# Variable Unloading II
### (For use with ECOLINE / CRII)

**Version 4 Note:** Version 4 reflects a change in the PLC Module which now uses a different style of memory card. For this reason the module, card, and kit part numbers have been revised.

## Overview
Variable Unloading can be used to control the unloader(s) on BITZER reciprocating compressors to vary the capacity of the compressor. Typically a rack controller outputs a 0-10V analog signal that is used to ramp a variable frequency drive up or down to vary the compressor capacity. The Variable Unloading II concept uses this same signal to control up to two unloaders on a 4 cylinder compressor or three unloaders on a 6 cylinder compressor.

VUII (Variable Unloading II) utilizes already existing unloader technology and only requires that the compressor be fitted with standard ECOLINE capacity regulating head(s), CRII unloading stem(s) and solenoid coil(s). Previous model compressor (".2 Generation") should not use VUII programs without replacing the unloading head and stem.

VUII requires these "off the shelf" PLC control modules:

> **PLC Module** (835-0003-01) Controller, powered by 24VDC, 0-10V input, controls 4 relays

> **Power Source** (837-0006-01) Transformer to convert 120 or 230 VAC to 24VDC

> **Program Card** (See chart below)

## Part Numbers

| Compressor Type | Available Minimum Capacity | Description | Part Number | Kit Number* |
|---|---|---|---|---|
| 4 Cylinder | 10% - 100% | Program to control up to: (2) 4 cylinder compressors | 837-0017-42 | 999-0032-01 |
| 6 Cylinder | 10% - 100% | Program to control: (1) 6 cylinder compressor | 837-0017-64 | 999-0033-01 |
| 4 Cylinder and/or 6 Cylinder | 50% - 100% 33% - 100% | Program to control up to: (2) 4 cylinder compressors (2) 6 cylinder compressor (1) 4 & (1) 6 cylinder compressor | 837-0017-52 | 999-0034-01 |

*Kits include PLC module, power source, and micro SD program card

## <u>ATTENTION!!</u>
This document does not replace or override the information provided by the manuals for the PLC control or power supply. All safety information for these products should be observed.

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## CRII System Application Limits

At large pressure ratios and for some refrigerants, the minimum load for operation of some 4-cylinder and 6-cylinder reciprocating compressors shall be limited (e.g. CRII ≥ 33%; CRII ≥ 20%). These minimum load requirements are pre-programmed and jumper selectable. See wiring diagrams below and the BITZER software or KT-101.

## Basic Function Description

### Analog Signal
The analog 0-10V signal(s) should utilize the same built-in functionality of the rack controller that would control a variable frequency drive. Please ensure the output for the rack controller (to the "VFD") is set for 0-10V and connects to either I7 and/or I8. A 0 volt output should correspond to minimum capacity on a 4 or 6 cylinder compressor. 10 volts should always correspond to 100% capacity.

The PLC module will read the analog signal and control the unloaders on the compressor with the appropriate unloading sequence. If using the module to variably unload more than one compressor, the functionalities of the two compressors are completely independent of each other. Please see Figures 1 through 4 for wiring diagrams.

### (1) or (2) 4 Cylinder Compressors
For each compressor, the PLC module requires a separate analog 0-10V signal from the rack controller to terminals I7 and/or I8. A 24V jumper from the power supply to terminal I1, I2, or I3 is required to select the minimum allowable capacity. Based on this/these signal(s), relays Q1, Q2 and/or Q3, and Q4 are controlled. Please see **Figure 1** for wiring diagram.

| Program 42: Jumper / Input / Output Unloader Control Combinations | | | |
|---|---|---|---|
| Compressor Type | Jumper | Analog Input* | Output |
| 4 Cylinder 10% | I1 | I7, (I8) | Q1, Q2, (Q3, Q4) |
| 4 Cylinder 20% | I2 | I7, (I8) | Q1, Q2, (Q3, Q4) |
| 4 Cylinder 33% | I3 | I7, (I8) | Q1, Q2, (Q3, Q4) |

**PLEASE NOTE – ONLY ONE INPUT (I1, I2, OR I3) SHOULD BE JUMPERED AT A TIME**

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## (1) 6 Cylinder Compressor

The program works in the same manner as with 4 cylinder compressors except that it controls three unloader heads on a 6 cylinder compressor. By utilizing input I7 and a 24V jumper from the power supply to terminal I1 or I2 to select the minimum allowable capacity, a single 6 cylinder compressor can be controlled. Based on this signal, relays Q1, Q2, and Q3 are controlled. Please see **Figure 2** for wiring diagram.

| Program 64: Jumper / Input / Output Unloader Control Combinations | | | |
|---|---|---|---|
| Compressor Type | Jumper | Analog Input* | Output |
| 6 Cylinder 10% | I1 | I7 | Q1, Q2, Q3 |
| 6 Cylinder 20% | I2 | I7 | Q1, Q2, Q3 |

**PLEASE NOTE – ONLY ONE INPUT (I1 OR I2) SHOULD BE JUMPERED AT A TIME**

## (1) or (2) 4 Cylinder Compressors

For each compressor, the PLC module requires a separate analog 0-10V signal from the rack controller to terminals I7 and/or I8. A 24V jumper from the power supply to terminal I1 and/or I2 is also required. Based on this/these signal(s), relays Q1, Q2 and/or Q3, and Q4 are controlled. Please see **Figure 3** for wiring diagram.

## (1) or (2) 6 Cylinder Compressors

The program works in the same manner as with 4 cylinder compressors except that it controls two unloader heads on a 6 cylinder compressor. By utilizing input I7 and/or I8 and a 24V jumper from the power supply to terminal I3 and/or I4, up to two 6 cylinder compressor can be controlled. Based on this/these signal(s), relays Q1, Q2, and/or Q3, Q4 are controlled. See **Figure 4** for wiring diagram.

## (1) 4 Cylinder and (1) 6 Cylinder Compressor

The program works in the same manner as with 4 and 6 cylinder compressors except that it controls one unloader head on a 4 cylinder compressor and two unloader heads on a 6 cylinder compressor. By utilizing inputs I7 & I8 and a 24V jumper from the power supply to terminals I1 & I4 or I2 & I3, the two compressors can be controlled. Based on these signals, relays Q1, Q3 & Q4 or Q3, Q1 & Q2 are controlled. See the table below for jumper / input / output combinations. Please see **Figures 5 and 6** for wiring diagram.

| Program 52: Jumper / Input / Output Unloader Control Combinations | | | |
|---|---|---|---|
| Compressor Type | Jumper | Analog Input* | Output |
| 4 Cylinder 50% | I1, (I2) | I7, (I8) | Q1, (Q3) |
| 6 Cylinder 33% | I3, (I4) | I7, (I8) | Q1, Q2, (Q3, Q4) |
| 4 Cylinder 50% and 6 Cylinder 33% | I1, I4 or I2, I3 | 17, 18 | Q1, Q3, Q4 or Q1, Q2, Q3 |

*Analog Input = From rack controller (only (1) input each to I7 and I8 can be used at a time)

**PLEASE NOTE – I1 AND I3 SHOULD NEVER BE JUMPERED TOGETHER**
**I2 AND I4 SHOULD NEVER BE JUMPERED TOGETHER**

Use the tables above and Figures 1 through 6 to set up the device for the desired configuration.

## Figure 1: Wiring when using (2) 4 cylinder compressors (Program 42):

**PLEASE NOTE – ALL WIRING SHOULD BE PERFORMED BY TRAINED ELECTRICIANS WHO OBSERVE SAFE WORK PRACTICES.**
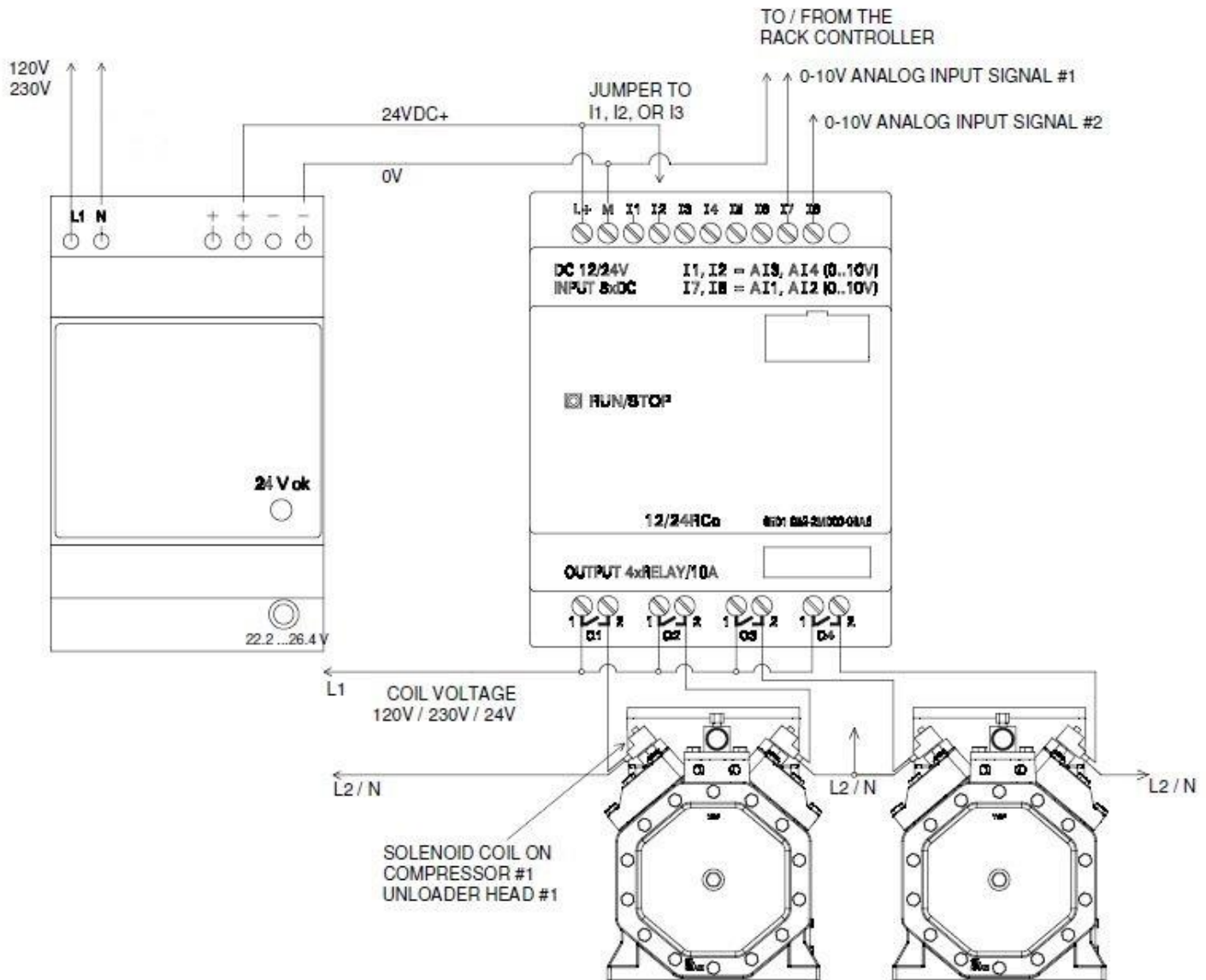


| Terminal Jumped | Compressor Minimum Capacity |
|:---:|:---:|
| I1 | 10% |
| I2 | 20% |
| I3 | 33% |

**PLEASE NOTE – YOU CANNOT HAVE TWO COMPRESSORS ON THE SAME CONTROLLER WITH DIFFERENT MINIMUM CAPACITIES**

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## Figure 2: Wiring when using (1) 6 cylinder compressor (Program 64):

**PLEASE NOTE – ALL WIRING SHOULD BE PERFORMED BY TRAINED ELECTRICIANS WHO OBSERVE SAFE WORK PRACTICES.**

TO / FROM THE RACK CONTROLLER

0-10V ANALOG INPUT SIGNAL #1

120V 230V

24VDC+

JUMPER TO I1 OR I2

0V

L1 N    + + − −

L+ M  I1 I2  I3 I4  I5 I6  I7 I8

DC 12/24V INPUT 8xDC    I1, I2 = AI3, AI4 (0..10V)    I7, I8 = AI1, AI2 (0..10V)

RUN/STOP

24 V dc

12/24RCo

OUTPUT 4xRELAY/10A

22.2 ...26.4 V

1  2   1  2   1  2   1  2
Q1    Q2    Q3    Q4

L1   COIL VOLTAGE 120V / 230V / 24V

L2 / N

SOLENOID COIL ON UNLOADER HEAD #3 SHOULD BE THE LAST TO UNLOAD AND MUST BE CONNECTED TO Q3

| Terminal Jumped | Compressor Minimum Capacity |
|-----------------|------------------------------|
| I1 | 10% |
| I2 | 20% |

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## Figure 3: Wiring when using (2) 4 cylinder compressors (Program 52):

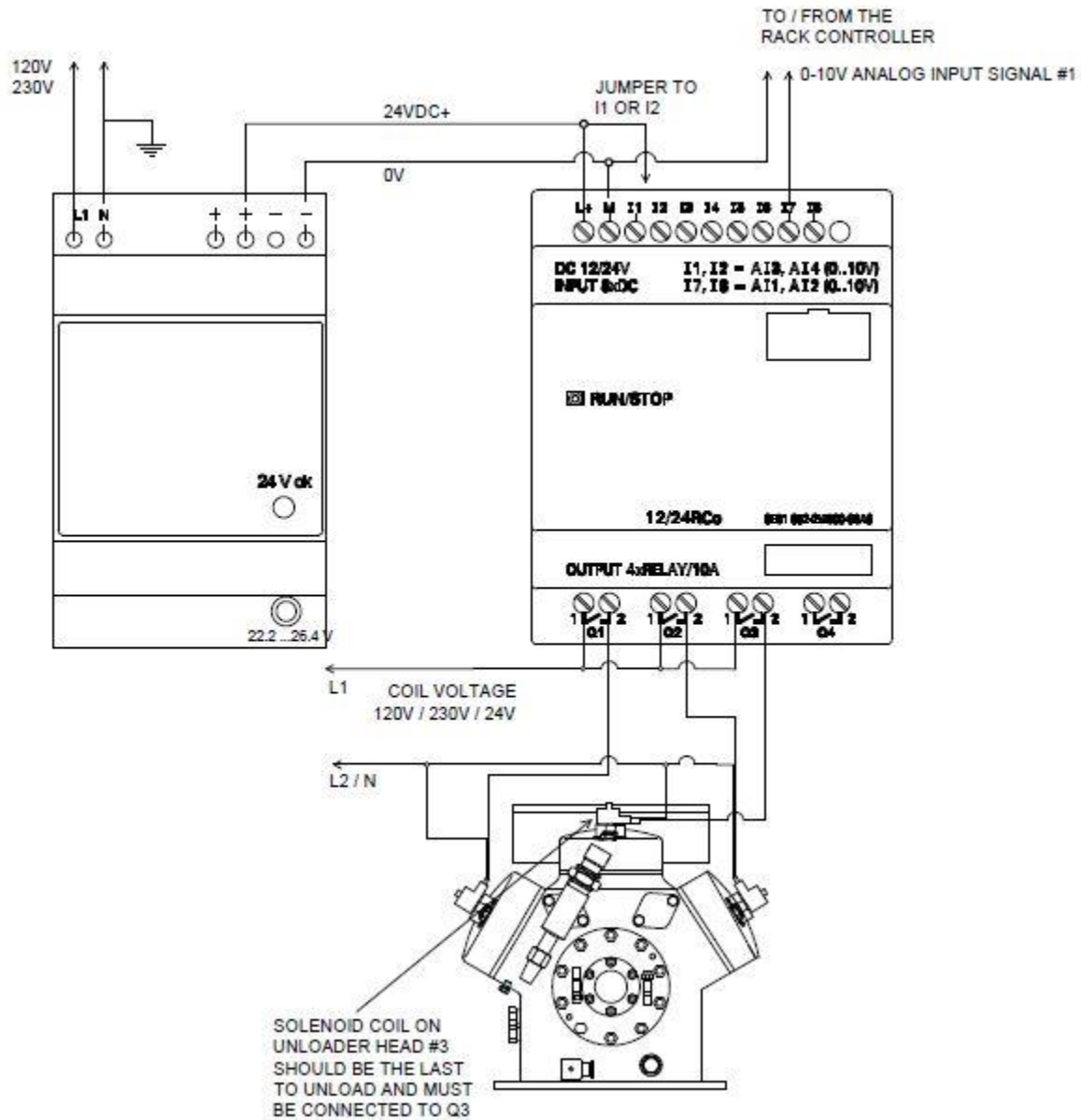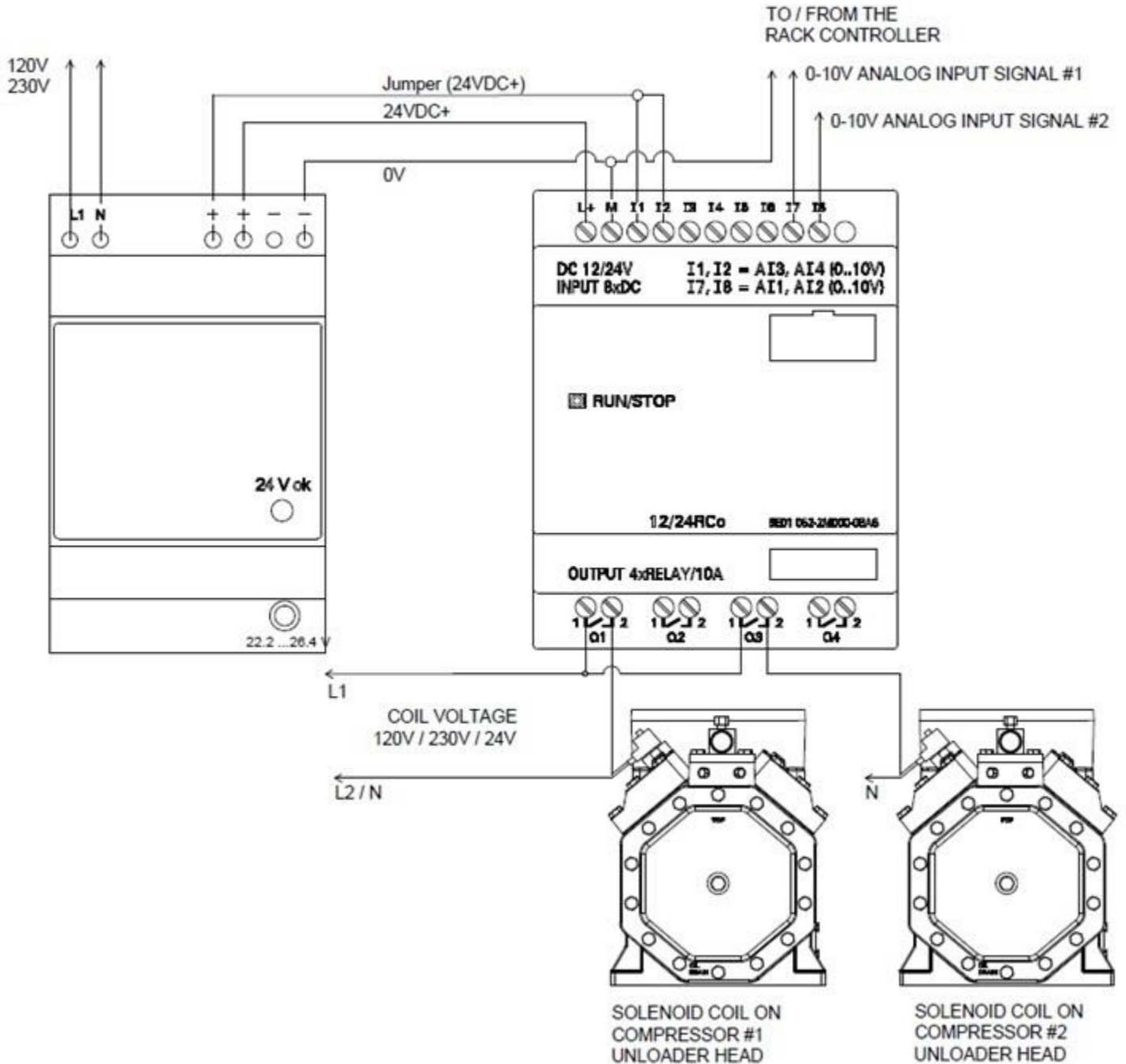**PLEASE NOTE – ALL WIRING SHOULD BE PERFORMED BY TRAINED ELECTRICIANS WHO OBSERVE SAFE WORK PRACTICES.**



| Terminal Jumped | Compressor Minimum Capacity |
|---|---|
| I1, I2 | 50% |

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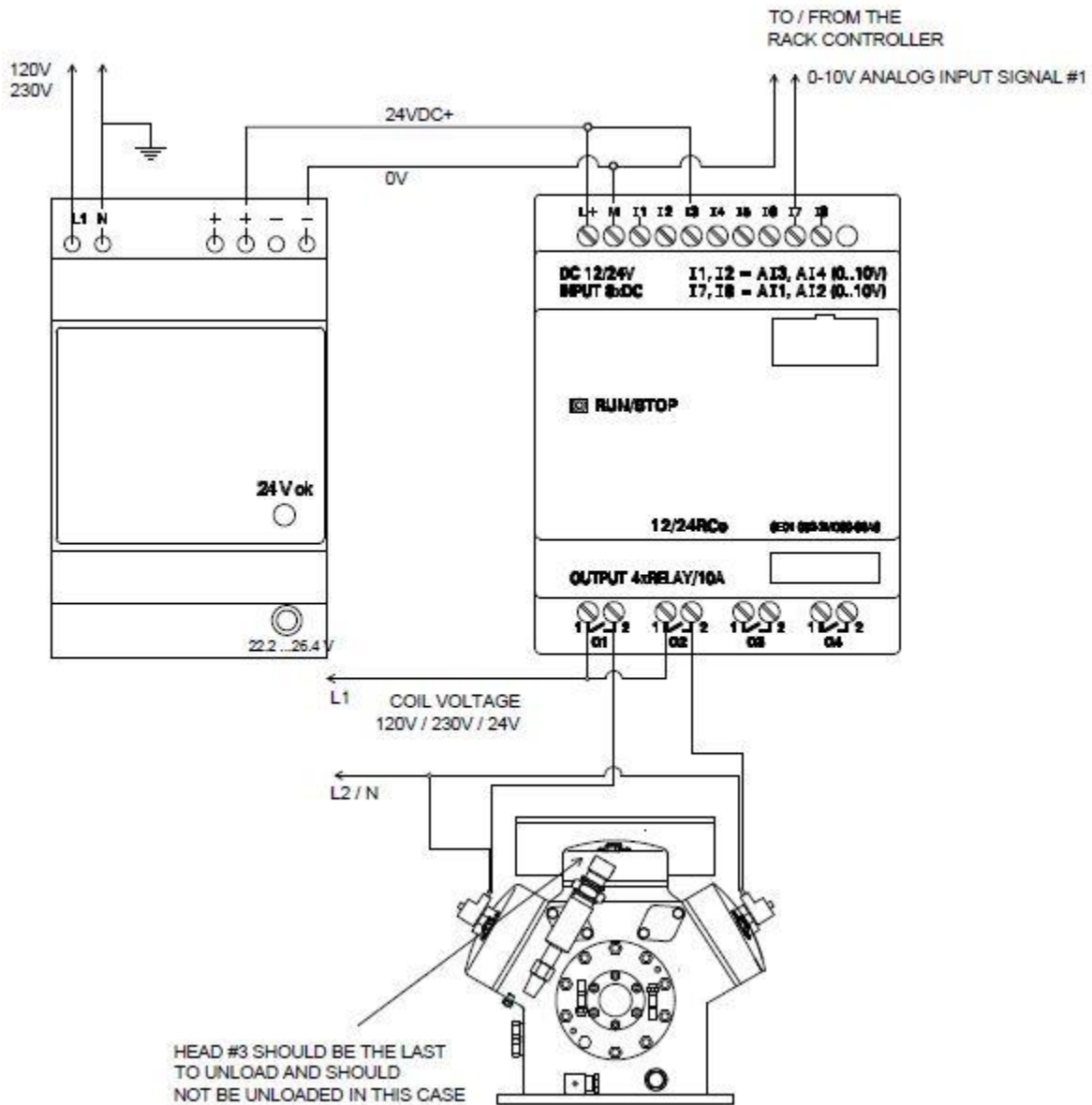**Figure 4: Wiring when using (2) 6 cylinder compressor (Program 52):**

**PLEASE NOTE – ALL WIRING SHOULD BE PERFORMED BY TRAINED ELECTRICIANS WHO OBSERVE SAFE WORK PRACTICES.**



| Terminal Jumped | Compressor Minimum Capacity |
|---|---|
| I3, I4 | 33% |

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## Figure 5: Wiring when using (1) 4 cylinder and (1) 6 cylinder compressor (Program 52):
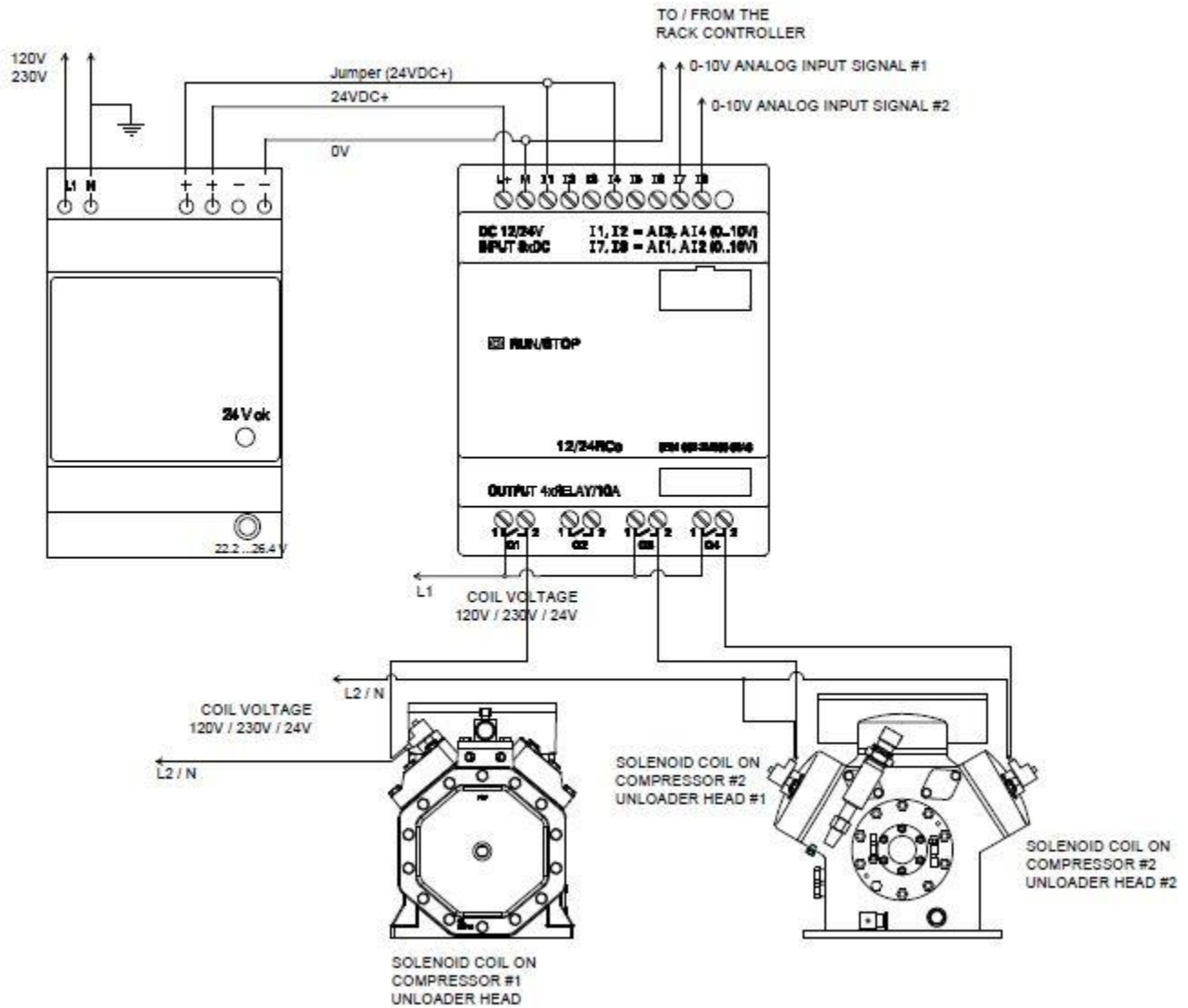
**PLEASE NOTE – ALL WIRING SHOULD BE PERFORMED BY TRAINED ELECTRICIANS WHO OBSERVE SAFE WORK PRACTICES.**



| Terminal Jumped | Compressor Minimum Capacity |
|:---:|:---:|
| I1 | 50% (4 cylinder only) |
| I4 | 33% (6 cylinder only) |

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## Figure 6: Alternate wiring using (1) 4 cylinder and (1) 6 cylinder compressor (Program 52):
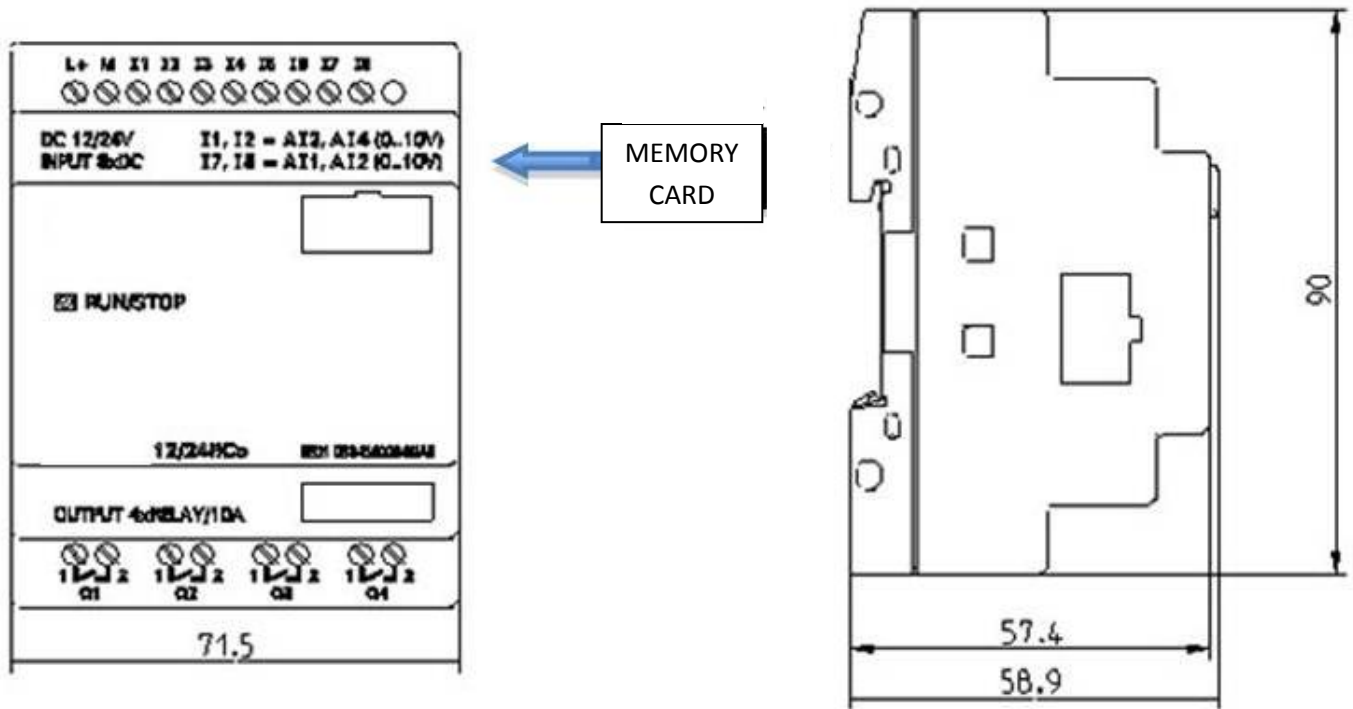
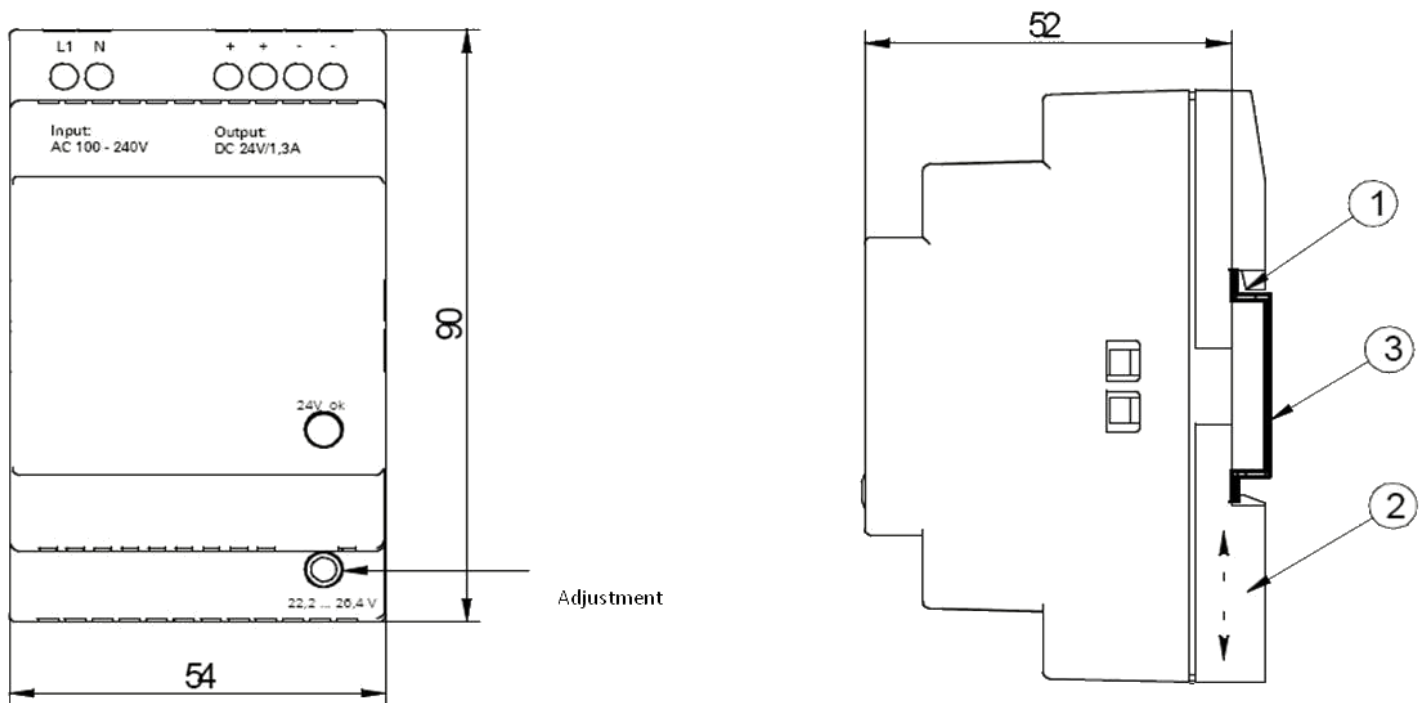**PLEASE NOTE – ALL WIRING SHOULD BE PERFORMED BY TRAINED ELECTRICIANS WHO OBSERVE SAFE WORK PRACTICES.**
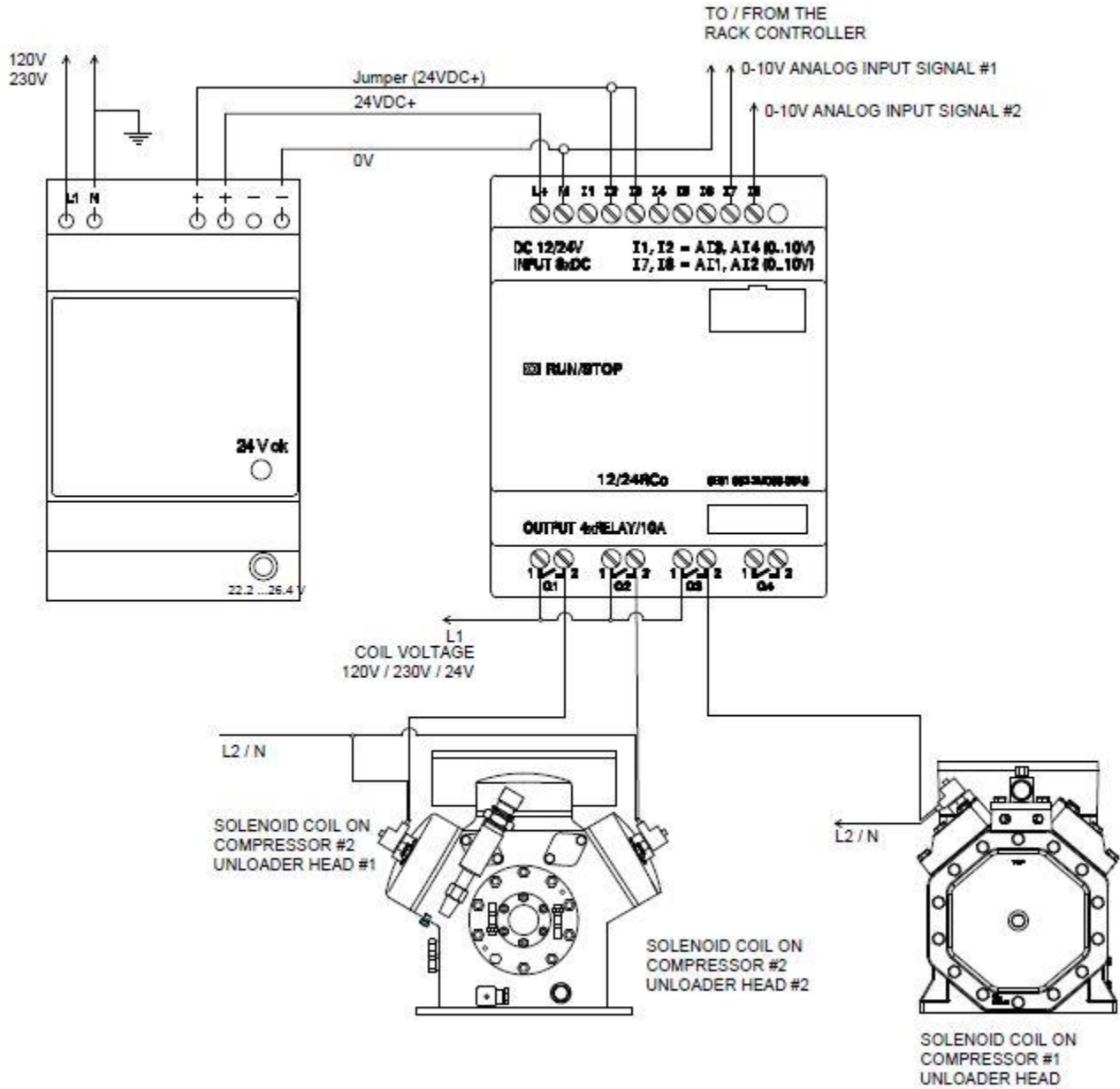


| Terminal Jumped | Compressor Minimum Capacity |
|:---:|:---:|
| I2 | 50% (4cylinder only) |
| I3 | 33% (6 cylinder only) |

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## Dimensions

**835-0003-01 (PLC Module)**



MEMORY CARD

**837-0006-01 (Power Supply)**



## Please note – All dimensions are provided in millimeters

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## Mounting

Both the power supply and PLC controller can be mounted to 35mm DIN rail.

1.  Hook the PLC module onto the rail.
2.  Push down the lower end to snap it on. The mounting interlock at the rear must engage.
3.  The power supply attaches to the DIN rail in a similar fashion.
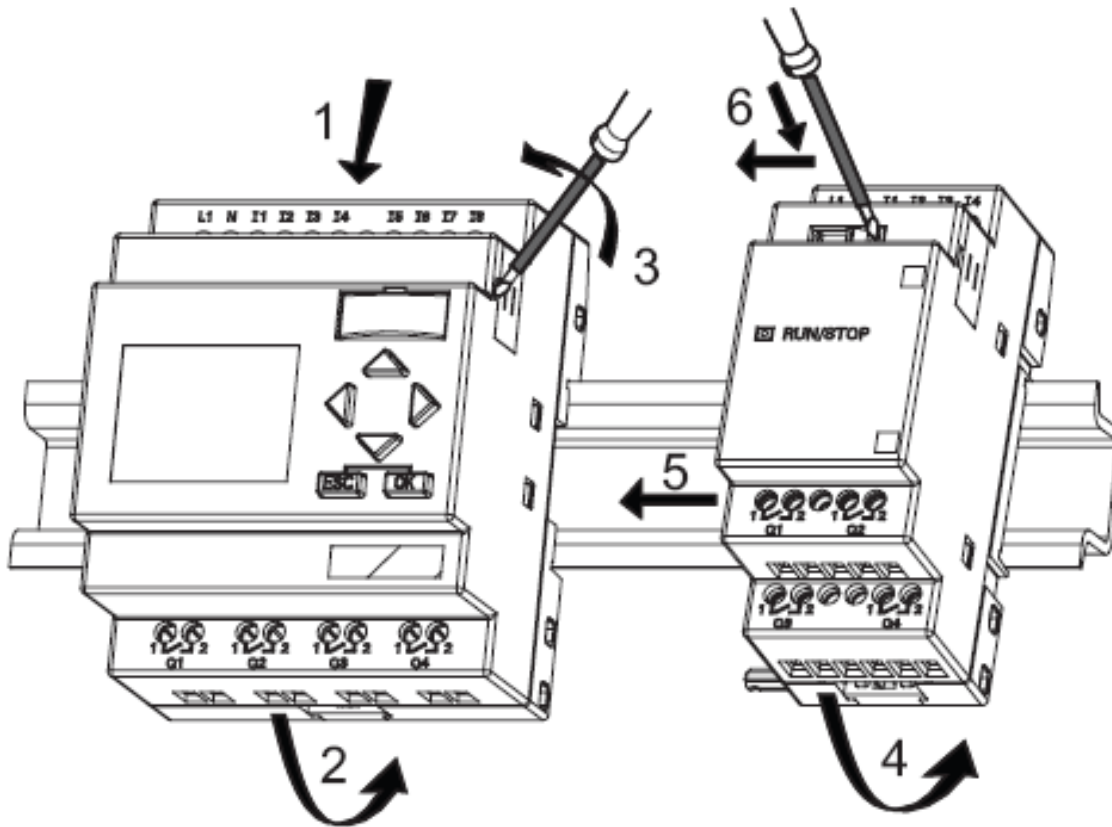
**Please note -** Items in picture are not identical to power supply or PLC module. The PLC module does not include a display or buttons. Both the power supply and PLC module can be wall mounted as well.

## Additional Information

Additional information regarding CRII capacity control for BITZER Reciprocating Compressors can be found in the BITZER Technical Bulletin KT-101. For more information on the PLC control module, please refer to PLC manual (SIEMENS document number A5E01248535-03). The power supply operating instructions are found in SIEMENS document number C98130-A7561-A2-5-6419).

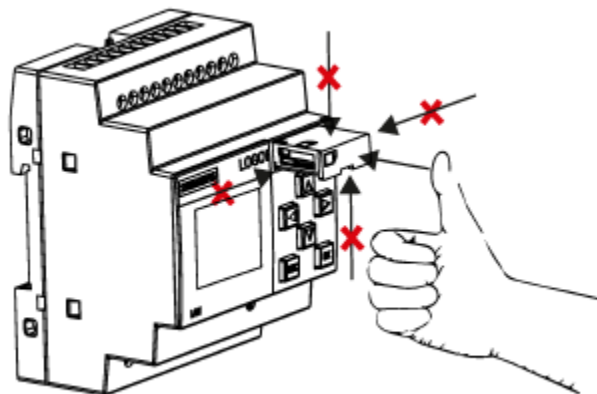|  | Main Phone: | Web: | Email: | Additional BITZER U.S. Contact Info: |
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## Inserting the Micro SD Card

Make sure that you insert the card into the right position in the socket until you hear an audible sound of a snap or click.

1. The entry of the card slot is chamfered on the bottom right. The edge of the card is chamfered to match. This prevents you from inserting a card in the wrong direction.
2. Using a screwdriver, insert the tip into the groove on the front of the SD card socket and slightly pry the cover out of the slot.
3. Pull the socket out to the position as the below figure shows.
4. Insert the card into the holder and push it in until it engages.
   a. **Note**: To avoid any possible damage to the SD card socket, Do Not pull the socket completely out from the module.
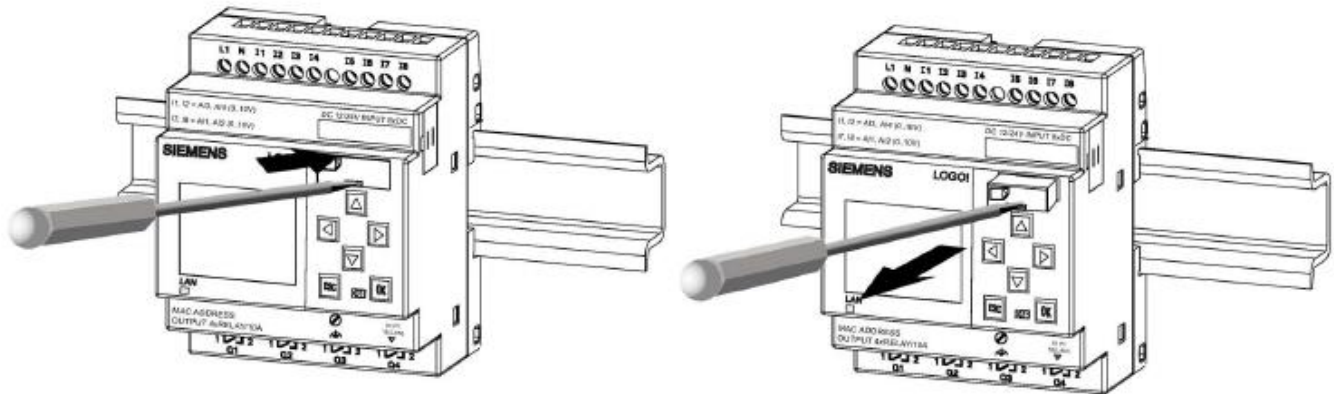


a. **Note**: If the SD card socket cannot be pushed in smoothly, don't push hard
   Pull the card, re-adjust the direction and push it in again.
   **Correct alignment is critical to avoid damage to tray pins.**

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## Proper Function

The following checks should be made in order to help ensure the module has been wired correctly and is functioning properly. The table below contains results based upon the voltage the module receives and is separated by program number and compressor type. While completing these checks, input voltage must be relatively constant (±0.5 V) and 5 or more seconds must have elapsed before results are realized.

| Program Number | Compressor Type | Input Voltage I7/I8 (V) | Result Solenoids Energized |
|---|---|---|---|
| 42 | 4 Cylinder | 0 | 2* |
| 42 | 4 Cylinder | 5 | 1 |
| 42 | 4 Cylinder | 10 | 0 |
| 64 | 6 Cylinder | 0 | 3* |
| 64 | 6 Cylinder | 3 | 2 |
| 64 | 6 Cylinder | 6 | 1 |
| 64 | 6 Cylinder | 10 | 0 |
| 52 | 4 Cylinder | 0 | 1 |
| 52 | 4 Cylinder | 10 | 0 |
| 52 | 6 Cylinder | 0 | 2 |
| 52 | 6 Cylinder | 5 | 1 |
| 52 | 6 Cylinder | 10 | 0 |

*Number of solenoid energized may vary if input voltage maintained for longer than 90 seconds

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