PROPOSAL OF AN ELECTRONIC DEVICE MICROCONTROLLED FOR PROTECTION AGAINST OVERCURRENT IN LOW VOLTAGE.

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***Abstract* – This paper proposes a device of protection microcontrolled for electric systems of low voltage typical domestic and commercial consideration the coordination of the protection with the thermal characteristics of insulation of electrical wires. The moust serius effect of excess current on conductors is the higher temperatue it causes. Excess heat can damage isulation, shorten the useful life of the conductor, or physically damage the material of conductor itself. During the elaboration of this work, studies on the development of projects following safety's conditions recommended by the norms were adopted [1][2][4]. After having analyzed the characteristics of the installation, was developed a software for dimensioning of the internal circuits of the installation that supplies the gauge of the drivers with the respective parameters for the construction of the curve time average versus the protection device, considering the characteristics of the types of electric lines: it sorts things out of installing, physical conditions of the temperature, the type of used electrical wires (material and insulation) and the grouping of circuits in the same conduit. The protection device uses a methodology where a sensor of current, a microcontrolled of the family is used PIC (MicroChip), where the curve is stored characteristic time versus current for it analyzes and control of the current.**

KEYWORDS

Circuit Breakers; Coordination of the Protection; Microcontrolled; Electrical Installations; Low Voltage.

I. INTRODUCTION

The circuit breakers, that it has the objective protection principal against overcurrents, operate through triggers that can be thermal, magnetic or electronic. Safety of the life and preservation of the property are the two more important factors in the project of the electrical installations [1].

The function of system protection may be defined as the detection and prompt isolation of the affected portion of the system when a short circuit or other abnormality occurs that might cause damage to, or adversely affect, the operation of any portion of the system or the load that it supplies.

The circuit breakers more used they are equipped with thermal triggers, which act in the occurrence of moderate overload currents, and magnetic triggers for high overcurrents.

The typical thermal trigger is constituted of a bimetallic sheet, composed by two metals that possess coefficients of different dilation. This bimetallic sheet bends under action of the heat produced by the passage of the electric current, that happens due to the different dilations of the two metals. That temporary deformation of the sheet interacts in a mechanism and it provokes the opening of circuit breakers. The bimetallic thermal trigger possesses characteristic inversely proportional the current, in other words, as larger the overcurrent, minor will be your time of performance.

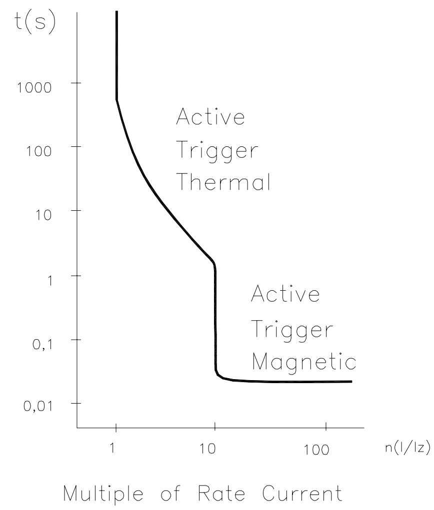

Fig. 1 - Characteristic time x current of Circuit Breaker Thermal-Magnetic.

The magnetic trigger is constituted by a relay (electromagnet) that attracts an articulate piece (armor) when the current reaches a certain value. That displacement of the armor provokes the opening of the main contacts of circuit breaker through joining mechanical.

The figure 1 show the curve time versus current of circuit breaker thermal-magnetic, evidencing the performance of the thermal and magnetic trigger (instantaneous).

The Electronic device propose is composed one button for to effects the actuation turn-off, sensor of current, an signal processing electronic device and of an switch device.

The sensor of current are constituted of a magnetic circuit and they elaborate the image of the measured current. The electronics processes the information and, depending on the value of the measured current, it determines the shot of circuit breaker in the foreseen time and one electronic trigger for actuation. The figure 2 presents the typical characteristic of time versus current of the electronic triggers.

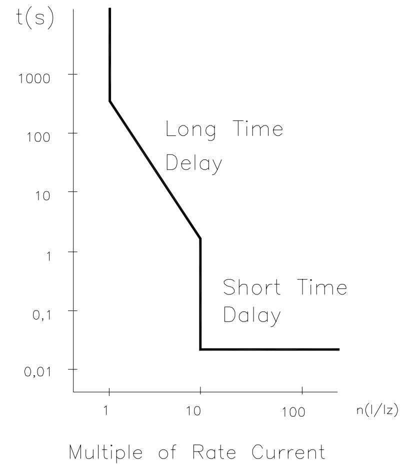

Fig. 2 - Characteristic time versus current of an electronic trigger.

Observe in the figure 2, the zone of protection of long time delay, that represents the same characteristics of elevation of temperature of the drivers and the zone of instantaneous performance, that is the one of the protection against high short-circuits and immediately later than circuit breaker.

In this work it tried to use the real conditions found in the electric facilities from your elaboration, which supplies the parameters for the coordination among the circuit that one want to protect and the proposed electronic device.

II. PRINCIPLE OF OPERATION OF THE PROPOSED CIRCUIT BREACK

In the first stage is executed the detection the current waveform by the sensor of the current for effect Hall. This sensor need one source for aliment symmetrical, given in your exit one tension very low, directly proportional the current flow in load.

In the second stage, a current waveform detected by the sensor is evaluate by the microcontrolled (PIC) in this order: The waveform (AC) in the exit of the sensor is to rectify because that the A/D converter in the input of the PIC work whit tensions in the interval [0-5Vdc]. One rectified accurate was used in this case.

The fig. 3 is a simplified functional block diagram of a propose device of the protection.

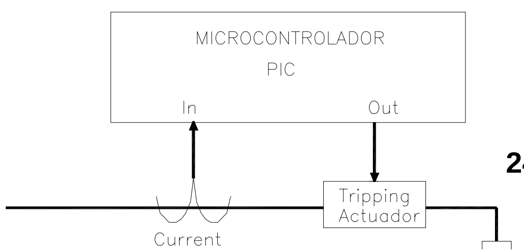

Fig. 3 Simplified functional block diagram of device of protection microcontrolled

The fig. 4 show the current waveform rectified in the input of the PIC and the fig. 5 show the current waveform that flow in load.

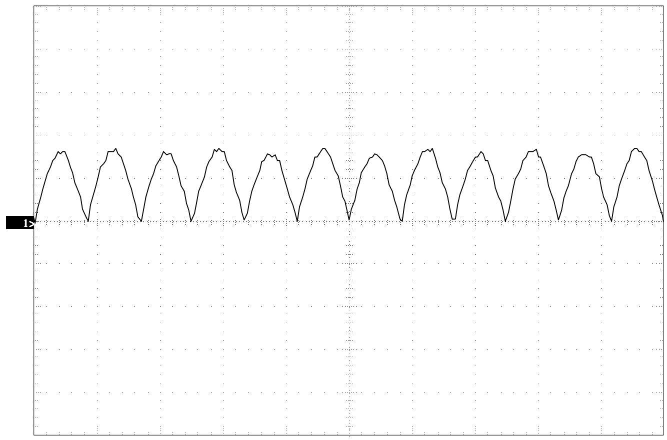

Fig. 4 - Waveform of the current rectified accurate.

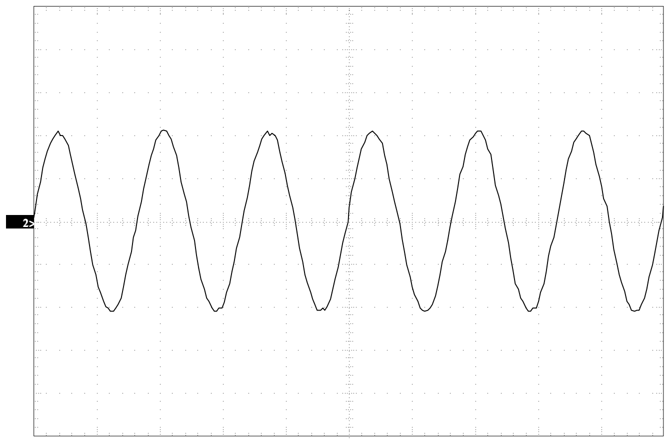

Fig. 5 – Load Current

After the read of the signal, the microcontrolled analyzing the metered and logged min/max current values to comparative whit current rms that flow in load. The use digital techniques that permit true rms sensing of the current.

The fig. 6 show the fluxogram for principle that work stored in microcontrolled.

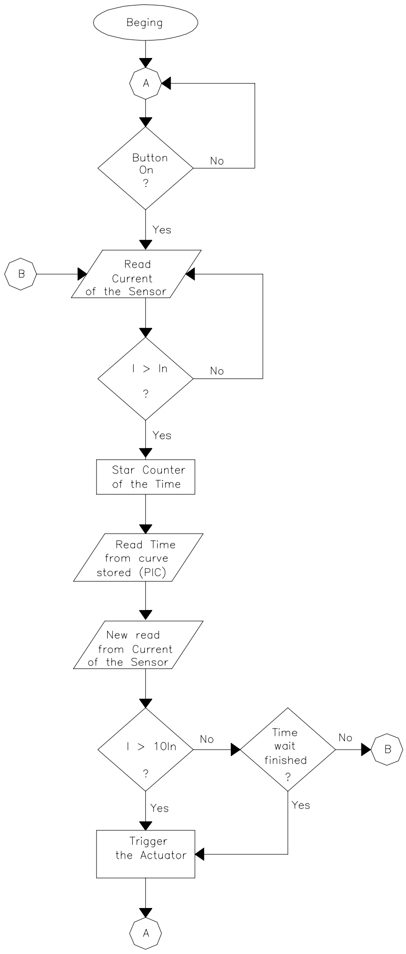

Fig. 6 – Simplified fluxogram of the program stored in the microcontrolled.

The rms value of a current wave is equal to the square root of the meam square, of the variable values sampled throughout one cycle. This relationship is mathematically expressed as:

$$Irms = \sqrt{1/T\int T \cdot i^2 dt} \qquad (1)$$

Were:

Irms = Current in amperes
T = Time period in seconds
i = Instantaneous current in amperes
dt = Derivative of time

This definition applies to any current wave form, sinusoidal or nonsinuosoidal.

By [5], based on the total samples taken over an entire cycle, the rms current value as calculated is expressed mathematically as follows:

$$I = \sqrt{\frac{1}{N}(i_1^{\,2} + i_2^{\,2} + i_3^{\,2} + ... + i_N^{\,2}} \qquad (2)$$

Where:

I = Calculated rms current in amperes
i_1,i_2...= Instantaneous current magnitudes at each sample for each cycle.
N = Number of samples per cycle

III. EXPERIMENTAL RESULTS

A prototype of the electronic device microcontrolled proposed was built and tested.

The fig 7 shows the harmonics in the current waveform.

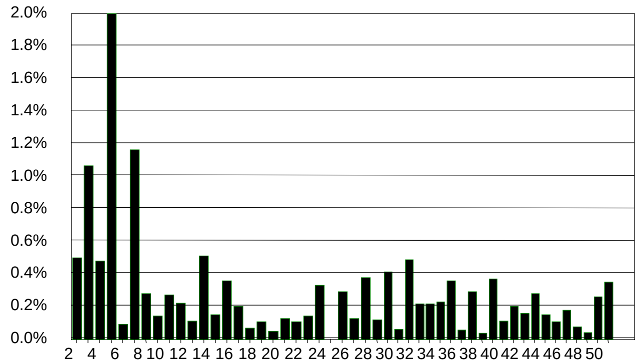

Fig 7 – Current Harmonic Spectrum

The figure 8 illustrate the actuation short time of the divece eletronic when the current of the overload is highest that the maximum determined by curve time versus current defined by condition of the coordination protection.

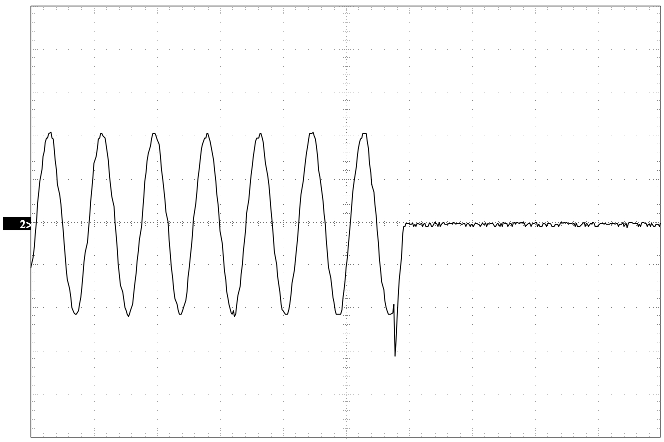

Fig 8 – Actuation in Short Time

As it can be noticed from the illustration above, the speed that actuation is very fast, because that speed of process mathematical by the microcontrolled, less that one a half cicle. The reference [6] explains that when applying current limiting devices, the clearing time will always be one half cicle (0.008 seconds) or less. Although not indicated in [3], current limiting circuit breakers whit on half cycle clearing time are also available on the market. Whit non current-limiting devices, the time is at least one cycle and the current is considered to be the full amount of the short circuit.

IV. CONCLUSION

The wires can be protection against the effects heat of the conductors caused by the current flow. In this paper an microcontrolled of the family PIC was used for control this current the overload.

In the future, providing a networked communications capability between the enhanced trip unit and a centralized location, power management can now be viewed from a new prospective. The integrated circuit can be a useful tool by implementing a variety of new features.

The main benefits for device of protection in low voltage can be summarized in:

- Greater precision of speed actuation,
- Tripping curves which can be adjusted according to use,
- Control of the load.

Allows precise protection and coordination selectivity of solid state trip units..

ACKNOWLEDGEMENT

Authors would like to thank CAPES, Cnpq, by the support.

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