



**SPECIFICATIONS**

**NB SKILLS**

**TRADE 19**

**AUTOMATION AND CONTROL**

**NB Provincial Skills Competition**  
**Trade 19 – Automation and Control**

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## **1.1 – Scenario**

### **1.1.1 – General**

With this challenge, we will assess your:

- a) ability to analyze technical data.
- b) quality of wiring.
- c) capacity to implement an automatic process.
- d) troubleshooting techniques.
- e) abilities to detect errors.

### **1.1.2 – Step A: Wiring an automated process within a panel**

As a technician, you should have the ability to completely wire a system and make any necessary modifications. We will assess the quality of your manual work and the accuracy of your interpretation of the drawings provided..

### **1.1.3 – Step B: Programming the automated process**

The programmable controller used in this challenge will be provided by the competition technical committee. You must program an automated process based upon the function provided. The system must be functional and adhere to the drawing instructions.

### **1.1.4 – Step C: Troubleshooting**

This section will assess your ability read and interpret a ladder diagram and to detect and solve problems. You will be given 15 minutes to diagnose the problem in the motor control circuit. You will use a voltmeter.

## **2.1 – Conductors**

### **2.1.1 – Size and use**

1. Power connections will be 12 AWG gauge teck cable.
2. 120V control conductors must be 14 AWG gauge.
3. Any exceptions to paragraphs 1 & 2 will be specifically mentioned on the drawings.
4. DIN rail must be individually bonded

### **2.1.2 – Colour Code**

The following colour code must be used to distinguish circuits:

- |                      |                              |                               |
|----------------------|------------------------------|-------------------------------|
| 1. Three phase power | motors/contactors            | L1-Red<br>L2-Black<br>L3-Blue |
| 2. AC Control        | Identified Conductor<br>Line | White<br>Black                |
| 3. Grounding/Bonding |                              | Green                         |

## **2.2 – Liquid Tight Conduit**

### **2.2.1 – Bending radius**

If it is necessary to bend conduit, the interior radius of the bend must be at least six times greater than the liquid tight's interior diameter or as per the CEC, section 12.

### **2.2.2 – Liquid Tight Conduit Supports**

All conduit must be supported.

### **2.2.3 – Quality and Finish**

Bends and strapping must be accomplished without deforming the pipe and without damaging its interior or exterior surfaces.

### **2.3 – Conduit fill Table**

Conduit fill must not exceed that which is specified in the CEC

### **2.4 – Cabinet Wiring**

**For the purpose saving space and time, the back panel of the lab bench will represent a nominal 24 x 30 enclosure.**

- 3Ø 208V wiring will be supplied by local disconnect via teck cable (to be installed by competitor)
- One 208/120V transformer will be provided to supply the Smart Relay, Smart Relay inputs and outputs..
- All inputs and outputs in the remote panel are to be wired to terminal blocks.
- Fuses (15 A) will be use to feed the contactor for the motor.
- Fuses (9 A) will be use on the primary side of the transformer.
- Wire a single fuse (1 A) to protect Smart Relay power.
- Wire a single fuse (1 A) for all inputs to the Smart Relay.
- All outputs circuit has to be fused individually (1 A for contactors and 250 mA for pilot lights).
- Motor has to be feed with teck cable and teck connector.

**Note 1: All inputs and outputs are 120 VAC**

**Note 2: 208V 3Ø will be installed to the Line and load side of the contactors.**

### **3.1 – General Description**

Forward/reverse control is often used in industrial processes, it may be necessary for a specific motor running a high inertia load to come to a complete stop before switching it's rotation.

This system consists of:

- A single 3 position selector switch
- A single red lamps will indicate that the motor is running.
- A single green lamp will be on when motor is not running and will flash when the motor is not running but waiting to start.
- Two mechanical interlock contactor with one overload.

#### **System Design**

- In order to see the program work, delay time of 10 seconds will be used between forward and reverse.
- The motor can start in forward or reverse with the selector swith (CW on selector swith will start the motor turning CW or forward and CCW on selector swith will start the motor turning in CCW or reverse). Stop will be in the middle position and green light shall be on to indicate that motor is ready.
- At first, green light is on and red off to indicate power is there and motor is ready to go. If you select forward or reverse, green light turns off and red light turns on to indicate motor is running. Then, if you select stop, red light turns off, green light turns on and if you select the opposite direction within 10 seconds, green light will blink to indicate it is waiting to start in the opposite direction and after the 10 second delay, motor will start in the opposite direction green light off red light on.
- Whenever the motor is waiting to start running in the opposite direction, the green light shall blink asynchronously (1 second on and 1 second off), the green light will be off when the motor is running.

- When the motor is running, the red indicating light will be on.
- An overload (OL) on the motor will cause the motor to stop.
- The red light will blink (0.5 second on and 0.5 second off) if the overload (OL) stop the motor.
- For the 2 wire control, because the 3 position selector switch is a maintained contact and stays in its position, auxiliary N.O. contact on the contactor will be use in the program to indicate the motor is running. The problem is that if overload trips, motor will restart when reset is pressed but this has to be corrected in the program. After the reset is pressed, the selector must be in or must go to stop position before motor is allowed to restart. The 10 second is still required if changing from forward to reverse or vice versa.
- Selector switch will only allow one of the contactor (forward or reverse) to be on at a time. If an error occurs in the wiring or programming that allows both coils to be energized at the same time, since mechanical interlocking device allows only one armature to pull in at a time, the other coil will draw a current of 4 to 10 times its pulled-in value. This excessive current will cause the coil to burn out. In order to prevent this, electrical interlock is required. This is achived by the use of two sets of N.C. contacts, one operated by the forward contactor and the other by reverse contactor. The wiring of these contacts is such that, when they open, they break the circuit to the opposite coil.

### **3.2 – Technological Choices**

- The automated process is controlled by a Smart relays (Zelio SR2B201FU) and software will already be installed in laptops provided by the technical team.

### **3.3 – Inputs and outputs technical details**

#### **Inputs**

The selector switch will be located on the door of the remote panel and will use 2 inputs on the Smart Relay.

The “seal in contact” (Seal\_in) on the forward and reverse starter shall be 2 other inputs to the Smart Relay.

The overload relays shall be hard wired in series with the coil. The normally open overload relay contacts (OL) will be another inputs to the Smart Relay.

#### **Outputs**

120V coils for forward and reverse motor starters. 208 volts three phase shall be supplied to the line side of each contactor from the fuse block. On the load side of the reverse contactor, any two lines will be interchange in order to reverse it's rotation. Two outputs on the Smart Relay shall be use, one for forward and one for reverse.

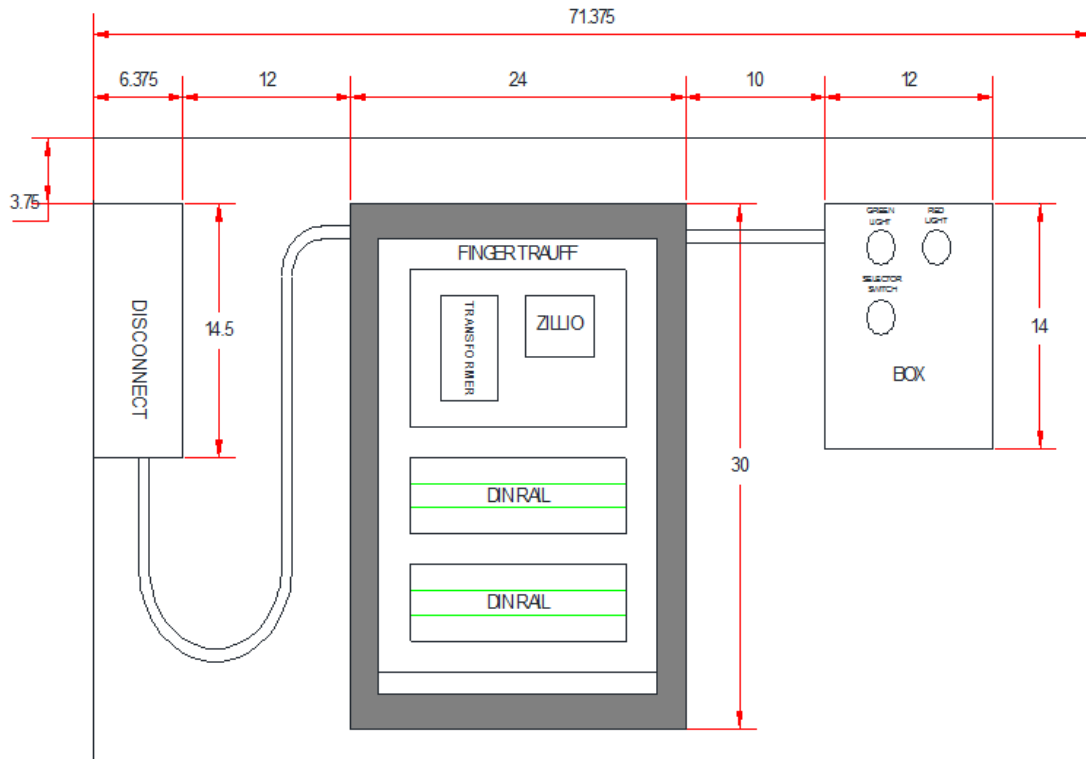
Red indicator light will be located on the door of the remote panel and shall be energized any time motor is running. Red light shall be another output on the Smart Relay.

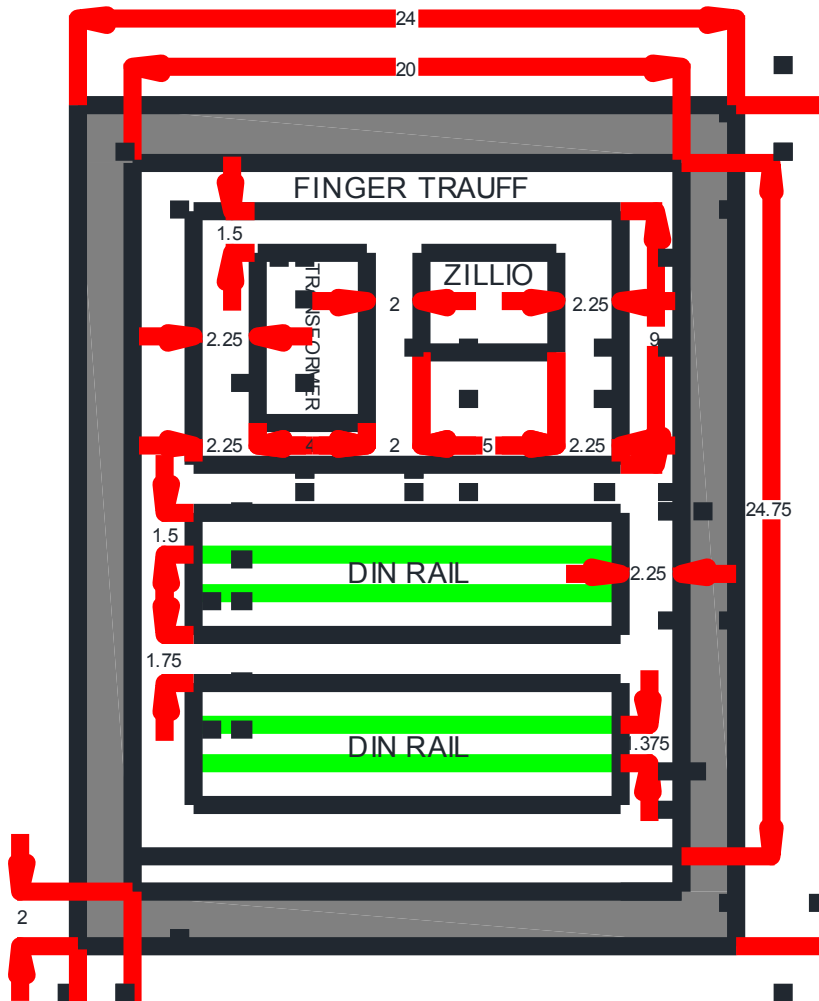
Green indicator light will be located on the door of the remote panel and shall be energized when selector is in the stop position or blinking asynchronously any time the motor is waiting to go in the opposite direction. Green light shall be another output on the Smart Relay.



### 3.4 – Cabinet and Wall Layout Diagram

Distance in inches





### 3.5 – Material Check list

1. 1 12 x 14 enclosure
2. 2 1" Liquid Tight Connectors
3. 1 single 3 position selector switch
4. 4 ½" Teck Connectors
5. 1 ½ EMT straps
6. 1 forward/reverse contactor
7. 1 overload relay
8. 1 red pilot light
9. 1 green pilot light
10. 1 3-pole fuse block
11. 1 2-pole fuse block