

F75 COMPANION

Final hardware wiring guide

ESP32-S3 + 3.5-inch ILI9488 touch display + Panasonic 1S Li-Po power system

READ BEFORE POWERING

This guide is for the new ESP32-S3 and ILI9488 hardware. The old ESP32/ILI9341 pin numbers are not reused. Verify every module's printed labels and measure the boost output before connecting the ESP or display.

Hardware covered

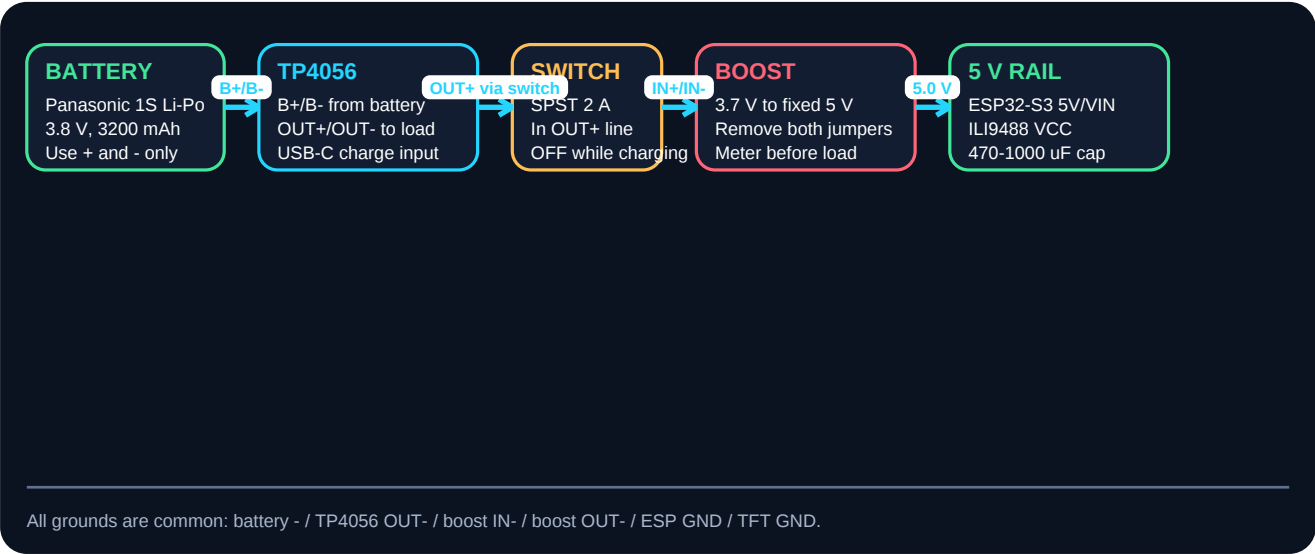
Part	Exact role in this build
ESP32-S3 DevKit	Dual-core 240 MHz board, 8 MB flash and 8 MB PSRAM, USB-C. Pin labels must be GPIO numbers.
3.5-inch ILI9488 SPI TFT	480 x 320 display with resistive XPT2046 touch and optional microSD. This replaces the old ILI9341 module.
Panasonic DWSP3200P66	1-cell Li-Po, 3.8 V nominal, 3200 mAh, 12.16 Wh, 4.35 V charge limit. Use labeled + and - contacts only.
TP4056 USB-C board	1-cell charger/protection board. It charges this pack only to about 4.2 V, so usable capacity is slightly reduced.
Selectable boost board	Raises battery voltage to a fixed 5.0 V rail. The board may ship configured for 12 V; set and meter-test it first.
AO3401A P-channel MOSFET	Small high-side ON/OFF switch for a 3.3 V-compatible single LED/BL pin. Add one 100 ohm and one 100k resistor.
SPST switch + capacitor	2 A rated power switch and 470-1000 uF, 10 V electrolytic capacitor on the 5 V rail.

Scope note

This document wires the companion module as its own device. It does not connect electrically to the F75 keyboard battery or PCB. The Windows companion app communicates with the ESP wirelessly.

1. Power system wiring

Build the power chain from left to right. Keep the load switched off while checking each stage.



From	To	Wire / note
Battery labeled +	TP4056 B+	Red wire. Confirm polarity with a multimeter.
Battery labeled -	TP4056 B-	Black wire.
Battery center contact	No connection	Likely temperature/ID. Insulate it individually; do not short it to + or -.
TP4056 OUT+	SPST switch input	The switch disconnects the complete load.
SPST switch output	Boost IN+	Use short, adequately sized wire.
TP4056 OUT-	Boost IN-	Common system ground.
Boost OUT+	ESP 5V/VIN + TFT VCC	Only after confirming 4.9-5.1 V with a meter.
Boost OUT-	ESP GND + TFT GND	All signal modules require a common ground.
Electrolytic capacitor	Across boost OUT+/OUT-	Cap + to 5 V; cap - stripe to GND. Use 470-1000 uF, at least 10 V.

BOOST SETTING

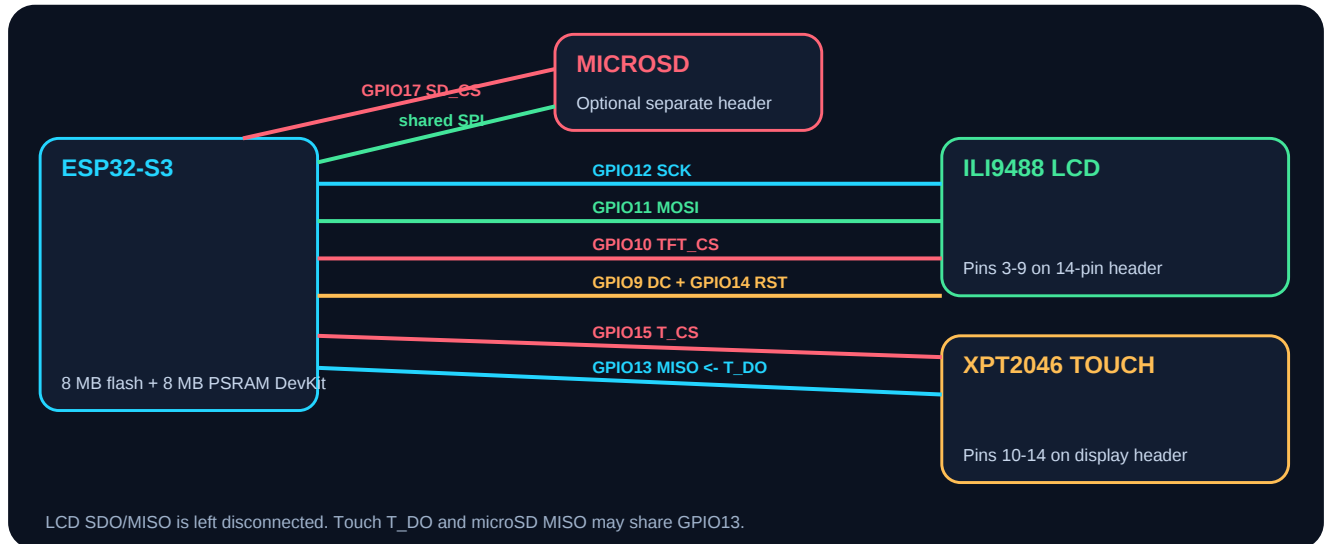
With the common A/B selectable board, both solder jumpers open normally select 5 V; other combinations can select 8, 9, or 12 V. Board revisions vary. Remove power before changing links, then measure the output with no ESP/display attached. Never trust the listing title alone.

Charging and USB rule

A basic TP4056 board has no true power-path/load-sharing controller. For the safe first build, switch the companion OFF while charging. Also switch battery power OFF before plugging the ESP32-S3 USB-C cable into the PC for flashing; some generic DevKits can back-feed their 5 V rail when USB and external 5 V are present together.

2. ESP32-S3 to ILI9488 display and touch

This is the proposed pin map for the new board. It avoids native USB pins GPIO19/20, boot strap pins, and GPIO35-37 that may be occupied by octal PSRAM on an N8R8 module.



Display pin / label	ESP32-S3 connection	Purpose
1 VCC	Boost 5 V rail	Only if the module is marked 3.3-5 V or 5 V capable.
2 GND	GND	Common ground.
3 CS	GPIO10	ILI9488 chip select.
4 RESET / RST	GPIO14	Display reset.
5 DC / RS	GPIO9	Command/data select.
6 SDI / MOSI	GPIO11	Shared SPI data from ESP.
7 SCK	GPIO12	Shared SPI clock.
8 LED / BL	AO3401A drain	ON/OFF backlight input; see section 4.
9 SDO / MISO	Leave disconnected	ILI9488 SDO may not release the SPI bus and can block touch/SD.
10 T_CLK	GPIO12	Touch shares SPI clock.
11 T_CS	GPIO15	Touch chip select.
12 T_DIN	GPIO11	Touch shares MOSI.
13 T_DO	GPIO13	Shared SPI MISO into ESP.
14 T_IRQ	Leave disconnected	Not used. Firmware polls XPT2046 over SPI instead.

LOGIC LEVELS

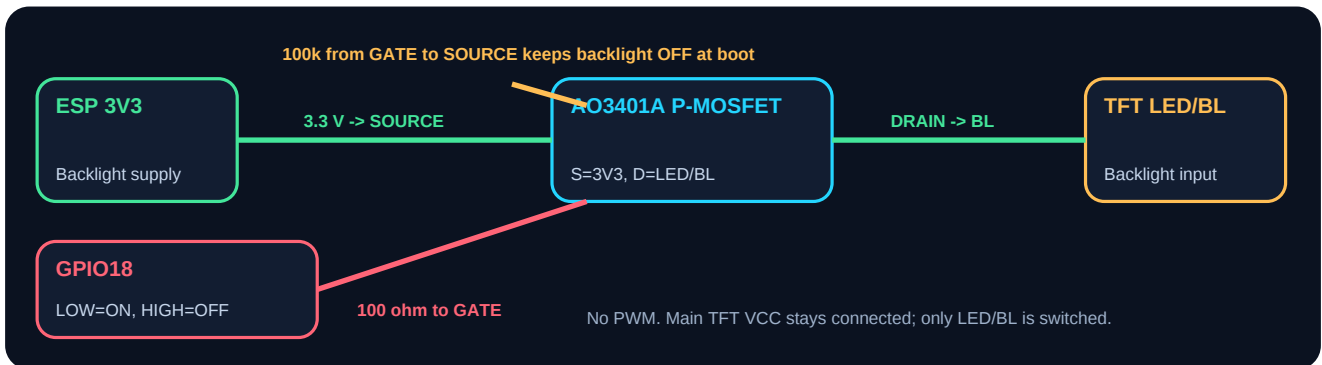
ESP32-S3 GPIO is 3.3 V only. Do not put 5 V into MOSI, MISO, SCK, CS, DC, RESET, or any GPIO. A display advertised as 5 V compatible should include its own regulator and input level shifting; confirm the actual PCB markings or seller schematic.

3. Optional microSD and control inputs

microSD label	ESP32-S3	Note
SD_CS	GPIO17	Unique chip-select line.
SD_SCK	GPIO12	Shared SPI clock.
SD_MOSI / SD_DI	GPIO11	Shared SPI MOSI.
SD_MISO / SD_DO	GPIO13	Shared MISO with touch T_DO.

If the display PCB has no separately labeled microSD header, do not infer the pin order. Leave the slot unused until its board-specific pinout is confirmed. During startup, firmware must keep TFT_CS, TOUCH_CS, and SD_CS HIGH before initializing the shared SPI bus.

4. Backlight ON/OFF transistor wiring



VERIFY LED/BL PIN

This one-transistor circuit assumes the display's single LED/BL pin accepts 3.3 V as a high-level backlight supply/control. Confirm that marking or seller specification before wiring. Do not switch the display's main VCC or GND; the touch controller must remain powered for polling.

Optional calibration button

Part	Connection	Firmware use
Momentary push button	GPIO21 to GND	Configure GPIO21 as INPUT_PULLUP; hold during boot to enter touch calibration.

Recommended physical wiring

Use short SPI wires, ideally under 10-15 cm. Route the backlight power and boost converter away from touch/MISO wires. Twist 5 V with GND and battery + with battery -. Add strain relief where wires enter the 3D-printed enclosure. Insulate every exposed battery and module terminal with heat-shrink or a proper enclosure.

5. Firmware pin definitions and first power-up

Use these definitions when the firmware is migrated to ESP32-S3 and an ILI9488-capable driver:

```
constexpr uint8_t PIN_SPI_SCK = 12;
constexpr uint8_t PIN_SPI_MISO = 13;
constexpr uint8_t PIN_SPI_MOSI = 11;
constexpr uint8_t PIN_TFT_CS = 10;
constexpr uint8_t PIN_TFT_DC = 9;
constexpr uint8_t PIN_TFT_RST = 14;
constexpr uint8_t PIN_TOUCH_CS = 15;
constexpr uint8_t PIN_SD_CS = 17;
constexpr uint8_t PIN_BACKLIGHT_SW = 18;
constexpr uint8_t PIN_CALIBRATE = 21;
```

**FIRMWARE CHANGE
REQUIRED**

The current project uses an ILI9341-specific 240 x 320 display driver and old ESP32 pins (SCK 18, MISO 19, MOSI 23, TFT CS 5, DC 2, RST 4, touch CS 15, backlight 32). It will not drive the new 480 x 320 ILI9488 correctly without a display-driver and layout migration.

First power-up checklist

Step	Test	Pass condition
1	Inspect battery	No swelling, puncture, heat, corrosion, or damaged insulation.
2	Confirm battery polarity	Meter agrees with the labeled + and - contacts; center remains isolated.
3	Set boost with no load	Output is stable at 4.9-5.1 V, not 8/9/12 V.
4	Check 5 V rail	Correct polarity at ESP 5V/VIN and TFT VCC connectors.
5	Power ESP alone	Boots normally; no hot components; 5 V remains stable.
6	Add TFT with BL temporarily ON	No excessive heat; display initializes; supply does not reset.
7	Add touch polling, then SD	Touches are stable without T_IRQ and SD works without bus conflicts.
8	Add transistor switch last	GPIO18 switches the backlight fully ON/OFF; there is no PWM brightness control.

Stop immediately if

the battery warms, swells, smells unusual, the TP4056 or boost converter becomes painfully hot, the 5 V rail exceeds 5.1 V, or connecting USB changes the measured rail unexpectedly. Disconnect the battery first and re-check polarity and module labels.

Touch-polling sleep behavior

Do not configure or read T_IRQ. Poll the XPT2046 over SPI about every 25-50 ms while the screen is asleep. After five minutes without valid touch input, set GPIO18 HIGH to turn the backlight OFF and send the ILI9488 Display OFF/Sleep IN commands. When polling detects a valid touch, wake the ILI9488, wait for its required startup delay, then set GPIO18 LOW to turn the backlight ON. Keep TOUCH_CS HIGH whenever the touch controller is not being read.

Clone layouts vary. Printed pin labels and meter readings take priority over board position or wire color.