

FACE-IT · NY-ÅLESUND, SVALBARD

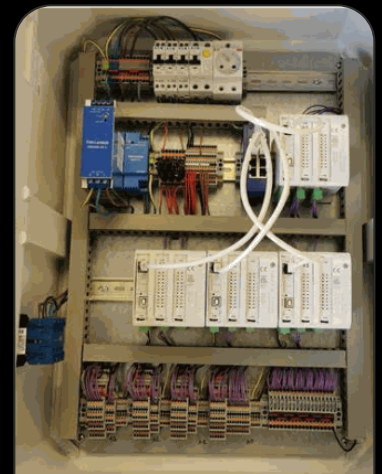
12 Arctic tanks, four water conditions. **M-Duino 42+ PLCs** keep each on target.

In Ny-Ålesund, in the Svalbard archipelago (Norway), FACE-IT studies warmer, fresher and more turbid Arctic water.

[Read the interactive success story online ›](#)



The mesocosms on the shore in Ny-Ålesund, in the Svalbard archipelago (Norway). © Cale Miller



The control cabinet with the Industrial Shields PLCs. © Frédéric Gazeau

12

mesocosms on the shore
in Ny-Ålesund, Svalbard

3+9

control mesocosms and
experimental mesocosms

3

mesocosms regulated by
each PLC

2

control valves per
mesocosm: temperature
and fresh water

THE CHALLENGE

Four water conditions. Three tanks each.

FACE-IT wants to study the effects of global warming: higher water temperature, lower salinity and turbidity. The design of the experiment has four groups of three mesocosms. RCP 4.5 and RCP 8.5 are greenhouse gas scenarios of the IPCC, here for the year 2100. Each tank must stay on the conditions of its group.

01

Control conditions

Three mesocosms run under control conditions. They are the reference for the other nine.

02

RCP4.5, 2100

Warmer water (+2 °C), turbid and fresher.

03

RCP8.5, 2100, warming only

Warmer water (+4 °C). Only the temperature changes.

04

RCP8.5, 2100, fjord

Warmer water (+4 °C), very turbid and fresher.

The customer: FACE-IT



The rapid loss of sea ice is a clear sign of the global climate crisis. Glacial fronts and sea ice are hotspots of biodiversity. Its team works with mesocosms in Ny-Ålesund, in the Svalbard archipelago (Norway). The overall objective of FACE-IT is to enable adaptive co-management of social-ecological fjord systems in the Arctic, in the face of rapid changes in the cryosphere and biodiversity. It asked for a PLC that is easy to program and easy to connect to sensors.

HOW IT WORKS

Three loops: regulate, measure, supervise.

Loop 1 · Temperature and fresh water

Two valves hold each tank on its scenario.

Each mesocosm has its own 3-way temperature control valve and its own 2-way fresh water control valve. Both take an analog signal from the PLC. More fresh water means lower salinity. The sensors give the PLC the real water values to compare with the target. The case does not publish the set points or the control algorithm. A typical way to do it: one PI loop per valve.

- 3-way valve: water temperature
- 2-way valve: fresh water, so salinity

Loop 2 · One PLC, three tanks

Each PLC regulates three mesocosms.

The work is split: each PLC regulates three mesocosms. With two valves per tank, that is six analog valve signals per PLC. Multiple sensors on an RS-485 bus measure the temperature, the salinity and the turbidity. The case does not publish the bus protocol, the sensor models or the wiring. The panel polls the bus with example frames.

- 3 mesocosms per PLC
- 6 analog valve signals per PLC, 2 per tank

Loop 3 · Log and supervise

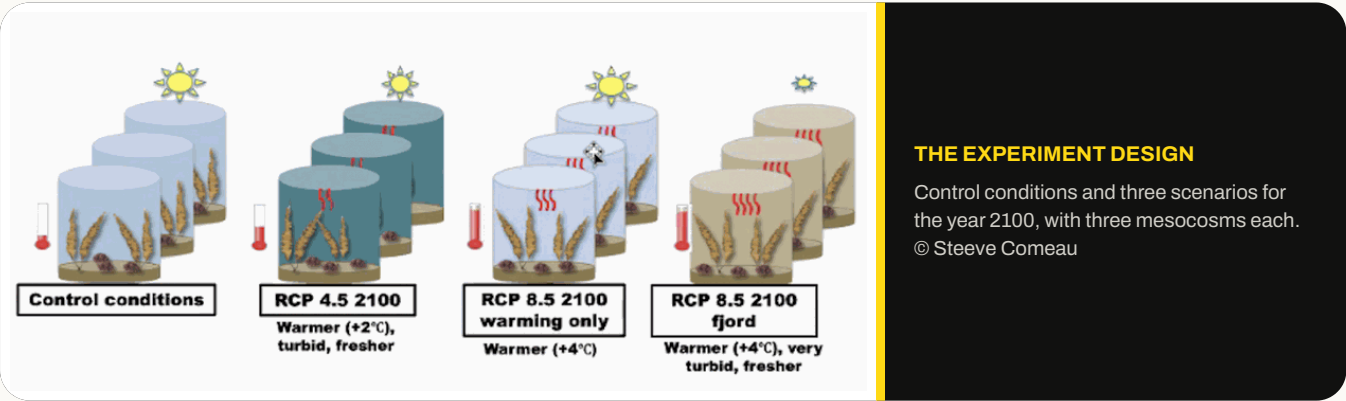
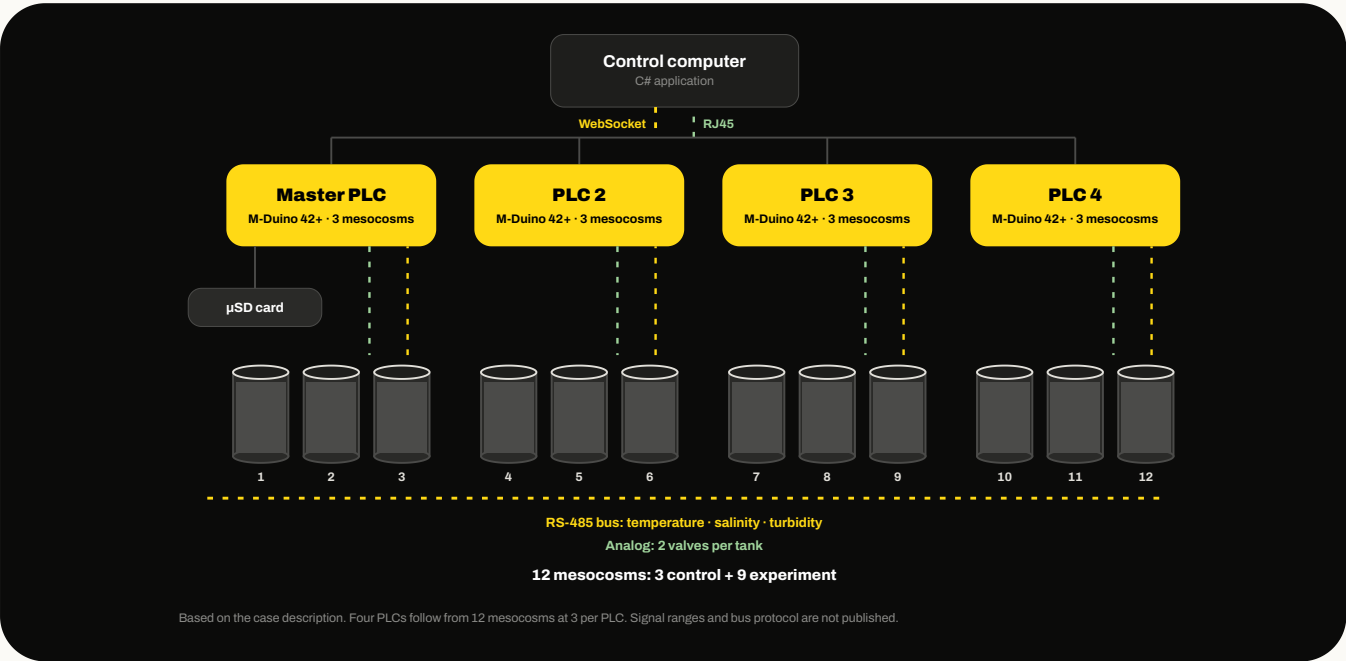
The master PLC logs. The computer supervises.

The master PLC logs the data on a µSD card and talks to a control computer. The PLCs connect to the computer through their RJ45 ports, with the WebSocket protocol. On the computer, an application written in C# monitors and controls the experiment.

- Master PLC: data log on a µSD card
- PLCs to computer: RJ45 (Ethernet), WebSocket

How do M-Duino 42+ PLCs regulate 12 Arctic mesocosms?

Each PLC drives two valves per tank with analog signals and reads the water sensors on an RS-485 bus. Twelve mesocosms at three per PLC make four PLCs. The master PLC logs to a μ SD card. All PLCs reach the control computer through RJ45 ports with WebSocket, and a C# application monitors and controls the experiment.



Signals and data

Flow	Between	Type	Purpose
Water temperature, salinity, turbidity	Sensors → PLCs	RS-485 bus	Measure the water in each mesocosm
Temperature valve	PLC → 3-way valve	Analog signal	Sets the water temperature of each mesocosm
Fresh water valve	PLC → 2-way valve	Analog signal	Sets the fresh water to each mesocosm
Data log	Master PLC → μ SD card	Local storage	Keeps the experiment data in the cabinet
Supervision	PLCs ↔ control computer	WebSocket, RJ45	Data to the computer, commands to the PLCs
Interface	Control computer	C# application	Monitor and control the experiment

M-Duino 42+ PLCs regulate the mesocosms.



M-Duino Ethernet PLC Arduino 42

An industrial PLC built on an original Arduino Mega 2560, with 26 inputs and 16 outputs, Ethernet, RS-485 and RS-232, for DIN rail. In this experiment each unit regulates three mesocosms: it drives two analog valve signals per tank and reads the sensors on the RS-485 bus.

Inputs	26: 12 analog/digital (0-10 V, 10-bit), 14 digital optoisolated, 4 with interrupt
Outputs	16: 6 analog/digital/PWM (0-10 V, 8-bit), 10 digital optoisolated
Ethernet	W5500, 10/100 Mbit, RJ45
Serial and buses	RS-485, RS-232, TTL, I2C, SPI
Built in	Real-time clock, microSD slot
Power supply	12 to 24 Vdc
Mounting	DIN rail TS35, IP20

The case PDF names the M-Duino 42+. The 2021 case page says M-Duino 42. This product page sells the current version, the M-Duino 42+. The case does not publish any extra modules.

[See the M-Duino 42+ ›](#)

Arduino IDE programming

The case gives two factors for the choice. The first is the programming platform: M-Duino PLCs are programmed with the Arduino IDE and the Industrial Shields boards package.

Flexible programming

The second factor in the case is the flexibility of programming. Here one PLC model reads the RS-485 sensors, drives the analog valve signals and talks WebSocket to the computer.

Room to grow

The PLCs are modular. The original case page notes that the specifications can be extended later.

SIMILAR PROJECT?

Tell us your tanks and your variables. An engineer will answer.

Tell us how many tanks or zones you regulate, which variables you measure, which valves or pumps you drive and where the data must go: a PC application, a SCADA or a database. We will tell you which controller fits and how to wire it.

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EMAIL

info@industrialshields.com

PHONE

[\(+34\) 938 760 191](tel:+34938760191)