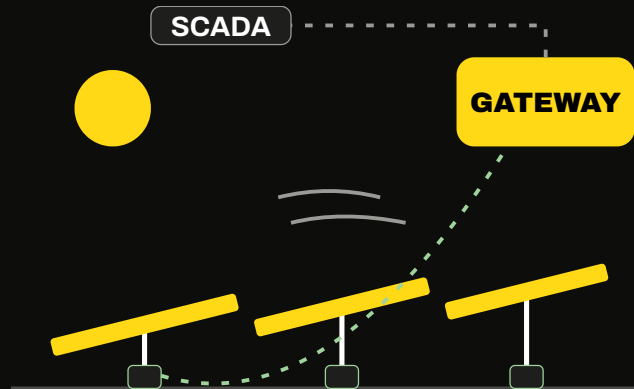


SECTOR: SOLAR PV PLANTS

Every tracker reports. The SCADA sees the whole field.

A controller per tracker row, a gateway per block, one map for the SCADA.

[Read the interactive case study online ›](#)



Schematic illustration

2

controller levels: one per tracker row, one gateway per block

CAN

board on the row controller for the inclinometer and the drive

1

stow command per block, from the gateway to every row

TCP

Modbus TCP register map for the SCADA, plus MQTT for O&M

THE CHALLENGE

Thousands of moving parts, one control room.

In a tracker plant, each row has its own motor, its own angle sensor and its own controller. The plant SCADA needs to know which rows follow the sun, which are stuck and which are in stow, without walking the field. And when the wind rises, a whole block has to go to its safe position at once. The builder or the integrator needs a data path that is the same in every block, and that keeps working when a link fails.

01

See every row

Angle, target, motor current and alarms of each row, in the same tags, block after block.

02

Stow on wind

A gust above the limit of the tracker maker sends every row of the block to its safe position.

03

One map for the SCADA

The SCADA reads one register map per block, whatever the number of rows behind it.

04

No gaps in the history

If the link to the control room drops, the block keeps the data and sends it later.



A row that does not answer is a fault too

Silence on the field bus is an alarm. The gateway marks the row, and the row goes to stow on its own if it loses the gateway.

HOW IT WORKS

Three levels of the data path: row, block, plant.

Level 1 · Row

The row controller follows the sun and watches its motor.

An ESP32 PLC 21 FLEX with a CAN board drives one row. It calculates the sun angle, reads the inclinometer, drives the motor and compares target and real angle. A large error with a high current means the row is stuck.

- Target angle from the position of the sun
- Real angle from a CANopen inclinometer
- Error and current watched together

Level 2 · Block

The gateway hears the wind and stows the block.

The block gateway reads the weather station and polls every row. When the gust passes the limit, it sends the stow command to all the rows and checks that each one gets there. It releases them only after the wind stays low for a set time.

- Wind read from the weather station
- One stow command for the whole block
- Release only after a calm period

Level 3 · Plant

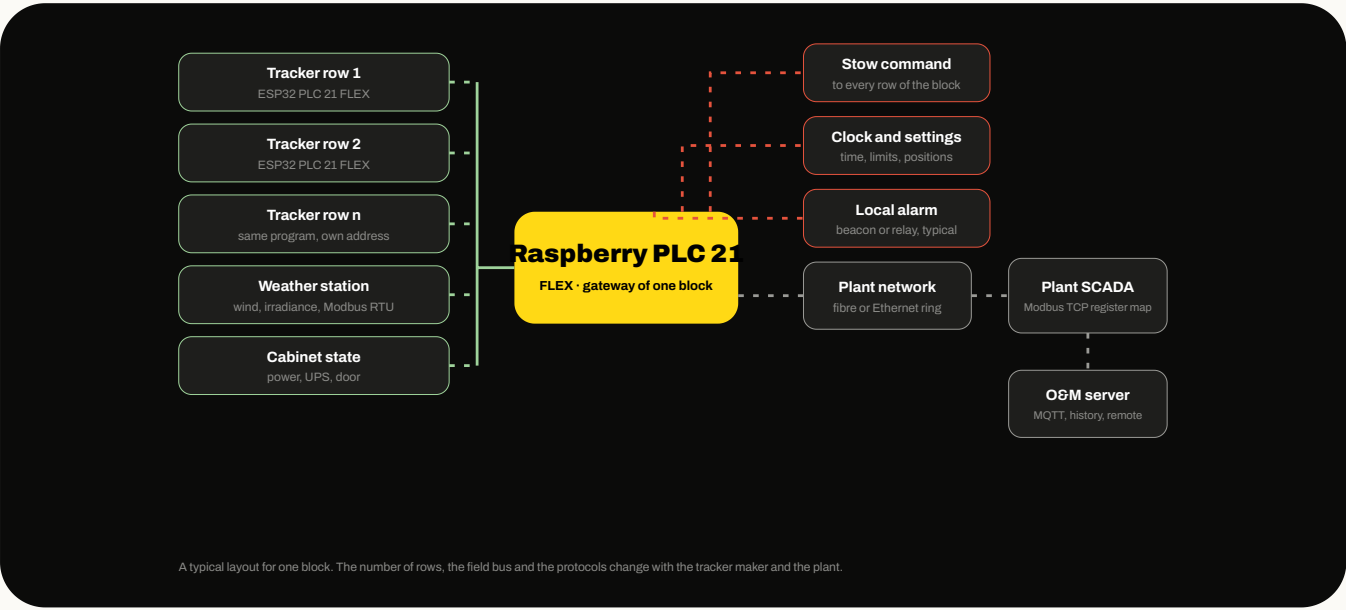
One register map for the SCADA, and nothing lost on the way.

The gateway publishes every row in a fixed register map over Modbus TCP for the SCADA, and over MQTT for the O&M server. If the plant network drops, it keeps the records on its disk and sends them when the link is back. A new row is a new block of registers, not a new program. Cut the link and bring it back.

- Modbus TCP server with a fixed map
- MQTT for history and remote work
- Records kept on disk while offline

How does tracker data get from the field to the plant SCADA?

Each tracker row has an ESP32 PLC 21 FLEX with a CAN board for its inclinometer and its drive. The rows of a block share a field bus to a RASPBERRY PLC 21 FLEX in the block cabinet, which also reads the weather station. The gateway sends the stow command to the rows, keeps the clock and the settings, and publishes every row to the plant SCADA over Modbus TCP and to the O&M server over MQTT.



— Into the gateway
 - - - From the gateway to the rows
 — Plant network

Signals and data

Data	Between	Type	Purpose
Real angle	Inclinometer → row controller	CANopen	Close the loop of the row
Motor command and state	Row controller ↔ drive	CANopen or outputs (typical)	Move the row, read current and faults
Row data	Row controllers → gateway	RS-485 Modbus RTU or CAN (typical)	Angle, target, mode, alarms
Wind and irradiance	Weather station → gateway	Modbus RTU	Stow decision, performance
Stow command	Gateway → all rows of the block	Field bus	Safe position on wind
Heartbeat	Gateway ↔ rows	Field bus	A silent link sends the row to stow
Clock and settings	Gateway → rows	Field bus	Same time and limits everywhere
Block register map	Gateway → plant SCADA	Modbus TCP	Live view and control room alarms
History and remote work	Gateway → O&M server	MQTT	Trends, reports, service

An ESP32 PLC in each row. A Raspberry PLC in each block.



TRACKER ROW

ESP32 PLC 21 FLEX

An industrial controller built on the dual-core ESP32, for DIN rail, programmed with the Arduino IDE. The FLEX version takes one communication board: here, CAN, for the inclinometer and the drive of the row.

Role	Follows the sun, closes the angle loop, stows on command or on its own
Processor	ESP32 dual core, up to 240 MHz
Inputs	13: 6 analog/digital (0-10 V, 11-bit), 7 digital optoisolated (5 to 24 Vdc), 2 of them with interrupt
Outputs	8: 3 analog/digital/PWM (0-10 V, 12-bit), 5 digital optoisolated (5 to 24 Vdc)
Option board	CAN in this design; also 4G (M1)-NB1 IoT LTE (u-blox) or LoRa
Wired	Ethernet, RS-485, RS-232

Outdoor row cabinets need the protection degree, the temperature range and the surge protection of the site. Check the operating range of the PLC against the climate of the plant.

[See the ESP32 PLC 21 FLEX ›](#)



BLOCK GATEWAY

RASPBERRY PLC 21 FLEX

An industrial controller built on a Raspberry Pi 4 with Debian. It polls the rows and the weather station, decides the stow for the block, keeps a local buffer and serves the plant SCADA and the O&M server.

Role	Block gateway: polling, stow, buffer, Modbus TCP server, MQTT client
Inputs	13: 6 analog/digital (0-10 V, 12-bit), 7 digital optoisolated (5-24 Vdc), 2 with interrupt
Outputs	8: 3 analog/digital/PWM (0-10 V, 12-bit), 5 digital optoisolated (5-24 Vdc)
Expansion	One board: CAN for a CAN field bus (also LoRa, 4G or M-Bus master)
Comms	Ethernet 1 Gigabit + 1 10/100, 2 x RS-485, Wi-Fi, Bluetooth LE
Computer	Raspberry Pi 4, Debian 64-bit

The two RS-485 ports can serve two segments of rows, or the rows and the weather station. Size each segment by the number of rows and the poll time you need.

[See the RASPBERRY PLC 21 FLEX ›](#)

Control stays in the row

Each row follows the sun with its own controller. The gateway adds commands and data, it does not run the motors.

Stow does not wait for the network

The block decides on the wind locally, and each row stows by itself if it loses the gateway.

One map, any size

The SCADA integrator works with one register map per block. Adding rows extends the map, it does not change it.

SIMILAR PROJECT?

Tell us about your tracker plant. An engineer will answer.

Tell us the tracker type, how many rows per block, the field bus you use and what the SCADA expects. We will tell you which controllers, which bus and which data map fit.

READ IT ONLINE

industrialshields.com/case-study-solar-tracker-data-gateway-raspberrypi-plc

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