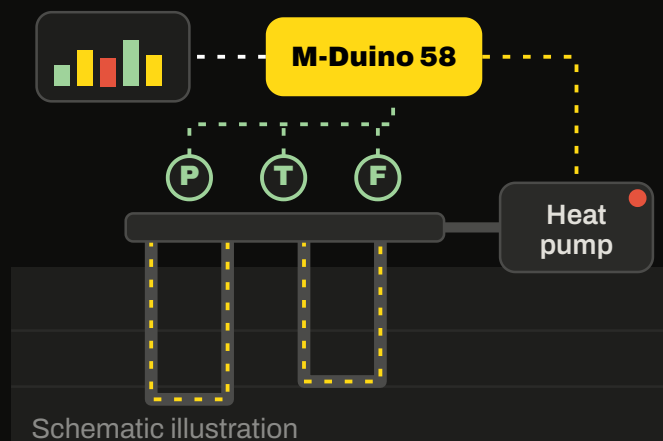


GEOTHERMAL ENERGY · M-DUINO 58

Watch the heat pump. Protect the plant.

Manifold sensors, pumps, valves, alarms and data on one M-Duino 58.

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


3

variables to watch: water or steam, reservoir, equipment

2

safety actions: alarm or emergency shutdown

58

I/O on one M-Duino 58

4

links in this design: Ethernet, RS-485, Wi-Fi, LoRa

THE CHALLENGE

Heat from the ground, inside safe limits.

Geothermal energy is the heat stored beneath the surface of the earth. It is renewable, but two things are critical for it to be viable and efficient: temperature control and efficient monitoring. High pressure and high temperature also wear the mechanical parts fast. The source covers both: the plant that takes the heat from the ground and the heat pumps that use it. The goal: a PLC that controls and monitors the heat pumps, protects the equipment and keeps the data.

01

Water or steam

The first variables are the temperature and the flow of the water or the steam.

02

A reservoir that lasts

Manage the reservoir in a sustainable way, so its capacity does not degrade over time.

03

Heat pump and plant

Detect abnormal or hazardous conditions before they damage the heat pump or the plant.

04

Wear under pressure

High temperature and high pressure wear the mechanical parts fast. Maintenance must be preventive and predictive.



Grid demand and regulations

The energy that goes into the grid has to follow a demand that changes. Energy policies and regulations also ask for control of the energy consumption and other factors.

HOW IT WORKS

Three loops: regulate, protect, then record and connect.

Loop 1 · Regulate

Sensors on the manifolds. Pumps and valves on the outputs.

The PLC reads sensors on the heat pump manifolds and on other critical parts of the system: pressure, temperature and other abnormal conditions. It also drives the actuators that regulate the pumps, the valves and other mechanical equipment, and adjusts them as needed. Its control program decides how to answer each signal, to keep the system inside the set parameters. A typical way to do it: a PI loop that sets the speed of the circulation pump to hold the temperature difference (ΔT) across the manifold.

Loop 2 · Protect

First an alarm. Then, if needed, an emergency shutdown.

Safety is part of the program. When a value leaves its limits, the PLC can trigger an alarm. When the condition is hazardous, it can start an emergency shutdown procedure, to prevent damage to the equipment or a safety hazard. A typical way to do it: two levels for each value, an alarm level and a trip level, a check for a broken sensor wire, and a manual reset after a trip.

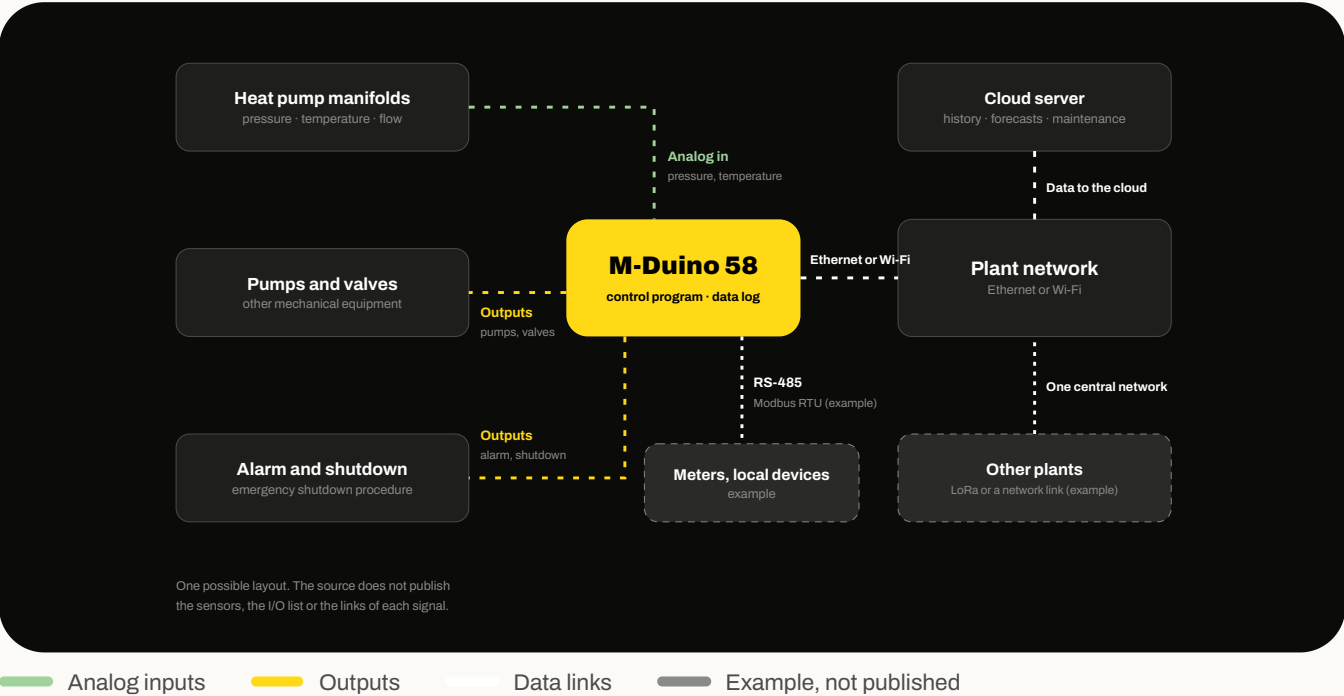
Loop 3 · Record and connect

Data for maintenance. One network for many plants.

The PLC collects and stores operational data for historical analysis, performance optimisation and strategic decisions. In the source, the data goes to the cloud, where forecasts help to plan preventive and predictive maintenance. With the same model, several geothermal plants can join one centralised and automated network. The source does not publish the link. A typical way to do it: keep each record on the microSD card, send it when the link is up, and send the waiting records after a cut.

How does a PLC control a geothermal heat pump system?

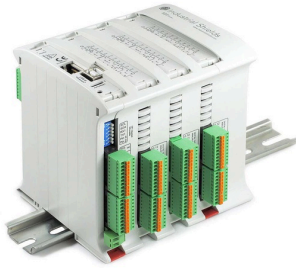
In this layout, pressure, temperature and flow sensors on the heat pump manifolds go to the analog inputs of the M-Duino 58. Its outputs drive the pumps and the valves, the alarm and the emergency shutdown. RS-485 can read meters and other local devices. Ethernet or Wi-Fi takes the data to the plant network and the cloud server, and LoRa can link remote sites. The source names these links but does not publish which one carries which data.



Signals and data

Signal	Between	Type	Purpose
Pressure	Sensors on the heat pump manifolds → M-Duino 58	Analog in (example)	Abnormal or hazardous conditions. Range not published
Temperature	Sensors on the manifolds and critical parts → M-Duino 58	Analog in (example)	Temperature control. Range not published
Flow of water or steam	Flow sensor → M-Duino 58	Not published	One of the variables of the extraction process
Pumps and valves	M-Duino 58 → pumps, valves, other mechanical equipment	Outputs	Regulate the operation and adjust it as needed. Signal types not published
Alarm and shutdown	M-Duino 58 → alarm, emergency shutdown procedure	Outputs	Prevent equipment damage and safety hazards
Operational data	M-Duino 58 → cloud server	Not published	Historical analysis, optimisation, forecasts for maintenance
Several plants	Each plant ↔ central system	Not published	One centralised and automated network (next step in the source)

In this design: one M-Duino 58.



M-DUINO ETHERNET PLC ARDUINO 58

An industrial PLC built on an original Arduino Mega 2560, with 58 I/O, Ethernet and RS-485, for DIN rail. In this design it reads the manifold sensors, drives the pumps and the valves, raises the alarms and logs the data.

Role	Manifold sensors, pumps and valves, alarms, data log
Inputs	36: 16 analog/digital (0-10 V), 20 digital optoisolated, 6 with interrupt
Outputs	22: 8 analog/digital/PWM (0-10 V), 14 digital optoisolated
Comms	Ethernet (W5500), RS-485, RS-232, TTL, I2C, SPI
Extras	Real-time clock, microSD slot
Power and environment	12 to 24 Vdc, 0 to 60 °C, DIN rail TS35, IP20

The source shows an M-Duino with a LoRa antenna and lists Arduino based PLCs with up to 58 I/O and Ethernet, RS-232, RS-485, LoRa, NB-IoT and Wi-Fi. It does not publish one exact model. The card shows the M-DUINO ETHERNET PLC ARDUINO 58. Its LoRa and Wi-Fi & BLE versions are described in the family datasheets.

[See the M-Duino 58 ›](#)

Many signals on one PLC

The M-Duino 58 has 36 inputs, 16 of them analog (0-10 V), and 22 outputs, 8 of them analog or PWM. Sensors, pumps, valves and alarms of one installation can fit on one controller.

Protection in the program

Alarm levels, trip levels and the shutdown sequence live in the same control program that regulates the system.

Data that stays

A real-time clock and a microSD slot let the PLC timestamp events and log data locally, before it goes to the cloud.

The link that fits the site

Ethernet and RS-485 are built in. The M-Duino family datasheets describe versions with Wi-Fi & BLE, GPRS/GSM and LoRa.

Open code you own

You program it with the Arduino IDE. You own the application, because you know the code.

Modular

The specifications can grow later. Add I/O or another PLC on the same network when the installation grows.

SIMILAR PROJECT?

Tell us your heat pumps and your signals. An engineer will answer.

Tell us how many heat pumps or sites you have, which values you measure (pressure, temperature, flow), what the PLC must drive and where the data should go. We will tell you which controller fits and which link to use.

READ IT ONLINE

industrialshields.com/geothermal-heat-pump-plc-case-study

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