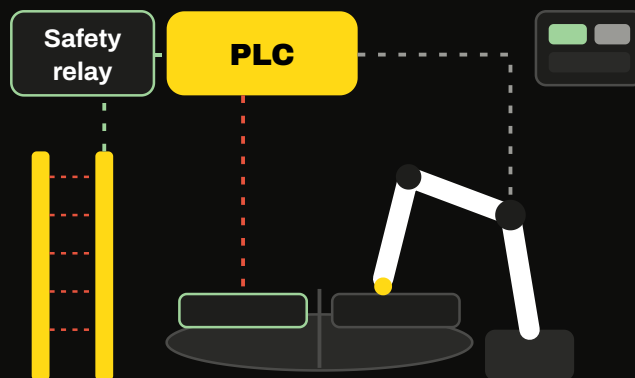


## AUTOMOTIVE

# The robots weld one side. The operator loads the other.

One PLC coordinates the fixtures, the robots, the air and the gas. A safety relay handles the stops.

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


Schematic illustration

**3**

safety devices: light barriers, a door lock and a scanner

**2**

sides of the spinning table: one is welded while the other is loaded

**1**

Modbus address for each sensor and valve of the fixtures

**1**

Panel PC with the synoptic of every cylinder and sensor

## THE CHALLENGE

# Constant, accurate and safe, in one cell.

The case describes a robotic welding cell for the automotive industry, where robotic cells for painting, handling, palletizing and welding are common. The goal is a machine that produces constantly, with accuracy, and complies with safety regulations. For that, every part must work in harmony, controlled by a PLC and a Panel PC: welding tools, robots, lights and all the safety devices.

01

### Stop safely

Light barriers, a door lock and a scanner trip a safety relay that stops power, air and robots when someone or something gets in.

02

### Weld while loading

Two sides on the spinning table: the robots weld one while the operator loads the other.

03

### Hold the part

Fixtures with pneumatic cylinders and clamps, checked by sensors, closed in sequence by the PLC.

04

### See every sensor

A Panel PC shows the synoptic of the welding tools, with every cylinder and sensor.



## Safety comes first

The case starts with safety, the most important part of the machine. Today the safety functions run in a certified safety relay or safety PLC, and the cell PLC reads their state.

## HOW IT WORKS

# Three jobs of the PLC: follow the safety state, hold the part, feed air and gas.

### Job 1 · Safety state

#### Someone steps in. The safety relay stops power, air and robots.

The light barriers watch the entry of the cell: if the operator walks in to load a tool, the safety relay stops power, air and the robots, and the PLC shows the cause. The safety lock watches the back door to the robots: if it opens, the spinning table stops too. The scanner under the welding tool checks that no part falls into the cell.

- Barriers at the entry
- Lock on the back door
- Scanner under the tool

### Job 2 · Hold the part

#### The clamps close in sequence, then the robot welds.

Presence sensors see the part, and the PLC closes the clamps of the fixture in sequence through the valve pack. Sensors on each cylinder confirm the state. Only then does the table turn and the PLC tell the robot to weld, and the robot reports which part it welded. Every sensor and valve has its own Modbus address. Load a part and follow the cycle.

- Part sensors and cylinder sensors
- Valve pack on Modbus
- Order to the robot, data back

### Job 3 · Air, gas and the operator

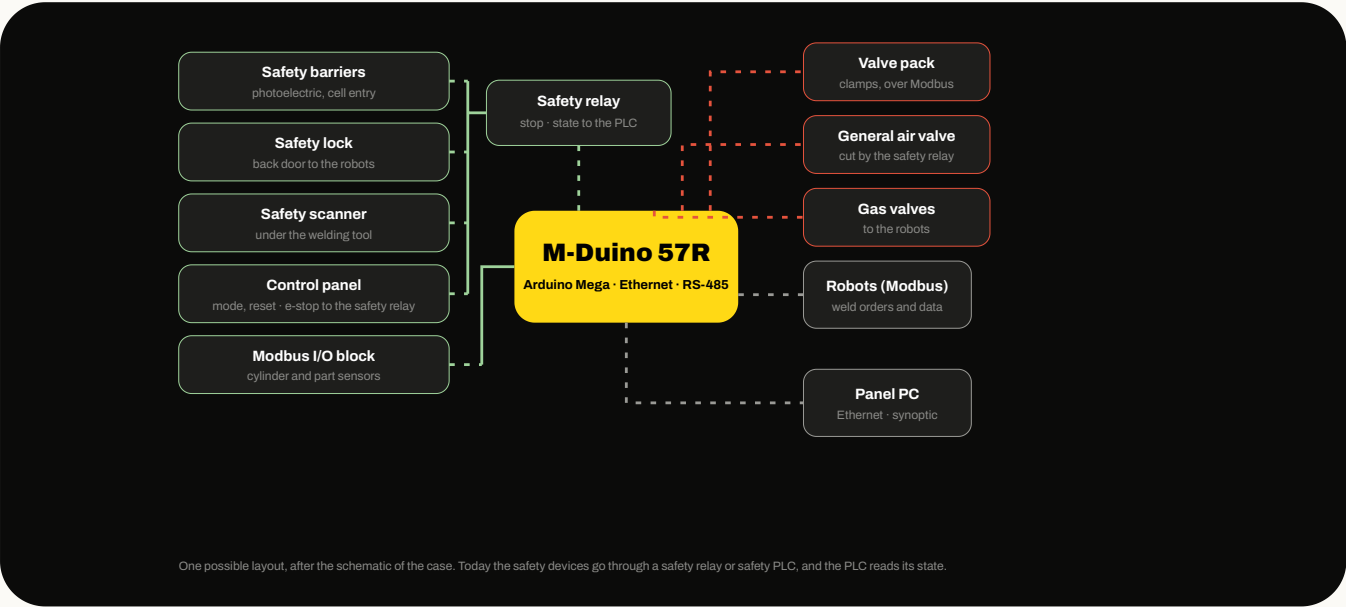
#### One general valve feeds the air, and the safety relay cuts it all.

The general valve of the fluid panel feeds compressed air to the welding tools, and a general gas valve feeds the robots. The PLC opens and closes them. When a safety device trips or the emergency stop is pressed, the safety relay drops the general valve and the air of the whole cell is cut. The PLC reads the state. The operator chooses the work mode and resets errors on the control panel. Change the mode, then stop the cell.

- General air and gas valves
- Work mode, reset, emergency stop
- Air cut on every safety stop

# How does a PLC control a robotic welding cell?

An M-Duino PLC is the brain of the cell. A safety relay reads the safety devices and the emergency stop, and the PLC reads the state of the relay. The control panel mode and reset reach its inputs. A Modbus signal distributor carries the cylinder sensors, the part sensors and the valve pack, so each one has its own address. Its outputs drive the general air and gas valves of the fluid panel. It gives the robots the order to weld over Modbus and reads which part was welded, and a Panel PC on Ethernet shows the synoptic.



Inputs to the PLC      Valves and outputs      Robots and Panel PC

## Signals

| Signal          | Between                                                                      | Type        | Purpose                                |
|-----------------|------------------------------------------------------------------------------|-------------|----------------------------------------|
| Safety barriers | Light barriers → safety relay → PLC input (state)                            | Digital in  | Stop power, air and robots             |
| Back door       | Safety lock → safety relay → PLC input (state)                               | Digital in  | Also stop the spinning table           |
| Scanner         | Safety scanner under the tool → safety relay → PLC input (state)             | Digital in  | No part falls into the cell            |
| Operator panel  | Mode and reset → PLC inputs; emergency stop → safety relay, state to the PLC | Digital in  | Run and recover the cell               |
| Fixture         | Cylinder and part sensors, valve pack ↔ Modbus I/O block ↔ PLC               | Modbus      | Clamp sequence, one address per device |
| Robots          | PLC ↔ robot controllers                                                      | Modbus      | Order to weld, part and parameters     |
| Air and gas     | PLC → general valves of the fluid panel (the safety relay can cut the air)   | Digital out | Air to the tools, gas to the robots    |
| Synoptic        | PLC ↔ Panel PC                                                               | Ethernet    | State of every cylinder and sensor     |

# An Arduino based PLC and a Panel PC.



LINKED IN THE ORIGINAL CASE

## M-DUINO ETHERNET PLC ARDUINO 57R

An industrial PLC built around an original Arduino Mega 2560, for DIN rail, programmed with the Arduino IDE. In this design it reads the safety states and the control panel, runs the clamp sequence over Modbus, gives the orders to the robots and drives the air and gas valves.

|                 |                                                                                    |
|-----------------|------------------------------------------------------------------------------------|
| Role            | Brain of the cell: inputs, Modbus to the fixtures and robots, valves, Panel PC     |
| Microcontroller | Arduino Mega 2560 (ATmega2560, 16 MHz)                                             |
| Inputs          | 18: 12 analog/digital (0-10 V, 10-bit) and 6 digital optoisolated, 5 to 24 Vdc     |
| Outputs         | 31: 8 analog/digital/PWM (0-10 V), 23 relays (230 Vac 4 A / 24 Vdc 2 A, resistive) |
| Communications  | Ethernet, RS-485, RS-232, I2C, SPI; Modbus RTU and TCP, master or slave            |
| Built in        | Real-time clock, microSD slot                                                      |

The original page links this model. The case only says "our Arduino based PLC".

[See the M-Duino 57R ›](#)


LINKED IN THE ORIGINAL CASE

## TouchBerry Pi Panel PC 10.1\"/>

An industrial Panel PC with a Raspberry Pi 4 and a capacitive touchscreen, connected to the PLC over Ethernet. It shows the synoptic of the welding tools, with every cylinder and sensor, and lets the operator navigate the cell.

|          |                                                       |
|----------|-------------------------------------------------------|
| Role     | Synoptic of the cell, states, parameters and messages |
| Screen   | 10.1\", capacitive touch                              |
| Computer | Raspberry Pi 4                                        |
| Network  | Gigabit Ethernet                                      |

The original page links the TouchBerry Pi 10.1\"/>

[See the TouchBerry Pi 10.1\"/>](#)

### Safety first

The design starts with the barriers, the door lock and the scanner on a safety relay, and with one valve that cuts all the air.

### No waiting for the robot

Two sides on the spinning table: loading happens while welding, which saves cycle time.

### Robots keep their programs

Each robot runs its own welding programs. The PLC only tells it when to weld and reads the result.

#### SIMILAR PROJECT?

**Tell us about your cell. An engineer will answer.**

Tell us what the cell does, how many robots, fixtures and safety devices it has, and what the operator must see. We will tell you which controller, which I/O and which links fit.

#### READ IT ONLINE

[industrialshields.com/case-study-robotic-welding-cell-automation-m-duino](https://industrialshields.com/case-study-robotic-welding-cell-automation-m-duino)

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