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Microcontrollor Based Over Current Relay for Protection System

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ABSTRACT

Inverse overcurrent is normally associated with the overcur- rent relay types, the operation lime is inversely proportional (in certain degrees) with their overcurrent ratio.

I. INTRODUCTION

E The general equation of the inverse overcurrent relays can be written as In t = constant and is used for the protection Of transmission lines and equipments. The value of index n is chosen to match the specific characteristic required by the system under consideration. This paper describes a proposed scheme of overcurrent relays dealing with programming of a single-board dsp IC-30 F 3011 microcontroller, getting experimental results with better relay characteristic performances and high flexibility for implementing the desired value of ii including non-integer values.

dealing with the following points

1) the introduction of special control features which differ from the standard systems;
2) the implementation of unforeseen operational changes after installation of an equipment;
3) the recent trend to depart from standard substation configurations;
4) successive stages in the development of a substation which may require radical changes in automatic switching facilities.

In such cases relatively high engineering charges and development costs may be incurred [1].

These factors have encouraged the movement towards more flexible approaches; an obvious one is to use programmable sequence controllers which are based on plug board or diode matrix segments [13. While for many applications these provide economic equipment, for applications above a certain order of complexity the equipment may become bulky with many components.

An alternative approach is the use of microcontroller testing aids running either on the microcontroller system itself or on a more powerful large computer [1]. The reliability of such equipment is, of course, of great importance and here again the microcontroller scores well. Firstly, the principle of the system is such that wide use is made of large-scale integrated circuits which means that the number of compo- nents is minimized, resulting in good reliability and small size. Secondly, it is possible to perform a certain amount of self- checking in normal operation.

II. SYSTEM DESCRIPTION AND OPERATION PRINCIPLE

Fig. 1 represents a block diagram of a proposed microcontroller-based overcurrent relay.

The limited dc voltage output of the measuring unit is proportional to the operating current [7], i.e.,

The voltage is fed to a microcomputer [5], whose function is to perform the following jobs sequentially through an appropriate programming (flow chart is shown in Fig. 2):

1) analog-to-digital conversion;

2) fault detection;
3) function generation;
4) automatic variable time delay achievement;
5) pulse generation

The microcomputer first converts the dc analog input voltage into a digital equivalent in terms of the hexadecimal system [3], [4], [7], i.e. ,

$$(X)h = V \cdots$$

This digital value is tested. If there is a fault, this means that tested value exceeds a stored digital pick-up value, then it will be processed through a software function generator, which consequently determines the type of the resulting overcurrent relay, i.e.,

$$\frac{K_2}{g(X)}$$

The operation time of the relay is determined by a specified time delay subroutine [2] depending upon the value *or(Y)h,* i.e.,

$$t—Kg(Y)h.....$$

systems which offer a number of attractions over other approaches. The approach lends itself to software design and

Hence, pulses are generated through an output port of the microcontroller fed to the triggering isolating circuit which triggers the triac and so the tripping circuit is complete and the fault current will be cleared.

If there is no fault, i.e., the digital value of the ADC output is less than the pick-up value, the relay will not operate.

Simple mathematical operations on the above equations give a relation between the operation time I of the relay and the operating current I of the load to be protected as follows [7]:

$$t = \frac{K_2 K_3}{K_1 g(I)}.$$

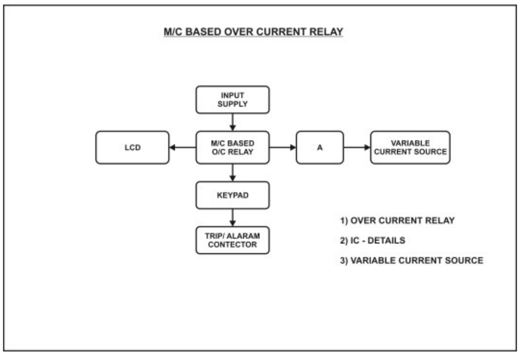

Figure 1

Figrue 2

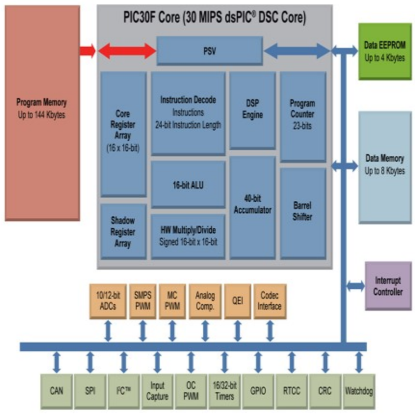

Figure 3

Description

1. Power ON/OFF Switch: Used to ON/OFF the input 230VAC of trainer kit
2. MCB: 20A Used to ON/OFF the Variable current source output
3. S1: START Button used to start the automatic relay tripping time measurement Circuit
4. S2: MANUAL STOP Button used to stop the automatic relay tripping time measurement Circuit
5. Autotransformer (Current adjustments) : Used to adjust the Variable ac current
6. Stop-Clock: Used to measure the relay tripping time

7. RESET Switch: Used to Restart the stop clock
8. Ammeter (Relay current): Used to measure the Applied relay current
9. Banana terminals (NC Contacts 1,2) – Over current relay Output NC Contacts
10. Banana terminals (C1,C2 , CT Input) – Over current relay Current input terminals
11. Banana terminals (C1A,C2A) – current source output terminals
12. Power input Connector (FM14-Back side) – Used for Mains input supply.

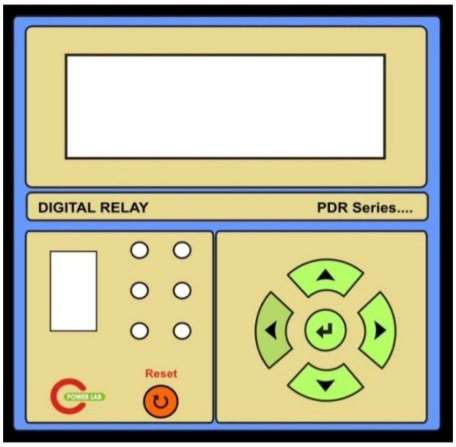

Figure 4

Make - PLI
Current Setting - 0-1A
Contacts 'No' & 'NC'

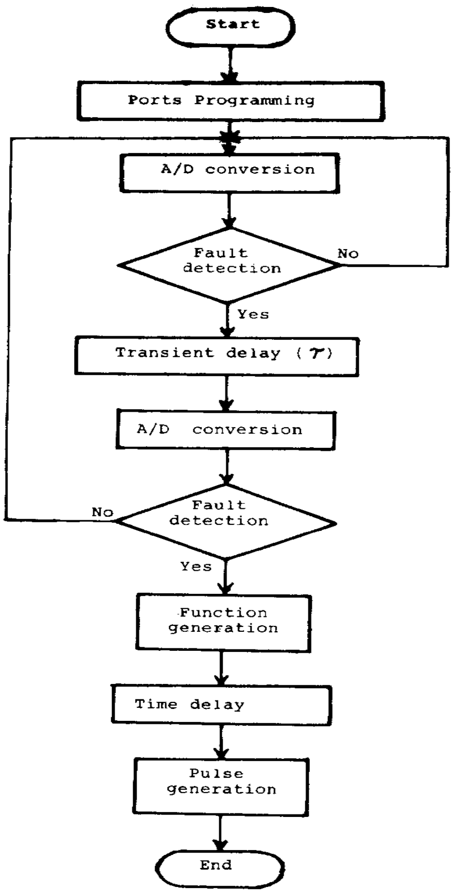

Fig. 2. Flow chart of the software in the microprocessor-based overcurrent relays.

or

$$tI^n = G \cdots \quad (6)$$

where $G = K_2K_3/K_1$ and $I^n = g(I)$.

Now it can be concluded that (6) is similar to the general equation [6] of the inverse time overcurrent relays.

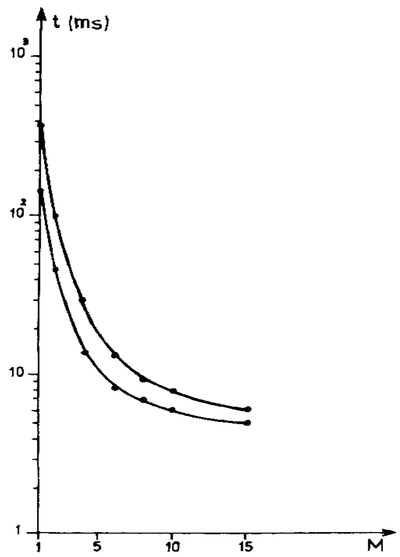

Fig. 3. Time-current characteristics for $n = 2$.

III. Experimental Results

In this proposed relay scheme, function generation is an important task achieved by the microcomputer since it will decide the type of resulting time-current characteristic [7]. Two types of function generation software have been used here.

1) The integer type used mathematical operations through multiplication and division subroutines to obtain characteristics with integer values of n. Fig. 3 shows time-current characteristic for $n = 2$.

2) The flexible type used a look-up table method in order to obtain the desirable value of n whether integer or non-integer as is shown in Fig. 4 for $n = 1.3$, which cannot be obtained in any other type.

Time multiplier settings can be obtained through a change in the time-delay subroutine.

It is useful to mention that the proposed technique cannot be used for instantaneous type overcurrent relay [7].

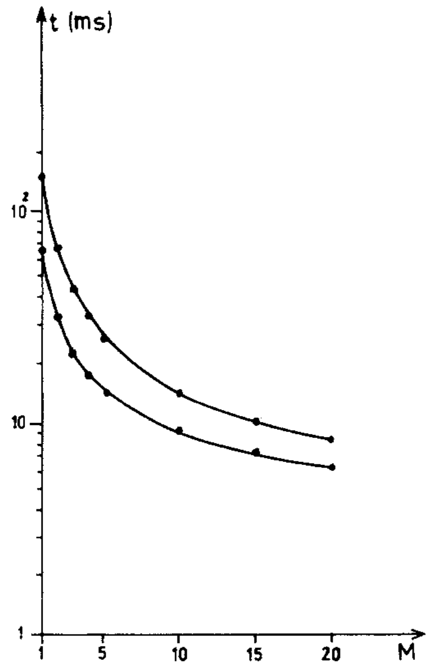

Fig. 4. Time-current characteristics for $n = 1.3$.

IV. Practical Applications

A brief discussion for applications of different types of time-current characteristics can be explained as follows [7]:

1) Definite time ($n = 0$): This is generally employed in cases of wide variation of system generating conditions. Another possible application is the differential protection of transformers. Also, it is used as backup relays for differential and distance protection schemes. Definite time is preferred to instantaneous over-current relay (discussed later) to serve as a check against short-time asymmetrical currents.

2) Inverse time ($n = 1$): This is generally employed in cases where the source impedance is much smaller than the line impedance. Because of the steep nature of the curve, it permits the use of the same-time multiplier setting for several relays in series. This reduces the time errors and overtravel so that the time margin for grading can be reduced.

3) Very inverse time ($n = 2$): Fuse coordination and thermal protection of transformers and induction motors require such characteristic. They are useful to protect against unbalanced operation of generators.

V. Conclusions

The proposed technique for generating inverse time overcurrent relay characteristics for any desired value of n is an accurate method of approaching theoretical characteristics. The basic design of the relay does not change with the different values of n desired. Only changing the subroutine of the function generation is required. This relay has a great advantage in ease of manfacturing and flexibility for any type of characteristics desired.

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