

PROTECTION DEVICE FOR SMALL CONSUMERS

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Abstract: In recent years, the most emphasis has been focused on the radiated threat. Conducted disturbances should not be neglected also. Short-circuits and overvoltages have the most important effects in the field of conducted disturbances in the main electrical network. The paper describes the impact of electrical disturbances on power equipment and presents a protection device with a microcontroller. The device measures the main network voltage and the consumed current through the analog digital conversion channels and reduces the voltage in the case of overvoltage.

Keywords: power quality, electromagnetic interference, conducted disturbances, overvoltage, short-circuits, protection.

1. INTRODUCTION

Theoretically, in a three phases distribution of electrical energy system, voltages and currents are equilibrated, with a perfect sinusoidal wave, and an unitary power factor. In reality, there are disturbances and unbalanced loading of system phases, due to consumers loads. Distortions (disturbances) causes are: non-symmetry created by single phases connected in three phases systems, harmonically currents inducted by nonlinear loads, inter-harmonic currents, the flicker and voltage variations (sags, interruptions) due to the network defects, or atmospheric lightening, etc.

2. POWER QUALITY AND ELECTROMAGNETIC COMPATIBILITY

The actual interest regarding the quality of the electrical energy and preservation of the environment is directly closed by electromagnetic compatibility in the field of energetic. Keeping the level of the electrical energy quality given by the seller and can't be realized outside technical conditions assured by distributor, transporter and electrical energy producer. The quality of the electrical energy has an important effect on the economically indicators of the transport network and is an important parameter to evaluate its performances. The disturbances diminish the quality level of the electric energy and there limitations has high importance.

The electromagnetic compatibility (EMC) present two directions: one side of the consumers equipment working in the network producing disturbances on it, and on the other side, the existing disturbances affecting the good work of the other equipments from the network.

To assure the network EMC it is necessary to:

- control the maximum level of disturbances from the network;
- establish the correct level of disturbances from the network for every element of existing equipment to obtain the immunity.

Every element of an electric equipment produce disturbances. These disturbances added to those of other equipments from the network increase the total level of disturbances at the dangerous level.

The standards of EMC for the electric equipment are designed to assure:

- weak emissions to preserve the general admissible limits of disturbances at the connection of the equipment to the network;
- the immunity of the equipment at the estimated limits of disturbances existing in the network.

For disturbances conducted by supply network, there are two types with notable effects:

1. Network voltage interruption of milliseconds or hundred of milliseconds can RESET the computers and data losses or even the hardware damages. In fig. 1 is presented a detection system for voltage sags.

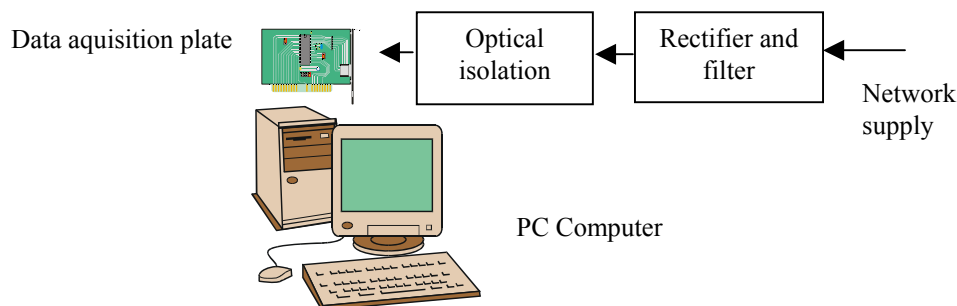


Fig. 1. Detection system for voltage sags

Measures effectuated in the industrial zone in the working time shows 60 sags/hour, and in houses zone only 3 sags/hour [1]. One of the most important cause of the voltage sags is the existence of short-circuits in the network. The link between short-circuits and voltage sags is presented in [2]. A possible solution to reduce the number of the voltage sags and the time of these is the use of the electronic fuses. Such a fuse with an original scheme was realized and patented [3], the solution taking the silver medal at the Eureka – Invent Saloon, in Brussels in 2002.

2. The short time overvoltages from the network give a disturbing effect, but the worse case is the destructive effect for coupled equipments. For instance, such defect at the French Consulate from Braşov or at the Braşov City Hall destroyed few calculus syst

There are used fuses and electronic circuits for shortcircuit protection and every type has advantages and disadvantages.

There are many type of fuses working on the principle of fusible fill (classic type), electromagnetic (Low Voltage Interrupters) or automatic fuses [4], [7].

Fuses are simplest protective devices used especially for short-circuit protection and sometimes for overload of low-voltage or high voltage installations and equipment. For the classic type, after the fuse has opened the circuit and the cause of interruption eliminated, the blown fuse link should be replaced by a new one of the same current rating. This operation is performed by hand. Fuses have simple design, small size, high breaking capacity and low cost, are ease of maintenance.

The single-phase automatic interrupter or commonly named “automatic fuse” is used in apartments or houses to protect electrical circuits of light and sockets against short circuits. The advantages are their small volume and the possibility to restore quickly the voltage.

Generally, the disadvantages of fuses are:

- high reaction time,
- low precision,
- thermal dissipation in case of short-circuit,
- necessity of some operation to repute under voltage of the protected circuit after the short-circuit elimination.

Generally the disadvantages of circuits protection are [3]:

- it is not possible to set a precise value for the shortcircuit current
- maximum power if the protected circuit is low (less than 2000 W)
- the decoupling time can not be controlled
- the circuit can not be adjusted
- there is a voltage drop in on the series resistor that detects the overcurrent

Because fuses have a long time to react, until the disconnection of the circuit the network voltage sag in the appropriate zone having as result EMC pollution.

To eliminate these disadvantages, now it is possible to design and construct small electronic devices having the purpose to protect the small consumers at overvoltages and overcurrents.

3. OVERCURRENT AND OVERVOLTAGE TRANSDUCER DEVICE IN LOW VOLTAGE INSTALATION FOR SMALL CONSUMERS

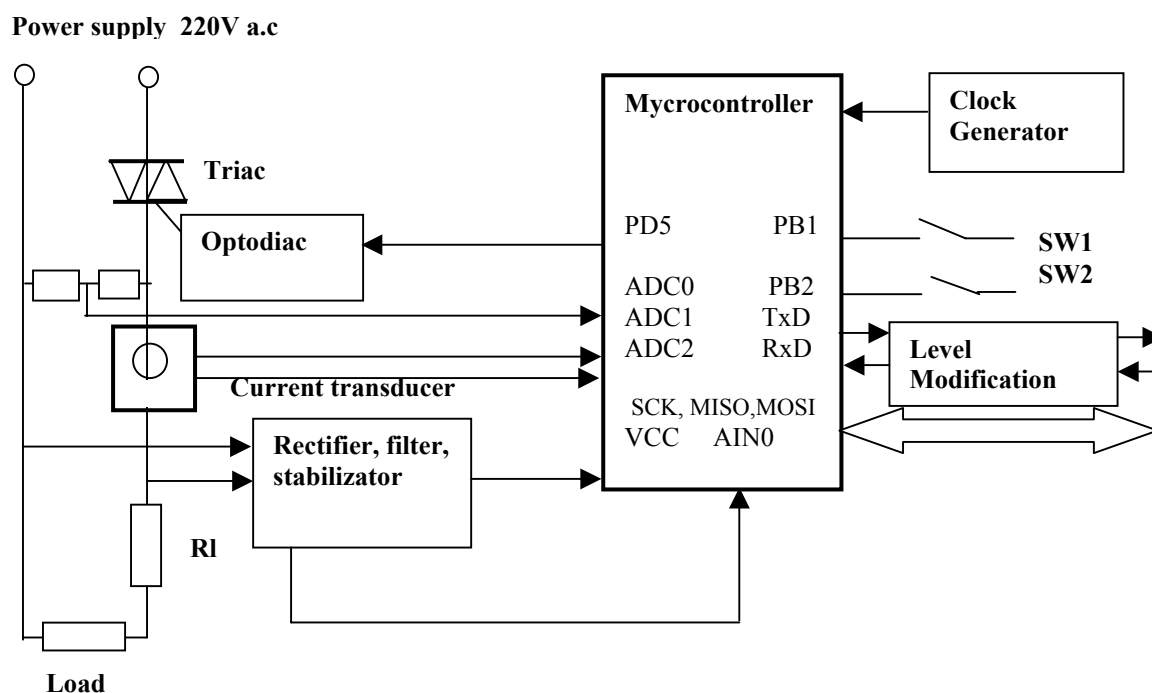


Fig.2 Block scheme of the protection device

The proposed device avoid the disadvantages of others solutions. It is controlled by a microcontroller. It assure the protection at short-circuit and overvoltages from the network. The overvoltage regulator permits the gradual protection working as a voltage regulator. The protected power is enough for an apartment. The high speed disconnection reduces the EMC pollution.

In fig.2 is presented the block scheme of the protection device. To detect the overcurrent (short-circuit) and overvoltages at low power consumers ($220V \times 40A = 8800W$ max.), was conceived a device with microcontroller, having in series in the power circuit a current variator with triac and a limiting resistance calibrated at the maximum peak value accepted by the triac (400A).

The analyze of the absorbed current realized by the microcontroller ATMEL RISC with analog-digital integrated converter. The current analyze is done by a Hall transducer, and the voltage analyze by rectifying, filtration and division. At short-circuit or overvoltage the microcontroller stops the ignition pulses for triac and the current transfer to consumer stops.

The target of the device is to increase the speed of the feedback in short-circuit or overvoltages and automatically quickly restoration of the normal state after short-circuit and respectively the diminishing of the voltage after overvoltage. The protection time is less than 10ms.

The device is mounted in series with the consumer, in the fuses panel. It blocks the supply in the short-circuit case and reduces the voltage at a overvoltages. The current and voltage value are tested many times on a period and at over range values blocks the ignition pulses at the end of the pulse.

The shortcircuit current value could be seated with high accuracy. In the microcontroller exist an analog digital integrated converter for this. The current transducer is a Hall element mounted in a tore around the conductor. For the voltage it is used other channel of the same analog digital converter.

Supplementary facilities: possibility of a display for values of the instant current and voltage or consumed power. The interface RS232 permits the device connection to computer working on-line without other display.

4. CONCLUSIONS

The presented protection device avoid disadvantages of the other known solutions, by the flexibility given by the microcontroller. The device assure the protection to short-circuit and overvoltages. Also, the device could be a voltage regulator, and the protection against overvoltage being graduated.

The protection at short-circuit with high speed reaction and breaking reduce the electromagnetic pollution of medium.

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