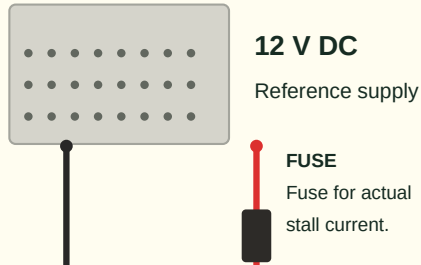




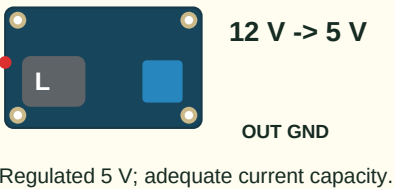
ESP32 + BTS7960 Wiring

MPU6050 + RTC | GPIO numbers; component positions illustrative. Verify your actual terminal labels.

1. Fused actuator supply



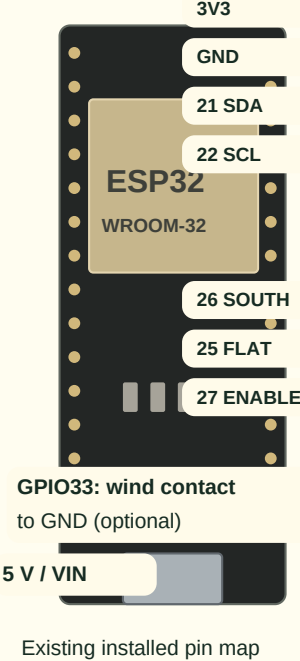
2. Controller regulator



Wire colors / build notes

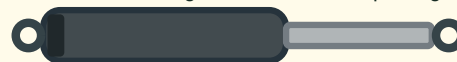
- 12 V actuator supply
- Regulated 5 V
- 3.3 V / sensor rail*
- Common ground
- I2C SDA / GPIO21
- I2C SCL / GPIO22
- GPIO26 SOUTH
- GPIO25 FLAT

ESP32-WROOM



Power and commissioning

Never connect 5 V I2C pull-ups to ESP32 GPIO.
DS1307 may require 5 V and a level shifter.
Do not assume every DS3231 board has the same supply and pull-up arrangement.
Calibrate after mounting; set actual travel limits.
Keep motor disabled until checks are complete.
GPS is not configured in the current package.



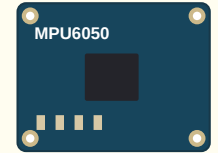
LINEAR ACTUATOR / MOTOR POWER VIA DRIVER

3. MPU6050 / GY-521

VCC: module-rated rail*

- GND
- SDA - GPIO21
- SCL - GPIO22
- AD0 - 3.3 V / 0x69

*3.3 V only if your breakout supports it.

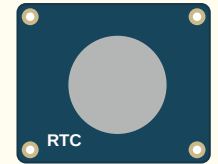


4. DS3231 / DS1307 RTC

VCC: module-rated rail*

- GND
- SDA - GPIO21
- SCL - GPIO22

0x68; DS1307 firmware component.



5. BTS7960 / IBT-2

RPWM - GPIO26

LPWM - GPIO25

R_EN + L_EN - GPIO27

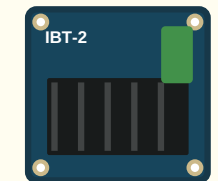
GND

VCC - regulated 5 V

B+ / B-: fused motor supply / negative

M+ / M-: actuator leads; verify direction

10 kohm to GND on GPIO25 / 26 / 27

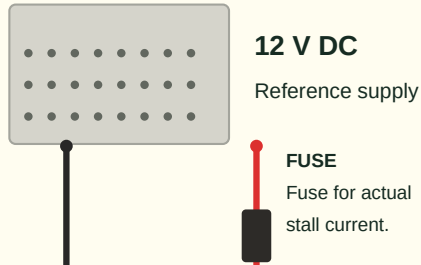




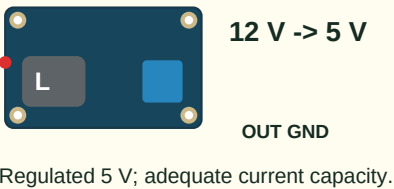
ESP32 + OONO Wiring

MPU6050 + RTC | GPIO numbers; component positions illustrative. Verify your actual terminal labels.

1. Fused actuator supply



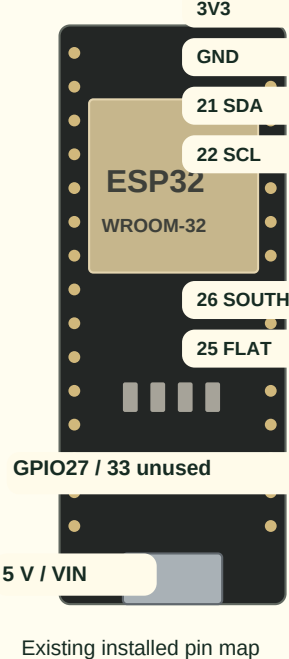
2. Controller regulator



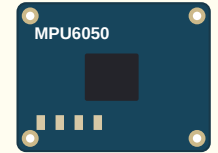
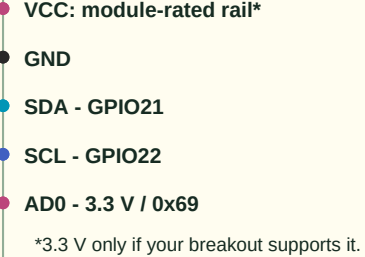
Wire colors / build notes

- 12 V actuator supply
- Regulated 5 V
- 3.3 V / sensor rail*
- Common ground
- I2C SDA / GPIO21
- I2C SCL / GPIO22
- GPIO26 SOUTH
- GPIO25 FLAT

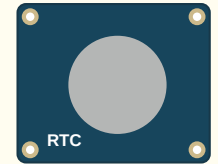
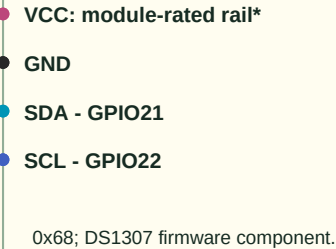
ESP32-WROOM



3. MPU6050 / GY-521

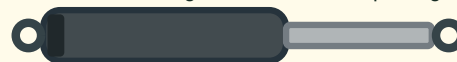


4. DS3231 / DS1307 RTC



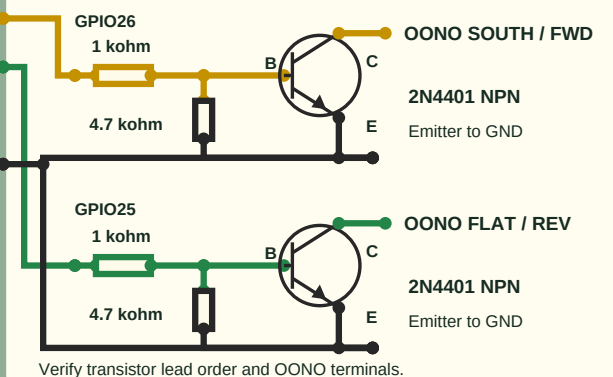
Power and commissioning

Never connect 5 V I2C pull-ups to ESP32 GPIO.
DS1307 may require 5 V and a level shifter.
Do not assume every DS3231 board has the same supply and pull-up arrangement.
Calibrate after mounting; set actual travel limits.
Keep motor disabled until checks are complete.
GPS is not configured in the current package.



LINEAR ACTUATOR / MOTOR POWER VIA DRIVER

5. OONO transistor interface



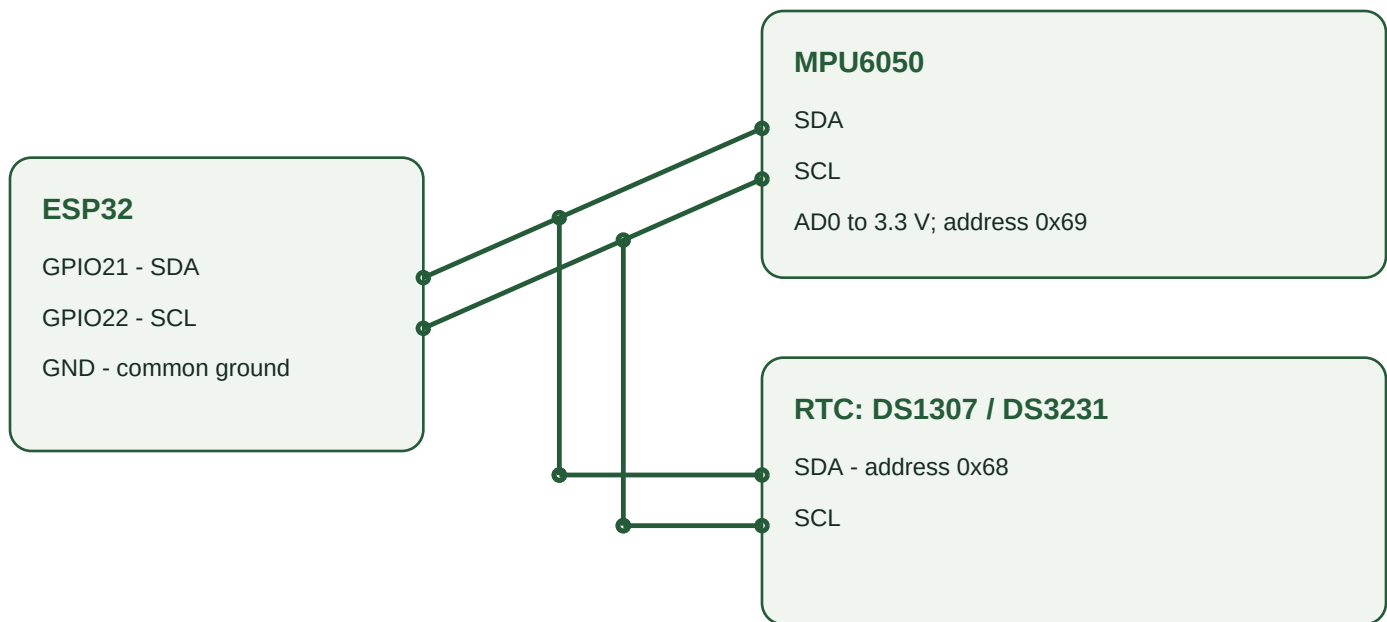


Shared sensor wiring

Use this page with either motor-driver profile. GPIO numbers are not header positions.

The clock and MPU6050 share the same I2C bus. Their addresses must be different. This is a connection guide for the existing ESP32-WROOM build; other ESP32 boards need a reviewed pin map.

Connection	ESP32 / configuration
MPU6050 SDA and RTC SDA	GPIO21
MPU6050 SCL and RTC SCL	GPIO22
MPU6050 GND and RTC GND	Common GND
MPU6050 AD0	3.3 V: selects address 0x69
RTC address	0x68; firmware uses the ds1307 component



Power and logic voltage

Power each breakout at its specified voltage. Keep SDA/SCL pull-ups at 3.3 V on the ESP32 side. A DS1307 board needing 5 V may need an I2C level shifter; never feed 5 V pull-ups directly into ESP32 GPIO. Check the exact module, not just the chip name.

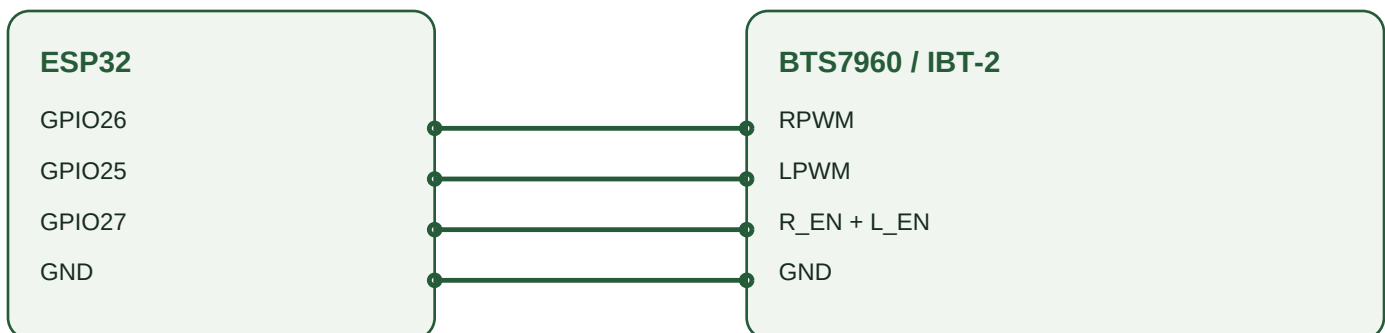
DS3231: field clock operation has been reported, but the package still uses ds1307. Verify battery-backed time after loss of Wi-Fi and power. Date/time on the webpage can also come from network synchronization.



BTS7960 / IBT-2 motor wiring

Select packages/solar-tracker.yaml. Array numbering does not select the motor driver.

BTS7960 connection	Wire / purpose
RPWM	GPIO26 - SOUTH / more tilt
LPWM	GPIO25 - FLAT / less tilt
R_EN and L_EN together	GPIO27 - driver enable
VCC logic supply	Regulated 5 V
GND	Common ESP32 / driver / supply ground
B+ / B-	Fused actuator supply / supply negative
M+ / M-	Two actuator motor leads
GPIO25, GPIO26 and GPIO27	Each has a physical 10 kohm pull-down to GND



Physical wind-safe input - BTS profile only

GPIO33 is an active-low input with an internal pull-up. A suitable dry contact to GND requests parking. Do not connect a powered wind-sensor output without checking its voltage and interface. GPIO32 is reserved and unassigned.

The installed reference uses a 12 V actuator supply. Size the fuse, wiring, driver and regulator for the actual actuator and its stall current. Motor power does not come from ESP32 GPIO or the ESP32 5 V pin.

GPIO commands are full-speed digital outputs with a 300 ms direction interlock. Before automatic operation, verify SOUTH increases the measured angle and FLAT decreases it. Stop and correct the wiring/direction if they do not.

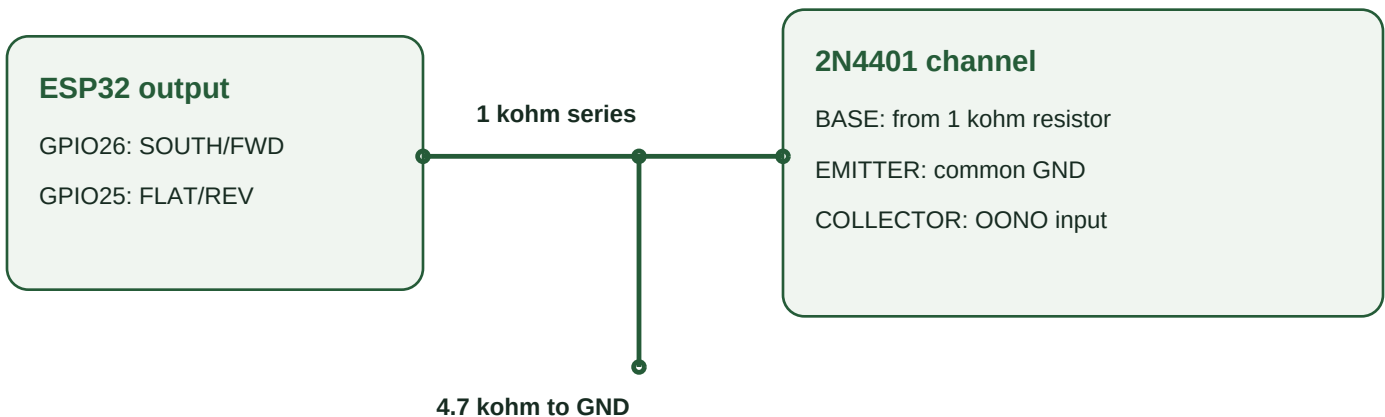


OONO relay motor wiring

Select packages/solar-tracker-oono.yaml. Preserve the installed transistor interface.

Connection	Installed assignment
GPIO26	1 kohm resistor to SOUTH/FWD transistor base
GPIO25	1 kohm resistor to FLAT/REV transistor base
Each transistor	2N4401 NPN; verify the exact part lead order
Each base	4.7 kohm pull-down from base to GND
Each emitter	Common GND
Each collector	Matching OONO direction control input
GPIO27 / GPIO33	Not assigned by this profile

Repeat this circuit for each direction



Driver power and motor terminals

Keep the installed OONO supply and actuator-terminal wiring. OONO models can differ: confirm the model label and terminal diagram before wiring a new board. This guide documents the known GPIO-to-transistor interface, not an unverified relay terminal layout.

Use a fused actuator supply and a regulated controller supply with common ground. Do not connect an OONO control input directly to an ESP32 pin unless the exact board interface has been independently verified.

Both direction outputs start LOW and use a 300 ms interlock. This profile has no dedicated hardware enable or wired wind-safe input; wind data and Safety Bus alerts are handled by the shared firmware.



Identity, setup and calibration

Saved settings survive firmware updates. Check the actual controller after every rename or rebuild.

Choose the hardware package, then the array number

Use array_number: "1" through "8" in substitutions. This generates the node name, initial display name, MQTT prefix and peer roster. Hardware is a separate package choice; a number does not change pins. Keep each device's API, OTA and web credentials in local secrets.

Hardware	Package file
OONO / 2N4401 interface	packages/solar-tracker-oono.yaml
BTS7960 / IBT-2 interface	packages/solar-tracker.yaml

After uploading through ESPHome

1. Check the saved Tracker Number, Tracker Name and MQTT Topic Prefix. Each installed controller needs a unique identity. A filename such as solar-array-00.yaml is not the controller identity.
2. Check latitude, longitude, time zone and panel-facing azimuth. wifi.use_address sets the upload destination; it does not assign a static IP.
3. Disable the motor. Install the MPU6050 firmly in its final orientation. Read Raw Panel Angle and confirm it changes smoothly when the panel tilts.
4. Measure the physical panel tilt with a level. Enter Calibration Reference Angle and press Calibrate From Known Angle. Use Capture Panel Flat only when physically flat (0 degrees).
5. Verify Actual Solar Angle agrees with the level. A large offset can be valid for an inverted sensor. Recalibrate after changing its orientation.
6. Set minimum and maximum angles inside the actual mechanism's travel. Reference defaults are 1.5 to 84 degrees; your actuator may stop earlier.
7. Verify short SOUTH and FLAT service jogs and STOP PANEL before returning to Auto Sun. Confirm movement follows the displayed angle in the correct direction.

MQTT and ESP-NOW

MQTT is optional; its saved enabled/disabled state survives restarts. Verify unique topics (for example tryon/solar/array4). All trackers need the same Safety Bus key and compatible Wi-Fi channel. The service list shows received online peers, not every configured slot.



Installation checks and references

Record the completed installation. This document does not certify an unseen physical build.

Complete these checks on each installed tracker

- ☐ Correct motor-driver package; see diagrams 1/2 and pin tables 4/5.
- ☐ Controller and driver grounds are common; motor circuit is fused.
- ☐ Required physical pull-downs are fitted; motor stays stopped at boot.
- ☐ I2C scan detects RTC at 0x68 and MPU6050 at 0x69.
- ☐ Calibration matches a physical level; mounting is secure.
- ☐ Travel limits stop commands before mechanical actuator end stops.
- ☐ SOUTH, FLAT and STOP PANEL behave correctly.
- ☐ Unique saved identity, MQTT prefix and Home Assistant entities.
- ☐ Time, location, wind data and expected online ESP-NOW peers checked.
- ☐ Restart preserves calibration and settings; backup exported.

Installation record

Record	Value
Array name / number	
Motor driver / ESP32 board	
IP address / installation date	
Minimum / maximum tilt	

Sources and project access

Firmware: github.com/Tryon-Electronics-Solar/tryon-solar-tracker

Source pin maps: [packages/hardware/bts7960.yaml](#); [packages/hardware/oono-relay.yaml](#); [packages/solar-tracker-core.yaml](#).

Home Assistant card: github.com/Tryon-Electronics/tryon-solar-tracker-card

Public project: tryonelectronics.com/projects/solar-tracker

Firmware access may require repository permission. No passwords, tokens or private controller addresses are included in this public guide. Cellular wiring is not part of the installed tracker profiles.