# Technical Manual for Efficient Flow AC Controller

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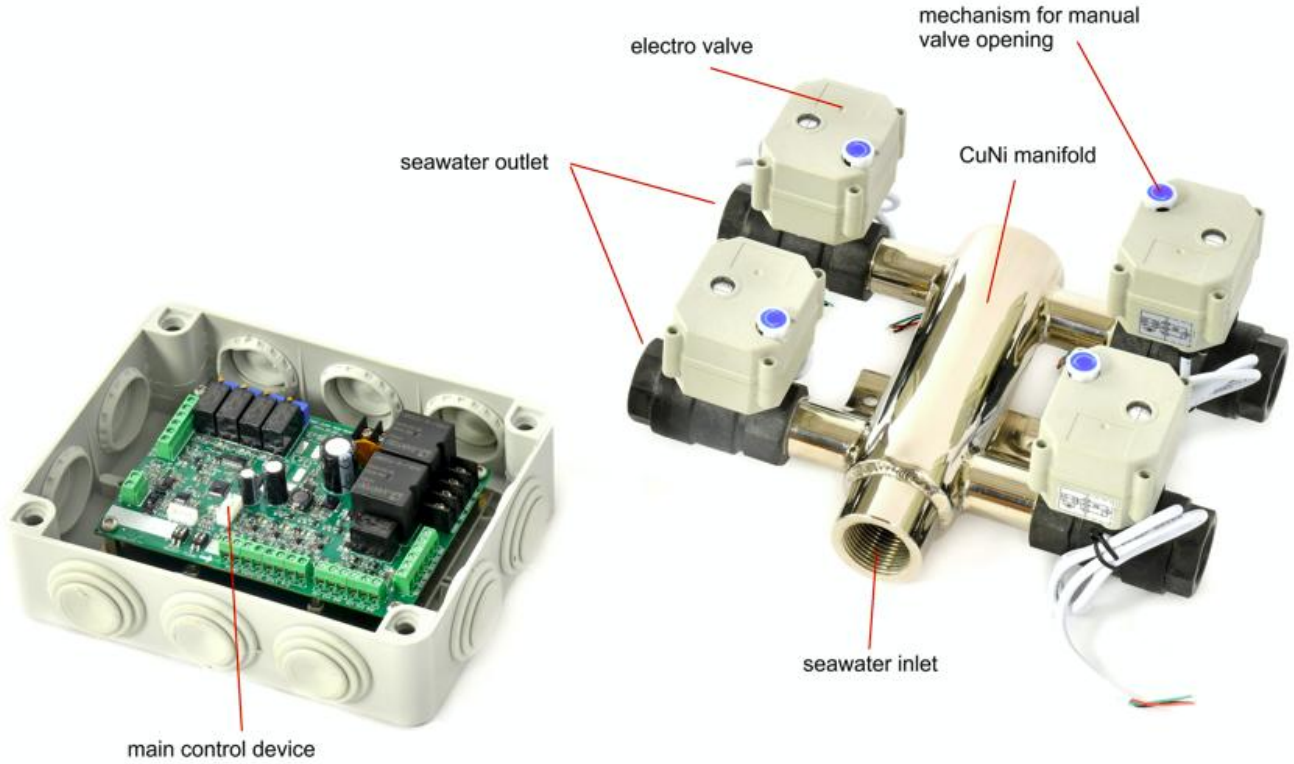
## 1. Introduction

The Efficient Flow AC Controller is designed to efficiently manage water cooling flow within air-conditioning systems, enhancing energy savings and extending equipment lifespan. The controller consists of a cupronickel (or POM-C) manifold, four electro valves, and a PCB control device capable of managing up to two variable-speed pumps and up to four electro valves. It can be powered by 12VDC, 24VDC, or 48VDC, making it suitable for a wide range of installations.

*Figure 1: control device PCB, Manifold with electro valves, variable-speed pumps*

## 2. Components, drawings and schematics




- Cupronickel (or POM-C) Manifold
- Electro valves (up to 4)
- PCB Control Device
- Variable-Speed Pumps (up to 2)

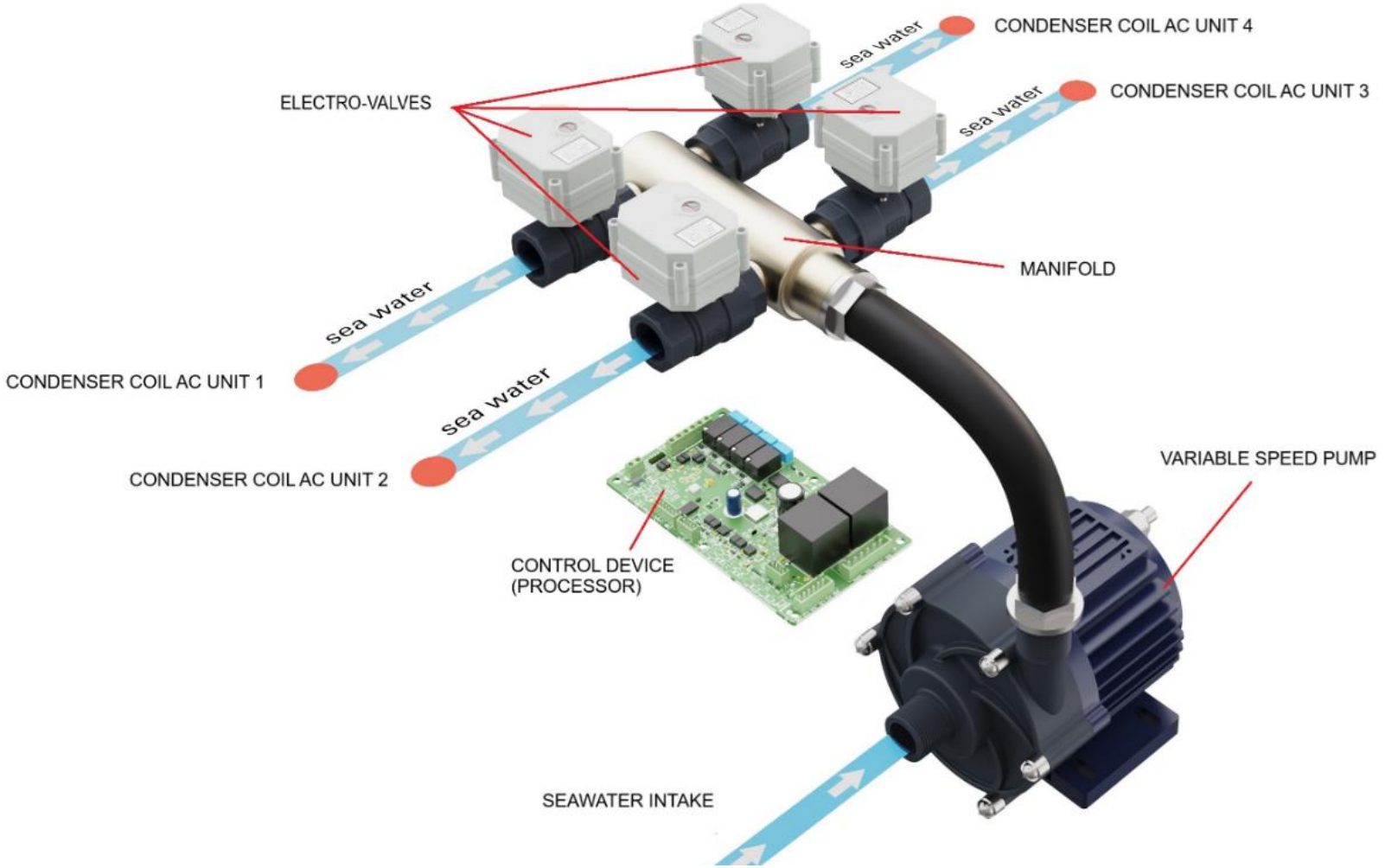



*Figure 2: Efficient Flow AC controller assembly*

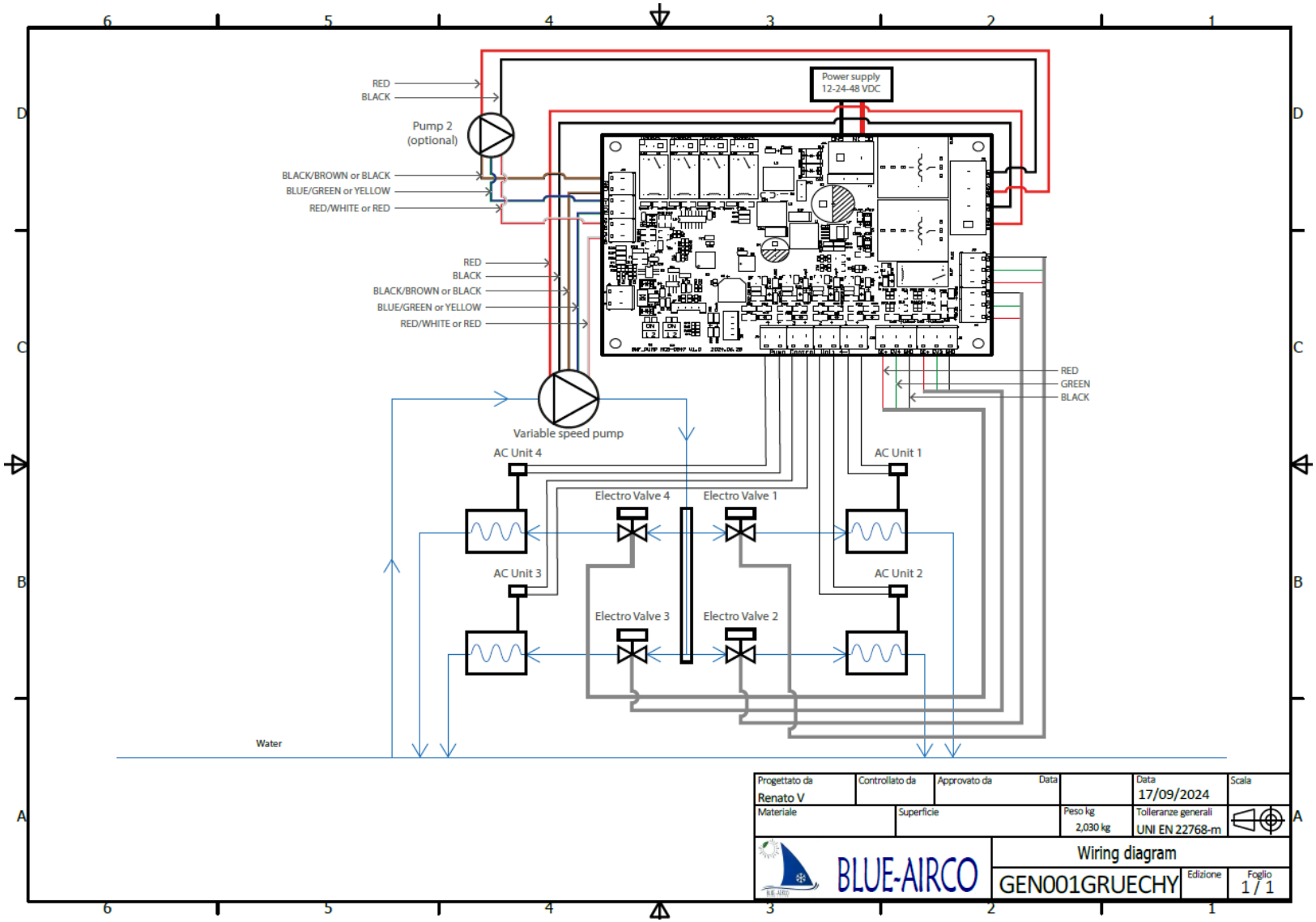



*Figure 3a: Efficient Flow AC controller, hydraulic and electric schematic 4 electro valves*

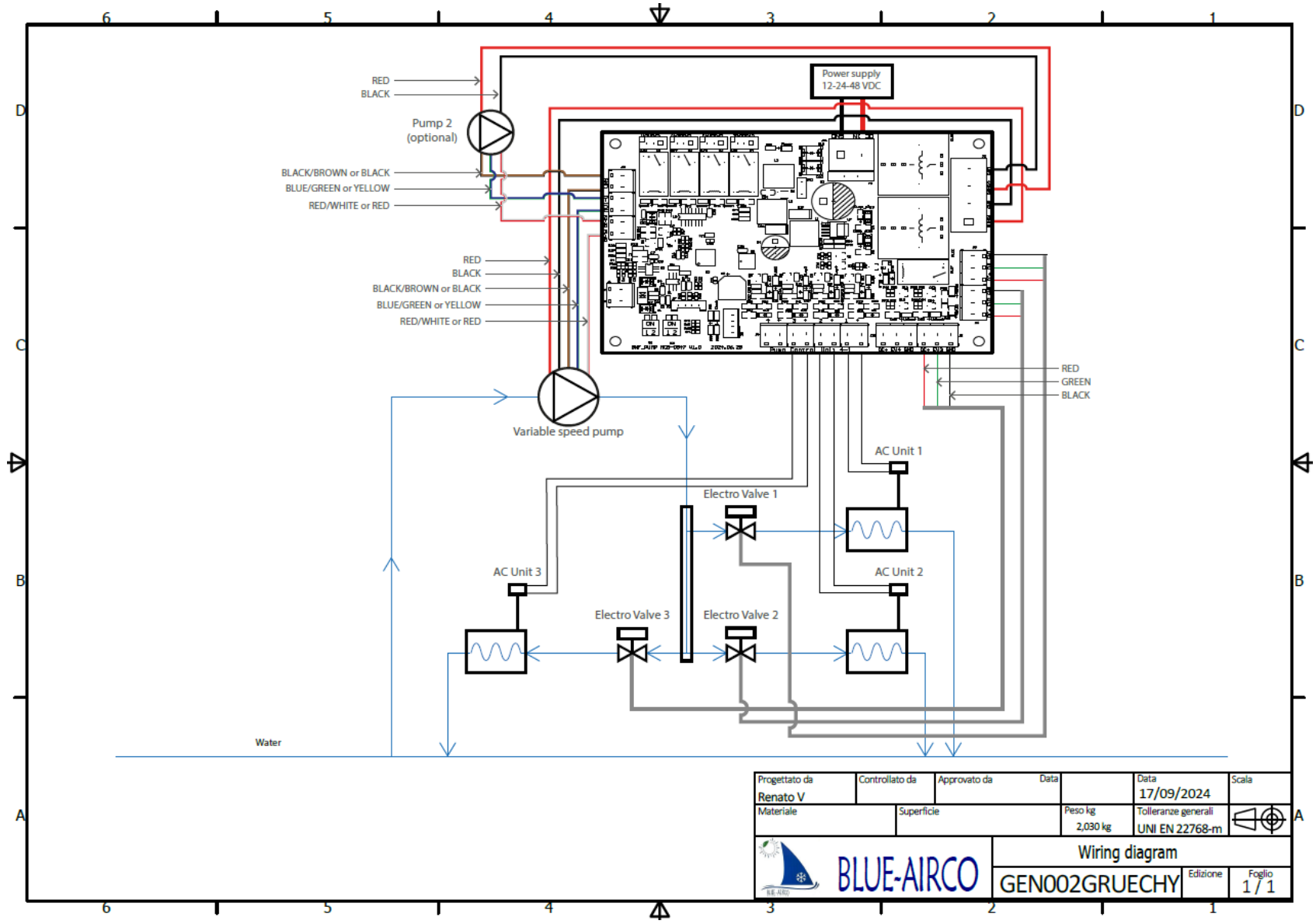



*Figure 3b: Efficient Flow AC controller, hydraulic and electric schematic 3 electro valves*

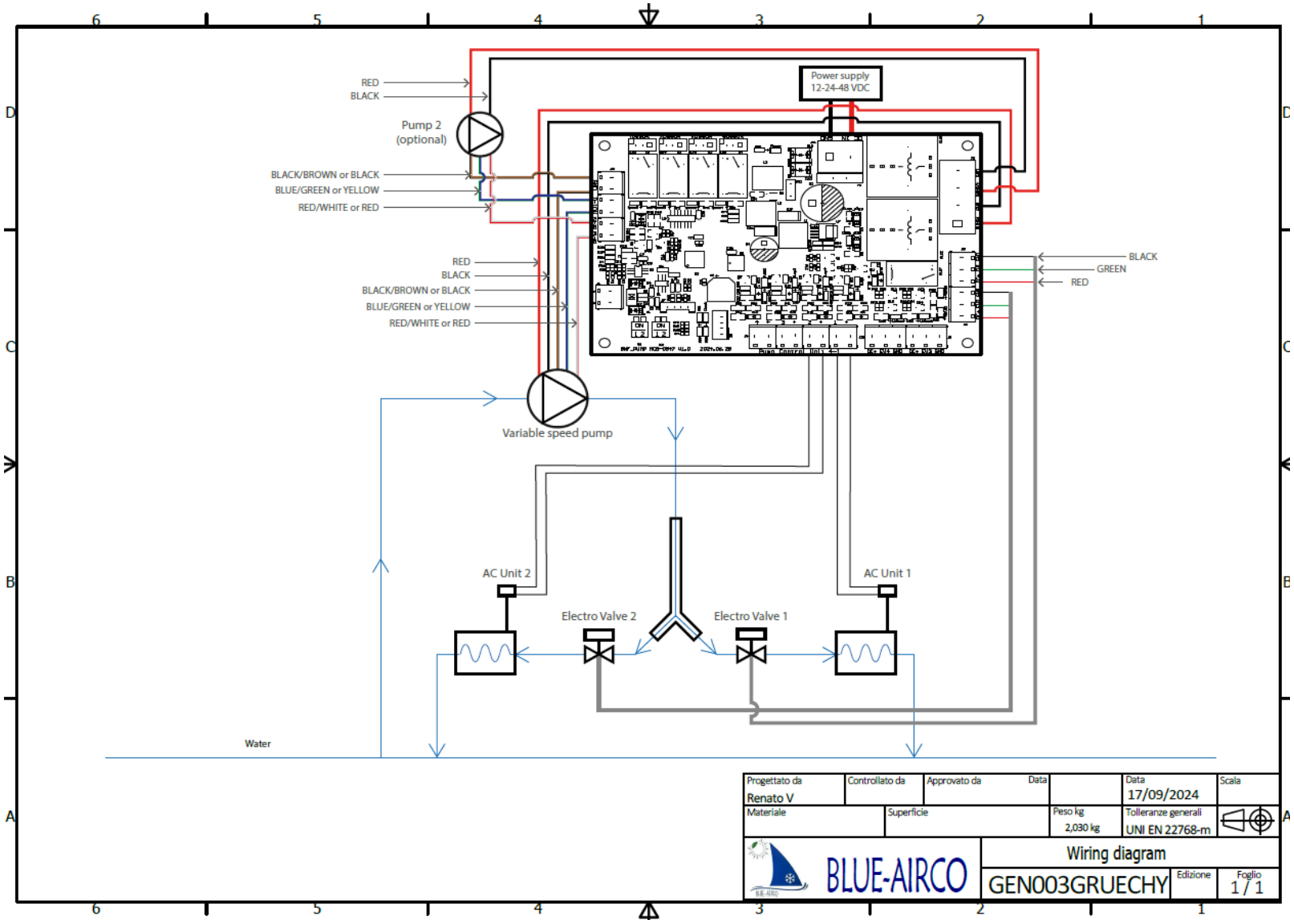



*Figure 3c: Efficient Flow AC controller, hydraulic and electric schematic 2 electro valves*

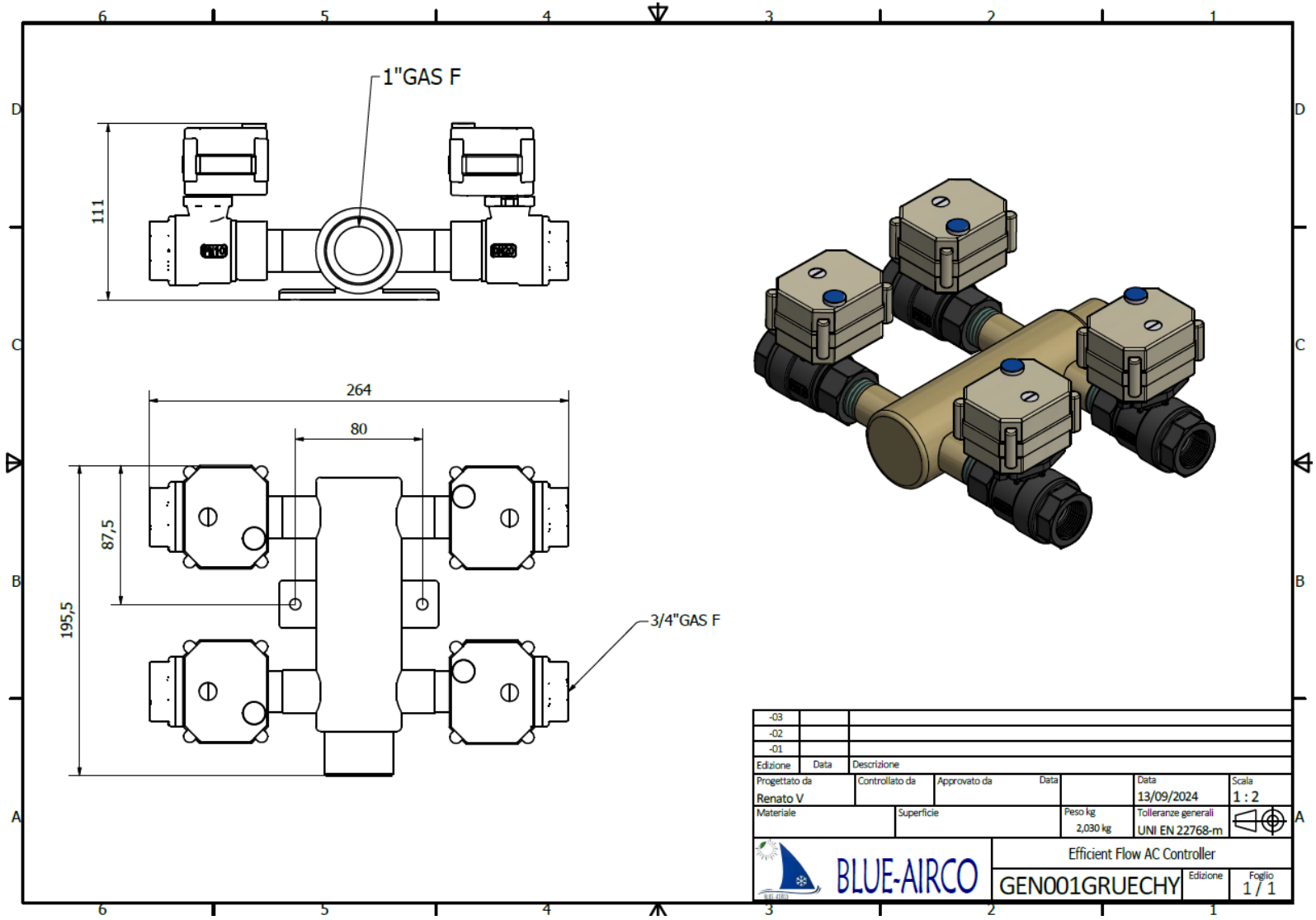



Figure 4a: Cu-Ni 90/10 (or POM-C) manifold dimensions 4-3EV

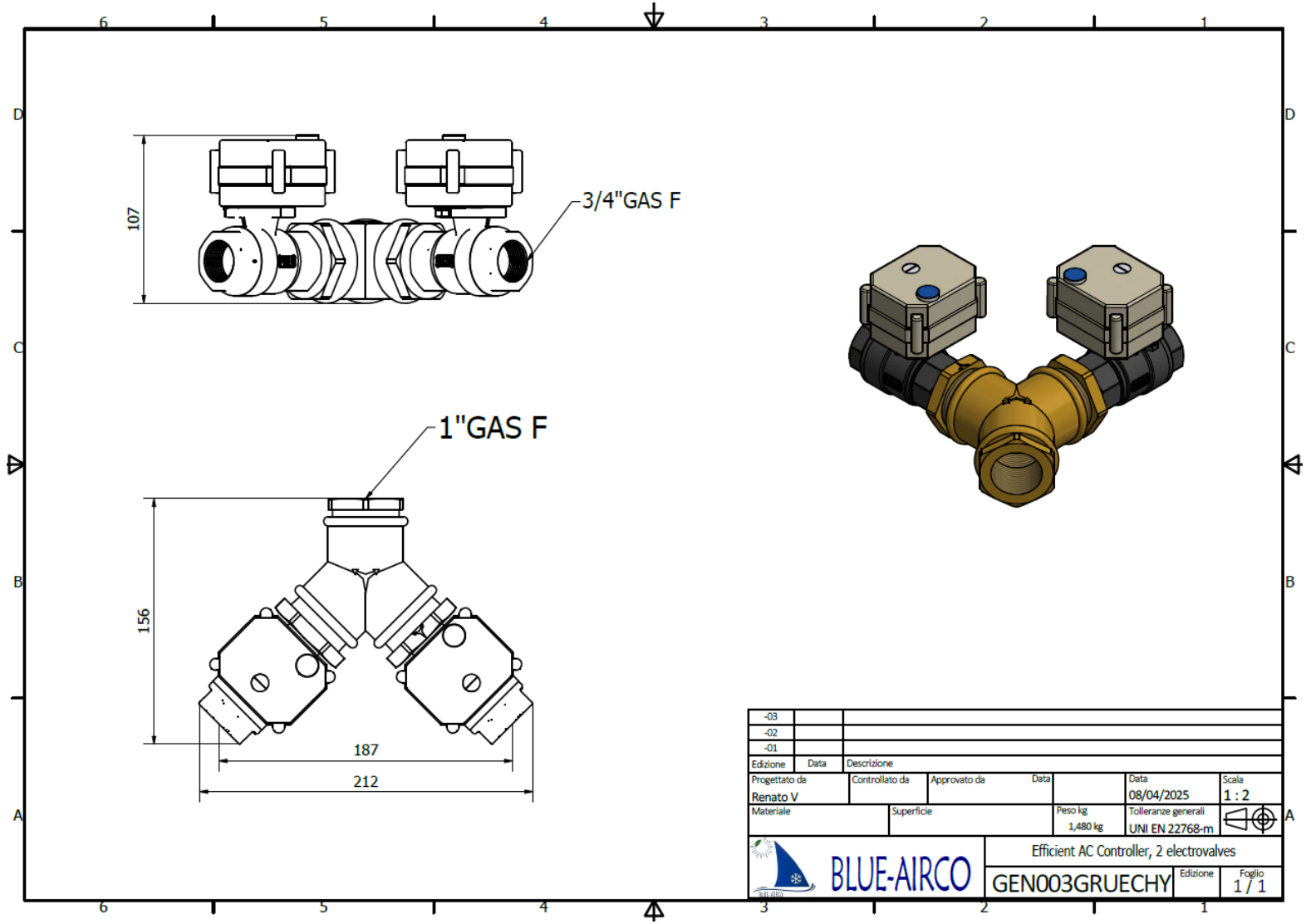



Figure 4b: CR brass manifold dimensions 2EV

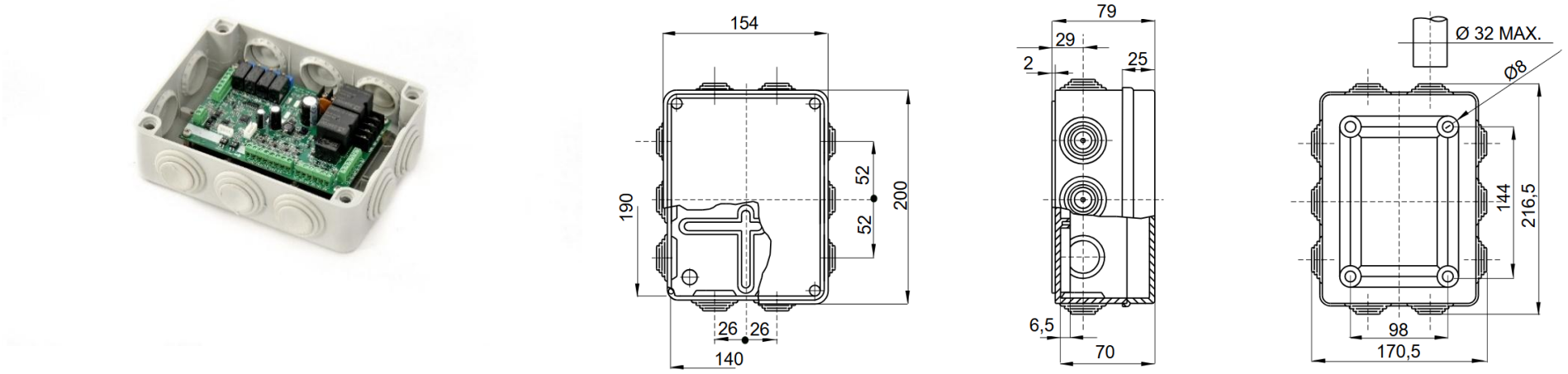



*Figure 5: electric box (control device PCB) dimensions 154 x 200 x 80 mm*

### 3. Power Supply

The system can be powered with the following nominal voltage values:

- 12VDC
- 24VDC
- 48VDC

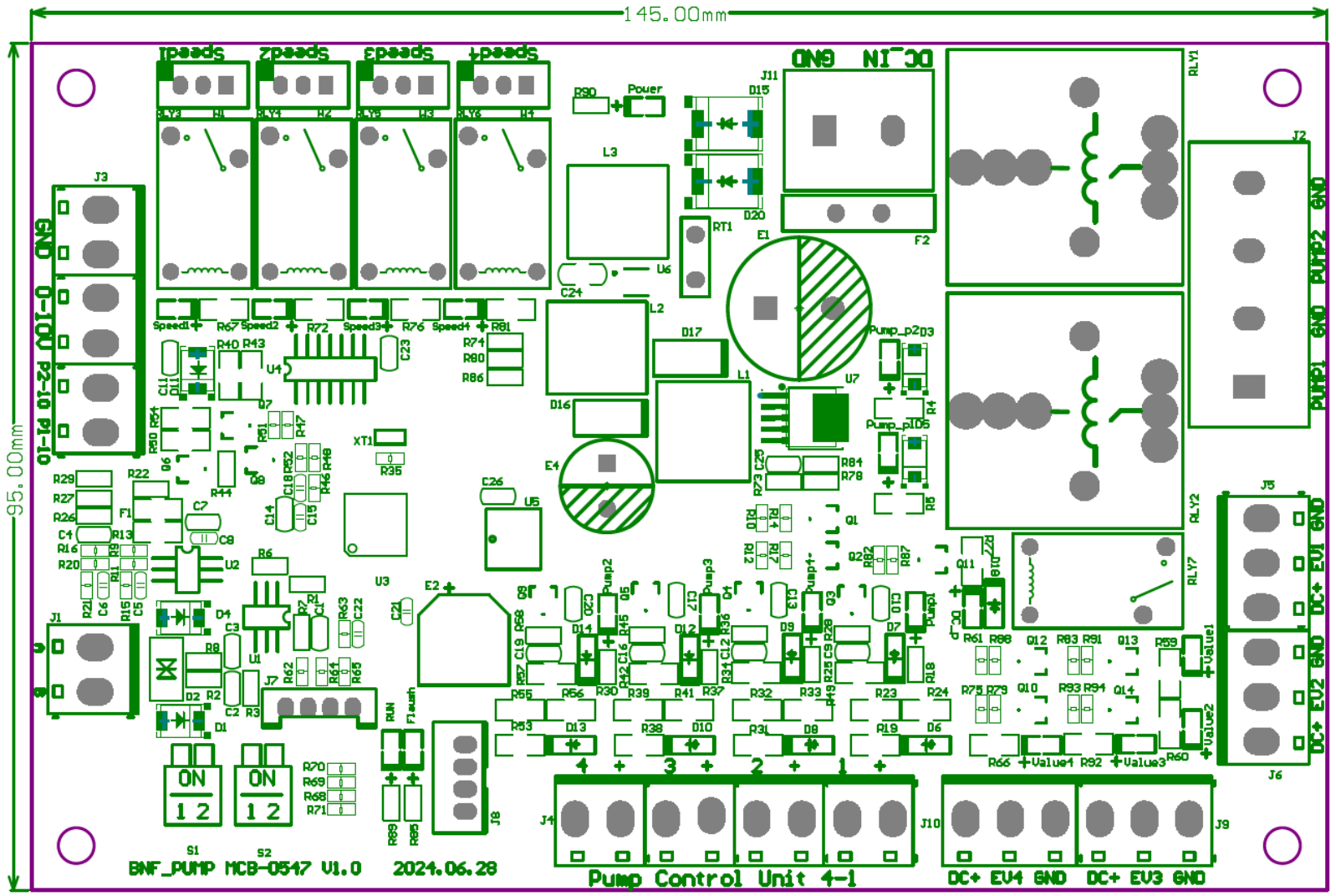



*Figure 6: control device PCB*

## 4. Pump Connection to PCB Control Device

The Efficient Flow AC Controller is equipped with terminals on the PCB control device to connect and manage two pumps. Follow the wiring instructions below for both power and speed control connections.

### 4.1 Pump Power Connection

1. Pump 1:
    - Connect the pump's + wire to the PUMP 1 terminal on the PCB.
    - Connect the pump's – wire to the GND terminal on the PCB.
2. Pump 2:
    - Connect the pump's + wire to the PUMP 2 terminal on the PCB.
    - Connect the pump's – wire to the GND terminal on the PCB.

### 4.2 Pump Speed Control Connection

1. GND Terminal:
    - Connect the GND terminal on the PCB to pump wire 1 (black-brown for IP65 or black for IP68 pumps).
2. 0-10V Terminal:
    - Connect the 0-10V terminal on the PCB to pump wire 2 (blue-green for IP65 or yellow for IP68 pumps).
3. P1/P2 -10 Terminal:
    - Connect the P1/P2 -10 terminal on the PCB to pump wire 3 (red-white for IP65 or red for IP68 pumps).

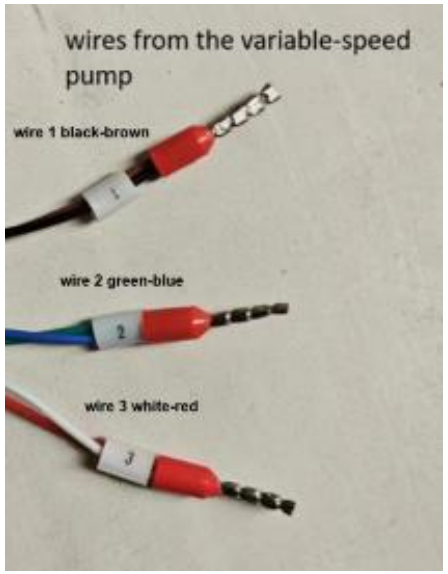



*Figure 7a: IP65 pumps (007001PUMOP12, GEN001PUMOP24, GEN001PUMOP48) speed control wires*

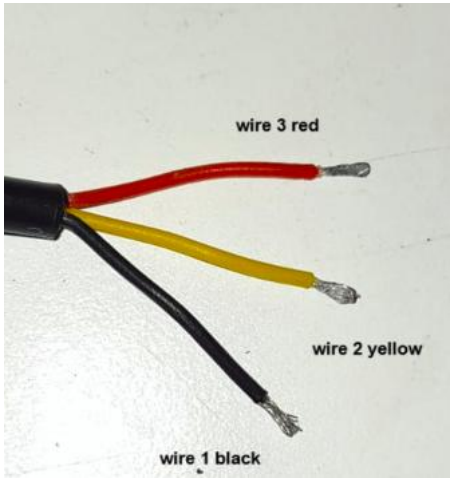
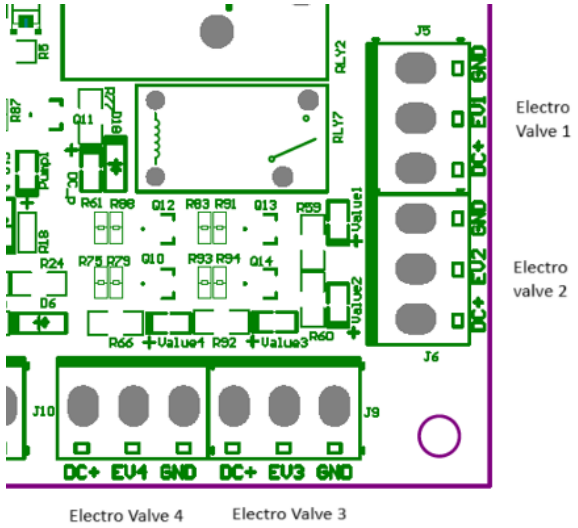



*Figure 7b: IP68 pumps (GEN004PUMOP***, GEN005PUMOP***) speed control wires*

## 5. Electro valve Connection

Each of the four electro valves should be connected to the PCB using three wires as follows:

- DC+ (RED WIRE)
- EV (GREEN WIRE)
- GND (BLACK WIRE)



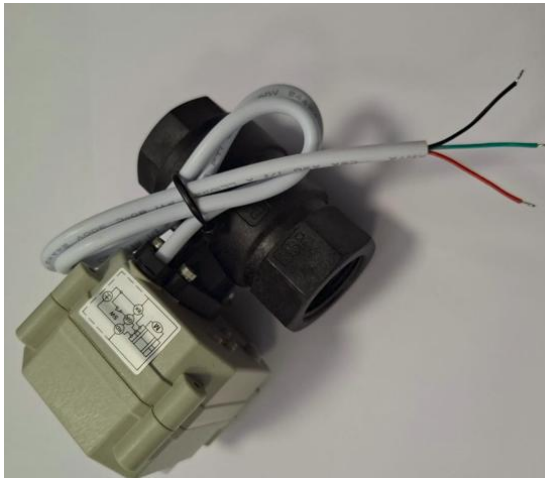



*Figure 8: electro valve connection to PCB (control device)*

Refer to the labels on the PCB for accurate wiring. Ensure that each electro valve is connected properly to avoid any malfunction.

## 6. Pump Activation via AC Unit Dry Contact

Each AC unit is normally equipped with a dry contact (pump activation PC) on its terminal board that is used to activate the pump whenever the AC unit is requested to start in cooling or heating mode (for heat pumps).

- The PCB must be connected to each AC unit's terminal board dry contact via the terminals labelled "Pump Control Unit 4-1" on the PCB.
- When the AC unit enters cooling or heating mode, the dry contact closes, signalling the control device to activate the corresponding pump.

Ensure that the wiring between the PCB and the AC unit's dry contact is secure and correctly connected to allow automatic pump activation when needed.

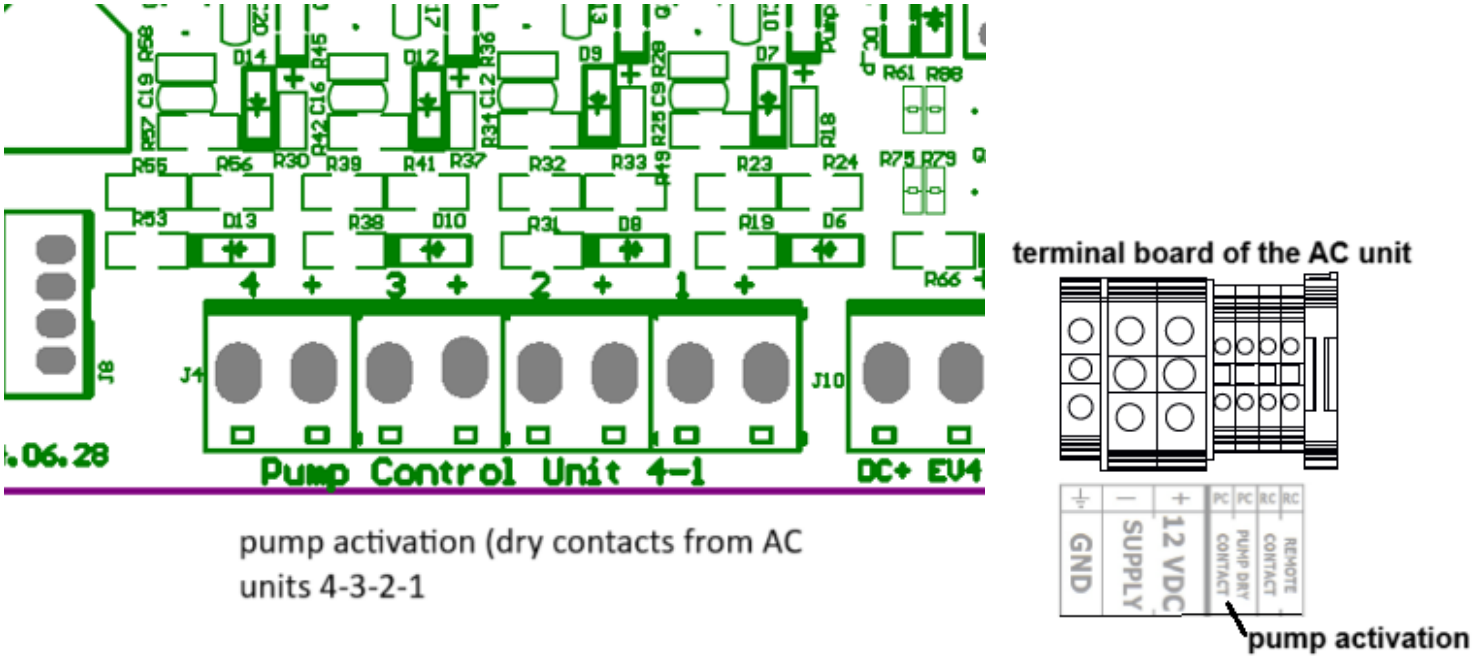



*Figure 9: PCB (control device) connection to every AC unit (dry contact for pump activation)*

## 7. LED Indicators

The Efficient Flow AC Controller includes LED indicators for monitoring pump and valve activation, as well as pump speed. Below is the functionality for each LED:

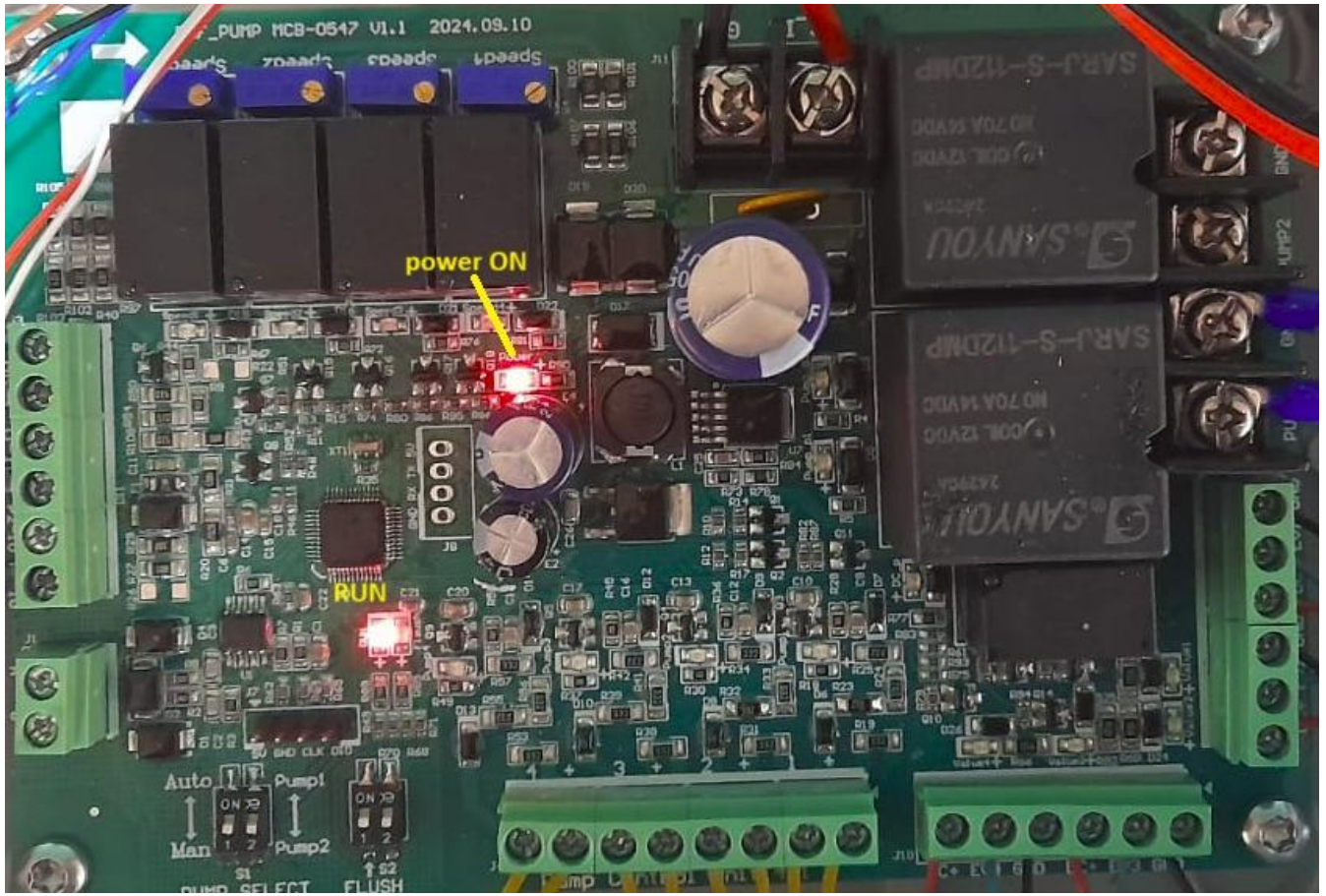



*Figure 10: PCB (control device) stand by*

- Speed 1: Indicates pump speed level 1 activation. At this speed, only one AC unit operates.
- Speed 2: Indicates pump speed level 2 activation. This speed supports two AC units working simultaneously.
- Speed 3: Indicates pump speed level 3 activation. At this speed, three AC units are active.
- Speed 4: Indicates pump speed level 4 activation. This speed enables all four AC units to operate concurrently.
- Pump 1 – Activation request from AC unit 1.
- Pump 2 – Activation request from AC unit 2.
- Pump 3 – Activation request from AC unit 3.
- Pump 4 – Activation request from AC unit 4.
- Valve 1 – Activation of Electro valve 1.
- Valve 2 – Activation of Electro valve 2.
- Valve 3 – Activation of Electro valve 3.
- Valve 4 – Activation of Electro valve 4.
- RUN – Power supply status (blinking)
- Pump_p1 – Activation of Pump 1.
- Pump_p2 – Activation of Pump 2.
- Power – Main control PCB power status.
- +DC_P – Power supply to pump status.

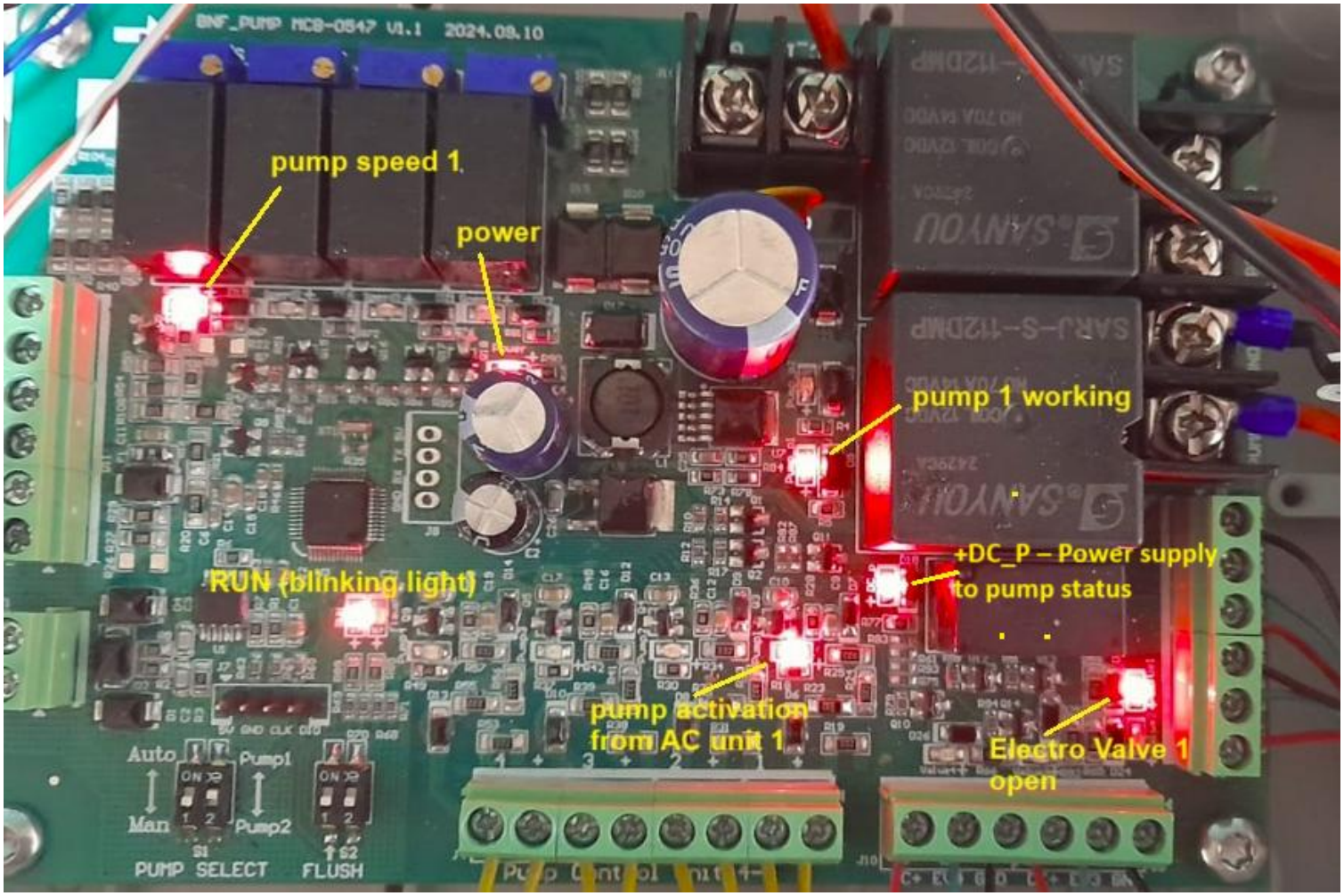



*Figure 11: The PCB (control device) shows pump 1 operating at speed 1. This is because only AC unit 1 is currently active*

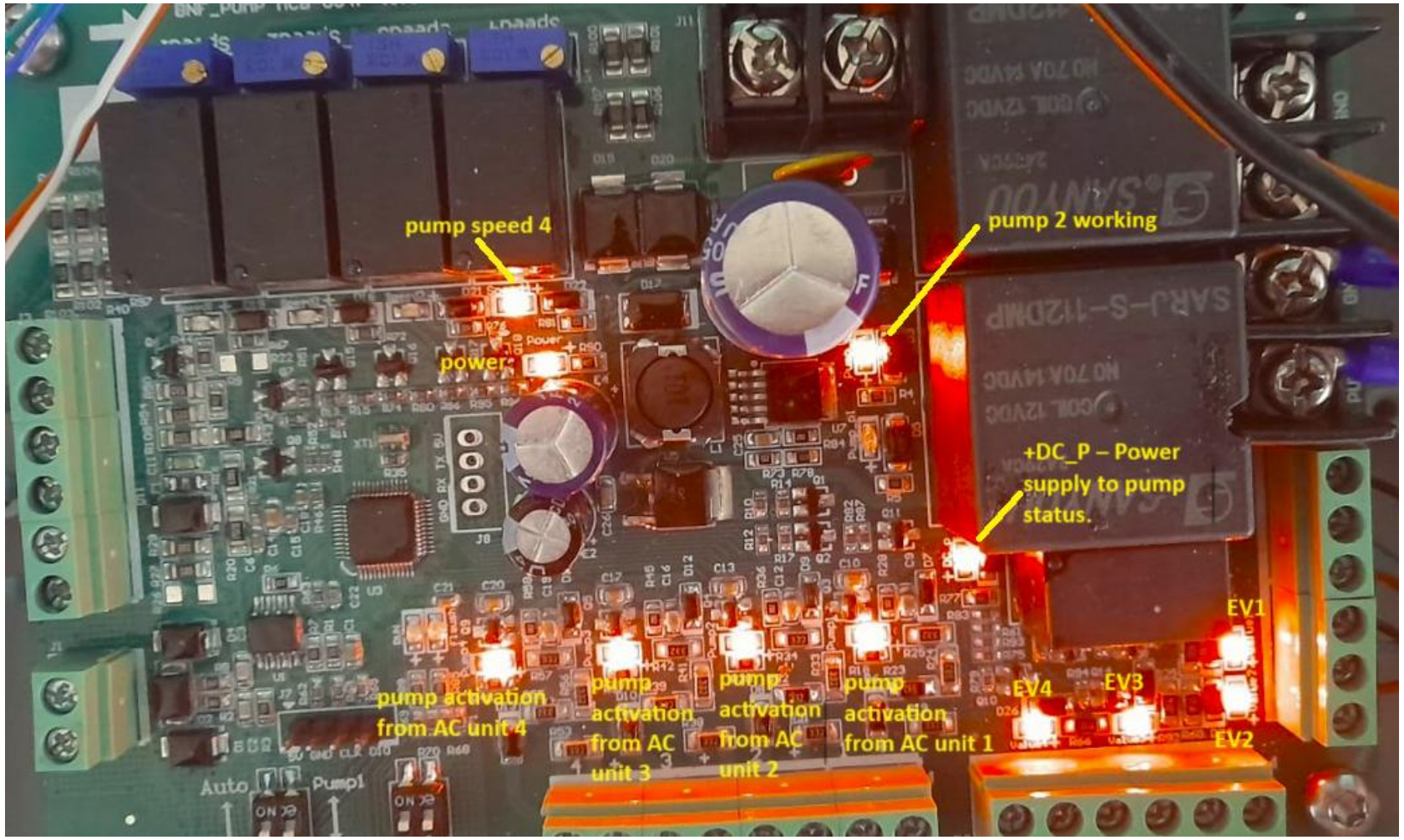



*Figure 12: The PCB (control device) shows pump 2 operating at speed 4. This is because all AC units are active.*

### 8.1 DIP Switch S1: Pump Operation Modes

The S1 switch sets the operation modes for the pumps:

| S1 Switch | Mode Description |
|---|---|
| **AUTO, PUMP 1** | Pumps 1 and 2 alternate operation automatically, starting with Pump 1 |
| **AUTO, PUMP 2** | Pumps 2 and 1 alternate operation automatically, starting with Pump 2 |
| **MAN, PUMP 1** | Normal operation with only Pump 1 running, if requested |
| **MAN, PUMP 2** | Normal operation with only Pump 2 running, if requested |

### 8.2 DIP Switch S2: Flush Mode Settings

The S2 switch configures the flush mode settings. The second switch (S2.2) is disabled and has no effect:

| S2 Switch | Mode Description |
|---|---|
| **1 OFF** | Normal operation, no flush mode activated. |
| **1 ON** | The selected pump from S1 runs at maximum speed in flush mode (all electro valves open). |
| **AUTO (S1)** | If AUTO is selected in S1, Pumps 1 and 2 alternate every 3 minutes at maximum speed in flush mode (all electro valves open). |

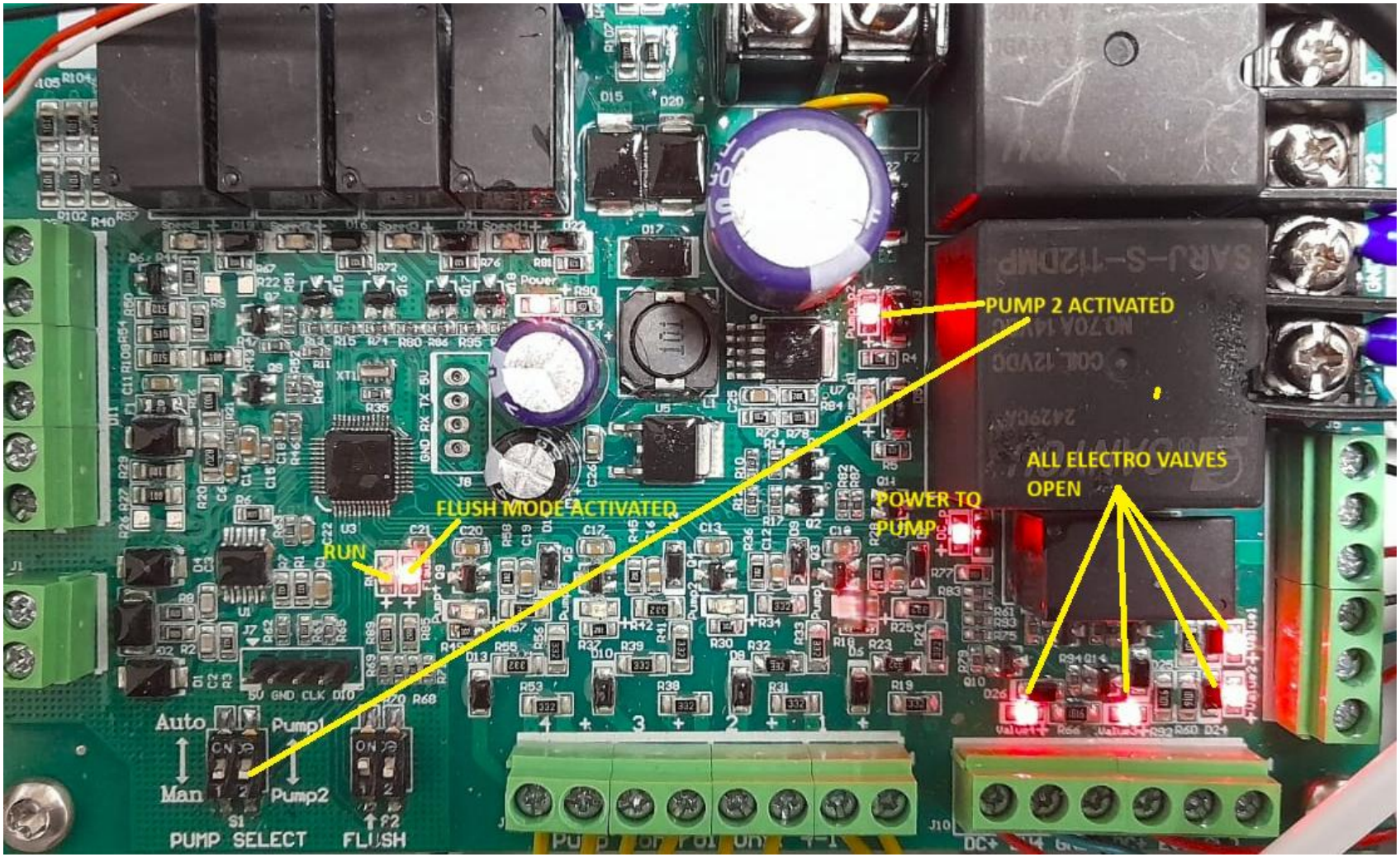



*Figure 13: The PCB (control device) indicates Pump 2 operating with all Electro Valves open in FLUSH MODE*

## 9. Water Flow Rate Calibration Procedure

The Efficient Flow AC Controller is equipped with four adjustable trimmers on the PCB, each corresponding to a different pump speed level. These trimmers regulate the seawater pump speed based on the number of air conditioning (AC) units operating simultaneously. The controller is factory-calibrated for a balanced system; however, since onboard installations often vary, fine-tuning the trimmers during installation is recommended to ensure optimal performance.

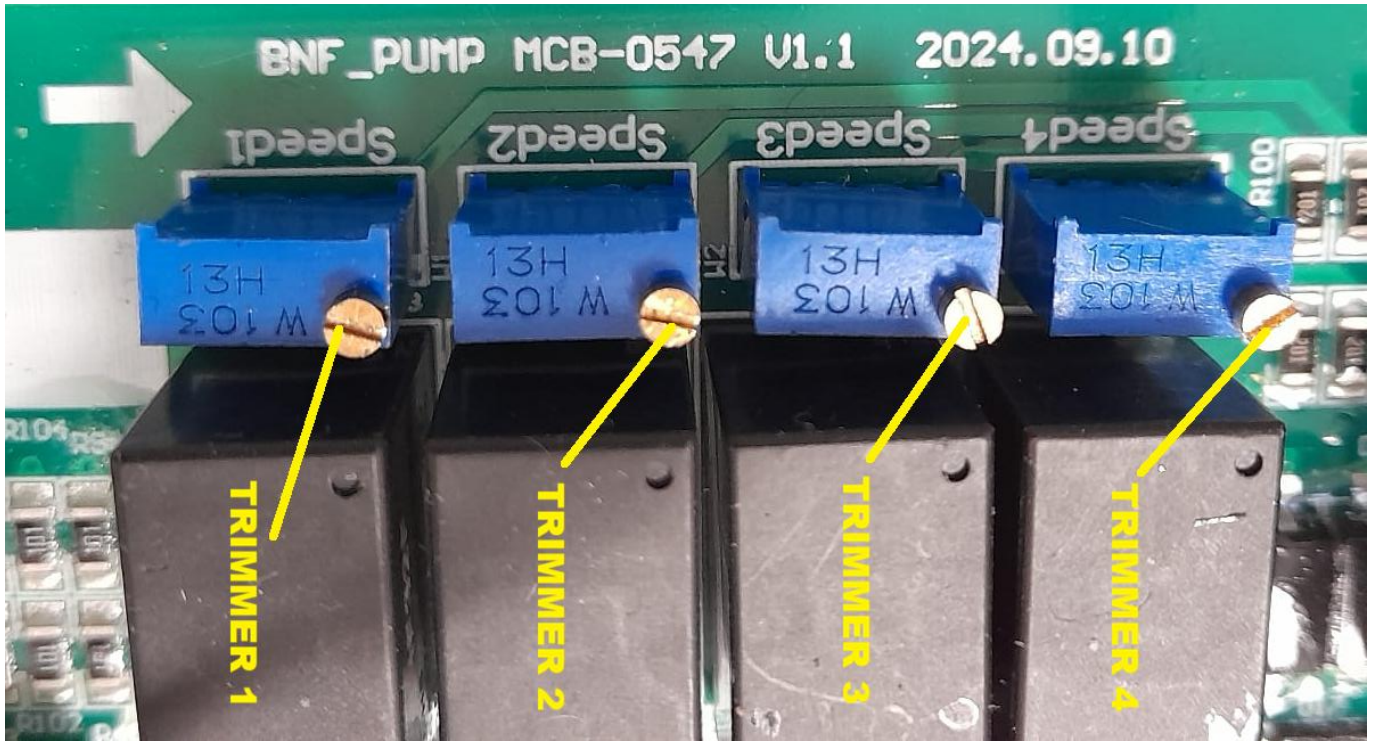



*Figure 14: Trimmers for pump speeds regulation*

| Trimmer | Pump Speed Level | Number of AC Units Running | Purpose |
|---|---|---|---|
| Trimmer 1 | Speed 1 (Lowest) | 1 Unit | Ensures sufficient seawater flow when only one AC unit is running |
| Trimmer 2 | Speed 2 | 2 Units | Provides adequate flow for two AC units running simultaneously |
| Trimmer 3 | Speed 3 | 3 Units | Calibrates flow rate for three AC units in operation |
| Trimmer 4 | Speed 4 (Highest) | 4 Units | Ensures full flow capacity for all four AC units running together |

Each trimmer sets the water pump speed for the corresponding number of active AC units. The goal is to ensure that each AC unit receives the proper seawater flow rate, as insufficient flow can compromise cooling efficiency and system longevity.

**Calibration Steps**

Step 1 – Calibrate Trimmer 1 (1 Unit Running):

- Turn off all AC units.
- Turn on only one AC unit, preferably the largest (highest cooling capacity) or the farthest from the Flow Controller.
- Measure the water flow rate from its overboard discharge.
- Adjust Trimmer 1 until the recommended flow rate for that unit is achieved.

Step 2 – Calibrate Trimmer 2 (2 Units Running):

- Keep the first unit running.
- Turn on a second AC unit, again selecting the next largest or farthest unit.
- Measure the water flow rate of *both* AC units from their respective discharges.
- Adjust Trimmer 2 so that each unit receives the recommended water flow rate.

Step 3 – Calibrate Trimmer 3 (3 Units Running):

- With the first two units still operating, turn on the third AC unit.
- Measure the water flow rate for all three AC units.
- Adjust Trimmer 3 until all three units receive sufficient and balanced flow.

Step 4 – Calibrate Trimmer 4 (4 Units Running, if applicable):

- Turn on the fourth AC unit, keeping the others running.
- Measure the water flow rate for all four AC units.
- Adjust Trimmer 4 so that every unit receives adequate seawater flow.

**Important Notes**

- Use only one unit's discharge at a time to measure flow accurately.
- Always calibrate starting from one unit up to four, not in reverse.
- Allow the system to stabilize for 1–2 minutes after starting each unit before taking measurements.
- The recommended seawater flow rate is approximately 1.7 - 2.0 l/min (27 - 32 gph) per 1,000 BTU of cooling capacity.

## 10. System Operation

1. Start-up: After connecting the power supply, pumps, and electro valves, configure the DIP switches according to the desired operation mode.
2. Monitoring: Use the LED indicators to monitor the activation of pumps, electro valves, and pump speed levels.
3. Flush Mode: Activate flush mode when required by adjusting the DIP switches (S2) to the appropriate settings.

4. Alternating Pumps: To balance wear and extend pump life, use the alternating operation mode via DIP switch S1.

## 11. Troubleshooting

- Issue: Pump not activating
  - Check the power connections (PUMP 1/GND or PUMP 2/GND).
  - Ensure the AC unit is sending an activation request.
  - Verify DIP switch settings for correct operation mode.
- Issue: Electro valve not functioning
  - Inspect the wiring between the electro valve and the PCB (DC+, EV, GND).
  - Verify that the correct LED indicator is lighting up when activation is requested.
- Issue: System not responding
  - Check the main power supply to the PCB and ensure voltage is correct (12VDC, 24VDC, or 48VDC).
  - Review DIP switch configuration and reset if necessary.

## 12. Maintenance

- Regularly inspect the connections to pumps and electro valves to ensure no wires are loose or damaged.
- To ensure proper operation and long service life, the system must undergo regular maintenance and inspection.
  The system must be cleaned periodically using non-corrosive descaling products that are specifically suitable for both plastic components and cupronickel materials. The use of aggressive or incompatible cleaning agents must be avoided, as they may damage system components.

In the event of clogging caused by severe fouling, it is recommended to replace the affected plastic parts, including the manifold and, if necessary, the electro valves.
Routine maintenance and inspection are essential to preserve system efficiency and prevent premature component failure.

- Check the DIP switches to ensure the settings are correct for the system's current operating conditions.

This technical manual provides detailed instructions for installation, operation, and troubleshooting of the Efficient Flow AC Controller. For additional support, please contact the manufacturer’s customer service team (www.blue-airco.com, info@blue-airco.com).