



# Automatic Changeover System using PLC

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## Abstract:

The use of electricity supply for industrial, commercial and domestic is highly unstable. Power failure or outage is the main issue regarding continuity of supply as industries, factories with constant power failure are not efficient. Whenever the power failure is considered, most of the factories, industries, and academic institutions use the generator for backup power supply. So, the manpower is required for manually controlled generator ON and OFF. The introduction of an automatic changeover system is mainly done to reduce the problem in manual switching along with challenges in smooth switching and this concept represents the procedure of fast connection of the electrical consumers to a backup electric power source. This paper presents the design and implementation of an auto changeover switch using a programmable logic controller (PLC). In case of mains power failure, this switch turns ON the generator automatically and connects the load to the generator output, alternatively it switches OFF the generator automatically when power is restored and returns the load to the mains power with the help of the desired range of parameters which may be set by programming. This helps in reducing the time consumption required for switching operations. In this way, the continuity of supply is maintained.

**Keywords:** Contactors, Generator, Relays, Power Supply (MSEB), PLC.

## I. INTRODUCTION

Power failure or outage is the main issue regarding that continuity of supply to be maintained like as industries, factories with constant power failure is not efficient. The changeover system mainly reduces the problem regarding manual switching. This paper can be represented by the construction and design of PLC based auto-changeover system. The world is increasing for the automation PLC is the main strike in our mind. For the controlling, monitoring, integrating system has PLC is a very efficient tool to automate. PLC can be withstanding any situation like temperature, humidity, noise, and moisture. The controlling and handling there is no need to expert, it can be operated easily. [2] Generally, inverters are not considered as the best choice of backup supply because inverter becomes fail to give continues supply insufficient battery time. This problem can be overcome by using the stand by the generator to fulfill the industrial need. [3] While using these alternative sources of power supply to meet up with the energy demand. The introduction of these alternative sources of supply is a challenge of smoothly and timely between the main supply and an alternative supply. When there is a failure on the main source. The example is given as an industry when there is a failure of supply the operator it goes on the panel board and then change over. During this process take more time to reduce these conditions uses the automatic changeover system. The important terms related to the changeover system as follows:

### A. Manual operated changeover system

This is the easiest type. It can be controlled manually by an operator and accordingly time required to conventional to the replacement supply varies. A manual source changeover has formed 2-3 automatically interlock manually operated circuit breakers.

### B. Remote operated changeover system

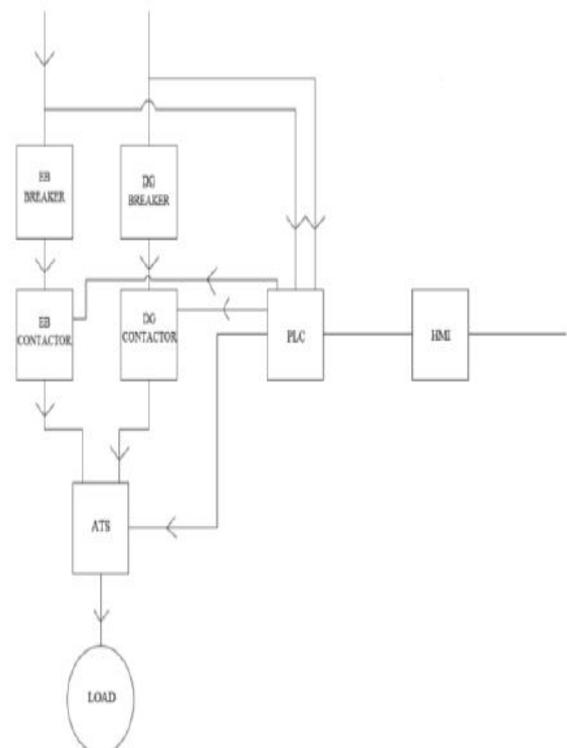
In this system, high rating devices can be used. There is no human investment is required. A remotely controlled change

over system formed of 2 or 3 circuit breakers or switch-disconnections connected electrically interlocking is totally different from a manually operated system.

### C. Automatic changeover system

The Automatic changeover system could also be added to a remotely operated changeover system for automatic source control with programmable operative modes. The automatic control system is applicable to a choice for communication with a supervisor. [4]

## II. METHODOLOGY



**Figure.1. Block Diagram of automatic changeover switch using PLC**

In this project the continuity of supply to be maintained from the transformer and diesel generator (DG) source. When the power failure from the transformer side then the PLC will give the command to the start the diesel generator (DG) set, when diesel generator starts the developing of the voltage then diesel generator (DG) contactor gets energies changeover happens and then the total load is connected to the Diesel generator (DG). When supply is restored by the transformer then contactor of diesel generator gets de-energies by getting the command from PLC to diesel generator (DG) set to stop. Now the ATS terminal will be on the transformer side. When PLC is not working properly then the HMI comes into the picture. HMI is a human-machine interface. We can on a transformer or diesel generator (DG) totally depends upon the availability of supply. Auto transfer arrangement is necessary for the automatic changeover from the utility supply to diesel generator (DG) whenever the utility of supply gets a failure.

### III. HARDWARE REQUIRED FOR PROTOTYPE MODEL

#### A. Relays

The relays used are simple 12V electromechanical relays. There are 2 relays used in the project. The output of one of the relay is used to trigger PLC. An electromagnetic relay consists of a normally open and normally closed switch. This may be explained as follows:

A normally closed (NC) contact is a contact that is closed or in a conductive state when it, or the device operating it, is in a de-energized or relaxed state.

A normally open (NO) contact is a contact that is open or in a non-conductive state when it is in a de-energized or relaxed state.

#### B. Step down Transformer

A step-down transformer of 230/0-12V 1Amp capacity is used to step down voltage so as to be used for hardware implementation.

#### C. Power supply

A 230V single-phase power supply is for the project.

#### D. PLC System

In this project, the PLC system is used to Programmable Logic Controller of MicroLogix Company. PLC is also referred to as programmable controllers that are used in commercial and industrial applications. Using PLC's to achieve automation has the following advantages:

- i) Complete control of the manufacturing process can be achieved.
- ii) Accuracy and quality can be improved.
- iii) Productivity can be improved.
- iv) It makes it easy to work in a difficult or hazardous environment.
- v) The implementation of SCADA and GSM becomes easier.

#### PLC Specifications:

- **No. of Inputs/Outputs** - 12 inputs (10 digital and 2 analog) and 6 outputs
- **Power Supply Voltage** - 24V dc
- **Input Circuit Type** - Digital: 24V dc sink/source (standard and high-speed), Analog: 0-10V dc
- **Output Circuit Type** - Relay/FET
- **Power Consumption** - 35W
- **Power Supply Inrush Current** - 24V dc: 15 A for 20 ms

- **Temperature** - (-20) to 65°C (operating), (-40) to 85°C (storage)
- **Relative Humidity** - 5-95% non-condensing
- **Weight** - 0.9 kg
- **Dimensions (mm)** - 90 (H) X 110 (W) X 87 (D)
- **Comm. Ports** - RS-232/485 combo (isolated), Ethernet
- **PLC Software** – RS LOGIX 500 ENGLISH

#### E. Diesel-Generator Set

The standby generator set is commonly used to supply emergency power to most of the power consumers where the mains supply is unstable. In this project, a generator set is used as an alternative power supply. Thus it is important to note the necessary part to be used with the automatic change over switch.

- (a) The generator must have an electrical 'start and stop' facility.
- (b) The generator battery has to be in good condition always.
- (c) The interconnecting cables must be in good order.

#### F. Load

The load is used as LED lights. For normal condition, all LEDs will glow through main power supply while during the power failure, switching is done and the same LEDs will glow through a generator.

### IV. AUTOMATIC SWITCHING TECHNIQUES

#### A. Automatic Switching by Using Microcontroller

AMF system consists of the main three elements it consists of PIC microcontroller, a voltage comparator, and a relay switch. The voltage comparator can be used for the set and monitor the voltage level at both power supplies. The PIC microcontroller can act as a brain of the whole system that can monitor the output signals from the voltage comparator circuit and control switching relay appropriately.

#### B. Automatic Switching by Using Lab view

One advantage of Lab VIEW over other development environments is the extensive support for accessing instrumentation hardware. Drivers and abstraction layers for many various types of instruments and buses are included. These currents themselves as graphical nodes. The abstraction layers offer standard software interfaces to give with hardware devices. The provided driver interfaces save program development time.

#### C. Automatic Switching by Using CMOS

CMOS is the (complementary metal oxide silicon) type. It consumes less power from the battery. That is why it was integrated into the circuit. This circuit also consists of relays that supply external switching. These devices are quite healthy for efficiency and reliability.

#### D. Automatic switching by using PLC

The PLC is hurt of the project for automatic switching operation. The circuit contains PLC and relays are used. The main goal of PLC is to automatically turn on the Generator when it senses that the power failure in the main supply, then turning it off when the main power supply returns, it makes sure that both supplies can't start simultaneously. A time delay provides to PLC wait for the main supply properly comes or not in case of any short power failure, after that time delay it sends a command to the generator it turns ON. If supply

comes properly PSR relay monitored the main power supply is OK then continues supply is maintained by the main supply.

### V. PROGRAMMING

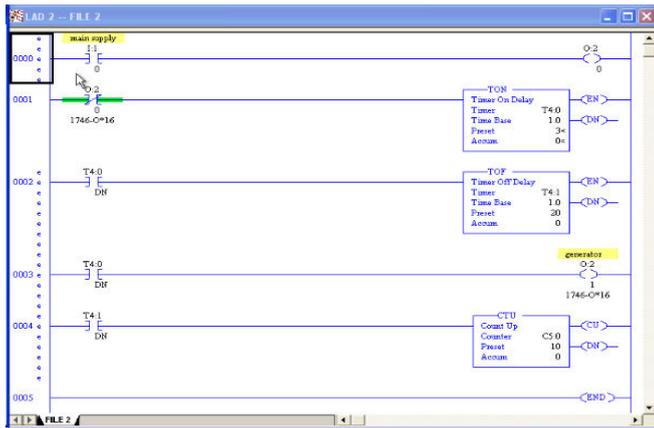


Figure.2. Ladder Diagram of PLC Program

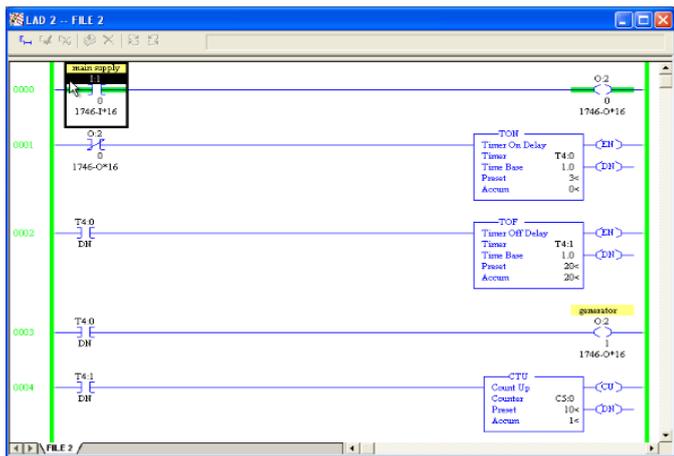


Figure.2a. MSEB ON Condition

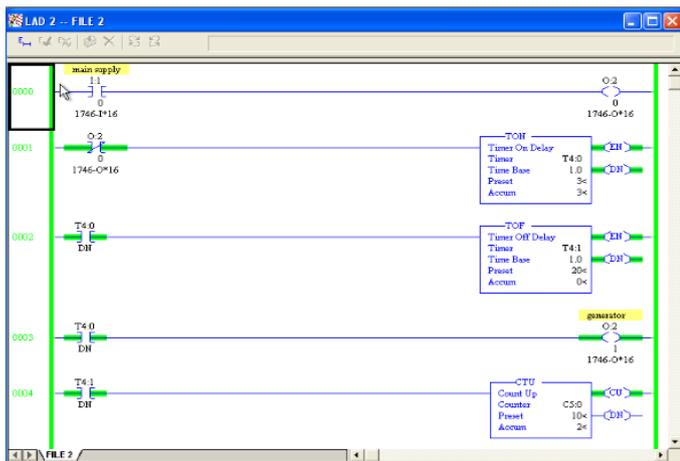


Figure.2b. DG ON Condition

The ladder program, shown in fig. 2, has been developed using computer software provided with the PLC. Programming symbols are listed in Table 1. The program has been simulated then downloaded to the PLC using the provided computer program. It should be noted that timer values could be individually set according to system requirements and restrictions.

**In this programming, there are 2 timers and 1 counter is used.**

TON - Timer ON Delay is used to the Generator ON.

TOFF - Timer OFF Delay is used to the Generator OFF.

CTU – Counter UP is used for the count the number of changeover system.

Fig. 2a shows When MSEB Supply will be ON condition then DG Supply will be OFF.

Fig. 2b shows When DG Supply will be ON condition then MSEB Supply will be OFF.

#### Normal condition:

If none of the main supply is out (I:1/0 ON):

1. If yes and stable for a time period (T4:1), disconnect the Generator through its Contactor (O:2/1 is OFF).

#### Changeover condition:

If any phase of the main supply is out (I:1/0 is OFF):

1. Instantaneously, disconnect the main source through its Contactor (O:2/0 is OFF).
2. After time delay starts the generator.
3. Check for the generator output voltage.
4. if yes and stable for a time period (T4:0), connect the Generator through its Contactor (O:2/1 is ON).

Table. 1. List of Programming Symbols

Symbol	Type	Comment
I:1/0	Input	Main Supply(MSEB)
O:2/0	Output	MSEB Contactor
O:2/1	Output	Generator Contactor
T4:0	Timer ON Delay	To Start the Generator
T4:1	Timer OFF Delay	To Stop the Generator
C5:0	Counter Up	To Count the no. of Changeover

Table.2. List of Experimental Tests

Case	Load	Main	Generator
Normal Operation	from OFF to ON	ON	OFF
Main Failure	from ON to OFF	from ON to OFF	OFF
Generator Starting	OFF	OFF	from OFF to ON
Emergency Operation	from OFF to ON	OFF	ON
Back to Normal	ON	ON	from ON to OFF

### VI. CONCLUSION

This paper is establishing steps for designing and implementation of PLC based automatic changeover switch. The overall system is to initiate simple and effective. It can be used for various educational, commercial and industrial applications. In this paper, many concerning of automatic transfer system by using PLC are presented. This paper presents a prototype model concern to the auto changeover system which can help the increasing the stability of the system and speed of operation which can improve reliability. It can eliminate the continuous manual switching operation, because of in continues manual switching voltage spike is present into a system. The different types of switching techniques are discussed in this paper. Their many techniques used are automatic switching. Such as by using a microcontroller, Lab-view, CMOS and PLC based.

Implementation of this technique is done on both hardware and software form Ladder diagram programming is to build the program. This paper has a wide variety of applications in the security of the control system. It will enhance the increasing productivity due to automatic switching and there is no interruption occurs during the whole operation. So we can reduce the power outage to the industries where continues production is necessary like as large scale industries such as chemical plants, pharmacy industries, the banking sector, hospitals, colleges, textile industries etc.

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