Semi Automatic Contactor Test Bench

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Abstract- *In these modern era, Automation takes part in every manufacturing, controlling process and testing of equipment. The purpose of the project is to carry out different test to check electromechanical contactor's parameters using Programmable Logic Controller. Contactor is a device which is used in many industrial as well as commercial applications for controlling various motors or large loads. So it is necessary to check whether all parameters of contactor are within specified range. This test bench is a modular design which tests a contactor for its parameters (continuity, pick-up time & drop-off time). It tests the product automatically & displays result as either PASS or FAIL. Test bench gets advantage of using PLC. We can change the program as per the requirement without changing the hardware configuration in case of change in product parameter values, etc. To benefits of automation data recording facilities can be also provided with test bench so that it will be easy to check for rejected product faults. Introduction of such a test bench eliminates human errors as well as increases productivity or rate of testing contactors because of high speed benefits of automation tools used in test bench*

Keywords- Contactor, PLC, Test Bench

I. INTRODUCTION

A contactor is an electrically controlled switch used for switching an electrical power circuit, similar to a relay except with higher current ratings. A contactor is controlled by a circuit which has a much lower power level than the switched circuit. Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contactor is not intended to interrupt a short circuit current. Contactors range from those having a breaking current of several amperes to thousands of amperes and 24 V DC to many kilovolt. A contactor is controlled by a circuit which has a much lower power level than the switched circuit. It consists of two contact parts stationary and movable. Whole circuit is connected to the stationary part and the movable part consists of a coil. When the coil is energized the movable contacts are closed against the stationary contacts, and the circuit gets completed. Contactor relays are often used in control and regulating functions. They are used in large quantities for the indirect control of motors, valves, clutches and heating equipment.

In most cases, the contactors does not simply wear out from normal use, the reason for their failure is their manufacturing faults. To overcome this fault and meet the rapid increasing demand of the contactor with all the proper specification there is need of automatic contactor testing.

Existing manual contactor testing system is electrically controlled and manually operated .it is very difficult to supervise the testing system continuously .so as to save the time and energy (money), we upgrade this system automatic by using the programmable logic controller. To convert it into automatic system, we have added some automation tools like PLC, limit switch ,solenoid valve, pneumatic piston ,compressor, control panel etc.

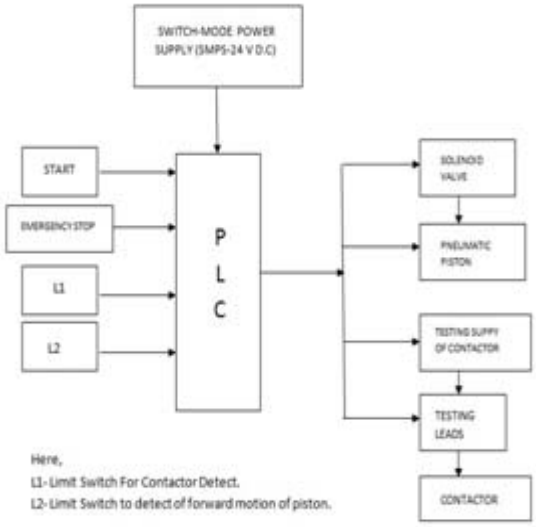
Here, The whole assembly is mounted on test bench Automatic contactor test bench is developed to test various contactor parameters automatically using PLC as controller. It eliminates human errors in testing process. The productivity or rate of testing contactor is also increased because of test bench. It takes very less time to carry out testing automatically than required for manual testing of contactor.

During this process, we are performing various test like 1)Flashing And Coil Continuity Test 2)Pick Up Time Test 3)Drop Off Time and the result of mentioned test will be displayed on the Control Panel in the form of pass and fail

II. METHODOLOGY

A. BLOCK DIAGRAM

In the below block diagram power supply to PLC is supplied through SMPS and for all the I/O ports power supply is supplied through PLC.



B. PROJECT DESCRIPTION

The contactor test bench is a semi automatic system designed to perform various test on contactor.
It consist of

- One fixture for testing one product at a time;
- Fixture supporting assembly with a terminal connectors;
- Programmable Logic Controller
- Control panel as a Man Machine Interface.

Fixture is to support product during test. It holds product in it and avoid excessive movement in product during test.

Supporting assembly has legs welded to a fixture base which support fixture and it also has a terminal connector fixed below fixture base. These connectors connect fixture IOs and control panel IOs to PLC.

PLC is brain of test bench. It has the program that executes all test for contactor and give result as per the standards.

The control panel and its control buttons enable use of various operating modes and give information on the product result.

C. TEST PERFORMED

Continuity Test:

This test is carried out at 100% of rated voltage and rated frequency for definite number of cycles. This test is basically done to ensure continuity between main and auxiliary contacts and also for proper functioning of the contactor. Any part wrongly inserted or component missing during final assembly and any such errors is elevated during flashing test.

Pick-Up Time:

Record the time between energizing the coil and contacts are closed. Check that this time is within specified limit. If it is within limit then product will PASS & go for next test indication. If it is not within limit then it will show FAIL. This test ensures that the contactor pick-up time is appropriate and which is within the standard specified range.

Drop-Off Time:

De-energized the coil after some time and record the time between de-energizing the coil and contacts are open. Check that this time is within specified limit. If it is within limit then indicate that product is PASSING. If it is not within limit then indicate that product is FAIL

III. COMPONENTS REQUIRED

A. PLC

PLC which we have used here is Allen-Bradley Micro830 Programmable Logic Controller. This Controllers support:

- As many as six High-Speed Counter inputs (HSC)
- High speed input interrupts
- Embedded USB port for programming and serial port (RS232/485)
- Modbus RTU protocol (serial port)
- Plug-in slots to customize according to needs
- Up to 88 digital I/O points in total with plug-ins on 48-pt controller

Connected Components Workbench Software is used among the entire Micro800 family of controllers, as well as other component products, such as Panel View Component HMIs and Power Flex drives.

Main Advantages of the software are-

i. Easy to Configure – Single software package reduces initial time to set-up controls.
ii. Easy to Program – User-defined function blocks speed machine development.
iii. Easy to Visualize – Tag configuration and screen design ease operator interface configuration.

Languages used in PLC Micro830: 1. Ladder Diagram 2. Functional Block Diagram 3. Structural text From the above mentioned languages as ladder diagram is used in the above process and is explained as follows:

1. Ladder Diagram-

The ladder diagram has the traditional way of representing electrical sequences of operations. These diagrams represent the interconnection of field devices in such a way that the activation or turning ON, of one device will turn ON another device according to a predetermined sequence of events. Ladder logic uses graphic symbols similar to relay schematic circuit diagrams. Ladder diagram consists of two vertical lines representing the power rails. Circuits are connected as horizontal lines between these two verticals.

B. Contactor

In this process we are going to test various series of contactors including MNX Series of contactors which are also known as Power contactors. These contactors are used in actual circuit of the power consuming device and have higher current ratings up to 650A. in most of the power contactors there is inbuilt auxiliary contacts which can be conventionally used for control circuit.

MNX9 Contactor Features:

- Ratings: 9A to 650A
- Available in six frame sizes
- Easy inspection and replacement of coils and contacts
- Alpha-numeric terminal markings
- Front ON/OFF indication.
- Aesthetic appearance .
- CE marked and CSI approved.
- Conforms to IEC60947-4-1, BSEN 60947-4-1, IS 13947-4-1.
- Operating band from 62% to 120% up to 32 A

Special features of 9A- 40A Contactors

- Snap fit construction
- Finger proof terminals
- Common coil for entire range

Accessories Available

- Add-on auxiliary contact block
- Surge suppressor
- Mechanical interlock kit

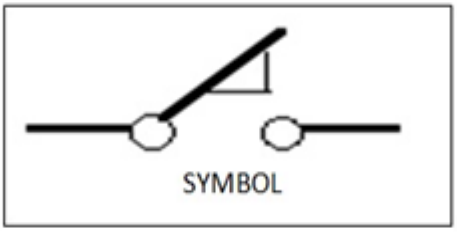
C. Switched Mode Power Supply:-

A switched-mode power supply (switching-mode power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a source, like mains power, to a load, such as a personal computer, while converting voltage and current characteristics.

This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight. In this project we use SMPS to convert the 240V AC 50Hz to 24V DC power supply to the PLC.

D. Limit Switch

A switch that limits the activation of an electrical circuit is a limit switch. Switches can control the flow of electrical current by opening and closing. When a circuit is closed, it allows electrical current to flow to the device that is powered. When open, the electrical flow stops. A Mechanical limit switch is a mechanical device which can be used to determine the physical position of equipment. The limit switch gives ON/OFF output that corresponds to object position.

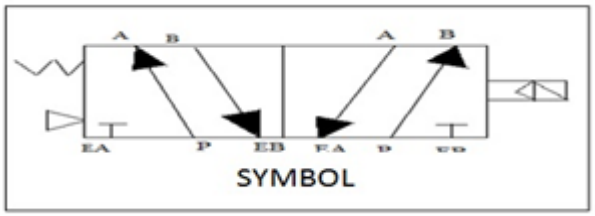


SPECIFICATION OF LIMIT SWITCH

AC Ratings	0.1A to 3A, 125V AC
Electrical life	100,000 cycles per min.
Movement Differential	<0.2mm
Contact Gap	<3mm

E. Solenoid Valve

A solenoid valve is an electromechanical valve for use with liquid or gas. The valve is controlled by an electric current through a solenoid; in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports.



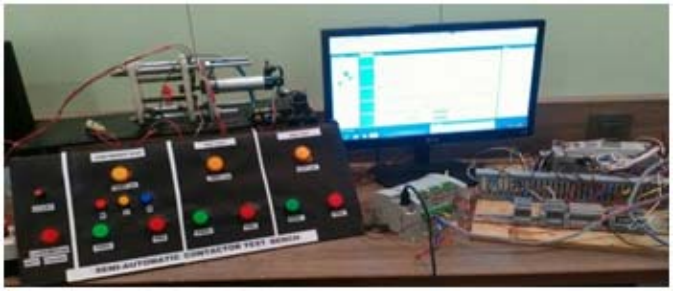
SPECIFICATION OF SOLENOID VALVE

Power	Solenoid
Ports	5 ports
Joint pipe bore	1/4"
Media	Compressed air
Coil voltage	230V AC
Pressure range	0.5 ~ 10 Kgf/cm2

F. Control Panel

A control panel is a flat, often vertical, area where control or monitoring instruments are displayed. They are found in factories to monitor and control machines or production lines and in places such as nuclear power plants, ships, mainframe computers and air craft. Older control panels are most often equipped with push buttons and analog instruments whereas today in many cases touch screens are used for monitoring and control purposes.

IV. WORKING MODEL



V. ADVANTAGES, DIS-ADVANTAGES

Advantages

i. Physical compactness and requires less floor space for installation.
ii. Full capacity of the machine can be utilized.
iii. Less wear and tear and hence marked reduction in maintenance cost.
iv. Ability to communicate with computer systems.
v. Rugged construction.

Disadvantages

i. High capital cost.
ii. Special skilled and maintenance staff required.

VI. CONCLUSION

Contactors like MNX9 is tested for its parameters with the help of PLC. It is easy to test the product automatically rather than testing it manually. Time required to test the product is also decreased with the benefits of automation tools. Indication of pass/fail helps to sort product accordingly.

In future pick and place assembly can be added to this test bench to take product into fixture automatically and take out product after test is over. Further HMI can be provided with interfacing PLC to PC and using SCADA.

So we conclude that contactor testing can be automated and by making use of PLC can make testing more advanced.

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