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Piangjai

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Optimization of Over Voltage Protection Circuit

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This research was aimed to study the optimization of over voltage protection circuit. This was based on the dissertation about the design of electronic load to protect AC surge as a device to receive over voltage in unstable power system and electrical power quality. At present, most protection device can only stop transient over voltage and voltage swell. The principle of the protection devices relate to both operational modes.

The research results showed that the transient over voltage protection circuit was based on 6000 V waveform (1.2/50μs). The voltage swell was also tested by the developed device to reduce the voltage swell in terms of RMS voltage. The protection device could be developed to meet the requirement much better than the device in the past. Moreover, the protection device could lengthen the lifetime of electrical appliances, electronic devices and protection devices.

Keywords:Over voltage / Transient over voltage / Voltage swell

1. INTRODUCTION

The problem about over voltage is one major problem which affects the operation of the electrical appliances and electronic devices. Therefore, there are many over voltage protection devices in the market. However, many manufacturers still use trial and error methods to work out the situation. If there is something wrong, new methods will be developed to tackle the issue. As a result, there is a waste in the design and the development of the quality.

This research on the optimization of over voltage protection circuit was based on applied electronic technology in over voltage protection circuit. It was based on the principle of malfunctioning equipment from over voltage. Then the over voltage protection circuit would be tested for its effectiveness.

This article will present the optimization of over voltage protection circuit in terms of effectiveness so that the electrical appliances can work longer without malfunction. The device is easy to use, compact and cheap. It is suitable for industrial factories, educational institutes and offices. It was based on the principle of over voltage protection circuit in order not to damage the electrical appliances.

Fig.1 Damage to the electrical appliances and electronic circuit

2. EXPERIMENT

2.1 Experiment to improve the effectiveness of over voltage protection circuit

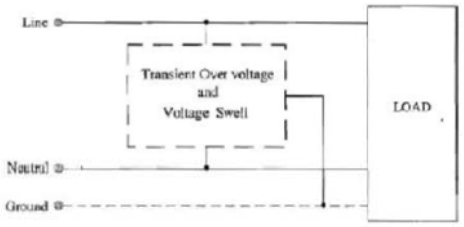

Fig. 2 Block diagram of the operation

The principle for the design of this circuit was that there were 2 modes to protect over voltage according to the specific capability of the material so that the working system can run effectively. Circuit mode 1 is to protect transient over voltage whereas circuit mode 2 is to protect voltage swell.

2.2 Experiment to assess the effectiveness of the proposed circuit

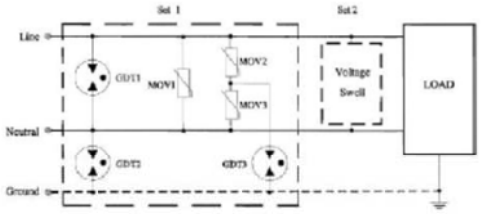

Fig. 3 shows circuit mode 1 to protect transient over voltage

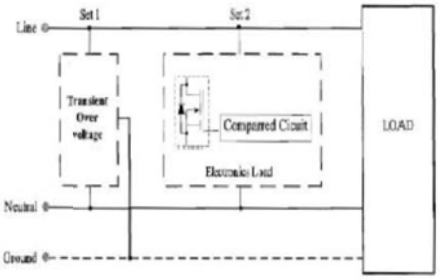

Fig.4 shows circuit mode 2 to protect voltage swell

In this research, the researchers improved the effectiveness of the over voltage protection circuit by using Gas Discharge Tube (GDT) and Metal Oxide Varistor (MOV). The GDT [11] was put at the front end to reduce the energy which will flow through the protection unit without damaging. The MOV will reduce over voltage from the front end material so that the energy which will be distributed to circuit mode 2 and load does not damage the electrical appliances and electronic devices. The GDT at the front end will have higher impedance value of the Giga Ohms range. Therefore, there is no need to worry about leakage. As for MOV [11], the impedance is very high to reduce the over voltage. As for the voltage swell, RMS voltage is increased to go beyond the maximum standard range (220V ± 10%). This was in parallel with the electrical system. The researchers would test the transient over voltage protection circuit with the output waveform of Gas Discharge Tube (GDT) and Metal Oxide Varistor (MOV). During the distribution of waveform at the standard range of IEEE C62.41 (Waveform 1.2/50µs) at 1000V, 2000V, 3000V, 4000V, 5000V and6000V, respectively. Oscilloscope was used to measure waveform which flows through the voltage swell protection device by measuring the output waveform of electronic load during the distribution of 50Hz AC at thevoltagerangeof260V,280V,300V,320V,340V,360V,380V and400 VRMS, respectively.

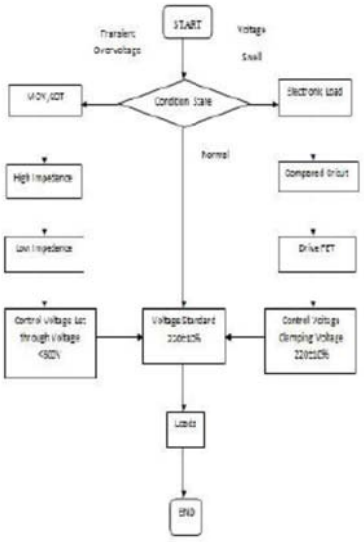

Fig.5 Flowchart showing the operation of over voltage protection circuit

To improve the effectiveness of over voltage protection circuit, the test was done to reduce the damage and to solve the problem about electricity difficulties as well as to reduce the damage to the electrical appliances and electronic devices. The researchers did an experiment. Figure 6 shows the parallel circuit of the MOV.

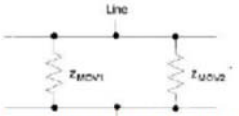

Fig.6shows the parallel circuit of the MOV.

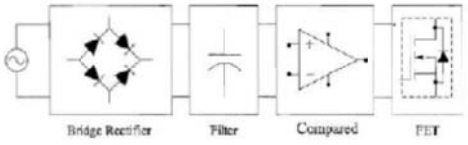

Fig.7 shows the voltage swell circuit components

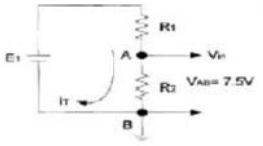

Fig.8 shows the circuit to split input voltage

The design of over voltage protection circuit follows this equation:

$$Z_T \quad Z_{MOV1} // Z_{MOV2} \qquad (1)$$

$$AV = \frac{V_{out}}{V_{in}} \qquad (2)$$

$$V_{ig} = \sqrt{2} V_{rms} \qquad (3)$$

The equation is used to design and develop the effectiveness of the device.

3. EXPERIMENT

To study, design and increase the effectiveness of the over voltage protection circuit and to control 50 Hz AC over voltage, components were tested in terms of reducing the over voltage level and finding solution to the malfunction of the electricity and the damage to the appliances due to over voltage.

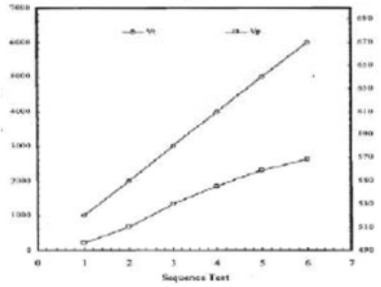

Fig.9 Graph showing the relationship between tested voltage and the voltage which flows through GDT and MOV components.

Table1 Testing the transient over voltage protection device

Sequence Test	Voltage Test(V)	Let Through Voltage (VLT) GDT and MOV
1	1000	496.5
2	2000	510.2
3	3000	530.1
4	4000	545.3
5	5000	559
6	6000	568.7

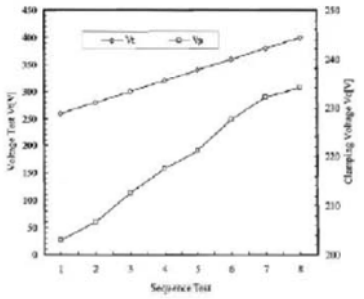

Fig.10 Graph showing the relationship between tested voltage (VT) and clamping voltage (VC)

Table2 Testing voltage swell protection device

Sequence Test	Voltage Test VT(V)	Clamping Voltage VC(V)
1	260	202.98
2	280	206.76
3	300	212.56
4	320	217.47
5	340	221.25
6	360	227.53
7	380	232.18
8	400	234.09

4. CONCLUSION

According to the result from the research on the optimization of over voltage protection circuit, the problem about the quality in electrical system was solved. The test was done to improve the effectiveness of protecting transient over voltage. It was found that the device could reduce the over voltage within the voltage range. The voltage was high and it took place in around5nS-5mS (second). As for the voltage swell

protection device, it could reduce the over voltage in terms of RMS voltage. The voltage was higher than the standard range and it took place in 10mS-1min (minute).

5. ACKNOWLEDGEMENTS

The research on the optimization of over voltage protection circuit to test the quality of over voltage protection device was based on the principle of op-amp and input circuits. It was finished due to the advice and suggestion byKomkrit Chomsuwan and other people when the researchers tested and collected the data. We would like to acknowledge them here.

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