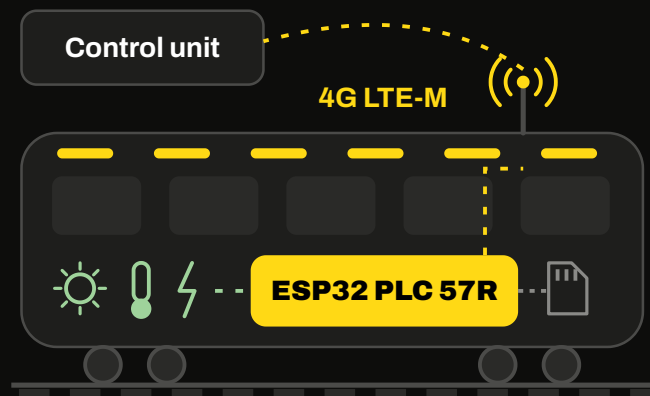


RAILWAY · ESP32 PLC 57R

Comfort on board. Energy data that waits for coverage.

Light, ventilation and A/C on board. Energy data over 4G LTE-M.

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


Schematic illustration

6

parameters to control and monitor

3

sensor types connected to the PLC

18/33

inputs and outputs on the ESP32 PLC 57R

LTE-M

4G link to the control unit, with a local buffer

THE CHALLENGE

Safe, efficient and comfortable carriages. And the energy in numbers.

The customer manages a railway network. Its main goal was a control and monitoring system for the train carriages of the company, for the safety, efficiency and comfort of passengers and staff on board. The case lists six parameters: lighting, ventilation, air conditioning, temperature, humidity and energy.

01

Light where it is needed

Ambient light in a carriage changes all the time. The lighting must follow the real light level, not a fixed schedule.

02

Climate in range

The values inside the carriage must stay within the established ranges. If they leave them, ventilation and air conditioning must react.

03

Energy you can measure

The operator wants to see the energy consumption of each wagon, find ways to reduce it, and plan maintenance with data.

04

A link that comes and goes

The data travels over a mobile network to a control unit. When coverage is lost, the data must not be lost with it.



Six parameters, one controller

Lighting, ventilation, air conditioning, temperature, humidity and energy on one ESP32 PLC 57R with a 4G LTE-M communication board.

HOW IT WORKS

Three loops: light, climate, energy.

Loop 1 · Light

A light sensor tells the PLC when to switch the lighting.

A light sensor measures the ambient light level in the carriage. The PLC opens or closes the light circuit, so the lighting follows what the carriage needs. The case also says the lighting can be dimmed as required, without more detail. A typical way to do it: two light levels, one to close the circuit and one to open it, so the lights do not flicker at the limit. Move the light level in the panel.

- Light sensor inside the carriage, connected to the PLC
- The PLC opens or closes the light circuit
- Example: on below 150 lx, off above 300 lx

Loop 2 · Climate

Out of range, the PLC starts ventilation or air conditioning.

A temperature and humidity sensor monitors the values inside the carriage all the time. When the values go outside the established ranges, the PLC activates the ventilation and/or the air conditioning. The case also lists an alert to maintenance staff after a dangerous temperature rise. A typical way to do it: high humidity starts the ventilation, high temperature starts the air conditioning, and a higher limit sends an alert. Move the sliders.

- One sensor for temperature and humidity
- Ventilation and/or air conditioning when a value leaves its range
- Alert to maintenance staff after a dangerous temperature rise

Loop 3 · Energy

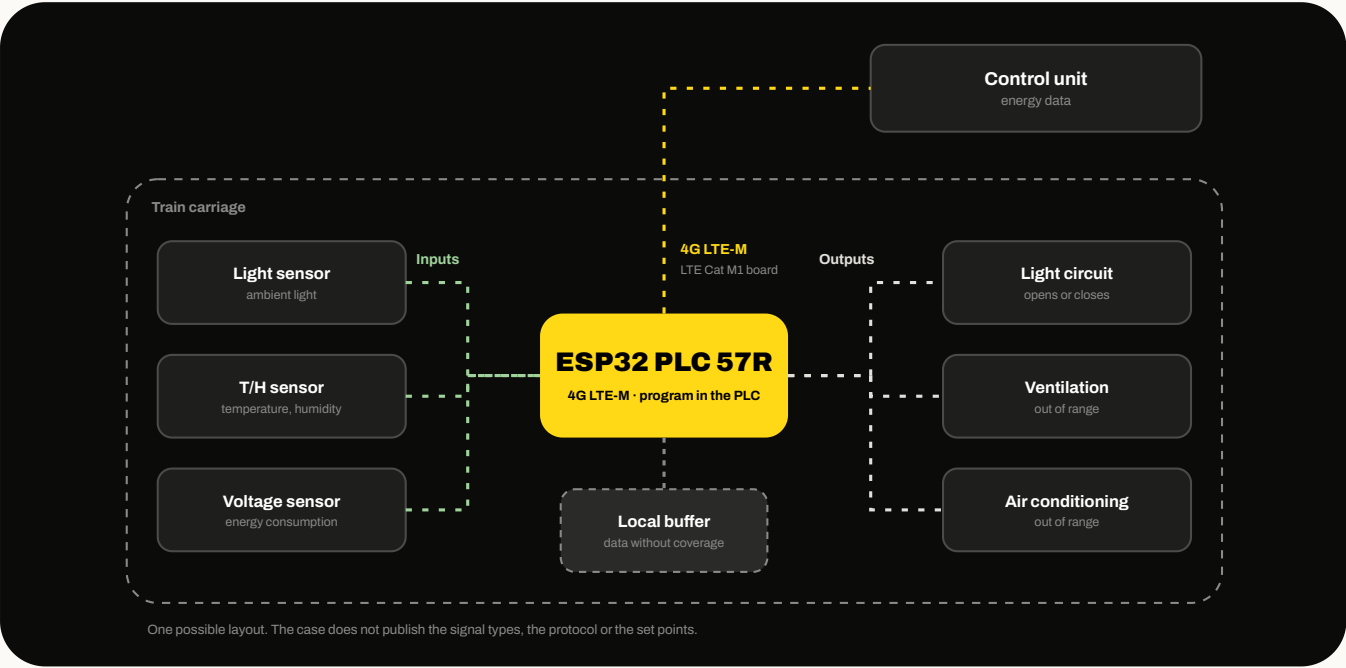
Energy data goes out over 4G LTE-M. Without coverage, it waits on board.

A voltage sensor connected to the PLC measures the energy consumption of the wagon. The PLC sends the data to a control unit over the mobile network: 4G LTE-M on the ESP32 PLC 57R, GPRS in the original installation. If coverage is lost, the PLC keeps the data on board until the connection is restored, and then sends it automatically. In the original installation, the buffer was the SD card of the controller. Press Lose coverage, wait, then restore it.

- Voltage sensor on the wagon supply, connected to the PLC
- Energy data to a control unit over 4G LTE-M
- Local buffer during loss of coverage, automatic sending after

How does an ESP32 PLC with 4G LTE-M control and monitor a train carriage?

Three sensors connect to the ESP32 PLC 57R: light, temperature and humidity, and voltage. The PLC drives the light circuit, the ventilation and the air conditioning of the carriage. It sends the energy data to a control unit over 4G LTE-M, and keeps it in a local buffer while there is no coverage.



— Sensor inputs — Outputs to the carriage loads — 4G LTE-M data — Local buffer and example elements

Signals and data

Signal	Between	Type	Purpose
Ambient light	Light sensor → ESP32 PLC 57R	Input	Light level in the carriage. Signal type not published
Temperature and humidity	T/H sensor → ESP32 PLC 57R	Input	Values inside the carriage, compared with the established ranges
Voltage	Voltage sensor → ESP32 PLC 57R	Input	Energy consumption of the wagon
Light circuit	ESP32 PLC 57R → lighting	Output	Opens or closes the light circuit
Ventilation and A/C	ESP32 PLC 57R → ventilation, air conditioning	Output	Start when temperature or humidity leave their ranges
Energy data	ESP32 PLC 57R → control unit	4G LTE-M	Consumption data of the wagon. Protocol not published. GPRS in the original installation
Data buffer	ESP32 PLC 57R → local storage	On board	Keeps the data during loss of coverage. Sent automatically when the link is back. SD card in the original installation
Maintenance alert	ESP32 PLC 57R → maintenance staff	Not published	Dangerous temperature rise or a lighting problem

ESP32 PLC 57R with a 4G LTE-M board.



ESP32 PLC 57R with the 4G (M1)-NB1 IoT LTE board

An ESP32 based industrial PLC for DIN rail, with analog inputs for the sensors, relays for the loads and an optional 4G LTE Cat M1 communication board for the data link to the control unit.

Role	Light and climate control, energy data over 4G LTE-M
Inputs	18: 12 analog/digital (0-10 V, 11-bit), 6 digital optoisolated
Outputs	33: 24 relays, 9 analog/digital/PWM (0-10 V)
Mobile link	Communication board 4G (M1)-NB1 IoT LTE (u-blox SARA-R412M), option
Other comms	Ethernet, Wi-Fi, Bluetooth LE, RS-485, RS-232, I2C, SPI
Built in	Real-time clock
Power	12 to 24 Vdc, DIN rail

The original installation used an M-Duino 54ARA with an integrated GPRS module (26 inputs, 25 outputs), no longer in the web shop. On the product page, choose the 4G (M1)-NB1 IoT LTE board as communication board 1.

[See the ESP32 PLC 57R ›](#)

4G LTE-M on the PLC

The ESP32 PLC 57R takes a 4G (M1)-NB1 IoT LTE communication board. No separate modem in the carriage. The original installation chose a controller with an integrated GPRS module for the same reason.

Store and forward

Without coverage, the data stays on board. When the link is back, the PLC sends it automatically. The control unit gets the data later, instead of losing it.

Decisions on board

Light and climate rules run in the PLC, next to the sensors and the loads. The mobile link carries data. It does not switch the lights.

Mixed I/O on one unit

18 inputs and 33 outputs on the ESP32 PLC 57R. One possible split: the 12 analog inputs for the sensors, the 24 relays for the loads, the 9 analog outputs if a load needs a reference.

Data for maintenance

Continuous values from every carriage help to find faults in lighting, ventilation and air conditioning, and to plan the work before a failure.

Open and modular

Programmed with the Arduino IDE, with no licence fees. The ESP32 PLC grows with up to 127 expansion modules over I2C.

SIMILAR PROJECT?

**Tell us about your vehicles and your data.
An engineer will answer.**

Tell us what you need to control on board, which sensors you have, how the data must reach your control centre and where coverage drops on your routes. We will tell you which controller fits, how to wire it and how to keep the data safe while the link is down.

READ IT ONLINE

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EMAIL

info@industrialshields.com

PHONE

(+34) 938 760 191