

SECTOR: AGVS AND MOBILE ROBOTS

The safety controller stops the AGV. The PLC runs the rest.

Lights, load sensors, charging and battery data on an ESP32 PLC that only reads the safety controller.

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


Schematic illustration

0

safety functions in the PLC: every stop goes through the certified safety controller

13 + 8

inputs and outputs on the ESP32 PLC 21 FLEX for the auxiliary functions

1

CAN board option to read the battery management system

12-24 V

supply of the PLC, from a DC/DC converter, not straight from the battery

THE CHALLENGE

One vehicle, two kinds of signals.

An AGV or an AMR carries two kinds of logic. Safety functions protect people: emergency stop, detection of people with safety laser scanners, speed control and braking. ISO 3691-4 gives each one a required performance level, met with ISO 13849-1, and they run in a certified safety controller or safety relay. Around them sit many signals that are not safety functions: tower light and sound, load sensors on the top module, charging contacts, battery data, and the link to the navigation computer and the fleet manager. The maker needs a small controller for those, built in series, that never weakens the stop chain.

01

Keep the stop chain certified

Emergency stops, scanners and bumpers wired to the safety controller, which removes torque from the drives (STO) and applies the brakes.

02

Read, never override

The PLC reads the state of the safety controller to show it, log it and report it. It has no wire into the stop chain.

03

Run the auxiliaries

Tower light, sound, blue spot, load sensors, lift end positions and charging contacts on the I/O of the PLC.

04

Talk to the rest

Battery data over CAN, the navigation computer over Modbus TCP, events to the fleet manager over MQTT.



Safety is a separate job

The PLC in this design is a standard controller, not a safety controller.

HOW IT WORKS

Three jobs: report the safety state, move the load, keep the battery in charge.

Job 1 · Report the safety state

The safety controller decides. The PLC tells everyone.

The safety laser scanners have a warning field and a protective field. When a person enters the warning field, the navigation slows the vehicle down; this is not a safety function, and the PLC turns the light amber. When the protective field is broken or an emergency stop is pressed, the safety controller removes torque and brakes, on its own.

- Warning field: navigation slows down, amber light
- Protective field: safety stop by the safety controller

Job 2 · Move the load

Dock, check, transfer, leave.

At a station, an AGV with a roller top module docks. The PLC checks the position and the handshake with the station, runs the rollers and watches the load sensors until the load is on board. Only then does it tell the navigation computer that the vehicle may leave.

- Handshake with the station over I/O or Wi-Fi
- Load sensors at both ends of the rollers

Job 3 · Keep the battery in charge

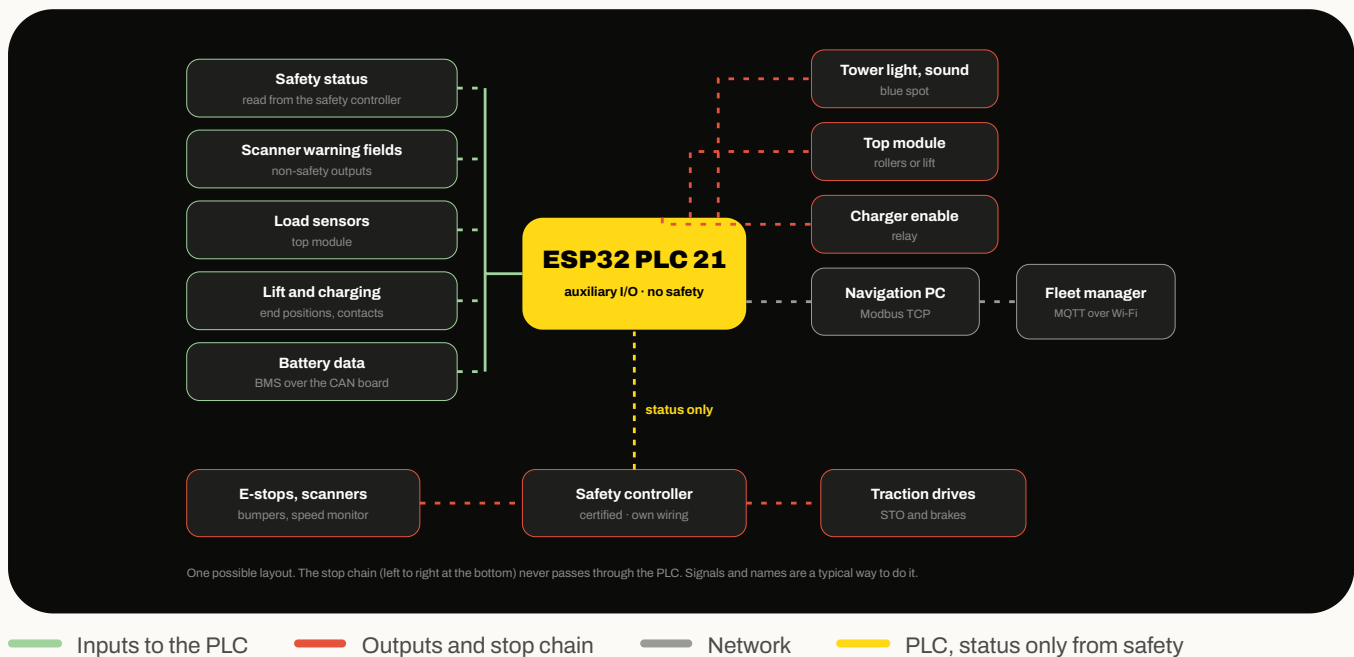
The PLC knows the battery before the fleet asks.

The battery management system (BMS) sends state of charge, current, temperature and alarms over CAN. The PLC reads them, passes them to the navigation computer and the fleet manager, and runs the charging side: contacts closed, charger enabled, end of charge. When the charge falls under the level set by the fleet, the vehicle goes to charge between missions.

- State of charge, current and temperature over CAN
- Charging contacts and charger enable on I/O

How do you split safety and auxiliary I/O on an AGV?

Safety devices (emergency stops, safety laser scanners, bumpers, speed monitoring) go to a certified safety controller, which removes torque from the traction drives and applies the brakes. The ESP32 PLC reads its status outputs and runs the auxiliary I/O: tower light, sound, load sensors, lift end positions and charging. Battery data arrives over CAN, the navigation computer talks Modbus TCP on Ethernet, and the fleet manager gets events over MQTT on Wi-Fi.



Signals

Signal	Between	Type	Purpose
Protective field, emergency stop, bumper	Devices → safety controller	Safety inputs, dual channel	Safety stop: STO and brakes, never through the PLC
Safety OK or safety stop	Safety controller → PLC	Digital input, status only	Light, sound, log, report to the fleet
Emergency stop pressed	Safety controller → PLC	Digital input, status only	Tell the operator and the fleet why it stopped
Warning field occupied	Scanner → navigation and PLC	Non-safety output	Slow down (navigation), amber light (PLC)
Load present, end positions	Sensors → PLC	Digital input, 24 V	Steps and timeouts of the transfer
Rollers or lift	PLC → top module drive	Digital output	Run the transfer
Tower light, sound, blue spot	PLC → signals	Digital output	Show the state of the vehicle
Charging contacts, charger enable	Contacts ↔ PLC	Digital input and output	Charge between missions
Charge, current, temperature, alarms	BMS → PLC	CAN, board option	Send to charge, report battery alarms
Mission, status, events	PLC ↔ navigation PC and fleet manager	Modbus TCP, MQTT	One view of every vehicle

One compact PLC for everything that is not safety.



OUR OPTION FOR THIS ROLE

ESP32 PLC 21 FLEX

An industrial controller built on the dual-core ESP32, for DIN rail, programmed with the Arduino IDE. It has the inputs and outputs for the auxiliary functions of a vehicle, Ethernet for the navigation computer, Wi-Fi for the fleet, and the FLEX version takes one communication board: here, CAN for the battery management system.

Role in this design	Auxiliary I/O, state of the safety controller, BMS over CAN, link to navigation and fleet
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)
Wireless and option board	Wi-Fi and Bluetooth LE built in; one option board: CAN here, or LoRa or 4G
Wired	Ethernet, RS-485, RS-232

It is a standard controller, not a safety controller: do not wire it into the stop chain. A 24 V vehicle battery goes above 28 V while charging, and 48 V systems are common, so feed the PLC from a DC/DC converter.

[See the ESP32 PLC 21 FLEX ›](#)

The certification stays put

The safety controller and its wiring keep their performance level. Changing the auxiliary program does not touch the safety validation.

Stops people can read

Because the PLC reads why the vehicle stopped, the light, the log and the fleet manager can say "emergency stop" or "protective field" instead of just "stopped".

Small enough for a vehicle

13 inputs and 8 outputs in a DIN rail housing, with Ethernet, RS-485, Wi-Fi and a CAN board option.

SIMILAR PROJECT?

Tell us about your vehicle. An engineer will answer.

Tell us which auxiliary signals your AGV or AMR has, which battery and BMS, how the navigation computer and the fleet manager talk, and how many vehicles a year you build. We will tell you which controller fits and how to keep it out of the stop chain.

READ IT ONLINE

industrialshields.com/case-study-agv-mobile-robot-auxiliary-io-esp32-plc

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