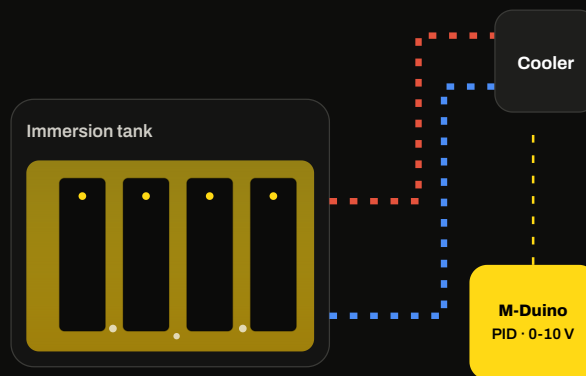


## DATA CENTER HVAC · ARDUINO PLC

# Servers in oil, a room people can work in. **One Arduino PLC** keeps both under control.

How an Industrial Shields M-Duino controls the oil temperature of an immersion-cooled server tank, the room climate and the ventilation that removes oil odors, in a setup designed to be replicated.

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


Schematic illustration

**3**

critical parameters:  
temperature, humidity, oil  
odors

**PID**

closed loop on the oil  
temperature

**0-10 V**

analog signal driving the  
fan VFD

**1 PLC**

M-Duino Ethernet 19R+  
runs it all

# Keep the tank, the room and the air within range at the same time.

A server farm cooled by an oil-based refrigeration system needed a new, more capable HVAC control. The servers are submerged in oil; the tank and the room must stay within a defined range of temperature and humidity, and a ventilation system has to reduce oil odors so operators can work in the plant.

01

## Temperature

Of the cooling fluid in the tank and of the room. Overheating is the first risk for the servers.

02

## Humidity

Kept within range in the room with a humidifier and a dehumidifier, together with the air conditioning.

03

## Oil odors

Removed by ventilation whose speed follows the odor level, so the room stays clean and functional.



### Designed to be replicated

The installation had to work as a model that can be copied, with the flexibility to change the control sequence if the oil cooler is later shared with additional server farms.

## HOW IT WORKS

### Three control loops, one controller.

#### Loop 1 - Fluid temperature

#### PID control of the oil bath

A temperature sensor in the tank feeds a PID algorithm in the PLC. The PLC compares the reading with the set point and calculates the flow the cooler has to deliver.

- Input: tank temperature
- PID in the PLC
- Output: cooler flow over serial

#### Loop 2 - Room climate

#### ON/OFF humidity and temperature

Room temperature and humidity sensors decide when the dehumidifier, the humidifier and the air conditioning are enabled or disabled.

- Inputs: room temp. and humidity
- Thresholds in the PLC
- Outputs: 3 x ON/OFF

#### Loop 3 - Air quality

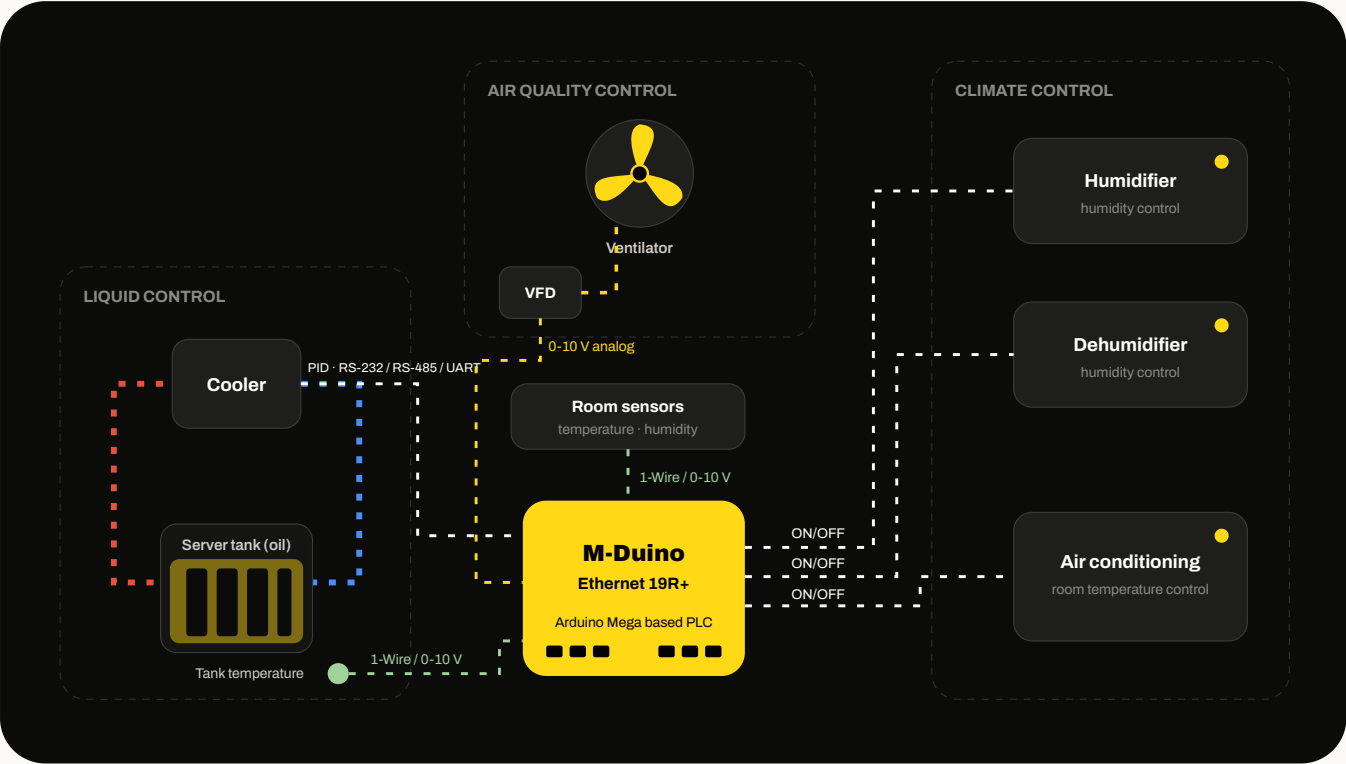
#### Variable-speed ventilation

The fan runs through a variable frequency drive. The PLC makes it turn faster or slower depending on the odor level, using an analog reference.

- Input: odor level
- Output: 0-10 V to the VFD
- Actuator: ventilation fan

# Every signal, end to end.

The original control scheme of the installation, redrawn. Sensors on the left and top, actuators on the right, the PLC in the middle.



— Analog (0-10 V)    — Digital / serial    — Sensor signal    — Hot oil    — Cooled oil

## Signal list

| Signal              | Direction    | Type                   | Purpose                                    |
|---------------------|--------------|------------------------|--------------------------------------------|
| Tank temperature    | Sensor → PLC | 1-Wire / 0-10 V        | Process value of the oil PID loop          |
| Room temperature    | Sensor → PLC | 1-Wire / 0-10 V        | Enables or disables the air conditioning   |
| Room humidity       | Sensor → PLC | 1-Wire / 0-10 V        | Enables the humidifier or the dehumidifier |
| Cooler flow         | PLC → Cooler | RS-232 / RS-485 / UART | PID output: flow the cooler has to deliver |
| Fan speed reference | PLC → VFD    | 0-10 V analog          | Ventilation speed according to odor level  |
| Humidifier          | PLC → device | ON/OFF                 | Raises room humidity                       |
| Dehumidifier        | PLC → device | ON/OFF                 | Lowers room humidity                       |
| Air conditioning    | PLC → device | ON/OFF                 | Room temperature control                   |

# One controller on the DIN rail.



## M-Duino Ethernet PLC Arduino 19R+

Arduino Mega based PLC for DIN rail, programmed with the Arduino IDE.

|        |                     |
|--------|---------------------|
| Inputs | 6 (4 analog 0-10 V) |
|--------|---------------------|

|         |                             |
|---------|-----------------------------|
| Outputs | 11 (8 relays, 3 analog/PWM) |
|---------|-----------------------------|

|                |                                         |
|----------------|-----------------------------------------|
| Communications | Ethernet, RS-485, RS-232, TTL, I2C, SPI |
|----------------|-----------------------------------------|

|       |                    |
|-------|--------------------|
| Power | 12 to 24 Vdc, IP20 |
|-------|--------------------|

[See the M-Duino 19R+ >](#)

### All three loops in one device

PID on the fluid, threshold logic on the room and an analog reference to the drive run in the same program, on the same controller.

### Easy to replicate

The same hardware and program can be installed again in another room, which was a requirement of the project.

### Flexible sequence

The control sequence lives in Arduino code, so it can be adapted if the oil cooler is shared with new server farms.

### SIMILAR PROJECT?

## Tell us your signals. An engineer will answer.

Server rooms, process cooling, climate control or ventilation: describe what you need to measure and drive, and we will tell you which controller fits.

### FULL CASE STUDY ONLINE

[industrialshields.com/case-study-hvac-immersion-cooling-arduino-plc](https://industrialshields.com/case-study-hvac-immersion-cooling-arduino-plc)

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