps down to 3.3v for Radio Modules

IDENTIFYING YOUR HARDWARE.

Original CYD · this is the first Iteration of the CYD, Note the Neo Pixel is near the SD Card slot and a JST Connector. This version does not have ·Exposed SPI· SPI is the bus that the radio modules use to connect to the ESP32. If you want this Case Hale's Case can be found here.



SPI CYD · This version is the most recent iteration of the CYD. This has the SPI interface exposed on the JST Connector, this will reduce some of the soldering needed. This version also includes an On-board charge controller, but we will get to that later.



The Modules · There are a variety of Modules you can buy, it comes down to quality, power and cost. I·ll stick to the build kits first. Below is what each version of the kit will use.

Ebyte E07 (CC1101) 

Ebyte E01 (NRF24) 

PN532

DIY Disclaimer · If you plan to DIY, there are some other budget friendly Modules that people have found on amazon and AliExpress, if you go this route, note that the cases you get from Hale will not support these modules due to space restrictions and may require modifications. The STL·s are not available from the Devs at this time, if you want to make your own, there are options out there and plenty of information on how to do so.

SOME ITEMS YOU MAY FIND USEFUL.

1. JST Cables (has up to 12pins for CC1101) - Amazon Link
2. JST Connectors and wires - Amazon Link
3. Thermal Pads - Amazon Link
4. More JST Options - Amazon Link
5. Touch Sensor - Amazon Link (wired to K on boost, 5v GND, and BAT+)
6. NFC Repeater - Midwestgadgets
7. On/Off Switch · Amazon Link
8. Helping Hands - Amazon Link
9. Switch - Amazon Link

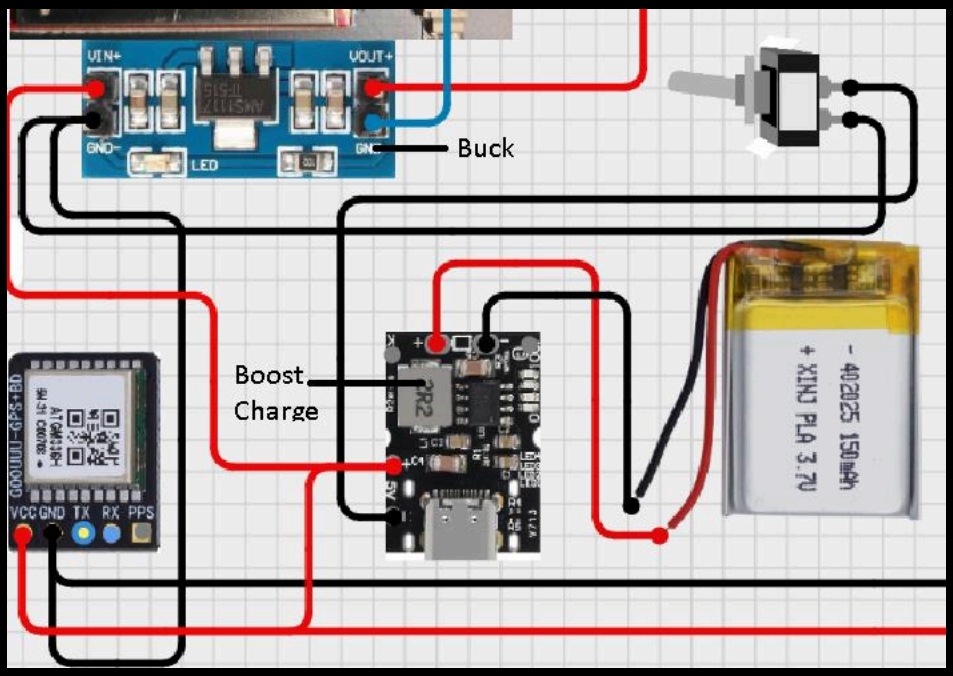
The Power · Due to the draw of these modules, it is not recommended to power the radios from the CYD. For that reason, the devs have decided to use a buck converter to draw 5v from a separate boost converter that is powered by the battery. But again, depending on which kit you buy, the wiring will vary slightly. Same goes for DIYers, you have a choice but please do your research if you decide to make your own.

THE WIRING

First, we will go over power Management. In any build you make, the CYD can only deliver 300 mah, so a separate Buck converter for the Radios is needed. The RFID, CC1101, and NRF24 all run from the 5v to 3.3v buck converter (which is connected to a 3.7 to 5v Boost module), The GPS and CYD run directly off the Boost Module at 5v. You would place your Switch at the Ground between the charge controller and Boost Module(this still allows for battery charging while the unit is turned off). In Hale·s kit, the boost converter is integrated into the charge controller. The Charge/Boost Module depicted below allows for a switch to be connected to pin

K and 5vGND or you can use the Standard on/off switch between 5v GND of Boost/Charger to Buck converter. All of Hale·s kits come with this module!

Hale·s Kit Wiring - Power

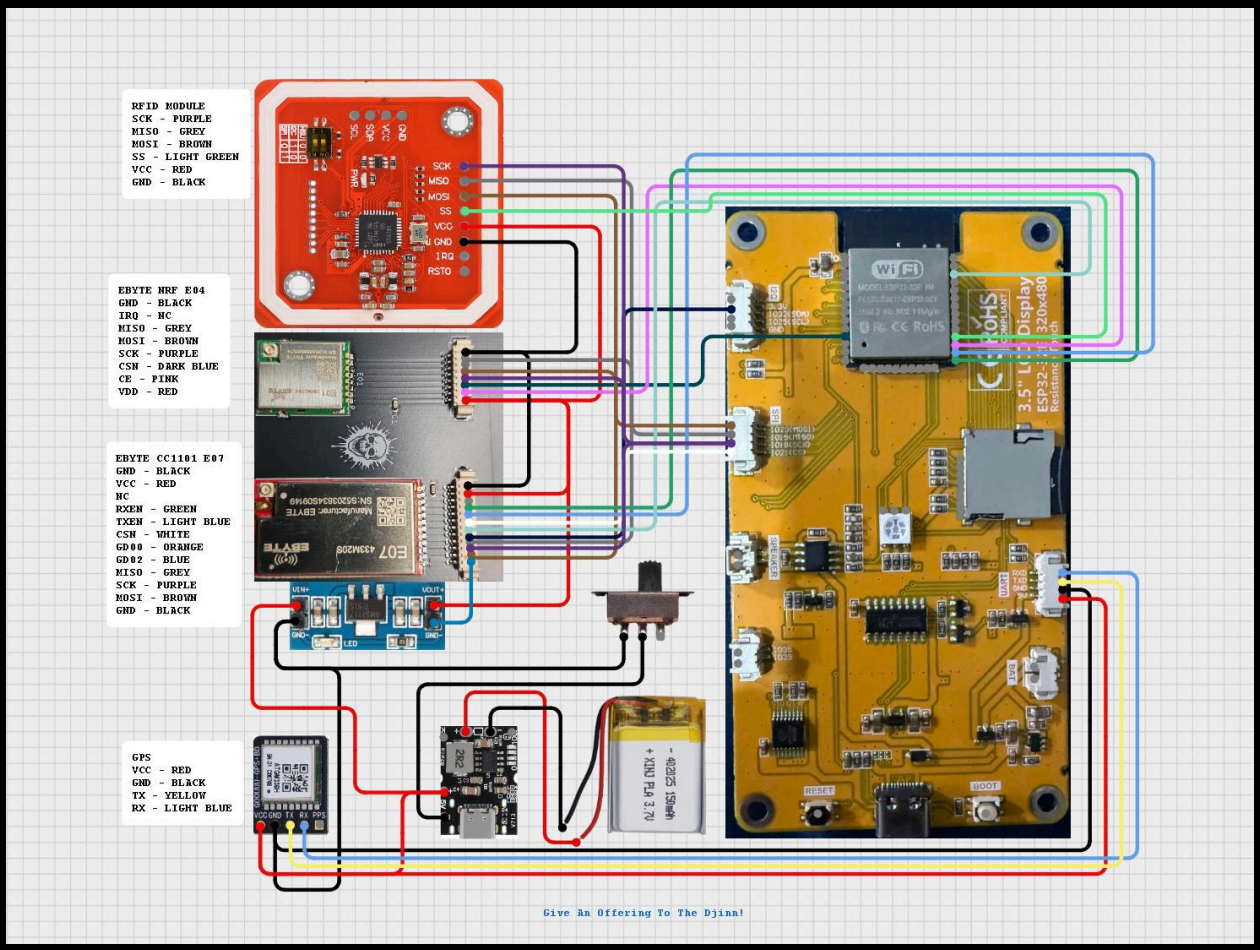


Step 1. Connect your power, This is the most important piece that is most commonly mis understood. See the Diagram Above. The CYD, BUCK and GPS, all take in 5V. All if the Radio Modules however (NFC, CC1101, NRF all take 3.3v which Is provided from the VOUT of the buck). Get a multimeter and test your points before hooking up the modules to ensure you are getting the right voltage. The switch you can find here Switch

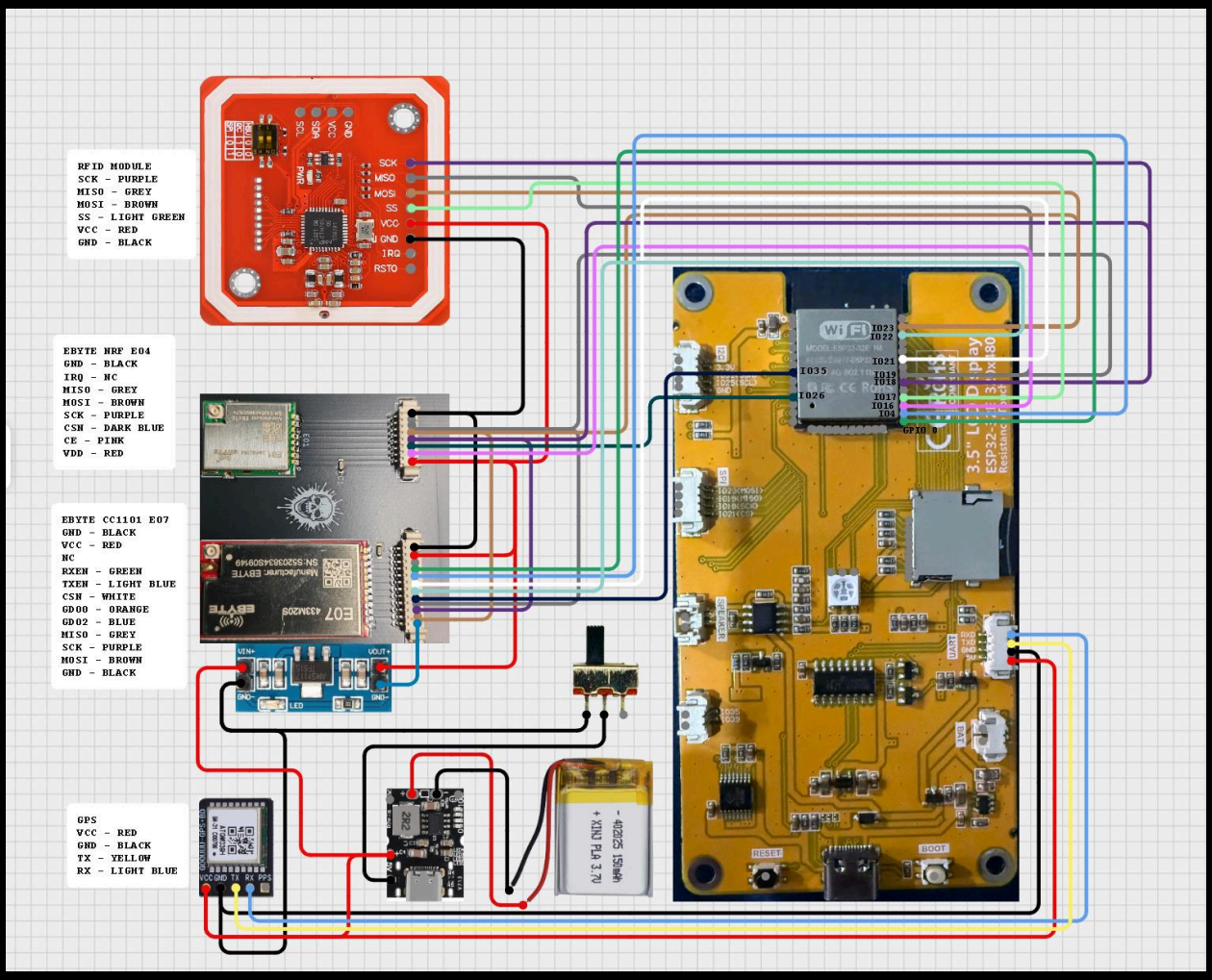
MODULES AND WIRING EXPLANATION.

Next are the Modules. There are 3 different combinations of these modules, the Basic ones from amazon with SMA connectors as depicted above (note only straight SMA connectors will fit, the Right angle Connectors will NOT Fit), The NRF24-GT Mini/CC1101 Red (these are smaller surface mount), and the Premium Ebyte Modules, the Ebyte ones are the only ones that are wired differently, Hale·s KIT has the Ebytes. With two additional connections. Below is a depiction of a SPI Radio Wiring. Note the radio modules share the SPI bus (GPIO 18/19/23 or SCK, MISO, MOSI) NOTE!! Pin 35 on the 2.8 is in the top left JST of the CYD while on the 3.5 its bottom Left. There are two different approaches to wiring, you can directly wire them to the ESP for all the connections or you can use the JST connectors to reduce some of that soldering. Also, these Examples show the Cinder Ferret which makes soldering a bit easier.

JST Example below



This method is how we would use the JST Connectors to hook up to the CYD and to the modules. The JST·s cover SPI Wires, CS21, 35, UART, 5v/GND. The rest is borrowed from either the ESP or LED (We recommend soldering directly to the ESP rather than the LED. Note you may not have the same color wire available to you, so what some people have done, is to write out their own chart on paper with the colors they are going to use and the accompanying GPIO. On the next page is a wiring example of coming directly of the ESP for ALL connections except GPS and UART.



Color	GPS	PN532	NRF	CC1101	CYD
Brown	N/A	MOSI	MOSI	MOSI	IO23 (MOSI)
Grey	N/A	MISO	MISO	MISO	IO19 (MISO)
Purple	N/A	SCK	SCK	SCK	IO18 (SCK)
White	N/A	N/A	N/A	CS	IO21 (CS)
Dark Blue	N/A	N/A	CS	N/A	IO26 (CS)
Light Green	N/A	SS	N/A	N/A	IO17 (SS)
Pink	N/A	N/A	CE/CSE	N/A	IO16 (CE)
Light Blue	N/A	N/A	N/A	GDOTX	IO22
Dark Blue	N/A	N/A	N/A	GD1RX	IO35
Yellow	TX	N/A	N/A	N/A	TX
Light Blue	RX	N/A	N/A	N/A	RX

Red	5v (Boost)	3.3v (buck)	3.3v(Buck)	3.3v (Buck)	5v (Boost)
Black	gnd (Boost)	Gnd (Buck)	Gnd (Buck)	Gnd(Buck)	Gnd(boost)
Light Blue	N/A	N/A	N/A	TX_EN	IO4
Green	N/A	N/A	N/A	RX_EN	IO0

NOTE · IF YOU HAVE THE OG CYD (NON SPI) CS for the CC1101 is 27, NRF CS is 26, CC1101 TX is 26 and RX is 0.

Device Documentation

Device	Purpose	Documentation
ESP32-2432S028 (2.8")	OG CYD (most common)	Docs
QDtech E32R28T (2.8")	SPI CYD (Less Common)	Docs
QDtech E32R35T (3.5")	SPI CYD 3.5inch	Docs
NRF24L01+PA+LNA	Basic NRF Module (DIY)	Docs
NRF24GT Mini	Mid Range	Docs
Ebyte E01-2G4M27D	Premium (Hales)	Docs
CC1101 red	Mid Range	Docs
Ebyte E07	Premium (Hales)	Docs
IP5306 Boost/Charge	Hales Kit	Docs
TP4057	Basic DIY	Docs
PN532	Hales Kit	Docs
Buck Converter AMS1117	Hales Kit	Docs
Mini PN532	Optional	Docs

Before we go through with the build, Below are some link·s to Hales Kit

Case Only Links

Hale·s 2.8 - ESP32-2432S028R

Hale·s 2.8 - ESP32-E32R28T (SPI)

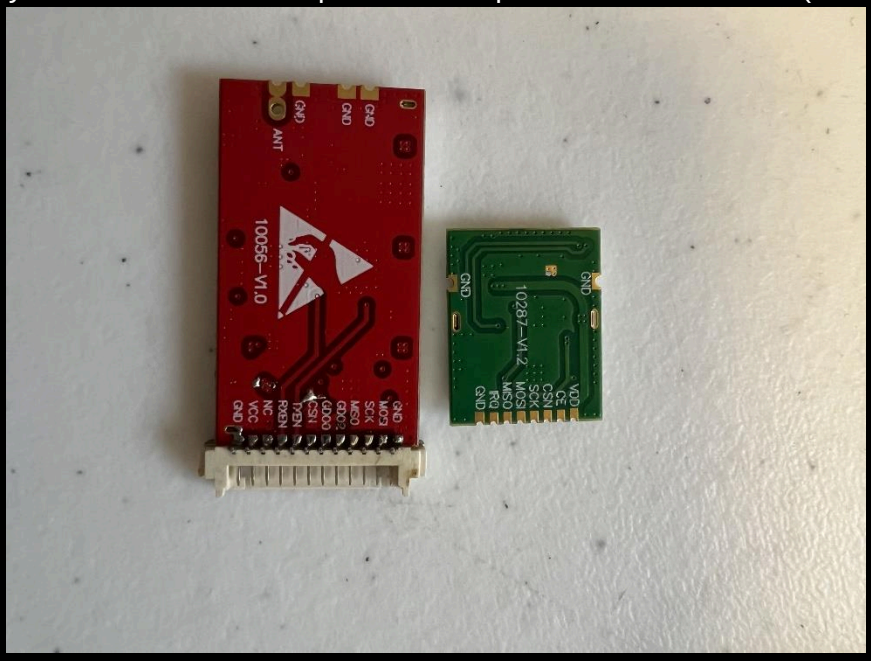
Build Kits

Hales 2.8 Complete (No battery) - 2.8 Kit

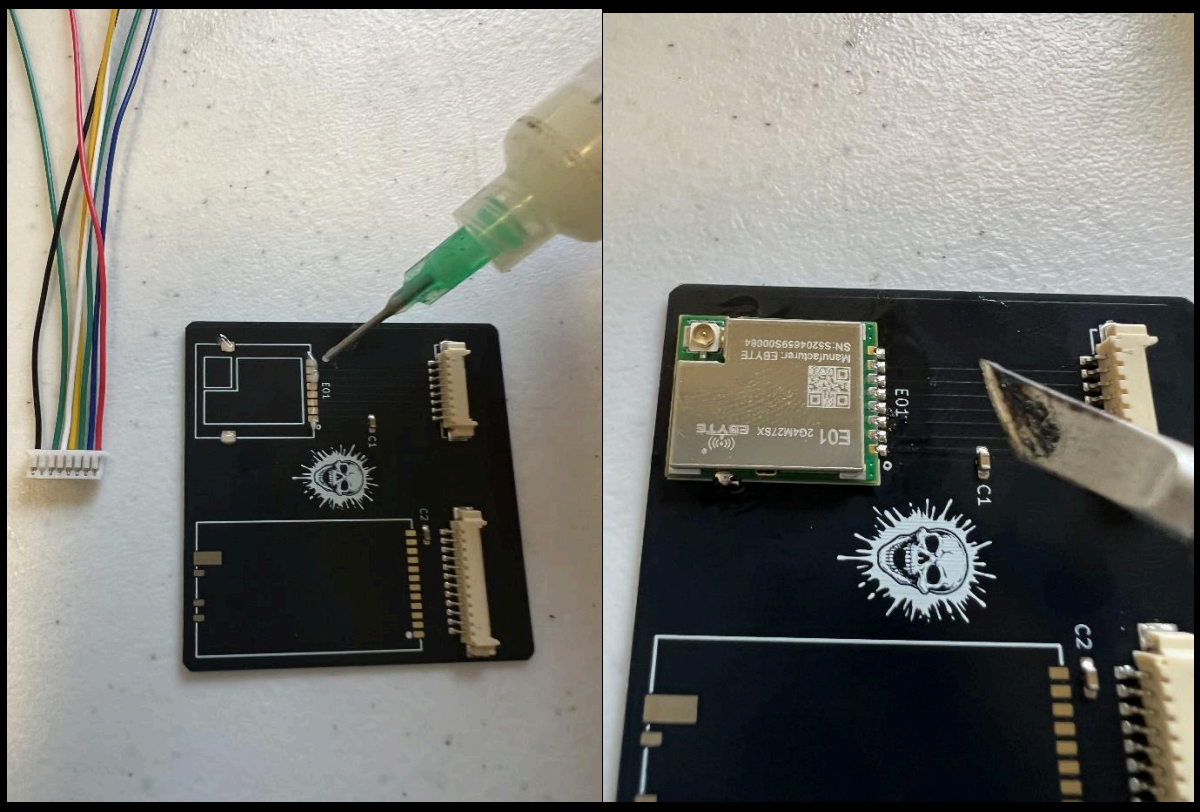
Hales 3.5 Kit (no battery) - 3.5 Kit

Since there are two kits you can buy, a reminder to review the wiring diagrams above, for this build, I·ll be referencing a 2.8 SPI Build. Some assumptions are made; your radios will come with JST connectors that you·ll need to solder onto them (If you have the Cinder Frett you don·t need to do this). Your NFC module has been configured for SPI. Route your SMA Antennas through the thru holes and get them screwed in.

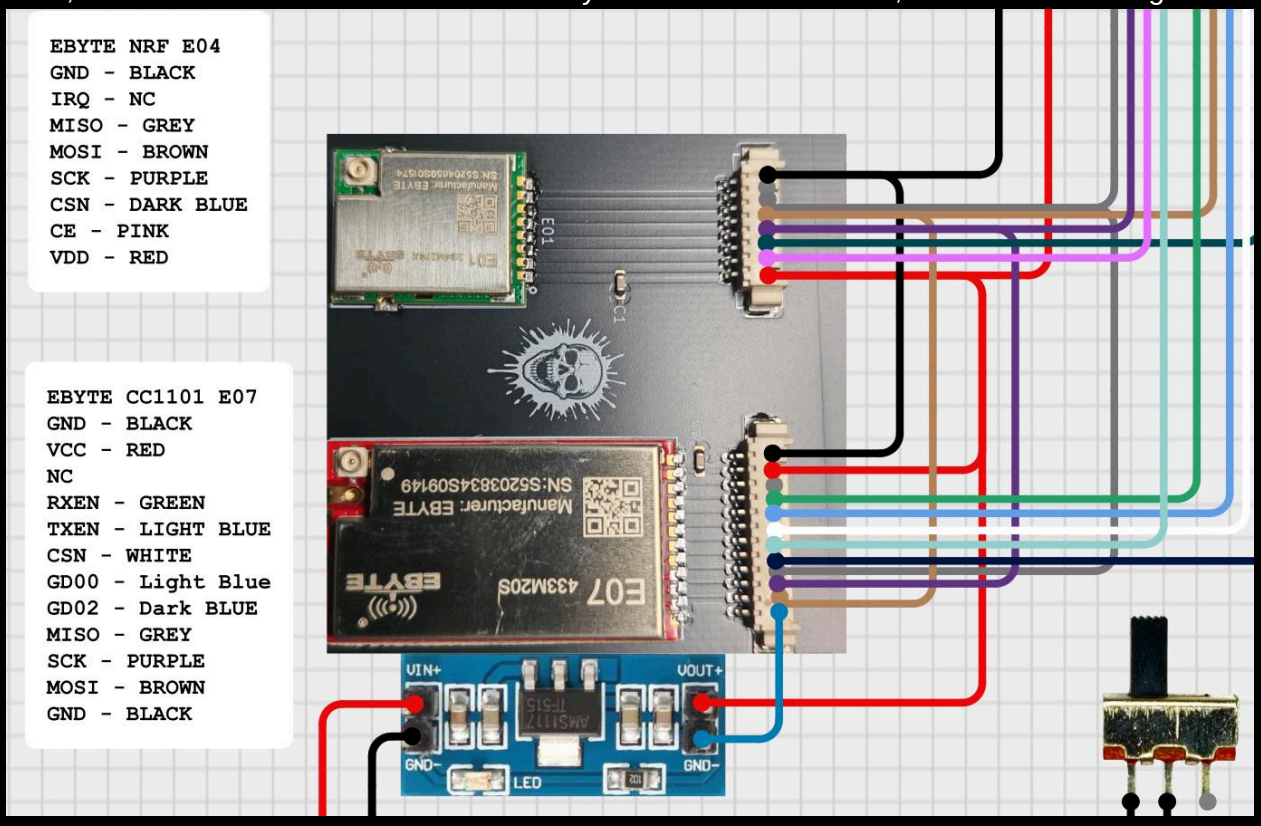
Step 1. Layout your Radios and take a picture of the pinout. Note Your SPIs (MISO,SCK.MOSI)



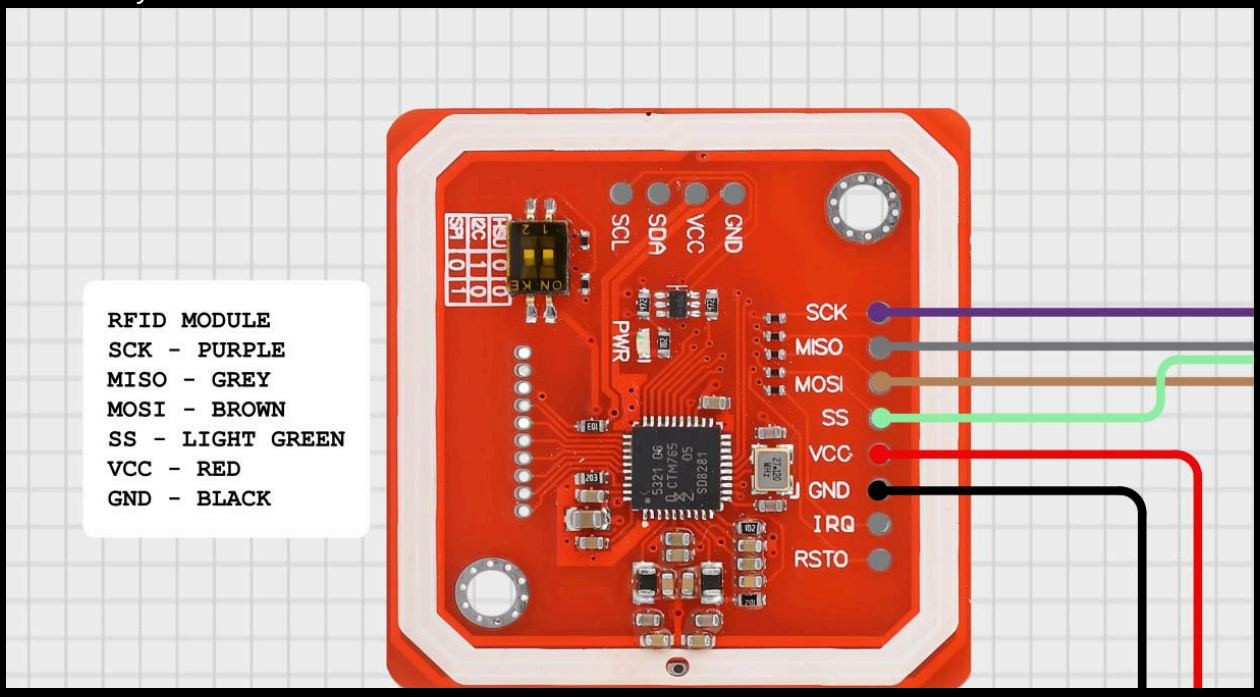
Step 2. Get your Radios, PerfBoard or Cinder Ferret Ready. Flux the Shit out of it (I prefer chip qwick). Add some solder to a Knife Tip (that·s what I use, use whatever feels comfortable) and solder your radios to the perfboard or Cinder Ferret. If you have Perfboard, You need to solder your connectors first. (I fluxed the board first, held the jst with Tweezers and used a knife tip)



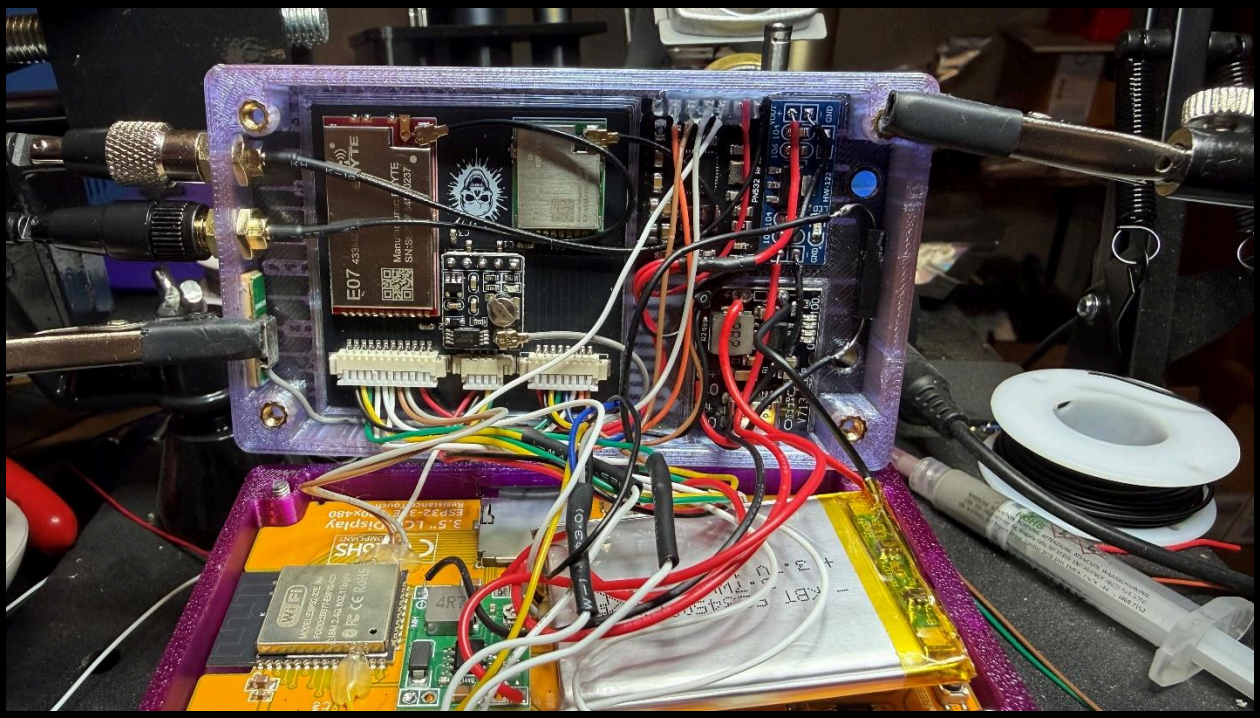
Next, Measure out the wire needed to make your runs for the Radios, See the below Diagram



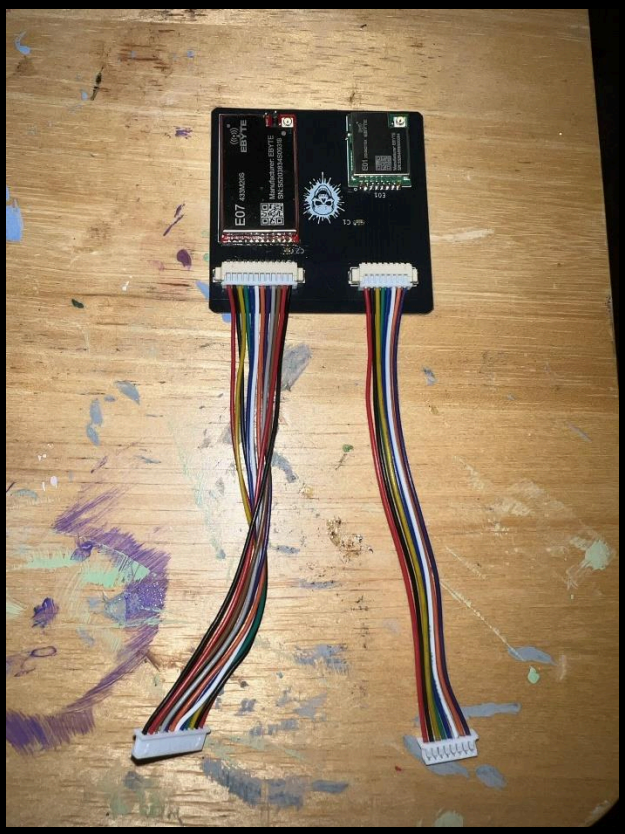
and if you want to make things easier to open your case to work on your build, you can add JST connectors between the battery and the charging Board. I added the buck on the CF/PerfBoard. Next wire your PN532.

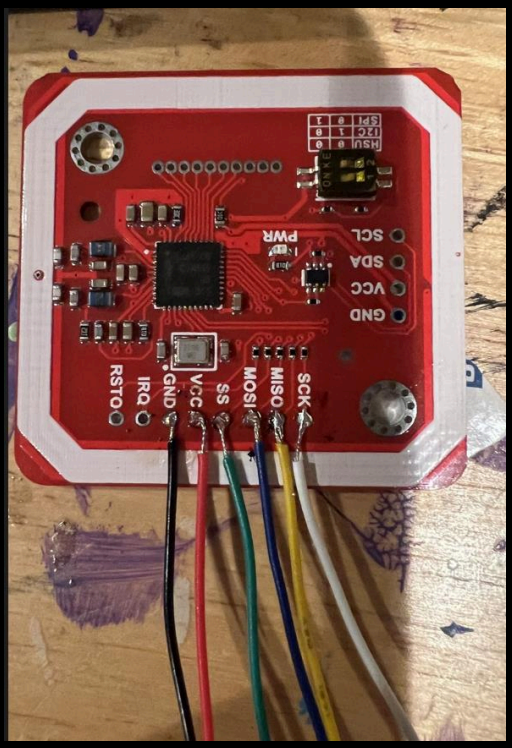


If you have the 3.5 with CF, here is the layout example from Hale, He is using the Castalate PN532, Cinder ferret v2. IT consolidates a lot of the module placement.

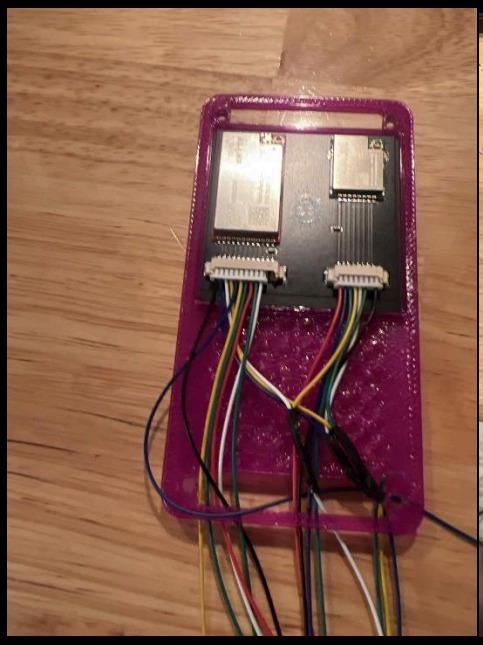


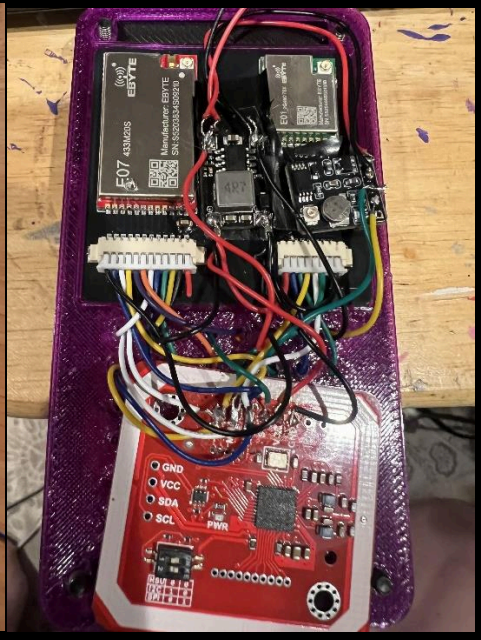
Connect your JST Wires to your radios, and section off your SPI Wires, Prep your RFID Board as well. Make sure its set to SPI, There is a little switch on the PN532, the bottom switch needs to be turned to the right and the top switch needs to be turned to the left. (See below).



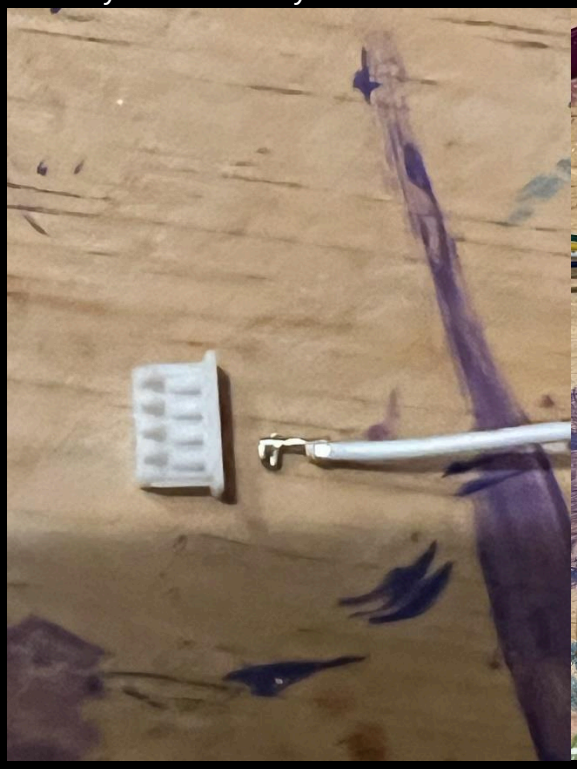


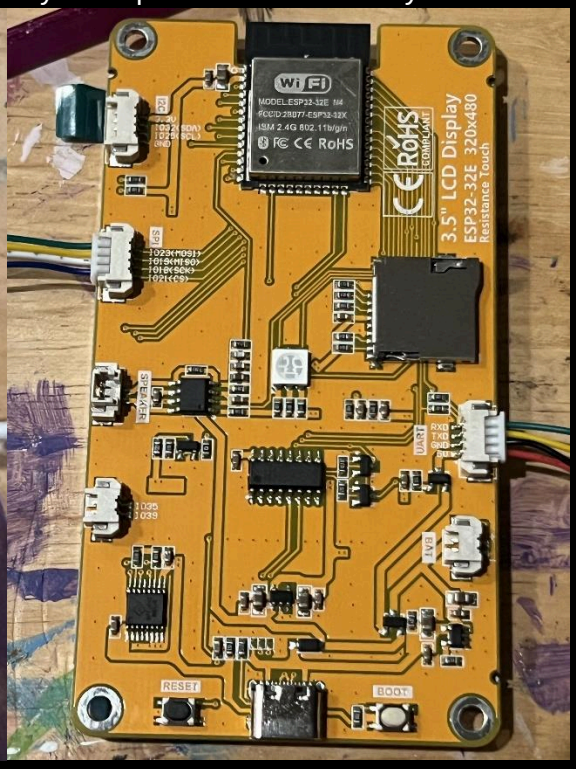
Place your boards, Join your SPI Wires together. You can do this a number of ways. I chose to redo mine to join at the RFID Module. I also Laid down Black electrical tape on the middle and placed my buck converter and GPS Module on top with some double sided tape. I ran wires through the holes on the center mount so I can minimize the wire length. DO A RADIO TEST BEFORE GLUEING ANYTHING!!!!!! Hot glue your GPS Antenna in place to avoid it touch the RTC Battery, otherwise it will short out.





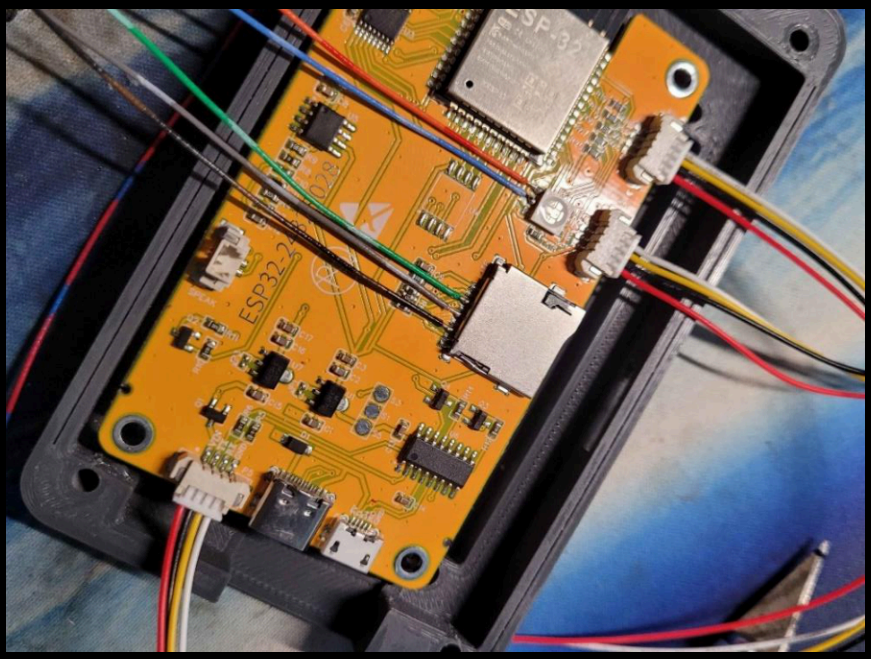
Now you can make your JST Connector for your exposed SPI Wires for your CYD.



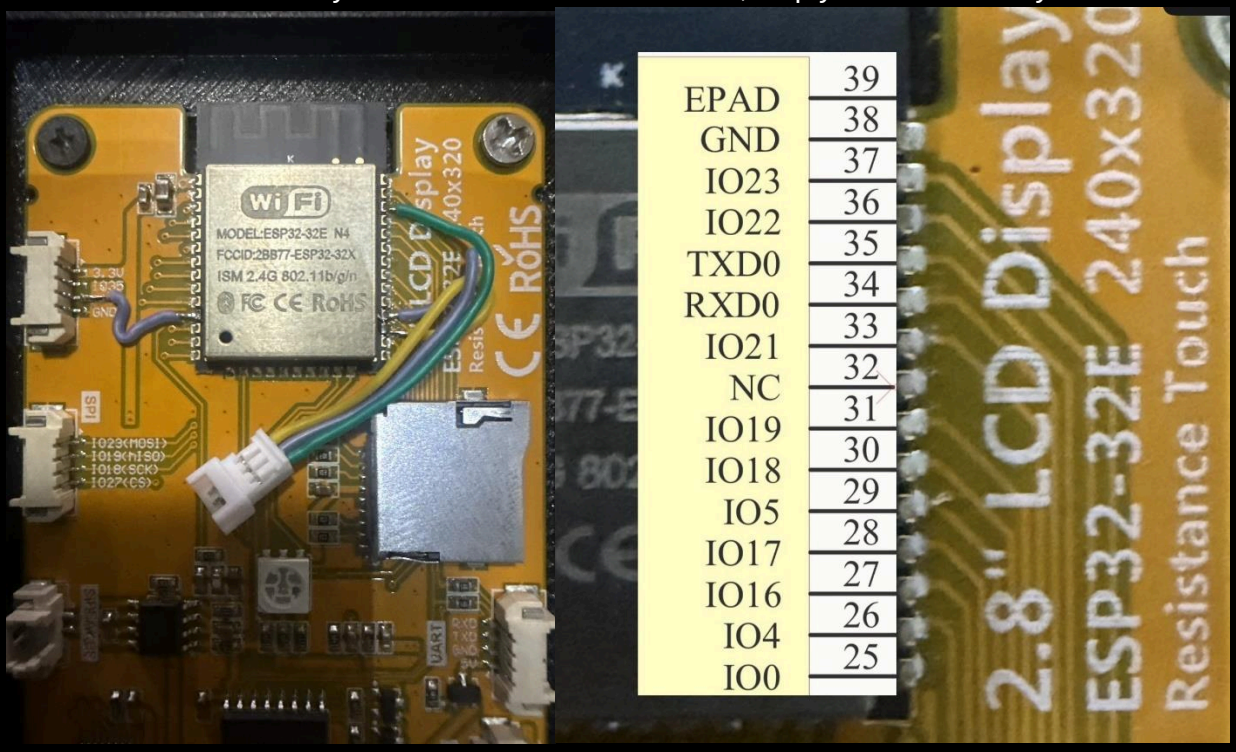


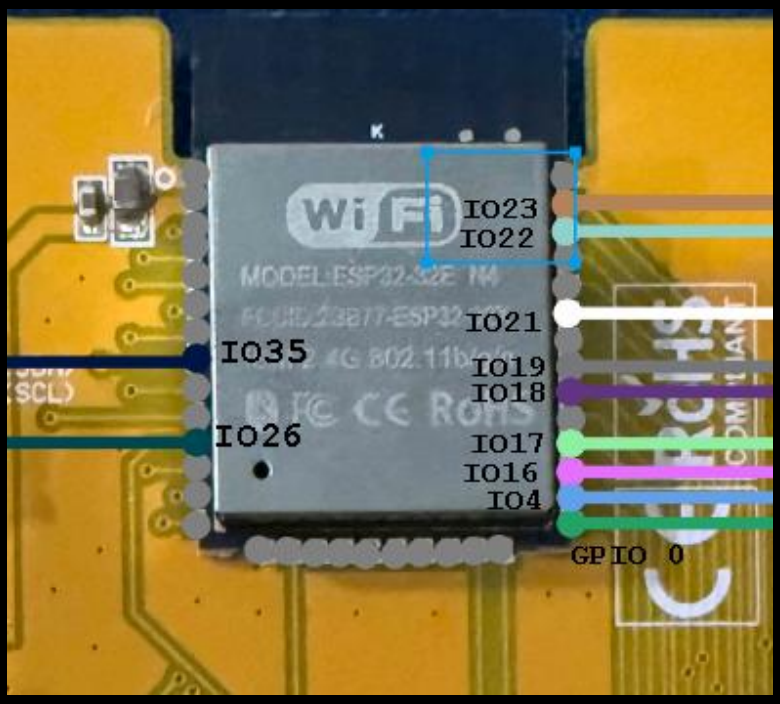
When you are making these, note the flat side goes up, push the wire in until you feel it click. Connect your JST Connectors and solder your CYD Connections. Your wire colors are up to you, PIN Mapping is what·s Important. Make your own chart if necessary.

Now we Prep our CYD, If you have the OG 2.8 see below, Note that we borrow SPI from the SD Card Slot, IO 16,17 and 22 are borrowed from the Neo Pixel. Add hot glue over the joints to keep them in place.

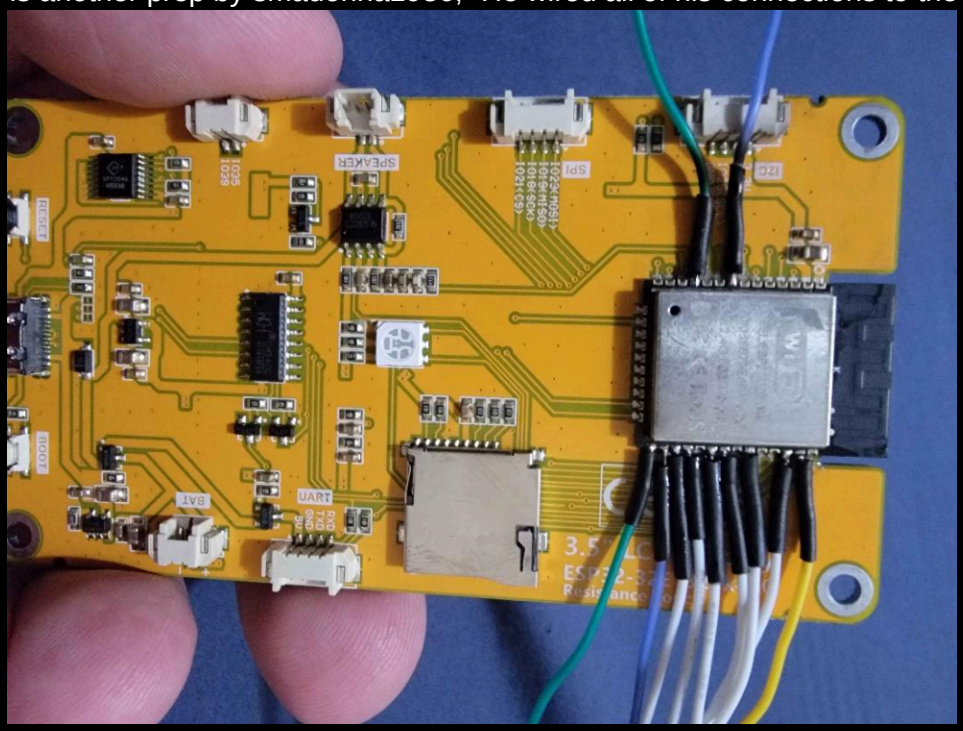


Here is a Prep of the SPI CYD which is what comes in Hale·s Kit by xs8nx. He used a JST connector and borrowed IO22,16,17,22,23 and 26 right off the ESP32. This is one of the cleanest ways to do it. Use a shit ton of flux, strip your wires closely.

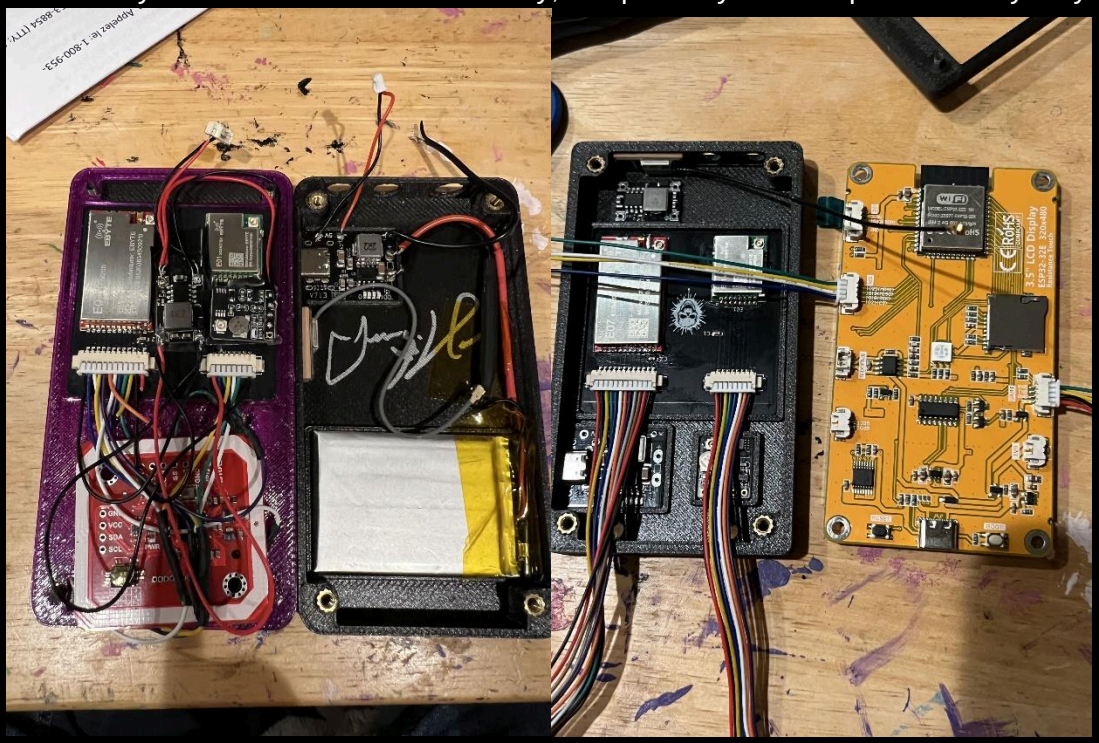




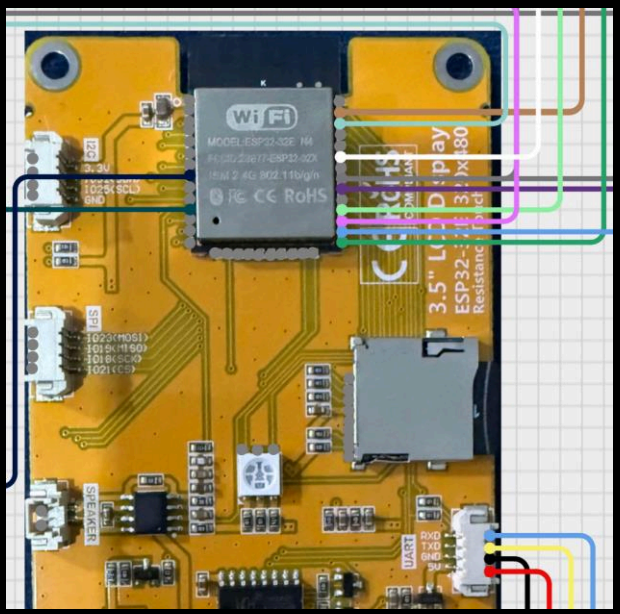
Here is another prep by smadonna1986, He wired all of his connections to the ESP



Now lets wire up the power and GPS, I used a JST for the battery, Buck converter sits in the middle, right next to the GPS. To the right is the 3.5.(WIP Still, Stay Tuned) Measure your wire as close as you can, leave some excess before cutting. This guide will NOT teach you how to solder or strip wire. There are Build videos on YouTube loosely based on this. The battery I used for my 2.8 is a PS3 Controller battery, it fit perfectly. Your experience may vary.



Wire Everything Up! Use the Diagram in this guide to match your pins! Use heat shrink tubing to make it neat.



Hale·s Example below with the perfboard.

Now we want to feed the wire to our perf board, The color of your wires may vary, if you are having trouble, revert back to the diagrams in the beginning of this document and sub out which ever colors you are using. Please ensure you use a generous amount of Flux and clean your connections with %70 or better Isopropyl Alcohol. This next step is important before you move forward, TEST YOUR POWER BEFORE YOU CONNECT ANYTHING! You should get 3.3v from the positive output of your buck board and 5v out from your boost board. Also, test that each ground has continuity. Next, connect your battery and test that you are getting 4.2 volts for charging. OPTIONAL, if you bring your own battery, please check the max charging current the battery is rated for. If it·s less than 1amp, then you NEED to swap a 7.5k resistor to the rPROG pin of your charging board. FAILURE to do so could lead to excessive heat. If you have Kapton tape, cover your power board solder joints. Also, you can glue all of your solder joints with hot glue to ensure they stay put. Flash your firmware and run the wiring diagram check before closing.

Author	Version	Date	Notes
Bkbroiler	1.0.1	5/4/2026	Original
Bkbroiler	1.3.1	5/19/2026	Added Kit builds
Bkbroiler	1.3.4	5/20/2026	Added Cap info
Bkbroiler	1.3.9	6/2/2026	New Diagrams