

## Three Phase Induction Motor Protection Scheme

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**Abstract** - This paper include a protection scheme for three phase induction motors against single-phasing faults. A simulation was proposed, which can help to determine the impact of single-phasing on any three phase induction motor. Using MATLAB/SIMULINK software a case study of single-phasing is carried out. A single-phasing protection by means of contactors was reviewed before an enhanced single-phasing protection was designed. The latter, in addition to protection against single-phasing, also protects the motor from under-voltage, over-voltage and voltage unbalance.

In the hardware circuit is completely controlled by the microcontroller and monitors the voltages of three phase. If voltage goes beyond the limit then it turn off the motor by switching. With the help of current transformer which senses the current and if it exceeds level then comparator sends signal to microcontroller to stop the motor. All the conditions are shown by it over the LCD display. In this paper we are utilizing the 8 bit microcontroller ATmega328p. It is a 28 pin microcontroller. Metering unit ADE7758 is used in this project. It protects the motor from single phasing, over voltage, dry run, over current.

**Key words:** Single phasing, Over voltage, over current protection.

### 1. INTRODUCTION

Induction motor is one of the most important motors used in industrial applications. The operating condition may sometime lead the machine into different fault situations. The main types of external faults experienced by these motors are overloading, single phasing, unbalanced supply voltage, locked rotor, phase reversal, ground fault, under voltage and over voltage.

#### 1. Under and over voltage supply conditions:

Under voltage and over voltage supply conditions are commonly occurring power line problems. Efficiency of induction motor decreases when voltage on the induction motor decreases even though all the three phases is balanced. When the

percentage balanced under voltage increases the speed decreases drastically with increase in load. When the percentage balanced under voltage exceeds 30%, then the induction motor performance is very poor and hence to be avoided. Operating the motor from 10% to 30% of balanced under voltage can be permitted with the compromise of reduced performance. During balanced over voltage condition, the increase in speed is not proportional to increase in voltage. But increase in current is proportional to voltage. Hence Losses in the motor is more i.e., increase in power delivered by the motor is less as compared to increase in power drawn by the motor. Hence efficiency is reduced.

#### 2. Heat dissipation/over temperature

Since the current drawn by the motor is more, heat dissipation in the stator and rotor is increased drastically when the percentage balanced over voltage exceeds 25%. Hence it is recommended to operate the motor within 10% of balance over voltage.

#### 3. Single phasing:

Single phasing condition affects the motor performance. The currents are enormously high so that the conductors cannot with stand the heavy current and hence losses are also more. The heat dissipation is heavy which will damage the stator and rotor conductors. Also there is heavy pulsation in torque and speed. Therefore, in the developed protection scheme top priority is given for protection of motor during single phasing condition.

## 2. SIMULATION MODEL

### 1. Single Phasing Prototype Model :

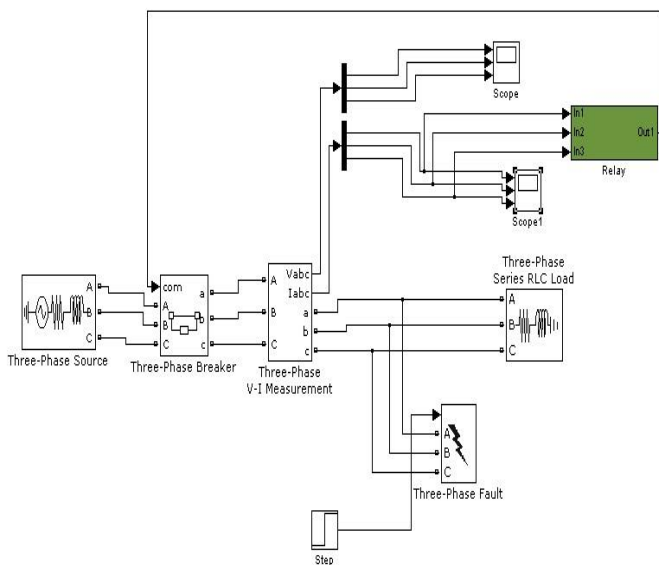


Figure 1. Single Phasing Prototype Model

Three phase supply is given to the motor, phase to phase voltage of 440 V is set in this block And having frequency 50Hz. The breaker is connected between source and VI measurement. Three phase load is connected. Fault is created in between any phase from voltage and current measurement block voltage and current measured separately then the relay logic is created. This is compared & given to the circuit breaker. As per the signal given the circuit breaker will operate. Circuit breaker will operate when it will receive signal from relay logic. The relay logic is shown in figure 2. If the output of relay logic is 1 then the circuit breaker will open the connection and protect the motor from damage. If the output of relay logic is 0 then the circuit breaker will not open the circuit and the motor will remain in running condition

### 2. Logic Of Relay:

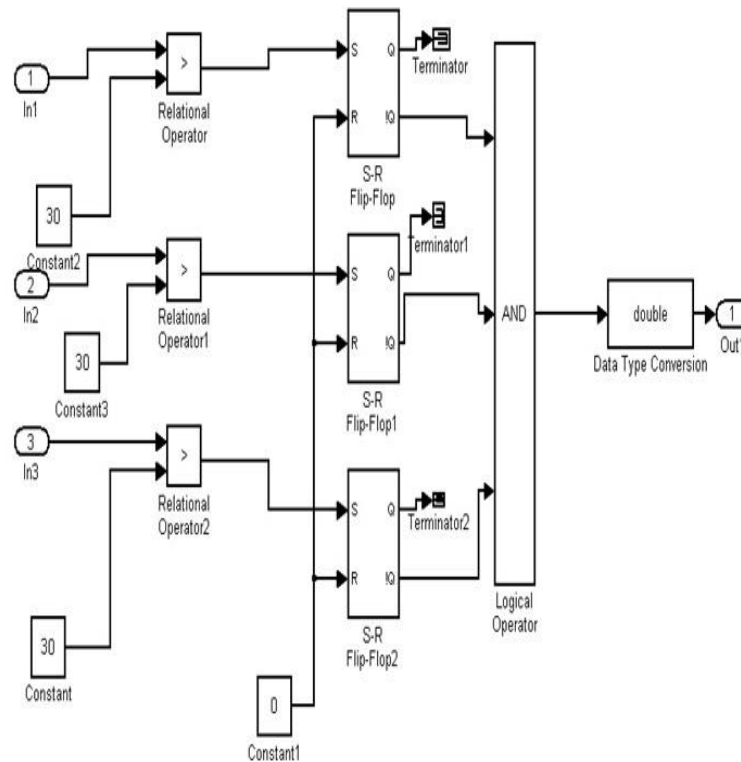


Figure 2. Logic Of Relay

Above figure 2 shows developed logic of the relay operation. Rational operator which compares two values of which one is constant and other is supply. This gives output 1 or 0 in binary after the comparison. SR flip flops are used to give output 1 or 0 to the and gate . if set is 1 & reset is 0 then the output given to the and gate is 1 otherwise it will be 0. If all inputs of the AND gate are 1 then the motor is running in normal condition. If one of the input is not 1 then the one of the phase is cut off hence single phasing is occurred . so it gives signal to the comparator which compares and trips the circuit breaker.

### 3. RESULTS AND ANALYSIS

#### 1. Voltage waveform:

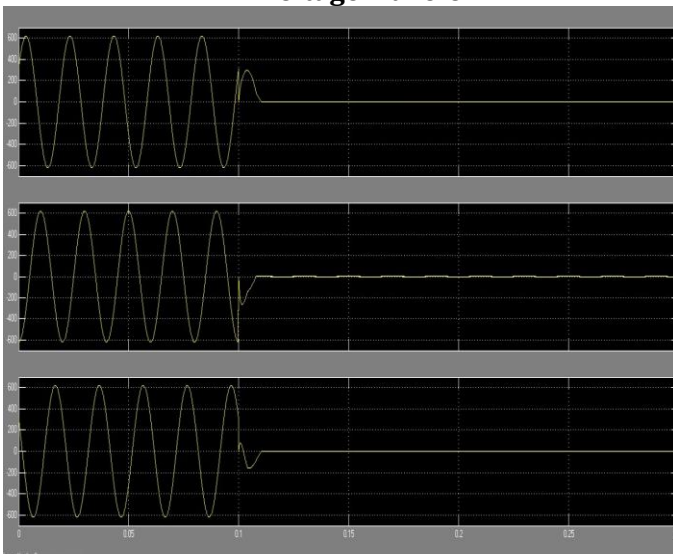


Figure 3. Voltage Waveform

From Above fig we studied Voltage Changes During Fault and After Fault.

In the Fig After 0.1 Sec the single phasing fault is occur And Breaker Cut the all Three Phases so that Voltage goes to zero value and induction motor stops.

#### 2. Current Waveform:

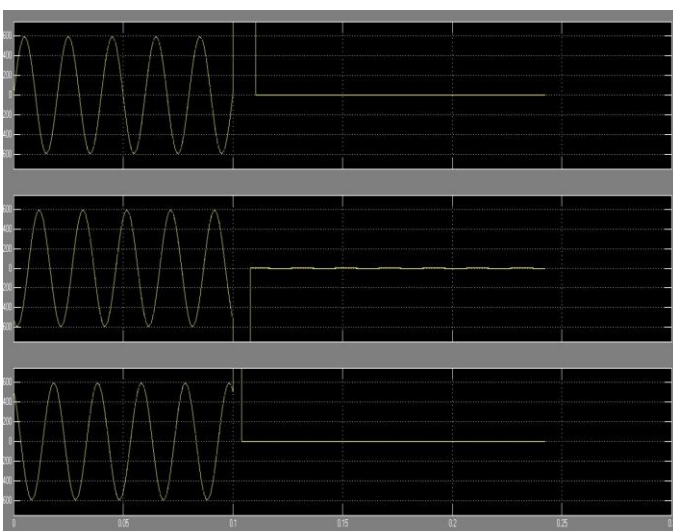


Figure 4. Current Waveform

Fig . Shows the current changes in Fault

Here After 0.1 Sec Single Phasing Fault is occur Then current suddenly increases.

At that time circuit breaker cut the supply so that current goes to zero value and motor stops.

From the above we studied about the single phasing of the 3 phase induction motor. Now we discuss about the some different protection i. overvoltage, over current, over temperature protection.

#### 4. CONCLUSION AND FUTURE WORK

Protection of three phase induction motor from under voltage, single phasing, over current and phase reversal provide the smooth running of motor improves its lifetime and efficiency. To make induction motor run efficiently and to protect it from various faults, sensing circuits have been designed. These sensing circuit sense the faults occur in an induction Motor. These faults are monitored by the protection system and if any fault occurs the motor automatically turned off.

Hence this prototype model of microcontroller based protection system is very simple in design, reliable, highly versatile, and cost effective and gives quick response.

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