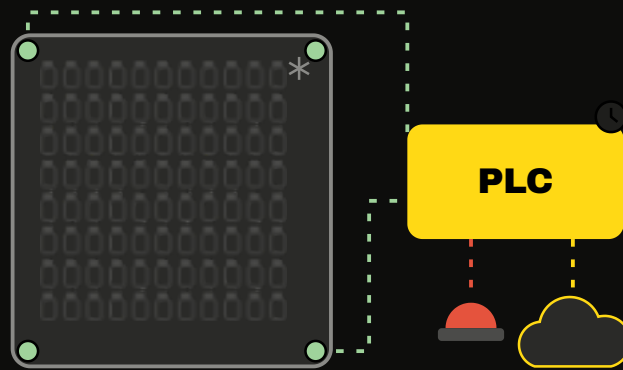


VACCINE COLD CHAIN · RASPBERRY PLC

Every corner of the freezer. One PLC watches it.

Probes in the tank, the PLC outside. Alarm, day count and record on one unit.

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


Schematic illustration

4

probes at the corners of the tank, in the scheme

−80 °C

the coldest band the case quotes

30

days: the use window the RTC counts

1

PLC outside the cold, with the alarm

THE CHALLENGE

Each product has a temperature band. Out of the band, the batch can spoil.

Vaccines and many medicines must stay in a set temperature band, in storage and in transport. The case quoted two examples from 2020: one vaccine kept below -80°C , and another kept at 2 to 8°C for up to 30 days, or for up to 6 months below -20°C . Always use the storage conditions in the product information of your product.

01

Very cold bands

Some products need an ultra-low freezer at -80°C , others -20°C , others a fridge at 2 to 8°C . The probes and the limits depend on the band.

02

Not one temperature

The temperature is not the same at every point of a tank. The case puts several sensors along the reservoir for a more accurate reading.

03

Act in time

If the tank warms over a limit, the supervisors must know at once. The case says it is crucial to correct the error as fast as possible, so that no samples spoil.

04

Count the days

Some products must be used within a time window. In the case, within one month. The system must know how long each batch has been in the tank.



Losses, handling and disposal

A batch that leaves its band is lost, and it takes time and resources to handle and dispose of. Keeping the product in its band avoids both.

HOW IT WORKS

Three jobs: watch, count, record.

Step 1 · Watch every corner

Four probes in the tank. The PLC reads them all and warns at the limit.

The PLC sits outside the freezing tank. The sensors are inside, distributed along the reservoir, and the PLC reads them by cable. If the temperature in the tank passes a limit, the PLC triggers an alarm to warn the supervisors. A typical way to do it: compare the warmest probe with the limit, and wait a short delay before the alarm, so that a short opening does not raise it. Pick a band, then open the lid or stop the cooling.

- PLC outside the tank, sensors inside
- Sensors along the reservoir for a more accurate reading

Step 2 · Count the days

The real-time clock knows how long each batch has been in the tank.

With the RTC (real-time clock), the PLC knows how many days have passed since a batch went into the tank. In the case, the product must be used within one month. A typical way to do it: register each batch when it goes in, store the date from the RTC, and warn some days before the window ends. The clock keeps the time with its own battery. Put a batch in, then move the days.

- Date and time from the RTC of the PLC
- One entry per batch (example)

Step 3 · Keep and send the record

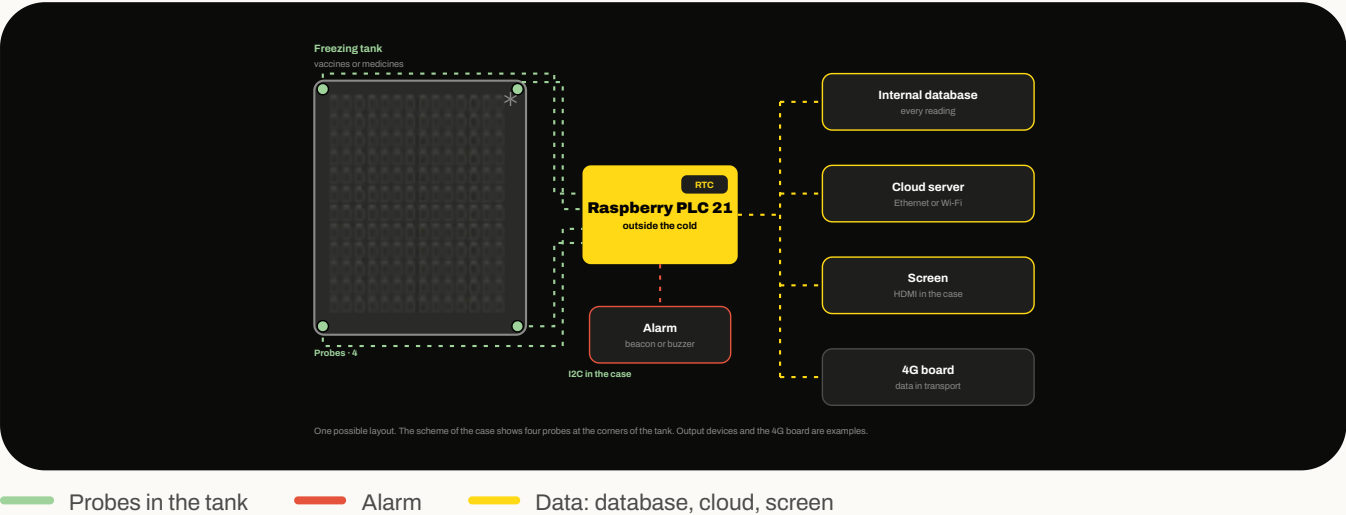
Every reading goes to a database on the PLC, and then to the cloud.

The Raspberry PLC runs Linux, so it can keep an internal database with all the data it collects. Over Ethernet or Wi-Fi it sends the data to the cloud. The case also shows the sensor data on a screen. A typical way to do it: write every reading to the local database first, and send it when the link is up, so a network cut leaves no gap. Cut the link, then bring it back.

- Internal database on the PLC
- Ethernet or Wi-Fi to the cloud

How does a reading from a vaccine freezer reach the supervisor and the cloud?

Temperature probes inside the tank connect by cable to a Raspberry PLC 21 FLEX outside the cold. The case reads them over the I2C bus. The PLC compares the readings with the limit, drives the alarm and dates every reading with its real-time clock. It keeps the data in an internal database, sends it to the cloud over Ethernet or Wi-Fi and shows it on a screen. In transport, a mobile network board sends the same data from the truck.



Signals and data

Data	Between	Link	Purpose
Temperature at each corner	Probes in the tank → PLC	I2C in the case	Temperature where the products are. The scheme shows four probes
Date and time	RTC of the PLC	Built in	Days since each batch went into the tank
Alarm	PLC → beacon or buzzer	Digital output	Warns the supervisors over the limit. The output device is an example
Record	PLC	Internal database	Every reading kept on the PLC
Cloud data	PLC → cloud server	Ethernet or Wi-Fi	The data in the cloud, away from the tank
Screen	PLC → screen	HDMI in the case	Sensor data next to the tank
Data in transport	PLC → server	Mobile network	GPRS in the case; a 4G board on the FLEX today

One Raspberry PLC next to the tank.



RASPBERRY PLC 21 FLEX

An industrial PLC built around a Raspberry Pi 4, with Debian 64-bit preinstalled. It has 13 inputs, 8 outputs, two Ethernet ports, Wi-Fi, a real-time clock with battery and a UPS. In this case it reads the probes, drives the alarm, counts the days of each batch, and keeps and sends the record.

Role	Probes, alarm, day count, database, cloud link
Computer	Raspberry Pi 4, 2, 4 or 8 GB of RAM
Inputs	13: 6 analog/digital (0-10 V, 12-bit), 7 digital optoisolated
Outputs	8: 3 analog/PWM (0-10 V), 5 digital optoisolated (70 mA max.)
Comms	Ethernet x2, Wi-Fi, Bluetooth LE, RS-485 x2, I2C, SPI, USB
Reliability	DS3231 RTC with battery, UPS for a safe shutdown
Expansion	One board: 4G (LTE-M/NB-IoT or LTE Cat 4), LoRa, CAN or M-Bus
Environment	0 to 50 °C, DIN rail TS35, IP20

The original case names a Raspberry Pi based PLC from Industrial Shields and does not fix the model. This page uses the Raspberry PLC 21 FLEX: analog inputs for probe transmitters, digital outputs for the alarm and a slot for a 4G board.

[See the Raspberry PLC 21 ›](#)

Probes where the risk is

Several probes along the tank give a more accurate picture than one point. The warmest one decides the alarm.

Electronics out of the cold

The PLC sits outside the tank, inside its 0 to 50 °C range. Only the probes go into the cold.

One controller, five jobs

Reading, alarm, day count, database and cloud link run on the same Raspberry PLC.

Time and data you can trust

The RTC has its own battery. The UPS shuts Linux down safely on a power cut, to protect the database from corruption.

Open and modular

Linux, Python and Node-RED: open tools you already know. Add probes, outputs or a 4G board when you need them.

Industrial hardware

Made for industrial use: DIN rail, 12 to 24 Vdc, inside a cabinet next to the freezer.

SIMILAR COLD STORE?

Tell us your product and its band. An engineer will answer.

Tell us what you store, its temperature band, how many freezers or rooms you have, how many probes per unit, how the alarm must reach people and where the data must go. We will tell you which controller and which probes fit, and how to connect them.

FULL CASE STUDY ONLINE

industrialshields.com/case-study-vaccine-cold-storage-monitoring-raspberry-plc

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