

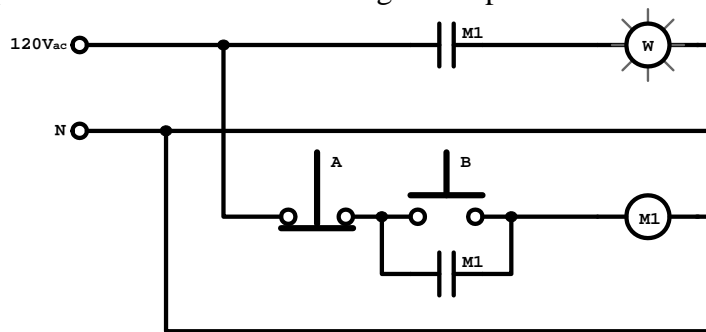
**Introduction:**

This experiment will introduce the concepts and the devices used to construct simple motor-control circuits. The investigation will primarily focus on the construction and operation of a basic “start-stop” controller which will then be modified in a step-by-step manner to change its operational characteristics. During each step, the students will be expected to predict the controller’s operation by applying relay-logic theory and then experimentally verify the operation of the controller.

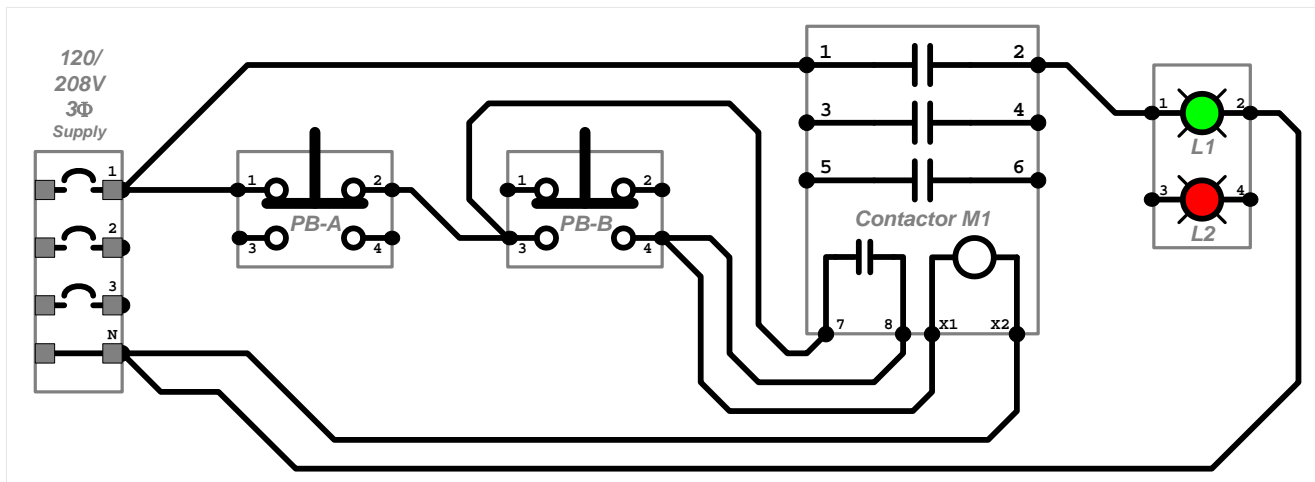
**Procedure:**

**WARNING – Switch OFF the power supply before making modifications to any circuit or if the controller appears to be operating in an uncontrolled/unsafe manner.**

1. Construct the Basic “Start-Stop” Controller shown in **Figure 3.1**. Note that an indicator lamp will be used in place of an actual motor during this experiment.



Schematic Diagram

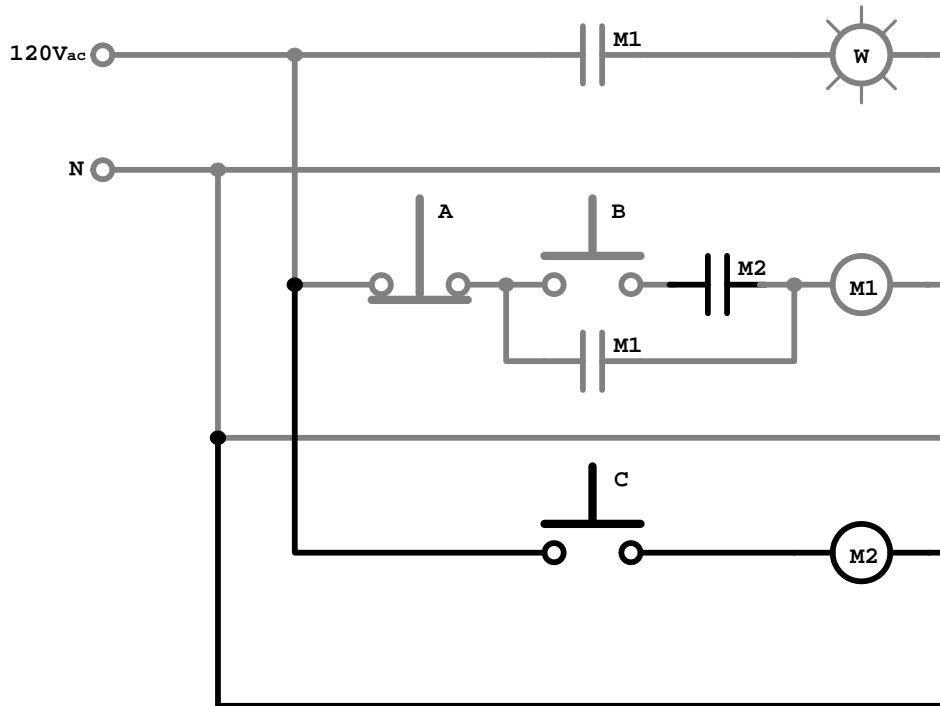


Wiring Diagram

**Figure 3.1 – Basic “Start-Stop” Controller**

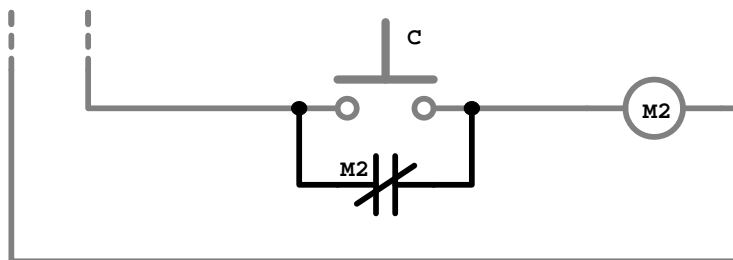
2. Experimentally verify the theoretical operation of the controller. If necessary, troubleshoot the circuit to achieve proper operation.
3. Demonstrate the proper operation of Basic “Start-Stop” Controller to the instructor and then **WAIT** for the instructor’s approval **before** proceeding to the next step.

4. Analyze the **Modified Controller #1** shown in Figure 3.2 in order to determine the operation of the modified controller. (I.e. – what steps are required to START and STOP the “motor”?)
5. Modify the controller’s circuit by wiring in the additional components that appear **black** in Figure 3.2. Note that the original circuit components appear grey in the figure.



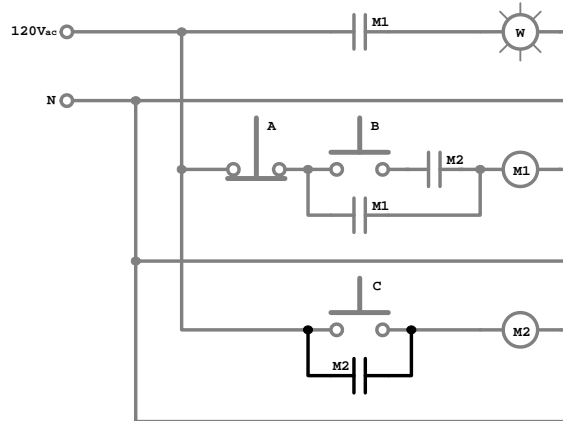
**Figure 3.2 – Modified Controller #1**

6. Experimentally **verify** the procedure required to START and STOP the “motor” using the modified controller. If the experimental and the theoretical operations do not coincide, re-analyze the circuit and/or troubleshoot its construction until any differences are eliminated.
7. Could the additional function provided by pushbutton “C” have been accomplished using a simpler circuit? Be prepared to state and justify your answer.
8. Demonstrate the proper operation of the Modified Controller #1 to the instructor and then **de-energize the main supply and WAIT for approval before proceeding to the next step.**
9. Modify the control circuit by wiring in the new component that appears black in **Figure 3.3**. Do **NOT** re-energize the main supply until instructed.



**Figure 3.3 – Modified Controller #2**

10. Analyze the Modified Controller #2 in order to determine its operation. Be prepared to provide a theoretical statement as to why the controller functioned in the observed manner.
11. Discuss your operational analysis of the Modified Controller #2 with the instructor and then **de-energize the main supply and WAIT for approval before proceeding to the next step.**
12. Replace the NC contact (added during step 9) with a NO contact, as shown in **Figure 3.4** but **do NOT re-energize the main supply until instructed.**



**Figure 3.4 – Modified Controller #3**

13. It is desired that the controller will function in the following manner:

**To illuminate the lamp from a de-energized state:**

- Pushbutton “C” must **first** be **pressed-and-released**, after which...
- **Pressing** (and releasing) Pushbutton “B” will then illuminate the indicator lamp.

**To de-energize the lamp:**

- **Pressing** (and releasing) Pushbutton “A” will de-energize the lamp.

Experimentally determine whether or not the controller operates in the prescribed manner. If it does not operate in the exact specified manner, be prepared to provide a theoretical statement regarding the operational difference(s). (Hint – it does not operate properly.)

Discuss your operational analysis of the Modified Controller #3 with the instructor and then **de-energize the main supply and WAIT for approval before proceeding to the next step.**

14. Determine a modification to “Controller #3” that would require Pushbutton “C” to be pressed **every time** when attempting to energize the lamp from a de-energized state.

(Hint – only one wire needs to be moved)

15. Determine the additional modifications to “Controller #3” that would require Pushbutton “C” to be pressed-and-released **before** Pushbutton “B” whenever attempting to energize the lamp.

16. Discuss your proposed modifications to “Controller #3” with the instructor and then **wait for approval before actually modifying and verifying the controller’s correct operation.**