ENERGY INDUSTRIES

CONTROL OF PROSERV PUMP USING AC500 PLC
User manual

Version

Table of Contents

1 About This User Manual

This manual is specifically designed for use with the PLC control cabinet configured for operating Proserv's pump, designated as "50V." The control panel, which is based on an AC500 PLC, has been developed primarily for instances when the pump is sent to Proserv for service. Consequently, this system operates in a highly manual mode and does not include protective functions, such as overpressure protection.

It is important to note that this control unit enables pressurizing the pressure chamber; however, this operation requires a solid understanding of the system. Please proceed with caution, as safe operation depends on the operator's familiarity with the system and adherence to the instructions provided in this manual.

1.1 Related Documentation

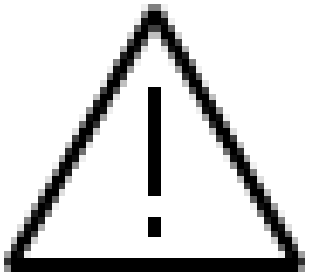
For a complete list of documentation applicable to <Product suite>, refer to the Release Notes (). Table 1 lists the <Product name> documents referenced in this manual.

Table 1: Related Documentation

Document ID	Title
<doc.no>	<title>

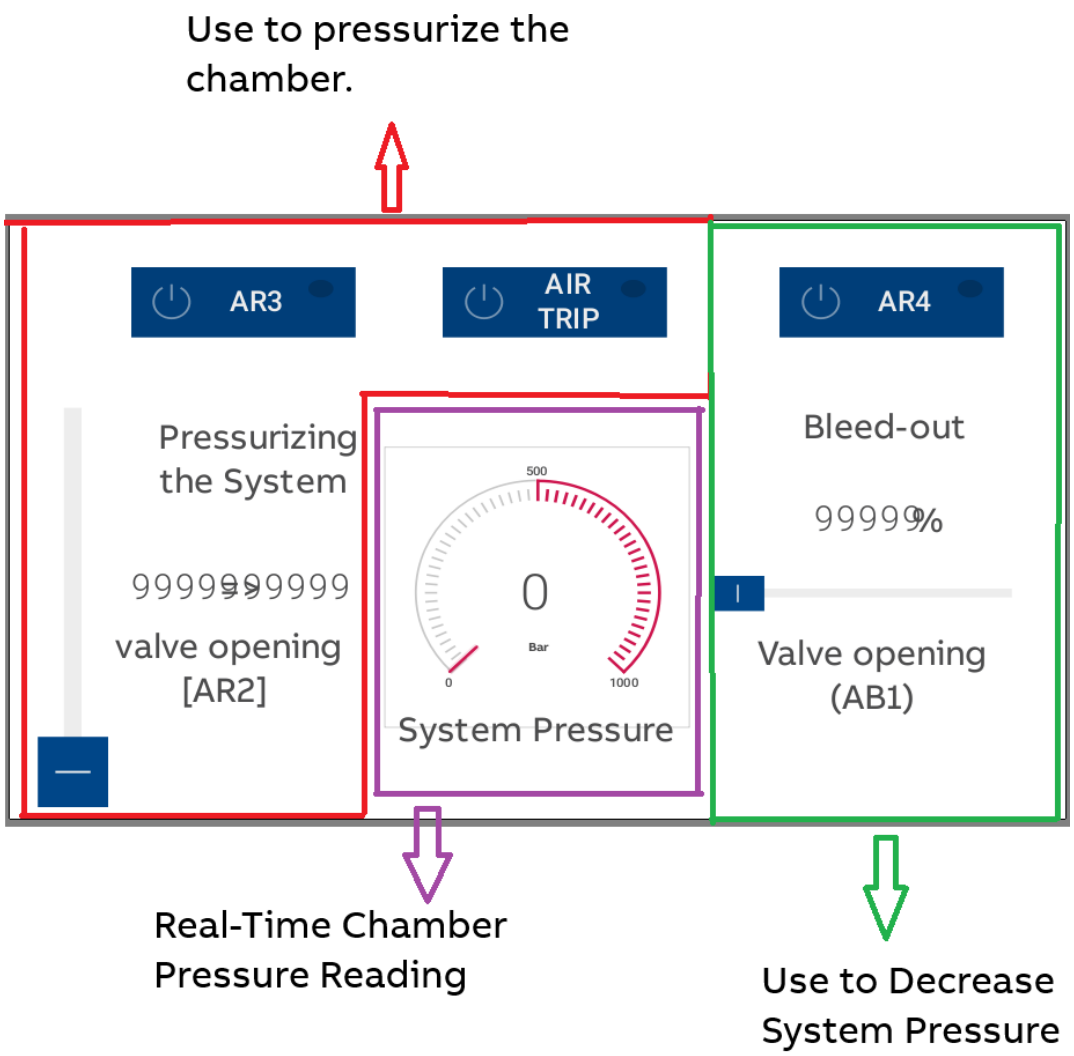
1.2 Warning, Caution, Information, and Tip Icons

During pressure testing, there is a risk that fittings or other connections may cause an oil spray. ALWAYS wear safety goggles when pressurizing the equipment.



Use Eye Protection

2 User manual for Proserv (During service)



Functional Testing of Electrical Components:

1. Connect the single-phase plug and wait for the display to boot up until the menu appears as shown in the image above (takes approximately 1 minute).
2. Connect the 20-pin plug to the test object.
3. Press the AR3 button on the display and listen for a clear clicking sound from the relay.
4. Press the Air-Trip button on the display and listen for a clear clicking sound from the relay. *(Note: Only Roar has access to this!)*
5. Press the AR4 button on the display and listen for a clear clicking sound from the relay.
6. Move the slider for AB1 to 100% and listen for the motor to spin until it stops (about 1 minute), then move the slider back to 0%.

Note: It is challenging to control AR2 and PT without pressurizing, so the last two steps are **optional**.

7. **Testing AR2 under Pressure:** Ensure that AB1 and AR4 are fully closed. Then set AR2 to position 1. Open AR3 and Air-Trip (Roar) and listen for the pump to start. You can increase the slider to hear the pump speed up or slow down. (Turn off pressure by closing AR3.)
8. **Testing PT:** Now that a slight pressure has been built up from the previous test, verify that the "System Pressure" value on the display roughly matches the reading on the physical pump's pressure gauge.

Follow the bleed-out steps in the user manual.

If any of these steps do not work, see the chapter: Troubleshooting.

3 User Manual (English)

3.1 Mechanicly assembly

Sett koble til mekanisk utstyr slik som henvist i dokument: xxxxxx av forfatter John Andersen

3.2 Pressurizing the System

Prepare the Testing Area
Prepare the area for testing. Set up barriers and clearly mark the area to indicate that testing is in progress

1. **Connect Power**
    - Plug the two-phase connector from the control box into an outlet that can be controlled from a safe location outside the testing zone in case of emergency.
    - Do the same for the air compressor.
2. **Initialize the PLC and Connect the Control Box**
    - Wait for the PLC to boot up correctly.
    - Connect the 20-pin plug from the control box to Proserv "50V."
3. **Check Mechanical Valves**
   Triple-check that the mechanical valves are set correctly:
    - **High-Pressure Valve**: Open one or two turns counterclockwise.
    - **Bleed-Off Valve**: Fully closed with a light, fingertight clockwise turn.
    - *(Remember: "Lefty loosey, righty tighty")*
4. **Confirm Air Compressor Status**
   Ensure the air compressor is not running before the next step to allow you to hear the panel's operation clearly.
5. **Set AR2 Valve Opening**
   Use the touch panel to set the AR2 valve to a desired opening level, such as level 2. Increase gradually if pressure build-up is too slow.
6. **Start Pressurization**
   Press the AR3 button to start pressurizing. The system will activate, and you should hear the air pump starting.
7. **Monitor Real Pressure**
   Monitor the actual system pressure using the "Real Pressure" sensor. Ensure the pressure does not exceed 300 bar.
8. **Stop Pressurization**
   When the "Real Pressure" value reaches the desired level, stop the pressure increase by turning off AR3.
9. **Close AR2 Valve**
   Reduce the AR2 valve opening back to 0.

Emergency Procedure

If the PLC is unresponsive:

- Unplug the air compressor only, leaving the PLC connected. This will prevent further pressure build-up.
- Wait two minutes to ensure stability. Then, manually close the high-pressure side on the panel and slowly open the bleed-off valve to release pressure safely.

3.3 Depressurizing the System

1. **Ensure Valves are Set**
   Make sure that the AR2 valve is set to 0 and that AR3 is turned off.
2. **Open AB1 Valve**
   Set the AB1 valve to approximately 20% open.
3. **Activate AR4 Valve and Monitor Pressure**
   Turn on the AR4 valve and monitor the "Real Pressure" reading to observe the pressure decrease.
   (If the pressure drops too slowly, you can increase the AB1 valve opening to speed up the process.)
4. **Secure Equipment**
   Before leaving the equipment, close the high-pressure mechanical valve (finger-tight) and open the bleed-off valve.
5. **Remove Safety Measures**
   Remove any physical barriers and high-pressure testing signage. barriers and high-pressure testing signage.

4 Bruker manual (Norsk)

4.1 Mekanisk Montering

Koble til mekanisk utstyr som angitt i dokument: xxxxxx.

4.2 Trykksetting av Systemet

1. **Gjør Klart Testområdet**
   Klargjør området for testing. Sett opp sperringer og marker tydelig at testing pågår.
2. **Koble til Strøm**
   - Koble tofasekontakten fra kontrollboksen til en stikkontakt som kan styres fra et trygt sted utenfor testområdet, i tilfelle en nødsituasjon.
   - Gjør det samme med luftkompressoren.
3. **Start Opp PLC-en og Koble til Kontrollboksen**
   - Vent til PLC-en har startet opp korrekt.
   - Koble 20-pinners pluggen fra kontrollboksen til Proserv "50V."
4. **Kontroller Mekaniske Ventiler**
   Sjekk tre ganger at de mekaniske ventilene er riktig satt:
   - **Høytrykksventil**: Åpen én eller to omdreininger mot klokken.
   - **Bleed-Off Ventil**: Helt lukket med en lett, fingerstram rotasjon med klokken.
   - *(Husk: "Venstre løs, høyre stram")*
5. **Bekreft Luftkompressorstatus**
   Sørg for at luftkompressoren ikke er i gang før neste steg, slik at du kan høre at panelet fungerer korrekt.
6. **Sett Åpning på AR2-Ventilen**
   Bruk berøringspanelet til å stille AR2-ventilen til ønsket åpning, for eksempel nivå 2. Øk gradvis hvis trykkøkningen er for treg.
7. **Start Trykksetting**
   Trykk på AR3-knappen for å begynne trykksetting. Systemet vil aktiveres, og du vil tydelig høre at luftpumpen starter.
8. **Overvåk Faktisk Trykk**
   Overvåk det faktiske trykket i systemet ved hjelp av "Real Pressure"-sensoren. Pass på at trykket ikke overstiger 300 bar.
9. **Stopp Trykksetting**
   Når "Real Pressure"-verdien når ønsket nivå, stopp trykkøkningen ved å skru av AR3.
10. **Lukk AR2-Ventilen**
    Reduser AR2-ventilåpningen tilbake til 0.

Nødprosedyre

Hvis PLC-en ikke reagerer:

- Trekk ut kontakten kun til luftkompressoren, og la PLC-en være tilkoblet. Dette vil forhindre videre trykkoppbygging.
- Vent i to minutter for å sikre stabilitet. Deretter kan du manuelt lukke høytrykkssiden på panelet og sakte åpne bleed-off-ventilen for å frigjøre trykket på en trygg måte.

4.3 Trykkavlastning

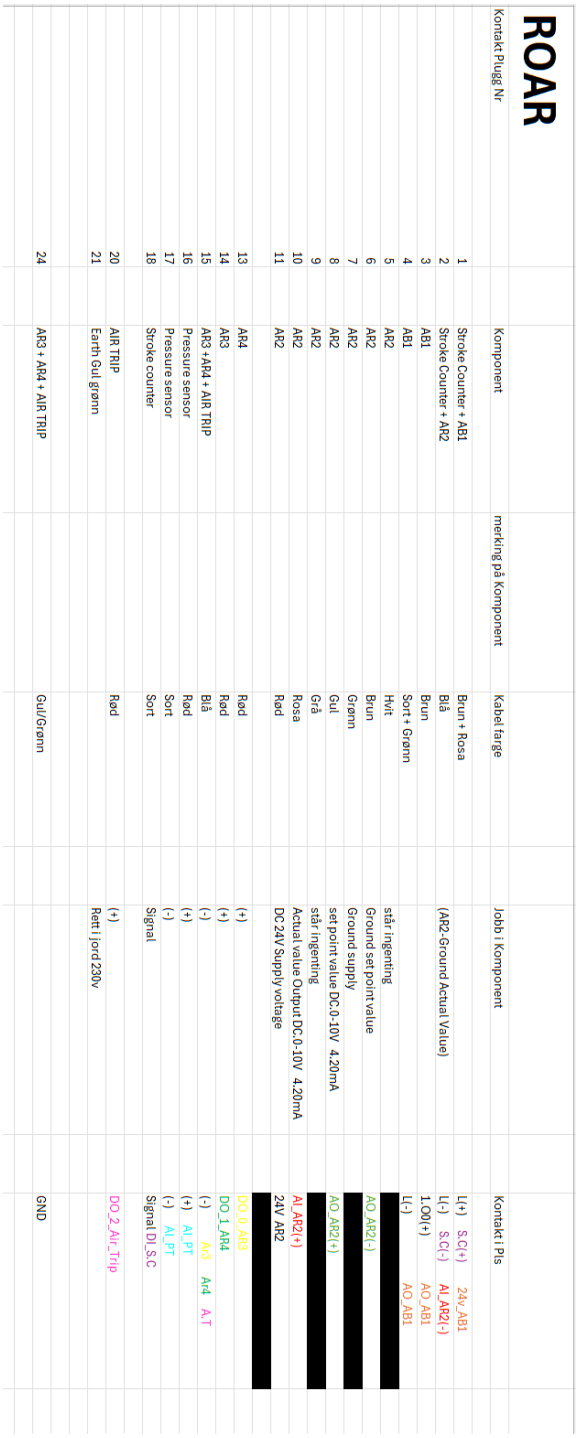
1. **Sjekk Ventilinnstillinger**
   Forsikre deg om at AR2-ventilen er satt til 0 og at AR3 er slått av.
2. **Åpne AB1-Ventilen**
   Still AB1-ventilen til omtrent 20 % åpning.
3. **Aktiver AR4-Ventilen og Overvåk Trykket**
   Skru på AR4-ventilen og overvåk "Real Pressure"-verdien for å observere trykkfallet. *(Hvis trykket faller for sakte, kan du øke AB1-ventilåpningen for å fremskynde prosessen.)*
4. **Sikre Utstyret**
   Før du forlater utstyret, lukk den mekaniske høytrykkssiden (fingerstram) og åpne bleed-off-ventilen.
5. **Fjern Sikkerhetstiltak**
   Fjern alle fysiske sperringer og merking for høytrykkstesting.

5 Technical information

5.1 introduction

This technical section provides a more advanced explanation for both understanding the system and troubleshooting if needed. This information is not necessary for operating the system and can be overlooked by those who do not have a 'special interest'.

5.2 Koblinger



ROAR

Kontakt Plugg Nr	Komponent	merking på Komponent	Kabel farge	Jobb i Komponent	Kontakt i Pls
1	Stroke Counter + AB1		Brun + Rosa		Li(+) S.C(+) 24v_AB1
2	Stroke Counter + AR2		Blå	(AR2-Ground Actual Value)	Li(-) S.C(-) AI_AR2(+)
3	AB1		Brun		1.OO(+) AO_AB1
4	AB1		Sort + Grønn		Li(-) AO_AB1
5	AR2		Hvit		[redacted]
6	AR2		Brun	stå ingenting	
7	AR2		Grønn	Ground set point value	AO_AR2(-)
8	AR2		Gul	Ground supply	[redacted]
9	AR2		Grå	set point value DC:0-10V 4:20mA	AO_AR2(+)
10	AR2		Rosa	stå i ingenting	[redacted]
11	AR2		Rød	Actual value Output DC:0-10V 4:20mA	AI_AR2(+)
				DC 24V Supply voltage	24V AR2
13	AR4		Rød	(+)	[redacted]
14	AR3		Rød	(+)	DO_U_AR3
15	AR3 +AR4 + AIR TRIP		Blå	(-)	DO_1_AR4
16	Pressure sensor		Rød	(+) Ar3 Ar4 A_T	
17	Pressure sensor		Sort	(+) AI_PT	
18	Stroke counter		Sort	(-) AI_PT	
				Signal	(-)
					Signal DI_S.C
20	AIR TRIP		Rød	(+)	DO_2_Air_Trip
21	Earth Gul grønn			Rett i jord 230v	
					GND
24	AR3 + AR4 + AIR TRIP		Gul/Grønn		

5.3 PLC-program

```
PROGRAM POU_logic
VAR

// Inputs
  Messured_pressure_AR2 : REAL;   // Calculated pressure value in Bar
  Messured_pressure_PT : REAL;    // Measured pressure value in Bar from Pressure Sensor

  // Outputs
  Set_AO_AB1 : INT;     // Desired valve opening (0-100%)
  Set_AO_AR2 : INT;     // Desired opening of valve for AR2 (0-10)

  // Constants
  Range_Max : REAL := 27656;    // Maximum range value for conversion
  Scale_PT : REAL := 1000;      // Scaling factor for pressure transmitter
            Scale_AR2 : REAL := 10;
            Scale_AB1 : REAL := 100;
            Button_AR3: BOOL := FALSE;
            Button_AR4: BOOL := FALSE;
            Button_Air_Trip: BOOL := FALSE;; //          Panel to manipulate Air Trip

END_VAR

Selve programet:
//OUTPUT

            DO_0_AR3 := Button_AR3; // Button_AR3 styres av displayet
            DO_1_AR4 := Button_AR4;          // Button_AR4 styres av displayet
            DO_2_Air_Trip := Button_Air_Trip; // Button_Air_Trip styres av displayet
            AO_AB1 := REAL_TO_INT( (Set_AO_AB1 / Scale_AB1) * Range_Max ); // Max trykk 100%. Set_AO_AB1 styres av dis-
playet
            AO_AR2 := REAL_TO_INT( (Set_AO_AR2 / Scale_AR2) * Range_Max ); // åpning av ventil Ar2. Set_Set_AO_AR2 styres
av displayet
```

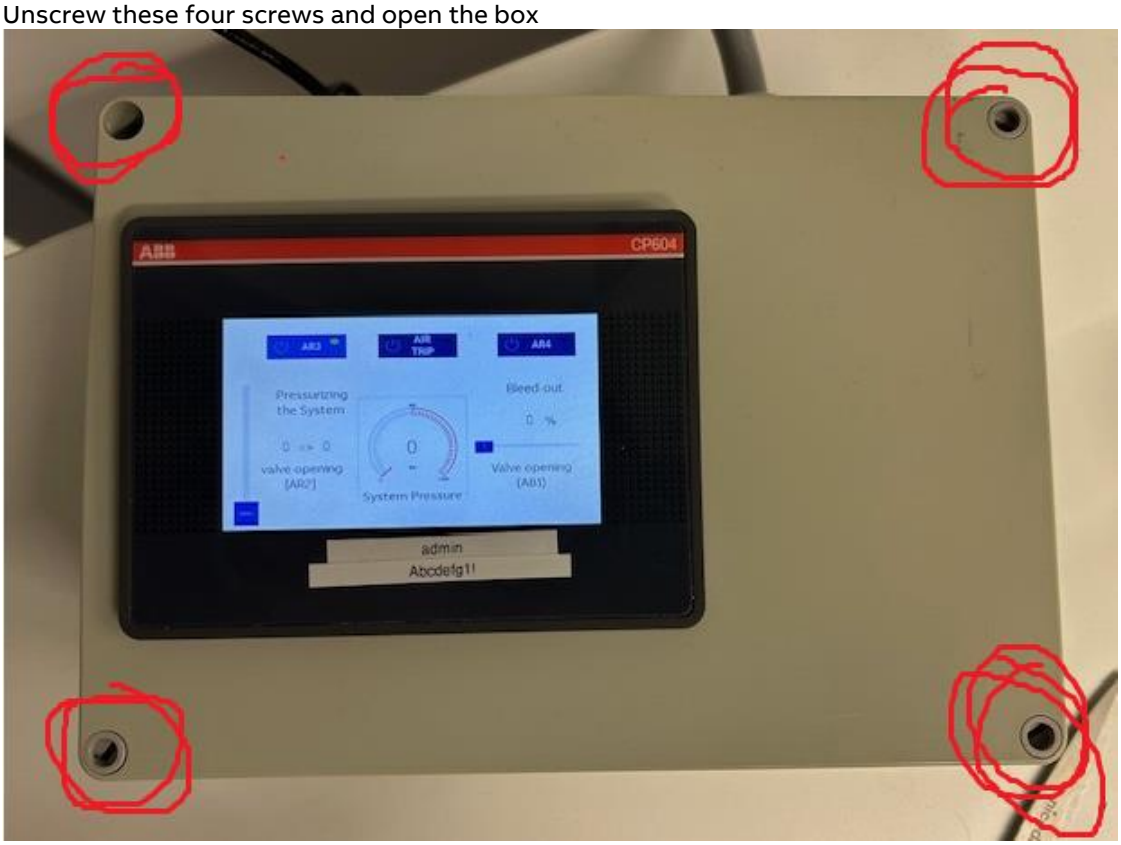
```
//INPUT


        // Lese trykket fra AI_AR2 (analog input INT, 0-20 Bar)

        Messured_pressure_AR2 := (INT_TO_REAL(AI_AR2) / Range_Max) * Scale_AR2;  //max trykk = 20 /denne er målt: 4mA = 0 20 = 1000 (-23.7 = ikke noe signal)


        // Lese trykket fra AI_PT (analog input INT, 0-1000 Bar)

        Messured_pressure_PT := (INT_TO_REAL(AI_PT) / Range_Max) * Scale_PT;  //max trykk = 1000   /denne er målt: 4mA = 0 20 = 1000 (-1184 = ikke noe signal)
```

6 Troubleshooting

<This is a basic guide showing the most essential steps to start a Troubleshooting for different problems.>

6.1 Display shows the interface but does not respond.

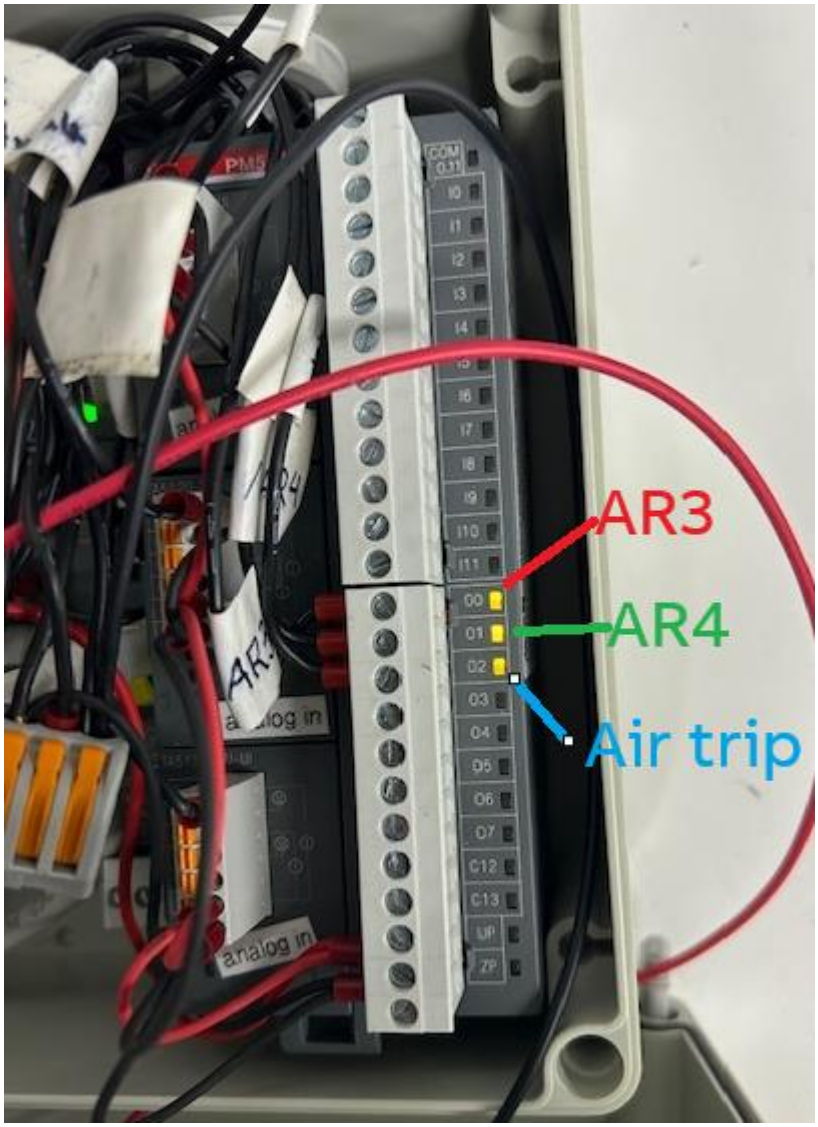
Unscrew these four screws and open the box



Inspect the PLC and make sure it is in Run mode, which is indicated by the green light.

6.2 AR3, AR4 or Air Trip

If you press the button on the display and hear no sound from the relay, start by opening the box as mentioned in the previous paragraph. Then, look at the right side of the PLC and confirm that the PLC lights up on the desired test object as shown in the picture.

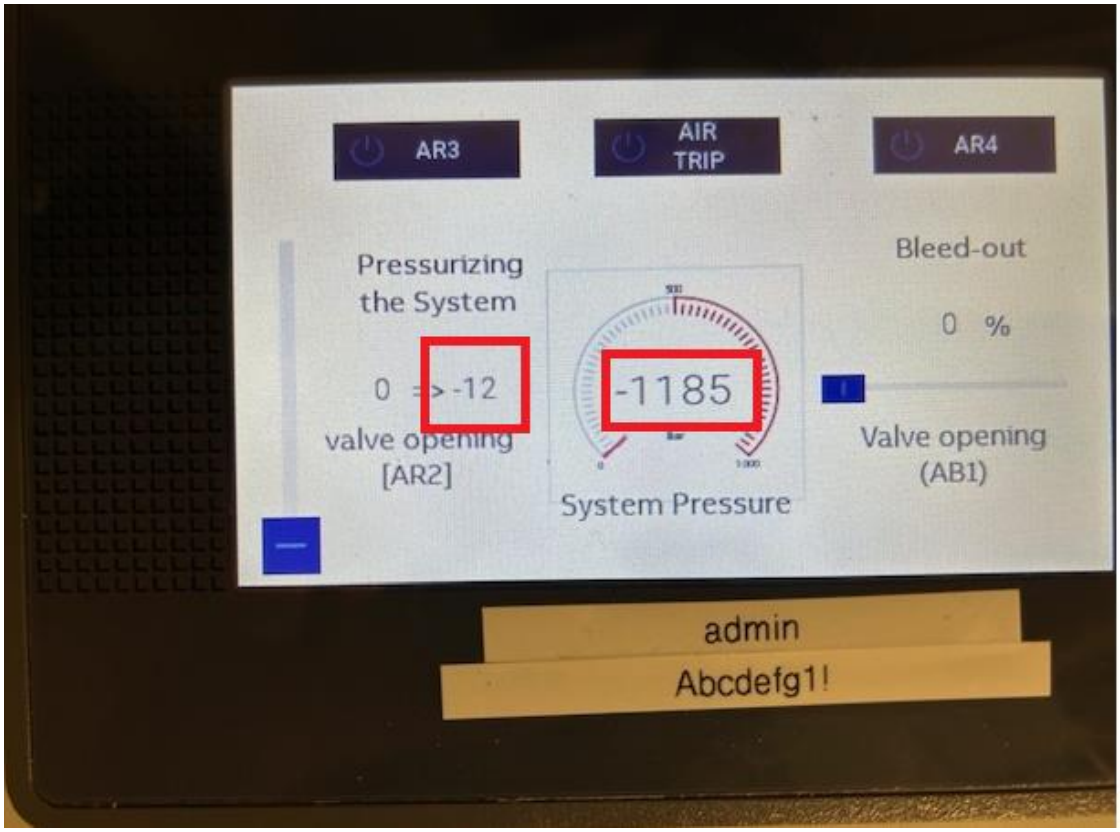


If the lights illuminate as shown in the picture after the desired use, we can proceed to check for 24V in the plug.

1. **Unplug the 20-connector plug.**
2. **Use a multimeter to measure the following:**
    - **dot/AR4:** Contact 13 (+), Contact 15 (-)
    - **dot/AR3:** Contact 14 (+), Contact 15 (-)
    - **dot/ Air trip:** Contact 20 (+), Contact 15 (-)

If you measure 24V, we know the problem is after the plug. If we do not measure 24V, we know the problem is from the PLC.

6.3 No respons from PT or AR2 actual value



These two values indicate that there is no signal at all, and you should start troubleshooting for breaks or cables that have come loose from their connectors.

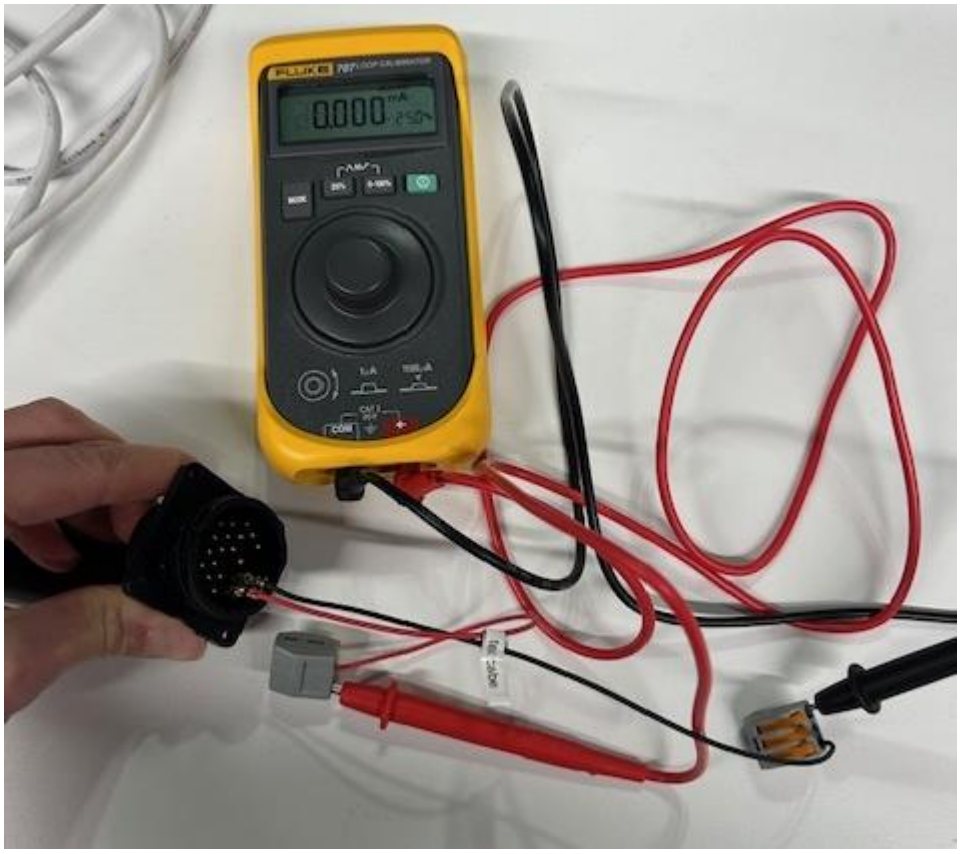
Note: There are no Light indication at the PLC for analog inputs

6.4 No output from AR2 or AB1

Put a multimeter or a Fluke 707 loop calibrator in measurement mode and measure the pins in the 20-pin connector using the measurement cables that should be loose inside the box. Measure between:

- **AB1:** Contact 3 (+), Contact 15 (-)
- **AB1:** Contact 8 (+), Contact 15 (-)

What you should be able to measure here is when the slider is at minimum = 4mA and when the slider is at maximum = 20mA, both on AB1 and AR2.



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