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Test Station for Measuring Electromechanical Relay Parameters Using Microcontroller

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ABSTRACT: This paper describes a test station for measuring of electromechanical relay parameters using PIC18F6520 microcontroller. The main component of the proposed system is microcontroller, interfaced to a PC through I/O card. The front end of the proposed system is realized in Visual Basic. The parameters, namely coil resistance, contact resistance, pull-in and dropout voltage, operate time and release time, bounce time are measured by using this test station. This system is capable of measuring parameters of both latching and non latching electromechanical relays with up to 8 poles. All defined parameters are measured within 30 Sec. It is based on Graphical User Interface and is user friendly. A single jig is suitable for all types of relays. The pull-in voltage and dropout voltage are measured with resolution of the order of µV. The operate time and release time are measured with resolution of the order of ns .The proposed paper introduces the hardware structure and the software process of the testing system.

KEYWORDS: PIC18F6520, Visual basic, coil resistance, contact resistance, operate and release time, bounce time, pull-in and dropout voltage.

I.INTRODUCTION

Electromechanical relays are widely used in electronic systems. The parameters such as voltage and time of the relay are used to ensure a product's quality. Electromechanical relays are switches needed for controlling high current, high voltage loads by a small controlling power. Galvanic isolation is provided between the input and load. Above mentioned relays offer contact resistance of the order of milliohm and no OFF state leakage current. The important parameters of an electromechanical relay are coil resistance, contact resistance, pull-in and dropout voltage, operate and release time and bounce time. This paper describes a test station for relay for the above said parameters.

Coil resistance is the electrical resistance of the relay coil at reference temperature. It varies with temperature and is expressed in Ω. The resistance between the contacts is named as Contact resistance, expressed in mΩ in the closed state. Operate time is the time that elapses between, the instant power is applied to a relay coil and the moment the contacts are closed. Release time is the elapsed time between the instant power is removed from a relay coil and the moment the contacts have opened. Bounce means intermittent opening and closing of contacts caused by abrupt application or removal of power to or from the relay coil.

Five 8 bit I/O ports , Serial port and Interrupt modules of PIC microcontroller are used for communicating with a PC, polling closure status of DUT's contacts, controlling coil voltage etc.

II. LITERATURE REVIEW

Taihang Du et, al proposed a detecting technology for electromechanical relay parameters using microcontroller PIC18F452. It is capable of testing only single coil 4 pair contact DC relays. Accuracy offered is only 10 µS .It uses many components such as flip flops, comparator, both A/D converter and D/A converter etc.

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III. BLOCK DIAGRAM OF TEST STATION

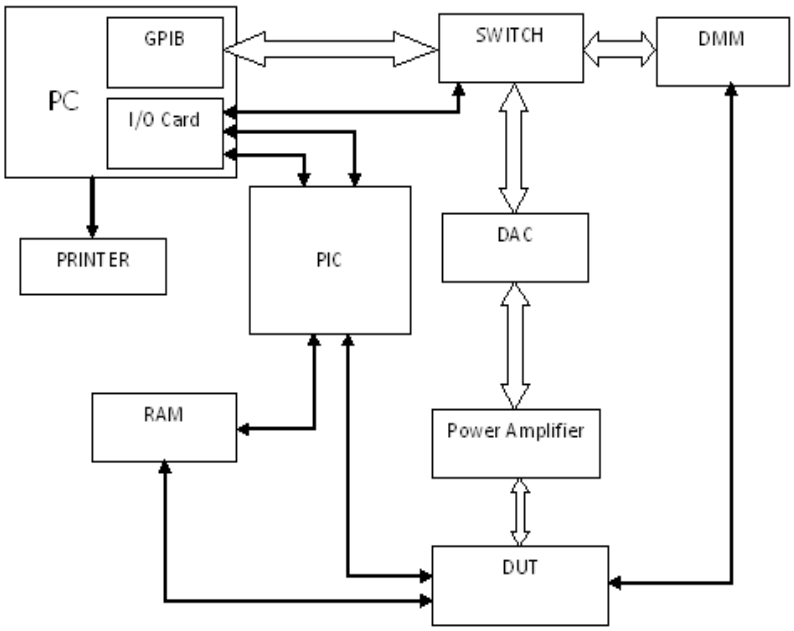

Fig.1 Block diagram of the test station.

PIC is the main controller. PC is interfaced to the microcontroller through 48 channel I/O card. The coil voltage of the relay is controlled by PC through a dual DAC. The resolution of the DAC is 12 bits. The output of the DAC drives a power amplifier which in turn drives the coil of the DUT. The Pull-in voltage and dropout voltage are measured by controlling the coil voltage through the DAC and polling the open and close status of contacts through the I/O port of PIC.
RAM is used to store the status of the contacts, it is a depth of 512 K. The system capable of acquiring the contact status at a sampling rate of 50 ns. This enables to measure of bounce of the chatter in the order of ns. The write/ read of RAM is controlled by PIC. Serial ports of PIC, interrupt modules and I/O ports of PIC microcontroller are made use of. The results are printed out by printer.

1. Pull-in and Dropout Voltage:

Method: Increase the electromechanical relay coil voltage linearly till all NO contacts get closed. That particular coil voltage where all the NO contacts get closed is the pull-in voltage. Fig.2 shows the procedure diagram of Pull-in voltage.

The electromechanical relay coil voltage is decreased linearly till all NO contacts get opened. The precise voltage where all the NO contacts get opened is the dropout voltage.

Algorithm: DAC is initialized zero coil voltage for pull-in voltage. PIC is interrupted from PC and DAC initialized to zero coil voltage through I/O card. The contact status are polled and sent to PC through the serial port of PIC. Based on the status read, DAC value is incremented till all contacts are closed and is shown in fig. 2.

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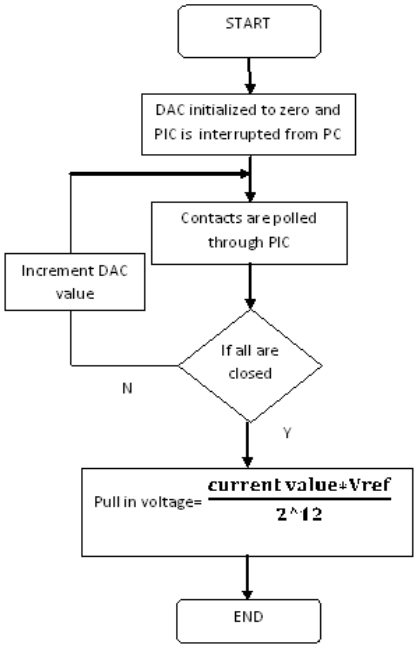

Fig.2 Pull-in voltage procedure diagram.

Algorithm: DAC is initialized maximum coil voltage for dropout voltage. PIC is interrupted from PC and DAC initialized maximum coil voltage through I/O card. The contact status are polled and sent to PC through the serial port of PIC. Based on the status read, DAC value is decremented till all contacts are opened and is shown in fig. 3.

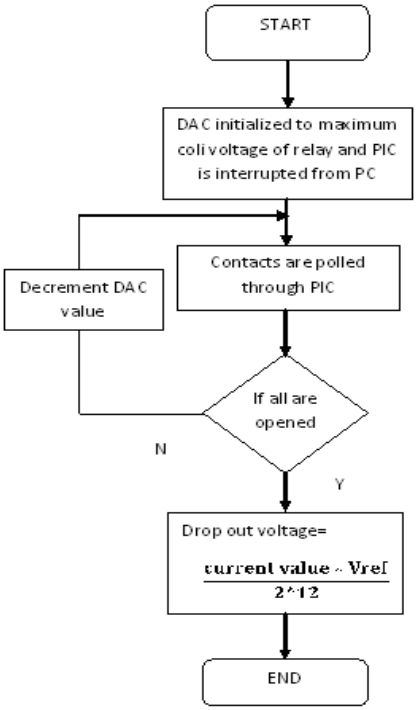

Fig.3 Dropout voltage procedure diagram.

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2. Coil resistance:

Coil resistance is measured by using 6½-Digit Multimeter which is interfaced through GPIB cable to the DUT. Through switches in the block diagram (Fig.1) the coil ends of DUT are connected to DMM.

3. Contact resistance:

A known current is forced to the closed contacts of the DUT. Through DAC, maximum coil voltage is forced from PC. DMM is used to measure the voltage across the contact. Contact resistance=voltage measured /forced current.

4. Operate Time:

Operate time is the time that elapses between, the instant power is applied to a relay coil and the moment the contacts are closed. Fig. 4 shows the Operate time and operate bounce time.

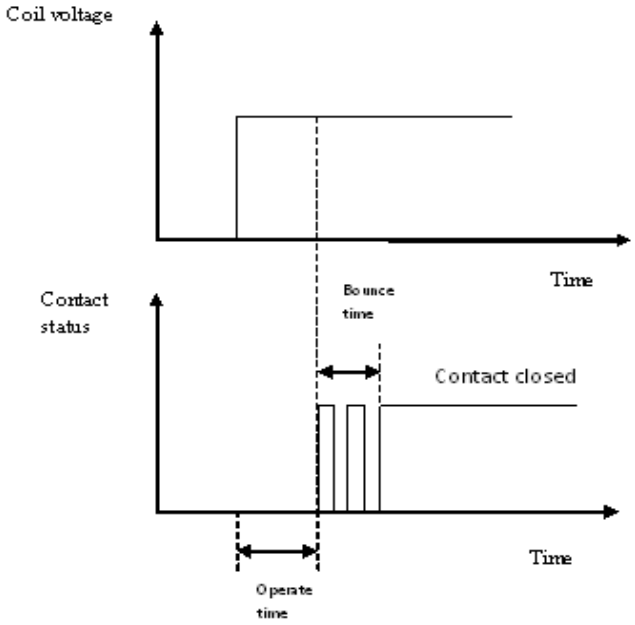

Fig. 4 Operate time

Method: PIC is interrupted. The relay made ON from PC via DAC, at time T1. The status of contacts is polled and written in a RAM. Control signals of the memory are produced by PIC in the interrupt service routine and the process is continued for x ms. The instant at which the contact starts to close (bounce starts) is T2. The instant at which the contact is fully closed is at T3. Then operate time=T1-T2. And the operate bounce time is T3-T2 is shown in fig.5.

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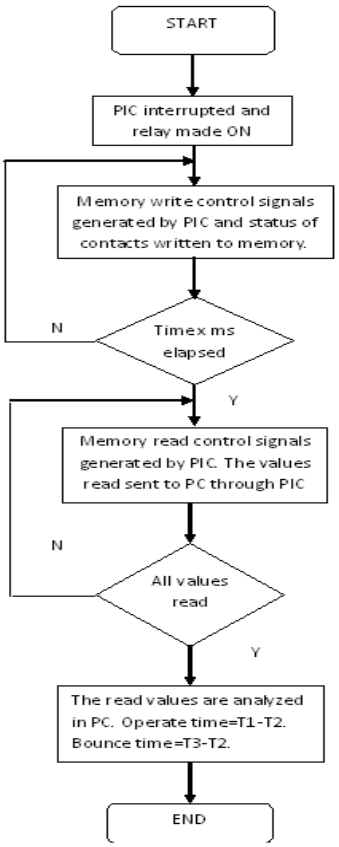

Fig.5 Operate time procedure diagram.

5. Release time:

Release time is the elapsed time between the instant power is removed from a relay coil and the moment the contacts have opened. Fig. 6 shows the release time and release bounce time.

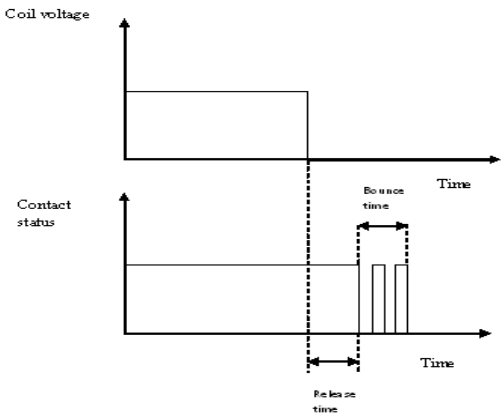

Fig. 6 Release time

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Method: PIC is interrupted. The relay made OFF from PC via DAC, at time T1. The status of contacts is polled and written onto a RAM. Control signals of the memory are generated by PIC in the interrupt service routine and the process is continued for y ms. The instant at which the contact starts to open (bounce starts) is T2. The instant at which the contact is fully opened is at T3. Then release time=T1-T2. And the release bounce time is T3-T2 is shown in fig.7.

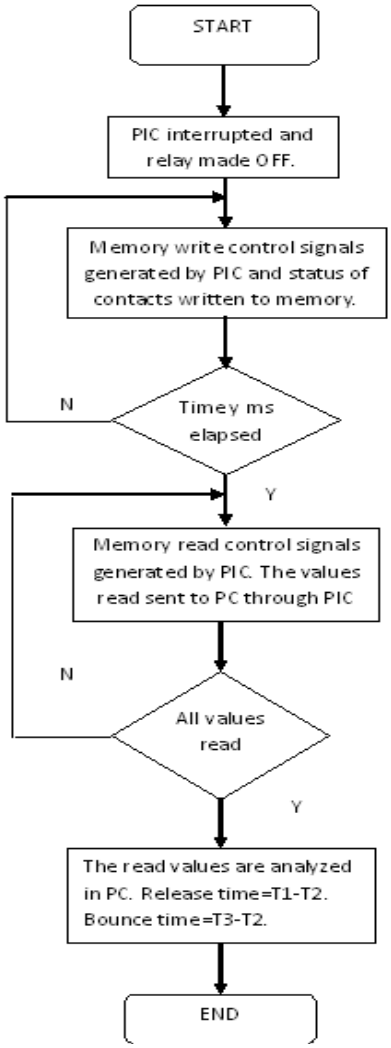

Fig. 7 Release time procedure diagram.

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IV. RESULT AND DISCUSSION

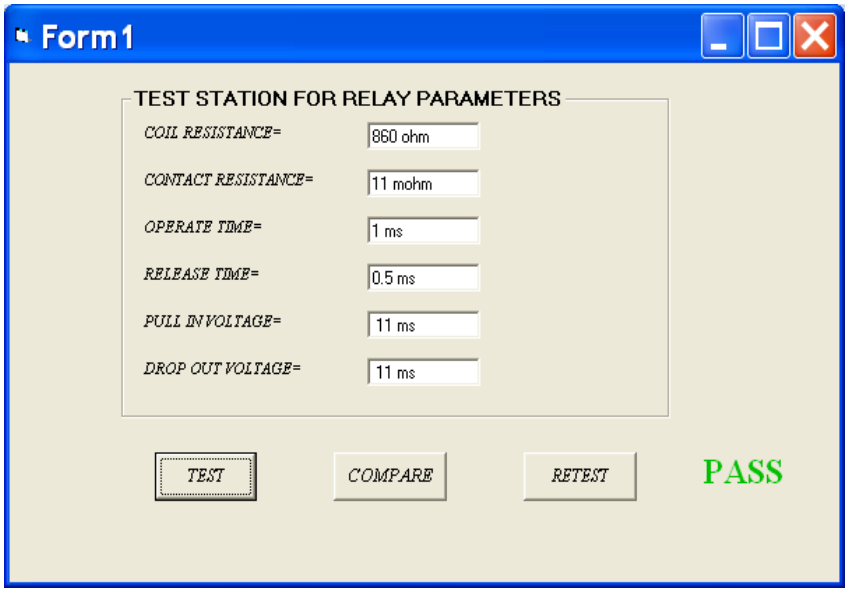

Fig.5 Human-computer interaction interface.

V. CONCLUSION

The testing system uses a single-chip microcomputer as the core, realizes the parameter testing of electromechanical relay, and makes the testing of relay parameter more accurate. In the testing of the relay parameters, the time approaches to 30 sec. The graphical user interface, visual basic in testing system reflects the intelligence and user-friendliness of the testing. The device has an efficient man machine interface along with a low cost, high accuracy and high level performance.

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BIOGRAPHY

Arunima Manuel, received her graduation in Bachelor of Technology in Applied Electronics and Instrumentation Engineering from Mar Baselios Christian College of Engineering and Technology, Peermade in 2013, Idukki ,kerala. currently PG Scholar at Mahatma Gandhi University College of engineering in Applied Electronics. Her main areas of interest are embedded and control system.